



Operations/Maintenance Manual

E190

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Do not operate this aerial device 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 aerial device and you have been properly trained by an experienced, qualified aerial device operator. The information in these manuals is a guide to assist qualified personnel in safe operation and maintenance of this aerial device 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 aerial device 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/SIA A92.2** standards for safe operation, inspection and maintenance of this aerial device. 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 **OSHA 1926.1400** regulation for correct, safe operation near power lines, hand signals and personnel qualification requirements.

READ, UNDERSTAND AND FOLLOW ALL SAFETY LABELS

BEWARE OF OVERHEAD POWER LINES

UNDERSTAND AND NEVER ATTEMPT EXCEEDING AERIAL DEVICE LOAD

CHARTS

NEVER EXCEED PLATFORM CAPACITY AND AREAS OF OPERATION

BEWARE OF ADVERSE WEATHER AND GROUND CONDITIONS

This manual must be retained with this aerial device for use by subsequent operating personnel.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech. Spec.	EEC-0095	1.0	Template Update	11/5/14
Tech Spec		1.1	Doc update	2/16/15



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.



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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 aerial device shall read and understand this manual prior to operation. Failure to read this manual is a misuse of this aerial device. **Death or serious injury** can result from the misuse or improper maintenance of this aerial device.

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 aerial device, is of utmost concern to Elliott Equipment Company. This manual has been developed with the safety of all personnel that work around, with, or operate 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 aerial device. 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 head these instructions can result in death or serious injury.

It is **your responsibility** to operate and maintain your aerial device with skill, good judgment, and caution. Following recognized safety procedures will help you avoid accidents. Modifications to any part of this aerial device 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 aerial device 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 aerial device. 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 an aerial device.

Signal personnel must also have good vision and sound judgment, know standard aerial device 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 aerial device when knowing it is unsafe and should always consult their 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.

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 aerial device. It is the operator's responsibility to determine that the machine can safely lift and maneuver the load through 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 aerial device 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 aerial device 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 aerial device 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 aerial devices 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

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0074	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/26/15

NOTE: Unless otherwise specified, all section references in this chapter refer to the latest version of ANSI/SIA A92.2.

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 an aerial device 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 aerial device 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 **Paragraph 6.4** of this standard and manuals for auxiliary equipment added by the installer.
- E. Installations:** The installer shall comply with Sections **5** and **6** and shall follow the instructions of the manufacturer. In the event the original manufacturer no longer exists, and equivalent entity may provide these instructions. The installer of an aerial device shall, before the mobile unit is placed in operation, perform stability tests in accordance with the requirements of **4.5.1** and **4.5.2**, the operational and visual tests in accordance with the requirements of **6.6.1** and **6.6.2** and the appropriate electrical tests required in **5.4.3** of this standard. The installer shall, when installing an aerial device on a chassis which is a highway vehicle, comply with all requirements of the applicable Federal Motor Vehicle Safety Standards in effect at the time of installation. Certification as a manufacturer (alteration, intermediate or final) of a motor vehicle under the Federal Motor Vehicle Safety Standards is required. The travel height of the mobile unit shall be posted in a location that is readily visible to the vehicle operator. For insulated aerial devices, the installer shall assure conformance to

the Qualification test requirements of **5.3.2** by either obtaining certification of the test and performing a periodic test after installation, or by performing the Qualification test.

- F. Quality Assurance:** The installer shall have a documented quality assurance program which will ensure compliance with this standard.
- G. Welding:** All welds made by the installer, whose failure could result in motion of the platform(s) shall meet the **Structural Welding Code AWS D1.1-98 and AWS D1.2-98**. The installer shall establish applicable welding quality assurance procedures for all weldments.
- H. Training:** The dealer or installer shall offer training or training materials that aid owners and users in the operation, inspection, testing and maintenance of the aerial device. This training shall be offered initially and subsequently on request.
- I. Dealer or Installer as User:** Whenever a dealer or installer directs personnel to operate an aerial device (inspecting, sales demonstrations, or any form of use), the dealer or installer shall assume the responsibilities of users as specified in Section 9 of this standard. All personnel authorized to operate the aerial device shall have been trained.

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 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. Verification by the manufacturer, the installer or an equivalent entity(s), meets this requirement.
 - 2. Regular Inspection and Tests:** The inspection procedure for mobile units is divided into two classifications based upon the intervals at which inspections and tests shall be performed. Intervals shall be set by the owner in

accordance with the manufacturer's recommendations. Such intervals are dependent upon component function and exposure to wear, deterioration and other agents which adversely affect component life. Two classifications are designated:

- a. Frequent Inspection and Test: Daily to monthly intervals.
- b. Periodic Inspection and Test: One to twelve month intervals.

3. Frequent Inspection and Test: Items determined by the owner in accordance with the manufacturer's recommendations for each specific aerial device shall be inspected for defects. The following tests and inspections shall be performed by the operator once daily, prior to first use:

- a. Operating controls and associated mechanisms for conditions interfering with proper operation.
- b. Visual and audible safety devices for malfunction.
- c. Hydraulic or pneumatic systems for observable deterioration or excessive leakage.
- d. Fiberglass and other insulating components for visible damage or contamination.
- e. Missing or illegible operational and instructional markings.
- f. Electrical systems of / or related to the aerial device for malfunction, signs of excessive deterioration, dirt and moisture accumulation.
- g. Visual inspection of bolts, pins, and other fasteners for loose, deformed or missing fasteners and other locking devices.

Any suspected items shall be carefully examined or 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.**

4. Periodic Inspection or Test: An inspection of the mobile unit shall be performed at the intervals defined in **B.2** depending upon its activity, severity of service, and environment, or as specifically indicated below. (These inspections shall include the requirements of **B.3**):

- a. Structural members for deformation, cracks or corrosion.

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- 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 system for proper oil level.
 - e. Hydraulic and pneumatic fittings, hoses, and tubing for evidence of leakage, abnormal deformation or excessive abrasion.
 - f. Compressors, pumps, motors, and generators for loose fasteners, leaks, unusual noises or vibrations, loss of operating speed, and excessive heating.
 - g. Hydraulic and pneumatic valves for malfunction and visible cracks in the external valve housing, leaks, and sticking spools.
 - h. Visually inspect any vacuum prevention systems and verify function of such systems on Category "A" aerial devices.
 - i. Hydraulic and pneumatic cylinders and holding valves for malfunction and visible damage.
 - j. Hydraulic and pneumatic filters for cleanliness and the presence of foreign material in the system indicating other component deterioration.
 - k. Electrical systems and components for deterioration or wear including those not readily visible on a frequent inspection.
 - l. Performance test of all boom movements.
 - m. Condition and tightness of bolts and other fasteners.
 - n. Welds as specified by the manufacturer.
 - o. Legible and proper identification, operational, and instructional markings.
 - p. If the aerial device is rated an insulated device, the electrical insulating components and system(s) shall be thoroughly inspected for lack of cleanliness and other conditions that compromise insulation. Then these components and system(s) shall be tested for compliance with the rating of the aerial device in accordance with one of the applicable methods and procedures as outlined in section **5.4.3** of this standard:

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- I. If the aerial device is used for AC bare hand work, the unit shall undergo a 60 Hz test as shown in Table 2 at least every three years;
 - II. If the aerial device is used for DC bare hand work, the unit shall undergo a DC test as shown in Table 2 at least every three years;
 - III. After repair or modification of any component that crosses the insulating system(s), or the repair or replacement of an insulating component(s), the unit shall be dielectrically tested in accordance with section **5.4.3**;
 - IV. An insulated replacement boom shall be tested to insure conformance to **5.3.3** by the supplier;
 - V. Bare-hand work units shall be tested as shown in Table 1 after any major repair to the insulated boom or any insulated boom replacement.

Any suspected items shall be carefully examined or 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.

C. Inspection and Test Records

1. 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 five years, or as required by applicable regulations.
2. Written, 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: Maintenance and frequency of maintenance shall be determined by the owner in accordance with the manufacturer's recommendations.

Welding repairs of components or welds, designated as critical in the manufacturer's manual, shall be made in accordance with the manufacturer's recommendations.

Should the original manufacturer no longer exist an equivalent entity may determine the required procedure.

- 1. Maintenance Training:** The owner shall train their maintenance personnel in inspection and maintenance of the aerial device in accordance with the manufacturer's recommendations and **Section 8** of this standard.
- E. Modifications:** No modifications or additions which affect the stability, mechanical, hydraulic, or electrical integrity or the safe operation of the aerial device 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 manufacturers design safety factors, whichever are greater. Should the original manufacturer no longer exist, an equivalent entity may approve required modification.
- F. Weight Distribution:** 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 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 an aerial device occurs, it shall be the responsibility of the seller to provide the manufacturer's manual(s) for that aerial device to the purchaser. It is the responsibility of the purchaser to notify the manufacturer of the unit model and serial number and the name and address of the new owner within 60 days.
- H. Markings:** The markings on the aerial device 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 aerial device 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 insure that the operating manual(s) is stored on the mobile unit.

L. Training, Retraining, and Familiarization of Operators

- 1. Owner as a Renter or Lessor:** When an owner functions as a renter or lessor he shall have the same responsibilities as specified under Section 11 of this standard.
- 2. General Training:** Only personnel, who have received general instructions regarding the inspection, application and operation of aerial devices, including recognition and avoidance of hazards associated with their operation, shall operate an aerial device. 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 aerial device 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 aerial device.
 - 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 C2-1997, National Electrical Safety Code** (applies to utility workers as defined in **ANSI C2**). The above standard is an example; other industries using aerial devices have safety rules pertinent to that industry.
 - i.** Authorization to operate.
 - j.** Operator warnings and instructions.

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- k. Actual operation of the aerial device. Under the direction of a qualified person, the trainee shall operate the aerial device for a sufficient period of time to demonstrate proficiency in the actual operation of the aerial device.
 - l. Proper use of personal fall protection equipment.
3. **Retraining:** The operator shall be retrained, when so directed by the user, based on the user's observation and evaluation of the operator.
4. **Familiarization:** When an operator is directed to operate an aerial device he/she is 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. Safety devices and operating characteristics specific to the aerial device.

Responsibility of Users

- A. **General Responsibilities:** Each user shall comply with the requirements of this section.
- B. **Personnel:** Only trained and authorized personnel shall be permitted to operate the aerial device.
- C. **Training, Retraining, and Familiarization of Operators**
1. **General Training:** Only personnel, who have received general instructions regarding the inspection, application and operation of aerial devices, including recognition and avoidance of hazards associated with their operation, shall operate an aerial device. 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 aerial device 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 aerial device.
 - e. Factors affecting stability.

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- f. The purpose of placards and decals.
 - g. Workplace inspection.
 - h. Applicable safety rules and regulations, such as **Part 4, ANSI C2-1997, National Electrical Safety Code**. (Applies to utility workers as defined in **ANSI C2**). The above standard is an example; other industries using aerial devices have safety rules pertinent to that industry.
 - i. Authorization to operate.
 - j. Operator warnings and instructions.
 - k. Actual operation of the aerial device. Under the direction of a qualified person, the trainee shall operate the aerial device for a sufficient period of time to demonstrate proficiency in the actual operation of the aerial device.
 - l. Proper use of personal fall protection equipment
- 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 an aerial device he/she is 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. Safety devices and operating characteristics specific to the aerial device.
- D. Application:** The employer and assigned operator shall insure that the aerial device is used only for intended applications as defined in the operating manual, and that recognized safety practices are observed.
- E. Mobile Operation:** Before and during driving, the driver shall:
- 1. Avoid traveling on any surface that adversely affects vehicle stability.
 - 2. Maintain a safe distance from obstacles and overhead lines.
 - 3. Maintain communications between the driver and the operator.
 - 4. Under all travel conditions, the driver shall limit travel speed in accordance with conditions of the ground surface, congestion, and slope.
- F. Alterations:** Altering or disabling of safety devices, guards, or interlocks if so equipped shall be prohibited.

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- G. Bare-Hand Work:** For bare-hand work, a Category “A” aerial device shall be used.
 - H. Lower Controls:** The lower controls of aerial devices shall not be used for continuous operation with personnel in the platform.

Responsibilities of Operators

- A. General Responsibilities:** Each operator shall comply with the requirements of this section.
- B. Operation:** During operation of the aerial device all platform occupants shall use appropriate fall protection connected to the aerial device at the platform position.
- C. Work Platform:** The operator shall not use railings, planks, ladders or any other device in or on the work platform for achieving additional working height or reach.
- D. Brakes:** The vehicle parking brake(s) shall be set at all times that the boom is elevated except when the aerial device is being used in accordance with 9.5.
- E. Loading:** Any loading which includes a horizontal load shall be avoided unless the mobile unit is designed for that application.
- F. Wind and Weather Conditions.** 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 30 miles per hour (48 kilometers per hour) at the raised platform height. 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, terminate the operation.

- G. Observations:** Observations during operation for any defects shall be conducted on an ongoing basis.

1. Pre-start Inspection: Items determined by the owner in accordance with the manufacturer's recommendations for each specific aerial device shall be inspected for defects prior to each day's operation. The following tests and inspections shall be performed by the operator once daily, prior to first use:

- a. Operating controls and associated mechanisms for conditions interfering with proper operation.
- b. Visual and audible safety devices for malfunction.
- c. Hydraulic or pneumatic systems for observable deterioration or excessive leakage.
- d. Fiberglass and other insulating components for visible damage or contamination.
- e. Missing or illegible operational and instructional markings.
- f. Electrical systems of / or related to the aerial device for malfunction, signs of excessive deterioration, dirt and moisture accumulation.
- g. Visual inspection of bolts, pins, and other fasteners for loose, deformed or missing fasteners and other locking devices.

Any suspected items shall be carefully examined or 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.

H. Worksite: Before the aerial device is used the worksite shall be surveyed for hazards such as:

1. Untampered earth fills.
2. Ditches.
3. Drop offs and floor obstructions.
4. Debris.
5. Overhead obstructions and electrical conductors.
6. Weather conditions.
7. Presence of unauthorized persons.

I. Precautions: Before and during each use the operator shall:

1. Check for overhead obstructions and electrical conductors.

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2. Insure that the load on the platform and / or load lifting devices are in accordance with the manufacturer's rated capacity.
 3. Insure that outriggers and stabilizers are used if the manufacturer's instructions require their use.
 4. Insure that guardrails are properly installed, and the gates are closed.
 5. Use outrigger pads when necessary to provide firm footing.
- J. Mobile Operation:** Before engaging in mobile operation the operator shall determine that the aerial device is specifically designed for mobile operation.
- K. Personnel:** Only trained and authorized personnel shall be permitted to operate the aerial device.
- L. Training, Retraining, and Familiarization of Operators**
1. **General Training:** Only personnel, who have received general instructions regarding the inspection, application and operation of aerial devices, including recognition and avoidance of hazards associated with their operation, shall operate an aerial device. 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 aerial device 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 aerial device.
 - 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 C2-1997, National Electrical Safety Code** (applies to utility workers as defined in **ANSI C2**). The above standard is an example: other industries using aerial devices have safety rules pertinent to that industry.
 - i. Authorization to operate.
 - j. Operator warnings and instructions.

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- k. Actual operation of the aerial device. Under the direction of a qualified person, the trainee shall operate the aerial device for a sufficient period of time to demonstrate proficiency in the actual operation of the aerial device.
 - l. Proper use of personal fall protection equipment.
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 an aerial device he/she is 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. Safety devices and operating characteristics specific to the aerial device.

Responsibilities of Renters, Lessors or Lessees

- A. **General Responsibilities:** Each renter or lessor or lessee shall comply with the requirements of the applicable section or sections below.
 1. **Lessor or Lessee as Dealer or Installer:** When a lessor or lessee uses the aerial device as a dealer or installer he shall have the same responsibilities as specified under Section 7 of this standard.
 2. **Lessor or Lessee as Owner:** When a lessor or lessee uses the aerial device as an owner he shall have the same responsibilities as specified under Section 8 of this standard.
 3. **Lessor or Lessee as User:** When a lessor or lessee uses the aerial device as a user he shall have the same responsibilities as specified under Section 9 of this standard.
 4. **Lessor or Lessee as Operator:** When a lessor or lessee uses the aerial device as an operator he shall have the same responsibilities as specified under Section 10 of this standard.
- B. **Ownership Duties:** The renter or lessor shall carry out the duties of ownership specified in this standard which are not assigned to the renting entity or lessee as the user.

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- C. Obligations:** Upon delivery each renter or lessor of an aerial device shall provide the operators manual and the **ANSI/SIA A92.2-xxxx Manual of Responsibilities** for dealers, owners, users, operators, lessors and lessees of Vehicle Mounted Elevating and Rotating Aerial Devices. These manuals shall be stored on the mobile unit.
- D. Training:** The renter or lessor shall offer training or training materials that aid the renting entity or lessee in the operation, inspection, testing and maintenance of the aerial device. This training shall be offered initially and subsequently on request.
- 1. General Training:** Only personnel, who have received general instructions regarding the inspection, application and operation of aerial devices, including recognition and avoidance of hazards associated with their operation, shall operate an aerial device. 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 aerial device 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 aerial device.
 - 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 C2-1997, National Electrical Safety Code** (applies to utility workers as defined in **ANSI C2**). The above standard is an example; other industries using aerial devices have safety rules pertinent to that industry.
 - i.** Authorization to operate.
 - j.** Operator warnings and instructions.

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- k. Actual operation of the aerial device. Under the direction of a qualified person, the trainee shall operate the aerial device for a sufficient period of time to demonstrate proficiency in the actual operation of the aerial device.
 - l. Proper use of personal fall protection equipment.
- 2. Familiarization:** When an operator is directed to operate an aerial device he/she is 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. Safety devices and operating characteristics specific to the aerial device.
- E. Communications:** In the event the manufacturer or installer provides the renter or lessor manuals, bulletins, or other materials for the information of the user of an aerial device, the renter or lessor shall pass them on to the user without any undue delay.

Responsibilities per ANSI/SIA A92.2



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0041	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15
Tech Spec.		1.2	Doc update	2/11/15

Aerial devices are designed and intended to be used for handling personnel. Guidance on the use of aerial devices is from **ANSI/SIA A92.2** (latest).

Personnel Platform Usage Guidelines

- A.** The aerial device 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.** Upper and lower controls shall be tested and inspected daily prior to use.
- C.** Only authorized persons shall operate the aerial device.
- D.** Operator and any crewmembers on the ground shall be in constant communication.
- E.** Boom and platform load ratings or work areas shall not be exceeded. Personnel in the platform shall wear a body harness (fall protection device) that is securely attached to the supplied lanyard attachment points at all times. Personnel in the platform 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 obtaining additional working height or reach.
- F.** Belting off to structures other than the platform while on platform shall not be permitted.
- G.** The aerial device shall not be moved when the boom is elevated. The aerial shall be supported by a firm surface. Blocking may be required to ensure that the load-bearing surface can support the weight of aerial operations. Provided outriggers shall be properly extended and no lifting of personnel is allowed when the aerial device is supported by tires.
- H.** The personnel platform and aerial device are not insulated. Do not operate near power lines or electrical hazards.

MINIMUM CLEARANCE REQUIREMENTS

	Minimum
Nominal Voltage kV (Phase to Phase)	Distance Required
Up to 50	10 feet
Over 50	10 feet
plus 1 foot for every 30 kV over 50 kV	

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.
- J. Wind and Weather Conditions.** 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 jib. Do not allow personnel lifts in wind speeds exceeding 30 miles per hour (48 kilometers per hour) at the raised platform height when the platform is attached to the main boom. 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, terminate the operation being performed.
- 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.
- 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.

AERIAL DEVICE OPERATOR

- A. Shall be qualified to operate the aerial device.
- B. Use protective equipment such as hard hats, safety glasses, hearing protection, and gloves in conditions where a hazard of injury exists.
- C. Shall be responsible for complying with the requirements of the standards as they relate to:
 - Aerial device capability.
 - Rated load constraints.
 - Operational limitations.
 - Confirming that all aerial device inspections have been completed and are satisfactory, prior to starting the lift.
- D. The operator shall not engage in any activity that will divert his attention while engaged in operating the aerial device.
- E. The operator shall inspect the aerial device 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.
- F.** Aerial device shall be operated with outriggers and stabilizers fully deployed and properly set.
- G.** The operator shall verify that the aerial device is set up and maintained within one percent of level (0.56°) during a personnel lift.
- H.** For aerial devices with a boom-attached platform, verify that the platform is attached as outlined in the installation section.
- I.** Not allow the platform's rating to be exceeded when loads are transferred to the elevated platform.
- J.** Not knowingly allow the platform load to exceed the platform rating.
- K.** Travelling with personnel in the equipment's personnel platform.
- L.** The operator shall perform all movements of the platform in a slow, controlled manner to minimize sudden and unexpected movements of the platform.
- M.** Set all brakes and locks on the aerial device after positioning of the personnel platform and before any personnel platform work.
- N.** Move the platform under controlled conditions.
- O.** 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 are met.
- P.** Not lift any loads on a boom winch load line with personnel in the platform.
- Q.** Not disable, or allowed to be disabled, any aerial device safety device.

GROUND CREW

- A.** Visually inspect the platform prior to each lift to verify all attachments and the platform structure are secure.
- B.** Inspect and attach the platform to the aerial device as specified by the manufacturer.
- C.** Verify the platform is evenly loaded, material secured, and the total platform weight does not exceed the platform rating or the reduced aerial device lift capacity.

- D. 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 crewmembers on the ground.
- 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.
- E. Be familiar with hand signals posted in the platform. All occupants shall know the emergency stop signal.
- F. Limit their number to the minimum number of personnel to complete the task, platform design, and aerial device limitations.
- G. Have materials and equipment evenly distributed and secured while the platform is in use.
- H. Shall always stand firmly on the floor of the platform and not climb or sit on the rails of the platform. Nor should platform personnel use planks, ladders, or any other materials for obtaining additional working height or reach.
- I. The platform occupant should keep all parts of their body inside the platform during raising, lowering, or positioning.

Lifting Personnel Near Electrical Power Lines

Lifting personnel near electrical power lines is not allowed. Lifting personnel where the aerial device 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 aerial device, load line, or personnel platform becoming a conductive path.

This aerial device 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.

Platform Installation

- A. Position the truck and aerial device 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 aerial device.
- F. Position the platform and pin the platform bracket to the sheave head of the boom or jib.
- 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 aerial device 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 aerial device 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.** Have platform personnel put on the body harnesses with the attached safety lanyard and attach the safety lanyards to the designated anchorage points.
- F.** 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.



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0070	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15
Tech Spec		1.2	Content update	2/9/15
Tech Spec		1.3	Content update	7/30/15

- Make sure outriggers/stabilizers are retracted and removable pads stowed if applicable. Always retract optional front bumper stabilizer before retracting outriggers and stabilizers.
- Make sure platform auto-leveling is shut off on units equipped with electric leveling sensors, and that the platform stow arrows are aligned.
- Secure the load line, headache ball or hook block to travel attach point.
- Boom must be retracted and in the boom rest.
- Secure all items on the truck bed.
- 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-0071	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/26/15
Tech Spec.		1.2	Content update	8/7/15

- A.** Position the vehicle in an area free of overhead restrictions. Check capacity chart for tasks required and position the aerial device in the proper place to complete the task safely.
- B.** Maintain a clearance of at least 10 feet (3.05M) between any part of the aerial device, load line or load and any electrical line carrying up to 50,000 volts. One additional foot (.30M) clearance is required for every additional 30,000 volts or less. Set ground markers in place to be used as a reference to assist in making sure the aerial device and load maintain minimum clearances required. Power lines and load lines deflect in wind and additional 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 aerial device and load to energized power lines, and warn when approaching the minimum safe distance. Use non-conductive tag lines when using boom or jib winch.
- D.** The aerial device 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 outriggers first so the aerial device is level from side to side and raise the vehicle until the suspension is unloaded. Level the aerial device using the bubble levels. Then extend stabilizers so aerial device is level from front to rear and the suspension is unloaded. After the aerial device 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.** Operate 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 30 miles per hour (48 kilometers per hour) at the raised platform height. 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-part 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.

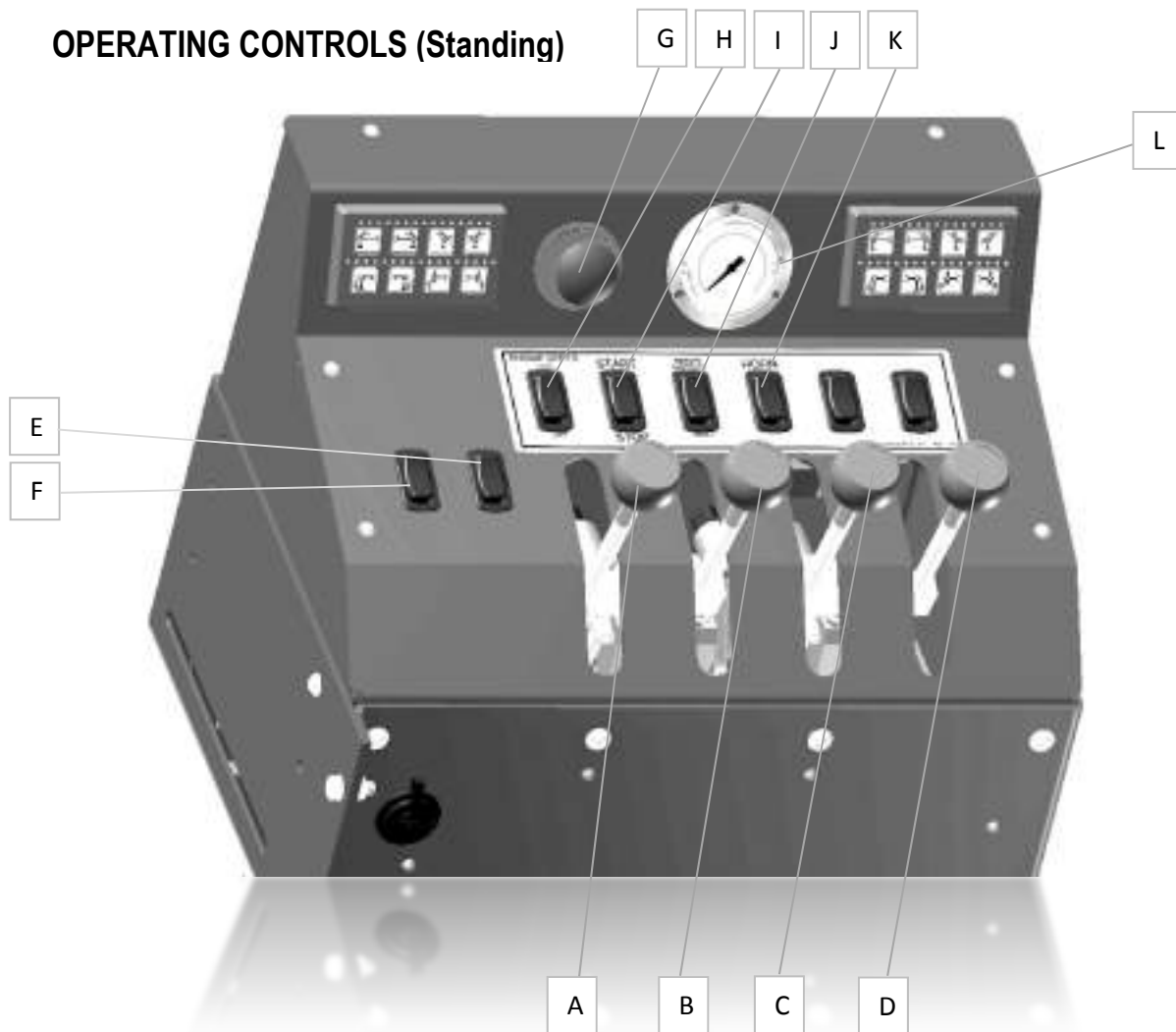


- R.** Only use Elliott approved personnel baskets attached to the boom for lifting personnel.
- S.** Do not operate the aerial device if the anti-two block safety system is inoperative.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0072	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/26/15
Tech Spec.		1.2	Content update	8/6/15

Operating/Outrigger Controls



Boom Controls

Power Take-Off (PTO)

This is located in the truck cab. Refer to truck manuals for operating instructions. PTO must be engaged to provide power to aerial device functions. **Refer to truck manuals for operating instructions.**

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

Master Switch – Emergency Stop Switch

This is located in the truck cab. Switch Master Switch to “**ON**” position, to operate aerial device.

A. Swing Control Lever

Pull back-“RIGHT” position swings turret right (clockwise)

Push forward-“LEFT” position swings turret left (counterclockwise)

B. Boom Telescope Control Lever

Push forward -“OUT” position extends the boom sections

Pull back-“IN” position retracts the boom sections

C. Winch Control Lever

Push forward -“DOWN” position – Winch pays out cable lowers load

Pull back-“UP” position – Winch winds up cable to raise load

D. Boom Control Lever

Push forward-“DOWN” position to lower boom

Pull back-“UP” position raise boom

E. Emergency Pump Switch

This momentary switch activates the Emergency Pump. Activate aerial device functions while holding button to activate the truck’s aerial device functions when the truck engine/PTO operation is not available.

F. LMI Override Switch

This momentary switch bypasses the LMI or Anti Two-Block function cutout. This switch is only to be used to move the aerial device/load to a safer position.

As this switch deactivates the function cut-out of the LMI and Anti Two-Block systems, the switch shall be used with discretion.

Unwarranted use of the override switch can result in harm to the aerial unit, as well as pose a threat to property and people using and located near the aerial device.

WARNING- NEVER use the override switch to overload the aerial or operate in a range not permissible according to the range diagram.

G. Emergency Stop

Button must be pulled out for aerial operation. Pushing this button while Master Power switch is in the **ON** position will stop the truck engine; however, pushing button with the Master Power switch in the **OFF** position will not affect truck operations.

H. Truck Throttle Control Switch: This switch is used to control the truck's engine throttle.

- 1. Increase throttle speed-**Press and hold switch to the high position. The engine speed increases incrementally to the maximum speed to order the hydraulic pump at the maximum flow.
- 2. Decrease throttle speed-**Press and hold switch to the low position. The engine speed decreases incrementally down to idle speed.
- 3. Intermediate throttle setting-**Release switch while engine speed is increasing or decreasing.

I. Truck Start Switch

This is a momentary switch used to start or stop the truck engine. Hold the switch in the start position to activate 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.

J. 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.

K. Horn Button: Press to activate horn.

L. Hyd. System Pressure Gauge

This is located inside control valve enclosure. Indicates Maximum pressure (0-3500 PSI) in the Winch and Function circuits.

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

For initial LMI setup and operation, refer to the **LMI Initial Setup** section of this manual. For operation information, boom/jib configuration, and troubleshooting, refer to the LMI Manufacturer manual included with this manual.

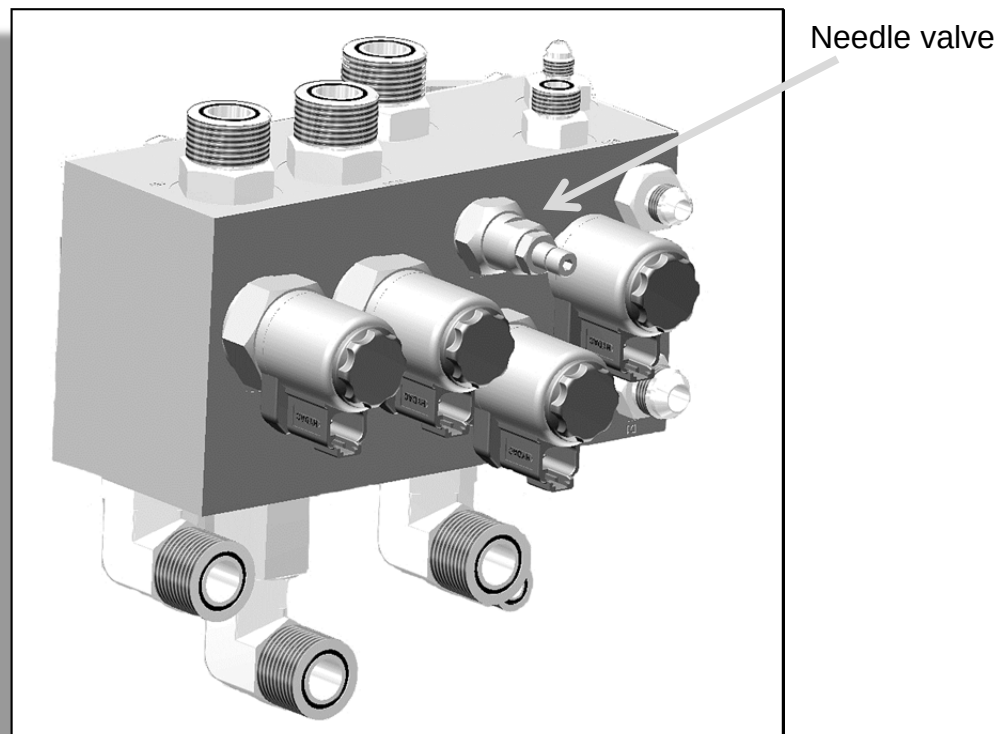
Anti Two-Block and LMI alarm

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.**

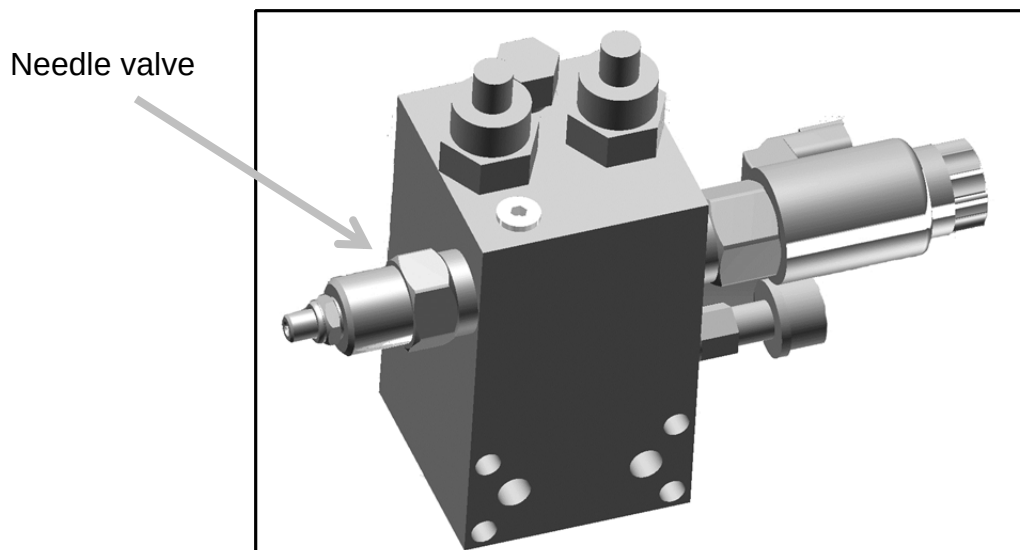
Extended Range Function Slow Down

The E145 and E190 aerial devices are equipped with the Extended Range Function Slow Down. The ERFSD is designed to decrease the speed of the boom raise and lower speed, and the swing speed when the boom is near or at its full extension.

The slow down feature activates when the boom length exceeds 100 feet during extension, and shuts off at 97 feet during retraction. To slow down the boom's speed, the unit's LMI outputs a signal to the lift circuit valve (**located in the stand-up console**) to restrict the flow of hydraulic fluid through the needle valve.



To slow down the boom's swing speed, the unit's LMI outputs a signal to the swing holding solenoid valve (**located on top of the swing motor in the turret**) to re-route part of the hydraulic fluid flow through the needle valve.



The ERFSD reduces hydraulic output by approximately 50 percent, so boom function speeds will be cut by half.

The following LMI modes will activate the slow down function in all modes:

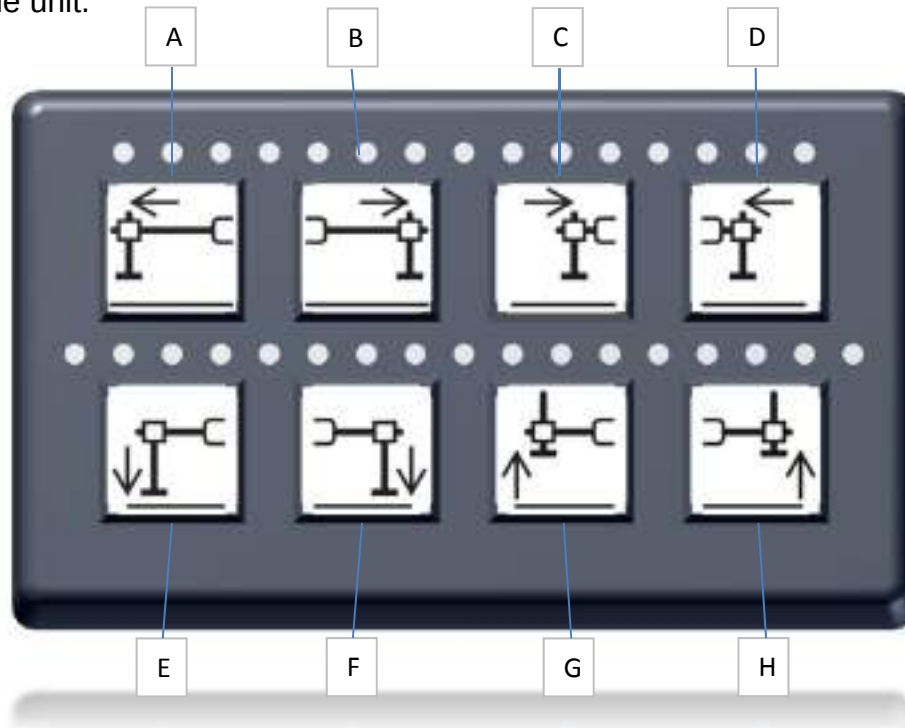
- **LMI Mode 1:** Boom Range Diagram w/ Platform Attached
- **LMI Mode 2:** Main Boom Load Ratings w/ Platform Attached
- **LMI Mode 3:** Main Boom Load Ratings w/ Platform Removed

NOTE: Please reference hydraulic schematics in the specifications section of this manual.

Operating/Outrigger Controls

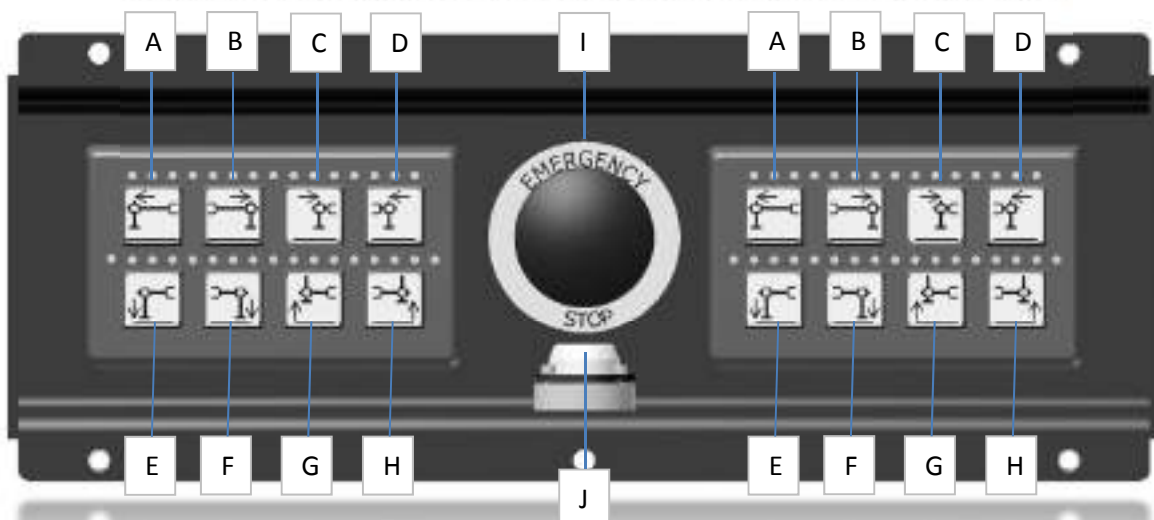
Outrigger Controls

There are two locations on the truck where there are outrigger controls. The first is on the standup console for this unit, where two outrigger control pads are mounted at the top of the unit.



Both pads are identical. Here, the **LEFT** pad controls the truck's **REAR** outriggers, and the **RIGHT** pad controls the truck's **FRONT** outriggers.

The second set of outrigger controls is located on either side of the truck bed.



As with the standup console unit, both pads are identical. However, outrigger control is determined by which side of the truck the operator is on. For example, if the operator is on the road side of the truck and is facing the outrigger controls, the front of the truck is to the operator's left; therefore, the left control pad operates the front outriggers and the right control pad operates the rear outriggers. Likewise, if the operator is on the curb side of the truck and is facing the outrigger controls, the front of the truck is to the operator's right; therefore, the right control pad operates the front outriggers and the left control pad operates the rear outriggers.

When the operator deploys the outriggers, always extend the beams to full-span prior to lowering the outrigger jacks.

NOTE-roadside (left) and curbside (right) are referenced by the operator standing at the control panel and facing the front of the truck.

- A. Roadside Outrigger Extend Beam Button-** Press button to extend left outrigger beam.
- B. Curbside Outrigger Extend Beam Button-** Press button to extend right outrigger beam.
- C. Roadside Outrigger Retract Beam Button-** Press button to retract left outrigger beam.
- D. Curbside Outrigger Retract Beam Button-** Press button to retract right outrigger beam.
- E. Roadside Outrigger Extend Jack Button-** Press button to extend left outrigger jack.
- F. Curbside Outrigger Extend Jack Button-** Press button to extend right outrigger jack.
- G. Roadside Outrigger Retract Jack Button-** Press button to retract left outrigger jack.
- H. Curbside Outrigger Retract Jack Button-** Press button to retract right outrigger jack.

- I. **Emergency Stop:** Button must be pulled out for aerial operation. Pushing this button while Master Power switch is in the **ON** position will stop the truck engine; however, pushing button with the Master Power switch in the **OFF** position will not affect truck operations.
- J. **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 aerial device.

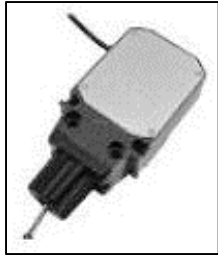
Operating/Outrigger Controls



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0035	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15
Tech Spec.		1.2	Add content	5/13/15

You will use Hirschmann's V-Scale D3-C1H system to aid in the aerial device's operation. Please ensure only an operator properly trained in safety procedures, aerial device manufacturer's specifications and the aerial device's capacity information operates this unit. There are several operation functions to be aware of when using this unit:

- **Boom Angle Sensor:** The aerial device uses a sensor connected to a potentiometer or pendulum assembly to measure the boom angle. The sensor is mounted within the aerial device's reeling drum assembly. 
- **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.
- **Swing Sensor:** The swing sensor measures the boom's angle as it relates to the aerial device chassis. 

Initial Setup

NOTE-this section only covers the initial setup 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.

1. Turning on the PTO switch inside the truck's cab. This engages PTO, and powers the aerial unit to master power. In turn, this activates the LMI system.
2. Once the unit is powered on, the following screen will appear:



This screen is to confirm that all four outriggers are extended to the full span position. Once the outriggers are extended to full span, follow the onscreen prompt, "Press to Confirm Selection", and press the bottom right button.

NOTE: The yellow arrow denotes the selection knob, and contains the same functionality as using the soft keys. The operator turns the knob left or right to scroll through the options, and pressing in selects the option.

3. The next screen prompts the operator to select whether the aerial device will perform **Aerial** duties (person inside basket), or **Material Handling** duties. Press one of the indicated buttons on either the bottom left or bottom right of the screen (as shown on the following page):



- A. If the operator selects **Material Handling**, the next screen asks the operator to select whether the aerial device will perform with a platform (basket) attached, or with the platform removed. When finished, press one of the indicated buttons on either the bottom left or bottom right of the screen to get to the rigging line screen. This screen allows the operator to select the parts of the line rigged. Select one or two parts, and then press one of the corresponding buttons on either the bottom left or bottom right of the screen to get to the platform screen.



- If the operator selects the **Platform Attached** option, this screen as shown below asks the operator to confirm selection and press the bottom right button:



⚠ DANGER

Personnel in the platform while material handling from the load line is unsafe and is NEVER allowed.

- If the operator selects the **Platform Removed** option, this screen asks the operator to confirm selection and press the bottom right button:



- B. If the operator selects **Aerial**, this screen asks the operator to confirm selection and press the bottom right button:



4. Once the user has pressed the button to confirm their selection, the following screen appears:



This screen indicates the aerial device is ready for operational use. If at any time, the operator makes a selection in error, simply press the "X" button and the unit will take the operator back to the first screen with the aerial device's outriggers.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech. Spec.	EEC-0002	1.0	Created Document	1/9/15
Tech. Spec		1.1	Illustration update	4/6/15

Hirschmann J1939 Network Installation



INSTALLATION OF E145 HIRSCHMANN-TRUCK CHASSIS J1939 NETWORK

Tools Needed:

- CAN-USB Adapter (Elliott uses GridConnect part number GC-CAN-USB)
- CAN tracing software (Elliott uses PCAN-View. Software comes bundled with GridConnect USB adapter)
- Notepad++ (free program available online)
- Multimeter

Overview of vScale D3 display unit (see following page):

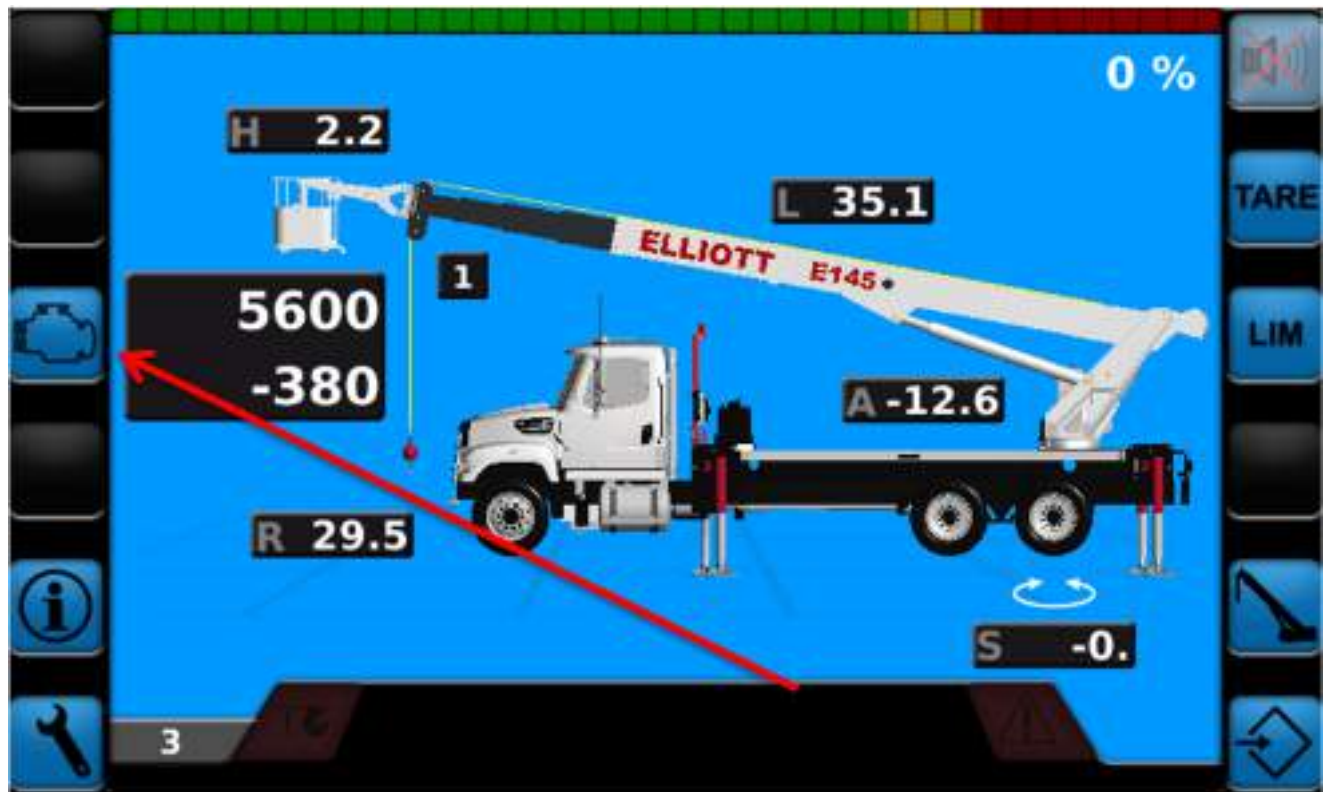
Hirschmann J1939 Network Installation



- 1 TFT color display
- 2 Function keys F1 - F12
- 3 Light sensor and status displays (LED)
- 4 Rotary control (encoder) with pushbutton function
- 5 Function key (SYSTEM) for system settings
- 6 Function key (Home) for return to RCL main menu
- 7 Function key (Esc) for returning to previous menus or abort
- 8 Front- USB 2.0 interface (use for service purposes)

NOTE: In order for the Hirschmann display unit to correctly relay J1939 truck information (found by pressing the “Engine” icon on the home screen), the J1939 network on the truck chassis **MUST BE CONNECTED** to the crane outrigger harness.

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**This procedure uses examples from a Freightliner truck, and most Freightliner trucks are similar to this document. If installing on a different brand of machine, consult the dealer or service manuals to connect to the correct CAN bus network.

RECORDING THE MESSAGES ON THE TRUCK CAN NETWORK:

- A. Power off the truck
- B. Locate the diagnostic connector inside the cab of the truck. This is usually located below the dash, underneath the steering wheel area. The connector is usually pointed towards the floor of the truck and can be released by applying pressure on the connector towards the driver's side door:



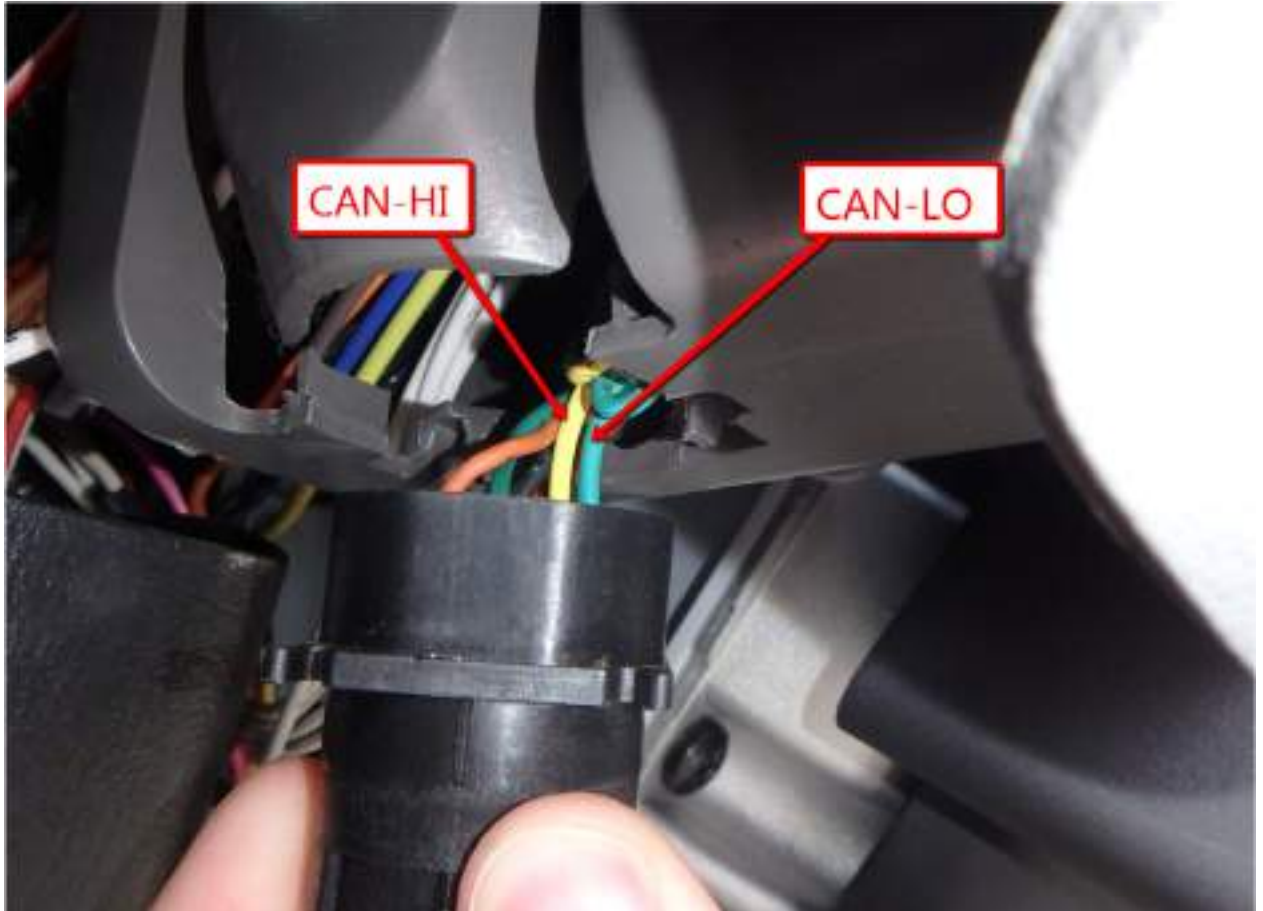
Hirschmann J1939 Network Installation



Below shows the connector in the released position:

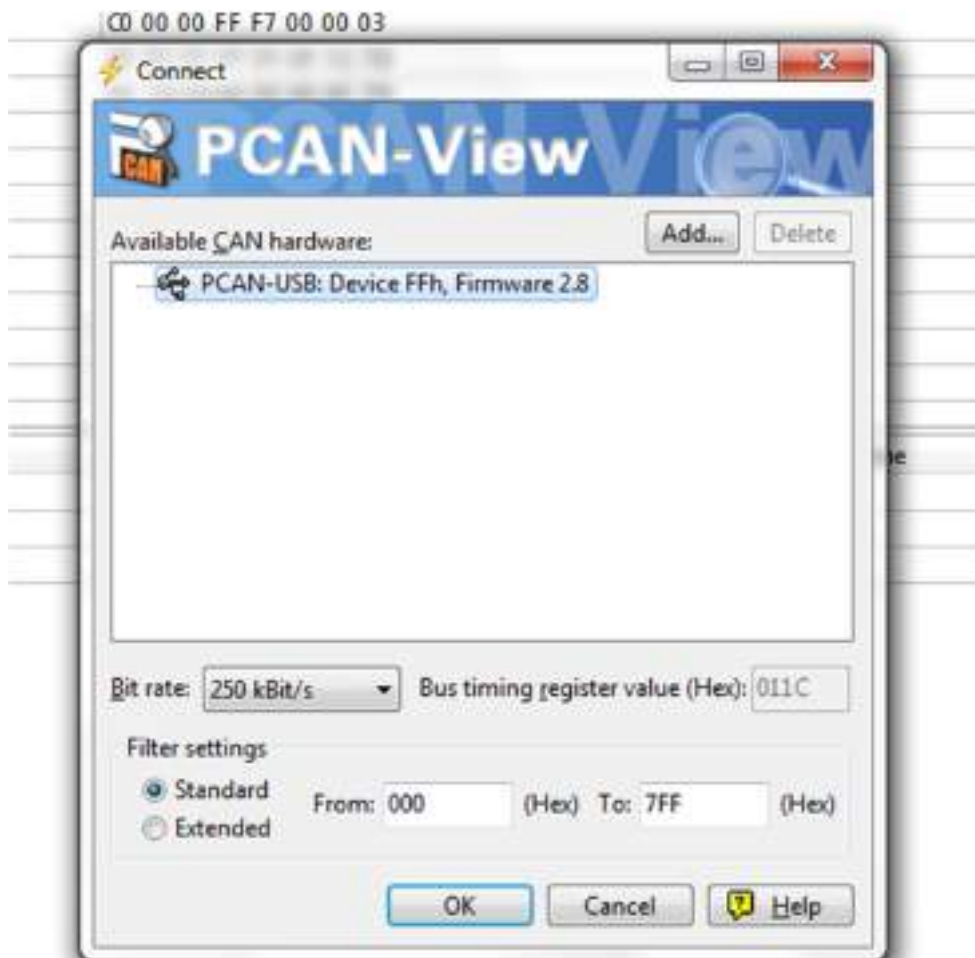


- C. Once you release the connector, locate the two pins that have yellow and green wires. Yellow will be CAN-HI and green will be CAN-LO. (Industry standard wiring color. Consult manufacturer's specifications to confirm)



- D. Connect to the CAN network using the USB-CAN adapter and connect the USB to a computer equipped with PCAN-View. Turn the key to start the truck and open up PCAN-View on the computer. PCAN-View should open up and a dialog box labeled **“Connect”** should pop up:

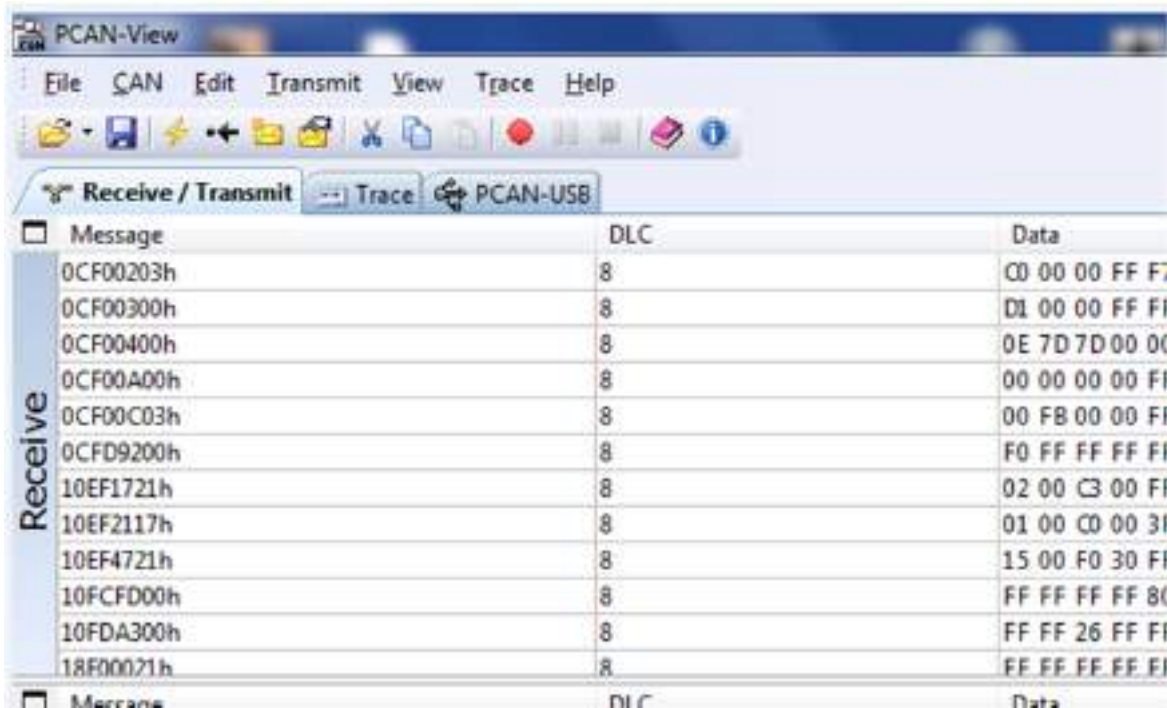
Hirschmann J1939 Network Installation



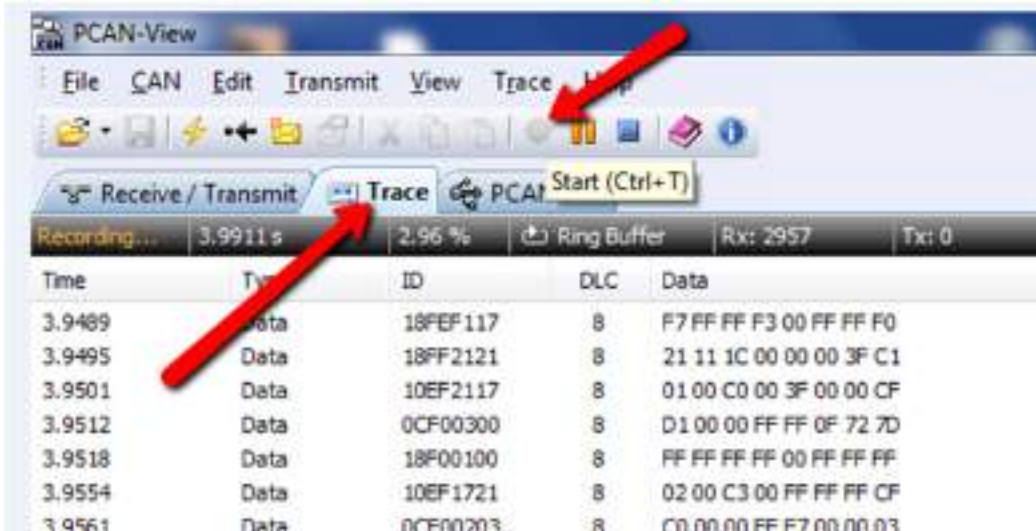
Choose 250 kbit/s (may vary depending on manufacturer) in the drop down box and click “OK.”

- E. The “**Receive**” portion of PCAN-View should populate with the truck’s J1939 messages that are present on the bus:

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- F. Run a trace on the CAN bus by clicking on the “Trace” tab, and clicking on the red circle in the upper tool bar:



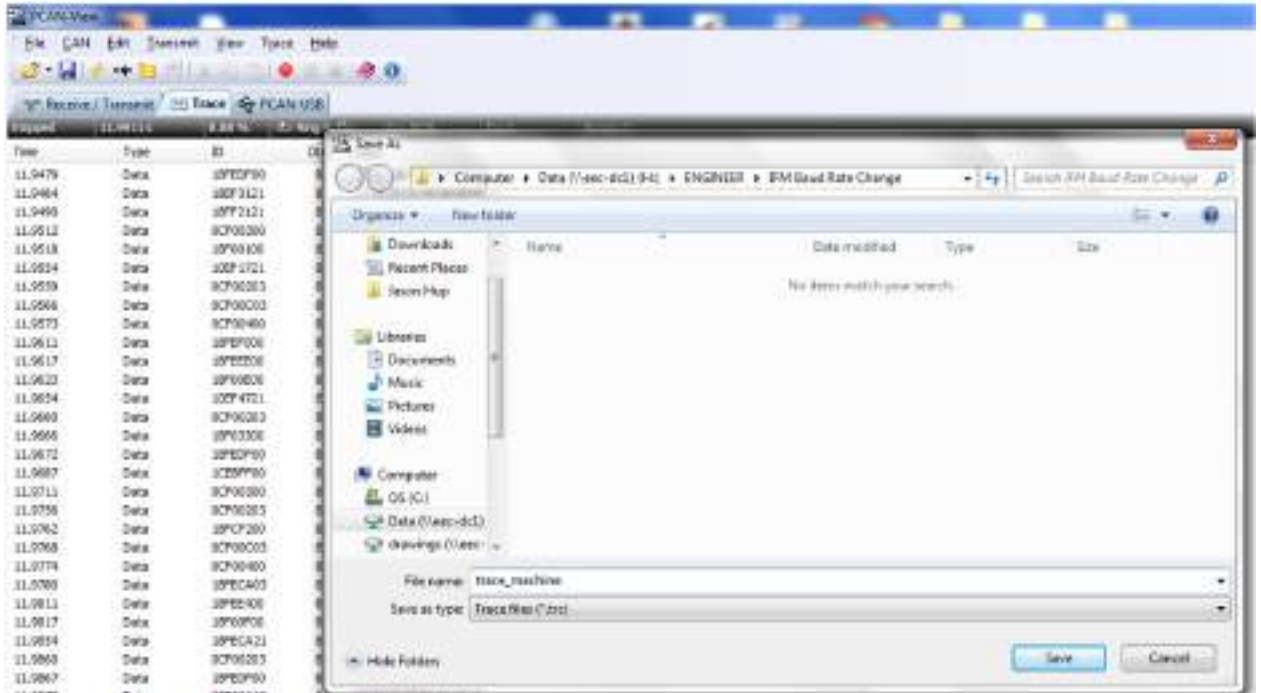
- G. Let the trace run for 10-20 seconds, and press the blue square to stop the trace:



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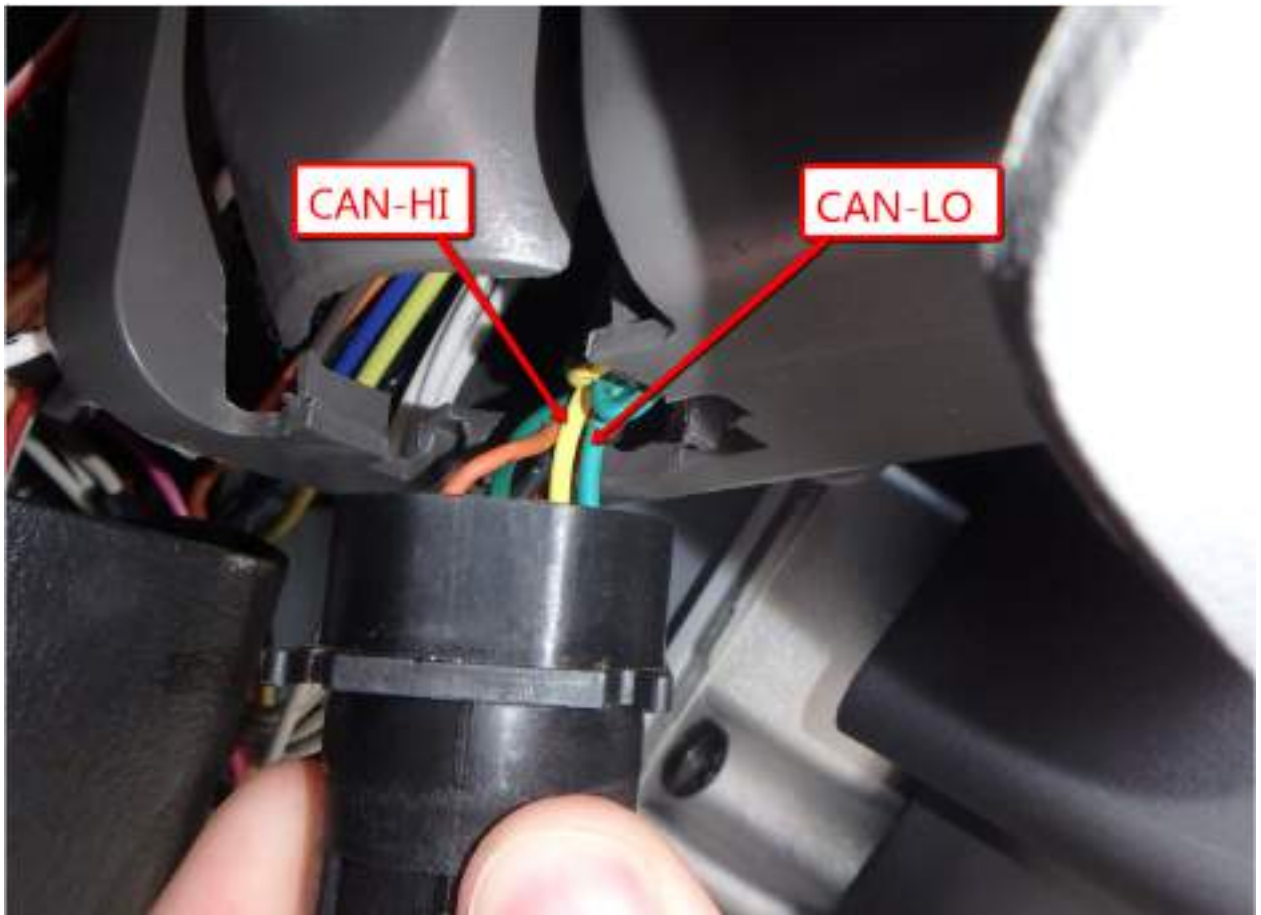
- H. Select **"File>Save As"** to save the trace to your desired location on your computer, and then save this example to the desktop. Give the file a name unique for the truck that was traced, in order to avoid confusion in the future:



- I. PCAN-View can now be closed, and the CAN-USB interface can be unplugged from the computer and the truck's diagnostic connector.

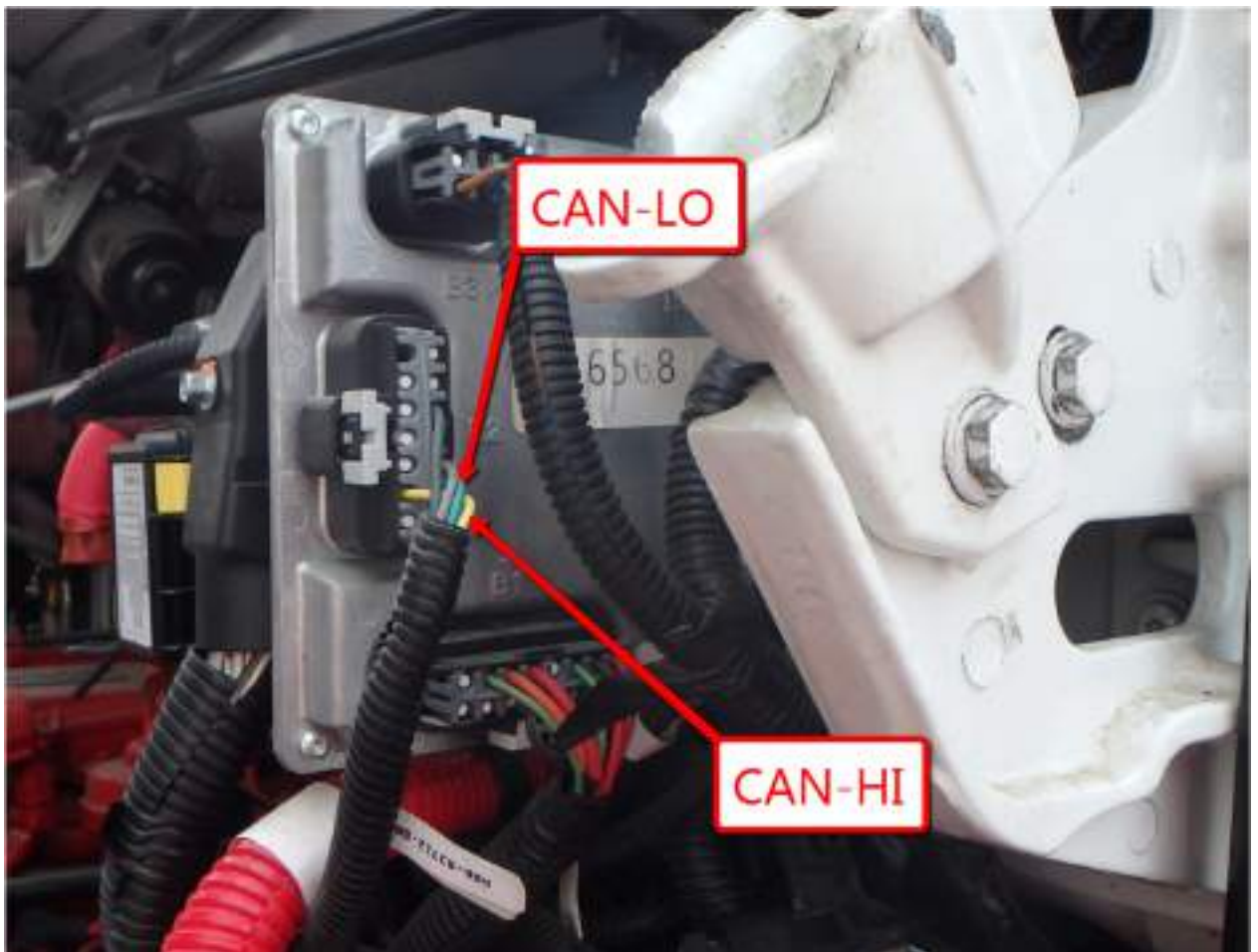
CONNECTING THE CRANE CAN NETWORK TO THE TRUCK CAN NETWORK:

1. Power off the truck.
2. Again, locate the diagnostic connector inside the truck, release it from the plastic holder (if it hasn't been done already), and locate the CAN-HI and CAN-LO wires on the connector:



3. A continuity check of the CAN system will now need to be done. Find a desirable location under the hood of the truck near the truck's ECU modules where the CAN wires are visible. On current generation Freightliner trucks, this is under the hood on the driver's side near the firewall:

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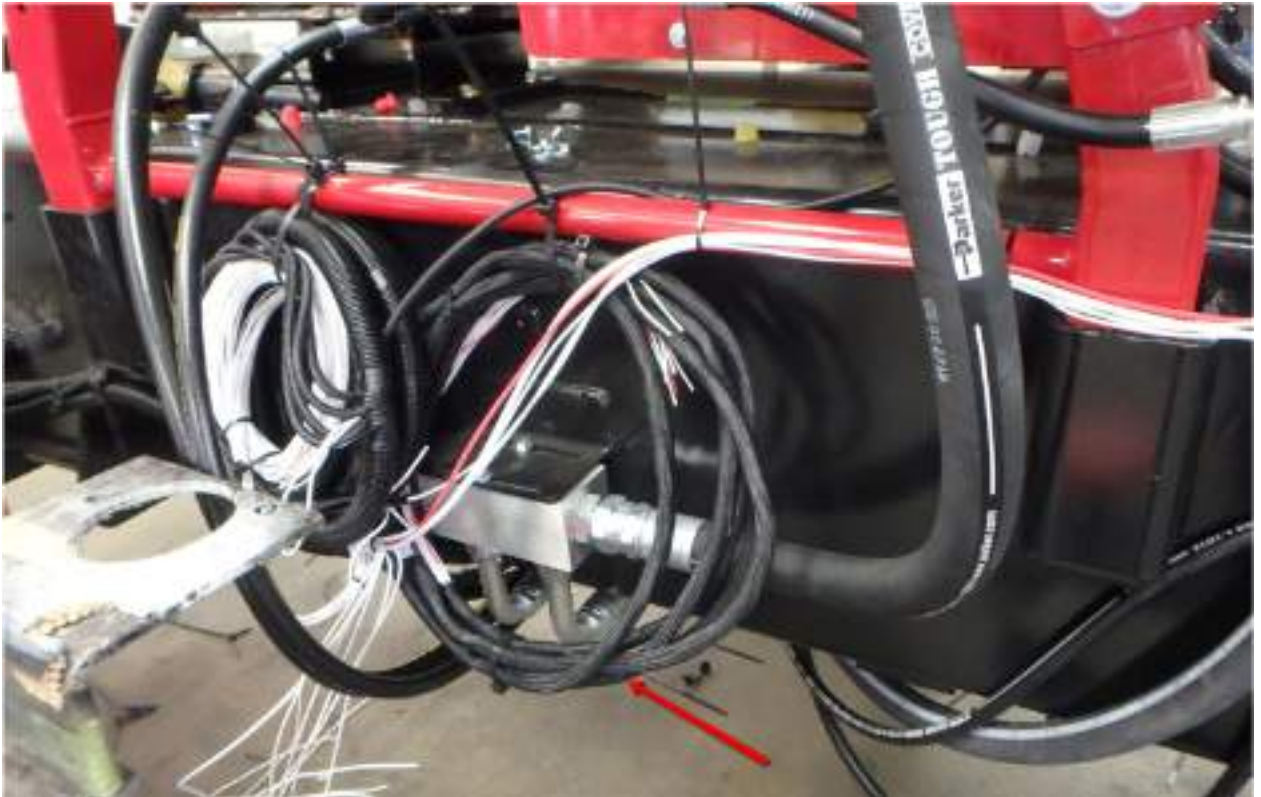


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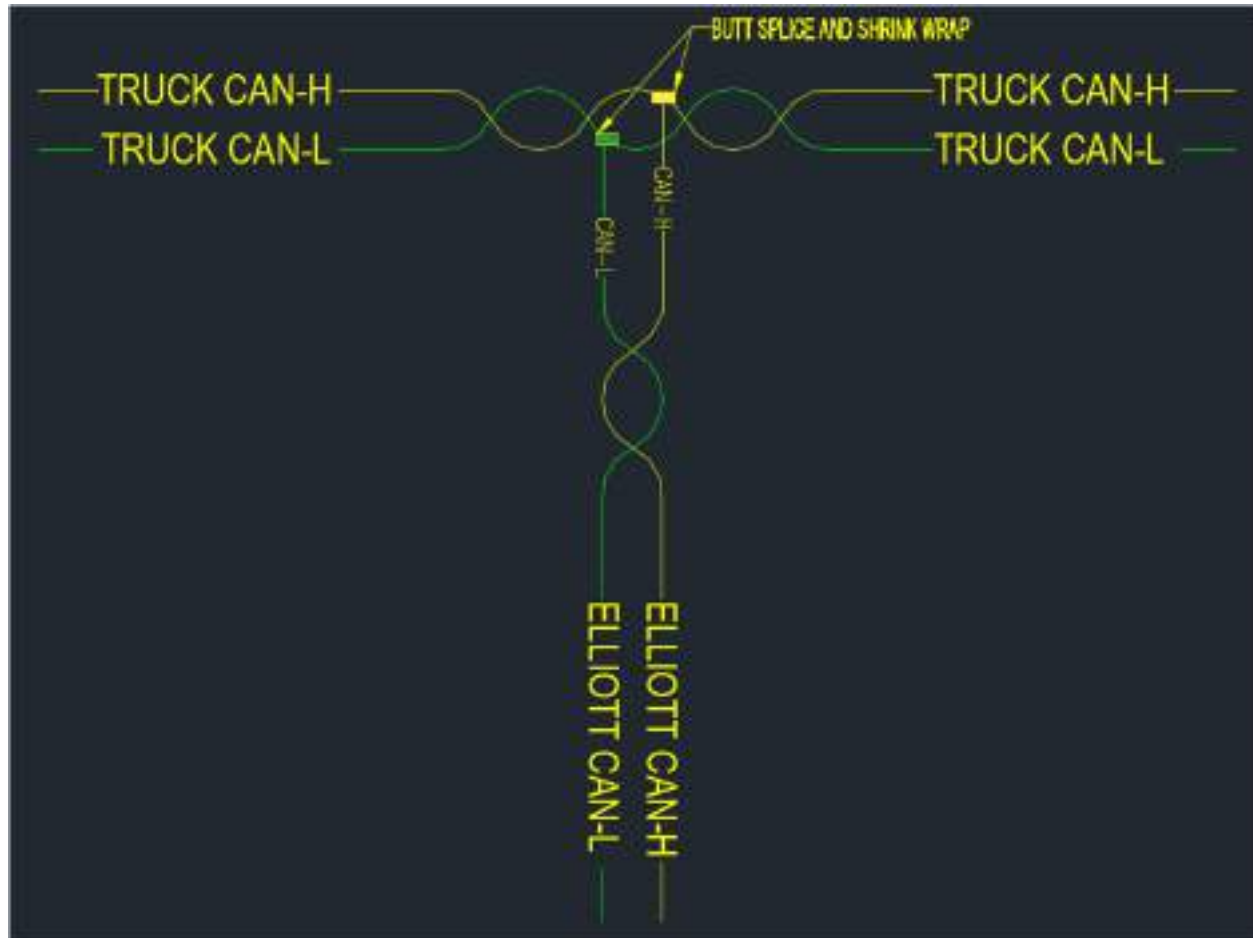
Perform a continuity check between the green and yellow wires present under the hood and the pins in the diagnostic connector under the dash. This ensures the wires are on the same CAN network.

4. Once it is verified the wires are continuous, find the connector on Elliott's outrigger control harness labeled **"Truck Engine Canbus Connection"** located on the front of the torque frame (when shipped as a kit):



5. Run the **"Truck Engine Canbus Connection"** under the hood of the truck along the already established harness routes, and secure every 12 inches with approved fasteners.

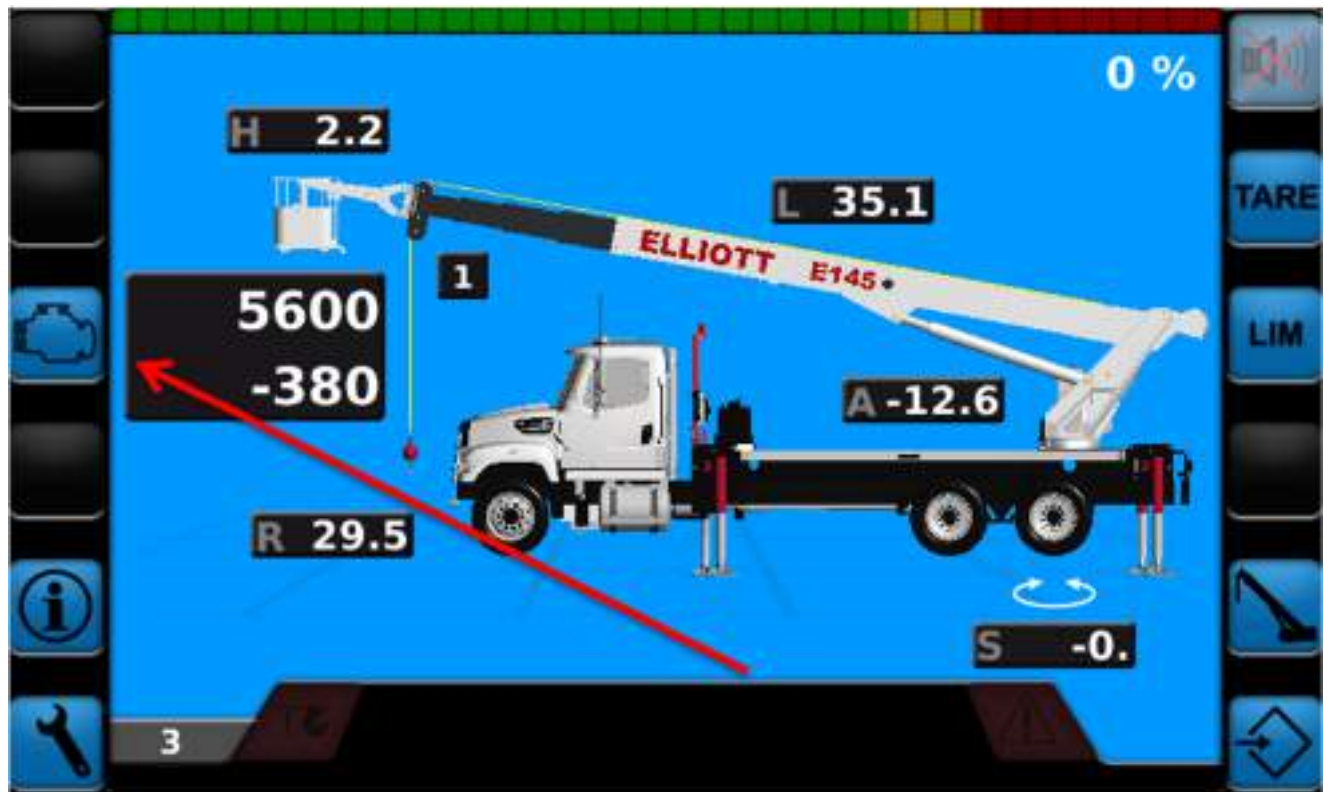
6. Splice the “**Truck Engine Canbus Connection**” wires into the truck’s existing CAN line as shown below. Use heat shrink to ensure shorts won’t occur in the CAN network, and cover wires with corrugated wire loom.



ENSURING THE DISPLAY HAS THE CORRECT SOURCE ADDRESS FOR THE REQUIRED PNGs:

1. After the two CAN networks are spliced together, it is possible the display might need to be properly configured. If so, open the gauge cluster display on the display unit with the truck running and the Elliott Truck Engine Canbus Connection spliced into the truck's J1939 network.

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Examine each of the gauges to ensure they display the correct information. The display has the ability to readout the following truck functions:

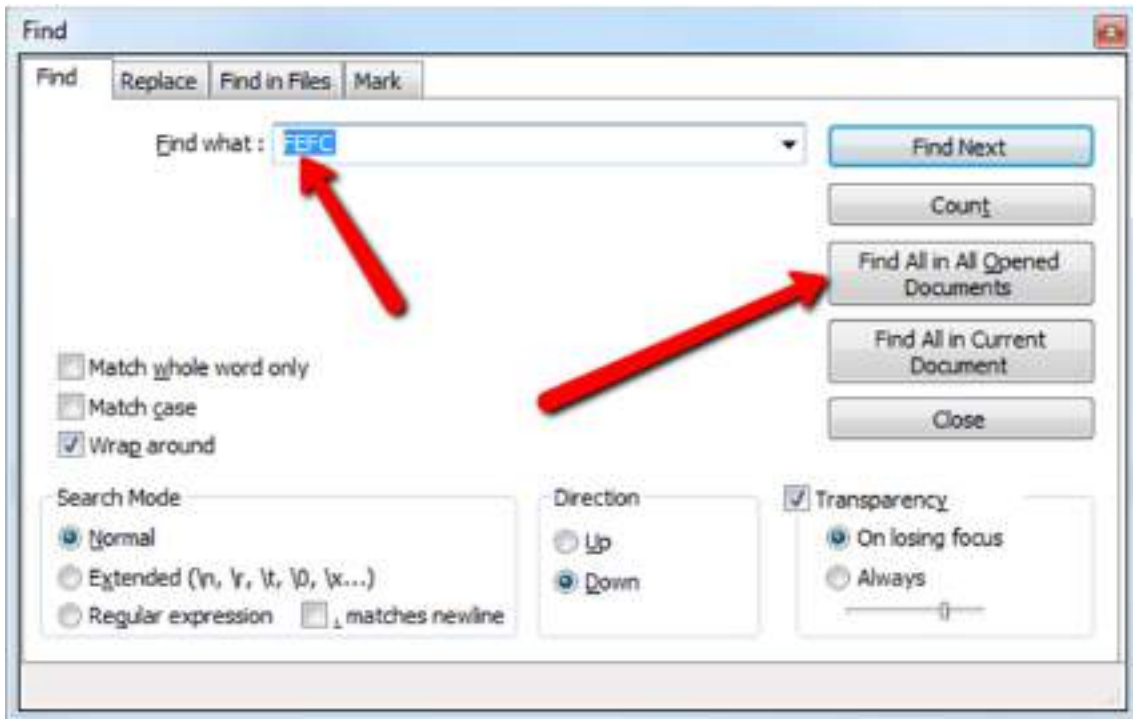
- Engine Oil Pressure
- Fuel Level
- Engine Speed
- Battery Voltage
- Engine Oil Temperature

If one or more of the gauges does not display the correct information, a manual correction is required. A list of the corresponding and related CAN network PNGs that will need to be searched for is shown below:

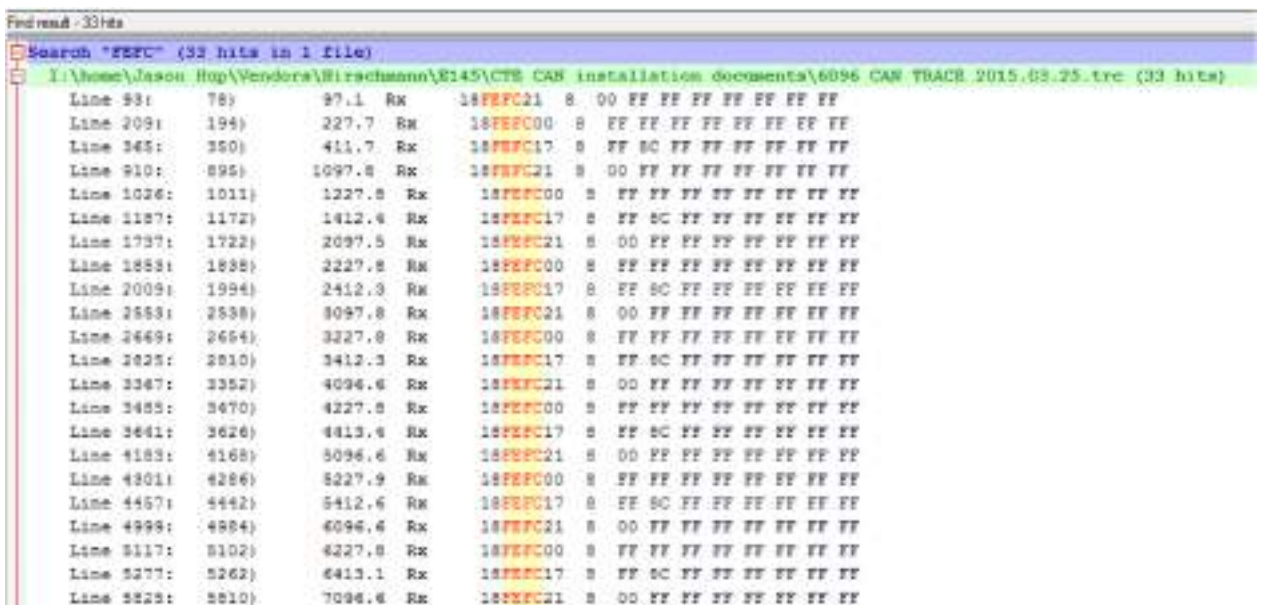
PNG I.D.	Description
F004	Engine Speed
FEFC	Fuel Level
FEF2	Fuel Rate
FEEF	Engine Oil Pressure
FEEE	Engine Oil Temperature
FEEE	Engine Coolant Temp.
FEF7	Battery Voltage
FEE5	Engine Hours
FD7C	DPF State
FD07	Protect Lamp
FD07	Amber Warning Lamp
FD07	Red Stop Lamp
FD07	Malfunction Lamp

2. The functions listed above can only be displayed if the information for each of the gauges is transmitted over the truck's CAN network. To determine if the information is on the network, open the CAN trace file saved on the desktop from PCAN-View with Notepad++.

- If one of the functions isn't working correctly, locate the corresponding PNG from the list above. In Notepad++ with the can trace open, press "**Ctrl+F**" on the keyboard to open up the "**Find**" dialog box. For example, if the Fuel Level gauge wasn't responding, the PNG "FEFC" will be searched for in Notepad++. Type in "**FEFC**" in the "**Find what**" box and click "**Find All in Current Document**":



- Search results will display as follows:



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The search results show that the data for Fuel Level is present on the CAN network. It is being transmitted by 4 different CAN addresses, and the correct one will have to be determined.

5. FEFC is being transmitted by 3 different CAN address: 21, 00, and 17:

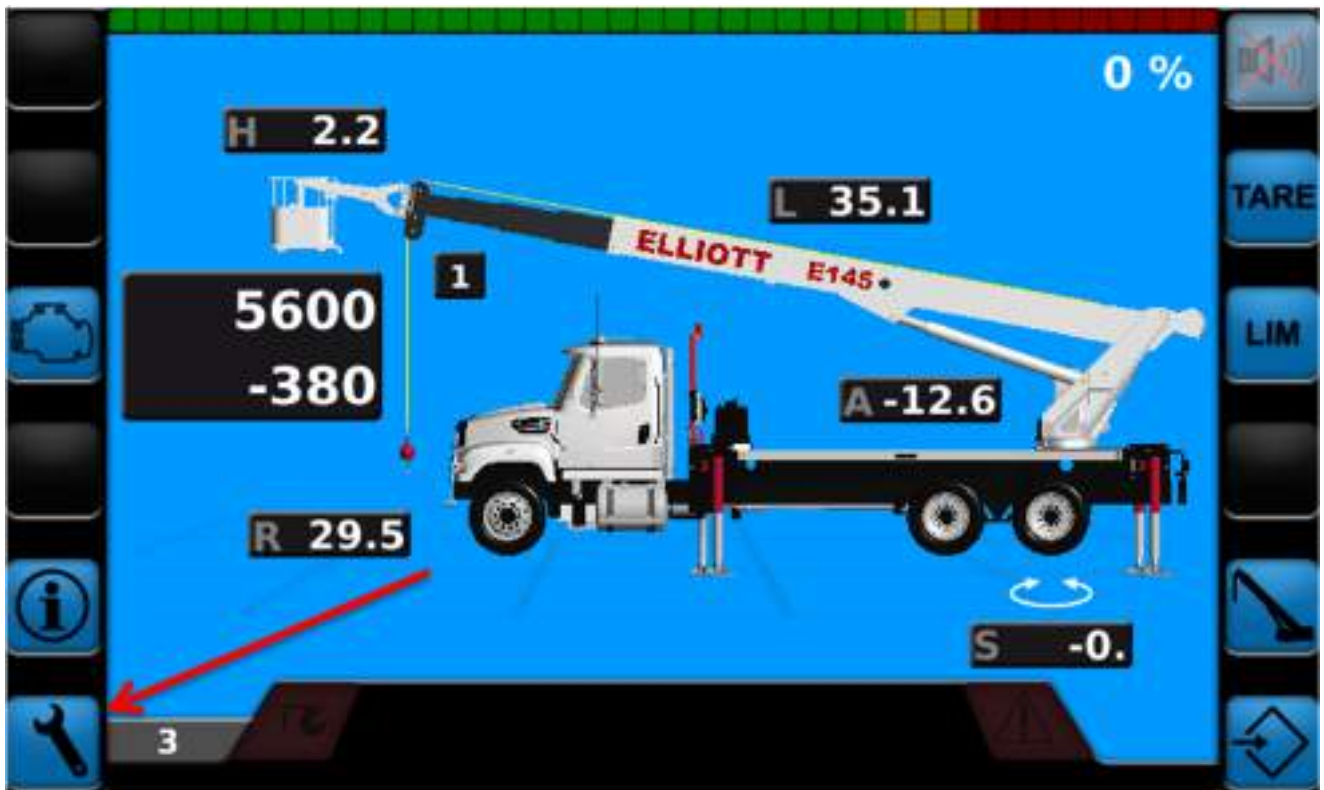
18 **FEFC21** 8 00 FF FF FF FF FF FF FF

18 **FEFC00** 8 FF FF FF FF FF FF FF FF

18 **FEFC17** 8 FF 8C FF FF FF FF FF FF

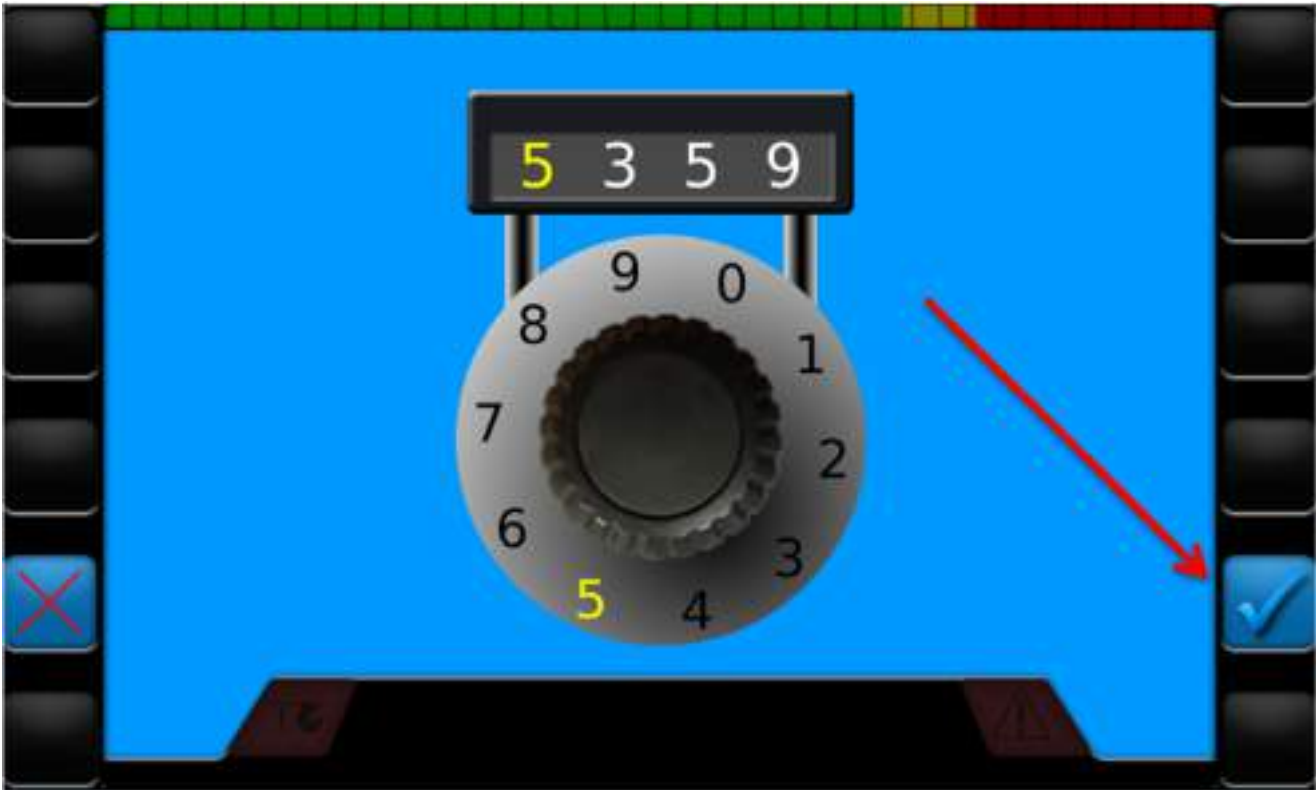
The “8” is the Data Length Code and the following letters and numbers are the Data Bytes. To determine which address is correct, the Data Bytes are to be examined. The “FF” byte is a byte placeholder and contains no data. The “00” byte also contains no data. The “8C” byte on the last row shows that the CAN address 17 holds data that needs to be transmitted on the gauge cluster display.

6. To change the CAN address of a PNG, press the Wrench icon on the main screen:



Then enter in “3539” for an unlock code using the rotary encoder (scroll wheel, pushing the scroll wheel in as a button to advance to the next number), and press the check mark to advance once all numbers are entered:

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Use the rotary encoder to scroll right until this screen is displayed:



Use the up and down arrows on the side to highlight the desired gauge description. Then press “**Set Adr**” on the right side, and a dialog box will pop up. Use the rotary encoder to select the number “**1**” and click the rotary encoder in to advance to the next number. Scroll over to “**7**” and then press the “**SYSTEM**” button to confirm the address change.

7. If a gauge responds incorrectly, and a search for the PNG in the trace document in Notepad++ provides no results, then the data is not available on the network and the PNG can be toggled off. On the PNG display screen, use the up and down arrows to highlight the desired PNG, and press the “**Set Active**” button in the upper right hand corner. The green check mark next to the PNG description will disappear, and that PNG will now display a value of “**0**” on the gauge cluster.



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Network Installation



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0110	1.0	New Document	5/11/15



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 via hard wired communication cable or be used as a radio remote control.**

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

When not using the remote controls, switch the remote 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 remote levers.

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. The remote control's system is designed for use either single or multiple functions at once and is fully proportional. See lever and switch designations found in the remote section of this text for specifics on operation of each lever and switch.

Aerial device and Option Function Levers

This remote is equipped with six two-way levers for the following boom functions; boom swing, telescope, spare, aux winch, main winch and boom lift. Additionally, and eight toggle switches and two buttons to operate the following functions: Truck Start/Stop, Tool Circuit, Engine Throttle, Emergency Pump, Aux Winch/ Main winch

Speed/Disable, LMI Function Cutout Override and Main Winch disable, Remote Start Up, Lever Inactive Override, and Lever Speed Control. The large red button is the Emergency Stop.

When the lever is in the center position, the function is inactive. Moving the lever from the center position initiates function movement. Multiple functions can be operated simultaneously with this system. Refer to these pictures and the descriptions of each lever/switch operation below the drawing.

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 remote

To start using the remote control, this sequence must be followed to power up the remote for use.

1. Twist up the **Emergency Stop** button.
2. Press the Power On button once; the LED power light above it will illuminate red.

Indicator Panel



At the top of the LCD screen are the Indicator Panel lights. From left to right, the Indicator Panel lights are:

- **Enable:** When the Enable switch is engaged, this LED indicates the levers and switches are operational.
- **Out Of Level:** This has a default value of 15 ACR minutes, the unit creates

an output that illuminates this LED, activates the OUT OF LEVEL on the LCD's Warning section, and sounds the PCU buzzer.

- **Anti-two-block:** This LED indicates when the A2B is activated.
- **Pre-Alarm:** This LED indicates when the LMI sends a signal that 90 percent of the maximum load is achieved.
- **Overload:** This LED light indicates when the LMI sends a signal that 110 percent of the maximum load is achieved.

The manufacturer's complete manual for this remote control system is included in the **Component Service** section. Refer to this section for complete troubleshooting, calibration, and communication information.

Functions

A. 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.**

B. Engine Speed Switch

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

c. Lever Shutoff Override/Horn Switch

After a period of inactivity, the lever controls shut down. Flip this momentary switch to reactivate the levers. Flip the switch down to sound the horn

D. 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.

E. Micro Toggle Switch

This momentary switch controls whether all analog functions on the remote function at reduced speed (**switch left**) or operate at full speed (**switch right**).

F. Emergency Pump Button

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

G. 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 remote to resume normal functions.

H. Aux Winch Switch

This switch is used to turn on or off the optional aux winch. If the aux winch lever is active, selecting the **"HIGH"** position activates the high speed winch feature. Selecting the **"DISABLE"** position de-activates the aux winch.

NOTE-High-speed aux winch feature is currently not available on the E145 model.

I. PCU Power/Backlight/Buzzer Silence Button

This cyclical button enables the operator to perform multiple functions.

1. To turn on the remote, press once.

2. To turn on the backlight, press the button (**NOTE-backlight cannot be operated within the first 5 seconds after the remote has been turned on**).
To turn off, press button again.
3. To silence buzzer, press and hold the button for 3 seconds while the buzzer is sounding.

J. Winch Switch

This switch is used to turn on or off the winch. If the winch lever is active, selecting the **“HIGH”** position activates the high speed winch feature. Selecting the **“DISABLE”** position de-activates the winch.

NOTE-High-speed winch feature is currently not available on the E145 model.

K. Disable Button

This momentary button provides an override lockout of the LMI / ATB function. Press to disable.

L. Boom Swing Lever

This lever 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)

M. Boom In/Out Lever

This lever operates the boom telescoping system.

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

N. Spare Lever

O. Aux Winch Lever

This lever 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

P. Winch Lever

This lever 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

Q. Boom Up/Down Lever

This lever operates the boom lift cylinder.

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

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech. Spec.	EEC-0001	1.0	Created Document	1/9/15

 DANGER

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

 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.**

 CAUTION

Before lifting any load, make sure that:

- A.** Outriggers and stabilizers are extended on a firm, uniformly supporting surface.
- B.** Aerial device is level.
- C.** The exact weight lifted is known, including all tackle and rigging.
- D.** 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.

- E.** Do not exceed the area of operation on the capacity chart.
- F.** Reduce load ratings to compensate for wind, ground conditions and the dynamic effects of swinging, hoisting, and lowering the load.

NOTE: For units installed outside the factory, the installer must perform a stability test in compliance with instructions furnished by Elliott Equipment Company.

Platform Removal: The load chart for the aerial device may be specified for use with the platform removed. Subtract the listed platform weight from the permitted lifting capacity if the platform is not removed. To remove the platform, follow the instructions in the “Platform Installation and Operation” section of this manual.

Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0125	1.0	Template update	6/25/15
Tech Spec.		1.1	Content update	8/3/15

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 float 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

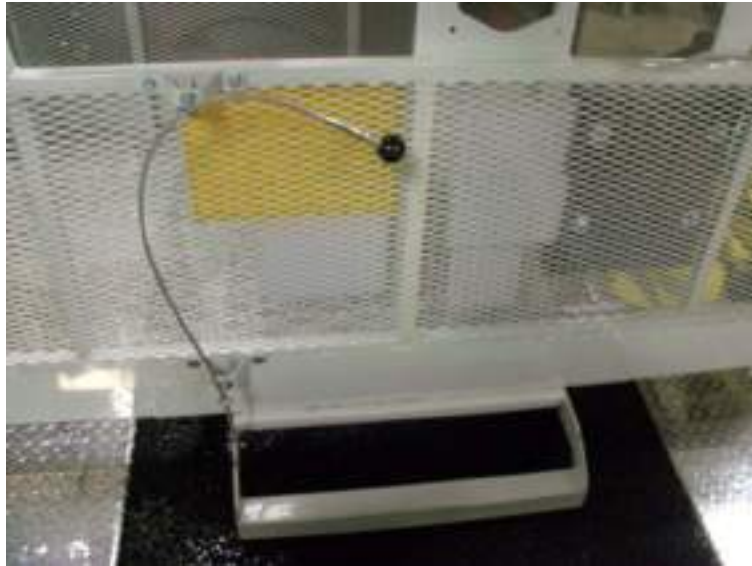
the hydraulic system, the air will need to be bled out. The bleeding procedure is outlined below

- 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.

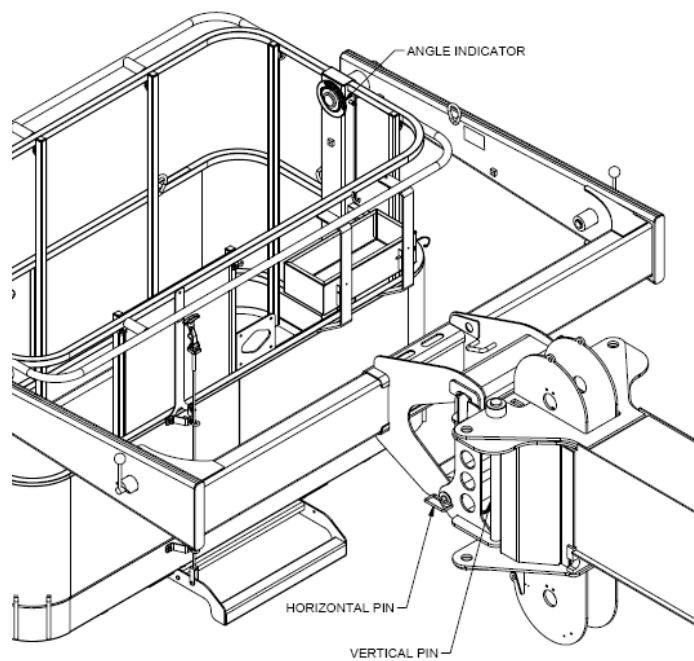
Kickstand

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.

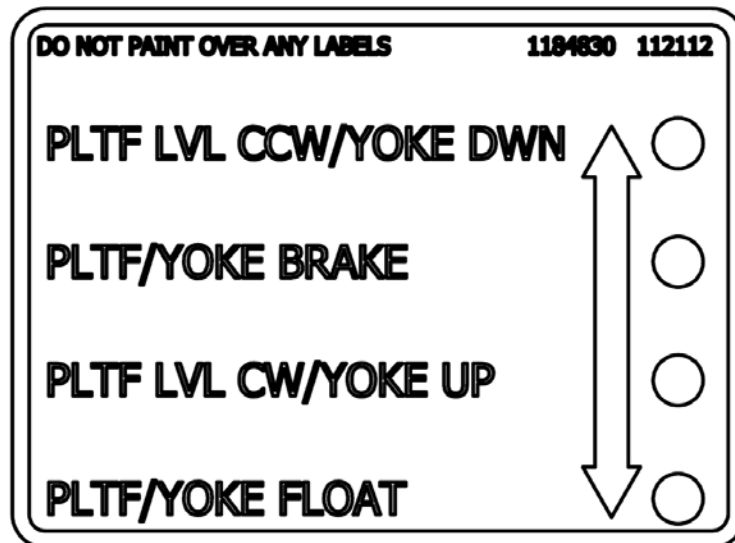


Float lock shown in the lock position Prevents function selector from being inadvertently bumped into float position unexpectedly.

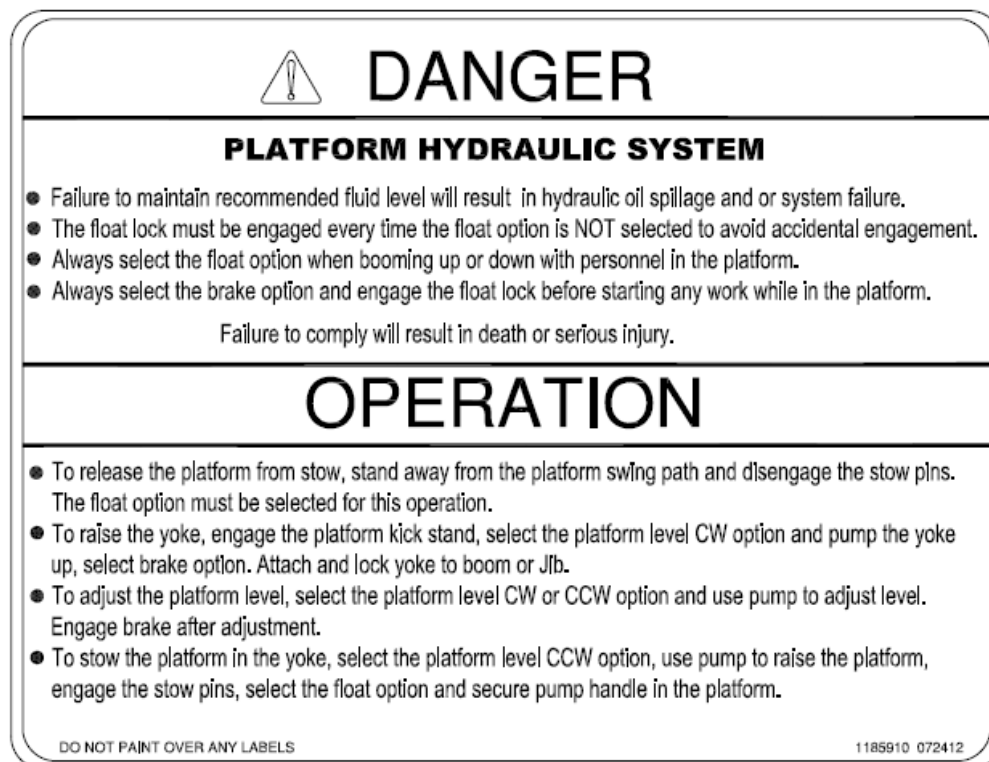


Float lock shown in the unlocked position

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.

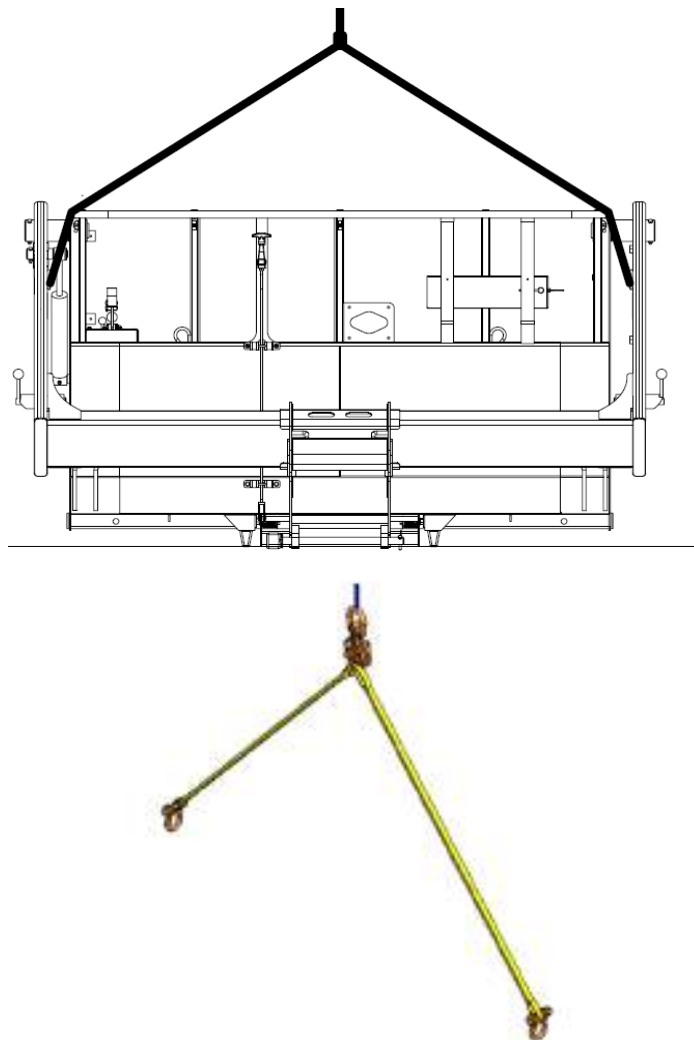


Figure 1: Sling attachment to platform assembly

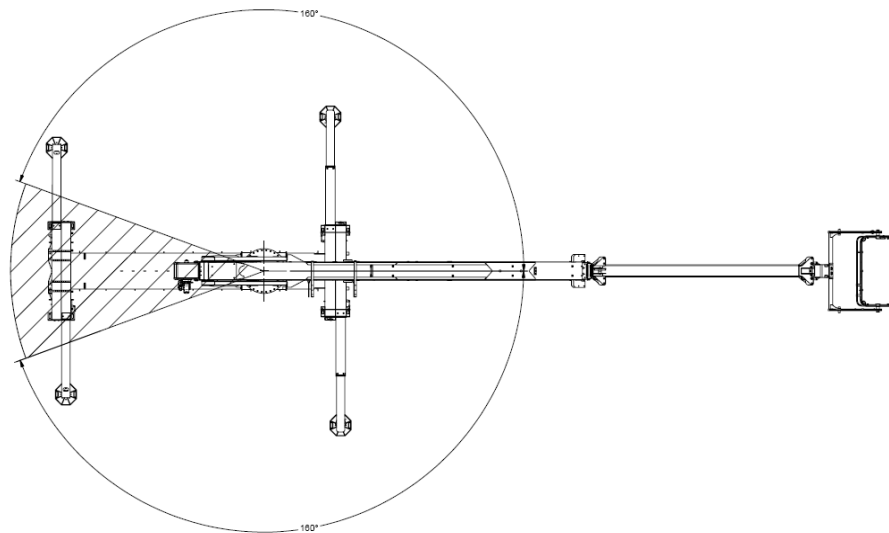


Figure 2: Platform location on ground

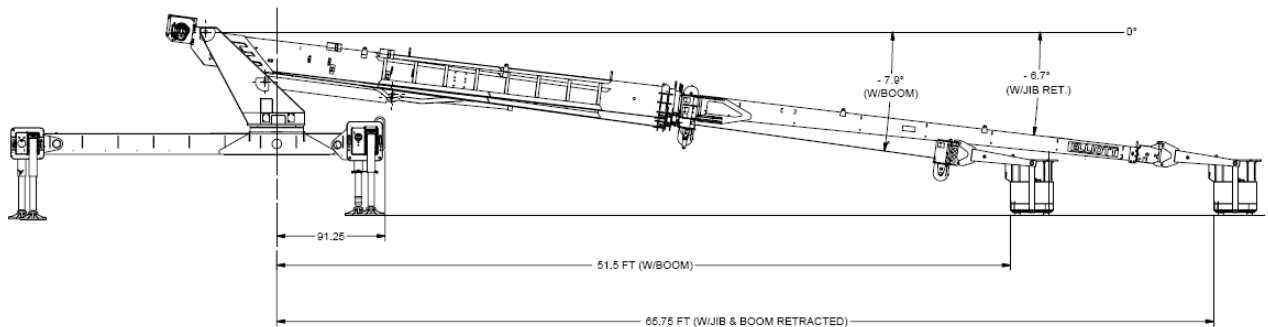


Figure 3: Platform ground location

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

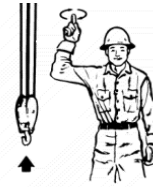
- A.** Set the platform at a 88.4 ft radius from the truck center of rotation as shown in Figure 3.
- B.** Raise the platform arm to 5 degrees angle; refer to the platform operation label for operation details.
- C.** Lower boom to maximum possible negative angle, align jib and platform
- D.** Extend boom to 39.9 ft radius on LMI display
- E.** Raise jib head into platform arm hook, insert and secure horizontal pin

Revision History

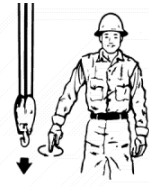
Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0049	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15

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.



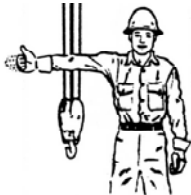
RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.



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)



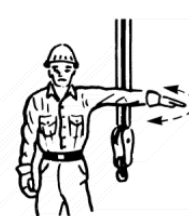
RAISE THE BOOM AND LOWER THE LOAD. With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.



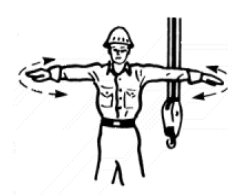
LOWER THE BOOM AND RAISE THE LOAD. With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.



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 aerial device 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 aerial device and its optional equipment. These records shall be kept in a location accessible to the operator.**



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

Daily Inspection

- Perform all items required in a standard walk around vehicle inspection in accordance with U.S. 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.**
- Inspect the unit's underside for structural damage and hydraulic leaks.**
- Check all hydraulic hoses, particularly those that flex in normal operation for any scuffing, cuts or wear marks.**
- 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.**
- Perform the daily lubrication per the "Lube Chart".**
- Check that oil level is at proper level.**
- 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 aerial device 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. Check proper operation of horn, start/stop switch, etc.
- V. 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 severity of the operation of the unit. This inspection should be performed at least once every twelve months and shall be performed by a competent individual or a government or private agency recognized by the U.S. Department of Labor.

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 known weight and measuring boom angle and radius.

Required Inspections



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0075	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/13/15

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 $1/5^{\text{th}}$, 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 knot is a convenient way to accomplish rope attachment. The strength loss is a result of the tight bends that occur in the knot. 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 are 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 the 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 rope 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 bits 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 circumference 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

Synthetic Rope Usage, Inspection, and Retirement



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

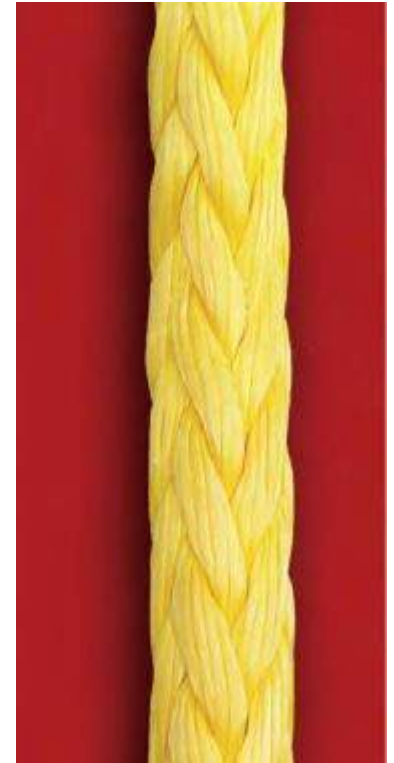
Rope Type

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	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

Synthetic Rope Usage, Inspection, and Retirement



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 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 as 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.

Synthetic Rope Usage, Inspection, and Retirement



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

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.**

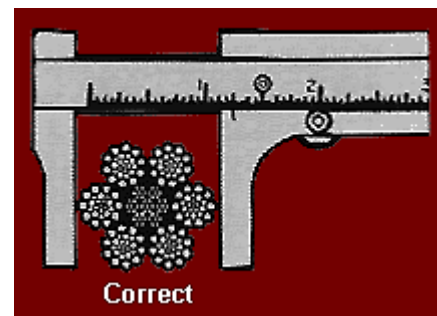
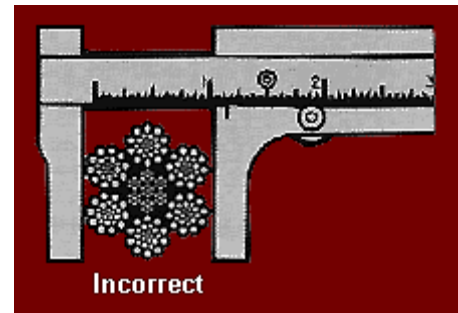
Replacement Criteria

- 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



Wire Rope Care/Maintenance

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

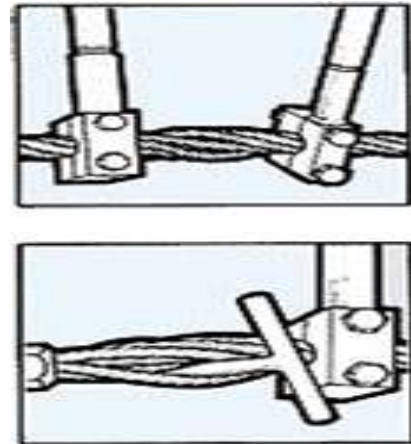
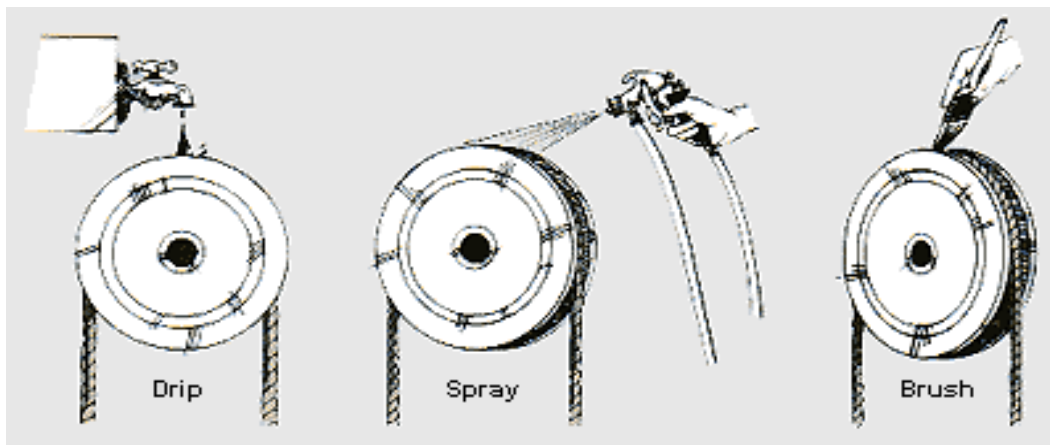


fig 3

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.**

Wire Rope Care/Maintenance



Revision History

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

Pump Specs

Hydraulic System	Pump Speed RPM	Max. Flow GPM	Flow L/Min		Pressure PSI	Pressure Bar
Piston Pump 84cc	2500	55	208	Relief Standby	3500 450 +/- 50	241 31.0 +/- 3.5
Emergency Pump		2.5	9.5	Relief	2200	152

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.**

E190 Specifications



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	3800	262				
Lift Up (Pump Ltd.)	3500	241	23.8	90	57 +/- 5	
Lift Down (Pump Ltd.)	3500	241	10.6	40	Gravity	
Boom Extend	2700	186	30	114	147 +/- 10	44
Boom Retract	2500	172	9	34	180 +/- 10	36
Winch Up/Down	3500	241	30	114		See Winch Line Pull Table
Swing Left	2100	145	9	34	45 +/- 5	
Swing Right	2100	145	9	34	45 +/- 5	
Tool Circuit-C1	2500	172	7	26		
Option-C2	2500	172	7	26		
Outriggers In/Out	2500	172				
Outriggers Up/Down	2500	172				
Reservoir Capacity	190 Gallons					
Filtration (Pressure)	20 Micron					
Filtration (Return)	6 Micron					

NOTE: Lift Up time is full cylinder stroke

Winch System Performance

Category	Standard
Line Pull	9,000 lb.
Wire Rope	9/16" Yale Ultrex
Breaking Strength	40,500 lb.
Cable Length	400 ft.

Winch Line Pull

Line Speed

Layer	Lb.	(Kg.)	FPM	(MPM)
1	15,000	(6804)	122	(37)
2	13,571	(6156)	135	(41)
3	12,377	(5614)	149	(45)
4	11,309	(5130)	162	(49)

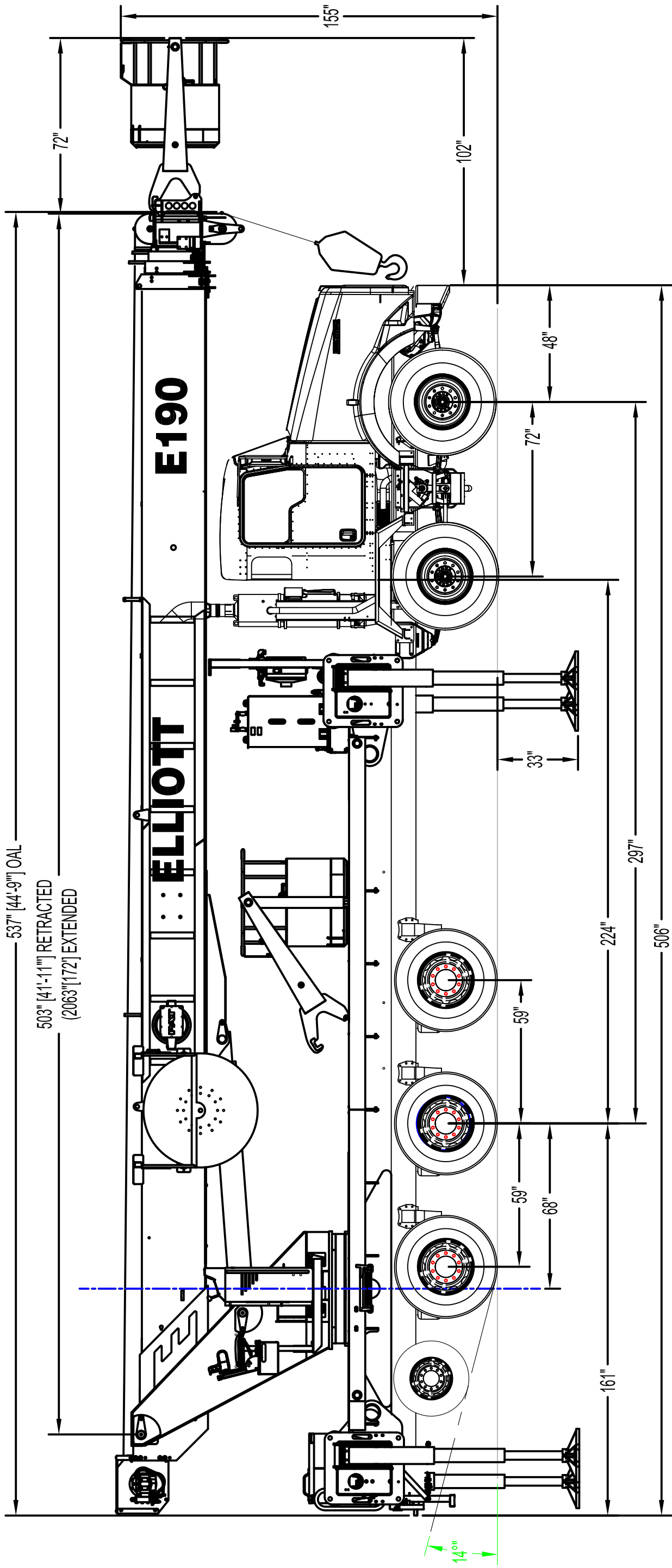
Ratings based on 30 GPM at 3500 PSI (114 LPM at 241 Bar)



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0126	1.0	Doc creation	6/26/15

REVISIONS				
DRT	REV	DESCRIPTION	DATE	ECO
MHG	A	ADD WTS TO DWG	3/6/15	
MHG	A	ADD PG 2 - WESTERN STAR	5/7/15	



Dimensions approximate and vary with truck specifications

GWR-108,000 lbs. Front axle-40,000 lbs. Rear axle-58,000 lbs. Aux. axle-10,000 lbs.

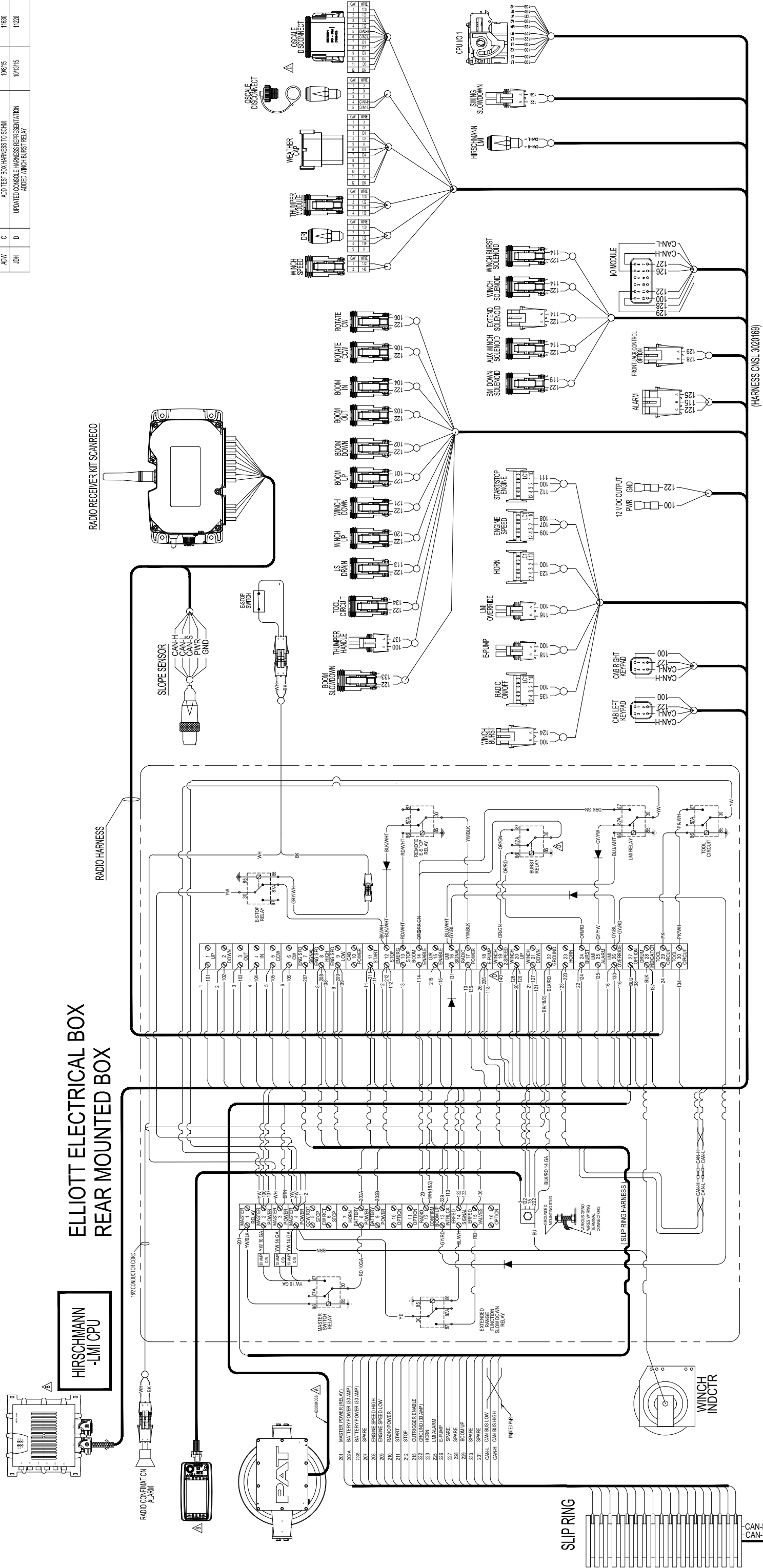
Completed Wt. W/(2) People & Fuel GVWR-74,400 lbs. Front axle-27,400 lbs. Rear axle-47,000 lbs. Aux. axle-0 lbs.

Completed Wt. W/2) People & Fuel GVWR-74,400 lbs. Front axle-31,500 lbs. Rear axle-32,900 lbs. Aux. axle-10,000 lbs.

Chassis Wt. (Bare) GVWR-26,300 lbs. Front axle-16,220 lbs. Rear axle-10,080 lbs.

ENG	TCR	ELLIOTT EQUIPMENT COMPANY	
DATE			
CHECKED			
DATE			
DTR	TCR		
DATE	01/15/15	TITLE: E190 PROTOTYPE -CTE KENWORTH T800	
DATE	01/15/15	SIZE: B SHEET: 1 OF 2 DWG#: P0027910.dwg	REV: B

REVISIONS				
DPT	REV	DESCRIPTION	DATE	ECO
JD#	A	UPDATED 80004638 TERMINATION ROUTING. UPDATED HRSC-MANN PART NUMBERS - PAGE 3	8/19/15	1131
JD#	B	ADDED HRSC-MANN VISUALS (PAGE 1) ADDED HRSC-MANN LHM HARNESS (PAGE 1)	9/4/15	11459
ADW#	C	ADD TEST BOX HARNESS TO SCAM	10/8/15	11630
JD#	D	UPDATED CONSOLE HARNESS REPRESENTATION ADDED WINCH/BLURST RELAY	10/19/15	11228



ABOVE ROTATION

BELOW ROTATION

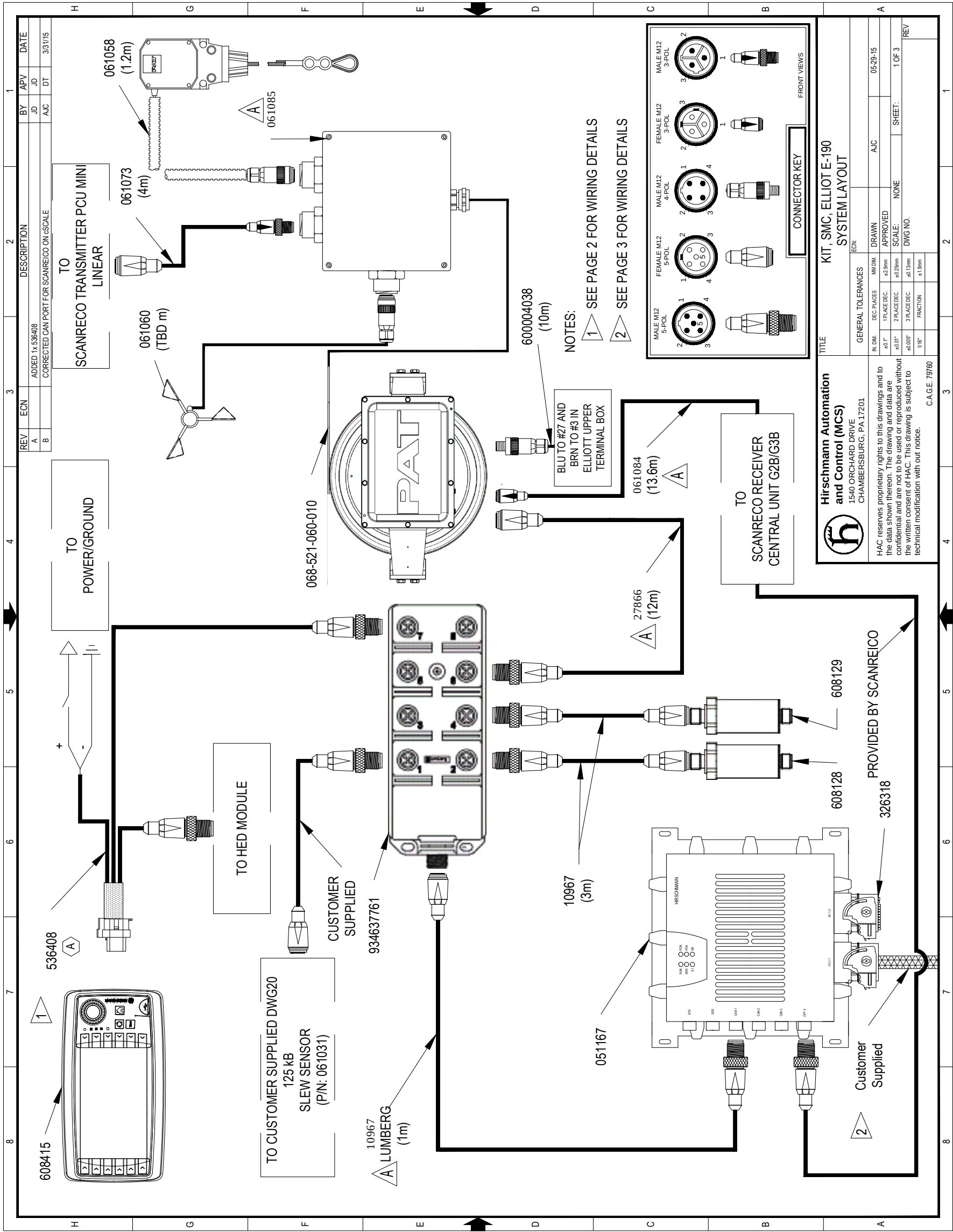
ABOVE ROTATION

BELOW ROTATION

ENG	JDH					TITLE: ELE SCHW-E190				REV	D
DATE	7/7/2015					SIZE	D	SHEET	1 OF 11	DWG#	2080290.dwg
CHECKED											
DATE											
DTR	JDH										
DATE	7/7/2015										

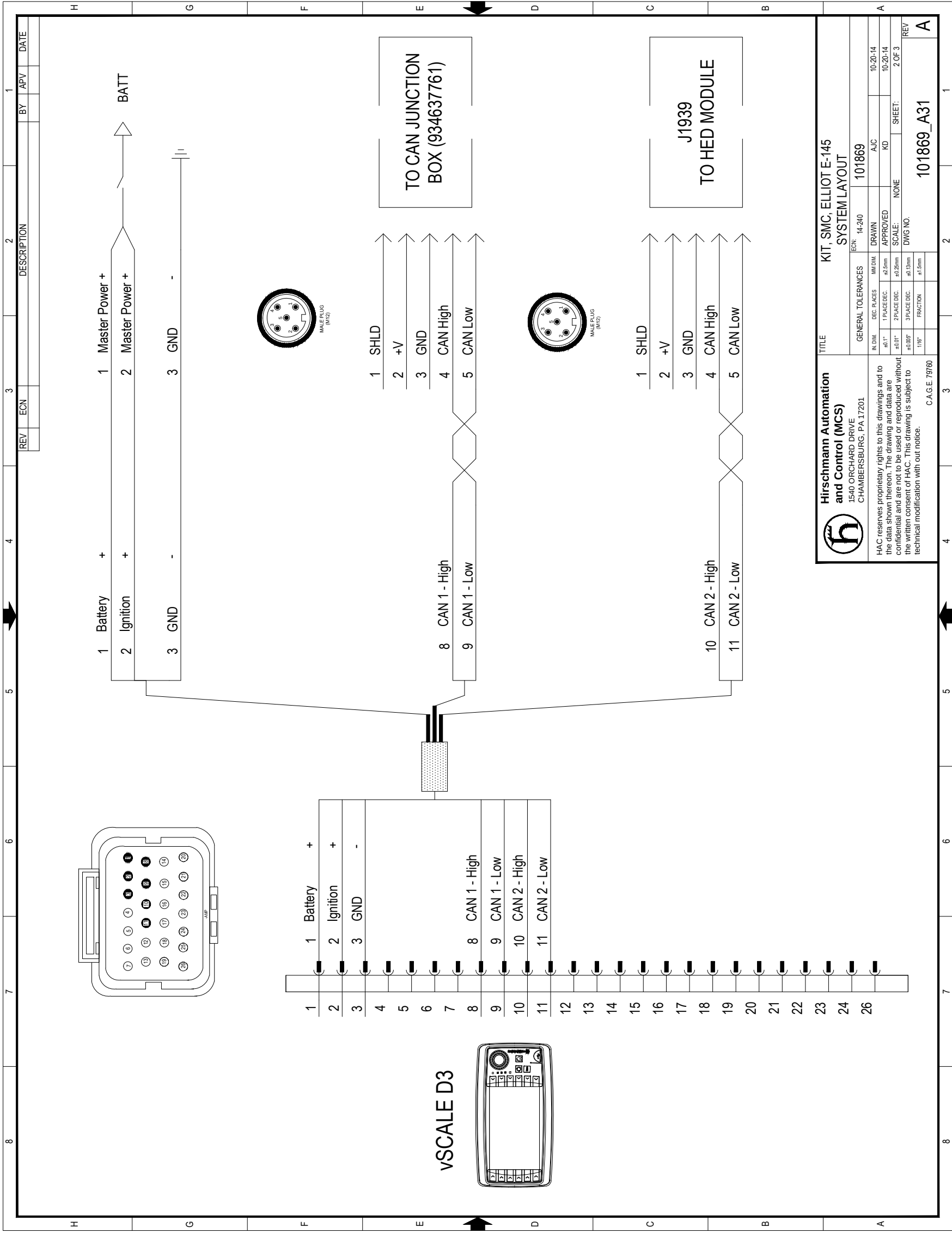
DATE	7/7/2015	SIZE	SHEET	DWG#	REV
		D	1 OF 11	2080290.dwg	D

REVISIONS		DATE	ECO
DRT	REV	DESCRIPTION	
		SEE PAGE 1 FOR ECO CHANGES	



ENG	JDH	ELLIOTT EQUIPMENT COMPANY	TITLE: ELE SCHW-E190				REV	D
DATE	7/7/2015		SIZE	D	SHEET	3 OF 11	DWG#	2080290.dwg
CHECKED								
DATE								
DTR	JDH							
DATE	7/7/2015							

REVISIONS		DATE	ECO
DRT	REV	DESCRIPTION	
		SEE PAGE 1 FOR ECO CHANGES	



ENG	JDH		TITLE: ELE SCHW-E190				REV	D
DATE	7/7/2015		SIZE	D	SHEET	4 OF 11	DWG#	2080290.dwg
CHECKED								
DATE								
DTR	JDH							
DATE	7/7/2015							

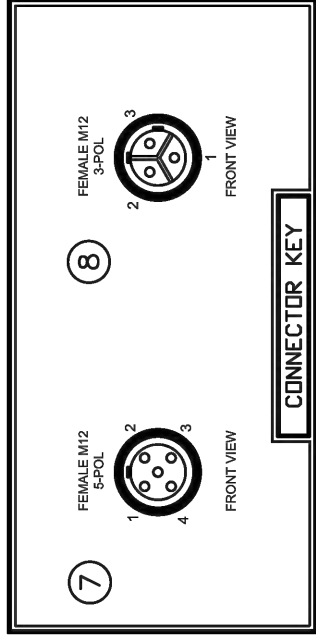
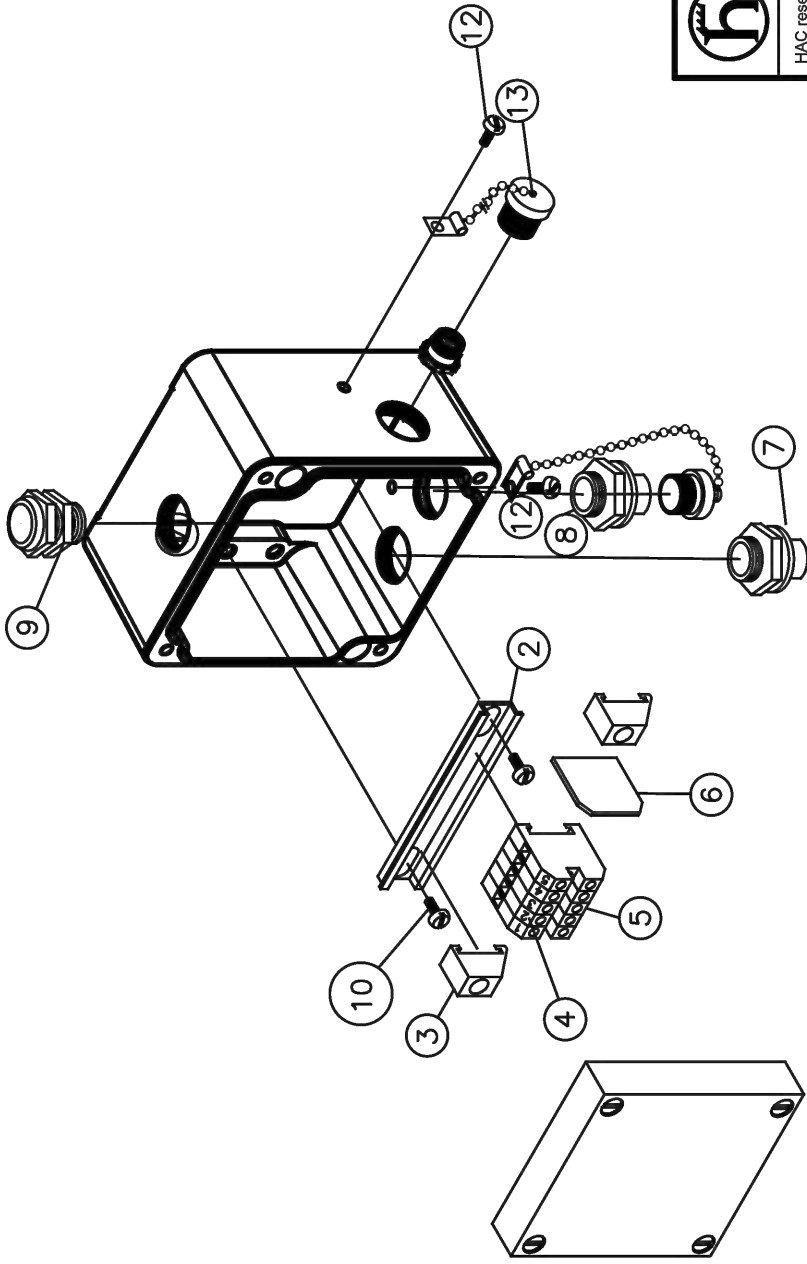
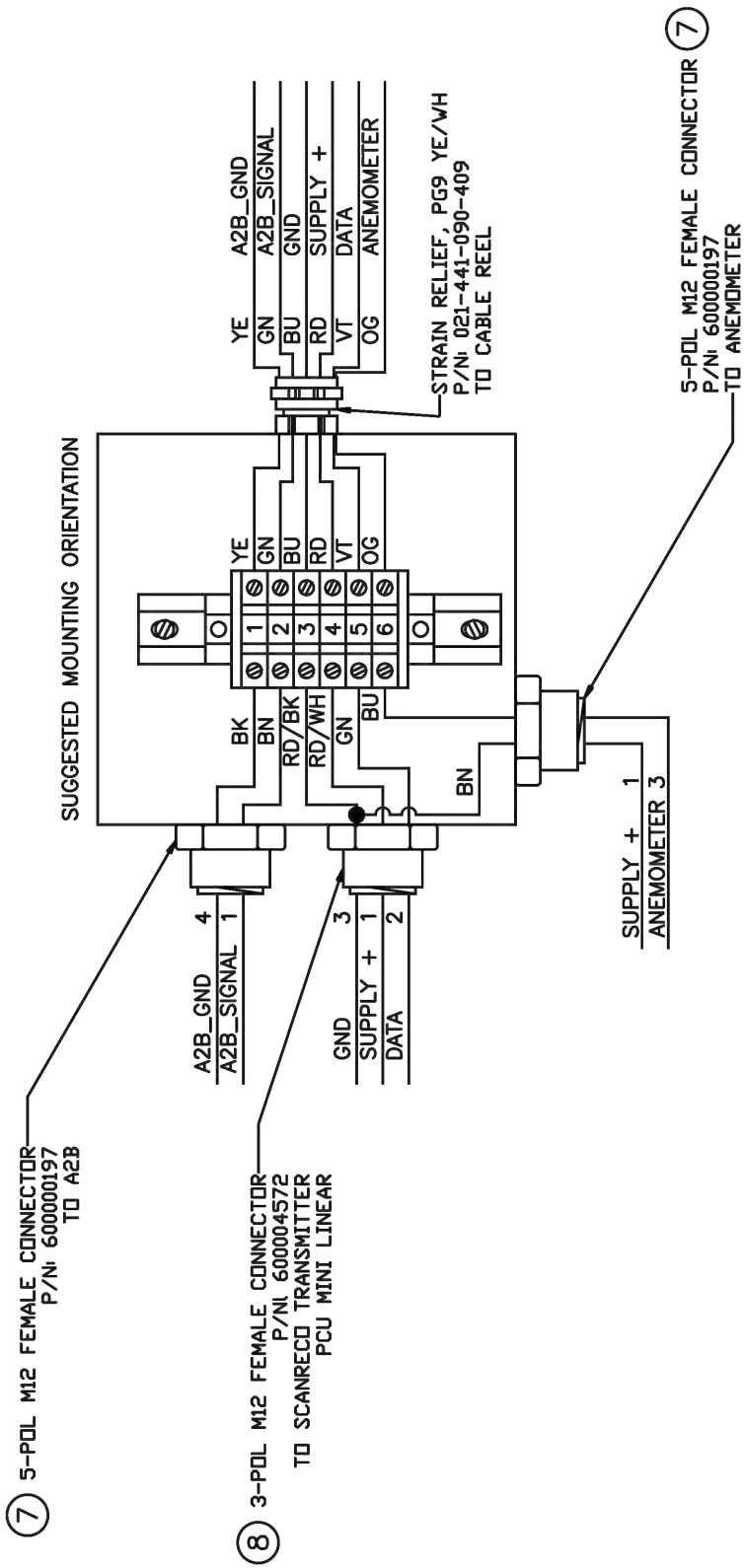
REVISIONS			
DRT	REV	DESCRIPTION	DATE
SEE PAGE 1 FOR ECO CHANGES			
			ECO

3		2		1	
REV	ECN	DESCRIPTION	BY	APV	DATE

7		6		5	4
					➔

NOTES:

NOTES:
1. APPLY RTV SEALANT

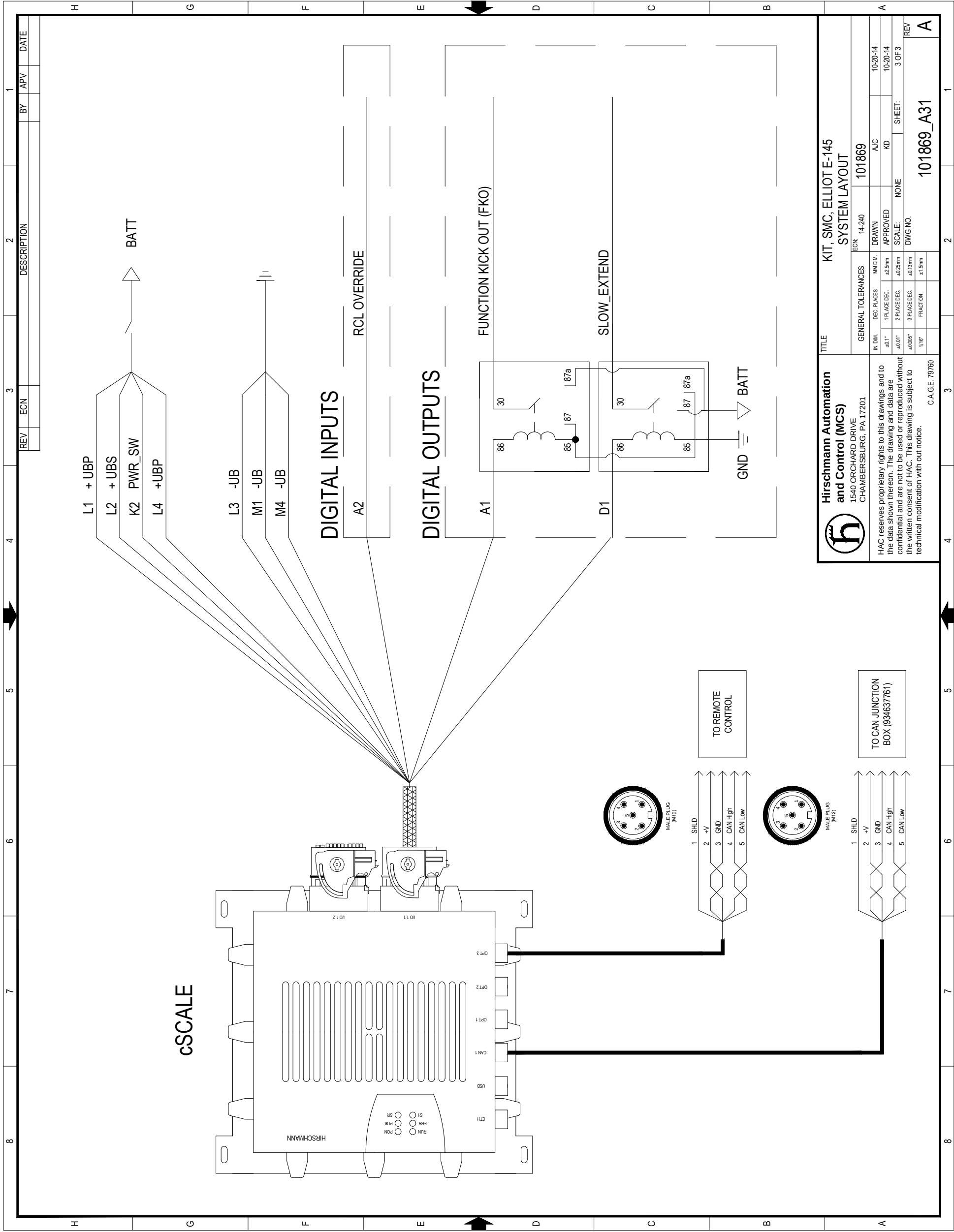


 Hirschmann Automation and Control (MCS) 1540 ORCHARD DRIVE CHAMBERSBURG, PA 17201	TITLE JUNCTION BOX ASSY, 80X75 1-PG9 1-4POL M12, 1-3POL M12									
	GENERAL TOLERANCES									
	ECN: 2015-117 061085									
HAC reserves proprietary rights to this drawings and to the data shown thereon. The drawing and data are confidential and are not to be used or reproduced without the written consent of HAC. This drawing is subject to technical modification with out notice.	IN. DIM. DEC. PLACES		MM DIM. DEC. PLACES		DRAWN		AUC		06-11-15	
	±0.1" 1 PLACE DEC.		±0.5mm 1 PLACE DEC.		APPROVED		AUC		06-11-15	
	±0.01" 2 PLACE DEC.		±0.25mm 2 PLACE DEC.		SCALE:		NONE		SHEET: 1 OF 1	
	±0.005" 3 PLACE DEC.		±0.13mm 3 PLACE DEC.		DWG NO.		061085_A06		REV	
	1/16" FRACTION		±1.5mm FRACTION		061085_A06		A		REV	

ENG	JDH					TITLE: ELE SCHAEF190		REV	D
DATE	7/7/2015								
CHECKED									
DATE									
DTR	JDH								
DATE	7/7/2015					SIZE	D	SHEET	9 OF 11
						DWG#	2080290.dwg		

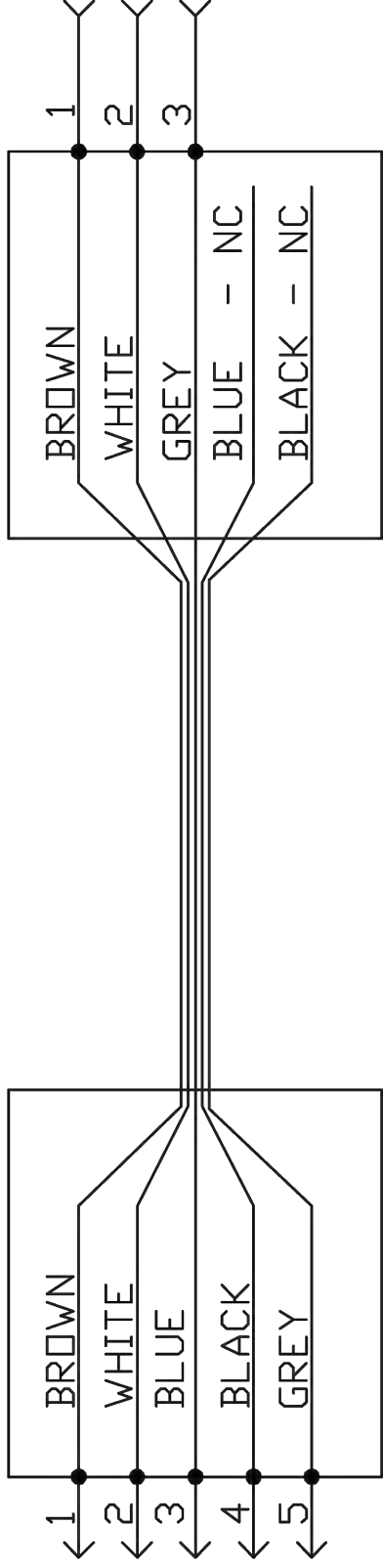
REVISIONS			
DRT	REV	DESCRIPTION	DATE
		SEE PAGE 1 FOR ECO CHANGES	
			ECO

ENG	JDH		TITLE: ELE SCHME'90			
DATE	7/7/2015		SIZE	SHEET	DWG#	REV
CHECKED			D	5 OF 11	2080290.dwg	D
DATE						
DTR	JDH					
DATE	7/7/2015					



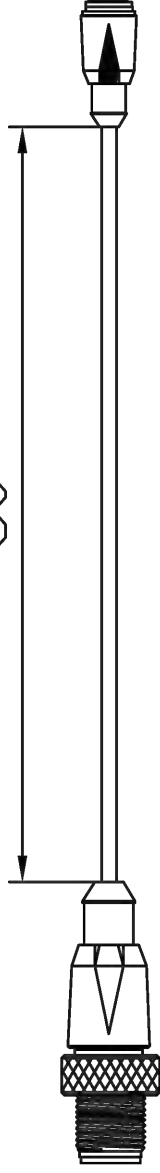
REVISIONS			
DRT	REV	DESCRIPTION	DATE
SEE PAGE 1 FOR ECO CHANGES			
			ECO

3		2	1	
REV	ECN	DESCRIPTION	BY	DATE



FRONT VIEW

FRONT VIEW

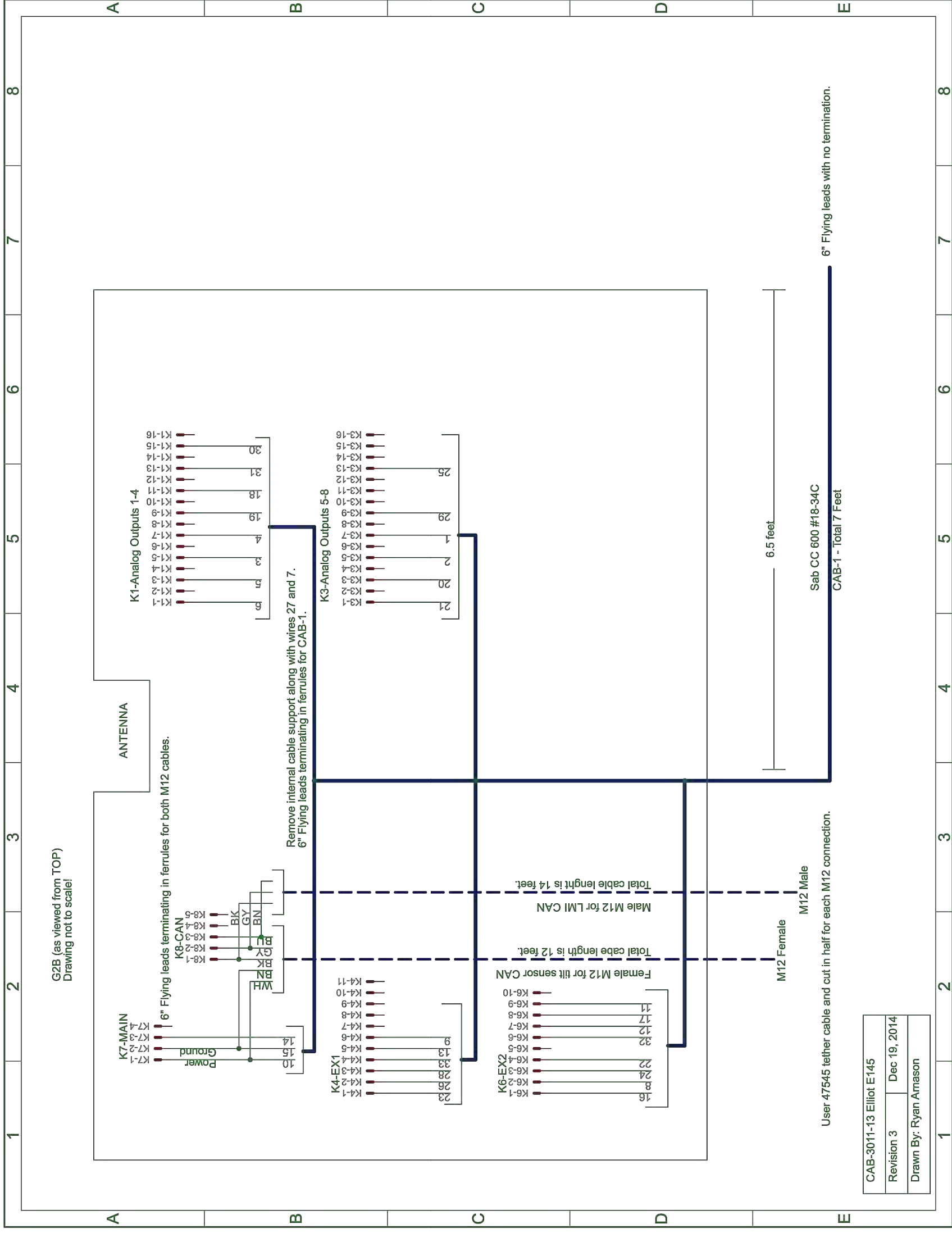


 Hirschmann Automation and Control (MCS) 1640 ORCHARD DRIVE CHAMBERSBURG, PA 17201	TITLE CABLE ASSY, M12, 5P MALE TO 3P FEM, LWG TO REMOTE, ELLIOTT									
	EDN: 061074									
	GENERAL TOLERANCES									
	IN. DIM. DEC. PLACES	MM DIM. DEC. PLACES	DRAWN	APPROVED	AJC	08-16-14				
±0.1"	1 PLACE DEC. ±0.25mm	±0.01"	2 PLACE DEC. ±0.25mm	AJC	10-20-14					
±0.005"	3 PLACE DEC. ±0.13mm	SCALE:	NONE	SHEET:	1 OF 1					
1/16"	FRACTION	±1.5mm	DWG NO.		REV					
C.A.G.E. 78760					A					

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ENG	JDH	ELLIOTT EQUIPMENT COMPANY				TITLE: ELE SCHAEF190	
DATE	7/7/2015						
CHECKED							
DATE							
DTR	JDH						
DATE	7/7/2015	SIZE D	SHEET 8 OF 11	IN/CH	2080/290.dwg	REV/ D	

REVISIONS			
DRT	REV	DESCRIPTION	DATE
SEE PAGE 1 FOR ECO CHANGES			



2015-01-07 2:24:30 PM f=0.90 C:\Users\Lindsey\Dropbox (SCANRECO)\SNA\Engineering\Customers\Elliott\E145\CAB-3011-13R3.sch (Sheet: 1/1)

SCANRECO CENTRAL UNIT INTERNAL OUTPUT SCHEMATIC

ENG	JDH	ELLIOTT EQUIPMENT COMPANY				TITLE: ELE SCHME190	
DATE	7/7/2015						
CHECKED							
DATE							
DTR	JDH						
DATE	7/7/2015	SIZE D	SHEET 10 OF 11	DWG#	2080290.dwg	REV/ D	

REVISIONS			
		REV	
DRT			DESCRIPTION
			SEE PAGE 1 FOR ECO CHANGES
			DATE
			ECO

FUNCTION	OUTPUT	CRCT
Boom Up	K3.7	1
Boom Down	K3.5	2
Boom Out	K1.5	3
Boom In	K1.7	4
Boom CCW	K1.3	5
BoomCW	K1.1	6
Winch Up	K3.3	20
Winch Down	K3.1	21
AUX Winch Up	K1.15	30
AUX Winch Down	K1.13	31
Spare -	K1.11	18
Spare +	K1.9	19

Switches	Engine Speed +	K6.2	8
	Engine Speed -	K4.6	9
	Truck Start	K6.9	11
	Truck Stop	K6.7	12
	E-Pump	K4.2	26
	Horn	K4.1	23
	Winch High	K6.4	22
	LMI Override	K6.1	16
	Tool Circuit	K6.3	24
	AUX Winch High	K6.6	32
	AUX Winch Disable	K4.4	33
	Spare (TLCT SW-)	K3.13	25

Signals	Power (+12VDC)	K7.1	10
	Ground	K7.2	15
	Emergency Stop	K4.5	13
	Enable Confirmation	K6.8	17
	Out Of Level	K4.3	28
	Hyd. Enable	K7.3	14
	IFSD Mode enable	K3.9	29

CAN	WP F-M12			
	CAN High	K8.1	A	4-BK
	CAN Low	K8.2	C	5-GY
	CAN Shield	K8.3	B	3-BU
	Power	K7.1		2-WH
	Ground	K7.2		1-BN

SCANRECO CENTRAL UNIT WIRE CODES

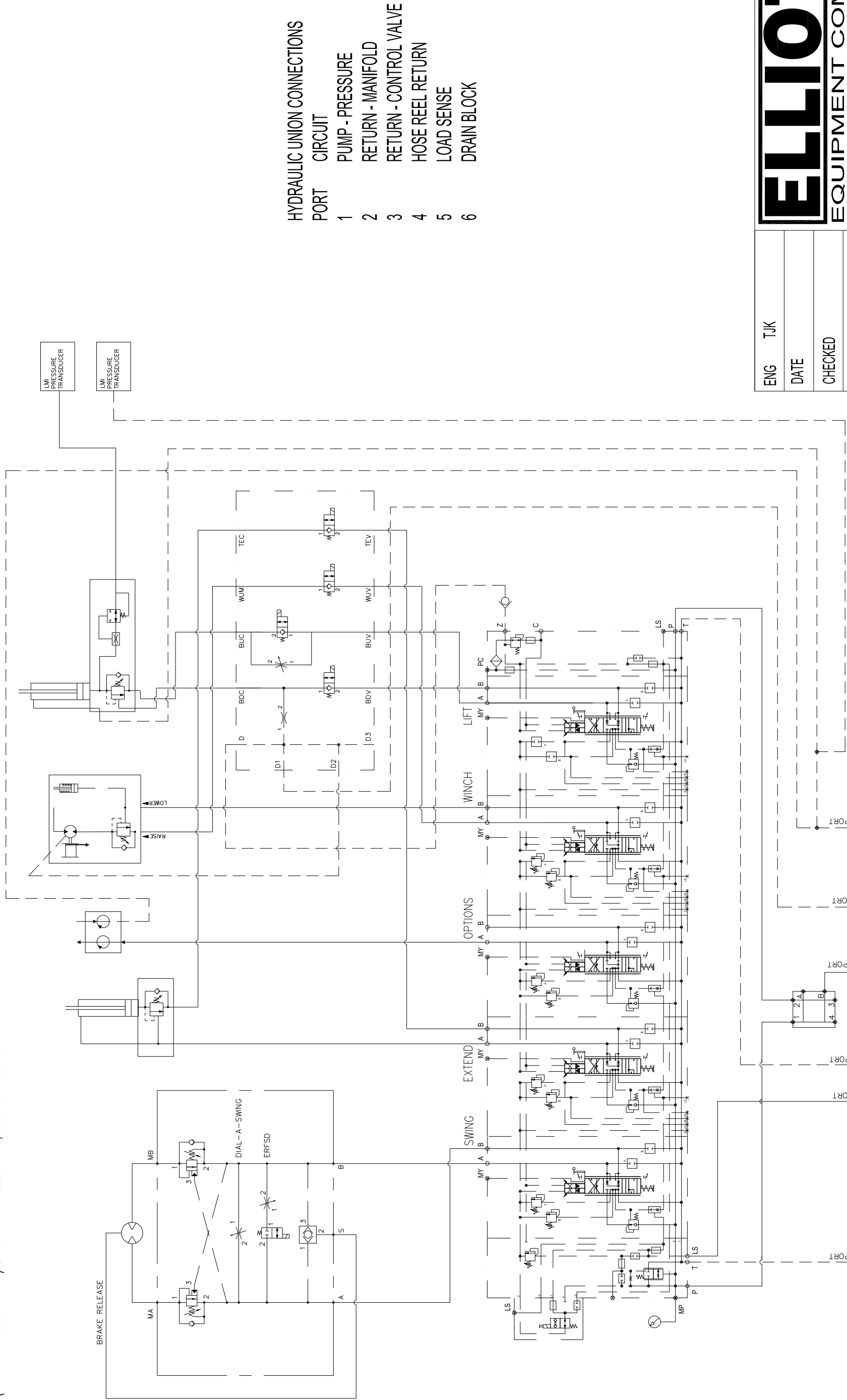
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DATE	7/7/2015		SIZE	D	SHEET	11 OF 11	DWG#	2080290.dwg
CHECKED								
DATE								
DTR	JDH							
DATE	7/7/2015							

PUMP SETTING

(OUTER ADJUSTMENT) STAND BY PRESSURE 450 PSI $\pm$ 50 PSI

(INNER ADJUSTMENT) SYSTEM PRESSURE 3,500 PSI $\pm$ 50 PSI

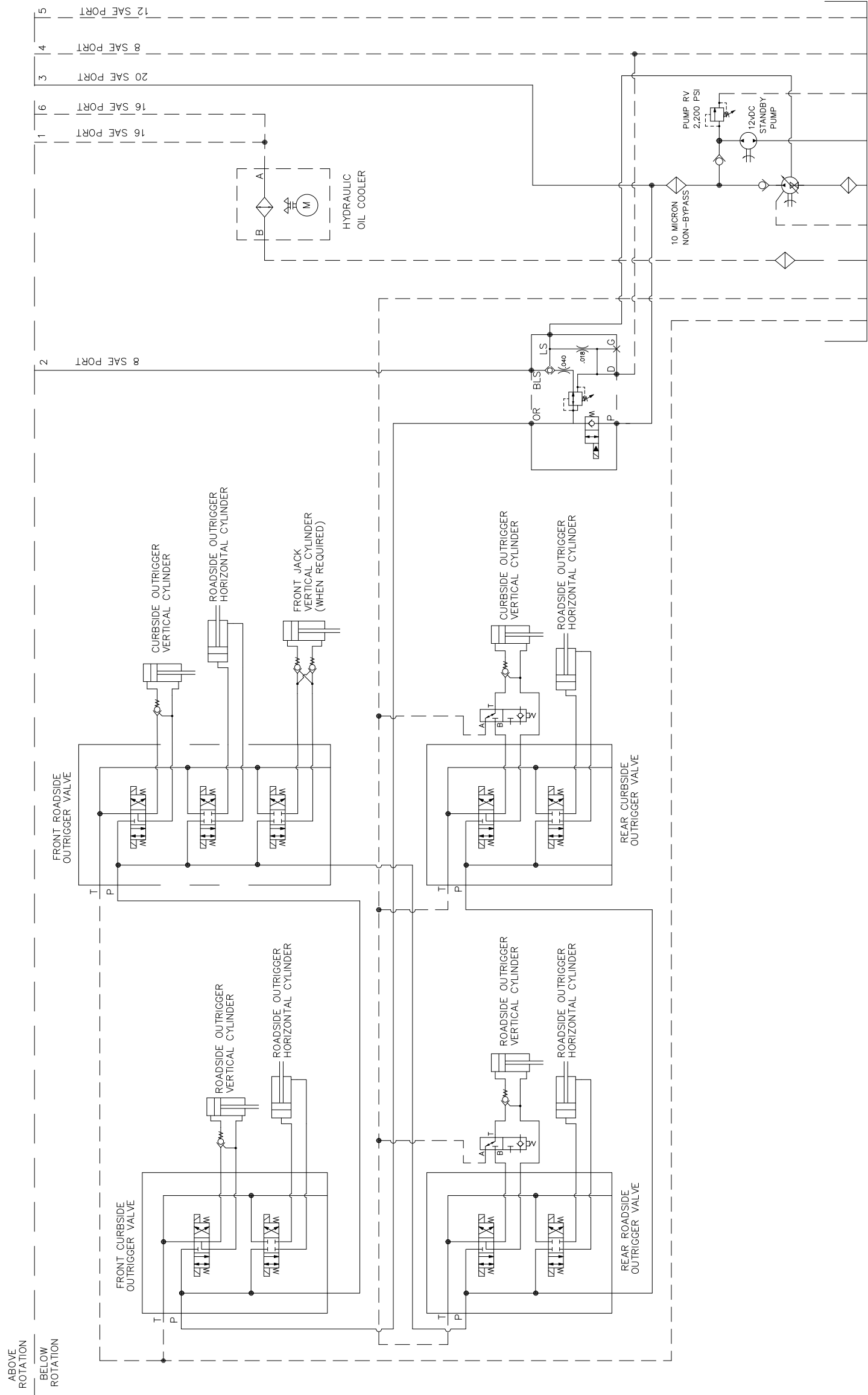
REVISIONS			
DRT	REV	DESCRIPTION	DATE
		SEE SHEET 1 FOR REVISIONS	ECO



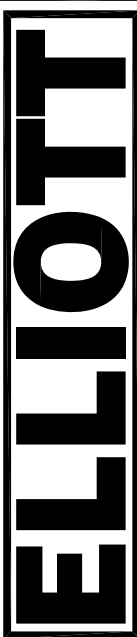
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DATE					
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DATE	3/30/15	SIZE B	SHEET 2 OF 4	DWG# 2080700.dwg	REV B

REVISIONS

DRT	REV	DESCRIPTION	DATE	ECO
TJK	A	UPDATE PUMP PRESSURE SETTING NOTES, REVISE ALL PAGES	7/13/15	11220
EF	B	HOSE 43 WAS 12, 46 WAS 35, 44 WAS 14, AND 45 WAS 36	09/17/15	11519



ENG	TJK
DATE	
CHECKED	
DATE	
DTR	TJK
DATE	3/30/15
SIZE	B
SHEET	1 OF 4
DWG#	2080700.dwg
REV	B



EQUIPMENT COMPANY	
TITLE: HYDRAULIC SCHEMATIC E190 CONTINUOUS	

PUMP SETTING
(OUTER ADJUSTMENT) STAND BY PRESSURE 450 PSI ± 50 PSI
(INNER ADJUSTMENT) SYSTEM PRESSURE 3,500 PSI ± 50 PSI

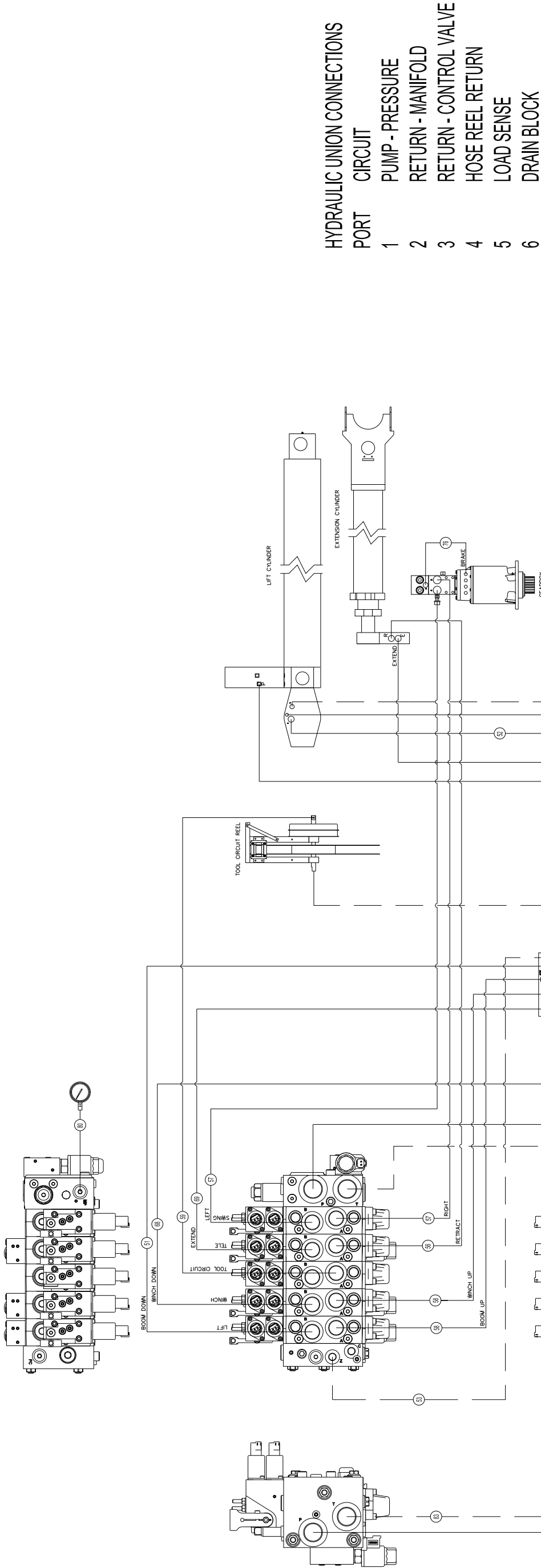
PUMP SETTING

(OUTER ADJUSTMENT) STAND BY PRESSURE 450 PSI ± 50 PSI

(INNER ADJUSTMENT) SYSTEM PRESSURE 3,500 PSI ± 50 PSI

REVISIONS

DRT	REV	DESCRIPTION	DATE	ECO
		SEE SHEET 1 FOR REVISIONS		



ENG	TJK
DATE	
CHECKED	
DATE	
DTR	TJK
DATE	3/30/15
SIZE	B
SHEET	3 OF 4
DWG#	2080700.dwg
REV	B

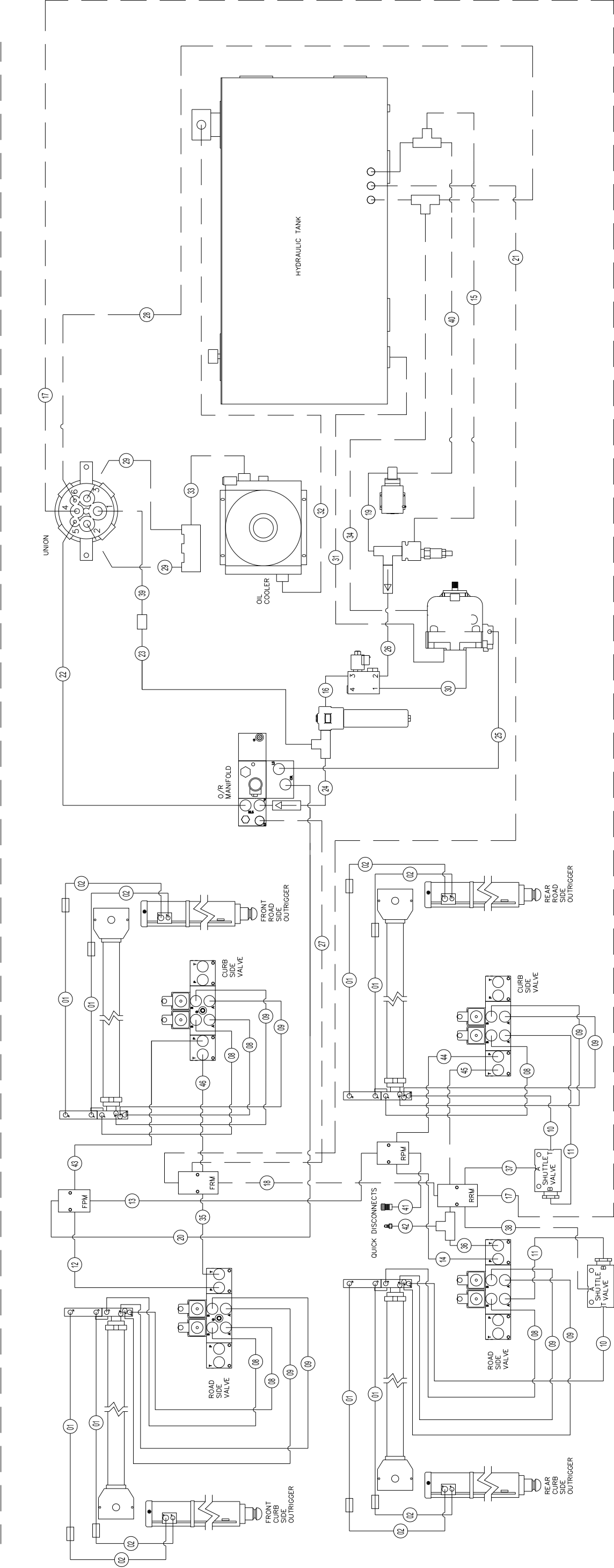
ELLIOTT
EQUIPMENT COMPANY
TITLE: HYDRAULIC SCHEMATIC E190
CONTINUOUS

PUMP SETTING

(OUTER ADJUSTMENT) STAND BY PRESSURE 450 PSI ± 50 PSI
(INNER ADJUSTMENT) SYSTEM PRESSURE 3,500 PSI ± 50 PSI

REVISIONS

DRT	REV	DESCRIPTION	DATE	ECO
		SEE SHEET 1 FOR REVISIONS		



HYDRAULIC UNION CONNECTIONS

PORT	CIRCUIT
1	PUMP - PRESSURE
2	RETURN - MANIFOLD
3	RETURN - CONTROL VALVE
4	HOSE REEL RETURN
5	LOAD SENSE
6	DRAIN BLOCK

ENG	TJK
DATE	
CHECKED	
DATE	
DTR	TJK
DATE	3/30/15
SIZE	B
SHEET	4 OF 4
DWG#	2080700.dwg
REV	B

ELLIOTT

EQUIPMENT COMPANY

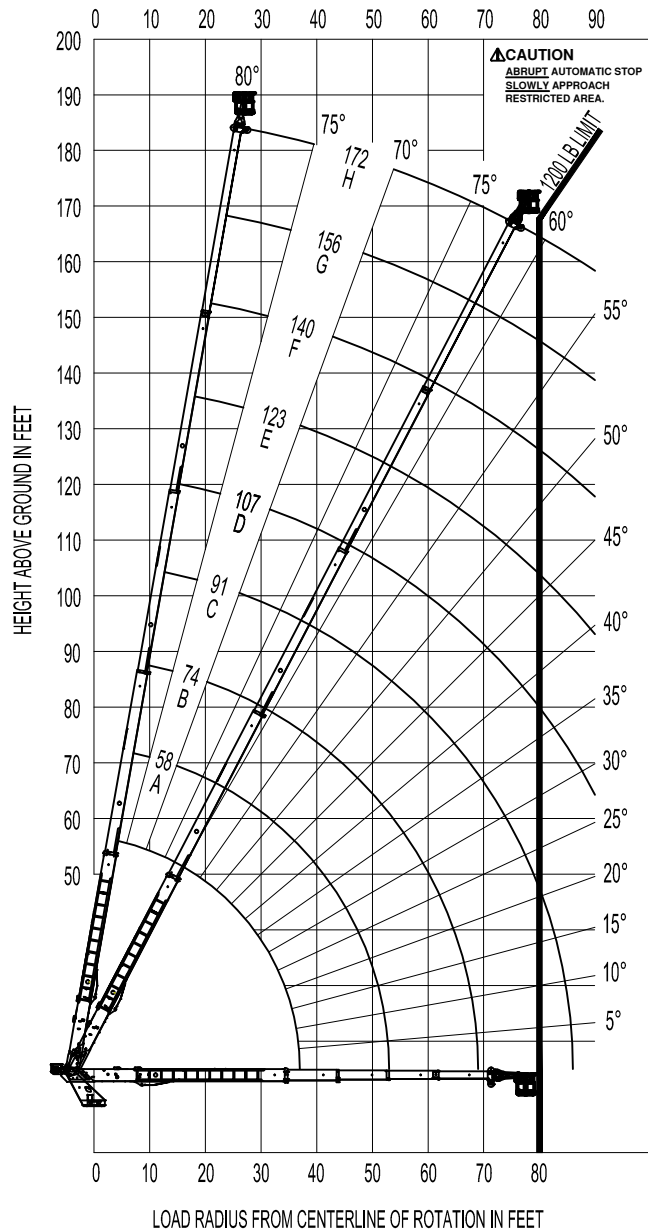
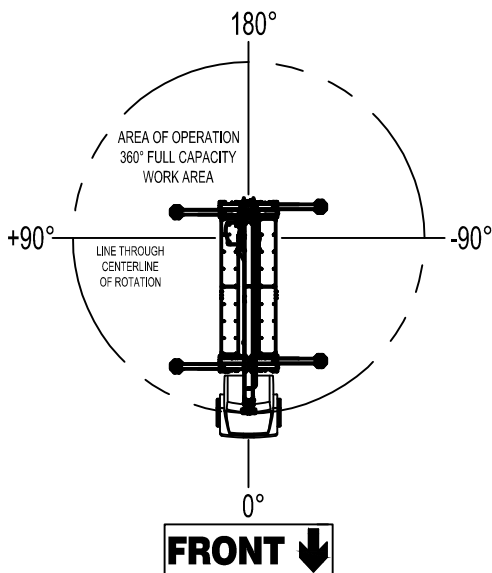
TITLE:HYDRAULIC SCHEMATIC E190
CONTINUOUS

BOOM RANGE DIAGRAM WITH PLATFORM ATTACHED TO MAIN BOOM

PLATFORM CAPACITY 1200 LBS MAX

PLATFORM LOAD	MAXIMUM RADIUS
1200 LBS	80 FT
600 LBS	90 FT

USE OUTRIGGERS
AT ALL TIMES



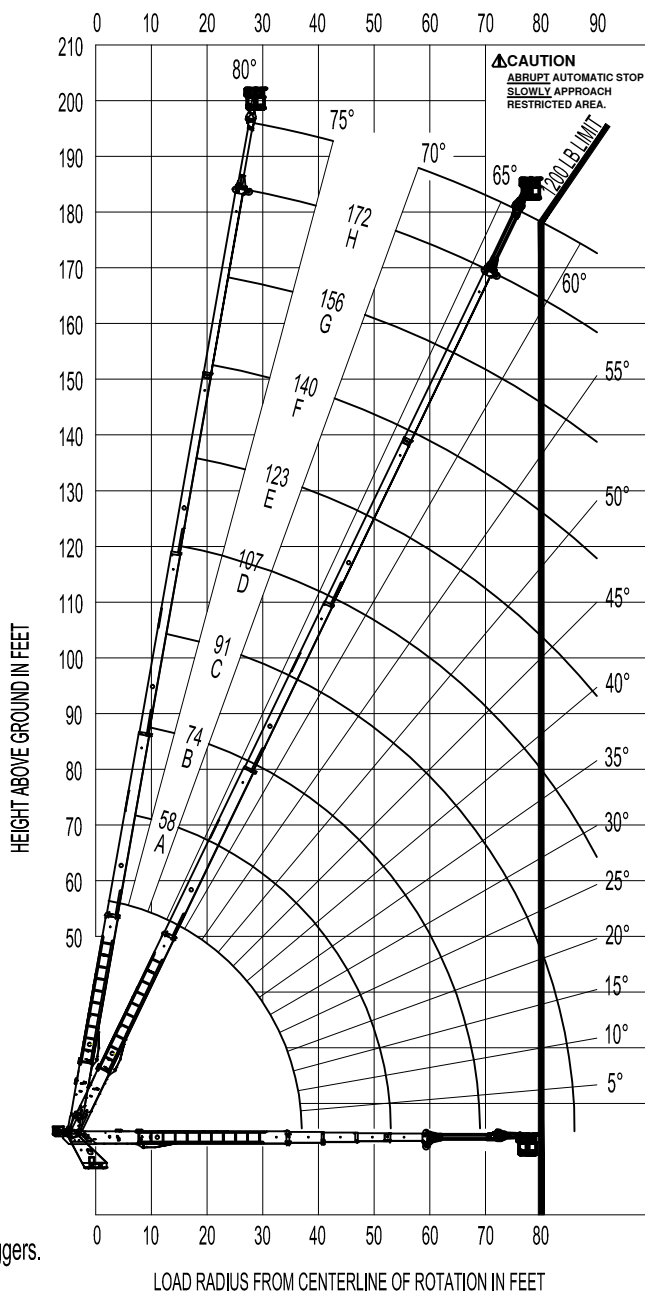
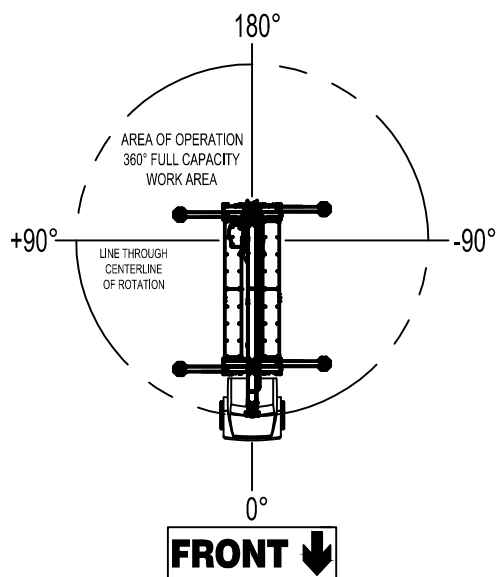
- NOTE:
1. Personnel handling is allowed only with full span outriggers.
 2. Boom load ratings are based on loaded boom radius.
Loaded boom angles are given as reference only.
 3. Radius is measured to the far platform railing.
 4. Refer to manual for wind considerations.

BOOM RANGE DIAGRAM WITH PLATFORM ATTACHED TO JIB

PLATFORM CAPACITY
1200 LBS MAX

PLATFORM LOAD	MAXIMUM RADIUS
1200 LBS	80 FT
600 LBS	90 FT

USE OUTRIGGERS
AT ALL TIMES



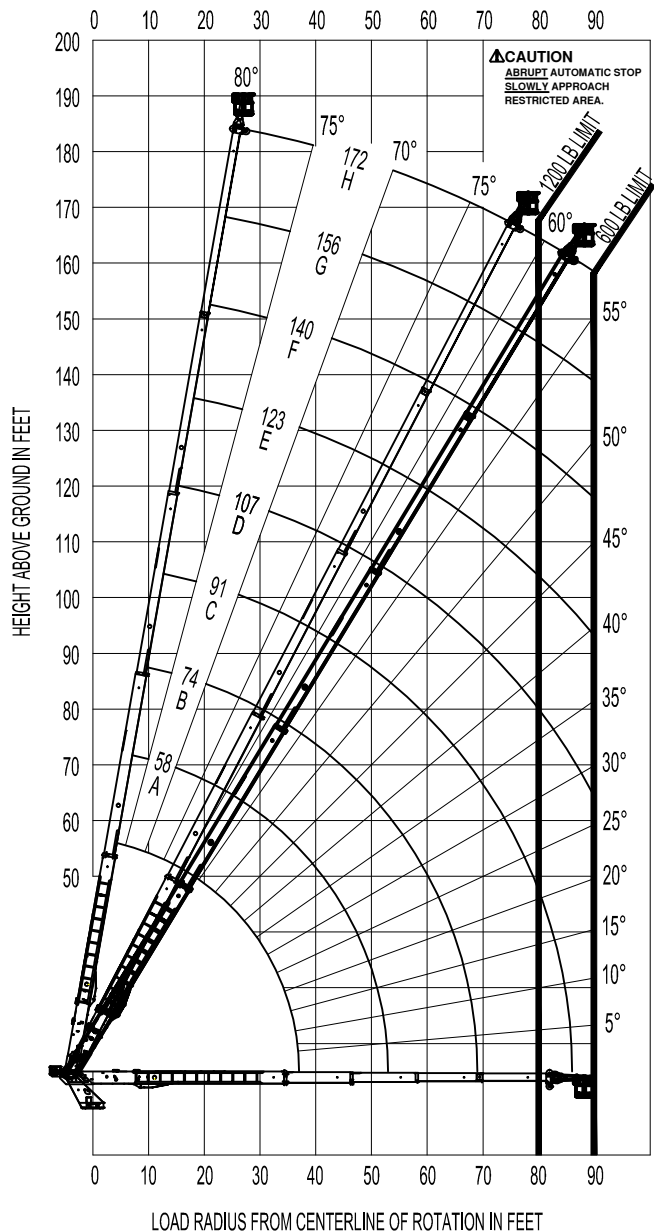
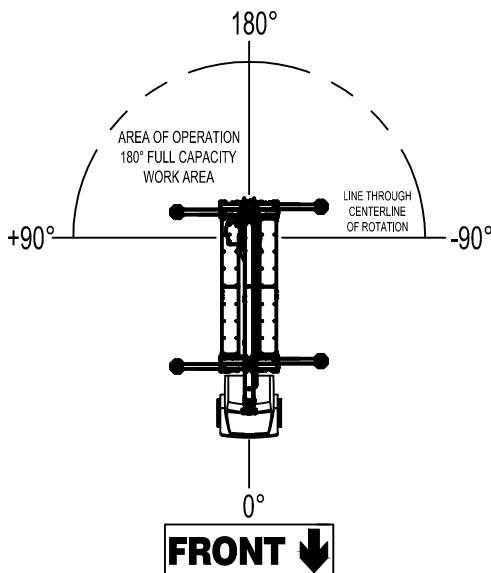
- NOTE:
1. Personnel handling is allowed only with full span outriggers.
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 3. Radius is measured to the far platform railing.
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BOOM RANGE DIAGRAM WITH PLATFORM ATTACHED TO MAIN BOOM

PLATFORM CAPACITY 1200 LBS MAX

PLATFORM LOAD	MAXIMUM RADIUS
1200 LBS	80 FT
600 LBS	90 FT

USE OUTRIGGERS
AT ALL TIMES



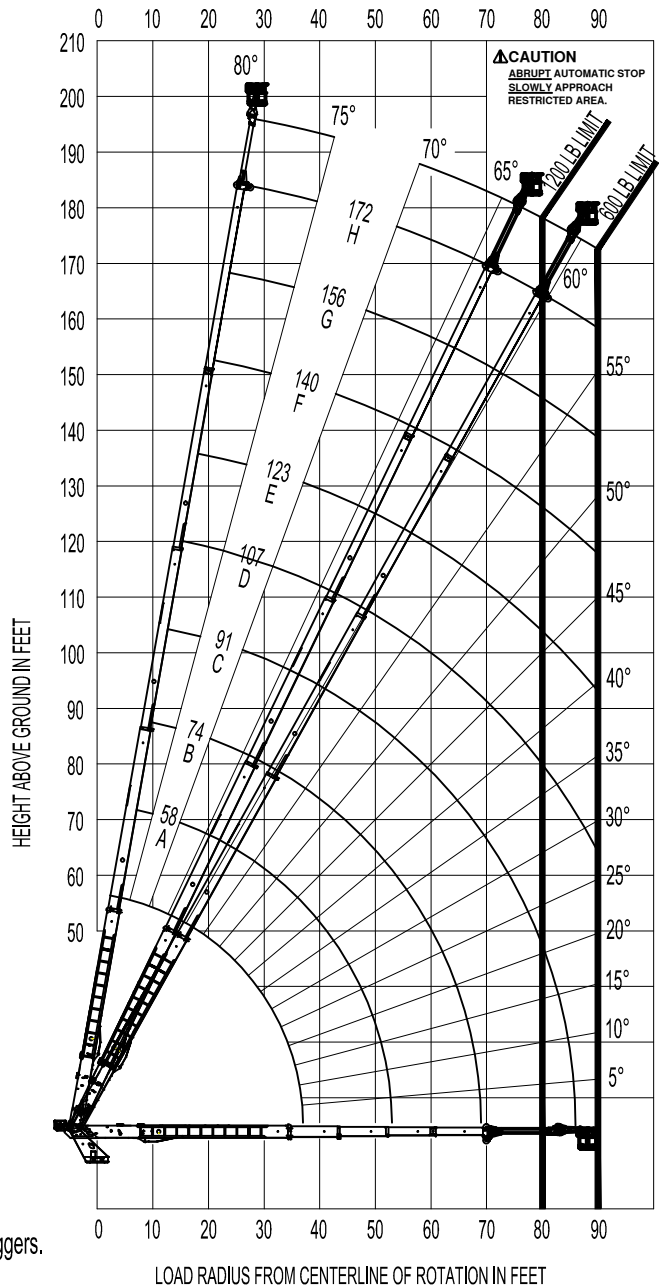
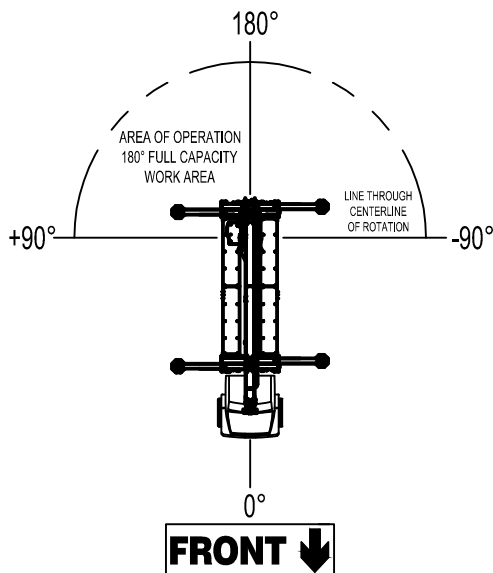
- NOTE:
1. Personnel handling is allowed only with full span outriggers.
 2. Boom load ratings are based on loaded boom radius.
Loaded boom angles are given as reference only.
 3. Radius is measured to the far platform railing.
 4. Refer to manual for wind considerations.

BOOM RANGE DIAGRAM WITH PLATFORM ATTACHED TO JIB

PLATFORM CAPACITY 1200 LBS MAX

PLATFORM LOAD	MAXIMUM RADIUS
1200 LBS	80 FT
600 LBS	90 FT

USE OUTRIGGERS
AT ALL TIMES



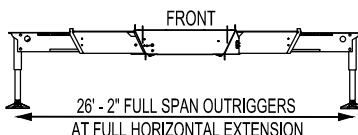
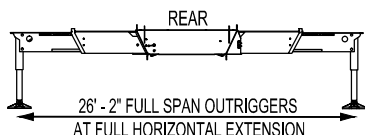
- NOTE:
1. Personnel handling is allowed only with full span outriggers.
 2. Boom load ratings are based on loaded boom radius.
Loaded boom angles are given as reference only.
 3. Radius is measured to the far platform railing.
 4. Refer to manual for wind considerations.

MAIN BOOM LOAD RATINGS WITH FULLY EXTENDED OUTRIGGERS

PLATFORM ATTACHED TO MAIN BOOM OR PLATFORM REMOVED AND JIB DEPLOYED

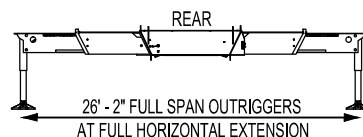
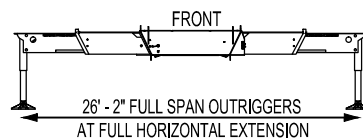
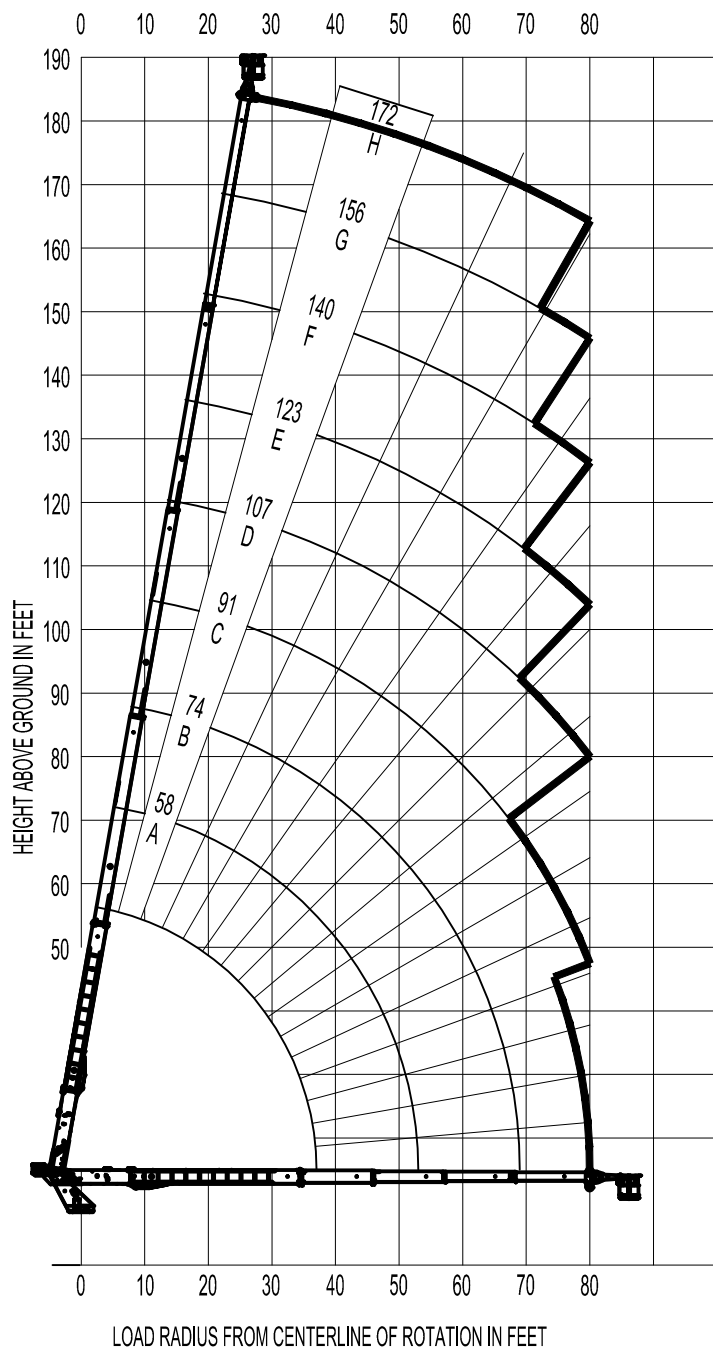
LOAD RATINGS IN lbs WITH OUTRIGGERS AND STABILIZERS EXTENDED

LOAD RADIUS (FT)	BOOM ANGLE (deg °)	42-ft	BOOM ANGLE (deg °)	A 58-ft	BOOM ANGLE (deg °)	B 74-ft	BOOM ANGLE (deg °)	C 91-ft	BOOM ANGLE (deg °)	D 107-ft	BOOM ANGLE (deg °)	E 123-ft	BOOM ANGLE (deg °)	F 140-ft	BOOM ANGLE (deg °)	G 156-ft	BOOM ANGLE (deg °)	H 172-ft
6	77.5	30,000																
8	75.0	30,000																
10	72.6	30,000	78.7	28,400														
15	65.7	27,300	73.6	24,600	77.6	21,900	79.1	18,600										
20	57.7	21,100	68.3	20,300	73.6	19,600	76.2	16,400	79.4	13,400								
25	48.6	16,100	62.9	15,400	69.5	14,800	73.2	14,200	77.0	11,400	78.4	9,900	80.0	6,400	81.1	5,400		
30	37.7	12,400	57.2	12,000	65.2	11,700	70.1	11,400	74.1	8,400	76.0	6,700	78.0	4,400	79.3	4,300		
35	22.7	9,400	50.9	8,900	60.7	8,500	66.7	8,100	71.0	6,200	73.8	4,300	76.0	4,300	77.8	4,300	79.6	4,200
40			44.0	5,800	56.1	5,300	63.1	4,750	68.3	4,200	71.5	4,200	73.9	4,200	76.1	4,200	77.9	4,100
45			35.9	5,800	51.1	5,250	59.4	4,600	65.4	4,100	69.2	4,100	71.9	4,100	74.4	4,100	76.5	4,050
50			25.5	5,100	45.8	4,750	55.5	4,300	62.4	4,000	66.7	4,000	69.9	4,000	72.6	4,000	74.9	3,900
55					39.9	4,300	51.6	4,100	59.4	3,900	64.0	3,900	67.8	3,900	70.9	3,900	73.3	3,750
60					33.0	4,200	47.5	4,000	56.2	3,850	61.3	3,850	65.6	3,850	69.0	3,850	71.7	3,600
65					24.5	3,600	43.2	3,500	52.7	3,550	58.1	3,500	63.4	3,500	67.2	3,450	70.1	3,450
70							38.2	2,500	49.1	2,500	55.6	2,500	61.1	2,500	65.1	2,500	68.4	2,500
75							32.6	2,150	45.2	2,150	53.0	2,150	58.6	2,150	63.1	2,150	66.6	1,550
80							25.7	600	41.0	600	49.7	600	56.1	600	60.9	600	64.6	600
	0	8,700	0	5,000	0	2,900												
	600		600		600		600		600		600		600		ADDITIONAL CAPACITY WHEN PLATFORM IS DETACHED (lbs) - JIB STOWED OR REMOVED			
	1,500		1,500		1,500		1,500		1,500		1,500		1,500		DEDUCT FROM CAPACITY WHEN PLATFORM ATTACHED TO DEPLOYED JIB			



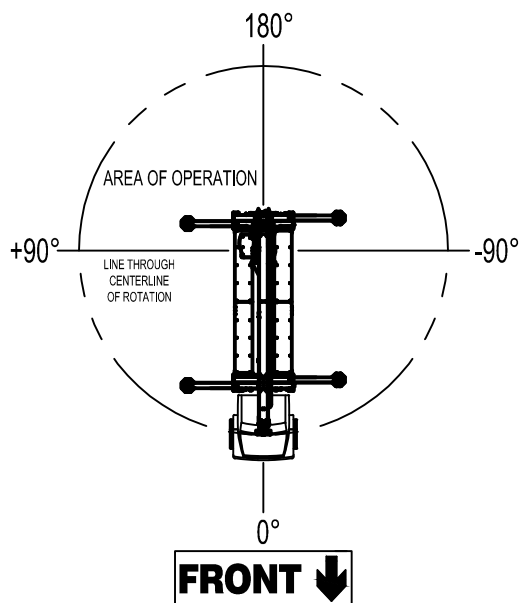
ELLIOTT EQUIPMENT CO. SUPPLIED
LOADLINE EQUIPMENT DEDUCTIONS:
SEE WEIGHT TAG ON TACKLE AND
DEDUCT APPROPRIATE WEIGHT FOR
DOWNHAUL WEIGHT AND SHEAVE
BLOCK.
RADIUS IS MEASURED FROM
CENTERLINE OF ROTATION TO LOAD
LINE.

RANGE DIAGRAM WITH FULLY EXTENDED OUTRIGGERS

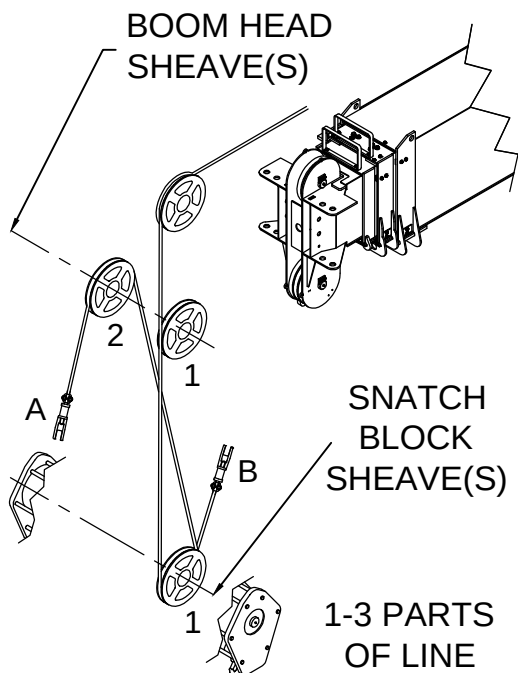


NOTE:

1. Boom load ratings are based on loaded boom radius.
Loaded boom angles are given as reference only.
2. Personnel handling is allowed only with full span outriggers.
3. Radius is measured from center of rotation to load line.



PARTS OF LINE



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, WITH THE PROPER BREAKING STRENGTH LISTED.
- ANTI-TWO-BLOCK SYSTEM MUST BE IN GOOD OPERATING CONDITION BEFORE LIFTING MATERIAL. SEE OPERATION & SAFETY MANUAL.

PARTS OF LINE	SHEAVE(S) ON BOOM HEAD	SHEAVE(S) ON SNATCH BLOCK	5/8" - SYNTHETIC ROPE 50,000-lbs. BREAKING STRENGTH
1	1	A	10,000 lbs
2	1 B	1	20,000 lbs
3	12	1A	30,000 lbs

A-DEAD END FOR ODD PARTS OF LINE
B-DEAD END FOR EVEN PARTS OF LINE

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

- 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 aerial device 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 or 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 aerial device 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

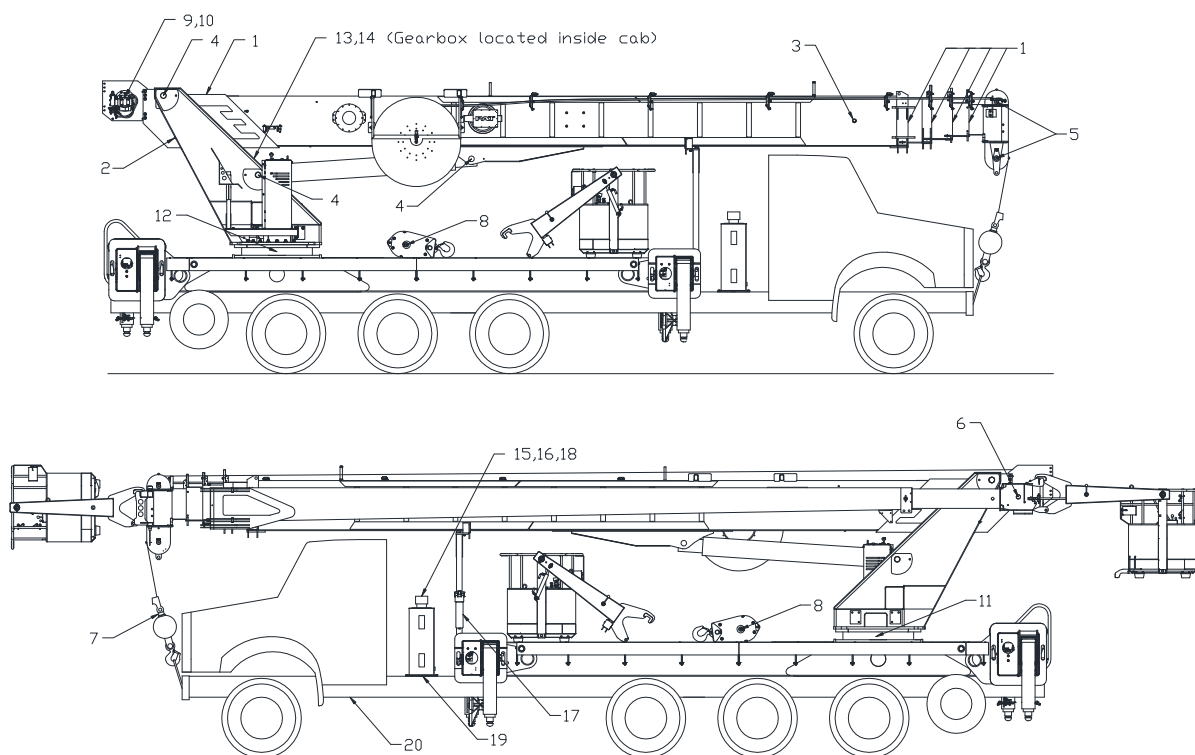
Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0076	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15

The long life of an aerial device'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-0077	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/26/15



	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(Snatch Block)	Grease	Gun	Weekly	
9	Winch Brake	SAE 20W-20 Motor Oil	Check Level	Monthly	5
10	Winch Gearbox	SAE 90 EP Gear Lube	Check Level	Monthly	5
11	Swing Bearing Grease Fitting	Grease	Gun	Monthly	6
12	Swing Bearing Gear Teeth	Grease	Gun/Brush	Monthly	7
13	Swing Gearbox Pinion Bearing	Grease	Gun	Monthly	8
14	Swing Reducer Gearbox	SAE 90 EP Gear Lube	Check Level	Semi-annually	8
15	Hydraulic Oil Tank Fill	See Notes	Check Level	Daily	9
16	Hydraulic Oil Filter - Return			Daily	10
17	Hydraulic Oil Filter - Pressure				
18	Hydraulic Tank Breather			Semi-annually	
19	Suction Strainer			At Oil Change	
20	Pump Drive U-Joint or	Grease			
	Pump Drive Spling Shaft	Coupling Lube	Remove Pump		
		Spline Lubricant	and apply to		
			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.



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.



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 or 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 aerial device 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-0006	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15

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	Grade	UNF Size	TPI	Grade	Grade
		5 ft-lb.	8 ft-lb.			5 ft-lb.	8 ft-lb.
1/4	20	8	12	1/4	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

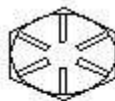
* Tolerance on Torque Values +/- 10%

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

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 aerial device 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 new, clean hydraulic oil.
- L.** Make sure the suction line shut off valve is open before starting the engine.
- 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.

Changing Hydraulic Oil



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0078	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

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

- A.** Extend outriggers and stabilizers and level the aerial device 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 aerial device 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 aerial device is level according to the carpenter's level.
- F.** Repeat this procedure until the aerial device 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.

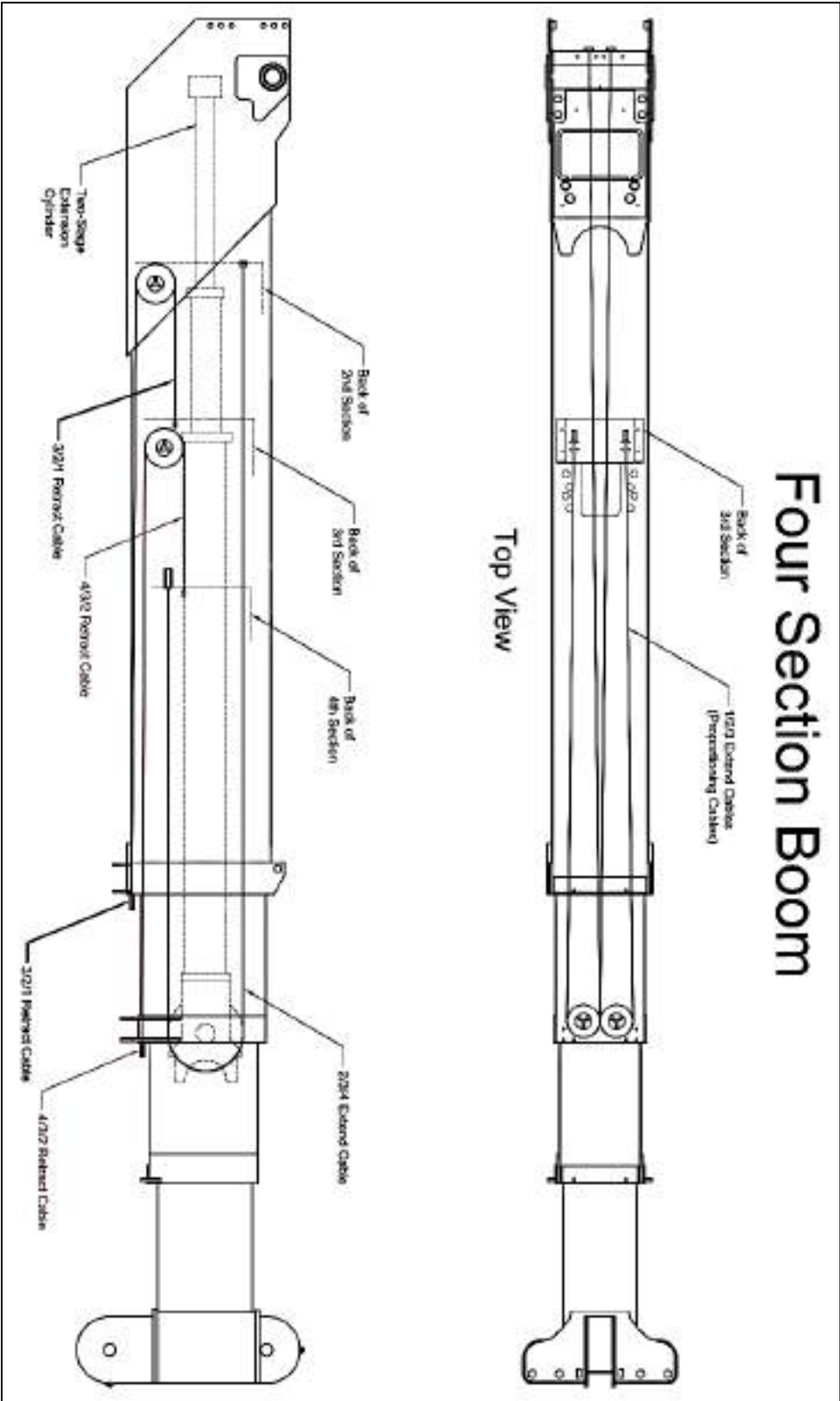
Bubble Level Adjustment



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0079	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/12/15

Four Section Boom Operation



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 is 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

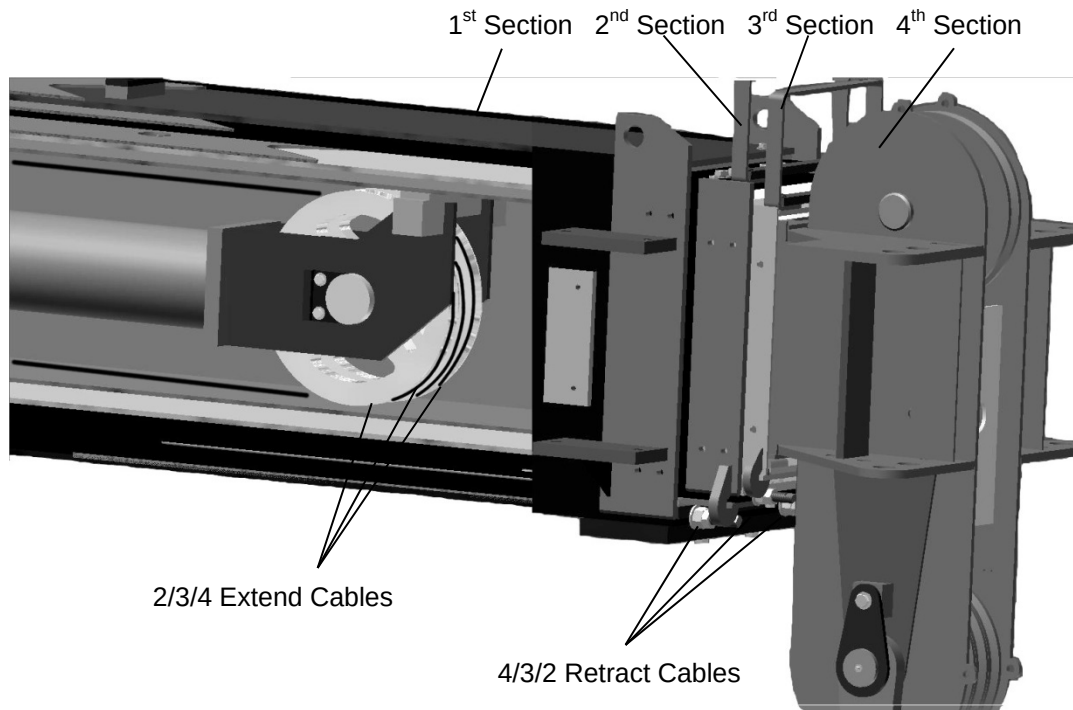
NOTE: Observation through the sheave case for the extend sheaves and the winch mount for retract sheaves will visually determine the amount of grease necessary for proper lubrication. A slight amount of grease extrusion around the pin joint is adequate for proper lubrication.

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 torquing. If the boom sections do not bottom out as specified (boom is out of sequence), adjust cables to achieve proper section positioning. After proper section position has been established, a scribe mark on all the sections at the boom tip end to identify proper sections at the boom tip end to identify proper section position relative to each other may be helpful during the tensioning process.
- 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 torquing 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 aerial device 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

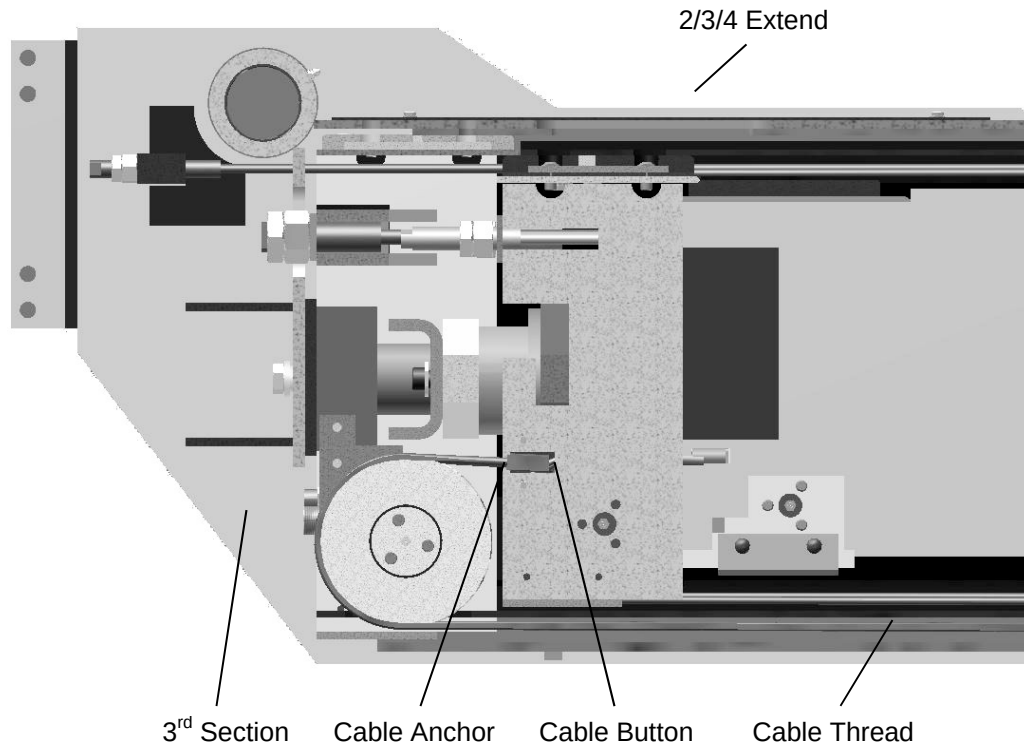
- A.** Clean all boom sections and inspect for wear, dents, bent or crooked boom sections, gouged metal, broken welds or any abnormal conditions. Repair or replace as required.
- B.** Inspect all sheaves for excessive groove wear or abnormal rim wear. Replace as required.
- C.** Inspect all sheave bearings 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 torquing cables. Refer to the "Four Section Cable Tensioning" section to properly torque the cables in the extend system. Cables must be torqued to proper specifications for proper boom operation.
- XX.** Install winch and anti-two block system

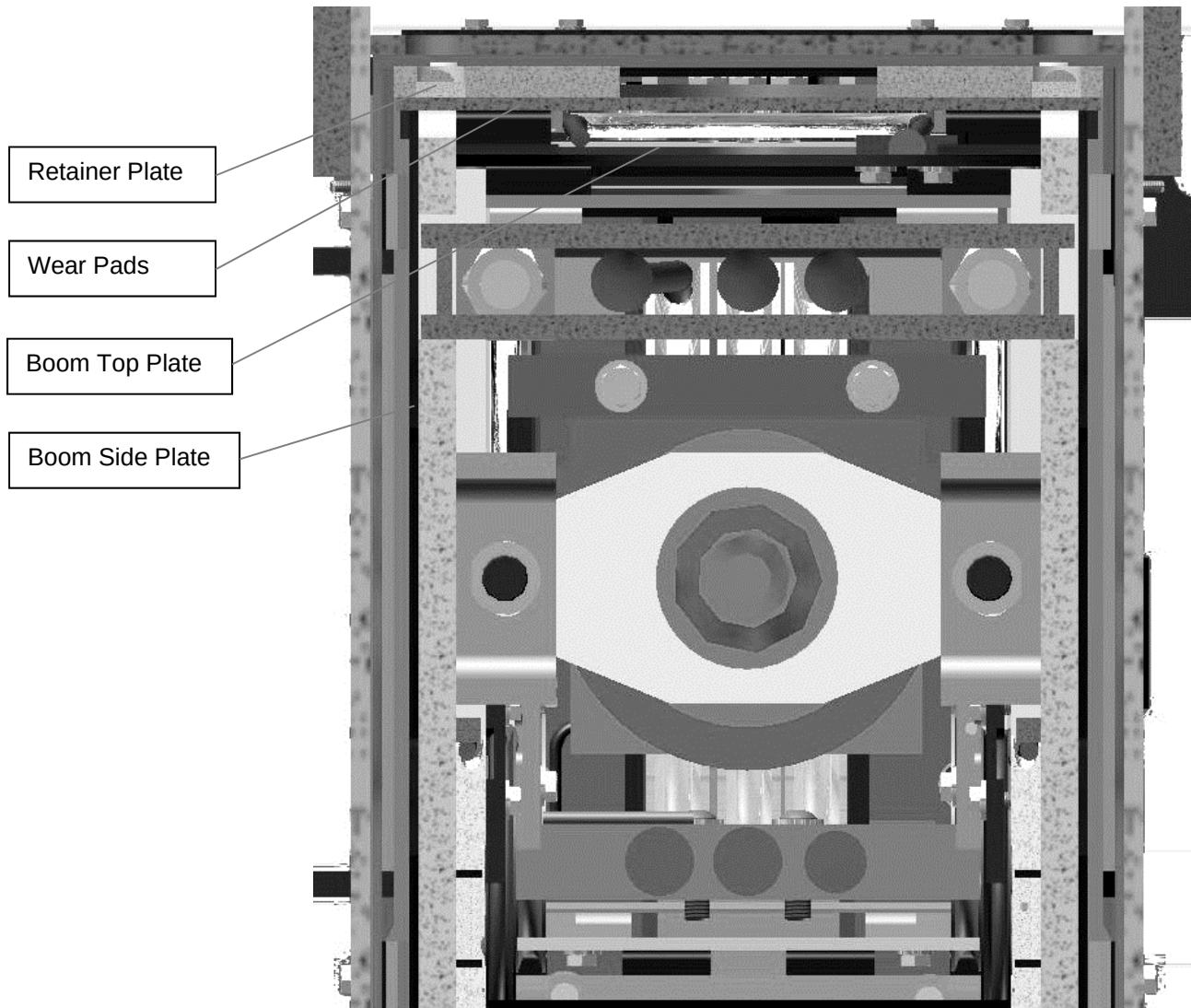
Top Wear Pad Adjustment

- 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.

Four Section Boom Operation



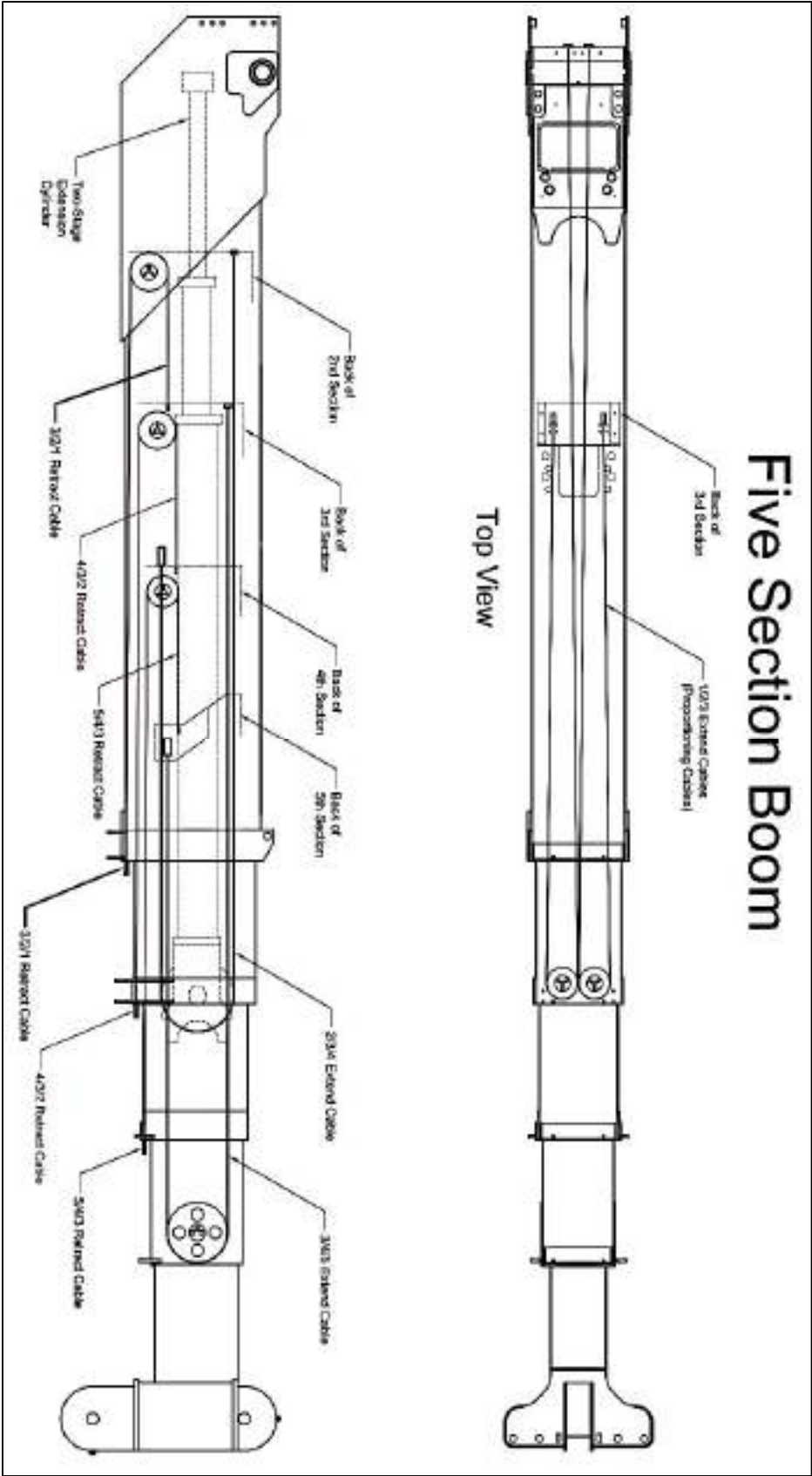
- Using an appropriate lifting device, sling around the 4th and 5th depending on configuration section boom and lift it up until weight is removed from the bottom pads in the front of the interior sections.
- Loosen and remove the capscrews holding the pad doubler plates in the front of the sections. 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.

Four Section Boom Operation



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0081	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



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 (Mid) Section. Primary function of these cables is to retract the 3rd (Mid) 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 (Mid) Section and Connects to Back of 4th (Next to Tip) Section. Primary function of these cables is to retract the 4th (Next to Tip) Section.

5/4/3 Retract Cable (Qty 2): Connects to the front of the 3rd (Mid) section and passes over sheave at back of 4th (Next to Tip) Section and Connects to Back of 5th (Tip) Section. Primary function of these cables is to retract the 5th (Tip) Section.

3/4/5 Extend Cable (Qty 2): Connects to the back of the 3rd (Mid) section and passes over sheave at front of 4th (Next to Tip) Section and Connects to Back of 5th (Tip) Section. Primary function of these cables is to extend the 5th (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 (Next to Tip) Section. Primary function of these cables is to extend the 4th (Next to 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 (Mid) Section. Primary function of these cables is 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 (Mid) Sections. Primary Function of the cylinder is to extend & retract the sections 1, 2 & 3 (Main, Next to Large, & Mid).

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

Boom Removal

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

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

Five Section Boom Maintenance

NOTE: 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, 3rd

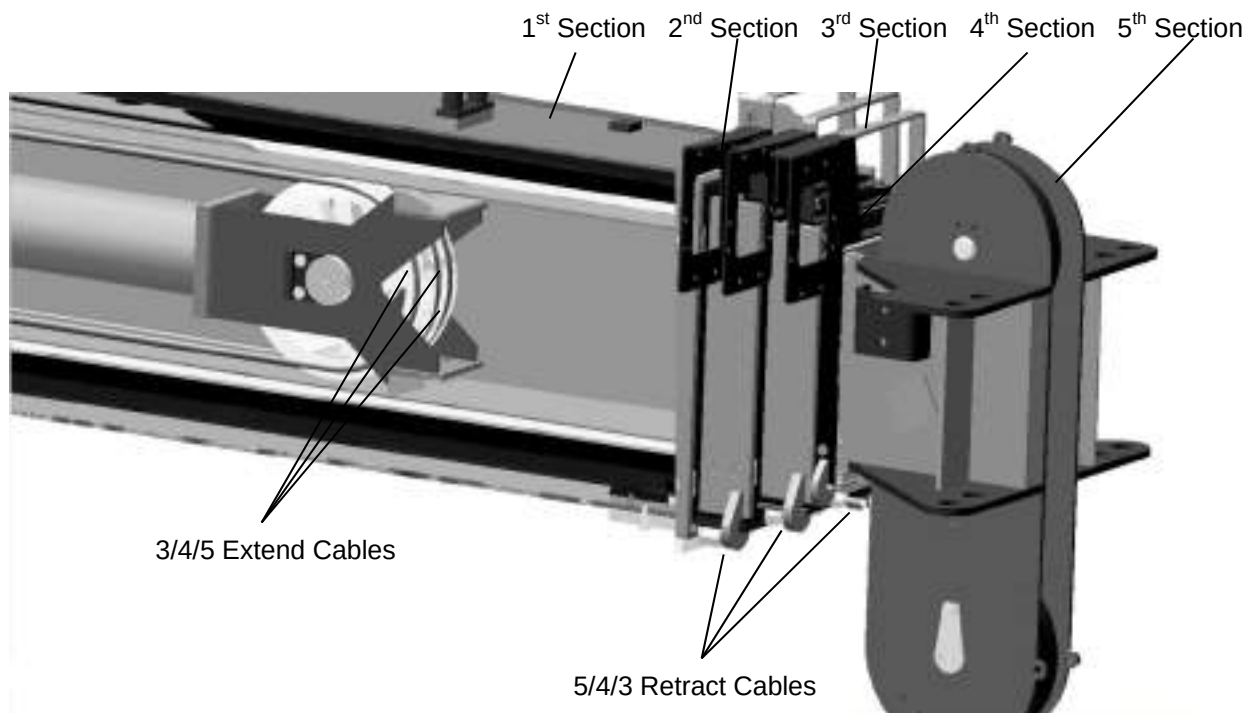
and 4th section and the extend cable sheave attached to the bottom of the top plate of the 2nd section at the sheave case end of the boom, are accomplished with the boom in its fully retracted position. A grease zerk is located on each lubrication end.

Five Section Cable Tensioning

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

- A.** Cycle boom approximately 8 ft (243cm) out and in a few times (2 feet (60cm) per section).
- B.** Fully retract boom. At full retraction the base of the 2nd boom bottoms out in the base of the 1st section boom, the base of the 3rd section bottoms out in the base of the 2nd bottom, the base of the 4th section boom bottoms out in the base of the 3rd section boom and the base of the 5th section boom bottoms out in the base of the 4th section boom. Marks should be scribed on the side plates along the front edge of each upper wear pad indicating where each section bottoms out. This will aid the mechanic during the cable tensioning procedure. When the cables are torqued (tensioned) properly, the boom sections should extend/retract proportionally and bottom out at the same time during retract.
- C.** Tighten the 5/4/3 retract, 3/4/5 extend, 4/3/2 retract, 2/3/4 extend, 3/2/1 retract and 1/2/3 extend cables (in order listed) to remove slack from the cables and to achieve proper sequencing of bottoming out base of booms. To reach the 3/4/5 extend cables boom must be extended out approximately 18 inches (45cm), 4.50 inches (11.43cm) per stage and tightened through openings in the 1st and 2nd section booms.

Five Section Boom Operation



- D. Torque the 5/4/3 retract cables to ft-lb (8.13 N.m) each. Use the flats at the front of the cable ends to keep the cables from rotating while torqueing. These cables are located at the bottom tip of the 3rd section boom.
- E. Torque the 3/4/5 extend cables to 15 ft-lb (20.37 N.m) each. These cables are located at the top base of the 3rd stage boom. (**Reference Step C for access to the 3/4/5 extend cables.**)
- F. Torque the 4/3/2 retract cables to 7 ft-lb (9.5 N.m). Use the flats at the front of the cable ends to keep the cables from rotating while torqueing. These cables are located at the bottom tip of the 2nd section boom.
- G. Torque the 2/3/4 extend cables to 20 ft-lb (27 N.m) each. These cables are located at the top base of the 2nd section boom. (Reference **step C** for access to the 2/3/4 extend cables).
- H. Torque the 3/2/1 retract cables to the 9ft-lb (12 N.m). Use the flats at the front of the cable ends to keep the cables from rotating while torqueing. These cables are located at the bottom tip of the 1st section boom.

- I. Torque the 1/2/3 extend cables to 7 ft-lb (9.5 N.m) each. These cables are located at the top of the 1st section boom winch bar.
- J. Check to ensure that boom sections are all bottoming out simultaneously as in Step 2. If not, proceed as follows:
 - 1. If the second section is bottoming out first, equally loosen the 1/2/3 extend cables and tighten the 3/2/1 retract cables. This will cause the second section boom to bottom out later but will also cause the 3rd, 4th and 5th sections to bottom out sooner.
 - 2. If the 3rd section is bottoming out first, equally loosen the 3/2/1 retract cables and tighten the 1/2/3 extend cables. This will cause the 3rd, 4th and 5th sections to bottom later and the 2nd section boom to bottom sooner.
 - 3. If the 4th section is bottoming out first, equally loosen the 4/3/2 retract cables and tighten 2/3/4 extend cables. This will cause the 4th and 5th sections to bottom out later and the 2nd and 3rd sections to bottom out sooner.
 - 4. If the 5th section is bottoming out first, equally loosen the 5/4/3 retract cables and tighten the 3/4/5 extend cables. This will cause the 5th section to bottom out later and the 2nd, 3rd and 4th sections to bottom out sooner.
- K. Cycle the boom a few feet out and in. Check to ensure that all sections are bottoming out simultaneously. **Repeat step J as required.**
- L. Repeat Steps 4 through 9. Torque the 5/4/3 retract cables to 12 ft-lb (16.26 N.m). Torque the 3/4/5 extend cables to 30 ft-lb (40 N.m). Torque the 4/3/2 retract cables to 14 ft-lb (19 N.m). Torque the 2/3/4 extend cables to 45 ft-lb (61 N.m). Torque the 3/2/1 retract cables to 18 ft-lb (24 N.m) Torque the 1/2/3 extend cables to 14 ft-lb (19 N.m).
- M. Cycle boom fully, check that all cables are torqued properly and that all sections are bottoming out simultaneously. **Repeat Step J as required** then add locknuts to all cables. Each threaded cable end must have two nuts locked together.

Five Section Boom Disassembly

For reference, front is sheave case end, rear (base) is winch mount end, left and right are viewed from rear to front.

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

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

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

- I. Remove lower L-pads, retract cables and retract cable retaining capscrews from rear of 2nd section. Remove retract cable retaining plates from the rear of the 3rd section. Remove 3/2/1 retract cables from anchor pocket in 3rd section.
- J. Remove retaining capscrews from cylinder anchor channels in the rear of the 2nd section. Remove upper top wear pads and cam plates from upper rear of the 3rd section.
- K. Remove cable guide and upper spacer bar/cable retainers from the front top of the 2nd section. Attach a sling or chain to the tip of the 3rd section boom and pull the 3rd-4th-5th assembly out of the 2nd approximately 12 inches (30cm). Suspend the 3rd section off of the lower wear pads.
- L. Remove capscrews retaining 1/2/3 extend sheaves to the top plate of the 2nd section, this will allow the sheaves, pins and extend cables to lie on the top plate of the 3rd section.
- M. Remove 4 capscrews which retain the lower front pad plate to the 2nd section. Remove pad plate. Remove and tag four side wear pads with shims from front of 2nd section. Pull the retract cables out and keep retract cables taut while pulling the 3rd-4th-5th assembly out of the 2nd section. Support the base end of the 3rd as it exits the 2nd section boom.
- N. Place 3rd-4th-5th assembly on a suitable horizontal surface. Take care not to damage the retract cables while lifting or supporting the 3rd-4th-5th assembly. Remove 1/2/3 extend cables from the top of the 3rd section by removing the anchor plates and capscrews at the rear of the section, place cables in an area to avoid damage.
- O. Remove lower L-pads, retract cables and retract cable retaining capscrews from rear of 3rd section. Remove retract cable retaining plates from the rear of the 4th section. Remove 4/3/2 retract cables from the anchor pocket in the 4th section.
- P. Remove lock bar and hardware from extend cylinder collar anchor pocket in the 3rd section. Lifting the butt plate end of the cylinder up will disengage the cylinder from its anchor pockets in the 3rd section. Slowly pull cylinder out of the 3/4/5 assembly. Keep 2/3/4 extend cables taut and in position to avoid damage as cylinder exits

boom assembly. Remove 2/3/4 extend cable anchor in the 4th section as the end of the cylinder nears the anchor position.

- Q.** Place cylinder assembly on suitable horizontal surface. Take care not to damage the extend cables while lifting or supporting the cylinder assembly. The cables can be disassembled from the cylinder at this time by removing the tapered wear pads on the front of the cylinder assembly and routing the cables through the access opening made by removing the pad. After tapered pads are removed use caution as the sheave pin and sheaves can move forward from the lock position into the assembly position, allowing pin and sheaves
- R.** Remove cable guide and upper spacer bar from the front top of the 3rd section. Loosen and remove hex nuts from threaded ends of 5/4/3 extend cables at rear of 3rd section. Remove top rear wear pads and cam plates from top of 4th section.
- S.** Attach a sling or chain to front of the 4th section boom and pull the 4th-5th assembly out of the 3rd approximately 12 inches (30cm). Suspend the 4th section off of the lower wear pads.
- T.** Remove 4 capscrews which retain the lower front pad plate to the 3rd section. Remove pad plate. Remove and tag four side wear pads with shims from the front of the 3rd section. Pull the retract cables out and keep retract cables taut while pulling the 4th-5th assembly out of the 3rd section. Support the base end of the 4th as it exits the 3rd section boom.
- U.** Place 4th-5th assembly on a suitable horizontal surface. Take care not to damage the retract cables while lifting or supporting the 4/5 assembly.
- V.** Remove lower L-pads, retract cables and retract cable keeper from rear of 4th section, coil 5/4/3 retract cables inside of 5th section. Remove upper top wear pads and cam plates from upper rear of 5th section.
- W.** Remove cable guide and upper spacer bar from the front of the 4th section. Remove side wear/cable retainer pads from front of 4th section, leave 3/4/5 extend sheaves and 3/4/5 extend cables in place.
- X.** Attach sling or chain to the front of the 5th section boom and pull the 5th section out of the 4th until there is approximately 36 inches (90cm) of the 5th still inserted in the

4th, use caution to keep 3/4/5 extend cables from damage as boom sections slide apart, if possible keep tension on 3/4/5 extend cables from the base end of the 4th boom section during this procedure.

- Y.** Lift 5th section off the lower pads and remove pads and hardware. Remove 3/4/5 extend sheaves and hardware.
- Z.** Slide 5th section completely out of 4th. Support the base end of the 5th as it exits the 4th section boom. Place 5th section boom on a suitable horizontal surface.
- AA.** Remove cable retainers and hardware from side anchor locations on the 5th section. Remove 3/4/5 extend and 5/4/3 retract cables from anchor points in the side of the 5th section, place in suitable area to avoid damage.
- BB.** Remove loadline sheaves by removing retainers and lightly tapping on sheave pin while removing sheaves and spacers until All sheaves are removed from boom sheave case.

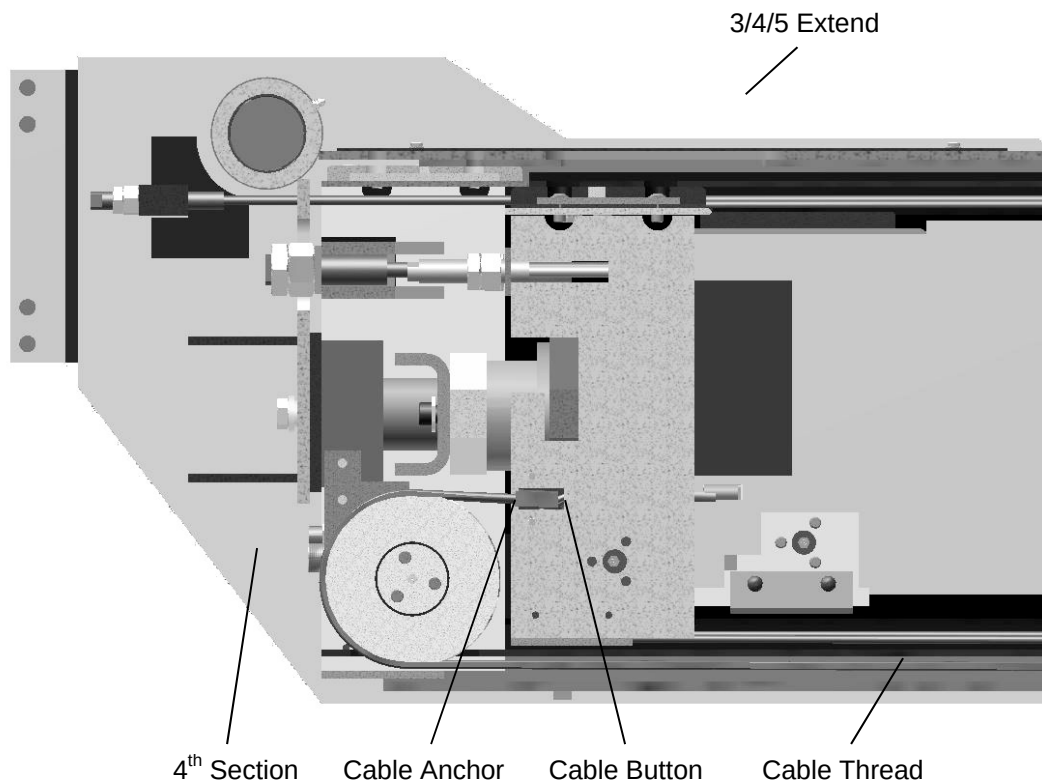
Additional Maintenance, Disassembled Boom

- 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 (.38mm) larger than pin diameter, bearing must be replaced. Any cut or gouge which causes the bearing liner to lose strands is cause for bearing replacement.
- 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.

Five Section Boom Assembly

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



- E.** Install 5th section into 4th section approximately 3 feet (100cm). Take care not to damage 3/4/5 extend cables. They should lie on the extended lip of the bottom plate of the 5th section.
- F.** Install 3/4/5 extend sheave pins and bearings into the 3/4/5 extend sheaves. Install wear plugs into the holes on each side of the extend sheaves. Loop 3/4/5 extend cables around the 3/4/5 extend sheaves and slide the sheaves between the 4th and 5th boom sections, make certain the grease hole in the pin is orientated correctly before attaching pin to 4th section. Install countersunk capscrews attaching 3/4/5 extend sheave pins to 4th section.
- G.** Raise the 5th section against the top of the 4th and install the bottom wear pads between the 4th and 5th, lower 5th section onto pads.
- H.** Install side wear pads with appropriate shims on front side inside of the 4th section boom. Install upper spacer bar and cable guide with wear pad and related hardware on the top of the 4th section. Shim according to calibration instructions or as pads were originally removed and tagged.
- I.** Push the 5th section completely inside the 4th section until it bottoms out on the doubler plates in the rear of the 4th, keep 3/4/5 extend cables tight when installing section. A scribe mark on the 5th at full retraction will aid in cable tensioning for proper boom sequence later.
- J.** Uncoil 5/4/3 retract cables out of the 5th section, assemble 4th section retract sheaves and pins into the inside of the 4th section rear, using proper hardware and Loctite 242, reeve cable over sheave installing upper keeper capscrew and lower rear pad, this pad serves as a cable keeper, lower pad and side pad for the rear of the section.
- K.** Install 4/3/2 retract cable button end into anchor point in 4th section and install keeper plate and capscrews. This keeper plate is installed temporarily to keep the button ends in place during this phase of the assembly, it will need to come back out during cylinder and 2/3/4 extend cable installation. Coil 4/3/2 retract cables temporarily into 5th section.

- L.** Assemble top rear wear pads with the cam plates to the top of the 5th section. The wear pad on each side of the top/rear of the boom can be adjusted over a range of 3/16 inch (4.8mm) by rotating, end for end, the wear pad and plate or the wear pads and plate independently. This is possible because the holes in these parts are offset from the center. The holes are .06 inch (1.5mm) off center in the plate and .03 inch (.8mm) off center in the wear pad. Various combinations of rotation of these parts allow this adjustment.
- M.** Pull threaded ends of 5/4/3 retract cable, now under the 4th section, towards front of boom.
- N.** Position 4th-5th section in front of 3rd section, ready for assembly. Route 5/4/3 retract cables to allow easy cable movement as the sections slide together.
- O.** Slide 4th-5th section into 3rd boom section approximately 36 inches (90cm) keep 4th-5th sections suspended to avoid damage to 5/4/3 retract cables.
- P.** Assemble bottom wear pads on 3rd section pad plate, raise 4th-5th section high enough in 3rd to allow plate with pads to slide between the sections, place retract cables in the grooves in the bottom pad plate, as boom sections are slid together, retract cables will pull through these grooves, use appropriate hardware and fasten pad plate to the bottom plate of the 3rd section.
- Q.** Install a nut on the threaded ends of the 5/4/3 retract cables, to keep the cable ends from pulling through the anchor as the sections are pushed together.
- R.** Push the 4th-5th section inside the 3rd section, until it is within 36 inches (90cm) of full insertion.
- S.** Install side wear pads with appropriate shims on front inside of the 3rd section boom. Install upper spacer bar and cable guide with wear pad and related hardware on the top to the 3rd section. Shim according to calibration instructions, or as pads were originally removed and tagged.
- T.** Slide 4th-5th section inside 3rd until the end of the 4th section hits against the doubler bars in the 3rd section. Use caution as the 5/4/3 retract cable threaded end gets close to the grooves in the lower front pad plate, adjust as necessary to allow proper

placement. A scribe mark on the 4th section at full retraction will aid in cable tensioning for proper boom sequence later.

- U.** Assemble top rear wear pads with the cam plates to the top of the 4th section. See **step K** for pad installation detail.
- V.** Uncoil 4/3/2 retract cables out of the 5th section, assemble 3rd section retract sheaves and pins into the inside of the 3rd section rear, using proper hardware and Loctite 242, reeve cable over sheave installing upper keeper capscrew and lower rear pad, this pad serves as a cable keeper, lower pad and side pad for the rear of the section.
- W.** Pull threaded end of 4/3/2 retract cables, now under the 3rd section, toward front of boom.
- X.** Assembly **step V** completes the 5/4/3 boom section stage, at this point the hydraulic extension cylinder and related cables and components are inserted into the 3rd-4th-5th section assembly starting with **step X**.
- Y.** Support extension cylinder in a workable location and install the 3 extend sheaves in the sheave case end of the cylinder, orientate the pin so that the bearing grease holes are on the unloaded side of the pin (towards cylinder butt plate).
- Z.** Install 3 - 2/3/4 extend cables over sheaves by placing button end through opening between the sheave and the front double tapered plate on the cylinder. After the cables are in place, install the plastic tapered cylinder pads on the top bottom shelves of the cylinder sheavecase, these pads when secured in place act as cable retainers as well as wear pads, again apply Loctite and jam nuts in these locations.
- AA.** Pull the 3 button ends through the extend cylinder sheavecase until there is enough slack to install the 2/3/4 extend cable anchor, install cable anchor on extend cables, keep capscrews clamping on the two halves of the anchor together just tight enough to not let the cables escape from their positions, this will allow easier assembly into the 4th section anchor point.
- BB.** Drape 2/3/4 extend cables that come off top of the sheaves in an area to avoid damage, preferably on the top of the top of the extend cylinder, this will put them in

their approximate location as the cylinder is installed into the 5th/4th/3rd boom assembly.

- CC.** Slide extend cylinder into the 3rd-4th-5th boom assembly approximately 36 inches (90cm). Raise cylinder up at an angle slightly to allow easier access to the 2/3/4 extend cable anchor in the rear of the 4th section. Install 2/3/4 extend cable anchor and cable ends into the anchor point. Install keeper plates over the retract cable ends these keepers are shaped to retain the 2/3/4 anchor as well as the retract cable ends. Tighten capscrews holding the two halves of the 2/3/4 anchor assembly together.
- DD.** Lower extend cylinder to a position parallel with the 3rd/4th/5th boom assembly and slowly push the cylinder into the 3rd/4th/5th boom assembly until the cylinder collar makes contact with the 3rd section rear vertical doubler plates. Monitor 2/3/4 extend cable location as cylinder slides into boom sections to avoid damaging cables.
- EE.** Raise extend cylinder up to allow cylinder collar to slide through and align with the anchor pocket on the back of the 3rd, lower cylinder, collar will move down into cylinder anchor pocket, if properly positioned over pocket. Assemble lock bar and proper hardware to the cylinder collar, this will retain the cylinder into the anchor pocket.
- FF.** Attach button end of 1/2/3 small extend cables into anchor point on the rear top plate of the 3rd section, a thin plate on the bottom and a thicker anchor plate on the top of the 3rd section top are required for proper cable retention, assemble with proper hardware and Loctite 242.
- GG.** Lay 1/2/3 extend cables on the top of the 3rd section with the proper sheaves and pins that eventually will attach to the top plate of the 2nd section. Arrange the cables.
- HH.** The 3rd/4th/5th and cylinder assembly is now ready to assemble into the 2nd section boom.
- II.** Slide 3rd/4th/5th and cylinder assembly is now ready to assemble into the 2nd section boom approximately 36 inches (90cm) keep the 3rd/4th/5th and cylinder assembly suspended to avoid damage to the 4/3/2 retract cables. Assemble bottom

wear pads on 2nd section pad plate, raise 3rd/4th/5th and cylinder assembly high enough in the 2nd to allow pad plate with pads to slide between the sections, place retract cables in the grooves in the bottom pad plate, as the boom sections are slid together, retract cables will pull through these grooves, use appropriate hardware and fasten the pad plate to the bottom of the 2nd section.

- JJ.** Install nuts on the threaded ends of the 4/3/2 retract cables, to keep the cable ends from pulling through the anchor as the sections are pushed together.
- KK.** Push the 3rd/4th/5th and cylinder assembly inside the 2nd section, until it is within 36 inches (90cm) of full insertion.
- LL.** Install side wear pads with appropriate shims on the front inside of the 2nd section, shim according to calibration instructions, or as pads were originally removed and tagged. Assemble 1/2/3 extend cable sheaves and pins with the appropriate hardware to the 2nd section top plate, assemble cable keeper/spacer bar plates to 2nd section, install cable guide and wear pad to the top of the 2nd section.
- MM.** Slide the 3rd/4th/5th and cylinder assembly into the 2nd section until the extend cylinder collar bottoms out in its anchor pocket in the rear of the 2nd section or the 3rd section side plates bottom out on the doubler plates on the rear of the 2nd section. Use caution as the 4/3/2 retract cable threaded ends get close to the grooves in the lower front pad plate, adjust as necessary to allow proper placement.
- NN.** Cylinder length adjustment may be necessary to properly position cylinder collar in the anchor pocket with the 3rd section side plates bottoming out on the doublers in the rear of the 2nd. A hydraulic power source may have to be utilized to adjust the cylinder length. Install appropriate hardware fastening the extend cylinder collar to the cylinder mounting channels in the rear of the 2nd section boom. A scribe mark on the 3rd section at full retraction will aid in cable tensioning for proper boom sequence later.
- OO.** Assemble top rear wear pads with the cam plates to the top of the 3rd section. See **step K** for pad installation detail.
- PP.** Assemble 3/2/1 retract cable button ends into anchor points in the rear of the 3rd section. Install keeper plates and capscrews. Assemble with Loctite 242.

- QQ.** Assemble 2nd section retract sheaves and pins into the inside of the 2nd section using proper hardware and Loctite 242, reeve 3/2/1 retract cables, anchored to 3rd, over sheaves attached to 2nd section and install upper keeper capscrew and lower rear pad, this pad serves as a cable keeper, lower pad and side pad for the rear of the section.
- RR.** Pull threaded ends of 3/2/1 retract cables, now under the 2nd section, towards the front of the boom.
- SS.** Suspend assembled boom sections, position of extend cylinder butt plate is holding valve down, rotate rod assembly to achieve proper orientation, place retract cables to avoid damage, and slide assembled boom sections into the 1st section approximately 36 inches (90cm). Keep boom assembly suspended to avoid damage to the retract cable.
- TT.** Assemble bottom wear pads on the 2nd section pad plate, raise the 2nd/3rd/4th/5th and cylinder assembly high enough in 1st to allow plate with pads to slide between the sections, place retract cables in the grooves in the bottom pad plate, as the boom sections are slid together, retract cables will pull through these grooves, use appropriate hardware and fasten pad plate to the bottom plate of the 1st section.
- UU.** Install nuts on the threaded ends of the 3/2/1 retract cables, to keep the cable ends from pulling through the anchor as the sections are pushed together.
- VV.** Push the 2nd/3rd/4th/5th and cylinder assembly inside the 1st section, until it is within 36 inches (90cm) of full insertion.
- WW.** Install the side wear pads with the appropriate shims on the front inside of the 1st section. Install upper spacer bar with appropriate hardware to the inside top of the 1st. Shim according to calibration instructions, or as pads were originally removed and tagged.
- XX.** Slide the 2nd/3rd/4th/5th and cylinder assembly into the 1st section until the extend cylinder butt plate contacts the back plate of the winch mount. Use caution as the holding valve nears the winch mount back plate, the holding valve nears the winch mount back plate, and the holding valve to back plate clearance requires the butt plate to be level, with the holding valve down. Use caution as the 3/2/1 retract cable

threaded ends get close to the grooves in the lower front pad plate, adjust as necessary to allow proper placement.

YY. Install proper hardware retaining extend cylinder butt plate to the 1st section winch mount.

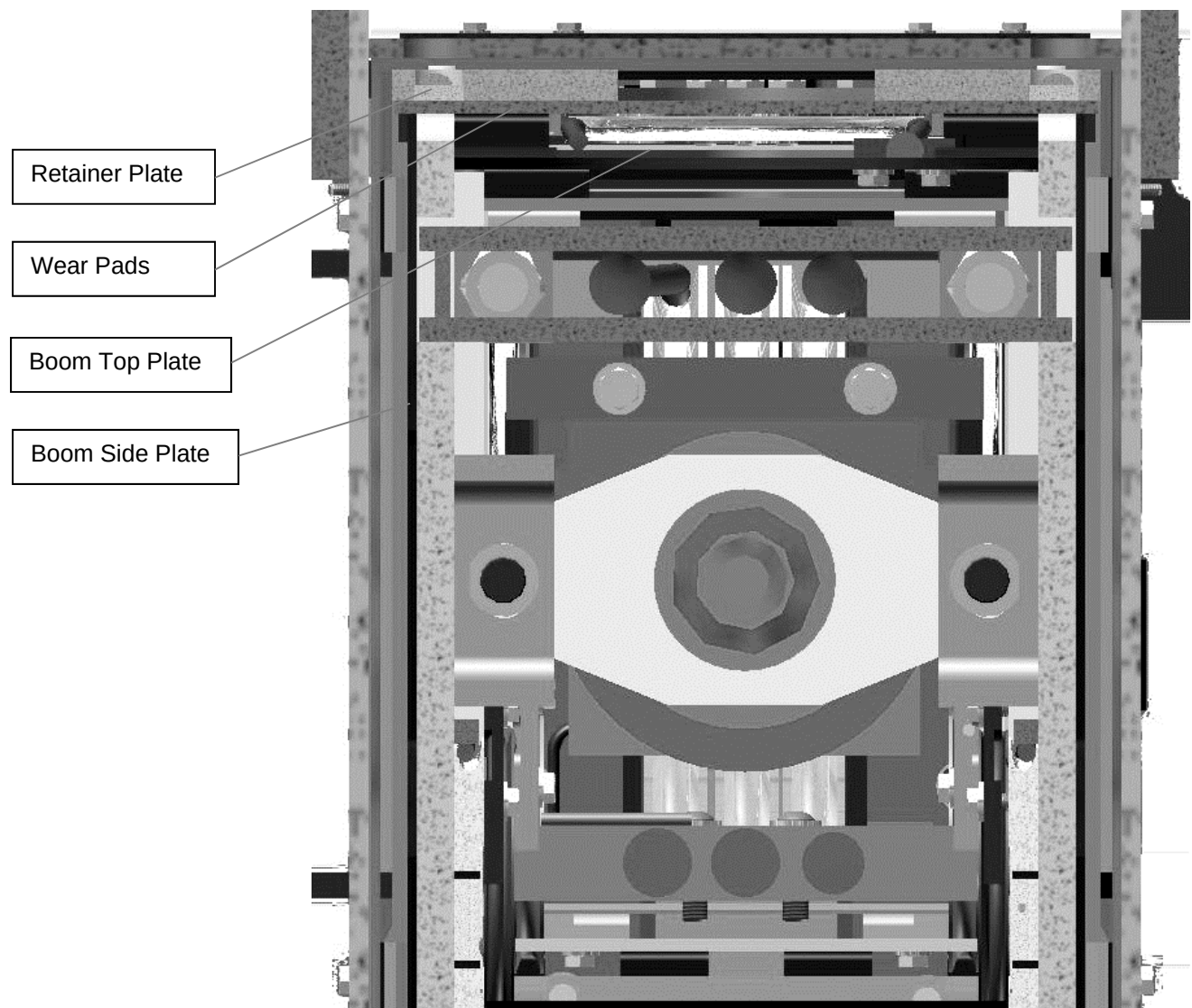
ZZ. Assemble top rear wear pads with the cam plates to the top of the 2nd section. See step #11 for pad installation detail.

AAA. Install cable guides, angle pendulum, winch and anti-two block system, see anti-two block system description and installation instructions.

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.

- E. 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.

Five Section Boom Operation



Revision History

Document type	Document Number	Revision History	Revision Notes	Revision Date
Tech Spec.	EEC-0080	1.0	Template update	11/05/14
Tech Spec.		1.1	Doc update	1/26/15
Tech Spec.		1.2	Illustration update	3/23/15
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 too 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



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brevini
winches

Manuale di installazione, utilizzo e manutenzione
argani da sollevamento e traino
*Installation, operation and maintenance manual
hoisting and recovery winches*



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W A R N I N G

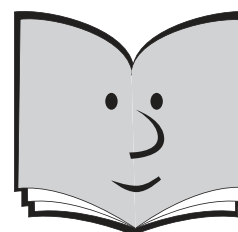
Please read the technical information in this manual with care and follow all the instructions provided before starting to use the winch.

Keep this manual and any appendixes in a place offering ready access to all users (operators and maintenance personnel) and which is known to all.

A T T E N Z I O N E

Prima di rendere operativo l'argano, leggere attentamente le istruzioni tecniche contenute nella presente pubblicazione e seguire scrupolosamente le indicazioni riportate.

Conservare il presente manuale e tutte le pubblicazioni allegate in un luogo accessibile e noto a tutti gli utilizzatori (operatori e personale addetto alla manutenzione).



1

INFORMAZIONI GENERALI



**GENERAL
INFORMATION**

1.1 INTRODUCTION

Brevini Winches would like to thank you for choosing one of its products and is pleased to welcome you as a Customer.

We are confident you will find using this winch very satisfactory.

1.2 AIM OF THIS MANUAL

This manual aims at giving the users of our winches all the necessary information in order to install, operate and maintain correctly the winches in compliance with the safety limits provided for by the standards in force.

In order to facilitate the understanding of this manual, we are listing the terms and symbols used below:

- **Danger Area:** area in or close to the machine where the presence of an unprotected person constitutes a risk for the health and safety of the person himself.
- **Unprotected Person:** any person who is completely or partially within a danger area.
- **Operator:** a person in charge of installation, start up, adjustment, maintenance and cleaning of the machine as a whole.
- **Qualified Technician:** a trained person in charge of special maintenance or repairs requiring particular expertise concerning the machine, including its operation, its safety devices and how they operate.

WARNING:

Standards for the prevention of accidents for the Operator and the Qualified Technician.



1.1 INTRODUZIONE

Brevini Winches ringrazia per la preferenza accordata ai propri prodotti ed è lieta di annoverarla tra i propri Clienti.

Confida che l'uso dell'argano sia per lei motivo di soddisfazione.

1.2 SCOPO DEL MANUALE

Il presente manuale fornisce all'utilizzatore degli argani le informazioni necessarie alla corretta installazione, uso e manutenzione dello stesso nel rispetto dei limiti di sicurezza dettati dalle norme vigenti.

Per migliorare la comprensione di questo manuale precisiamo di seguito i termini e le simbologie in esso utilizzati:

- **Zona Pericolosa:** zona all'interno o in prossimità della macchina in cui la presenza di una persona esposta costituisce un rischio per la sicurezza e la salute della persona stessa.
- **Persona Esposta:** qualsiasi persona che si trovi interamente o in parte in una zona pericolosa.
- **Operatore:** persona incaricata di installare, di fare funzionare, di regolare, di eseguire la manutenzione e di pulire la macchina nel suo complesso.
- **Tecnico Qualificato:** persona specializzata destinata ad effettuare interventi di manutenzione straordinaria o riparazioni che richiedano una particolare conoscenza della macchina, del suo funzionamento, delle sicurezze e delle loro modalità d'intervento.

ATTENZIONE:

Norme antinfortunistiche per l'Operatore e il Tecnico qualificato.



CAUTION:

Possibility of machine damage and/or damage to machine parts.



PRECAUTION/IMPORTANT:

Additional information relating to the process in question.s



NOTE:

Useful or important information.



Please contact Brevini Winches Technical Department in case of any doubt, or should this manual be damaged or misplaced.

TELEPHONE +39 0522 277711

FAX +39 0522 514977

Stating:

- A) TYPE OF WINCH
- B) SERIAL NUMBER OF THE WINCH
- C) YEAR OF MANUFACTURE

This information can be found on the name plate attached to the winch.

		VIA U. DEGOLA 1 42100 REGGIO EMILIA / ITALY Tel. +39 0522 277711 www.breviniwinches.it		
TIPO TYPE	A	DIAMETRO FUNE ROPE DIAMETER		mm
NUM. MATR. SERIAL NR.	B	TIRO MAX 1= STRATO MAX LINE PULL 1=LAYER		Kg
ANNO YEAR	C	PRESSIONE MAX MAX PRESSURE		bar
PESO WEIGHT		MAX. PORTATA MAX OIL FLOW		l/min

AVVERTENZA:

Esiste la possibilità di arrecare danno alla macchina e/o ai componenti della stessa.



PRECAUZIONE/IMPORTANTE:

Ulteriori notizie inerenti l'operazione in corso.



NOTA:

Fornisce informazioni utili o importanti.



Per eventuali dubbi ed in caso di danneggiamento o di perdita del manuale non esitate a contattare il Servizio Tecnico Brevini Winches.

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indicando:

- A) TIPO DI ARGANO
- B) NUMERO DI MATRICOLA DELL'ARGANO
- C) ANNO DI COSTRUZIONE

Queste indicazioni vanno rilevate sulla targhetta identificativa fissata sull'argano.

		VIA U. DEGOLA 1 42100 REGGIO EMILIA / ITALY Tel. +39 0522 277711 www.breviniwinches.it		
TIPO TYPE	A	DIAMETRO FUNE ROPE DIAMETER		mm
NUM. MATR. SERIAL NR.	B	TIRO MAX 1= STRATO MAX LINE PULL 1=LAYER		Kg
ANNO YEAR	C	PRESSIONE MAX MAX PRESSURE		bar
PESO WEIGHT		MAX. PORTATA MAX OIL FLOW		l/min

1.3 GUARANTEE AND TESTING

Brevini Winches S.p.A. guarantees its products are free from any material or manufacturing defects for the period stated in the supply agreement or order confirmation.

This guarantee will be considered null and void should the cause of the fault or anomaly be deemed the result of incorrect or unsuitable application of the product and in case of failure to comply with start up, which must be done within six (6) months of the date of shipment.

1.4 INFORMATION FOR PERSONNEL

All employers must ensure that personnel are informed about the following issues relating to safe operation of the winch:

- Accident risks.
- Devices designed for operator safety.
- General rules for the prevention of accidents or rules provided for by international directives and by the legislation of the country where the winch is to be used.

However, Operators and Qualified Technicians must safeguard full compliance with standards for safety and prevention of accidents in the country where the winch is to be used.

Both Operators and Qualified Technicians must be acquainted with the features of the winch before starting on a job and must have read this manual in full.

Modifying or replacing winch parts without

1.3 GARANZIA E COLLAUDO

La Brevini Winches S.p.A. garantisce che i suoi prodotti sono esenti da difetti di materiale o di costruzione per il periodo indicato nel contratto di fornitura o sulla conferma d'ordine.

La garanzia non avrà validità se l'inconveniente o anomalia risulterà dipendente da applicazioni non corrette o non adeguate al prodotto e se lo stesso non sarà in conformità alla messa in servizio, da effettuarsi non oltre i sei (6) mesi dalla spedizione.

1.4 INFORMAZIONI AL PERSONALE

E' obbligo del datore di lavoro provvedere ad informare il personale sui seguenti argomenti inerenti la sicurezza nell'utilizzo dell'argano:

- Rischio di infortunio.
- Dispositivi predisposti per la sicurezza dell'operatore.
- Regole antinfortunistiche generali o previste da direttive internazionali e dalla legislazione del paese di destinazione dell'argano.

E' comunque obbligo dell'Operatore e del Tecnico Qualificato rispettare scrupolosamente le norme di sicurezza e antinfortunistiche del paese di destinazione dell'argano.

Sia l'Operatore che il Tecnico Qualificato, prima di iniziare il lavoro, devono conoscere le caratteristiche dell'argano e devono avere letto integralmente il presente manuale.

Le eventuali modifiche o sostituzioni di parti dell'argano, non autorizzate per iscritto dalla Brevini Winches S.p.A. possono costituire pe-

due authorisation issued by Brevini Winches S.p.A. in writing, could result in damage to things or injury to people. In such case, the winch manufacturer is no longer liable for any civil or criminal damages.

1.5 HOW TO USE THIS MANUAL

We have made it easier to consult this manual by adding a general index on page 3. This will help you to find the topic you are looking for.

The chapters are arranged in a hierarchy structure to facilitate the search for the information required.

1.6 REPRODUCTION AND COPYRIGHT

All rights reserved by Brevini Winches S.p.A.

The structure and the contents of this manual may not be copied, even partially, without prior authorisation issued by Brevini Winches S.p.A. in writing.

1.7 VERSIONS OF THIS MANUAL

This manual is subject to review further to application and operation changes.

ricolo di infortunio a persone e danni a cose; in tal caso si solleva il costruttore dell'organo da responsabilità civili e penali.

1.5 MODALITÀ DI CONSULTAZIONE

DEL MANUALE

La consultazione di questo manuale è facilitata dall'inserimento in terza pagina dell'indice generale che consente la localizzazione in maniera coerente dell'argomento d'interesse.

I capitoli sono organizzati con una struttura gerarchica che facilita la ricerca dell'informazione desiderata.

1.6 LIMITI DI RIPRODUZIONE E COPYRIGHT

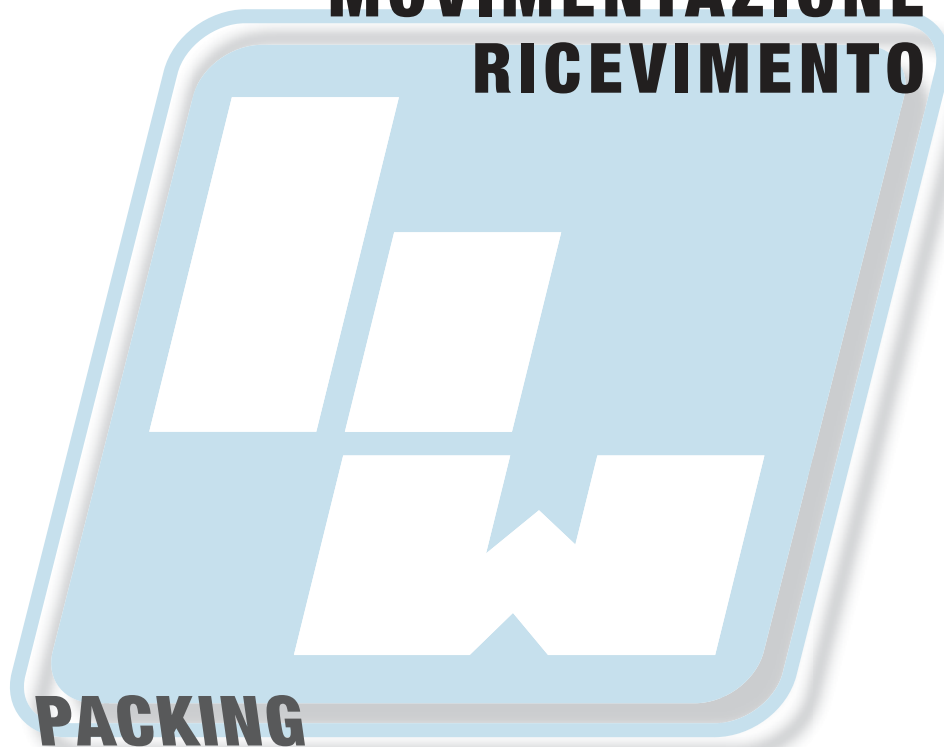
Tutti i diritti riservati alla Brevini Winches S.p.A.

La struttura ed il contenuto del presente manuale non può essere riprodotta, neppure parzialmente, salvo espressa autorizzazione scritta della Brevini Winches S.p.A.

1.7 REVISIONI DEL MANUALE

Il presente manuale può subire revisioni a seguito di modifiche funzionali o di applicazione.

IMBALLO SPEDIZIONE MOVIMENTAZIONE RICEVIMENTO



PACKING SHIPMENT HANDLING INCOMING GOODS PROCEDURES

2.1 PACKING AND SHIPMENT

Winches are packed and shipped in crates or on pallets on a case-by-case basis.

2.2 INCOMING GOODS PROCEDURES

When the winches arrive, check that the items supplied match the items stated in the order and that the packing and contents have not been damaged during transport

WARNING:

The packing strap is sharp. It may hit the Operator when cut.



The packing materials should be removed as follows:

- cut the packing straps with snips (take care as the ends could hit the Operator).
- cut away, or pull off, the surrounding packing material.
- take the winches off the pallets.

If you notice any damage, faults or missing items, please notify Brevini Winches Technical Department without delay.

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Stating:

A)	TYPE OF WINCH
B)	SERIAL NUMBER OF THE WINCH
C)	YEAR OF MANUFACTURE

2.1 IMBALLO E SPEDIZIONE

Gli argani vengono imballati e spediti, secondo i casi, in casse o su pallets.

2.2 RICEVIMENTO

Al ricevimento degli argani, verificare che la fornitura corrisponda alle specifiche dell'ordine; che l'imballo ed il suo contenuto non abbia subito danneggiamenti durante il trasporto

ATTENZIONE:

La reggia è tagliente. Quando si taglia può colpire l'Operatore.



Le demolizioni dell'imballo deve essere effettuata come segue:

- tagliando con le cesoie le reggette (fare attenzione alle estremità che potrebbero colpire l'Operatore).
- tagliando o sfilando l'imballo di contorno.
- rimuovere gli argani dai pallets.

Nel caso vengano riscontrati danni, difetti o mancanze, avvertire immediatamente il Servizio Tecnico Brevini Winches.

TELEFONO +39 0522 277711

FAX +39 0522 514977

indicando:

A)	TIPO DI ARGANO
B)	NUMERO DI MATRICOLA DELL'ARGANO
C)	ANNO DI COSTRUZIONE

This information can be found on the **name plate** attached to the winch.

		VIA U. DEGOLA 1 42100 REGGIO EMILIA / ITALY Tel. +39 0522 277711 www.breviniwinches.it		
TIPO TYPE	A	DIAMETRO FUNE ROPE DIAMETER		mm
NUM. MATR. SERIAL NR.	B	TIRO MAX 1= STRATO MAX LINE PULL 1= LAYER		Kg
ANNO YEAR	C	PRESSIONE MAX MAX PRESSURE		bar
PESO WEIGHT		MAX. PORTATA MAX OIL FLOW		l/min

NOTE:
The Customer is responsible for the disposal of the packing materials and must ensure this is done in compliance with the regulations in force in the country where the winch is to be used.

2.3 HANDLING THE WINCH

WITHOUT PACKING

WARNING:
Before taking the winch out of its packing, secure it with suitable lifting accessories (protect any painted surfaces) so that it will not slip or overturn.

Before handling the winch, remove any wooden blocks inserted inside the packing to safeguard stability during handling and transport.

When lifting the winch, take care that the weight is distributed evenly during handling.

Queste indicazioni vanno rilevate sulla **targhetta identificativa** fissata sull'argano.

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TIPO TYPE	A	DIAMETRO FUNE ROPE DIAMETER		mm
NUM. MATR. SERIAL NR.	B	TIRO MAX 1= STRATO MAX LINE PULL 1= LAYER		Kg
ANNO YEAR	C	PRESSIONE MAX MAX PRESSURE		bar
PESO WEIGHT		MAX. PORTATA MAX OIL FLOW		l/min

NOTA:
Lo smaltimento dei materiali d'imballaggio sarà a cura del destinatario che dovrà eseguirlo in conformità alle norme vigenti nel Paese nel quale l'argano va montato.

2.3 MOVIMENTAZIONE DELL'ARGANO

SENZA IMBALLO

ATTENZIONE:
Prima di rimuovere l'argano dal proprio imballo assicurarne con gli accessori di sollevamento idonei allo scopo (proteggere le parti verniciate) in modo che non possa scivolare o ribaltarsi.

Prima di movimentare l'argano togliere gli eventuali tacchi di legno inseriti nell'imballo per assicurare la stabilità durante le operazioni di movimentazione e trasporto.

Sollevare l'argano facendo attenzione a non sbilanciare il carico durante le manovre.

2.4 HANDLING

WARNING:
When moving pallets, use vehicles suitable for the type of packing and offer sufficient carrying capacity for the job in question.

- Do not tip or overturn when lifting or moving.
- If items are moved with a fork lift truck, make sure the weight is distributed evenly on both forks
- If items are moved using a hoist, make sure the weight is distributed evenly and use lifting accessories in the sling, which are approved in compliance with legal standards.
- For items shipped on pallets, make sure that the lifting accessories do not damage the winch.
- If necessary, place suitable wooden blocks under the item to facilitate the use of lifting accessories.

WARNING:
When lifting the item and putting it into position, avoid impacts and violent knocks.

2.5 STORAGE

If the winch is to be stored for a 'temporary' period, or for a period exceeding six months, follow the instructions below after completing functions testing.:

- Completely fill the reduction gear section and the hydraulic motor with oil (for the use of oils, see the section on "lubrication" and "hydraulic oil").
- Store in a safe, dry place, without significant variations in temperature and humidity levels.

2.4 MOVIMENTAZIONE

ATTENZIONE:
Per lo spostamento dei pallets utilizzare mezzi idonei al tipo di imballo e di portata adeguata al lavoro da svolgere.

- Non inclinare o capovolgere durante il sollevamento e trasporto.
- Se i colli vengono movimentati con un carrello elevatore, assicurarsi che il peso sia bilanciato sulle forche di sollevamento
- Se i colli vengono movimentati con un paranco assicurarsi che il carico sia bilanciato e nell'imbracatura utilizzare accessori per il sollevamento omologati a norma di legge.
- Per i colli spediti su pallets fare attenzione che gli accessori di sollevamento non danneggino l'argano.
- Se necessario mettere adeguati cunei di legno sotto il collo per facilitare l'utilizzo degli accessori di sollevamento.

ATTENZIONE:
Durante il sollevamento ed il posizionamento del collo evitare impatti ed urti violenti.

2.5 IMMAGAZZINAMENTO

Dopo il collaudo funzionale, nel caso occorra immagazzinare l'argano per un periodo "temporaneo" o superiore a sei mesi attenersi a quanto segue:

- Riempire d'olio totalmente la parte riduttore e il motore idraulico (vedere per l'utilizzo degli oli il paragrafo "lubrificazione" e "olio idraulico").
- Immagazzinare in luogo asciutto e protetto onde evitare forti sbalzi termici e di umidità.

WARNING:

If the storage period is to be longer than six months, the efficiency of the rotating seals will deteriorate (we recommend regular control and replacement of seals when starting up, if necessary).



- Do not stack items one on top of another.
- Do not place on top of items material that could damage them.
- Do not store the item in close proximity to areas of transit.
- Do not rest the winch directly on the floor.

ATTENZIONE:

Per l'immagazzinamento prolungato oltre i sei mesi decade l'efficienza per le tenute rotanti (si consiglia un controllo periodico e eventuale sostituzione delle tenute all'atto dell'avviamento).



- Non mettere pezzi uno sopra l'altro.
- Non appoggiare sui colli materiali che possano danneggiarli.
- Tenere lontano il collo dalle zone di passaggio.
- Non appoggiare l'organo direttamente sul pavimento.

3

DESCRIZIONE DELLA MACCHINA E DATI TECNICI



MACHINE DESCRIPTION AND SPECIFICATIONS

3.1 OPERATING PRINCIPLE

In its various configurations, this winch is designed for lifting or recovery jobs.

3.2 CONFIGURATION AND

CONSTRUCTION TYPE

The configuration of the winch is defined by contract.

The winch is basically composed of:

- Drum.
- Supporting structure.
- Epicyclical reduction gear.
- Fail-safe negative brake.
- Valve for blocking and controlling descent or recovery.
- Hydraulic motor.
- Accessories.

3.3 TECHNICAL REFERENCE STANDARDS

The specifications sheet is stored in the Technical Department. It contains the engineering documents, the standards applied, calculations, verifications of gear systems, references of material, test certificates, dimensions, assembly drawings and lists of spare parts.

3.4 OPERATING ENVIRONMENTAL

CONDITIONS.

To ensure correct winch operation, it must be used in places where the room temperature is between -10°C and $+40^{\circ}\text{C}$. Contact Brevini Winches Technical Department prior to use in case of other operating temperatures.

3.5 OPERATION IN CONTAMINATED

ENVIRONMENTS

Should the winch be used in corrosive situations, with coarse pollutants or extremely fine dust, clean the winch with water or appro-

3.1 PRINCIPIO DIFUNZIONAMENTO

L'argano è progettato per eseguire nelle varie configurazioni operazioni di sollevamento o traino.

3.2 CONFIGURAZIONE E

TIPOLOGIA COSTRUTTIVA

La configurazione dell'argano è definita a livello contrattuale.

L'argano è essenzialmente composto da:

- Tamburo.
- Struttura di sostegno.
- Riduttore epicicloidale.
- Freno negativo di stazionamento.
- Valvola di blocco e controllo discesa o traino.
- Motore idraulico.
- Accessori.

3.3 NORME TECNICHE DI RIFERIMENTO

Il fascicolo tecnico è depositato presso il Servizio Tecnico; contiene la documentazione di progetto, le normative utilizzate, i calcoli, le verifiche delle ingranaglierie, le referenze dei materiali, i certificati di collaudo, le dimensioni, i disegni di montaggio e le liste ricambi.

3.4 CONDIZIONI AMBIENTALI D'ESERCIZIO.

Per garantire un corretto funzionamento dell'argano è necessario che sia impiegato in luoghi con temperatura ambiente compresa tra i -10°C ed i $+40^{\circ}\text{C}$, per temperature di esercizio differenti consultare preventivamente il Servizio Tecnico Brevini Winches.

3.5 UTILIZZO IN AMBIENTI CONTAMINATI

Qualora si utilizzi l'argano in ambienti corrosivi, con inquinanti grossolani, con polveri estremamente fini; procedere al lavaggio

appropriate liquid to prevent deposits, which could damage important parts such as bolts and screws, rings and washer seals.

It is important that maintenance is carried out in line with an appropriate schedule and using appropriate methods in order to prevent excessive wear of the winch.

3.6 VIBRATION

When operating conditions comply with the instructions for correct use provided in this manual, vibration will not result in any hazardous situations.

Should vibration occur, the Operator should stop the machine immediately and notify Brevini Winches Technical Department.

3.7 NOISE

This winch is designed and manufactured so as to reduce the noise level at source. Brevini Winches informs its Customers with regard to the issue of winch noise so that they may take appropriate measures according to the operating environmental conditions (for example: in the presence of reverberating parts or other noise sources in the vicinity).

3.8 ATMOSPHERES WITH EXPLOSION AND/OR FIRE HAZARD

This winch is not designed to be used in an explosive atmosphere. Should such operating conditions be envisaged, it is essential you contact Brevini Winches Technical Department.

dell'argano con acqua o liquidi adeguati, per evitare depositi pericolosi per la integrità di parti importanti come viterie, anelli e rosette di tenuta.

E' importante intervenire con modalità e tempi di manutenzione adeguati in modo da evitare l'usura eccessiva dell'argano.

3.6 VIBRAZIONI

In condizioni di impiego conformi alle indicazioni di corretto utilizzo fornite nel presente manuale, le vibrazioni non sono tali da far insorgere situazioni di pericolo.

Se esse si verificassero, l'Operatore dovrà arrestare immediatamente la macchina e segnalare il fenomeno al Servizio Tecnico Brevini Winches.

3.7 RUMORE

L'argano è progettato e realizzato in modo tale da ridurre alla sorgente il livello di potenza sonora.

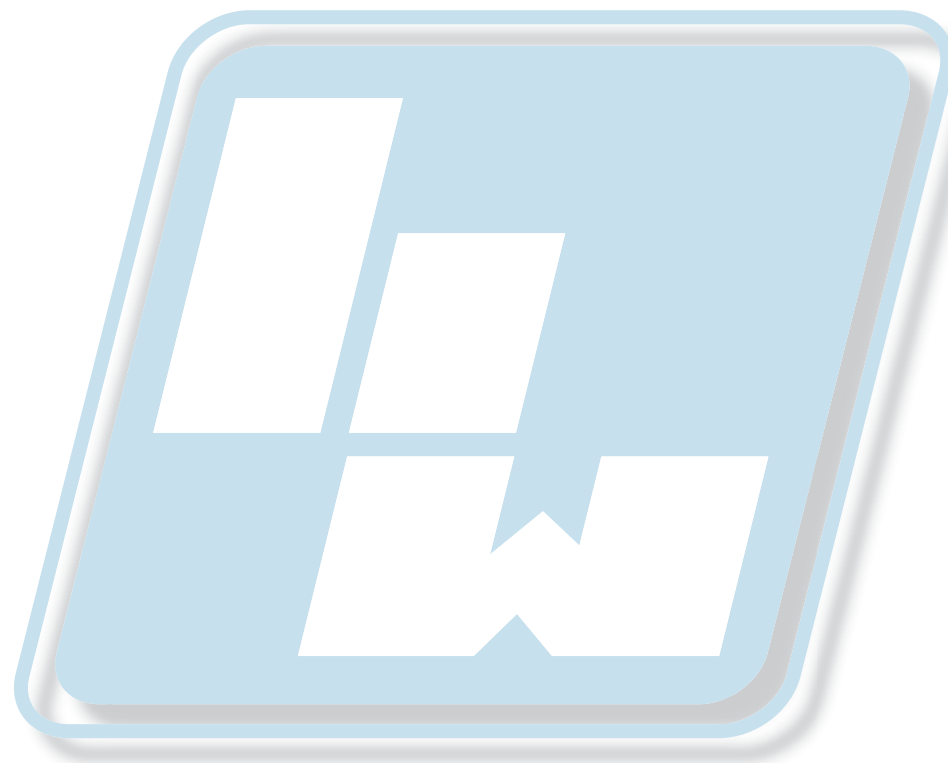
La Brevini Winches informa l'utilizzatore in merito alle emissioni sonore dell'argano; per far sì che egli assuma provvedimenti adeguati in funzione alle condizioni ambientali di esercizio (esempio: presenza di parti più o meno riverberanti o di altre fonti sonore poste nelle vicinanze).

3.8 ATMOSFERA CON RISCHIO DI ESPLOSIONE E/O INCENDIO.

L'impiego dell'argano non è previsto in ambienti con atmosfera esplosiva.

Nel caso dovesse essere previsto questo utilizzo, occorre obbligatoriamente consultare il Servizio Tecnico Brevini Winches.

INSTALLAZIONE



INSTALLATION

4.1 RULES FOR CORRECT INSTALLATION

WARNING:

The winch must be installed by Operators and Qualified Technicians.



The winch must be assembled onto the support prepared by the user using its interface. It must be installed onto a rigid structure with an even surface, secured using good quality bolts and screws for final application.

Screws should be used with resistance class 8.8 or 10.9 and with torque according to standards in force, as indicated in the table below.

Torque for bolts and screws (Nm)		
Ø (mm)	8.8 class screws	10.9 class screws
M12	90	113
M14	144	180
M16	225	281
M18	309	387
M20	439	549
M22	597	747
M24	759	949
M27	1110	1388
M30	1508	1885

4.1 NORME PER LA CORRETTA

INSTALLAZIONE

ATTENZIONE:

La corretta installazione dell'organo deve essere effettuata da Operatori e Tecnici Qualificati.



L'organo deve essere montato tramite la sua interfaccia sul supporto predisposto dall'utilizzatore; la struttura a cui va installato deve essere rigida, con un buon piano d'appoggio e fissata, in applicazione finale con viterie di qualità.

Si consiglia l'utilizzo di viti con classe di resistenza tipo 8.8 o 10.9, utilizzandole con coppie di serraggio secondo normative correnti e indicate nella sottostante tabella.

Coppia di serraggio viterie (Nm)		
Ø (mm)	Vite classe 8.8	Vite classe 10.9
M12	90	113
M14	144	180
M16	225	281
M18	309	387
M20	439	549
M22	597	747
M24	759	949
M27	1110	1388
M30	1508	1885

NOTE:

For correct assembly, use the holes provided on the winch/application interface.



4.2 LUBRICATION

The winch is supplied with the amount of lubricant oil inside it (VG 150 mineral ISO 3448) as stated in the winch's specifications sheet. The first oil change must be done prior to completion of 50 hours of operation: initial running in period. After this, every 500 hours of winch operation. For controlling, topping up and changing the oil, use the plugs provided for this purpose, as shown in the specifications sheet. The washer seals under the plugs should be changed every time they are unscrewed for such work. Lubricant should be changed when the oil is hot in order to prevent sludge formation. When changing the oil, you should also clean inside the reduction gear using liquid suitable for this purpose, and recommended by lubricant manufacturers. You should control the lubricant level every 20 days, regardless of the number of hours of operation.

NOTE:

When operating the winch at room temperatures below -10°C , we recommend using a lubricant with viscosity class (VG 100 synthetic ISO 3448).



4.3 HYDRAULIC SYSTEM OIL

For the supply of the winch's hydraulic motor, use mineral oil with wearproof additives and VG 46 index of viscosity. It is essential that you use 10 micron hydraulic oil filters on the motor inlet in order to safeguard correct operation and satisfactory

NOTA:

Per un corretto montaggio vanno utilizzati i fori predisposti sull'interfaccia argano/applicazione



4.2 LUBRIFICAZIONE

L'argano viene consegnato con l'olio lubrificante al suo interno (VG 150 minerale ISO 3448) nel quantitativo indicato sulla scheda tecnica dell'argano. Il primo cambio del lubrificante deve avvenire entro e non oltre le 50 ore di funzionamento, primo rodaggio. Successivamente ogni 500 ore di funzionamento dell'argano. Utilizzare per il controllo, rabbocco e sostituzione olio, i tappi predisposti allo scopo, indicati sulla scheda tecnica. E' consigliato sostituire le rosette di tenuta sotto i tappi, tutte le volte che si svitano per gli interventi. E' consigliato il cambio del lubrificante ad olio caldo per evitare la formazione di morchie. Al momento del cambio dell'olio è consigliato anche di provvedere ad un lavaggio interno del riduttore, con liquido adatto allo scopo e consigliato dai produttori dei lubrificanti. E' consigliato, a prescindere dalle ore di funzionamento, un controllo del livello lubrificante ogni 20 giorni solari.

NOTA:

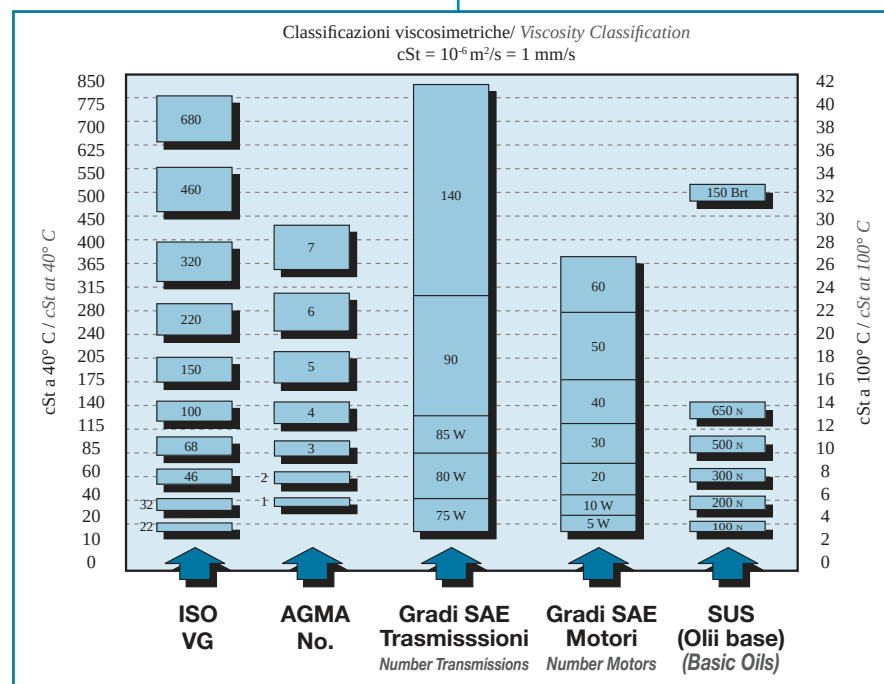
Per l'utilizzo dell'argano con temperature ambientali inferiori a -10°C è consigliato un lubrificante con classe di viscosità (VG 100 sintetico ISO 3448).



4.3 OLIO IMPIANTO IDRAULICO

Per l'alimentazione del motore idraulico dell'argano utilizzare olio a base minerale con additivi antiusura e indice di viscosità VG 46. Per assicurare un buon funzionamento ed una buona durata del motore idraulico, del freno

Figura 1
Feature 1



duration of the hydraulic motor, the fail-safe negative brake, the selector valve for release of the brake and of the valve for control of the load descent.

SEE FIGURE 1

4.4 CONNECTING THE HYDRAULIC SYSTEM TO THE WINCH

The winch must be connected to the hydraulic system by means of three pipes: two of these handle its supply and the third one is connected directly to the hydraulic system's tank for draining the motor, when necessary (the dimensions and the specifications of the couplings for connecting the pipes to the hydraulic motor are stated in the specifications sheet for the winches).

negativo, della valvola selettiva per l'apertura del freno e della valvola per il controllo del carico in discesa è indispensabile avere una filtrazione dell'olio idraulico in entrata al motore 10 micron assoluti.

VEDI FIGURA 1

4.4 COLLEGAMENTO IMPIANTO

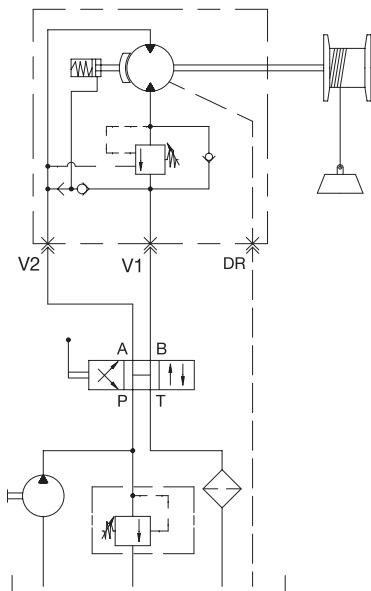
IDRAULICO ALL'ARGANO.

L'argano deve essere collegato all'impianto idraulico per mezzo di tre tubazioni, due che provvedono all'alimentazione dello stesso ed una terza collegata direttamente al serbatoio dell'impianto idraulico, per il drenaggio del motore ove necessario (le dimensioni e le caratteristiche degli attacchi per le connessioni delle tubazioni al motore idraulico, sono indicate sulla scheda tecnica degli argani).

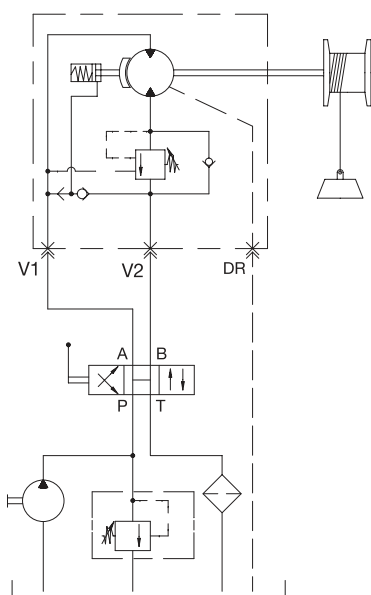
Figura 2
Feature 2

SCHEMA IDRAULICO CONSIGLIATO CON DRENAGGIO MOTORE MESSO A SCARICO DIRETTO IN SERBATOIO
RECOMMENDED HYDRAULIC LAYOUT WITH DIRECT MOTOR DRAIN INTO THE TANK

CODICE SALITA
LIFTING CODE **01**



CODICE SALITA
LIFTING CODE **02**



The internal diameter of the pipes must be adequate so as to prevent the loss of load and unsatisfactory counter pressure leading to an increase in pressure throughout the whole system.

4.5 STANDARD "01" - "02"

HYDRAULIC SYSTEM

SEE FIGURE 2

WARNING:

When the system is stationary, the pressure needed for the flow of oil through the pipes, must not exceed three (3) bar.



CAUTION:

Use oil-pressure winch control distributors, which have V1-V2 drainage lines in neutral position (configuration H), in order to prevent the negative brake from being accidentally released by any hydraulic pressure remaining in the pipes when the winch is stationary.



CAUTION:

During normal winch operation, the negative brake will be automatically released by means of the valve or the motor itself when the motor is started up and must lock again when the motor stops running.



To release the brake, pressure is taken from the supply line to the motor. When the winch stops, in

Le tubazioni devono avere un diametro interno di dimensioni adeguate, per non creare perdite di carico e contropressioni indesiderate e quindi un aumento della pressione in tutto l'impianto.

4.5 SCHEMA IDRAULICO

STANDARD "01" - "02"

VEDI FIGURA 2

ATTENZIONE:

La pressione necessaria a fare scorrere l'olio lungo i tubi, a sistema fermo, non deve superare i tre (3) bar.



AVVERTENZA:

Utilizzare distributori oleodinamici di comando argano aventi le linee V1-V2 a scarico in posizione neutra (configurazione H), per evitare che il freno negativo possa venire accidentalmente aperto ad argano fermo da eventuale pressione idraulica residua nelle tubazioni.



AVVERTENZA:

Durante il normale funzionamento dell'argano il freno negativo si apre in modo automatico per mezzo della valvola o del motore stesso all'avviamento del motore e deve richiudersi quando il motore stesso viene fermato. Per aprire il freno si preleva pressione dal ramo di alimentazione del motore, all'arresto dell'argano.



order to allow the negative brake to lock again, the remaining pressure must not be above three (3) bar in the two supply lines when the distributor lever is placed in the centre.

DANGER WARNING:

The lifting of a load applied to the winch rope must never make use of the hydraulic jib of the crane where the winch is installed. In this case, the pressure relief valve may not be able to protect the winch from very dangerous overloads. Tampering with the pressure relief valve for loads in excess of those allowed is PROHIBITED.



no, per permettere il richiudersi del freno negativo, occorre che quando la leva del distributore viene posizionata al centro non rimanga una pressione superiore ai tre (3) bar nei due rami di alimentazione

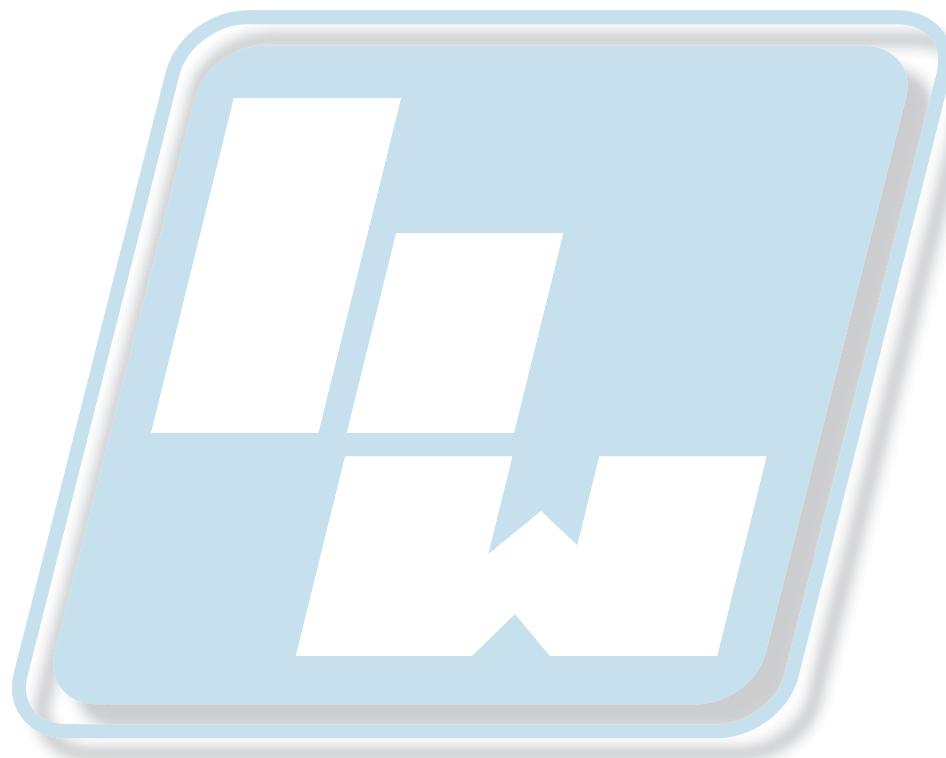
ATTENZIONE PERICOLO:

Il sollevamento di un carico applicato alla fune dell'argano non deve mai avvenire mediante il braccio idraulico della gru sul quale l'argano o il vericello è installato; in questo caso la valvola di sovrappressione non potrebbe proteggere l'argano da sovracarichi molto pericolosi.

È comunque assolutamente **VIE-TATO** manomettere la valvola di sovrappressione per carichi superiori a quelli consentiti.

**5**

MESSA IN FUNZIONE

**START UP**

WARNING:

Before starting up the winch for the first time, check the following:



- the level of the lubricant is correct.
- all bolts and screws are securely tightened.
- the hydraulic system complies with the specifications listed in the relative section.
- the direction of drum rotation is correct.

5.1 SECURING THE ROPE

NOTE:

The winch is normally supplied without rope wound on the drum.



The assembly of the rope must be carried out by an Operator or Qualified Technician according to the instructions provided by the rope manufacturer.

IMPORTANT:

Read carefully the recommendations in Appendix "A".



5.2 TESTING OF OPERATION

NOTE:

All data relating to pressure, hydraulic oil flow and velocity are listed in the table of winches technical specifications.



When starting up, you must run the winch without a load in both directions of rotation for about ten minutes.

For the first time, only lift a small load to a height of about one metre and check that the brake is working correctly.

ATTENZIONE:

Prima di effettuare il primo avviamento dell'organo occorre verificare quanto segue:



- Controllare che il livello del lubrificante sia corretto.
- Controllare il serraggio di tutte le viterie.
- Verificare che l'impianto idraulico rispetti le caratteristiche descritte nel paragrafo ad esso dedicato.
- Verificare il corretto senso di rotazione del tamburo.

5.1 FISSAGGIO FUNE

NOTA:

Normalmente l'organo viene fornito senza fune avvolta sul tamburo.



Il montaggio della fune deve essere eseguito da Operatore o Tecnico Qualificato, rispettando quanto prescritto dal costruttore della fune.

IMPORTANTE:

Leggere attentamente i consigli riportati nell'appendice "A"



5.2 PROVE FUNZIONALI

NOTA:

Tutti i dati relativi a pressioni, portata olio idraulico e velocità sono indicate nella tabella dati tecnici degli organi.



E' obbligatorio all'avviamento un funzionamento di circa dieci minuti senza carico per

Make sure you are able to control descent and that the pressure in the return line does not exceed three (3) bar when the winch is stationary.

NOTE:

*The winch is designed for lifting or recovery loads. Any use with loads exceeding the specifications listed in the specifications sheet is considered **IMPROPER**. Using the winch for lifting or transporting people is strictly prohibited.*



IMPORTANT:

The person in charge of the final application of the winches is responsible for their safe employment, including issuing the list of further risks and the application of the safety devices required by standards in force.



WARNING:

It is important to bear in mind that starting up any type of appliance inevitably entails a certain amount of risk. Therefore, every single action should be awarded maximum attention and concentration.



entrambi i sensi di rotazione.

Eseguire il primo sollevamento con un carico modesto ad un'altezza di circa un metro, verificare il corretto funzionamento del freno.

Accertare che la discesa avvenga in modo controllato e che la pressione nel ramo di ritorno dell'argano fermo non superi i tre (3) bar.

NOTA:

L'argano è un apparecchio utilizzato per il sollevamento o il traino di carichi, è pertanto considerato **USO IMPROPRIO** l'utilizzo degli stessi con valori superiori da quelli indicati nelle schede tecniche. È assolutamente vietato l'uso per il sollevamento o il trasporto di persone.



IMPORTANTE:

la messa in sicurezza degli argani è demandata all'applicatore finale, come pure la stesura dell'elenco dei rischi residui e all'applicazione di tutti i sistemi di sicurezza richiesti dalle norme vigenti.

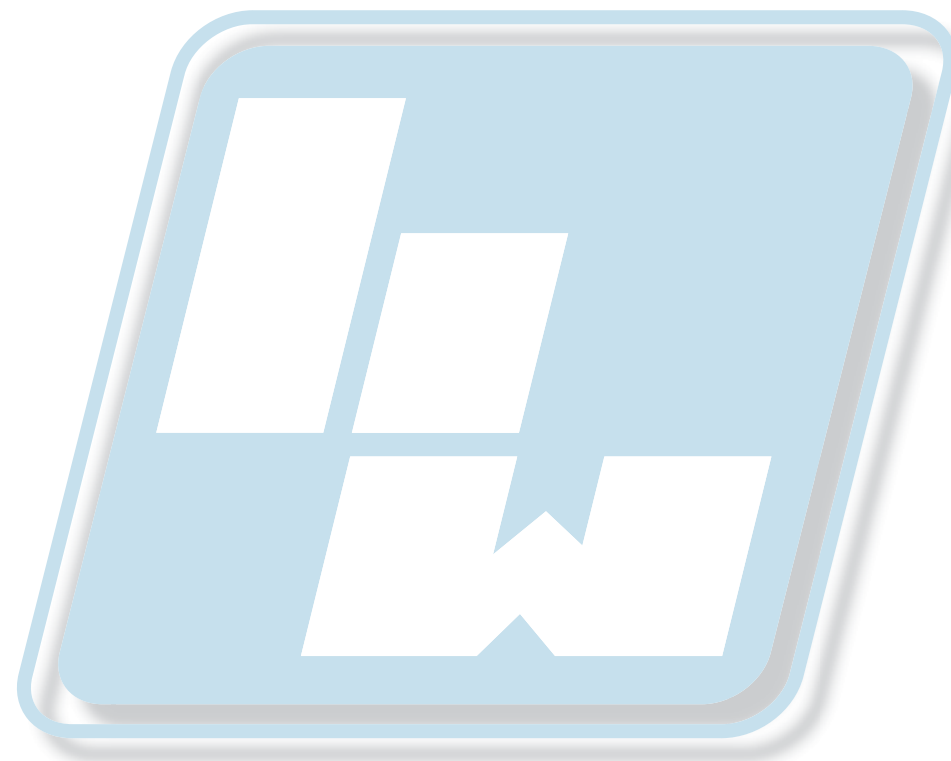


ATTENZIONE:

È importante tenere presente che la messa in funzione di una qualunque apparecchiatura implica dei rischi; pertanto è bene affrontare ogni tipo di operazione con la massima attenzione e concentrazione.



MANUTENZIONE



MAINTENANCE

NOTE:

Maintenance may be classed as “routine” or “special” maintenance.



WARNING:

All maintenance work, whether routine or special, must be carried out in the safest conditions, in places equipped for the purpose, offering perfect ventilation and lightening.



6.1 ROUTINE MAINTENANCE

The Operator is in charge of routine maintenance, including the following tasks:

- Changing the reduction gear oil as instructed in section (4.2) after no more than 50 hours of operation (running in).

Regardless of the type of work the winch is used for, check the status and the level of lubricant on a regular basis and top up when necessary. Top up the amount of grease in the drum support transmission bearing when necessary, normally given in the specifications sheet.

NOTE:

We recommend keeping a file for each winch; this should be duly filled in and updated every time maintenance work is carried out.



NOTA:

La manutenzione può essere del tipo “ordinaria” oppure “straordinaria”



ATTENZIONE:

Tutte le attività di manutenzione sia ordinaria che straordinaria devono essere eseguite in condizioni di massima sicurezza, in locali attrezzati allo scopo, perfettamente aerati ed illuminati.



6.1 MANUTENZIONE ORDINARIA

La manutenzione ordinaria è di pertinenza dell'Operatore con le seguenti attività:

- Dopo un periodo di funzionamento non superiore alle 50 ore (rodaggio) cambiare l'olio del riduttore, come specificato al paragrafo (4.2).

Controllare periodicamente a prescindere dalla tipologia di lavoro dell'organo lo stato e il livello del lubrificante ed eventualmente ripristinare i livelli normali. Dove necessario ripristinare il quantitativo di grasso nel cuscinetto di rinvio a supporto del tamburo; normalmente indicato sulle schede tecniche.

NOTA:

Si consiglia per ogni organo, di tenere una scheda che verrà debitamente compilata e aggiornata ogni qualvolta si esegua una operazione di manutenzione.



6.2 SPECIAL MAINTENANCE

CAUTION:

Brevini Winches S.p.A. does not allow the opening of the hydraulic motor or any work on the negative brake. Brevini Winches does not allow the opening of the reduction gear for any reason except for routine maintenance.



Contact Brevini Winches Technical Department if necessary.

TELEPHONE +39 0522 277711

FAX +39 0522 514977

6.3 SPECIAL MAINTENANCE

OF THE NEGATIVE BRAKE

After 1000 hours of winch operation (with average operating cycles at 60% nominal load) a full service of the negative brake is mandatory. This work must be done by Brevini Winches Technical Department or by an authorised service centre.

6.2 MANUTENZIONE STRAORDINARIA

AVVERTENZA:

La Brevini Winches S.p.A. vieta l'apertura del motore idraulico e di intervenire sul sistema del freno negativo.



La Brevini Winches vieta l'apertura del riduttore per qualsiasi operazione che non sia compresa nella manutenzione ordinaria.

In caso di necessità contattare il Servizio Tecnico Brevini Winches.

TELEFONO +39 0522 277711

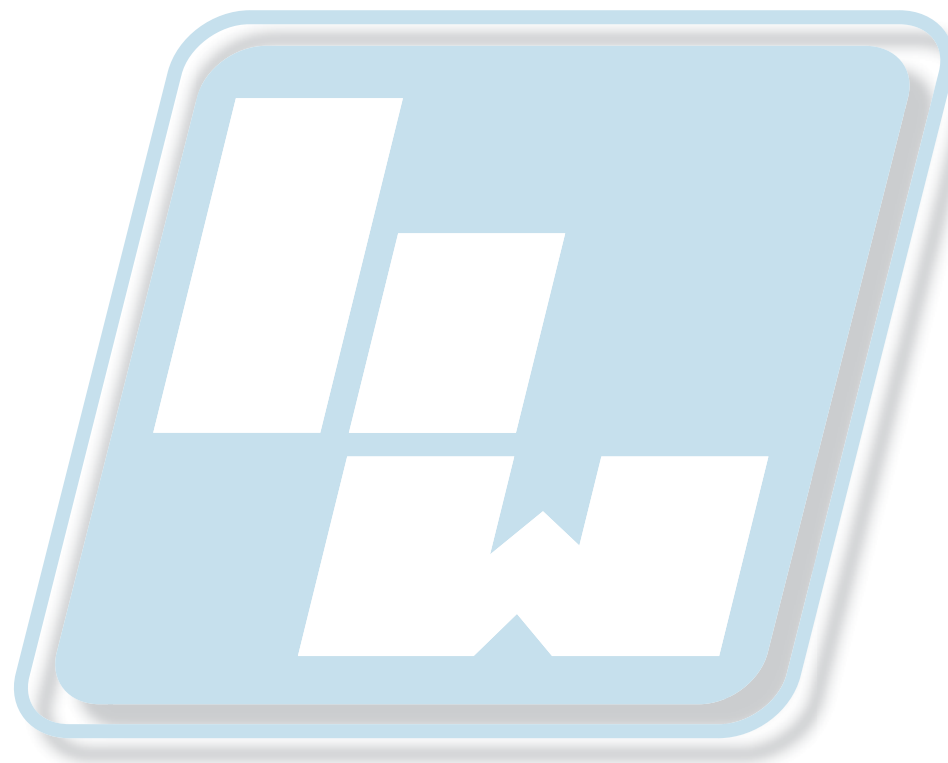
FAX +39 0522 514977

6.3 MANUTENZIONE STRAORDINARIA

DEL FRENO NEGATIVO

Dopo 1000 ore di funzionamento dell'argano (con cicli di lavoro medio pari al 60% del carico nominale) è obbligatorio eseguire una revisione completa del sistema freno negativo. Questa operazione deve essere eseguita presso il Servizio Tecnico Brevini Winches o suo centro di riparazioni autorizzato.

DEMOLIZIONE



DISPOSAL

WARNING:

Disposal must be carried out by a Qualified Technician.



NOTE:

As different methods of disposal are required in different countries, you must comply with the requirements provided for by the laws and regulations provided for by the Institutions in charge in each country.



The winch must be transported to a suitable place for the dismantling of its various parts. Before starting work, make sure the reduction gear and hydraulic motor areas have been emptied of the relative liquids they contain. Store these in suitable containers separated by type.

Dismantle all the various parts of the unit, taking extreme care with the negative brake. Separate and store the different types of materials so they can be sent for waste recycling or disposal.

ATTENZIONE:

La demolizione dell'argano deve essere effettuata da un Tecnico Qualificato.



NOTA:

Essendo in vigore una differente modalità di demolizione nei vari Stati, si devono osservare le prescrizioni imposte dalle leggi e regolamenti dagli Enti preposti dai paesi stessi.



L'argano va trasportato in luogo idoneo ad effettuare lo smontaggio delle sue parti. Prima dell'intervento assicurarsi di svuotare la zona riduttore e quella del motore idraulico dai fluidi in essa contenuti; stoccarli in recipienti idonei e suddivisi per tipo. Eseguire lo smontaggio del gruppo in tutte le sue parti, facendo molta attenzione ad eseguire le operazioni sul freno negativo. Dividere e stoccare le differenti tipologie di materiali per avviarli alla raccolta differenziata per lo smaltimento dei rifiuti.

**ACCESSORI PER ARGANI
DA SOLLEVAMENTO
E TRAINO**



**LIFTING
AND RECOVERY WINCH
ACCESSORIES**

8.1 LIFTING

The following accessories are available for correct winch operation:

- **Ropes and Hooks**
- **Special Paints, on request**
- **Pressure roller systems**
- **Pressure roller systems with control of minimum and maximum capacity of the rope wound onto the drum, with electric or oil pressure signal reading**
- **Direct or indirect reading systems for the number of drum revs**
- **Only with installer support: the option of systems for the reading of winch overload**
- **Installation of motor-driven systems other than hydraulic liquid systems, where possible**

CAUTION:

The adjustment and calibration of systems for controlling the minimum and maximum capacity of the rope wound onto the drum must be carried out by the installer before the winch start up. The above also applies to any other systems aiming to control winch overload and produced in co-operation with the final installer.



8.1 SOLLEVAMENTO

Per un corretto funzionamento dell'argano e del vericello sono disponibili i seguenti accessori:

- **Funi e Ganci**
- **Verniciature Speciali a richiesta**
- **Sistemi di Rulli Pressa Cavo**
- **Sistemi di Rulli Pressa Cavo con controllo della capacità minima e massima della fune avvolta sul tamburo, con lettura del segnale di tipo elettrico o oleodinamico**
- **Sistemi di lettura diretta o indiretta del numero di giri tamburo**
- **Esclusivamente in collaborazione con l'installatore, la possibilità di realizzazione di sistemi atti a determinare la lettura del sovracarico a cui può essere soggetto l'argano**
- **L'applicazione di motorizzazioni, dove possibile, differenti da quelle a fluido idraulico**

AVVERTENZA:

Le regolazioni e tarature dei sistemi di controllo della capacità minima e massima della fune avvolta sul tamburo, devono essere eseguite dall'installatore prima della messa in funzione dell'argano. Le operazioni sopra descritte valgono anche per tutti i sistemi realizzati in collaborazione con l'installatore finale, atti a controllare il sovracarico dell'argano.



8.2 RECOVERY

The following accessories are available for correct operation of the recovery winch:

- *Pneumatic declutch*
- *Pressure roller systems*
- *Ropes and Hooks*
- *Pulley Blocks*
- *Different systems for drum blocking or releasing*
- *Special Paints, on request*
- *Special Rope Guiding System, where possible*
- *Installation of motor-driven systems other than hydraulic systems, where possible*
- *Hydraulically-controlled valves for controlling the load and release of the negative lamellar brake*

NOTE:

Winches for recovery are supplied with manual drum release, unless specified otherwise.



8.2 TRAINO

Per un corretto funzionamento dell'argano da traino sono disponibili i seguenti accessori:

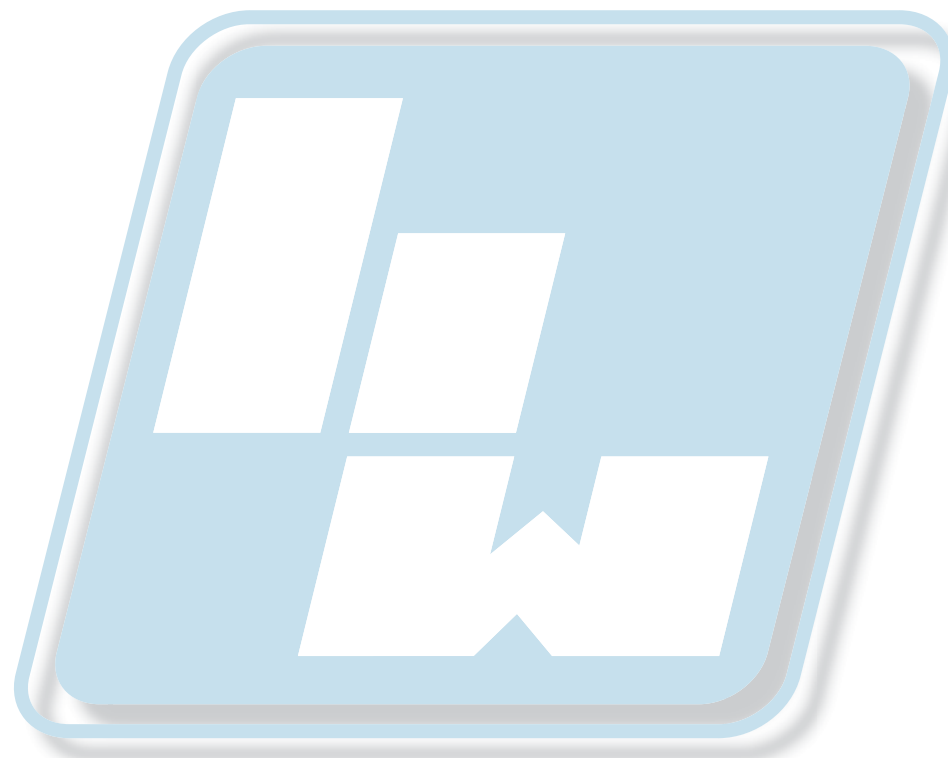
- **Disinnesti Pneumatici**
- **Sistemi di Rulli Pressa Cavo**
- **Funi e Ganci**
- **Pulegge di Rinvio**
- **Sistemi differenti di blocco o sblocco tamburo**
- **Verniciature Speciali a richiesta**
- **Sistemi di Guida Fune speciali, dove possibile**
- **Motorizzazioni differenti da quelle idrauliche, dove possibile**
- **Valvole idropilotate per il controllo del carico e apertura freno negativo lamellare**

NOTE:

Gli argani da traino salvo ordine contrario vengono forniti con desinnesto tamburo manuale.



APPENDICE A FUNI - PULEGGE E TAMBURI



APPENDIX A ROPES - PULLEYS AND DRUMS

GENERAL INFORMATION FOR USE AND MAINTENANCE OF ROPES

MAIN FEATURES

Rope is a complex piece of equipment and deciding which format to use is the result of a compromise between various factors that could affect its life.

Steel rope is a composite material and can include a number of different materials, depending on its type:

- a) its core can be made in the same quality of carbon steel used for the outer strands or in natural or synthetic fibre.*
- b) the lubricant*
- c) coatings or fillings for improving protection against external agents when applicable.*

Normal steel stranded ropes with textile core, generally used for recovery, can be used at temperatures between -40° and $+100^{\circ}\text{C}$. For the steel stranded ropes with metal core, generally used for lifting, the range goes from -40° to $+200^{\circ}\text{C}$, taking into consideration a possible drop in capacity of around 10% between 100° and 200°C .

Special lubricants must be used if the temperature exceeds 200°C ; we also recommend contacting the rope manufacturer.

Moreover, the end sections of a rope also have limits for use depending on the temperature.

PROCEDURES PRIOR TO USE

It is always good practice to inspect the rope and the documents relating to it before use because its description and/or designation will enable you to identify the parts it is made of. This is also important for storage purposes, which must be in a well-ventilated, dry and enclosed area, which is off the ground,

INFORMAZIONI GENERALI PER L'USO E LA MANUTENZIONE DELLE FUNI

CARATTERISTICHE PRINCIPALI

La fune è una macchina complessa e la scelta della formazione da utilizzare è il risultato di un compromesso tra i vari fattori che possono influenzarne la durata.

La fune in acciaio è un materiale composito ed in funzione del tipo, può contenere un numero diverso di materiali:

- a) l'anima che può essere in acciaio al carbonio della stessa qualità utilizzata per i trefoli esterni oppure in fibra naturale o sintetica.
- b) Il lubrificante
- c) Ove applicabili rivestimenti o riempimenti, per migliorare la protezione da agenti esterni.

Le funi in acciaio a trefoli con anima tessile, tipiche per il traino possono essere usate con temperature comprese fra i -40° e i $+100^{\circ}\text{C}$; mentre per le funi in acciaio a trefoli con anima metallica, usate per il sollevamento in generale, il campo di utilizzo va da -40° a $+200^{\circ}\text{C}$; riservandosi di considerare una possibile perdita di capacità dell'ordine del 10% della portata stessa tra i 100° e i 200°C . Nel caso di temperature superiori ai 200°C devono essere utilizzati lubrificanti particolari e si consiglia di consultare il produttore della fune.

Anche le parti terminali di una fune hanno dei limiti di utilizzo in funzione della temperatura, in aggiunta a quanto indicato sopra.

NORME PRE-UTILIZZO

È buona norma ispezionare la fune ed i documenti ad essa collegati, prima di utilizzarla perché la descrizione e/o la sua designazione permetterà di identificare le parti che la com-

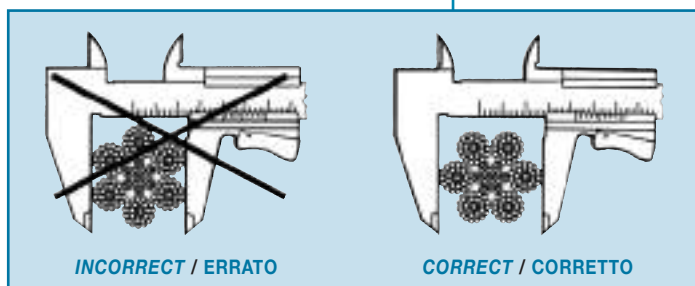


Figura 3
Feature 3

so that routine inspection and handling are possible in order to improve the effect of the lubricant.

MEASURING THE ROPE DIAMETER

Rope diameter is the diameter of the circle circumscribing the rope section. You should consider the rope's diameter to be the same as the circle circumscribed around the section, taking care to measure the distance between the outer edge of a strand and the one diametrically opposite when taking the measurement.

SEE FIGURE 3

HOW TO HANDLE THE ROPE

Before fitting new rope you should control the conditions and dimensions of the machine parts connected to the rope, such as drums, pulleys and rope guides, etc. in order to verify that they are still within the operating limits provided for by the manufacturer of the machine, if they have been used previously. It is always good practice to verify that all pulley blocks and rope guide pulleys are not blocked.

For handling and fitting the rope, we should distinguish between two different types of supply formats:

pongono. Ciò è anche funzione del relativo stoccaggio che deve avvenire in un luogo coperto, sollevata dal terreno, ben ventilato ed asciutto consentendo un'ispezione periodica e un movimento della stessa per migliorare l'azione del lubrificante.

MISURAZIONE DEL DIAMETRO DELLA FUNE

Il diametro della fune è il diametro del cerchio che circonda la sezione della fune. Si considera come diametro della fune quello del cerchio circoscritto alla sezione medesima, ponendo attenzione durante la misurazione a rilevare la misura tra esterno di un trefolo e quello diametralmente opposto.

VEDI FIGURA 3

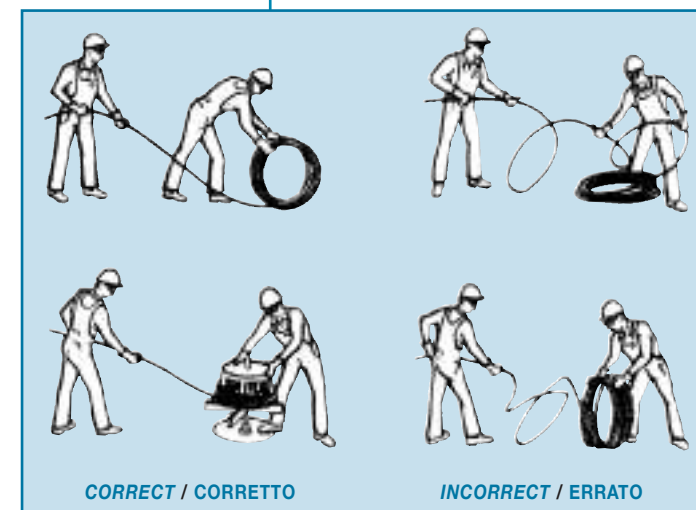
COME MANEGGIARE LA FUNE

Prima di installare la nuova fune bisogna controllare le condizioni e le dimensioni delle parti delle macchine collegate alla fune, tamburi, pulegge, guida fune, eccetera al fine di verificare che siano, se già utilizzati, ancora nei limiti operativi specificati dal costruttore del macchinario.

Sarebbe opportuno sempre verificare il non bloccaggio di tutte le pulegge di rinvio ed di guida fune.

Per maneggiare ed installare la fune è necessario distinguere due tipi di fornitura:

Figura 4
Feature 4



1. Coiled rope: the coil of rope should be placed on the ground and uncoiled in a straight line, so that it does not become twisted or knotted, taking steps to prevent it from getting dirty due to dust, sand, damp material or other harmful substances (the appropriate revolving supports can be used for large coils).

SEE FIGURE 4

2. Rope wound onto a reel: insert a suitably strong shaft inside the reel and then place it on a stand which allows it to turn and be stopped at the same, in order to prevent it from gaining too much speed due to momentum during installation so that the coils can be wound onto the drum or winch correctly, especially with multi-layer coils. It is particularly important that the coils in the lower layers of the rope are wound tightly onto the drum surface (apply a pre-load to keep the rope taut during winding). It is important to place the reel of rope so that the angle of deviation is reduced as much as

1. Fune fornita in un rotolo: il rotolo di fune dovrebbe essere posizionato al suolo e svolto in linea retta, in modo da non creare così torsioni o nodi, assicurandosi che non venga contaminato da polvere, sabbia, materiale umido od altri prodotti dannosi. (per rotoli di dimensioni elevate si può ricorrere all'utilizzo di appropriati supporti girevoli).

VEDI FIGURA 4

2. Fune avvolta su bobina: inserire un albero di adeguata resistenza all'interno della bobina e posizionare la stessa su un cavalletto che consenta la rotazione della stessa ed il contempo di essere frenata, al fine di evitare la corsa eccessiva per inerzia durante l'installazione, consentendo un corretto avvolgimento delle spire sul tamburo o sull'argano soprattutto nel caso di avvolgimenti multi-strato. E' particolarmente importante che le spire della fune degli strati inferiori siano avvolte in modo serrato alla superficie del tamburo (avere un precarico che tiene in tensione la fune in fase d'avvolgimento). E' importante posizionare la bobina di fune in modo tale

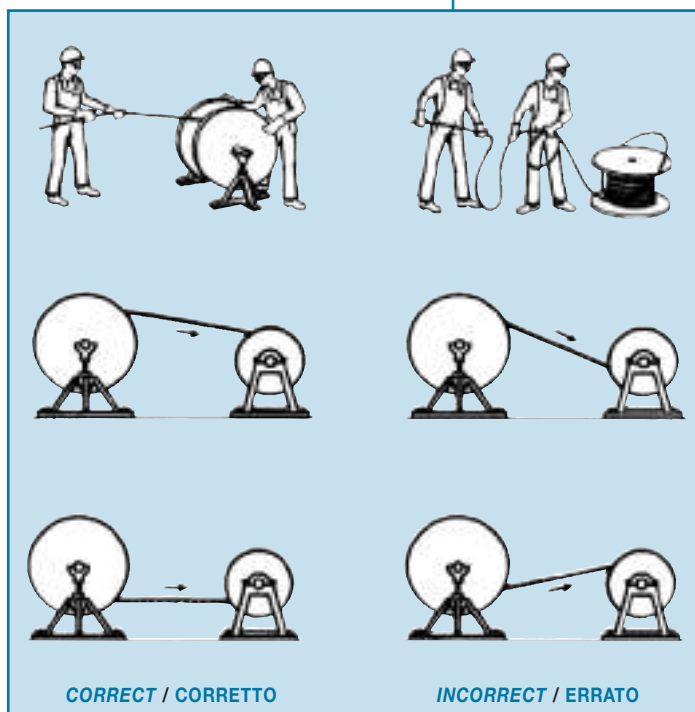


Figura 5
Feature 5

possible during installation (see instructions for fitting the rope).

Should a loop (kink) accidentally occur along the rope, it must not be pulled order to prevent permanent distortion and that it does not come across unwelcome obstacles or contact.

SEE FIGURE 5

DIRECTION FOR WINDING THE ROPE

Looking at the direction used for twisting the rope itself, we call it a **Z** winding when we can see the letter **Z** when looking at the direction of the threads in the mid section and holding the rope vertically. We call it an **S** winding

da ridurre al minimo l'angolo di deviazione (vedi montaggio fune) durante l'installazione. Se casualmente si formasse un'asola (occhiello) sulla fune è bene assicurarsi che non venga tirata fino a formare una deformazione permanente e che non incontri ostacoli o contatti indesiderati.

VEDI FIGURA 5

SENSI DI AVVOLGIMENTO DELLA FUNE

Ponendo l'attenzione sul senso di avvolgimento proprio della fune possiamo definire **avvolgimento Z** quello, dove tenendo la fune in posizione verticale, presenta all'osservatore le spire visibili nella direzione del tratto

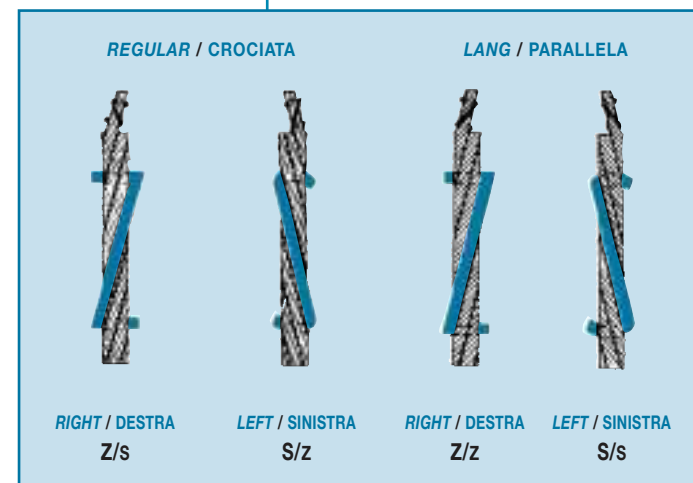


Figura 6
Feature 6

when we can see the letter **S**, again holding the rope vertically and looking at the direction of the threads in the mid section.

This defines the direction of the strand twist in the ropes; we must now define the direction of the outer strand wires.

SEE FIGURE 6

There are four possible cases:

- **Z/s right regular lay rope (strands Z and wires s)**
- **S/z left regular lay rope (strands S and wires z)**
- **Z/z right lang lay rope (strands Z and wires z)**
- **S/s left lang lay rope (strands S and wires s)**

mediano della lettera **Z**; mentre **avvolgimento S** è quello, tenuta sempre in posizione verticale la fune, che presenta all'osservatore le spire visibili nella direzione del tratto mediano della lettera **S**.

Questo ha definito il senso di avvolgimento dei trefoli nelle funi poi resta da definire il senso di avvolgimento dei fili esterni nei trefoli.

VEDI FIGURA 6

I casi possibili sono quattro:

- **Fune crociata destra Z/s (trefoli Z e fili s)**
- **Fune crociata sinistra S/z (trefoli S e fili z)**
- **Fune parallela destra Z/z (trefoli Z e fili z)**
- **Fune parallela sinistra S/s (trefoli S e fili s)**

ROPE FITTING AND MAINTAINING

It is essential to check that the rope is wound onto the drum correctly and that there is no looseness in the rope coils or crossing over of layers on the drum, so it is able to gradually adapt to working conditions as the load increases.

Ropes must also be inspected thoroughly by trained personnel during the routine and special maintenance of the machinery.

In conditions of heavy and continuous use of the machinery, ropes should be checked much more frequently than the scheduled intervals for normal maintenance.

With cranes, a check should be carried out at the start of each shift or working day when the crane is in operation, in order to ensure the ropes are placed correctly on their pulleys and on the drums and have not been tampered with.

When the crane is working normally, the ropes should be inspected at least once a week to check for any broken wires, kinking or flattening, and any other damage, excess wear and surface corrosion.

All rope heads, swivels, safety accessories, pins and pulleys should be checked for damage and worn or seized bushings.

Hooks and other couplings for lifting, safety devices and swivels should be checked for damage and that they can move freely and checked for wear.

Every bolt hook and the stop nut should be checked for prohibited movement, which could indicate wear and corrosion.

ROPE LUBRICATION

The protection guaranteed by the lubricant used by the rope manufacturer is usually sufficient to prevent deterioration due to corrosion during shipment and storage and for the initial period of rope use.

However, for optimum performance, the majority of ropes will benefit from the applica-

MONTAGGIO E MANUTENZIONE DELLA FUNE

È fondamentale controllare che la fune venga avvolta correttamente sul tamburo e che non si presentino allentamenti nelle spire della fune o sovrapposizioni incrociate su strati del tamburo, consentendo di adattarsi gradualmente alle condizioni operative con carichi crescenti.

Inoltre le funi devono essere esaminate accuratamente da personale competente durante i periodi di manutenzione ordinaria e straordinaria del macchinario. Nei casi di utilizzo pesante e continuativo dei macchinari stessi è corretto eseguire le verifiche funi anche in periodi molto più brevi tra i periodi intercorsi dalle normali manutenzioni.

Nel caso di gru bisognerebbe operare un controllo all'inizio di ogni turno o giornata lavorativa in cui la gru è in funzione al fine di assicurarsi che le funi siano correttamente posizionate sulle loro pulegge e sui tamburi e non siano state manomesse. Quando la gru sta operando normalmente le funi dovrebbero essere ispezionate per accertarsi della presenza di eventuali fili rotti, deformazioni od appiattimenti od altri indicatori di danno, consumo eccessivo e corrosione della superficie almeno una volta alla settimana. Tutti i terminali della fune, girevoli, perni ed accessori di ritenuta e le pulegge dovrebbero essere controllati per eventuali danni, bronzie consumate o grippate. Anche i ganci ed altri attacchi per il sollevamento, sicurezze e girevoli dovrebbero essere controllati per eventuali danni, libertà di movimento od usura. Ogni gancio a gambo filettato ed il dado di sicurezza dovrebbero essere controllati per accertare eventuali movimenti non consentiti che potrebbero significare usura e corrosione.

LUBRIFICAZIONE DELLA FUNE

La protezione garantita dal lubrificante utilizzato dal costruttore della fune è solitamente

tion of a service lubricant.

The recommended type depends on the application of the rope and the conditions the rope is exposed to.

The service lubricant must be compatible with the original one used by the manufacturer and the methods of application vary from brush lubricators to drip-feed lubricators, high- or low-pressure sprays.

It is always advisable to use lubricants suitable for neutral rope as well as for the type and place of use.

ROPE SELECTION

Once you verify that the primary factor determining deterioration is abrasion (wear caused by repeated and ongoing contact with another element, such as drum, pulleys, etc.), your choice should be directed towards a rope whose outer wires are as large as possible.

We recommend lang lay rope (with both heads blocked so as to be impossible to turn) and ropes with compacted strands for high levels of abrasion.

Flattening is another problem/malfunction which may occur for various reasons but most frequently when the rope is subject to multi-layer winding on the drum.

Additionally, greater pressure is found between the rope and a smooth or flat surface compared to a grooved drum.

When winding with several layers, ropes and strands with textile core should not be used for lifting.

Ropes with steel core and compacted strands offer greater resistance against crushing and deformation.

To prevent corrosion, in addition to the use of lubricant, you can also use galvanized wires, outer protection and different materials, such as stainless steel, in special circumstances.

adeguata a prevenire il deterioramento dovuto alla corrosione durante le fasi di spedizione e stoccaggio e per i primi periodi di lavoro della fune; tuttavia al fine di ottenere le prestazioni ottimali, la gran parte delle funi trarrà beneficio dall'applicazione di un lubrificante di servizio, il tipo consigliato varia in funzione dell'applicazione della fune e delle condizioni ambientali alle quali la fune risulta essere esposta.

Il lubrificante di servizio deve essere compatibile con il lubrificante originale del costruttore e, i metodi di applicazione sono diversi dalla spazzola all'oliatore a goccia o a spray più o meno pressurizzato.

È sempre consigliato utilizzare lubrificanti per funi di tipo neutro ed appropriato alla tipologia ed al luogo d'uso.

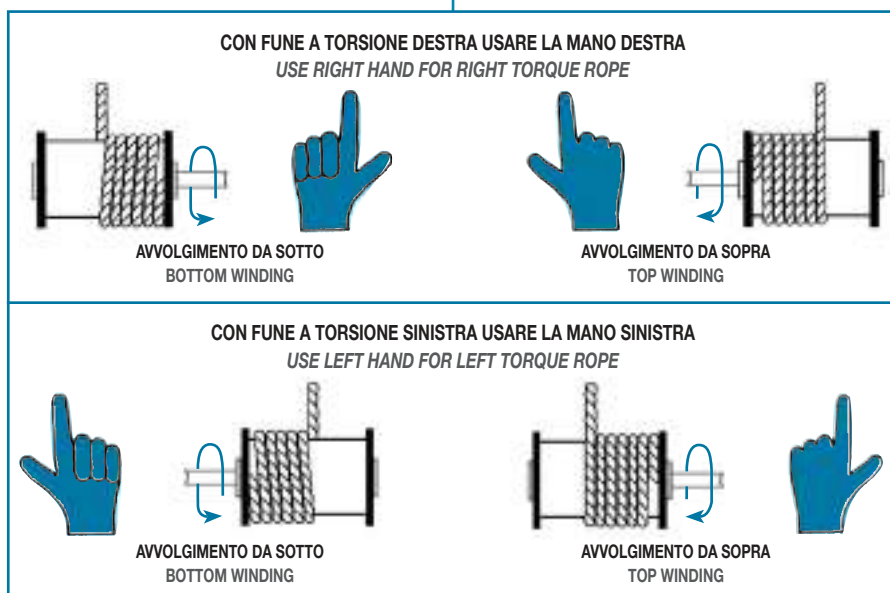
SELEZIONE DELLA FUNE

Quando si è a conoscenza che il fattore primario del deterioramento è l'abrasione (usura per il contatto ripetuto e continuo con un altro corpo quali tamburo, pulegge, ecc.), bisogna indirizzare la propria scelta verso una fune avente i fili esterni più grandi possibile. Si consigliano funi parallele (aventi entrambe le estremità bloccate ed impossibilitate a girare) e funi con trefoli compattati dove si è in presenza di elevata abrasione.

Lo schiacciamento è un altro fenomeno che può accadere a causa di una serie diverse di ragioni ma più frequentemente quando la fune è soggetta ad avvolgimento multistrato su tamburo. Ancora si riscontra una maggiore pressione tra la fune e la superficie liscia o piana rispetto a quella di un tamburo scanalato. Nel caso di avvolgimenti su più strati per il sollevamento non dovrebbero essere utilizzate funi e trefoli con anima tessile. Funi con anima di acciaio e con trefoli compattati sono maggiormente resistenti allo schiacciamento ed alle deformazioni.

Per combattere la corrosione, oltre al lubrificante, si può ricorrere all'utilizzo di fili zincati, protezioni esterne ed eventualmente in

Figura 7
Feature 7



ROPE ANCHORING ONTO THE DRUM AND WINDING DIRECTION

Unless specified otherwise in the instructions provided by the manufacturer of the machine, the position for connecting the rope onto the drum and the winding direction must comply with the illustration above.

SEE FIGURE 7

NOTE:

The hand rule can be explained as follows:

- the "thumb" indicates the point and the side for anchoring the rope onto the drum
- the "index finger" indicates the type of rope outlet (top or bottom)



casi particolari materiali diversi quali l'acciaio inossidabile.

ANCORAGGIO DELLA FUNE SUL TAMBURO E SENSO DI AVVOLGIMENTO

A meno che non sia altrimenti specificato nelle istruzioni del costruttore della macchina, la posizione dell'attacco della fune sul tamburo e la direzione di avvolgimento dovrebbero rispettare quanto raffigurato.

VEDI FIGURA 7

NOTE:

La regola dell'utilizzo della mano è così spiegata:

- Il dito "pollice" indica il punto ed il lato di ancoraggio della fune sul tamburo



- The right hand indicates the use of right torque rope
- The left hand indicates the use of left torque rope
- The direction of rope winding onto the drum is indicated by a curve starting from the tip of the index finger and has the tip of the thumb as the arrow
- The direction of rope winding onto the drum is always considered as starting at the rope's anchor point. This is also the observation point for drum rotation during winding

This system applies both to smooth drums and grooved drums.

BLOCKS STABILITY DURING ROTATION

In order to limit the risks associated with load rotation during lifting and to safeguard the safety of personnel in the relative area, you should always use anti - swivel rope which will, however, give a minimum amount of turning when subjected to a load.

If rotation resistant ropes are used, whose ring of outer strands is twisted in the opposite direction to that of the strands layer underneath, the amount of twist produced when loaded, either with both heads blocked (twisting moment) or when one head is free to rotate, is considerably less than with rope with a single layer of threads.

ANGLE OF DEVIATION

The angle of deviation is the angle formed by the axis of the rope and the surface passing through the race of the pulley. The pulley must be directed so as to minimize the entry angle as far as possible, ranging from zero when the rope is midway on the drum to maximum when it is close to one of the two flanges.

- Il dito "indice" indica il tipo di uscita fune (da sopra o da sotto)
- La mano destra indica l'utilizzo di una fune a torsione destra
- La mano sinistra indica l'utilizzo di una fune a torsione sinistra
- Il senso di avvolgimento della fune sul tamburo è indicato da una curva che parte dalla punta del dito indice e ha come freccia la punta del dito pollice
- Il senso di avvolgimento della fune sul tamburo è sempre considerato dal punto di ancoraggio della fune stessa, che è anche il punto di osservazione per la rotazione del tamburo in avvolgimento

Questo sistema si applica sia ai tamburi lisci che a quelli scanalati.

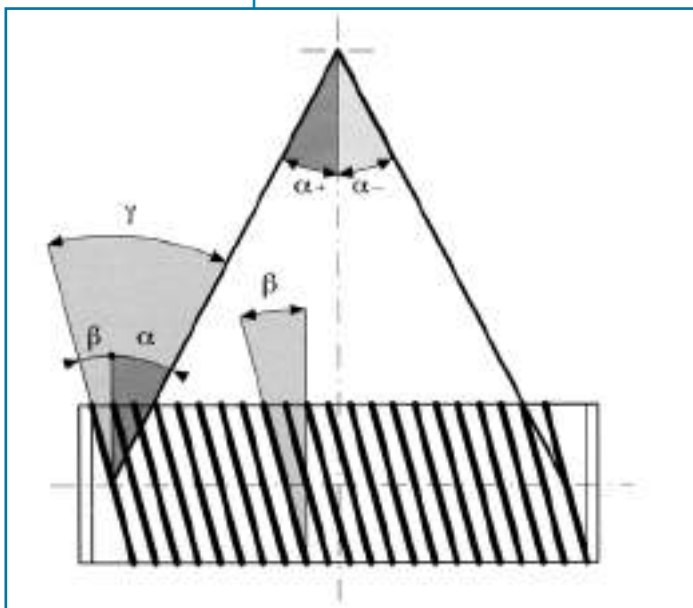
STABILITÀ DEI BOZZELLI ALLA ROTAZIONE

Al fine di limitare i rischi legati alla rotazione del carico durante un sollevamento e per assicurare la sicurezza del personale nella area di sollevamento, è sempre preferibile selezionare una fune anti - girevole che comunque ruoterà in modo minimo quando sottoposta ad un carico. Avvalendosi di funi resistenti alla rotazione che presentano la corona dei trefoli esterni avvolti in senso opposto rispetto a quelli dello strato di trefoli sottostanti, la quantità di torsione generata sotto carico sia con entrambe le estremità bloccate (momento torcente) che nel caso in cui una estremità è libera di ruotare è nettamente inferiore rispetto ad una fune con uno strato singolo di trefoli.

ANGOLO DI DEVIAZIONE

L'angolo di deviazione è l'angolo formato dall'asse della fune con il piano passante per la gola della puleggia. Questa deve essere

Figura 8
Feature 8



SEE FIGURE 8

The figure shows a large helical grooved drum whose pitch has angle β and race (pulley) bending. When the rope unwinds starting from the drum towards the pulley, it forms the angle of deviation α . On the drum, the rope will be subject to bending equal to angle γ .

$$\gamma = \alpha + \beta$$

α = maximum angle of deviation on the first pulley

β = groove angle

γ = worst case total angle

Every time there is an angle of deviation, as the rope enters the pulley, it will initially come into contact with the pulley's flanges.

orientata in modo da ridurre al minimo l'angolo d'entrata, che varia da zero quando la fune si trova a metà del tamburo al massimo quando si trova in prossimità di una delle due flangie.

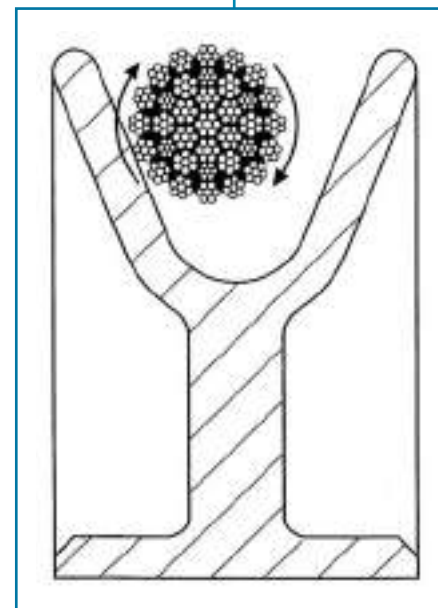
VEDI FIGURA 8

La figura mostra un ampio tamburo scanalato elicoidale con un passo avente un angolo β ed un piegamento della (puleggia) gola. Quando la fune si svolge partendo dal tamburo verso la puleggia forma un angolo di deviazione α . Sul tamburo la fune subirà un piegamento pari ad un angolo γ .

$$\gamma = \alpha + \beta$$

α = angolo massimo di deviazione sulla prima puleggia

Figura 9
Feature 9



As the rope continues to move from the pulley, it moves away from the flange until it reaches the pulley's race bottom. During this movement, the rope rolls and slips at the same time. As a result of the roll, the rope will turn on its own axis causing a twist which can be generated on the rope or outside of it, both by shortening and lengthening the winding pitch, resulting in inferior fatigue performance and, in the worst case, in a structural damage to the rope which takes on a bird cage shape. As the angle of deviation increases, so does the induced rotation.

SEE FIGURE 9

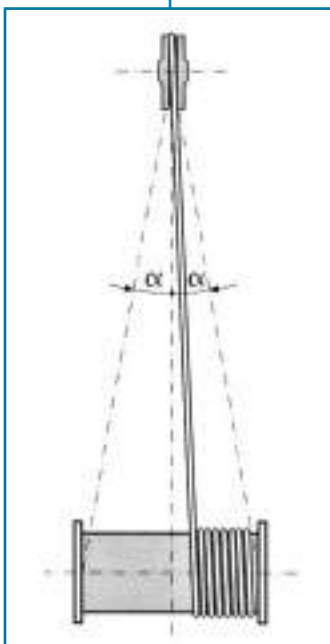
β = angolo della scanalatura

γ = angolo totale nella condizione più sfavorevole

Ogni qualvolta esiste un angolo di deviazione come la fune entra nella puleggia, essa inizialmente entrerà in contatto con le flangie della puleggia. Nello svolgersi del movimento di passaggio continuo della fune della puleggia, il cavo si sposta dalla flangia fino a raggiungere il fondo gola della puleggia. Durante tale spostamento la fune rotola e scivola allo stesso tempo. Come risultato del rotolio la fune ruoterà sul proprio asse causando un giro che può essere prodotto nella fune od al di fuori di essa, sia accorciando che allungando il passo di avvolgimento, risultando in una riduzione della performance della fatica e nel peggiore dei casi in un danno strutturale della fune che prende la forma di infiascature (bird cage). All'aumentare dell'angolo di deviazione aumenta la rotazione indotta.

VEDI FIGURA 9

Figura 10
Feature 10



When the rope is wound onto drums without grooves or in several layers, the angle of deviation must not exceed $1^{\circ}30'$ in order to prevent irregular winding of the rope onto the drum. If the angle exceeds this, a rope guide should be used. When the rope is wound onto a grooved drum, the angle of deviation γ should never exceed 4° .

SEE FIGURE 10 AND 11

NOTE:
For practical reasons, the construction drawings of some cranes and hoists may not be able to comply with these instructions (recommended values). In this case, the life of the rope will be affected.



Quando la fune si avvolge su tamburi non scanalati o su più strati, l'angolo di deviazione non deve superare $1^{\circ}30'$ per evitare l'irregolare avvolgimento della fune sul tamburo. Se l'angolo è superiore si raccomanda l'impiego di un guida fune. Quando la fune invece si avvolge su un tamburo scanalato, l'angolo di deviazione γ non deve superare mai i 4° .

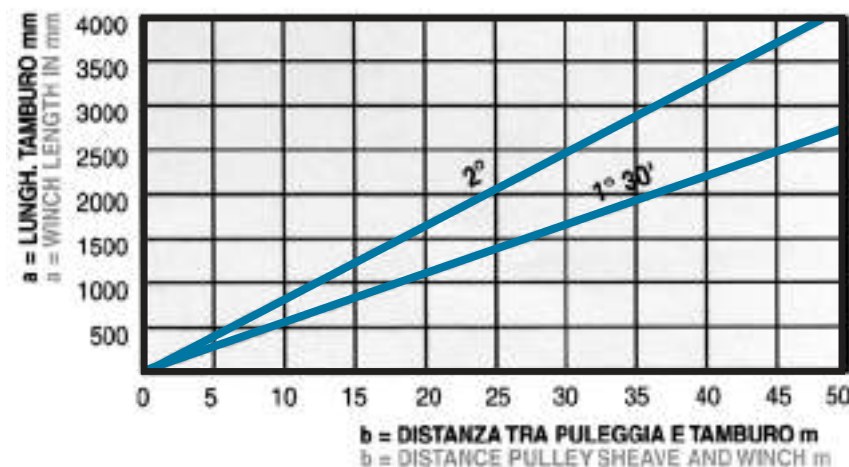
VEDI FIGURA 10 E 11

NOTA:

Per ragioni pratiche il disegno costruttivo di alcune gru e paranchi può non essere in grado di rispettare tale prescrizione (valori raccomandati), in tal caso verrà influenzata negativamente la vita della fune.



Figura 11
Feature 11



The angles of deviation may be reduced as follows:

- a) by reducing drum width;
- b) by increasing the distance between the pulley and the drum

Excessive angles of deviation force the rope to be wound onto the drum prematurely, creating vacant spaces between the various coils of rope placed close to the drum flange and therefore increasing the pressure on the rope in crossover positions.

Even when the drum has helical grooves, large angles of deviation will inevitably result in local areas of mechanical damage as the wires break (catch) on one another.

This phenomenon is usually referred to as "interference" but its extent can be reduced by choosing a "lang lay" rope, if the winding system allows it, or a compacted rope.

Gli angoli di deviazione possono essere ridotti come segue:

- a) riducendo la larghezza del tamburo;
- b) aumentando la distanza tra la puleggia ed il tamburo

Angoli di deviazione eccessivi spingono la fune ad avvolgersi sul tamburo prematuramente, creando dei vuoti tra le diverse spire della fune posizionate vicino alla flangia del tamburo, aumentando così la pressione sulla fune nelle posizioni di incrocio.

Anche nei casi in cui il tamburo è provvisto di scanalature elicoidali, ampi angoli di deviazione daranno inevitabilmente luogo ad aree localizzate di danno meccanico in quanto i fili si strappano (si pizzicano) vicendevolmente.

Ci si riferisce solitamente a tale fenomeno definendolo "interferenza" ma l'ampiezza di quest'ultimo può essere ridotta selezionando una fune "parallela" se il sistema di avvolgimento lo consente o una fune compattata

CRITERIA FOR TARGETED ROPE CONTROL

The illustration below gives you a broad outline of the possible defects to take into consideration while checking the ropes for lifting, such as damaged wires, wear, reduction in diameter, corrosion and excessive lengthening, in relation to the various positions of the rope on the equipment.

SEE FIGURE 12

There are tables and standards stating the extreme conditions urging the rope to be replaced, based on the rope's category and the use required. It is not possible, in fact, to define a life cycle for this accessory. In addition to the types of deformation already mentioned, the following may also be encountered: helical distortion, basket distortion, strand protrusion, wire protrusion, local increase or reduction in diameter, flattened sections, twisting and kinks.

CRITERI PER IL CONTROLLO MIRATO

DELLE FUNI

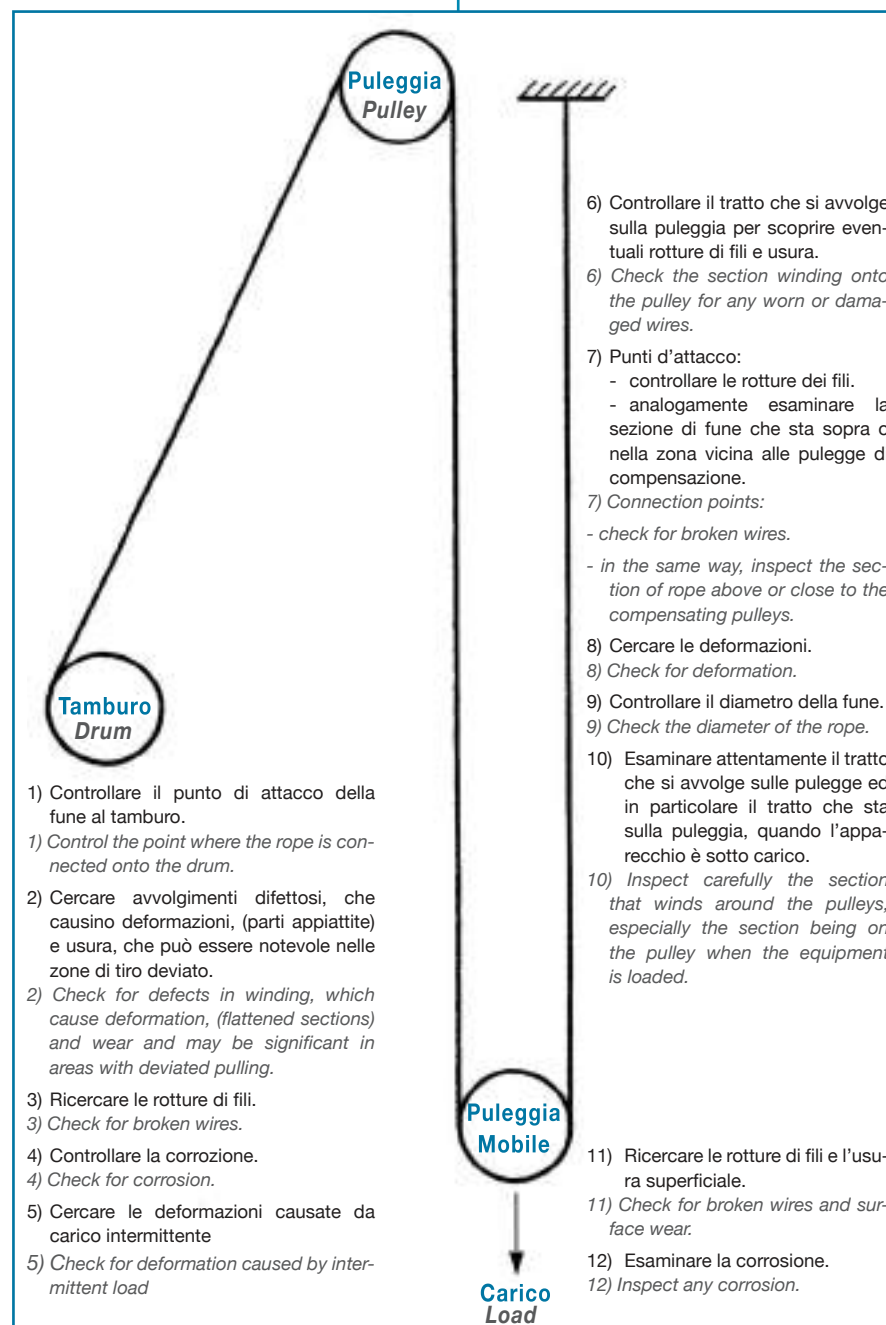
Di seguito un'illustrazione schematica degli eventuali difetti da prendere in considerazione durante il controllo delle funi per il sollevamento quali la rottura dei fili, l'usura, la riduzione del diametro, la corrosione e l'allungamento eccessivo, in relazione alle diverse posizioni della fune sull'apparecchio.

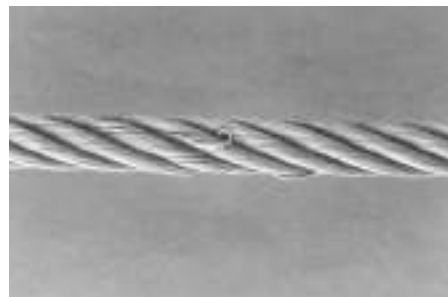
VEDI FIGURA 12

Esistono tabelle e normative che in base alla classe di appartenenza e all'utilizzo preposto indicano la condizione limite cui deve avvenire la sostituzione della fune, infatti non è possibile definire un ciclo vita di questo accessorio.

Un elenco dei fenomeni di deformazione che si possono incontrare è il seguente oltre a quelli già menzionati: distorsione a elica, distorsione a canestro, espulsione di trefoli, espulsione di fili, aumento o riduzione localizzata del diametro, parti appiattite, attorcigliamenti e pieghe.

Figura 12
Feature 12





A

Wire protrusion

Espulsione di fili



B

Strand protrusion

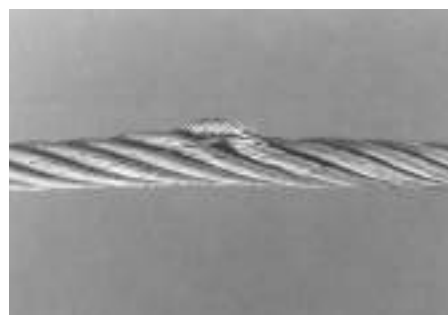
Espulsione di trefoli



C

Local reduction of rope diameter

Riduzione localizzata
del diametro della fune



D

Strand protrusion

Espulsione di trefoli

Flattened portion

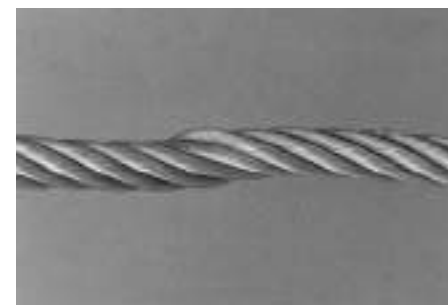
Parte appiattita



E

Kink

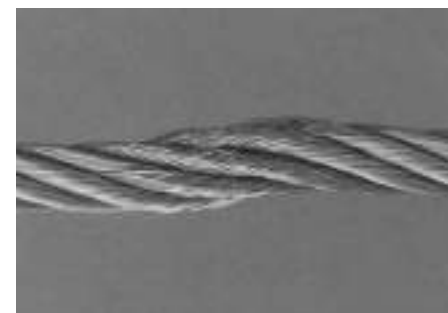
Piega



F

Kink

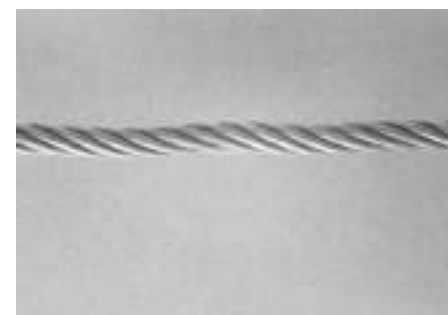
Piega



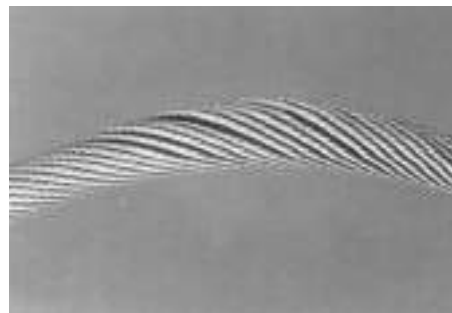
G

Waviness

Ondulazione



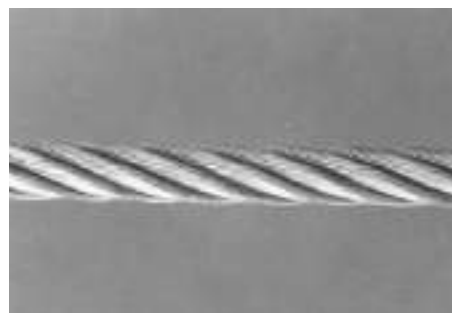
H



Deformazione a canestro

Basket deformation

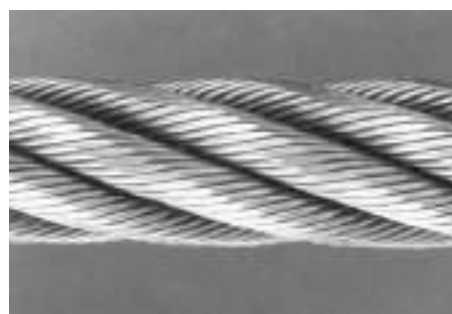
I



Usura esterna

External wear

L



Ingrandimento della Fig. L

Enlargement of Fig. L

M



Corrosione esterna

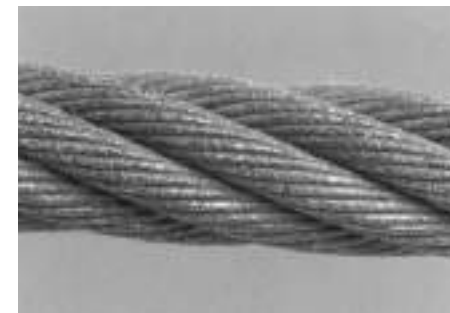
External corrosion

N

Ingrandimento della Fig. N

Enlargement of fig.N

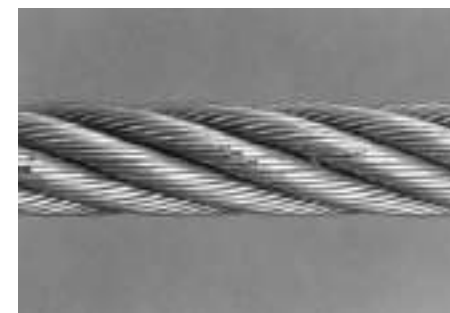
O



Fili rotti nella parte esterna della fune

Broken wires on the 'crowns' of the strands of the rope

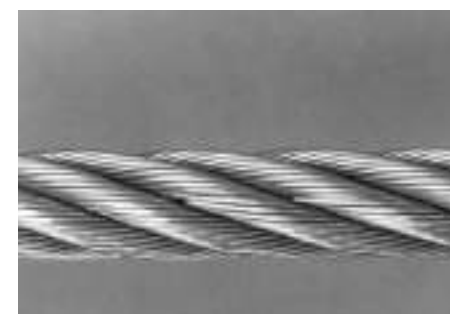
P



Fili rotti nei "solchi"
(a volte chiamati fazzoletto o interstizi)
tra i trefoli esterni della fune

*Broken wires in the 'valleys'
(sometimes called gussets or interstices)
between the outer strands of the rope*

Q

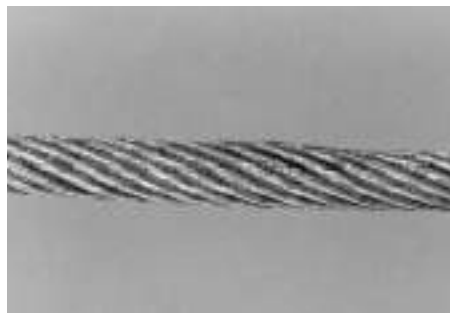


Espulsione dell'anima

Core protrusion

R





Aumento localizzato del diametro della fune dovuto all'espulsione dell'anima

Local increase in rope diameter due to core protrusion

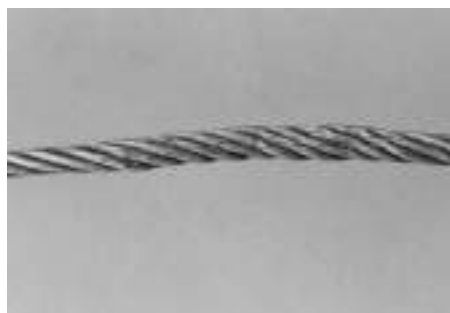
S



Kink

Occhiello

T



Flattened portion

Parte appiattita

U

APPENDICE B TEORIA DEL RECUPERO E DEL TRAINO



APPENDIX B NOTIONS ON TOWING AND RECOVERY

You can achieve the best results in using winches for recovery if you know a little about the mechanics involved and the difference between the lifting and pulling of a vehicle.

Resistance to lifting is very different to resistance to pulling and can be deduced from 4 main factors affecting the recovery of a vehicle:

- 1. the inherent resistance to movement of the vehicle**
- 2. the total weight of the vehicle**
- 3. the type of surface where the vehicle is to be pulled across**
- 4. the gradient of the surface where the vehicle is to be recovered.**

- *The inherent resistance of a vehicle depends on the state of its tyres, surface friction, the weight of the vehicle and its mechanical conditions.*

Assuming the vehicle is in good working order, that is to say its tyres are not blocked and are satisfactory (a flat tyre would demand more pulling power), check its status before starting recovery and change any worn parts, if necessary, and then inspect the surrounding area.

- *The vehicle weight must include all its fittings and equipment including luggage, fuel, passengers on board, etc.*
- *The type of surface where the vehicle is to be pulled across is the biggest variable in the recovery equation. The pulling power needed to start moving a vehicle in good condition on a tarmac road will be about 4% of its overall weight, whilst a vehicle that has to be pulled out of deep mud will need the equivalent of 50% of its overall weight in pulling power.*

I risultati migliori negli argani da recupero avvengono se si fanno alcune considerazioni intuitive e di natura meccanica sulla differenza tra il sollevamento e il traino di un veicolo.

La resistenza nel sollevamento è ben diversa da quella del traino e si può desumere da questi 4 fattori, che influenzano il recupero di un veicolo:

- 1. l'inerzia resistente al movimento del veicolo**
- 2. il peso totale del veicolo**
- 3. la natura della superficie su cui il veicolo è trainato**
- 4. il grado d'inclinazione della superficie su cui deve essere recuperato il veicolo.**

- La resistenza dovuta all'inerzia di un veicolo dipende dallo stato dei pneumatici, dall'attrito sulla superficie, dal peso del veicolo e se questo è in buono stato meccanico.

Per ipotesi assumiamo il veicolo in buone condizioni cioè che le gomme non siano bloccate e che siano a posto (una gomma sgonfia richiederebbe maggior sforzo); quindi prima di iniziare il recupero controllarne lo stato e se necessario cambiare gli organi deteriorati e monitorare l'ambiente circostante.

- Nel peso del veicolo deve essere incluso di tutto l'equipaggiamento compreso bagagliaio, benzina, passeggeri a bordo, ecc..
- La natura della superficie su cui deve essere trainato il veicolo è la variabile più grande dell'equazione del recupero. Un veicolo in buone condizioni su una strada asfaltata avrà bisogno di una forza di traino corrispondente a circa il 4% del suo peso complessivo per indurlo in movimento, mentre invece un veicolo che deve essere

The table below shows different surfaces with their relative proportions of power needed to start moving the vehicle.
(type of surface and power required to move the vehicle in proportion to its weight)

best TARMAC road or surface 0.04 of total vehicle weight
GRASS 0.143 of total vehicle weight
DAMP HARD SAND 0.166 of total vehicle weight
GRAVEL 0.2 of total vehicle weight
DAMP SOFT SAND 0.2 of total vehicle weight
DRY SOFT SAND 0.25 of total vehicle weight
SHALLOW MUD 0.33 of total vehicle weight
DEEP MUD 0.5 of total vehicle weight
STICKY CLAY 0.5 of total vehicle weight

Follow the indications provided in the technical documentation for any other coefficients of friction.

A simple formula is shown below for a rough calculation of the power of resistance of a vehicle to be towed on any type of non-sloping surface in the list:

recuperato nel pantano avrà bisogno di una forza equivalente a circa il 50% del suo peso complessivo.

La tabella sottostante mostra le differenti superfici con le relative proporzioni di sforzo per produrre il movimento nel veicolo.
(tipo di superficie e sforzo richiesto per muovere il veicolo in proporzione al suo peso)

ASFALTO miglior strada o superficie 0.04 del peso totale del veicolo
ERBA 0.143 del peso totale del veicolo
SABBIA DURA UMIDA 0.166 del peso totale del veicolo
GHIAIA 0.2 del peso totale del veicolo
SABBIA SOFFICE UMIDA 0.2 del peso totale del veicolo
SABBIA SOFFICE SECCA 0.25 del peso totale del veicolo
FANGO POCO PROFONDO 0.33 del peso totale del veicolo
PANTANO 0.5 del peso totale del veicolo
ARGILLA APPICCIOSA 0.5 del peso totale del veicolo

Per coefficienti di attrito mancanti attenersi a quanto indicato dalle pubblicazioni tecniche.

W = overall weight
S = coefficient of resistance according to the table

W x S = Power of resistance

- However, if the surface is not flat, the calculation must take into account the resistance of the slope depending on its gradient. The coefficient for determining resistance based on the slope's gradient, when the distances are short or if the distance is longer but has no bumps or obstacles of any type, is simple.

Usually, each degree of gradient can be said to correspond to a coefficient of **0.017 of the vehicle's weight**, up to a maximum of 45° (gradient of 100%); above this, it is considered lifting.

When slopes are involved, this handy formula is added to the previous one, indicating the degrees with G and resulting in:

**(W x S) + (G x W x 0.017) =
Power of resistance**

Should maximum winch recovery capacity be exceeded with direct pulling (considered maximum at the first layer of rope on the drum), you can solve the problem using a pulley block.

Un semplice calcolo per dare approssimativamente il valore della resistenza di un veicolo da trainare su una qualsiasi superficie non inclinata di quelle elencate è riportata nell'esempio:

W = peso complessivo
S = coefficiente di resistenza da tabella

W x S = Forza resistente

- Però se la superficie non è piana il calcolo deve tenere conto della resistenza del piano inclinato in base ai gradi d'inclinazione. Il coefficiente per determinare la resistenza in funzione dei gradi d'inclinazione su cui si trova il veicolo quando le distanze sono brevi, o se la distanza è elevata ma senza avvallamenti o ostacoli di qualsiasi natura, è di intuizione pratica.

Di solito viene proposto che ogni grado d'inclinazione assume un peso corrispondente a un coefficiente corrispondente a un coefficiente di **0.017 del peso del veicolo** fino a quando questo non supera i 45° (inclinazione del 100%), dopo di che si considera come sollevamento puro.

Questa formula, puramente pratica, va aggiunta alla precedente quando si è in presenza di superfici inclinate ne risulta, indicando con G i gradi che:

**(W x S) + (G x W x 0.017) =
Forza resistente**

SEE FIGURE A

The same pulley can be used for self-recovery.

SEE FIGURE B

Otherwise it can also be used for direct recovery but with the load creating an angle with the winch axis.

SEE FIGURE C

CAUTION:

All the information in this section is purely theoretical and is provided as a users guide for a correct and rational use of winching equipment.



Nel caso che si superi a traino diretto la capacità massima dell'organo di recupero (considerando che è massima al primo strato di fune sul tamburo) è possibile ovviare con l'utilizzo di una puleggia di rinvio.

VEDI FIGURA A

La stessa puleggia può essere utilizzata per eseguire il lavoro di auto-recupero.

VEDI FIGURA B

Altrimenti viene utilizzata anche per recuperi diretti ma con carico angolato rispetto all'asse dell'organo.

VEDI FIGURA C

AVVERTENZA:

Tutte le indicazioni contenute in questo paragrafo sono puramente teoriche, ma vogliono indicare all'utilizzatore un uso corretto e ragionato di un apparecchio da traino.



Figura A
Figure A

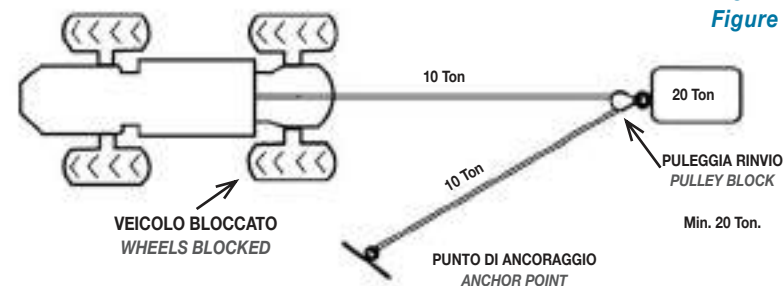


Figura B
Figure B

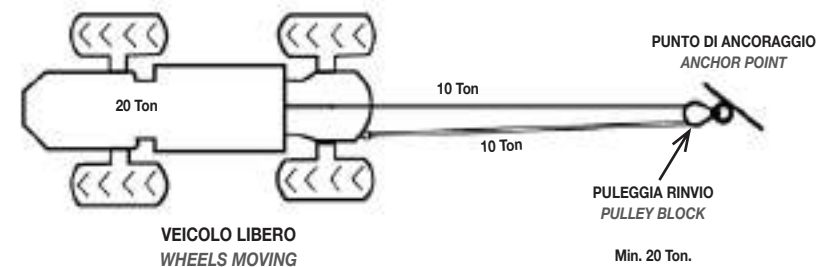


Figura C
Figure C

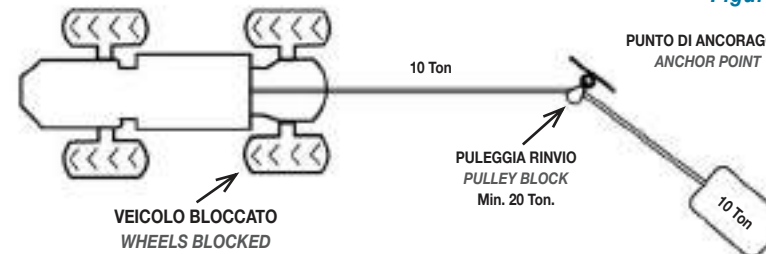


TABELLE DI CONVERSIONE



CONVERSION TABLES

Unità Base / Base Unit

MISURE / MEASUREMENT	UNITÀ / UNIT	SIMBOLI / SYMBOLS
LUNGHEZZA / LENGTH	METRO / METER	m
MASSA / MASS	KILOGRAMMO / KILOGRAM	kg
TEMPO / TIME	SECONDO / SECOND	s
CORRENTE ELETTRICA / ELECTRIC CURRENT	AMPERE	A
TEMPERATURA / TEMPERATURE	KELVIN	K
INTENSITÀ LUMINOSA / LUMINOUS INTENSITY	CANDELA	cd
QUANTITÀ / QUANTITY	MOLE	mol

Lunghezze / Lengths

	INCH	FOOT	YARD	MILLIMETRO / MILLIMETER	METRO / METER
1 inch =		0.0833	0.0278	25.4	0.0254
1 foot =	12		0.333	304.8	0.3048
1 yard =	36	3		914.4	0.9144
1 millimetro = 1 millimetre	0.03937	0.0033	0.00109		0.001
1 metro = 1 meter	39.37	3.2808	1.0936	1,000	

Momento / Moment

	INCH OUNCE	INCH POUND	FOOT POUND	KILOGRAMMETRO KILOGRAM-METER	NEWTON METER
1 inch ounce =		0.0625	0.0052	7.2×10^{-4}	7.06×10^{-3}
1 inch pound =	16		0.0833	1.152×10^{-2}	0.1130
1 foot pound =	192	12		0.1383	1.356
1 Kilogrammetro = 1 Kilogram-meter	1,388.7	86.796	7.233		9.80665
1 Newtonmeter =	141.6	8.850	0.7375	0.1020	

Area / Area

	INCH ²	FOOT ²	YARD ²	MM ²	M ²
1 inch ² =		0.0069	0.00077	645.16	6.45×10^{-4}
1 foot ² =	144		0.111	92,903	0.0929
1 yard ² =	1,296	9		836,100	0.8361
1 mm ² =	0.0016	1.0764×10^{-5}	1.196×10^{-6}		10^{-6}
1 m ² =	1,550	10.764	1.196	10^6	

Volume / Volume

	INCH ³	US QUART	IMP. GALLON	FOOT ³	US GALLON	LITRO / LITRE
1 inch ³ =		0.0173	0.0036	0.00058	0.0043	0.0164
1 US quart =	57.75		0.2082	0.0334	0.25	0.9464
1 Imp. gallon =	277	4.8		0.1604	1.2	4.546
1 foot ³ =	1,728	29.922	6.23		7.48	28.317
1 US gallon =	231	4	0.8327	0.1337		3.785
1 litro = dm ³	61.024	1.0567	0.220	0.0353	0.264	

Temperatura / Temperature

	KELVIN	°C	°F
1 Kelvin =		K - 273.15	K 9/5 - 459.67
1 °C =	°C + 273.15		°C 9/5 + 32
1 °F =	5/9 (°F - 32) + 273.15	(°F - 32) x 5/9	

Densità / Density

	ONCE/INCH ³	POUND/FOOT ³	g/CM ³
1 once/inch ³ =		108	1.73
1 pound/foot ³ =	0.0092		0.016
1 g/cm ³ =	0.578	62.43	

Forza / Force

	NEWTON (N)	KILOPOUND (KP)	POUNDFORCE
1 newton (N) =		0.10197	0.22481
1 Kilopound (kp) =	9.80665		2.20463
1 poundforce =	4.4482	0.45359	

Massa/ Mass

	ONCE	POUND	KG
1 once =		0.0625	0.0283
1 pound =	16		0.4536
1 kg =	35.274	2.2046	

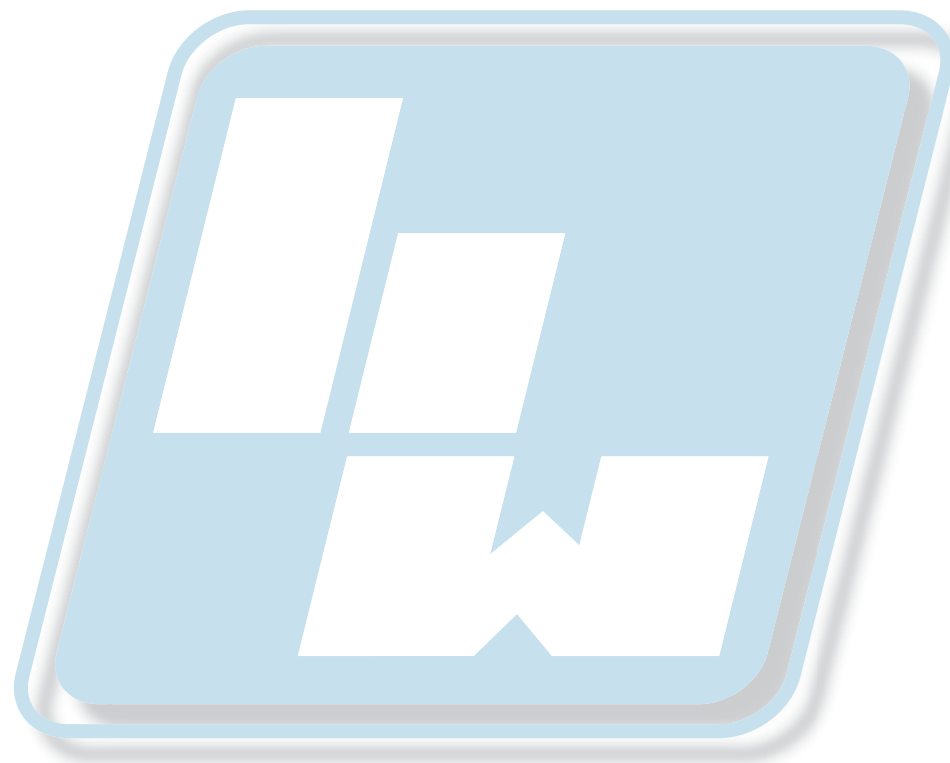
Velocità / Velocity

	FOOT/S	FOOT/MIN	MILE/HOUR	METRI/S. METER/S.	KM/ORA KM/HOUR
1 foot/s =		60	0.6818	0.3048	1.097
1 foot/min =	0.017		0.0114	0.00508	0.01829
1 mile/hour =	1.4667	88		0.447	1.609
1 metri/s. = 1 meters/s.	3.280	196.848	2.237		3.6
1 Km/ora = 1 km/hour	0.9133	54.68	0.6214	0.278	

Pressione / Pressure

	INCH HG	PSI	ATMOSFERA ATMOSPHERE	TORR	MM HG	BAR	MPa	KG/CM ²
1 inch Hg =		0.491	0.0334	25.4	25.4	0.0339	0.00339	0.0345
1 psi =	2.036		0.0680	51.715	51.715	0.0689	0.00689	0.0703
1 Atmosfera = 1 Atmosphere	29.921	14.696		760	760	1.0133	0.10133	1.0332
1 torr =	0.0394	0.0193	0.0013		1	0.0013	0.00013	0.00136
1 mm Hg =	0.0394	0.0193	0.0013	1		0.0013	0.00013	0.00136
1 bar =	29.53	14.504	0.987	749.87	749.87		0.1	1.020
1 MPa =	295.3	145.04	9.869	7498.7	7498.7	10		10.2
1 kg/cm ² =	28.950	14.22	0.968	735.35	735.35	0.980	0.098	

**CONDIZIONI GENERALI
DI VENDITA**



**CONDITIONS
OF SALE**

1. DEFINITIONS

In the present General Conditions of Sale, unless the context calls for a different interpretation, the following words and expressions shall be taken as follows:

- *SUPPLIER shall mean BREVINI WINCHES S.p.A., based in Via Degola 1, Villaggio Industriale Crostolo, 42100 Reggio Emilia, Italy;*
- *CUSTOMER shall mean the person, firm or company from whom the purchase order is received.*

2. SCOPE AND FIELD OF APPLICATION

2.1 All the sales and supplies made by the SUPPLIER shall be regulated exclusively by the present General Conditions of Sale. Acceptance of any offer by the CUSTOMER is subject to these General Conditions of Sale. All additional and/or different terms and conditions shall be deemed worthless. No additional and/or different terms or conditions may become part of the Contract between the CUSTOMER and the SUPPLIER unless accepted in writing by the SUPPLIER. The SUPPLIER's acceptance of any purchase request by the CUSTOMER is expressly conditioned by the CUSTOMER's acceptance of these General Conditions of Sale. At all events, acceptance of these products shall constitute acceptance by the CUSTOMER.

2.2 The SUPPLIER's obligations and the contract shall not enter into force until the SUPPLIER has sent written confirmation of the order to the CUSTOMER or has issued the invoice, whichever comes first.

1. DEFINIZIONI

Nelle presenti Condizioni Generali di Vendita, le seguenti parole ed espressioni, dove il contesto non richieda una diversa interpretazione, hanno il significato riportato:

- per "FORNITORE" s'intende BREVINI WINCHES s.p.A. con sede in Via Degola 1, Villaggio Industriale Crostolo, 42100 Reggio Emilia, Italia
- per "cliente" s'intende la persona, la ditta o società dalla quale si riceve l'ordine di acquisto.

2. OGGETTO E AMBITO DI APPLICAZIONE

2.1 Tutte le vendite e forniture effettuate dal FORNITORE saranno disciplinate esclusivamente dalle presenti Condizioni Generali di Vendita. L'accettazione da parte del CLIENTE di una qualunque offerta è limitata alle presenti Condizioni Generali di Vendita. Ogni termine o condizione in aggiunta e/o diverse con quelle indicate nelle presenti Condizioni Generali di Vendita sono da ritenersi prive di effetto. Nessuno di questi termini o condizioni in aggiunta e/o diverse potranno diventare parte del Contratto tra il CLIENTE e il FORNITORE, salvo accettazione scritta da parte del FORNITORE. L'accettazione da parte del FORNITORE di una qualunque richiesta d'acquisto da parte del CLIENTE è espressamente condizionata dall'accettazione da parte del CLIENTE delle presenti Condizioni Generali di Vendita. L'accettazione dei prodotti costituisce in ogni caso accettazione da parte del CLIENTE.

2.2 Gli obblighi del FORNITORE ed il contratto non entreranno in vigore fintanto che il FORNITORE non ha provveduto ad inviare conferma scritta di accettazione dell'ordine al CLIENTE o a fatturare, quale dei due avviene prima.

3. PRICES

3.1 Unless otherwise confirmed in writing by the SUPPLIER, the prices quoted or billed shall be net and do not include packaging and shipping costs.

3.2 The prices do not include taxes, stamps, customs duties and any other additional costs. Unless exempted, these costs and charges shall be paid by the CUSTOMER and if paid by the SUPPLIER, they will be billed in total to the CUSTOMER in addition to the prices quoted.

3.3 The prices shall be subject to corrections resulting from printing errors.

4. TECHNICAL DATA, DRAWINGS AND

DOCUMENTS CONCERNING THE SUPPLY

4.1 All the drawings, photos, illustrations, descriptions, technical data and services, and all other data and information provided concerning the products, whether they are contained in documents or drawings attached to the SUPPLIER's offer or reported in the SUPPLIER's catalogues, tables, price lists, advertising, shall be purely indicative. Differences or divergences from the said data shall not be grounds for the non-acceptance of goods, the vitiation of the contract or be grounds for complaints against the SUPPLIER.

4.2 Any drawings sent to the CUSTOMER for approval shall be automatically deemed to have been approved by the CUSTOMER until they are returned to the SUPPLIER complete with notes and comments within 10 working days or before the deadlines agreed at the time of being submitted to the CUSTOMER.

4.3 All the tables, drawings, technical data and any other material and technical information contained in the offer or supplied in connection with the supply shall remain the SUPPLIER's property and cannot be reproduced or divulged to third parties without

3. PREZZI

3.1 Salvo diversa conferma scritta da parte del FORNITORE, i prezzi quotati o fatturati sono netti e non comprendono i costi d'imballo e spedizione.

3.2 Le imposte, bolli, spese doganali ed ogni altro onere aggiuntivo non sono compresi nei prezzi. Salvo una qualunque esenzione, tali costi ed oneri saranno pagati dal CLIENTE e se eventualmente pagati dal FORNITORE, il loro ammontare sarà fatturato al CLIENTE in aggiunta ai prezzi quotati.

3.3 I prezzi sono soggetti a correzioni dovute ad errori di stampa.

4. DATI TECNICI, DISEGNI E DOCUMENTI

INERENTI LA FORNITURA

4.1 Tutti i disegni, fotografie, illustrazioni, descrizioni, dati tecnici e prestazioni od ogni altro dato ed informazione riguardante i prodotti siano essi contenuti in documenti o disegni acclusi all'offerta del FORNITORE o risultanti da cataloghi, prospetti, listini prezzi, pubblicità del FORNITORE hanno carattere esclusivamente indicativo. Deviazioni o scostamenti da questi non potranno costituire ragioni e motivi per la non accettazione della merce o viziare il contratto o essere motivo per reclami nei confronti del FORNITORE.

4.2 Tutti i disegni eventualmente inviati al CLIENTE per approvazione saranno ritenuti automaticamente approvati dal CLIENTE a meno che non vengano restituiti al FORNITORE con note e commenti diversi entro 10 giorni lavorativi o entro i termini concordati all'atto della loro sottomissione al CLIENTE.

4.3 Tutti i prospetti, disegni, dati tecnici ed ogni altro materiale e informazioni tecniche acclusi all'offerta o forniti in connessione con la fornitura rimarranno di proprietà del FORNITORE e non potranno essere ripro-

the written agreement of the SUPPLIER.

5. ESTIMATES, OFFERS

The estimates and offers shall remain valid for a period of 30 days from the date of issue, unless otherwise stated in writing by the SUPPLIER. The SUPPLIER reserves the right to cancel or revise the estimates and offers at any time prior giving written confirmation of the acceptance of the order for reasons of force majeure.

6. VARIATIONS

6.1 *The prices indicated in the offer or in the written confirmation of acceptance of the order are based on the SUPPLIER's costs, at the date of the offer or the acceptance. If variations to the said costs (labour, machines, materials, etc.) occur between the date of the offer and the acceptance of the order, the SUPPLIER, at its sole discretion, reserves the right to revise the prices providing the notice of this variation is given to the CUSTOMER within 14 days of the goods being delivered or the supply completed.*

6.2 *If the CUSTOMER asks to modify the goods, the CUSTOMER shall bear all additional costs, as well as the possible delays to delivery resulting from the said changes.*

6.3 *The SUPPLIER reserves the right to make changes to the product at any time, provided the said changes do not substantially alter the performance and/or specifications of the products.*

7. AMENDMENTS AND CANCELLATIONS

No order can be changed or cancelled by the CUSTOMER after written confirmation of acceptance of the order by the SUPPLIER. If the SUPPLIER accepts the change or cancellation, the SUPPLIER reserves the right to invoice the CUSTOMER for any costs and

dotti o comunicati a terzi senza il consenso scritto del FORNITORE.

5 QUOTAZIONI, OFFERTE

Le quotazioni ed offerte rimarranno in vigore per un periodo di tempo di 30 giorni dalla data di emissione salvo diversa conferma scritta del FORNITORE. Il FORNITORE comunque si riserva il diritto di annullare o rivedere le quotazioni ed offerte in qualunque momento prima della emissione della conferma scritta di accettazione dell'ordine per cause di Forza Maggiore.

6 VARIAZIONI

6.1 I prezzi indicati nell'offerta o nella conferma scritta di accettazione dell'ordine sono basati sui costi del FORNITORE alla data dell'offerta o della conferma. Qualora intervengano variazioni di tali costi (manodopera, macchine, materiale etc.) tra la data dell'offerta o di accettazione dell'ordine, il FORNITORE, a sua sola discrezione, si riserva il diritto di variare i prezzi conseguentemente a patto che l'avviso di tale variazione sia data al CLIENTE entro 14 giorni prima della consegna della merce o completamente della fornitura.

6.2 Qualora il CLIENTE richieda di modificare la merce, il CLIENTE sopporterà tutti i costi aggiuntivi ed eventuali ritardi di consegna che dovessero derivare da tali modifiche.

6.3 Il FORNITORE si riserva la facoltà di apportare modifiche al prodotto in qualunque momento purchè tali modifiche non alterino in modo sostanziale le prestazioni e/o specifiche dei prodotti.

7 MODIFICHE E CANCELLAZIONI

Nessun ordine può essere modificato o annullato da parte del CLIENTE dopo la conferma scritta di accettazione dell'ordine da parte del

expenses incurred after the change or cancellation.

8. DELIVERIES

8.1 Unless otherwise indicated in writing by the SUPPLIER in the written confirmation of acceptance of the order, the goods shall be sold ex SUPPLIER's factory.

8.2 On delivery of the goods to the CUSTOMER or to the carrier, the SUPPLIER is released from the obligation to deliver and all risks involving the materials pass to the CUSTOMER irrespective of the terms of transport, even in the event that the SUPPLIER is charged to provide transport.

8.3 Any delivery date stated on the written confirmation of acceptance of the order is purely indicative. The SUPPLIER will make all reasonable efforts to respect the stipulated delivery date. However, the SUPPLIER will not be responsible for any delays and the CUSTOMER will be obliged to accept delivery of the goods when the latter are ready.

8.4 The delivery dates are calculated with effect from the date on which the SUPPLIER gives written confirmation of acceptance of the order.

8.5 The delivery deadlines will be automatically extended: a) if the CUSTOMER does not supply the data required for the supply in good time or if it requires alterations during the course of execution or if it delays responding to requests to approve drawings and executive schemes; b) if the CUSTOMER is not in line with payments; c) if, at the SUPPLIER's final judgement, the customer's financial situation and/or the extent of its credit is deemed such that it is a risk to attaining the price.

FORNITORE. Qualora il FORNITORE accetti la modifica o annullamento, il FORNITORE si riserva la facoltà di fatturare al CLIENTE i costi e le spese eventualmente sostenute in seguito alla modifica o annullamento.

8 CONSEGNE

8.1 Salvo diversamente indicato per iscritto del FORNITORE nella conferma scritta di accettazione dell'ordine, le merci sono vendute franco fabbrica del FORNITORE.

8.2 Con la remissione della merce al CLIENTE o al vettore, il FORNITORE si libera dall'obbligo di consegna e tutti i rischi sui materiali passano al CLIENTE indipendentemente dalle condizioni di spedizione, anche nel caso in cui il FORNITORE sia incaricato della spedizione.

8.3 Ogni data di consegna indicata sulla conferma scritta di accettazione dell'ordine ha solo carattere indicativo. Il FORNITORE farà ogni ragionevole sforzo per mantenere le date di consegna stipulate. Il FORNITORE non sarà, tuttavia, in ogni caso responsabile di eventuali ritardi ed il CLIENTE sarà tenuto ad accettare la consegna della merce quando essa verrà pronta.

8.4 Le date di consegna si computano a partire dalla data della conferma scritta di accettazione dell'ordine da parte del FORNITORE.

8.5 I termini di consegna s'intendono automaticamente prolungati: a) qualora il CLIENTE non fornisca in tempo utile i dati necessari per la fornitura o richieda modifiche in corso di esecuzione o ancora ritardi nel rispondere alle richieste di approvazione di disegni e schemi esecutivi; b) qualora il CLIENTE non sia in regola con i pagamenti; c) qualora a giudizio insindacabile del FORNITORE, la condizione patrimoniale del cliente e/o l'ammontare del suo credito sia ritenuto tale da costituire evidente pericolo per il conseguimento del prezzo.

8.6 Unless otherwise agreed in writing, if the goods are ready for shipment before the agreed date, the SUPPLIER may opt to make the shipment and the CUSTOMER cannot refuse to accept delivery of the goods.

8.7 If the CUSTOMER fails to accept the delivery of the goods, for reasons attributable to the former, or for reasons unrelated to the wishes of the SUPPLIER, the CUSTOMER shall assume the risks and costs for their safekeeping.

8.8 For special products, the SUPPLIER reserves the right to deliver 5% more or less than the quantity ordered and to consider the order as fully dispatched. Payment will be made for the quantity actually delivered.

9. PAYMENTS

9.1 Unless otherwise agreed and confirmed in the written confirmation of acceptance of the order, the prices shall be regarded as net, not inclusive of packaging costs and all additional charges, and payment must be made in advance and must be received by the SUPPLIER at the latest 10 days before the date fixed for delivery.

9.2 The terms of payment are obligatory and essential. In the event of late payment, without the need to issue a warning, the SUPPLIER may apply interest at the minimum lending rate (MLR) in force at the time increased by five points.

9.3 In the event of payment by instalments, if just one instalment is paid in arrears, the SUPPLIER can immediately demand the full price agreed (irrespective of the conditions stated in Article 1186 of the Civil Code) or consider the contract as terminated through non-compliance. In this case, the SUPPLIER can withhold any sums received on credit by way of indemnity for the damage and claim the return of the goods delivered.

8.6 Salvo diverso accordo scritto, qualora la merce venga pronta per la consegna prima della data stabilita, il FORNITORE potrà effettuare la spedizione ed il CLIENTE non potrà rifiutare di prendere in consegna la merce.

8.7 Nel caso di mancata presa in consegna della merce da parte del CLIENTE per fatto a lui imputabile o, comunque, per cause indipendenti dalla volontà del FORNITORE, il CLIENTE si assumerà i rischi e le spese per la loro custodia.

8.8 Per prodotti speciali, il FORNITORE si riserva la facoltà di consegnare nella misura del più o meno 5% della quantità ordinata e considerare l'ordine evaso completamente. Il pagamento sarà per le quantità effettivamente consegnate.

9. PAGAMENTI

9.1 Salvo diversamente concordato e confermato nella conferma scritta di accettazione dell'ordine, i prezzi s'intendono netti, non comprensivi del costo d'imballo o di ogni onere accessorio ed il pagamento dovrà essere effettuato anticipatamente e dovrà essere ricevuto dal FORNITORE al più tardi 10 giorni prima della data stabilita per la consegna.

9.2 I termini di pagamento sono tassativi ed essenziali. In caso di ritardato pagamento, senza necessità di costituzione di mora, il FORNITORE potrà applicare interessi in ragione del tasso ufficiale di sconto (TUS) in vigore all'epoca, sì com'è aumentato di cinque punti.

9.3 In caso di pagamento dilazionato qualora non fosse puntualmente pagata anche una sola rata di prezzo, il FORNITORE potrà esigere immediatamente l'intero prezzo pattuito (indipendentemente dalle condizioni di cui all'art. 1186 CC) ovvero considerare risolto il contratto per inadempienza: in tal caso il FORNITORE potrà trattenere le somme eventualmente

9.4 In no case can the payments be suspended or delayed: in the event of disputes, legal action cannot be initiated or continued if the payment of the price has not first been made in accordance with the terms and methods agreed.

9.5 The SUPPLIER is free to accept or not accept the CUSTOMER's contractual proposal at its own final judgement; at all events, the content of the following articles shall still be applicable: 1460 CC, 1461 CC, 2762 CC.

10. WARRANTY

10.1 Unless otherwise agreed in writing, the SUPPLIER shall guarantee its products against manufacturing defects and materials used for a period of 12 months from the date of shipment (reference will be made to the serial number printed on the identification plate) or for 6 months from the date it becomes operative, whichever occurs first.

10.2 Within this period, the SUPPLIER undertakes, at its own final judgement, to replace, repair or refund the invoice value provided that a) the CUSTOMER has promptly reported the fault in writing; b) the SUPPLIER, at its own choice, has had the chance to inspect the product on its own premises; c) the said inspection shows that the faults were not caused by incorrect assembly and/or use and/or maintenance; d) the product has not been tampered with, which would invalidate the warranty; e) the CUSTOMER has complied punctually with the methods of payment. The CUSTOMER must make the faulty material available to the SUPPLIER c/o the SUPPLIER's plant.

percepito in conto maggior avere a titolo di risarcimento del danno e pretendere la restituzione dei beni consegnati.

9.4 I pagamenti, in nessun caso, potranno essere sospesi o ritardati: qualora fossero insorte contestazioni, le relative azioni non potranno essere iniziate o proseguite se prima non si sarà provveduto al pagamento del prezzo secondo i termini e i modi stabiliti.

9.5 Il FORNITORE è libero di accettare o non accettare la proposta contrattuale del CLIENTE secondo proprio insindacabile giudizio: resta in ogni caso applicabile il portato dei seguenti articoli 1460 CC, 1461 CC, 2762 CC.

10. GARANZIA

10.1 Salvo diversamente concordato per iscritto, il FORNITORE garantisce i suoi prodotti contro difetti di lavorazione e materiale impiegato per un periodo di 12 mesi dalla data di spedizione (fa fede il n. di matricola riportato sulla targhetta di identificazione) o di 6 mesi dalla data della sua messa in funzione, qualora dei due scada prima.

10.2 Entro tale periodo, il FORNITORE s'impegna, a propria insindacabile scelta, a sostituire, riparare o rifondere il valore in fattura a patto che: a) il CLIENTE abbia prontamente comunicato per iscritto l'esistenza di tale difetto; b) che il FORNITORE abbia, a sua scelta, avuto l'opportunità di ispezionare il prodotto presso la propria sede; c) che dall'ispezione, risulti che tali difetti non siano stati causati da montaggio, e/o utilizzazione e/o manutenzione non corretta; d) che il prodotto non sia stato manomesso pena la decadenza della garanzia stessa; e) il CLIENTE abbia rispettato puntualmente le modalità di pagamento del prezzo. Il materiale difettoso dovrà essere messo a disposizione del FORNITORE da parte del CLIENTE c/o lo stabilimento

10.3 The aforesaid warranty will cease to be valid if the product has been tampered with and/or repaired by a party other than the SUPPLIER or by persons not authorised in writing by the SUPPLIER.

10.4 Replacements and/or repairs under warranty will be carried out ex SUPPLIER's factory and the costs of transport and other expenses will be borne by the CUSTOMER.

10.5 If the CUSTOMER, in agreement with the SUPPLIER, requests that the replacement and/or repair take place at its own premises, the former will be charged for the travel and accommodation costs of technical personnel provided by the SUPPLIER and will provide all the means and additional personnel needed to carry out the intervention quickly and safely.

10.6 The aforesaid warranty exclusively covers the products manufactured by the SUPPLIER. Products supplied by the SUPPLIER but not manufactured by it will be covered by the same warranty that the SUPPLIER receives from the supplier of the said goods.

10.7 The aforesaid warranty represents the only and exclusive guarantee provided by the SUPPLIER for the finished products, thereby excluding any other guarantee of any kind, both express and implicit, including, but not restricted to the guarantee of correct operation, suitability for use and the commercial nature of the products. No affirmation or statement made by the SUPPLIER in these conditions or elsewhere may be construed as an extension of the aforesaid warranty.

10.8 The CUSTOMER declares that it freely chose the goods, at its own final judgement, from the vast range of products offered by the SUPPLIER. The SUPPLIER does not know and is not responsible for the practical use that the CUSTOMER will make of the goods.

del FORNITORE.

10.3 La garanzia di cui sopra cesserà di operare qualora il prodotto sia stato manomesso e/o riparato non dal FORNITORE e comunque da persone non autorizzate per iscritto dal FORNITORE stesso.

10.4 Le sostituzioni e/o riparazioni in garanzia vengono effettuate f.co stabilimento del FORNITORE ed i costi di trasporto e ogni altra eventuale spesa sono a carico del CLIENTE.

10.5 Qualora il CLIENTE, in accordo con il FORNITORE, richieda di effettuare la sostituzione e/o riparazione presso di lui, quest'ultimo sosterrà le spese di viaggio e soggiorno del personale tecnico messo a disposizione dal FORNITORE e fornirà tutti i mezzi ed il personale ausiliario necessari per eseguire l'intervento nel modo più rapido e sicuro.

10.6 La garanzia di cui sopra copre esclusivamente i prodotti di produzione del FORNITORE. Prodotti forniti dal FORNITORE ma da esso non prodotti saranno coperti dalla stessa garanzia che il fornitore di quest'ultimo riconoscerà al FORNITORE.

10.7 La garanzia di cui sopra costituisce la sola ed esclusiva garanzia fornita dal FORNITORE in relazione ai prodotti finiti rimanendo, pertanto, esclusa ogni altra garanzia di qualsiasi tipo, sia espressa che implicita, inclusa, ma non in via limitativa, quelle di buon funzionamento, di idoneità all'uso e del carattere mercantile dei prodotti. Nessuna affermazione o rappresentazione fatta dal FORNITORE alle presenti condizioni o aliunde può essere interpretata nel senso di estendere la garanzia di cui sopra.

10.8 Il CLIENTE dichiara di aver liberamente scelto i beni tra la vasta gamma di prodotti del FORNITORE secondo proprio libero ed insindacabile giudizio. Il FORNITORE non conosce e non risponde dell'utilizzo pratico e dell'impiego concreto che il CLIENTE imporrà ai beni.

11. TRADEMARKS

The identification plates and/or any other form of identification on the products sold by the SUPPLIER must not be removed without the SUPPLIER's written consent. All obligations arising from these General Conditions of Sale will be deemed invalid if the identification plate and/or other form of identification on the product has been removed or tampered with.

12. INSPECTION

All products produced by the SUPPLIER are subject to a standard final inspection before delivery. This inspection is regarded as final and conclusive. Any additional and/or special inspection must be requested and specified by the CUSTOMER in the purchase order and is subject to acceptance by the SUPPLIER and will be undertaken at the CUSTOMER's expense.

13. RETENTION OF OWNERSHIP

The SUPPLIER will retain the ownership of the products until such time as the CUSTOMER has fully paid the price agreed, as well as any outstanding invoices. Until such time as the ownership of the products has been transferred to the CUSTOMER, the latter shall be responsible for keeping the products in safe and good condition.

14. FORCE MAJEURE

The SUPPLIER shall not assume the risk and shall not be liable for delays or the failure to comply with any of the obligations for the reasons outside its control listed below as grounds of Force Majeure.

The grounds of Force Majeure will include, without exceptions: accidents, acts of God, strikes or labour contracts, government laws, fires, floods, delays resulting from the failed

11. MARCHI

Ogni targhetta di identificazione e/o ogni altra forma di identificazione posta sui prodotti venduti dal FORNITORE non può essere rimossa senza il consenso scritto del FORNITORE. Ogni obbligo derivante da queste Condizioni Generali di Vendita dovrà ritenersi privo di effetto qualora la targhetta di identificazione e/o ogni altra forma di identificazione posta sul prodotto sia stata rimossa o manomessa.

12. COLLAUDO

Tutti i prodotti di produzione del FORNITORE sono sottoposti a collaudo finale standard prima della consegna. Tale collaudo è da ritenersi finale e conclusivo. Ogni collaudo addizionale e/o speciale deve venire richiesto e specificato dal CLIENTE nell'ordine di acquisto ed è soggetto ad accettazione da parte del FORNITORE e verrà eseguito a spese del CLIENTE.

13. RISERVA DI PROPRIETÀ

La proprietà dei prodotti rimarrà del FORNITORE sino al momento in cui il CLIENTE avrà saldato interamente l'ammontare concordato unitamente all'ammontare di eventuali altre fatture. Fintantoché la proprietà dei prodotti non sarà passata al CLIENTE, quest'ultimo è responsabile della loro conservazione in buono e sicuro stato.

14. FORZA MAGGIORE

Il FORNITORE non si assume il rischio e non sarà responsabile per i ritardi o la mancata ottemperanza di uno qualunque degli obblighi per ragioni al di fuori del suo controllo qui di seguito indicate come Causa di Forza Maggiore.

Cause di Forza Maggiore sono da ritenersi senza esclusione: incidenti, atti di Dio, scioperi o contratti di lavoro, leggi governative,

delivery by suppliers and/or carriers and any other cause outside the SUPPLIER's reasonable control.

15. LIABILITY AND OBLIGATIONS

The SUPPLIER is solely responsible for the correct operation of the products supplied in terms of the characteristics and performance that it has expressly indicated. The SUPPLIER's liability is limited to the replacement and/or repair and/or reimbursement of the invoiced value. With the exception of this liability, the SUPPLIER cannot in any way be held responsible for any direct and/or indirect and/or consequential damage to the CUSTOMER or to third parties as a result of defects to the products, including loss of production, damage to things or persons or others.

16. WHOLE CONTRACT

These General Conditions of Sale, together with any other derogative or additional term or condition which has been accepted in writing by the SUPPLIER, constitute the whole contract between the parties in relation to the sale and supply of the products. Any other term and/or condition shall not be valid and shall not be deemed to be part of the Contract.

17. EXPRESS RESCISSION CLAUSE

AND CONDITIONS FOR WITHDRAWAL

17.1 *The Supply contract will be rescinded by law in accordance with Article 1456 CC following the SUPPLIER's simple written declaration that it wishes to enforce the express rescission clause, if the CUSTOMER:*

- a) misses or delays the payments due;*
- b) delays or fails to accept delivery of the products within the terms stated in Article 8 above;*
- c) does not comply with the obligation of confidentiality stated in Article 4.*

incendi, inondazioni, ritardi per mancata consegna da parte di fornitori e/o vettori ed ogni altra causa al di fuori del ragionevole controllo da parte del FORNITORE.

15. RESPONSABILITÀ E OBBLIGHI

Il FORNITORE è esclusivamente responsabile del buon funzionamento dei prodotti forniti in rapporto alle caratteristiche e prestazioni da lui espressamente indicate. La responsabilità del FORNITORE è limitata alla sostituzione e/o riparazione e/o rimborso del valore fatturato. Tolto l'obbligo di cui sopra, il FORNITORE non potrà in ogni caso essere ritenuto responsabile per qualsiasi danno diretto e/o indiretto e/o consequenziale derivante al CLIENTE o a terzi da difetti del prodotto, incluse perdite di produzione, danni a cose o persone o altro.

16. CONTRATTO INTERO

Le presenti Condizioni Generali di Vendita unitamente ad ogni eventuale termine o condizione derogativa o complementare e che sia stata accettata per iscritto dal FORNITORE costituiscono l'intero contratto tra le parti per quanto riguarda la vendita e fornitura dei prodotti. Qualsiasi altro termine e/o condizione non avrà validità e non sarà ritenuta parte del Contratto.

17. CLAUSOLA RISOLUTIVA ESPRESSA

E CONDIZIONE RISOLUTIVA

17.1 Il contratto di fornitura sarà risolto di diritto ai sensi dell'art. 1456 CC, per effetto della semplice dichiarazione scritta del FORNITORE di volersi avvalere della presente clausola risolutiva espressa, qualora il CLIENTE:

- a) Ometta o ritardi i pagamenti dovuti;
- b) Ritardi o manchi di prendere in consegna i prodotti nei termini previsti dal precedente art. 8;

17.2 The contract shall be rescinded if the CUSTOMER is placed in liquidation or is the subject of any form of credit proceedings.

18. OPTING-OUT CLAUSE

In the event that the CUSTOMER reduces the guarantees that it has submitted or does not provide the guarantees as promised, the SUPPLIER shall be entitled to withdraw from the contract without giving prior notice.

19. APPLICABLE LAW

These General Conditions of Sale shall be exclusively governed by Italian law and must be construed in conformity with the said law.

20. JURISDICTION

Any disputes arising between the parties in relation to these General Conditions of Sale, including, but not restricted to those concerning their existence, validity, effectiveness, interpretation, execution, etc., shall be brought before the sole jurisdiction of the Court of Reggio Emilia – Italy.

c) Non osservi gli obblighi di riservatezza previsti dall'art. 4.

17.2 Il contratto si intenderà risolto nel caso in cui il cliente venga posto in liquidazione o sia assoggettato ad una qualsiasi procedura concorsuale.

18. RECESSO CONVENZIONALE

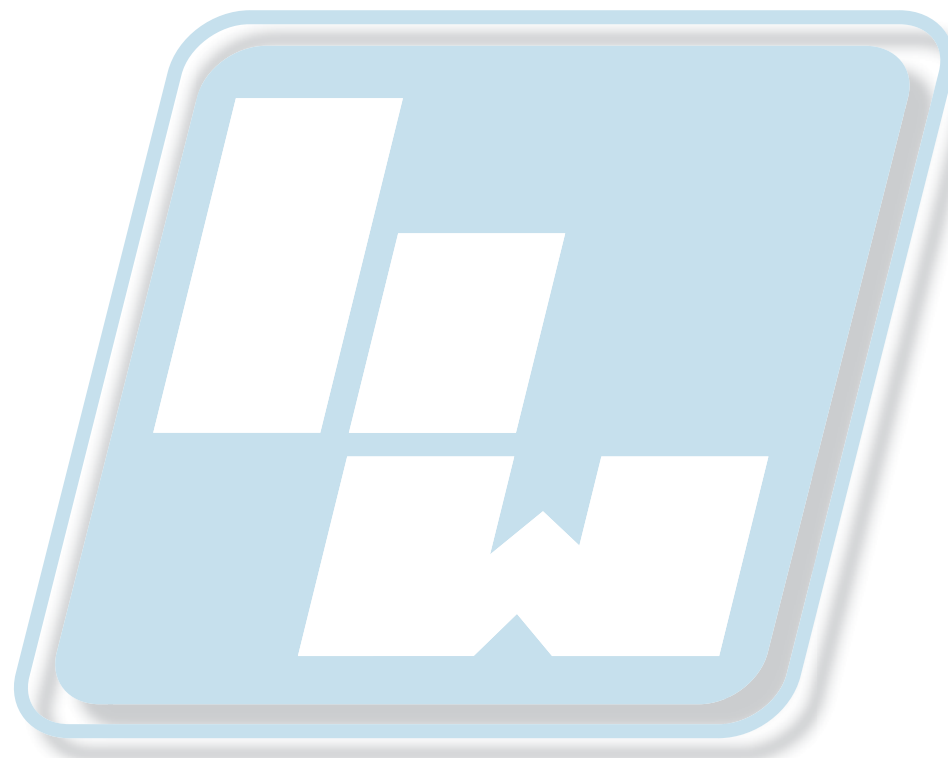
Nel caso in cui il CLIENTE diminuisca le garanzie che aveva dato o non fornisca le garanzie che aveva promesso, il FORNITORE avrà facoltà di recedere dal contratto senza necessità di preavviso.

19. LEGGE APPLICABILE

Le presenti Condizioni Generali di Vendita sono soggette in via esclusiva alla legge Italiana e vanno interpretate in conformità alla stessa.

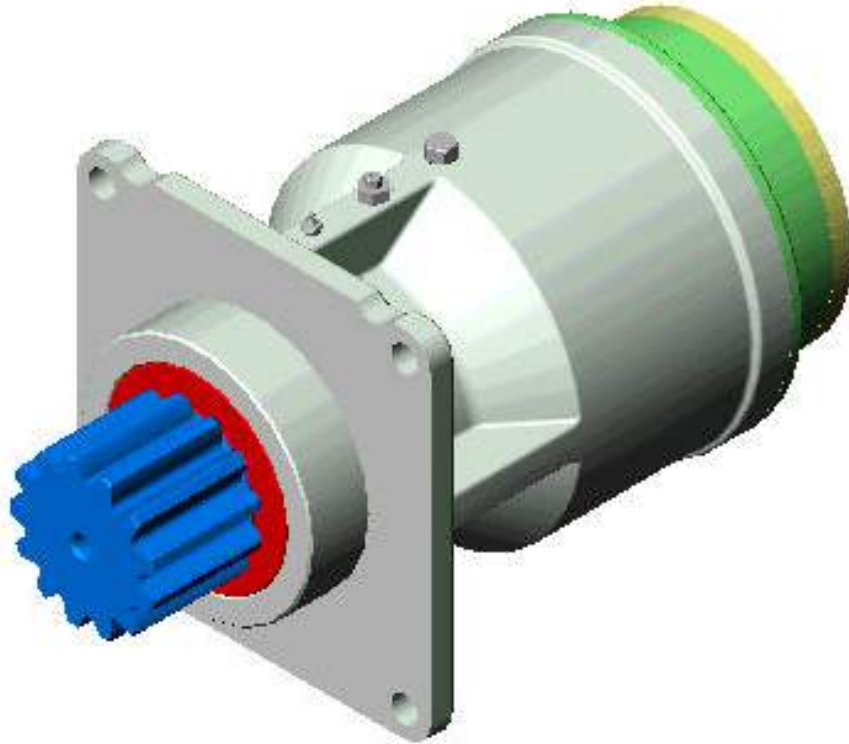
20. FORO COMPETENTE

Tutte le controversie che insorgano tra le parti in connessione con le presenti Condizioni Generali di Vendita, incluse, ma non in via limitativa, quelle concernenti la loro esistenza, validità, efficacia, interpretazione, esecuzione etc. saranno soggette alla giurisdizione esclusiva del Foro di Reggio Emilia - Italia.





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

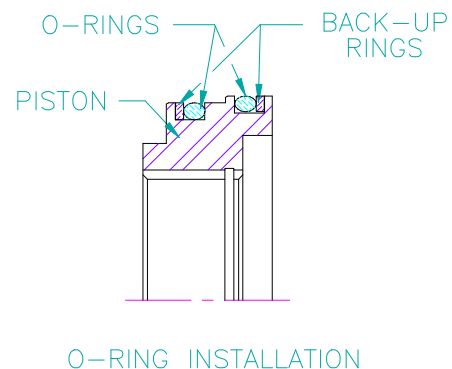
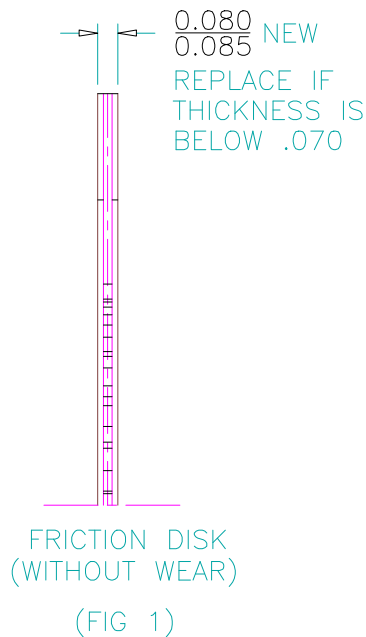
1. Remove drive from vehicle and drain gearbox lubricant by removing the drain plug **(31)**.
2. Remove the motor from the motor adapter **(30)**.
3. Remove the brake assembly from the gear housing assembly **(7)** by removing eight hexhead capscrews **(18)**. NOTE: Notice the position of the brake port 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.



(FIG 2)

ASSEMBLY PROCEDURE

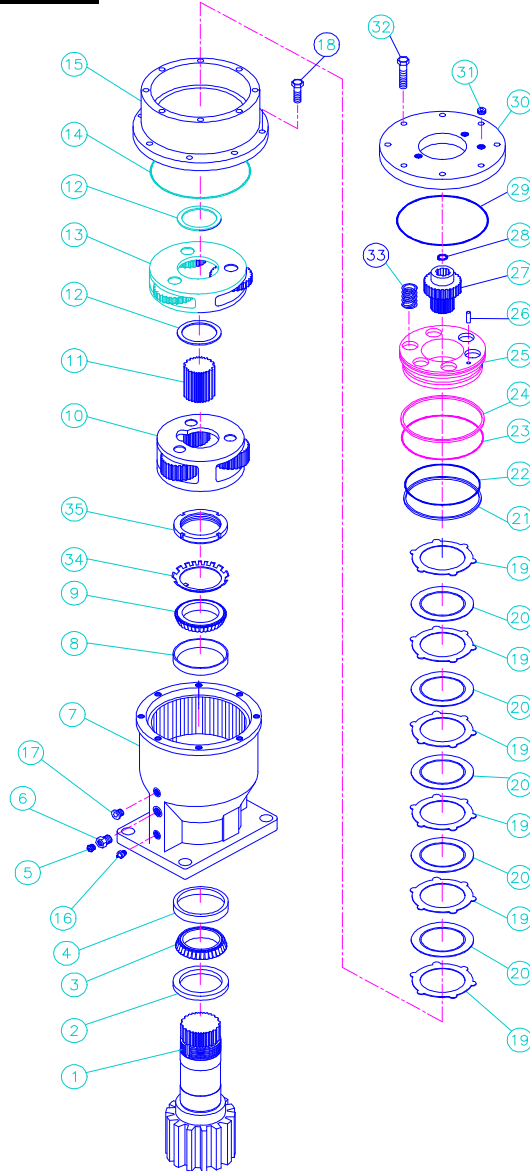
FOR 5200 & 6000 SERIES SWING DRIVES

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 </td
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

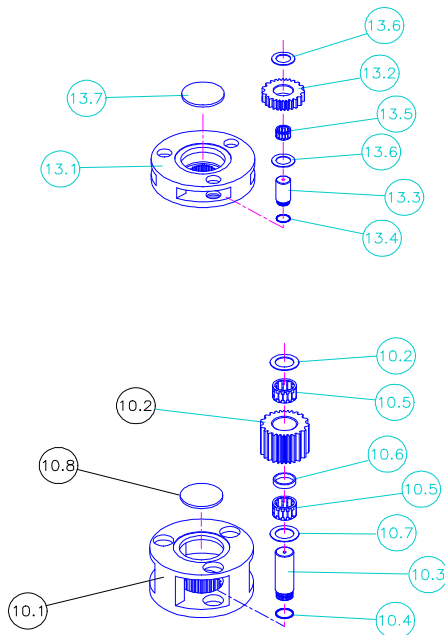


GEAR SET (ITEM 13 ABOVE)

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 </td
13.7	1	41769	PLATE

GEAR SET (ITEM 10 ABOVE)

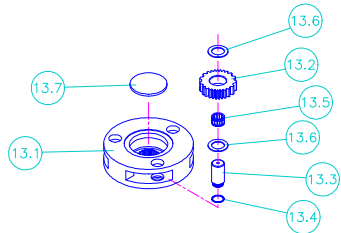
10.1	1	42324	CARRIER, OUTPUT
10.2	3	42306	GEAR, PLANET
10.3	3	41747	PIN, PLANET
10.4	3	41716	RING, RETAINING
10.5	6	41717	BEARING
10.6	3	41739	SPACER
10.7	6	939249	RACE </td
10.8	1	41769	PLATE



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 </td
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

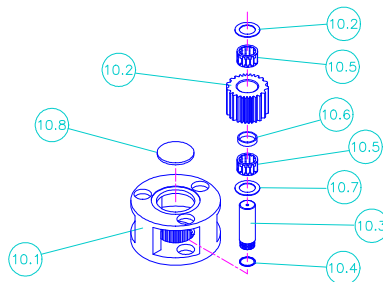
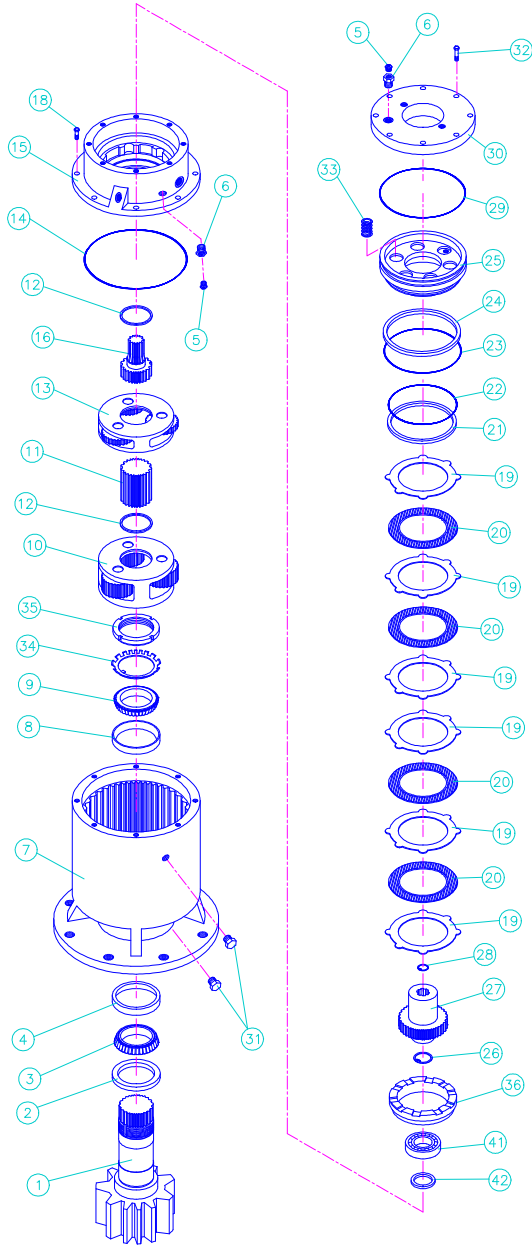


GEAR SET (ITEM 13 ABOVE)

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 </td
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 </td
10.8	1	41769	PLATE



You will use Hirschmann's V-Scale D3-C1H 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.
- **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.
- **Swing Sensor:** The swing sensor measures the boom's angle as it relates to the crane chassis.

Initial Setup

NOTE-this section only covers the initial setup 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.

1. Turning on the PTO switch inside the truck's cab. This engages PTO, and powers the aerial unit to master power. In turn, this activates the LMI system.

2. Once the unit is powered on, the following screen will appear:



This screen is to confirm that all four outriggers are extended to the full span position. Once the outriggers are extended to full span, follow the onscreen prompt, "Press to Confirm Selection", and press the bottom right button.

NOTE: The yellow arrow denotes the selection knob, and contains the same functionality as using the soft keys. The operator turns the knob left or right to scroll through the options, and pressing in selects the option.

3. The next screen prompts the operator to select whether the crane will perform **Aerial** duties (person inside basket), or **Material Handling** duties. Press one of the indicated buttons on either the bottom left or bottom right of the screen.



- A. If the operator selects **Material Handling**, the next screen asks the operator to select whether the crane will perform with a platform (basket) attached, or with the platform removed. When finished, press one of the indicated buttons on either the bottom left or bottom right of the screen to get to the rigging line screen. This screen allows the operator to select the parts of the line rigged. Select one or two parts, and then press one of the corresponding buttons on either the bottom left or bottom right of the screen to get to the platform screen.



- If the operator selects the **Platform Attached** option, this screen asks the operator to confirm selection and press the bottom right button:



⚠ DANGER

Personnel in the platform while material handling from the load line is unsafe and is NEVER allowed.

- If the operator selects the **Platform Removed** option, this screen asks the operator to confirm selection and press the bottom right button:



- B. If the operator selects **Aerial**, this screen asks the operator to confirm selection and press the bottom right button:



4. Once the user has pressed the button to confirm their selection, the following screen appears:



This screen indicates the crane is ready for operational use. If at any time, the operator makes a selection in error, simply press the “X” button and the unit will take the operator back to the first screen with the crane outriggers.

Revision History

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Document number S071	
Revision C	Date 2011-10-17
Document type Manual	

SERVICE MANUAL

Remote Control System RC400 G2B/G3B



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Revision	Date	Name	Note
A	2010-10-29	Scanreco AB	First release
B	2011-08-14	Scanreco AB	G3B Central Unit added Major changes in document
C	2011-10-17	Scanreco AB	G2B Standard Cable kit chapter added Minor changes in document

1 General

1.1 Synopsis

Scanreco Remote Control System RC400 G2B/G3B Service Manual

This service manual is intended as a complement to the Remote Control System RC400 G2B Instruction manual and covers more in-depth information surrounding service and fault findings on the systems.

1.2 Distribution

Name	Rule
Internal	Only within own organization

1.3 Terminology

Abbreviation	Description
n/a	Not applicable
PWM	Pulse Width Modulation
PCU	Portable Control Unit
CU	Central Unit
LED	Light Emitting Diode
ST	Status LED
DV	Dump Valve

1.4 Applicable products

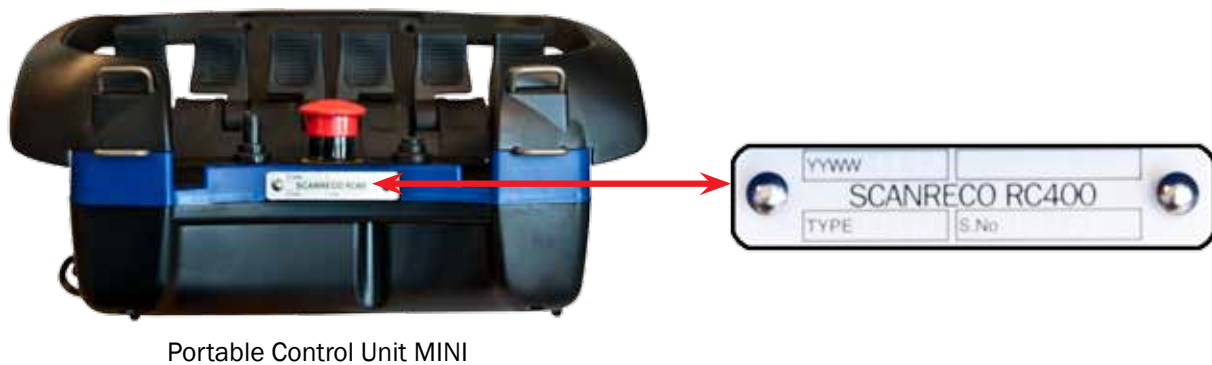
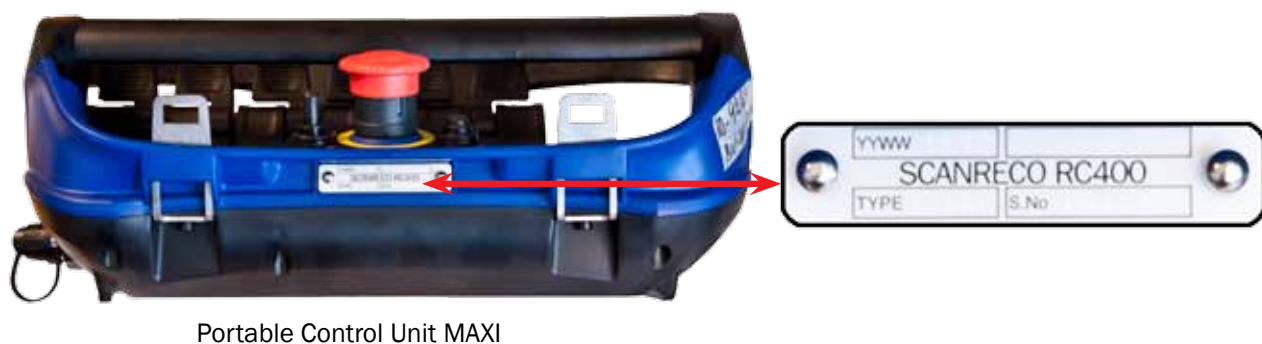
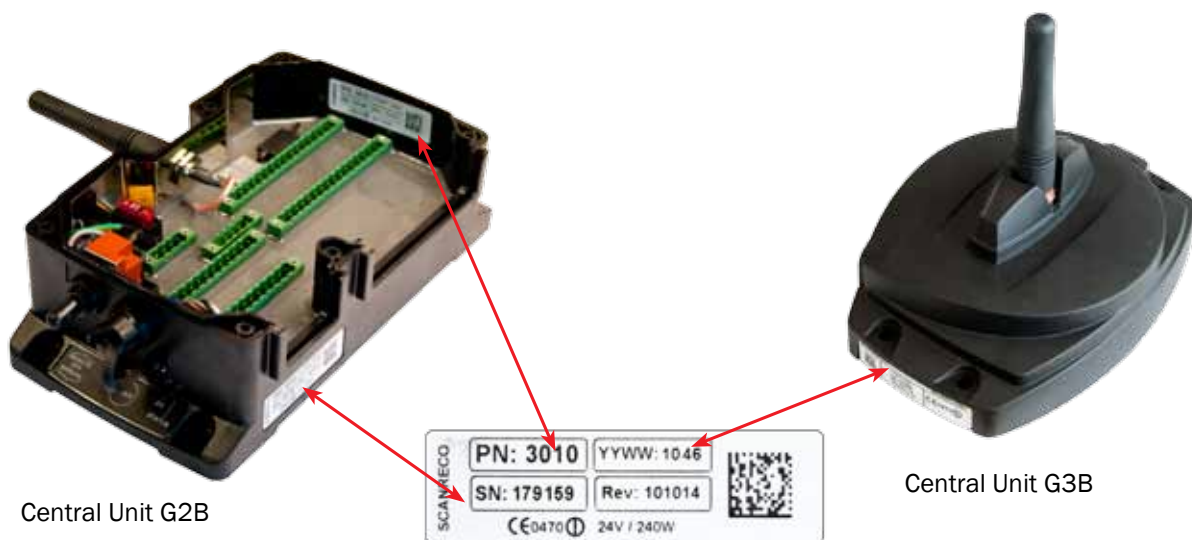
This document is applicable on the below declared products and program versions.

Item no:	Description	Program version
3010	G2B Central Unit PWM EU	4.10
3011	G2B Central Unit PWM NAFTA	4.10
2010	G2B Central Unit Danfoss EU	2.14
2011	G2B Central Unit Danfoss NAFTA	2.14
1602	G3B Central Unit Type 1 EU	1.00
1603	G3B Central Unit Type 1 NAFTA	1.00
1604	G3B Central Unit Type 2 EU	1.00
1605	G3B Central Unit Type 2 NAFTA	1.00
n/a*	G2B Portable Control Unit Maxi Linear	1.07
n/a*	G2B Portable Control Unit Maxi Joystick	1.07
n/a*	G2B Portable Control Unit Mini Linear	1.07
n/a*	G2B Portable Control Unit Mini Joystick	1.07

*Due to the variety of configurations available for the Portable Control Units, item numbers are not declared; only the available Portable Control Unit platform types are declared, for more detailed information refer to customer part list where available.

1.5 Product identification

All SCANRECO Products are labeled with product part number and serial number for verification. Below illustrations shows where these numbers can be located.



Always check and verify product item- and serial no. before any type of service is commissioned, refer to customer parts list and system-/product technical specifications in order to determine system-/product configuration.

2 Preface

2.1 General information

This manual is intended as a complement to the crane / machine instruction book and covers the Scanreco RC 400 G2B/G3B Remote Control System.

The Scanreco RC 400 G2B/G3B offers the driver an extremely advanced remote control system with speed, precision, control and maximum safety.

In order to ensure your safety and the safety of your crane / machine you should study and learn these instructions. This will enable you to quickly familiarise yourself with your new remote control system and how to utilise it.

- Remotely controlled cranes may only be operated by qualified personnel. The driver must be aware of the contents of chapter 4 "Safety regulations and Operating instructions" available in the Instruction Manual before operation is started. Serious accidents may occur if these instructions are not followed.
- To protect the portable control unit from damage and for safety reasons, the control unit must be kept in a locked cabin
- Follow the instructions given in the crane handbook regarding moving the crane from its parking position, the best arm positioning while loads are being handled and parking of the crane.
- Due to the unlimited variety of cranes, machines, objects, vehicles and equipment on which the remote control system are used, and the numerous standards which are frequently the subject of varying interpretation, it is impossible for the personnel at Scanreco to provide expert advice regarding the suitability of a given remote control for a specific application. It is the responsibility of the purchaser to determine the suitability of any Scanreco remote control product for an intended application and to insure that it is installed and guarded in accordance with all country, federal, state, local, and private safety and health regulation, codes, standards and Scanreco recommendation (this manual). If the Scanreco RC 400 G2B/G3B will be used in a safety critical application, the customer / driver must undertake appropriate testing and evaluation to prevent injury to the ultimate user. Scanreco does not take responsibility for any damage or injury.
- Unauthorized tampering with a Scanreco remote control system automatically invalidates guarantee.

3 General system description

3.1 General description of Scanreco RC-400 G2B/G3B

The Scanreco RC 400 G2B/G3B remote control system has been especially developed for hydraulically driven mobile cranes and machinery. The system is a digital remote control system based on an extremely advanced microprocessor technology. Years of exhaustive and demanding testing have shown that the remote control system can cope with the roughest of environments.

The system is protected against electromagnetic and radio frequency radiation and can be installed onto most hydraulic valve types (voltage, current pulse width, or protocol steered) found on the market.

In its basic form the remote control system is comprised of a portable control unit with manoeuvre levers for proportional control and switches for ON/OFF functions, a central unit with connection cable for driving proportional electro-hydraulic slide controllers.

Digitally coded control information (lever deflection and switch position) is sent from the control unit via electric cable or via radio to the central unit. The control unit and central unit translate the magnitude and direction of the manoeuvre lever deflections and switch positions to corresponding valve function, speed and direction and thus crane movement.

3.2 Schematic overview of Scanreco RC-400 G2B

Below illustrations shows a typical system consistency for the G2B system



No	Description	Qty
1	Portable Control unit (PCU)	1
2	Central unit G2B (CU)	1
3	Battery Charger (10 - 30 VDC)	1
4	Battery cassette (NiMH 7.2 VDC)	2
5	Manoeuvre cable (10 meters)	1
6	Emergency stop box (Optional)	1
7	Cable kit supply cables + digital outputs	1
8	Cable kit valves cables (analogue outputs)	1

3.3 Schematic overview of Scanreco RC-400 G3B

Below illustrations shows a typical system consistency for the G3B system



No	Description	Qty
1	Portable Control unit (PCU)	1
2	Central unit G3B (CU)	1
3	Battery Charger (10 - 30 VDC)	1
4	Battery cassette (NiMH 7.2 VDC)	2
5	Manoeuvre cable (10 meters)	1

4 Getting started

4.1 Portable Control Unit definition

The illustrations below aims to delare all entities mentioned in this document.



Activating the Portable Control Unit

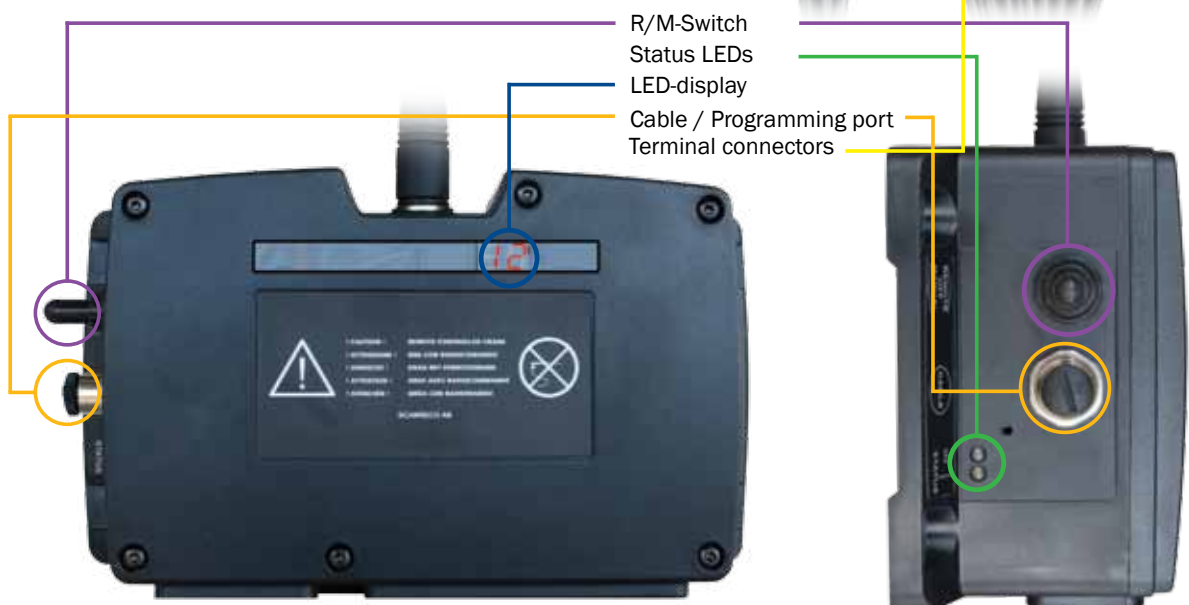
Insert battery or connect cable connector!

1. Twist up the Stop-button
2. Press the On-button once
- LED-Power will be illuminated RED



4.2 Central Unit G2B definition

The illustrations below aims to declare all entities mentioned in this document.



Activating the Central Unit

The Central Unit can be activated in two modes via the R/M switch; REMOTE or MANUAL mode. In REMOTE mode the Central Unit is controlled by the PCU, in MANUAL mode the system supplies only the DV-output intended for Dump valve supply; the complete system is by-passed allowing manual operation of distributor bench (where available).

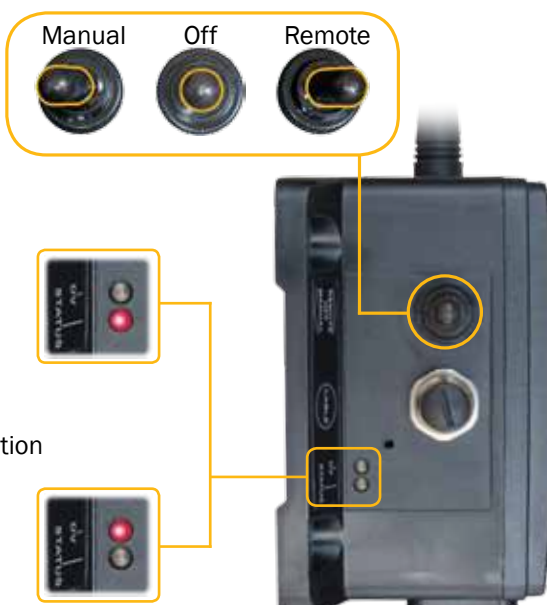
REMOTE MODE:

Operation via PCU
LED STATUS will be illuminated red at first then green when in contact with PCU.

MANUAL MODE:

System by-pass / Manual operation

LED DV will be illuminated red.



4.3 Central Unit G3B definition

The illustrations below aims to declare all entities mentioned in this document.



Activating the Central Unit G3B

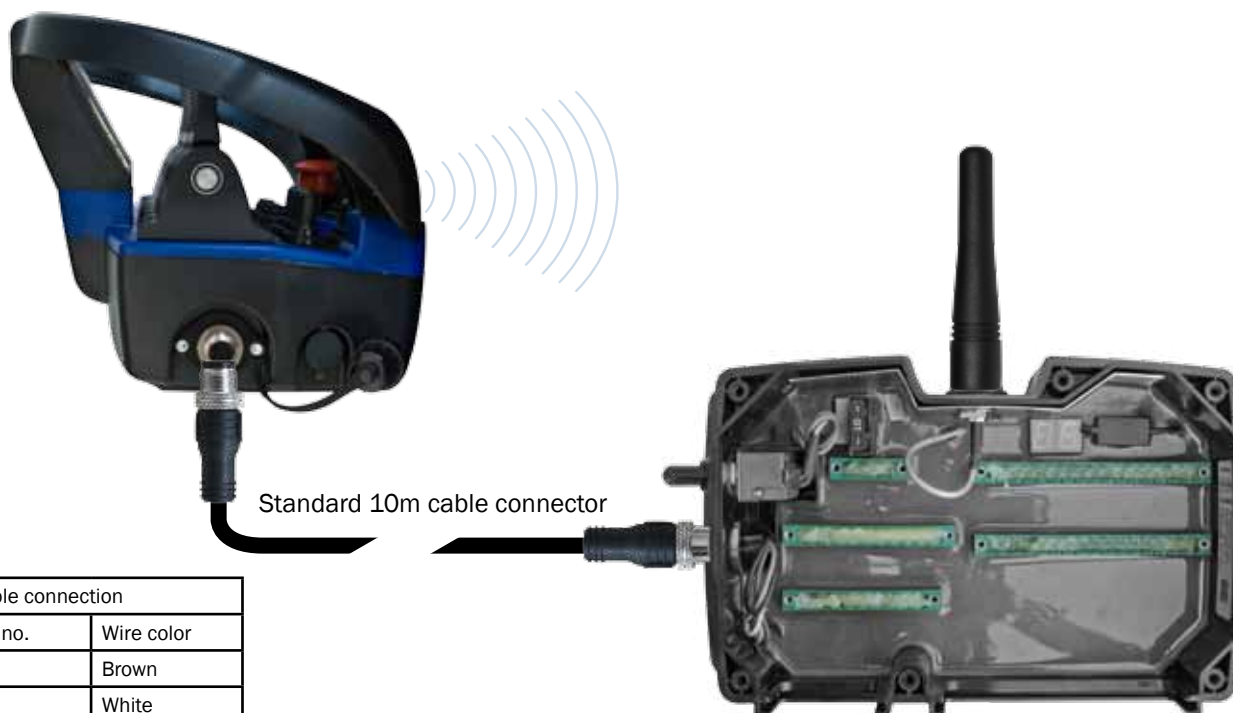
The Central Unit G3B is supplied thru Cable A and requires external power switching, see chapter 5.8 for further info.

The Central Unit G3B exists in 2 different versions; one with 2 cable outputs and one with 3 cable outputs. Refer to chapter 5.8 for further info.

4.4 Cable or radio communication

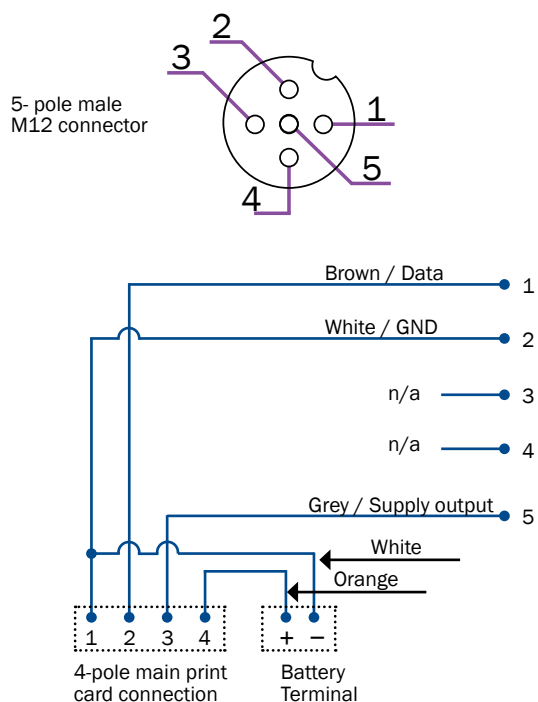
Cable communication has higher priority than radio communication, if a cable link is present between the PCU and Central Unit this will be detected by the system, disabling radio communication.

4.5 Cable connection schematics

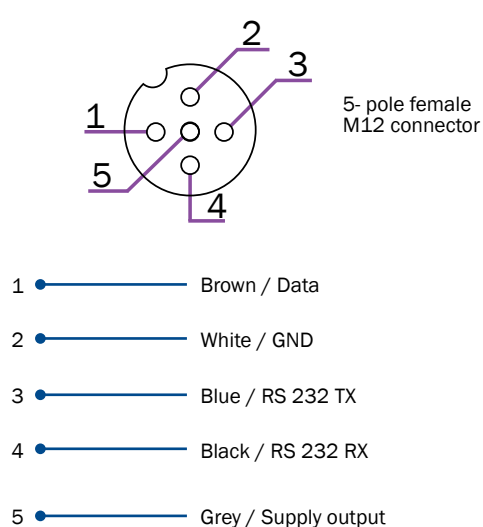


Cable connection	
Pin no.	Wire color
1	Brown
2	White
3	Blue
4	Black
5	Grey

Portable Control Unit Pin assignments



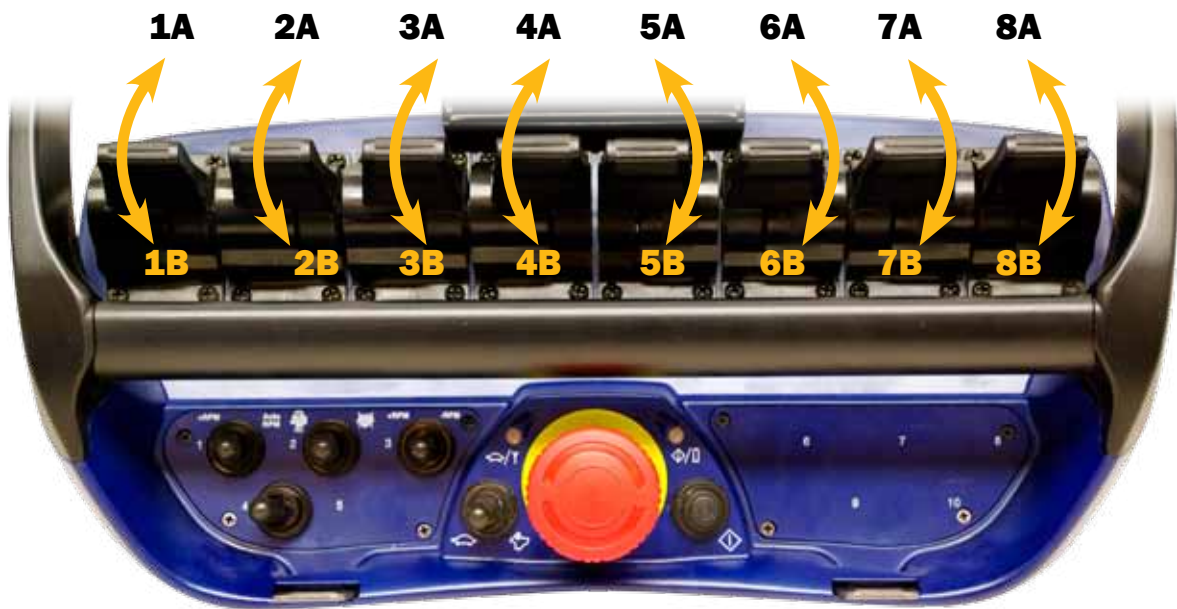
Central Unit G2B/G3B Pin Assignments



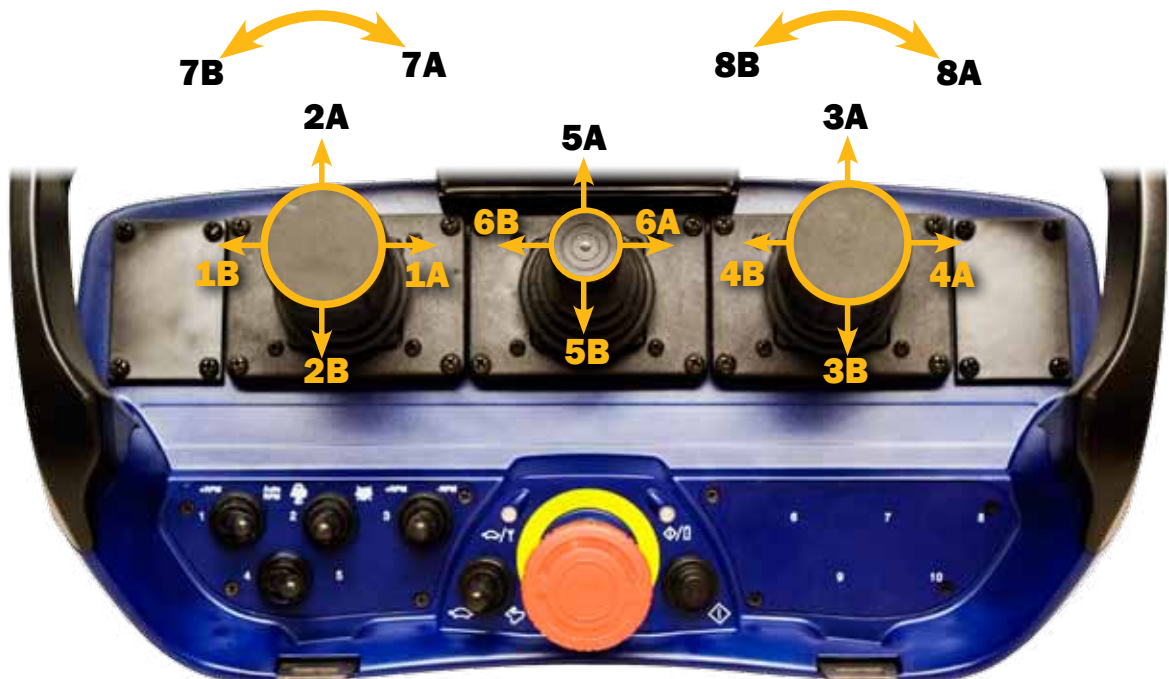
5 Inputs & Outputs

5.1 Analogue functions

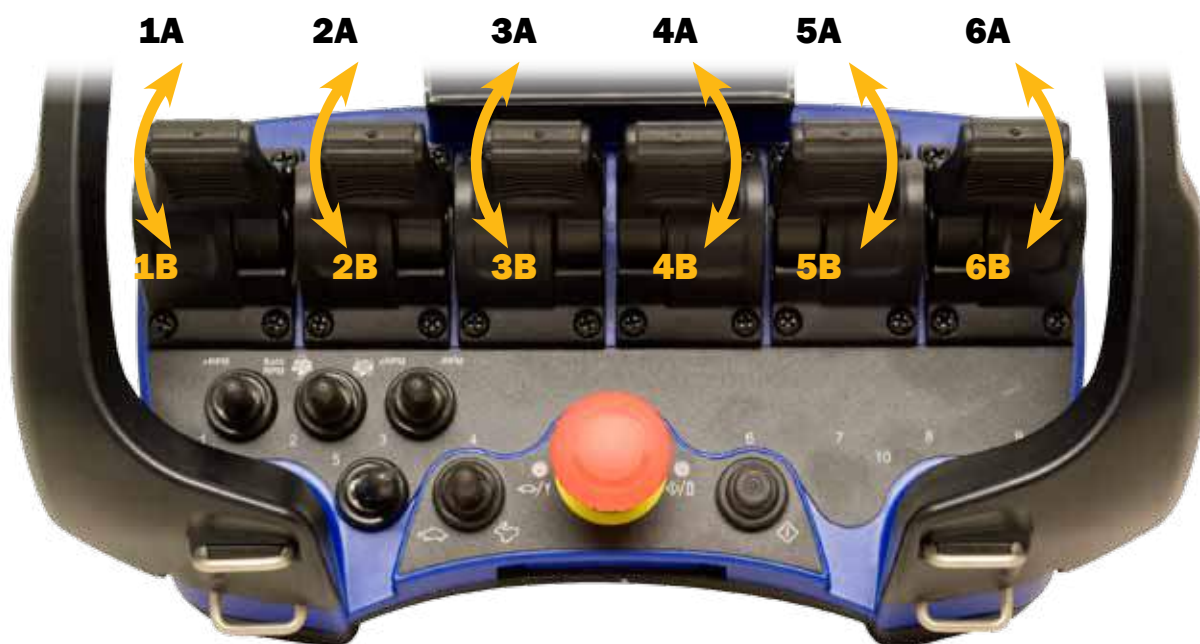
The analogue inputs available for each platform (MAXI Linear, MAXI Joystick, MINI Linear and MINI Joy stick) are by default assigned an analogue output on the Central Unit, below figures declares the standard assignments.



PCU MAXI Linear standard assignments



PCU MAXI Joystick standard assignments



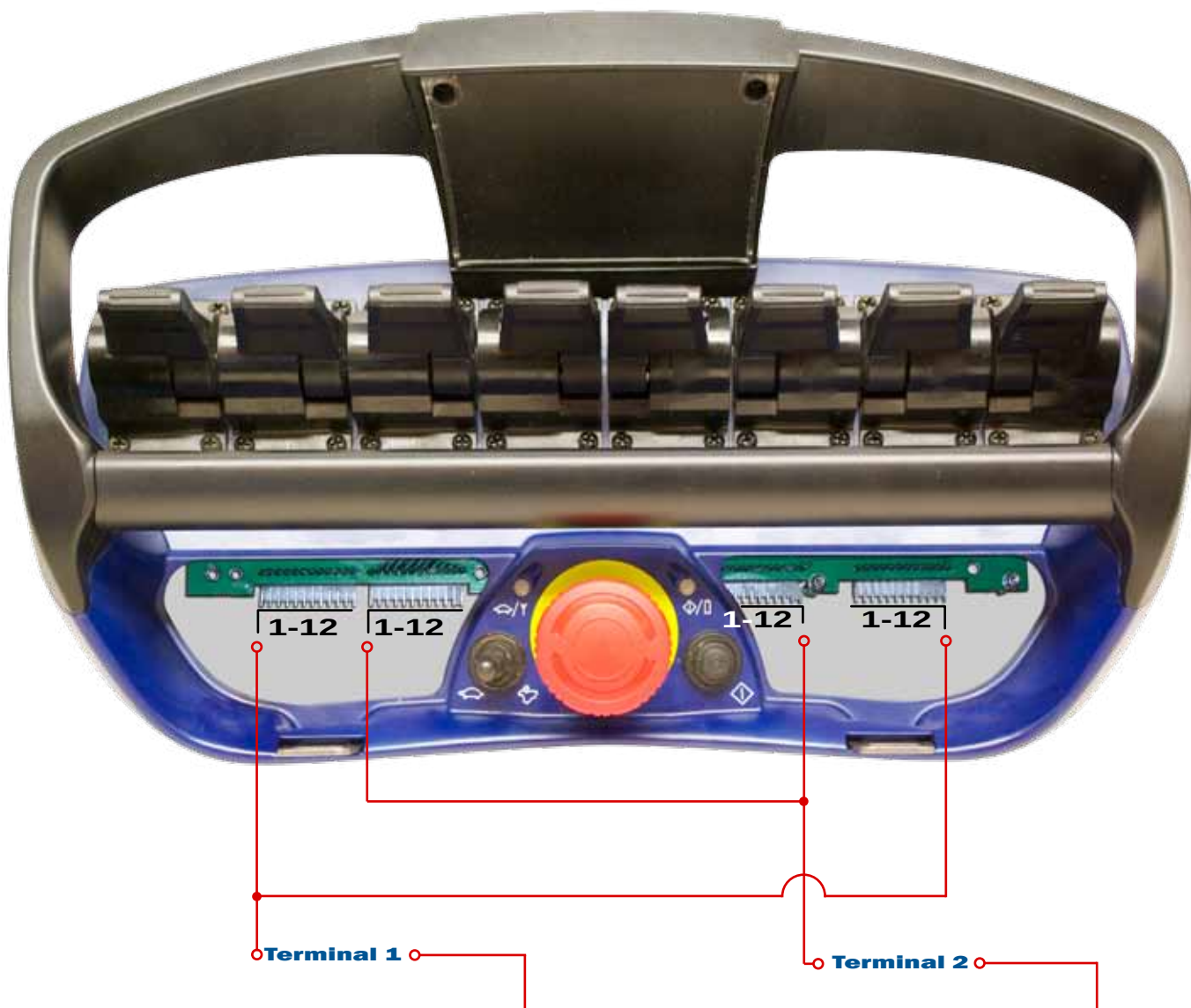
PCU MINI Linear standard assignments



PCU MINI Joystick standard assignments

5.2 Portable Control Unit MAXI digital inputs

The digital inputs available are NOT all by default assigned an digital output on the Central Unit, below figures only declares digital input access.



No.	Type	Colour code	AMP Pin no.
-	Common (GND)	Black	1
10	Digital input 33	Pink	2
9	Digital input 06	Grey	3
8	Digital input 02	Brown	4
7	Digital input 32	Purple	5
6	Digital input 05	Orange	6
5	Digital input 31	Black	7
4	Digital input 07	White	8
3	Digital input 04	Blue	9
2	Digital input 03	Green	10
1	Digital input 01	Yellow	11
-	Supply output	Red	12

No.	Type	Colour code	Amp Pin no.
-	Common (GND)	Black	1
20	Digital input 36	Pink	2
19	Digital input 35	Grey	3
18	Digital input 34	Brown	4
17	Digital input 37	Purple	5
16	Digital input 08	Orange	6
15	Digital input 09	Black	7
14	Digital input 13	White	8
13	Digital input 12	Blue	9
12	Digital input 11	Green	10
11	Digital input 10	Yellow	11
-	Supply output	Red	12

Note that on the MAXI platform the Terminals 1 and 2 are mirrored and available on both left and right hand side of the stop button

5.3 Portable Control Unit MINI digital inputs

The digital inputs available are NOT all by default assigned an digital output on the Central Unit, below figures only declares digital input access.



Terminal 1

No.	Type	Colour code	AMP Pin no.
-	Common (GND)	Black	1
10	Digital input 33	Pink	2
9	Digital input 06	Grey	3
8	Digital input 02	Brown	4
7	Digital input 32	Purple	5
6	Digital input 05	Orange	6
5	Digital input 31	Black	7
4	Digital input 07	White	8
3	Digital input 04	Blue	9
2	Digital input 03	Green	10
1	Digital input 01	Yellow	11
-	Supply output	Red	12

Terminal 2

No.	Type	Colour code	Amp Pin no.
-	Common (GND)	Black	1
20	Digital input 36	Pink	2
19	Digital input 35	Grey	3
18	Digital input 34	Brown	4
17	Digital input 37	Purple	5
16	Digital input 08	Orange	6
15	Digital input 09	Black	7
14	Digital input 13	White	8
13	Digital input 12	Blue	9
12	Digital input 11	Green	10
11	Digital input 10	Yellow	11
-	Supply output	Red	12

5.4 Digital functions

The digital functions utilized varies depending on system configuration, up to 20 digital functions can be implemented thru left- and/or right switch panels with programmable assignments to up to 14 digital outputs.

In excess the On-button may also be assigned a digital output.

Below shows PCU platforms standard digital inputs and default Central Unit output assignment



PCU MINI Standard assignment

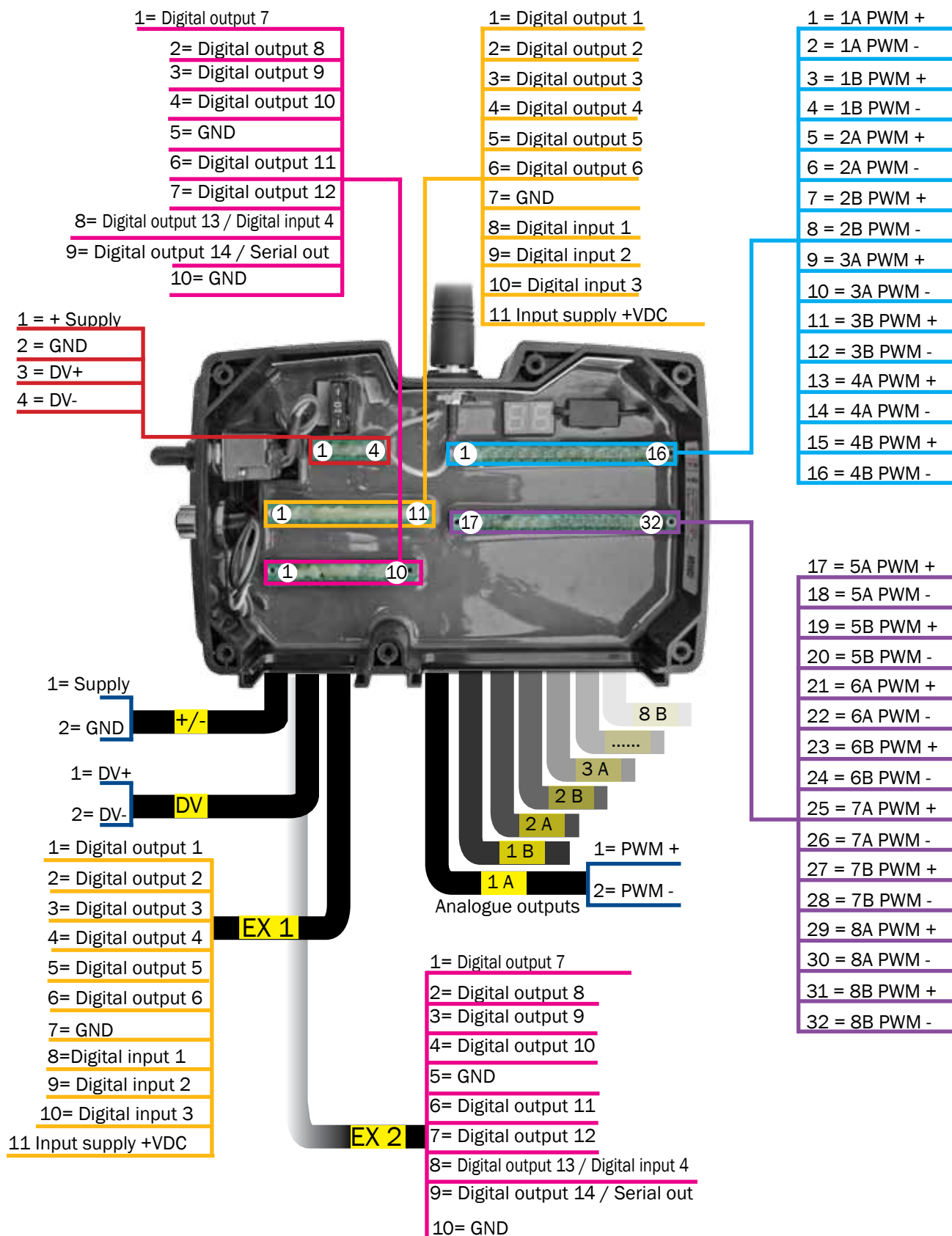


PCU MAXI Standard assignment

Position	Type	Central Unit
301	3 way detent toggle	Digital output 1 / Digital output 1 Parallel with analogue input movement (AutoRPM engine feature)
302	3 way spring back toggle	Digital output 2 / Digital output 3 (Engine start / Engine stop)
303	3 way spring back toggle	Digital output 4 / Digital output 5 (Engine RPM+ / Engine RPM-)
304/305	2 way detent toggle	Digital output 6 (Optional)
On-button	Push button	Digital output 7

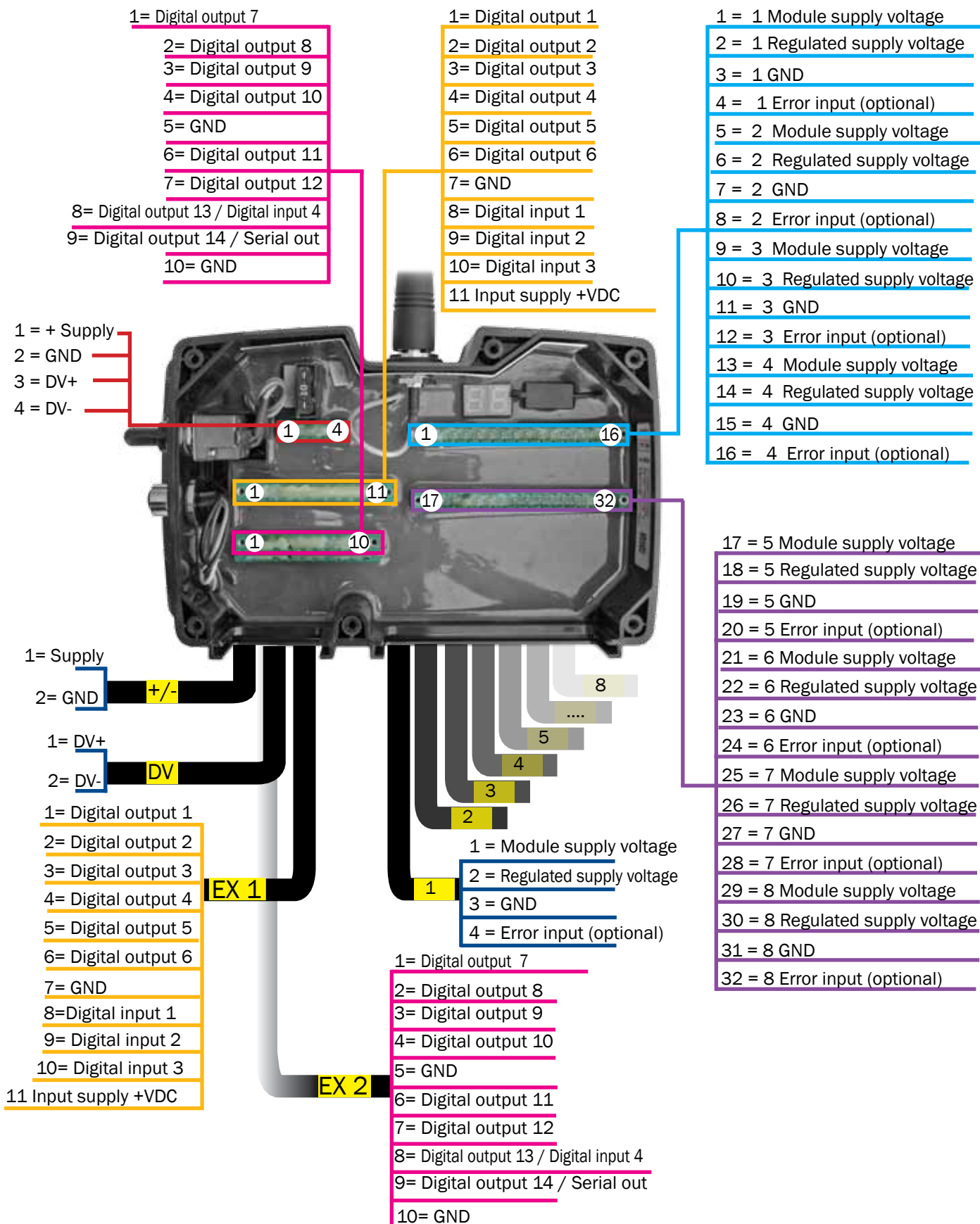
5.5 Terminal schematics for current controlled Central Unit G2B

The drawing below declares access points for each available input and output both from the inside terminal (above) and the standard cable kits (below). Standard cable wire number/markings is also declared.



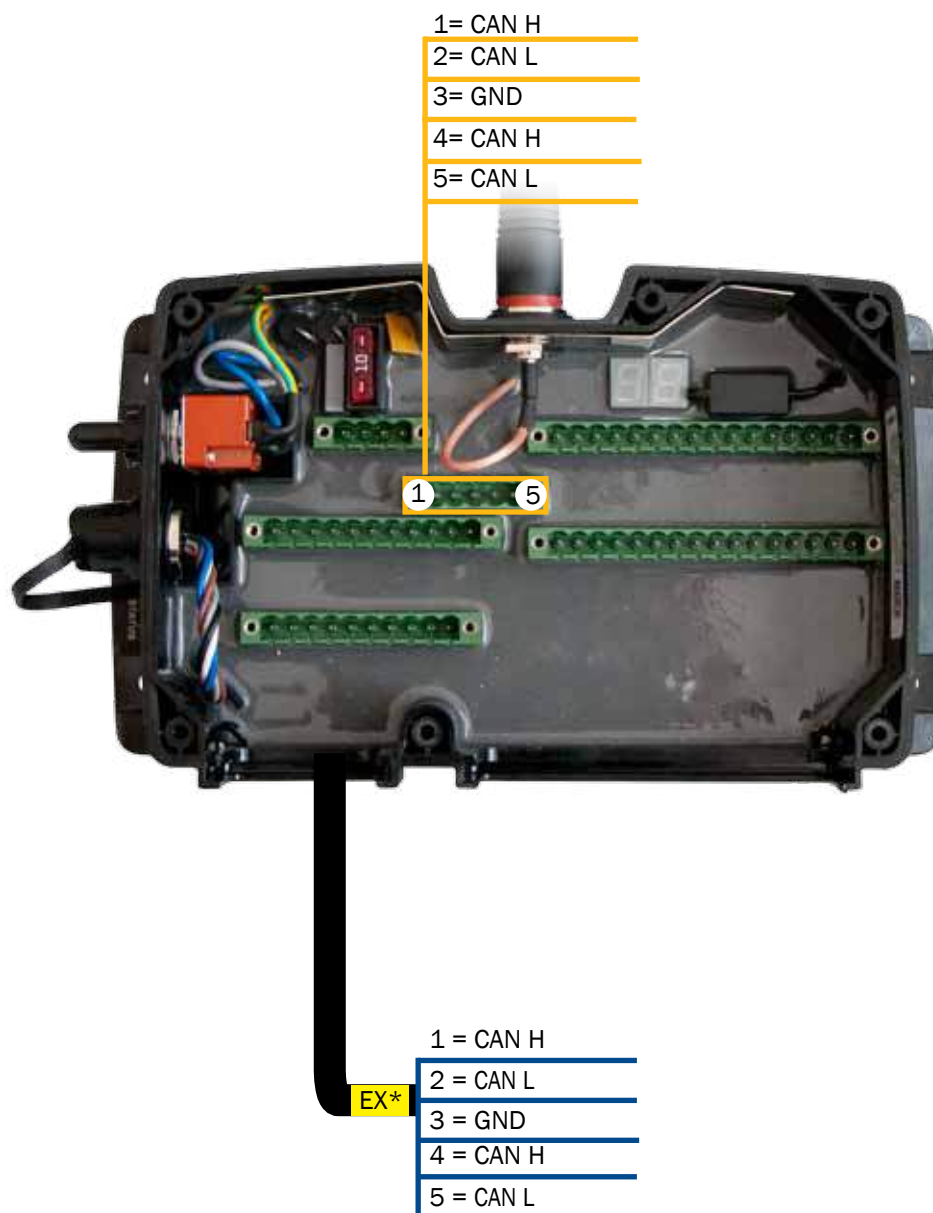
5.6 Terminal schematics for voltage controlled Central Unit G2B

The drawing below declares access points for each available input and output both from the inside terminal (above) and the standard cable kits (below). Standard cable wire number/markings is also declared.



5.7 Terminal schematics for Central Unit G2B CAN interface

The Central Unit is equipped with terminal connections for CAN. The drawing below declares the access points both from the inside terminals (above) and the standard cable kit (below).



NOTE:

* as various cable kits exists, please refer to chapter 13 or system technical specification for further information

The Central Unit G2B is not equipped with a specific "STOP loop" connection, if needed a digital output are in such cases assigned; if more info is required; refer to system technical specification.

If required; a terminator resistor can be installed between points 4 & 5: the resistor value needs to be defined by the system installer.

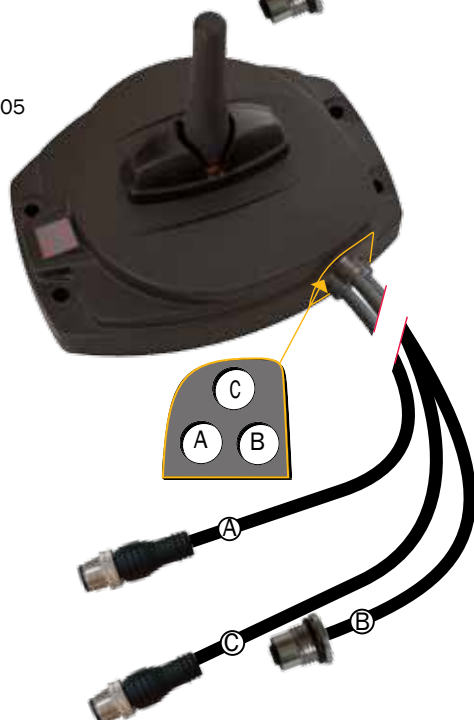
5.8 Connection schematics for Central Unit G3B

The Central Unit G3B is equipped with either 2 or 3 circular M12 5-pole connectors (check item no).
The drawing below declares Pin-assignments for both versions of the Central Unit G3B

Item no: 1602, 1603



Item no: 1604, 1605



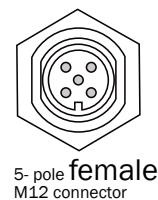
Cable A (3 meters)

Connection	
Pin no.	Colour / Function
1	Brown / DV1
2	White / Power supply
3	Blue / GND
4	Black / CAN_HIGH
5	Grey / CAN_LOW



Cable B (3 meters)

Connection	
Pin no.	Colour / Function
1	Brown / DATA
2	White / GND
3	Blue / RS 232 TX
4	Black / RS 232 RX
5	Grey / Supply output



Cable C (3 meters)

Connection	
Pin no.	Colour / Function
1	Brown / DV2
2	White / LOOP1_OUT
3	Blue / LOOP1_IN
4	Black / LOOP2_OUT
5	Grey / LOOP2_IN



6 Operational indications

6.1 Central Unit status and operational indications

The Central Unit G2B is equipped with 2 individual positions where status and operational indications can be read, the external LEDs STATUS and DV provides basic limited information whilst the LED display provides more detailed information, the Central Unit G3B only have the LED-display as shown below.



Position 4: Status LEDs

Position 5: LED-display

External LEDs (on Central Unit G2B only!)

LED STATUS	Meaning
OFF	Off, Central Unit is deactivated
RED	ON – Central Unit is activated in REMOTE mode No communication with PCU
GREEN	ON – Central Unit is activated in REMOTE mode Communication link with Portable Control Unit
RED flashing 4/1	Error code being displayed on internal LED Display

LED DV	Meaning
RED	Dump Valve output is supplied

Note that the LED STATUS is used also for error code alarms and operator controlled functions and is then triggered by an event, the type of indication will be declared for each event further in this document.

6.2 Central Unit LED-display

Below table shows the variety of status indications available for both the Central Unit G2B and G3B:

LED Display	Meaning
	Off, deactivated
	Standby mode, no communication link with PCU
	Standby mode, communication link with PCU
	Communication link via cable, ID-code approved
	Communication link via cable, ID-code not approved
	Communication link via radio, frequency hopping
	Communication link via radio, frequency locked on channel 1
	Communication link via radio, frequency locked on channel 2
	Communication link via radio, frequency locked on channel 3
	Communication link via radio, frequency locked on channel 4
	Communication link via radio, frequency locked on channel 5
	Communication link via radio, frequency locked on channel 6
	Communication link via radio, frequency locked on channel 7
	Communication link via radio, frequency locked on channel 9
	Communication link via radio, frequency locked on channel 10
	Communication link via radio, frequency locked on channel 11
	Communication link via radio, frequency locked on channel 12
	Communication link via radio, frequency locked on channel 13
	Radio communication deactivated via program setting (WinSCI)
	ID-programming procedure is active (See chapter 12 for further info)
	ID-programming procedure rejected (See chapter 12 for further info)

6.3 Portable Control Unit status indications

The Portable Control Unit uses 2 LEDs to indicate operational status, the Portable Control Unit is also equipped with an internal buzzer that emits sounds and alarms when required.



Typical status indications involving the Micro- and Power-LED are declared below:

Power-LED	Meaning
OFF	Off, Portable Control Unit is deactivated
RED Fixed	ON – Transmitting data
RED Flashing 1/1 sec.	ON – Transmitting data Low battery! (Buzzer will emit an alarm for the first three sequences when low level is detected)

Micro-LED	Meaning
OFF	Normal mode
Green Flashing 1/3th sec.	Micro step 1 active
2 / 3rd sec	Micro step 2 active
3 / 3rd sec	Micro step 3 active
4 / 3rd sec	Micro step 4 active
5 / 3rd sec	Micro step 5 active

Note that these LEDs are used also for error code alarms and operator controlled functions and are then triggered by an event, the type of indication will be declared for each event further in this document.

7 Error code indications

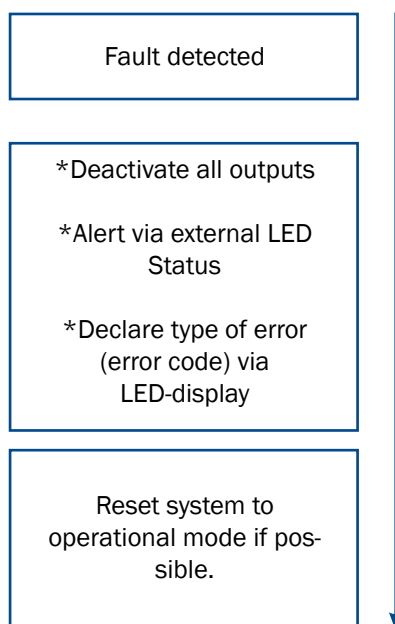
7.1 General description

Both the Portable Control Unit and the Central Unit are embedded with constant fault monitoring, any errors noticed by the system will result in interruption of all operational commands.

7.2 Central Unit Error codes

All of the Central Units outputs are fault monitored for short circuits and/or overloads, in the event of an error being detected the Central Unit will alert that an error has occurred via the external LED Status and indicate the appropriate error code via the LED-display, the Central Unit will then reset to operational mode if possible.

Below example flowchart on behaviour:



This fault sequence will take an approximately 6 seconds The external LED STATUS will flash rapidly in red colour declaring that an error has been detected, for more detailed information; the LED-display must be monitored (or error code log available from diagnostics menu).

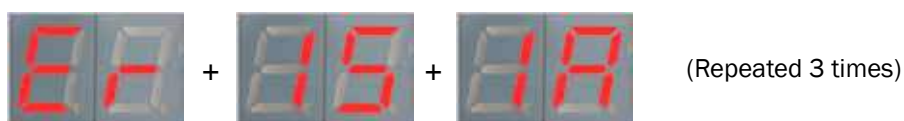
The LED-display Error codes are displayed in up to 3 sequences, this allows the Central Unit to declare exactly which output that is related to the error (where applicable).

First sequence: Letters E:r is presented declaring an error code

Second sequence: Type of error code

Third sequence: Additional information (where applicable)

In example:



The example would imply that there is an short circuit on output 1A

7.2.1 Error codes

2nd	3rd	Description	Cause	Action
01.	01	EEPROM failure.	Incorrect checksum on EEPROM, last stored data will be set.	Reset system, if persistent; Re-load application program.
01.	02	Flash memory failure.	Incorrect checksum on flash memory.	Reset system, if persistent; Re-load application program.
01.	03	Stack memory failure.	Incorrect sizes of data in CANopen protocol, incorrect dataflow or stack overflow.	System will self reset automatically. If persistent; Re-load application program.
01.	04	RAM memory failure.	Incorret RAM and/or hardware identification.	System will self reset automatically. If persistent; Re-load application program.
02.	01	Illegal voltage; DVoutput.	DV-output error; DV-output (DV+) externally supplied	System will self reset. Check DV-output connection. Remove terminal connector and reset system.
02.	02	Short circuit; DV-output.	DV-output error; DV output (DV+) short circuited or overloaded.	System will self reset. Check DV-output connection. Remove terminal connector and reset system.
02.	03	Safety switch error	Safety switch output read back error, incorrect voltage (High instead of Low)	System will self reset. Remove all terminal connectors and reset system.
02.	04	Safety switch error	Safety switch output read back error, incorrect voltage (Low instead of High)	System will self reset. Remove all terminal connectors and reset system.
03.	00	Illegal voltage; Digital output	Digital output (1-14) illegal voltage, expected low signal but read as high (Could be any of the available 14	System will self reset. Check digital output connections. Remove terminal connector and reset

7.2.1 Error codes (continued)

2nd	3rd	Description	Outputs	system
04.	00	Short circuit; Digital output	Digital output (1-14) short circuited or overloaded (Could be any of the available 14 outputs)	System will self reset. Check digital output connections. Remove terminal connector and reset system.
05.	00	Error input triggered (Danfoss CU only).	Error signal for Danfoss valve triggered (Could be any of the available 8 inputs)	System will self reset. Check analogue output connections. Remove terminal connector and reset system.
06.	x	Illegal voltage analogue output	Wrong voltage on analogue output (3rd sequence declares related output; 1A,1B....).	System will self reset. Check analogue output connections. Remove terminal connector and reset system.
07.	x	Illegal voltage analogue output	Wrong current on analogue output (3rd sequence declares related output; 1A,1B....).	System will self reset. Check connections. Remove terminal connector and reset system.
08.	01	CAN Passive	CAN bus in passive mode.	System will self reset. Check CAN connections. Check other nodes on bus and reset system.
08.	02	CAN I/O Buffer overflow	CAN overrun; either the CAN input or CAN output buffer are full	System will self reset. Reset system, re-initiate via CAN controller.
08.	03	CAN physical layer error	Bad communication/transmission	System will self reset. Check CAN connections. Check other nodes on bus and reset system.
08.	04	CAN PDO length exceeded	PDO length is too long	System will self reset. Reset system, re-initiate via CAN controller.
08.	05	CAN PDO length error	PDO length is too short	System will self reset. Reset system, re-initiate via CAN controller.
08.	06	CAN Transmit COB-ID collision	To many collisions on CANbus	System will self reset. Check CAN connections. Check other nodes on bus and reset system, re-initiate via CAN controller.
10.	00	PCU failure; Emergency stop	Error transmitted from PCU: Illegal signal from PCU emergency stop switch	System will self reset. Check emergency stop switch on PCU
11.	00	PCU failure; Analogue input	Error transmitted from PCU: Analogue input active on start-up input	System will self reset. Ensure all analogue inputs on PCU are at zero/neutral position. Restart PCU.
12	00	PCU failure; Analogue input	Error transmitted from PCU: Signal redundancy test; illegal signal from analogue input.	System will self reset; Diagnose PCU via TEST MODE
13.	n/a	PCU failure; Analogue input	Error transmitted from PCU: Signal redundancy test; illegal signal from analogue input.	System will self reset; Diagnose PCU via TEST MODE

7.2.1 Error codes (continued)

14.	01	ID programming failure	ID-code and/or parameter settings not accepted.	System will self reset. Verify ID-programming procedure. Reset application program.
14.	02	Program failure	Programmable logic parameter error	System will self reset. Reset application program.
15.	x	PWM output failure	Analogue output short circuited or overloaded. (3rd sequence declares related output; 1A,1B....).	System will self reset. Check analogue output connections. Remove terminal connector and reset system.
16.	x	PWM output failure	Analogue output not connected (Programmable feature). (3rd sequence declares related output; 1A,1B....).	System will self reset. Check analogue output connections. Remove terminal connector and reset system.
17.	01	Low supply power	Low power supply (Below 8,5 VDC)	System will self reset. Check power supply and supply connections.
17.	02	High supply power	High power supply (Above 36,0 VDC)	System will self reset. Check power supply and supply connections.
98.	n/a	Undefined PCU error	Undefined error in PCU.	Diagnose PCU via TEST MODE
99.	n/a	Undefined CU error	Undefined error in CU.	System will self reset. Remove all terminal connectors Check power supply and supply connections. Reset system.

7.3 Portable Control Unit error codes

The Portable Control Unit monitors all analogue and digital inputs for faults and uses the Power-LED and BUZZER to indicate alarms.

Below available error codes:

Indications	Meaning
1	Analogue input 1 not at zero position during start-up
2	Analogue input 2 not at zero position during start-up
3	Analogue input 3 not at zero position during start-up
4	Analogue input 4 not at zero position during start-up
5	Analogue input 5 not at zero position during start-up
6	Analogue input 6 not at zero position during start-up
7	Analogue input 7 not at zero position during start-up
8	Analogue input 8 not at zero position during start-up

8 Radio

8.1 General description

Radio is used as a bus link for data packages between the transmitter (Portable Control Unit) and receiver (Central Unit), the radio continuously transmits the positions of the analogue and digital inputs available on the Portable Control Unit to the Central Unit for further processing.

The digitalized data transfer protocol uses a high security level for verification of each data package, no loss of individual functions due to radio interferences can occur.

The unique ID-code held in the Portable Control Unit ensures that the system can not be operated unintentionally by other Control Unit.

The transmission allows interferences to some extent as long as multiple data packages are not interfered successively.

8.2 Determining radio quality

The radio quality can be determined by the external status LED and/or the first 7-segment on the LED-display during radio communication

When an optimal communication is acquired the external Status LED will be fixed green and the Central Unit LED-display will indicate "1x" (x being dependent on program setting).

Short interruptions and losses of data packages will be indicated by irregular flashes of these indicators, an increasing intensity of flashes indicates a decreasing radio reception.

Note that irregular flashes is a common occurrence, unless they cause an interruption in communication they should not be considered a cause for concern.



NOTE:

In such cases that a locked frequency is used the second 7-segment indication will be different, check chapter 6.2 for further information.

8.3 Radio channel / Frequency

Refer to separate document for radio channel used in your region

8.4 Range

Refer to separate document for radio channel used in your region

9 Diagnostics mode

9.1 General description

A diagnostics mode has been made available as to diagnose and manage the system, the LED-display is required to be monitored during diagnostics and will allow operator to read out recently occurred error codes, output characteristics and program information in order to diagnose the system.

9.2 Activating diagnostics mode

Note that the LED-display is required to be monitored during diagnostics mode.

Do as follows:

1. Remove the battery pack. Connect the cable between the Portable Control Unit and turn off the Central Unit via the R/M-switch.
2. Activate the Central Unit in REMOTE mode.
3. Press the Portable Control units On-button once.
-The Power-LED should be illuminated
4. Produce impulses in very quick succession with the Micro-toggle to the LEFT (MICRO-ON direction) 15 times or until the Central Units LED-display indicates D:i – 0:0.
5. Diagnostics mode is now active!

The diagnostics mode consist of 8 different menus' that can be toggled using the on-button, once a menu is entered the current values for that specific parameter is presented in the LED-display.

To exit diagnostics mode press Stop-button on Portable Control Unit.



If activation fails, the 4th step may have been done too slow, the toggle has to be done with a maximum 0,5 second interval.

Attention:

Note that system will operate outputs as in normal operational mode, real-time values (where available) are shown in the LED-display.

Note that by entering the diagnostics mode, the Micro function has been activated and analogue outputs may operate reduced speeds, if full speeds are desired; press Micro-toggle to the right once (MICRO-OFF direction).

9.3 Table / diagnostics data

Position / LED Indication	Meaning
D:i - 0:0	Default position
D:i - 0:1	Analogue output status
D:i - 0:2	Digital output status
D:i - 0:3	Digital Input status
D:i - 0:4	Error code Log
D:i - 0:5	Program save
D:i - 0:6	Program load
D:i - 0:7	Central Unit firmware version
D:i - 0:8	Portable Control Unit firmware version
-	Return to position 00

9.3.1 Position 1 - Analogue output status

Press On-button once from position D:i - 0:0

D:i - 0:1 is displayed

As to determine the current status for all analogue outputs. Lever/joystick assignments and analogue output start, stop and ramp values.

While in this position, actuating a specific lever will result in the LED-display presenting which output that is assigned, the direction and the current real time value.

In example:

Lever is actuated, display responds by indicating related output for 1 second

In example

1:A, 2:A, 3:A, 4:A, 5:A, 6:A, 7:A, 8:A, 1:b, 2:b, 3:b, 4:b, 5:b, 6:b, 7:b, 8:b

Followed by the current value in correspondance to lever angle.

1-99, h:i*

*h:i indicating that 100% velocity is achieved

9.3.2 Position 2 - Digital output status

Press On-button two times from position D:i – 0:0

D:i – 0:2 is displayed for 1 second, the LED-display will then toggle all Central Unit digital outputs and present current value (High or Low)

O:n – 0:1 - 0:1 or 0:0 (High/Low)

O:n – 0:2 - 0:1 or 0:0 (High/Low)

O:n – 0:3 - 0:1 or 0:0 (High/Low)

...

O:n – 1:4 = 0:1 or 0:0 (High/Low)

As to determine the current status for all digital outputs.

While in this position the LED display will present each digital output from 1 to 14, high or low, continuously

9.3.3 Position 3 - Digital input status

Press On-button three times from position D:i – 0:0

D:i – 0:3 is displayed for 1 second, the LED-display will then toggle all Central Unit digital inputs and present current value (High or Low).

i:n – 0:1 - 0:1 or 0:0 (High/Low)

i:n – 0:2 - 0:1 or 0:0 (High/Low)

i:n – 0:3 - 0:1 or 0:0 (High/Low)

i:n – 0:4 - 0:1 or 0:0 (High/Low)

As to determine the current status for all digital inputs.

While in this position the LED-display will present each digital input from 1 to 4, high or low, continuously

9.3.4 Position 4 - Error code log

Press On-button four times from position D:i – 0:0

D:i – 0:4 is displayed for 1 second, the LED-display will then toggle the 5 most recent error codes that have been triggered in the Central Unit.

As to determine faults registered by the Central Unit, refer to chapter 7 for error code information.

The LED-display will toggle the logged error codes continuously.

9.3.4.1 Clear error code log

Hold Micro-toggle in LEFT position for 5 seconds

E:r – C:L is displayed in the LED-display (Error Clear)

Release and press Micro-toggle once more to LEFT position to confirm.

Central Unit error code logg is cleared.

An error code clear is suitable to conduct after service!

9.3.5 Position 5 - Program save

Press On-button five times from position D:i – 0:0

D:i – 0:5 is displayed

Press and hold Micro-toggle in LEFT position for 3 seconds

C:o – F:A is displayed

Release and press Micro-toggle once more to LEFT position to confirm and store the current settings

Saves the current settings for DIRECTION and SPEEDS (START, STOPP, MICRO, RAMP) and DV-delay time as back-up for eventual future program load, see below chapter “program load”.

9.3.6 Position 6 - Program load

Press On-button six times from position D:i – 0:0

D:i – 0:6 is displayed

Press and hold Micro-toggle in LEFT position for 3 seconds

P:o – F:A is displayed

Release and press Micro-toggle once more to LEFT position to confirm and load the settings previously stored

Enables a reset to previously stored application program setting “Program save”

9.3.7 Position 7 - Central Unit program version

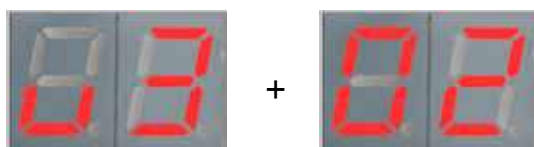
Press On-button seven times from position D:i – 0:0

D:i – 0:7 is displayed followed by current firmware version

V:n – n:n

The current version of the Central Units program is presented in two sequences, continuously repeated

In example:



9.3.8 Position 8 - Portable Control Unit program version

Press On-button eight times from position D:i – 0:0

D:i – 0:8 is displayed followed by the current firmware version

V:n – n:n

The current version of the Portable Control Units program is presented in two sequences, continuously repeated

10 Online Programming mode

10.1 General description

The Scanreco RC 400 offers considerable possibilities for system constructors of hydraulically driven mobile cranes and machines. The program in the control system is very comprehensive, flexible and has many adaptation possibilities for specific applications. The control system offers simple programming of a number of functions which can easily be turned on or off or altered during operation.

To obtain the best manoeuvre characteristics in the simplest way, all programming / calibration of manoeuvre characteristics is made during operation (so called on-line programming). All programming / calibration is made from the Portable Control Unit.

Programming is simple and does not require tools / instruments.

The installer/system designer is responsible for seeing that system is used correctly and is responsible for any re-programming of the system functions and the characteristics changes caused by this!

The system has 4 levels of authorisation:

Authorisation level 1. (Installer)

Change direction of analogue movement

Authorisation level 2. (Well trained installer, well trained service personnel)

Change direction of analogue outputs A/B

Change start speeds for analogue outputs

Change stop speeds for analogue outputs

Change micro speed for analogue outputs

Change ramp speeds for analogue outputs

Authorisation level 3. (Well trained crane and valve manufacturer, well trained system constructor)

Not declared in this document

Authorisation level 4. (Scanreco AB)

Not declared in this document

IMPORTANT SAFETY NOTE:

In online programming mode, when you select a programming step, the system automatically activates the speeds of the corresponding selected lever. Speeds used are independent by SET selected in the system and depend only by programming step in which you are.

EXAMPLE:

Even if the system is working in SET1 (SET1 argument is valid), when you enter in the programming mode step no. 8 (SET2), the system will activate and work with the speeds of SET2

10.2 Activating online programming mode

The Central Units LED-display or Portable Control Units acoustic step signalling is required to be monitored during programming mode, check the table (10.3) for the indications given.

Do as follows:

1. Remove the battery pack. Connect the cable between the Portable Control Unit and the Central Unit and test run the system.
2. Press the Stop-button on the Portable Control Unit and deactivate the Central Unit via the R/M-switch.
2. Twist up the Stop-button on the Portable Control Unit and activate the Central Unit in REMOTE mode.
3. Press the Portable Control Units On-button once.
-The Power-LED should be illuminated
4. Produce impulses in very quick succession with the Micro-toggle to the RIGHT (MICRO-OFF direction) 10 times or until the Portable Control Unit gives a long beep signal and the Central Units LED-display indicates P:o – 0:0.
5. Online programming mode is now active, The online programming mode consist of 15 different menu's that can be toggled using the On-button, once a menu is entered the Central Units LED-display will indicate the current parameter value of any actuated analogue output, MICRO-ON (left) will decrease the value and MICRO OFF (right) will increase the value.

To exit online programming mode press the Stop-button on the Portable Control Unit.



If activation fails; the 4th step may have been done too slow, the toggle has to be done with a maximum 0,5 second interval.

Attention:

Note that the system will operate outputs as in normal operational mode!

Online programming is done in real time, any parameters set are immediately effective!

If not satisfied with the new settings you may be able to retrieve previous/default parameter setting via the diagnostics mode, load program.

10.3 Table / Programming options

Position via CU LED Indication	PCU Acoustic signal (L=Long, S=Short)	Meaning
P:0 - 0:0	1L	Start / Default position
P:0 - 0:1	1S	Direction
P:0 - 0:2	2S	Start value SET1
P:0 - 0:3	3S	Stop value SET1
P:0 - 0:4	4S	Micro value SET1
P:0 - 0:5	1L, 1S	Ramp delay up SET1
P:0 - 0:6	1L, 2S	Ramp delay down SET1
P:0 - 0:7	1L, 3S	Start value SET2
P:0 - 0:8	1L, 4S	Stop value SET2
P:0 - 0:9	2L, 1S	Micro value SET2
P:0 - 1:0	2L, 2S	Ramp delay up SET2
P:0 - 1:1	2L, 3S	Ramp delay down SET2
P:0 - 1:2	2L, 4S	Start value SET3
P:0 - 1:3	3L, 1S	Stop value SET3
P:0 - 1:4	3L, 2S	Micro value SET3
P:0 - 1:5	3L, 3S	Dump valve delay time
-		Return to position 00

10.3.1 Position 01 - Direction

For individual adjustment of the direction of lever movement

Available values

0 or 1 (Normal or reversed direction)

When actuating a lever/joystick the LED-display will indicate which output that is active and its corresponding direction.

Example:

1:b - 0:1 meaning reversed direction is enabled for output 1

10.3.2 Position 02 - Start speed SET1

For individual adjustment of start speed

Available values:

Values ranging from 1-100

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding start speed.

Example:

2:A - 2:0 meaning that the start speed is set to 20% of the maximum velocity on output 2A

10.3.3 Position 03 - Stop speed SET1

For individual adjustment of stop speed

Available values:

Values ranging from 1-100

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding start speed.

Example:

3:b - h:l meaning stop speed is set to 100% of maximum velocity on output 3B

10.3.4 Position 04 - Micro speed SET1

For individual adjustment of 1st step micro speed

Available values:

Values ranging from 1-100

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding 1st step micro speed.

Example:

4:b – 6:0 meaning micro speed is set to 60% of maximum velocity on output 4B.

10.3.5 Position 05 - Start ramp SET1

For individual adjustment of start ramp

Available values:

Values ranging from 0-100 (0 = No ramp delay, 1-50 = x100 ms delay/step)

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding start ramp speed.

10.3.6 Position 06 - Stop ramp SET1

For individual adjustment of stop ramp

Available values:

Values ranging from 0-100 (0 = No ramp delay, 1-50 = x100 ms delay/step)

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding stop ramp speed.

10.3.7 Position 07 - Start speed SET2

For individual adjustment of start speed

Available values:

Values ranging from 1-100

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding start speed.

10.3.8 Position 08 - Stop speed SET2

For individual adjustment of stop speed

Available values:

Values ranging from 1-99

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding stop speed.

10.3.9 Position 09 - Micro speed SET2

For individual adjustment of 1st step micro speed

Available values:

Values ranging from 1-100

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding 1st step micro speed.

10.3.10 Position 10 - Start ramp SET2

For individual adjustment of start ramp

Available values:

Values ranging from 0-100 (0 = No ramp delay, 1-50 = x100 ms delay/step)

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding start ramp speed.

10.3.11 Position 11 - Stop ramp SET2

For individual adjustment of stop ramp

Available values:

Values ranging from 0-100 (0 = No ramp delay, 1-50 = x100 ms delay/step)

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding stop ramp speed

10.3.12 Position 12 - Start speed SET3

For individual adjustment of start speed

Available values:

Values ranging from 1-100

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding start speed.

10.3.13 Position 13 - Stop speed SET3

For individual adjustment of stop speed

Available values:

Values ranging from 1-100

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding stop speed.

10.3.14 Position 14 - Micro speed SET3

For individual adjustment of 1st step micro speed

Available values:

Values ranging from 1-100

When activating a lever/joystick the LED-display will indicate which output that is active and its corresponding 1st step micro speed.

10.3.15 Position 15 - Dump valve delay time

For adjustment of the dump valve delay time

A lever/joystick is required to be actuated before value can be changed.

Available values:

Values ranging from 0-100 (0= No delay, 1-99= x100 ms delay/step, 100 = Always active*

*The DV output will remain active after lever/joystick actuation until CU is reset,

11 Portable Control Unit self test mode

11.1 General description

To simplify service and faultfinding, the portable control unit can be put into internal self test mode. This means that the service man can easily control the Portable Control unit's switches and manoeuvre levers, without the need to open the Portable Control Unit. When each switch or manoeuvre lever is activated / manoeuvred the Portable Control Unit gives a "beep - signal" to confirm that the function is working.

11.2 Activating Portable Control Unit Self Test Mode

1. Press the Stop-button on the Portable Control Unit to disable it.
2. Twist up the Stop-button and press On-button once so that the Power-LED is illuminated red.
3. Wait approx. 1 seconds from step 2 then press the On-button in quick successions until the Power-LED is distinguished (approx 10 times).
4. Portable Control Unit Self Test Mode is now active

Each time a switch is activated / manoeuvred the control unit should beep.

Each time a manoeuvre lever is activated / manoeuvred a beep signal should be heard from the Portable Control Unit which increases in "sound intensity" along with lever displacement. The control unit beeps with a continuous tone when the manoeuvre lever is manoeuvred to maximum. This gives a confirmation that the control unit's levers have been manoeuvred fully / max. (If a certain manoeuvre lever does not beep there is a fault in the manoeuvre lever, pin / socket contact or in the control unit's electronic card).

When testing of the Portable Control Unit is completed, press down the Stop-button to exit self test mode.

Note:

When self test mode is active no data is transmitted to the Central Unit.



12 ID-code programming

12.1 General description

The unique ID-code required for radio communication is programmed between the Portable Control Unit and Central Unit

The Central Unit may store the ID-code of maximum one (1) Portable Control Unit, if another Portable Control Unit is required to operate the Central Unit via radio the ID-code procedure is required to be done.

The previous ID-code will be overwritten.

12.2 Procedure

1. Remove the battery pack from the Portable Control Unit. Test run the system/application via cable control.
2. Leave the cable control connected between the Portable Control Unit and the Central Unit.
3. Press the Stop-button on the Portable Control Unit and deactivate the Central Unit via the R/M-switch
4. Activate the Central Unit in REMOTE mode, twist up the Stop-button on the Portable Control Unit.
5. Press and hold the On-button on the Portable Control Unit until you get a beep indication (approx 5 seconds). Release the On-button and wait; the Portable Control Unit will beep once followed by the indication "Po-Id" in the LED-display (approx 8 seconds) then further followed by 5 beeps and the deactivate.
6. When ID- programming is completed, remove the cable control, insert battery pack and test run the system/application with radio control.

-If the initial short beep is followed by one long beep, the Central Unit LED-display indication "bL" and Portable Control Unit then deactivates the ID-programming has been rejected, check below for further info.

Note:

Via cable control option you can easily determine via the LED-display if the ID-code is accepted; if the LED-display indicates "2-" the ID-code programming procedure is required prior to radio operation, if the LED-display indicates "1-"; the ID-code has already been programmed/accepted.

Typical reasons to ID-programming failure:

The 5th step, pressing and holding the on-button, needs to be initialized from max. 10 seconds from activation of the Central Unit.

The cable control cable is damaged, ensure that no battery is inserted in the Portable Control Unit and that the system/application can be operated via cable alone.

The Portable Control Unit deactivates immediately upon start-up, check that the Power-LED remains lit during the procedure, the Power-LED should remain lit until the last 5 beeps can be heard; if the Portable Control Unit deactivates beforehand it has an internal malfunction.

13 G2B Standard Cable Kits

13.1 General description

Various standard cable kits exist to suit certain system configurations and valves/coils.

Typically two sets of cable kits are required, one for power supply and digital functions and one for analogue functions, see below illustration.



- 1 = Left side; "Supply Cable kit" for power supply and digital functions.
2 = Right side; "Valve Cable kit" for analogue functions.

13.2 Standard Supply cable kits

For connection of power supply input, DV-output, Digital functions and CANBUS.

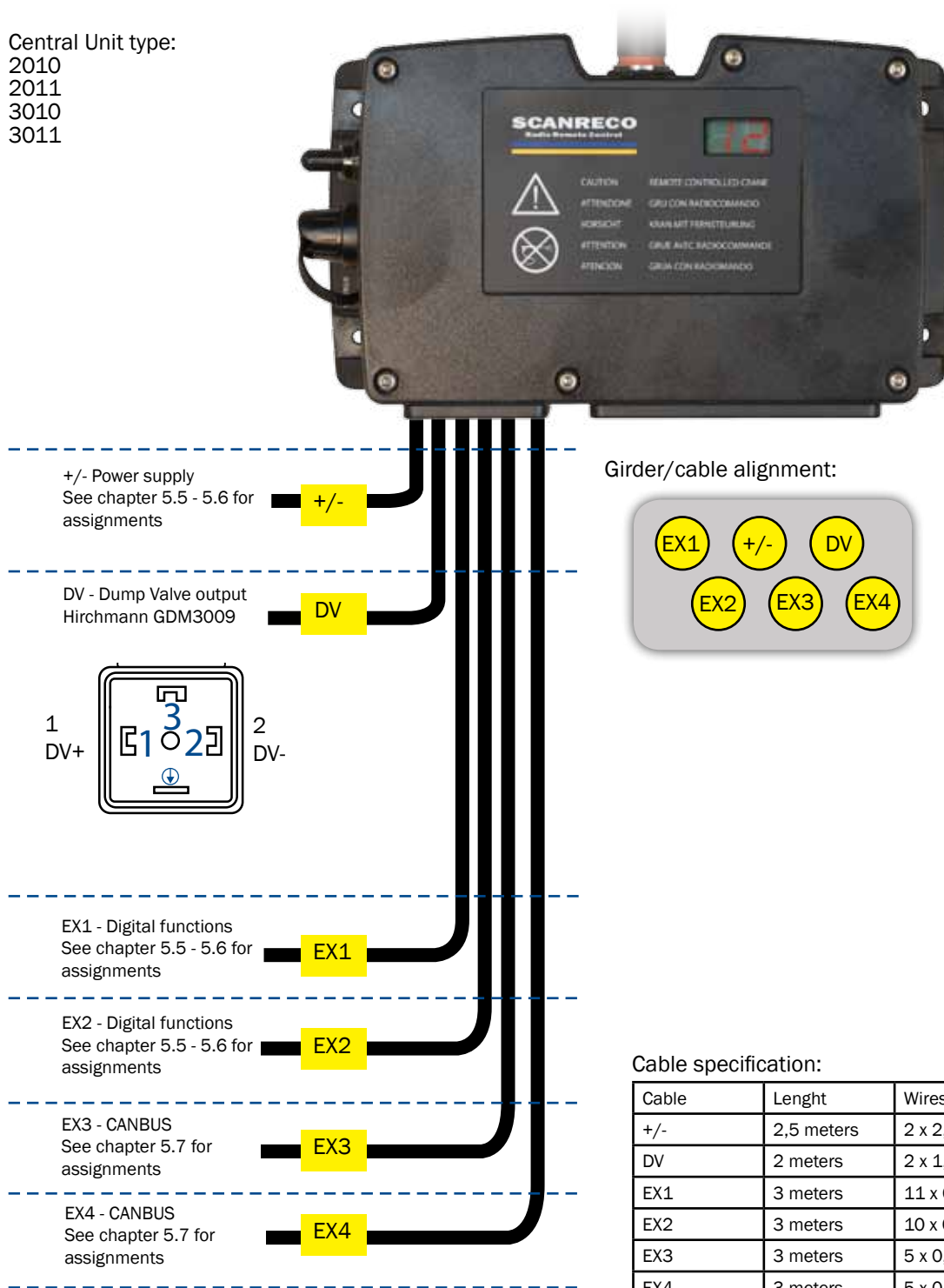
Central Unit type:

2010

2011

3010

3011



Part number information:

Part no:	Output Cables
47979	Power supply, DV & EX1
47752	Power supply, DV, EX1 & EX2
48810	Power supply, DV, EX1, EX2, EX3 & EX4

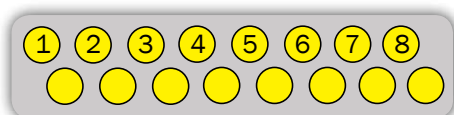
13.3 Standard valve cable kits for Sauer-Danfoss PVG-32

For connection of analogue functions for Sauer-Danfoss PVG-32 module

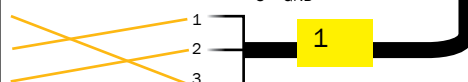
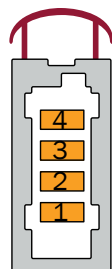
Central Unit type:
2010
2011



Girder/cable alignment:

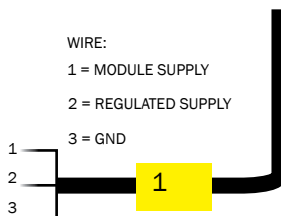
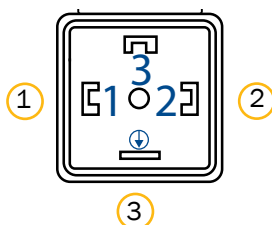


CONNECTOR:
AMP-JPT 4-pol



WIRE:
1 = MODULE SUPPLY
2 = REGULATED SUPPLY
3 = GND

CONNECTOR:
Hirschmann GDM3009



WIRE:
1 = MODULE SUPPLY
2 = REGULATED SUPPLY
3 = GND

Cable specification:

Cable	Lenght	Wires x Dim.
1-8	2 meters	3 x 0,5mm

Part number information:

Part no:	No of outputs	Type of connector
47753	8	AMP-JTP 4-pol
47961	8	Hirschmann GDM3009

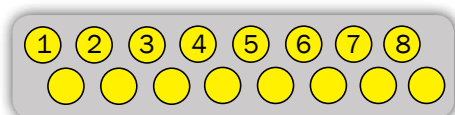
13.3 Standard valve cable kits for HAWE

For connection of analogue functions for HAWE module

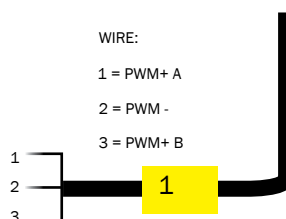
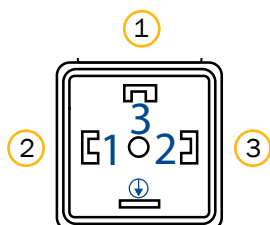
Central Unit type:
3010
3011



Girder/cable alignment:



CONNECTOR:
Hirschmann GDM3009



Cable specification:

Cable	Lenght	Wires x Dim.
1-8	2 meters	3 x 0,5mm

Part number information:

Part no:	No of outputs	Type of connector
48046	8	Hirschmann GDM3009

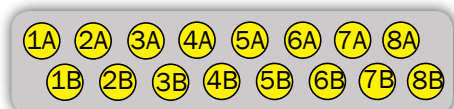
13.3 Standard valve cable kits for PWM solenoids

For connection of analogue functions for PWM solenoids

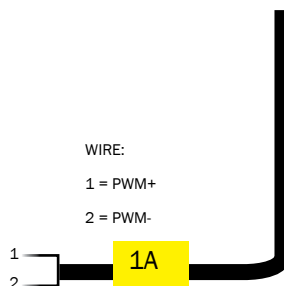
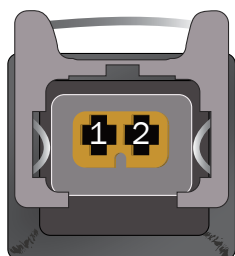
Central Unit type:
3010
3011



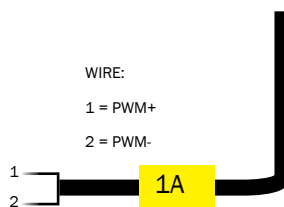
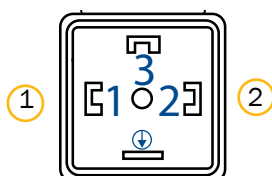
Girder/cable alignment:



CONNECTOR:
AMP-JPT 2-pol



CONNECTOR:
Hirschmann GDM3009



Cable specification:

Cable	Lenght	Wires x Dim.
1-8 (A/B)	2 meters	2 x 0,5mm

Part number information:

Part no:	No of outputs	Type of connector
47925	8 (1A-4B)	Hirschmann GDM3009
47924	12 (1A-6B)	Hirschmann GDM3009
47903	16 (1A-8B)	Hirschmann GDM3009
48238	12 (1A-6B)	AMP-JPT 2-pol
48362	16 (1A-8B)	AMP-JPT 2-pol

SCANRECO

Radio Remote Control

OPERATORS' GUIDE

REL-10-I

10,000 PSI INTENSIFIER



This revolutionary intensifier will increase line pressure to a maximum of 10,000 psi and is fully compatible with all high pressure hydraulic equipment. (i.e. Crimping, Cutting & Spearing Tools)

NOTICE

Sizes, weights and tool specifications listed in this manual are subject to change without notice. Please consult factory for information and updates.

REL-10-I-SA REL-10-I-SA/D

SINGLE & DOUBLE ACTING
HYDRAULIC 10,000 PSI
INTENSIFIER / VALVE

The **NEW** REL-10-I-SA/D single & double acting control systems provides a unique solution to your high pressure tooling requirements.

This system combines the power of a high pressure intensifier with the simplicity of a fixed position three way control valve.



RELIABLE EQUIPMENT & SERVICE CO., INC.
92 Steamwhistle Drive • Ivyland, PA 18974 • USA
Phone: 215-357-3500 • Fax: 215-357-9193

MODEL: REL-10-I & REL-10-I-SA
SOURCE PRESSURE: 2,000 PSI
INTENSIFIED PRESSURE: 10,000 PSI
SERIAL NO.: _____
YEAR: _____



WARNING



All information found in this guide must be read and understood before operation or testing of this tool.

Failure to read and understand these warnings and safe handling instructions could result in severe personal injury and or death.



RELIABLE EQUIPMENT & SERVICE CO., INC.

DISTRIBUTED BY

REGISTRATION

UPON RECEIPT OF THIS TOOL, COMPLETE THE REGISTRATION BELOW.

COMPANY _____

ADDRESS _____

PHONE _____ FAX _____

SERIAL NUMBER _____

DATE OF PURCHASE _____

DEALER NAME _____

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THIS SYMBOL INDICATES ITEMS OF EXTREME IMPORTANCE.

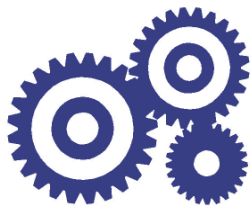
Safety of user and others may be in jeopardy if these instructions are not read and understood.



WARNING

Operation/Safety methods may vary in accordance with the working guidelines established by each utility or contractor

For your own safety, ensure that you fully comply with all safe operation guidelines required by your employer.



RELIABLE EQUIPMENT & SERVICE CO., INC.

REL-10-I

INTENSIFIER
10,000 PSI



Height 4.50 in.
Length 5.25 in.
Width 4.25 in.
Weight 9.75 lb.



A SMALL TOOL FOR A BIG JOB!

This revolutionary intensifier will increase line pressure to a maximum of 10,000 psi and is fully compatible with all high pressure hydraulic equipment. (i.e. Crimping, Cutting & Sparring Tools)

In comparison to the Stage Pump's 75 to 185 moving parts, Reliable's Intensifier with only 12 moving parts will provide consistent, smooth operation and simplicity of service, which was never before available in it's costly and complex counterpart.

SPECIAL FEATURES

1. H/P Quick-Disconnects
2. Folding Handle with 90° Stop
3. Adjustable Mounting Brackets

REL - 4 - I Increase to 4,000 psi
REL - 6 - I Increase to 6,000 psi
REL-10-I Increase to 10,000 psi

SPECIFICATIONS

HYDRAULIC SYSTEM Open or Closed Center
MOTOR Gear Driven
OPERATING PRESSURE 1,400-2,000 psi
FLOW RANGE 4-7 gpm
OPTIMUM OPERATING PRESSURE .. 1,800 psi @ 6 gpm
OUTPUT - FAST ADVANCE MODE 305 in.³/min
OUTPUT - HIGH PRESSURE MODE 30 in.³/min
RELIEF VALVE SETTING 4,000 - 10,000 psi
HIGH PRESSURE PORT 3/8 in. NPT
INLET PORT 3/8 in. NPT
RETURN PORT 3/8 in. NPT

SPECIAL FEATURES

HIGH PRESSURE COUPLER Included
ADJUSTABLE MOUNTING BRACKETS Included
UL-BCA - MOUNTING BUCKET Optional



**RELIABLE EQUIPMENT
& SERVICE CO., INC.**

92 Steamwhistle Drive • Ivyland, PA 18974
Phone: 800-966-3530 • Fax: 215-357-9193
Visit us on the web at www.Reliable-Equip.com



REL-10-I-SA

SINGLE ACTING 10,000 PSI
INTENSIFIER/VALVE

REL-10-I
INTENSIFIER

PVA-00L3
3-WAY VALVE



The **REL-10-I-SA** provides quick advance and retract for high pressure (10,000 psi) single acting spring return tools, without the need for additional H/P hoses, couplers or an in-line control valve.

This system combines the power of a high pressure intensifier with the simplicity of a fixed position three way control valve.

The **REL-10-I** intensifier will increase line pressure to a maximum of 10,000 psi and is fully compatible with all high pressure hydraulic equipment.

The **PVA-00L3** single-acting control valve, provides 3-way control (Advance, Neutral, Retract) direct from the high pressure source. Together this intensifier/valve package allows return oil to bypass the intensifier and return directly to the tank (return) line, increasing tool speed and performance.

SPECIFICATIONS

HYDRAULIC SYSTEM	Open or Closed Center
MOTOR	Gear Driven
OPERATING PRESSURE	1,400-2,000 psi
FLOW RANGE	4-7 gpm
OPTIMUM OPERATING PRESSURE ...	1,800 psi @ 6 gpm
OUTPUT - FAST ADVANCE MODE	305 in. ³ /min
OUTPUT - HIGH PRESSURE MODE	30 in. ³ /min
RELIEF VALVE SETTING	4,000 - 10,000 psi
HIGH PRESSURE PORT	3/8 in. NPT
INLET PORT	3/8 in. NPT
RETURN PORT	3/8 in. NPT

SPECIAL FEATURES

HIGH PRESSURE COUPLER	Included
ADJUSTABLE MOUNTING BRACKETS	Included
UL-BCA - MOUNTING BUCKET	Optional

SPECIFICATIONS - HYD. POWER SOURCE

200 PSI back pressure is the maximum agreed standard for the Hydraulic Tool Manufacturers Association (HTMA).

1. Maximum fluid temperature must not exceed 140°F (60°C) at the maximum expected ambient temperature. A sufficient oil cooling capacity is needed to limit the fluid temperature.
2. Maximum flow must not exceed 8 GPM. Install a flow meter in the return line to test the rate of flow in the system before working the tool.
3. Pressure relief valve must not exceed 2,200 PSI. The pressure relief valve must be located in the supply circuit between the pump and the intensifier to limit excessive pressure to the tool.

Any hydraulic power source used with this unit must meet the requirements above.

RELIABLE EQUIPMENT COMBINES FORCE & FUNCTION

REL-10-I-S/DA

TYPICAL SINGLE ACTING SET-UP

(SHOWN ON THE RIGHT)

TYPICAL DOUBLE ACTING SET-UP

(4-WAY VALVE REQUIRED)

(SHOWN BELOW)

REL-10-I-S/DA

REL-60SA
S/A CRIMPING HEAD



3VE3
10,000 PSI HOSE

REL-10-I-S/DA



PVA 1122
CONTROL VALVE W/ 3VE3 HOSES

3VE3
10,000 PSI HOSE SET

REL-60DA
D/A CRIMPING HEAD

The **REL-10-I-S/DA** is the perfect 10,000 psi power source, providing all the benefits of a double acting tool system, while complementing existing single acting tool inventories.

Power, function, and simplicity have been combined into this unique all in one hydraulic power system.

This system combines the power of a high pressure intensifier with the simplicity of a fixed position three way control valve.

When using the single acting connection:

REL-10-I-SA/D provides quick advance and retract for high pressure (10,000 psi) single acting spring return tools, without the need for additional H/P hoses, couplers or an in-line control valve.

When using the double acting connection:

REL-10-I-SA/D provides quick advance and retract for high pressure (10,000 psi) double acting tools, combined with the versatility and efficiency of a four way control valve.

SPECIFICATIONS

HYDRAULIC SYSTEM	Open or Closed Center
MOTOR	Gear Driven
OPERATING PRESSURE	1,400-2,000 psi
FLOW RANGE	4-7 gpm
OPTIMUM OPERATING PRESSURE ..	1,800 psi @ 6 gpm
OUTPUT - FAST ADVANCE MODE	305 in. ³ /min
OUTPUT - HIGH PRESSURE MODE	30 in. ³ /min
RELIEF VALVE SETTING	4,000 - 10,000 psi
S/A HIGH PRESSURE PORT	3/8 in. NPT
D/A HIGH PRESSURE PORT	1/4 in. NPT
LOW PRESSURE INLET PORT	3/8 in. NPT
LOW PRESSURE RETURN PORT	3/8 in. NPT

SPECIAL FEATURES

HIGH PRESSURE COUPLERS	Included
ADJUSTABLE MOUNTING BRACKETS	Included
UL-BCA - MOUNTING BUCKET	Optional

REL-10-I-S/DA

SINGLE / DOUBLE ACTING HIGH PRESSURE CONTROL SYSTEM

(4-WAY CONTROL VALVE REQUIRED
FOR D/A OPERATION)

PVA-00L3 SINGLE-ACTING CONTROL VALVE

DOUBLE ACTING
HIGH PRESSURE CONNECTIONS

1/4" N.P.T.
PRESSURE PORT
FOR DOUBLE ACTING
TOOL CONNECTION

1/4" N.P.T.
RETURN PORT
FOR DOUBLE ACTING
TOOL CONNECTION

3/8" N.P.T.
SINGLE ACTING
HIGH PRESSURE
CONNECTION

The REL-10-I intensifier will increase line pressure to a maximum of 10,000 psi and is fully compatible with all high pressure hydraulic equipment.

The PVA-00L3 single-acting control valve, provides 3-way control (Advance, Neutral, and Retract) direct from the high pressure source.

Together this intensifier/valve package allows return oil to bypass the intensifier and return directly to the tank (return) line, increasing tool speed and performance.

REL-10-I INTENSIFIER

ADJUSTABLE
MOUNTING BASE

LOW PRESSURE PORTS
(TO POWER SUPPLY)

TANK
3/8" M.N.P.T.

PRESSURE
3/8" F.N.P.T.



SPECIFICATIONS - HYD. POWER SOURCE

200 PSI back pressure is the maximum agreed standard for the Hydraulic Tool Manufacturers Association (HTMA).

1. Maximum fluid temperature must not exceed 140°F (60°C) at the maximum expected ambient temperature. A sufficient oil cooling capacity is needed to limit the fluid temperature.
2. Maximum flow must not exceed 8 GPM. Install a flow meter in the return line to test the rate of flow in the system before working the tool.
3. Pressure relief valve must not exceed 2,200 PSI. The pressure relief valve must be located in the supply circuit between the pump and the intensifier to limit excessive pressure to the tool.

Any hydraulic power source used with this unit must meet the requirements above.



WARNING

BEFORE USING THIS TOOL, READ THE WARNINGS and the recommended practices described in this manual. Failure by the operator to read and fully understand these warnings will leave this person unqualified to use and operate this tool. Property damage, severe personal injury, and/or death could result by not following these warnings.

These warnings will appear in appropriate locations when they are pertinent to the particular subject being shown. Read each one carefully and follow them strictly.



Eye Protection

WARNING

Always wear eye protection to avoid injury from flying debris or hydraulic oil leaks. Failure to do so can result in serious personal injury.



Skin Irritation

WARNING

Hydraulic oil may cause irritation. Use care to prevent contact with skin. In case of accidental contact, wash affected area immediately



Hard Hat

WARNING

Always wear a hard hat to avoid injury from falling debris. Failure to do so can result in serious personal injury.



Foot Protection

WARNING

Always wear foot protection. Failure to do so can result in serious personal injury.



Hearing Protection

WARNING

Always wear hearing protection, to avoid hearing loss due to long term exposure to high noise levels.



Protective Gloves

WARNING

Always wear protective gloves. Failure to do so can result in serious personal injury.



WARNING

Safe Operation & Care

USE THIS TOOL FOR ITS INTENDED PURPOSE ONLY
Any other use can result in injury or property damage.
INSPECT TOOL BEFORE USE. Replace any worn, damaged or missing parts. A damaged or improperly assembled tool may malfunction, injuring operator and/or nearby personnel.
INSPECT HYDRAULIC HOSES AND COUPLINGS before each use. Repair or replace if any cracking, leakage, wear or damage is found. Worn or damaged hoses may fail resulting in personal injury or property damage.
CLEAR WORK AREA of all bystanders and unnecessary personnel before operating this tool.
KEEP ALL PARTS OF THE BODY AWAY FROM MOVING PARTS.
Failure to observe this warning could result in serious injury.



WARNING

Safety

DO NOT attempt to make any changes to any of the component parts or accessories when connected to the power source.
DO NOT adjust, inspect, or clean tool while the tool is connected to the power source. The tool could accidentally start up and cause serious injury.
DO NOT lock the tool in the On Position. In an emergency, serious damage or injury could occur during the time required to stop the tool.



WARNING

Oil Injection Injury

Hydraulic oil or fluid under the skin is a serious injury. Oil under pressure can penetrate the skin and may cause dismemberment or loss of life. Seek medical assistance immediately if such an injury should occur.

Always wear safety gloves, eye protection and all required safety equipment when operating or handling this tool.
DO NOT use fingers or hands to attempt to locate a leak.
DO NOT handle hoses or couplers while system is pressurized.
NEVER open or service the system before depressurizing.



WARNING

Burn Hazard

Do Not connect or disconnect tool, hoses or fittings while power source is running or while hydraulic fluid is hot. Hot hydraulic fluid may cause serious burns.

Failure to observe this warning could result in serious injury.



WARNING

Electrical Shock Hazard

Use only certified nonconductive hoses and fittings. Always wear and use the necessary clothing, equipment and safety practices to protect against electrical shock. Failure to follow these rules can result in serious personal injury or death.



CAUTION

Safe Handling

HYDRAULIC FLUID MAY CAUSE SKIN IRRITATION.

Prevent hydraulic fluid from making contact with skin.

IN THE EVENT OF SKIN CONTACT immediately wash thoroughly.

Failure to observe this warning could result in injury.



CAUTION

General Safety

Ensure that all fellow employees and bystanders are clear and protected from possible injury caused by this tool or the operations being performed. Persons in close proximity could be injured and property damaged if the tool were to malfunction.

This tool should always be used within the limits and purposes stated by the product manufacturer. Abuse or usage beyond the manufacturers' intended purposes could cause damage to the tool and severe injury to the operator.



CAUTION

The information in this manual is intended to guide the user in the use and application of this tool. It is not intended as a substitute for proper training and experience in safe work practices for this type of equipment.

Consult your supervisor or safety personnel if you have any questions regarding the safe operation of this tool.

PRE-OPERATION OF TOOL



WARNING

DO NOT connect hoses or fittings to pump before reading all of the instructions in this section.

Ensure power source is **OFF**, hydraulic flow is turned **OFF**.

Failure to comply with this warning can result in severe injury or death.

Before attempting to run or use the REL-10-I, REL-10-I-SA or connected tools, check all connections, including hoses, and couplings. (See WARNINGS on pages 4-7)

Wear all safety items required, and make sure that the working area is clear of obstructions and non-essential personnel.

HYDRAULIC FLUIDS

All hydraulic fluids that meet these listed specifications or the listed HTMA specifications may be used for this tool.

S. U. S.

@ 100° F (38° C) **140 TO 225**

@ 210° F (99° C) **40 minimum**

FLASH POINT **340° F min. (170° C min.)**

POUR POINT .. **-30° F min. (-34° C min.)**



WARNING

HOSES AND FITTINGS

There exists the potential for shock in using anything other than certified nonconductive hoses and hydraulic oil with dielectric properties, when using system components near energized electrical lines. Failure to recognize these conditions could cause electrocution.

Hoses and fittings used with this tool must comply with S.A.E. J1273 which covers recommended practice for selection, installation, and maintenance of hose and hose assemblies. The **correct hoses and fittings are available from your supplier.**

WARNING: Failure to comply with these warnings could result in severe bodily injury.

NOTICE

If you have any questions regarding the information found in this manual please contact the supervising authority, or RELIABLE EQUIPMENT before continuing.
Phone: 215-357-3500 Toll Free: 800-966-3530 Fax: 215-357-9193



WARNING

UNIT/HOSE CONNECTIONS

ALWAYS TURN OFF hydraulic source and move valve handle to **RETRACT** before connecting or disconnecting any components.

ALWAYS DEPRESSURIZE hydraulic system, before slowly connecting/disconnecting this unit or any of the systems components.

ALWAYS TIGHTEN couplings completely. Loose or improperly tightened couplings will not allow fluid to pass through the hose creating a blockage in the supply or return line.

ALWAYS INSPECT HOSES AND CONNECTORS before connection to tool. Replace or repair if any leakage is evident. Leakage is a sign of deterioration in component parts. Worn or leaking parts must be repaired or replaced. Tool damage or severe injury could result.



CAUTION

HOSE INSTALLATION

1. **ENSURE POWER SOURCE IS OFF AND OIL HAS COOLED,**
2. **ENSURE HYDRAULIC FLOW IS TURNED OFF.**
3. ALWAYS ENSURE CONNECTORS ARE CLEAN.
4. CONNECT HOSES TO HYDRAULIC SUPPLY.
5. ENSURE THAT THE VALVE IS IN THE RETRACT POSITION.
6. CONNECT THE REL-10-I-SA INTENSIFIER.
7. ENSURE THAT THE VALVE IS IN THE RETRACT POSITION.
8. CONNECT THE HOSE TO THE PRESSURE PORT ON THE REL-10-I-SA, THEN CONNECT TO THE PORT ON THE TOOL.



CAUTION

DISCONNECTING HOSES

Turn OFF hydraulic source, ensure valve handle is in the RETRACT position and oil has cooled before disconnecting the hydraulic source, tool, or hoses.

Disconnect hose from the REL-10-I-SA, before disconnecting the tool. Disconnect the pressure hose from the pressure "P" port on the hydraulic source, then disconnect the hose from the pressure port on the REL-10-I-SA.

Disconnect the return hose from the return "T" port on the REL-10-I-SA, then disconnect the hose from the return (tank) port on the source.

Install dust caps on all connectors to prevent dirt and contaminants from entering the hydraulic system.

WARNING: Failure to comply with these warnings may result in severe bodily injury.

REL-10-I-SA OPERATION

USE ALL APPROPRIATE AND APPLICABLE PERSONAL SAFETY PROCEDURES AND EQUIPMENT AS REQUIRED BY THE OPERATING COMPANY.

Inspect, set-up and connect the tool as described on the previous pages.

WARNING: DO NOT connect or disconnect the tool, hoses, or fittings while the tool is running, hot, or under pressure. **Serious injury or burns could result.**

Replace all parts that show signs of wear or damage.

A damaged or improperly assembled tool may injure operator and/or nearby personnel.

Set up desired operation. (ie. crimp, cut, or spearing).

Review and understand all operation and safety guidelines relating to the operation to be performed.

Ensure that valve is in the **RETRACT** position before initiating hydraulic power source.

Activate the **REL-10-I-SA** by moving valve handle to the **ADVANCE** position. *The tool operation will begin immediately.*

NOTE: Moving the valve handle to the **HOLD** (center) position will stop the tool action allowing for confirmation and repositioning as needed.

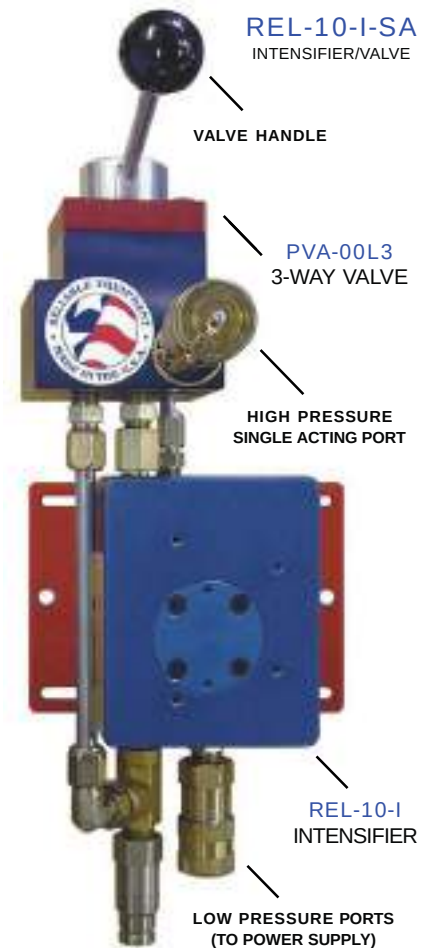
When relief valve popping occurs desired pressure has been achieved and operation should be complete.

Repeat as necessary.

NOTE: Holding valve handle in the **ADVANCE** position after relief valve has popped will cause unnecessary wear on relief valve and pump assembly.

Move valve to **RETRACT** and allow tool cutting blades, crimping jaws or ram to return fully.

Valve should be in the **RETRACT** position when not in use.



NOTICE

If you have any questions regarding the information found in this manual please contact the supervising authority, or RELIABLE EQUIPMENT before continuing.

Phone: 215-357-3500 Toll Free: 800-966-3530 Fax: 215-357-9193

REL-10-I-SAD S/A OPERATION

USE ALL APPROPRIATE AND APPLICABLE PERSONAL SAFETY PROCEDURES AND EQUIPMENT AS REQUIRED BY THE OPERATING COMPANY.

Inspect, set-up and connect the tool as described on the previous pages.

WARNING: DO NOT connect or disconnect the tool, hoses, or fittings while the tool is running, hot, or under pressure. **Serious injury or burns could result.**

Replace all parts that show signs of wear or damage.

A damaged or improperly assembled tool may injure operator and/or nearby personnel.

Set up desired operation. (ie. crimp, cut, or spearing).

Review and understand all operation and safety guidelines relating to the operation to be performed.

Ensure that valve is in the **RETRACT** position before initiating hydraulic power source.

Activate the **REL-10-I-SA** by moving valve handle to the **LEFT ADVANCE** position. *The tool operation will begin immediately.*

NOTE: Moving the valve handle to the **HOLD** (center) position will stop the tool action allowing for confirmation and repositioning as needed.

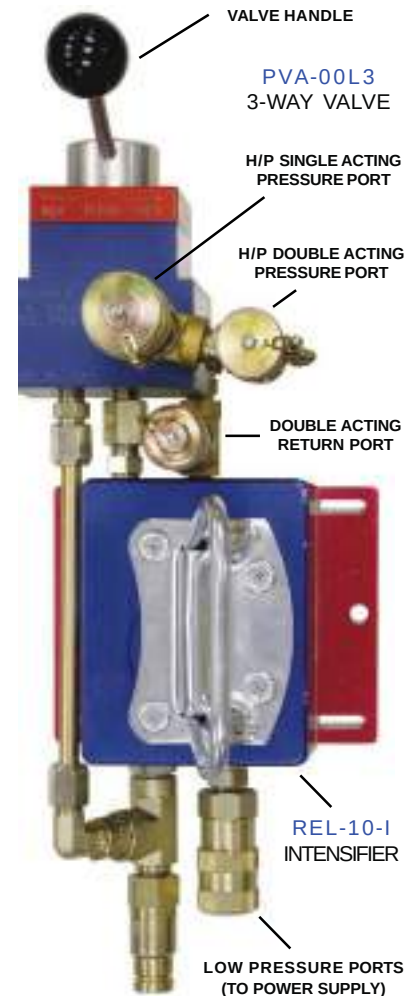
When relief valve popping occurs desired pressure has been achieved and operation should be complete.

Repeat as necessary.

NOTE: Holding valve handle in the **ADVANCE** position after relief valve has popped will cause unnecessary wear on relief valve and pump assembly.

Move valve to **RIGHT/RETRACT** and allow tool cutting blades, crimping jaws or ram to return fully.

Valve should be in the **RETRACT** position when not in use.



NOTICE

If you have any questions regarding the information found in this manual please contact the supervising authority, or RELIABLE EQUIPMENT before continuing.

Phone: 215-357-3500 Toll Free: 800-966-3530 Fax: 215-357-9193

REL-10-I-SAD D/A OPERATION

USE ALL APPROPRIATE AND APPLICABLE PERSONAL SAFETY PROCEDURES AND EQUIPMENT AS REQUIRED BY THE OPERATING COMPANY.

Inspect, set-up and connect the tool as described on the previous pages. **NOTE: AN IN LINE FOUR WAY CONTROL VALVE IS REQUIRED FOR DOUBLE ACTING OPERATION.**

WARNING: DO NOT connect or disconnect the tool, hoses, or fittings while the tool is running, hot, or under pressure.

Tool damage, serious injury or burns may result.

Replace all parts that show signs of wear or damage.

A damaged or improperly assembled tool may injure operator and/or nearby personnel.

Set up desired operation. (ie. crimp, cut, or spearing).

Review and understand all operation and safety guidelines relating to the operation to be performed.

Ensure that valve is in the **RETRACT** position before initiating hydraulic power source.

Activate the **REL-10-I-SA/D** by moving valve handle to the **LEFT/ADVANCE** position.

Operate in-line control valve to activate double acting tool and begin cutting or crimping procedure.

When relief valve popping occurs desired pressure has been achieved and operation should be complete.

NOTE: Holding control valve in the **ADVANCE** position after relief valve has popped will cause unnecessary wear on relief valve and pump assembly.

Use the in-line control valve to open or retract tool jaw/blades.

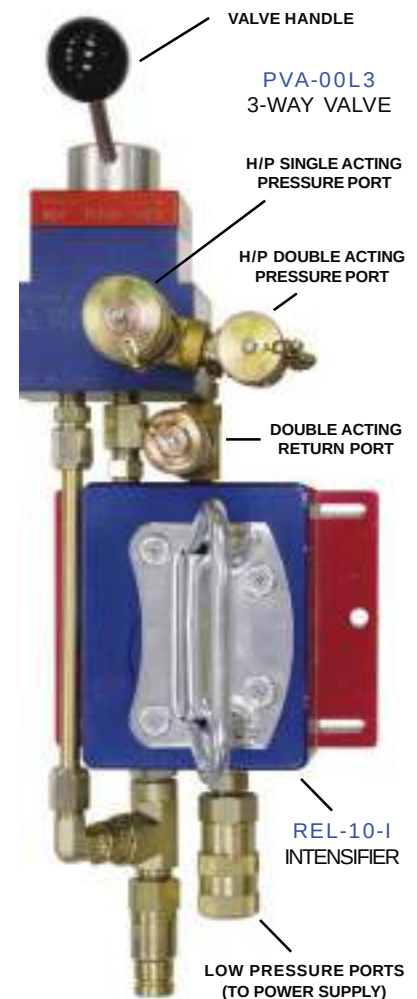
Repeat as necessary.

Move valve handle to **RIGHT/RETRACT** to stop pressure.

Valve should be in **RIGHT/RETRACT** position when not in use.

WARNING: ALWAYS ensure valve handle is in the retract position and hydraulic source is turned off before you connect or disconnect the tool, hoses, or fittings while the tool is running, hot, or under pressure.

Serious property damage, injury, or burns may result.



NOTICE

If you have any questions regarding the information found in this manual please contact the supervising authority, or RELIABLE EQUIPMENT before continuing.

Phone: 215-357-3500 Toll Free: 800-966-3530 Fax: 215-357-9193

SCHEDULED MAINTENANCE

The life, reliability, and safety of the tool is dependent on proper maintenance.

DAILY MAINTENANCE

Clean all surfaces including, hand control, fittings, hoses and housing.

Inspect tool for wear and damage. Worn or damaged parts can cause malfunction.

Inspect for cracked hoses and leaking fittings.

Check fluid level of the power source reservoir frequently.

All the above items must be replaced with new parts if signs of wear are evident.

FLUID CONTAMINATION: Cover the ends of fittings with a dust cap when disconnected. This will help keep the fluid from contamination.



IMPORTANT: The greatest cause of hydraulic pump/valve failure is dirt. Prevent the introduction of foreign matter into the unit via hydraulic fluid, dirty connections or accumulation of sediment.

MONTHLY MAINTENANCE: Inspect per Appendix A, SAE Standard J1273, 5/86 for hose or fitting damage such as wear, cracks or leakage; replace the necessary parts.

NOTE: Keep Label Set clean and legible. Replace decals when necessary.



WARNING

Failure to observe all warnings and instructions could result in property damage, severe personal injury, and/or death.

BEFORE USING THIS PRODUCT READ THE SAFETY WARNINGS and recommended practices described in the manual. Failure by the operator to read and fully understand the warnings will leave this person unqualified to use and operate the tool.

CAUTION

Operation and safety methods may vary in accordance with the guidelines established by each utility. For your safety, ensure that you fully comply with all safe operation guidelines established by your respective power utility.

REL-SM

DANGER



The user should be properly trained in the correct procedures required for work on or around electrical lines.

READ BEFORE DISASSEMBLY

Complete disassembly is not recommended.

Return the unit to an authorized dealer for total disassembly and/or repair.

All maintenance or disassembly should take place on a flat, clean work surface covered with towels or wipers so as to have a clean space for the disassembled parts.

Inspect each part during disassembly for wear, scratches, and cuts. Discard the worn or damaged parts and replace with new parts.

Use only factory specified parts when repairing and/or replacing.

Severe damage to the tool can occur with non-specified parts.

O-rings are sensitive to sharp edges. Inspect closely for cuts or damage. A small cut will cause a leak. When assembling or disassembling O-rings, use hydraulic fluid as a lubricant to help disassembly or installation.

The unique plumbing required to integrate the **REL-10-I** with the **PVA-00L3** 3-way valve is custom fitted for each unit, and cannot be purchased for non-factory repairs at this time. If any unit requires repair or replacement of these parts, please return to **RELIABLE** for factory authorized service.



WARNING

Safety

DO NOT attempt to make any changes to any of the component parts or accessories when connected to the power source. DO NOT adjust, inspect, or clean tool while the tool is connected to the power source. The tool could accidentally start up and cause serious injury.



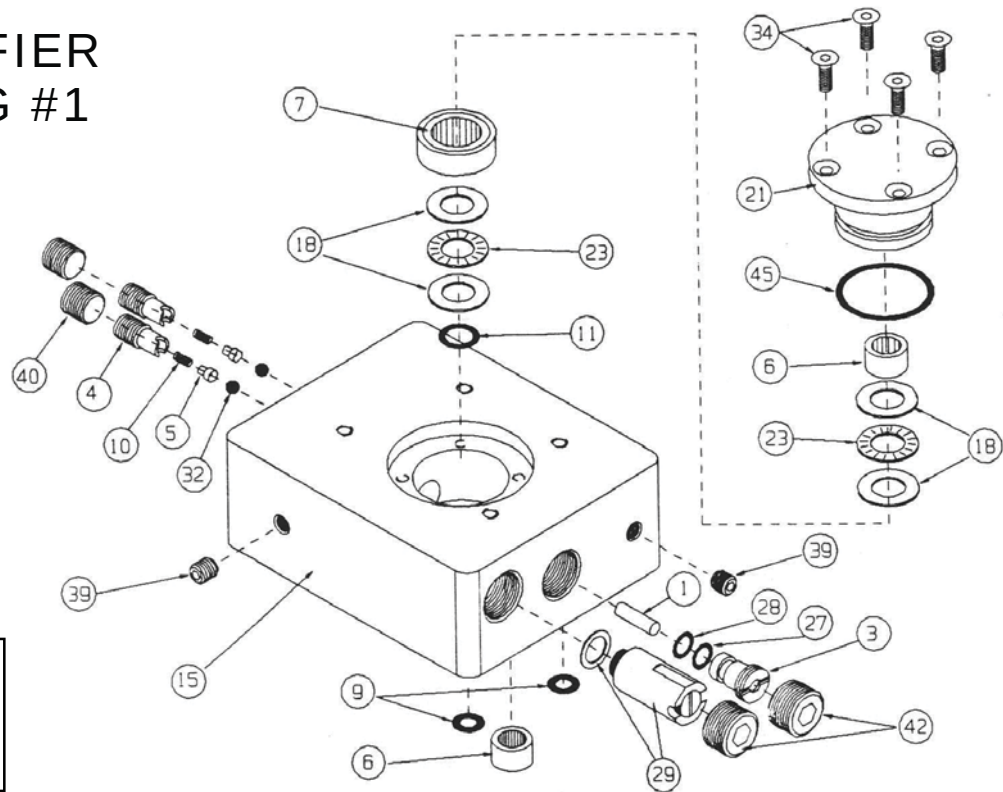
WARNING

Before disassembly, disconnect hoses as described in this manual. Any residual pressure within the unit can and will spray at high velocity, injuring the person doing the disassembly. Hot or pressurized hydraulic fluid will cause serious injury or death. **Complete disassembly is not recommended. Return the unit to an authorized dealer for total disassembly and/or repair.**

If you have any questions regarding the information found in this manual please contact the supervising authority or RELIABLE EQUIPMENT before continuing.

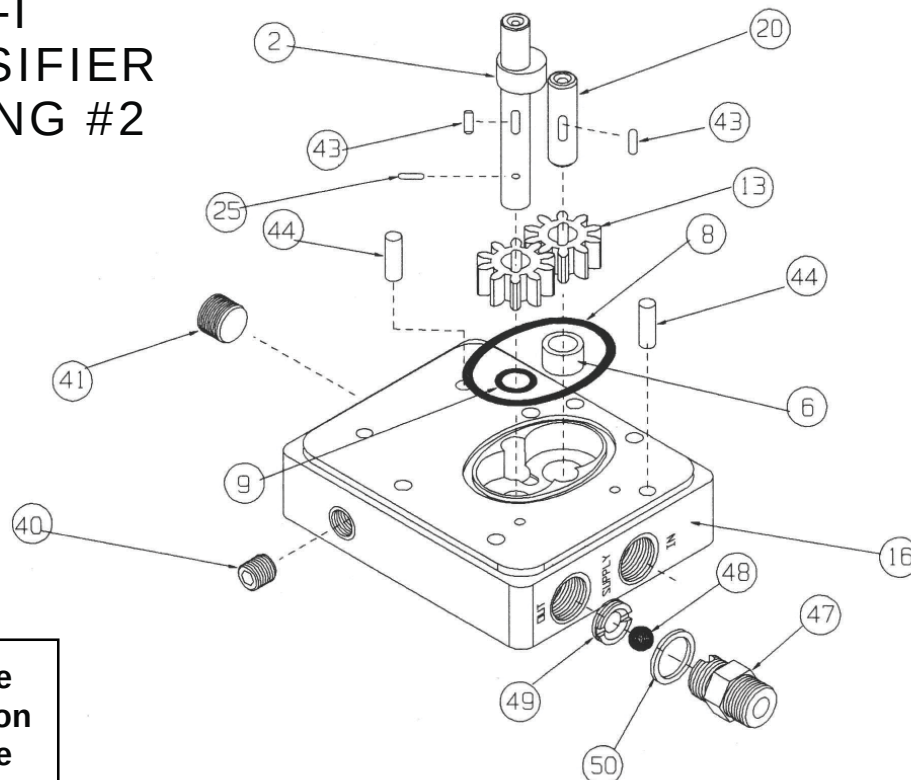
Phone: 215-357-3500 Toll Free: 800-966-3530 Fax: 215-357-9193

REL-10-I INTENSIFIER DRAWING #1



Reference
Parts List on
Next Page

REL-10-I INTENSIFIER DRAWING #2



Reference
Parts List on
Next Page

DRAWING #1 PARTS LIST

REF.	PART	QTY.	DESCRIPTION
* 1	12728	1	PISTON
* 3	12732	1	BUSHING (PRESSURE)
4	12733	2	CHECK VALVE BODY
5	12734	2	PINTLE
6	12736	6	SHAFT BEARING
7	12737	1	CAM BEARING ASSEMBLY
** 9	12739	3	O-RING HOLE SEAL
10	12740	2	SPRING (PINTLE)
** 11	12742	2	O-RING SHAFT SEAL
15	12766	1	PRESSURE BLOCK
18	12769	4	THRUST WASHER
21	12772	1	INSERT REAR
23	12774	2	BEARING (THRUST)
** 27	12778	1	BACK-UP RING
** 28	12779	1	O-RING BUSHING
29	12780	1	VALVE ASSEMBLY
32	12783	2	BALL (3/16")
34	12786	4	SCREW
39	12791	5	1/16 NPT PLUG
40	12792	1	1/4 NPT PLUG
42	12794	1	1/2 NPT PLUG
** 45	12741	1	O-RING REAR SEAL

DRAWING #2 PARTS LIST

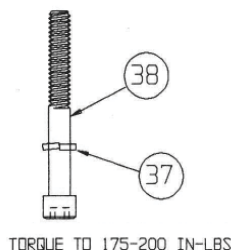
REF.	PART	QTY.	DESCRIPTION
2	12731	1	CAM SHAFT ASSEMBLY
6	12736	6	SHAFT BEARING
** 8	12738	2	O-RING FACE SEAL
** 9	12739	3	O-RING HOLE SEAL
13	12745	2	PUMP GEAR
16	12767	1	PUMP BLOCK
20	12771	1	SHAFT (IDLER, PUMP)
25	12776	2	PIN (DRIVE)
40	12792	3	1/4 NPT PLUG
43	12795	2	PINS (DRIVE)
44	12796	4	DOWELS
47	12735	1	REV. CHECK ADAPTER
48	12744	1	3/8 BALL
49	12743	1	BALL SEAT
** 50	12748	1	O-RING

* TO BE SOLD AS A MATCH SET

** SUPPLIED IN **SEAL KIT K3195** SAPRTLST 12/20/96

REL-10-I INTENSIFIER DRAWING #3

Reference
Parts List
Below



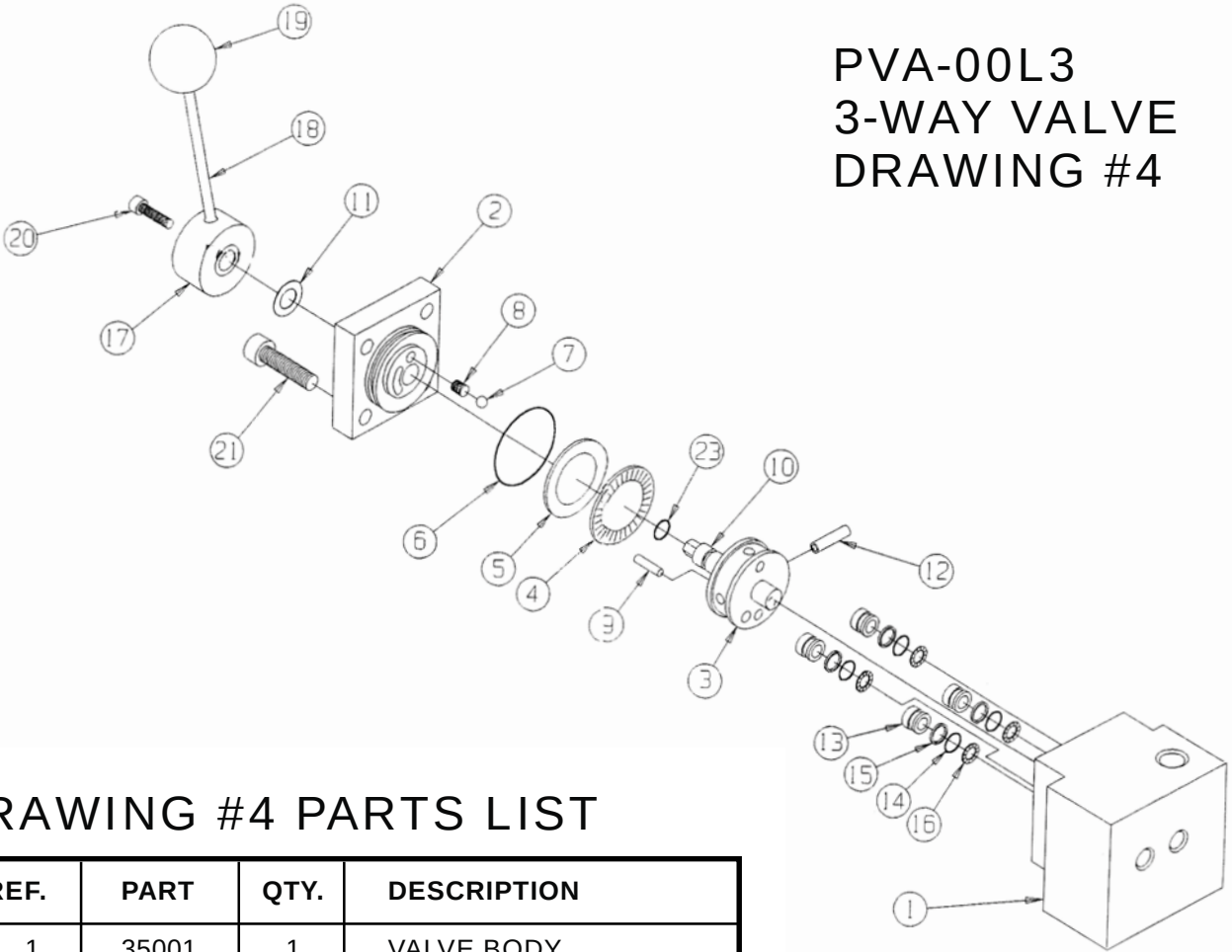
DRAWING #3 PARTS LIST

REF.	PART	QTY.	DESCRIPTION
6	12736	6	SHAFT BEARING
** 8	12738	2	O-RING FACE SEAL
14	12746	2	RETURN GEAR (please advise serial # when ordering)
17	12768	1	PUMP GEAR (RETURN BLOCK)
22	12773	1	SHAFT (IDLER, RETURN)
30	12781	2	MOUNT
36	12788	4	SCREW (SCFH)
37	12789	6	SREW (SHCS)
38	12790	6	LOCKWASHER
43	12795	4	PINS (DRIVE)
44	12796	4	DOWELS

** SUPPLIED IN **SEAL KIT K3195** SAPRTLST 12/20/96

If you have any questions regarding the information found in this manual please contact the supervising authority, or RELIABLE EQUIPMENT before continuing.
Phone: 215-357-3500 Toll Free: 800-966-3530 Fax: 215-357-9193

PVA-00L3 3-WAY VALVE DRAWING #4



DRAWING #4 PARTS LIST

REF.	PART	QTY.	DESCRIPTION
1	35001	1	VALVE BODY
2	35002	1	CAP
3	35003	1	ROTOR
4	35004	1	THRUST BEARING
5	35005	1	THRUST WASHER
* 6	35006	1	O-RING (CAP)
7	35007	1	BALL, 1/4 DIA.
8	35008	1	SPRING
9	35009	1	ROLL PIN
10	35010	1	SHAFT
* 11	35011	1	GREASE SEAL
12	35012	1	SPIROL PIN
13	35013	4	GROMMET
* 14	35014	4	O-RING
* 15	35015	4	BACK UP RING
16	35016	4	CUST. WAVE SPRING
17	35017	1	END BLOCK
18	35018	1	STUD
19	35019	1	PLASTIC BALL
20	35020	1	SCREW (BHSC)
21	35021	4	SCREW (SHCS)
22	35022	2	PLUG (NOT SHOWN)
* 23	35022	1	SHAFT SEAL
* SUPPLIED IN SEAL KIT PART #R35100			

NOTICE

The unique plumbing required to integrate the **REL-10-I** with the **PVA-00L3** 3-way valve is custom fitted for each unit, and cannot be purchased for non-factory repairs at this time. If any unit requires repair or replacement of these parts, please return to **RELIABLE** for factory authorized service.

Consult your **RELIABLE** representative for more information about our complete line of hydraulic tools.

MAINTENANCE RECORDS

Date	Parts or Service Required

If you have any questions regarding the information found in this manual please contact RELIABLE EQUIPMENT at the address, phone or fax numbers shown below.



**RELIABLE EQUIPMENT
& SERVICE CO., INC.**

92 Steamwhistle Drive • Ivyland, PA 18974

Phone: 800-966-3530 • Fax: 215-357-9193

Visit us on the web at www.Reliable-Equip.com

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