ELLIOTT
EQUIPMENT COMPANY

Built for You.

Operations/Maintenance Manual

Digger Derrick Truck

Elliott Equipment Company
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Elliott PN: 3020571
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Contents

COMPONENT SERVICE MANUALS

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 contacting the factory.

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Always refer to the latest version of **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.

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

BEWARE OF ADVERSE WEATHER AND GROUND CONDITIONS

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

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0003	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15
Tech Spec.		1.2	Doc update	3/5/15

ELLIOTT EQUIPMENT COMPANY

WARRANTY

Subject to the terms and conditions of this warranty, Elliott Equipment Company ("Elliott") hereby warrants all equipment manufactured by Elliott ("Equipment") to be free from defects in material and workmanship for a period of one year. 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.

All Equipment shall have a limited one-year warranty ("one-year warranty"), effective from the date that the Equipment is shipped from Elliott and subject to the terms and conditions contained herein. Elliott's sole obligation under the one-year warranty shall be the replacement of the defective part(s), but specifically excludes paint. This one-year 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.

In addition to the one-year warranty, the following structural components shall have a lifetime parts-only warranty from the date of shipment from Elliott: Subframe, Turrets and Structural Components of all steel booms ("lifetime warranty"). Elliott's sole obligation under the lifetime warranty is replacement of the defective part(s), but specifically excluding any labor or other costs incurred. This lifetime warranty for structural components excludes hydraulic and electrical components, bed and body components, chassis, jibs, outriggers and platform. This lifetime warranty also specifically excludes any other parts or components, including without limitation seals, gaskets, hydraulic components and exterior coatings. All replacement parts are original equipment parts from Elliott. In the event ownership of the Equipment is transferred to a person or entity other than the original purchaser of the Equipment, the lifetime warranty shall terminate.

The lifetime warranty and one-year warranty as set forth herein apply only to Equipment shipped from Elliott after January 1, 2012.

EXCLUSIONS: No warranty claims shall be valid unless Elliott is notified in writing of the defect within a reasonable time following its discovery. The one-year warranty and lifetime warranty are valid only if an annual service inspection is performed and documented by an authorized Elliott distributor. The one-year warranty and lifetime 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, failure to perform routine maintenance, overloading or misuse, including without limitation, an operator's failure to follow the instructions issued with the equipment. The one-year warranty and lifetime warranty are void if any modifications are made to the Equipment.

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.

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, LOST PROFITS OR COSTS OF ANY KIND OR FOR ANY DAMAGES FOR WHICH BUYER MAY BE LIABLE TO OTHER PERSONS.

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. In particular, the remedy of replacement provided for herein is the exclusive remedy for breach of the one-year warranty and lifetime warranty.

ELLIOTT
EQUIPMENT COMPANY

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CHANGE OF OWNERSHIP

Please complete this form in full and return to Elliott Equipment Company

Date	Dealer	Dealer Address, City, State, Zip Code	
Equipment Serial Number	Crane Model	Customer Unit Number	
Chassis Year	Truck Make & Model	Chassis VIN	
New Owner (Individual or Company)			
Mailing Address (Street address or PO Box)			
City, State, Zip Code			
Shipping Address (If different from mailing address)			
City, State, Zip Code (If different from mailing address)			
Phone Number (Please include area code)	Fax number (Please include area code)		
Email Address			
Name of person safety information should be addressed to			

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 know and understand the specific requirements and hazards that exist, including adverse weather and ground conditions. 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. 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 read these instructions can result in death or serious injury.

It is **your responsibility** to operate and maintain your boom truck with skill, good judgment, 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.

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 judgment, 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 judgment, 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.**

Operator's Responsibilities

Safety must be the operator's most important concern. The operator 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 judgment.

Before and during each use, the operator shall measure wind speed from the aerial platform at the height of use with an anemometer. Do not allow personnel lifts in wind speeds exceeding 20 miles per hour (32 kilometers per hour) at the raised platform height when the platform is attached to the boom or jib unless otherwise indicated on the load chart.

Winds aloft can be much stronger than at the ground. Follow all applicable instructions for operating an anemometer. Weather can be unpredictable, and the operator must determine prior to operation whether it is safe to use the equipment given the conditions. Operators should be aware of high or erratic winds, electric storms, snow, ice, sleet, or other adverse weather conditions that could affect the safety of

personnel or property. If high winds or adverse weather conditions are encountered, do not use the equipment. If high winds or adverse weather conditions develop during the lift, terminate the lift.

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.

Signal Person's Responsibilities

The signal person must have good vision and sound judgment. 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 take up a position where 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.

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.

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.

Revision History

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Tech Spec.	EEC-0052	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15
Tech Spec.		1.2	Doc update	3/5/15

NOTE: Unless otherwise specified, all section references in this chapter refer to the latest version of ANSI/ASSE A10.31.

SECTION 6-Responsibilities of Manufacturers

A. **General Responsibilities:** Each manufacturer of a digger derrick covered by this standard shall comply with all requirements of **ANSI/ASSE A10.31, Section 4** for mechanical design, **Section 5** for electrical performance (where related to a manufacturer) and the requirements of this section.

B. **Specifications**

1. **Vehicle Specifications:** The digger derrick manufacturer shall provide to the installer the minimum values, as applicable, for the following characteristics of vehicles required to provide a stable and structurally sound vehicle for the digger derrick:
   - **a.** Front gross axle weight rating (GAWR front)
   - **b.** Rear gross axle weight rating (GAWR rear)
   - **c.** Gross vehicle weight rating (GVWR)
   - **d.** The frame section modulus
   - **e.** Yield strength of the vehicle frame
   - **f.** Frame resisting bending moment (RBM)
   - **g.** Wheelbase dimension (WB)
   - **h.** The rear of cab to rear axle centerline dimension (CA)
   - **i.** The minimum axle weights of the mobile unit required for stability
2. **Digger Derrick Specifications:**
   - **a. General:** The digger derrick manufacturer shall clearly state in the manual and on the digger derrick the following information:
     - **I.** Make and model
     - **II.** Serial number
     - **III.** Year of manufacture
     - **IV.** Insulating or non-insulating
     - **V.** Maximum pressure of the hydraulic system and voltage of the electrical control system

VI. Cautions and restrictions of operation, including the applicable ambient temperature range where the digger derrick may be used
VII. Rated load capacity
VIII. Platform capacity
IX. Multiple configurations
X. Compliance with **ANSI/ASSE A10.31**

b. **Digger Derrick Component Ratings:** The digger derrick components shall be rated in the following terms:
I. Make and model
II. Serial number
III. Year of manufacture
IV. Insulating or non-insulating
V. Maximum pressure of the hydraulic system and voltage of the electrical control system
VI. Cautions and restrictions of operation, including the applicable ambient temperature range where the digger derrick may be used
VII. Rated load capacity
VIII. Platform capacity
IX. Multiple configurations
X. Compliance with **ANSI/ASSE A10.31**

c. **Digger Derrick Component Ratings:** Digger derrick components shall be rated in the following items:
I. Winch capacity
II. Winch line. Manufacturers should recommend the size, length, type and average breaking strength of the synthetic rope and minimum breaking strength of wire rope for use with the winch
III. Rating classification
IV. Rated capacity
V. Platform capacity
VI. Digger rating. The manufacturer shall specify for each speed range:

- Running torque
- Rotation speed in RPM at rated hydraulic flow
- Rated hydraulic flow
- Rated hydraulic pressure

d. **Design Voltage and Qualification Voltage:** If the digger derrick is the insulating type, the manufacturer shall state the design and qualification voltage in the manual, and the qualification voltage on the identification plate(s).

NOTE: ANSI/ASSE A10.31, Section 5 details the procedures for electrical requirements.

C. **Quality Assurance:** The manufacturer shall have a documented quality assurance program that will ensure compliance with this standard.

D. **Manuals:** The manufacturer shall provide a separate operator's manual and a separate parts/maintenance manual for each digger derrick. Two hard copies of the operator's manuals shall accompany each digger derrick. Two parts and maintenance manuals, either hard copy or electronic format, shall be provided for each digger derrick. The manuals shall contain:

1. Descriptions, specifications and ratings of the digger derrick
2. Operating instructions for the digger derrick and its auxiliary systems
3. Precautions relating to multiple configurations such as personnel platforms, jibs, etc.
4. Instructions regarding routine and frequency of recommended maintenance
5. Replacement part information
6. Instructional markings, per the **Instructional Markings s**ection on page 4.
7. Facsimiles of all safety and operating decals and their location
8. Notice of the requirement of dealers, installers, owners, users, operators, lessors, lessees, and brokers to comply with the appropriate section(s) of this standard

E. **Markings:** The digger derrick shall have identification, operation, and instruction placards, decals, plates or the equivalent, which are legible and readily visible. In

no event shall markings be applied which reduce the insulating properties of the digger derrick. Markings on the digger derrick may refer to the unit manuals for additional identification, operation and instructional material.

1. **Application of Markings:** The manufacturer shall install on each digger derrick the markings or provide these markings with appropriate installation instructions.
2. **Identification Markings:** The manufacturer shall install or provide an identification plate(s) to indicate the following minimum information:
   - **a.** Make
   - **b.** Model
   - **c.** Insulating or non-insulating
   - **d.** Qualification voltage and date of test
   - **e.** Serial number
   - **f.** Year of manufacture
   - **g.** Rated load capacity
   - **h.** Digger derrick hydraulic system pressure or digger derrick control system voltage, or both
   - **i.** Unit equipped with platform(s) and platform(s) capacity
   - **j.** Unit equipped with jib and the rated capacity of the jib
   - **k.** Minimum ambient temperature for operation of the digger derrick to maintain structural integrity
   - **l.** Name and location of manufacturer
   - **m.** Installer
3. **Operational Markings:** The manufacturer shall install or provide markings describing the function of each control and a boom angle indicator readable from the lower control station(s). See **ANSI/ASSE A10.31, Appendix B** for recommended symbols for control functions.
4. **Instructional Markings:** Markings shall be determined by the manufacturer, or the manufacturer and user jointly to indicate hazards inherent in the operation of a digger derrick. Instructional markings shall be provided for:

a. Electrical hazards involved in the operation of the machine to warn that:

I. A digger derrick does not provide protection to platform occupant(s) from contact with, or in proximity to, electrically-charged equipment, conductor, or other components when the platform occupants(s) is in contact with, or in proximity to, another electrical component.

II. A digger derrick in proximity to energized conductors, including load line and load being lifted, shall be considered energized, and that contact with the digger derrick, winch line, load being lifted or vehicle (including attached trailers) under those conditions may cause serious injuries.

b. Hazards resulting from failure to operate the equipment in a prescribed manner.

c. Information related to the use and load rating of the equipment for material handling.

d. Information related to the use and load rating of the digger derrick for multiple configurations.

e. Information warning the operator that winch lines are not insulating.

f. Information related to operator cautions.

g. Notice of the requirement to comply with the appropriate section(s) of this standard.

F. Mechanical Tests and Inspection

1. **Operational Tests:** In addition to the manufacturer's prototype tests and quality assurance measures, each digger derrick, including mechanisms, shall be tested by the manufacturer as necessary to ensure compliance with the operational requirements of this section. Some examples are:

a. Boom(s) elevating and lowering mechanism

b. Boom(s) extension mechanism

c. Rotating mechanism

d. Stability tests

e. Safety devices (each digger derrick shall be operated to verify the function of all safety devices)

f. Load hoisting and lowering mechanism

g. Auger drive and stowage mechanism

When the manufacturer does not complete the mobile unit, such as tests, which can be performed only after complete assembly and installation, shall be the responsibility of the installer.

2. **Visual Inspection:** After testing, a visual inspection of all components shall be made for evidence of defects such as deformation of any component, loose connections, damaged rope, hydraulic leaks and other items critical to the safe operation of the digger derrick.

G. Electrical Tests: Insulating digger derricks shall be tested in accordance with the requirements of **ANSI/ASSE A10.31, Section 5.**

H. Installation Instructions: The manufacturer shall provide instruction for installing or mounting the digger derrick to the installer.

I. Welding: All welds whose failure could result in uncontrolled motion of the digger derrick shall meet the **ANSI/AWS D1.1/D1.1M, Structural Welding Code-Steel, and ANSI/AWS D1.2/D1.2M, Structural Welding Code-Aluminum.** The manufacturer shall establish applicable welding quality assurance procedures for all weldments. Methods of nondestructive examination shall be described in the manufacturer's quality assurance procedures. The manufacturer shall designate in an appropriate manual the welds to be examined, the extent, and method of examination. Of non-destructive examination is designated, the particular method used shall be in accordance with **ANSI/AWS B1.10, Guide for the Non-Destructive Inspection of Welds.**

J. Training and Training Materials: Manufacturers shall develop and offer training materials that aid dealers, installers ,owners, users, operators, lessors, lessees, and brokers in the operation, inspection, testing, and maintenance of the digger derrick.

SECTION 7-Responsibilities of Dealers and Installers

A. **General Responsibilities:** Each dealer or installer as applicable shall comply with the requirements of this section.

B. **Vehicle Specifications:** Each dealer or installer (or both) who sells a digger derrick shall inform the owner or user (or both) of the manufacturer's minimum vehicle specifications.

C. **Vehicle Weight Distribution:** The installer shall be responsible for the weight distribution of the completed mobile unit in accordance with the requirements of the digger derrick and the applicable regulations. Allowance shall be made for the weight of readily-removable tools and material specified by the user.

D. **Manuals:** Upon delivery of the equipment to the owner or user, the dealer or installer shall provide the manuals as required by the **Manuals** section on page 3, and manuals for auxiliary equipment added by the installer.

E. **Installations:** The installer shall comply with **ANSI/ASSE A10.31 Sections 5 & 6** relating to proper installations and shall follow the instructions of the manufacturer. In the event the original manufacturer no longer exists, an equivalent entity may provide these instructions. The installer of a digger derrick shall meet the following requirements before the mobile unit is placed in operation:

1. Complete successful stability tests in accordance with the requirements of **ANSI/ASSE A10.31, Sections 4.5.1, 4.5.2, and 4.5.3.**
2. Complete operational and visual tests in accordance with the requirements of the **Operational Tests** section on page 5 and the **Visual Inspection** section on page 6.
3. Complete the appropriate electrical tests required in **ANSI/ASSE A10.31, Section 5.4.** For insulating digger derricks, the install shall assure conformance to the qualification test requirements of **ANSI/ASSE A10.31 Section 5.3.2,** either by obtaining certification of the test and performing a periodic test after installation, or by performing the qualification test.

4. Measure and post the travel height of the mobile unit in a location that is readily visible to the vehicle operator.
5. Comply with all requirements of the applicable Federal Motor Vehicle Safety Standards in effect at the time of installation when installing a digger derrick on a chassis that is a highway vehicle.
6. Certification as a manufacturer (alteration, intermediate, or final of a motor vehicle under the Federal Motor Vehicle Safety Standards is required.

F. **Quality Assurance:** The installer shall have a documented quality assurance program that will ensure compliance with this standard.

G. **Welding:** All welds made by the installer, whose failure could result in motion of the digger derrick, shall meet the Structural Welding Code **ANSI/ASSE D1.1/D1.1M** and **ANSI/ASSE D1.2/D1.2M.** The installer shall establish applicable welding quality assurance procedures for all welded joints and assemblies. If non-destructive testing is designated, the particular method used shall be in accordance with **ANSI/ASSE B1.10.**

H. **Training:** The dealer or installer shall offer training or training materials that aid owners, users, operators, lessors or lessees, and brokers in the operation, inspection, testing and maintenance of the digger derrick. This training or training materials shall be offered initially and subsequently on request.

I. **Dealer or Installer as User:** Whenever a dealer or installer directs personnel to operate a digger derrick (inspecting, sales demonstrations or any form of use), the dealer or installer shall assume the responsibilities of users as specified in **ANSI/ASSE A10.31, Section 9.** All personnel authorized to operate the digger derrick shall have been trained.

J. **Rated Load Capacity Charts:** Upon completion of the stability test(s) as required in **ANSI/ASSE A10.31, Section 4.5.1,** the installer shall permanently attach appropriate rated load capacity charts, visible to the operator at the controls. Rated load capacity charts shall be provided by the manufacturer, or by the installer at the specific instruction of the manufacturer. The rated working load of the winch line may limit the maximum capacity of the digger derrick.

Rated load capacity charts shall include the number of platforms, platform ratings, the options included, and the winch line rated working load (see **ANSI/ASSE A10.31, Section 9.6)**.

SECTION 8-Responsibilities of Owners

A. General Responsibilities: Each owner shall comply with the requirements of this section. The following responsibilities pertain to the owner's inspection, testing, maintenance, modification, training and transfer of ownership. These activities shall be performed by a qualified person(s).

B. Inspection and Testing Classifications

1. **Initial Inspection and Test:** Prior to initial use, all new or modified mobile units shall be inspected and tested to ensure compliance with the provisions of this standard. Certification by the manufacturer, the installer, or an equivalent entity or entities meets this requirement.
2. **Regular Inspection and Test:** The inspection procedure for mobile units is divided into two classifications based upon the intervals that inspections and tests shall be performed. The owners shall set intervals in accordance with the manufacturer's recommendations. Such intervals are dependent upon component function and exposure to wear and deterioration as well as other agents that adversely affect component life. Two classifications are designated:
   a. **Frequent inspection and test**
   b. **Periodic inspection and test**
3. **Frequent Inspection and Test:** items determined by the owner in accordance with the manufacturer's recommendations for each specific digger derrick shall be inspected for defects.
   Immediately prior to first use during each work shift, the operator shall perform the following tests and inspections:
   a. conduct a walk-around visual inspection to look for damaged components; cracks; corrosion; excessive wear; and any loose, deformed or missing bolts, pins, fasteners, locking devices, and covers.
   b. Check all controls and associated mechanisms for proper operation to include, but not limited to the following:
      I. Proper operation of interlocks

II. Controls return to neutral when released and do not stick
III. Control functions and operation clearly marked

c. Check visual and audible safety devices for proper operation.
d. Visually inspect fiberglass and insulating components for visible damage and contamination.
e. Check for missing or illegible operational and instructional markings.
f. Check hydraulic and pneumatic systems for observable deterioration and excessive leakage.
g. Check electrical systems related to the digger derrick for malfunctions, signs of excessive deterioration, dirt, and moisture accumulation.
h. Check winch lines for any areas of gross damage or deterioration that would result in appreciable loss of original strength.
i. Perform functional test to include, but not limited to, the following:
   I. Set up the digger derrick for operation, including outriggers
   II. Cycle the digger derrick functions through the complete range of motion from the lower controls, except where operation through the complete range of motion would create a hazard
   III. Check functionality of emergency controls

Any suspected items shall be carefully examined or tested, and a determination will be made by a qualified person as to whether they constitute a safety hazard.

All unsafe items shall be replaced or repaired before use.

4. **Periodic Inspection and Test:** An inspection of the mobile unit shall be performed at a range of one- to 12-month intervals, depending on its activity, severity of service, and environment or as specifically indicated below (these inspections shall include the requirements of **ANSI/ASSE A10.31, Frequent Inspection and Test** section on page 9:
   a. Structural members for deformation, cracks, or corrosion.

b. Parts, such as pins, bearings, shafts, gears, rollers, locking devices, chains, chain sprockets, wire, and synthetic ropes and sheaves for wear, cracks or distortion.

c. Hydraulic and pneumatic relief valve settings.

d. Hydraulic and pneumatic fittings, hoses, and tubing for evidence of leakage, abnormal deformation or excessive abrasions.

e. Compressors, pumps, motors and generators for loose fasteners, leaks, unusual noises or vibrations, loss of operating speed, and excessive heating.

f. Hydraulic and pneumatic valves for malfunction and visible cracks in the external valve housing, leaks, and sticking spools.

g. Visually inspect any vacuum prevention systems and verify function of such systems on digger derricks that have a sheave height or platform height greater than 50 feet.

h. Hydraulic and pneumatic cylinders and holding valves for malfunction and visible damage.

i. Hydraulic and pneumatic filters for cleanliness and the presence of foreign material in the system indicating other component deterioration.

j. Electrical systems and components for deterioration or wear including those not readily visible on a frequent inspection.

k. Performance test of all boom movements.

l. Condition and tightness of bolts and other fasteners, in accordance with the manufacturer's recommendation.

m. Welds, in accordance with the manufacturer's recommendation.

n. Legible and proper identification, operational and instructional markings.

o. If the digger derrick is rated as an insulating device, the electrical insulating components and system(s) shall be thoroughly inspected for lack of cleanliness and other conditions that compromise insulation.

p. If the digger derrick is rated as insulating, it shall be tested for compliance with the rating of the digger derrick in accordance with one of the applicable methods as outlined in **ANSI/ASSE A10.31, Section 5.4.3.**

q. If the digger derrick is rated as insulating, it shall be dielectrically tested after repair or modification of any component that crosses the insulating system(s) in accordance with **ANSI/ASSE A10.31 Section 5.4.3.**

r. An insulating replacement boom shall be tested to ensure conformance to **ANSI/ASSE A10.31 Section 5.4.2.**

Any suspected items shall be carefully examined to tested and a determination made by a qualified person as to whether they constitute a safety hazard. All unsafe items shall be replaced or repaired before use.

5. **Post Event Inspection or Test:** After any reported event during which structural members of a digger derrick are suspected of being subjected to loading of stresses in excess of design stress such as after an accident involving overturning of the digger derrick or application of unintended external mechanical or electrical forces to the digger derrick, the digger derrick shall be removed from service and subjected to the applicable periodic inspection requirements of **ANSI/ASSE A10.31, Periodic Inspection and Test** section on page 10. In addition to the periodic inspection, supplemental non-destructive examination procedures or other tests to assist in detecting possible structural damage to the digger derrick may be required. All damage items shall be replaced or repaired before the unit is returned to service. A return to service shall be approved by a qualified person.

C. Inspection Records and Test Records

1. **Frequent:** Items to be inspected shall be designated to the operator or other authorized person making frequent inspections. Records of frequent inspections need not be made. However, where a safety hazard is found, it shall be reported in writing to a person responsible for the corrective action,

and that report and a record of the correction shall be maintained for a period of five years, or as required by applicable regulations.

2. **Periodic:** Written or appropriately archived electronic, dated and signed reports and records shall be made of periodic inspections and tests and retained for a period of five years or as required by applicable regulations.

D. **Maintenance:** The owner shall determine maintenance and frequency of maintenance in accordance with the manufacturer's recommendations.

1. **Maintenance Training:** The owner shall train their maintenance personnel in inspection and maintenance of the digger derrick in accordance with the manufacturer's recommendations and **Section 8.**
2. **Welding:** Welding repairs of components or welds, designated as critical in the manufacturer's manual, shall be made in accordance with the manufacturer's procedure and **ANSI/AWS D1.1 or ANSI/AWS D1.2.** Should the original manufacturer no longer exist, an equivalent entity may determine the required process.

E. **Modifications:** No modifications or additions that affect the stability, mechanical, hydraulic, or electrical integrity or the safe operation of the digger derrick shall be made without the written approval of the manufacturer. If such modifications or changes are made, the capacity, operation and maintenance instruction markings shall be changed accordingly. In no case shall the safety factors be reduced below those specified in this standard, or below the manufacturer's design safety factors, whichever is greater. Should the original manufacturer no longer exist, an equivalent entity may approve required modification.

1. **Alternations:** Altering or disabling the function of safety devices, guards or interlocks, if so equipped is prohibited.

F. **Weight Distribution:** The owner shall specify to the install the payload and its distribution, as well as complete vehicle specifications when the owner supplies the vehicle. Changes in loading or additions made to the mobile unit after the final acceptance that affect weight distribution shall meet applicable regulations by governmental agencies. In no case shall the axle loads of the fully-loaded

vehicle exceed the gross axle weight ratings (GAWR) assigned by the manufacturer.

NOTE: Any change in weight distribution may adversely affect stability.

G. **Transfer of Ownership:** When a change in ownership of a digger derrick occurs, it shall be the responsibility of the seller to provide the manufacturer's manual(s) for that digger derrick to the purchaser. It is the responsibility of the purchaser to notify the manufacturer of the unit model, serial number, and the name and address of the new owner within 60 days. If the owner uses other entities as agents (i.e. brokers) for the sale or the arrangement of a sale of a digger derrick(s), the owners or agents responsibilities under this section continue.

H. **Markings:** The markings on the digger derrick shall not be removed, defaced, or altered. All missing or illegible markings shall be promptly replaced.

I. **Parts:** When parts or components are replaced, they shall be identical. In specification and function to the original digger derrick parts or components or shall provide an equal or greater factor of safety.

J. **Safety Bulletins:** Owners shall comply with safety-related bulletins as received from the manufacturer, dealer or installer.

K. **Manuals:** The owner shall ensure that the operating manual(s) is stored on the mobile unit.

L. **Training, Retraining and Familiarization of Operators**

1. **General Training:** Only personnel who have received general instructions regarding the inspection, application and operation of digger derricks, including recognition and avoidance of hazards associated with their operation, shall operate a digger derrick. Such items covered shall include, but not necessarily be limited to the following issues and requirements:
   - **a.** The purpose and use of manuals.
   - **b.** That operating manuals are an integral part of the digger derrick and must be properly stored on the vehicle when not in use.
   - **c.** A pre-start inspection.

d. Responsibilities associated with problems or malfunctions affecting the operation of the digger derrick.

e. Factors affecting stability.

f. The purpose of placards and decals.

g. Workplace inspection.

h. Applicable safety rules and regulations, such as **Part 4, ANSI/IEEE C2, National Electrical Safety Code** (applies to utility workers as defined in **ANSI/IEEE C2**). The above standard is an example, and other industries using digger derricks have safety rules pertinent to that industry.

i. Authorization to operate.

j. Operator warnings and instructions.

k. Actual operation of the digger derrick. Under the direction of a qualified person, the trainee shall operate the digger derrick for a sufficient period of time to demonstrate proficiency in the actual operation of the digger derrick.

l. Proper use of personal fall protection equipment when the digger derrick is equipped with a platform(s). Fall protection systems criteria and practices are covered in **29 CFR 1926.502.**

2. **Retraining:** The operator shall be retrained, when so directed by the user, based on the user's observation and evaluation of the operator.
3. **Familiarization:** When an operator is directed to operate a digger derrick they are not familiar with, the operator, prior to operating, shall be instructed regarding the following items and issues:

a. The location of the manuals.

b. The purpose and function of all controls.

c. The safety devices and operating characteristics specific to the digger derrick.

d. Under the direction of a qualified person, the trainee shall operate the digger derrick for a sufficient period of time to demonstrate proficiency in the actual operation of the digger derrick.

M. Owner as a Lessor: When owners function as lessors, they shall have the responsibilities of **ANSI/ASSE A10.31, Section 11.**

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0168	1.0	New Document	11/13/15

Digger Derrick Nomenclature

To promote clear communication between the manufacturer, dealer, installer, user and operator, the nomenclature presented in this section should be used by the manufacturer, dealer, installer, and lessor in all publications concerning the digger derrick, including:

- Operator's Manual
- Service Manual
- Installation Manual
- Replacement Parts Manual
- Sales Specifications
- Advertising Specifications

A. **Upper Controls:** Those controls located in or near the optional platform.

B. **Platform:** The optional personnel-carrying component of a digger derrick, such as a bucket, basket, stand or equivalent device including the attachment means to the boom.

C. **Platform Pin:** The horizontal pin that attaches the platform to the digger derrick boom, and about which the platform rotates with respect to the boom.

D. **Upper Boom Tip:** The end of the boom farthest from the turntable.

E. **Extension Cylinder:** The hydraulic cylinder(s) that extend and retract the booms.

F. **Boom Pin:** The horizontal shaft about which the boom pivots as it is raised or lowered relative to the turntable.

G. **Lower Boom:** The structural member attached to the turntable that supports the extensible boom(s).

H. **Intermediate boom(s):** Structural member(s) that extend and are located between the lower and upper booms.

I. **Upper Boom:** The structural member that extends the farthest and supports the boom tip or optional platform(s), or both.

J. **Winch Line:** The load hoisting rope or cable.

K. **Boom Tip Winch:** A winch located at the tip of an intermediate or upper boom.

L. **Boom Tip Sheave:** The sheave(s) located at the boom tip that carries the winch line.

M. **Pole Guide:** A mechanism located at the intermediate or upper boom tip used for guiding and stabilizing a pole.

N. **Pole Guide Tilt Cylinder:** The hydraulic cylinder that controls the attitude of the pole guide.

O. **Digger Hanger Bracket:** The structural member on the boom that supports the digger.

P. **Digger:** The mechanism that drives the auger or screw anchor-setting device.

Q. **Auger:** The hole-boring tool attachment on the digger.

R. **Auger Stowage Bracket:** The mechanism that stores the digger and auger assembly when it is not in use.

S. **Lower Boom Winch:** A winch located at the base end of the lower boom.

T. **Lower Controls:** The controls, either remote, on the vehicle, on the turntable or on the pedestal, which are designed to operate the functions of the digger derrick.

U. **Pedestal:** The stationary base that affixes the rotation bearing of the digger derrick to the vehicle.

V. **Rotation Bearing:** the rotating member of the digger derrick between the pedestal and the turntable that allows slewing of the booms.

W. **Rotation (Slewing) Mechanism:** The mechanism of a digger derrick that controls rotation of the booms and turntable about the centerline of rotation.

X. **Turntable:** The structure above the rotation bearing that supports all the booms.

Y. **Turntable Winch:** A winch located on the turntable.

Z. **Lift Cylinder:** The hydraulic cylinder that lifts or articulates the boom.

AA. **Outriggers:** The structural members that are extended or deployed to assist in stabilizing the mobile unit.

BB. **Outrigger Cylinder:** The hydraulic cylinder that extends or deploys the outrigger.

CC. **Outrigger Controls:** The controls for operating the outriggers.

DD. **Boom Angle Indicator:** A device that indicates the angle between the boom and a horizontal plane.

EE. **Jib:** An auxiliary boom that attaches to the upper boom tip to extend the reach of the boom.

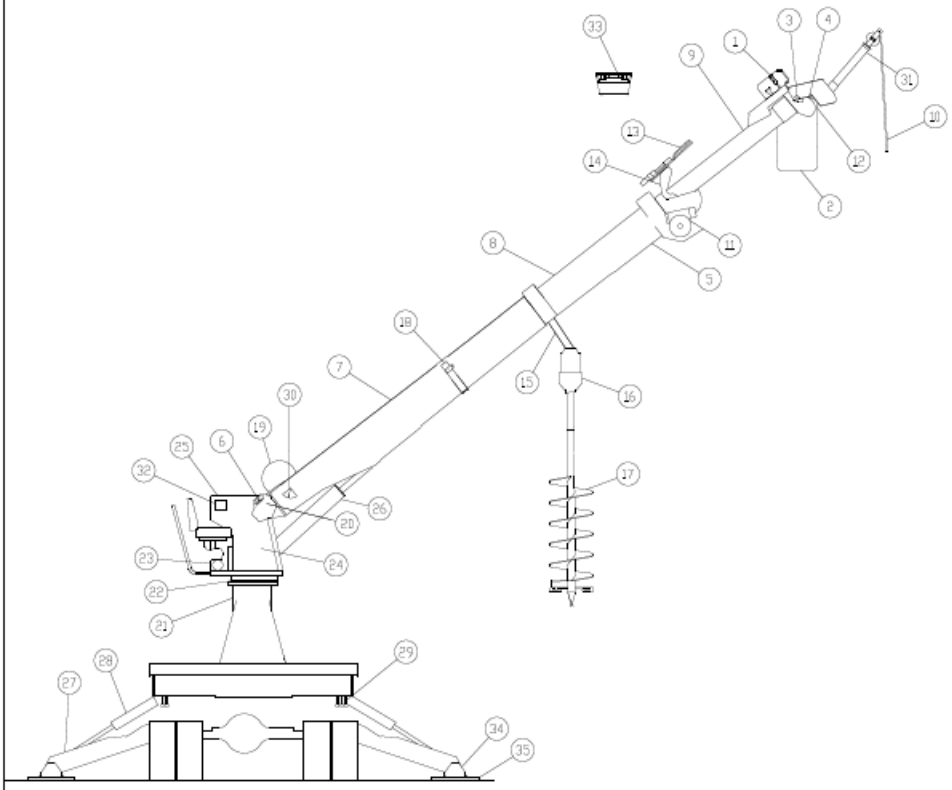
FF. **Rated Load Capacity Chart:** A chart that indicates the rated load capacity of the digger derrick in all positions specified by the manufacturer or installer.

GG. **Remote Controls:** Controls that are not permanently attached to the mobile unit.

HH. **Outrigger Foot (Shoe):** The component of the outrigger that rests on the outrigger pad or ground.

II. **Outrigger Pad:** An accessory used to distribute the outrigger load to the ground.

Figure 1 - Digger Derrick Nomenclature



1. Upper Controls
2. Platform
3. Platform Pin
4. Upper Boom Tip
5. Extension Cylinder
6. Boom Pin
7. Lower Boom
8. Intermediate Boom
9. Upper boom
10. Winch Line
11. Boom Tip Winch
12 Boom Tip Sheave
13. Pole Guide
14. Pole Guide Tilt cylinder
15. Digger Hanger Bracket
16. Digger
17. Auger
18. Auger Stowage Bracket
19. Lower Boom Winch
20. Lower Controls
21. Pedestal
22. Rotation Bearing
23. Slewing mechanism
24. Turn Table
25. Turntable Winch
26. Lift Cylinder
27. Outriggers
28. Outrigger Cylinder
29. Outrigger Controls
30. Boom Angle Indicator
31. Jib
32. Load Capacity Chart
33. Remote Controls
34. Outrigger Foot (Shoe)
35. Outrigger Pad

Note 1: This illustration is used to amplify and explain the text and is not meant to cover all possible configurations for digger derrick equipment.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0169	1.0	New Document	11/13/15

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.

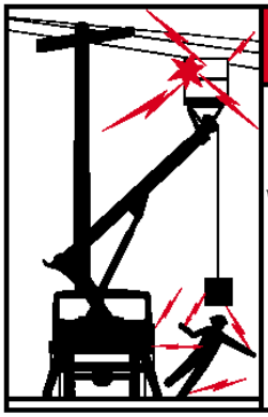
DO NOT PAINT OVER ANY LABELS 1003360 111193

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 1002300 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. 1926.550**, must also be followed.

Personnel Platform Usage Guidelines

A. The crane shall not be used for other lifting operations while handling personnel. Downhaul weight or load-block must be removed from loadline. The loadline must be stowed on top of main boom. Anti-two-block switch must be overridden.

B. Lift controls and platform shall be tested and inspected daily prior to use.

C. 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.

D. 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.

E. 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.

F. Belting off to structures other than the boom or the platform shall not be permitted.

G. 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.

H. 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.

I. 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.

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

J. Rated loads account for wind to 20 MPH (32 km/hr) and 15 MPH (24 km/hr) on jib capacities. Above these wind velocities, loads and/or boom lengths must be appropriately reduced for safe operation. Cease all personnel lifting activities if hazardous conditions such as electrical storms, snow, ice, sleet or any other adverse conditions occur.

K. Modification of the structural integrity of the personnel platform shall not be done without written approval of the manufacturer.

L. 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.

M. Properly stow the personnel platform, jib, boom, and outriggers prior to road travel.

Special Work Considerations

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

A. When welding from the personnel platform electrode holders shall be protected from contact with the metal components of the personnel platform.

B. 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.

C. A boat with rescue personnel shall be available during a personnel lift over water.

D. Special personnel protective equipment shall be provided and required to be worn around toxic, flammable or hazardous materials or fumes.

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.

A. 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.

B. 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.

C. Crane and personnel platform shall be inspected daily prior to any lifting events. An inspection record is to be maintained.

D. Personnel lifting activities shall be made under controlled conditions with the aid of an appointed signalperson.

E. 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:

- Proper use of all equipment.
- Assignment and responsibilities of each person involved in the lift.
- The procedures to be followed.
- Guidance on general and specific safety precautions.
- Special signals for the operation.
- Unique considerations of the lift.
- Work to be accomplished during the lift.
- 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.

F. 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.

Personnell Reponsibilites and Qualifications

MANAGEMENT

A. 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.

B. Shall designate qualified persons to perform duties of “Personnel Lift Authorizer”.

Personnel Lift Authorizer shall:

- Verify need for personnel lift.
- Verify equipment to be used meets standards.
- Authorize the personnel lift operation.

- Require lift personnel to follow guidelines of standards.

C. Shall designate person to perform duties of “Personnel Lift Supervisor”.

Personnel Lift Supervisor shall:

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

EQUIPMENT OPERATOR

A. Shall be qualified to operate the equipment being used in the personnel lift.

B. 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.

C. Successfully meet training and qualification criteria outlined in hoisting equipment volumes of **ASME B30** (latest).

D. Shall be responsible for complying with the requirements of the standards as they relate to:

- Hoisting equipment capability.
- Rated load constraints.
- Operational limitations.
- Confirming that all hoisting equipment inspections have been completed and are satisfactory, prior to starting the lift.
- Operating the hoisting equipment in compliance with specified procedures.

E. 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:

- The operator does not feel physically or mentally fit to perform the operation.

- 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.
- The operator did not have at least eight hours off immediately prior to the work shift containing the personnel lift operation.

F. The operator shall not engage in any activity that will divert his attention while engaged in operating the hoisting equipment.

G. 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.

H. When safety is in doubt, the operator shall consult with the Personnel Lifting Supervisor before commencing or continuing a lift.

I. 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.

J. 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.

K. The operator shall refer to manufacturer's instructional material regarding operation requirements of the hoisting machine and attachments.

L. 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:

- Excessive load and/or radius.
- Overhead obstructions and electrical transmission lines.
- Hazardous locations.
- Inadequate surface and support to withstand all forces imposed.
- Wind, weather, and unstable conditions.
- Any potentially hazardous conditions.

M. 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.

N. Hoisting equipment shall be operated with outriggers and stabilizers fully deployed and properly set.

O. The operator shall verify that the hoisting equipment is set up and maintained within one percent of level (0.56°) during a personnel lift.

P. For hoisting equipment with a boom-attached platform, verify that the platform is attached as outlined in the installation section.

Q. 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**.

R. 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.

S. 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.

T. Verify during the trial lift, the platform is loaded to at least the weight expected during the actual lift.

U. Not knowingly allow the platform load to exceed the platform rating, except during proof testing.

V. Travelling with personnel in the equipment's personnel platform.

W. The operator shall perform all movements if the platform in a slow, controlled manner to minimize sudden movements of the platform.

X. Remain at the hoisting equipment controls at all times the personnel platform is occupied.

Y. Set all brakes and locks on the hoisting equipment after positioning of the personnel platform and before any personnel platform work.

Z. Move the platform under controlled conditions and under the direction of a designated signalperson.

AA. 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.

BB. 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.

CC. Not disable, or allow to be disabled, any hoist equipment safety device during a personnel lift.

DD. Not operate a platform with motion controls without the platform operation manual available in the platform.

EE. 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

A. Visually inspect the platform prior to each lift to verify all attachments and the platform structure are secure.

B. 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.

C. Inspect and attach the platform to the hoisting equipment as specified by the platform manufacturer.

D. 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.

E. 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

A. Remain in continuous sight or in communication with the operator and the signalperson.

B. Maintain a stable and even loading of the platform.

C. Use protective equipment such as hard hats, safety glasses, hearing protection, and gloves in conditions where a hazard of injury exists.

D. 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.

E. Be familiar with hand signals posted in the platform. All occupants shall know the emergency stop signal.

F. Limit their number commensurate with the work being performed, platform design, and hoisting equipment limitations.

G. Have materials and equipment evenly distributed and secured while the platform is lifted.

H. 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.

I. Not pull the platform out of plumb with the hoisting equipment.

J. 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.

K. 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.

Communications

A. Signals to the operator shall be in accordance with the hoisting equipment **ASME B30** volume, unless voice communication (telephone, radio, or equivalent) is utilized.

B. Signals shall be discernible or audible to the operator.

C. Hand signals shall be posted as specified:

- As required by the hoisting equipment **ASME B30** volume.
- Inside the personnel platform.
- At any platform motion control station.

D. Some operations may require additions to, or modifications of standard signals.

- Any special signal shall be agreed upon and understood by the signalperson and the hoisting equipment operator.
- Special signals shall not conflict with the hoisting equipment standard signals.

E. If communications between the operator and platform occupants are disrupted, all operations shall be stopped until communication is reestablished.

F. If radios or other electrical means of communication are used, they should be operated on a secure channel.

G. Proper performance of communications shall be verified prior to each lift if radios or other electrical communication devices are used.

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.

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.

Platform Installation

A. Position the truck and crane for use as outlined in the Owner's Manual.

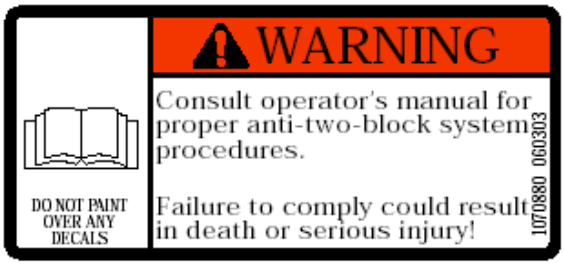
B. If the platform has been transported to the job site on the truck, attach the loadline hook to the platform and set the platform on the ground at a radius that will allow the platform to be pinned onto the boom or jib, whichever is to be used.

C. 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.

D. Attach anti-two-block override flag onto the anti-two-block switch.

E. 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.

F. 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.



G. 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.

Operation

A. 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.

B. Attach the personnel platform as previously described.

C. 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.

D. Referring to the load chart, plan the platform lift operation and review where the load chart will allow the loaded personnel platform to travel.

E. Make sure deductions are taken the jib, if stowed along the main boom, and any other boom mounted options.

F. Where no capacities are shown on the load-rating chart, operation is allowed with the boom fully retracted.

G. Have platform personnel put on the body harnesses with the attached safety lanyard and attach the safety lanyards to the designated anchorage points.

H. 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 in aligns with one of cogs in the locked position.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0061	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15

ELLIOTT EQUIPMENT COMPANY

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**

The proper procedures for jib deployment and stowing can be found in the **Jib Operation** section of the **Safety & Operation** chapter. 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.**
2. 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 cannot 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:

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

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0045	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15

- Make sure outriggers/stabilizers are retracted and removable pads stowed-if applicable. Always retract optional front bumper stabilizer before retracting outriggers and stabilizers.
- Secure the loadline, headache ball or hook block to travel attach point.
- Boom must be in boom rest and turret locked for optional turret locks.
- Secure all items on the truck bed.
- Make sure jib-if supplied-is stowed properly and pinned to boom.
- Disengage the PTO.
- Perform DOT pre-trip inspection.
- Release park brake.
- 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.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0051	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15

A. Position the vehicle in an area free of overhead restrictions. Check capacity chart for tasks required and position the crane in the proper place to complete the task safely.

B. Maintain a clearance of at least 10 feet (3.05 M) between any part of the crane, loadline or load and any electrical line carrying up to 50,000 volts. One additional foot (.30 M) 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.

C. 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.

D. 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.

E. Always set the park brake and disengage the transmission.

F. Use a signal person to set the outriggers safely if not visible and avoid a crushing hazard.

G. Extend the outriggers first so the crane is level from side to side, and raise the vehicle's 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.

H. Run all controls and safety devices, including the anti-two block system, through a cycle prior to lifting loads.

I. Operate control levers and engine speed smoothly to avoid sudden starts and stops, which could cause loads to swing.

J. Do not side load the boom. Side loading can result in sudden structural failure or tipping. Side loading occurs when:

- Rapidly starting and stopping swing operations, operating out of level, dragging or pulling loads sideways or operating in high winds.

K. 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.

L. 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.

M. Keep the load as close to the ground as possible.

N. Do not allow personnel lifts in wind speeds exceeding 20 miles per hour (32 kilometers per hour) at the raised platform height when the platform is attached to the main boom. Do not allow personnel lifts during electric storms, snow, ice, sleet, or other adverse weather conditions that could affect the safety of personnel. Terminate personnel-lifting operations if adverse conditions develop during the lift. Winds aloft can be much stronger than at the ground.

O. Use multi-part rope reeving when required. Keep at least five 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.

P. 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.**

Q. Do not allow anyone to ride the loadline, hook or load.

R. Only use Elliott approved personnel baskets attached to the boom or jib for lifting personnel.

S. Do not exceed 80 percent of the crane rating when using a clam bucket.

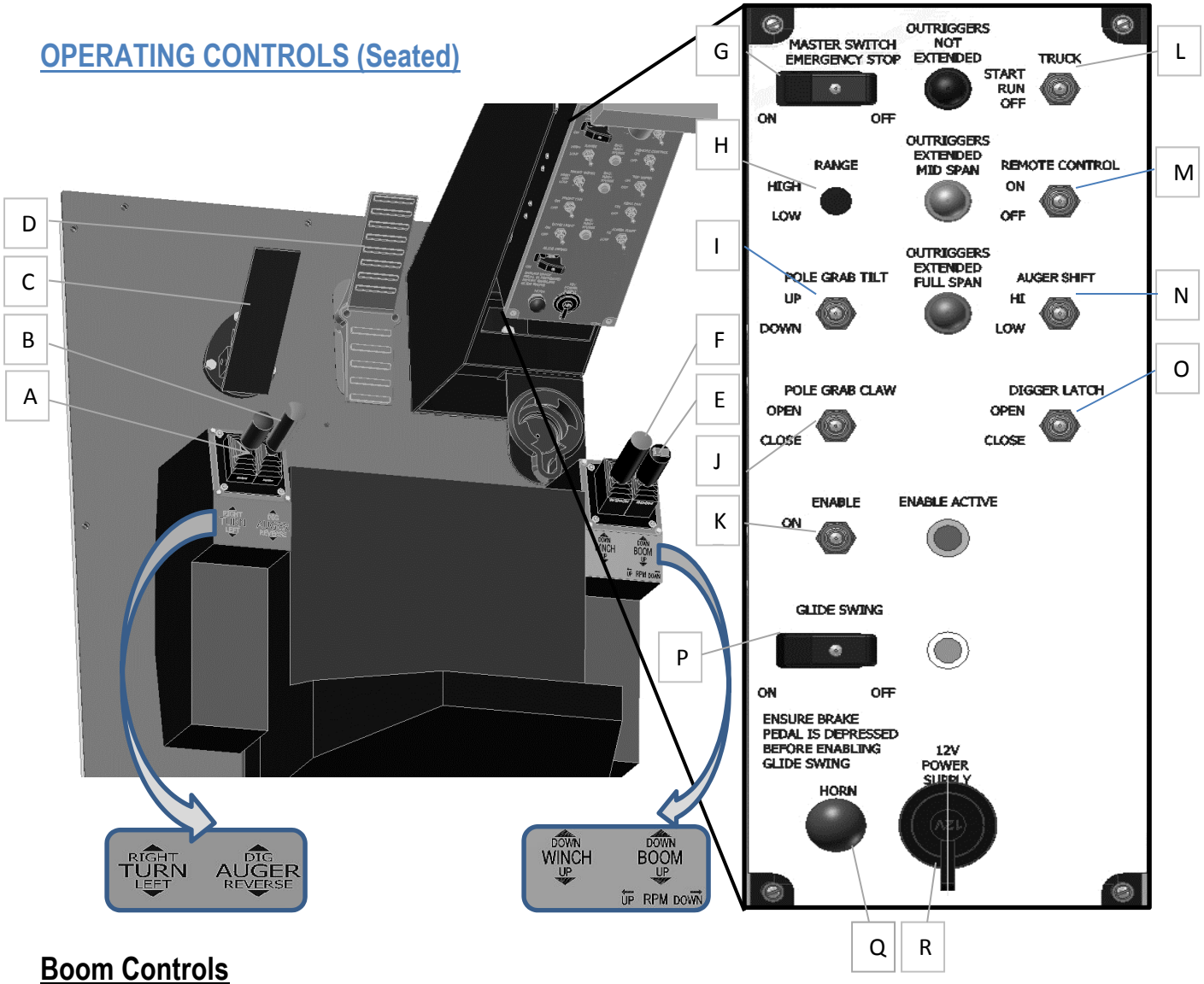
T. Do not operate the crane if the anti-two block safety system is inoperative.

Do not operate the crane if the Load Moment Limiter/Load Moment Indicator System installed on the crane is inoperative.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0024	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15
Tech Spec.		1.2	Content update	7/30/15

OPERATING CONTROLS (Seated)



Boom Controls

Power Take-Off (PTO)

The PTO switch is located in the truck carrier cab. Refer to truck manuals for operating instructions. The PTO switch must be engaged to provide power to crane functions. **Refer to truck manuals for operating instructions.**

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

A. Swing Control Joystick

Push forward-"**RIGHT**" position-Turret swings right - Clockwise

Pull back-"**LEFT**" position – Turret swings left – Counterclockwise

NOTE: *If not equipped with optional continuous rotation, the crane has a 372 degree swing rotation in both directions. A mechanical stop will push the swing lever to neutral when the boom rotates beyond the centerline of the cab over the front.*

B. Digger Control

Push forward -"**DIG**" position – Turns the digger's flighting clockwise

Pull back - "**REVERSE**" position – Turns the digger's flighting counterclockwise. Use to reverse or to clear dirt from the flighting

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.*

C. Glide Swing Brake

The brake pedal activates the swing drive brake. If the **Glide Swing Switch (T)** is in the **"ON"** position, the swing system will not have any brakes until the pedal is applied. To stop rotation, apply pressure to the pedal

D. Boom Telescope Pedal

Push forward with toes-Boom sections extend

Push down with heel-Boom sections retract

E. Boom Control Lever

Push forward - "**DOWN**" position – Lowers boom

Pull back - "**UP**" position – Raises boom

F. Winch Control Lever

Push forward -"**DOWN**" position – Winch pays out cable lowers load.

Pull back - "**UP**" position – Winch winds up cable, raises load.

NOTE-*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.*

1. **Winch Burst of Speed Switch:** Depress button to start high speed winch operation.

CAUTION: *Only operate Burst-of Speed with unloaded loadline. Operating high speed with load on loadline may damage pump and PTO.*

G. Master Switch – Emergency Stop Switch

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

H. 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. 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.

I. Pole Shift Tilt

This momentary switch is used to tilt the boom-mounted pole grab. Pressing the switch in the **"UP"** direction will tilt the pole grab back towards the boom. Pressing the switch in the **"DOWN"** direction will tilt the pole grab away from the boom.

J. Pole Grab Claw

This momentary switch is used to open and close the claws of the pole grab. Pressing the switch in the **"OPEN"** direction will spread the claws apart and release the pole. Pressing the switch in the **"CLOSE"** direction will pull the claws together to grab the pole.

K. Joystick Enable Switch

This momentary switch enables all lower operator joystick functions. Pressing the switch in the "**ON**" direction enables joystick function. Joystick inactivity for more than 14 seconds automatically disables all joystick functions, and the switch must be pressed to resume functionality.

L. Truck Start 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 "OFF" 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.

M. Remote Control Switch

On units equipped with remote controls, this switch activates the remote controls. Set the switch to the "**ON**" position to activate the remote controls. Set this position to the "**OFF**" position to turn remotes off. See operating instructions in the "**Optional Remote Controls**" section of this manual.

N. Auger Shift

This switch is used to shift the digger into either **"HI"** or **"LOW"** speed. For most digging operations, select **"LOW"** speed for digging and **"HI"** Speed for cleaning the flighting. If soil conditions allow, the digger can be used to dig in high speed.

O. Digger Latch

This momentary switch opens and closes the digger stow latch cylinder. To un-stow the digger, use the **Digger Control Joystick (B)** to lift the digger off the latch, and press the switch to the **"OPEN"** position. Once the latch cylinder has retracted and the latch is open, lower the digger using the **Digger Control Joystick.**

To stow the digger, first ensure the latch is open (if not, see previous paragraph to open the latch). Next, use the **Digger Control joystick** to raise the digger into the stow bracket and is above the latch, and then push the switch into the **"CLOSE"** position. Once the cylinder extends and the latch is closed, the digger is stowed.

NOTE: *Ensure the latch is completely closed before continuing crane operation, or transporting the unit.*

P. Glide Swing Switch

 **DANGER**

This unit is equipped with Glide Swing. To switch Glide Swing on, the red **Master Switch – Emergency Stop Switch (G)** must be opened on the toggle switch must be set to the **"ON"** position. When the Glide Swing toggle switch is in the **"ON"** positon, the swing system is **NOT LOCKED** and can swing freely. To apply brake with Glide Swing on, apply pressure to the **Glide Swing Brake (C)**. Any time the red **Master Switch – Emergency Stop Switch** is closed, ensure the **Glide Swing Switch** is in the **"OFF"** position. If switch is on, apply the **Glide Swing Brake,** and then move the **Glide Swing Switch** to the **"OFF"** position.

Q. Horn

Press momentary button to sound horn.

R. 12V Power Outlet

Remove cover to insert 12V power adapter cord. Keep outlet cover on when not in use.

Hyd. System Pressure Gauge

Located inside the control valve enclosure. The pressure gauge indicates Maximum pressure (0-3000 PSI) in the Winch and Function circuits; however, it does not display pressure in the swing circuit.

Bubble Level

Master Level located on sub-base 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.**

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0172	1.0	New Document	11/24/15

SAFETY

The safe operation of the digger system depends on the operator, the condition of the equipment, and your maintenance and inspection procedures.

The operator and service mechanic are key figures in any safety program, and must read and become familiar with all safety precautions presented to help prevent serious injury to themselves and other personnel. The information in this section is designed to present some of the issues that may be encountered by the operator, service mechanic, and other personnel.

Safety Tips:

- Before the unit is transported, make sure the digger is properly stowed and that all pins, fasteners, and the stow latch is in place and is secure
- Do not operate boom or accessories within 10 feet of live power lines
- Check for buried underground utilities services, (i.e., power lines, telephone lines, gas lines, and water lines before digging)
- Before operating the digger, set outriggers following the normal procedures described in the operation section of the Owner's Manual
- Inspect all digger system components prior to operation (i.e., fasteners, pins, stow rope, hydraulic components, and weldments)
- Never stow or un-stow the digger until all persons are clear of the area
- Stow only in the proper direction as indicated on the control level
- Stand clear of auger flighting, and rotating shaft during digging, cleaning, and stowing operation to avoid personal injury
- While digging, feed the digger into the hole ***slowly***. **Do not allow the auger flighting to "corkscrew" into the ground.** This can overload the digger and cause extensive damage to the boom and digger system
- Do not push down with the boom to force the digger into the ground. This can cause extensive damage to the boom and digger system. Boom down *slowly* as the digger loosens the soil. Once the auger flighting is full of soil, boom up out

the hole and allow the flighting to clean itself before continuing the digging process

OPERATION

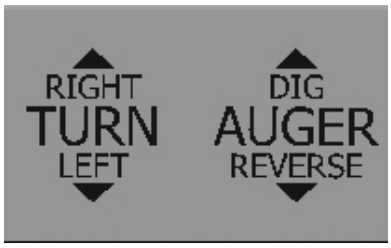
System

The digger system consists of:

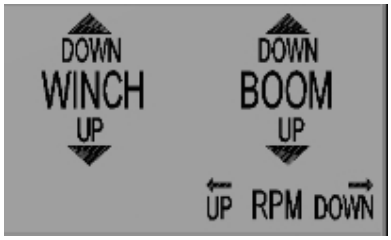
- A two-speed, digger motor
- Digger drive gearbox that drives the digger flighting
- Stow bracket and lock mechanism with wind-up rope for storing he digger on the boom
- Digger mount assembly and boom transfer mechanism
- Digger drive hydraulic circuit with proximity sensors that detect when the digger drive is stowed

The digger's controls will be operated from rotation seated controls located on the turret. The following operator control labels are at the controls.

Operator Control Label (Left Control)



Operator Control Label (Right Control)



A more detailed description of these components is provided in the following Service and Maintenance section. The digger drive (and digger wind-up) is controlled by a level located at the operator's station. Right next to the level is another that opens and closes the hydraulic stow latch mechanism, located inside the digger stow bracket.

The **AUGER ROTATION** level controls the direction of the auger flighting. Operating it in a clockwise direction will turn the auger flighting in the "dig" direction, and will un-stow the auger from the stow bracket on the side of the boom once the **AUGER LATCH** is opened.

***NOTE* Stow auger only in the proper direction as indicated by this document, and by the AUGER DEPLOY AND STOW PROCEDURE decal at the operator's station.**

System

1. Visually inspect the auger system to ensure all pins and keepers are in place, and all fasteners are properly tightened. Repair or replace damaged parts as required
2. Inspect all tubes, fittings, and hoses for damage, kinks, or looseness. Repair or replace damaged parts as required
3. Inspect wind-up rope for damage and the rope end connections to ensure the rope is taut and properly connected to the flighting and stow bracket. Repair or replace damaged parts as required
4. Inspect selector (overwind) valve and stow latch mechanism for damage or improper condition. Repair or replace damaged parts as required
5. Set unit up into its proper operating condition following normal operating procedures as outlined in the Operation section of the Owner's Manual
6. Clear all personnel from the work area
7. Raise the boom from the boom rest to approximately 30 degrees of elevation, and rotate the boom over the work area. **Make sure the boom is fully retracted before attempting to un-stow the auger**

8. Slowly operate the **AUGER ROTATION** lever in the CCW direction until the auger shaft raises itself up from the stow latch and contacts the over wind valve. While holding the auger in this position, operate the **AUGER LATCH** lever in the **OPEN** direction and hold until the auger latch is fully open **Do not continue rotating the auger if contact with the over wind valve does not stop rotation. Damage may occur to the wind-up rope or stow bracket which could cause the auger to drop**
9. Operate the **auger rotation** lever in the CW direction until the auger is un-stowed and hanging vertical, and the wind-up rope is slack. Disconnect the wind-up rope from the auger flighting

Digging

1. The boom should be extended a few feet before commencing digging operations so that as the auger digs, the boom can be retracted or extended to maintain a vertical hole
2. Start rotating the auger in the CW direction and slowly lower the boom until the auger comes in contact with the ground
3. Apply slight **BOOM DOWN** force with the boom level while digging to keep the auger penetrating into the ground and to follow the auger with the boom so as not to structurally overload the boom
4. Depending on soil conditions, care should be exercised when digging so that the auger does not screw itself into the ground (corkscrew), and cause a machine overload
5. When the auger flighting is filled with soil, pull the auger form the hole using the **BOOM UP** level and deposit the soil in the desired location. Soil can be removed from the auger flighting by carefully switching directions of the auger. **Do not slam the auger level back and forth aggressively, or damage can result to the operator lever, lever to valve linkage, or the digger drive assembly**
6. Replace the auger into the hole and extend or retract the boom as necessary to maintain a vertical hole

7. Follow steps 3 through 5 until the hole is to the desired depth. For increased digging depth, the lower pin connecting the auger flighting to the Kelly bar may be unpinned and the digger drive can be raised to extend the length of the Kelly bar. Insert pin in the proper hole of the Kelly bar before resuming the digging operation. Hole depths of up to 16 feet can be obtained. Be sure to retract the Kelly bar before stowing

Stowing

The digger system is designed to stow with the auger flighting attached. If it is necessary to stow the auger drive without the flighting, care should be taken when rotating the Kelly bar into the stow bracket because the over wind valve may not match up with the Kelly bar. **The over wind valve is an operator's aid only, and may not stop the auger from turning completely. Care should always be taken when stowing the auger.**

1. Clean the flighting before stowing to maintain a longer life, and to reduce excessive strain on the stow bracket due to additional weight. This will also prevent dirt from falling off the flighting during the stowing procedure or when transporting the crane
2. Retract the boom completely before starting the stow procedure
3. Attach wind-up rope to the upper end of the auger flighting and **clear all personnel from the work area**
4. Operate the **AUGER ROTATION** lever in the CCW (or Reverse) direction to start wrapping the wind-up rope on the auger flighting shaft. Stow only in the CCW direction as indicated on the **DEPLOY AND STOW PROCEDURE** decal located at the operator's station. Raise the boom to approximately 45 degrees, as lesser boom angles may cause the rope to wind improperly on the auger flighting shaft. While raising the auger to stow, hold the **AUGER LATCH** lever in the **OPEN** position. Once the auger flighting shaft rises into the pocket of the stow bracket and is contacting the over-wind valve, move the **AUGER LATCH** lever into the **OPEN** position. Once the auger flighting shaft raises into the pocket of the stow

bracket and is contacting the over wind valve, move the **AUGER LATCH** lever into the **CLOSE** position and hold until the latch is completely closed. Return the **AUGER ROTATION** lever to the neutral position and the auger flighting shaft will rest on the closed stow bar. **Do not continue rotating the auger if contact with the over wind valve does not stop rotation. Damage may occur to the wind-up rope or stow bracket, which could cause the auger to drop.** Visually check the complete auger system after it is stowed to ensure that the auger is properly locked in the stow position and that all ropes, pins, and keepers are properly installed prior to machine shutdown

5. Refer to the "Shut Down and Preparing for Road Travel" Section in the Owner's Manual when stowing the machine after use.

Machine Use with Auger Stowed

1. Refer to normal "Operating Procedures" as outlined in the Operation Section of the Owner's Manual to set the crane up properly
2. Inspect the auger stow mechanism to ensure all ropes, pins and keepers are in place so that the auger is securely stowed
3. Before lifting any loads with the crane, refer to the "Capacity Deduction" decal located at the operator's station. With the auger stowed on the side of the boom, each maximum capacity load showed on the load chart must be reduced by the amount shown on this decal

Digger System Description

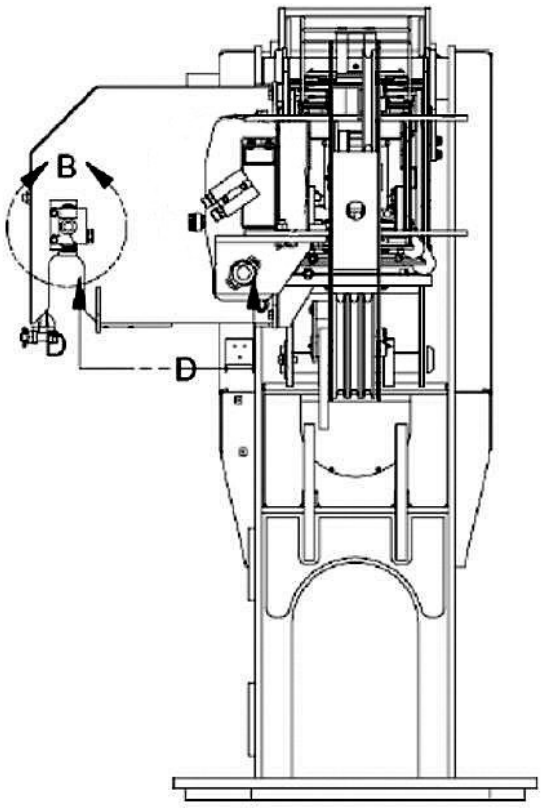
The Digger System hydraulic schematic is provided in the specifications section of this manual. The hydraulic circuit is explained below:

Digger Circuit

The required flow for the digger is approximately 55 GPM for optimum performance. The ¾ inch hoses that feed the digger motor are directly connected to the main control valve. These hoses are routed through a hose carrier system that is mounted on the side of the boom.

The digger drive is powered by a two-speed, piston hydraulic motor. This motor has a bi-directional “kickdown” system.

There is an over wind valve **(see detail B in the corresponding system schematic**) mounted on the digger stow bracket. This valve is also plumbed in parallel with the digger motor so when stowing the digger, if this valve is depressed by the auger flighting shaft, the flow will bypass the digger motor.



There may still be some back pressure present, and it may not completely stop the digger drive motor. This back pressure level depends on several factors such as oil viscosity, temperature, return filter condition, etc. **do not continue rotating the auger if contact with the over wind valve does not stop rotation. Damage may occur to the wind-up rope or stow bracket, which could cause the auger to drop.**

Auger Latch Circuit

The auger latch consists of a small hydraulic cylinder located inside the stow bracket. The hoses for this cylinder are run through the hose carrier and connect to an independent valve section that opens or closes the stow latch. This circuit operates at crane system pressure.

Auger Latch Proximity Switch

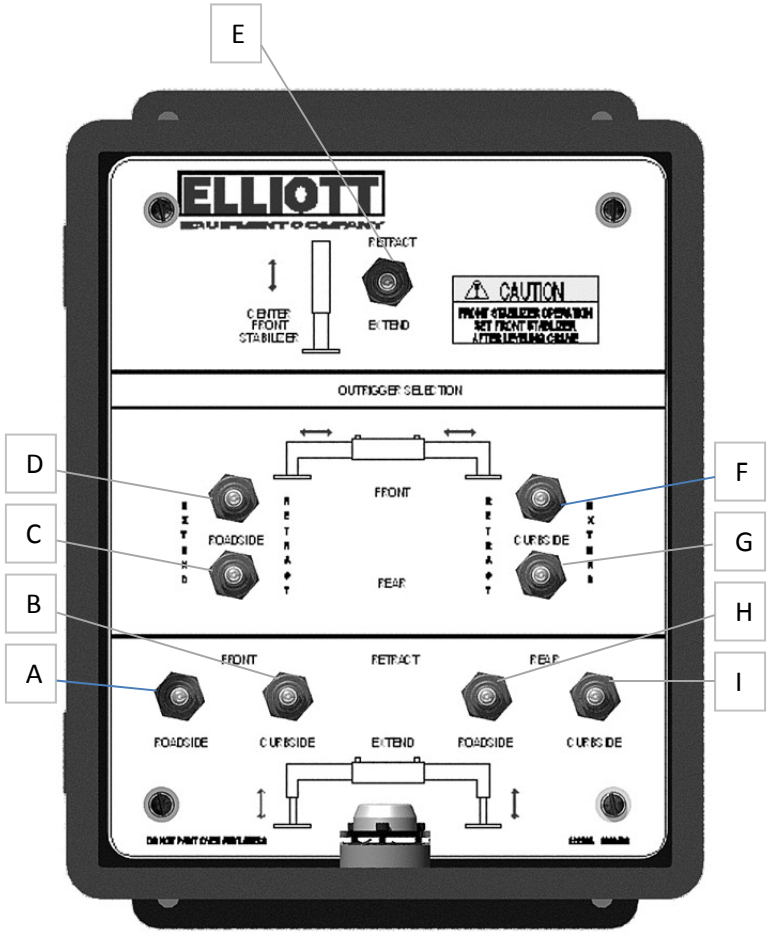
When the digger is deployed, the boom extension must be limited due to structural issues. This is achieved by limiting the hose carrier beam with a mechanical stop, and limiting the extend pressure to approximately 600 PSI.

There is a proximity switch on the digger stow bracket that detects when the digger is stowed. When this switch is magnetized, it sends a signal to a normally open solenoid that is plumbed into the extend circuit and is located in the control console near the main control valve. When this solenoid is energized, the boom extend circuit will have full extend pressure.

When the auger is deployed, and the proximity sensor is no longer magnetized, the signal to the solenoid is removed, and the solenoid opens to insert a 600 PSI relief into the extend circuit. When the boom is extended until the digger hose carrier reaches its mechanical stop, the extend pressure is limited to 600 PSI.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0109	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	5/11/15
Tech Spec		1.2	Doc update	11/23/15



Note: *When deploying outriggers, always set the beams to full- or mid-span prior to lowering the outrigger jacks.*

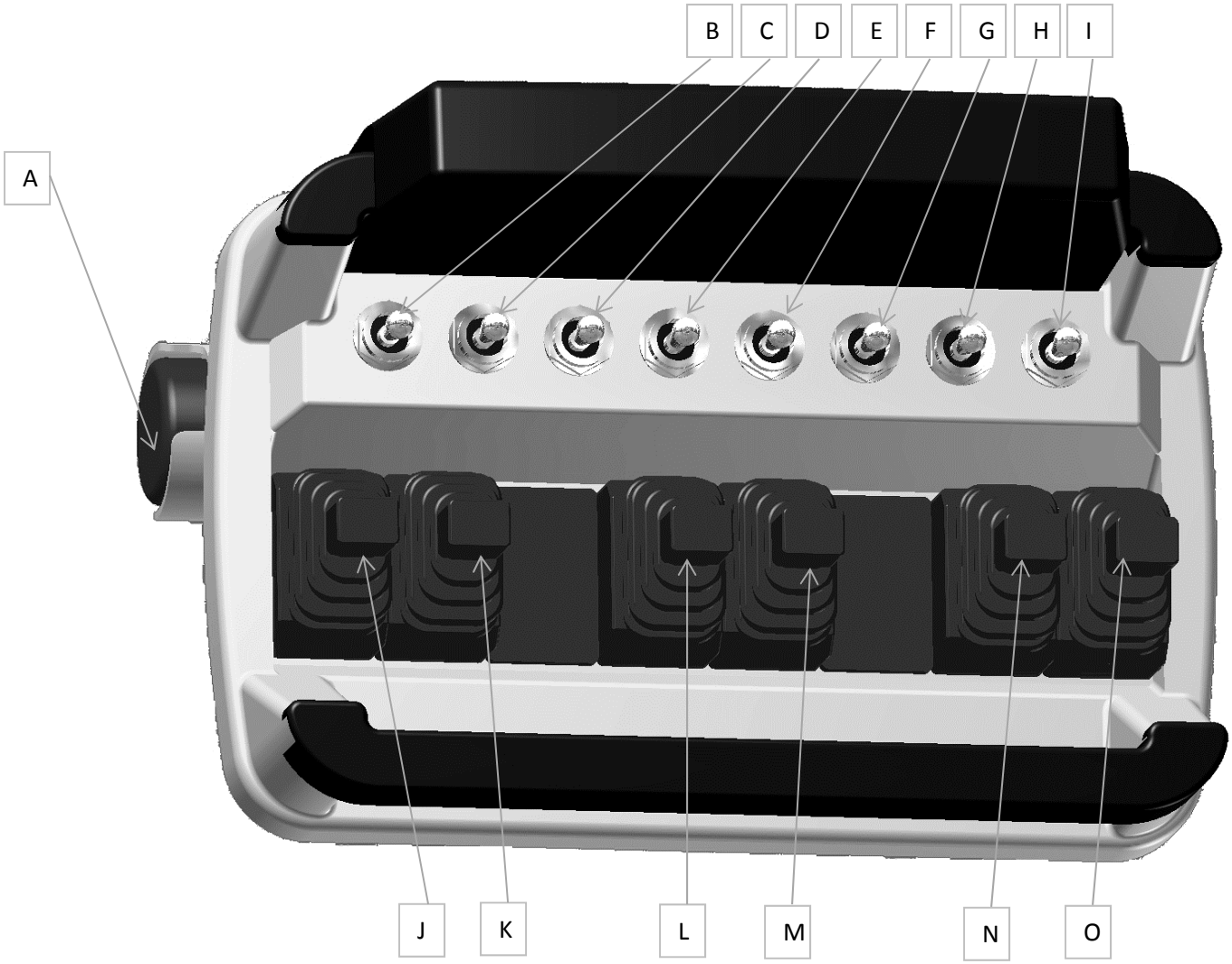
A. **Right Front Outrigger Jack Switch-**Activate switch “**UP**” or ”**DOWN**” to raise/lower right front outrigger jack
B. **Left Front Outrigger Jack Switch-** Activate switch “**UP**” or ”**DOWN**” to raise/lower left front outrigger jack
C. **Right Rear Outrigger Beam Switch-** Activate switch “**LEFT**” or ”**RIGHT**” to retract/extend right rear outrigger beam
D. **Right Front Outrigger Beam Switch-** Activate switch “**LEFT**” or ”**RIGHT**” to retract/extend right front outrigger beam
E. **Center Front Stabilizer Switch-** Activate switch “**UP**” or ”**DOWN**” to raise/lower center front stabilizer. This stabilizer should always be lowered last and raised first
F. **Left Front Outrigger Beam Switch-** Activate switch “**LEFT**” or ”**RIGHT**” to retract/extend left front outrigger beam

G. **Left Rear Outrigger Jack Switch-** Activate switch “**UP**” or ”**DOWN**” to raise/lower right rear outrigger jack
H. **Left Rear Outrigger Beam Switch-** Activate switch “**LEFT**” or ”**RIGHT**” to retract/extend left rear outrigger beam
I. **Right Rear Outrigger Jack Switch-** Activate switch “**UP**” or ”**DOWN**” to raise/lower right rear outrigger jack

Note: *Left and right are based on operator’s left and right as they stand at the outrigger control box facing the front of the truck.*

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0037	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15



DANGER

DANGER ELECTROCUTION HAZARD

This crane is not insulated, and the remote control provides no protection against electrocution hazards. Do not operate near live electrical power lines. All warnings in the **Safety and 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 platform/radio control system is necessary. This check shall include verifying all safety features are operational before using this system. **Controls are equipped to be connected to hard wired communication cable or be used as radio remote controls.**

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 unto 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 in, and then make sure the remote control power switch is switched to the off position. This will prevent inadvertent operation of the aerial device 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.

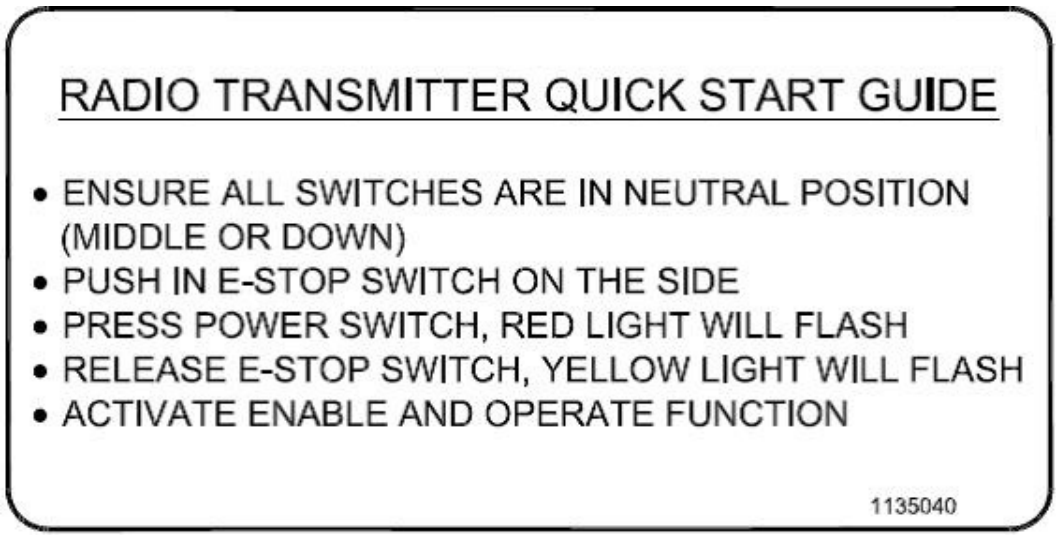
Aerial device and Option Function Joysticks

This transmitter is equipped with seven single axis joysticks for the following boom functions; boom swing, telescope, spare, spare, aux winch, main winch and boom lift and eight toggle switches to operate the following functions; Transmitter power/Enable/Calibrate, Truck Start/Stop, Operation control Range, Emergency Pump,

Aux Winch, Main winch Speed, LMI / ATB function cutout Override and Main Winch disable, and engine speed.

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 boom & platform 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 pictures that follow. Refer to these pictures and the descriptions of each joystick/switch operation below the drawing.

The proportional joysticks can be calibrated to the operator's preference by following calibration procedures found in the component operator's manual within this manual.



Elliott remote controls provide the operator with the same load and capacity information to the operator using the remote controls as if they were operating from the operator's cap or platform. This provides the operator in the platform or at the hook

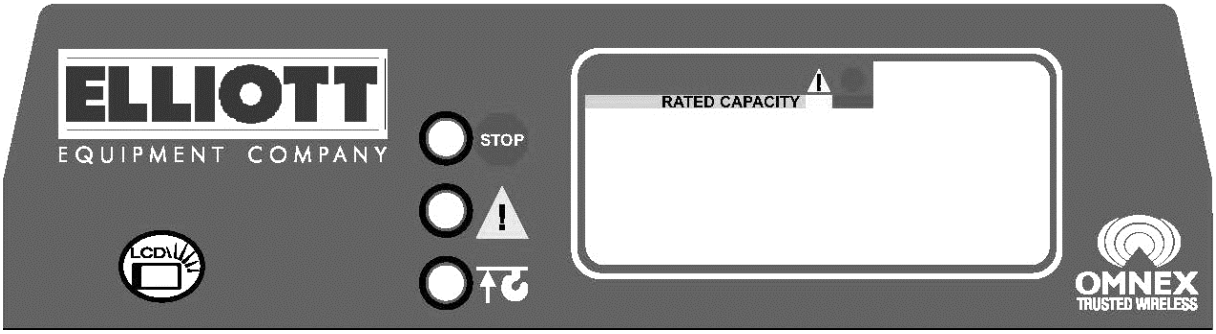
point with boom length, angle and load radius information along with allowable load and actual load values.

Powering up the transmitter

To start using the remote controls, this sequence must be followed to power up the transmitter for use. **These procedures are also located on a decal on the bottom side of the transmitter.**

1. Ensure all switches and joysticks are in the neutral position. Any two position toggle switches need to be in the lower position. (Transmitter will not power up if the switches are not in neutral position).
2. Select and release the Power switch in the **"ON/Horn"** direction.
   The Red, Emergency Stop light will flash quickly.
3. Release the **Emergency Stop** (Red button on side of transmitter) by rotating clockwise. The yellow (Active) light on the transmitter will begin to flash

Indicator Panel



Indicator Panel lights are, from top to bottom: E-Stop, Active, and Battery/Pendant. For complete information on interpreting these lights, see the **Component Service** section of this manual.

Complete Remote Control System Manufactures Manual is included with this manual in the **Component Service** section. Refer to this section for complete troubleshooting, calibration, and communication information.

Functions

A. Emergency Stop button (red push button)

Press this button in to kill the truck's engine. **When the Emergency Stop button is pushed in completely**, it will automatically lock and keep the button in a depressed state. **To release the Emergency Stop button**, turn the button clockwise and the button will pop up and allow the transmitter to resume normal functions.

Switch Labels

B. Power, ON/Enable, Horn, Calibrate Button

This push button switch needs to be depressed before operating any of the joysticks. The horn will sound momentarily when the button is pushed to alert personnel in the working area that aerial device movement is about to begin. Any time the transmitter is inactive, the enable will stay active for 15 seconds, and then this switch needs to be activated again.

C. 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 stops running, release the switch. **If this switch is released while engine is still turning over, the truck will restart.**

D. Control Range Switch

With this switch set to **"HIGH"**, the full activation of the joystick will move the valve spool to its maximum flow position. Setting this switch to **"LOW"**, the 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 aerial device to other objects.

E. Emergency Pump Switch

This momentary switch can be used to operate the **Emergency Pump** by holding in either direction. To operate the unit with the pump, hold this switch and activate desired functions.

F. Tool Circuit Switch

This switch is used to operate the **Tool Circuit** by holding in either direction to either open or close the hydraulic valve.

G. Aux Winch

This button is used to turn on or off the optional aux winch. If this switch is in the center/neutral position, and the aux winch joystick is active, selecting the **"HIGH"** position activates the high speed winch feature. Selecting the **"LOW"** position de-activates the aux winch.

H. Override / Winch Disable

This switch turns on or off the main winch, and provides an override lockout of the LMI / ATB function. To disable the main winch, select this switch to the **"WINCH DISABLE"** position. To override the LMI / ATB function cutout, select this switch to the **"OVERRIDE"** position.

I. Engine Speed Switch

This momentary toggle switch is used to activate the change engine speed between **"HIGH"** Idle and **"LOW"** Idle.

Joystick Labels

J. Boom Swing Joystick

This joystick operates the boom rotation system.

1. **Push forward-"CW"** position to swing boom clockwise (right).
2. **Pull back-"CCW"** position to swing boom counter clockwise (left).

K. Boom In/Out Joystick

This joystick operates the boom telescoping system.

1. **Push forward -"OUT"** position to extend boom.
2. **Pull back - "IN"** position to retract boom.

L. Spare Joystick

M. Boom Up/Down Joystick

This joystick operates the boom lift cylinder.

1. **Push forward -"DOWN"** position to lower the boom.
2. **Pull back - "IN"** position to raise the boom.

N. Winch Joystick

This joystick operates the main winch.

1. **Push forward -"DOWN"** position to pay out winch line or lower load.
2. **Pull back - "UP"** position to reel in winch line or raise load.

O. Aux Winch Joystick

This joystick operates the optional aux winch.

1. **Push forward-“DOWN”** direction to pay out winch line or lower load.
2. **Pull back-“UP”** direction to reel in winch line or raise load.

Revision History

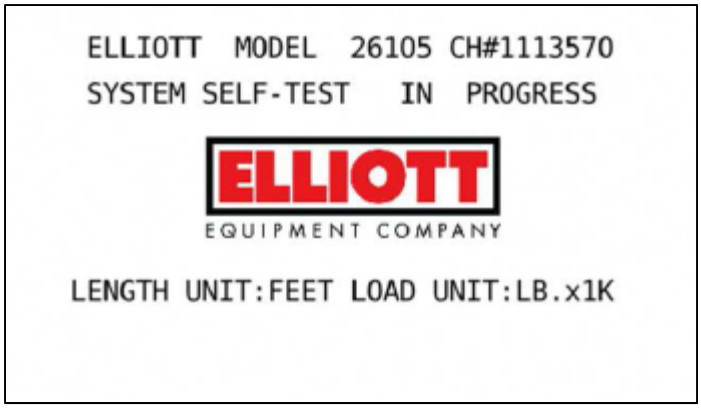
Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0039	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15

You will use the Greer Insight system to aid in the crane's operation. Please ensure only an operator properly trained in safety procedures, crane manufacturer's specifications and the crane's capacity information operates this unit. There are several operation functions to be aware of when using this unit:

- **Boom Angle Sensor:** The crane uses a sensor connected to a potentiometer or pendulum assembly to measure the boom angle. The sensor is mounted within the cable reeling drum's assembly.
- **Extension Sensor:** This sensor is mounted inside the cable reeling drum assembly, and measures the extension of the boom arm.
- **Pressure Sensors:** Two sensors measure the boom hoist cylinder's pressure; one sensor measures pressure on the cylinder rod, and the other sensor measures pressure on the piston.
- **Anti-Two-Block switch:** The ATB switch monitors the hookblock/overhaul ball on its approach to the boom head. The switch remains closed until the hookblock/overhaul ball raises a weight that connects to the hoist rope**,** which opens the switch. Once open, the switch sends a signal to the LMI computer, which triggers the ATB alarm, followed by a function kick-out.
- **Function Kick-Out:** A function kick-out uses hydraulic solenoids to disconnect the control lever functions for boom hoist lowering, telescoping out, and winch up once the ATB alarm activates.
- **Operator Programmable Alarms:** The operator uses these alarms to set the crane's minimum and maximum angle, maximum height, and maximum length.
- **Work Area Alarm:** This alarm allows the operator to define the crane's operating zone by only using two set points.
- **Swing Sensor:** The swing sensor measures the rotation angle of the boom as it relates to the crane chassis. **NOTE:** This feature is not used on all models.

Initial Setup

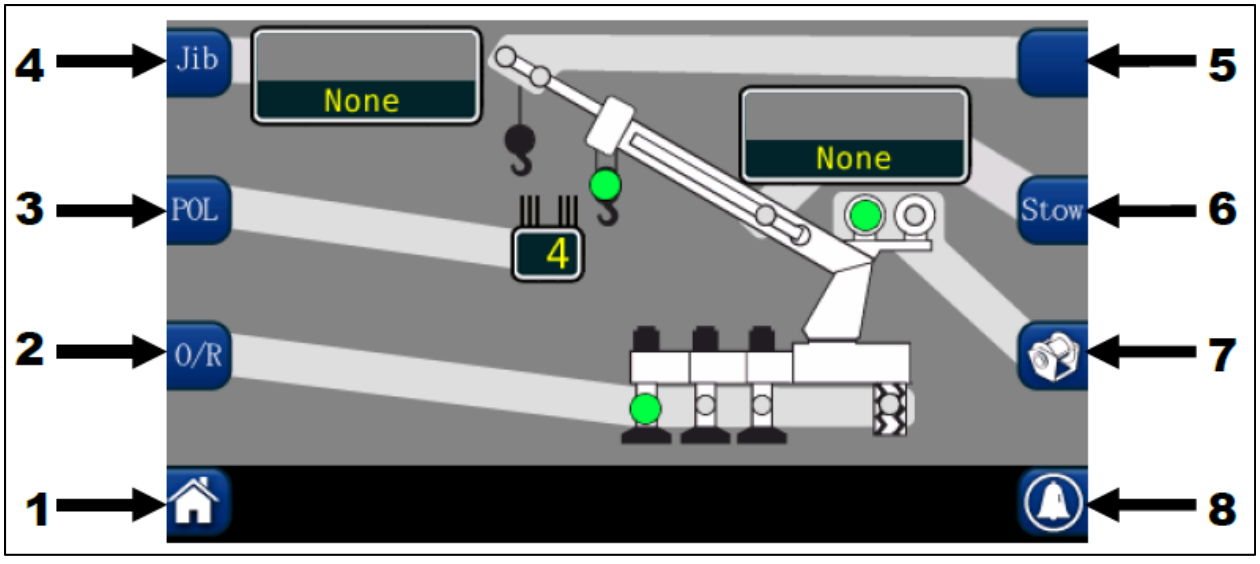
NOTE-this section only covers the initial setup and usage of the LMI unit. For more detailed information about this product or for troubleshooting procedures, please consult the manufacturer's insert under the "Component Service Manuals" section of this operator's manual.



- Once the unit is powered up, the system conducts a brief system test. During the test the system shows the unit's model, load chart number, and units in use.

- After the startup test completes, the unit's **Crane Configuration** page appears:

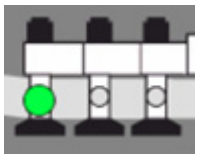
Crane Configuration screen



This display shows the current system's setup. The green indicator dots represent the selected option on the hook location, winch, and outriggers.

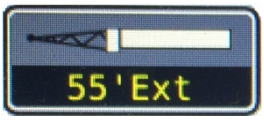
1. **Home button:** This returns the user to the Home display.

2. **Outrigger button:** The operator uses this option to select the outrigger position.



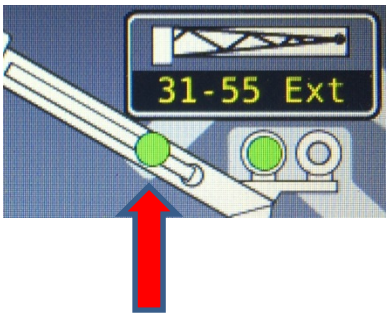
3. **Parts Of Line button:** This button selects the increment number of the POL (i.e. 1, 2, 3). Once the maximumum POL is reached, the next button push sends the indicator back to one POL.

4. **Jib Options button:** The operator can press the jib button multiple times to scroll through each of the jib position options. If no options are available, the display reads “None.”



5. **Pick Long, Pick Short, Pick Main button:** This feature is not used on all models.

6. **Stow button:** This button refers to the position of the jib when stowed. The green indicator light appears on the display when the jib is in the stow position. Use the button to scroll through the jib options. If no options are availale, the display reads “None.”

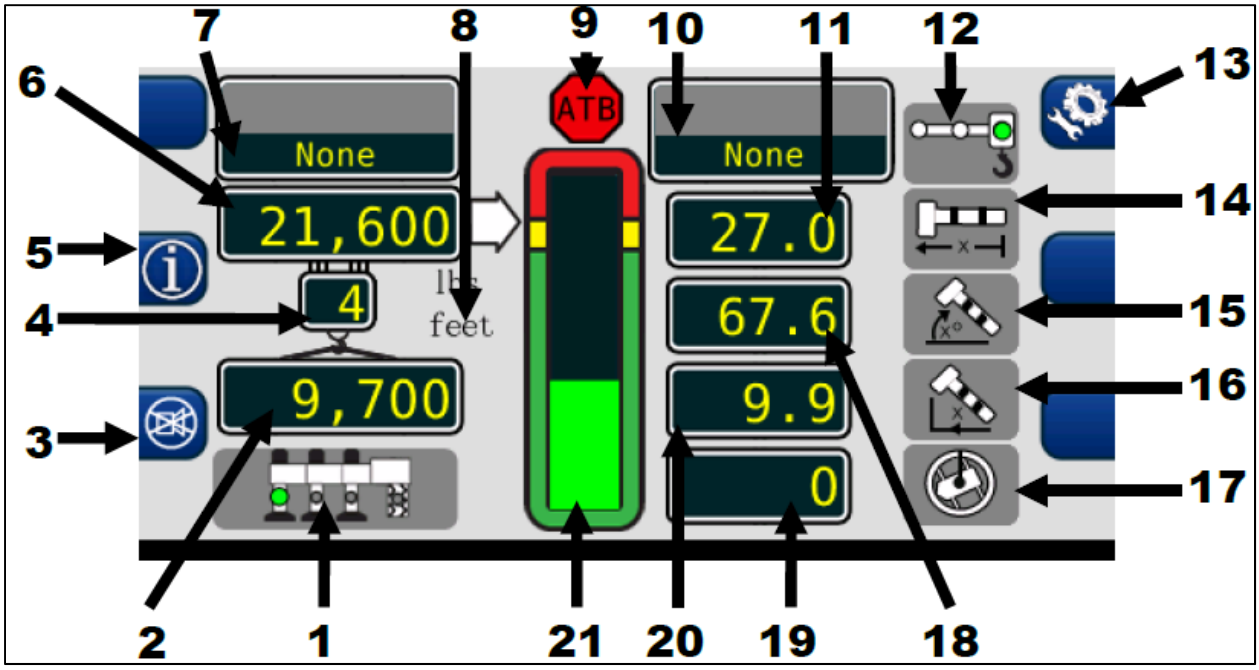


7. **Winch button:** The operator presses the button to select either the front or rear winch. There are two green indicator lights that appear when the appropriate winch is selected.

8. **Operator Alarms button:** The operator presses the button to access this function.

Once the operator has made all necessary selections on the Crane Configuration screen, press the **Home screen** button to get to the Home Display:

Home screen



1. **Outrigger setting:** Green indicator light reflects when the operator selects either full, intermediate, or retracted outriggers on the Crane Configuration screen.

2. **Actual Load Value:** This displays the total load amount (including slings, etc.) suspended below the lifting point.

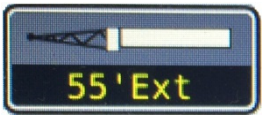
3. **Cancel Alarm button:** The operator uses this button to silence the alarm generated by either Overload, Anti-Two-Block, Outrigger Position Mismatch, or an Operator Programmable Alarm.

4. **Parts Of Line:** This displays shows the amount of line selected for the chosen configuraiton. Adjustments must be made on the Crane Configuration screen.

5. **Information:** This button displays messages regarding the module's software version and fault codes. Operator must keep button pressed to view informaiton.

6. **Rated Capacity:** This displays the crane's maximum-rated capacity in its curent position.

7. **Erected Jib:** This display shows the jib options selected for the crane, or if no jib options are available or are in use, the display will show "None."



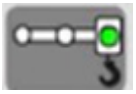
8. **System:** This shows either Metric or Imperial units.

9. **Anti-Two-Block:** This indicator illuminates when the ATB Limit switch detects approach to a two-block condition.

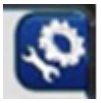
10. **Jib Stowed:** This display shows the stowed jib from the Crane Configuration screen.

11. **Boom Length:** This display shows the main boom's length from the pivot pin to the sheave pin at the boom head. Measurements are displayed in either Metric or Imperial units.

12. **Pick Long, Pick Short, Pick Main:** This feature is not used on all models.



13. **Configuration Button:** This returns the operator to the Crane Configuration screen.



14. **Boom Length Symbol:** This is displayed to the right of the boom length display.

15. **Boom Angle Symbol:** This is displayed to the right of the boom angle display.

16. **Load Radius Symbol:** This is displayed to the right of the load radius display.

17. **Swing Angle Symbol:** This is displayed to the right of the swing angle display. **NOTE:** This feature is not used on all models.

18. **Load Radius:** This display is to the left of the Load Radius Symbol.

19. **Swing Angle:** This display shows the swing angle of the boom, and is to the left of the Swing Angle Symbol.

20. **Boom Angle:** This display shows the degree angle of the boom relative to horizontal, and is to the left of the Boom Angle Symbol.

21. **Bar Graph:** This indicates the actual load vs. the crane's rated capacity.

- **Green:** Load is within rated capacity.
- **Yellow:** Load is near rated capacity.
- **Red:** Load is at/above rated capacity. LMI will cut off functions.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech. Spec.	EEC-0066	1.0	Created Document	1/20/15

⚠ 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.

⚠ DANGER

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 until full extension is reached. **Do not exceed radius indicated on the load chart at full boom extension**.

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.

⚠ CAUTION

Before lifting any load, make sure that:

A. Outriggers and stabilizers are extended on a firm, uniformly supporting surface.
B. Crane is level.
C. The exact weight lifted is known.
D. 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.
E. 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.
F. Do not exceed the area of operation on the capacity chart.

G. Reduce load ratings to compensate for wind, ground conditions and the dynamic effects of swinging, hoisting, and lowering the load.

NOTE: **The installer must perform a stability test in compliance with instructions furnished by Elliott Equipment Company.**

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0046	1.0	Template update	1/13/15
		1.1	Content update	6/25/15

Wire Rope Anchoring

ELLIOTT EQUIPMENT COMPANY

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 on to 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.

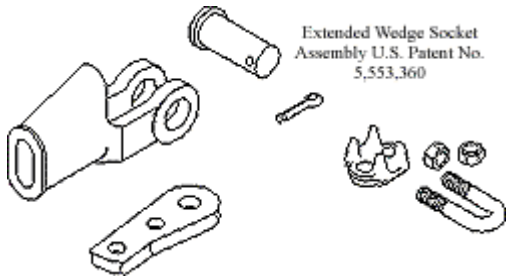
Breaking in Wire Rope

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.

Revision History

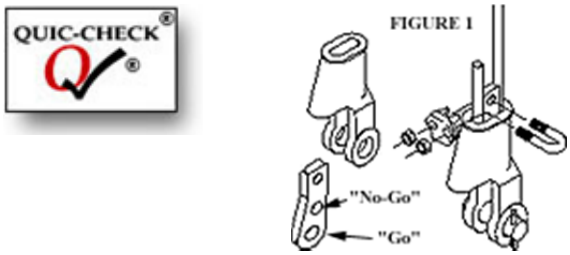
Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0054	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15

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

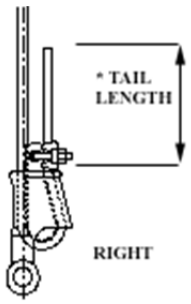
New **QUIC CHECK**® "Go" and "No-Go" features cast into wedge. The proper size wire rope is determined when the following criteria are met: 1. The wire rope shall pass through the "Go" hole in the wedge. 2. The wire rope shall NOT pass through the "No-Go" hole in the wedge.

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.

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".

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⚠WARNING

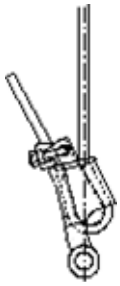
- Loads may slip or fall if the Wedge Socket is not properly installed.
- A falling load can seriously injure or kill.
- Read and understand these instructions before installing the Wedge Socket.
- Do not side load the Wedge Socket.
- Apply first load to fully seat the Wedge and Wire Rope in the socket.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



WRONG
Rope
Backward

WRONG
Wedge
Backward

WRONG
Tail Clipped
to live Line

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.
- Efficiently 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).

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0054	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15

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:

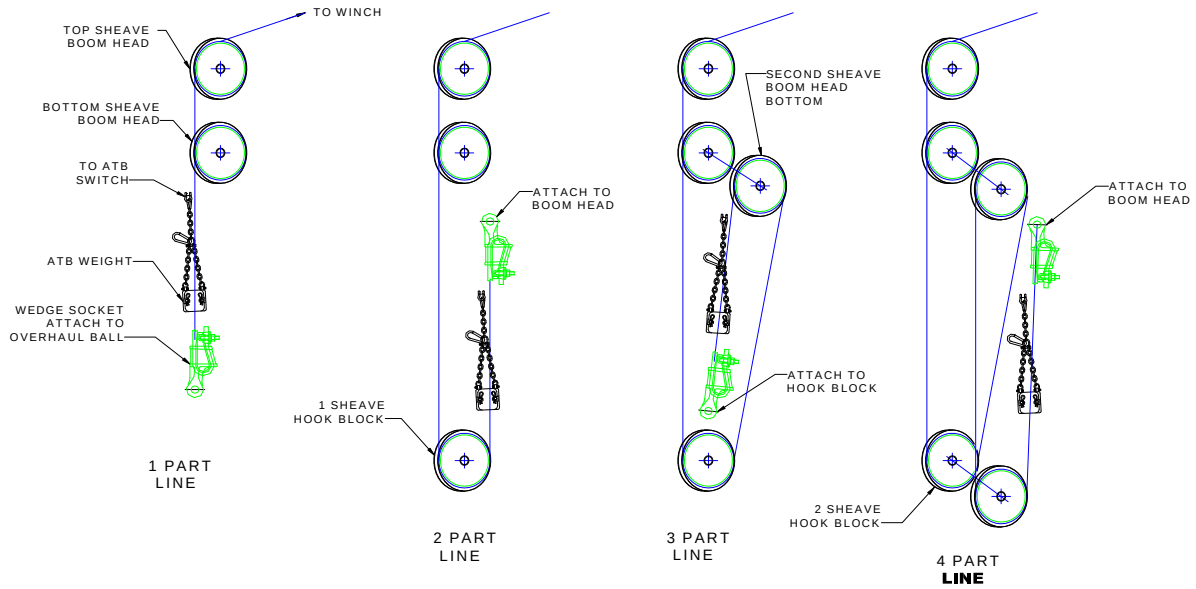
A. Install the ATB transmitted on the main boom head or jib head, if jib is erected.

B. 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.

C. 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



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Diagram	EEC-0047	1.0	Template update	11/05/14
Diagram		1.1	Doc update	1/13/15

A. 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.

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.
3. Operate with jib by boom angle when main boom is not fully extended. **Do not exceed** rated jib capacities at any reduced boom lengths.
4. When angle is between points listed on capacity chart, the load shown at next lower boom angle shall be used.

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

C. 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.

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

E. Operate boom and turn functions very slowly and carefully when using jib since jibs can increase boom length by 50 percent.

F. Area where jib swings around must be clear of obstructions and power lines when stowing and unstowing jib.

G. Use safety glasses when pounding pins with hammer.

H. **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.

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

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

K. 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.

Deployment Procedure

A. Using boom telescope function, fully retract boom.

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

C. 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.

D. Locate the stowed position of pins '**C2'**. If in jib attachment holes or boom sheave case jib holes, remove pins from storage location.

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

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

G. Attach tag line to sheave case end of jib.

H. Using lift function, raise boom to a horizontal position.

I. 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.

J. Using tag line, swing jib into deployed position.

K. 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.

L. Remove loadline from boom sheave case and place in an area to minimize possible damage.

M. 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.

N. 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.

O. 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.

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

Q. 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.

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

S. Remove tag line from jib sheave case.

T. 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.

Stowing Procedure

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

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

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

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

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

F. Attach tag line to sheave case end of jib.

G. Remove spring clips from pins '**C2'** on both upper and lower jib ears.

H. Remove pins '**C2'** from upper and lower jib ears. **Do not remov**e '**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.

I. Using lift function, raise boom to a horizontal position.

J. Using telescope function, extend boom approximately 1 foot.

K. 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.

L. 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.

M. 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.

N. 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.

O. 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.

P. 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.

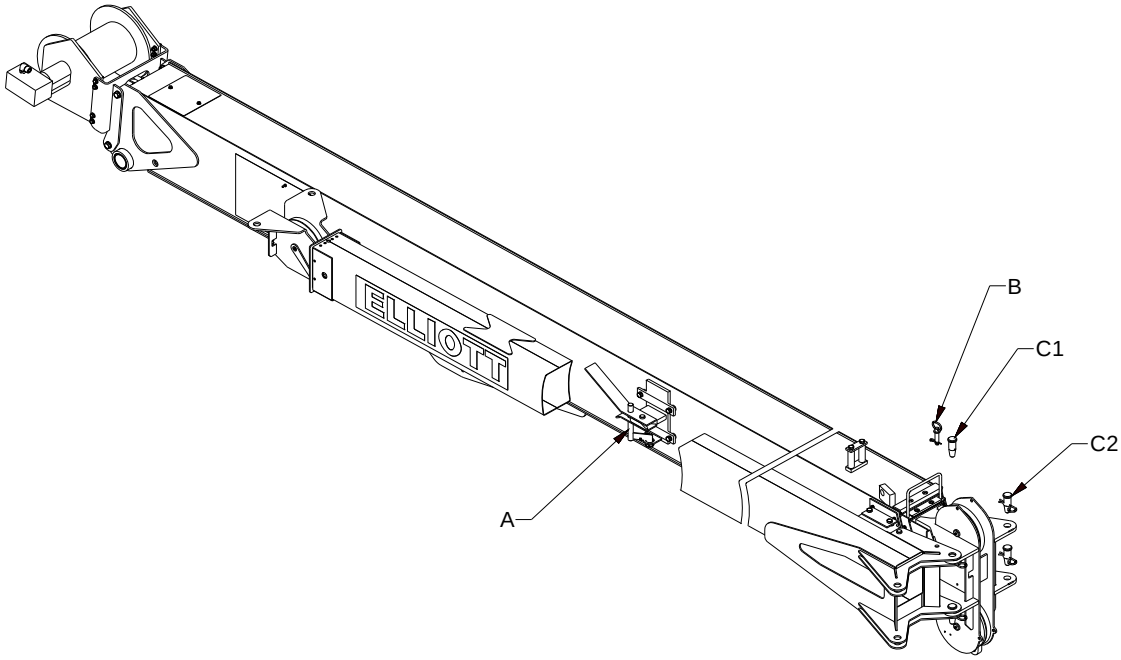
Jib Maintenance

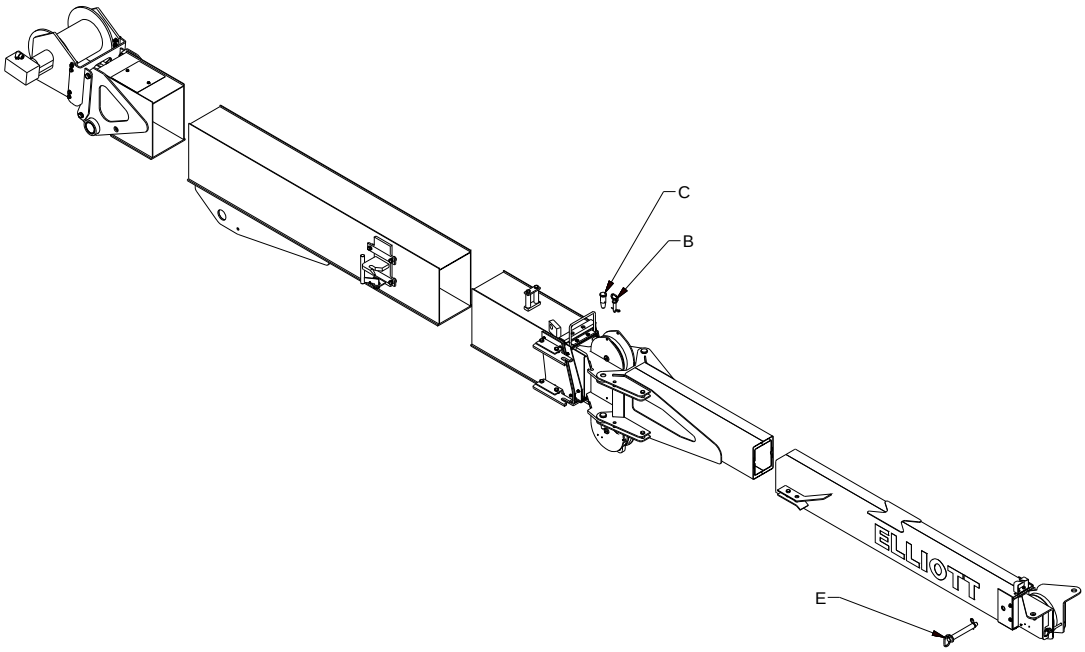
- **A.** Lubricate sheave pin on jib with grease gun containing chassis grease weekly.
- **B.** Check for free rotation of jib sheave daily when using jib.
- **C.** Lubricate jib sheave case pivot pin with grease gun containing chassis grease monthly.

Jib removal

Should jib removal from the boom become necessary, proceed as follows:

- **A.** Unstow and swing jib into position on the boom tip according to steps 1-10 in the preceding jib deployment section.
- **B.** Support and raise the jib at its balance point and remove the two swing around pins. Jib is now free of boom.
- **C.** To install, proceed in reverse order of removal.


ELLIOTT
B
C1
C2
A


C
B
ELLIOTT
E

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0044	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15

The platform is permanently suspended in a yoke that can be attached to the boom or jib head. The platform leveling system consists of a function selector valve, a hydraulic cylinder and a hand pump assembly that includes a hydraulic oil reservoir and handle.

Platform selector valve function positions

The leveling system can be used for the following functions:

A. **Lift** the yoke for alignment with the jib or boom tips for attachment
B. Swing the platform to the **stow** position in the yoke
C. **Adjust** and **lock** platform level when its suspended in the yoke

Lift the yoke for jib/boom head attachment

Remove the horizontal locking pin from the arm and select the **PLTF LVL CW/Yoke Up** position, use hand pump to raise yoke to position for attachment to boom or jib.

Stow the platform in the yoke

Select the **PLTF LVL CCW/Yoke Down** position, use pump to raise the platform into stow position, engage the stow pins and select the float position

Release the platform from the stow position

A. Ensure the float position is selected, stand away from the platform swing path and disengage the stow pins
B. The float function allows the platform to pivot freely until level or end of travel of the hydraulic cylinder

Float position lock

When engaged, the flow position lock prevents accidental selection of the float function.

To avoid unintentional platform movement, the brake should be selected and the float lock engaged before any work commences from the platform when boom is elevated.

Air Bleeding Process

The platform hydraulic system needs to be free of air to operate smoothly. Any time any of the platform hydraulic lines are removed, or air is suspected in

the hydraulic system, the air will need to be bled out. The bleeding procedure is outlined below

A. Remove leveling cylinder upper pin and suspend the cylinder horizontal to the ground (**zip ties may be used**)

B. Ensure the oil level in the reservoir is above the minimum level for the entire procedure

C. With the cylinder fully retracted: Select the platform **CW** position and loosen the bleeding cap on the retract port. Pump until cylinder is fully extended. Tighten the bleeding cap.

D. With the cylinder fully extended: Select the platform **CCW** position and loosen the bleeding cap on the extend port. Pump until cylinder is fully retracted. Tighten the bleeding cap.

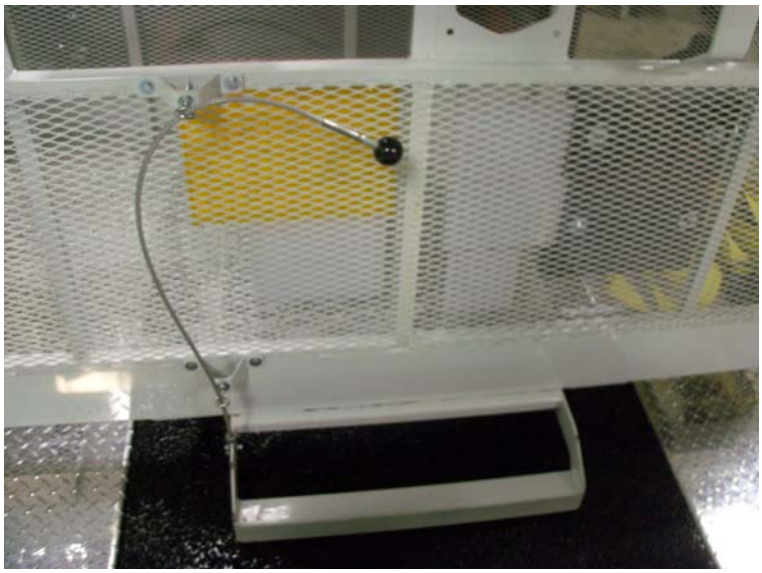
E. Repeat steps 3 and 4, two to three times or until all air is removed from the system

F. Re-install the cylinder upper pin and test the system with platform hooked to the boom or jib. Select the platform brake position and rock the platform back and forth. The platform swing should be less than 10 degrees.

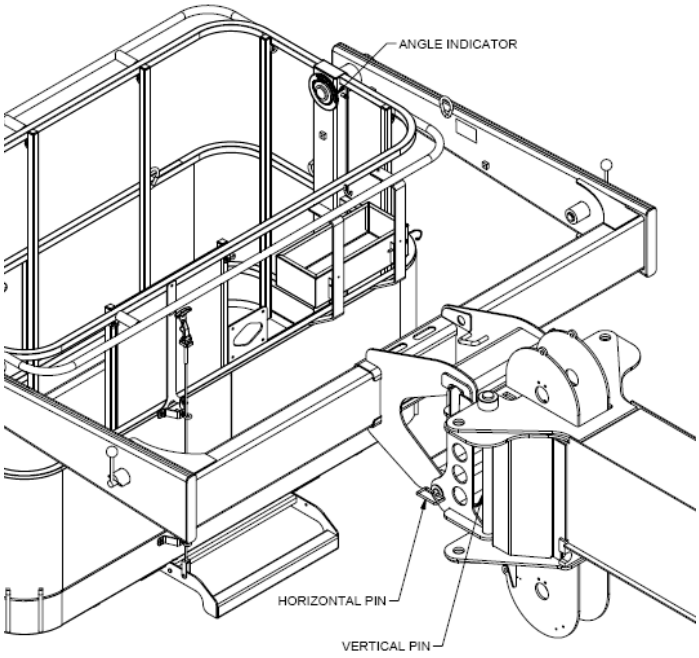
Kickstand

This is a spring loaded part of the platform assembly that retracts towards the platform floor when the platform is lifted off the ground. A hand-pulled cable is used to launch the kickstand when landing the platform on the ground. When deployed the kickstand provides support for the platform while the yoke is lifted for boom or jib alignment.

Kickstand deployed with cable unlatched



Platform attached to Boom using Adaptor

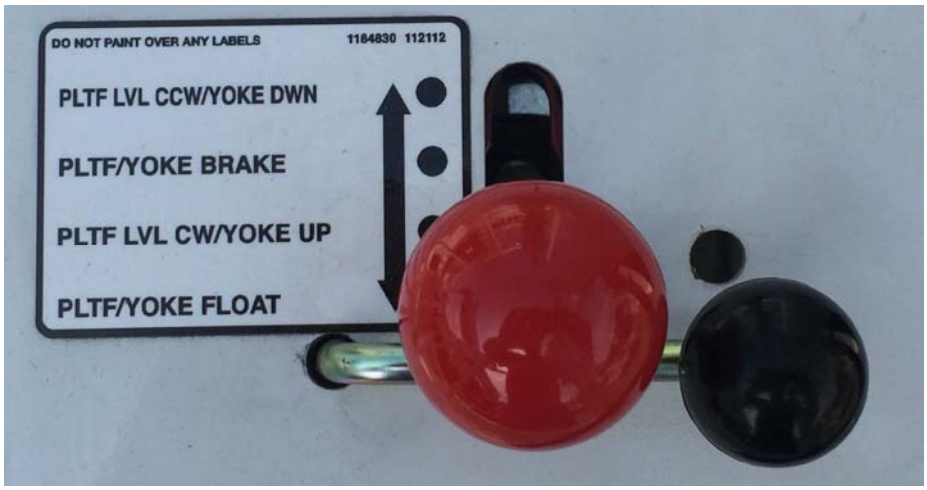


Platform Function Selector and Float lock

Large/Red knob: – Function selector.

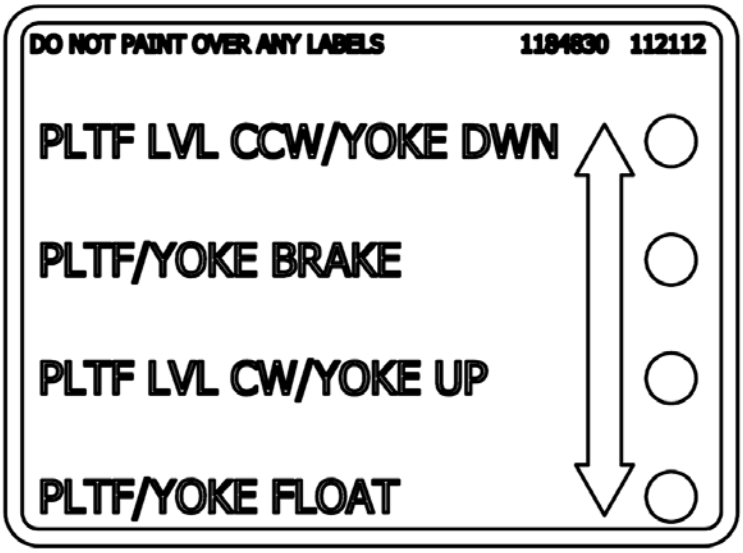
Small/Black knob: – Float lock.

Float lock shown in the lock position Prevents function selector from being inadvertently bumped into float position unexpectedly.

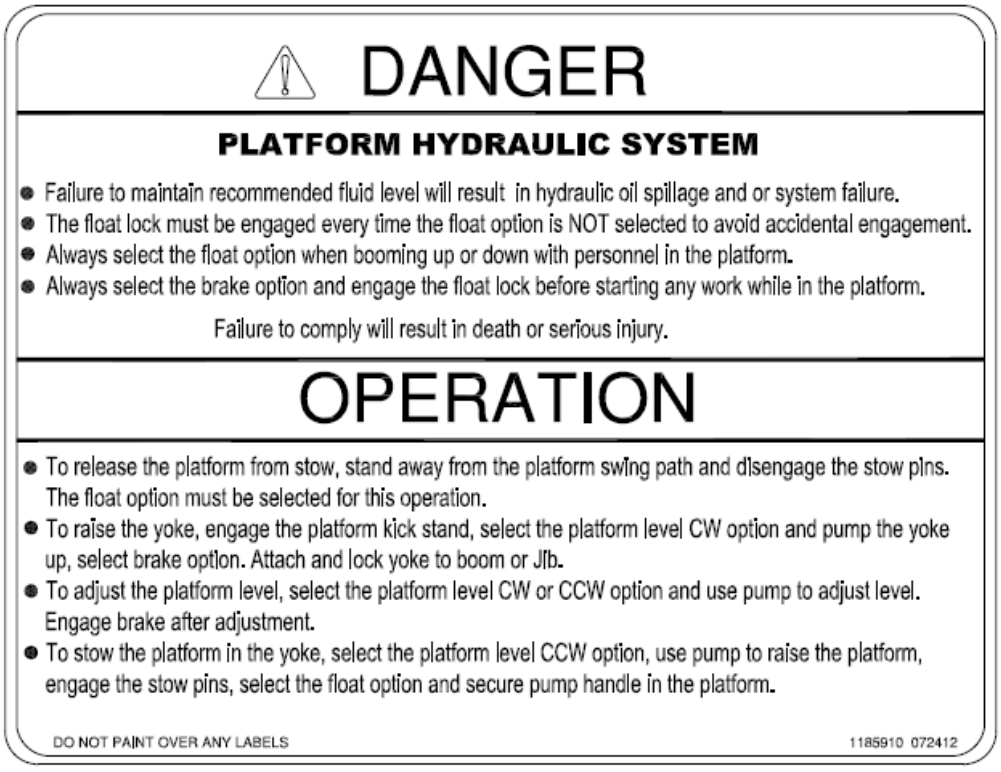


Float lock shown in the unlocked position

Labels:



Platform selector valve positions



Platform operation label

PLATFORM ASSEMBLY RIGGING FOR OPERATION PLATFORM TRANSFER FROM TRUCK BED

A. Rig the platform from the yoke lift lugs as shown in Figure 1

B. Select the brake position on the platform selector valve

C. Lift and set the assembly on level ground, with kickstand deployed.

D. Locate the platform at a radius corresponding to boom, retracted jib or extended jib operation mode desired, see Figures 2 and 3.

E. Unlatch the kickstand deploying cable to ensure platform leveling during boom up operation.

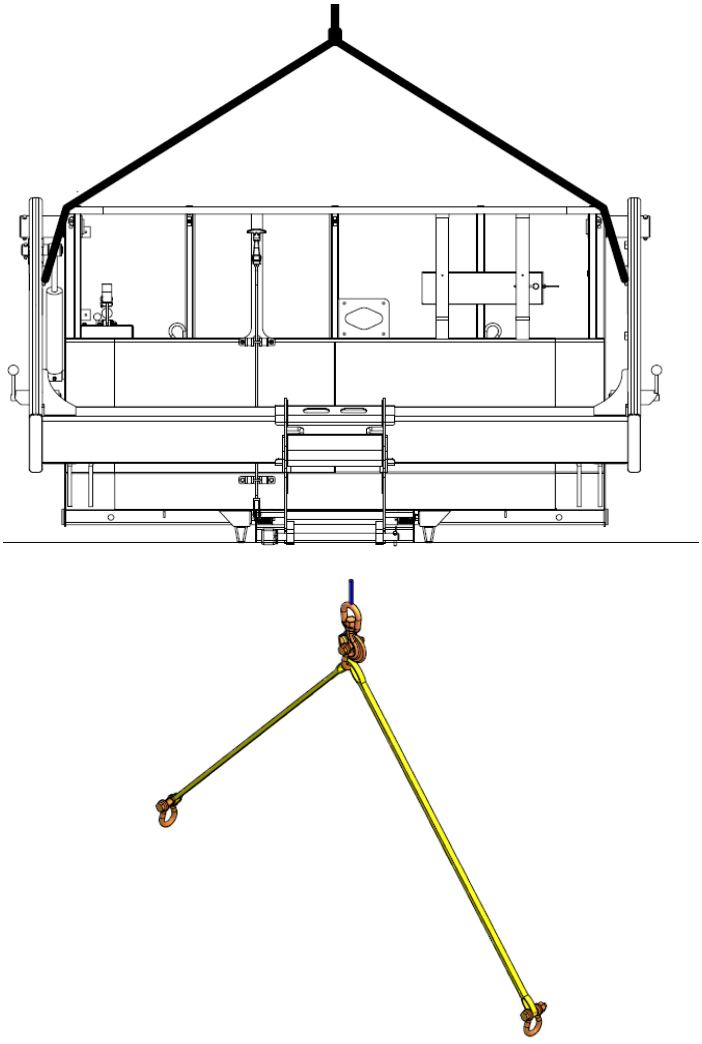


Figure 1: Sling attachment to platform assembly

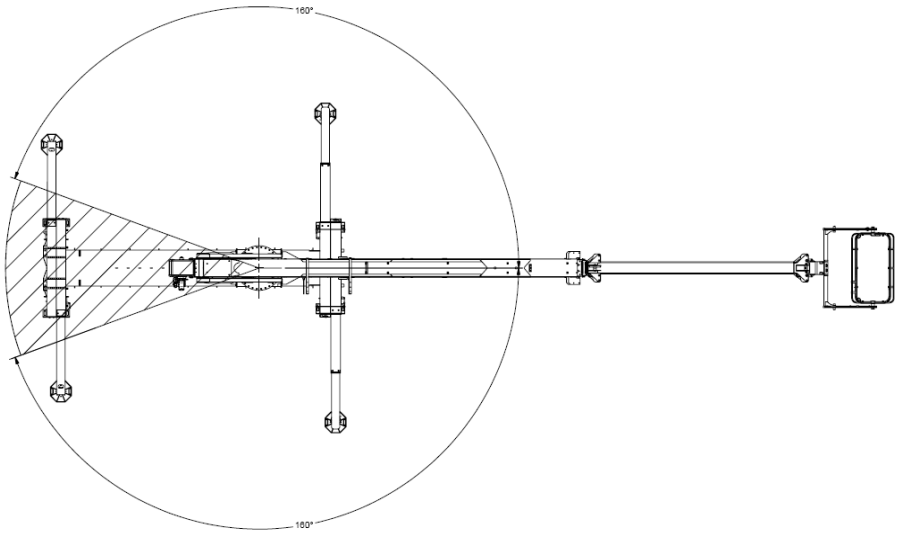


Figure 2: Platform location on ground

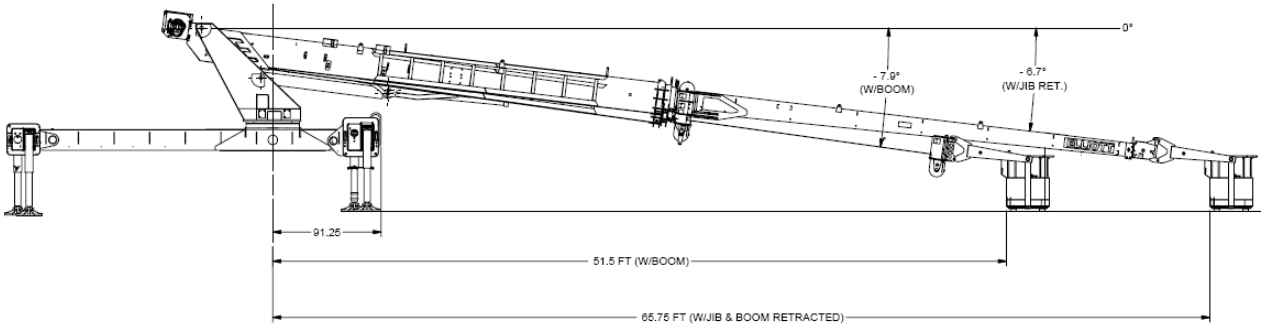


Figure 3: Platform ground location

RIGGING PLATFORM ASSEMBLY TO THE BOOM HEAD

A. Set the platform at a 51.5 ft radius from the truck center of rotation as shown in Figure 3.

B. Raise the platform arm to its maximum angle; refer to the platform operation label.

C. Lower the boom to negative 7.9 degrees on LMI display

D. Set the adaptor on top of boom head lower plate, insert and secure vertical pins

E. With boom and platform aligned, extend boom to 46.6 ft radius on LMI display

F. Lower platform arm hook into the adaptor, insert and secure horizontal pin

RIGGING PLATFORM ASSEMBLY TO RETRACTED JIB (BOOM RETRACTED)

A. Set the platform at a 65.8 ft radius from the truck center of rotation as shown in Figure 3.

B. Raise the platform arm to its maximum angle; refer to the platform operation label.

C. Lower boom to minus 6.8 degrees on LMI display, align jib and platform

D. Lower platform arm hook into jib head, insert and secure horizontal pin

OR

A. Set the platform at a 65.8 ft radius from the truck center of rotation as shown in Figure 3.

B. Raise the platform arm to approximately 7 degrees angle; refer to the platform operation label for operation details.

C. Lower boom to maximum possible negative angle, align jib and platform

D. Raise jib head into platform arm hook, insert and secure horizontal pin

RIGGING PLATFORM ASSEMBLY TO EXTENDED JIB (BOOM RETRACTED)

A. Set the platform at a 88.4 ft radius from the truck center of rotation as shown in Figure 3.

B. Raise the platform arm to its maximum angle; refer to the platform operation label for operation details.

C. Lower boom to minus 5.2 degrees on LMI display, align jib and platform

D. Extend boom to 39.9 ft radius on LMI display

E. Lower platform arm hook into jib head, insert and secure horizontal pin

OR

A. Set the platform at a 88.4 ft radius from the truck center of rotation as shown in Figure 3.

B. Raise the platform arm to 5 degrees angle; refer to the platform operation label for operation details.

C. Lower boom to maximum possible negative angle, align jib and platform

D. Extend boom to 39.9 ft radius on LMI display

E. Raise jib head into platform arm hook, insert and secure horizontal pin

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0049	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15

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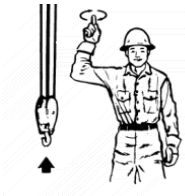
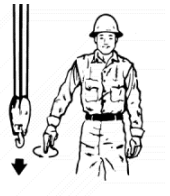
Standard Hand Signals for Crane Operators

ASME B30.5-1998



HOIST. With forearm vertical, and forefinger pointing up, move hand in small horizontal circle.



LOWER. With arm extended downward, forefinger pointing down, move hand in a small horizontal circle.

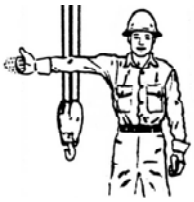
USE MAIN HOIST. Tap fist on head; then use regular signals.

USE WHIPLINE. (Auxiliary Hoist) Tap elbow with one hand; then use regular signals.

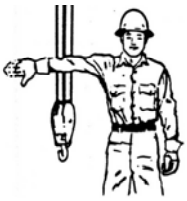
RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.

LOWER BOOM. Arm extended, fingers closed, thumb pointing downward.

MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. *(Hoist Slowly shown as example)*

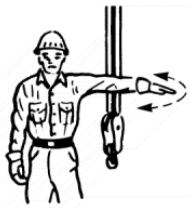


RAISE THE BOOM AND LOWER THE LOAD. With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.

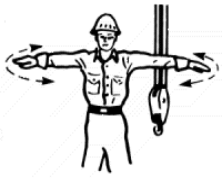


LOWER THE BOOM AND RAISE THE LOAD. With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.

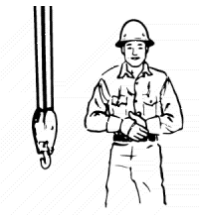
SWING. Arm extended, point with finger in direction of swing of boom.



STOP. Arm extended, palm down, move arm back and forth horizontally.



EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally.



DOG EVERYTHING. Clasp hands in front of body.

EXTEND BOOM. (Telescoping Booms). One Hand Signal. One fist in front of chest with thumb tapping chest.

RETRACT BOOM. (Telescoping Booms). One Hand Signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.

RETRACT BOOM. (Telescoping Booms). Both fists in front of body with thumbs pointing toward each other.

EXTEND BOOM. (Telescoping Booms). Both fists in front of body with thumbs pointing outward.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Diagram.	EEC-0043	1.0	Template update	11/05/14
Diagram		1.1	Doc update	1/12/15

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 are performed and 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.

Daily Inspection

A. 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.

B. Inspect the unit's underside for structural damage and hydraulic leaks.

C. Check all hydraulic hoses, particularly those that flex in normal operation for any scuffing, cuts or wear marks.

D. 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.

E. Perform the daily lubrication per the "Lube Chart".

F. Check that oil level is at proper level.

G. Check oil filter condition by reading dirty filter gauge on the filter housing. This needs to be checked while engine is running and PTO is engaged.

H. Inspect the wire rope for wear and damage, check for corrosion, kinking, crushing, cuts, and slippage of clamps at wedge socket.

I. Check for proper wire rope spooling on the winch drum and proper reeving. Make sure all sheaves turn freely.

J. Make sure the load line is correctly fastened to the hook block/headache ball

K. Make sure the hook block/headache ball latch works properly.

L. Check slings, chains, etc. for damage or wear.

M. Check that the Lift Capacity Charts and all other decals are in place and readable.

N. Check proper operation of all crane functions.

O. Check boom proportioning. Verify all sections start and stop simultaneously.

P. Check all control mechanisms for maladjustment that could interfere with proper operation.

Q. Verify that all control mechanisms when released to the neutral position all functions stop.

R. Make sure all control mechanisms are free of excessive wear and are not contaminated by lubricants or other foreign matter.

S. Check the hook block/headache ball for excessive wear and overload. Check for cracks, spread side plates, elongated holes, bent tie bolts etc.

T. 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.

U. 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

V. Check proper operation of horn, start/stop switch, etc.

W. If supplied, clean oil cooler core for proper heat transfer.

⚠ CAUTION

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

Weekly Inspection

A. Perform the daily and weekly lubrication per the “Lube Chart”.

B. Perform the “Daily Check List”.

C. Check the winch drum and sheaves for cracks, wear and damage.

D. Make sure the boom angle indicator is working.

E. Check boom lift and outrigger holding valves for proper operation.

F. Verify winch brake stops and holds load. Check at rated line capacity.

G. 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.

Monthly Inspection

A. Perform the daily, weekly and monthly lube services.

B. Perform the “Daily Check List” and “Weekly Check List”.

C. Check the boom and all structural components-especially welds-for deformation, cracks, corrosion and other forms of damage.

D. Inspect full length of wire rope for damage and excessive wear. See wire rope maintenance section for details.

⚠ 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.

E. Check the wire rope attachment at the wedge socket for damage and/or loose parts.

F. Check wiring for damage, dirt accumulation, loose connections etc.

G. Check hydraulic hoses for wear on outside surfaces and leakage at connections.

H. Check hydraulic pump for loose bolts, leaks, noise and vibration.

I. Check the hydraulic valves for leaking.

J. Check the hydraulic cylinders for drifting due to holding valve failure, rod seal leakage, weld joint leaks, visual damage.

K. Check foot throttle engine speed.

L. Check all pins for proper installation and retention.

M. Check boom wear pad retention bolts.

N. Adjust the tension on the extended and retracted cables in the boom.

⚠ 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 serverity of the operation of the unit. This inspection should be performed at least once every twelve monthes and shall be performed by a competant individual or a government or private agency recognized by the U.S. Department of Labor.

Periodic Inspection

A. Perform all lube services.

B. Perform the “Daily”, ”Weekly”, ”Monthly”, and “Semiannual Checklist”.

C. Check all fasteners and retighten. Check torque of all bolts on “Bolt Torque” chart.

D. Check the relief valve settings per the hydraulic schematic.

E. Check for worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers and locking devices.

F. Test lift and outrigger cylinders for drift from possible internal leakage.

G. Check PTO drive line or direct mounted pump for proper alignment, lubrication, and tightness.

H. Check Rotation bearing and gearbox mounting bolts for proper torque. See “Bolt Torque” chart for appropriate torque values.

I. Check mounting bolts, except “huck-bolts” for proper torque. See “Bolt Torque” chart for appropriate torque values.

J. Check all “huck-bolts” for damage and tightness.

K. Inspect all electrical wires and connections for wear, cuts, deterioration, etc. Replace as required.

L. Check condition of extend and retract cables for wear or damage.

M. Re-shim the boom wear pads as required. Replace worn or damaged wear pads as required.

N. Check boom angle and boom length indicators for accuracy throughout entire operating range.

O. Check LMI system for inaccuracies. Perform this check by lifting load of know weight and measuring boom angle and radius.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0050	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15

It is important to ensure all wire ropes are provided proper maintenance and inspections on regular intervals. Failure to provide the proper care and maintenance can drastically reduce the lifespan of wire ropes, which increases the risk to personnel and property.

Breaking in Wire Rope

The unit's wire rope should be broken in to allow component parts to settle to adjust to actual operating conditions. This can be accomplished by conducting several test runs through the normal operation procedure under a light load. **NOTE: It is not recommended to conduct an overload test with test loads that exceed the working load limit.**

Wire Rope Cleaning

Wire ropes that operate in extremely harsh conditions and come into regular contact with certain chemicals should be cleaned on a regular basis. Particles that remain lodged in, or substances allowed to make contact with the rope for extended periods of time, could cause the wire rope's tensile strength to be degraded over time.

Wire Rope Inspections

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.

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 six-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.

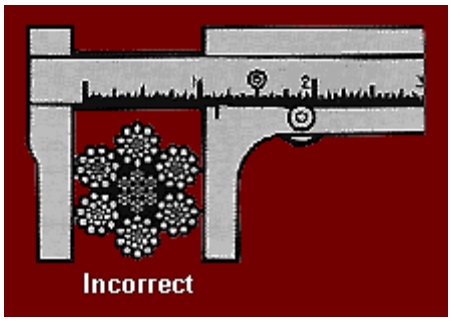
Drum crushing is caused by small drums, high loads and multiple winding conditions.

If broken wires are detected during the course of an inspection, particularly those that could cross adjacent wires and destroy them when running over sheaves, these

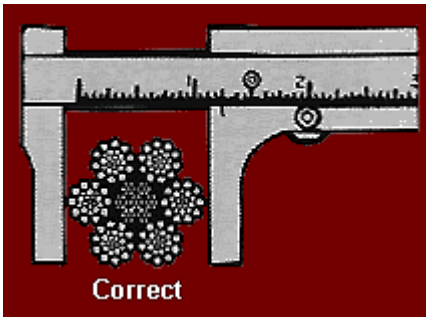
wire ends must be removed. It is recommended to move the wire ends back and forth until they break deep within the cord valley between two outer strands. **At no time should the wire ends be pinched off with nippers.**

Replacement Criteria

A. 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:



B. 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.



C. 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.

D. Wear on one-third the original diameter of outside wires.

E. Kinking, crushing, bird caging, core protrusion or any other damage resulting in distortion of the rope structure.

F. Evidence of heat damage.

G. Severe Corrosion.

H. Reduction from the nominal diameter of more than the following limits.

1. 1/64 inch for rope diameters through 5/16 inch

2. 1/32 inch for rope diameters 3/8 through 1/2 inch
3. 3/64 inch for rope diameters 9/16 through 3/4 inch

I. 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

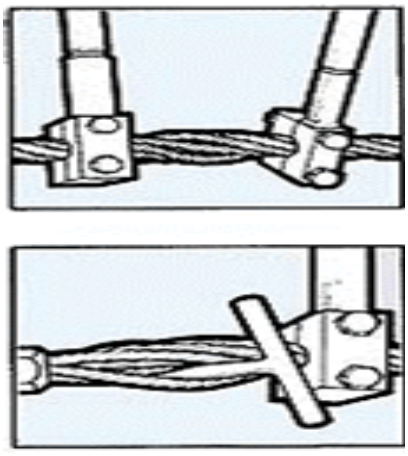
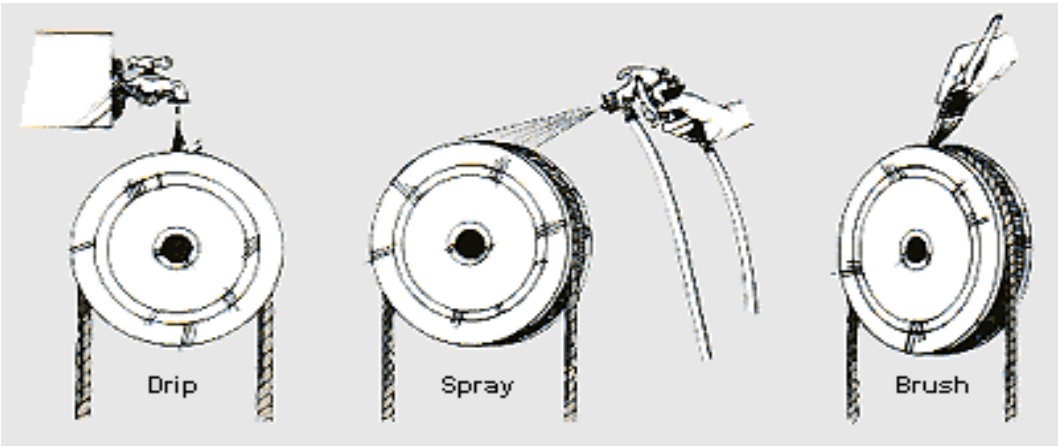


fig 3

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. As a result, it is 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 applied should be light-bodied enough to penetrate to the rope's core. There are three methods commonly used to apply a lubricant: 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, as that is where the rope's strands are spread by bending and more easily penetrated. In addition, there are pressure lubricators available commercially. The 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.**

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0117	1.0	New Doc	6/5/15

Rope Selection

Selecting a rope involves evaluating a combination of factors. Some of these factors are straightforward, like comparing rope specifications. Others are not easily quantified, like color preference or how a rope feels In your hand. Cutting corners, reducing sizes, or strengths on an initial purchase creates unnecessary replacements, potentially dangerous conditions, and increases long-term costs.

Elliott Equipment currently uses both Yale and Samson rope products in 9/16" (yellow) and 5/8" (blue) sizes.

Fiber and construction being equal, a larger rope outlasts a smaller rope because of the greater surface wear distribution. Similarly, a stronger rope outlasts a weaker one because it will be used at a lower percentage of its break strength with less chance of being overstressed.

NOTE: Always consult the manufacturer before using rope when personal safety or possible danger to property is involved. Make sure the rope is adequate for the job. **Do not use rope that is too small or the wrong type.**

The following areas should be considered in your rope selection.

Strength

When given a choice between ropes, select the strongest of any given size. A load of 200 pounds represents 2 percent of the strength of a rope with a breaking strength of 10,000 pounds. The same load represents 4 percent of the strength of a rope that has a breaking strength of 5,000 pounds. The weaker rope is having to work harder, and as a result will have to be retired sooner. Braided ropes are stronger than twisted ropes of the same size and fiber strength.

Note carefully the quoted breaking strengths of the various products. These are average breaking strengths. Published breaking strengths are determined by standard cordage testing and do not cover conditions such as sustained loads or dynamic loading. These strengths are attained under laboratory conditions. Remember also that this is a breaking strength, not a recommended working load.

Elongation

It is well accepted that ropes with lower elongation under load will give you better load control-a big help at complicated job sites. However, ropes with lower elongation that are dynamic loaded, like a towering line, can fail without warning, even though it appears to be in good shape. Low elongating ropes should be selected with the highest possible strength. Both twisted ropes and braided ropes are suitable for rigging. Twisted rope has lower strength and more stretch. Braided rope has higher strength and lower stretch.

Dynamic (Shock) Loading

Working loads as described herein are not applicable when rope has been subjected to dynamic loading. Whenever a load is picked up, stopped, moved, or swung there is an increased force caused by the dynamic nature of the movement. The force increases as these actions occur more rapidly or suddenly, which is known as dynamic, or shock, loading.

An example of applications where dynamic loading occurs includes ropes used as a tow line, picking up a load on a slack line, or using rope to stop a falling object. In extreme cases, the force put on the rope may be two, three, or more times the normal load involved. Dynamic-loading effects are greater on a low elongation rope such as polyester than on a high-elongation rope such as nylon, and greater on a short rope than on a long one.

For example, the dynamic load on a winch line that occurs when a 5,000-lb object is lifted vertically with a sudden jerk can weigh 30,000 lbs. under the dynamic force. If the winch line is rated in the 30,000-lb break strength range, it is very likely to break.

Where dynamic loads, sustained loads, or where life, limb or valuable property is involved, it is recommended that an increased working load factor be used. It is also recommended that a lower working load factor be selected with only expert knowledge of conditions and professional estimates of risk; if the rope has been inspected and

found to be in good condition; and if the rope has not been subjected to dynamic loads, excessive use, elevated temperatures, or extended periods under load.

For dynamic loading applications that involve severe exposure conditions, or for recommendations on special applications, consult the manufacturer.

Firmness

Select ropes that are firm and round and hold their shape during use. Soft or mushy ropes will snag easily and abrade quickly, causing accelerated strength loss. Because the fibers are in a straighter line, which improves strength but compromises durability, loose or mushy rope will almost always have higher break strengths than a similar rope that is firm and holds its shape.

Abrasion

It is important to choose the right rope construction for your application, because it affects resistance to normal wear and abrasion. Ropes can be severely damaged if subjected to rough surfaces or sharp edges. Chocks, bits, winches, drums and other surfaces must be kept in good condition and free of burrs and rust. Similarly, sheaves must be free to rotate and should be of proper size to avoid excessive wear. Clamps and similar devices will damage and weaken the rope, and should be used with extreme caution. Do not drag the rope over rough ground. Dirt and grit picked up by the rope can work into the strands, thus cutting the inside fibers and reducing the rope's strength.

Assigned Working Load Factors

Assigned working load factors vary in accordance with the different safety practices and policies of utilities and industrial users. However, our recommendation, and one that is fairly well accepted in the industry, is a minimum 5:1 working load factor. Thus, your maximum workload should be approximately 1/5th, or 20 percent, of the quoted breaking strength. This factor provides greater safety and extends the service life of the winch line.

Assume that you have seven identical ropes, each with a 30,000-lb breaking strength and you work these ropes daily with each rope lifting a different load. The higher the working load factor, the greater the service life and the lower the replacement factor. Therefore, the working load factor directly reflects the economy of the purchase.

NOTE: Many industries are subject to state and federal regulation on workload limits that supersede the manufacturer's recommendation. It is the responsibility of the rope user to be aware of and adhere to those laws and regulations.

Rope Handling/Usage

WARNING-Persons should be warned against the serious danger of standing in line with a rope under tension. Should the rope part, it may recoil with considerable force and speed. In all cases where any such risks are present, or where there is any question about the load involved, or the condition of use, the working load should be substantially reduced and the rope properly inspected before every use.

Attaching Line to a Winch Drum

There are various methods of attaching a winch line to a winch drum:

- Using a wedge/plug and set-screw in the drum's main body
- Using a "U" bolt through the side of the side of the flange
- Welding a round plug to the winch drum, and then place the soft eye at the end of the winch line over the plug and secure with a flat keeper

It is strongly recommended to have an eye splice in both ends of the winch so that it can be reversed in the event of damage to one end; however, this is not always possible depending upon the method of attachment to the winch drum and whether or not a closed thimble is spliced into the eye. If an eye is not used at the drum end, it should be tightly whipped with a strong twine.

Avoid All Abrasive Conditions

All rope will be severely damaged if subjected to rough surfaces or sharp edges. Chocks, bitts, winches, drums, and other surfaces must be kept in good condition and free of burrs and rust. Pulleys must be free to rotate, and should be of proper size to avoid excessive wear.

Winding onto a Winch

1. **Level Winding:** Using the appropriate amount of tension, wind the rope evenly, without spaces across the drum of the winch. The next level should wind over the previous layer of rope, and follow the valleys between turns on the previous level. This pattern is followed for all layers of the rope, with each layer of turns slightly offset from the layer below.
2. **Cross Winding:** When the rope is placed under load it can dive, or push into, the previously wrapped level below it. To avoid diving, cross winding is recommended.

   When cross winding, start with two layers of level wound rope using the appropriate back tension.

Winding Rope on the Winch Drum

The first layer (wrap) around the winch drum should be put on closely and tightly. The initial winding tension (load) should be approximately 50 pounds. This will prevent subsequent wraps from slipping down between turns when tension is applied.

Dielectric Properties

Based on rope industry practices, dielectric property testing is conducted on clean, new rope samples, and holds true only under such ideal conditions. Dirt, grease, foreign matter, and moisture (including humidity) will alter the non-conductivity/conductivity of any synthetic rope or material. No rope manufacturer can attest to a rope's dielectric properties under actual operating conditions.

Removing Rope from a Reel or Coil

Synthetic-fiber ropes are normally shipped on reels for maximum protection while in transit. The rope should be removed from the reel by pulling it off the top while the reel is free to rotate. This can be accomplished by passing a pipe through the center of the reel and jacking it up until the reel is free from the deck. Rope should never be taken from a reel lying on its side. If the rope is supplied on a coil, it should always be uncoiled from the inside so that the first turn comes off the bottom in a counter-clockwise direction.

Rope Storage: Coiling, Flaking and Bagging

Great care must be taken in the stowage and proper coiling of 3-strand ropes to prevent the natural built-in twist of the line from developing kinks and hockles. Braided ropes, on the other hand, have no built-in twist and are far more resistant to kinking. Even if kinks do develop, they cannot develop further into hockles.

Eye Splices

The standard eye splice cannot be pulled out under tension; however, it can be pulled out by hand when the winch line is in a relaxed state. To prevent such tampering, it is recommended that lock stitching or tight seizing be applied to the base or throat of the splice.

Lock stitching may also prove advantageous on some splices to prevent no-load opening due to mishandling. The material required is one fid length of nylon whipping twine approximately the same size diameter as the strands in the rope you are lock stitching. The strands cut from the rope you are lock stitching may also be used, but whipping twine is preferable.

Eye splices at the end of winch lines (if not put in at the factory) should be done in strict accordance with the steps and procedures outlined. These splicing methods can be easily learned and executed by line crews and shop personnel.

Knots

While it is true that a knot reduces rope strength, it is also true that a know is a convenient way to accomplish rope attachment. The strength loss is a result of the tight bends that occur in the know. With some knots, ropes can lose approximately 50 percent of their strength; however, this number can be higher or lower based on rope construction and fibers used. It is vital that the reduction in strength by the use of knots be taken into account when determining the size and strength of a rope to be used in an application. To avoid knot strength reduction, it is recommended that a rope be spliced according to the manufacturer's instructions. Splice terminations are used in all ropes to determine new and unused tensile strengths. Therefore, whenever possible, spliced terminations should be used to maximize the rope strength for new and used ropes.

Use of Slings with Winch Lines

The winch line itself should not be used as a choker to pick up a pole or other objects. The hook attached on the end of the winch line can cut deeply into the rope itself. We recommend a separate line, sling or strap be used as the choker and not the winch line itself.

Sharp Cutting Edges

Winch lines should not be exposed to sharp edges and surfaces, such as metal burrs on winch drums, sheaves, shackles, thimbles, wire slings, etc. Winch lines are made from synthetic fibers and can be cut or damaged by sharp edges. When installing winch lines on old truck units, great care must be exercised to assure that the rope is not coming in contact with hardware that has been scored and chewed by previously-used wire lines. Sheaves, shackles, thimbles, etc., should be replaced in most cases. Other metal surfaces should be carefully examined and dressed if necessary.

Abrasion Protection of Line

Depending on manufacturer specifications, most ropes have an outer jacket of polyester, which has a relatively high degree of resistance to abrasion and melting.

However, all synthetics to subject to melting if subjected to enough friction and heat; therefore, practices such as surging on a gypsy-head winch, hard rendering around poles, over cross-arms, etc., should be avoided whenever possible.

Temperature

Friction can be your best friend or worst enemy if it is not managed properly. Friction takes place anytime two surfaces come in contact. Mild friction, sometimes referred to as grip, is a good characteristic (i.e. winching applications). However, friction creates heat, and the greater the friction the greater the heat buildup. Heat is an enemy to synthetic fiber, and elevated temperatures can drastically reduce the strength and/or cause rope melt-through.

High temperatures can be achieved when checking ropes on a cable, or running over stuck or non-rolling sheaves or rollers. Each rope's construction and fiber type will yield a different coefficient of friction (resistance to slipping) in a new or used state. It is important to understand the operational demands, and take into account the size of the rope, construction, and fiber type to minimize heat buildup.

Never let ropes under tension rub together or move relative to one another. Enough heat to melt the fibers can build up and cause to rope to quickly fail, as if cut by a knife.

Be aware of heat buildup and take steps to minimize them. Under no circumstances let any rope come in contact with an exhaust muffler or any other hot object. The strength of a used rope can be determined by testing, but often the rope is destroyed in the process so the ability to determine the retirement point before it fails in service is essential. That ability is based on a combination of education in rope use and construction, along with good judgment and experience. Remember, you almost always get what you pay for in the form of performance and reliability.

Strength Degradation from Ultraviolet Light

Prolonged exposure of synthetic ropes to ultraviolet (UV) radiation from sunlight causes varying degrees of strength degradation. Polyester fibers are the least affected

by UV exposure, and the resulting strength degradation of exposed fibers is negligible. Nylon is more susceptible to strength loss due to ultraviolet rays, but with both polyester and nylon, the degree of susceptibility to UV damage is dependent on the type of fiber and the various inhibitors with which the fiber manufacturer treats them.

Polyolefin and PBO fibers are severely affected by ultraviolet exposure, especially in their natural, undyed, and/or uncovered states.

Harmful Chemicals

Certain chemicals can break down synthetic fibers. Sulfuric acids, alkalis, and chlorinate hydrocarbons over 160° Fahrenheit should be avoided, while strong cleaning agents or bleaches may be harmful. If you are unsure about the effect of a specific chemical, contact Yale Cordage for more information.

Avoid Dynamic Loading

Dynamic loading of any line-synthetic, manila, or wire-produces a drastically different set of physical properties and results, as compared with normal loading. Dynamic loading is a jerking or snatching of a line, or a very sudden change in tension such as from a relaxed state or low load to one of high load. A sudden drop off of a platform from as short a distance as four inches actually doubles the rope's load. Similarly, an overwrap "falling" off the winch drum can result in a dynamic load. This results in accelerated wear of the rope.

Fatigue

Synthetic fibers have memory: They remember and retain the effects of being overloaded and dynamic loaded. This is why winch line procedures are so important to reducing the danger of dynamic loading, which prolongs the life of the rope and reduces premature down grading. If there is a reason to believe that a line has been dynamic loaded above its recommended working load, it should be logged. If a number of these instances occur, the line should be inspected and rotated.

End-For-Ending

It is recommended that every winch line be rotated end-for-end on a periodic basis. This will vary high stress and wear points and extend useful life. The recommended end-for-ending period is six months, at which time visual inspection and washing can also be done.

Bending Radius

Any sharp bend in a road under load decreases its strength substantially, and may cause premature damage or failure. In sizing the radius of bits, fairleads and chocks for best performance the following guidelines are offered:

- When a rope bends more than 10 degrees around bitts or chocks, or is bending across any surface, the diameter of that surface should not be less than three times the diameter of the rope. That is, whatever is the diameter of the surface should be no less than three times the diameter of the rope. Using a ratio of 4:1 or greater is better because the durability of the rope increases substantially as the diameter of the surface of which it is worked increases.
- On a cleat when the rope does not bend radially around, the cleat's barrel can only be one-half of the rope's circumferences at a minimum.
- The ratio of the length of an eye splice to the diameter of the object over which the eye placement (i.e. bollard, bitt, etc.) should be at least 3:1, but preferably 5:1. So, for example, bollard that is 2 feet in diameter should have the eye splice to be no less than 6 feet in length, preferably 10 feet in length.

Boom-Sheave Recommendations

To assure maximum efficiency and safety, sheaves for braided ropes should be no less than eight times the rope's diameter, and the sheave groove diameter should be no less than 10 percent greater than the rope's diameter. The sheave groove should be round in shape, and sheaves with a "V"-shape groove should be avoided, as they tend to pinch and damage the rope excessive friction and crushing rope fibers. Sheave

surfaces should be kept smooth, and free of burrs and gouges. Bearings should be maintained to ensure smooth rotation.

- Twisted/Plaited: 10 times the rope's diameter
- Braided: 8 times the rope's diameter

Rope Type

Yale Ultrex

Ultrex is a 12-strand, single braid comprised of 100 percent Ultra High Molecular Weight Polyethylene (UHMPE) fiber enhanced with Yale's Maxijacket HP coating (see next section) supplying superior abrasion resistance.

Ultrex's braid angles and twist level are designed to optimize break strength and keep stretch low. UHMPE is the most forgiving high modulus fiber, and provides better sheave cycling capabilities than other high tech fibers.

Ultrex also has zero water absorption, and maintains its flexibility even in freezing conditions. As is the case for all Yale ropes, the strengths shown in the following charts are for spliced ropes, and the splice technique for Ultrex is very easily mastered.

Samson Amsteel

Amsteel is a 12-strand, torque-free single braid that yields the maximum in strength-to-weight ratio and, size-for-size, is the same strength as steel-except it is light enough to float. Amsteel Blue is an excellent wire rope replacement with extremely low stretch, superior flex fatigue, and wear resistance.

Yale Ultrex Specifications Chart

Diameter Inches (mm)		Average Spliced Break Strength*		Minimum Spliced Break Strength*		Maximum** Work Load 5:1		Weight	
		Lbs	Kg	Lbs	Kg	Lbs	Kg	Lbs/ 100ft	Kg/ 100m
1/16	(2.0)	800	360	720	325	160	70	0.1	0.2
1/8	(3.0)	1,900	860	1,710	775	380	170	0.3	0.5
5/32	(4.0)	3,150	1,430	2,835	1,285	630	285	0.5	0.7
3/16	(5.0)	5,250	2,380	4,725	2,145	1,050	475	1.0	1.5
1/4	(7.0)	9,600	4,355	8,640	3,920	1,920	870	1.7	2.5
5/16	(8.0)	13,500	6,125	12,150	5,515	2,700	1,225	2.4	3.6
3/8	(9.0)	20,000	9,080	18,000	8,170	4,000	1,815	3.5	5.2
7/16	(11.0)	25,700	11,665	23,130	10,500	5,140	2,330	4.6	6.8
1/2	(12.0)	37,400	16,975	33,660	15,280	7,480	3,395	6.2	9.2
9/16	(14.0)	45,000	20,430	40,500	18,385	9,000	4,085	7.5	11.2
5/8	(16.0)	53,000	24,060	47,700	21,655	10,600	4,810	9.5	14.1
3/4	(18.0)	75,000	34,050	67,500	30,645	15,000	6,810	13.5	20.1
7/8	(22.0)	98,000	44,490	88,200	40,040	19,600	8,895	19.5	29.0
1	(24.0)	120,000	54,480	108,000	49,030	24,000	10,895	23.5	35.0
1-1/8	(27.0)	148,000	67,190	133,200	60,470	29,600	13,435	32.0	47.7
1-1/4	(30.0)	172,000	78,085	154,800	70,275	34,400	15,615	38.0	56.6
1-5/16	(32.0)	184,000	83,535	165,600	75,180	36,800	16,705	44.0	65.5
1-1/2	(36.0)	230,000	104,420	207,000	93,975	46,000	20,880	57.0	84.9
1-5/8	(40.0)	285,000	129,390	256,500	116,450	57,000	25,875	65.0	96.8
1-3/4	(42.0)	330,000	149,820	297,000	134,835	66,000	29,960	78.0	116.2
2	(48.0)	390,000	177,060	351,000	159,350	78,000	35,410	92.0	137.0

* **Knots** and abrupt bends significantly reduce the strength of all ropes and lowers maximum working load.
** **Working load** is based on static or moderately dynamic lifting/pulling operations. Instantaneous changes in load up or down, in excess of 10 percent of the rope's rated working load constitutes hazardous shock load and would void normal working load recommendation. Consult Yale Cordage for guidelines for working loads and safe use of rope.

YELLOW highlighted section denotes Elliott Equipment sizes

Samson Amsteel Specifications Chart

DIAM. (inch)	CIRC. (inch)	WEIGHT PER 100 FT. (lbs)	AVG. STRENGTH (lbs)	MIN. STRENGTH (lbs)	DIAM. (mm)	CIRC. (mm)	WEIGHT PER 100 M (kg)	AVG. STRENGTH (kg)	MIN. STRENGTH (kg)	ISO 2307 STRENGTH (metric tons)
7/64	5/16	0.3	1,600	1,400	2.5	7.5	0.45	730	650	0.73
1/8	3/8	0.5	2,500	2,300	3	9	0.74	1,100	1,000	1.1
5/32	15/32	0.75	4,000	3,600	4	12	1.1	1,800	1,600	1.8
3/16	9/16	1	5,400	4,900	5	15	1.5	2,400	2,200	2.4
1/4	3/4	1.6	8,600	7,700	6	18	2.4	3,900	3,500	3.9
5/16	1	2.7	13,700	12,300	8	24	4	6,200	5,600	6.2
3/8	1 1/8	3.6	19,600	17,600	9	27	5.4	8,900	8,000	8.9
7/16	1 1/4	4.5	23,900	21,500	11	33	6.7	10,800	9,800	10.8
1/2	1 1/2	6.4	34,000	30,600	12	36	9.5	15,400	13,900	15.4
9/16	1 3/4	7.9	40,500	36,500	14	42	11.8	18,400	16,500	18.4
5/8	2	10.2	52,800	47,500	16	48	15.2	24,000	21,600	24
3/4	2 1/4	13.3	64,400	58,000	18	54	19.8	29,200	26,300	29.2
13/16	2 1/2	17	82,000	73,800	20	60	25.3	37,200	33,500	37.2
7/8	2 3/4	19.6	90,800	81,700	22	66	29.2	41,200	37,100	41.2
1	3	21.8	109,000	98,100	24	72	32.4	49,400	44,500	49.4
1 1/16	3 1/4	27.5	131,000	118,000	26	78	40.9	59,400	53,500	59.4
1 1/8	3 1/2	31.9	148,000	133,000	28	84	47.5	67,100	60,400	67.1
1 1/4	3 3/4	36.2	165,000	149,000	30	90	53.9	74,800	67,400	74.8
1 5/16	4	41.8	184,000	166,000	32	96	62.2	83,500	75,100	83.5
1 3/8	4 1/8	45	205,000	185,000	34	100	67	93,000	83,700	93
1 1/2	4 1/2	51.7	228,000	205,000	36	108	76.9	103,000	93,100	103
1 9/16	4 3/4	57.6	254,000	229,000	38	114	85.7	115,000	104,000	115
1 5/8	5	65.2	283,000	255,000	40	120	97	128,000	116,000	128
1 11/16	5 1/4	71	307,000	276,000	42	126	106	139,000	125,000	139
1 3/4	5 1/2	78.4	335,000	302,000	44	132	117	152,000	137,000	152
2	6	87	381,000	343,000	48	144	129	173,000	156,000	173

YELLOW highlighted section denotes Elliott Equipment size

Rope Coatings and Finishes

Yale Maxijacket Coating

This is a spliceable urethane coating, which is applied after the rope is braided. Maxijacket firms the rope, increases snag resistance, and helps keep contaminants from entering the rope. Unlimited lengths may be processed at our facility through our automated coaters, which apply and control the polymer penetration, curing the coating at precisely controlled temperatures.

Maxijacket maintains the rope's splicing characteristics and is available in a range of colors for rapid line identification. The colors are also useful to track time in service, to color code for load rating, for phase identification, or to make the rope more visible. Coatings are also available in clear or white.

Samson Samthane Coating

Samthane is an abrasion-resistant coating specifically formulated for specific rope constructions and related applications. Some of the advantages of a Samthane coating include reduced snagging, improved service life, enhanced abrasion resistance, and reduced cutting damage.

Rope Retirement

One commonly-asked question is when to retire a rope. The most obvious answer is: Before it breaks. However, without a thorough understanding of how to inspect it and knowing the load history, you are left making an educated guess.

Unfortunately, there are no definitive rules, nor are there industry guidelines to establish when a rope should be retired because there are so many variables that affect rope strength. Factors like load history, bending radius, abrasion, chemical exposure, or some combination of those factors, make retirement decisions difficult.

Inspecting your rope should be a continuous process of observation before, during, and after each use. In synthetic fiber ropes, the amount of strength loss due to abrasion and/or flexing is directly related to the amount of broken fiber in the rope's cross section. After each use, look and feel along every inch of the rope length

inspecting for abrasion, glossy or glazed areas, inconsistent diameter, discoloration, and inconsistencies in texture and stiffness.

Visual Inspection

The load-bearing capacity of double braid ropes is divided equally between the inner core and the outer cover. If upon inspection, there are cut strands or significant abrasion damage, the rope must be retired because the strength of the entire rope is decreased and, as such, is compromised.

Core-dependent double braids have 100 percent of their load-bearing capacity handled by the core alone. For these ropes, the jacket can sustain damage without compromising the strength of the load-bearing core. Inspection of the core-dependent double braids can be misleading because it is difficult to see the core. In the case of 12-strand single braids, each of the stands carries approximately 8.33 percent, or one-twelfth, of the load. Upon inspection, if it is discovered there are cut strands or significant abrasion damage to the rope, the rope must be retired, or the areas of damage removed and the rope repaired with the appropriate splice.

Abrasion

When a 12-strand, single-braid rope is first put into service, the outer filaments of the rope will quickly become frizzy. This is the result of the filaments breaking, which actually forms a protective cushion to shield the fibers underneath. This condition will stabilize, and should not progress. If the surface roughness increases, excessive abrasion is taking place and strength is subsequently being lost. When inspecting the rope, look closely at both the inner and outer fibers. When either is worn, the rope is obviously weakened.

Open the strands and look for powdered fiber, which is one sign of internal wear. Estimate the internal wear to estimate total fiber abrasion. If total fiber loss is 20 percent, then it is safe to assume the rope has lost 20 percent of its strength as a result of abrasion.

As a general rule for braided ropes, when there is 25 percent or more wear from abrasion, or the fiber is broken or worn away, the rope should be retired from service. For double-braided ropes, 50 percent wear on the cover is the retirement point, and with three-strand ropes, 10 percent or more wear is accepted as the retirement point.

- **Glossy or Glazed Areas:** Glossy or glazed areas are signs of heat damage with more strength loss than the amount of melted fiber indicates. Fibers adjacent to the melted areas are probably damaged from excessive heat, even though they appear normal. It is reasonable to assume that the melted fiber has damaged an equal amount of adjacent unmelted fiber.

Discoloration: With use, all ropes get dirty. Be on the lookout for areas of discoloration that could be caused by chemical contamination. Determine the cause of the discoloration, and replace the rope if it is brittle or stiff.

- **Inconsistent Diameter:** Inspect area for flat edges, bumps, or lumps. This can indicate core or internal damage from overlooking or dynamic loads and is usually sufficient reason to replace the rope.
- **Inconsistent Texture:** Inconsistent texture of stiff areas can indicate excessive dirt or grit embedded in the rope or dynamic load damage, and is usually reason to replace the rope.
- **Residual Strength:** Periodic testing of samples taken from the ropes currently in service ensures that retirement criteria are updated to reflect the actual conditions of service.

Single Braid/Double Braid Retirement Checklist

Elongation (Stretch)/Components of Stretch

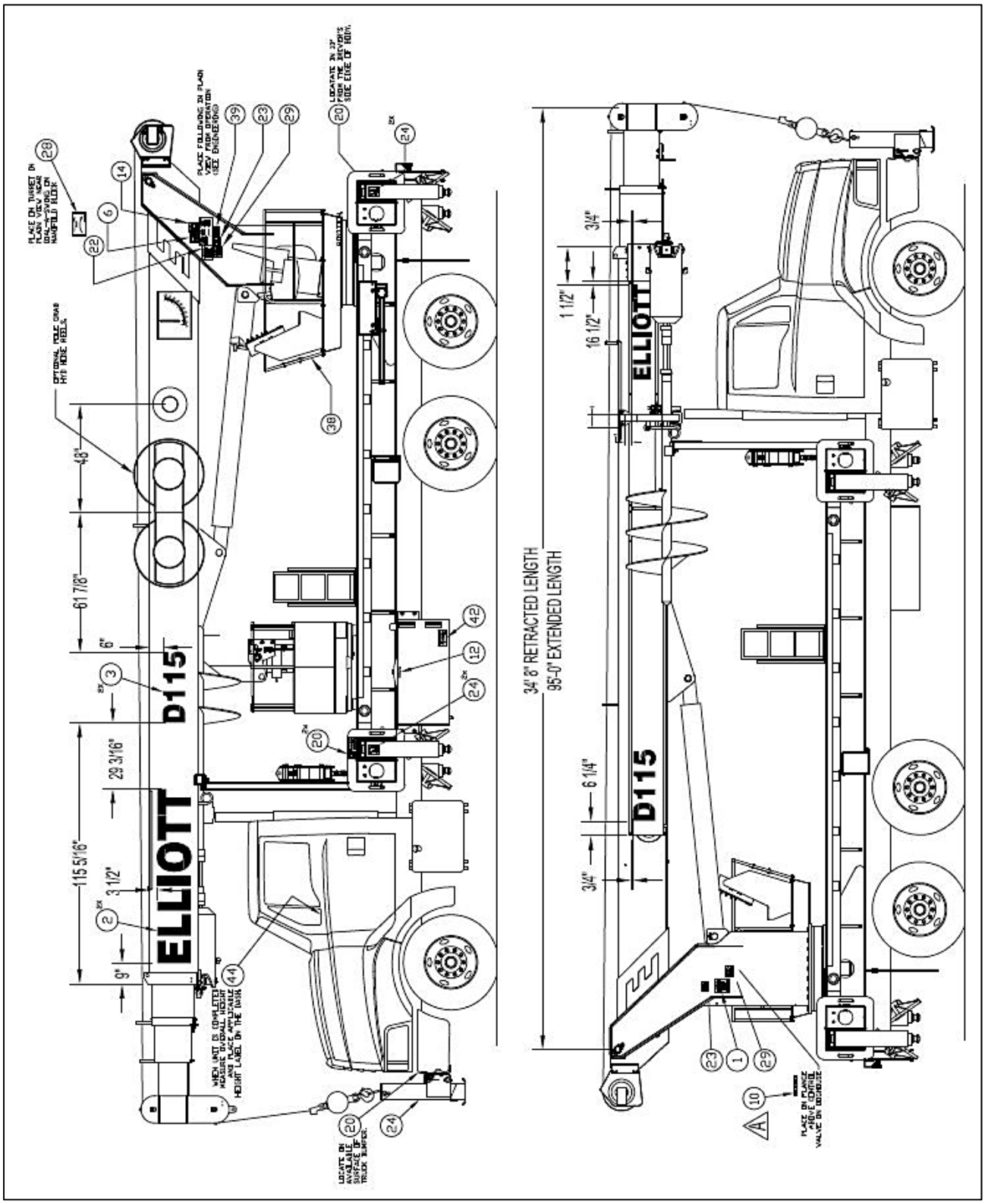
- **Elastic Elongation (EE):** Elastic elongation refers to the portion of stretch or extension of a rope that is immediately recoverable after the load on the rope is released. The rope's tendency to recover is a result of the fiber(s) rather than the rope construction. Each type of synthetic fiber inherently displays a unique degree of elasticity. Relatively speaking, high-performance fiber has extremely low elasticity as compared to nylon fiber.

- **Elastic Hysteresis:** Elastic Hysteresis refers to a recoverable portion of stretch or extension over a period of time after a load is released. In measuring elastic recovery, it is the portion that occurs immediately when a load is removed. However, a remaining small percentage of elastic recovery occurs gradually over a period of hours or days. Elastic hysteresis is measured in a length/time scale.
- **Permanent Extension (PE) After Relaxation:** Permanent extension while working is the amount of extension that exists when stress is removed but no time is given for hysteretic recovery. It includes the non-recoverable and hysteretic extension as one value, and represents any increase in the length of ta rope in a constant working situation, such as during repeated surges in towing, or other similar cyclical operations. The percentage of PE over the working load range is generally in order of 4-6 percent for braided ropes, and 2-3 times as much for plaited. However, it varies slightly with different fibers and rope constructions. In some applications, such a s subsurface mooring or devices that demand precise depth location and measurement, allowances must be made for this factor.
- **Creep:** A material's slow deformation that occurs while under load over a long period of time. Creep is mostly non-reversible. For some synthetic ropes, permanent elongation and creep are mistaken for the same property and used interchangeably when, in fact, creep is only one of the mechanisms that can cause permanent elongation.
- **Constructional Elongation:** The elongation of a loaded rope that results from compaction as the fibers and strands align and adjust.
- **Slice Setting:** The elongation of a spliced rope caused by the adjustment and setting of the strands in the splice.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech. Spec.	EEC-0060	1.0	New Document	1/13/15
Tech. Spec.		1.1	Doc update	5/12/15
Tech Spec.		1.2	Doc update	5/20/15

Digger Derrick Labels



Digger Derrick Labels

ELLIOTT EQUIPMENT COMPANY

Seq/Ref	Component	Description	Qty	UOM
01	1212010	PLT-ALUM DATA	1.0000	EA
01A	1106010	LBL-ALUM DATA PLT BMTRK	1.0000	EA
02	3010704	LBL-ELLIOTT LRG RD	2.0000	EA
03	1212020	LBL-D115 RED	2.0000	EA
04	3012494	LBL KIT-STD CRN KIT	1.0000	EA
05	1031540	LBL-DGGR CCW CW DGGR LTCH	1.0000	EA
06	1058450	LBL-DNGR FLLNG JIB	1.0000	EA
07	104314L	PLT RT PC-.19X15X5	2.0000	EA
09	1106150	PAINT SPEC-28T 32T 1870CP	1.0000	EA
11	1201850	LBL DEDUCTIONS	1.0000	EA
12	100142CP	LBL-HYD OIL 4.75X1	1.0000	EA
20	1087710	LBL-DNGR ELE HZRD CNTACT	7.0000	EA
22	1003360	LBL-FAILURE TO OBEY	1.0000	EA
23	1001150	LBL-OWNERSHIP TRANSFER	1.0000	EA
24	1001500	LBL-DNGR STND CLEAR	5.0000	EA
28	1087670	LBL-REDUCE SWING SPEED	1.0000	EA
29	1095600	LBL-MANUAL LMI OVERRIDE	1.0000	EA
30	1209760	LBL-30T 5-SECT DGGR VLV	1.0000	EA
38	1070970	LBL-CRANE OPRTN HND SGNL	1.0000	EA
39	1065510	LBL-DNGR PERSON ON WINCH	6.0000	EA
44	1007680	LBL-OAH TRVL HGHT LBL SHT	1.0000	EA

NOTE: Highlighted items have corresponding pictures of labels below.

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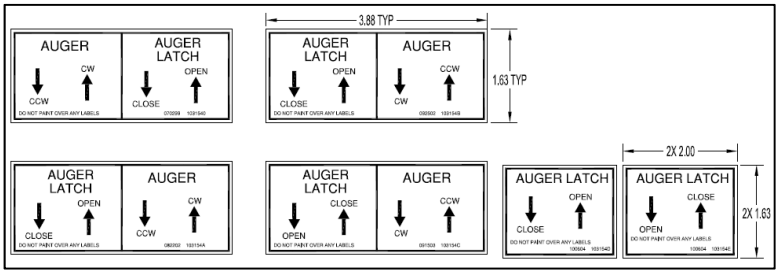

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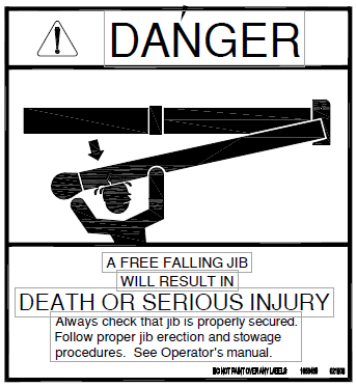

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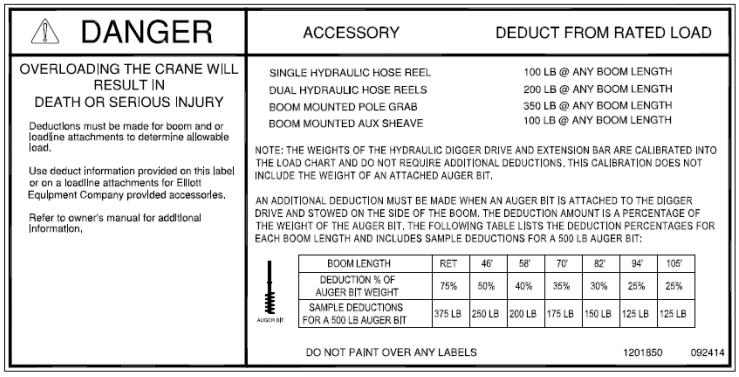

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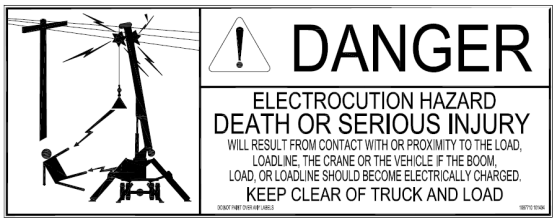

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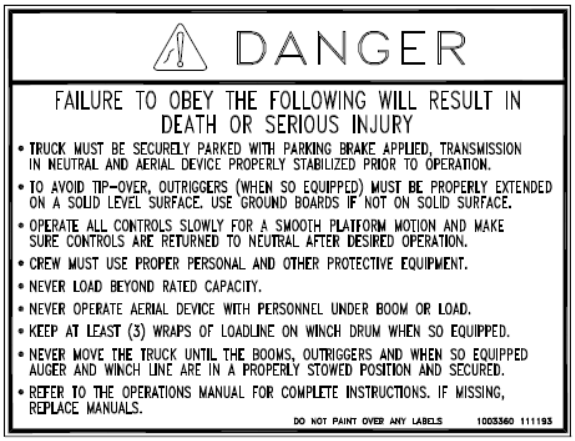

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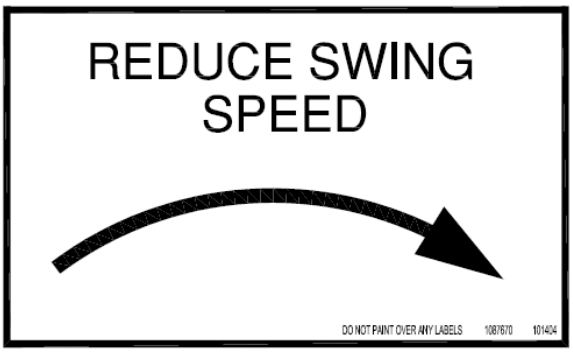

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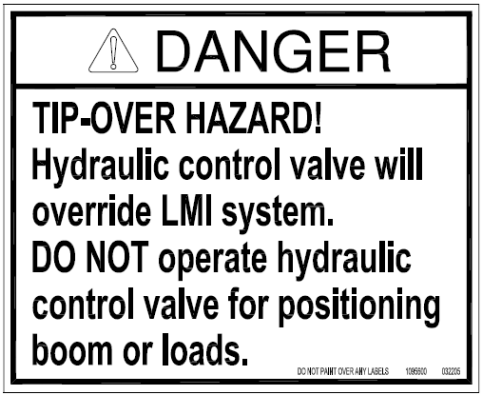

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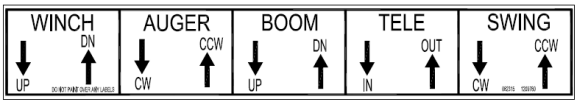
WINCH
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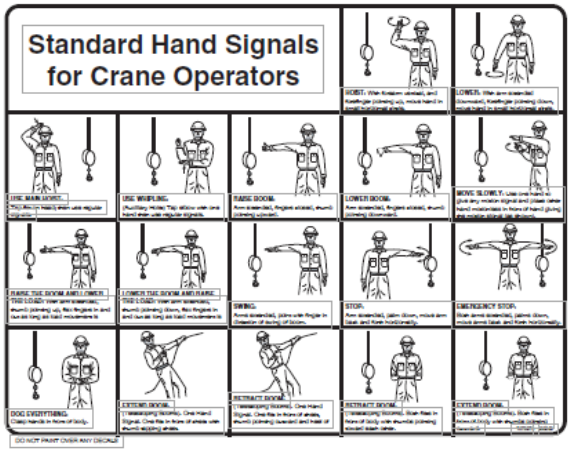
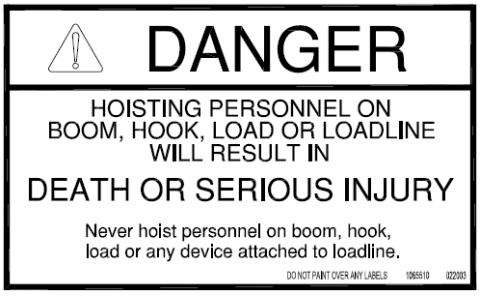

Standard Hand Signals
for Crane Operators

39.


DANGER
HOISTING PERSONNEL ON
BOOM, HOOK, LOAD OR LOADLINE
WILL RESULT IN
DEATH OR SERIOUS INJURY
Never hoist personnel on boom, hook,
load or any device attached to loadline.
DO NOT PAINT OVER ANY LABELS

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0171	1.0	New Document	11/18/15

Pump Specs

Hydraulic System	Pump Speed RPM	Max. Flow GPM	Flow L/Min		Pressure PSI	Pressure Bar
Piston Pump 130cc	2100	72	273	Standby Pump	400 4800	28 330

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

- Standby pressure is adjusted at the pump, and is the pressure created by the pump when there is no demand
- Standby pressure is displayed on the console gauge when there are no active functions

Control Valve Specs

Pressure values are measured in the load sense line with the work port blocked, function stalled, or cylinder at the end of stroke.

The system pressure gauge on the control console displays the pump pressure. Pump pressure is the total of work port pressure plus standby (differential) pressure; therefore the gauge will read higher than work port pressure by the value of the standby pressure.

The inlet relief (on the control valve) is a secondary protection in the case of pump relief valve failure. To set this pressure, the pump pressure must be temporarily adjusted higher than specification. Once the inlet relief is adjusted, the pump relief valve must be reset to its proper pressure. **Failure to do so will cause the truck engine to attempt to start under load, or create excess heat generation.**

Digger Derrick Specifications

ELLIOTT EQUIPMENT COMPANY

Functions	Max Load Sense Pressure PSI	Max Load Sense Pressure Bar	Flow GPM	Flow L/min	Operating Time Seconds	Operating Speed FPM
Control Valve Inlet Relief	5000	345				
Lift Up	3500	241	28	106	38 +/- 5	
Lift Down	3500	241	14	53	30 +/- 5	
Boom Extend	2700	186	31	117		54
Boom Retract	2200	152	15	57		60
Winch Up	3500	241	39	148		**See Winch Line Pull Table**
Winch Down	3500	241	39	148		**See Winch Line Pull Table**
Swing Left	2200	152	11	42	34 +/- 5	
Swing Right	2200	152	11	42	34 +/- 5	
Auger-Dig	4800	330	55	208		
Auger-Clean	4800	330	55	208		
Outriggers In/Out	2500	172				
Outriggers Up/Down	2500	172				
Front Stabilizers	2500	172				
Reservoir Capacity	120 Gallons					
Filtration (Pressure)	20 Micron					
Filtration (Return)	6 Micron					

Winch System Performance

Category	Standard
Line Pull	9,060 lb.
Wire Rope	9/16” Spin-Resistant
Breaking Strength	45,300 lb.
Cable Length	375 ft.

Winch Line Pull		Line Speed		
Layer	**Lb.**	**(Kg.)**	**FPM**	**(MPM)**
1	12,000	(5443)	105	(32)
2	11,620	(5271)	116	(35)
3	10,579	(4799)	128	(39)
4	9,710	(4404)	139	(42)

Ratings based on 30 GPM at 3500 PSI (114 LPM at 241 Bar)

Digger Derrick Specifications

ELLIOTT EQUIPMENT COMPANY

D115 Physical Specifications & List

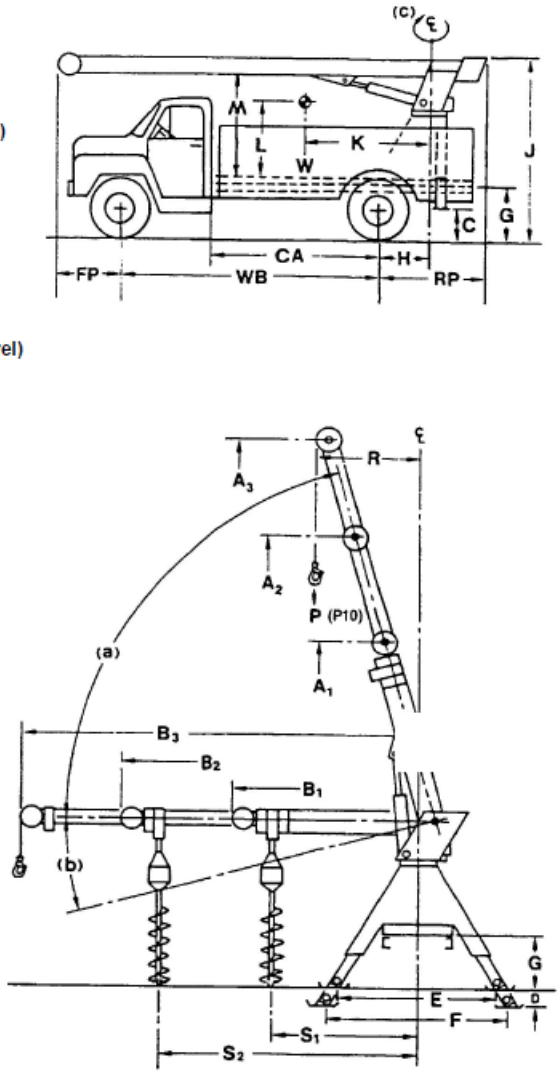
A3	Sheave Height (Max. Extension)	115’
A1	Sheave Height (Retracted)	43’
B3	Horizontal Reach (Max. Extension)	102’
B2	Horizontal Reach (Intermediate Extension)	45’
B1	Horizontal Reach (Retracted)	28’
S2	Digging Radius (Maximum)	44’
S1	Digging Radius (Minimum)	27’
a	Elevation (Above Horizontal)	80°
b	Elevation (Below Horizontal)	-8°
c	Turntable Rotation	360° Continuous
C	Outrigger Height (on 44’ Frame Height Chassis)	16’- ½”
E2	Outrigger Spread (Full Span)	20’-0”
E1	Outrigger Spread (Mid Span)	13’-11”
D	Outrigger Penetration (on 44” Frame Height Chassis)	10’-¼”
P10	Rating Classification	23,000 lb.
P	Rated Capacity	50,000 lb.

Digger Specifications

	Low Speed	High Speed
Running Torque	20,000 ft-lb.	9,000 ft-lb.
Rotation Speed	35 RPM	80 RPM
Hydraulic Flow	55 GPM	55 GPM
Hydraulic Pressure	4,800 PSI	4,800 PSI

Figure 2 - Digger Derrick Specifications

A_3 Sheave Height (Maximum Extension)
A_2 Sheave Height (Intermediate Extension)
A_1 Sheave Height (Retracted)
B_3 Horizontal Reach (Maximum Extension)
B_2 Horizontal Reach (Intermediate Extension)
B_1 Horizontal Reach (Retracted)
S_2 Digging Radius (Maximum)
S_1 Digging Radius (Minimum)
(a) Elevation (Above Horizontal)
(b) Elevation (Below Horizontal)
(c) Turntable Rotation
C Outrigger Height
E Outrigger Spread (At Ground Level)
F Outrigger Spread (Fully Extended)
D Outrigger Penetration (Below Ground Level)
G Chassis Frame Height
J Travel Height (Boom Stowed)
K Digger Derrick C.G. (Horizontal)
L Digger Derrick C.G. (Vertical)
H Center of Rotation Location (Longitudinal)
CA Cab Axle Dimension
WB Wheelbase
FP Front Projection
RP Rear Projection
R Load Radius
P Rated Load Capacity
W Digger Derrick Weight
M Stow Clearance



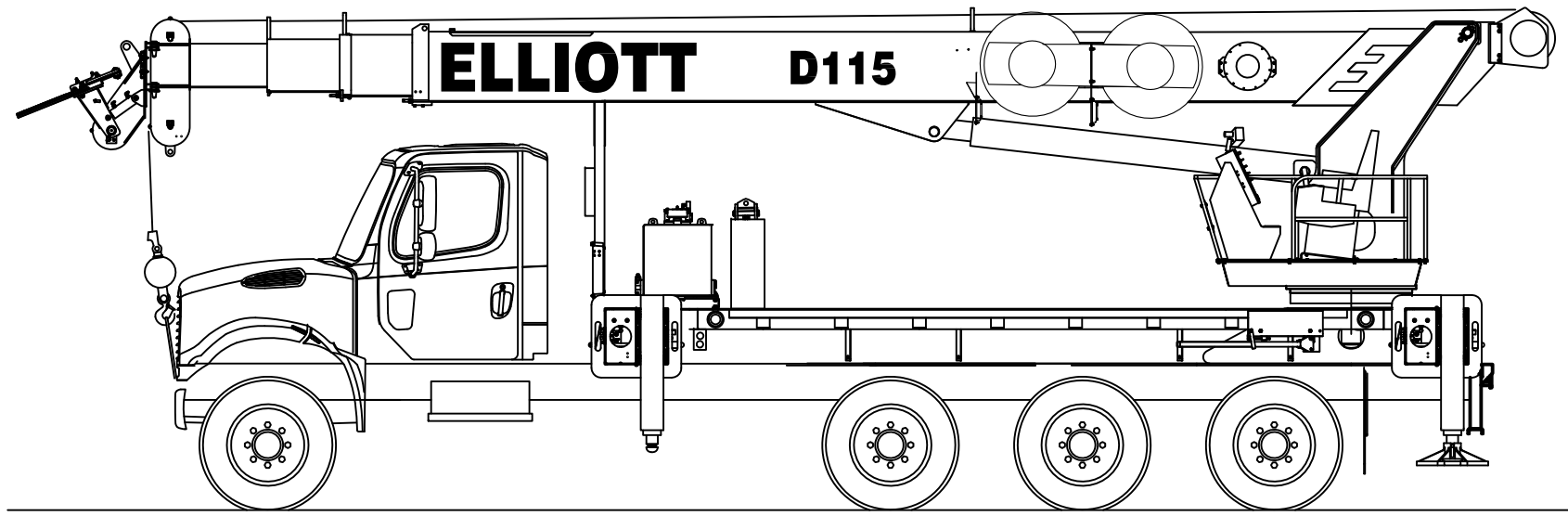
Note 1: This illustration is used to amplify and explain the text and is not meant to cover all possible configurations for digger derrick equipment.

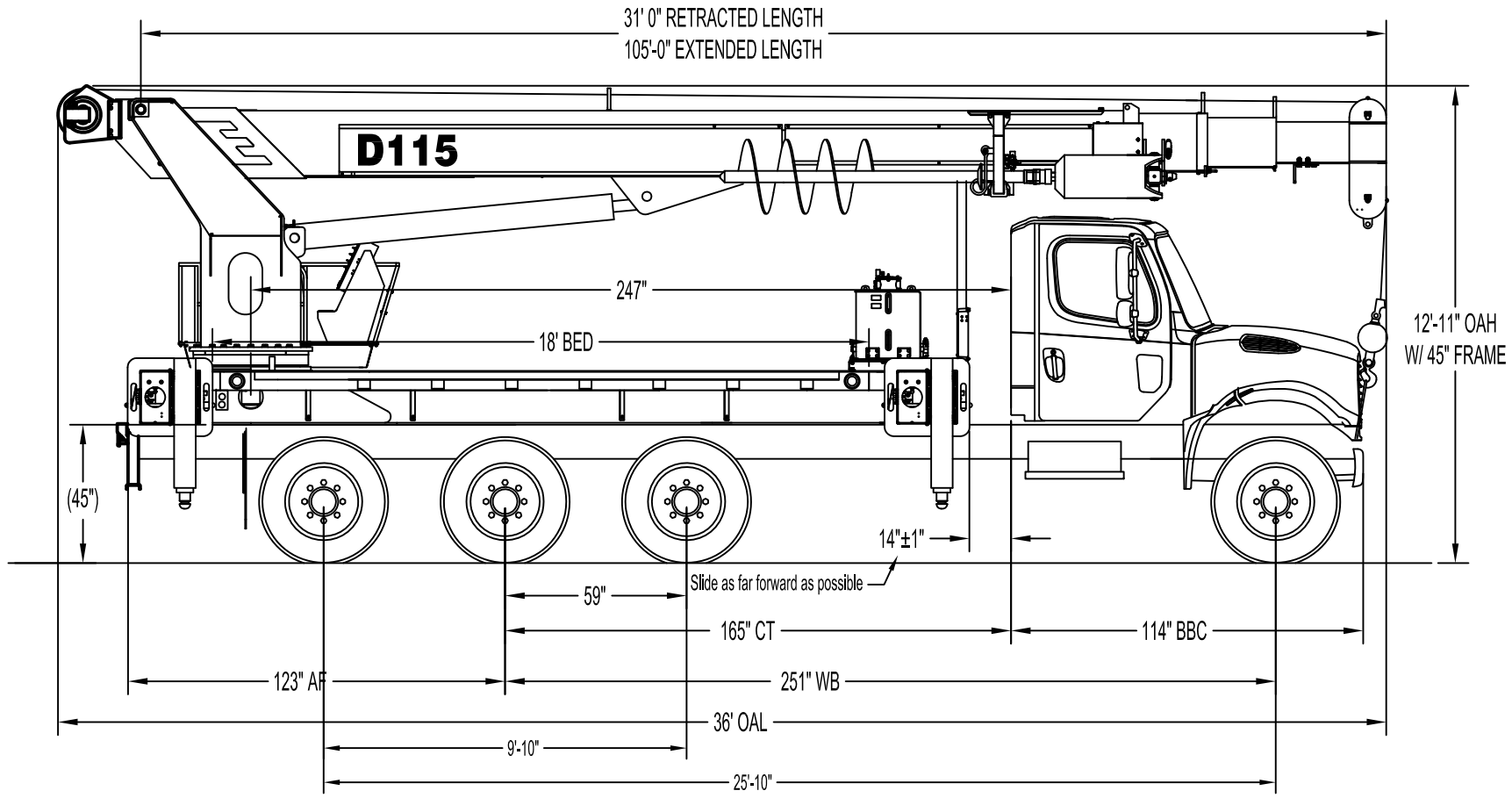
Note 2: Reprinted with permission of the Association of Equipment Manufacturers (formerly EMI).

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0170	1.0	New Document	11/16/15

REVISIONS				
DRT	REV	DESCRIPTION	DATE	EFFECTIVE



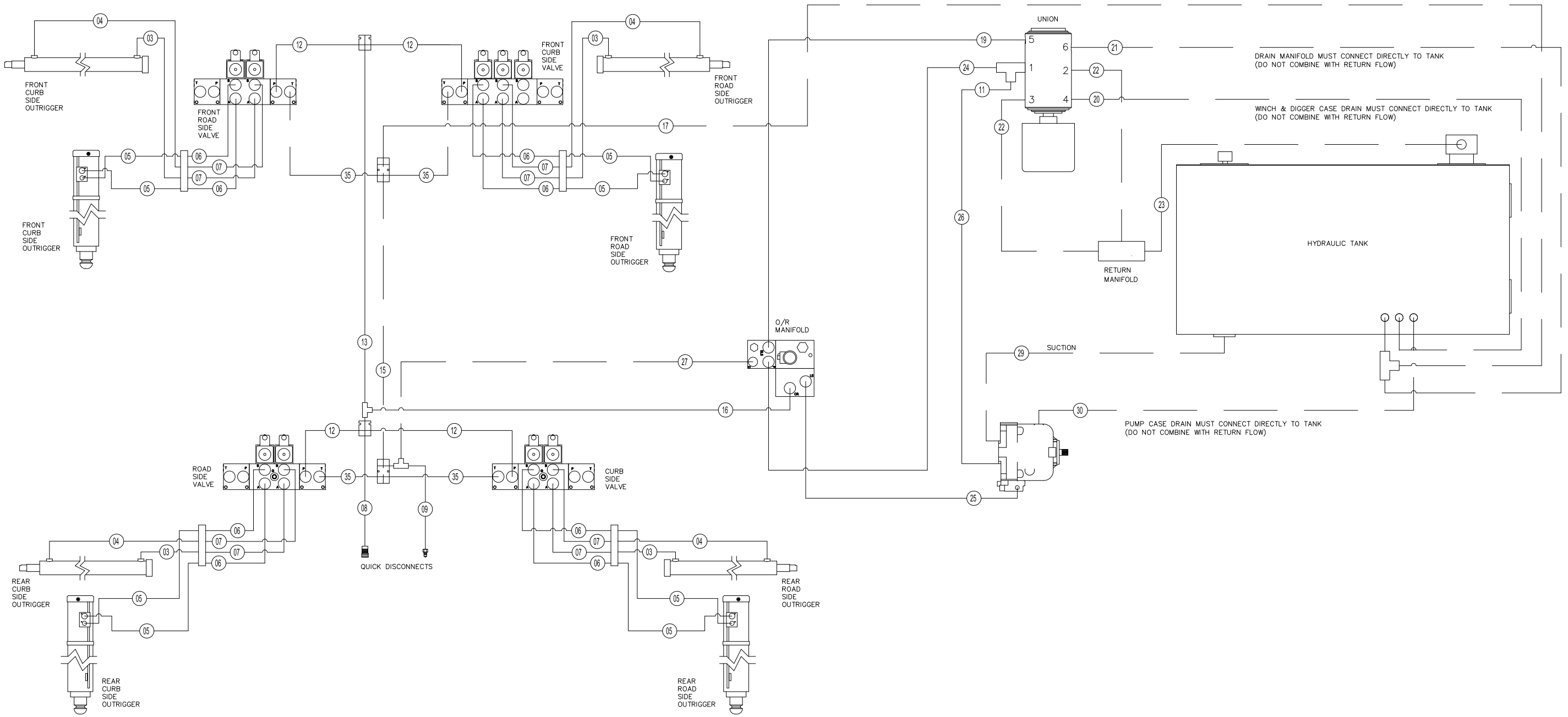


Dimensions approximate and vary with truck specifications

GVWR-80,000 lbs. Front axle-20,000 lbs. Rear axle-60,000 lbs.
Bare Chassis Weights- Total- 20,800 lbs. Front axle- 9,600 lbs. Rear axle-11,200 lbs.
Estimated Weight (2 people, full of fuel) Total- 52,650 lbs. Front axle- 13,150 lbs. Rear axle- 39,500 lbs.

ENG TCR	ELLIOTT EQUIPMENT COMPANY				
DATE	TITLE: D115 DIGGER DERRICK				
CHECKED					
DATE					
DTR EF					
DATE 11/12/15	SIZE B	SHEET 1 0F 1	DWG# P0030010.dwg	REV -	

REVISIONS				
DTR	REV	DESCRIPTION	DATE	ECO



NOTES:

1. PUMP SETTING
   (OUTER ADJUSTMENT) STAND BY PRESSURE __ PSI ± 50 PSI
   (INNER ADJUSTMENT) SYSTEM PRESSURE 4,800 PSI ± 50 PSI

HYDRAULIC UNION CONNECTIONS

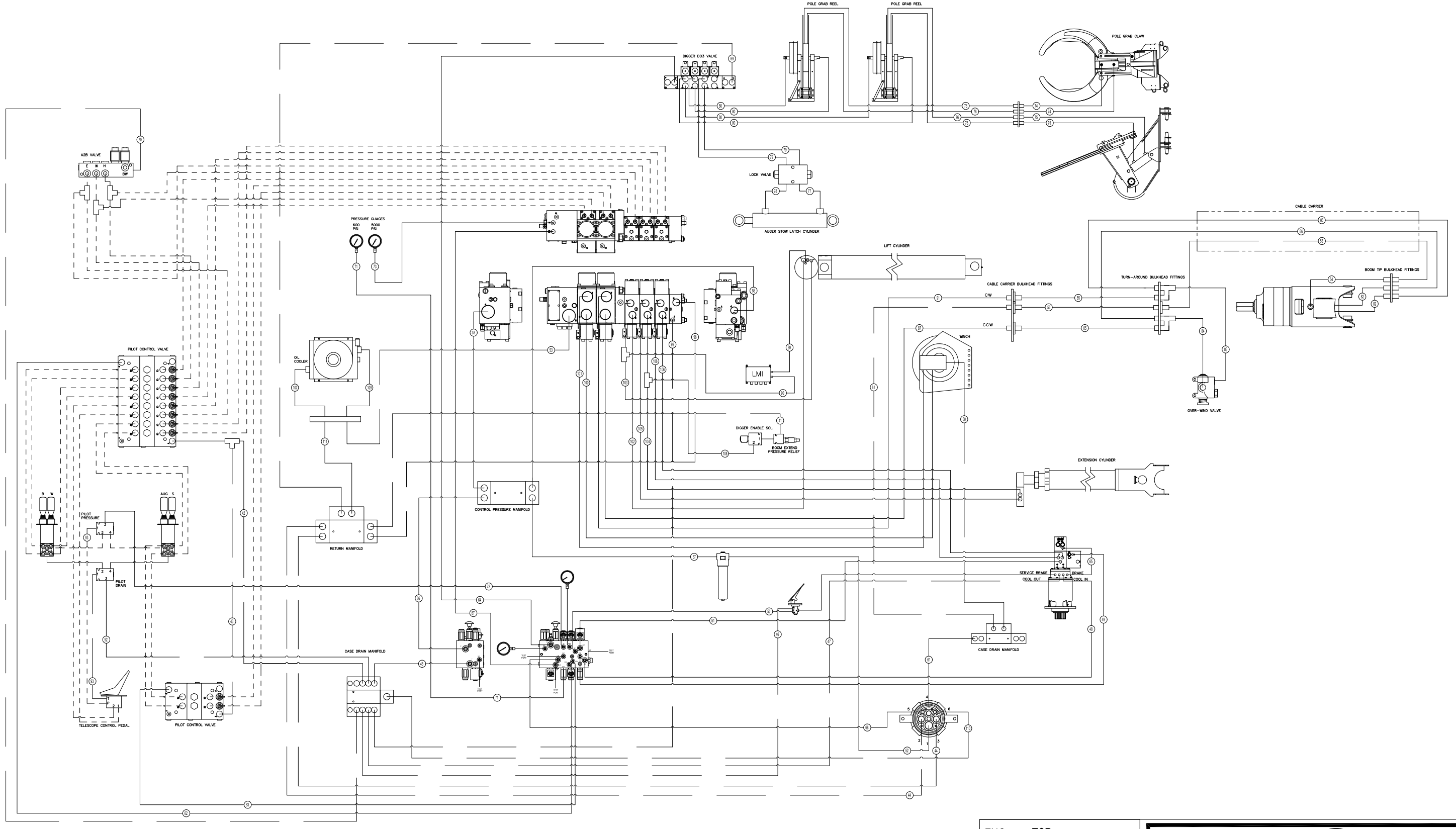
PORT	CIRCUIT
1	SUPPLY PRESSURE
2	RETURN - RETURN MANIFOLD
3	RETURN - RETURN MANIFOLD
4	CASE DRAIN - WINCH & DIGGER
5	LOAD SENSE
6	TANK - DRAIN MANIFOLD

ENG	TCR
DATE	2/26/15
CHECKED	
DATE	
DTR	TJK
DATE	2/26/15

ELLIOTT EQUIPMENT COMPANY

TITLE: PLUMBING DIAGRAM 30T 5-SECT DGGR TRUCK

SIZE	SHEET	DWG#	REV
B	2 OF 4	2080310.dwg	-



HYDRAULIC UNION CONNECTIONS

PORT	CIRCUIT
1	SUPPLY PRESSURE
2	RETURN - RETURN MANIFOLD
3	RETURN - RETURN MANIFOLD
4	CASE DRAIN - WINCH & DIGGER
5	LOAD SENSE
6	TANK - DRAIN MANIFOLD

NOTES:

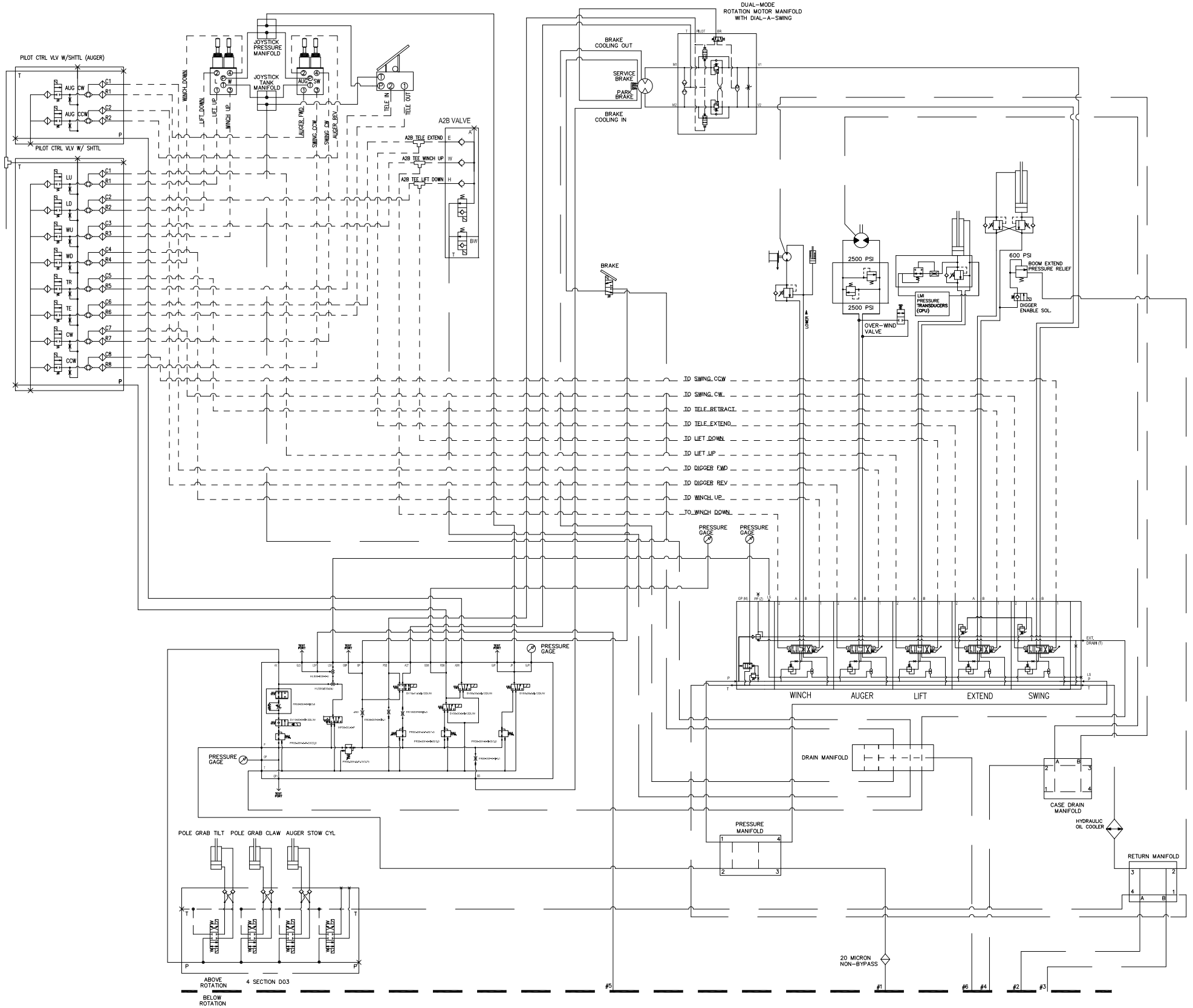
1. PUMP SETTING
   (OUTER ADJUSTMENT) STAND BY PRESSURE __ PSI ± 50 PSI
   (INNER ADJUSTMENT) SYSTEM PRESSURE 4,800 PSI ± 50 PSI

ENG	TCR
DATE	2/26/15
CHECKED	
DATE	
DTR	TJK
DATE	2/26/15

ELLIOTT EQUIPMENT COMPANY

TITLE: PLUMBING DIAGRAM 30T 5-SECT DGGR TRUCK

SIZE	SHEET	DWG#	REV
B	2 OF 4	2080310.dwg	-



NOTES:

1. PUMP SETTING
   (OUTER ADJUSTMENT) STAND BY PRESSURE ___ PSI ± 50 PSI
   (INNER ADJUSTMENT) SYSTEM PRESSURE 4,800 PSI ± 50 PSI

ENG	TCR
DATE	2/26/15
CHECKED	
DATE	
DTR	TJK
DATE	2/26/15

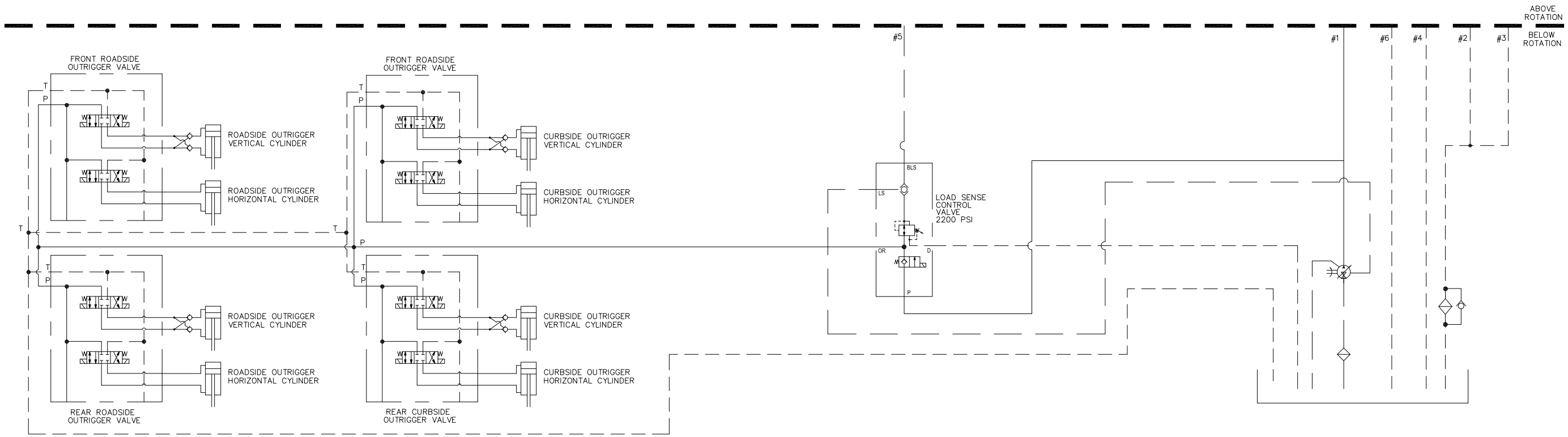
ELLIOTT EQUIPMENT COMPANY

TITLE: HYDRAULIC SCHEMATIC 30T 5-SECT DGGR TRUCK

SIZE	SHEET	DWG#	REV
B	4 0F 4	2080310.dwg	-

NOTES:

1. PUMP SETTING
   (OUTER ADJUSTMENT) STAND BY PRESSURE ___ PSI ± 50 PSI
   (INNER ADJUSTMENT) SYSTEM PRESSURE 4,800 PSI ± 50 PSI



ENG	TCR
DATE	2/26/15
CHECKED	
DATE	
DTR	TJK
DATE	2/26/15

ELLIOTT EQUIPMENT COMPANY

TITLE: HYDRAULIC SCHEMATIC 30T 5-SECT DGGR TRUCK

SIZE	SHEET	DWG#	REV
B	3 0F 4	2080310.dwg	-

REVISIONS				
DRT	REV	DESCRIPTION	DATE	EFFECTIVE

ELLIOTT ELECTRICAL BOX
REAR MOUNTED BOX

OPTIONAL RADIO HARNESS REFERENCE 1748640

OMNEX RADIO R2170

OMNEX RADIO D180

OMNEX RADIO D160

GREER - LMI CPU

OIL COOLER

TEMP THERMASTAT RD/WH WH/RD

BK BL BK 12G BL 12G

RADIO CONFIMATION ALARM WH BK

18/2 CONDUCTOR CORD

RADIO CONFIRM WHT 717

(OIL COOLER HARNESS 1757360)

(CAB CONSOLE HARNESS - OPTIONS 3020532)

(CAB CONSOLE HARNESS 1783190)

SLIP RING

(SLIP RING HARNESS)

201	MASTER POWER (RELAY)	
202A	BATTERY POWER (30 AMP)	
202B	BATTERY POWER (30 AMP)	
207	SPARE	
208	ENGINE SPEED HIGH	
209	ENGINE SPEED LOW	
210	RADIO POWER	
211	START	
212	STOP	
215	OUTRIGGER ENABLE	
222	GROUND (30 AMP)	
223	HORN	
225	LMI ALARM	
226	SPARE	
227	SPARE	
228	SPARE	
229	SPARE	
230	FULL SPAN	
231	MID SPAN	

MASTER RELAY

MASTER SWITCH RELAY

MID SPAN RELAY

FULL SPAN RELAY

OIL COOLER RELAY

RADIO RELAY

FULL-SPAN LIGHT

MID-SPAN LIGHT

NO-SPAN LIGHT

18/5 CABLE

GROUNDED MOUNTING STUD

VARIOUS GRND WIRES W/ RING TERMINAL CONNECTORS

2-SPD SOLENOID

18/2 CONDUCTOR CORD

WINCH INDCTR

E-STOP RELAY

REMOTE E-STOP RELAY

ENABLE RELAY

LMI RELAY

SWING DUAL MODE

SET PRESSURE SWITCH AT 600 PSI

E-STOP SWITCH

SEAT SWITCH

18/5 CONDUCTOR CORD

DIGGER RETRACT PROX

18/2 CONDUCTOR CORD

DIGGER ENABLE

18/2 CONDUCTOR CORD

DIGGER SHIFT

DO3 ENABLE | DIGGER SHIFT | POLE GRAB UP | POLE GRAB DOWN | POLE GRAB OPEN | POLE GRAB CLOSE | DIGGER LATCH OPEN | DIGGER LATCH CLOSE

DIGGER DO3 (HARNESS 1764990)

BOOM LIFT ENGINE SPEED

BOOM WINCH INDICATOR

BOOM EXT OR AUX BOOM WINCH INDICATOR

SEE PAGE 3 FOR INTERNAL BOX WIRING SCHEMATIC

BOOM SWING

CAB

STEREO

ALARM | GLIDE SWING | LOAD SENSE BOOM ENABLE | A/C SOLENOID | A2B SOLENOID | AUX WINCH DISABLE | PILOT ENABLE

BOOM UP | BOOM DOWN | BOOM OUT | BOOM IN | BOOM CCW | BOOM CW | WINCH UP | WINCH DOWN | AUX WNCH UP | AUX WNCH DOWN | DIGGER CW | DIGGER CCW | RADIO PILOT | DUAL MODE

RADIO PULSARS (VALVE HARNESS 2074970)

ABOVE ROTATION

NOTE: -NO SOLENOID HARNESS
-NO AUX WINCH

ENG	JDH
DATE	
CHECKED	
DATE	
DTR	JDH
DATE	11/20/2015

ELLIOTT EQUIPMENT COMPANY

TITLE: ELE SCHM-30T-DR115R SEATD PILOT

SIZE	SHEET	DWG#	REV
D	1 OF 3	2081250.dwg	-

REVISIONS				
DRT	REV	DESCRIPTION	DATE	EFFECTIVE

BELOW ROTATION

TRUCK

(SLIP RING HARNESS)

(OUTRIGGER HARNESS 1724540)

BELOW ROTATION

TRUCK KEY SW.
IGN
MASTER SWITCH
312
ORG/BLK 14 GA
ORG/BLK 16 GA
C/B
10 AMP
PTO ENGAGED LIGHT
308
SEE APPROPRIATE DRAWING FOR HOT SHIFT PTO WIRING.
TO TRUCK CLEARANCE LIGHT CIRCUIT
311
TO TRUCK HORN CIRCUIT
316
30 AMP
OIL COOLER
RED 8 GA
321 (10 GA)
322 (10 GA)
301 (8 GA)
TRUCK BATTERY 12 VOLT
BATTERY STUD ON FIRE WALL
GROUND
305
ENGAGE SWITCH ON PTO CASE

SEE CHASSIS DRAWING
1737500 FOR ENGINE SPEED
1738470 FOR ENGINE START
1735000 FOR ENGINE KILL
1740750 FOR IGNITION CIRCUIT
1740760 FOR PTO HOUR METER

CHASSIS HARNESS REFERENCE 20702230

OPTIONS
421
422
423

MASTER SWITCH RELAY
TRUCK HORN RELAY
10 AMP C/B
YW/BLK
YW 14 GA
RD 10 GA
YW/RD
YW/WH
YW/RD 14 GA
RD 10GA
322 (10 GA)
312
305
BULBK
RS
ORG
GY/BK
GROUNDED MOUNTING STUD
VARIOUS GRND WIRES W/ RING TERMINAL CONNECTORS
BLK/RD

MASTER RELAY POWER
MASTER POWER
MASTER POWER
LOW RO1 STOP
LOW RO1 STOP
HORN
BATTERY POWER
BATTERY POWER
OPTION
OPTION
OPTION
OR POS RS
OR POS CS
OR POS FULL SPAN
OR POS MID SPAN

201 YW
400
RED
WH
YW/BK
223
202A
301 8GA
202B
BLU
ORG
230
GRY/BLU
221
PK
424
222
81X
225

1 UP
2 DOWN
3
4 IN
5 COM
6 CW
OILCOOLER THRM PWR
ENG SPD LOW
ENG SPD HIGH
CAB POWER
START
STOP EMERG
STOP BOOM ENABLE
O/R ENABLE
LMI SIGNAL
RADIO POWER
BURST
E-STOP IN
E-STOP CS
WINCH DOWN
GROUND
HORN
BURST
LMI ALARM
LMI OVERRIDE
OIL COOLER BATT
OIL COOLER PWR
OIL COOLER THRM PWR
OIL COOLER THRMST

207
321
208
209
211
212
BK/WT
401
215
WH
BK
BK
BLK/RD
BK
BK/WH
GRY/WH
WH
BK WH BK

E-STOP RELAY
18/2 CONDUCTOR CORD
18/2 CONDUCTOR CORD
E-STOP SWITCH
E-STOP SWITCH
O/R VALVES
O/R VALVES
O/R ENABLE
O/R VALVES
O/R VALVES
FRONT JACK
400
401
410
420
423
424
421
422

OUTRIGGER CONTROL BOX (ONE MOUNTED ON EACH SIDE OF CHASSIS)
ELLIOTT EQUIPMENT COMPANY
RETRACT
CENTER FRONT STABILIZER
EXTEND
CAUTION
FRONT STABILIZER OPERATION NOT ONCE STABILIZER AFFECTS BEING STORED
OUTRIGGER SELECTION
FRONT
ROADSIDE
CURBSIDE
REAR
EXTEND
RETRACT
FRONT
RETRACT
REAR
ROADSIDE
CURBSIDE
EXTEND
ROADSIDE
CURBSIDE
DO NOT PAINT OVER ANY LABELS
12134 100600

OUTRIGGER HARNESS (1775270)
CS-FR-OUTER
CS-FR-INNER
CS-RR-OUTER
CS-RR-INNER
RS-FR-OUTER
RS-FR-INNER
RS-RR-OUTER
RS-RR-INNER

ELLIOTT ELECTRICAL BOX

A YW/BK
B BK/WT
C BK/RD
MALE 3-PIN
HARNESS 1799200

NOTE: -NO SOLENOID HARNESS
-NO AUX WINCH

ENG JDH	ELLIOTT EQUIPMENT COMPANY
DATE	
CHECKED	
DATE	TITLE: ELE SCHM-30T-DR115R SEATD PILOT
DTR JDH	
DATE 11/20/2015	SIZE D / SHEET 2 OF 3 / DWG# 2081250.dwg / REV -

UPPER CONTROL BOX
INTERNAL SCHEMATIC

REVISIONS				
DRT	REV	DESCRIPTION	DATE	EFFECTIVE

CAV	CRCT	
1	MASTER	RED 8
2	MASTER	YLW
3	CAB PWR	BLK
4	HIGH RNG	
5	START	WHT
6	GND	BLK 14
7	DUAL MODE	GN/YW
8	DO3 ENABLE	GRY
9	STOP	GRN
10	RADIO PWR	BLU
11	GLD SWNG	PK
12	TILT IN	RD/BLK
13	TILT OUT	PK/BLK
14	CLAW OPEN	WHT
15	CLAW CLSE	PK/YW
16	HORN	YW/RD
17	AGGR SHFT	BLU
18	SWG H/L	ORG/GN

CAV	WIRE	
R	SPARE	
S	SPARE	
U	SPARE	
V	SPARE	
T	SPARE	
W	SPARE	
X	PRESS SW PWR	RD/WH 16
Y	PRESS SW SIGNAL	WH 16
Z	PILOT SOL PWR	BLU 16

MASTER SWITCH
ENGINE START/STOP
RADIO RELAY
DUAL MODE RELAY
GLIDE SWING RELAY
REMOTE
GLIDE SWING
GLIDE SWING LIGHT
POLE GRAB TILT
POLE GRAB CLAW
DIGGER LATCH
HORN
DIGGER SHIFT
DC OUTLET
SWING HI
ACTIVATION CONFIRM LIGHT
ACTIVATION SWITCH
ACTIVATION TIME OUT RELAY

ENGINE START/STOP 5 AMP
REMOTE 5 AMP
GLIDE SWING 5 AMP
DC OUTLET 10 AMP
SPARE
SPARE
SPARE
SPARE
SPARE
DIGGER SHIFT
DO3 ENABLE
HORN
POLE GRAB TILT
POLE GRAB CLAW

TIME DELAY RELAY SETTING:
1 – ON
2 – OFF
POT – FULLY TURNED COUNTER CLOCKWISE

ENG	JDH
DATE	
CHECKED	
DATE	
DTR	JDH
DATE	11/20/2015

ELLIOTT EQUIPMENT COMPANY

TITLE: ELE SCHM-30T-DR115R SEATD PILOT

SIZE	SHEET	DWG#	REV
D	3 OF 3	2081250.dwg	-

ELLIOTT EQUIPMENT COMPANY

MODEL D115 DIGGER DERRICK

MAIN BOOM LOAD RATINGS WITH FULLY EXTENDED OUTRIGGERS

MAIN BOOM LOAD RATINGS

LOAD RATINGS IN lbs WITH OUTRIGGERS AND STABILIZERS EXTENDED

LOAD RADIUS IN FEET	LOADED BOOM ANGLE	31-ft	LOADED BOOM ANGLE	A 46-ft	LOADED BOOM ANGLE	B 58-ft	LOADED BOOM ANGLE	C 70-ft	LOADED BOOM ANGLE	D 82-ft	LOADED BOOM ANGLE	E 94-ft	LOADED BOOM ANGLE	F 105-ft
5	80.0	50,000												
6	78.0	40,000												
8	74.2	30,000	79.2	18,500										
10	70.3	23,000	76.6	17,500										
12	66.2	18,000	74.0	16,250	77.4	15,800								
14	62.0	16,000	71.3	15,000	75.4	14,800	78.0	13,550						
16	57.6	14,000	68.6	14,000	73.3	13,900	76.3	12,750	78.3	10,950				
18	52.9	12,000	65.8	13,100	71.1	12,900	74.5	11,900	76.9	10,350	78.6	9,400		
20	47.8	10,000	62.9	11,850	69.0	11,900	72.8	11,100	75.4	9,700	77.3	8,500		
22	42.3	8,200	60.0	10,600	66.8	11,000	71.0	10,300	74.0	9,050	76.1	8,000	78.0	5,250
25	32.2	7,200	55.3	8,750	63.5	9,550	68.4	9,100	71.7	8,100	74.2	7,400	76.1	5,250
30			46.9	8,700	58.1	7,700	64.2	7,200	68.3	7,200	71.2	6,400	73.2	5,250
35			37.8	7,100	51.8	6,200	59.4	5,800	64.4	5,800	67.9	5,550	70.3	5,250
40			24.3	5,000	44.9	6,050	54.4	5,700	60.3	4,800	64.5	4,800	67.4	4,600
45					36.9	5,900	49.0	5,150	56.1	4,650	61.0	4,000	64.3	3,900
50					26.7	4,700	43.1	4,350	51.7	4,300	57.4	3,900	61.2	3,250
55							36.3	3,700	46.9	3,650	53.6	3,600	58.0	3,100
60							28.1	3,200	41.7	3,150	49.6	3,100	54.6	2,600
65							16.1	2,750	35.9	2,700	45.4	2,700	51.1	2,350
70									30.0	2,350	40.7	2,200	47.4	1,850
75									19.9	1,750	35.6	1,500	43.5	1,400
80											29.7	800	39.2	1,000
85													34.5	700
	0	7,000	0	4,900	0	3,250								
DEDUCTIONS FOR STOWED JIB (lbs)		850		600		450		400		350		300		250
		550		350		300		250		200		150		150

DEDUCTIONS FOR STOWED EXTENDABLE JIB (lbs)

DEDUCTIONS FOR STOWED FIXED LENGTH JIB (lbs)

JIB LOAD RATINGS

LOAD RATINGS IN lbs WITH OUTRIGGERS AND STABILIZERS EXTENDED

	26-ft FIXED LENGTH JIB		26-45 ft EXTENDABLE JIB			
LOAD RADIUS IN FEET	LOADED BOOM ANGLE	26-ft JIB	LOADED BOOM ANGLE	26-ft JIB RETRACTED	LOADED BOOM ANGLE	45-ft JIB EXTENDED
30	78.7	3,000	78.5	2,800		
35	76.5	2,700	76.3	2,550	77.4	1,650
40	74.3	2,450	74.1	2,300	75.4	1,550
45	72.0	2,150	71.7	2,000	74.0	1,500
50	69.5	1,900	69.3	1,750	72.2	1,400
55	67.1	1,850	66.8	1,700	70.3	1,300
60	64.6	1,800	64.3	1,650	68.3	1,200
65	62.0	1,600	61.7	1,400	66.2	1,100
70	59.4	1,400	59.1	1,250	64.2	1,000
75	56.7	1,300	56.4	1,050	62.0	900
80	53.9	1,100	53.6	850	59.7	750
85					57.3	700
90					55.1	650

ELLIOTT EQUIPMENT CO. SUPPLIED LOADLINE EQUIPMENT DEDUCTIONS:

DOWNHAUL WEIGHT (WIRE).....200 lbs

DOWNHAUL WEIGHT (SYNTHETIC)...100 lbs

ONE SHEAVE BLOCK.....251 lbs

TWO SHEAVE BLOCK.....291 lbs

THREE SHEAVE BLOCK.....640 lbs

AUXILIARY SHEAVE.....100 lbs

1-PART LINE	2-PART LINE	3-PART LINE	4-PART LINE	5-PART LINE	6-PART LINE
					
MAX PULL: 9,060 lbs	18,120 lbs	27,180 lbs	36,240 lbs	45,300 lbs	50,000 lbs
MAX PULL: 9,000 lbs	18,000 lbs	27,000 lbs	36,000 lbs	45,000 lbs	50,000 lbs

9/16" - SPIN RESISTANT (5:1 S.F.) 45,300 lbs. BREAKING STRENGTH

9/16" - SYNTHETIC (5:1 S.F.) 45,000 lbs. BREAKING STRENGTH

NOTICE

- DO NOT DEADHEAD LINE BLOCK AGAINST BOOM TIP WHEN EXTENDING BOOM.
- KEEP AT LEAST 5 WRAPS OF LOADLINE ON THE WINCH DRUM AT ALL TIMES.
- USE ONLY 9/16" DIAMETER ROPE, AS SPECIFIED BELOW, WITH THE PROPER BREAKING STRENGTHS LISTED.
- ANTI-TWO-BLOCK SYSTEM MUST BE IN GOOD OPERATING CONDITION BEFORE OPERATING CRANE. SEE OPERATION & SAFETY MANUAL.

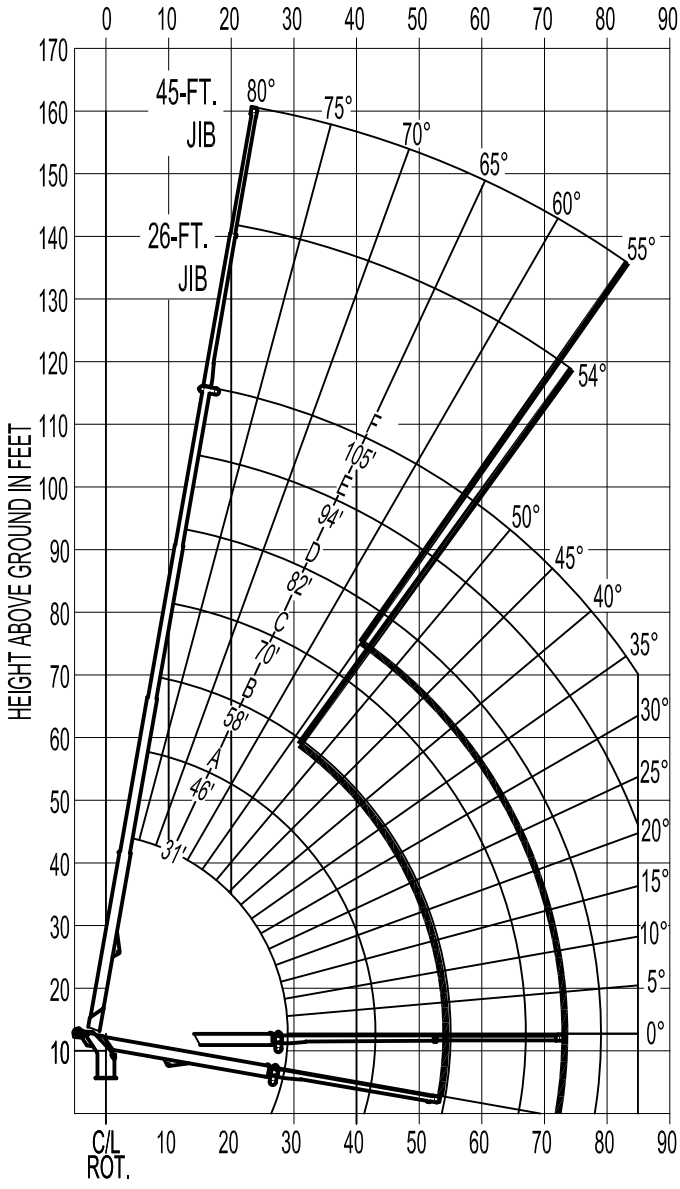
CRANE MEETS ASME B30.5 REQUIREMENTS AT TIME OF MANUFACTURE

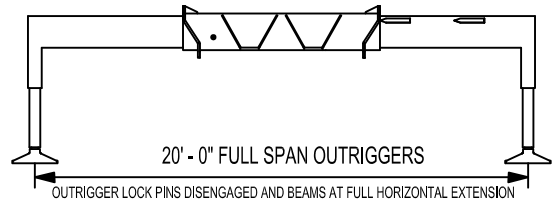
DO NOT PAINT OVER ANY LABELS 121200 111115

ELLIOTT
EQUIPMENT COMPANY

MODEL D115
DIGGER DERRICK

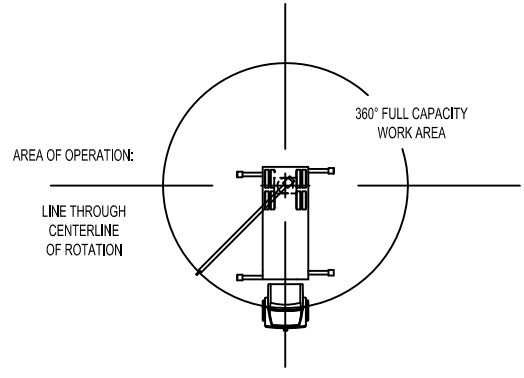
RANGE DIAGRAM WITH FULL SPAN OUTRIGGERS





NOTE:

1. Operate jib by radius when main boom is full extended. Increase boom angle if necessary to maintain load radius.
2. When boom is retracted, operate jib by boom angles. Do not exceed any rated jib capacities at reduced boom lengths.
3. Capacities do not exceed 66.7% stability.
4. Personnel handling is allowed only with full span outriggers.
5. Boom load ratings are based on loaded boom radius. Loaded boom angles are given as reference only.



DO NOT PAINT OVER ANY LABELS 1212000 111115

ELLIOTT EQUIPMENT COMPANY

MODEL D115 DIGGER DERRICK

MAIN BOOM LOAD RATINGS WITH OUTRIGGERS AT MID-SPAN POSITION

MAIN BOOM LOAD RATINGS

LOAD RATINGS IN lbs WITH OUTRIGGERS AND STABILIZERS EXTENDED

LOAD RADIUS IN FEET	LOADED BOOM ANGLE	31-ft	LOADED BOOM ANGLE	A 46-ft	LOADED BOOM ANGLE	B 58-ft	LOADED BOOM ANGLE	C 70-ft	LOADED BOOM ANGLE	D 82-ft	LOADED BOOM ANGLE	E 94-ft	LOADED BOOM ANGLE	F 105-ft
5	80.0	50,000												
6	78.0	40,000												
8	74.2	30,000	79.2	18,500										
10	70.3	23,000	76.6	17,500										
12	66.2	18,000	74.0	16,250	77.4	15,800								
14	62.0	16,000	71.3	15,000	75.4	14,800	78.0	13,550						
16	57.6	14,000	68.6	14,000	73.3	13,900	76.3	12,750	78.3	10,950				
18	52.9	12,000	65.8	13,100	71.1	12,900	74.5	11,900	76.9	10,400	78.6	9,400		
20	48.9	10,000	62.9	11,900	69.0	11,950	72.8	11,100	75.4	9,700	77.3	8,500		
22	42.3	8,150	60.0	9,550	66.8	10,250	71.0	10,300	74.0	9,000	76.1	8,000	78.0	5,250
25	33.8	6,450	55.3	8,200	63.5	7,550	68.7	8,100	72.0	8,100	74.2	7,350	76.1	5,250
30			46.9	5,990	58.1	5,350	64.2	5,500	68.3	5,650	71.2	5,900	73.2	5,250
35			37.8	4,000	51.8	3,550	59.4	3,700	64.4	3,850	67.9	4,100	70.3	4,250
40			24.3	2,800	44.9	2,350	54.4	2,500	60.3	2,650	64.5	2,800	67.4	2,950
45					36.9	1,450	49.0	1,600	56.1	1,750	61.0	1,900	64.3	2,050
50					26.7	700	43.1	900	51.7	1,050	57.4	1,200	61.2	1,350
55									46.9	500	53.6	650	58.0	750
	0	3,850	0	1,250										
DEDUCTIONS FOR STOWED JIB (lbs)		850		600		450		400		350		300		250
		550		350		300		250		200		150		150

DEDUCTIONS FOR STOWED EXTENDABLE JIB (lbs)

DEDUCTIONS FOR STOWED FIXED LENGTH JIB (lbs)

JIB LOAD RATINGS

LOAD RATINGS IN lbs WITH OUTRIGGERS AND STABILIZERS EXTENDED

	26-ft FIXED LENGTH JIB		26-45 ft EXTENDABLE JIB			
LOAD RADIUS IN FEET	LOADED BOOM ANGLE	26-ft JIB	LOADED BOOM ANGLE	26-ft JIB RETRACTED	LOADED BOOM ANGLE	45-ft JIB EXTENDED
30	78.7	3,000	78.5	2,800		
35	76.5	2,700	76.3	2,550	77.4	1,650
40	74.3	2450	74.1	2,300	75.4	1,550
45	72.0	2,150	71.7	2,000	74.0	1,500
50	69.5	1,850	69.3	1,550	72.2	1,400
55	67.1	1,200	66.8	950	70.3	1,300
60					68.3	1,150
65					66.2	750

ELLIOTT EQUIPMENT CO. SUPPLIED LOADLINE EQUIPMENT DEDUCTIONS:

DOWNHAUL WEIGHT (WIRE).....200 lbs

DOWNHAUL WEIGHT (SYNTHETIC)...100 lbs

ONE SHEAVE BLOCK.....251 lbs

TWO SHEAVE BLOCK.....291 lbs

THREE SHEAVE BLOCK.....640 lbs

AUXILIARY SHEAVE.....100 lbs

1-PART LINE	2-PART LINE	3-PART LINE	4-PART LINE	5-PART LINE	6-PART LINE
					
MAX PULL: 9,060 lbs	18,120 lbs	27,180 lbs	36,240 lbs	45,300 lbs	50,000 lbs
MAX PULL: 9,000 lbs	18,000 lbs	27,000 lbs	36,000 lbs	45,000 lbs	50,000 lbs

NOTICE

- DO NOT DEADHEAD LINE BLOCK AGAINST BOOM TIP WHEN EXTENDING BOOM.
- KEEP AT LEAST 5 WRAPS OF LOADLINE ON THE WINCH DRUM AT ALL TIMES.
- USE ONLY 9/16" DIAMETER ROPE, AS SPECIFIED BELOW, WITH THE PROPER BREAKING STRENGTHS LISTED.
- ANTI-TWO-BLOCK SYSTEM MUST BE IN GOOD OPERATING CONDITION BEFORE OPERATING CRANE. SEE OPERATION & SAFETY MANUAL.

9/16" - SPIN RESISTANT (5:1 S.F.) 45,300-lbs. BREAKING STRENGTH

9/16" - SYNTHETIC (5:1 S.F.) 45,000-lbs. BREAKING STRENGTH

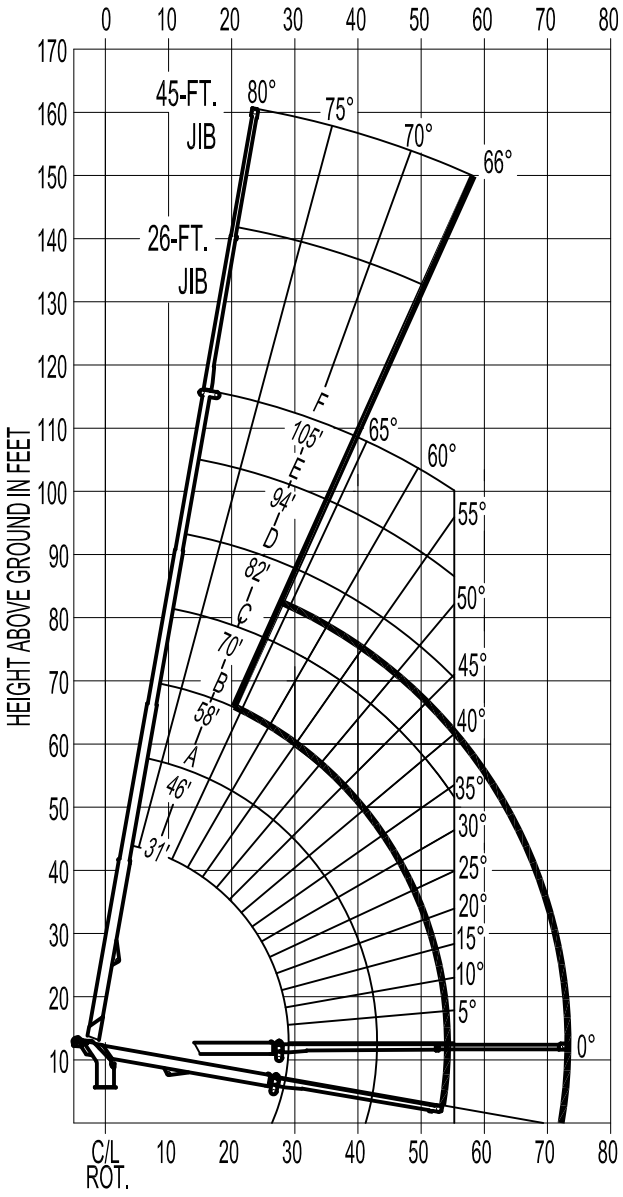
CRANE MEETS ASME B30.5 REQUIREMENTS AT TIME OF MANUFACTURE

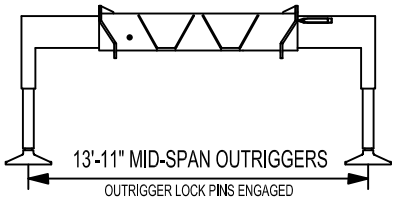
DO NOT PAINT OVER ANY LABELS 1212000 111115

ELLIOTT EQUIPMENT COMPANY

MODEL D115
DIGGER DERRICK

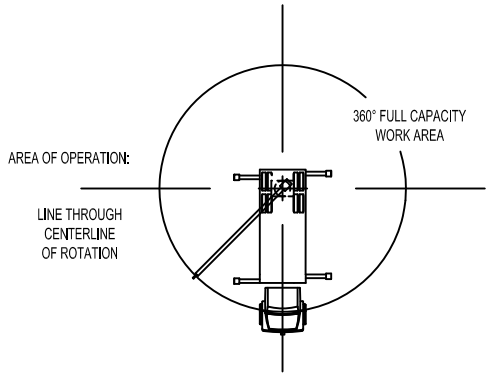
RANGE DIAGRAM WITH OUTRIGGERS AT MID-SPAN POSITION





NOTE:

1. Operate jib by radius when main boom is full extended. Increase boom angle if necessary to maintain load radius.
2. When boom is retracted, operate jib by boom angles. Do not exceed any rated jib capacities at reduced boom lengths.
3. Capacities do not exceed stability based on ANSI / ASSE A10.31.
4. Personnel handling is allowed only with full span outriggers.
5. Boom load ratings are based on loaded boom radius. Loaded boom angles are given as reference only.



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

A. Apply the Parking brake.

B. Lower all loads to ground and disconnect.

C. Stow boom on rest if possible.

D. Move all controls to off position.

E. Disengage PTO and turn engine off.

F. Tag start controls warning personnel that crane is being serviced and must not be started.

G. Do not place hands or tools in openings in boom sections while engine is running or boom sections are moving.

H. Read and thoroughly understand all applicable instructions.

I. Pressurized oil can penetrate human skin causing serious injury. Do not use bare hands to check for hydraulic leaks.

 **WARNING**

Hydraulic oil is flammable. Keep open flames away.

J. Do not alter specified relief settings for hydraulic pressure.

K. Make sure boom, outriggers, etc. are securely blocked of resting on the ground before removing cylinders.

L. Know the weight of heavy objects and do not attempt to lift them.

M. Replace all guards and covers prior to returning the crane to service.

N. Never climb on turret, winch, or top of boom. Use ladder and/or manlift to obtain access to these areas.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0022	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15

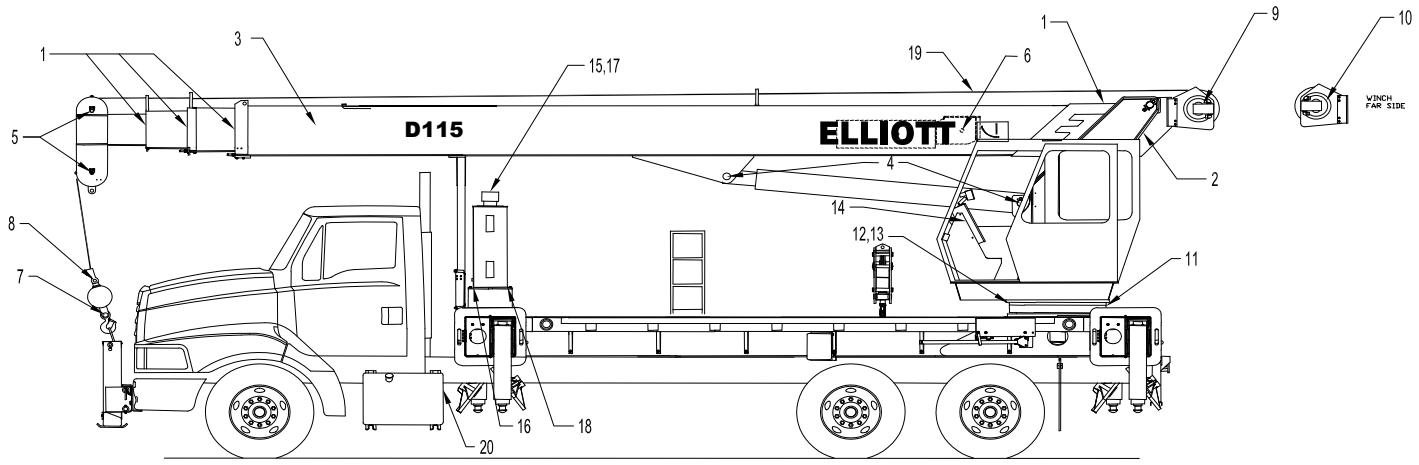
The long life of a crane's hydraulic components is dependent on keeping dirt out of the system. Whenever hydraulic lines are disconnected, clean the adjacent area, as well as the point of disconnection. Immediately cap or plug openings to prevent entry of dirt. Clean all parts and cover to keep clean.

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.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0019	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15

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	Grease	Remove Pump		
Pump Drive Spline Shaft	Coupling Lube	and Apply to		
	Spline Lubricant	Shaft		

Lubrication notes

A. Fully extend boom and apply a light coat of grease to sides and bottom of moving boom sections in area of wear pads.

B. Fully retract boom. Remove cover on top, rear of base boom and coat wear pads with grease. On four-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.

C. 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.

D. 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.

E. See “Tulsa Winch Service Manual” for complete lubrication checking and oil changing directions.

F. 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.

G. Brush or spray grease on each gear tooth. Note: Swing cover must be removed.

H. Apply approx. 3 pumps of grease.

I. See “Tulsa Winch Swing Drive Service Manual” for complete lubrication and oil changing directions.

J. Remove doors to expose linkage and replace after oiling.

K. 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.

L. 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.**

M. 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.

N. Replace at earlier intervals if required. **Do not clean and reuse.**

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0173	1.0	New Document	11/25/15

Bolt Torque

ELLIOTT EQUIPMENT COMPANY

The torque values for fasteners are listed below. Make sure each fastener is the correct size and grade prior to torqueing. 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. Use a calibrated torque wrench and recalibrate on a regular basis.

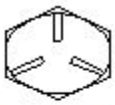
Tightening Torque

Coarse Threaded Fasteners				Fine Threaded Fasteners			
UNC Size	TPI	Grade 5 ft-lb.	Grade 8 ft-lb.	UNF Size	TPI	Grade 5 ft-lb.	Grade 8 ft-lb.
1/4	20	8	12	1/4	28	10	14
5/16	18	17	25	5/16	24	19	25
3/8	16	30	45	3/8	24	35	50
7/16	14	50	70	7/16	20	55	80
1/2	13	75	110	1/2	20	90	120
9/16	12	110	150	9/16	18	120	170
5/8	11	150	220	5/8	18	180	240
3/4	10	260	380	3/4	16	300	420
7/8	9	400	600	7/8	14	440	660
1	8	580	900	1	14	640	1000
1 1/8	7	800	1280	1 1/8	12	880	1440
1 1/4	7	1120	1820	1 1/4	12	1240	2000
1 3/8	6	1460	2380	1 3/8	12	1680	2720
1 1/2	6	1940	3160	1 1/2	12	2200	3560

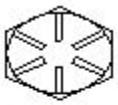
* Tolerance on Torque Values +/- 10%

NOTE: These values are used when torque value is not specified on engineering drawings (and Parts Manual).

See engineering drawings (Parts Manual) for rotation bearing bolt torque values.



GRADE 5 BOLT
OR SCREW



GRADE 8 BOLT
OR SCREW

GRADE 8 NUT

GRADE MARKINGS

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0016	1.0	Template update	11/05/14
Tech Spec.		1.1	Content update	1/12/15
Tech Spec.		1.2	Content update	8/5/15

Changing Hydraulic Oil

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

A. Bring the oil to operating temperature by running the crane functions.

B. With all controls in neutral position, turn the truck engine off.

C. 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.

D. Thoroughly clean dirt from the access cover on the top of the tank and remove the cover.

E. Clean out any sediment inside the tank.

F. Remove the suction strainer. Soak in solvent and blow off with compressed air before reinstalling.

G. Reinstall the cover on the tank top, replace gasket as required.

H. Replace the filter element.

I. Replace the breather.

J. Clean metal particles from the drain plug and reinstall.

K. Fill the hydraulic tank to the proper level with approved, filtered hydraulic oil-use 10 micron filter.

L. Make sure the suction line shut off valve is open before starting the engine; otherwise the pump will produce cavitation and destroy itself.

M. Start the engine, engage the PTO and let the pump run a couple minutes with no load at low RPM.

N. Gradually increase speed and operate all functions. Operation may be sluggish or erratic as air is purged.

O. Once the functions are operating smoothly, stow the boom and outriggers and then stop the engine.

P. Fill the hydraulic tank to the full level on the sight gauge.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0018	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15

Bubble Level Adjustment

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

A. Extend outriggers and stabilizers and level the crane with the bubble level.

B. Raise the fully retracted boom to 80 degrees.

C. Place an accurate carpenter's level on either side of the turret top plate.

D. Adjust the outriggers and stabilizers so the crane is level from front to rear according to the carpenter's level.

E. 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.

F. Repeat this procedure until the crane is level and needs no further adjustment. Note: Tires must be off the ground.

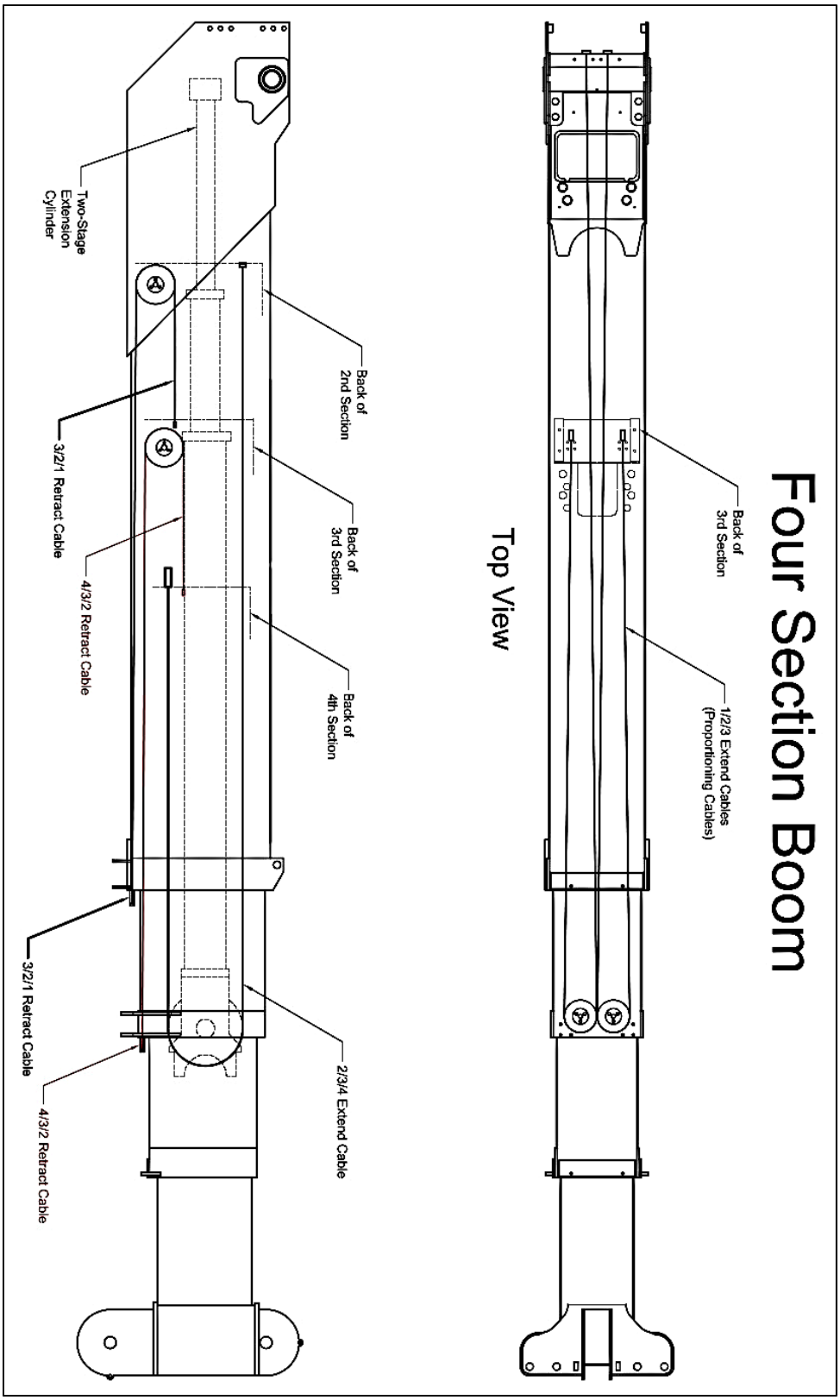
G. Check the bubble level at each console.

H. Shim under the level base with washers at mounting screws as required until the bubble is centered in the circle.

I. Retighten mounting screws.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0017	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15


Four Section Boom
Top View
Back of 3rd Section
1/2/3 Extend Cables (Proportioning Cables)
Two-Stage Extension Cylinder
Back of 2nd Section
3/2/1 Retract Cable
Back of 3rd Section
4/3/2 Retract Cable
Back of 4th Section
3/2/1 Retract Cable
4/3/2 Retract Cable
2/3/4 Extend Cable

3/2/1 Retract Cable (Qty 2): Connects to the front of the 1st (Main) section and passes over sheave at back of 2nd (Next to Large) section and connects to back of 3rd (Next to Tip) section. Primary function of these cables is to retract the 3rd (Next to Tip) section.

4/3/2 Retract Cable (Qty 2): Connects to the front of the 2nd (Next to Large) section and passes over sheave at back of 3rd (Next to Tip) section and connects to back of 4th (Tip) section. Primary function of these cables is to retract the 4th (Tip) section.

2/3/4 Extend Cable (Qty 3): Connects to the back of the 2nd (Next to Large) section and passes over sheave on the extension cylinder and connects to back of 4th (Tip) section. Primary function of these cables is to extend the 4th (Tip) section.

1/2/3 Extend Cable/Proportioning Cable (Qty 2): Connects to the back of the 1st (Main) section and passes over sheave at front (on top) of 2nd (Next to Large) section and connects to Back of 3rd (Next to Tip) section. Primary function of these cables to synchronize the telescope cylinder/boom.

Extension Cylinder - Two Stage (Qty 1): Connects to the back of the 1st (Main) section, Back of the 2nd (Next to Large), and 3rd (Next to Tip) sections. Primary Function of the cylinder is to extend & retract the sections 1, 2 & 3 (Main, Next to Large, & Next to Tip).

Do not, under any 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 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.

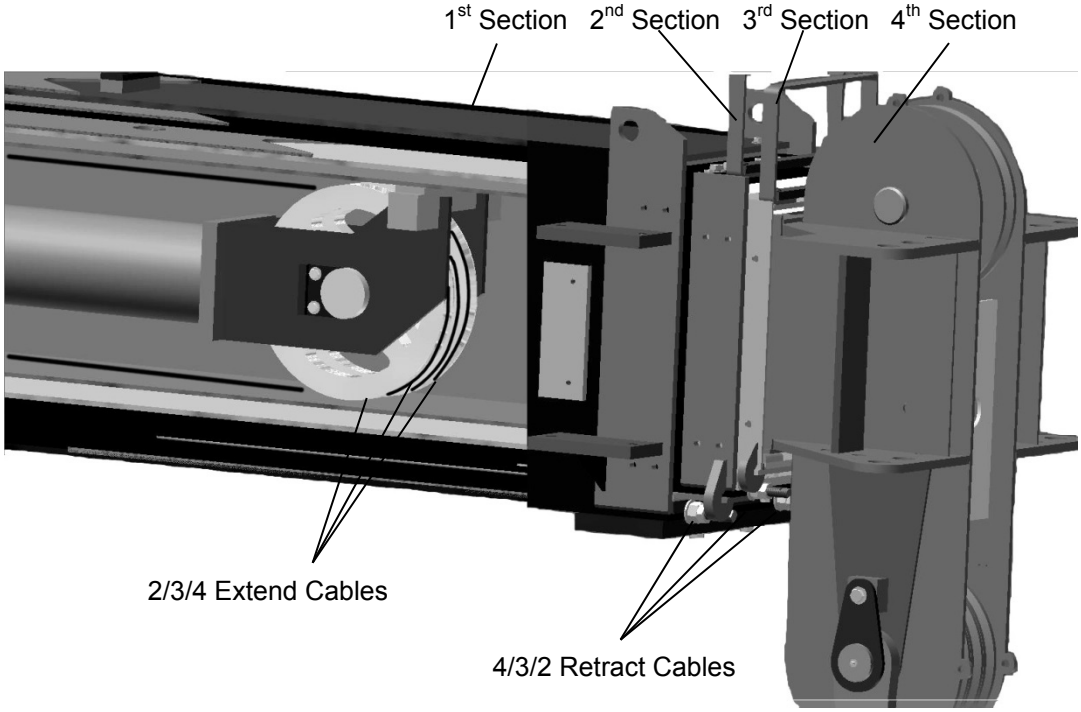
Four Section Cable Tensioning

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 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.

A. 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.

B. It is important to achieve these boom section positions before torqueing. 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.

C. 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 torqueing retainer nuts.



D. Torque the 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.

E. 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 torqueing retainer nuts.

F. 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.

G. Repeat steps 4,5,6 and 7, torqueing 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).

H. 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.

Boom Removal

A. Extend and set machine outriggers. Boom must be completely retracted and stowed in the boom rest.

B. If equipped, remove swing around jib according to procedures outlined in the "Safety & Operation" section.

C. 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.

D. 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.

E. Tag and disconnect extend cylinder lines and winch hydraulic lines. Cap all open lines and ports.

F. 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.

Boom Disassembly

A. 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.

B. 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.

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

D. Extend and set all outriggers and SFO.

E. Fully retract the boom and place in a horizontal position.

F. Winch removal optional.

Boom Disassembly Alternative

A. 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.

B. 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.

C. 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.

D. Loosen and remove two capscrews, lockwashers and spacers which anchor the extend cylinder rod butt plate to the rear of the 1st section.

E. Loosen and remove two capscrews and lockwashers securing spacer bar to the inside top of the front of the 1st section. Remove spacer bar.

F. 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.

G. 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.

H. 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.

I. Place 2nd-3rd-4th assembly on a suitable horizontal surface. Take care not to pinch or crush retract cables while lifting or supporting assembly.

J. 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.

K. 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.

L. Loosen and remove six capscrews securing retract sheave pin and retract sheaves to 2nd section. Remove sheaves and pins.

M. Loosen and remove two capscrews functioning as upper retract cable keepers. Remove retract cables.

N. 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.

O. 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.

P. 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.

Q. 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.

R. 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.

S. Loosen and remove two capscrews, cable guide, wear pad and spacer bar from the front top of the second section.

T. Loosen and remove four capscrews attaching the bottom pad plate to the second section. Slightly lift third section and remove pad plate.

U. 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.

V. Loosen and remove two capscrews, cable guide wear pad and spacer bar from the front top of the third section.

W. Loosen and remove four capscrews attaching the bottom pad plate to the third section. Slightly lift 4th section and remove pad plate.

X. 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.

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

Additional Maintenance, Disassembled Boom

A. 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.

B. Inspect all sheaves for excessive groove wear or abnormal rim wear. Replace as required.

C. 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.

D. 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.

E. Inspect all sheave pins for nicks, gouges or pitting due to rust in the bearing surface area. Replace if any damage is evident.

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

G. Replace all lubricating plugs in all wear pads.

Four Section Boom Assembly

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

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

B. 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.

C. Attach rear wear pads on bottom of 4th section. Using Loctite 242 blue, Loctite all wear pad mounting capscrews.

D. Install 4th boom section into 3rd section. Slide together approximately 5 feet (150cm).

E. Assemble bottom front wear pads for 3rd section. Attach pads to pad plate.

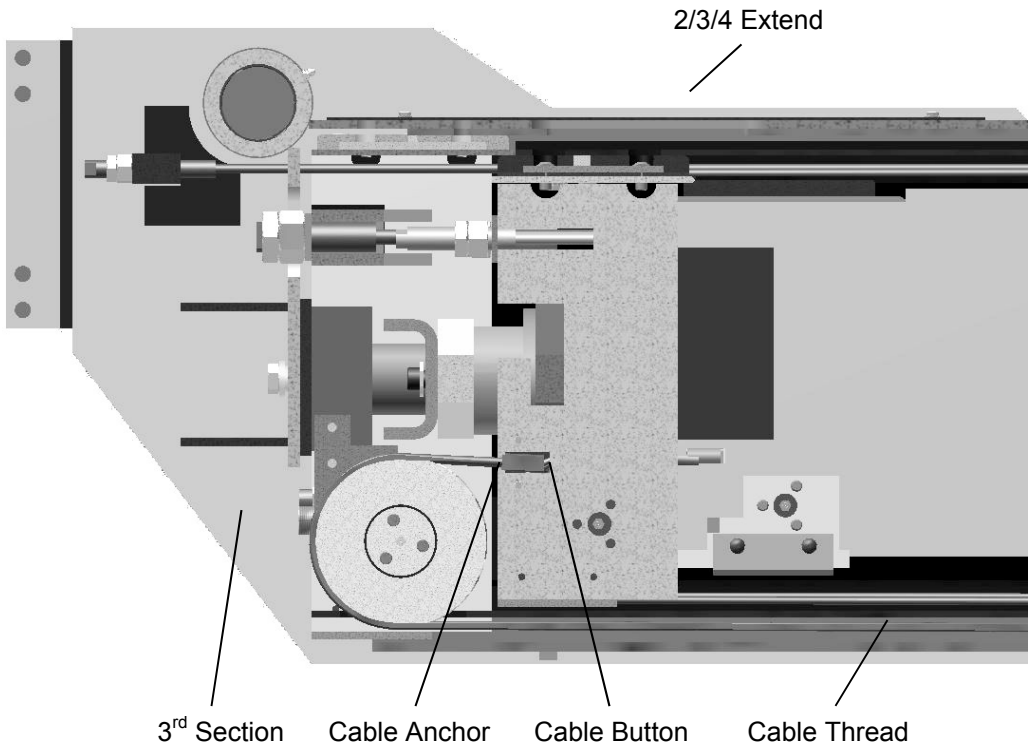
F. Using appropriate lifting device, lift 4th section to allow for wear pad/pad plate installation in front of 3rd. Install wear pad/pad plate assembly. Slide sections together within 12 inches (30cm) of full retraction.

G. Install cable guide and upper spacer to front of 3rd section.

H. 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.

I. 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.

J. 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.



K. 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.

L. 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.

M. 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.

N. 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.

O. 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.

P. 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.

Q. 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.

R. 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.

S. Assemble bottom front wear pads for 2nd section. Attach pads to pad plate.

T. 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.

U. Install cable guide and spacer to top of 2nd section.

V. 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.

W. 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.

X. 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.

Y. 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.

Z. 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.

AA. 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.

BB. 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.

CC. 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.

DD. 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.

EE. 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.

FF. Slide extend cylinder/extend cables into 2nd-3rd-4th boom assembly enough to assemble extend cable anchor into bottom rear of 4th section (See Figure 1 on next page). Be aware of extend cable location when inserting cylinder into boom sections, inadvertent crushing or other damage to cables will warrant replacement.

GG. Tighten capscrews clamping extend cable anchor together. This will also lock anchor in place in the anchor cutouts in the 4th section.

HH. 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.

II. 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.

JJ. 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.

KK. Install lock bar and capscrews to the extend cylinder collar in the 3rd section.

LL. 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.

MM. 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.

NN. 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.

OO. Assemble bottom front wear pads for 1st section.

PP. 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.

QQ. Install upper spacer to front of 1st section.

RR. 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.

SS. 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).

TT. 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 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.

UU. Install thick winch attachment bar into the mount. This bar anchors the extend cable.

VV. Install the threaded ends of the small extend cables through hole in center of the winch mount attachment assembly.

WW. Slightly tighten all cables. Cycle boom slowly to assure proper operation before torqueing 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.

XX. Install winch and anti-two block system

Top Wear Pad Adjustment

A. 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

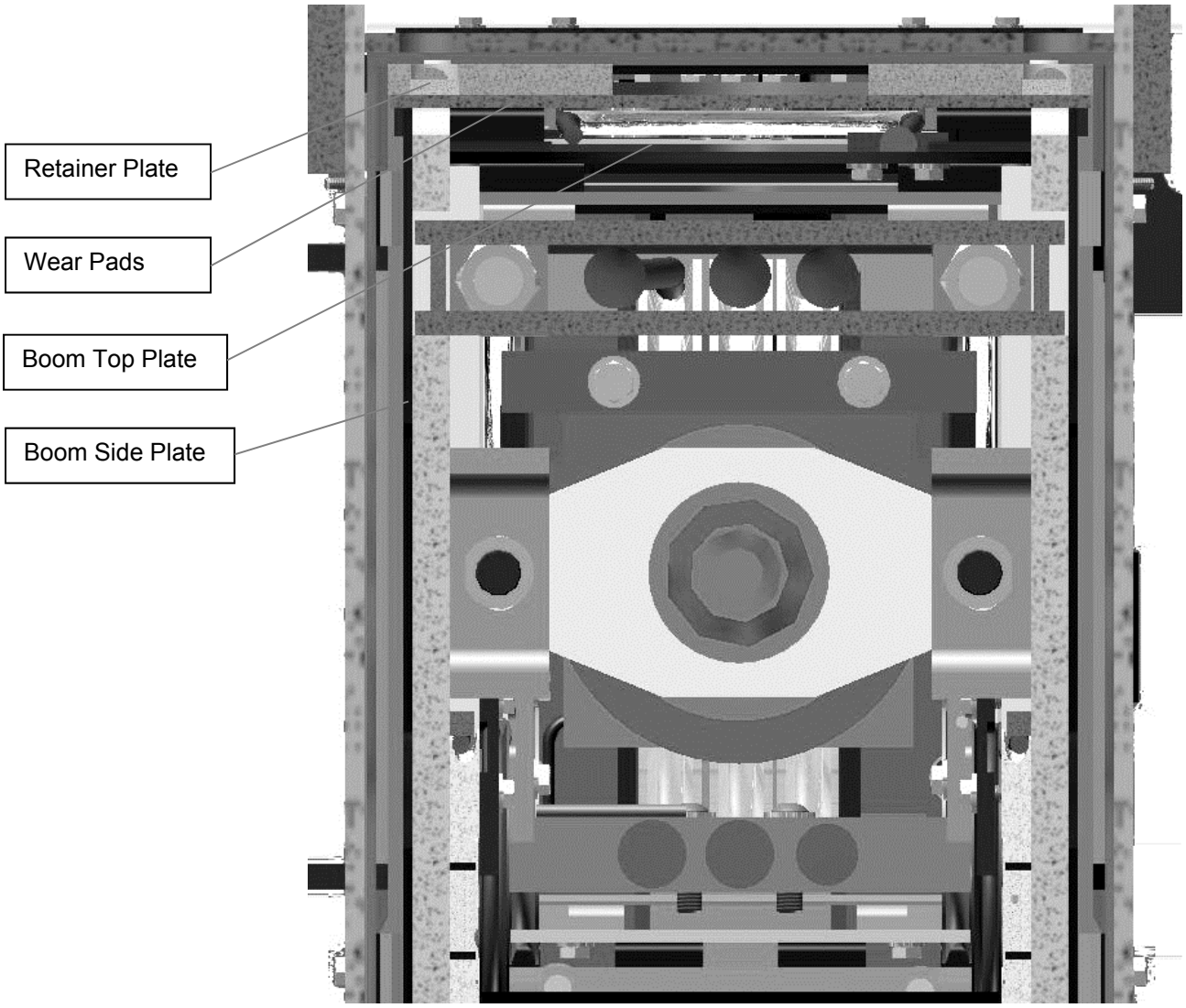
position of the section can be used. It is often difficult to pry the very most inner sections over.

B. 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.

C. 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.

D. 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.

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.



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

Properly aligned wear pad: The retainer plate holes align with the threaded holes in the smaller boom section; the wear pad is tight against the side plate of the larger boom section; with properly aligned/adjusted wear pads, install the capscrews and torque to 75 lb. feet (100N.m)

Improperly aligned wear pad: A gap exists between wear pad and side plate on larger boom section; capscrews cannot be installed.

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.

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.

- Retract boom completely.
- Remove capscrews through access holes on top rear of sections.
- Remove wear pads, shims and cam plates from the rear of the boom through open winch mount end.
- Note all pad locations and tags accordingly.
- Inspect pads for wear using previously mentioned inspection criteria.
- Install new pads through winch mount end of boom. See top pad adjustment procedure for proper pad and section position.
- 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.

Front Bottom Pad Replacement

- Extend boom approximately 4 feet (120cm) out.
- Remove cable guides and upper spacer bars from front of boom sections.
- Loosen and remove hex nuts on retract cables on the front of the 1st and 2nd sections.

- 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.
- 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.
- Inspect pads for wear using previously mentioned inspection criteria.
- Install new pads on plates or boom sections. Reassemble plates in boom in proper locations.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0021	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/26/15
Tech Spec.		1.2	Illustration update	3/25/15
Tech Spec.		1.3	Illustration/info update	4/8/15

BOOM EXTENDS DURING TRANSPORTATION

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

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.

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.

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.

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.

BOOM CHATTERS WHEN EXTENDING OR RETRACTING

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

BOOM DOES NOT SEQUENCE PROPERLY

Adjust the Extend/Retract boom cables per the manual.

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

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.

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.

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

SWING BRAKE DOES NOT HOLD

Brake return springs probably broken or brake discs worn or damaged. Disassemble the brake and replace faulty parts.

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

- Check 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

OUTRIGGER/STABILIZER CREEPS IN UNDER LOAD

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

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

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**

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

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

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

Revision History

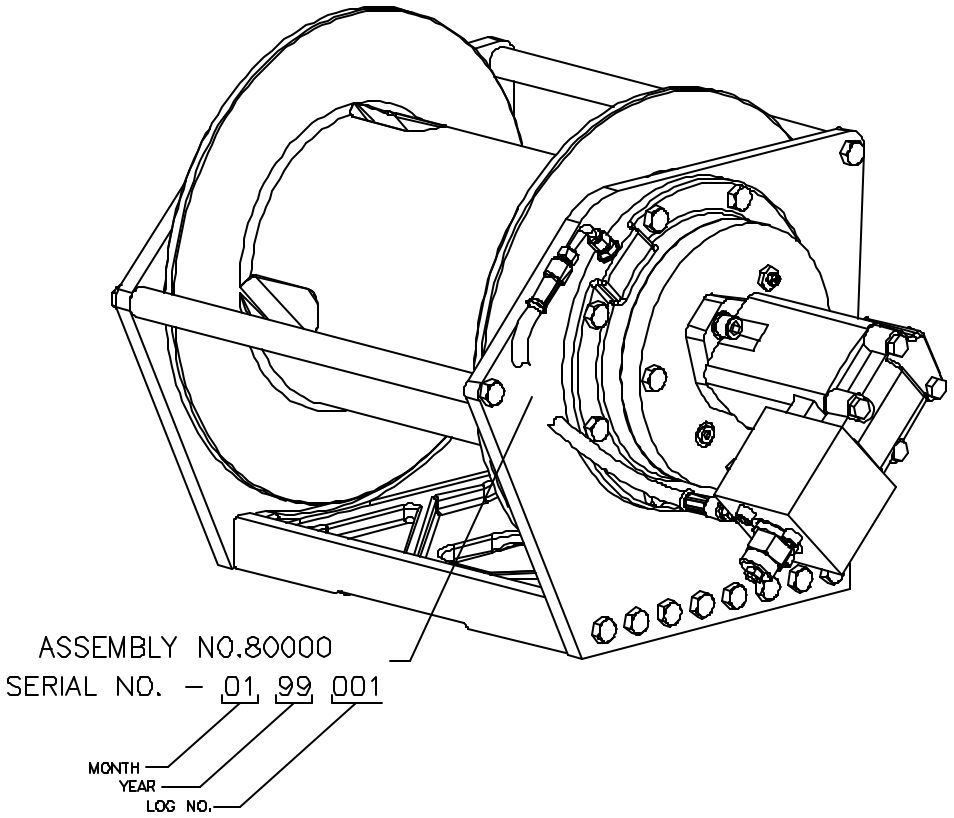
Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0023	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15

Service Manual
Model 1200W Winch

Table of Contents

PART & SERIAL NUMBER LOCATION

Part and serial numbers can be located on the winches as shown below:



Safety Notes

WARNING

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

Tulsa winches are not to be used to lift, hoist, or move people. If your task involves lifting or moving people, you MUST use the proper equipment, not this winch.

Cable anchors on Tulsa winches are not designed to hold the rated load of the winch. You must keep at least five (5) wraps of cable on the drum to insure that the cable doesn't come loose.

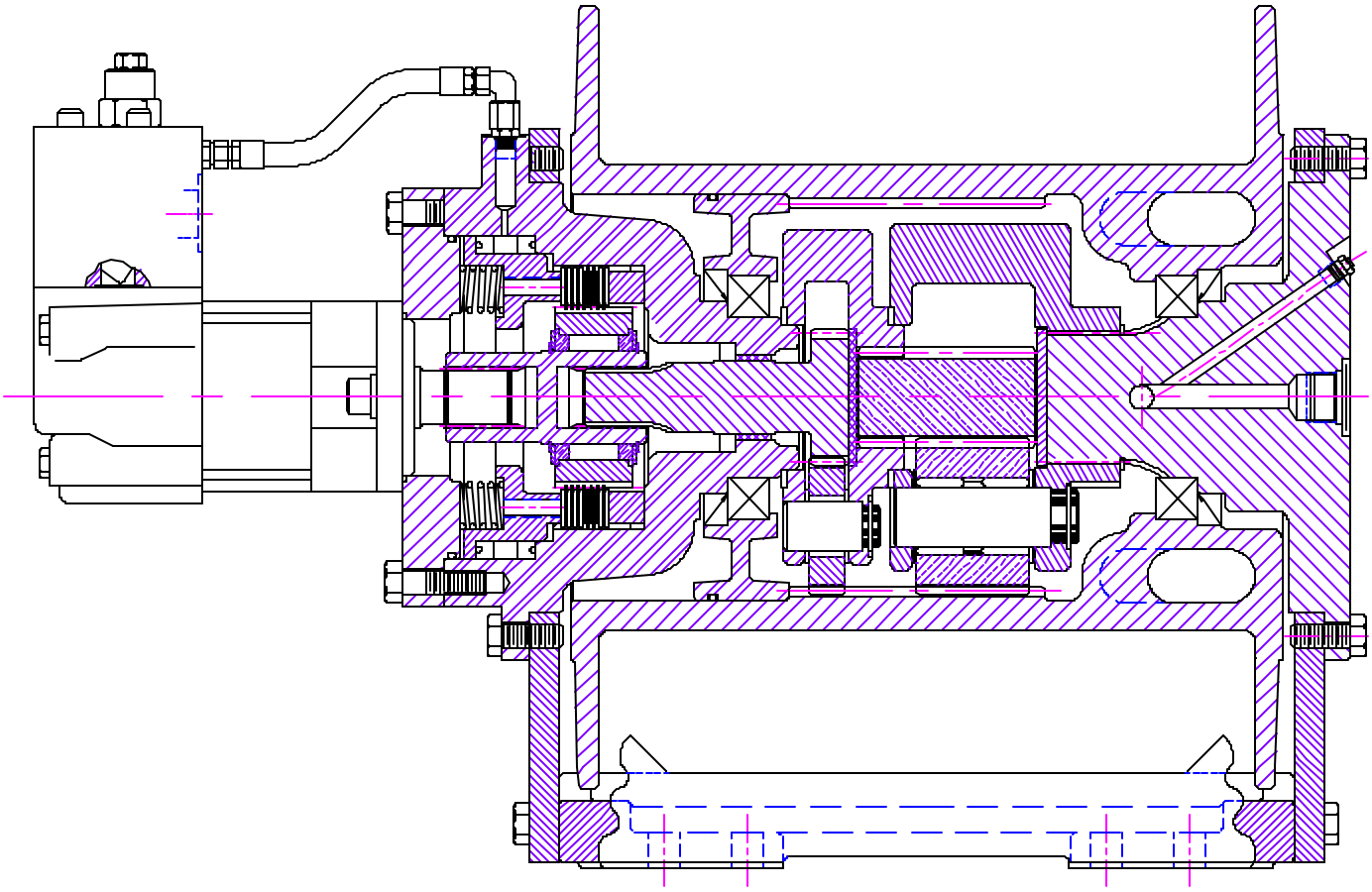
Stay clear of suspended loads and of cable under tension. A broken cable or dropped load can cause serious injury or death.

Make sure that all equipment, including the winch and cable, is maintained properly.

Avoid shock loads. This type of load imposes a strain on the winch many times the actual weight of the load and can cause failure of the cable or of the winch.

Winch operators must be trained in the proper, safe operation of the winch.

INTRODUCTION AND THEORY OF OPERATION

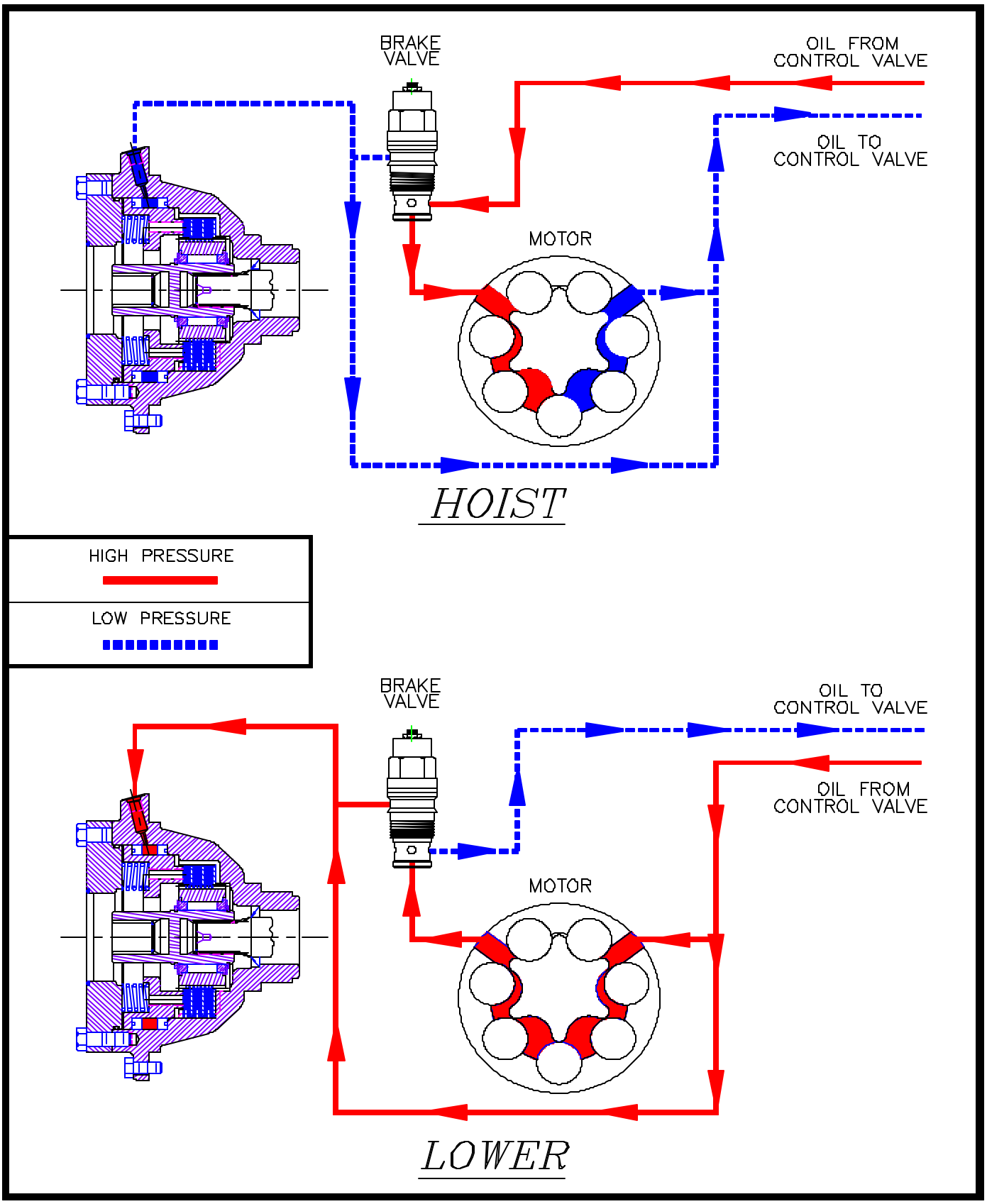


The 1200W planetary winch design is composed of an input either from a high torque; low speed geroler motor or a high-speed gear or piston motor, driving through a multiple disc brake, through a pair of planetary gear sets to the cable drum.

The multiple disc 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 load is prevented from moving by the brake.

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 oil through the motor. The brake valve is modulated by sensing pressure on the other main line, the line from the directional control valve to the motor. Also, any time there is sufficient pressure to modulate the brake valve, this same pressure releases the multiple disc brake.

HYDRAULIC SCHEMATIC



MAINTENANCE

Tulsa Model 1200W planetary winches, like any other pieces of machinery, need to be periodically serviced and well maintained to insure their proper operation.

Good maintenance consists of three steps:

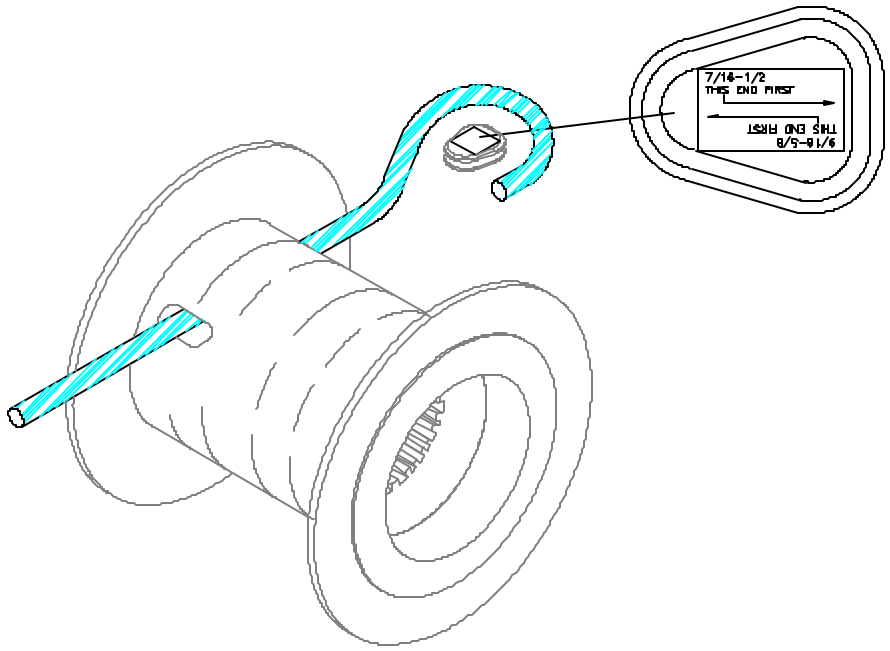
1. A daily inspection to insure that there is no oil leaks present, that all mounting bolts and other fasteners are tight, and that wire rope is in good condition.

2. Periodic servicing of the winch including changing the oil in both the gearbox and the brake section. Severity of use will determine the need for oil changes but it should be checked at a minimum of every 500 operating hours and changed every 1000 operating hours. Factors such as extremely dirty conditions or widely varying temperature changes may dictate even more frequent servicing.

3. Complete teardowns and component inspections. Again, severity and frequency of use will determine how often this should be done. If the crane or other equipment, which this winch is mounted on, is subject to standards for this type of inspection, then those standards must be followed. If oil changes reveal significant metallic particles, then a teardown and inspection must be made to determine the source of wear.

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



LUBRICATION

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

Tulsa Model 1200W Winches are shipped from the factory with SAE 90 EP gear lube in the gearbox and SAE 20-20W motor oil in the brake section. This oil should be satisfactory for operation in ambient temperatures from -10º F. to +110º F. If your work calls for operation in temperatures outside this range, contact Tulsa Winch for recommendations.

Gearbox oil is drained by first removing the level plug (*Item 28*) in the center of the output shaft (*Item 29*). The drain plug (*Item 30*) is then removed by rotating the drum so that the plug is visible through the lower hole in the shaft (*Item 29*). Screw in a piece of 1" black pipe to allow the oil to drain, then with a 3/8" hex wrench remove the drain plug located inside of 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 1" pipe. Rotate drum so that the plug (*Item 30*) is visible through upper hole in side plate. Install 1" pipe and elbow through upper hole in side plate *(See Fig. 3)*. Fill the gearbox with 1 1/2 to 2 quarts of new SAE 90 EP gear lube. Remove the 1" pipe and elbow. Replace the center plug (*Item 28*) and plug (*Item 30*). Make sure the poppet breather (*Item 27*) is not frozen and replace if necessary.

Drain the brake section by removing the drain plug (*Item 40*) under the motor and the breather (*Item 42*) above the motor *(See Fig. 4)*. On some units, the drain and fill plugs may be located on the edge of the motor cover. Inspect the oil for signs of metallic particles and/or burning and re-install the drain plug. Fill with 1/2 to 1 pint of SAE 20-20W motor oil.

⚠ WARNING

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

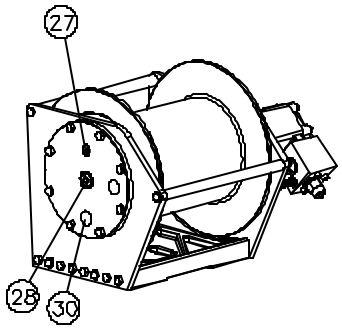


Fig. 1

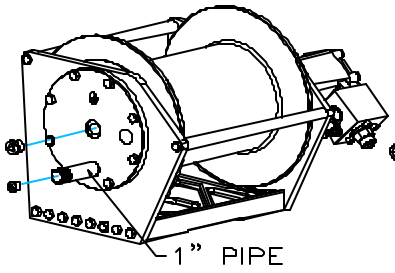


Fig. 2

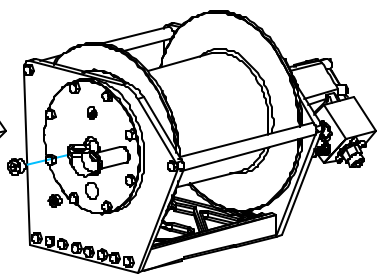


Fig. 3

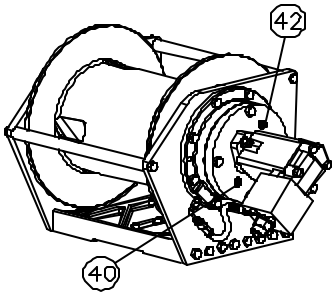


Fig. 4

DISASSEMBLY

1. Stand the winch on its end with the motor pointing up.

2. Remove the brake hose from the brake housing (*Item 18*). Remove the motor and brake valve assembly from the winch by removing the capscrews holding the motor to brake cover. *See Servicing the Motor section for motor and counterbalance valve dis-assembly.*

3. Remove the brake sub-assembly from the winch by removing the eight capscrews (Item 9) holding the brake housing to the side plate (*Item 26*). Re-install two of these capscrews into the two extra tapped holes and tighten them evenly until the brake housing has come loose from the side plate. *See Servicing the Brake section for brake repair*.

4. Using two crows foot pry bars, hook the bearing carrier (*Item 23*) from inside and pull it out of the cable drum. If necessary remove and replace the bearing (*Item 25*) and seal (*Item 22*) located in the bearing carrier.

5. Remove the input sun gear (*Item 8*) from the input planet assembly (*Item 32*).

6. Install three 1/4" eyebolts into the three planet pins in the input planet set (Item 32) and with a piece of chain, pull the planet set from the drum. Inspect the planet set for wear and repair as needed. *See Servicing the Planetary Set section for dis-assembly and repair.*

7. Remove the output sun gear (Item 14).

8. Check the drum teeth for wear. This wear can be measured as follows: place a magnetic base dial indicator on the output carrier and adjust the plunger of the dial indicator at the approximate middle of one of the planet gear teeth. Using a screwdriver or your finger, rotate the planet gear back and forth, reading the movement on the dial indicator. If the total movement is greater than 0.025", then the drum should be replaced.

9. Using the same procedure as in Step 6, remove the output planet set (*Item 4*) from the drum. Inspect the planet set for wear and repair as needed. *See Servicing the Planetary Set section for dis-assembly and repair.*

10. Carefully turn the winch over onto the motor side.

11. Remove shaft (*Item 29*) from side plate (*Item 26*) by removing eight capscrews (*Item 9*) holding shaft (*Item 29*) to side plate (*Item 26*). Inspect retaining ring (*Item 3*) to insure it is still in groove and is not bent over, replace if necessary.

12. Remove the drum (*Item 5*).

13. Inspect bearing (*Item 25*) for signs of spalling or pitting and if necessary replace the bearing (*Item 25*) and seal (*Item 22*) located in the drum.

REASSEMBLY

1. Thoroughly clean all parts. Replace those, which show wear or damage.

2. Inspect the drum (*Item 5*) and base (*Item 7*) for structural integrity and replace if necessary.

3. Set the drum so that it is centered on the hole in side plate (*Item 26*).

4. Install the shaft (*Item 29*) through sideplate *(Item 26)* into the drum (*Item 5*) making sure the vent is oriented properly. Then attach shaft (*Item 29*) to the side plate using eight capscrews *(Item 9)*. Torque the capscrews to 100 to 110 ft. lb.

5. Carefully turn the assembly over onto the output shaft side and install the output planet carrier (*Item 4*) using the same eyebolts and chain used to disassemble the unit.

6. Put a light coating of grease on the thrust washer (*Item 6*) to keep it in place. Install thrust washer into the output planet set, then insert the output sun gear (*Item 14*) into the output planet set.

7. Install the input planet set (*Item 32*) into the drum, making sure that it fits over the output sun gear (*Item 14*).

8. Install the input sun gear (*Item 8*) and thrust washer (*Item 6*) into the input planet set. Again, coat the thrust washer with a light coat of grease.

9. Install a new o-ring (*Item 24*) and if necessary bearing (*Item 25*) & seal (*Item 22*) into the bearing carrier (*Item 23*). Grease the o-ring and seal on the bearing carrier and install the bearing carrier into the drum. It must be installed with the o-ring nearest the motor end.

10. Place the brake sub-assembly into the side plate (*Item 26*), making sure that the pilot of the brake section aligns with the bore in the bearing carrier and that the bolts for the motor are lined up properly. Install 8 capscrews (*Item 9*), Tighten capscrews evenly to 100 to 110 ft. lb. torque. Also make sure that the drain and vent plugs in the cover are properly oriented.

11. Install a new o-ring on the face of the motor and re-install the motor/counterbalance valve assembly then re-connect the hose.

12. Fill both the gearbox and the brake section with the proper amount and type of lubricants as discussed in the Lubrication section.

SERVICING THE MOTOR

1. Tag hoses for proper re-installation and remove them from the motor and counterbalance block.

2. Remove the counterbalance block from the winch motor.

3. Remove the counterbalance valve from the counterbalance block and inspect the small metering hole located on the side of the cartridge valve to make sure it is not obstructed (See F*ig. 5*). Also, inspect the O-rings to insure that they are not cut or flattened. Replace if necessary.

4. Units with geroler type motors have only one external line. Pilot pressure to operate the brake valve is obtained from inside the counterbalance block.

5. On units with gear motors, remove the large fitting *(Item 38-12)* with the pilot line in it and inspect the check valve (*Item 38-11*) to make sure it is seating properly (See *Fig. 8*). The check valve should be installed so that the arrow on the side is pointed in toward the center of the valve, not out toward the large fitting.

6. Motors and counterbalance valves are not serviceable in the field. Return them to an authorized dealer for service.

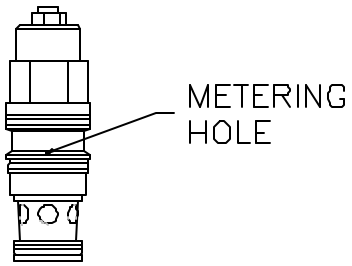


Fig. 5

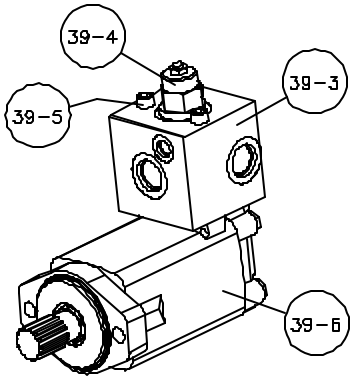


Fig. 6

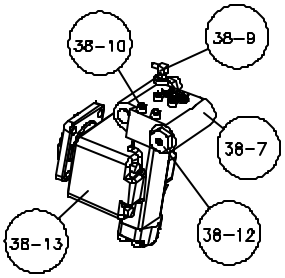


Fig. 7

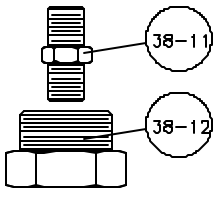


Fig. 8

SERVICING THE BRAKE

1. Evenly remove the four capscrews (*Item 41*) holding the brake cover in place. Spring pressure will raise the cover up as the capscrews are loosened. Remove the cover from the brake housing.

2. Remove the springs (*Item 21*) from the piston and check them for 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 air to slowly pressurize the brake cavity and blow the piston out of the bore.

4. Grasp the brake driver/clutch assembly (*Item 3*4) and remove it from the brake housing.

5. Remove the stator plates (*Item 1*7) and friction discs (*Item 16*) from the brake housing and check them for excessive wear. Replace if necessary. Be sure to 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 in. thickness and stator plates should measure no less than 0.068 in. thickness.

6. With a hook wire or pry bar, remove the seal (*Item 33*).

7. Examine the bushing (*Item 35*) in the brake housing for wear and, if worn, replace it.

8. If brake housing (Item 18) is removed from winch, examine the journal on the brake housing where the seal (*Item 22*) runs for wear. If severely worn, replace the brake housing.

9. Carefully dis-assemble the brake driver/clutch assembly noting the direction of lockup for the clutch (Item 31). The clutch assembly must be re-assembled with the arrow pointing in the proper direction for the winch to function properly. Inspect the surface on the brake driver (*Item 11*) where the clutch (*Item 31*) runs. If there is any pitting or spalling on the driver, then 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 33*) into the brake housing, If brake housing is removed from the winch, temporarily install the input sun gear into brake housing, and slide the driver/clutch assembly onto the sun gear spline.

12. Install the stator plates (*Item 17*) and friction discs (*Item 16*) 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 on (*Fig. 9*). 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. Inspect each new seal (Item 19) to make sure it has an o-ring in the groove of the seal. Install one seal into the bore of the brake housing with the open side toward the brake pack. Place the other seal onto the piston with the open side toward the flange of the piston *(See Fig. 9).*

15. Carefully install the piston into the brake housing and gently tap it down until it is seated.

16. Install the springs (*Item 21*) 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 43*) with light oil and install it into the groove on the brake cover (*Item 20*).

18. Install the brake cover onto the brake housing (*Item 18*) and draw it down evenly, alternating between opposite capscrews. Make sure that the cover is aligned properly with the brake housing to orient the motor and oil fill/level ports, as they should be.

19. Check the brake release with a portable hydraulic pump. Full release should be obtained at 320-340 psi, plus or minus 20 psi. Also, check the brake for proper operation by applying 280 psi to the brake port and adapting a torque wrench to the input shaft. The torque here in the payout direction should be 95 to 115 in. lb.

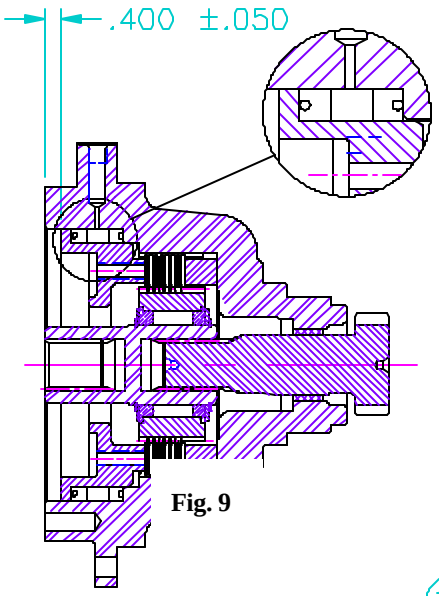


Fig. 9

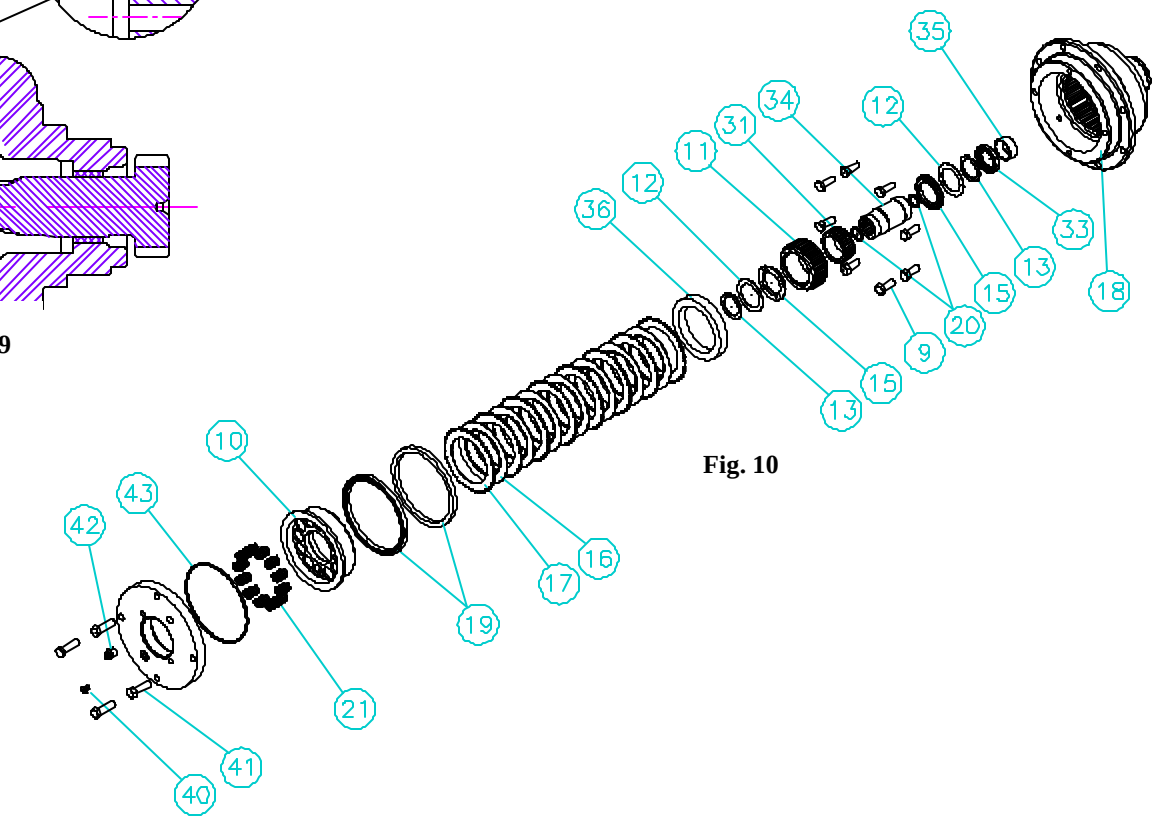
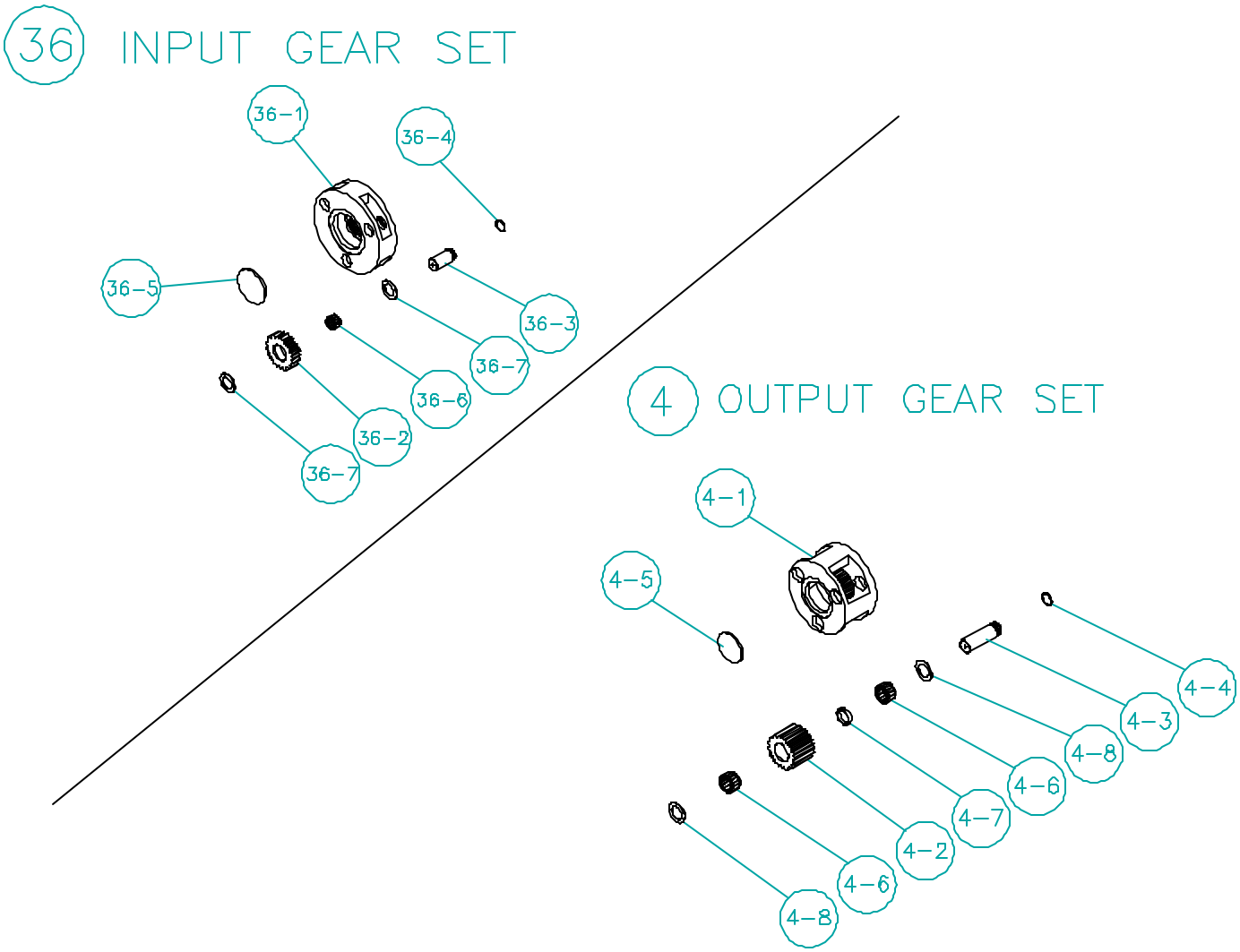


Fig. 10

SERVICING THE PLANETARY SET

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



TROUBLESHOOTING

Problem: Winch won't hold load

Solution 1: Excessive back pressure in the system. Check the system for restrictions and reduce the backpressure.

Solution 2: Brake discs are worn out. Replace brake discs.

Solution 3: Winch clutch is slipping. Inspect the clutch and driver for wear and replace worn parts.

Problem: The winch will not raise the load it should.

Solution 1: Relief valve setting may be too low to allow proper lifting. Increase relief valve pressure setting.

Solution 2: Load being lifted may be more than the winch's rating. Reduce the load or re-rig to increase mechanical advantage.

Problem: The winch will not lower the load.

Solution 1: The brake valve was improperly hooked up after being disconnected. Check plumbing and connect lines properly.

Solution 2: The cartridge in the brake valve may have a plugged metering hole. Remove the cartridge and clean it if necessary.

Problem: Oil leaks from the vent on the motor side of the winch.

Solution 1: The motor shaft seal may have failed. Replace this seal and reduce backpressure if that caused the shaft seal to fail.

Solution 2: Brake piston seals may have failed. Service the brake section and replace worn parts.

BILL OF MATERIALS

ITEM NO.	TWI PART NO.	QTY.	DESCRIPTION
1	29792	20	CAPSCREW
2	42134	2	SUPPORT ROD
3	29973	1	RETAINING RING
4	4142	1	OUTPUT GEAR SET
4-1	41755	1	OUTPUT CARRIER
4-2	41728	3	OUTPUT PLANET GEAR
4-3	41747	3	PLANET PIN
4-4	41716	3	RETAINING RING
4-5	41769	1	PLATE
4-6	41717	6	BEARING
4-7	41739	3	SPACER
4-8	939249	6	RACE
5	41731	1	DRUM (9 3/4" barrel, 16 3/8" flange)
	41996	1	DRUM (10 5/8" barrel, 20" flange)
	42128	1	DRUM (9 3/4" barrel, 15" flange)
	42413	1	DRUM (10 5/8" barrel, 16 3/8" flange)
	42471	1	DRUM (10 5/8" barrel, 18" flange)
	42510	1	DRUM (9 3/4" barrel, 13 3/4" flange)
	43171	1	DRUM (10 5/8" barrel, 14" flange)
6	41722	2	RACE
7	42393	1	BASE
8	41734	1	INPUT SUN GEAR (41 & 59:1 Ratios)
	41735	1	INPUT SUN GEAR (29:1 Ratios)
	41736	1	INPUT SUN GEAR (21:1 Ratios)
9	20524	16	CAPSCREW
10	41738	1	BRAKE PISTON
11	41740	1	BRAKE DRIVER
12	41723	2	RACE
13	26980	2	RETAINING RING
14	41742	1	OUTPUT SUN GEAR (21, 29 & 41:1 Ratios)
	41741	1	OUTPUT SUN GEAR (59:1 Ratios)
15	41743	2	BUSHING
16	32765	7	FRICTION DISC
17	26854	8	STATOR PLATE
18	41749	1	BRAKE HOUSING
19	41721	2	OIL SEAL
20	29043	2	RETAINING RING
21	41718	12	BRAKE SPRING
22	41720	2	OIL SEAL
23	41752	1	BEARING CARRIER
24	939452	1	O-RING
25	34550	2	BALL BEARING
26	CONTACT FACTORY	2	SIDE PLATE

27	13050	1	BREATHER
28	41879	1	O-RING PLUG
29	41758	1	SHAFT
30	41719	1	O-RING PLUG
31	41759	1	CLUTCH
32	4137	1	INPUT GEAR SET (29:1 RATIO)
	4138	1	INPUT GEAR SET (21:1 RATIO)
	4139	1	INPUT GEAR SET (41:1 RATIO)
	4140	1	INPUT GEAR SET (59:1 RATIO)
32-1	41765	1	INPUT PLANET CARRIER (59:1 RATIO)
	41766	1	INPUT PLANET CARRIER (41:1 RATIO)
	41767	1	INPUT PLANET CARRIER (29:1 RATIO)
	41768	1	INPUT PLANET CARRIER (21:1 RATIO)
32-2	41761	3	INPUT PLANET GEAR (21:1 RATIO)
	41762	3	INPUT PLANET GEAR (29:1 RATIO)
	41763	3	INPUT PLANET GEAR (41:1 RATIO)
	41765	3	INPUT PLANET GEAR (59:1 RATIO)
32-3	41760	3	PLANET PIN
32-4	41715	3	RETAINING RING
32-5	41769	1	PLATE
32-6	30484	3	BEARING
32-7	28771	6	RACE
33	41805	1	OIL SEAL
34	CONTACT FACTORY	1	BRAKE DRIVER
35	32445	1	BUSHING
36	41806	1	SPACER
37	41756	1	THIMBLE
38	GEAR MOTOR ASS'Y (SEE MOTOR BILL OF MATERIALS)		
39	GEROLER MOTOR ASS'Y (SEE MOTOR BILL OF MATERIALS)		
40	41307	1	PLUG
41	10381	4	CAPSCREW
42	4101	1	BREATHER KIT
43	33094	1	O-RING

MOTOR BILL OF MATERIALS

(Motor components may vary based upon OEM application. Consult factory if different from below).

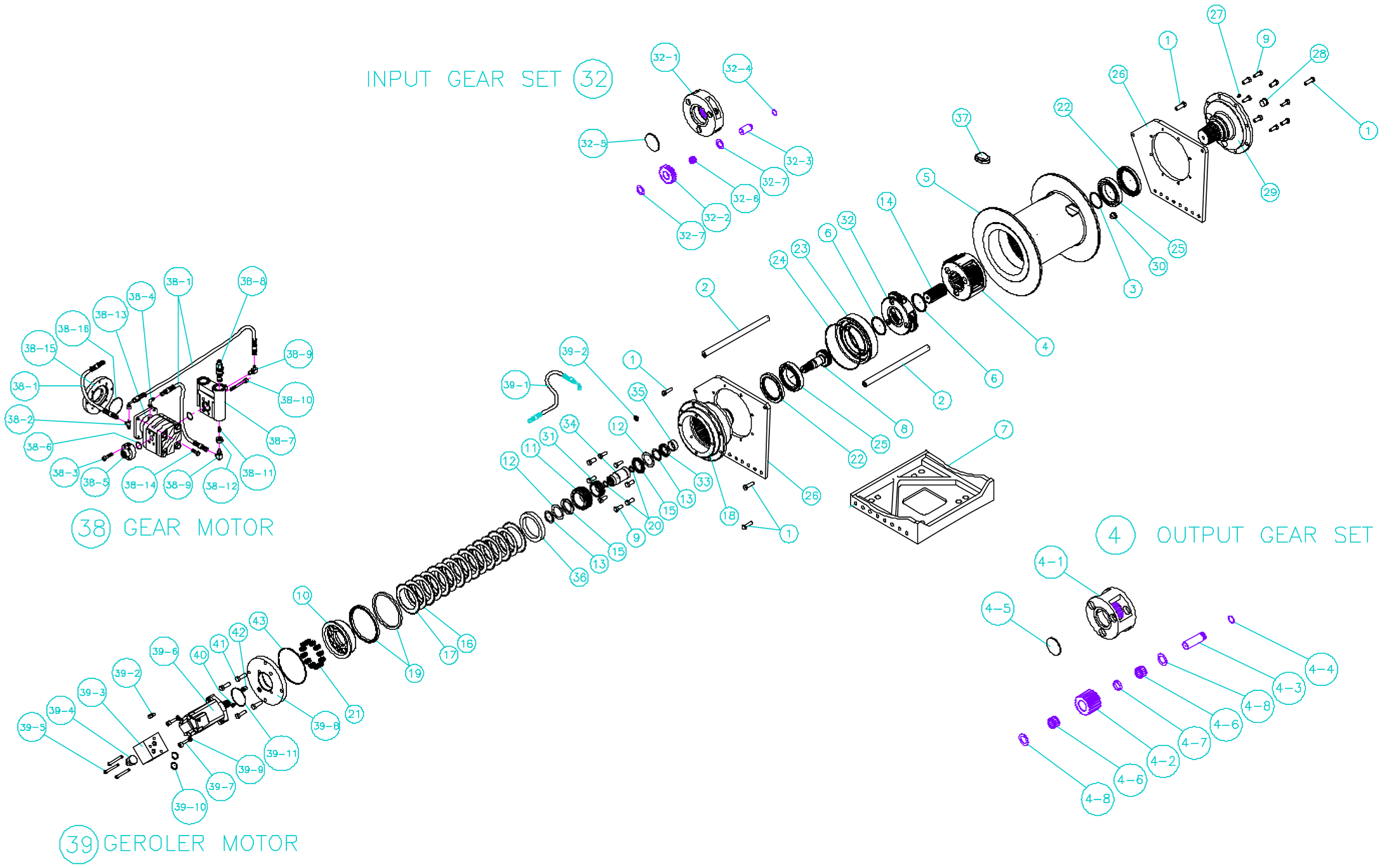
GEAR MOTOR

ITEM NO.	TWI PART NO.	QTY.	DESCRIPTION
38-1	42030	3	HOSE
38-2	42209	1	TEE
38-3	29421	4	CAPSCREW
38-4	42259	1	ELBOW
38-5	42211	1	FLANGE
38-6	32182	2	O-RING
38-7	42029	1	COUNTERBALANCE BLOCK
38-8	41867	1	COUNTERBALANCE VALVE
38-9	42089	2	ELBOW
38-10	42263	4	CAPSCREW
38-11	42223	1	CHECK VALVE
38-12	42225	1	ADAPTER PLUG
38-13	42021	1	MOTOR (4 Bolt “B”, 4.46 cu. In.)
	42022	1	MOTOR (4 Bolt “B”, 6.38 cu. In.)
	42023	1	MOTOR (4 Bolt “B”, 5.10 cu. In.)
	42131	1	MOTOR (4 Bolt “C”, 4.46 cu. In.)
38-14	20524	4	CAPSCREW
38-15	CONTACT FACTORY	1	BRAKE COVER
38-16	CONTACT FACTORY	1	O-RING

GEROLER MOTOR

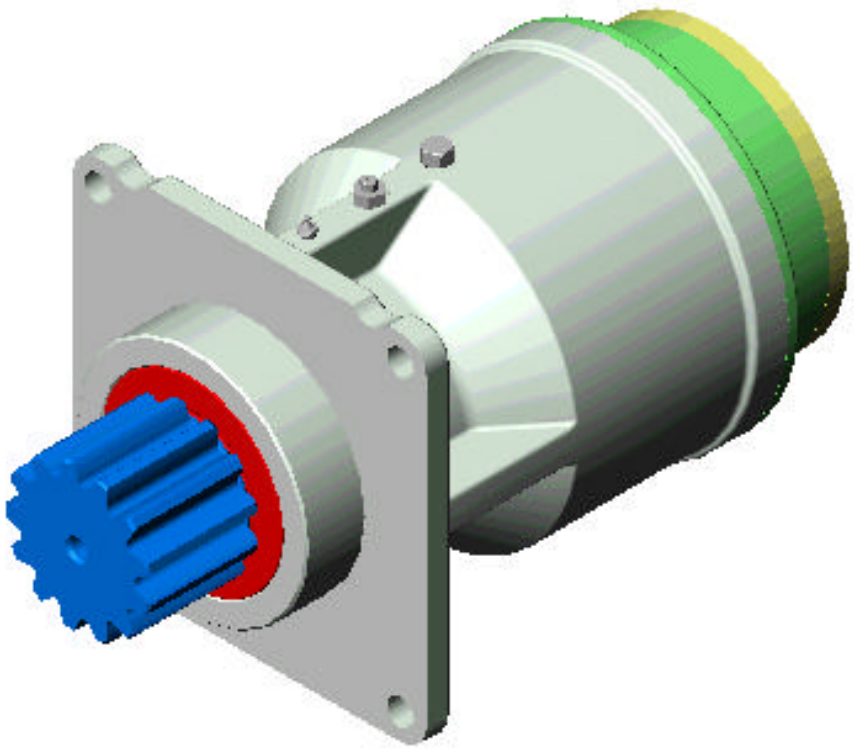
ITEM NO.	TWI PART NO.	QTY.	DESCRIPTION
39-1	42123	1	HOSE
39-2	41838	2	STRAIGHT ADAPTER
39-3	40434	1	COUNTERBALANCE BLOCK, (RO & LU)
	40637	1	COUNTERBALANCE BLOCK, (RU & LO)
39-4	43482	1	COUNTERBALANCE VALVE
39-5	40557	3	CAPSCREW
39-6	41868	1	MOTOR
39-7	13529	2	CAPSCREW
39-8	CONTACT FACTORY	1	BRAKE COVER
39-9	41000	2	WASHER
39-10	42475	2	O-RING
39-11	CONTACT FACTORY	1	O-RING

EXPLODED ISOMETRIC ASSEMBLY DRAWING



Tulsa Winch

5200 SERIES
6000 SERIES
SWING DRIVE
SERVICE MANUAL



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**).

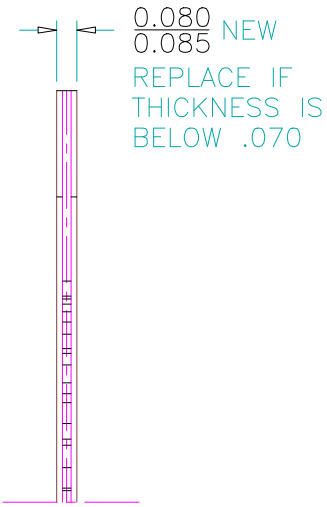
14. Remove the output sun gear (**11**), from the output planet carrier **(10.)**. Lift the output planet set out of the housing **(7)**.

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**).

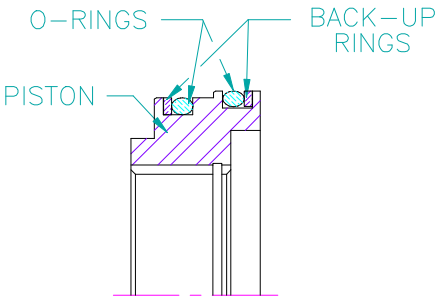
17. Remove the pinion shaft (**1**) from the housing (**7**) inspect the pinion shaft, seal, and bearing for wear and replace if necessary. Remove the inboard bearing (**9**) and inspect for wear.

18. Remove outboard seal (**2**) and bearing (**3**) Inspect for wear and replace if necessary.



FRICTION DISK
(WITHOUT WEAR)

(FIG 1)



O-RING INSTALLATION

(FIG 2)

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.

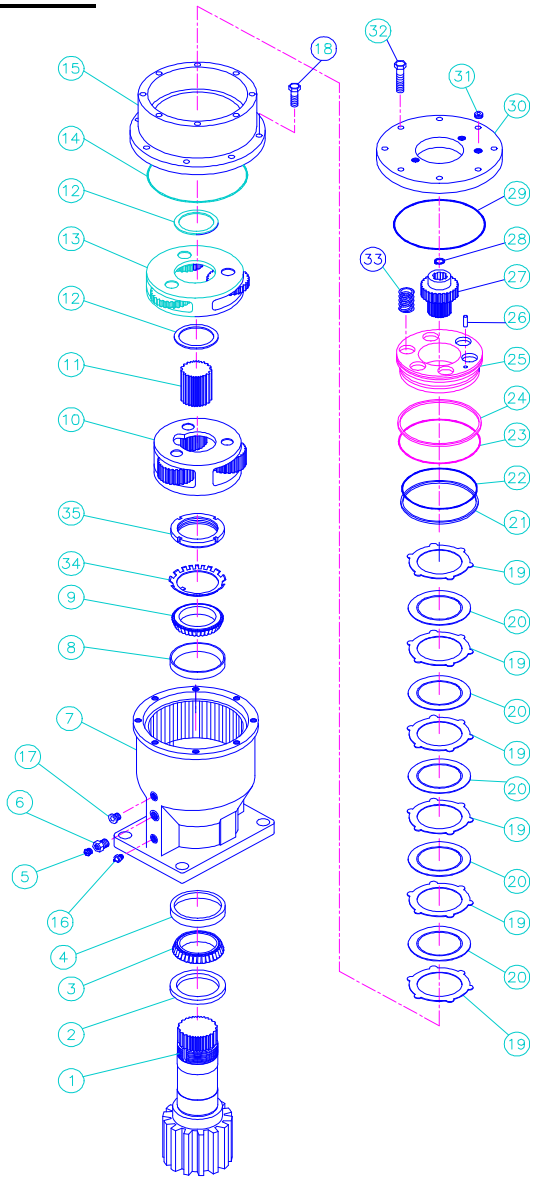
17. Mount the motor to the adapter (**30**).

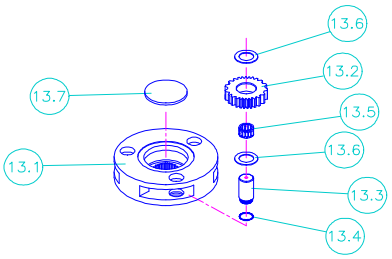
18. Fill the gearbox to desired level with EP-90 gear lube.

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	42697	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

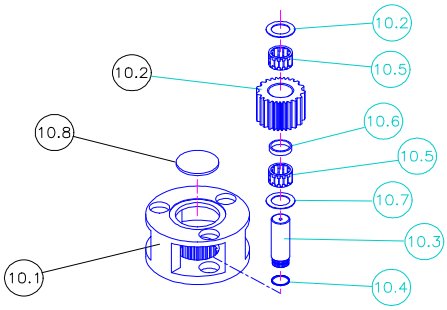
PART NO. TAKEN FROM 81631





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



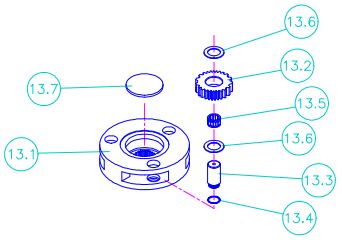
GEAR SET (ITEM 10 ABOVE)

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, STATOR
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	29043	RING, RETAINING
27	1	42327	DRIVER, BRAKE
28	1	41994	RING, RETAINING
29	1	33094	O-RING
30	1	42712	COVER, BRAKE
31	2	939487	PLUG, O-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 81459

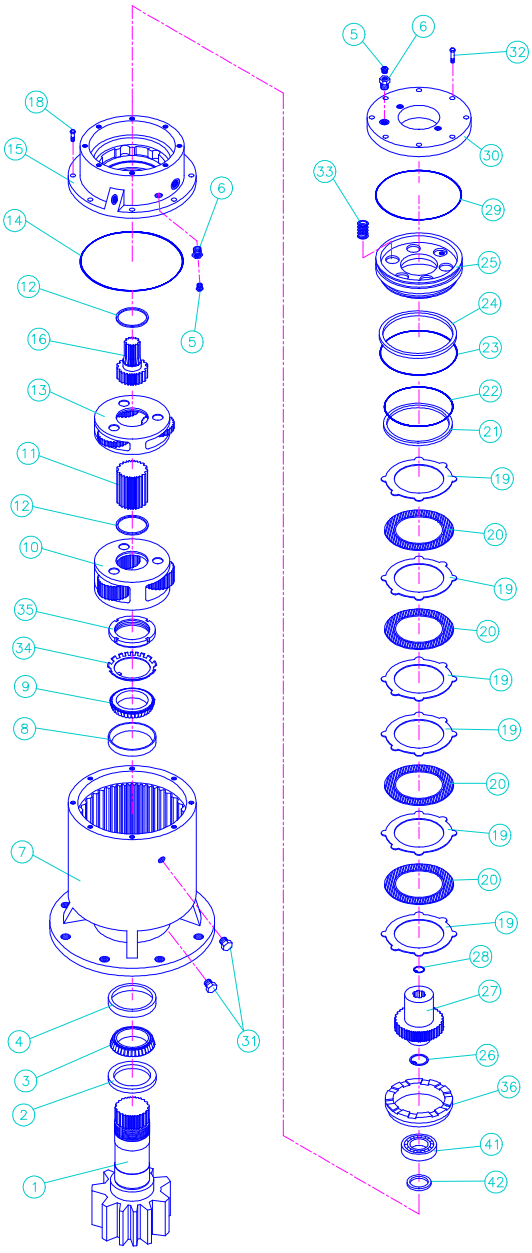


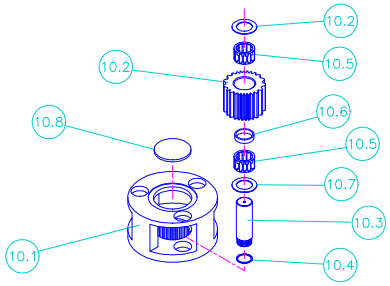
GEAR SET (ITEM 13 ABOVE)

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





Elliott Operating Manual

GREER COMPANY®

Introduction

The GREER INSIGHT System is designed for use as an aid to crane operation. Do not use this system without a properly trained operator who is knowledgeable in safety guidelines, crane capacity information, and the crane manufacturer's specifications. This manual describes the operation of the GREER INSIGHT, hereinafter referred to as the system. Please read, understand, and follow the contents and instructions contained

Table of Contents

Outline of Operation

The system is intended to aid the crane operator by monitoring the load and warning of an overload or two-block condition. Crane functions are monitored by a variety of sensors.

The system compares the load suspended below the boom head to the crane capacity chart stored within the computer's memory.

At approach to overload, the system sends audible and visual warning signals. The system can be configured to cause function kick-out by sending a signal to function disconnect solenoids.

System Components

- Display Unit
- Computer Unit
- Pressure Sensors
- Swing Sensor
- Reeling Drum Assembly, with Extension and Angle Sensors
- Anti-Two-Block Switches
- Cables
- Audible Alarm
- Installation/Operator Manuals

Display Unit

The display unit provides the operator with:

- Rated Capacity
- Actual Load
- Bar graph representation of Actual Load vs. Rated Capacity
- Radius of the Load
- Boom Angle
- Main Boom Length
- Working Area
- Crane Configuration

BOOM ANGLE SENSOR

The boom angle is measured by a potentiometer/pendulum assembly. It provides a voltage proportional to boom angle. This sensor is mounted inside the cable reeling drum assembly.

EXTENSION SENSOR

The extension sensor provides a voltage proportional to the extension of the boom. The extension sensor is mounted inside the cable reeling drum assembly.

PRESSURE SENSORS

There are two pressure sensors which measure pressure in the boom hoist cylinder. One sensor to measure the rod-side pressure and one sensor to measure the piston-side pressure.

ANTI-TWO-BLOCK (ATB)

The ATB switch monitors the approach of the hookblock or overhaul ball to the boom head. The switch is held in the normal position until the hookblock or overhaul ball raises a weight that is mounted around the hoist rope. When the weight is raised it opens the switch. The resultant switch open signal is sent to the computer via the reeling drum. This results in the ATB alarm operating and a function kick-out to occur.

FUNCTION KICK-OUT

Electrically-operated hydraulic solenoids disconnect the control lever functions for boom hoist lower, telescope out, and winch up when an overload or ATB alarm condition occurs.

OPERATOR PROGRAMMABLE ALARMS

These alarms, when properly set by the operator, define the working range. The operator can set the minimum angle, maximum angle, maximum height, and maximum length.

These alarms are programmable for each job site and allow the operator to work in a defined area.

WORK AREA ALARM

This alarm permits the operator to define the operating zone by only two set points. The use of this method results clearly defines the operating zone.

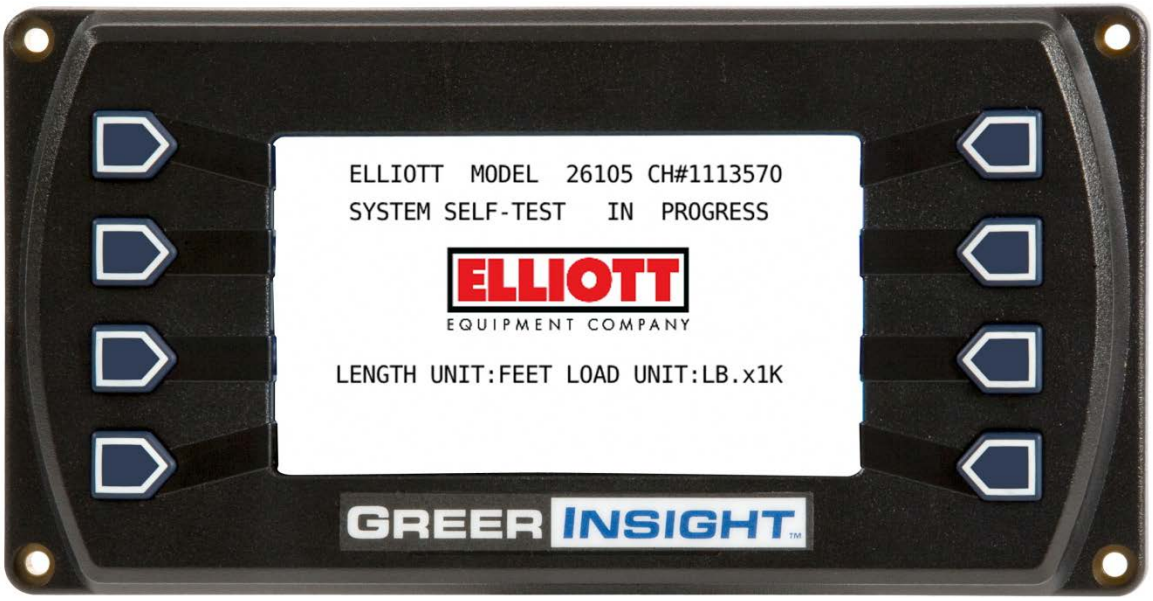
OUTRIGGER POSITION SENSING

This alarm alerts the operator, audibly and visually, when the selected outrigger position does not match the detected outrigger position.

SWING SENSOR

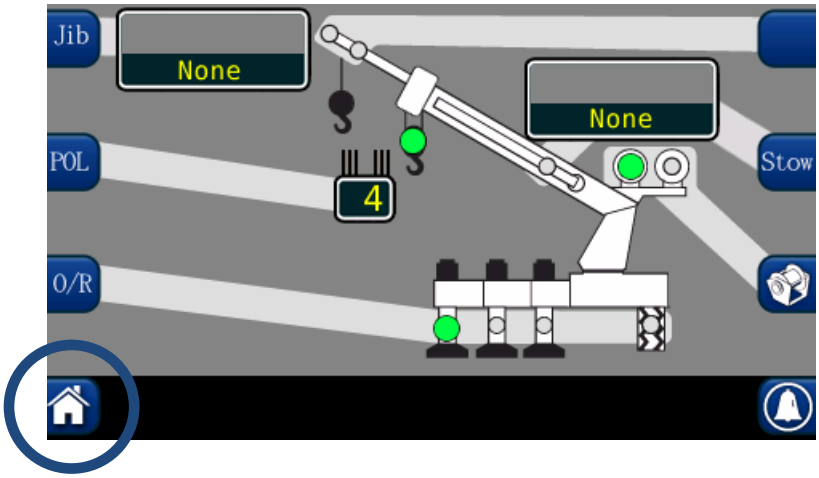
This measures the angle of the boom relative to the chassis.

Power Up Self-Test



Immediately following electrical power up, the system performs a system self-test which lasts for approximately 10 seconds. During this time the display shows the rating chart number, units in use, and load.

After the startup screen, the Crane Configuration page will display. This will allow the operator to check the current setup of the machine. Press the circled button to return to the home screen.

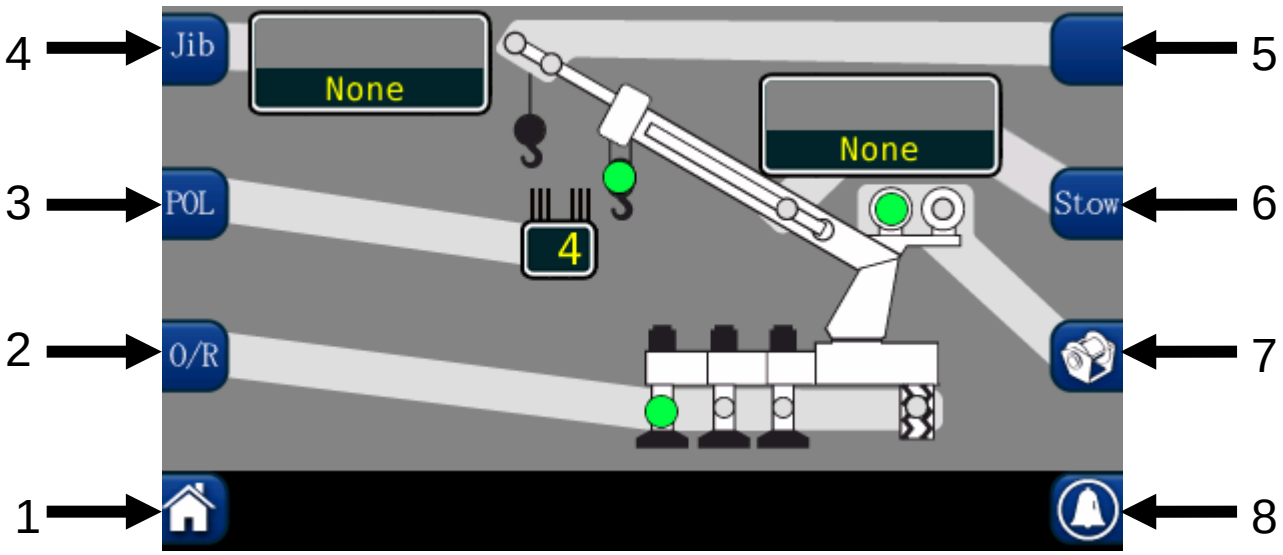


Home Display

NOTE: The Configuration Display may be accessed from the Home Display by pressing the button indicated above.

The system has the capability to remember the last configuration. When removing power to the system, and re-powering, the settings remain intact until reset by the operator.

The Configuration Display



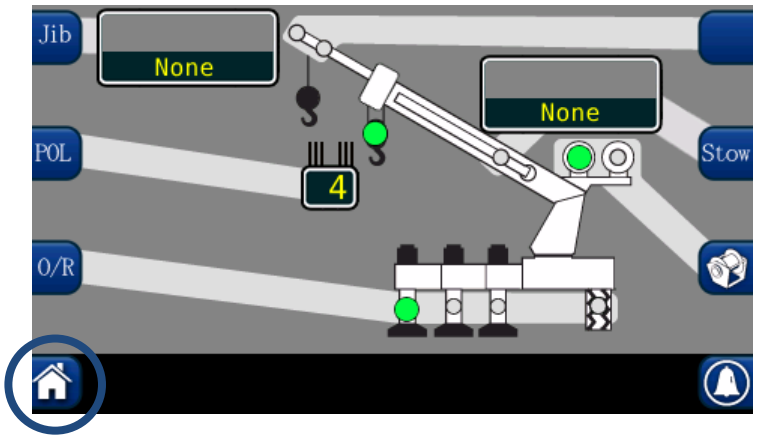
The Configuration Display gives a pictorial representation of the current system setup. Each shaded area contains a group of one or more green indicators and a button to change the setup selection, depending on the application. In groups with multiple options, green indicators illuminate individually to indicate the selection. When the configuration is complete, press the Home button to return to the Home display.

NOTE: Always check the point of lift and parts of line upon selection of the winch.

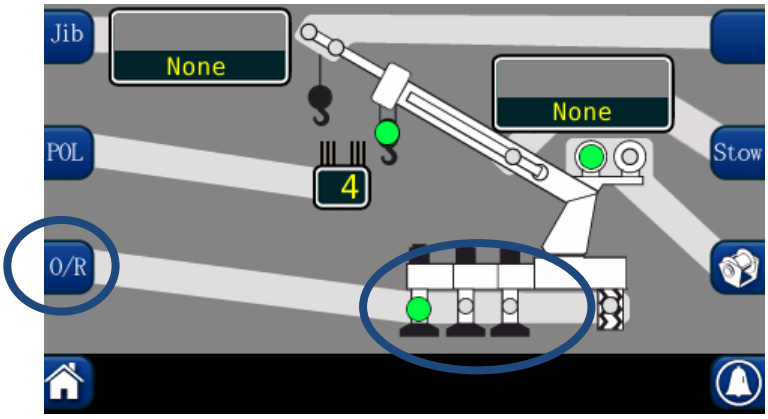
WARNING!!

THE DISPLAYED LOAD AND CAPACITY ARE BASED UPON THE CURRENT SELECTED POINT OF LIFT. NEITHER THE GREER INSIGHT SYSTEM, NOR THE CRANE CAPACITY CHART ALLOWS FOR LIFTING FROM MORE THAN ONE HOOK AT A TIME.

1. The **HOME** button will return the user to the Home display.



2. The **OUTRIGGER** selections are made by pressing the button circled. *NOTE: Some cranes will not have the option of selecting different outrigger positions*.



OUTRIGGER POSITION SENSING (IF EQUIPPED)

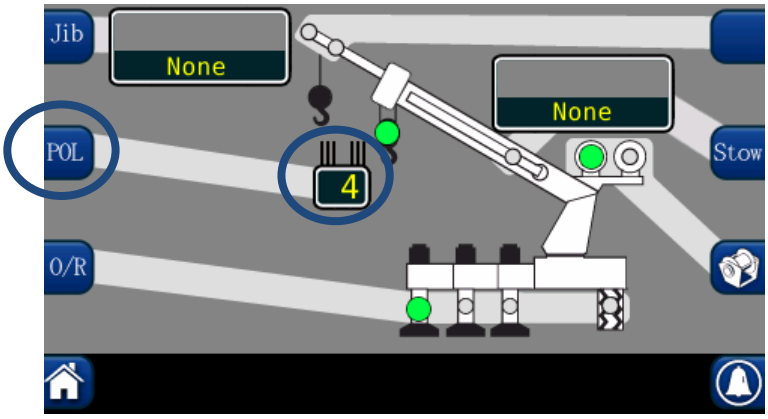
At power up, the system will pick the chart based on the last used configuration. It will display a white arrow above the corresponding outrigger position on the screen.

The operator will be warned if the selected outrigger position does not match the detected outrigger position.

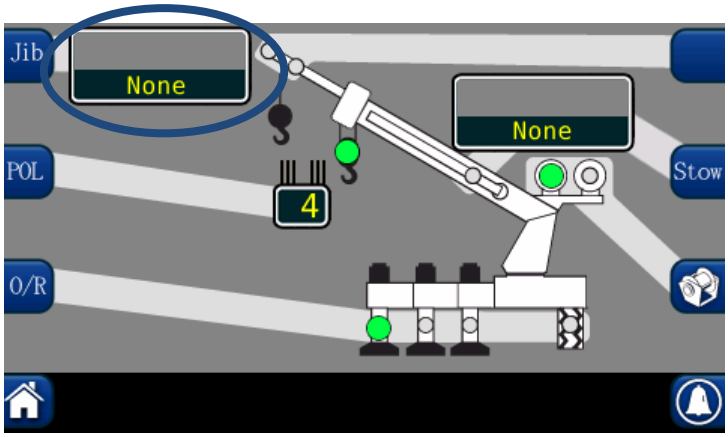
Correct Selection: The selection will have a solid green indicator, when the selected and detected outrigger positions match.

Incorrect Selection: The detected position will flash a red indicator and the selected position will be a solid yellow indicator. On the main screen, an audible alarm will sound if the selected position is greater than the detected position. The alarm will sound if the operator has selected fully extended outriggers, but the outriggers are in the intermediate or fully retracted position.

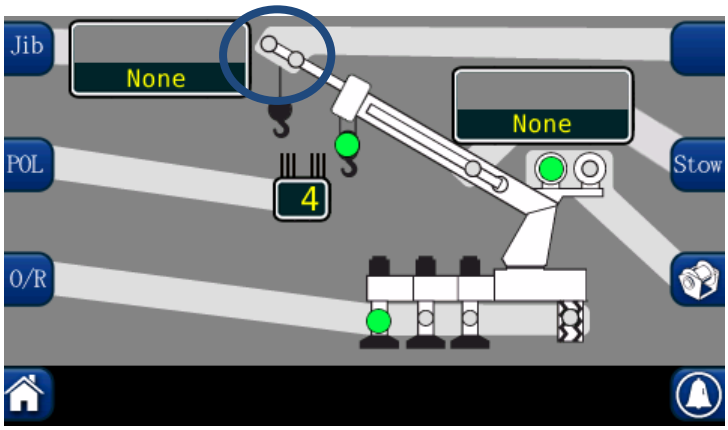
3. The **PARTS OF LINE (POL)**, button selects the current **POL**. Pressing the **POL** button will increase the **POL**. When the maximum parts of line for the equipment being used is reached, the indicator will rollover to one **POL**.



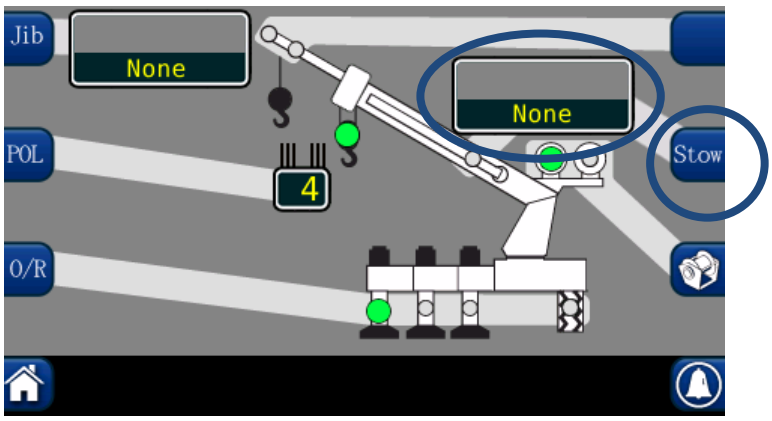
4. The **JIB OPTIONS** may be selected by pressing the jib button multiple times to scroll through the jib options. If there aren't any options available, the display will show "**None**". *NOTE: The jib must be stowed before it is erected.*



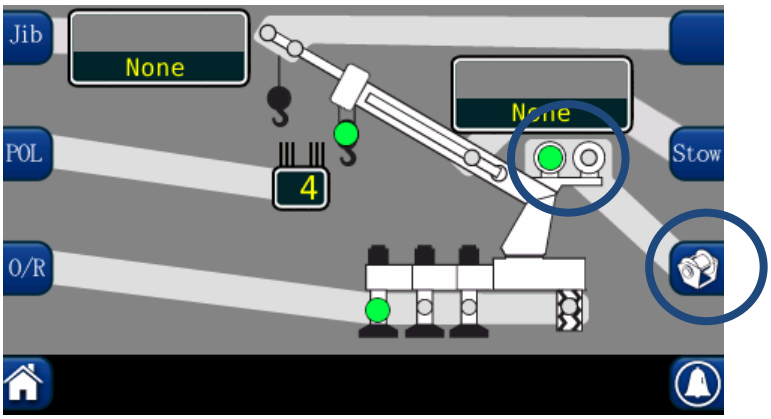
5. The **PICK POINT** selections are dependent upon the model of crane being used.



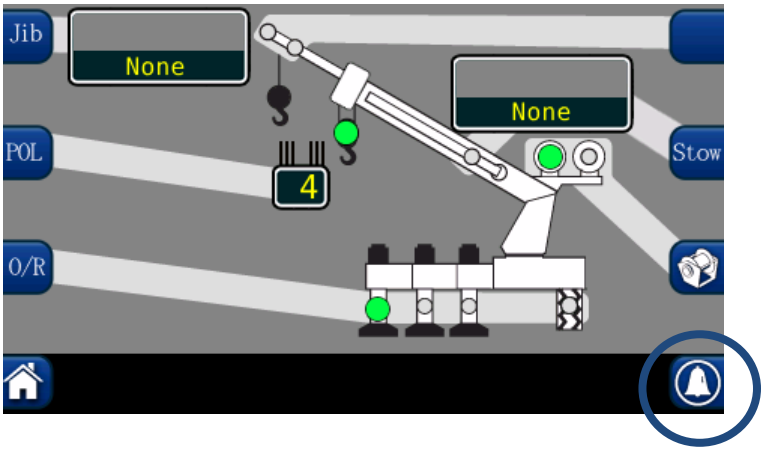
6. The **STOW (STOWED JIB)**, group contains one green indicator. This will illuminate when the jib is stowed on the boom. Press the Stow button multiple times to scroll through the jib options. If there are no options available, the display will show "**None**".



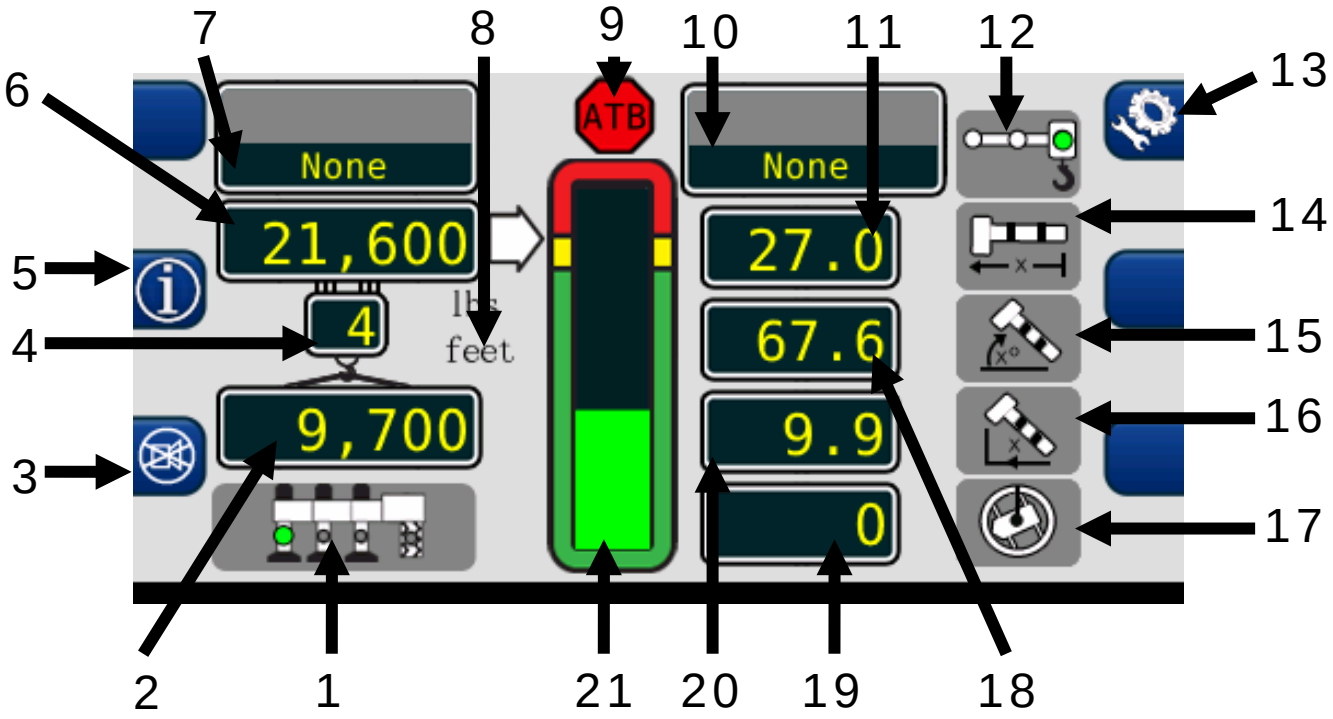
7. The **WINCH** group contains two green indicators, which indicate the selection of Front or Rear winch. *NOTE: If the crane is equipped with two winches, always select the winch to be used for the lift, prior to selecting the parts of line selections for each winch.*



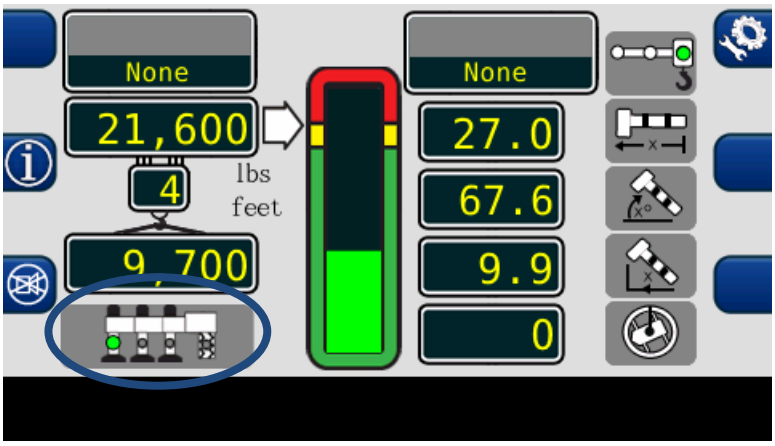
8. The **OPERATOR ALARMS** may be accessed by pressing the operator alarm button.



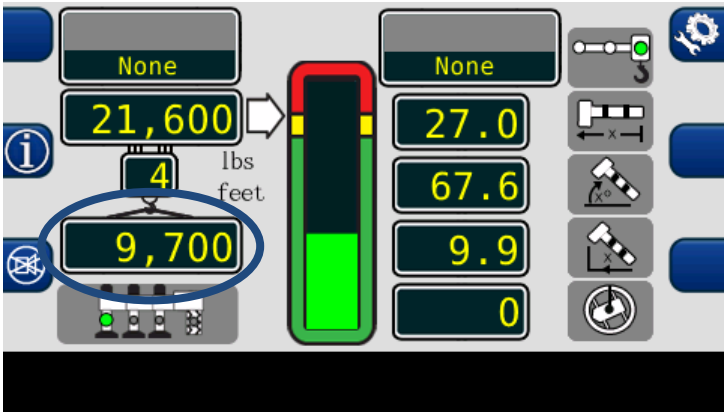
The Home Display



1. The **OUTRIGGER** setting contains four green indicators. They indicate the selection of full, intermediate, retracted outriggers and the “On Tires” selection, if applicable. The user must make the selection from the Configuration display. *NOTE: OUTRIGGER selections are dependent on the crane being used.*

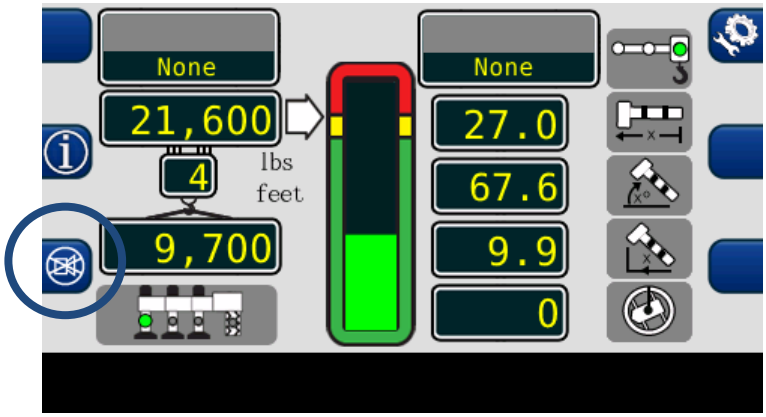


2. The **ACTUAL LOAD** window displays the total load, including slings, etc., suspended below the lifting point.

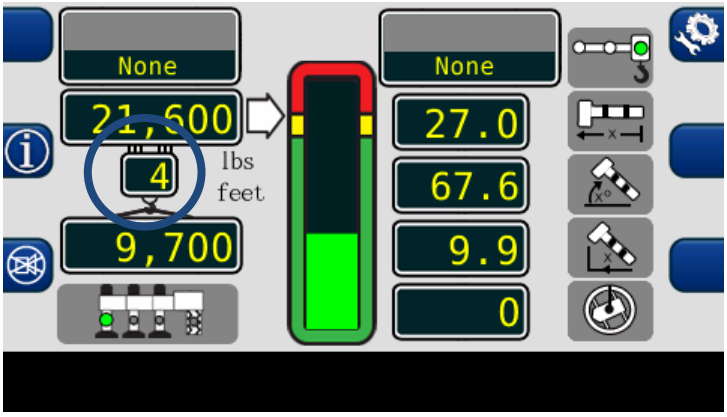


3. The **CANCEL ALARM BUTTON** is used to silence the audible alarm generated by the following conditions:
    - Overload
    - ATB Alarm
    - Outrigger Position Mismatch
    - Operator Programmable Alarm

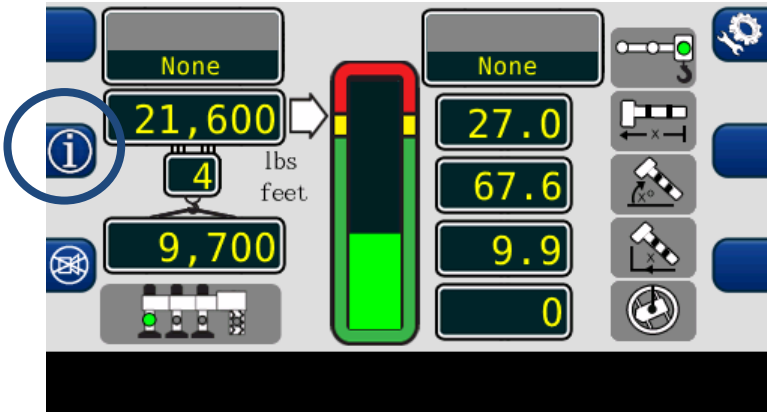
    The audible alarm remains cancelled until the condition causing the alarm has been resolved. Or until another overload or two-block condition occurs.



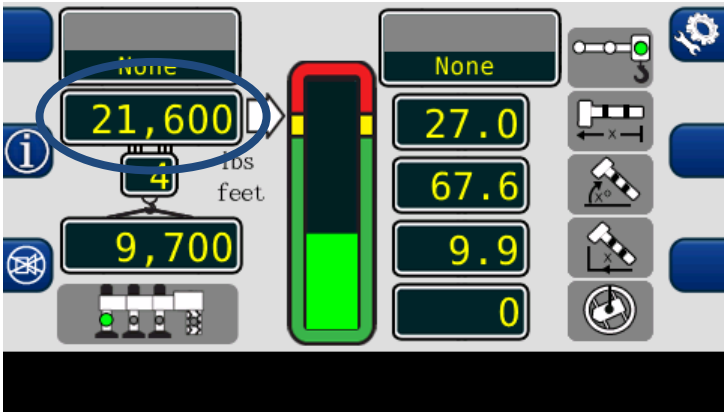
4. The **PARTS OF LINE** window shows the amount of line chosen for the configuration selected. It is adjustable from the Configuration screen.



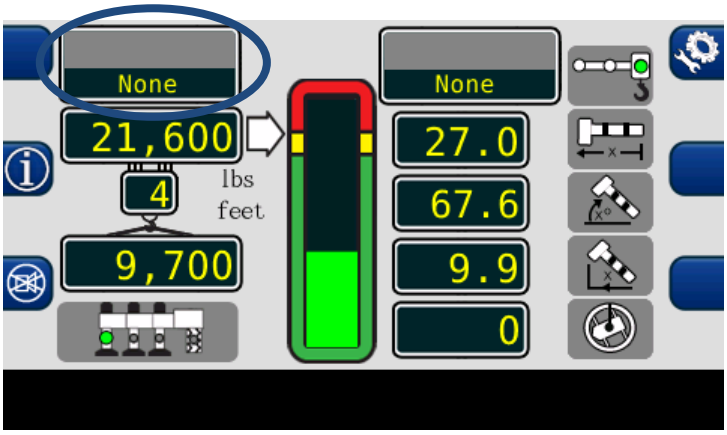
5. The **INFORMATION** button displays system generated messages regarding the software versions of the equipment and fault codes. When the information button is pressed, the data is displayed as long as the button is held.



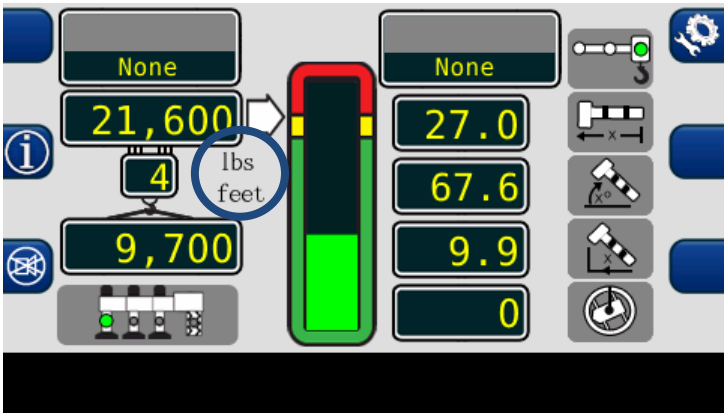
6. The **RATED CAPACITY** window shows the maximum rated capacity of the machine in the current configuration.



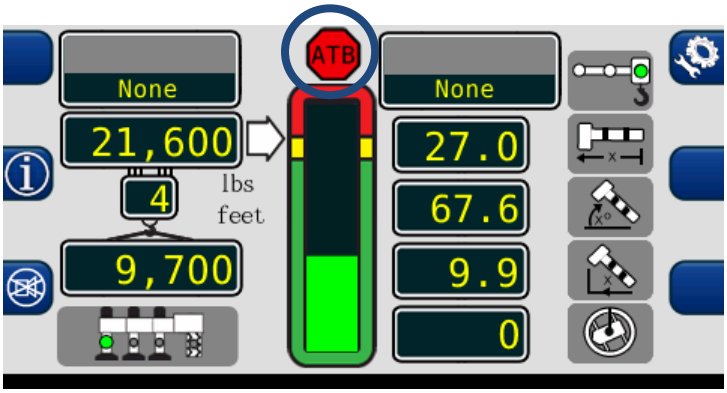
7. The **ERECTED JIB** window shows the jib options selected for the machine. If there are no jib options available, the display will show "**None**".



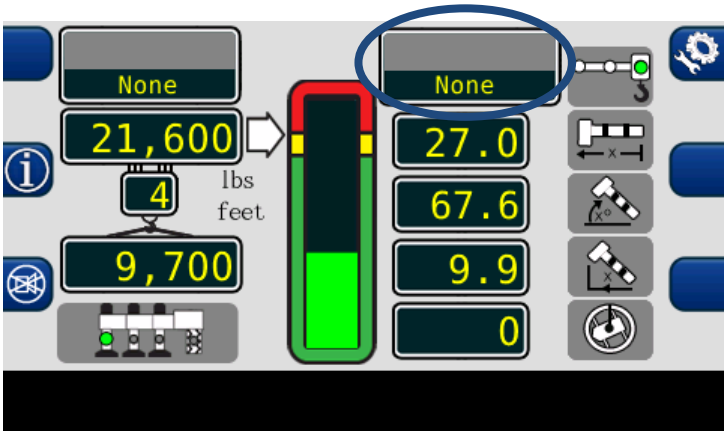
8. The **SYSTEM** has the capability of showing Metric or Imperial units.



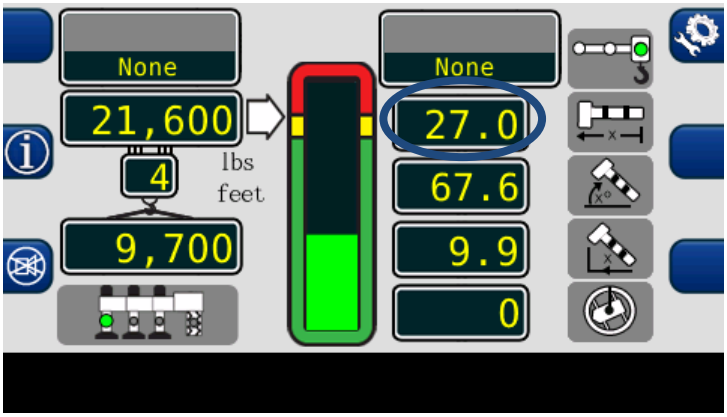
9. The **ANTI-TWO-BLOCK** indicator illuminates when the ATB Limit switch detects approach to a two-block condition.



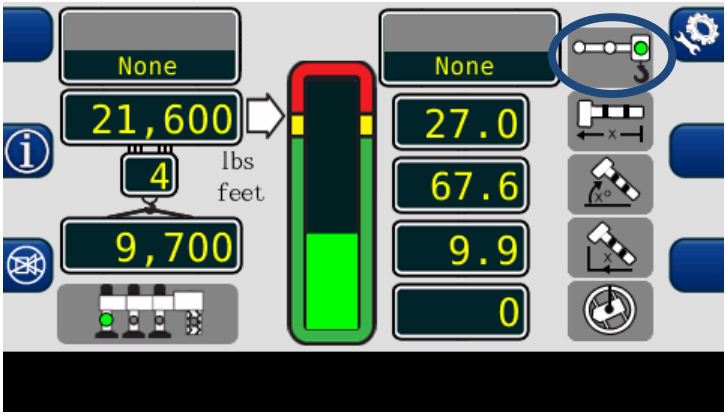
10. The **JIB STOWED** window shows the stowed jib from the configuration screen. The length and offset of the jib in use is also shown in the Home Display.



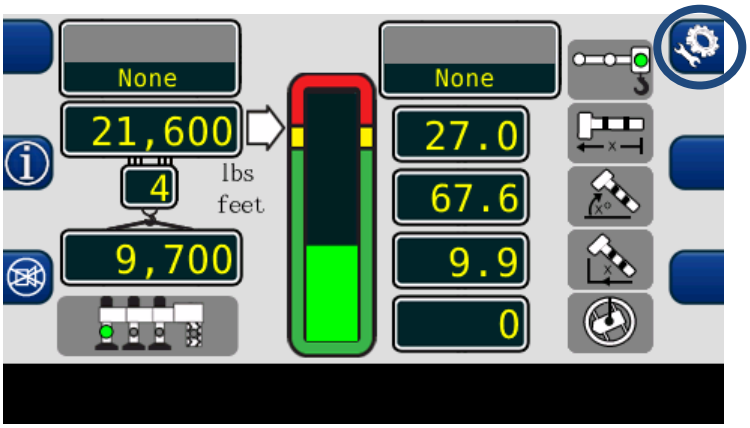
11. The **BOOM LENGTH** window shows the length of the main boom from the boom foot pin to the sheave pin of the main boom head machinery. This measurement can be shown in Imperial or Metric units.



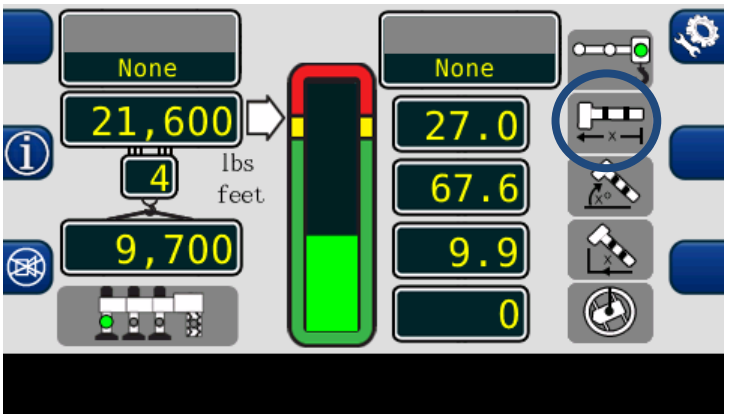
12. The **PICK POINT** is automatically selected when a jib is erected. It is dependent on the model of crane and the options shown in the operator setup.



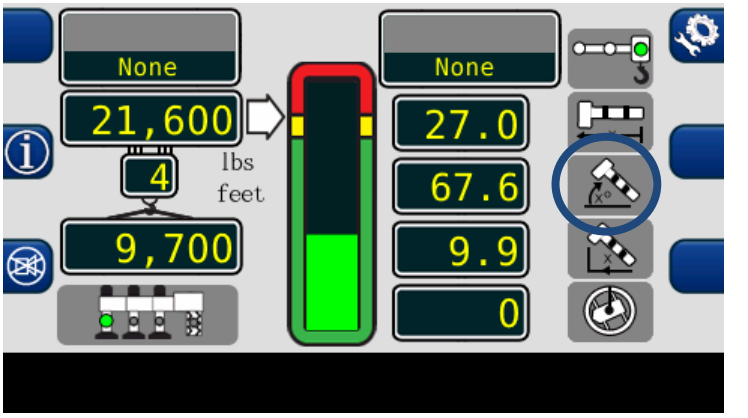
13. Press the **CONFIGURATION BUTTON** to return to the Configuration display screen.



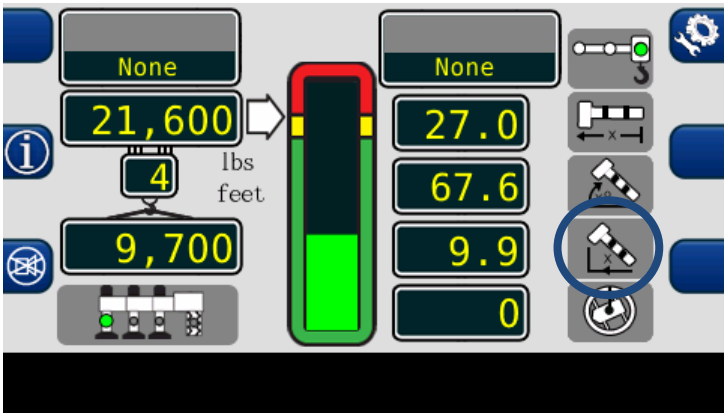
14. The **BOOM LENGTH** symbol is shown to the right of the boom length window.



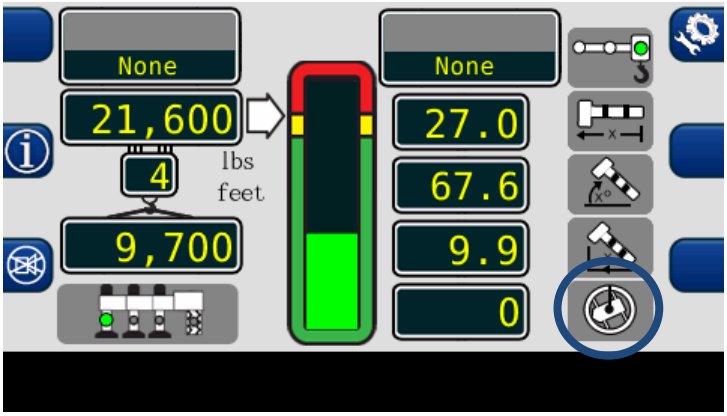
15. The **BOOM ANGLE** symbol is shown to the right of the boom angle window.



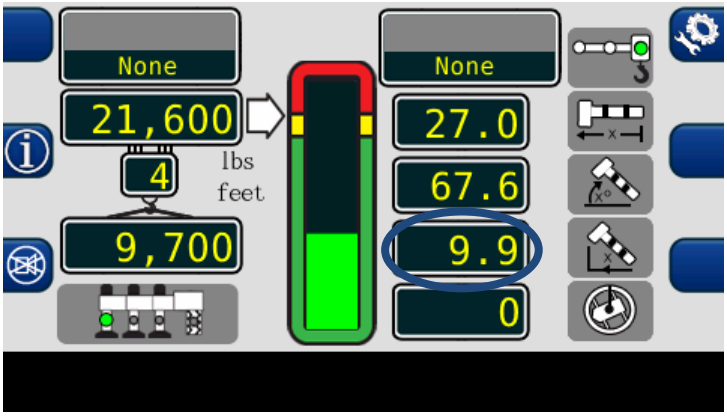
16. The **LOAD RADIUS** symbol is shown to the right of the boom angle window.



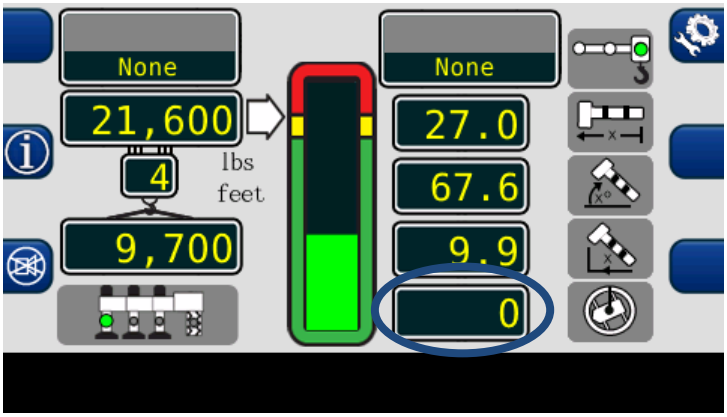
17. The **SWING ANGLE** symbol is shown to the right of the swing angle window. *NOTE: Not used on all models.*



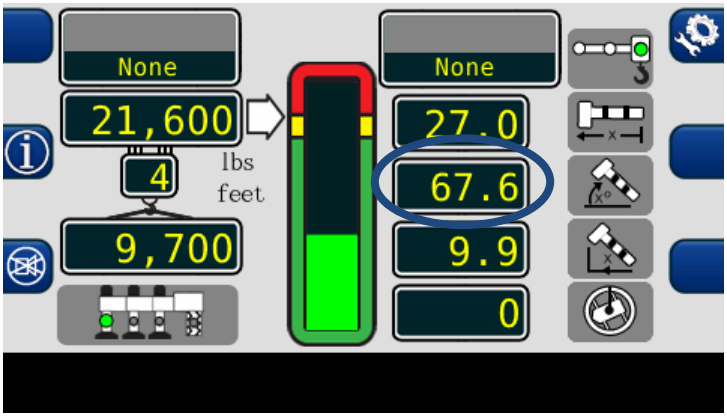
18. The **LOAD RADIUS** window indicates the current radius of the boom.



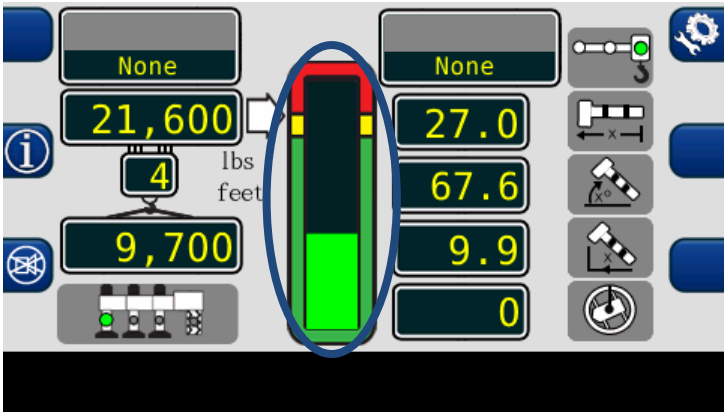
19. The **SWING ANGLE** window indicates the swing of the boom. *NOTE: Not used on all models.*



20. The **BOOM ANGLE** window indicates in degrees, the angle of the main boom relative to horizontal.



21. The **BAR GRAPH** indicates the actual load relative to the maximum rated capacity of the equipment being used.



Cancel Alarm Button

The cancel alarm button is used to silence the audible alarm. Pressing this button once will cancel an audible alarm from an: Overload, ATB Alarm, or Operator Programmable Alarm. The audible alarm remains cancelled until the condition which caused the alarm has been resolved.

Reset Function Kick-Out

When rigging the machine, it may be necessary to place the boom in a position which could cause a function kick-out. In this situation, it would be necessary to use the bypass (Cancel Alarm Button). In order to move the boom, the button must be held down. If the button is released, the until will revert to the alarm mode.

The cancel alarm button is also used to temporarily reset the function disconnect relay. Press and hold the button for 5 seconds to reset the relay. A second beep is heard confirming the bypass.

When the condition which caused the alarm is no longer present, the function disconnect relay will reset to the normal condition.

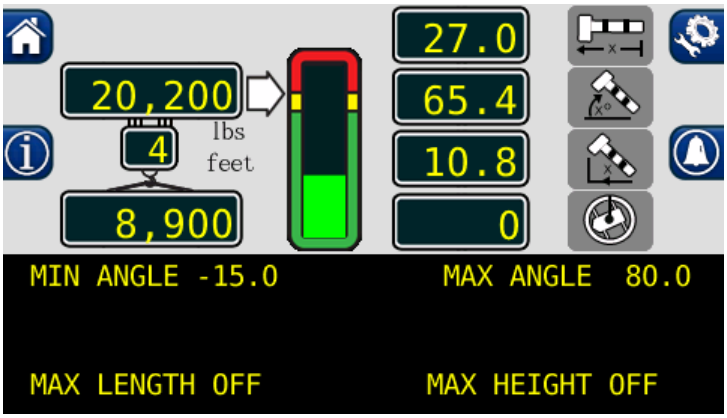
WARNING!!

WHEN THE FUNCTION DISCONNECT RELAY IS RESET BY MEANS OF THE CANCEL ALARM BUTTON, THERE IS NO LONGER PROTECTION AGAINST THE CONDITION THAT CAUSED THE FUNCTION KICK-OUT.

Operator Programmable Alarms

Accessing the Operator Alarms

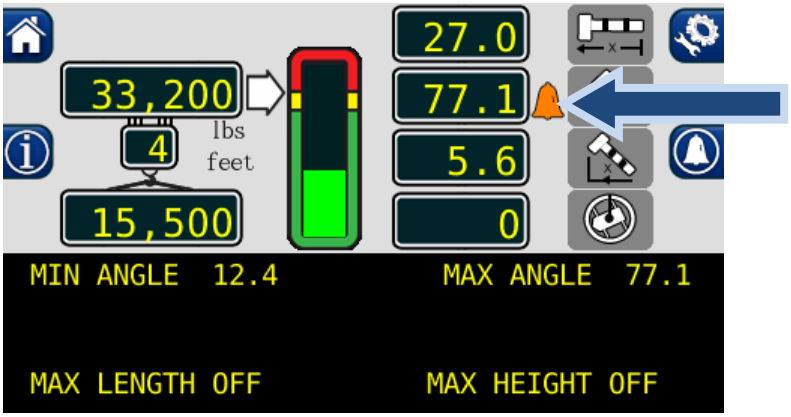
1. Press the configuration button to access the operator alarms from the main working screen.
2. Press the operator alarm button. The information screen will show the current status of the operator alarms. The system has default settings for minimum and maximum boom angle; negative 15° for minimum boom angle and 80° for maximum boom angle.



Each button corresponds to the displayed alarm. These buttons operate as a toggle switch. If the alarm to be set is OFF, pressing the button will turn the alarm ON. If the alarm to be set is ON, pressing the button will turn the alarm OFF.

NOTE: Press the operator alarm button in order to cycle through the various user programmable alarms. Press the home button to return to the main screen. Exit at any time.

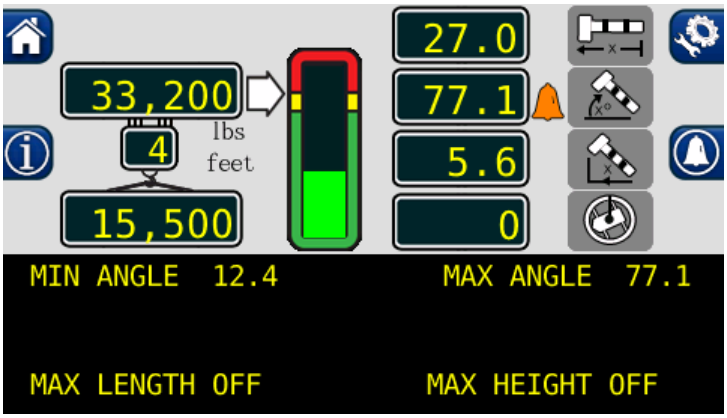
When operator alarms are set, the orange alarm will appear. An example below:



Operator Programmable Alarms

Setting the Minimum Boom Angle Alarm

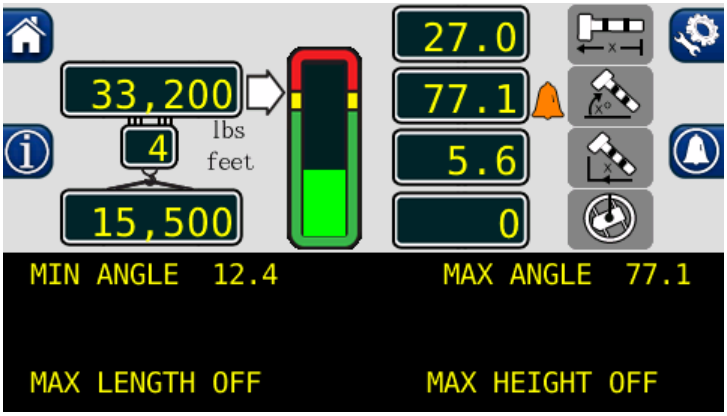
1. Move the boom to the desired minimum angle, in this example, 12.4 °.
2. Press the “MIN ANGLE -15.0” button.
3. The display will show the desired minimum angle, in this example, 12.4°.



4. Pressing the “MIN ANGLE” button again will cancel user set value and return to the default negative 15° setting. The display will read: “MIN ANGLE -15.0”.

Setting the Maximum Boom Angle Alarm

1. Move the boom to the desired maximum angle, in this example, 77.1°.
2. Press the “MAX ANGLE 80.0” button.
3. The display will show the desired maximum angle, in this example, 77.1°.

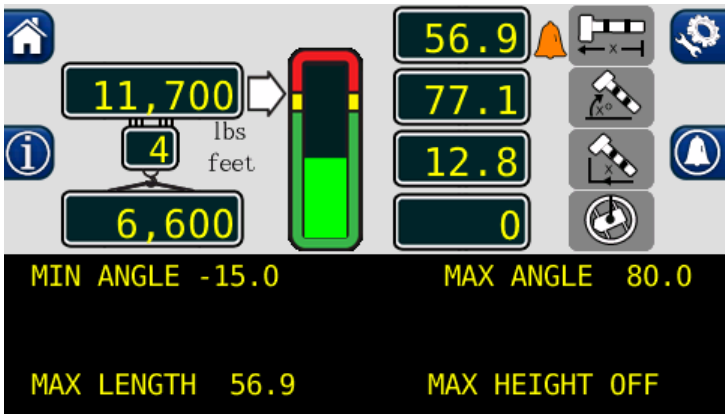


4. Pressing the “MAX ANGLE” button again will cancel the user set value and return to the default 80° setting. The display will read “MAX ANGLE 80.0”.

Operator Programmable Alarms

Setting the Maximum Boom Length Alarm

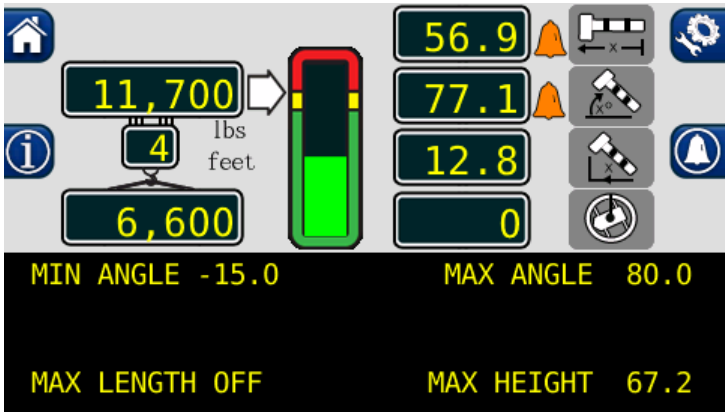
1. Move the boom to the desired maximum length, in this example, 56.9 ft.
2. Press the “MAX LENGTH OFF” button.
3. The display will show the desired maximum length, in this example, 56.9 ft.



4. Pressing the “MAX LENGTH” button again will cancel the alarm. The display will read “MAX LENGTH OFF”.

Setting the Maximum Tip Height Alarm

1. Move the boom to the desired maximum height, in this example 67.2 ft.
2. Press the “MAX HEIGHT OFF” button.
3. The display will show the desired maximum height, in this example 67.2 ft.



4. Pressing the “MAX HEIGHT” button again will cancel the alarm. The display will read “MAX HEIGHT OFF”.

Operator Programmable Alarms

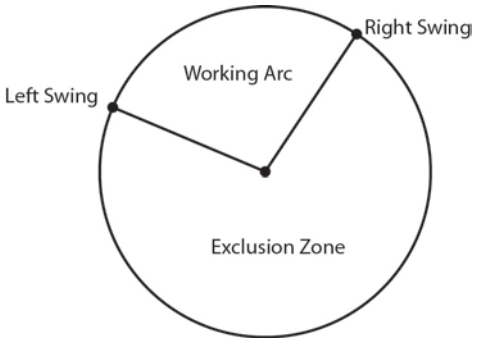
Swing Alarms Illustrated (If Equipped with Swing Sensor)

These alarms permit the operator to define a working arc and an exclusion zone by two set points. The following diagram illustrates the working arc and exclusion zone.

A left swing alarm is activated when swinging to the left.

A right swing alarm is activated when swinging to the right.

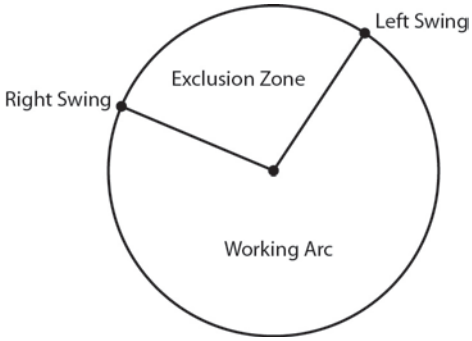
In this example the working arc is the smaller piece of the pie.



A left swing alarm is activated when swinging to the left.

A right swing alarm is activated when swinging to the right

In this example the working arc is the larger piece of the pie.



WARNING!

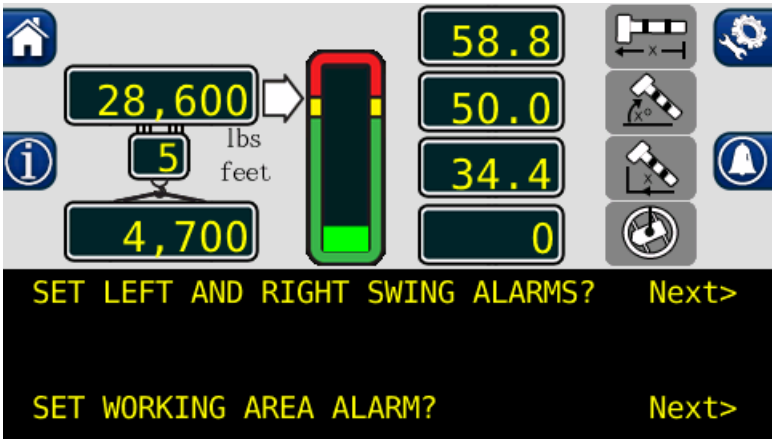
THE OPERATOR DEFINED SWING ALARM IS A WARNING DEVICE. ALL FUNCTIONS REMAIN OPERATIONAL WHEN ENTERING THE OPERATOR DEFINED EXCLUSION ZONE. IT IS THE RESPONSIBILITY OF THE OPERATOR TO SET SWING ALARMS THAT ENSURE THE CRANES BOOM, ATTACHMENT, LOAD, RIGGING, ETC. MAINTAIN A SAFE WORKING DISTANCE FROM THE OBSTACLE. AVOID POSITIONING THE BOOM, ATTACHMENT, LOAD, RIGGING ETC. IN THE EXCLUSION ZONE WHEN MOVING TO THE LEFT AND RIGHT SWING POINTS. WHEN SELECTING LEFT AND RIGHT SWING POINTS ENSURE THE LOAD WILL MAINTAIN A SAFE DISTANCE FROM THE OBSTACLE. RESET THE SWING ALARMS IF THE CRANE OR OBSTACLE IS MOVED OR IF A DIFFERENT SIZE LOAD IS LIFTED.

Operator Programmable Alarms

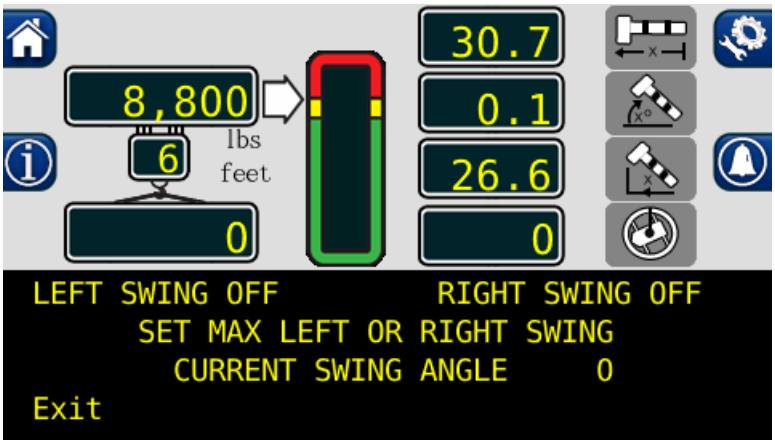
Setting the Swing Alarms (If Equipped with Swing Sensor)

When the swing travels one degree past either set point, the operator will be visually and audibly warned. The display will show either, “WARNING! – RIGHT SWING!” or “WARNING! – LEFT SWING!” The alarm condition will once the crane is back into the working area.

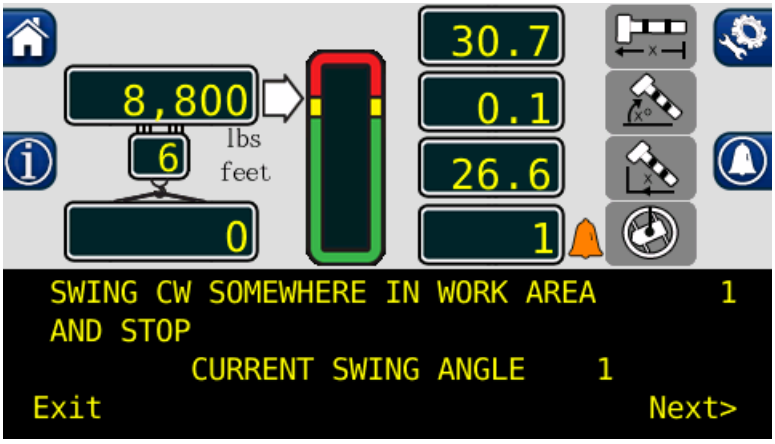
1. Press the configuration button to access the operator alarms from the main working screen.
2. Then press the operator alarm button twice.
3. Press “Next” button adjacent to “SET LEFT AND RIGHT SWING ALARMS?”



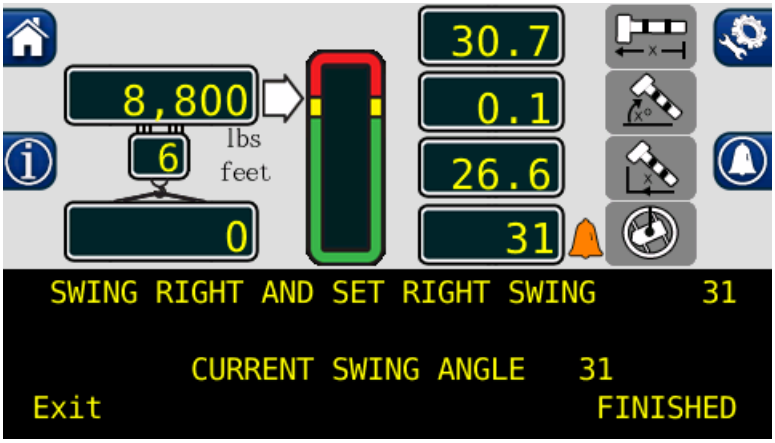
4. If a swing alarm is already set, press the “LEFT SWING” and “RIGHT SWING” buttons, to turn off the current alarms.



5. Swing the boom to the desired left swing point and press the “LEFT SWING OFF” button. This sets the left swing point value.
6. Press the “NEXT” button to continue.
7. Move the boom into the desired working area and press the “SET” button.
8. Press the “NEXT” button.



9. Swing the boom to the desired right swing point and press the “OFF” button.



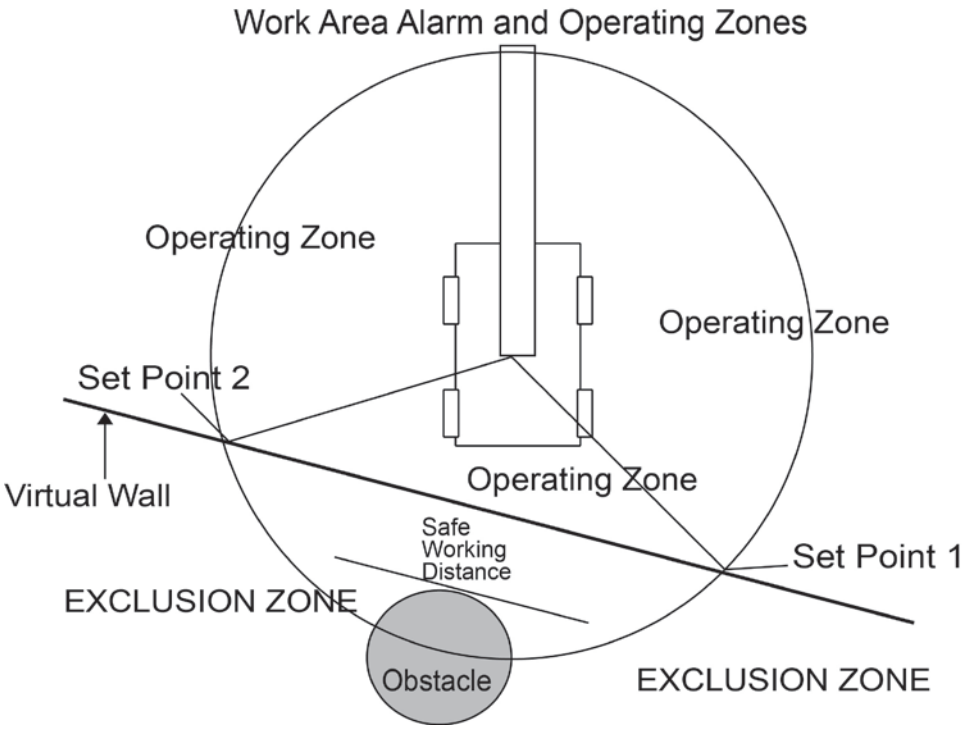
10. The swing alarms are now set. Press the “Exit” button to return to the calibration menu.

Operator Programmable Alarms

Work Area Alarms (If Equipped with Swing Sensor)

This alarm permits the operator to define an operating zone by only two set points. The use of this method results in a more defined operating zone. The following diagram illustrates the operating zone and the exclusion zone.

The set points are calculated using the tip of the boom. This means the set point isn't determined just by the swing of the boom, but also the distance from the centerline of rotation to the tip of the boom.

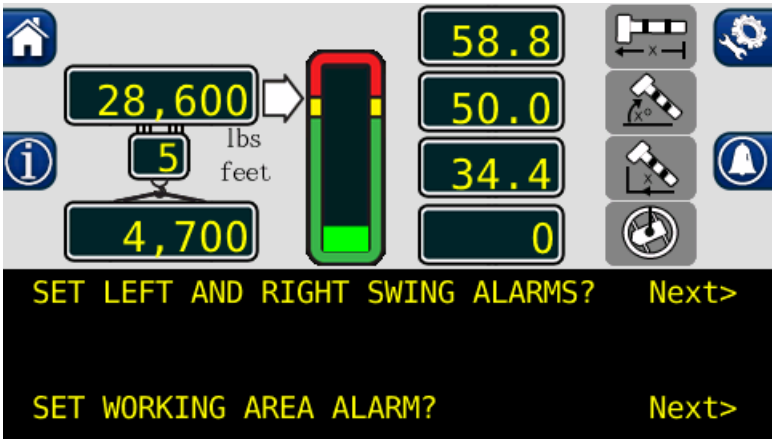


The work area alarm, defines an imaginary vertical plane between two set points. When the plane is passed the red warning indicator will be displayed, the alarm will sound, and the message "!! EXCLUSION ZONE !!" will flash as shown below.

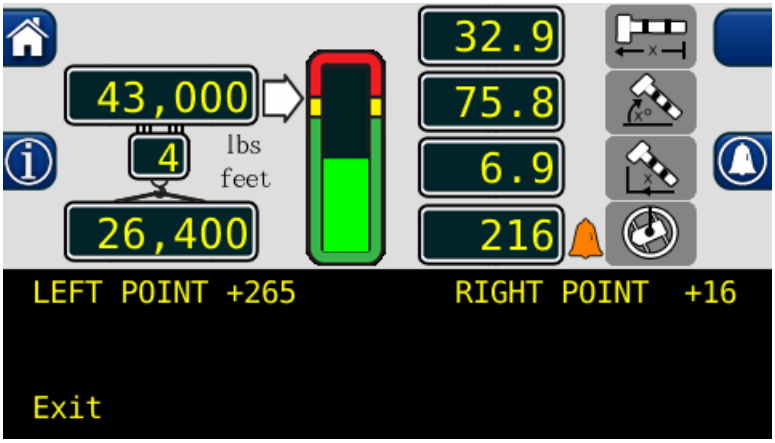
Operator Programmable Alarms

Setting the Work Area Alarms

1. Press the configuration button to access the operator alarms from the main working screen.
2. Then press the operator alarm button twice. The information screen will show the current status of the swing and work area alarms. *NOTE: The location of the operator alarm button moves after the first press.*
3. Press “NEXT” button adjacent to “SET WORKING AREA ALARM?”



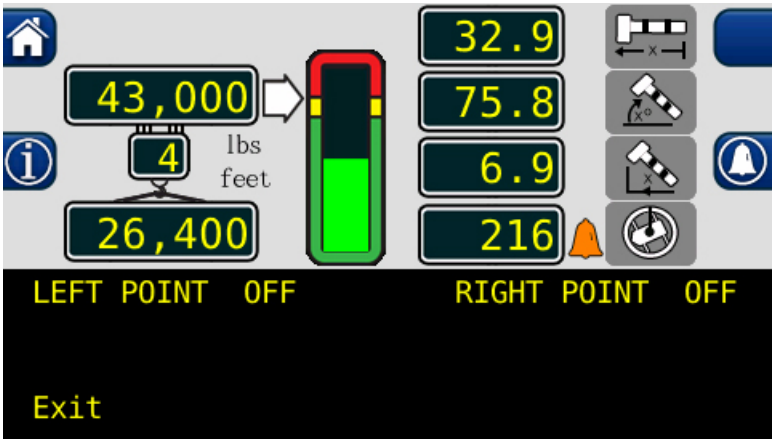
4. To set a new swing area, the left and right points must be reset.



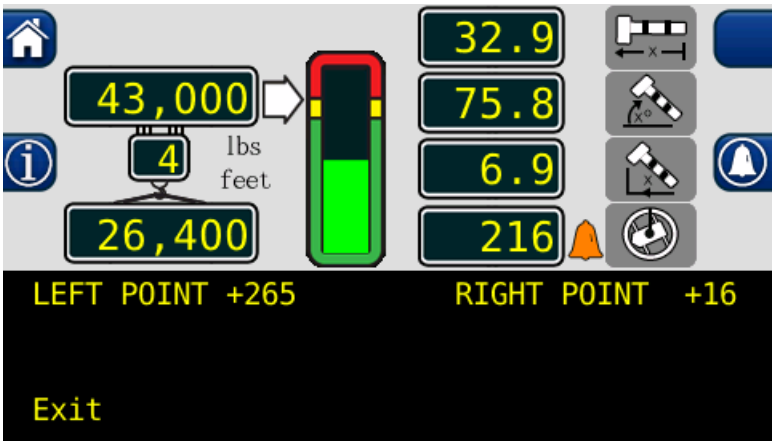
NOTE: In order for the swing alarms to function properly both alarms must be set. If the procedure is aborted before both points are set, the alarms will default to “OFF.”

5. Press the “LEFT POINT” and “RIGHT POINT” buttons. This will reset the set points.

6. The display will now show “LEFT POINT OFF”, “RIGHT POINT OFF”.



7. Place the boom tip at the desired left point. This should be the point to the left of the obstacle facing the exclusion zone to be defined.
8. Press the “LEFT POINT” button. The left point will now be set.
9. Rotate the boom to the right, taking care to avoid the obstacle by raising or retracting the boom. Or rotate the boom to the left to avoid moving the boom through the exclusion zone.
10. Press the “RIGHT POINT” button.
11. The work area alarm set points are now set.
12. To deactivate the alarms, go back to the screen displaying the left and right set points.



13. Press the “LEFT POINT” and “RIGHT POINT” buttons to toggle OFF.

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W450320A 09/12

Elliott Calibration and Troubleshooting Manual

GREER COMPANY®

TABLE OF CONTENTS

Introduction

This system is designed as an aid to crane operation. The operator must be knowledgeable in safety guidelines, crane capacity information, and the crane manufacturer's specifications.

This manual describes the setup, operation, and maintenance of the System. Please read, understand, and follow the instructions in this manual.

1.1 Overview and Preparation

This manual provides general information and methods for isolating problems that may happen during operation. Some problems may require the replacement of parts, or return of parts to the factory for servicing. Service personnel should have previous training and experience in the procedure for setup and operation of this system.

Tools necessary:

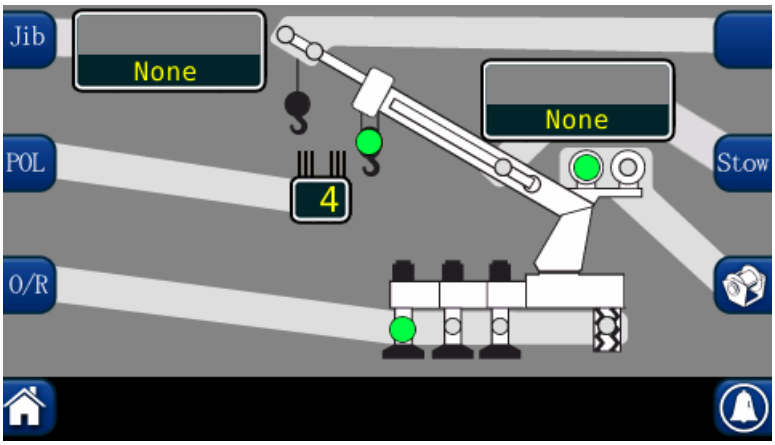
- Tool kit consisting of wrenches and screwdrivers (flat and Phillips')
- Digital level accurate to 0.1°
- 150-200 ft tape measure graduated in tenths of a foot (1/10)
- Digital multimeter

NOTE: Low-cost analog meters are not appropriate; their input impedance may give false readings.

2.1 System Self-Test

When the power is turned on, the System performs a “SELF-TEST.” This verifies the computer, display console, cable, and sensors are working properly. During the self-test, the display will show the crane model/load chart number and units of measurement.

After the startup screen, the Crane Configuration page will display. Use this screen to check the configuration of the crane before proceeding to the home, operator alarm, or calibration screen.



If the above does not occur, refer to **Display Console Problems**.

2.2 Display Console Problems

Display console problems can be difficult to isolate due to the interaction between the display and the computer unit. Failure of either unit or the cabling connecting the units can cause a malfunction. “No Fault Code” diagnoses of other system problems can be completed without the display and it’s communication with the computer unit.

To solve problems using the display indications, observe the display at “Power On” and through the self-test. Use the following chart to help with the diagnosis.

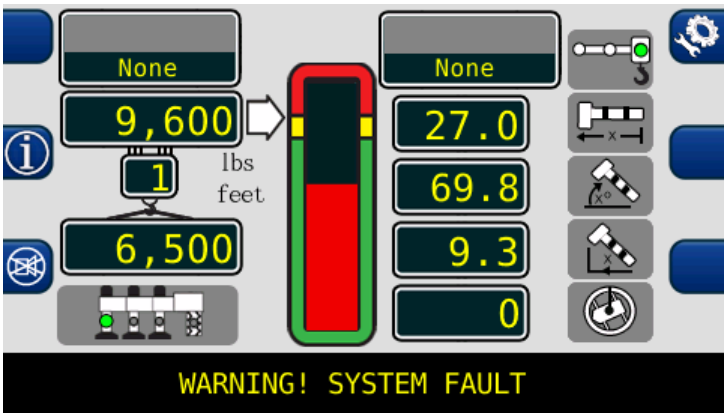
Problem	Action
There are no display indications in any of the windows when the power is turned on. Or a “No Communications” message appears.	Refer to **Computer Internal Status Indicators**.
The display unit does not cycle through the self-test. The data in the display windows appears jumbled with missing segments.	Replace the display unit.

2.3 Fault Reporting and Fault Codes

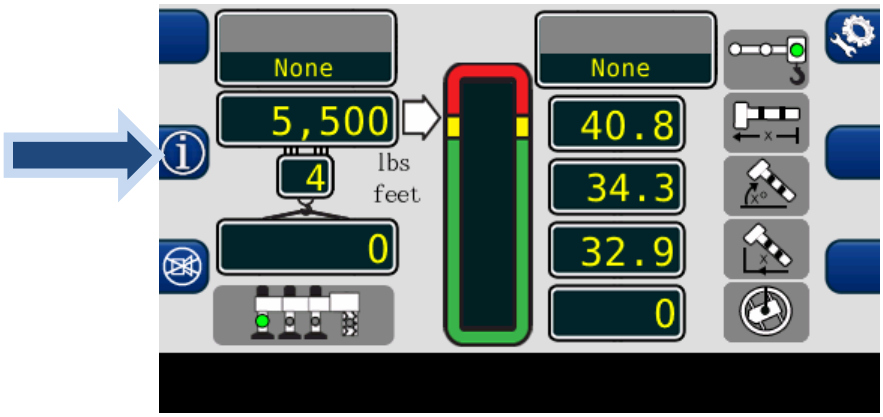
System fault codes provide ways to locate and assess problems within the Insight system. Each time the system is turned on, it performs a self-test that lasts approximately 6 seconds.

Faults detected during the self-test are indicated on the display console:

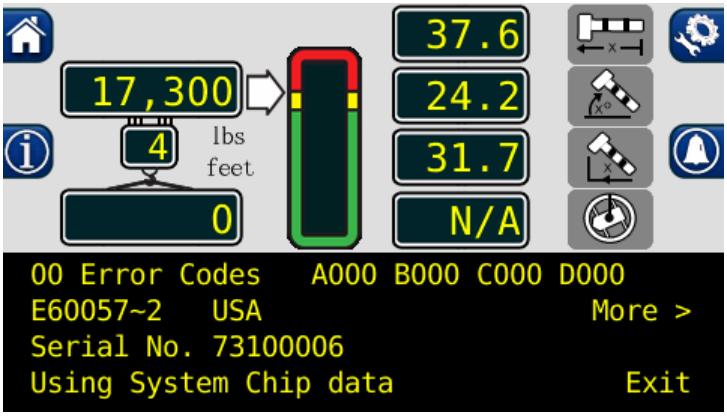
- "WARNING SYSTEM FAULT!" will display at the bottom of the text window.



To view the fault codes, press and hold the (i) button as shown.



The faults will be listed across the bottom of the text window.



2.3.1 Group “A” Fault Codes

NOTE: Check and repair “B” and “C” group faults before proceeding with group “A” fault finding sensors.

Group “A” fault codes represent faults detected for analog sensors.

The following chart details all the available codes in the left column and the actions to take in the right column.

FAULT CODE	SWING SENSOR	BOOM ANGLE SENSOR	EXTENSION SENSOR	TDX 1 ROD PRESSURE	TDX 0 PISTON PRESSURE	ACTION
000	No Fault Found					None
001					X	Replace the Computer.
002				X		
003				X	X	
004			X			Refer to the Extension Calibration instructions.
008		X				Refer to Angle Sensor in Calibration instructions.
012		X	X			Refer to Extension, Angle and Reeling Drum Calibration instructions.

2.3.2 Group “B” Fault Codes

Group “B” fault codes represent faults detected for internal analog functions and power feeds to the function kickout and anti-two block switches.

The following chart details all of the available codes in the left column and the actions to take in the right column.

FAULT CODE	FKO POWER FEED	ATB POWER FEED	DISPLAY CONSOLE	ADC 2 INTERNAL FAULT	ADC 1 INTERNAL FAULT	ACTION
016	X					Check Crane Circuit Breakers

2.3.3 Group “C” Fault Codes

Group “C” fault codes represent faults detected for internal computer memories. The following chart details all the available codes in the left column and the actions to take in the right column.

FAULT CODE	SERIAL EEPROM	CRANE DATA	RAM	DUTY DATA	PROGRAM	ACTION
000	NO FAULT FOUND					NONE
008		X				Erase Crane Data
016	X					Replace the Computer

2.3.4 Group “D” Fault Codes

Group “D” fault codes represent faults detected for capacity chart selection. The following chart details all the available codes in the left column and the actions to take in the right column.

FAULT CODE	WRONG SWING AREA	WRONG BOOM LENGTH	CHART NOT FOUND	ACTION
000	No Fault Found			NONE
001			X	Check other sensor faults first, Reselect CRANE SETUP
002		X		Boom length is out of range for selected chart. Check crane setup, boom length and extension.
003		X	X	Check other sensor faults first, Reselect CRANE SETUP

2.4 “No Fault Code” Problems

This section addresses problems not reported by the computer fault code system.

2.4.1 Anti-Two-Block Alarm (ATB)

This section aides diagnosing ATB alarm problems. For detailed information, schematic, and voltages, refer to **ANTI-TWO-BLOCK FUNCTION OVERVIEW**.

PROBLEM:

- *The Anti-Two-Block alarm is continuously ON. Operating the switch at the boom head does not deactivate the alarm.*

This problem suggests an open circuit between the computer ATB input and the ATB switch, or an open circuit between the computer ATB feed and the ATB switch. Check the reeling drum cable for damage. Ensure the two-block switches are correctly connected. Check the slip-ring and wiring inside the extension reel. Check the reel-to-computer cable. Check the connectors.

PROBLEM:

- *The Anti-Two-Block alarm is continuously OFF (safe). Opening the switch at the boom head, by lifting the ATB weight does not activate the alarm.*

This problem suggests a short circuit between the computer ATB input and the computer ATB feed somewhere between the computer and the ATB switch. Check the reeling drum cable for damage. Ensure the two-block switches are correctly connected. Check the slip-ring and wiring inside the extension reel. Check the reel-to-computer cable. Check the connectors.

2.4.2 Displayed Load or Radius Errors

This section gives direction to fault diagnosis of load and radius errors. Load or radius errors can cause early or late tripping of overload alarms. Accuracy of load is governed by the radius accuracy, and the extension, angle, and pressure sensors. Accuracy of radius (unloaded) is governed by the extension and angle sensors.

Ensure there are no system faults before continuing.

2.4.2.1 Check Boom Extension and Boom Angle

1. Ensure the boom is fully retracted.
2. Ensure the reeling drum cable is correctly layered as a single layer across the extension reel surface. Any stacking of the cable will cause extension errors.
3. Using an inclinometer set the boom to 0° (zero) and ensure the displayed boom angle value is 0.0°. If the angle value is not 0.0°, refer to **CALIBRATING THE ANGLE SENSOR ZERO.**
4. Raise the boom to a high angle (60°) and measure the angle with the inclinometer. Ensure the displayed angle matches the inclinometer reading within 0.1°. If the displayed angle is incorrect, refer to **CALIBRATING SPAN OF EXTENSION AND ANGLE**.

5. Check the extension value in the display window for the correct retracted boom length. The retracted boom length should match the retracted boom length from the load chart. The value must be within ± 0.2ft. Fully telescope the boom and ensure the displayed boom length value matches the maximum length of the boom. If the length value is incorrect, follow the EXTENSION SPAN procedure in **CALIBRATING SPAN OF EXTENSION AND ANGLE**.

2.4.2.2 Check Main Boom Radius

NOTE: The required accuracy of taped radius measurements is within ±0.5 feet. When taking radius measurements use a good quality tape that does not stretch. The tape should be graduated in feet and tenths of a foot. Always measure between the swing center of the crane and the center of the load hook with the crane centered over front (rough terrain) or centered over rear (truck crane).

1. Fully retract the boom and ensure the crane configuration is correctly set up.
2. Raise the boom to about 45° and measure the radius. The measured radius must match the displayed radius within +0.5 ft. If it does not match, refer to **CALIBRATING THE ANGLE SENSOR ZERO**.

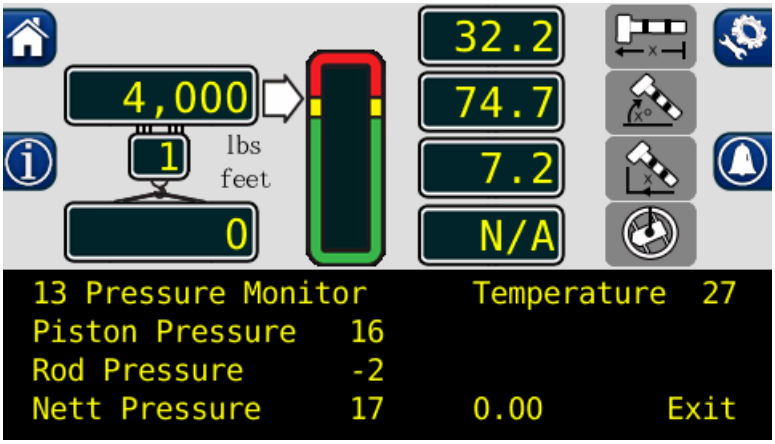
2.4.2.4 Check Pressure Sensors

There are two pressure sensors installed as part of the system. Both pressure sensors are mounted within the computer unit. One is connected to the piston side of the boom hoist cylinder via flexible hose; the other is connected to the rod side of the boom hoist cylinder via flexible hose. Both hoses are protected by velocity fuses within the boom hoist cylinder valve block on the end of the cylinder.

The pressure sensor located on the piston side, is subject to the hydraulic pressure needed to support the weight of the boom, any attachments, and the load. The pressure sensor on the rod side monitors the pressure necessary to control the down motion of the boom. The computer unit uses this information (along with other sensors such as extension and angle), to compute the weight of the suspended load. The maximum continuous working pressure for the sensors is 250 bar (3625 PSI).

The pressure sensing system is calibrated at the factory. Pressure sensors may not be individually replaced. Any serious problem will necessitate changing the entire computer unit.

1. Lower the boom until the boom hoist cylinder is fully retracted and on its stop.
2. Loosen the hydraulic connections to the pressure sensors to ensure zero pressure is present on the sensors.
3. Enter the calibration mode and press “Menu Up” to access “13 Pressure Monitor” to view both sensor pressures and nett pressure.
4. Check the pressure values of both sensors. The pressure values should be between -75 and +75 PSI. If not, replace the computer unit.
5. Check the nett pressure values of both sensors. This should be between -35 and +35 psi. If not, replace the computer unit.



WARNING!

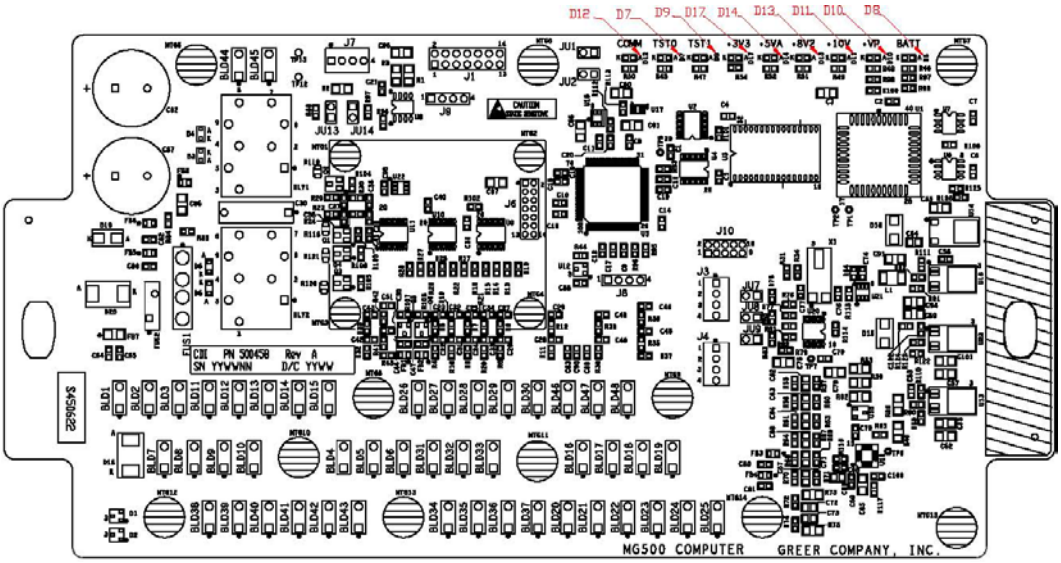
BOTH PRESSURE SENSORS ARE PRE-CALIBRATED FROM THE FACTORY AND SUPPLIED AS PART OF THE COMPUTER. THE PRESSURE SENSORS MAY NOT BE REPLACED. REMOVAL OR REPLACEMENT OF THE PRESSURE SENSORS FROM THE COMPUTER INVALIDATES THE WARRANTY AND WILL ADVERSELY AFFECT THE PRESSURE CALIBRATION.

3.1 Computer Unit Overview

The Computer Unit is the center of the System. It reads the sensors, controls computations and disconnect functions, and communicates with the display console/internal bar graph. The two hydraulic pressure sensors required to sense pressure within the boom hoist cylinder contained within the unit. These sensors, as well as the computer are factory pre-calibrated as a unit and may not be separately replaced in the field.

3.2 Computer Unit Layout

NOTE: Due to differences in computer unit configurations, the locations of board components may vary.



Blade Style Computer

3.3 Internal Status Indicators

The computer unit contains a row of LED indicators for checking computer operation. During normal operation, all LEDs will be illuminated with the COMM indicator blinking. If not, please contact Technical Support for assistance. Use the following chart and preceding images for LED location.

LED Indicator	Function
D7	Communication Indicator TST0
D8	Battery Power_POS
D9	Communication Indicator TST1
D10	+VP
D11	+10V
D12	COMM (Communication Indicator)
D13	+8V2
D14	+5V
D17	+3V3

3.4 Function Kickout Fuse (FUS1)

The computer unit contains a standard 10 AMP replaceable fuse. The fuse protects the function kickout circuit and relay contacts, if a short circuit occurs across the crane kickout solenoids. Replace the fuse, if the system error codes indicate that the function kickout power feed is missing. Ensure the crane circuit breaker is closed and power from the crane is present.

NOTE: Prior to replacing the fuse, ensure any electrical shorts which may have caused the failure of the original fuse have been removed.

3.5 Replacing the Computer Unit

Computer Removal

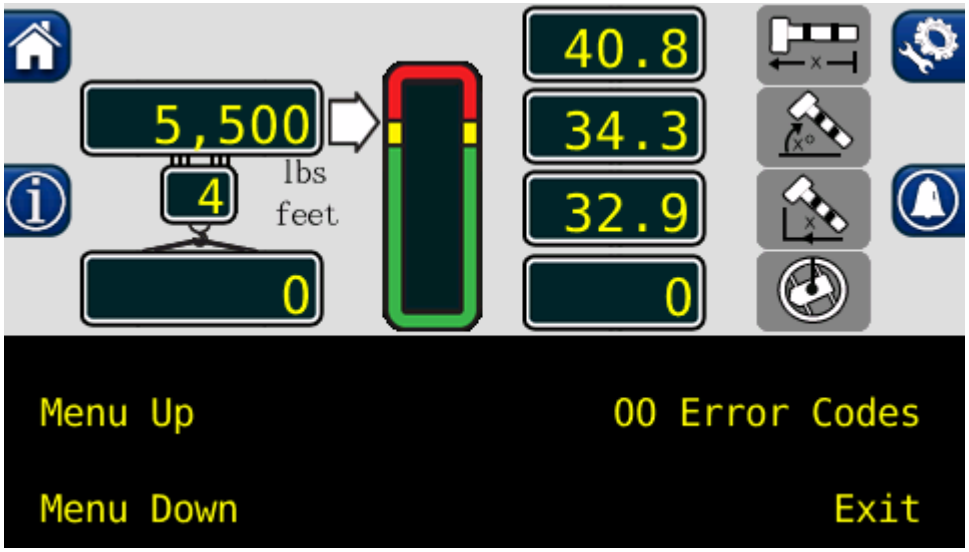
1. Lower the boom until the boom hoist cylinder is completely retracted and on its stop or the boom is firmly in the boom rest.
2. Disconnect the hydraulic connections at the computer unit.
3. Disconnect both electrical connectors at the computer unit.
4. Remove the hardware securing the computer to the cab wall.

Computer Installation

1. Secure the computer unit to the cab wall with the mounting hardware.
2. Ensure the electrical connections face downward.
3. Connect the electrical connectors.
4. Remove the protective caps from the hydraulic ports.
5. Connect the base-side pressure (green band) hose to the piston pressure port.
6. Connect the rod-side pressure (red band) hose to the rod pressure port.

4.1 Display Console Overview

The Display Console allows the user to see the crane values and crane configuration selection. The display also provides calibration functions used for testing and fault diagnosis.



4.2 Checking the Display Console

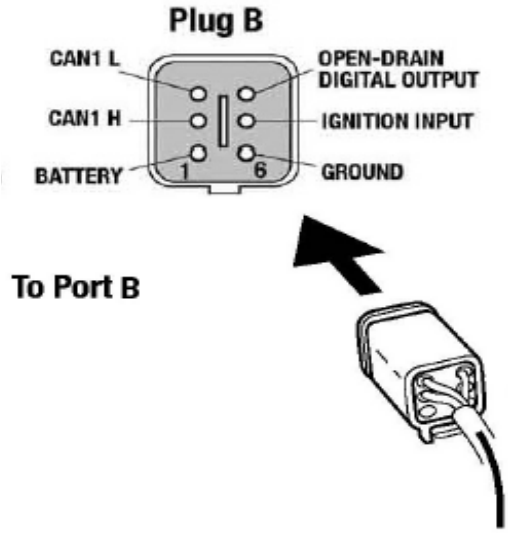
When operated for extended periods under extreme conditions, the console can become damaged. The damage is not always apparent. To help identify subtle faults that are sometimes difficult to find, please review 4.3 through 4.6.

4.3 Unresponsive Buttons

All button options are not available for use at all times. It is important to verify that the non-responsive button is programmed to respond during the operation of the System. Press the button in the center. Pressing the printed symbol ‘at one end’ may not activate the switch underneath. Buttons that are damaged or have a surface that is worn may cause the switch underneath to operate improperly. In this case, refer to **REPLACING THE DISPLAY CONSOLE**.

4.4 Connectors

There are four, 6-pin Deutsch connectors on the rear of the Insight.



4.5 Horn

Ensure the horn is connected to the wiring harness via the two-pin Deutsch connector.

4.6 Moisture

The Display Console conforms to IP67 in protection against dust and water, when correctly installed.

4.7 Replacing the Display Console

Removal

1. Ensure all power is shut off during this procedure.
2. Disconnect the electrical cable from the rear of the operator's display console.
3. Remove the defective display console from the bracket in the cab.

Installation

1. Put the operator's display console on the bracket located in the cab.
2. Connect the electrical cable to the rear of the console.
3. Power can be turned on.

5.1 Calibration Mode

The Greer Insight is an aid to crane operation. Use this system with an operator trained in Safety Guidelines, crane capacity information, and the crane manufacturer's specifications.

When the computer is new, it has no "Zero" or "Span" calibrations. It is necessary to enter "Zero" and "Span" settings for accurate length and angle calculations.

Tools Needed:

- Digital level accurate to 0.1°
- 150-200ft. tape measure graduated in tenths of a foot
- Digital multimeter

Pre-Requisites for Calibration

- The crane must be properly set on level ground per the Manufacturer's specifications.
- Maximum boom height will be needed. It is necessary the area is free of overhead obstructions.
- All options such as Jibs, Fly's, and Auxiliary Heads must be configured in the computer.

5.2 Entering the Calibration Mode

Follow these steps to ensure proper calibration of the Element unit. The actual crane setup must be reflected on the display. Check the **Greer Element Operator's Manual** for proper setup of the display unit.

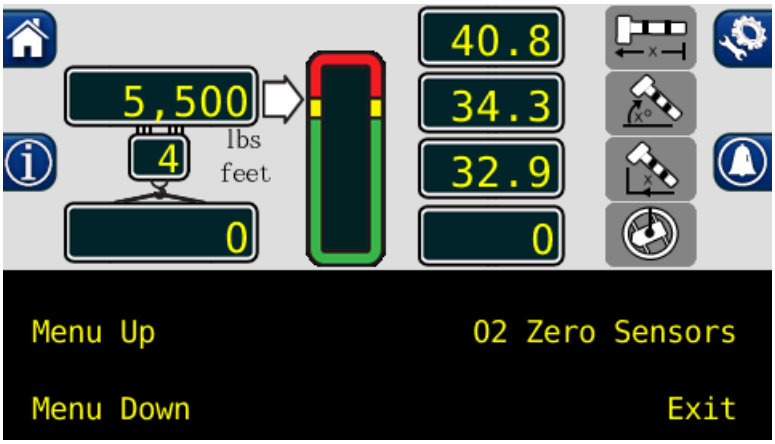
1. To enter Calibration Mode, the display must be in "Normal Operating" mode as shown below.
2. Press and hold the indicated buttons simultaneously until the display prompts the user for the security code.

3. Enter the Security Code within 5 seconds, or the system will revert to the "Normal Operating" mode. The numbers in parenthesis indicate the correct order to press the buttons.

5.3 Calibration Menus

Once the security code has been entered, the display will show the following menu.

Scroll through the menu options by pressing the “Menu Up” or “Menu Down” buttons. To select an item, press the button adjacent to the menu listing as shown in the example.

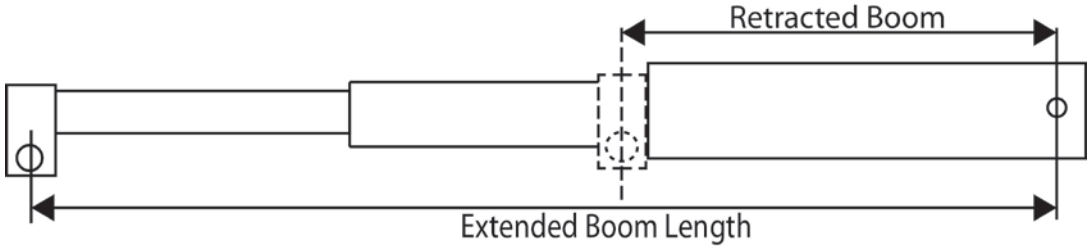


The main menu items used to calibrate the system are:

- 02 Zero Sensors
- 03 Span Sensors
- 04 Swing Sensor

The only calibrations needed are for the Boom Extension Function and the Boom Angle Function. They must be properly set to ZERO. The Swing must also be set to zero, if present.

The Boom Extension and Boom Angle functions must be given a value in order for the Span to be calculated. These numbers are determined by using a digital level on the Boom Angle, and a physical measurement of the Boom Extension.

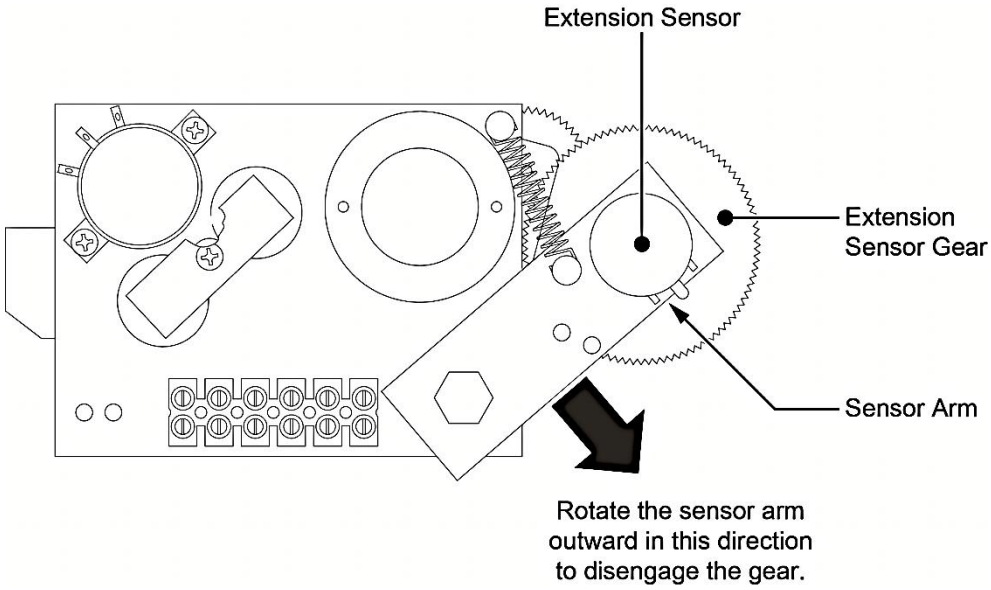


Extended Length – Retracted Length = Span

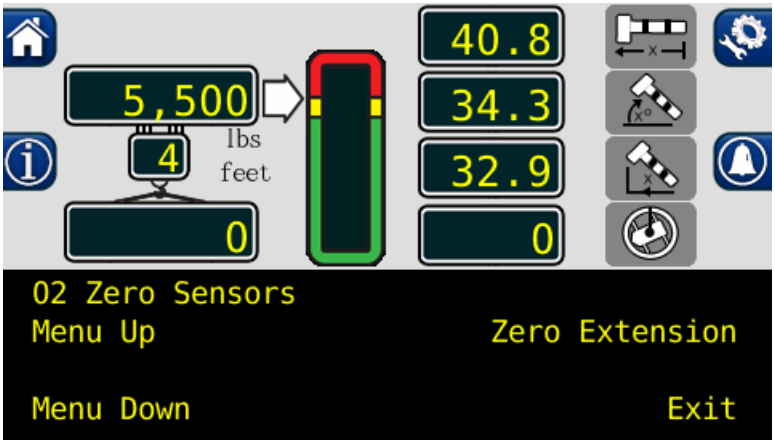
5.4 Calibrating the Extension Sensor Zero

The reeling drum must be installed on the machine, the cable tied-off and the potentiometer set to a starting point for the zero.

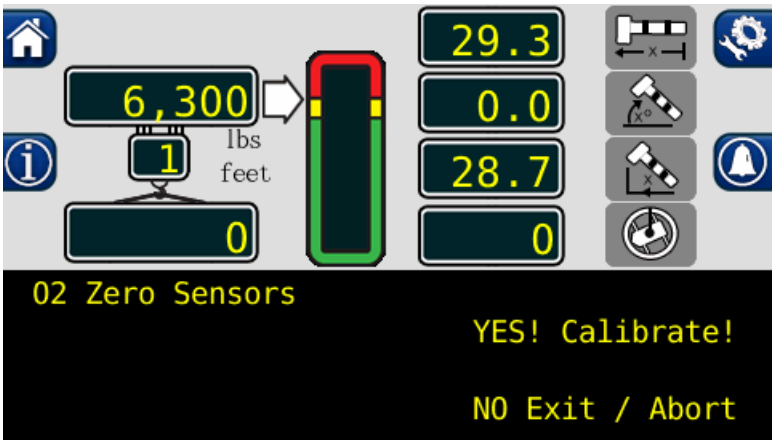
1. Fully retract the boom and lower to “0.0” while using a digital level.
2. Remove the cover from the reeling drum to expose the baseplate sensor assembly.
3. Rotate the extension sensor gear clockwise until the clutch drags/clicks and rotate a ½ turn counterclockwise.
4. The voltage reading between the blue wire and the white wire on the terminal block should measure 0.15 to 0.35 volts. If outside this voltage, rotate the gear to attain proper voltage with the boom fully retracted.



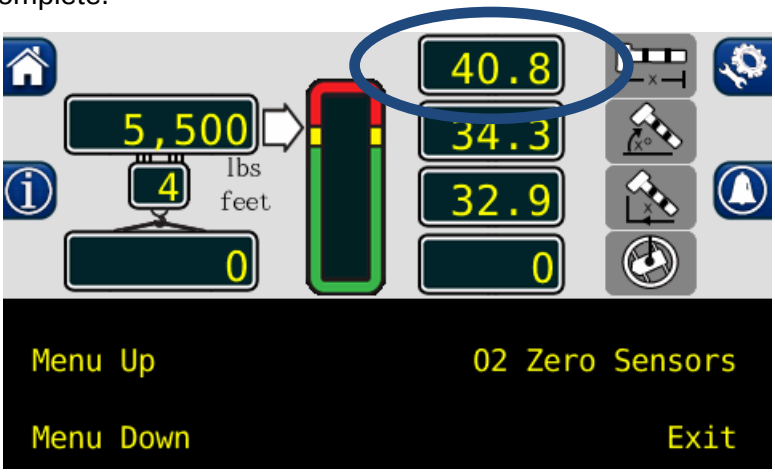
5. Press the “Menu Up” button until “02 Zero Sensors” is reached.
6. Press the “02 Zero Sensors” button one time and the screen should appear as shown.



7. Press the “Zero Extension” button to prompt with the question “YES! Calibrate!” Press the “YES! Calibrate!” button to calibrate zero.



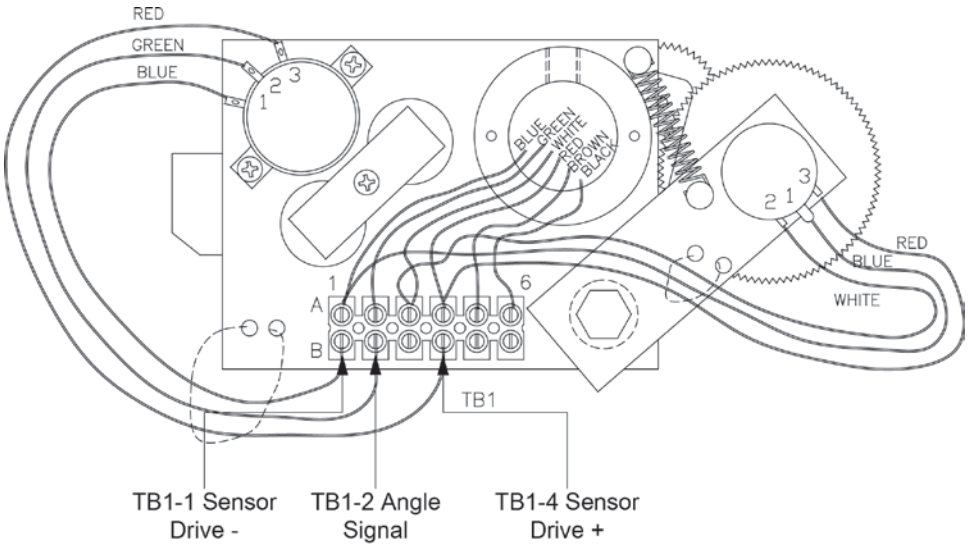
8. The retracted boom length will be displayed in the boom length window. Extension Sensor Zero calibration is complete.



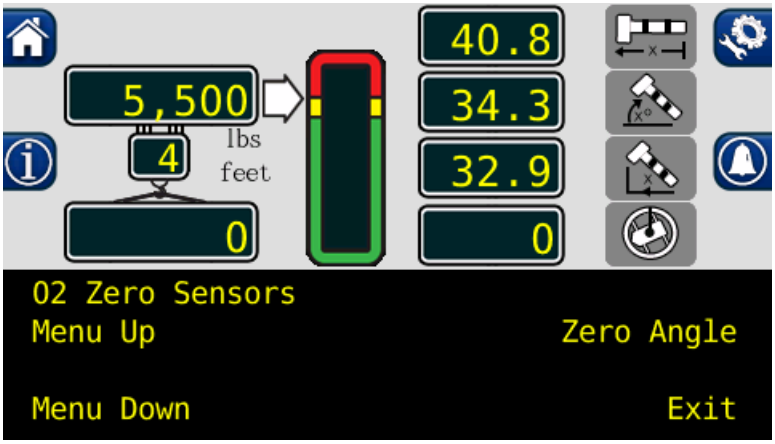
5.5 Calibrating the Angle Sensor Zero

The angle sensors are preset to zero on the Potentiometer before leaving the factory. If the potentiometer is disturbed, the zero setting can be affected. If this happens, the angle sensor will be inaccurate.

If the factory setting has been disturbed, reestablish it by loosening the attaching screws, and rotating the pot until the desired voltage reading is attained.



1. Raise the boom to “0.0” degrees. Verify using a digital level.
2. Check the voltage between blue wire and the green wire. It should measure between 0.400 and 0.600V in the correct position.
3. Enter the “02 Zero Sensors” menu.
4. Press the “Menu Up” button to display “Zero Angle”.



5. Press the “Zero Angle” button.
6. Press the “YES! Calibrate!” button and the routine is complete.

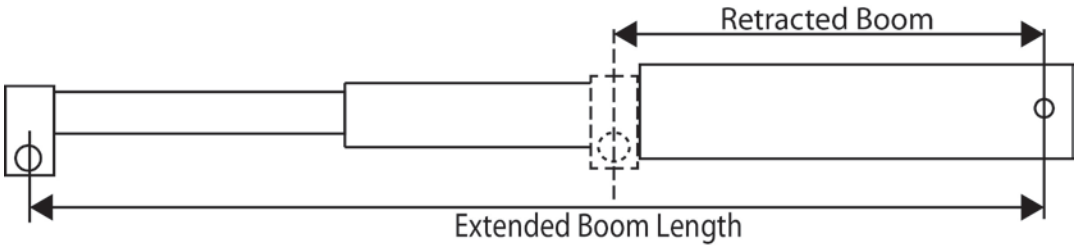
5.6 Calibrating Span of Extension and Angle

WARNING!

THE AREA OVERHEAD ABOVE THE CRANE MUST BE CLEAR OF OBSTRUCTIONS PRIOR TO CALIBRATING SPAN OF EXTENSION AND ANGLE!

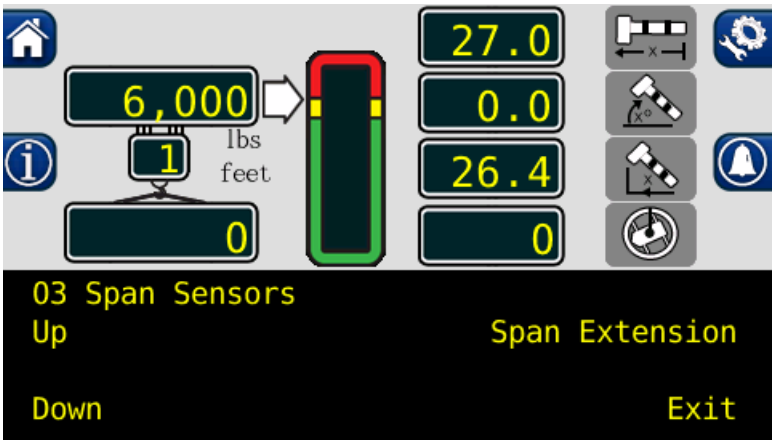
In order for the system to properly calculate the boom length and the boom angle, the “Span Number” must be entered into the system. Obtain the Span Number with the following steps:

1. Measure the boom from the base foot pin to the center of the head sheave pin. Record this measurement.

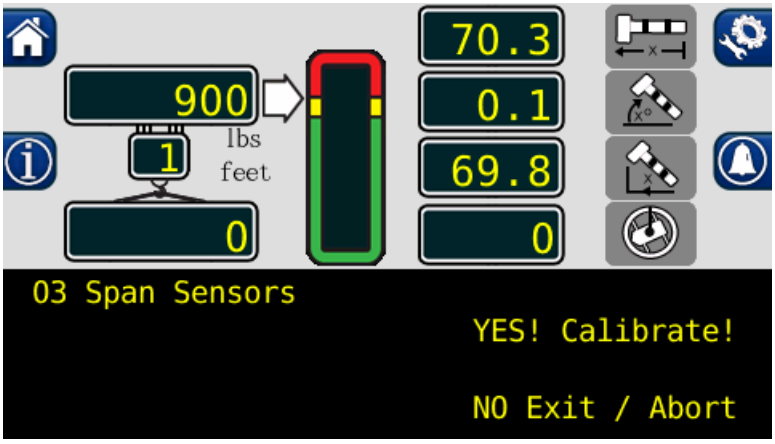


Extended Length – Retracted Length = Span

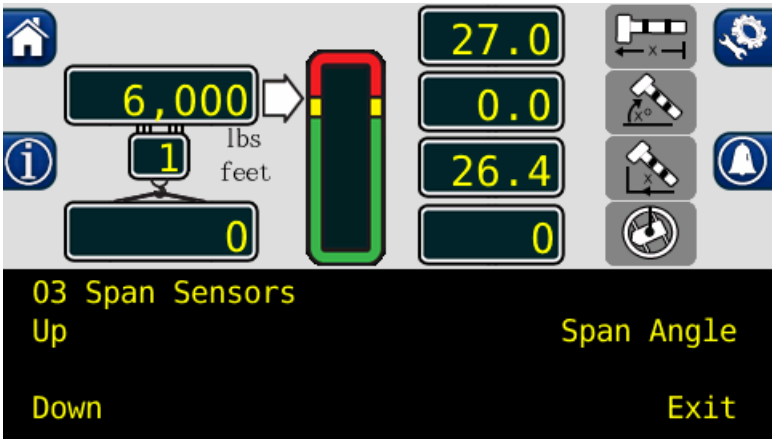
2. Raise the boom to between 60°-65° and fully extend the boom. Record the measurement from the digital level, for entry into the system later in this procedure.
3. From the main screen, press the “Menu Up” button until “03 Span Sensors” is reached.
4. Press the “Span Extension” button.



5. Press the “YES! Calibrate!” button.

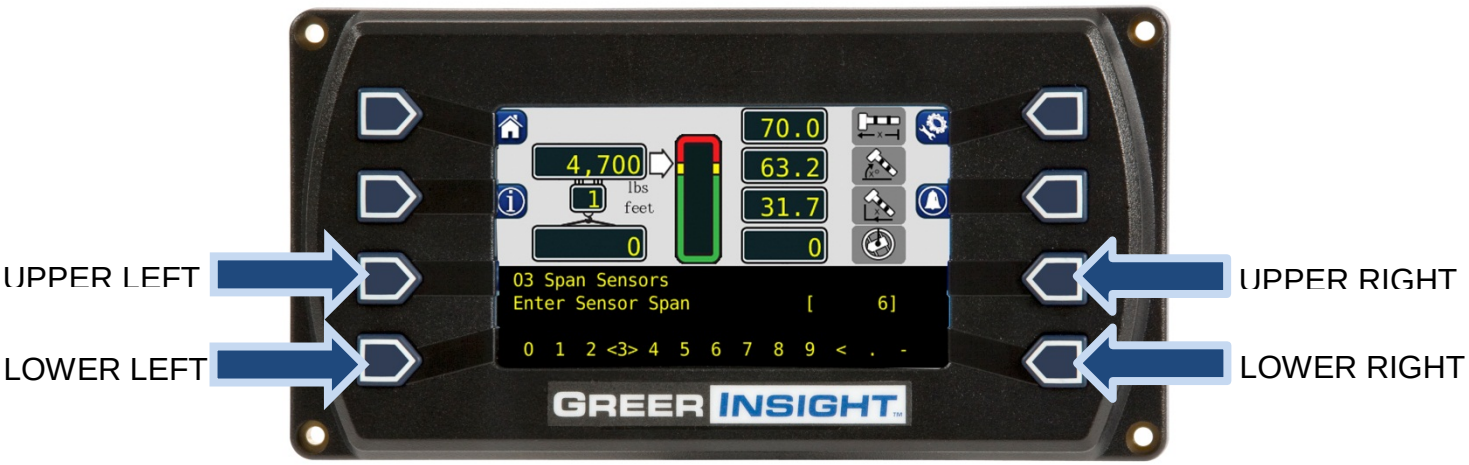


6. The Span of Extension is now calibrated. And the maximum boom length will be displayed.
7. Press the “Menu Up” button to access the Span Angle option.



8. Press the “Span Angle” button to enter the current reading from the digital level.

9. Use the following screen to enter the number. Always enter numbers with a decimal point.

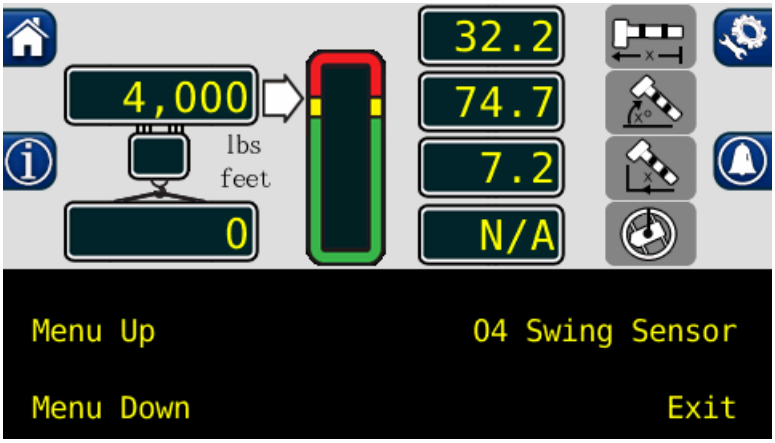


10. The lower left and lower right buttons are used to select the number. The number inside the brackets is the current selection, in the above image, the number 3 is between the brackets.
11. Use the upper left button to enter the numbers, one at a time.
12. When the number is entered, press the upper right button to enter the number into the system memory. Once entered the extension and span calibration routine is complete.

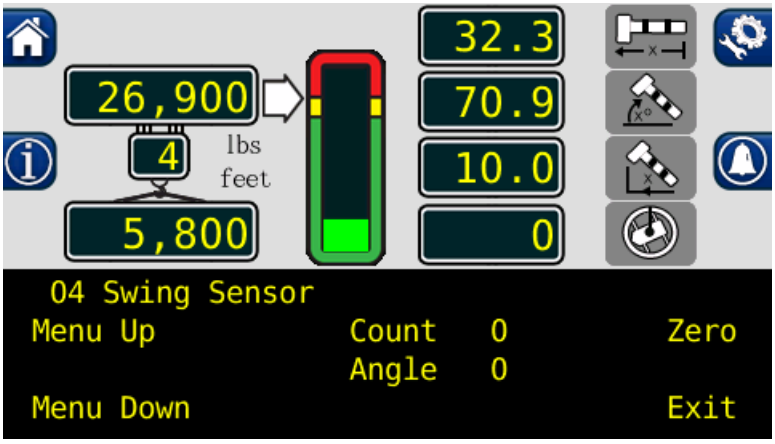
5.7 Calibrating the Swing Sensor (If Equipped)

After completing the extension and angle span, return to the main calibration screen.

1. Press the “Menu Up” button until “04 Swing Sensor” is reached. This menu will allow a zero point to be set on the swing circle and a direction for the system to track the rotation angle.
2. Press the “04 Swing Sensor” button.



3. Press the “Zero” button, to set the swing sensor to zero with the current boom location.

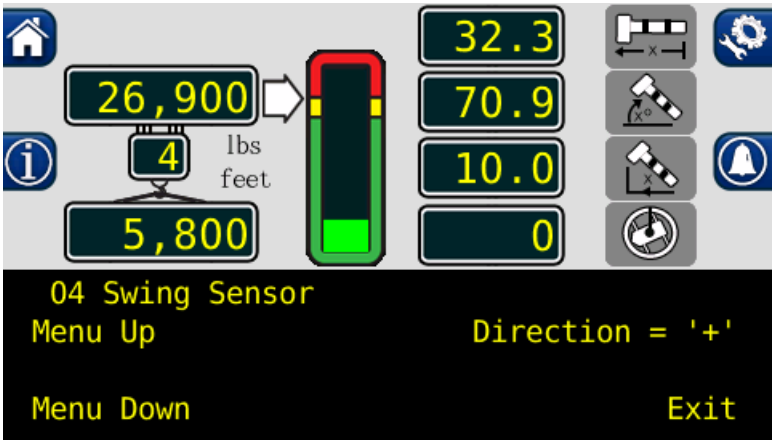


4. The swing sensor is now zeroed.

5.7.1 Calibrating the Swing Direction

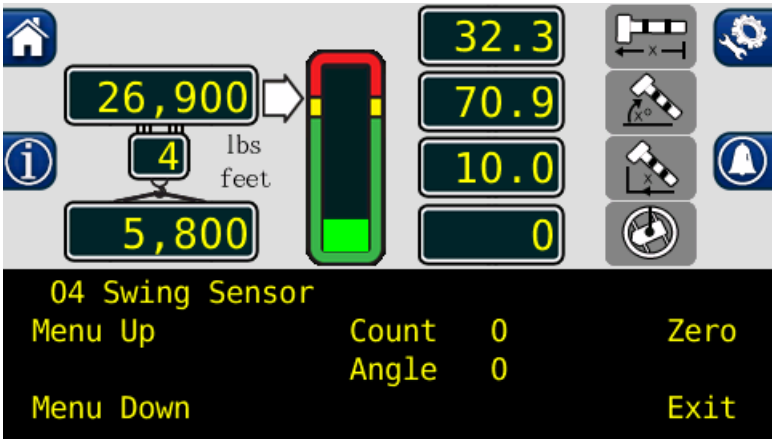
The swing sensor supplies data for either direction. For consistency, the swing should count upwards (0, 1, 2, 3, etc.) when rotating clockwise. The direction of the swing can be changed while using the Greer Insight display.

1. While still in the “04 Swing Sensor” menu, and sensor zeroed, press the “Menu Up” button until “Direction = +” is displayed.
2. Press the “Direction = +” button to toggle directions on the swing count.



5.7.2 Enabling the Swing Sensor

1. Enter the calibration menu and press “Menu Up” to display “04 Swing Sensor”.
2. Press the “04 Swing Sensor” button. If the swing sensor is connected, entering this menu will automatically initialize the sensor.
3. Press the “Zero” button, to set the swing sensor to zero with the current boom location.

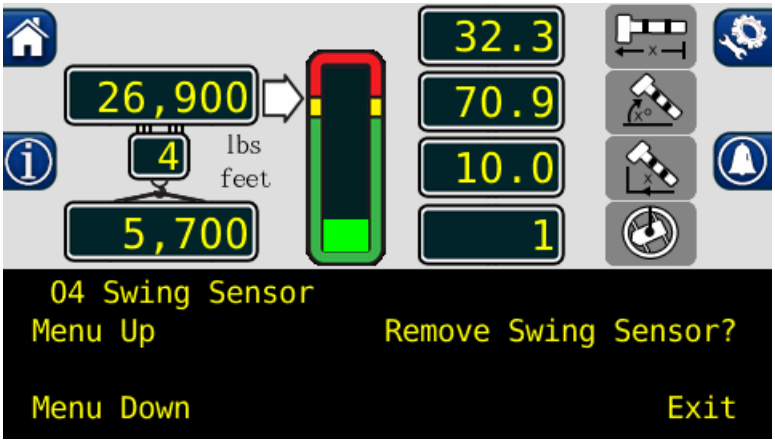


4. The swing sensor is now initialized with a zero point. This will allow the use of the Swing Alarms and Work Area Alarms.

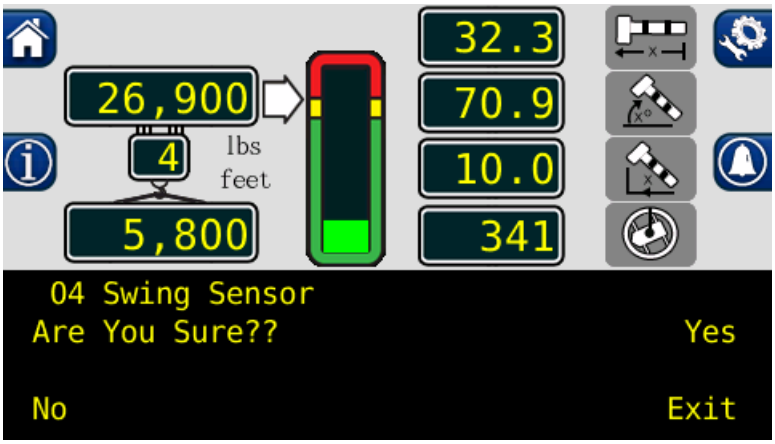
5.7.3 Disabling the Swing Sensor

If there is a problem with the Swing counter or the ISS Module, it may be necessary to disable the functionality in the calibration menu. This will remove any error codes and allow the crane to be operated until the problem can be fixed.

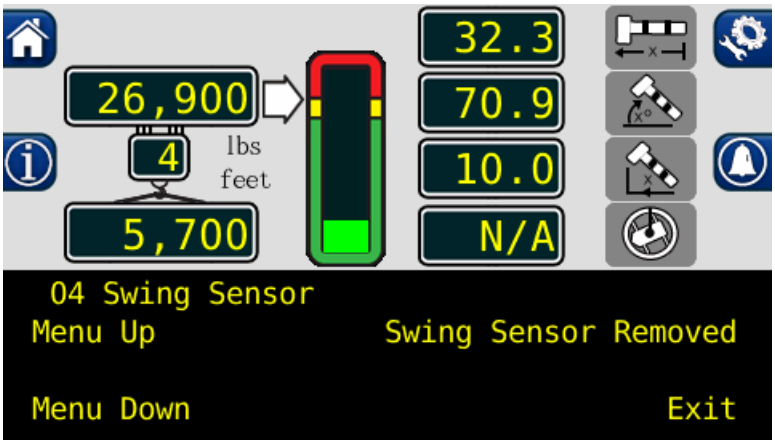
1. Enter the calibration menu and press “Menu Up” to display “04 Swing Sensor”.
2. Press the “04 Swing Sensor” button.
3. Press the “Menu Up” button to display the “Remove Swing Sensor?” option.
4. Press the “Remove Swing Sensor?” button.



5. Press the “Yes” button when prompted with “Are you sure??”



6. The Swing sensor is now disabled. The Swing angle window will display “N/A” instead of a number.



5.8 Calibrating the Outrigger Position Sensor

For cranes with digital switch outrigger position sensors, replace the faulty sensor. No calibration is needed.

At power up, the system will use the last used OPS position and select the corresponding chart. It will display a white arrow above the corresponding outrigger position on the screen. The operator can then continue with setup as normal.

The system will pick the chart based on these inputs:

DI1	DI2	Chart
0	1	No-Span
1	0	Mid-Span
1	1	Full-Span
0	0	Error

5.9 After the Calibration Routine

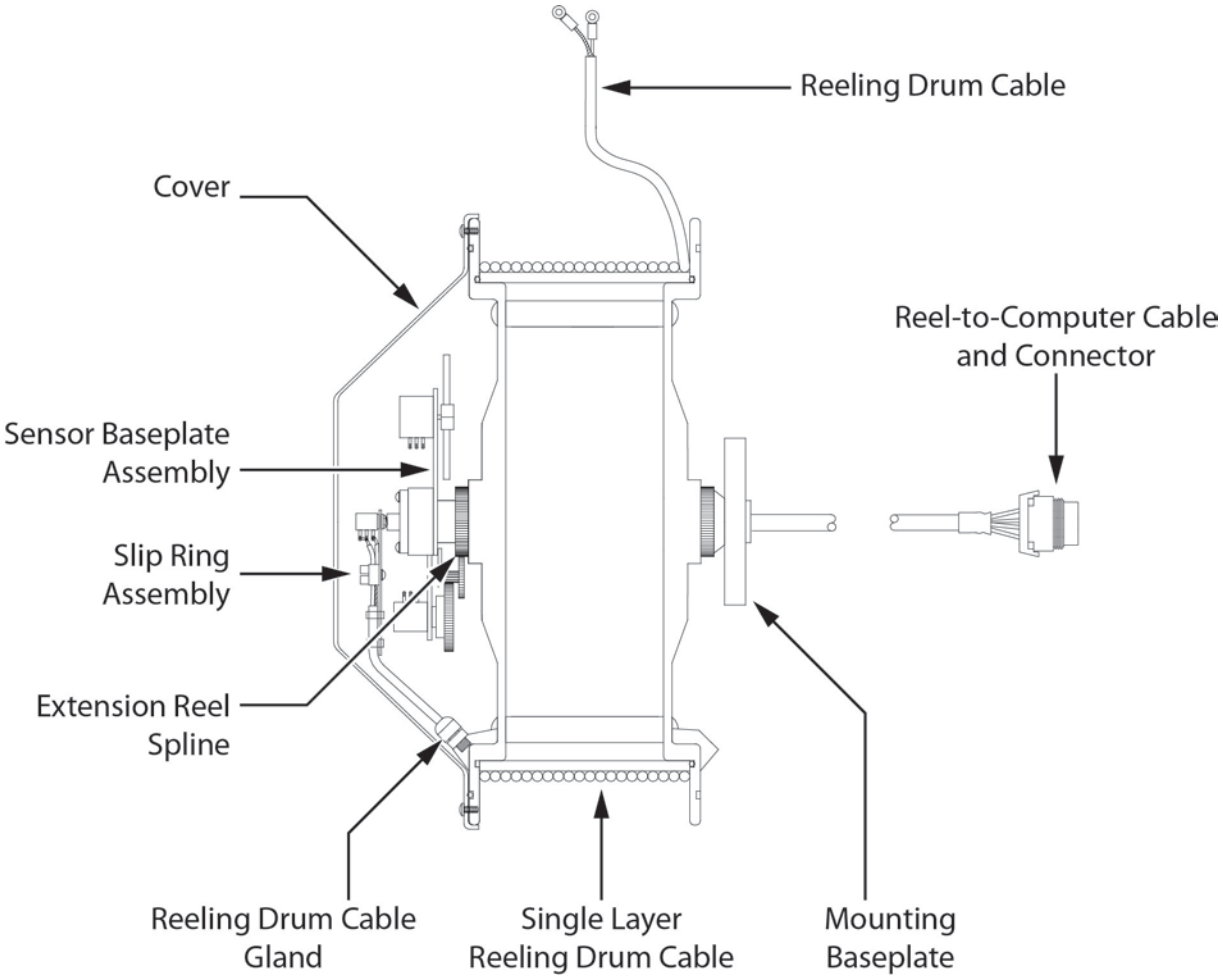
When the calibration routine is complete, thoroughly test the unit to ensure the radius on the unit is accurate to + .5 of a foot. No negative tolerance is acceptable.

In order to perform load testing, a known weight is necessary. Perform testing from 2-3 different boom angles, as well as extensions.

The load must within +10% when testing, no negative tolerance is acceptable. If the load is outside these limits, the calibration should be rechecked for accuracy.

6.1 Reeling Drum Overview

The primary operation of the Reeling Drum is to measure the extension of the telescoping sections of the main boom. The Reeling Drum also includes an angle sensor to measure the main boom angle, and an electrical slip-ring which transfers the Two-Block signal from the Reeling Drum cable to the system computer. It is important the setup and maintenance of these devices is properly carried out per the procedures in this manual. Incorrect maintenance can result in system calculation errors.

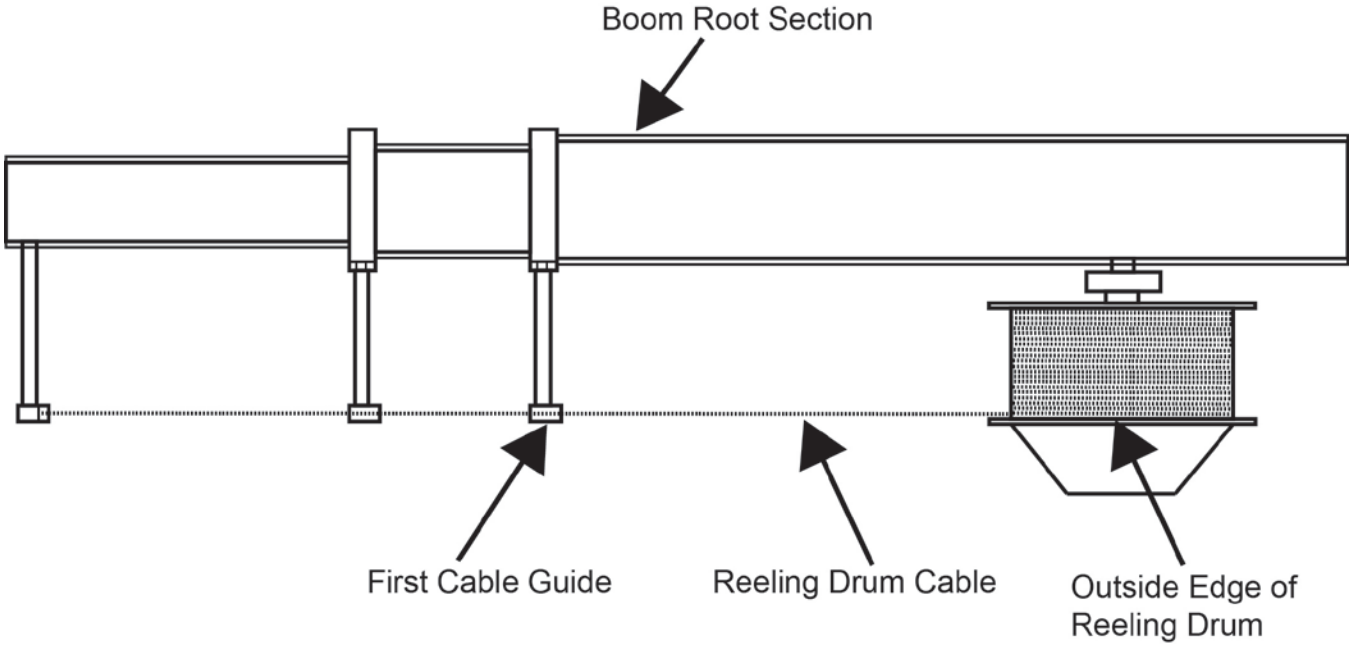


6.2 Checking the Reeling Drum Cable Layering

The extension reel is designed to provide accurate measurement of boom extension. To provide accurate measurement, the Reeling Drum cable must form a single flat layer across the surface of the extension reel as the boom is telescoped in and out. Any stacking of the cable will cause extension errors as the boom retracts.

1. Telescope the boom fully out and then fully in.
2. Check that the reeling drum cable forms a flat single layer across the surface of the extension reel, with each successive turn of cable lying next to the last.

NOTE: If any stacking or build up of the cable occurs, ensure the first cable guide at the top of the boom root section is correctly aligned with the outside edge of the extension reel. Clean the reeling drum cable, and lubricate it with a silicone spray, as shown below.



Reeling Drum Viewed from Above

6.3 Checking the Reeling Drum Cable

The outer braid of the cable carries the Anti-Two-Block feed to the switches. If the cable sheath is damaged, this may cause a short circuit to the boom/chassis. The same fault code will be indicated if the ATB switch is closed and the inner core of the cable is shorted to the chassis at some point in the wiring.

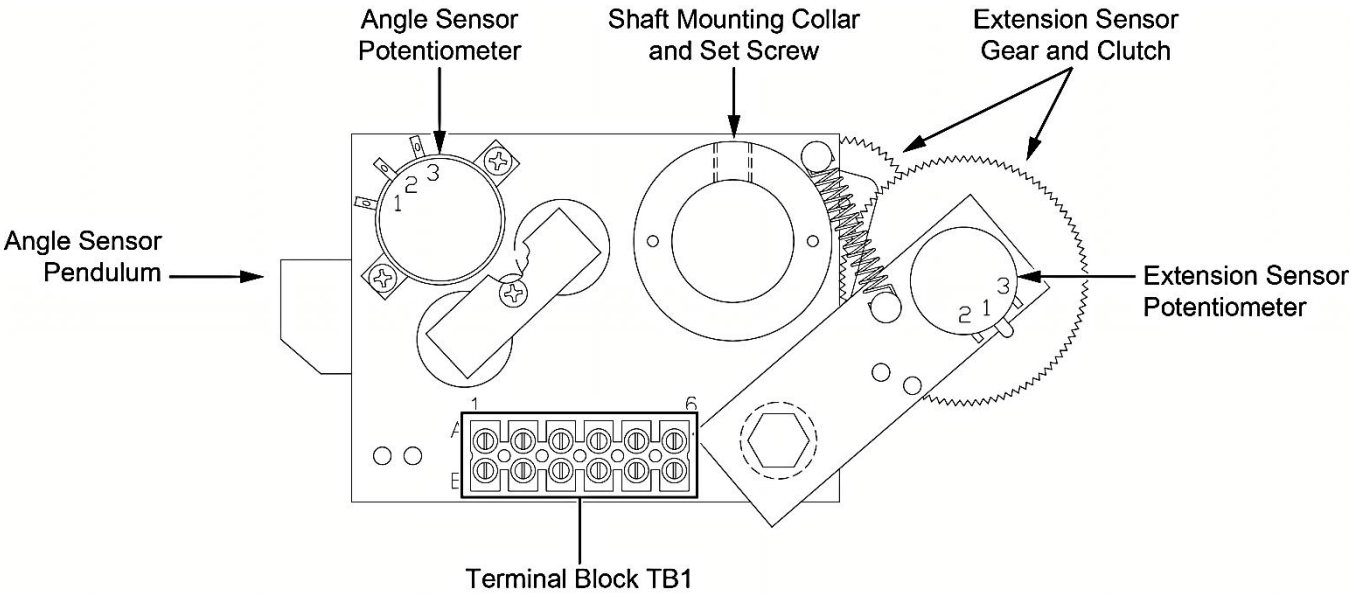
1. Carefully inspect the reeling drum cable for wear.
2. Check for signs of damage to the outer sheath of the cable.
3. Check for any signs of severe “kinking” or crushing of the cable.

6.4 Sensor Baseplate Assembly

The Sensor Baseplate Assembly supports and connects the extension and angles sensors. It also supports the two-block switch signal and signal cable to the computer.

Electrical or mechanical failure of either the angle sensor or the extension sensor potentiometers cannot be repaired in the field. The angle sensor pendulum is factory set on the potentiometer shaft and the extension potentiometer gear contains a protection clutch which is difficult to replace in the field. In the event of failure of either item, replace the entire sensor baseplate assembly.

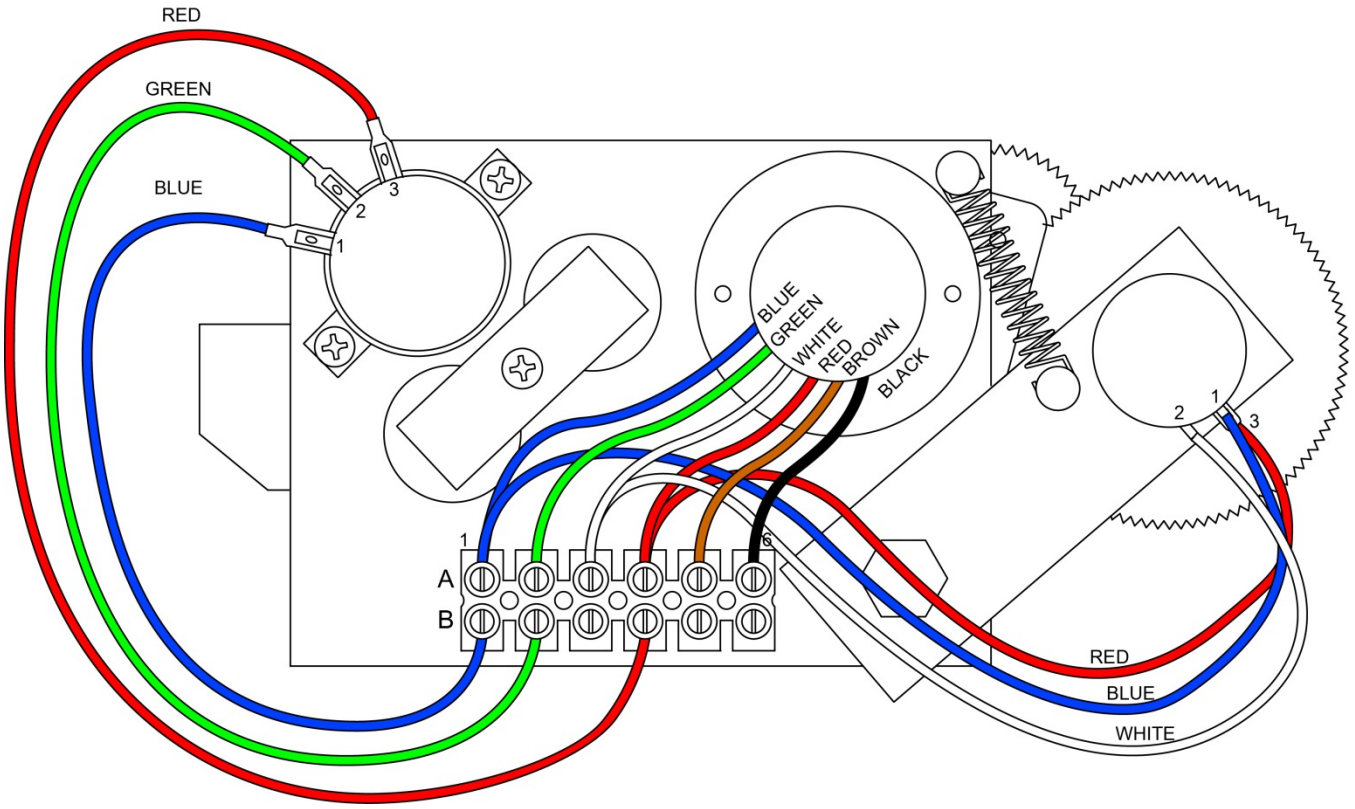
The terminal block (TB1) mounted on the assembly provides wiring connection for all internal parts of the Reeling Drum and Reel-to-Computer cable. Most electrical diagnoses of the boom sensors can be made at this terminal block.



6.5 Reeling Drum Voltage Checks

If problems occur with the two-block alarm operation, angle, or extension sensor, refer to the following chart. Follow the Boom Position/Action column before performing any voltage checks. Measure all voltages with a digital voltmeter set to DC volts range.

SIGNAL	BOOM POSITION/ ACTION	VOLTAGE		VOLTMETER CONNECTION	
		MIN	MAX	RED (+)	BLACK (-)
SENSOR DRIVE	-	+4.7V	+5.3V	RED	BLUE
ANGLE SENSOR OUTPUT	0 degrees	0.4V	0.6V	GREEN	BLUE
EXTENSION SENSOR OUTPUT	0 ft. FULL RETRACTED	0.15V	0.35V	WHITE	BLUE
TWO-BLOCK DRIVE	ATB WEIGHT DOWN	5.5V	7.5V	BLACK	BLUE
	ATB WEIGHT UP	9.5V	10.5V	BLACK	BLUE
TWO-BLOCK SIGNAL	ATB WEIGHT DOWN	5.5V	7.5V	BROWN	BLUE
	ATB WEIGHT UP	0V	2V	BROWN	BLUE



6.6 Anti-Two-Block Function Overview

The computer supplies a protected positive feed to the Anti-Two-Block switches at the boom/jib head via the extension reel signal cable, slip-ring, and reeling drum cable. With the Anti-Two-Block weight hanging freely on the switch, the switch contact is closed and the signal return to the computer is high (6.25 volts). When the weight is lifted by the hook block, the switch contact is opened, and the computer will sense a low signal input (0 volts) from the ATB signal return.

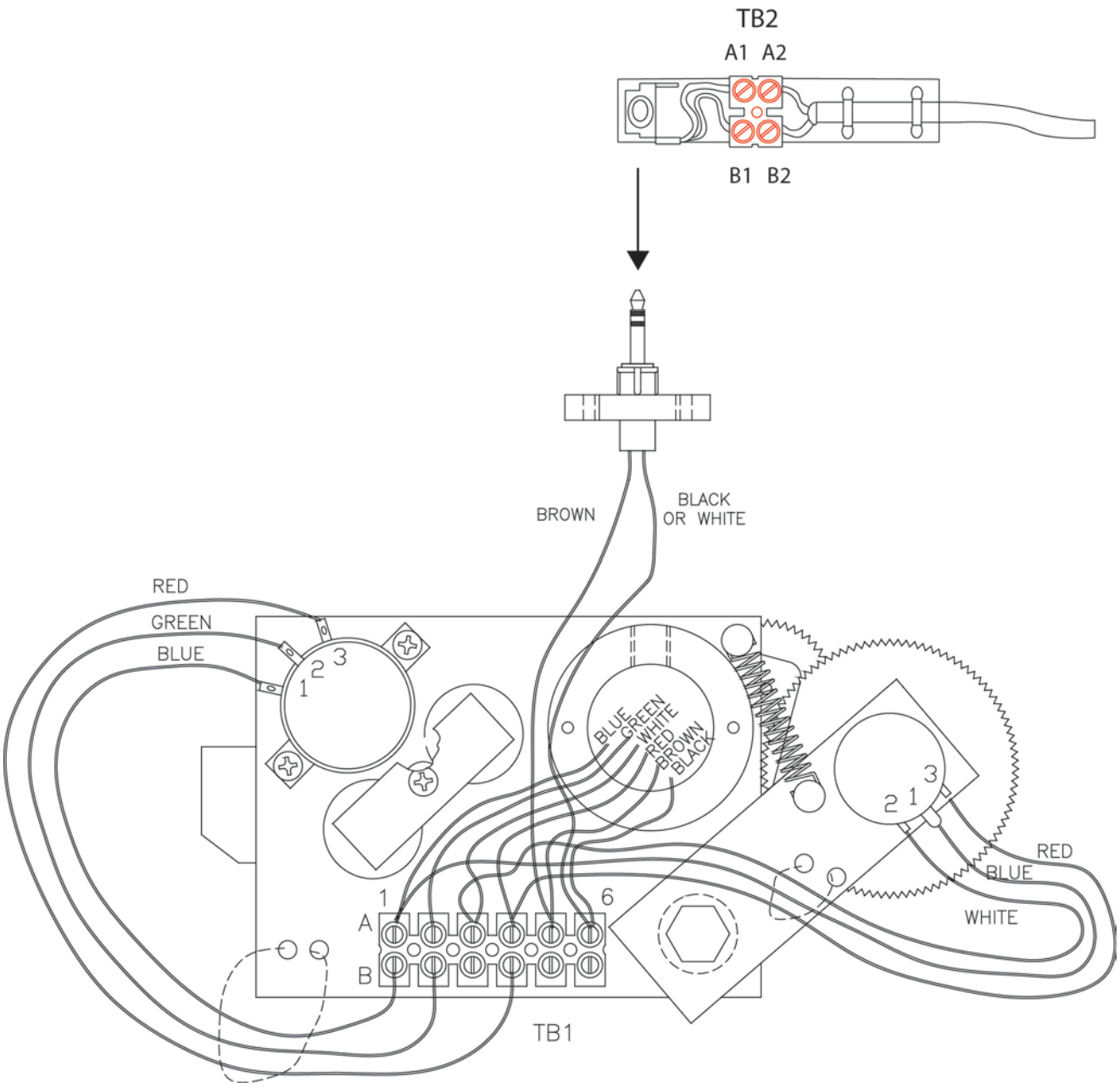
Since the computer checks the protected feed voltage internally, the system is capable of detecting a short circuit of the feed (or the ATB signal return when the switch is closed) to the crane chassis. Refer to **FAULT REPORTING AND FAULT CODES**.

Most problems with the ATB circuit may be identified through inspection of cables, switches, and the extension reel. Damage to these parts may result in continuous or intermittent ATB alarms.

6.7 Checking the Anti-Two-Block Circuit

Before continuing, ensure the connectors are correctly connected to the ATB switches at the boom head/jib. This procedure checks the ATB circuit when no power is applied to the circuit, use the diagram on the following page. If power is present on the circuit, refer to **REELING DRUM VOLTAGE CHECKS**.

1. Remove the extension reel cover.
2. Disconnect the slip-ring arm from the plug by pulling it away from the center of the reel.
3. Close the ATB switch at the boom head by suspending the weight from it or pulling on the chain.
4. Measure the resistance between the blue and green wire terminal connections on the sensor arm.
5. With the ATB switch closed, the resistance should be less than 300 ohms. If not, inspect the reeling drum cable, ATB switch, and the boom head connectors for an Open circuit.
6. Open the ATB switch at the boom head by lifting the weight.
7. Measure the resistance between blue and green wire terminal connections on the sensor arm.
8. With the ATB switch open, the resistance should be greater than 10,000 ohms. If not, inspect the reeling drum cable, ATB switch, and the boom head connectors for a short circuit.


TB2
A1 A2
B1 B2
BROWN
BLACK
OR WHITE
RED
GREEN
BLUE
1
2
3
BLUE
GREEN
WHITE
RED
BROWN
BLACK
RED
BLUE
WHITE
1
6
A
B
TB1

7.1 WAD/ISS Overview (If Equipped)

The WAD/ISS (Work Area Definition/Integrated Swing Sensor) incoporates a sensor housed in the swing drive of the crane that measures the angle of the upper structure of the crane relative to its carrier. The sensor measures the angle by counting electronic pulses on the target gear relative from the zero point (set by the operator) in either a positive or negative direction. The conditioning box translates the signal so it can be processed by the computer and shown in the information window of the display console.

WAD/ISS Conditioning Box

The advantage of the WAD/ISS over a typical swing potentiometer is the swing potentiometer is housed in the collector column and maintenance and/or removal is difficult. The WAD/ISS is a small unit mounted directly onto the swing drive and is easily accessible.

During normal operation, faults detected with the WAD/ISS will be shown on the display unit. During such fault conditions the red “Overload” LED will flash accomapnied by an intermittent audible beep. Additionally, the swing angle display will “ERROR” as well as the information window showing an error condition message. All swing related operator alarms, work area alarms, etc, will be displayed.

7.2 WAD/ISS Troubleshooting Table

Error Message / Problem	Cause	Correction
"SWING SENSOR SIGNAL 1 ERROR!" "SWING SENSOR SIGNAL 2 ERROR!" "SWING SENSOR ERROR!" "SWING SENSOR LOGIC REPORT!"	Cable from sensor to condition box disconnected. Cable from sensor to conditiong box grounded.	Replace sensor.
"SWING SENSOR COMMS ERROR!"	Cable from condiiton box to computer disconnected at computer or conditiong box. Cable from condition box to computer grounded.	Check cable. Check connection at conditiong box and computer. Replace cable. If display shows load, angle, radius, etc, replace the conditioning box.
Intermittent, inaccurate, or no output activity	WAD/ISS too far from target within swing drive. WAD/ISS sensor too close to target within swing drive. WAD/ISS not responding normally but drawing normal current and providing normal outputs. WAD/ISS disconnected from computer.	Check sensor and sensor connection.

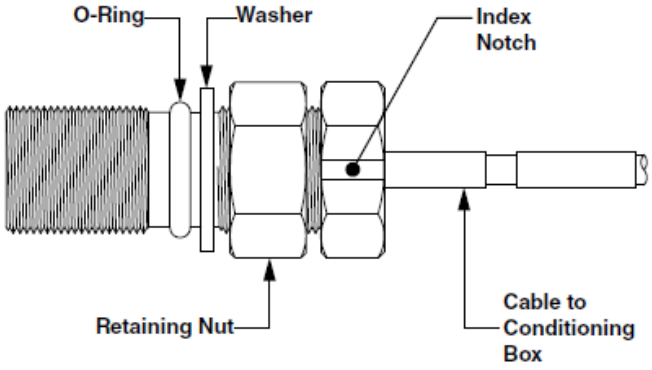
7.3 Replacing the Swing Sensor

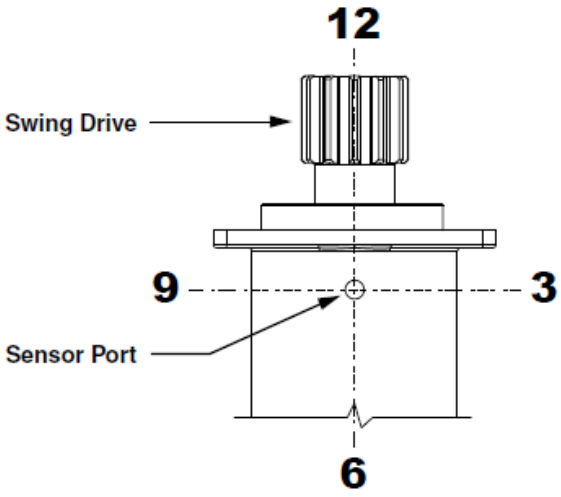
7.3.1 Swing Sensor Removal

1. Place the boom in the rest (stowed position).
2. Turn off the power to the crane.
3. Disconnect the sensor cable from the conditioning box.
4. Loosen the sensor retaining nut.
5. Remove the sensor from the swing drive housing.

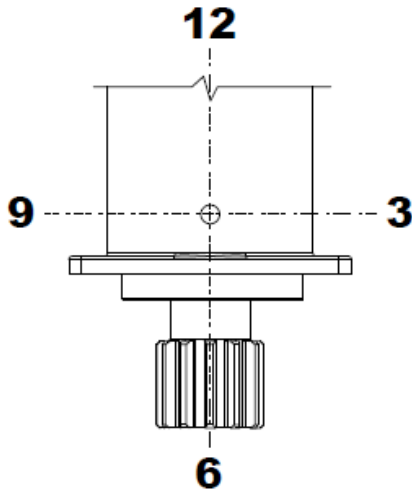
7.3.2 Swing Sensor Installation

1. Insert the threaded end of the sensor into the sensor port of the swing drive and screw it in until the end of the sensor contacts the gear inside the swing drive housing. Do not force the sensor any farther past this point.
2. Note the location of the index notch on the sensor. Rotate the sensor counterclockwise a ½ turn. (Illustrations on next page.)
3. Note the position of the index notch on the sensor and continue to rotate counterclockwise until the index notch reaches the ‘three o’clock’ or ‘nine o’clock’ position.
4. If the initial 180° turn puts the index notch on the ‘three o’clock’ or ‘nine o’clock’ position, continue to rotate counterclockwise until the next ‘three o’clock’ or ‘nine o’clock’ position is reached.
5. For calibration instructions, refer to **Swing Sensor Setup**.





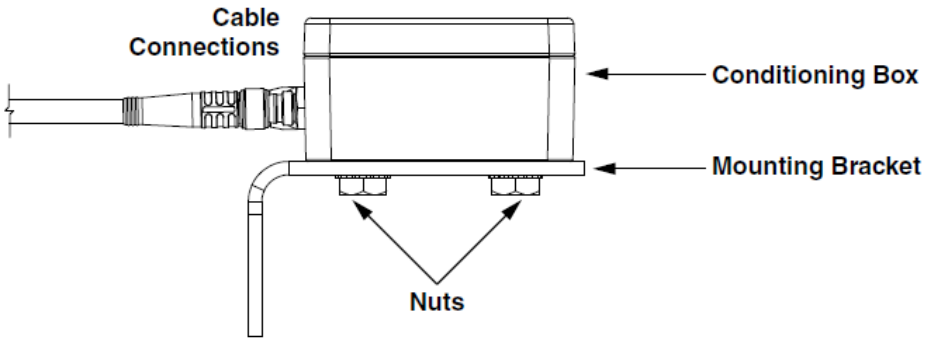
PINION UP



PINION DOWN

7.4 Replacing the Conditing Box

1. Place the boom in the rest (stowed position).
2. Turn of power to the crane.
3. Disconnect the cables from the conditioning box.
4. Remove the two nuts attaching the conditiong box to the mounting bracket.
5. Install the new conditioning box onto the mounting bracket.
6. Reconnect the cables to the new conditioning box.



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W450321A 09/12

OMNEX
TRUSTED WIRELESS

Elliott
LMI Interface

Installation / Configuration Manual

T2300 Transmitter

R2170 Receiver

D160 Expansion Module

D180 Expansion Module

October 7, 2008

Revision 2

DM-R2170-0002A

#74-1833 Coast Meridian Road, Port Coquitlam, BC, Canada • V3C 6G5
Ph# (604) 944-9247 • Fax# (604) 944-9267
Toll Free 1-800-663-8806

Table of Contents

NOTE: *These instructions are intended only for installing and operating the remote control equipment described here. This is not a complete Operator's Manual. For complete operating instructions, please read the Operator's Manual appropriate for your particular machine.*

Safety Precautions

READ ALL INSTRUCTIONS

CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Failure to follow the SAFETY PRECAUTIONS may result in radio equipment failure and serious personal injury

Installation

PROVIDE A SAFETY CUTOFF SWITCH. If maintenance is required, the radio must be disconnected from power

USE PROPER WIRING. Loose or frayed wires can cause system failure, intermittent operation, machine damage, etc.

DO NOT INSTALL IN HOT AREAS. This apparatus can be damaged by heat in excess of 158°F (70°C)

Personal Safety

MAKE SURE MACHINERY AND SURROUNDING AREA IS CLEAR BEFORE OPERATING. Do not activate the remote system unless it is safe to do so.

TURN OFF THE RECEIVER POWER BEFORE WORKING ON MACHINERY. Always disconnect the remote system before doing any maintenance to prevent accidental operation of the machine

Care

KEEP DRY. Do not clean the transmitter / receiver under high pressure. If water or other liquids get inside the transmitter battery or receiver compartment, immediately dry the unit. Remove the case and let the unit air dry

CLEAN THE UNIT AFTER OPERATION. Remove any mud, dirt, concrete, etc. from the unit to prevent clogging of buttons, switches, etc. by using a damp cloth.

Maintenance / Welding

DISCONNECT THE RADIO RECEIVER BEFORE WELDING on the machine the receiver is connected to. Failure to disconnect will result in the destruction of the radio receiver.

System Overview

The **ORIGA** T2300 / R2170 / D180 / D160 is a portable, long range, programmable radio remote control system. Designed as a compact and easy-to-use product, this member of the **ORIGA** family puts complete control of your crane where it's needed most, with the operator. It's robust, easy to install and has complete self-diagnostics. This system can be a simple cable replacement or add intelligence to make it a total control package. It's a radio, a PLC and a valve driver all in one.

The **ORIGA** T2300 / R2170 / D180 / D160 system uses Frequency Hopping Spread Spectrum (FHSS) technology. FHSS devices concentrate their full power into a very narrow signal that randomly hops from frequency to frequency within a designated band. This transmission pattern, along with CRC-16 error-checking techniques, enables signals to overcome interference that commonly affects licensed radios.

The R2170 receiver is designed to be powered from a 12VDC or 24VDC system. The R2170 is a radio receiver that takes commands from an OMNEX wireless transmitter and translates the commands into CANbus or 485 protocol messages. The R2170 receiver may also be configured as a CANbus bridge.

The D180 Expansion Unit has up to fourteen current-control, PWM, or voltage outputs, or a combination of these types.

The D160 Expansion Unit has up to nineteen digital I/O channels, four of which may be configured as proportional PWM or voltage output signals.

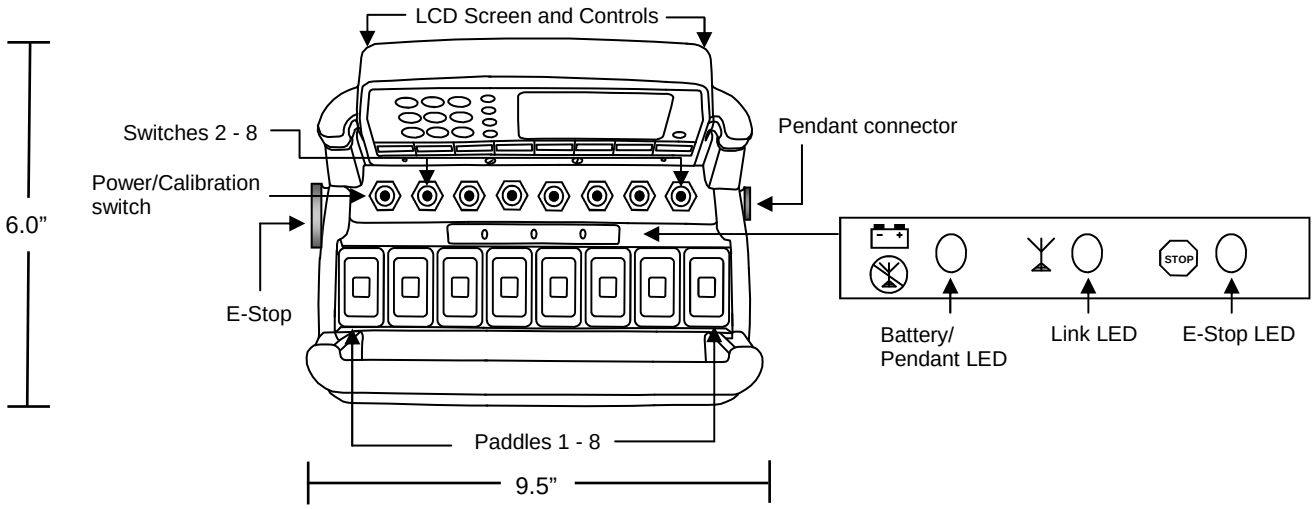
The T2300 transmitter comes with up to sixteen proportional and sixteen digital controls. The T2300 can accommodate up to eight single axis paddles, eight three-position switches and a re-settable E-Stop. A unique ID code is used by each T2300 to ensure that no two systems will conflict on a job site.

Features

- FCC, ISC, CE approved
- License free
- 900 foot range @ 2.4 GHz
- Compact / weatherproof / ergonomic
- Simple "wire-and-use" installation
- Resilient to impact and shock
- Available with paddles and/or joysticks for proportional control
- Available with an optional pendant cable
- Factory configurable for all custom applications.

T2300 Transmitter

T2300 Dimensions and Controls

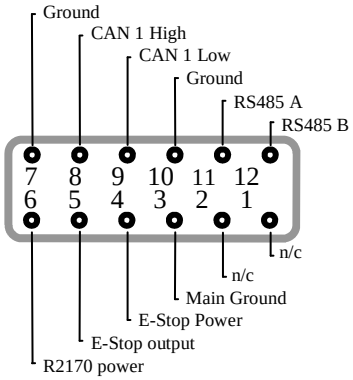


R2170 Pin Assignments

There are two connectors on the R2170. Connector A is Grey, while Connector B is Black. Normally, OMNEX will provide you with the appropriate pre-terminated cables for connection to the R2170. For reference, the pin functions for both connectors are provided below:

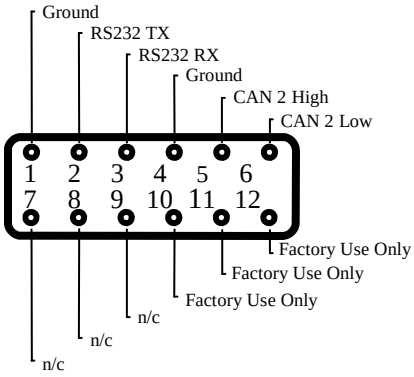
Connector A (Grey)

Pin	Function
1	n/c
2	n/c
3	Main Ground Connection
4	Power in to E-Stop Relay (internally fused to 7.5A)
5	Output of E-Stop Relay
6	Positive Battery supply for R2170 Electronics
7	Ground
8	CAN 1 High
9	CAN 1 Low
10	Ground
11	RS485 A (for Wired Remotes)
12	RS485 B (for Wired Remotes)

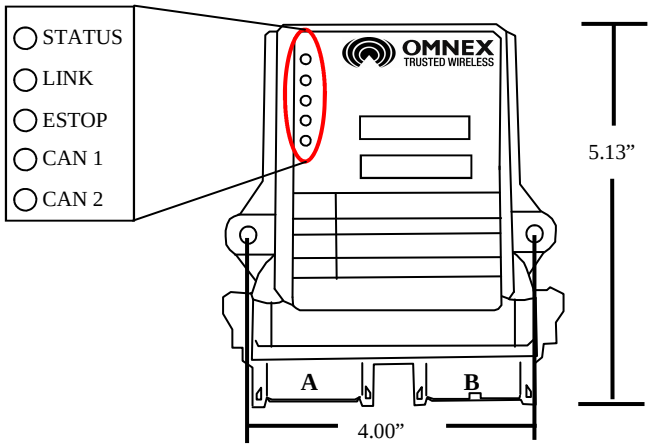


Connector B (Black)

Pin	Function
1	Ground
2	RS232 TX (for serial configuration menus)
3	RS232 RX (for serial configuration menus)
4	Ground
5	CAN 2 High
6	CAN 2 Low
7	n/c
8	n/c
9	n/c
10	Factory Use Only
11	Factory Use Only
12	Factory Use Only



R2170 Dimensions and Status Indicators



The (Status) light is GREEN when in normal operating mode.

The (Link) light flashes GREEN to indicate a signal is being received from an OMNEX transmitter.

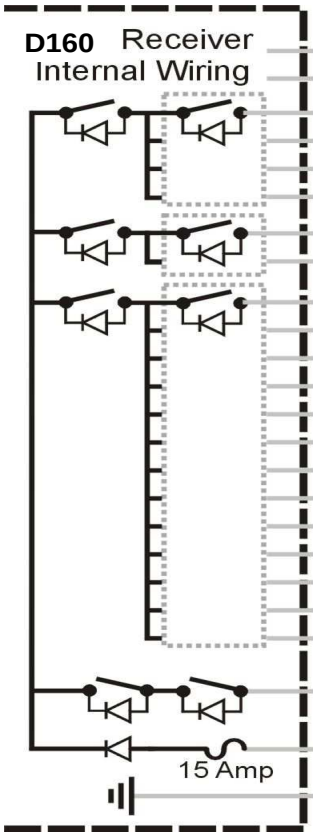
The (E-Stop) light is RED when the Emergency-Stop relay is open and GREEN when the relay is closed (a valid radio link is received by the R2170).

The (CAN 1) and (CAN 2) lights indicate when the respective CAN ports are active.

Installing the D160 Expansion Module for T2300-000201

Use the **Wiring Diagram** and the **Connector Diagram** below to connect the receiver pins directly to the appropriate contacts of the machine electronics. D160 Output Cables can be provided with every system to simplify the wiring process. The Wire Color column below only applies to the OMNEX Output Cable configuration. Tips on mounting, power connections and filtering are also provided under **Installation Considerations**.

Wiring Diagram



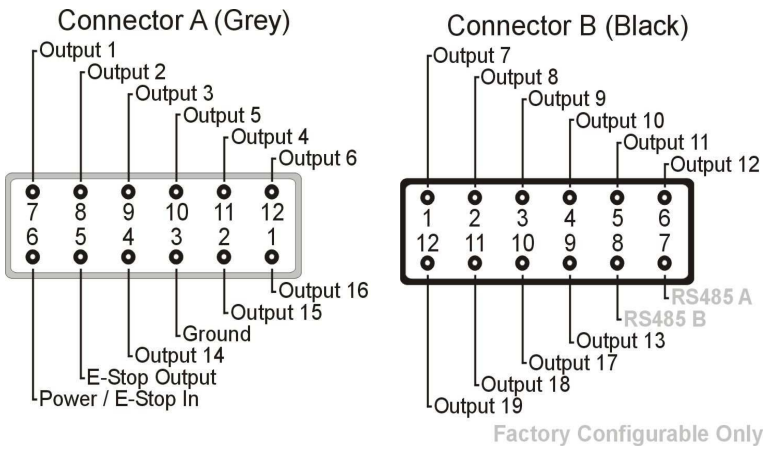
Pin-Output	Wire Colors	Functions
B7		Factory Configurable Only
B8		Factory Configurable Only
B12 - 19	Black/Red	TOOL CIRCUIT ON (Momentary Digital Output)
B11 - 18	White/Black	POLE GRAB CLOSE (Momentary Digital Output)
B10 - 17	Blue/White	POLE GRAB OPEN (Momentary Digital Output)
A1 - 16	Blue/Black	AUGER LATCH CLOSE (Momentary Digital Output)
A2 - 15	Black/White	AUGER LATCH OPEN (Momentary Digital Output)
A4 - 14	Green/Black	ENGINE SPEED LOW (Momentary Digital Output)
B9 - 13	Red/White	HYD. ENABLE (On while any paddle is activated)
B6 - 12	Orange	ENGINE SPEED HIGH (Momentary Digital Output)
B5 - 11	White	Unused
B4 - 10	Green/Black/White	OVERRIDE (Momentary Digital Output)
B3 - 9	Green	Unused
B2 - 8	Red/Black/White	Unused
B1 - 7	White/Red/Black	Unused
A12 - 6	Orange/Red	Unused
A10 - 5	Orange/Black	CONTROL RANGE HIGH (Momentary Digital Output)
A11 - 4	Blue/Red	TRUCK KILL (Momentary Digital Output)
A9 - 3	White/Red	TRUCK START (Momentary Digital Output)
A8 - 2	Red/Green	Unused
A7 - 1	Orange/Green	HORN (Momentary Digital Output)
A5	Black/White/Red	Switches to Power with Link
A6	Red	Power Input (+9V to 30VDC)
A3	Black	Ground

Outputs: 19 solid state, high-side driver outputs, 5A max. per pin and 7A max per bank, total combined current 15A

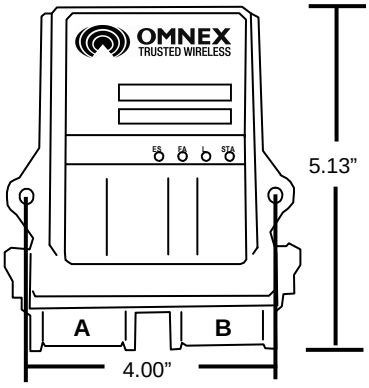
Inputs: All output pins can be factory configured as inputs. Input pins should be connected to a current limiting (fused) source

Connector Pin Assignments

Connectors as seen from under the receiver



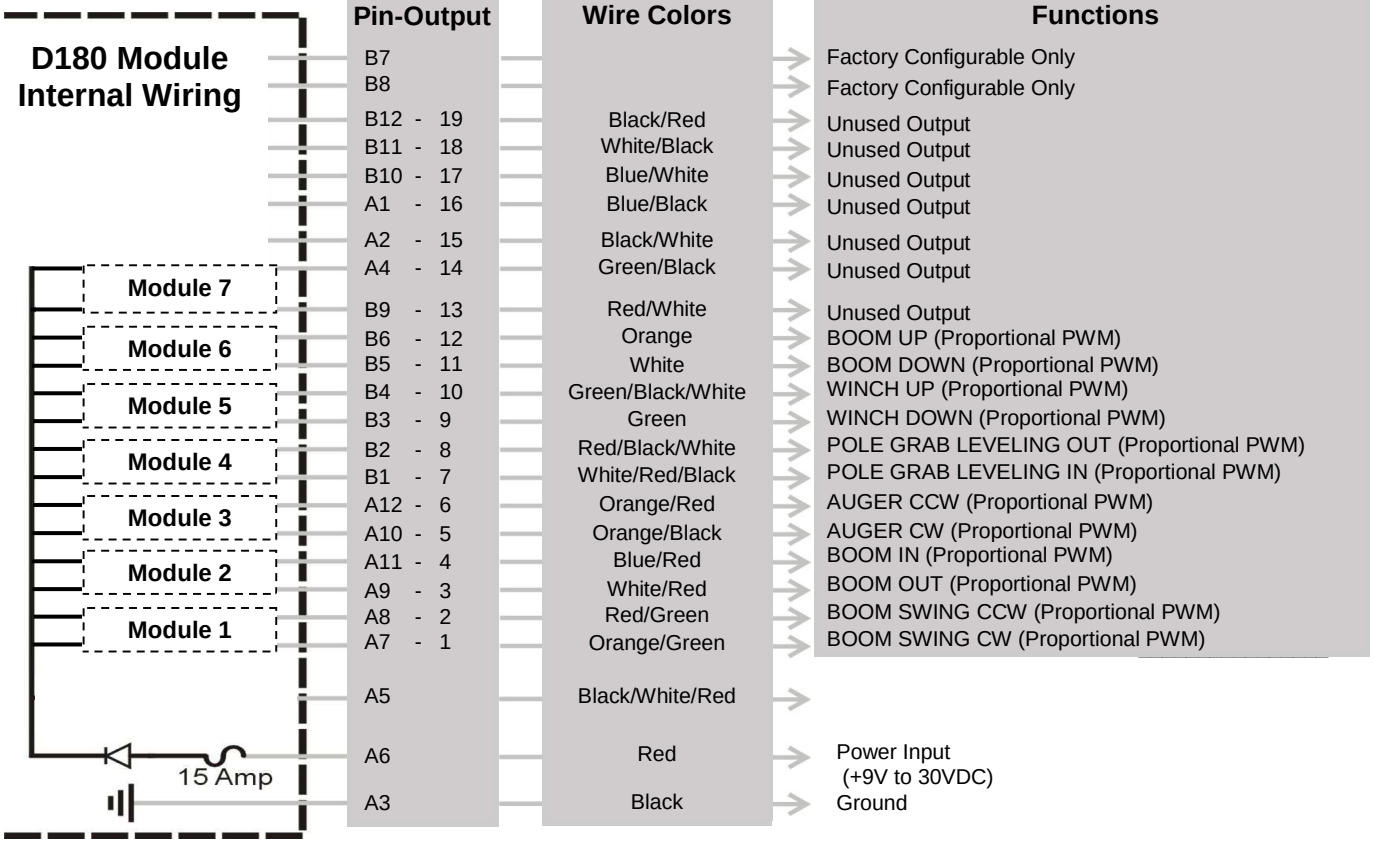
D1XX Dimensions



Installing the D180 Expansion Module for T2300-000201

Use the **Wiring Diagram** and the **Connector Diagram** below to connect the Expansion module pins directly to the appropriate contacts of the machine electronics. D180 Output Cables are provided with every system to simplify the wiring process. The Wire Color column below only applies to the OMNEX Output Cable configuration. Tips on mounting, power connections and filtering are also provided under **Installation Considerations**.

Wiring Diagram



Pin-Output	Wire Colors	Functions
B7		Factory Configurable Only
B8		Factory Configurable Only
B12 - 19	Black/Red	Unused Output
B11 - 18	White/Black	Unused Output
B10 - 17	Blue/White	Unused Output
A1 - 16	Blue/Black	Unused Output
A2 - 15	Black/White	Unused Output
A4 - 14	Green/Black	Unused Output
B9 - 13	Red/White	Unused Output
B6 - 12	Orange	BOOM UP (Proportional PWM)
B5 - 11	White	BOOM DOWN (Proportional PWM)
B4 - 10	Green/Black/White	WINCH UP (Proportional PWM)
B3 - 9	Green	WINCH DOWN (Proportional PWM)
B2 - 8	Red/Black/White	POLE GRAB LEVELING OUT (Proportional PWM)
B1 - 7	White/Red/Black	POLE GRAB LEVELING IN (Proportional PWM)
A12 - 6	Orange/Red	AUGER CCW (Proportional PWM)
A10 - 5	Orange/Black	AUGER CW (Proportional PWM)
A11 - 4	Blue/Red	BOOM IN (Proportional PWM)
A9 - 3	White/Red	BOOM OUT (Proportional PWM)
A8 - 2	Red/Green	BOOM SWING CCW (Proportional PWM)
A7 - 1	Orange/Green	BOOM SWING CW (Proportional PWM)
A5	Black/White/Red	
A6	Red	Power Input (+9V to 30VDC)
A3	Black	Ground

Outputs: 14 solid state, high-side driver Current Control outputs 5A max. each, total combined current 15A

Special Functions

Paddle controlled outputs are set to 50% of the full stroke while the CONTROL RANGE [LOW] switch is latched.

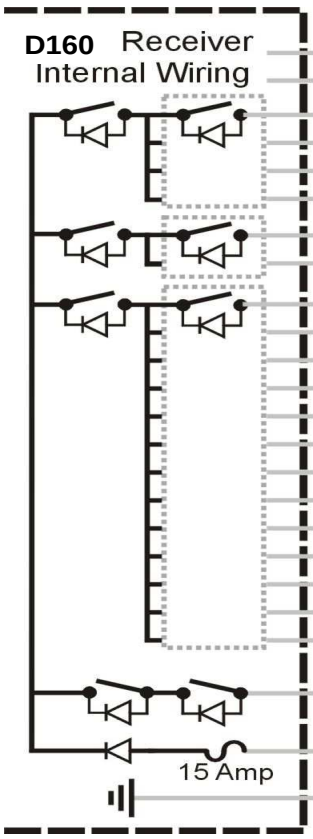
The WINCH [UP, DOWN] functions are enabled while the WINCH [DISABLE] switch is not latched.

All remote functions except TRUCK [START/KILL] must be enabled by pressing the HORN switch. These functions must be re-enabled after 15 seconds of inactivity.

Installing the D160 Expansion Module for T2300-000205

Use the **Wiring Diagram** and the **Connector Diagram** below to connect the receiver pins directly to the appropriate contacts of the machine electronics. D160 Output Cables can be provided with every system to simplify the wiring process. The Wire Color column below only applies to the OMNEX Output Cable configuration. Tips on mounting, power connections and filtering are also provided under **Installation Considerations**.

Wiring Diagram



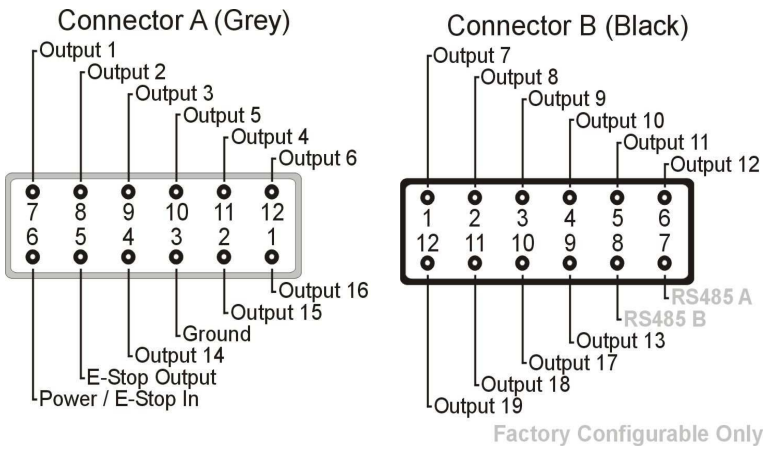
Pin-Output	Wire Colors	Functions
B7		Factory Configurable Only
B8		Factory Configurable Only
B12 - 19	Black/Red	WINCH HIGH (Momentary Digital Output)
B11 - 18	White/Black	AUX WINCH DISABLE (Momentary Digital Output)
B10 - 17	Blue/White	AUX WINCH HIGH (Momentary Digital Output)
A1 - 16	Blue/Black	Spare Down (Momentary Digital Output)
A2 - 15	Black/White	Spare Up (Momentary Digital Output)
A4 - 14	Green/Black	ENGINE SPEED LOW (Momentary Digital Output)
B9 - 13	Red/White	HYD. ENABLE (On while any paddle is activated)
B6 - 12	Orange	ENGINE SPEED HIGH (Momentary Digital Output)
B5 - 11	White	Unused
B4 - 10	Green/Black/White	OVERRIDE (Momentary Digital Output)
B3 - 9	Green	Unused
B2 - 8	Red/Black/White	Unused
B1 - 7	White/Red/Black	Unused
A12 - 6	Orange/Red	Unused
A10 - 5	Orange/Black	CONTROL RANGE HIGH (Momentary Digital Output)
A11 - 4	Blue/Red	TRUCK KILL (Momentary Digital Output)
A9 - 3	White/Red	TRUCK START (Momentary Digital Output)
A8 - 2	Red/Green	Unused
A7 - 1	Orange/Green	HORN (Momentary Digital Output)
A5	Black/White/Red	Switches to Power with Link
A6	Red	Power Input (+9V to 30VDC)
A3	Black	Ground

Outputs: 19 solid state, high-side driver outputs, 5A max. per pin and 7A max per bank, total combined current 15A

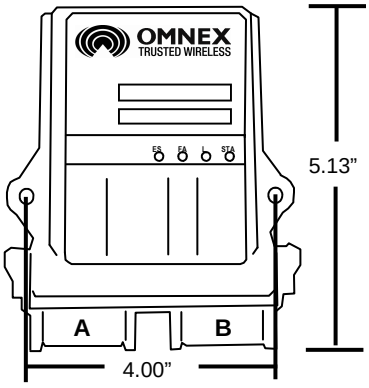
Inputs: All output pins can be factory configured as inputs. Input pins should be connected to a current limiting (fused) source

Connector Pin Assignments

Connectors as seen from under the receiver



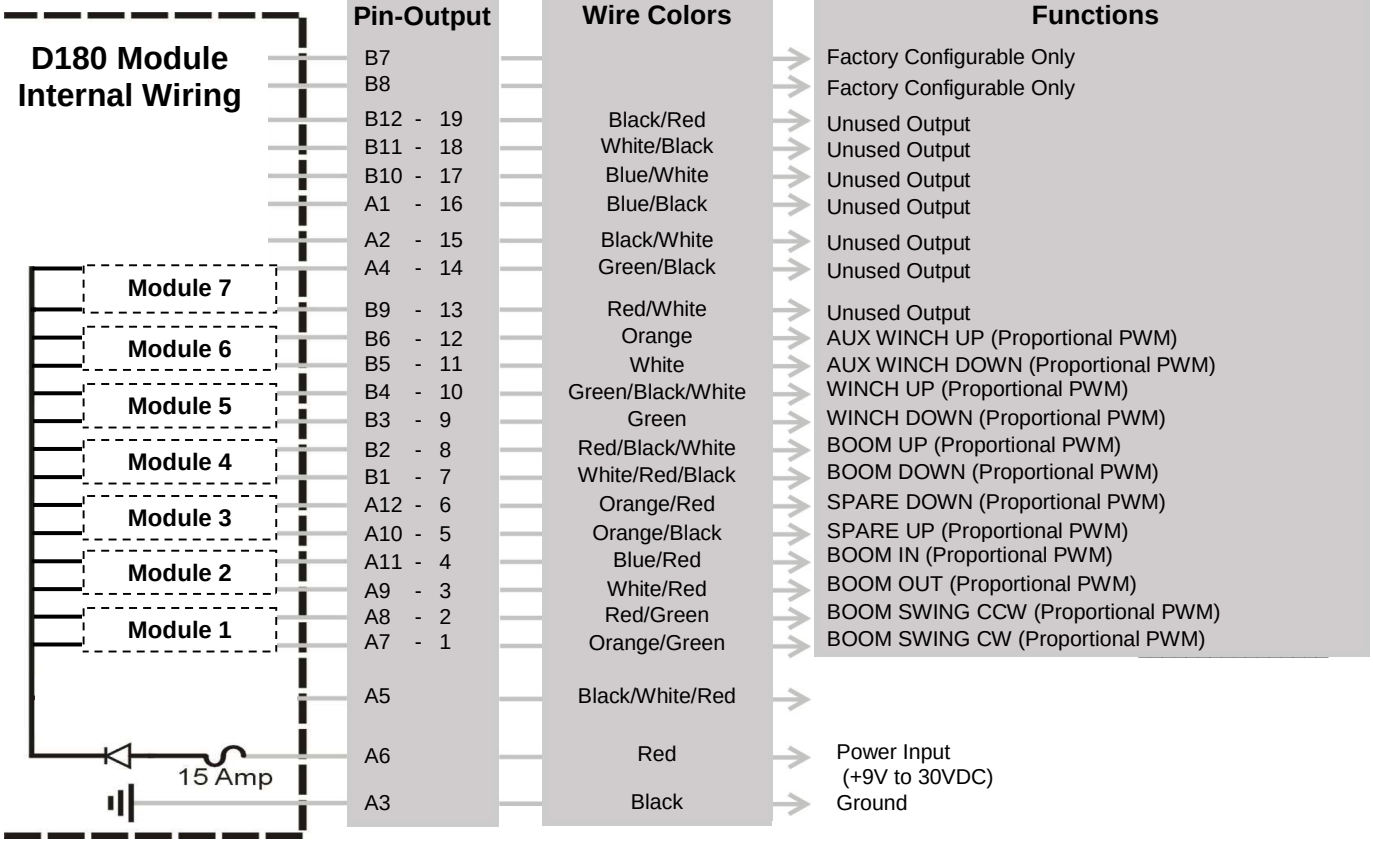
D1XX Dimensions



Installing the D180 Expansion Module for T2300-000205

Use the **Wiring Diagram** and the **Connector Diagram** below to connect the Expansion module pins directly to the appropriate contacts of the machine electronics. D180 Output Cables are provided with every system to simplify the wiring process. The Wire Color column below only applies to the OMNEX Output Cable configuration. Tips on mounting, power connections and filtering are also provided under **Installation Considerations**.

Wiring Diagram



Outputs: 14 solid state, high-side driver Current Control outputs 5A max. each, total combined current 15A

Special Functions

Paddle controlled outputs are set to 50% of the full stroke while the CONTROL RANGE [LOW] switch is latched.

The WINCH [UP, DOWN] functions are enabled while the WINCH [DISABLE] switch is not latched.

All remote functions except TRUCK [START/KILL] must be enabled by pressing the HORN switch. These functions must be re-enabled after 15 seconds of inactivity.

Installation Considerations

NOTE: *The FCC and ISC require that the antenna be restricted to that supplied by the manufacturer and approved for use with this product. An optional 0dB coax wire antenna may be supplied. For other antenna options, please contact OMNEX Control Systems ULC*

Mounting and Installation

The receiver can be mounted by fastening two ¼" bolts through the two mounting holes in the unit's enclosure. When mounting, ensure that the receiver is oriented so that the text is reading right and the connectors pointing "down".

When selecting a mounting point for the receiver, it is recommended that the location require only a minimal length of wiring to connect it to the control panel, that it will be in a visible area where it has good exposure to the operator and that it is mounted on a surface that sustains minimal vibration. It is also recommended that the receiver have the best possible line of sight with the transmitter

Power Connections and Wiring

Whenever a power connection is made to an electronic device, it is a good practice to make both the Power (+) and Ground (-) connections directly to the Battery and avoid connecting the power from the charging side of existing wiring or making use of existing "ACC" or other peripheral connection points.

Make sure that wire of sufficient gauge and insulator type is used when connecting the outputs of the receiver to the control panel. Observe any component manufacturer's instructions and recommendations for proper integration of their product. This includes the power ratings and requirements of such components as relays, valves, solenoids, etc.

Be sure to test each of the outputs with a multi-meter prior to connecting the outputs to your end devices. This will ensure that each output has been programmed to operate in the manner required by each end device.

Filtering and Noise Suppression

Whenever a solenoid or electromagnetic switch is controlled by the receiver, it is a good practice to install a Diode across its terminals to ensure that surges and spikes do not continue back into the circuit. Appropriate 36V Bi-directional Diodes kits can be ordered under the OMNEX part number "AKIT-2492-01".

Power the Transmitter

1. **Install the batteries in the transmitter**

   Batteries are installed in the transmitter by removing the battery cover using a slotted screwdriver and inserting 4 "C" alkaline batteries. Orientation of the batteries is embossed inside the battery housing. No batteries are required when the transmitter is connected to the receiver by a Pendant cable.

   NOTE: *For operation at temperatures below –10°C lithium batteries are recommended. Low temperatures reduce battery performance for both alkaline and lithium types. Refer to the battery manufacturer's specifications for detailed information on low temperature performance.*

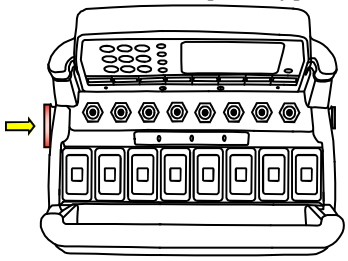
Transmitter Battery Housing

2. **Turn on the transmitter**

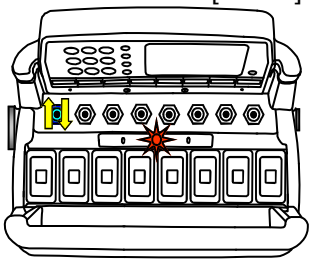
   Ensure all transmitter switches and paddles are in the neutral position. Turn on the transmitter by, pressing and releasing the [Power] switch The RED (E-Stop) light will flash quickly. Release the [E-Stop], the yellow (Active) light on the transmitter will begin to flash.

WARNING: do not install batteries backwards, charge, put in fire, or mix with other battery types. May explode or leak causing injury. **Replace all batteries at the same time as a complete set and do not mix and match battery types.**

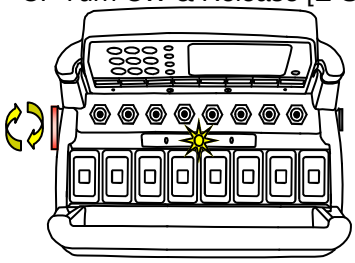
A. Press the [E Stop]



B. Press and release [Power] switch



C. Turn CW & Release [E-Stop]



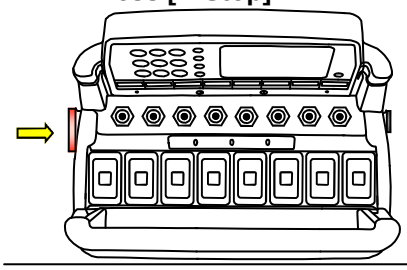
Light Legend	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Green Light

Test the Transmitter / Receiver Link

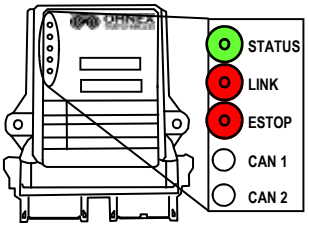
Follow these steps to ensure that there is a Radio Link between the transmitter and receiver

Refer to the Light Legend below for diagram details

1. Press [E-Stop]

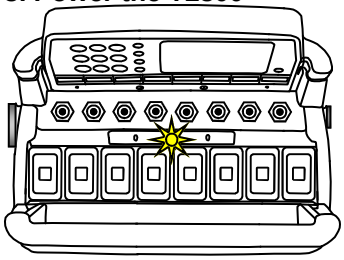


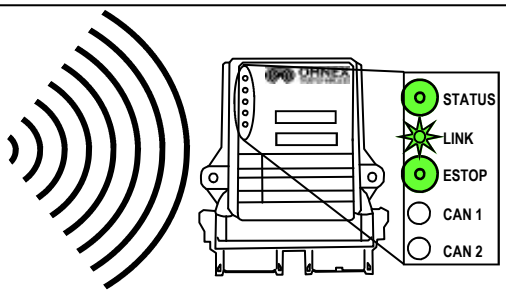
2. Power the R170



The (E-Stop) light and the (Link) light will display RED (provided the transmitter is off), and the (Status) light will show GREEN.

3. Power the T2300





If the (Active) light on the transmitter is flashing and the (Link) light on the receiver is flashing GREEN, a link between the two exists.

NOTE: *The transmitter will shut itself off (and the receiver will then shut off all outputs) after 2 hours of inactivity as a battery saving feature. To restart the timer before the transmitter shuts off automatically, momentarily operate any toggle switch or paddle.*

The ORIGA System is now ready for use.

If the receiver's (Link) light does not become GREEN follow the steps under **Download ID Code**.

Light Legend	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Green Light

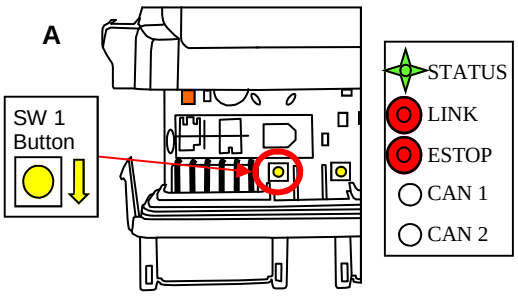
Downloading the Transmitter ID

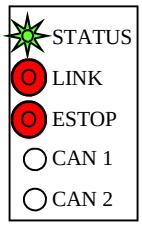
The R2170 requires a transmitter ID from an OMNEX wireless transmitter before it can be operated. The R2170 can only hold a single transmitter ID; if another ID is downloaded then the new ID will overwrite the previous ID. OMNEX transmitter IDs are unique, ensuring that the R2170 will only respond to the correct transmitter.

1. Setting R2170 into Configuration Mode

A. Press and hold [SW 1] on the front of the R2170

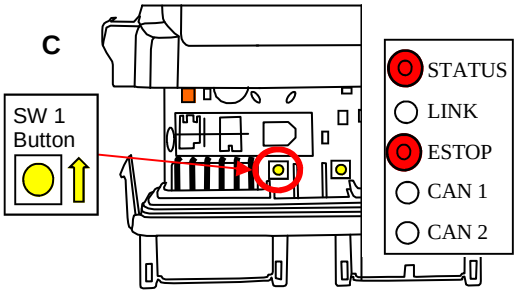
B. Hold [SW 1] until the (Status) light begins to flash GREEN quickly



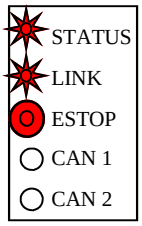


C. When this occurs, release the button to enter Setup mode.

D. If the [SW1] button is held for more than 10 seconds, the (Status) and (Link) LEDs will rapidly flash RED showing the "stuck switch" indicator.

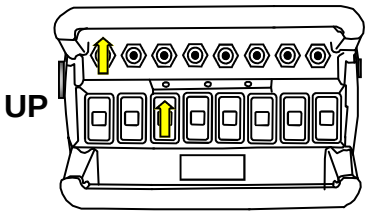


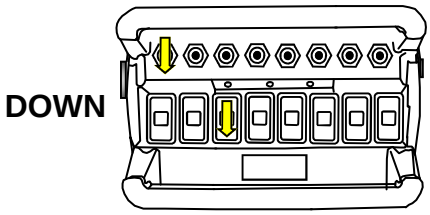
NOTE: *The R2170 will only remain in Setup Mode for 30 seconds. If a transmitter ID is not successfully received during this time, the R2170 will exit Setup Mode. The (Status) and (Link) lights will also flash RED to indicate that there was an error downloading the transmitter ID. If this happens try downloading the transmitter ID again as described above. Pressing [SW 1] again will stop the (Status) and (Link) lights from flashing RED.*



Unsuccessful ID download

NOTE: *For this document, orientation of the paddle and switch operation will be defined as follows:*
Paddle UP—is towards the switches
Paddle DOWN—is away from switches
Switch UP—is away from paddles
Switch DOWN—is towards the paddles.





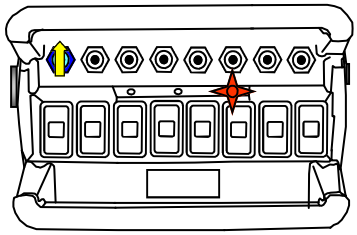
Light Legend	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Green Light

Downloading the Transmitter ID (continued)

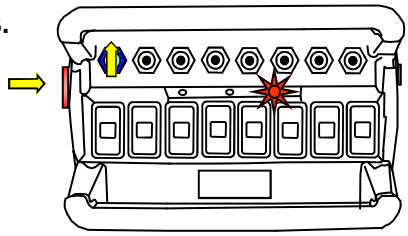
4. Power T2300 into Configuration

A. Hold [Power] switch UP
B. Press [E-Stop]
C. Twist CW & release [E-Stop]
D. Release [Power] Switch

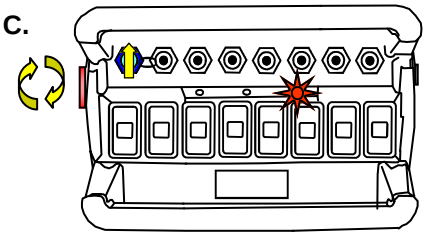
A.



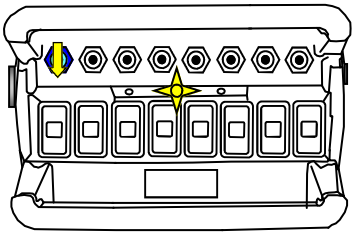
B.



C.



D.



5. Download ID Code

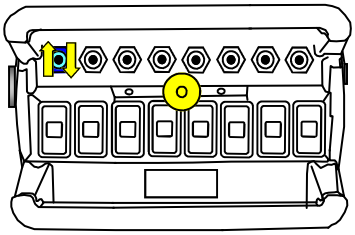
NOTE: *When downloading a new ID to a receiver, a safety feature requires that the transmitter be in close proximity to the receiver. This will prevent a transmitter from accidentally reprogramming a different receiver in the area.*

A. Press [Power] switch UP and release

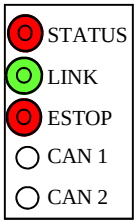
B. (Link) light goes to GREEN during download.

C. Once complete, (Link) light goes to RED as the transmitter turns off

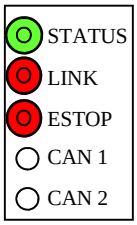
A.



B.



C.



NOTE: *When replacing the receiver cover, ensure the cover snaps completely into place to create a weather proof seal around the base of the receiver.*

NOTE: *A transmitter ID may be downloaded at anytime even if the R2170 already has a valid transmitter ID—the new ID will simply overwrite the previous ID. When the R2170 enters Setup Mode, it shuts down the CAN ports and opens the Emergency-Stop Relay, thus disabling normal operations.*

If, for some reason, [SW 1] or [SW 2] is stuck "on", the R2170 will indicate this fault by flashing its (Status) and (Link) lights RED, and also flash its (CAN 1) light GREEN. (Refer to the R2170 Diagnostic page for more details

Stuck Buttons

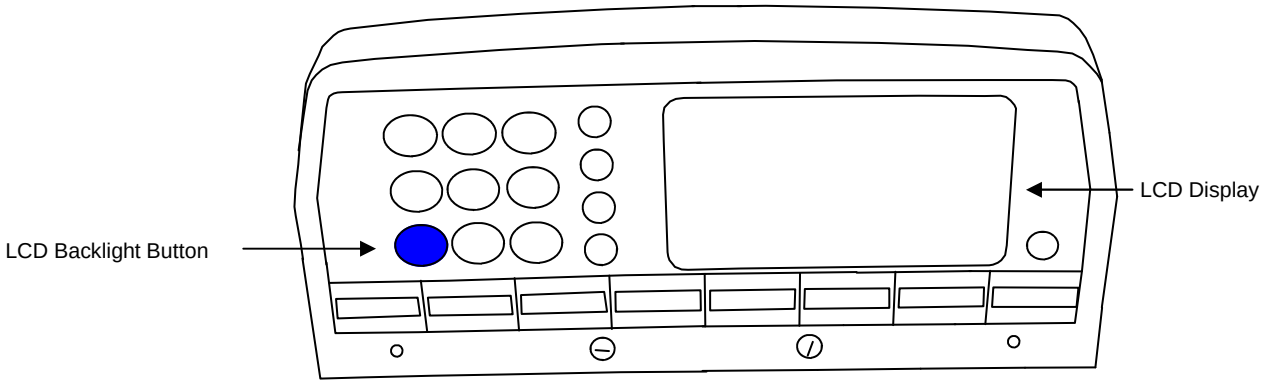
LCD Display Operations

The LCD display contains a 9 button keypad.

For this version, the bottom left button is operational.

Pressing this button toggles the LCD backlight feature to either ON or OFF.

Note: *Leaving the LCD backlight on will reduce battery life*



Calibrating Proportional Controls

The transmitter's Paddles control the receiver's proportional output. The Paddles/Joysticks are used in conjunction with any of the transmitter's switches. The proportional output can be activated when a switch is held UP or DOWN; it will become active at an increasingly high level as the Paddle/Joystick is pushed/pulled. The minimum and maximum levels of the proportional output can be calibrated by following these steps.

Refer to the **Light Legend** below for diagram details.

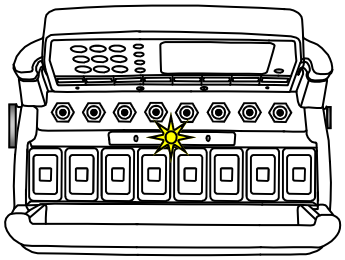
NOTE: *Calibration settings can be reset to factory default in steps 3 & 4 by holding the [Power] switch UP or DOWN for 5 seconds.*

1. Power T2300, Power R2170

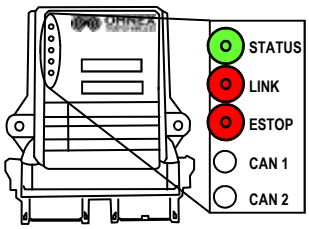
A. Refer to steps in "Power the Transmitter"

B. Supply power to the R2170

A.



B.



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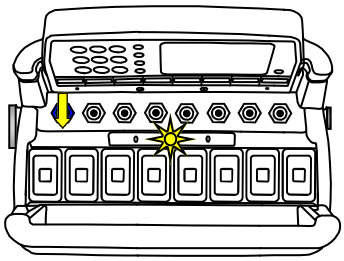
2. Setup T2300 for Output Calibration

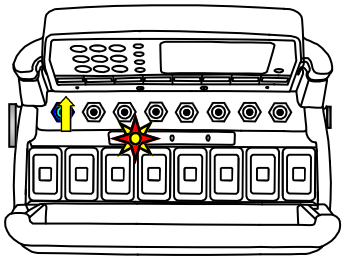
A. Hold [Power] switch DOWN for 5 seconds until the (Battery) LED goes to alternating RED and YELLOW.

B. Release [Power] switch

A.



B.



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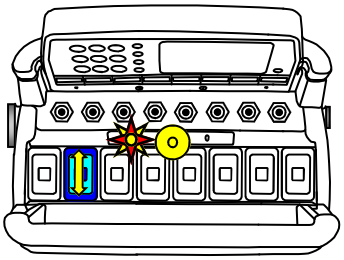
3. Set Minimum Level

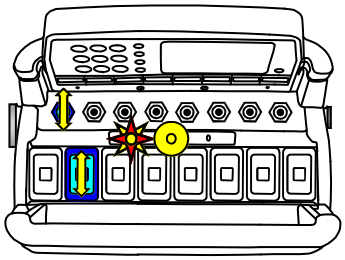
A. Push the paddle (function) in the direction you wish to calibrate until the (Active) LED comes on

B. Hold paddle and Press [Power] switch UP to decrease minimum level or DOWN to increase it

A.



B.



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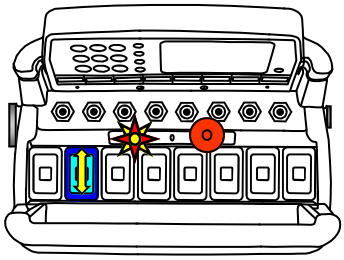
4. Set Maximum Level

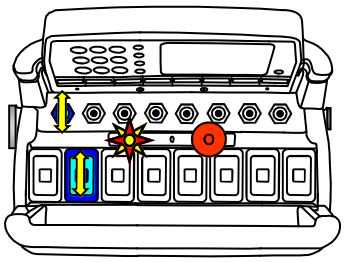
A. Fully push the paddle (function) in the direction you wish to calibrate until the (E-Stop) LED comes on.

B. Hold paddle and Press [Power] switch UP to decrease maximum level or DOWN to increase it

A.



B.



Note: *Repeat steps 3 and 4 for each paddle (function) that needs to be calibrated.*

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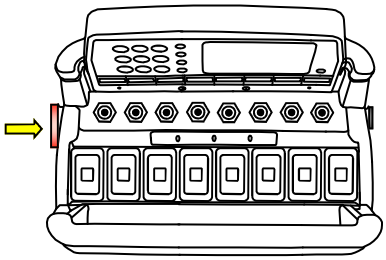
5. Power Off

A. Press [E-Stop]

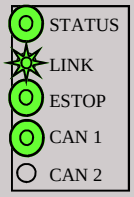
A.



Light Legend	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Yellow Light

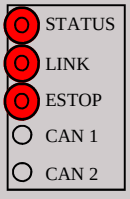
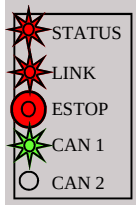
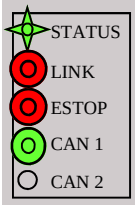
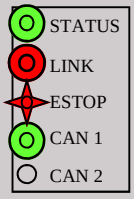
Diagnostics - R2170 Receiver

Normal Operation

Indicator Lights	Description
	**Transmitter is OFF** If the transmitter is off, the receiver is operating properly. This will be the status of the receiver after the Download ID procedure as the transmitter automatically shuts off after ID download.
	**Transmitter is ON** When the transmitter is turned on, the Link light (fast flashing) and E-Stop (GREEN) indicates the receiver is operating properly

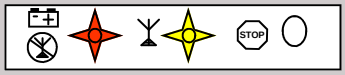
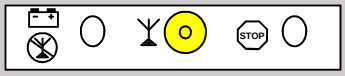
Trouble Indicators

Note: *In some cases, the indicator lights will be different depending on whether the transmitter is on or off. For all cases listed below, the transmitter's status is OFF unless otherwise indicated. Please note the transmitter status in the "Description" column for each case.*

Indicator Lights	Description	Solution	Indicator Lights	Description	Solution
	**Transmitter is OFF** The SW 1 button is stuck for more than 10 seconds *(If the transmitter is on, the LINK light will be OFF)*	Wiggle the button to try and get unstuck. If condition persists, contact customer service.		During normal operation, this may indicate irrecoverable CAN software error or upon power-up, out of the box, the unit has no setup information or setup information is corrupt	Proceed through the Download ID procedure. If this doesn't work contact Customer Service
	**Transmitter is OFF** The SW 2 button is stuck for more than 10 seconds *(If the transmitter is on, the LINK light will be OFF)*	Wiggle the button to try and get unstuck. If condition persists, contact customer service.		Setup download failed.	Try again, no more than a couple of times, or contact customer service.
	**Transmitter is OFF** A low battery condition has been detected.	To detect intermittent conditions caused by poor or corroded ground or power circuits, the GREEN light will continue to flash for		**Transmitter is OFF** E-Stop relay failure *(If the transmitter is ON, the LINK light will be fast flashing GREEN)*	Contact Customer Service

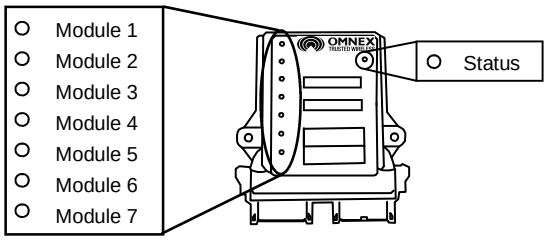
Light Legend	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Green Light

Diagnostics—T2300 Transmitter

	Tether connection detected
	Low battery. Unit will run approximately 20 hours after Battery light starts flashing.
	The transmitter is in Calibration mode
	Power switch is stuck in the **"UP"** position.
	The Active light remain on momentarily when a function is activated (i.e. a switch or paddle is triggered). This is normal operation.
	**Normal Operation** The transmitter is in Download Mode.
	**Normal Operation** The Active light will flash 2 times per second, indicating that the transmitter is sending signals to the receiver.
	Stuck switch detected. Ensure that all switches are in a centered position. The transmitter will not power up when a function is ON.
	**On Power Up** Release the E-Stop button within 10 seconds to power up the transmitter, or the unit will power down.
	**On Power Up** Press and release the E-Stop button within 10 seconds to power up the transmitter, or the unit will power down.

Diagnostics - D180 Expansion Module

Indicator lights for the D180 Expansion Module



Status Indicator

STATUS	Module is operating properly	STATUS	Low battery condition detected
STATUS	There is a fault with the module	STATUS	Fuse blown
STATUS	Communication to the module is active		

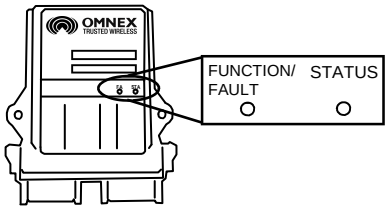
Module 1-7 Indicators

MODULE	Module is installed and operating properly	MODULE	There is a short to supply
MODULE	There is a short to ground / over current	MODULE	No Module installed

Light Legend	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Yellow Light

Diagnostics - D160 Expansion Module

Indicator lights for the D160 Expansion Module

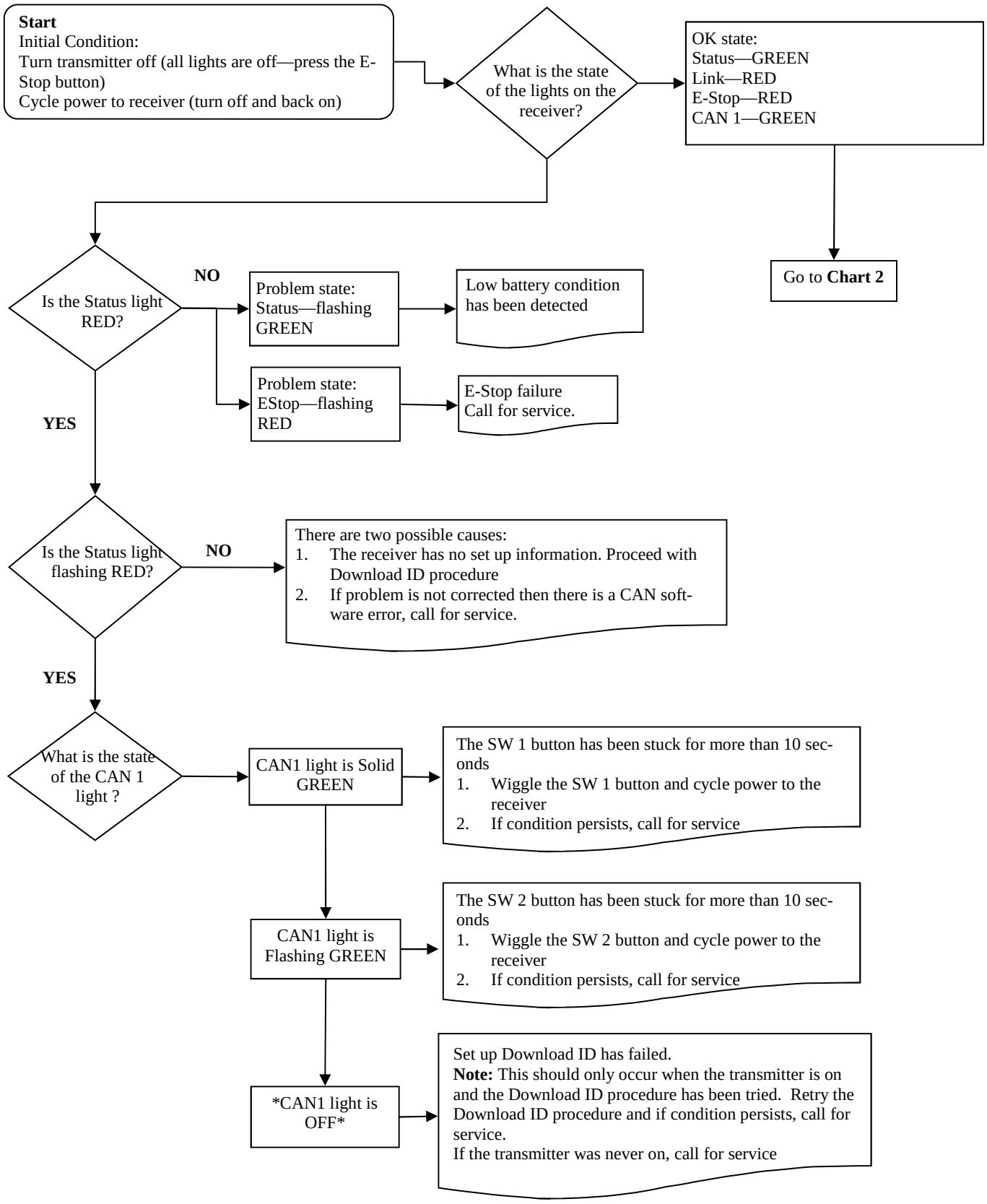


Status Indicator

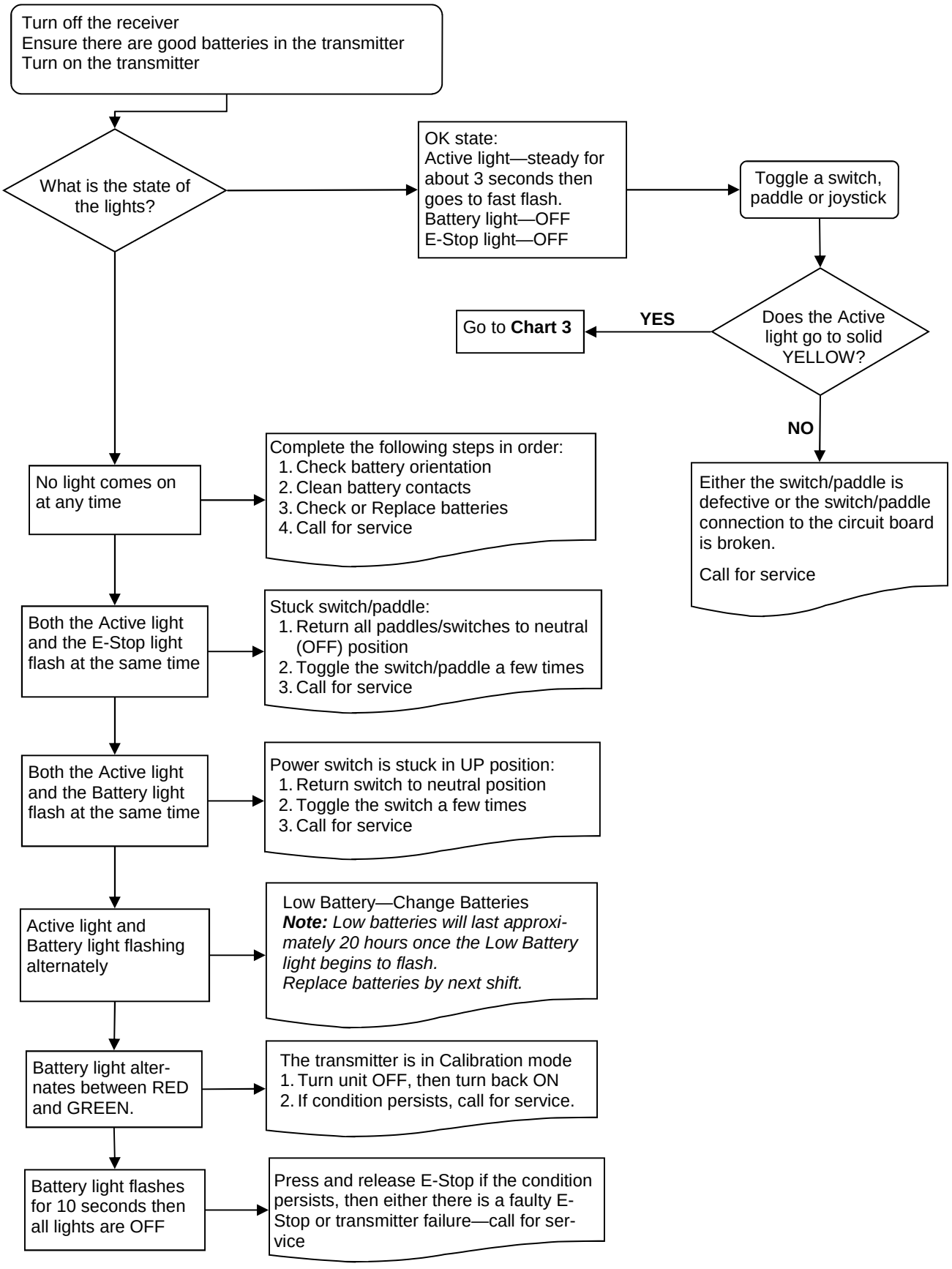
FAULT STATUS	Module is operating properly with a function on	FAULT STATUS	Low battery condition detected (refer to R160 diagnostic page for possible solution)
FAULT STATUS	Module is operating properly with a function off	FAULT STATUS	Fuse blown (refer to R160 diagnostic page for possible solution)
FAULT STATUS	Module has an unrecoverable fault, return for service	FAULT STATUS	There is a short to ground/over current (refer to R160 diagnostic page for possible solution)
FAULT STATUS	The module is powered incorrectly (refer to R160 diagnostic page for possible solution)	FAULT STATUS	There is a short to supply (refer to R160 diagnostic page for possible solution)

Light Legend	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Green Light

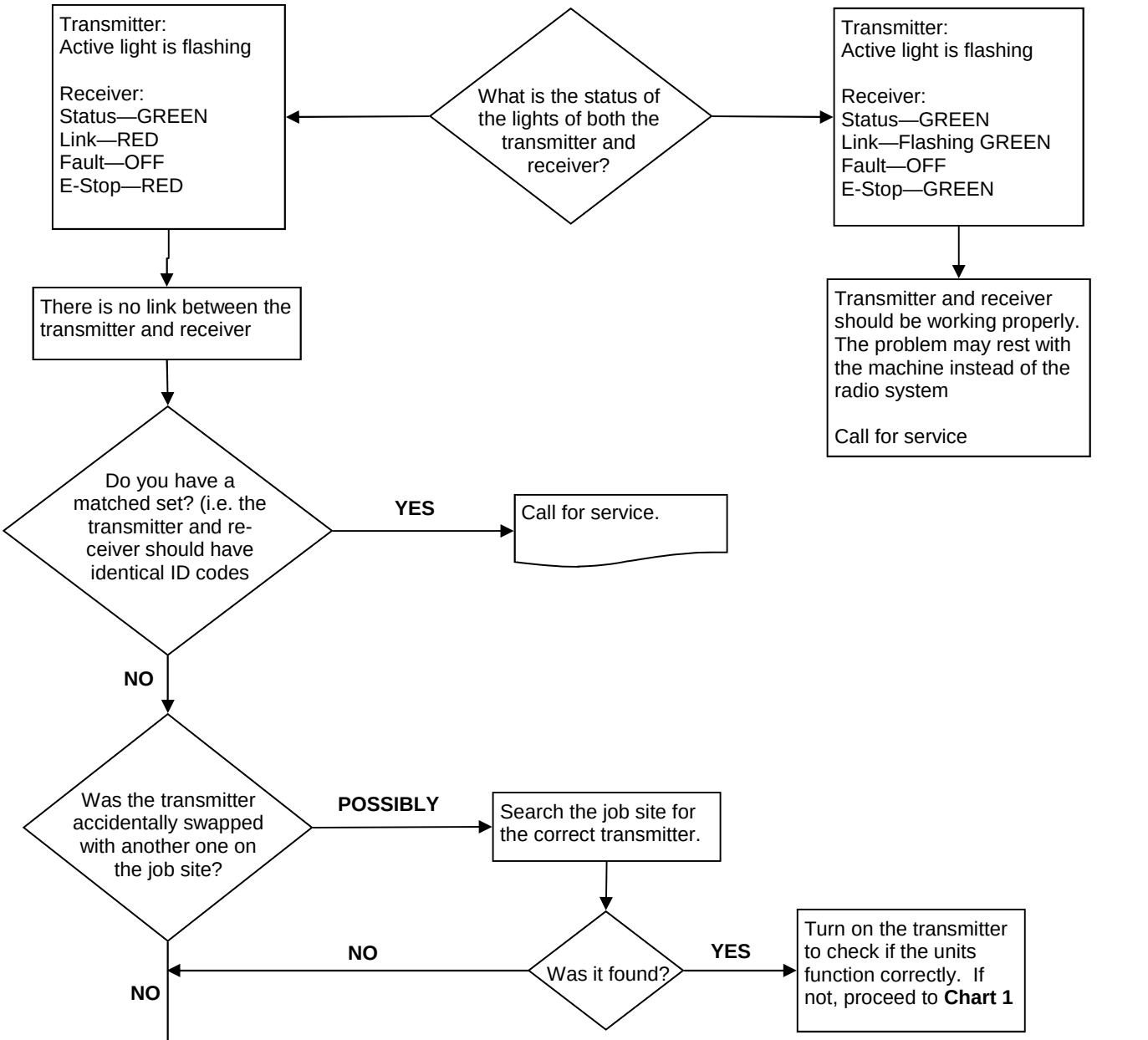
Test the Receiver—R2170



Test the Transmitter—T2300



Testing the Transmitter / Receiver Communication



!!Caution!!

Note: Before you proceed with the Download ID procedure located on **Page 10 & 11,** great care and caution must be adhered to. Also, refer to **Chart #4** for Tips and Considerations.

If by accident, the transmitters have been switched with another unit, by downloading the ID code to a new receiver, it is possible for the transmitter to operate 2 units at the same time (if the original receiver unit is still on the job site). Therefore it must be certain that the transmitter / receiver pair are the correct set.

Secondly, once the download procedure is completed, ensure all other units on the job site are stopped. Test the operation of the newly configured set to ensure no other machines on the site work with the same transmitter.

Once you are certain that the transmitter / receiver pair are a unique set, continue normal operations.

Considerations when Downloading the ID

Potential downloading issues

If testing of the receiver and transmitter both show the system as working (Chart 1 & 2), then the transmitter and receiver will both go into Download/Configuration mode.

Possible issues could arise during Step 4, the download phase of reprogramming. In this case there are 2 symptoms to look for:

1. The Link light on the receiver will not turn GREEN when the power switch is toggled on the transmitter to download
2. The receiver will "time out" indicating that it didn't receive a signal from the transmitter within the 30 seconds from the time the receiver was put into Setup Mode.

If all indications appear normal during the download phase, test the link by turning on the transmitter (note: the transmitter shuts off after transmitting the ID code in Step 4)

1. If the Link light on the receiver doesn't turn GREEN, the receiver didn't receive all of the information that was sent from the transmitter.

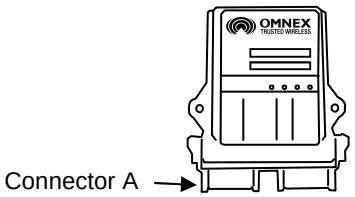
Possible Solutions

1. Try the Downloading steps again
2. If this doesn't correct the problem, send both the transmitter and receiver in for service.

Note: *you could try to determine whether the fault lies with the transmitter or receiver by completing the downloading procedure with a different transmitter. If this step works, then the fault lies with the original transmitter. If not, the fault may lie with the receiver.*

!!Caution!!

Note: Before attempting downloading with another transmitter, understand that reprogramming the receiver with another transmitter, could result in two receivers on the job site responding to the one transmitter. If the original transmitter was sent in for repair, Disconnect the receiver (disconnect connector A) to continue using the machine without remote capability and without fear of inadvertently operating the machine with the other transmitter.



Reprogramming Tips:

1. Use a pointy instrument to depress the Setup button on the receiver (i.e. a pen) as the button is relatively small
2. Follow each step as laid out in the procedure
3. Never lay the receiver circuit board down on anything metallic (there are contact points on the back which could contact the metal and damage the receiver)

Parts & Accessories

Part	OMNEX Part Number	Description
Batteries	B0012	4 x “C” alkaline
Fuse	F0055	36V Bi-directional, Bussman ATM-7.5
Shoulder Strap	FMEC-2709-01	T300 Tear-away shoulder strap
Output Cable	ACAB– 2727-01	R170 Output Cable, Generic
Pendant Cable	ACAB-2455-01	Cable, 10m
	ACAB-2455-02	Cable, 8m
	ACAB-2710-01	Cable, 4-12ft
Connector Kit	AKIT-2337-01	Includes Deutsch socket connectors, wedges, pins and sealing plugs
Bipolar Diode Kit	AKIT-2492-01	Motorola P6KE36CA

Shoulder Strap

Pendant Cable

Pendant Coil

R170 Output Cable

Specifications

	D160/D180 Module	R2170 Receiver	T2300 Transmitter
Size	5.1” x 4.7” x 1.4” (130mm x 119mm x 36mm)	5.1” x 4.7” x 1.4” (130mm x 119mm x 36mm)	9.5" x 6.0" x 5.0" (240mm x 152mm x 127mm)
Weight	0.65lbs (0.295kg)	0.65lbs (0.295kg)	3.5 lbs (incl. batteries) (1.2kg)
Construction	High impact plastic, weather-proof	High impact plastic, weather-proof	High impact, low temperature plastic, weatherproof
Input Power	+9V to 30VDC	+9V to 30VDC	4C alkaline batteries
Battery Life	N/A	N/A	500 hours (continuous use)
Operating Temperature Range	-40F to 158F (-40C to 70C)	-40F to 158F (-40C to 70C)	-40F to 140F (-40C to 60C)
Outputs	3A (max) each (sourcing), 10A (max) each (combined)	N/A	N/A
Antenna	N/A	External	Internal
Approvals	**USA**- FCC part 15.247 **Canada**- ISC RSS 210 Issue 6, Sept. **Europe**- EN 440 **Australia-** C-Tick		

FCC Rules and Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC	Part 15.247
ISC	RSS 210 Issue 6, Sept. 2005

Warranty

OMNEX Control Systems ULC warrants to the original purchaser that the OMNEX products are free from defects in materials and workmanship under normal use and service for a period of ONE YEAR, parts (EXCLUDING: SWITCHES, CRYSTALS, OR PARTS SUBJECT TO UNAUTHORIZED REPAIR OR MODIFICATION) and labor from the date of delivery as evidenced by a copy of the receipt. OMNEX's entire liability and your exclusive remedy shall be, at OMNEX's option, either the (a) repair or (b) replacement of the OMNEX product which is returned within the warranty period to OMNEX freight collect by the OMNEX APPROVED carrier with a copy of the purchase receipt and with the return authorization of OMNEX. If failure has resulted from accident, abuse or misapplication, OMNEX shall have no responsibility to repair or replace the product under warranty. In no event shall OMNEX be responsible for incidental or consequential damage caused by defects in its products, whether such damage occurs or is discovered before or after replacement or repair and whether or not such damage is caused by the negligence of OMNEX Control Systems ULC.

OMNEX Control Systems ULC

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Fax: 604-944-9267

Toll Free: 1-800-663-8806

www.omnexcontrols.com

SERVICE MANUAL
75 SERIES DIGGER MODELS

Example Part Number

75	51	6	2	F	61	-	-
Model	Ratio	Shaft	Bail Boss	Motor Supplier	Motor Number	Option 1	Option 2

THIS SERVICE MANUAL IS EFFECTIVE:
S/N: 102358 TO CURRENT
DATE: 7-2012 TO CURRENT
VERSION: SM75_0413

NOTE: Individual customer specifications (spindle mounting, sprocket pilot, brake assembly, etc.) may vary from exploded drawing and standard part numbers shown. If applicable, refer to customer drawing for details.

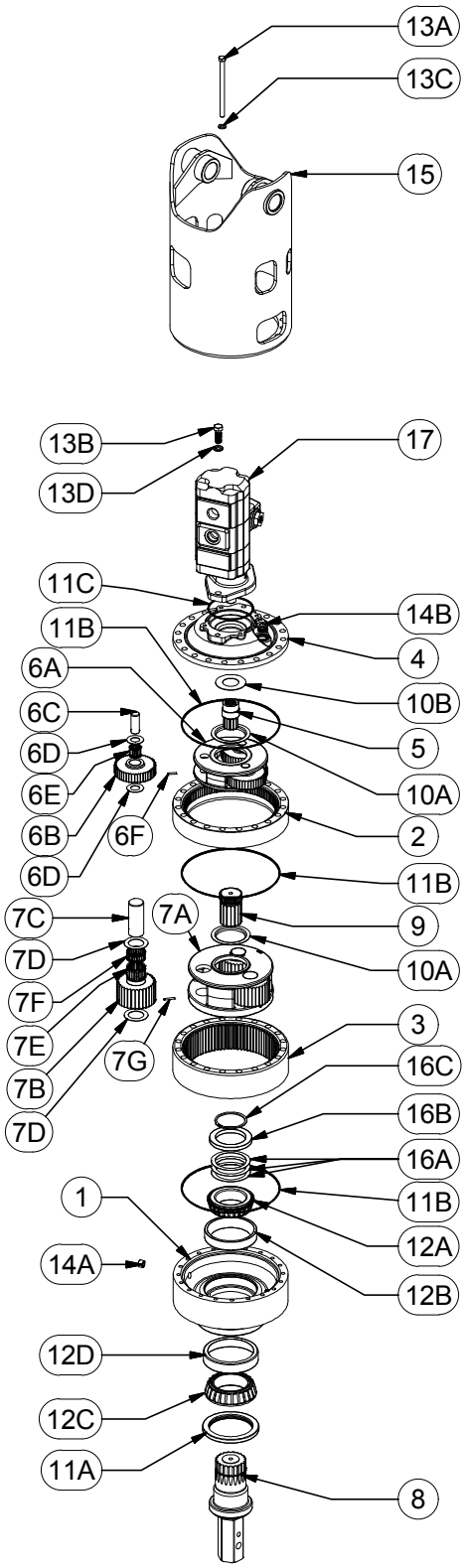
Exploded View Drawing

EFFECTIVE
FROM: S/N 102358 07-01-2012
TO: CURRENT

X75-0014ad ECN:3451E 07-11-12 HWP

MODEL 75 SERIES (HYDRASYNC) AUGER DRIVE							
GROUP	ITEM	QTY	DESCRIPTION	51.43:1	40.25:1	37.80:1	29.58:1
	1	1	BEARING CARRIER	75-004-3012	75-004-3012	75-004-3012	75-004-3012
	2	1	RING GEAR- PRI	25-004-1012	25-004-1012	25-004-1012	25-004-1012
	3	1	RING GEAR- SEC	25-004-1022	25-004-1022	25-004-1022	25-004-1022
	4	1	COVER	25-004-1222	25-004-1222	25-004-1222	25-004-1222
	5	1	INPUT GEAR	25-004-1162	25-004-1162	25-004-1172	25-004-1172
6	-	1	CARRIER ASSY-PRI	25-005-2001	25-005-2001	25-005-2011	25-005-2011
	6A	1	CARRIER - PRI	25-004-1032	25-004-1032	25-004-1042	25-004-1042
	6B	3	PLANET GEAR - PRI	25-004-1102	25-004-1102	25-004-1112	25-004-1112
	6C	3	PLANET SHAFT - PRI	25-004-1031	25-004-1031	25-004-1031	25-004-1031
	6D	6	THRUST WASHER - PLANETS	81-004-1561	81-004-1561	81-004-1561	81-004-1561
	6E	3	BEARING	01-105-0570	01-105-0570	01-105-0570	01-105-0570
	6F	3	ROLL PIN	01-153-0020	01-153-0020	01-153-0020	01-153-0020
7	-	1	CARRIER ASSY - SEC	25-005-2031	25-005-2041	25-005-2031	25-005-2041
	7A	1	CARRIER - SEC	25-004-1062	25-004-1072	25-004-1062	25-004-1072
	7B	3	PLANET GEAR - SEC	25-004-1082	25-004-1092	25-004-1082	25-004-1092
	7C	3	PLANET SHAFT	25-004-1021	25-004-1021	25-004-1021	25-004-1021
	7D	6	PLANET WASHER	25-004-1041	25-004-1041	25-004-1041	25-004-1041
	7E	3	BEARING	01-105-0550	01-105-0550	01-105-0550	01-105-0550
	7F	3	BEARING	01-105-0560	01-105-0560	01-105-0560	01-105-0560
	7G	3	ROLL PIN	01-153-0190	01-153-0190	01-153-0190	01-153-0190
8	-	1	SHAFTS	-	-	-	-
		-	OUTPUT SHAFT - 2-5/8 HEX	75-004-4022	75-004-4022	75-004-4022	75-004-4022
		-	OUTPUT SHAFT - 3" HEX	75-004-4012	75-004-4012	75-004-4012	75-004-4012
	9	1	SUN GEAR - SEC.	25-004-1142	25-004-1152	25-004-1142	25-004-1152
10	-	-	THRUST WASHERS	-	-	-	-
	10A	2	CARRIER THRUST WASHER	25-004-1132	25-004-1132	25-004-1132	25-004-1132
	10B	1	INPUT THRUST WASHER	81-004-2883	81-004-2883	81-004-2883	81-004-2883
11	-	-	SEALS & 0-RINGS	-	-	-	-
	11A	1	OUTPUT SHAFT SEAL	01-405-0500	01-405-0500	01-405-0500	01-405-0500
	11B	3	O-RING	01-402-0020	01-402-0020	01-402-0020	01-402-0020
	11C	1	O-RING	01-402-0010	01-402-0010	01-402-0010	01-402-0010
12	-	-	OUTPUT SHAFT BEARINGS	-	-	-	-
	12A	1	INNER BEARING CONE	01-102-0250	01-102-0250	01-102-0250	01-102-0250
	12B	1	INNER BEARING CUP	01-103-0250	01-103-0250	01-103-0250	01-103-0250
	12C	1	OUTER BEARING CONE	01-102-0120	01-102-0120	01-102-0120	01-102-0120
	12D	1	OUTER BEARING CUP	01-103-0110	01-103-0110	01-103-0110	01-103-0110
13	-	-	HARDWARE	-	-	-	-
	13A	20	HEX HEAD CAP SCREW (1/2-13 X 7.5)	01-150-1660	01-150-1660	01-150-1660	01-150-1660
	13B	2	HHCS (5/8-11 X 1-3/4)	01-150-0110	01-150-0110	01-150-0110	01-150-0110
	13C	20	FLATWASHER - HDN (1/2 X 7/8 X 1/8)	01-166-0120	01-166-0120	01-166-0120	01-166-0120
	13D	2	LOCKWASHER - 5/8 ZINC PLATED	01-166-0040	01-166-0040	01-166-0040	01-166-0040
14	-	-	PLUGS AND GREASE FITTINGS	-	-	-	-
	14A	1	PLUG - 1/2 NPT MAGNETIC	01-207-0041	01-207-0041	01-207-0041	01-207-0041
	14B	1	HOLLOW HEX PLUG (05HP-12)	01-208-0030	01-208-0030	01-208-0030	01-208-0030
15	-	1	BAIL ASSEMBLIES	-	-	-	-
	-	-	2" BOSS - BACKHOE M50 MOTORS	75-005-2222	75-005-2222	75-005-2222	75-005-2222
	-	-	1.5" BOSS, M50 MOTORS	75-005-2082	75-005-2082	75-005-2082	75-005-2082
	-	-	2" BOSS M50 MOTORS	75-005-2222	75-005-2222	75-005-2222	75-005-2222
16	-	-	MISCELLANEOUS	-	-	-	-
	16A	*	SHIM	25-004-1051	25-004-1051	25-004-1051	25-004-1051
	16B	1	SUPPORT RING (250)	25-004-1061	25-004-1061	25-004-1061	25-004-1061
	16C	1	RETAINING RING	01-160-0600	01-160-0600	01-160-0600	01-160-0600
17	-	1	MOTORS	-	-	-	-
	-	-	MOTOR - C.S. WM51B 2.5 X 2.5 (HI)	01-304-0530	01-304-0530	01-304-0530	01-304-0530

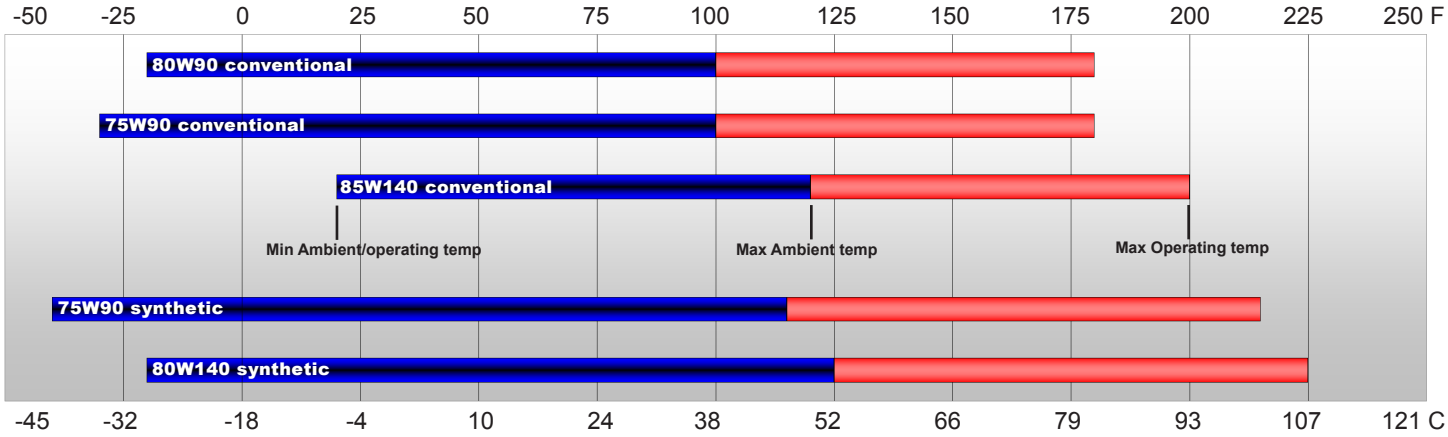
* NUMBER OF SHIMS DEPENDANT UPON BEARING PRELOAD.



LUBRICATION & MAINTENANCE

Using the chart below, determine an appropriate lubricant viscosity. Use only EP (extreme pressure) or API GL-5 designated lubricants. Change the lubricant after the first 50 hours of operation and at 500 hour intervals thereafter. The auger drive should be partially disassembled to inspect gears and bearings at 1000 hour intervals.

Recommended ambient and operating temperatures for conventional and synthetic gear lubricants



Note: Ambient temperature is the air temperature measured in the immediate vicinity of the gearbox. A gearbox exposed to the direct rays of the sun or other radiant heat sources will operate at higher temperatures and therefore must be given special consideration. The max operating temp must not be exceeded under any circumstances, regardless of ambient temperature.

If your unit was specified “shaft up” or with a “-Z” option, a grease zerk was provided in the base housing. For shaft-up operation, the output bearing will not run in oil and must be grease lubricated. Use a lithium based or general purpose bearing grease sparingly every 50 operating hours or at regular maintenance intervals. Over-greasing the output bearing should be avoided as it tends to fill the housing with grease and thicken the oil

ESKRIDGE MODEL 75 OIL CAPACITY

Operating Position	Oil Capacity			Oil Level	
	Single stage	Double stage	Triple stage		
 Vertical Shaft (Pinion Down)		10 pts / 4.7 liters		To midway on upper/ primary gear set	

WARNING: While working on this equipment, use safe lifting procedures, wear adequate clothing and wear hearing, eye and respiratory protection.

ESKRIDGE PART NUMBER INTERPRETATION

Note: All non custom Eskridge Geardrives are issued a descriptive part number which includes information regarding the Model, means of shaft retention, base style, shaft style, input mounting, input shaft size, overall ratio and various available options. For a detailed breakdown of this information, please refer to Eskridge product specification sheets found at: http://www.eskridgeinc.com/diggers/diggerprodspecs.html

Unit Disassembly Procedure

1) Scribe a diagonal line across the outside of the unit from the bail **(15)** to the base **(1)** before disassembly to aid in the proper positioning of pieces during reassembly.

2) Remove magnetic drain plug **(14A)** and drain oil from unit. The oil will drain out faster and more completely if warm.

3) Remove the twenty hex-head capscrews **(13A)** and flat washers **(13C)**.

4) Separate bail **(15)** from cover **(4)** and remove from digger assembly.

5) Remove hex-head capscrews **(13B)** and lockwashers **(13D)** and remove motor **(17)** from cover **(4)**.

6) Remove cover **(4)**, thrust washers **(10B & 10A)**, and input gear **(5)**. Inspect o-ring **(11B)**; discard if damaged or deformed.

7) Lift Stage I planet carrier assembly **(6)** out of the unit Remove ring gear **(2)** and inspect o-ring **(11B)**; discard if damaged or deformed.

8) Remove secondary sun gear **(9)** and thrust washer **(10A)**.

9) Lift the Stage II planet carrier assembly **(7)** out of the unit.

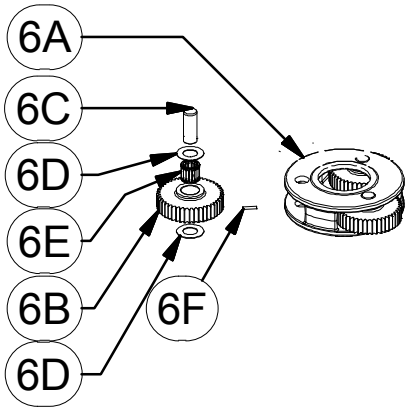
10) Remove the Stage II ring gear **(3)**. Inspect o-ring **(11B)**; as before, discard if damaged.

11) The unit is now separated into subassemblies. The area(s) requiring repair should be identified by thorough inspection of the individual components after they have been cleaned and dried.

Stage I Carrier Subassembly

(Items 6A, 6B, 6C, 6D, 6E & 6F)

Disassembly



1) Rotate planet gears **(6B)** to check for abnormal noise or roughness in bearings **(6E)** or planet shafts **(6C)**. If further inspection or replacement is required, proceed as follows.

NOTE: Support only the carrier (6A) while pressing out planet shafts.

2) Drive roll pins **(6F)** completely into the planet shafts **(6C)**.

3) Press or drive planet shafts **(6C)** out of carrier **(6A)**.

4) Remove planet gears **(6B)** and thrust washers **(6D)** from the carrier **(6A).**

5) Inspect the planet gear **(6B)** bearing bore, planet shaft **(6C)** and bearings **(6E)**. Check for spalling, bruising or other damage. Replace components as necessary.

6) Check primary planet shafts **(6C)** for any abnormal wear, especially ones where bearings needed to be replaced. If any abnormal wear is found, replace planet shafts.

7) Use 3/16 inch pin punch to remove roll pins **(6F)** from planet shafts **(6C)**.

NOTE: If either the bearings or the planet shafts (pins) are damaged, both components should be replaced.

Reassembly

1) Install bearing **(6E)** into planet gear **(6B)**. Place one thrust washer **(6D)** on each face of the planet gear. Install gear assembly into carrier **(6A)**.

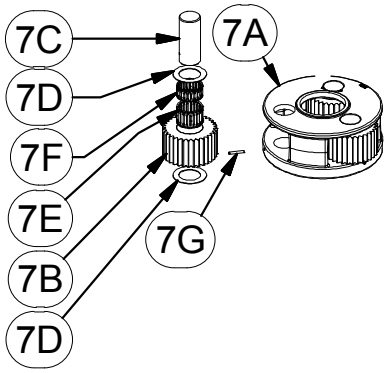
2) Planet shafts **(6C)** should be installed with chamfered end of 3/16 inch hole toward outside diameter of the carrier **(6A)**. This will aid in alignment of holes while inserting roll pins **(6F)**.

3) Drive a roll pin **(6F)** through the carrier hole and into the planet shaft to retain the parts. Repeat for other planet gears.

Stage II Carrier Subassembly

(Items 7A, 7B, 7C, 7D, 7E, 7F, & 7G)

Disassembly



1) Rotate planet gears **(7B)** to check for abnormal noise or roughness in bearings **(7E & 7F)**. If further inspection or replacement is required, proceed as follows.

2) Drive roll pins **(7G)** completely into the planet shafts **(7C)**.

3) Slide planet shafts **(7C)** out of carrier **(7A)**.

4) Remove planet gears **(7B)**, washers **(7D)** and bearings **(7E & 7F)** from carrier **(7A)**.

5) Inspect the planet gear **(7B)** bearing bore, planet shaft **(7C)** and bearings **(7E & 7F)**. Check for spalling, bruising or other damage. Replace components as necessary.

6) Remove roll pins **(7G)** from primary planet shafts **(7C)** using a 3/16 inch pin punch.

Reassembly

1) Rebuild primary planet carrier assembly in reverse order using any needed new parts.

2) Install bearing **(7E & 7F)** into planet gear **(7B)**. Place one thrust washer **(7D)** on each face of the planet gear. Install gear assembly into carrier **(7A)**.

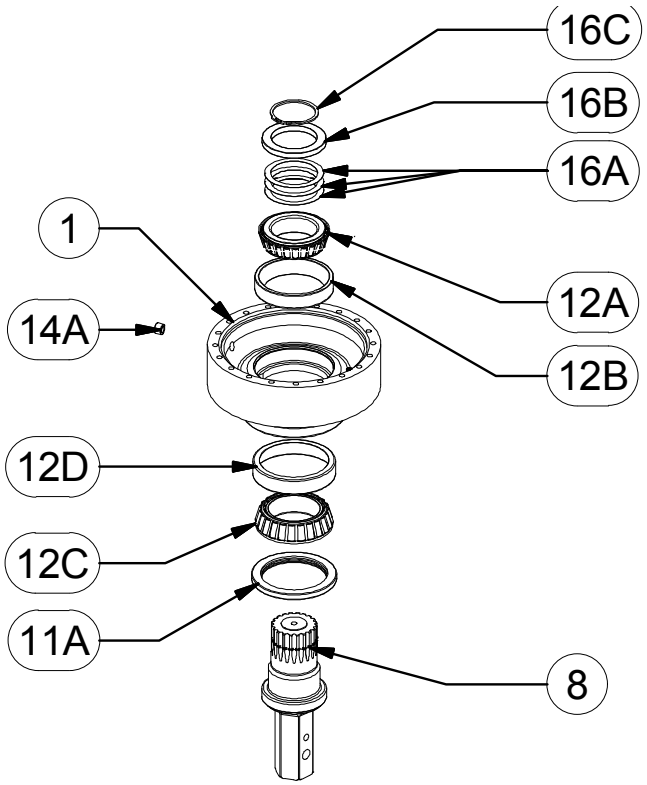
3) Planet shafts **(7C)** should be installed with the chamfered end of the 3/16 inch hole towards the outside diameter of the carrier **(7A)**; this will aid in alignment of holes while inserting roll pins **(7G)**.

4) Drive roll pin **(7G)** into the carrier hole and into the planet shaft to retain the parts. Repeat for remaining planet gears.

Base Subassembly

(Items 1, 8, 11A, 12A, 12B, 12C, 12D, 14A, 16A, 16B, 16C)

Disassembly



1) Remove the retaining ring **(16C)**, support ring **(16B)** and shims **(16A)**.

Caution: Since the output shaft is no longer retained, care should be taken to avoid personal injury. Care should also be taken not to damage it when it is pressed through base.

2) Base **(1)** should be set shaft side down, as shown, on a plate or table. Press output shaft **(8)** through the bottom of base by applying a load to top end (internal end) of shaft until it passes through inner shaft bearing cone **(12A)**.

Note: Removing the shaft from the base assembly damages the shaft seal and the seal will need to be replaced.

3) A gear puller may be used to remove the outer bearing cone **(12C)** from the shaft **(8)**. If reusing old bearing cone, do not pull on or damage roller cage. Remove the shaft seal **(11A)** from the shaft for replacement.

4) Inspect inner and outer bearing cups **(12B & 12D)**. If cups are damaged, drive them out using a brass drift and utilizing the bearing knock-out notches in the base **(1)**

Reassembly

1) Clean all foreign material from magnetic oil plug **(14A)** located on the side of the base **(1)**.

2) Place base **(1)** (output side up, opposite shown) on the table.

3) Apply a layer of lithium or general purpose bearing grease to the roller contact surface of outer bearing cup **(12D)**.

4) Press outer bearing cone **(12C)** (large end down as shown) onto the shaft **(8)** until it seats against the shoulder.

Note: Press bearing cone onto output shaft by pressing on inner race only. DO NOT press on roller cage, as it may damage bearing.

5) Place the shaft **(8)** with the bearing **(12C)** into the base **(1)**.

6) Flip this assembly, resting the base **(1)** on the end of the output shaft **(8)**.

7) Apply a layer of lithium or general purpose bearing grease to the roller contact surface of the inner bearing cup **(12B)**. Press the inner bearing cone **(12A)** (large end up as shown) onto the shaft **(8)** until it is seated against inner bearing cup.

8) Without the shaft seal **(11A)** installed, the preload may result in a rolling torque that varies between 50 to 300 in-lb. The bearing preload should be tailored to your application; a low-speed application may require a high pre-load, high-speed applications usually benefit from low pre-load. Adding shims **(16A)** will increase the pre-load on the bearing set. Determine your pre-load requirement and install shims to obtain this pre-load. Place the support ring **(16B)** over the shims **(16A)** and install the retaining ring **(16C)** into the groove in the shaft **(8)**.

9) Lubricate inner lip of new shaft seal **(11A)** and slide it onto the shaft **(8)** and over the shaft seal diameter then press the seal into the base bore **(1)**.

All subassembly service or repairs should be complete at this time. Continue to Unit Assembly to complete unit buildup.

Unit Assembly

1) When all subassemblies are complete, the unit is ready to be assembled.

2) Install the Stage II carrier assembly **(7)** onto the output shaft; align the splines of the carrier **(7A)** with the splines of the shaft **(8)** and slide the carrier onto the shaft.

3) Lubricate o-ring **(11B)** and install on the pilot of the Stage II ring gear **(3)**.

Caution: Hold ring gear by outside or use lifting device to prevent injury.

5) Install Stage II sun gear **(9)** into Stage II carrier assembly **(7)**. Place thrust washer **(10A)** onto Stage II carrier **(7A)**.

6) Align gear teeth of ring gear **(3)** with the gear teeth of the planet gears **(7B)** and place on base. Align mounting holes of ring gear with holes in base using the scribed line made during disassembly for reference.

7) Lubricate o-ring **(11B)** and install on the pilot of the Stage I ring gear **(2)**. Install ring gear and align mounting holes of ring gear with holes in base. Use the scribed line made during disassembly for reference.

8) Slide Stage I carrier **(6A)** onto Stage II sun gear **(9)**.

9) Install input gear **(5)** and thrust washers **(10A & 10B)**. Lubricate o-ring **(11B)** and install on the pilot of the gearbox cover **(4)**. Noting the scribed line made during disassembly, install cover**.**

10) Ensure the unit spins freely by using a splined shaft to drive the input gear **(5)**.

11) Install motor **(17)** onto cover **(4)** using hex-head capscrews **(13B)** and lockwashers **(13D).** Lube fasteners and torque to 110 ft-lb.

12) Place bail **(15)** onto assembly and align holes in bail and cover **(4)** using scribed line made during disassembly as a reference. Install and torque the 20 1/2-13 hex head capscrews **(13A)** with flatwashers **(13C)**. **Torque the capscrews to 110 ft-lbs dry, or 80 ft-lbs if fasteners are lubricated.**

13) Fill the unit to the proper level, as specified, with GL5 EP 80/90 gear oil.

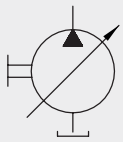
The digger is now ready to use.

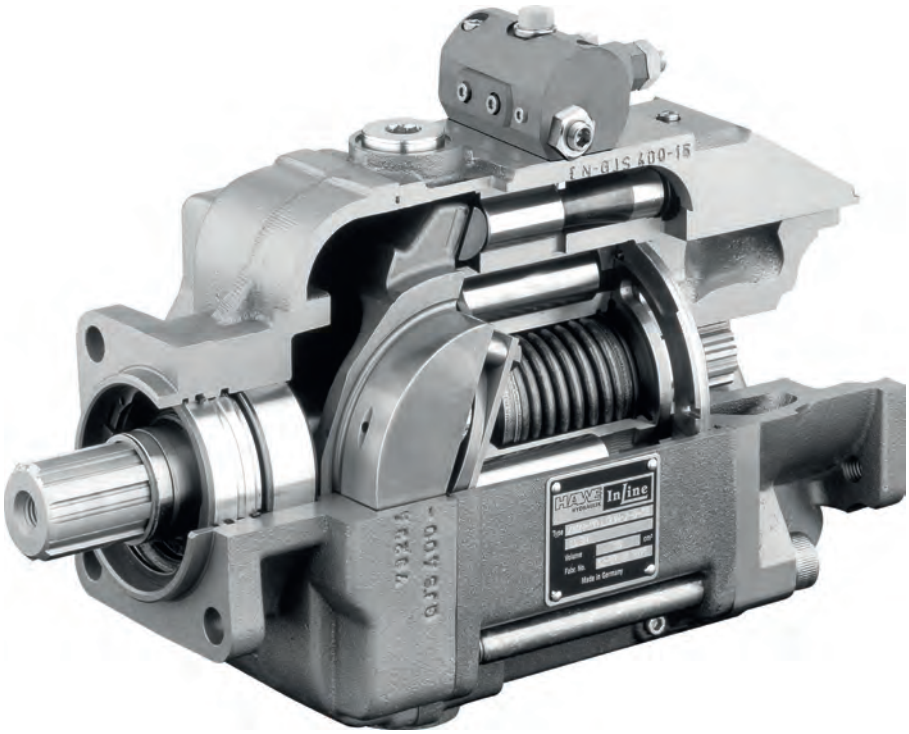
Variable displacement axial piston pump V60N

Applications including commercial vehicles, open circuit

Nominal pressure $p_{nom\ max}$:	400 bar
Maximum pressure p_{max}:	450 bar
Geometric displacement V_{max}:	60 ... 130 cm³/rev.

Circuit symbol:





Product documentation
D 7960 N
10-2014-2.1

SOLUTIONS FOR A WORLD UNDER PRESSURE

HAWE HYDRAULIK

Contents

1 Overview: variable displacement axial piston pump types V60N

Variable displacement axial piston pumps adjust the geometric delivery volume from maximum to zero. As a result they vary the volumetric flow that is provided to the loads.
The axial piston pump type V60N is designed for open circuits in mobile hydraulics and works according to the swash plate principle. It is available with the option of a thru-shaft for operating additional hydraulic pumps in series.
The pump is fitted above all to the power take-off on commercial vehicle transmissions. The range of pump controllers allows the axial piston pump to be used in a variety of applications.

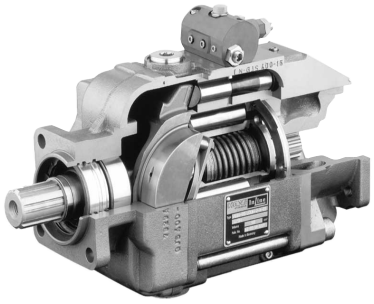


Figure 1: Variable displacement axial piston pump type V60N-110

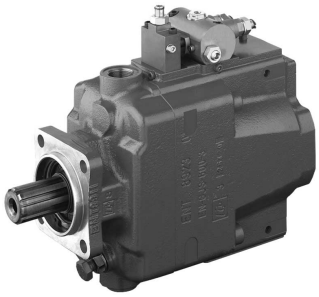


Figure 2: Variable displacement axial piston pump type V60-130

Features and benefits:

- Optimized power-to-weight ratio
- High self-suction speed
- Wide range of controllers

Intended applications:

- Machines for forestry and agricultural purposes
- Cranes and lifting equipment
- Truck-mounted concrete pumps
- Municipal trucks

2 Available versions, main data

2.1 Basic version

Circuit symbol:

Order coding example:

V60N	-090	R	D	Z	N	- 2	-0	03	/LSNR/ZL	- 2/65	- 350	-	A00/76	- C 022

Flange version Table 13 Flange versions (output side)

Suction intakes Suction intakes: see Section Chapter 7, "Accessories, spare parts and separate components"

Ports Table 12 Ports

Pressure specification (bar)

Stroke limitation Table 11 Stroke limitations

Controller Table 8 Controllers; Table 9 Intermediate plates; Table 10 Solenoid voltage and versions

Release

Additional function Table 7 Additional function

Housing version Table 6 Housing versions

Seal Table 5 Seals

Flange version Table 4 Flange versions (input side)

Shaft version Table 3 Shaft versions

Rotation direction Table 2 Rotation directions

Nominal size Table 1 Nominal sizes

Basic type

Table 1: Nominal size

Coding	Geometric displacement (cm^3/rev)	Nominal pressure p_{nom} (bar)	Peak pressure p_{max} (bar)
060	60	350	400
090	90	350	400
110	110	350	400
130	130	400	450

Table 2: Rotation directions

Coding	Description
L	Anti-clockwise
R	Clockwise

When looking at the shaft journal

(for information on change of rotation direction, seeChapter 3, "Parameters")

Table 3 Shaft versions

Coding	Description	Designation/Standard	Max. drive torque (Nm)
D	Parallel key splined shaft	Similar to DIN ISO 14 (trucks)	800
M	Spline shaft	DIN 5480 (only V60N-090, V60N-110)	530
H	Spline shaft	SAE-B J 744 13T 16/32 DP 22-4 ISO 3019-1 (only V60N-060)	210
U	Spline shaft	SAE-B J 744 short 13T 16/32 DP 22-4 ISO 3019-1 short (only V60N-060)	210
T	Spline shaft	SAE-BB J 744 15T 16/32 DP 25-4 ISO 3019-1 (only V60N-060)	340
S	Spline shaft	SAE-C J 744 14T 12/24 DP 32-4 ISO 3019-1	640
Q	Spline shaft	SAE-CS 21T 16/32 DP 35-4 ISO 3019-1 (only V60N-090, V60N-110, V60N-130)	900

Table 4 Flange versions (input side)

Coding	Description	Designation
Y	Flange	ISO 7653-1985 (for trucks)
P	Flange	ISO 7653-1985 10° rotated (for trucks) (only V60N-110, V60N-130) [1]
X	Flange	SAE-B 2-hole J 744 - 45° rotated 101-2 ISO 3019-1 (only V60N-060)
Z	Flange	SAE-B 4-hole J 744 101-4 ISO 3019-1 (only V60N-060)
F	Flange	SAE-C 4-hole J 744 127-4 ISO 3019-1
G	Flange	125 B4 HW ISO 3019-2 (only V60N-090)

Table 5 Seals

Coding	Description
N	NBR
V	FKM

Table 6 Housing versions

Coding	Description
1	Suction and pressure port axial
2	Suction and pressure port radial, with thru-shaft
3	Suction and pressure port radial
4	Suction and pressure port axial, ports SAE J 518 (only V60N-090)

Table 7 Additional functions

Coding	Description
0	None

[1] For narrow installation spaces, e.g. Mercedes Benz NA 124 gear manufacturing

Table 8 Controllers

Coding	Description
LSNR	Load-sensing controller with integrated pressure limitation. The LSNR controller is a delivery flow controller that generates a variable volumetric flow independently of the speed. It sets a constant difference between the load pressure and pump pressure by continuously adapting the geometric displacement of the pump to the quantity required for the consumers. The integrated pressure limitation restricts the maximum pressure to a set value. Coding LSN: Discontinued unit; see Chapter 7.1, "Discontinued controller units"
LSNRT	Load-sensing controller with forced LS relief and integrated pressure limitation. As well as the LSNR controller, the LSNRT contains internal LS signal relief. It is suited to hydraulic systems whose LS relief does not take place in proportional directional spool valves. Internal leakage current ≤ 1.5 lpm
NR	Pressure controller, adjustable directly at the pump. The pressure controller maintains a constant system pressure independently of the required delivery flow. It is suited to constant pressure systems where differing delivery flows are required or for efficient pressure limitation of a hydraulic system. Coding N: Discontinued unit; see Chapter 7.1, "Discontinued controller units"
NXR	Remote-controlled pressure controller. The pressure is set using an externally piped pressure-limiting valve (not included in the scope of delivery).
QNR/...	Size **060**, **090**, **110**: Delivery flow controller with integrated pressure limitation for setting a constant volumetric flow independently of the speed. The quantity controller generates a constant differential pressure via an orifice in the P channel. The differential pressure can be adjusted between 20 and 55 bar; the orifice is available in various gradings. This allows flexible adjustment of the volumetric flow.

Orifice (mm)	Volumetric flow at 20 bar differential pressure (lpm)	Orifice (mm)	Volumetric flow at 20 bar differential pressure (lpm)
3	approx. 23	**7**	approx. 127
3.5	approx. 32	**7.5**	approx. 146
4	approx. 42	**8**	approx. 166
4.5	approx. 53	**8.5**	approx. 188
5	approx. 65	**9**	approx. 210
5.5	approx. 65	**9.5**	approx. 234
6	approx. 94	**10**	approx. 260
6.5	approx. 110		

Table 8: Controllers

Coding	Description
PR	Electric proportional pressure controller with increasing characteristic curve. The maximum pressure and minimum pressure can be adjusted mechanically; in between these values, electrical adjustment is possible.
P1R	Electric proportional pressure controller with decreasing characteristic curve. The controller is specifically developed for fan and generator drives. In the event of a power failure, the pump generates the maximum pressure. The maximum pressure and minimum pressure can be mechanically adjusted at the controller.
/V	Size **130**: Electric proportional delivery flow controller with increasing characteristic curve. The V controller is an electrically actuated controller that sets an appropriate geometric displacement for the pump in accordance with a current value. Therefore, the pump generates a variable volumetric flow that is dependent on the speed. For use in open centre systems with operating pressures of < 25 bar, an external supply pump or pump pre-load valve must be provided to ensure reliable adjustment. Only in combination with pressure control (codings NR or NXR)
/V1	Size **130**: Electric proportional delivery flow controller with decreasing characteristic curve. In comparison with the /V controller, the /V1 controller has a negative characteristic curve, i.e. in the event of power failure, the pump operates at a maximum geometric displacement. For use in open centre systems with operating pressures of < 25 bar, an external supply pump or pump pre-load valve must be provided to ensure reliable adjustment. Only in combination with pressure control (codings NR or NXR)

Table 9 Intermediate plates

Intermediate plate version, only in combination with one of the controllers described above

Coding	Description
/ZL	Size **060**, **090**, **110**: Intermediate plate with power controller (torque limitation) Product “Pressure x Delivery flow” = constant Adjustment range: 25 ... 100% max. drive torque Coding LLSN, LN: Discontinued units, see Chapter 7.1, "Discontinued controller units"
/ZW	Angled intermediate plate (45°) mandatory for mounting controllers at pumps with housing version -2, -3
/L	Adjustment range: 200 - 700 Nm Size **130**: Power controller (standard)
/PR	Electric proportional pressure controller with increasing characteristic curve. The maximum pressure and minimum pressure can be adjusted mechanically; in between these values, electrical adjustment is possible.
/ZV	Size **060**, **090**, **110**: Electric proportional delivery flow controller with increasing characteristic curve. For use in open centre systems with operating pressures of < 25 bar, an external supply pump or pump pre-load valve must be provided to ensure reliable adjustment. The ZV controller is designed as an intermediate plate. (It acts on the set piston from above and electrically adjusts the pivoting angle of the pump.)
/ZV1	Size **060**, **090**, **110**: Electric proportional delivery flow controller with decreasing characteristic curve. For use in open centre systems with operating pressures of < 25 bar, an external supply pump or pump pre-load valve must be provided to ensure reliable adjustment. The ZV1 controller is designed as an intermediate plate. (It acts on the set piston from above and electrically adjusts the pivoting angle of the pump.)

Table 10 Solenoid voltage and version

Coding	Nominal voltage	Description
G 12 **G 24**	12 V DC 24 V DC	Version with connection DIN EN 301-803 With plug
S 12 **S 24**	12 V DC 24 V DC	Version with bayonet connection (bayonet PA 6, SCHLEMMER, suitable for cone with bayonet 10 SL). The delivery does not include a plug.

Table 11 Stroke limitation

Coding	Description
No designation	No stroke limitation
2	With adjustable stroke limitation (for housing version 1 and 4: all sizes, for housing version 2 and 3: only V60N-090, V60N-130)
2/...	Stroke limitation fixed with specification of the set geometric displacement V_g (cm^3/rev.)

Table 12 Ports

Coding	Ports
No designation	ISO 228/1
UNF	SAE J 514

Order coding example:

V60N-110 RDYN-2-0-01/LSNR-350-A00/76- **C 022**

Table 13 Flange versions (output side)

Coding V60N			Flange	Shaft
060	090/110	130		
C 010	--	C 030	ISO 7653-1985	DIN ISO 14
C 011	C 021	C 031	SAE-A 2-hole J 744 82-2 ISO 3019-1	SAE-A J 744 (16-4 ISO 3019-1) 9T 16/32 DP
C 012	C 022	C 032	SAE-A 2-hole J 744 82-2 ISO 3019-1	SAE-A J 744 (16-4 ISO 3019-1) [1)] 9T 16/32 DP [1)]
C 013	--	--	SAE-A 2-hole J 744 82-2 ISO 3019-1	19-4 ISO 3019-1 11T 16/32 DP
C 014	C 024	C 034	SAE-B 2-hole J 744 101-2 ISO 3019-1	SAE-B J 744 (22-4 ISO 3019-1) 13T 16/32 DP
--	--	--	SAE-B 2-hole J 744 101-2 ISO 3019-1	SAE-BB J 744 (25-4 ISO 3019-1) 15T 12/24 DP
C 015	C 025	C 035	SAE-B 4-hole J 744 101-4 ISO 3019-1	SAE-B J 744 (22-4 ISO 3019-1) 13T 16/32 DP
--	C 027	C 037	SAE-C 2-hole J 744 127-2 ISO 3019-1	SAE-C J 744 (32-4 ISO 3019-1) 14T 12/24 DP
--	C 028	C 038	SAE-C 4-hole J 744 127-4 ISO 3019-1	SAE-C J 744 (32-4 ISO 3019-1) 14T 12/24 DP

Note
Pay attention to the maximum permissible drive torque, as the flange or shaft may be damaged otherwise.

Note
An additional support is to be provided for pump combinations.
Other versions on request.

[1)] ANSI B 92.1, FLAT ROOT SIDE FIT, spline width deviating from the standard, s = 2.357-0.03

3 Parameters

3.1 General

Description	Variable displacement axial piston pump
Design	Axial piston pump according to the swash plate principle
Mounting	Power take-off on commercial vehicle gearboxes (flange ISO 7653-1985 for trucks) or flange mounting
Surface	Primed
Drive/output torque	See Chapter 3, "Parameters", under "Additional parameters"
Installation position	Any (for installation information see Chapter 5, "Installation information")
Rotation direction	Clockwise or anti-clockwise
Change of rotation direction	**V60N-060...-110:** Turn the end plate of the pump (see dimension diagram) and replace the port plate; see also Assembly instructions for variable displacement axial piston pump type V60N: B 7960 N
Ports	▪ Suction port ▪ Pressure port ▪ Drain port ▪ Pressure gauge connection
Hydraulic fluid	Hydraulic oil: according to DIN 51 524 Part 1 to 3; ISO VG 10 to 68 according to DIN 51 519 Viscosity range: min. approx. 10; max. approx. 1000 mm ²/s Optimal operating range: 16 to 35 mm²/s Also suitable for biologically degradable pressure fluids type HEPG (polyalkalene glycol) and HEES (synthetic ester) at operating temperatures up to approx. +70°C.
Purity class	**ISO 4406** 19/17/14
Temperatures	Ambient: approx. -40 to +60°C, oil: -25 to +80°C, pay attention to the viscosity range! Start temperature: down to -40°C is permissible (observe start-viscosity!), as long as the steady-state temperature is at least 20K higher for subsequent operation. Biologically degradable pressure fluids: note manufacturer specifications. With consideration for the seal compatibility, not above +70°C.

Pressure and delivery flow

Operating pressure	See Chapter 2, "Available versions, main data"
Geometric displacement	See Chapter 2, "Available versions, main data"

Dimensions

Type V60N	With controller (kg)
060	24
090	27
110	30
130	30.8

Additional parameters

Description	Nominal size			
	060	090	110	130
Max. swash plate angle	20.5°	21.5°	21.5°	21.5°
Absolute inlet pressure required in open circuit	0.85 bar	0.85 bar	0.85 bar	0.85 bar
Max. permissible housing pressure (static/dynamic)	2 bar/3 bar	2 bar/3 bar	2 bar/3 bar	2 bar/3 bar
Max. permissible inlet pressure (static/dynamic)	20 bar/30 bar	20 bar/30 bar	20 bar/30 bar	20 bar/30 bar
Max. speed during suction operation and max. swash plate angle at 1 bar abs. Inlet pressure	2500 rpm	2300 rpm	2200 rpm	2100 rpm
Max. speed with zero stroke and 1 bar abs. Inlet pressure	3000 rpm	3000 rpm	3000 rpm	3000 rpm
Min. speed in continuous operation	500 rpm	500 rpm	500 rpm	500 rpm
Required drive torque at 100 bar	100 Nm	151 Nm	184 Nm	230 Nm
Drive power at 250 bar and 2000 rpm	53 kW	79.5 kW	97.2 kW	120 kW
Weight torque	30 Nm	35.5 Nm	40 Nm	40 Nm
Inertia torque	0.005 kg m^2	0.008 kg m^2	0.01 kg m^2	0.011 kg m^2
Noise level at 250 bar, 1500 rpm and max. swash plate angle (measured in acoustic measurement chamber according to DIN ISO 4412, measurement distance 1 m)	75 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)

Max. permissible drive/output torque

Description		Nominal size			
		060	090	110	130
Parallel key splined shaft D	**Drive/output**	430 Nm/100 Nm	530 Nm/530 Nm	800 Nm/600 Nm	800 Nm/700 Nm
Spline shaft M	**Drive/output**	--	530 Nm/530 Nm	530 Nm/530 Nm	--
Spline shaft H	**Drive/output**	210 Nm/100 Nm	--	--	--
Spline shaft U	**Drive/output**	210 Nm/100 Nm	--	--	--
Spline shaft T	**Drive/output**	340 Nm/100 Nm	--	--	--
Spline shaft S	**Drive/output**	430 Nm/100 Nm	530 Nm/530 Nm	640 Nm/600 Nm	640 Nm/640 Nm
Spline shaft Q	**Drive/output**	--	530 Nm/530 Nm	900 Nm/600 Nm	900 Nm/700 Nm

3.2 Planning information for parameters

Determination of nominal sizes

Delivery flow	$Q = \frac{V_g \cdot n \cdot \eta_V}{1000} (l/\min)$
Drive torque	$M = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} (Nm)$
Drive power	$P = \frac{2\pi \cdot M \cdot n}{60000} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t} (kW)$

V_g	= Geom. delivery volume (cm³/rev.)
Δp	= Differential pressure
n	= Speed (rpm)
η_v	= Volumetric efficiency
η_{mh}	= Mechanical-hydraulic efficiency
η_t	= Overall efficiency ($\eta_t = \eta v \cdot \eta_{mh}$)

3.3 Characteristic curves

Delivery flow and power (basic pump)

The diagrams illustrate the delivery flow/pressure (without controller).
Drive power at max. swash plate angle and drive power at zero stroke and 1500 rpm.
Drive power/pressure at zero stroke and 1500 rpm

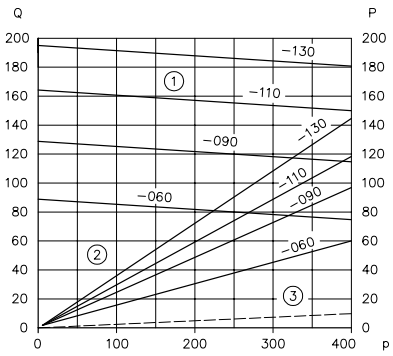


Figure 3: p pressure (bar); Q delivery flow (lpm); P power (kW)

1 Delivery flow/pressure
2 Drive power/pressure
3 Drive power/pressure (zero stroke)

Inlet pressure and self-suction speed

The diagrams show the inlet pressure/speed at the max. swash plate angle and an oil viscosity of 75 mm²/s

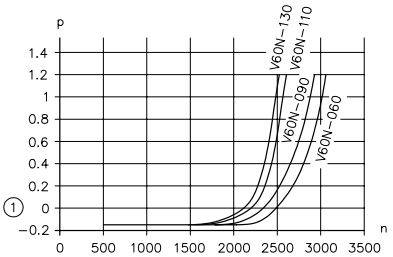
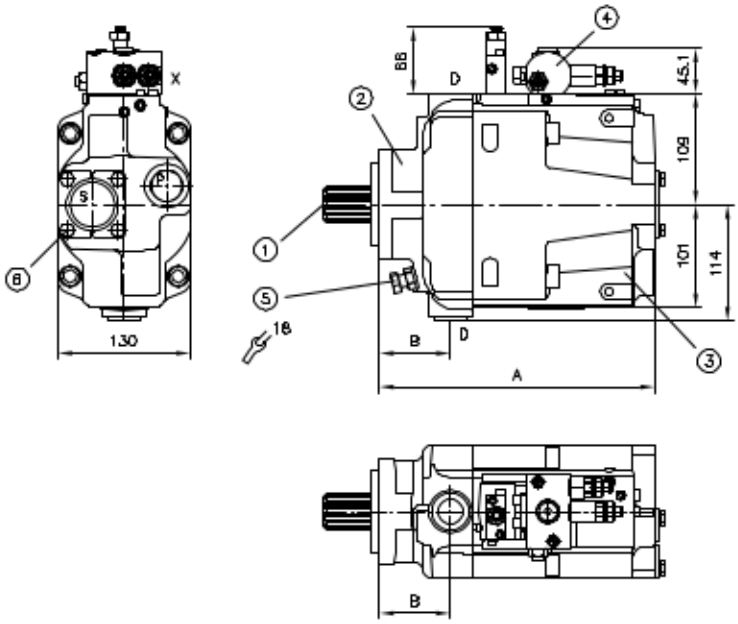


Figure 4: n speed (rpm); p inlet pressure (bar)

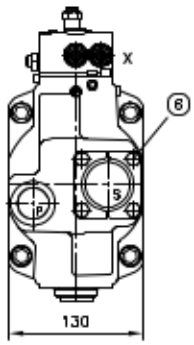
1 0 bar relative = 1 bar absolute

4.1.4 Type V60N-130

Rotation direction **clockwise** (viewed from shaft journal)



Rotation direction **anti-clockwise** (viewed from shaft journal)



1 Shaft version
2 Flange version
3 Housing version
4 Controller and intermediate plates according to Section 4.2
5 Stroke limitation (13 cm^3/rev.)
6 Delivery includes attachment kit for suction intakes according to Section 7.2

Flange version	Housing version	A	B
Y, P	-1	269.5	69.5
F	-1	266.8	66.8
Y, P	-2	323.5	69.5
F	-2	320.8	66.8

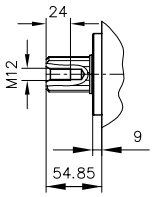
A- V60 090 110 130

Ports P, S and D (ISO 228/1)	
P	Pressure port G 1
S	Flange suction port
D	Drain port G 3/4
X	G 1/4

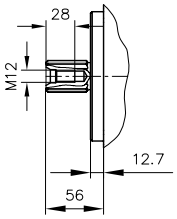
For coding UNF, ports SAE J 514	
P	Pressure port 1 5/16-12 UN-2B
S	Flange suction port
D	Drain port 1 1/16-12 UN-2B
X	G 1/4 (ISO 228/1) with adapter for 7/16-20 (SAE-4)

Shaft versions

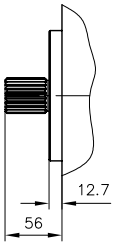
Spline shaft
Coding **D**
(similar to DIN ISO 14)



Spline shaft
Coding **S**
(SAE-C 14T 12/24DP)

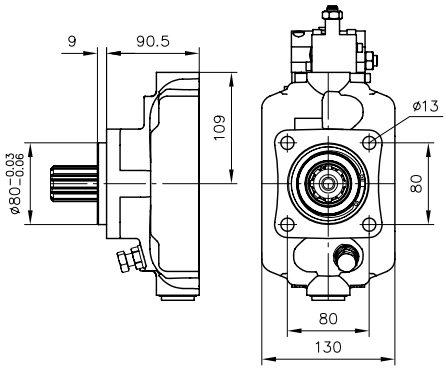


Spline shaft
Coding **Q**
(SAE-CS)

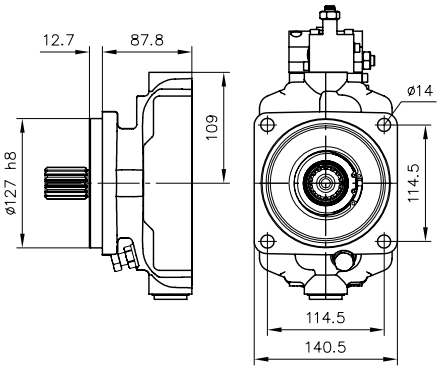


Flange versions

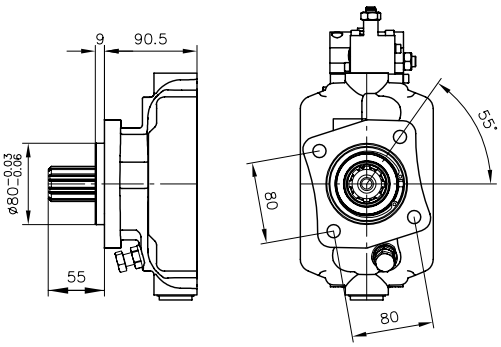
Coding **Y**
(ISO 7653-1985)



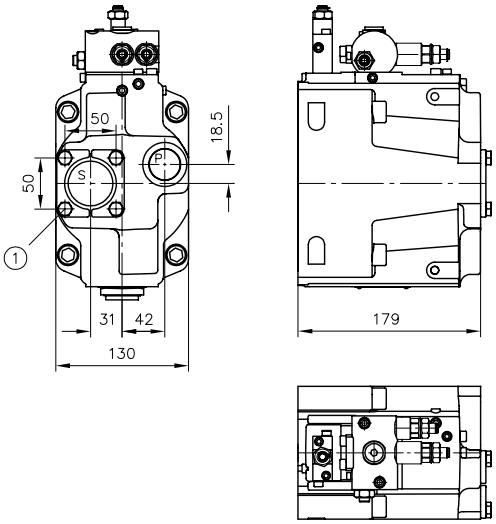
Coding **F**
(SAE-C 4-hole)
(127-4 ISO 3019-1)



Coding **P**
(ISO 7653-1985)



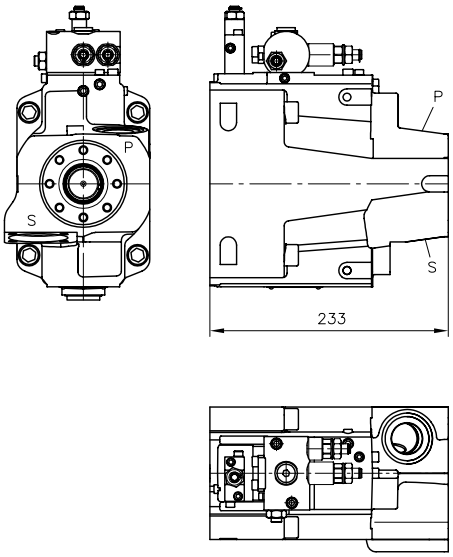
Housing version -1 (axial ports)



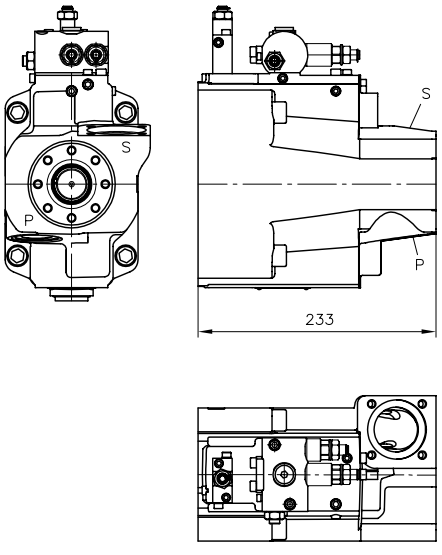
1 Delivery includes attachment kit for suction intakes according to Section 7.2

Housing version -2 (radial ports, with thru-shaft)

Rotation direction **clockwise**

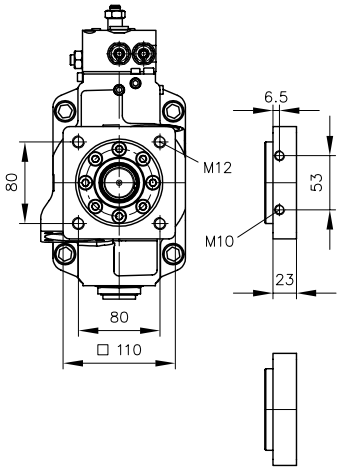


Rotation direction **anti-clockwise**

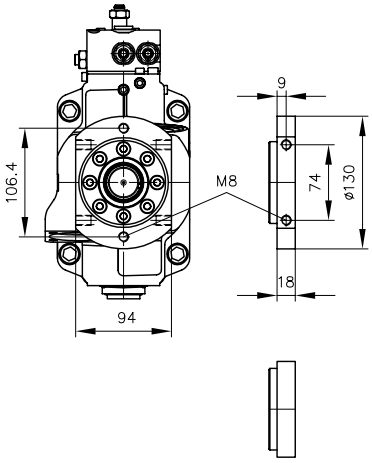


Flange version (output side)

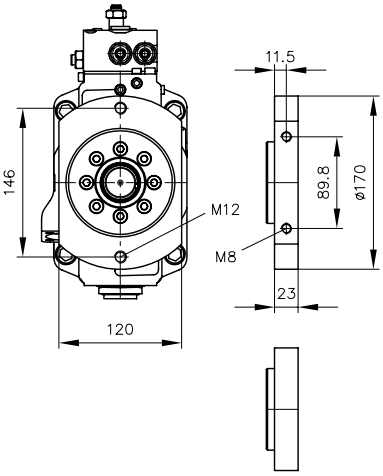
Coding **C 030**
(ISO 7653-1985)



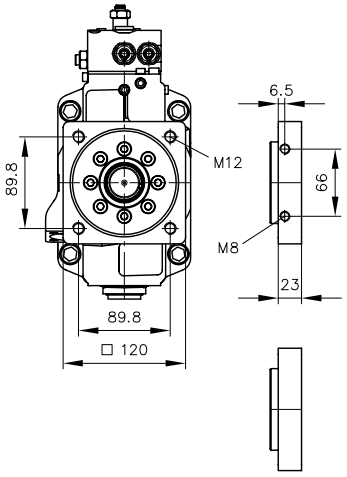
Coding **C 031, C 032**
(SAE-A 2-hole)



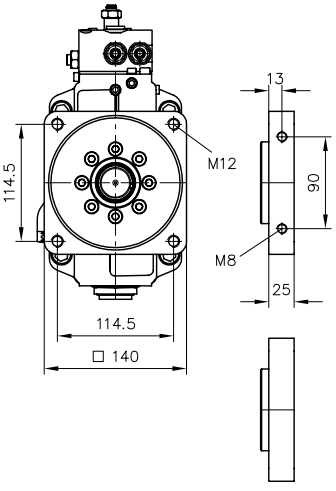
Coding **C 034**
(SAE-B 2-hole)



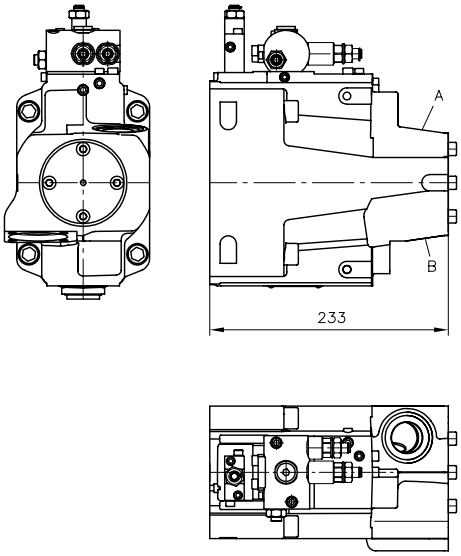
Coding **C 035**
(SAE-B 4-hole)



Coding **C 038**
(SAE-C 4-hole)



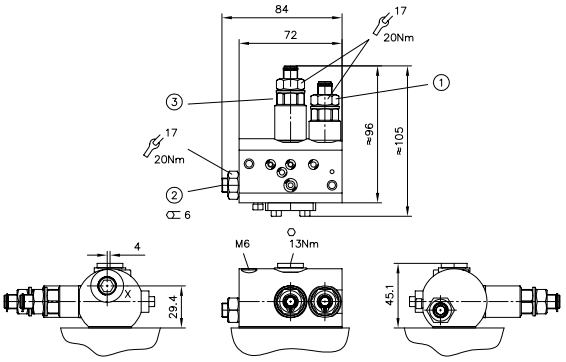
Housing version -3 (radial ports)



Rotation direction clockwise	Rotation direction anti-clockwise
A = pressure port	A = suction port
B = suction port	B = pressure port

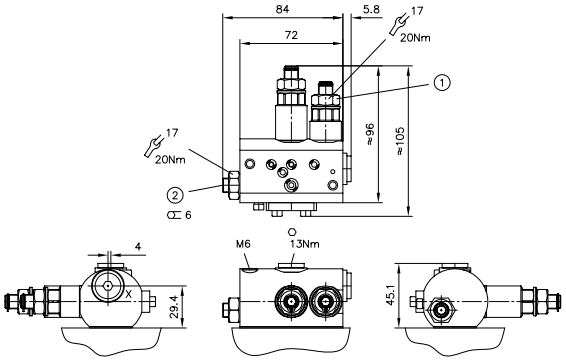
4.2 Controllers and intermediate plates

Coding **LSNR, LSNRT, NXR**



1 Pressure limitation
2 Dynamic throttle
3 Differential pressure Δp (stand-by pressure) (only codings LSNR and LSNRT)

Coding **NR**



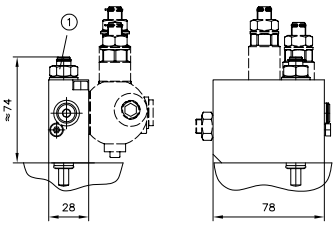
1 Pressure limitation
2 Dynamic throttle

Port X (ISO 228/1): G 1/4

LS signal port, order reference for adapter for UNF thread 79.93 245

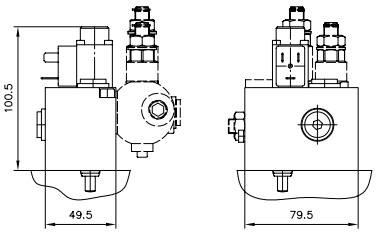
Adjustment range for ② and ⑤ restricted by retaining ring

Coding **/ZL**
Intermediate plates version



1 Torque setting

Coding **/ZV, /ZV1**



Pressure adjustment

	Pressure range (bar)	Δp (bar) /revolution	Default pressure setting (bar)
Pressure limitation	20 ... 400	approx. 50	300
Differential pressure Δp (only type LSNR)	20 ... 55	approx. 10	27
Differential pressure Δp (only type QNR)	20 ... 55	approx. 10	20

Torque setting

	ΔM (Nm) /revolution	Default torque setting (Nm)
Power controller /ZL	Approx. 190	200
Power controller /L	Approx. 190	700

Caution
Risk of injury on overloading components due to incorrect pressure settings!

- Always monitor the pressure gauge when setting or changing the pressure.

5 Installation information

5.1 General information

The V60N variable displacement axial piston pump is designed for use in an open circuit.

It can be mounted directly on a truck power take-off (PTO) using a flange in accordance with ISO 7653-1985 or using a flange in accordance with specifications.

Further connection options are available with a propshaft and suitable coupling sleeves (see Chapter 7, "Accessories, spare parts and separate components")

A change of rotation direction is available for types V60N-060, V60N-090 and V60N-110 variable displacement axial piston pumps. For conversion instructions, please contact HAWE Hydraulik SE.

The following essential points must be noted when installing the pump:

Mounting and removal of the pump and attached components may be performed by trained persons only. Ensure absolute cleanliness during all work. Contamination may have an adverse effect on the function and service life of the pump.

- Remove all plastic plugs prior to initial operation.
- Avoid installing the motor above the tank (see Installation positions" inChapter 5.3, "Installation positions").
- Observe the reference values in Section Chapter 7, "Accessories, spare parts and separate components" .
- Prior to initial operation, fill the pump with oil and bleed. Automatic pump filling via the suction line by opening the drain ports is not possible.
- Prevent the pump and suction line from running dry.
- Always ensure a constant supply of oil. Even a brief shortage in the supply of hydraulic fluid to the pump may damage internal parts. This may not be immediately evident after initial operation.
- The hydraulic oil returning to the tank from the system must not be sucked back in immediately (baffles).
- Run the pump for approx. 10 minutes at max. 50 bar after initial operation.
- Thorough bleeding/flushing of the entire system is recommended before the full pressure range is used.
- Observe the max. permissible operating range temperatures (see Chapter 3, "Parameters") at all times.
- Always comply with the specified oil purity classes (see Chapter 3, "Parameters"); provide appropriate hydraulic fluid filtering.
- Use of a filter in the intake line must be approved by HAWE Hydraulik.
- Include a main pressure-limiting valve in the pressure line to limit the max. system pressure.

5.2 Ports

The nominal diameter of the connecting lines depends on the specified operating conditions, the viscosity of the hydraulic fluid, the start-up and operating temperatures and the speed of the pump. In principle we recommend the use of hose lines due to the superior damping characteristics.

Pressure port

The pressure port connection on type V60N-060 is established via a threaded connection G 3/4"; on type V60N-090/110/130 via a threaded connection G 1".

Observe the tightening torque specified by the part manufacturer.

Suction port

The suction port on all pumps is established via standardised suction intakes with a size that is dependent on the max. delivery flow of the pump.

The specifications of the max. delivery flow Q_{max} must be observed. These can be found in the following table.

Nominal width (N)	38 (1 1/2")	42	50 (2")	64 (2 1/2")	74 (3")	6 (G 1 1/4)	7 (G 1 1/2)
Q_{max} (l/min)	75	90	125	190	250	90	125

The suction intakes can be ordered as an option with the pump.

If possible, route the suction line to the tank in such a way that it is steadily rising. This allows trapped air to escape. Observe the specifications in "Installation positions"Chapter 5, "Installation information". The absolute intake pressure must not fall below 0.85 bar. A hose line should generally be used in preference to a rigid pipe.

Drain port

The V60N pumps have 2 drain ports G 3/4" or 1 1/16-12-UN-2B. A G 1/8" threaded connection is also available for the flange version SAE-B2, SAE-B4 and SAE-4. This is used for bleeding in the case of vertical installation positions.

The nominal diameter of the overflow oil line must not be less than 16 mm. The cross-section is determined by the max. permissible housing pressure.

Integrate the overflow oil line in the system in such a way as to prevent direct connection with the suction line of the pump. Both drain ports can be used simultaneously.

A separate overflow oil line from the controller to the tank is not required. Observe the specifications inChapter 5.3, "Installation positions".

LS port for version LSNR, LSNRT, NXR

The LS line is connected to the controller via a G 1/4" threaded connection.

The nominal diameter of the line depends on the installation position of the pump and should be 10% of the pressure line capacity. A hose line should generally be used in preference to a rigid pipe.

- When the proportional directional spool valve is in a neutral position, the LS line must be fully relieved (only controller type LSNR, LSN). In the case of controller type LSNRT, relief takes place internally in the controller.

5.3 Installation positions

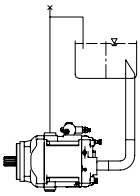
The variable displacement axial piston pump V60N can be installed in any installation position.

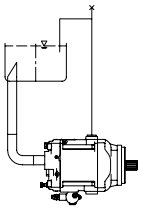
Observe the truck manufacturer's specifications if installing the pump directly on a truck power take-off.

A support is required for tandem pumps or two hydraulic pumps mounted in series. The following points must be observed:

Horizontal installation: (pump below the min. fill level)

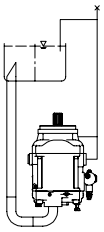
For horizontal installation, use the uppermost drain port.





Vertical installation: (pump below the min. fill level)

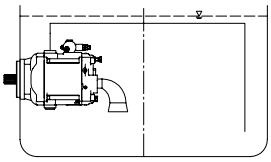
Mount the pump so that the pump mounting flange is facing upwards. Only pumps with mounting flanges of type SAE-B2, SAE-B and SAE-C are approved for vertical installation. For vertical installation, use the uppermost drain port. Also connect the G 1/4" bleeding port on the pump flange. Take appropriate measures to ensure continuous bleeding of this line (line routing/bleeding).
For installation with the pump flange facing downwards, please contact HAWE Hydraulik.

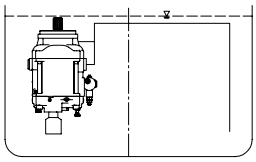


5.4 Tank installation

Tank installation (pump below the min. fill level)

The pump can be operated either with or without a suction tube. Using a short suction intake is recommended.



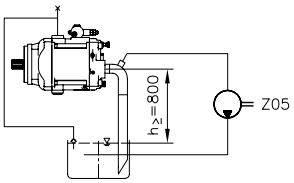


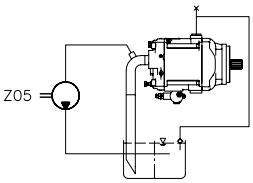
Additional notes regarding installation above the fill level

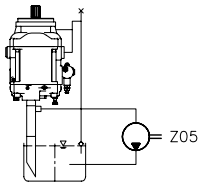
Special measures are required if the pump is installed above the fill level. The pump must not run dry via the pressure, intake, drain, bleed or control lines. This applies in particular to long periods of downtime.

- A check valve (opening pressure approx. 0.5 to 0.6 bar) in the overflow oil line can prevent the pump housing from being emptied.
- Facilitate bleeding of connecting lines via separate bleed openings.
- Adjust the bleeding sequence to the specific installation.
- A gear pump must be provided in order to fill the suction line.

For specialist advice on designing axial piston pumps, the following contact form is available:
Checklist for designing variable displacement axial piston pumps: B 7960 checklist.







For further information on installation, operation and maintenance, see the relevant assembly instructions:
B 7960, B 5488.

6 Installation, operation and maintenance information

6.1 Designated use

This fluid-power product has been designed, manufactured and tested using standards and regulations generally applicable in the European Union and left the plant in a safe and fault-free condition.

To maintain this condition and ensure safe operation, operators must observe the information and warnings in this documentation.

This fluid-power product must be installed and integrated in a hydraulic system by a qualified specialist who is familiar with and adheres to general engineering principles and relevant applicable regulations and standards.

In addition, application-specific features of the system or installation location must be taken into account if relevant.

This product may only be used as a pump within oil-hydraulic systems.

The product must be operated within the specified technical parameters. This documentation contains the technical parameters for various product versions.

Note
Non-compliance will void any warranty claims made against HAWE Hydraulik.

6.2 Assembly information

The hydraulic accumulator must be integrated in the system via state of the art connection components (screw fittings, hoses, pipes, etc.). The hydraulic system must be shut down as a precautionary measure prior to dismounting; this applies in particular to systems with hydraulic accumulators.

6.3 Operating instructions

Product, pressure and/or flow settings

All statements in this documentation must be observed for all product, pressure and/or flow settings on or in the hydraulic system.

Caution
Risk of injury on overloading components due to incorrect pressure settings!

- Always monitor the pressure gauge when setting or changing the pressure.

Filtering and purity of the hydraulic fluid

Soiling in the fine range, e.g. abraded material and dust, or in the macro range, e.g. chips, rubber particles from hoses and seals, can cause significant malfunctions in a hydraulic system. It is also to be noted that new hydraulic fluid “from the drum” does not necessarily meet the highest purity requirements.

For trouble-free operation pay attention to the purity of the hydraulic fluid (see also purity class in Chapter 3, "Parameters").

For further information on installation, operation and maintenance, see the relevant assembly instructions:
B 7960, B 5488.

7.2 Suction intakes

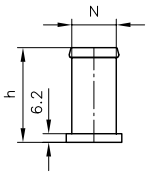
Order coding example:

V60N - 090 R DZ N - 1 - 0 - 01/LSNR - 350 - **A00/76**

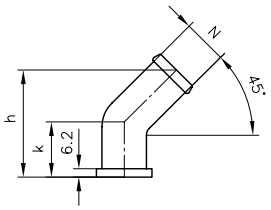
Table of suction intakes (including attachment kit)

Nominal width (N)	Flow Q_{max} (lpm)	Geometric shape									
		Straight A00/..	Order number	45° A45/..		Order number	90° A90/..		Order number	Thread A.	Order number
		h		h	k		h	k		h	
38 (1 1/2″)	75	65	79 93336 00	-	-	-	53	70	79 93344 00	-	-
42	90	-	-	85	40	79 93340 00	-	-	-	-	-
50 (2″)	125	65	79 93337 00	96	40	79 93341 00	53	84	79 93345 00	-	-
64 (2 1/2″)	190	90	79 93338 00	96	40	79 93342 00	109	129	79 93346 00	-	-
76 (3″)	250	106	79 93339 00	106	40	79 93343 00	-	-	-	-	-
7 (1 1/2″)	125	-	-	-	-	-	-	-	-	28.5	79 40717 00
7 UNF (1-7/8-12 UN-2B)	125	-	-	-	-	-	-	-	-	28.5	79 41595 00

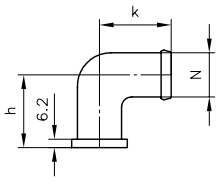
A00/...



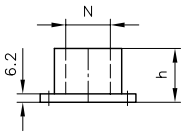
45/...



A90/...



A6
A7



Delivery includes attachment kit for suction intakes, comprising:

- 4x hex bolt M8x16-8.8
- O-ring 44.2x3 NBR 70 Sh
- 2 mounting flange halves

(Order no. 79 93355 00)

Note
Use nominal width 38 (1 1/2″) for reduced displacement volume only!

Observe installation information in Chapter 5, "Installation information".

Additional versions

- General operating manual for the assembly, initial operation and maintenance of hydraulic components and systems: B 5488
- Variable displacement axial piston pump type V40M: D 7961
- Variable displacement axial piston pump type V30D: D 7960
- Variable displacement axial piston pump type V30E: D 7960 E
- Fixed displacement axial piston pump type K60N: D 7960 K
- Axial piston motors type M60N: D 7960 M
- Proportional directional spool valve, type PSL and PSV size 2: D 7700-2
- Proportional directional spool valve, type PSL, PSM and PSV size 3: D 7700-3
- Proportional directional spool valve, type PSL, PSM and PSV size 5: D 7700-5
- Proportional directional spool valve type PSLF, PSVF and SLF size 3: D 7700-3F
- Proportional directional spool valve type PSLF, PSVF and SLF size 5: D 7700-5F
- Proportional directional spool valve banks, type PSLF, PSVF and SLF size 7: D 7700-7F
- Load-holding valve type LHT: D 7918
- Load-holding valve type LHDV: D 7770
- Proportional amplifier type EV1M3: D 7831/2
- Proportional amplifier type EV1D: D 7831 D

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Appendix B:Parts Index

Appendix A:Pages Index