

# Grove TMS9000-2

## Operator Manual





## **WARNING**

### **California Proposition 65**

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information, go to [www.P65warnings.ca.gov/diesel](http://www.P65warnings.ca.gov/diesel)

Batteries, battery posts, terminals, and related accessories can expose you to chemicals, including lead and lead compounds, which are known to the State of California to cause cancer and birth defects or other reproductive harm. Wash hands after handling. For more information, go to [www.P65warnings.ca.gov](http://www.P65warnings.ca.gov)

### **California Spark Arrestor**

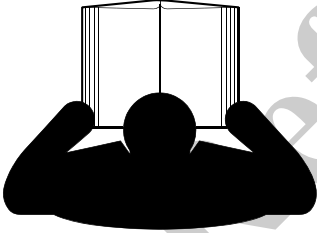
Operation of this equipment may create sparks that can start fires around dry vegetation. A spark arrestor may be required. The owner/operator should contact local fire agencies for laws or regulations relating to fire prevention requirements.

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The original language of this publication is English.

# OPERATOR MANUAL

## TMS9000-2

|                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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|  A black silhouette of a person sitting and reading an open book. The book is held up in front of their face, and their hands are visible at the bottom corners of the pages. | <p><b>⚠ DANGER</b></p> <p><b>An untrained operator subjects himself and others to death or serious injury. Do not operate this crane unless:</b></p> <ul style="list-style-type: none"><li>• You are trained in the safe operation of this crane. Grove is not responsible for qualifying personnel.</li><li>• You read, understand, and follow the safety and operating recommendations contained in the crane manufacturer's manuals and load charts, your employer's work rules, and applicable government regulations.</li><li>• You are sure that all safety signs, guards, and other safety features are in place and in proper condition.</li><li>• The Operator's Manual and Load Chart are in the holder provided on crane.</li></ul> |
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**For  
Reference  
Only**

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TABLE OF CONTENTS

**SECTION 1 . . . . . Introduction**

- General . . . . . 1-1
  - Ambient Operation Temperature . . . . . 1-1
  - Customer Support . . . . . 1-1

**SECTION 2 . . . . . Safety Information**

- Safety Messages . . . . . 2-2
  - General . . . . . 2-2
  - Safety Alert Symbol . . . . . 2-2
  - Signal Words . . . . . 2-2
- General . . . . . 2-2
  - Safety Decals . . . . . 2-2
- Accidents . . . . . 2-2
- Operator Information . . . . . 2-3
- Operator Qualifications . . . . . 2-3
- Operational Aids . . . . . 2-4
  - Rated Capacity Limiter (RCL) Systems . . . . . 2-4
  - Anti-Two-Blocking Device . . . . . 2-5
  - Working Area Limiter (If Equipped) . . . . . 2-5
- Crane Stability/Structural Strength . . . . . 2-6
  - Load Charts . . . . . 2-7
  - Work Site . . . . . 2-7
- Wind Forces . . . . . 2-7
  - Wind Speeds . . . . . 2-8
  - Lifting Operations . . . . . 2-20
    - Multiple Crane Lifts . . . . . 2-21
    - Lifting Multiple Loads . . . . . 2-21
    - Tilt-Up Panel Lifting . . . . . 2-21
  - Counterweight . . . . . 2-22
  - Outrigger Lift Off . . . . . 2-22
- Pile Driving and Extracting . . . . . 2-22
  - Crane Equipment . . . . . 2-23
  - Crane Inspection . . . . . 2-23
- Electrocution Hazard . . . . . 2-23
  - Set-Up and Operation . . . . . 2-24
  - Electrocution Hazard Devices . . . . . 2-25
  - Electrical Contact . . . . . 2-25
  - Special Operating Conditions and Equipment . . . . . 2-26
  - Grounding the Crane . . . . . 2-26
- Personnel Handling . . . . . 2-27
- Environmental Protection . . . . . 2-28
- Maintenance . . . . . 2-28
  - Service and Repairs . . . . . 2-28
  - Lubrication . . . . . 2-29
  - Tires . . . . . 2-29
- Hoist Rope . . . . . 2-30
  - Synthetic Hoist Rope . . . . . 2-30
  - Wire Rope . . . . . 2-30
  - Sheaves . . . . . 2-31
  - Batteries . . . . . 2-32
  - Super Capacitor (If Equipped) . . . . . 2-32
  - General Maintenance . . . . . 2-32
- Transporting the Crane . . . . . 2-32
- Travel Operation . . . . . 2-33

TOC

|                                                      |      |
|------------------------------------------------------|------|
| Work Practices . . . . .                             | 2-34 |
| Personal Considerations . . . . .                    | 2-34 |
| Crane Access . . . . .                               | 2-34 |
| Job Preparation . . . . .                            | 2-34 |
| Working . . . . .                                    | 2-35 |
| Lifting . . . . .                                    | 2-35 |
| Hand Signals . . . . .                               | 2-36 |
| Boom Extension . . . . .                             | 2-38 |
| Parking and Securing . . . . .                       | 2-38 |
| Shut-Down . . . . .                                  | 2-38 |
| Cold Weather Operation . . . . .                     | 2-38 |
| Temperature Effects on Hook Blocks . . . . .         | 2-39 |
| Temperature Effects on Hydraulic Cylinders . . . . . | 2-39 |
| Overload Inspection . . . . .                        | 2-40 |
| Boom Inspection . . . . .                            | 2-42 |
| Superstructure Inspection . . . . .                  | 2-44 |
| Carrier Inspection . . . . .                         | 2-46 |

**SECTION 3. . . . . Operating Controls and Indicators**

|                                                          |     |
|----------------------------------------------------------|-----|
| Carrier Cab Controls and Indicators . . . . .            | 3-3 |
| Transmission Shift Lever . . . . .                       | 3-4 |
| Spare Switch/Indicator . . . . .                         | 3-4 |
| USB Ports . . . . .                                      | 3-4 |
| 12 Volt Outlet . . . . .                                 | 3-4 |
| Fire Extinguisher . . . . .                              | 3-4 |
| Horn Button . . . . .                                    | 3-4 |
| Turn Signal/Headlight High Beam Low Beam Lever . . . . . | 3-4 |
| Steering Column Tilt/Telescope Lever . . . . .           | 3-4 |
| Cab Circulating Fan . . . . .                            | 3-4 |
| Windshield Wiper and Washer . . . . .                    | 3-4 |
| Carrier Camera Display . . . . .                         | 3-4 |
| Dome Light . . . . .                                     | 3-4 |
| Air Horn . . . . .                                       | 3-4 |
| Throttle Pedal . . . . .                                 | 3-5 |
| Brake Pedal . . . . .                                    | 3-5 |
| Clutch Pedal . . . . .                                   | 3-5 |
| Steering Wheel . . . . .                                 | 3-5 |
| Headlights Switch . . . . .                              | 3-6 |
| Dimmer Switch . . . . .                                  | 3-6 |
| Beacon Light Switch (Optional) . . . . .                 | 3-6 |
| Engine Brake ON/OFF Switch . . . . .                     | 3-7 |
| Engine Brake High/Low Switch . . . . .                   | 3-7 |
| Exhaust System Cleaning Initiate Switch . . . . .        | 3-7 |
| Engine Idle Increment/Decrement Switch . . . . .         | 3-7 |
| Remote Control ON/OFF Switch . . . . .                   | 3-7 |
| Remote Control Indicator . . . . .                       | 3-7 |
| ABS/ATC Switch . . . . .                                 | 3-7 |
| Hill Start Aid (HSA) Switch (Optional) . . . . .         | 3-7 |
| HSA Indicator (Optional) . . . . .                       | 3-7 |
| Inter-Axle Lock Switch . . . . .                         | 3-7 |
| Cross-Axle Lock Switch (Optional) . . . . .              | 3-7 |
| Suspension Inflation Switch . . . . .                    | 3-7 |
| Tire Inflation Switch . . . . .                          | 3-8 |
| Heater/Air Conditioner Fan Switch . . . . .              | 3-8 |
| Heater/Air Conditioner Control . . . . .                 | 3-8 |
| Heater/Air Conditioner Select Switch . . . . .           | 3-8 |

|                                                                                         |      |
|-----------------------------------------------------------------------------------------|------|
| Ignition Switch . . . . .                                                               | 3-8  |
| Parking Brake Control . . . . .                                                         | 3-8  |
| Dual Air Pressure Gauge . . . . .                                                       | 3-8  |
| Trailing Boom Air Supply Control (Optional) . . . . .                                   | 3-8  |
| Control Panel Indicator and Gauge Display . . . . .                                     | 3-8  |
| Carrier Cab Control Panel Indicator and Gauge Display . . . . .                         | 3-9  |
| Cross-Axle Locked Indicator . . . . .                                                   | 3-10 |
| Inter-Axle Locked Indicator . . . . .                                                   | 3-10 |
| Suspension Deflated Indicator . . . . .                                                 | 3-10 |
| Traction Control Indicator . . . . .                                                    | 3-10 |
| Tire Inflation ON Indicator . . . . .                                                   | 3-10 |
| Left Turn Signal Indicator . . . . .                                                    | 3-10 |
| Lights ON Indicator . . . . .                                                           | 3-10 |
| High Beam Indicator . . . . .                                                           | 3-10 |
| Parking Brake Engaged Indicator . . . . .                                               | 3-10 |
| Battery Charge Indicator . . . . .                                                      | 3-11 |
| Low Air Pressure Indicator . . . . .                                                    | 3-11 |
| Emergency Stop Indicator . . . . .                                                      | 3-11 |
| Right Turn Signal Indicator . . . . .                                                   | 3-11 |
| System Fault Indicator . . . . .                                                        | 3-11 |
| Anti-Lock Braking System (ABS) Indicator . . . . .                                      | 3-11 |
| Check Transmission Indicator (Automated Transmission Only) . . . . .                    | 3-11 |
| Malfunction Indicator Lamp (MIL) . . . . .                                              | 3-11 |
| Low Oil Pressure Indicator . . . . .                                                    | 3-11 |
| Engine Stop Indicator . . . . .                                                         | 3-11 |
| Engine Warning Indicator . . . . .                                                      | 3-11 |
| OK Button . . . . .                                                                     | 3-11 |
| Menu Button . . . . .                                                                   | 3-12 |
| Fuel Level Gauge Indicator . . . . .                                                    | 3-12 |
| Speedometer . . . . .                                                                   | 3-12 |
| Low Fuel Level Indicator . . . . .                                                      | 3-12 |
| High Exhaust System Temperature Indicator . . . . .                                     | 3-12 |
| Engine Temperature Indicator . . . . .                                                  | 3-12 |
| Cruise Control Indicator . . . . .                                                      | 3-12 |
| Engine Coolant Temperature Gauge . . . . .                                              | 3-12 |
| Down Button . . . . .                                                                   | 3-12 |
| Up Button . . . . .                                                                     | 3-12 |
| Seat Belt Unfastened Indicator . . . . .                                                | 3-12 |
| Tachometer . . . . .                                                                    | 3-12 |
| Exhaust System Cleaning Indicator . . . . .                                             | 3-12 |
| LCD (Display) . . . . .                                                                 | 3-13 |
| Outrigger Controls and Indicators . . . . .                                             | 3-15 |
| Outrigger Control Summary . . . . .                                                     | 3-15 |
| Outrigger Control Panel . . . . .                                                       | 3-16 |
| Cribbing Mode . . . . .                                                                 | 3-16 |
| Two Methods for Activating Cribbing Mode . . . . .                                      | 3-16 |
| Superstructure Cab . . . . .                                                            | 3-17 |
| Superstructure Cab . . . . .                                                            | 3-18 |
| Superstructure Side Panel . . . . .                                                     | 3-20 |
| Superstructure Cab, Rear . . . . .                                                      | 3-22 |
| Superstructure Control Panels . . . . .                                                 | 3-23 |
| Superstructure Control Levers . . . . .                                                 | 3-25 |
| Superstructure Heating System . . . . .                                                 | 3-26 |
| Operator Display Module (ODM)/Crane Control System (CCS) Control Unit . . . . .         | 3-27 |
| Crane Control System (CCS) – Home Screen . . . . .                                      | 3-29 |
| Alert Icons . . . . .                                                                   | 3-31 |
| Short Description of the Operating Elements of the Crane Control System (CCS) . . . . . | 3-33 |

|                                                                                     |       |
|-------------------------------------------------------------------------------------|-------|
| Definition of Direction Information . . . . .                                       | 3-33  |
| General Rules for Buttons and Symbols on the Display . . . . .                      | 3-34  |
| Crane Control System (CCS) . . . . .                                                | 3-35  |
| Display CCS . . . . .                                                               | 3-35  |
| Engine Speed Display . . . . .                                                      | 3-36  |
| Seat Contact Switch and Dead-Man Switches . . . . .                                 | 3-38  |
| Settings Menu Groups . . . . .                                                      | 3-41  |
| Control Lever Characteristic Curve Menu . . . . .                                   | 3-42  |
| Setting the Control Lever Characteristic Curves . . . . .                           | 3-42  |
| Crane Functions Speeds Menu . . . . .                                               | 3-43  |
| Adjusting the Wiper Stroke Interval of the Windshield and Skylight Wipers . . . . . | 3-43  |
| Economy Mode Menu . . . . .                                                         | 3-44  |
| Aircraft Warning Light (Optional) . . . . .                                         | 3-45  |
| Exhaust System Cleaning Menu . . . . .                                              | 3-46  |
| Setting the Time Menu . . . . .                                                     | 3-47  |
| Adjusting Display Brightness . . . . .                                              | 3-47  |
| Switch Units Menu . . . . .                                                         | 3-49  |
| Power Unit Speeds Menu . . . . .                                                    | 3-50  |
| Operating Hours Menu . . . . .                                                      | 3-51  |
| Crane Operation Error Menu . . . . .                                                | 3-53  |
| Software Version Menu . . . . .                                                     | 3-54  |
| CCS – Overview Menu Groups . . . . .                                                | 3-55  |
| Camera Display Options . . . . .                                                    | 3-57  |
| Telescoping Semi-Automation Menu . . . . .                                          | 3-58  |
| Boom Configurator Menu . . . . .                                                    | 3-59  |
| Manual Telescoping Menu . . . . .                                                   | 3-60  |
| Outrigger Menu . . . . .                                                            | 3-61  |
| Superstructure Lock Menu . . . . .                                                  | 3-62  |
| Bi-Fold Boom Extension Menu . . . . .                                               | 3-63  |
| Working Range Limiter (WRL) . . . . .                                               | 3-64  |
| WRL - Swing Angle Menu . . . . .                                                    | 3-67  |
| WRL - Boom Angle Limits Menu . . . . .                                              | 3-69  |
| WRL - Overall Height Menu . . . . .                                                 | 3-71  |
| WRL - Working Radius Menu . . . . .                                                 | 3-73  |
| WRL - Virtual Walls Menu . . . . .                                                  | 3-75  |
| Telescoping Emergency Program . . . . .                                             | 3-77  |
| Access Telescoping Emergency Program Menu . . . . .                                 | 3-78  |
| ODM Error Code Viewer . . . . .                                                     | 3-86  |
| Resetting the Current Telescoping . . . . .                                         | 3-87  |
| RDM (RCL Display Module) . . . . .                                                  | 3-89  |
| RCL – Menu Groups . . . . .                                                         | 3-90  |
| Inclination Indicator . . . . .                                                     | 3-94  |
| Anemometer Display . . . . .                                                        | 3-94  |
| Counterweight Menu . . . . .                                                        | 3-95  |
| ODM Display . . . . .                                                               | 3-98  |
| Auxiliary Hoist . . . . .                                                           | 3-99  |
| Swing . . . . .                                                                     | 3-99  |
| Boom Lifting/Lowering Mechanism . . . . .                                           | 3-100 |
| Telescoping Mechanism . . . . .                                                     | 3-101 |
| Hydraulic System . . . . .                                                          | 3-105 |
| Superstructure House Lock Menu . . . . .                                            | 3-105 |
| Remote Control . . . . .                                                            | 3-106 |
| Remote Control Icon . . . . .                                                       | 3-106 |
| Remote Control Operation . . . . .                                                  | 3-106 |
| Scope . . . . .                                                                     | 3-106 |
| System Overview . . . . .                                                           | 3-106 |
| System Components . . . . .                                                         | 3-107 |

- Remote Control Components . . . . . 3-109
- Display Components . . . . . 3-110
- Preparing for Remote Control Operation . . . . . 3-112
- Operating Remote Control . . . . . 3-113
- Telescoping Mode Number Entry . . . . . 3-132
- Economy Mode . . . . . 3-138
  - Terminology . . . . . 3-139
  - Requirements . . . . . 3-139
  - Operation . . . . . 3-139
  - Benefits . . . . . 3-139
- Electrical System . . . . . 3-139
  - Voltage Monitoring Warning . . . . . 3-139
  - 12 Volt Outlet . . . . . 3-139
- Lighting, Windshield Wiper/Washing System . . . . . 3-140
  - Lighting . . . . . 3-140
  - Windows . . . . . 3-142
  - Superstructure Cab Door . . . . . 3-142
- CraneSTAR® System . . . . . 3-143
  - Overview . . . . . 3-143
  - Position of the Components . . . . . 3-143

**SECTION 4 . . . . . Operating Procedures**

- Breaking-In a New Crane . . . . . 4-2
- Pre-Starting Checks . . . . . 4-2
  - Fuel Supply . . . . . 4-2
  - Engine Oil . . . . . 4-3
  - DEF Fluid Level . . . . . 4-3
  - Engine Coolant . . . . . 4-3
  - Batteries . . . . . 4-3
  - Hydraulic Reservoir and Filter . . . . . 4-3
  - Wire Rope . . . . . 4-3
  - Hook Block and Overhaul Ball . . . . . 4-3
  - Seats . . . . . 4-3
  - Seat Belts . . . . . 4-3
  - Signal and Running Lights . . . . . 4-3
  - Service and Parking Brakes . . . . . 4-3
  - Tires . . . . . 4-3
  - Wheels . . . . . 4-3
  - Other Equipment . . . . . 4-3
  - Daily Lubrication . . . . . 4-4
- Cold Weather Operation . . . . . 4-4
  - Derated Capacities for Each °F Below -40°F . . . . . 4-4
  - Derated Capacities for Each °C Below -40°C . . . . . 4-4
- Cold Climate Operation . . . . . 4-4
  - Crane Warm-Up Procedures . . . . . 4-4
    - Engine . . . . . 4-5
    - Transmission . . . . . 4-5
    - Hoist . . . . . 4-5
    - Swing Drive and Turntable Bearing . . . . . 4-5
    - Axles . . . . . 4-6
    - Hydraulic Oil System . . . . . 4-6
- Heating and Ventilating the Superstructure Cab . . . . . 4-6
  - Heating System . . . . . 4-6
    - Heating System Manual Operation . . . . . 4-7
    - Heating System Automatic Operation . . . . . 4-9
  - Air-Conditioning System . . . . . 4-10

|                                                                    |      |
|--------------------------------------------------------------------|------|
| Anti-Lock Brake System (ABS) . . . . .                             | 4-11 |
| ABS Power-Up Sequence . . . . .                                    | 4-12 |
| ABS Switch Operation . . . . .                                     | 4-12 |
| Automatic Traction Control (ATC) Functional Overview . . . . .     | 4-12 |
| ATC Operation . . . . .                                            | 4-13 |
| System Operation . . . . .                                         | 4-13 |
| Component Function . . . . .                                       | 4-13 |
| Traction Control Power-Up Sequence . . . . .                       | 4-13 |
| Traction Control Switch Operation . . . . .                        | 4-13 |
| Thermal (Brake Heat) Protection . . . . .                          | 4-13 |
| ABS/ATC Partial Shutdown . . . . .                                 | 4-13 |
| Engine Operation . . . . .                                         | 4-13 |
| Engine Starting Procedure . . . . .                                | 4-13 |
| Cold Weather Starting . . . . .                                    | 4-14 |
| Jump Starting the Crane . . . . .                                  | 4-14 |
| Idling the Engine . . . . .                                        | 4-14 |
| Racing the Engine . . . . .                                        | 4-15 |
| Shutdown Procedure . . . . .                                       | 4-15 |
| Exhaust System Cleaning . . . . .                                  | 4-15 |
| Crane Travel Operation . . . . .                                   | 4-16 |
| Traveling - General . . . . .                                      | 4-17 |
| Jobsite Travel Configurations . . . . .                            | 4-17 |
| Axle Weight Distribution Table . . . . .                           | 4-23 |
| Manual Transmission Clutch Operation . . . . .                     | 4-25 |
| Shifting Gears - Manual Transmission . . . . .                     | 4-25 |
| Automatic Transmission (Optional) . . . . .                        | 4-28 |
| Differential Control Switches . . . . .                            | 4-32 |
| Brakes . . . . .                                                   | 4-32 |
| Engine Brake . . . . .                                             | 4-33 |
| Recommended Crane Shutdown Procedures . . . . .                    | 4-33 |
| Unattended Crane . . . . .                                         | 4-34 |
| Superstructure Cab Platform . . . . .                              | 4-34 |
| Proper Leveling of the Crane . . . . .                             | 4-34 |
| Bubble-Level Indicator Adjustment . . . . .                        | 4-34 |
| Using the Outriggers . . . . .                                     | 4-34 |
| Setting the Outriggers from Outrigger Keypads . . . . .            | 4-35 |
| Additional Cribbing Needed to Increase Ground Clearance . . . . .  | 4-35 |
| Prior to Entering Cribbing Mode . . . . .                          | 4-35 |
| Methods and Requirements for Activating Cribbing Mode . . . . .    | 4-35 |
| Activating Cribbing Mode from Outrigger Keypads . . . . .          | 4-36 |
| Activating Cribbing Mode from Superstructure Cab ODM . . . . .     | 4-37 |
| Exiting Cribbing Mode . . . . .                                    | 4-40 |
| Auto-Level Procedure from Carrier / Superstructure (ODM) . . . . . | 4-40 |
| Engaging Outrigger Beam Extension Lock Pins . . . . .              | 4-40 |
| Outrigger Monitoring System (OMS) . . . . .                        | 4-41 |
| Stowing the Outriggers . . . . .                                   | 4-42 |
| Stowage of Outriggers Using Cribbing Mode . . . . .                | 4-42 |
| Stowing the Partial/Mid Extension Lock Pin . . . . .               | 4-42 |
| Stowing the Center Front Stabilizer . . . . .                      | 4-43 |
| Crane Operation . . . . .                                          | 4-43 |
| Before Operating the Crane . . . . .                               | 4-43 |
| Preheating the Hydraulic Oil . . . . .                             | 4-47 |
| Switching the 360° Lock ON/OFF . . . . .                           | 4-47 |
| Operation of the Rated Capacity Limiter . . . . .                  | 4-48 |
| Enter Rigging Mode . . . . .                                       | 4-50 |
| Crane Operation with Main Boom . . . . .                           | 4-61 |
| Telescoping Mechanism . . . . .                                    | 4-67 |

Semi-Auto Mode . . . . . 4-78  
 Boom Configurator . . . . . 4-85  
 High-Speed Mode . . . . . 4-87  
 Swing Gear . . . . . 4-88  
 Possible Movement Combinations . . . . . 4-90  
 Settings and Displays for Crane Operation . . . . . 4-91  
     Inclining the Crane Cab . . . . . 4-91  
     Switching Units of Measure . . . . . 4-91  
     Setting the Characteristic Curves for the Control Levers . . . . . 4-91  
     Limiting the Power Unit Speeds . . . . . 4-92  
     Carrier Camera Display Set-Up . . . . . 4-93  
     Using the Slewable Spotlights . . . . . 4-94  
     Warnings in the Start Menu . . . . . 4-94  
 Mechanical Emergency Unlocking and Locking of the Telescopic Sections . . . . . 4-95  
     Maintenance . . . . . 4-96  
 Work Break . . . . . 4-97  
     In Case of Short Work Breaks . . . . . 4-97  
     In Case of Work Breaks of More than 8 Hours . . . . . 4-97  
 Trailing Boom Carrier Option . . . . . 4-97  
     Description . . . . . 4-97  
     Operation . . . . . 4-98  
     Returning to Normal Crane Operation . . . . . 4-101  
     Parking the Trailing Boom Carrier . . . . . 4-101  
 Tilt-Up Panel Procedure Using the Heavy Duty Boom Extension . . . . . 4-101

**SECTION 5 . . . . . LUBRICATION**

General . . . . . 5-1  
     Environmental Protection . . . . . 5-1  
     Cummins Oil Registration List . . . . . 5-1  
     Arctic Conditions Below -18° C (0° F) . . . . . 5-2  
 Lubrication Points . . . . . 5-2  
     Standard Lubricants . . . . . 5-3  
     Cold Weather Lubricants . . . . . 5-5  
     Arctic Lubricants and Conditions . . . . . 5-7  
     Drivetrain Lubrication . . . . . 5-9  
     Clutch Release Bearing Grease Interval . . . . . 5-12  
     Steering Lubrication . . . . . 5-14  
     Axle Lubrication . . . . . 5-15  
     Outrigger Lubrication . . . . . 5-19  
     Miscellaneous Lubrication . . . . . 5-20  
     Turntable & Cab Tilt Lubrication . . . . . 5-21  
     Hoist Lubrication . . . . . 5-23  
     Turntable Central Lubrication . . . . . 5-24  
     Boom Lubrication . . . . . 5-25  
     Monthly Lubrication Work . . . . . 5-30  
 Carwell® Rust Inhibitor . . . . . 5-31  
     Protecting Cranes From Corrosion . . . . . 5-31  
     Cleaning Procedures . . . . . 5-31  
     Inspection and Repair . . . . . 5-32  
     Application . . . . . 5-32  
     Areas of Application . . . . . 5-32

**SECTION 6 . . . . . Set-up and Installation**

General . . . . . 6-2  
 Installing Cable On The Hoist . . . . . 6-2  
 Cable Reeving . . . . . 6-2

|                                                                                                      |      |
|------------------------------------------------------------------------------------------------------|------|
| Dead-End Rigging/Wedge Sockets . . . . .                                                             | 6-3  |
| Installing Wedge and Socket . . . . .                                                                | 6-4  |
| Positioning/Removing the Hoist Cable . . . . .                                                       | 6-5  |
| Possible Reeving on the Main Boom . . . . .                                                          | 6-6  |
| Rigging Work for Crane Operation With the Main Boom . . . . .                                        | 6-12 |
| Rigging . . . . .                                                                                    | 6-12 |
| Unrigging . . . . .                                                                                  | 6-13 |
| Removable Counterweight . . . . .                                                                    | 6-14 |
| Counterweight Versions/Combinations . . . . .                                                        | 6-16 |
| Lifting Individual Counterweight Sections . . . . .                                                  | 6-16 |
| Rigging the Counterweight . . . . .                                                                  | 6-18 |
| Unrigging the Counterweight . . . . .                                                                | 6-19 |
| Lower 3,000 lb Tray Plate on the Counterweight Platform . . . . .                                    | 6-19 |
| Check the Position of the Locking Pins for 3,000 & 5,000 lb<br>Counterweight Sections . . . . .      | 6-20 |
| Assembling Counterweight Versions/Combinations . . . . .                                             | 6-21 |
| Counterweight Hoist Unit . . . . .                                                                   | 6-23 |
| Rotating With the Rigged Counterweight . . . . .                                                     | 6-24 |
| Unlocking/Locking the Rear Counterweight Platform . . . . .                                          | 6-28 |
| Rigging Work on the Main Boom . . . . .                                                              | 6-30 |
| Hook Block on the Bumper . . . . .                                                                   | 6-30 |
| Hook Block on a Separate Vehicle . . . . .                                                           | 6-30 |
| Installing/Removing the Anti Two-Block Switch . . . . .                                              | 6-36 |
| Locking/Unlocking the Anti-Two Block Switch . . . . .                                                | 6-40 |
| Anemometer and Boom Position Indicator Light . . . . .                                               | 6-40 |
| Switching the Boom Position Indicator Light ON and OFF . . . . .                                     | 6-41 |
| Other Rigging Work . . . . .                                                                         | 6-41 |
| Cameras for Crane Operation . . . . .                                                                | 6-41 |
| Hoist Maintenance Platform . . . . .                                                                 | 6-42 |
| Slings Points for Personal Protective Equipment . . . . .                                            | 6-42 |
| Boom Extensions . . . . .                                                                            | 6-43 |
| Installing the Folding Boom Extension . . . . .                                                      | 6-44 |
| Extension Erecting Warnings and Requirements . . . . .                                               | 6-45 |
| Erecting Procedure - 35 ft (10.5 m) Base Extension . . . . .                                         | 6-45 |
| Erecting Procedure - 58 ft (17.7 m) Extension . . . . .                                              | 6-50 |
| Extension Electrical Connections . . . . .                                                           | 6-57 |
| Connecting the Anti-Two Block Switch . . . . .                                                       | 6-58 |
| Extension Hydraulic Connections (Optional Hydraulic Extension) . . . . .                             | 6-59 |
| Folding Deflection Sheaves . . . . .                                                                 | 6-61 |
| Positioning/Removing the Hoist Cable . . . . .                                                       | 6-62 |
| Mechanical Luffing Boom Extension (Adjustable Boom Extension) . . . . .                              | 6-64 |
| Stowing the Folding Boom Extension . . . . .                                                         | 6-65 |
| Boom Extension Removal . . . . .                                                                     | 6-72 |
| Installing and Removing the 26 ft (8 m) Extension Insert . . . . .                                   | 6-73 |
| 3.5 m (11.4 ft) Manual Off-Settable Heavy Duty Boom Extension . . . . .                              | 6-79 |
| Separating Manual Off-Settable Heavy Duty Boom Extension from<br>Lattice Extension . . . . .         | 6-79 |
| Installing Manual Off-Settable Heavy Duty Boom Extension . . . . .                                   | 6-79 |
| Setting Heavy Duty Boom Extension Manual Offset . . . . .                                            | 6-80 |
| Removing the Manual Off-Settable Heavy Duty Extension . . . . .                                      | 6-80 |
| 3.5 m (11.4 ft) Hydraulic Off-Settable Heavy Duty Boom Extension . . . . .                           | 6-80 |
| Separating Hydraulic Off-Settable Heavy Duty Boom Extension from Lattice<br>Base Extension . . . . . | 6-80 |
| Removing the Hydraulic Off-Settable Heavy Duty Extension . . . . .                                   | 6-83 |
| Auxiliary Single-Sheave Boom Nose (Optional Equipment) . . . . .                                     | 6-84 |
| Identification . . . . .                                                                             | 6-84 |
| Installing/Removing Auxiliary Single-Sheave Boom Nose . . . . .                                      | 6-84 |



Removing the Auxiliary Single-Sheave Boom Nose . . . . . 6-85  
Rigging the Auxiliary Single-Sheave Boom Nose . . . . . 6-85  
Rigging in Transport Position . . . . . 6-85  
Rigging in Working Position . . . . . 6-86  
Attaching and Removing Hoist Cable . . . . . 6-86  
Possible Reeving Methods on the Auxiliary Single-Sheave Boom Nose . . . . . 6-86  
Anti-Two Block Switch . . . . . 6-86  
Raising and Setting Down the Main Boom with Rigged Lattice Extension . . . . . 6-86  
Telescoping with Rigged Lattice Extension . . . . . 6-86  
Operating with the Lattice Extension . . . . . 6-86  
    Procedure IF the Permissible Wind Speed is Exceeded . . . . . 6-87  
Anti-Two Block Troubleshooting . . . . . 6-87

For  
Reference  
Only

TOC

For  
Reference  
Only

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# SECTION 1 INTRODUCTION

## SECTION CONTENTS

|                                                                                                            |                                   |
|------------------------------------------------------------------------------------------------------------|-----------------------------------|
| <p><b>General</b> ..... 1-1</p> <p style="padding-left: 20px;">Ambient Operation Temperature ..... 1-1</p> | <p>Customer Support ..... 1-1</p> |
|------------------------------------------------------------------------------------------------------------|-----------------------------------|

## GENERAL

This manual provides important information for the operator of the Model TMS9000-2 Series Grove Crane.

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

Hydraulic, two-stage double box telescopic beam with jack cylinder outriggers are integral with the carrier frame. The outriggers are utilized in four positions; fully extended, mid-extended, partial extended, and fully retracted (100%, 79%, 57% and 0%). The carrier is also equipped with a center front stabilizer with a permanently installed pad.

The superstructure is capable of 360° rotation in either direction. All crane functions are controlled from the fully enclosed cab. The crane is equipped with a 11.2 m to 51.6 m (36.7 to 169 ft) five section boom.

Lifting is provided by a main and auxiliary hoist. Swingaway hydraulically offsettable and manually offsettable boom extensions are available.

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

Basic nomenclature is shown in (Figure 1-1)

## Ambient Operation Temperature

This crane is permitted to operate in ambient temperatures from -29 °C to 49 °C (-20 °F to 120 °F). Consult Manitowoc Crane Care for instructions on operation of this crane for ambient temperatures outside of the permitted range.

## Customer Support

Grove and our Distributor Network want to ensure your satisfaction with our products and customer support. Your local distributor is the best equipped and most knowledgeable to assist you for parts, service and warranty issues. They have the facilities, parts, factory trained personnel, and the information to assist you in a timely manner. We request that you first contact them for assistance. If you feel you need factory assistance, please ask the distributor’s service management to coordinate the contact on your behalf.

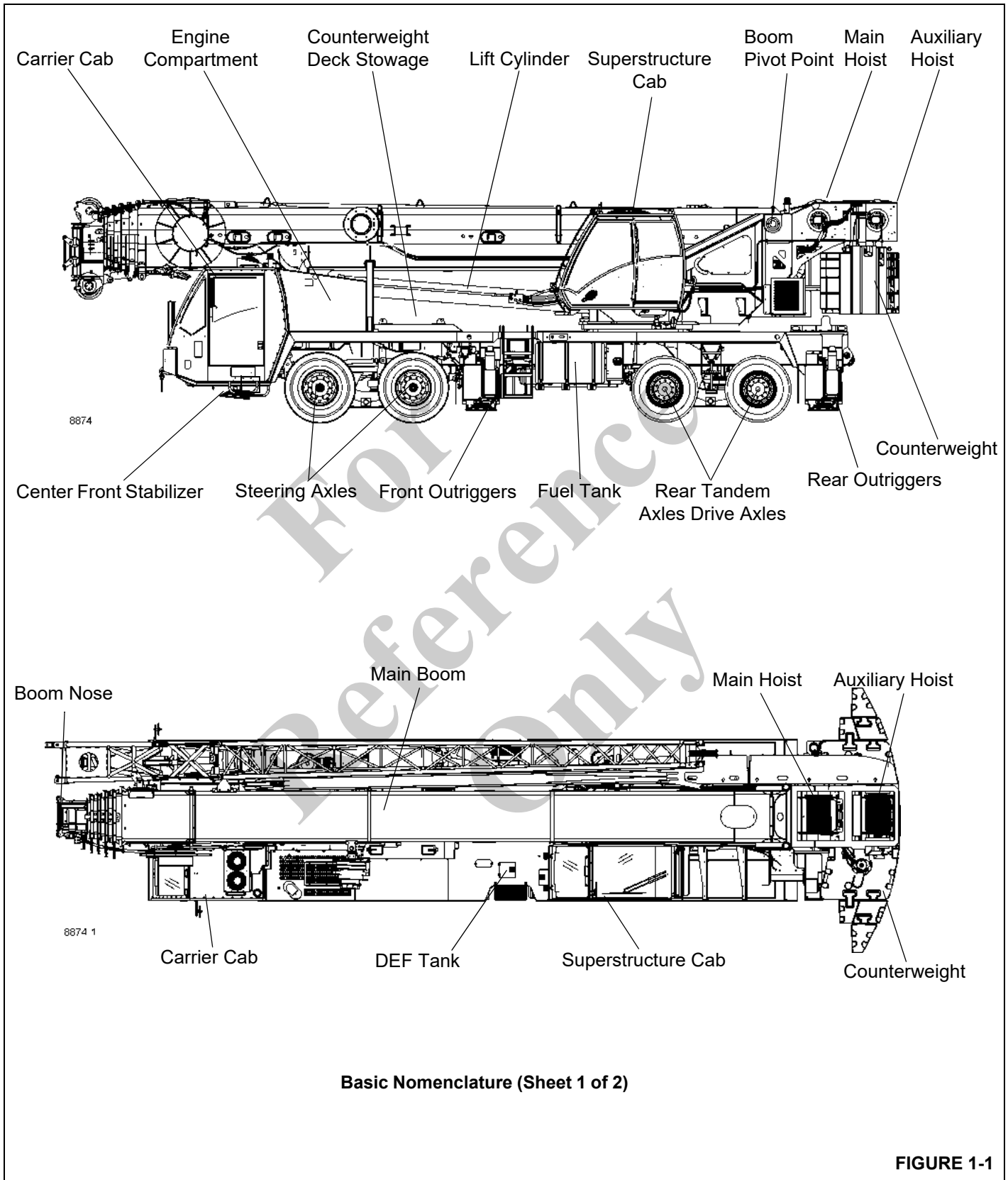
### **Supplemental Information**

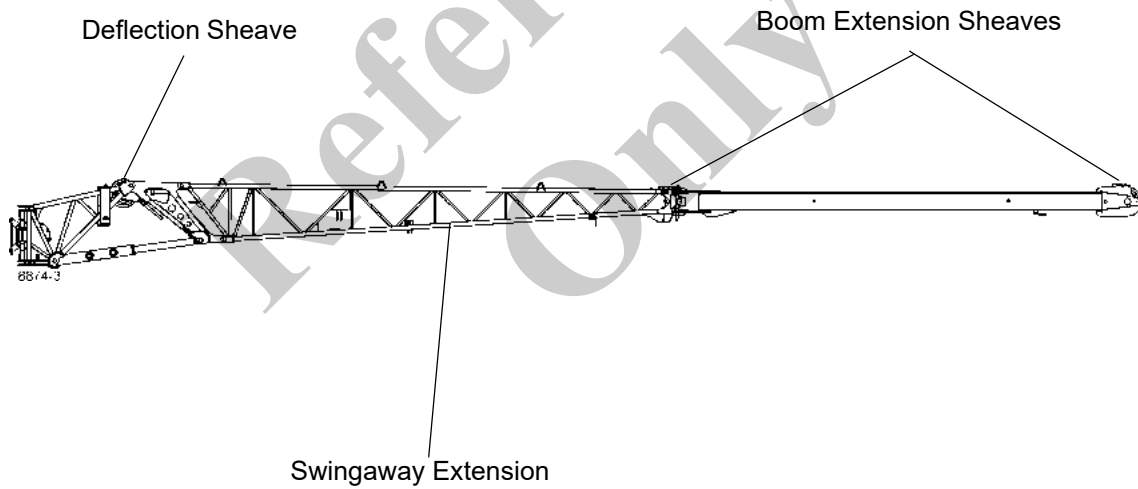
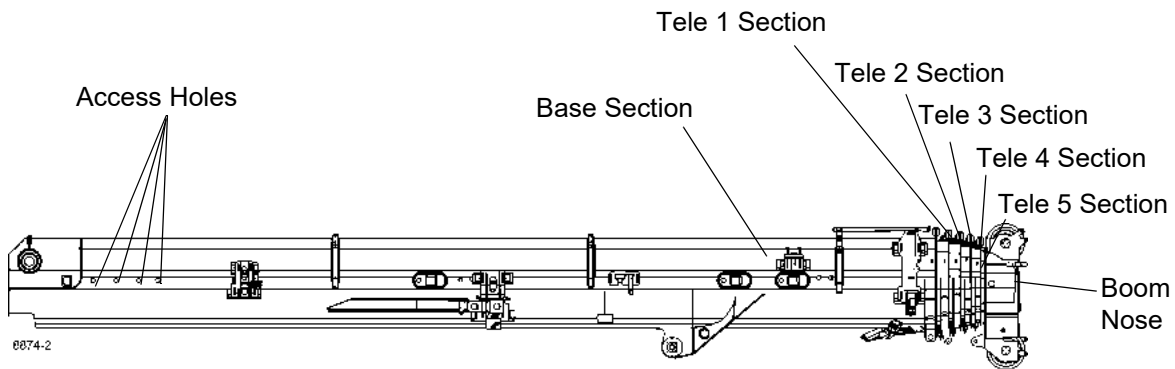
A Safety Compact Disc or a USB flashdrive which includes sections on Operation, Service and a Safety Video for Grove operators and owners is supplied when the equipment is purchased new. Additional copies are available from your local distributor.

### **New Owners**

If you are the new owner of a Grove crane, please register it with Manitowoc Crane Care so we have the ability to contact you if the need arises.

Go to: <https://www.manitowoccranes.com/en/services/crane-care/service-and-tech-support/Change-of-Ownership-Form> and complete the form.





Manually Offsettable Boom Extension

Basic Nomenclature (Sheet 2 of 2)

FIGURE 1-1 continued

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## SECTION 2 SAFETY INFORMATION

### SECTION CONTENTS

|                                                  |             |                                                       |             |
|--------------------------------------------------|-------------|-------------------------------------------------------|-------------|
| <b>Safety Messages</b> .....                     | <b>2-2</b>  | <b>Personnel Handling</b> .....                       | <b>2-27</b> |
| General.....                                     | 2-2         | <b>Environmental Protection</b> .....                 | <b>2-28</b> |
| Safety Alert Symbol.....                         | 2-2         | <b>Maintenance</b> .....                              | <b>2-28</b> |
| Signal Words.....                                | 2-2         | Service and Repairs.....                              | 2-28        |
| <b>General</b> .....                             | <b>2-2</b>  | Lubrication.....                                      | 2-29        |
| Safety Decals.....                               | 2-2         | Tires.....                                            | 2-29        |
| <b>Accidents</b> .....                           | <b>2-2</b>  | <b>Hoist Rope</b> .....                               | <b>2-30</b> |
| <b>Operator Information</b> .....                | <b>2-3</b>  | Synthetic Hoist Rope.....                             | 2-30        |
| <b>Operator Qualifications</b> .....             | <b>2-3</b>  | Wire Rope.....                                        | 2-30        |
| <b>Operational Aids</b> .....                    | <b>2-4</b>  | Sheaves.....                                          | 2-31        |
| Rated Capacity Limiter (RCL) Systems.....        | 2-4         | Batteries.....                                        | 2-32        |
| Anti-Two-Blocking Device.....                    | 2-5         | Super Capacitor (If Equipped).....                    | 2-32        |
| Working Area Limiter (If Equipped).....          | 2-5         | General Maintenance.....                              | 2-32        |
| <b>Crane Stability/Structural Strength</b> ..... | <b>2-6</b>  | <b>Transporting the Crane</b> .....                   | <b>2-32</b> |
| Load Charts.....                                 | 2-7         | <b>Travel Operation</b> .....                         | <b>2-33</b> |
| Work Site.....                                   | 2-7         | <b>Work Practices</b> .....                           | <b>2-34</b> |
| <b>Wind Forces</b> .....                         | <b>2-7</b>  | Personal Considerations.....                          | 2-34        |
| Wind Speeds.....                                 | 2-8         | Crane Access.....                                     | 2-34        |
| Lifting Operations.....                          | 2-20        | Job Preparation.....                                  | 2-34        |
| Multiple Crane Lifts.....                        | 2-21        | Working.....                                          | 2-35        |
| Lifting Multiple Loads.....                      | 2-21        | Lifting.....                                          | 2-35        |
| Tilt-Up Panel Lifting.....                       | 2-21        | Hand Signals.....                                     | 2-36        |
| Counterweight.....                               | 2-22        | <b>Boom Extension</b> .....                           | <b>2-38</b> |
| Outrigger Lift Off.....                          | 2-22        | <b>Parking and Securing</b> .....                     | <b>2-38</b> |
| <b>Pile Driving and Extracting</b> .....         | <b>2-22</b> | <b>Shut-Down</b> .....                                | <b>2-38</b> |
| Crane Equipment.....                             | 2-23        | <b>Cold Weather Operation</b> .....                   | <b>2-38</b> |
| Crane Inspection.....                            | 2-23        | <b>Temperature Effects on Hook Blocks</b> .....       | <b>2-39</b> |
| <b>Electrocution Hazard</b> .....                | <b>2-23</b> | <b>Temperature Effects on Hydraulic Cylinders</b> ... | <b>2-39</b> |
| Set-Up and Operation.....                        | 2-24        | <b>Overload Inspection</b> .....                      | <b>2-40</b> |
| Electrocution Hazard Devices.....                | 2-25        | Boom Inspection.....                                  | 2-42        |
| Electrical Contact.....                          | 2-25        | Superstructure Inspection.....                        | 2-44        |
| Special Operating Conditions and Equipment... .. | 2-26        | Carrier Inspection.....                               | 2-46        |
| Grounding the Crane.....                         | 2-26        |                                                       |             |



## SAFETY MESSAGES

### General

The importance of safe operation and maintenance cannot be overemphasized. Carelessness or neglect on the part of operators, job supervisors and planners, rigging personnel, and job site workers can result in their death or injury and costly damage to the crane and property.

To alert personnel to hazardous operating practices and maintenance procedures, safety messages are used throughout the manual. Each safety message contains a safety alert symbol and a signal word to identify the hazard's degree of seriousness.

### Safety Alert Symbol



This safety alert symbol means **ATTENTION!** Become alert - **your safety is involved!** Obey all safety messages that follow this symbol to avoid possible death or injury.

### Signal Words



#### DANGER

Identifies **hazards** that will result in death or serious injury if the message is ignored.



#### WARNING

Identifies **hazards** that may result in death or serious injury if the message is ignored.



#### CAUTION

Identifies **hazards** that could result in minor or moderate injury if the message is ignored.

#### CAUTION

Without the safety alert symbol, identifies **hazards** that could result in property damage if the message is ignored.

**NOTE:** Emphasizes operation or maintenance procedures.

## GENERAL

It is impossible to compile a list of safety precautions covering all situations. However, there are basic principles that **must** be followed during your daily routine. Safety is **your primary responsibility**, since any piece of equipment is only as safe **as the person at the controls**.

Read and follow the information located in *Model Specific Information* near the end of this section.

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

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

You are the only one who can be relied upon to assure the safety of yourself and those around you. Be **professional** and follow the **rules of safety**.

**Remember**, failure to follow just one safety precaution could cause an accident that results in death or serious injury to personnel or damage to equipment. You are responsible for the safety of yourself and those around you.

### Safety Decals

Refer to the *Parts Manual* for a drawing indicating the location of safety decals on the crane.

## ACCIDENTS

Following any accident or damage to equipment, the Grove distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Should the distributor not be immediately available, contact should be made directly with Grove Product Safety at the address below. The crane must not be returned to service until it is thoroughly inspected for any evidence of damage. All damaged parts must be repaired or replaced as authorized by your Grove distributor and/or Manitowoc Crane Care.



If this crane becomes involved in a property damage and/or personal injury accident, **immediately** contact your Grove distributor. If the distributor is unknown and/or cannot be reached, contact Product Safety at:

**Grove U.S. L.L.C.**

1565 East Buchanan Trail  
Shady Grove, PA 17256-0021

Phone: 888-777-3378 (888-PSR.DEPT)  
717-597-8121

Fax: 717-593-5152

E-mail: [product.safety@manitowoc.com](mailto:product.safety@manitowoc.com)

## OPERATOR INFORMATION

You must **read** and **understand** this *Operator Manual* and the *Load Chart* before operating your new crane. You must also **view** and **understand** the supplied safety video. This manual and *Load Chart* must be readily available to the operator at all times and must remain in the cab (if equipped) or operator's station while the crane is in use.

The *Operator Manual* supplied with and considered part of your crane must be read and completely understood by each person responsible for assembly, disassembly, operation and maintenance of the crane.

No personnel shall be allowed to climb onto the crane or enter the crane cab or operator's station unless performance of their duties require them to do so, and then only with knowledge of the operator or other qualified person.

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



**Do not remove** the *Load Chart*, this *Operator Manual*, or any decal from this crane.

Inspect the crane every day (before the start of each shift). Make sure that routine maintenance and lubrication are being dutifully performed. Don't operate a damaged or poorly maintained crane. You risk lives when operating faulty machinery—including your own.

If adjustments or repairs are necessary, the operator shall notify the next operator and personnel responsible for the maintenance and repair of the crane.

## OPERATOR QUALIFICATIONS

**Qualified person** is defined as one who by reason of knowledge, training and experience is thoroughly familiar with crane operations and the hazards involved. Such a person shall meet the operator qualifications specified in Occupational Safety and Health Administration (OSHA) Regulations (United States Federal Law), in ASME B30.5 American National Standard, or in any other applicable federal, state or local laws.

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

Refer to the *Parts Manual* for this crane for the locations of all safety decals.

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



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

**You must not operate this crane unless:**

- You have been trained in the safe operation of this crane.

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

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

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

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

As operator of this crane, you are granted the authority to stop and refuse to lift loads until safety is assured.

## OPERATIONAL AIDS

Operational aids are accessories that provide information to facilitate operation of a crane or that take control of particular functions without action of the operator when a limiting condition is sensed, as stated in the latest revision of the ASME B30.5, and ASME B30.8 standards. Examples of such devices include, but are not limited to, the following: anti-two-block device, rated capacity indicator, rated capacity limiter, boom angle or radius indicator, boom length indicator, crane level indicator, hoist drum rotation indicator, load indicator, and wind speed indicator.

Grove remains committed to providing reliable products that enable users and operators to safely lift and position loads. Grove has been an industry leader in the incorporation of operational aids into the design of its cranes. Federal law requires that cranes be properly maintained and kept in good working condition. The manuals that Grove provides that are specific for each crane and the manufacturer's manuals for the operational aids shall be followed. If an operational aid should fail to work properly, the crane user or owner must assure that repair or recalibration is accomplished as soon as is reasonably possible. If immediate repair or recalibration of an operational aid is not possible and there are exceptional circumstances which justify continued short-term use of the crane when operational aids are inoperative or

malfunctioning, the following requirements shall apply for continued use or shutdown of the crane:

- Steps shall be taken to schedule repairs and recalibration immediately. The operational aids shall be put back into service as soon as replacement parts, if required, are available and the repairs and recalibration can be carried out. Every reasonable effort must be made to expedite repairs and recalibration.
- When a *Load Indicator, Rated Capacity Indicator, or Rated Capacity Limiter* is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures for determining load weights and shall ascertain that the weight of the load does not exceed the crane ratings at the radius where the load is to be handled.
- When a *Boom Angle or Radius Indicator* is inoperative or malfunctioning, the radius or boom angle shall be determined by measurement.
- When an *Anti-Two-Blocking Device, Two-Blocking Damage Prevention Device or Two-Block Warning Device* is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures, such as assigning an additional signal person to furnish equivalent protection. This does not apply when lifting personnel in load-line supported personnel platforms. Personnel shall not be lifted when anti-two-block devices are not functioning properly.
- When a *Boom Length Indicator* is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish the boom lengths at which the lift will be made by actual measurements or marking on the boom.
- When a *Level Indicator* is inoperative or malfunctioning, other means shall be used to level the crane.

## Rated Capacity Limiter (RCL) Systems

Your crane is equipped with an RCL system which is intended to aid the operator. An RCL is a device that automatically monitors radius, load weight, and load rating and prevents movements of the crane, which would result in an overload condition

Test daily for proper operation. Never interfere with the proper functioning of operational aids or warning devices.

Under **no condition** should it be relied upon to replace the use of *Load Charts* and operating instructions. Sole reliance upon these electronic aids in place of good operating practices can cause an accident.

Know the weight of all loads and always check the capacity of the crane as shown on the *Load Chart* before making any lifts.

NEVER exceed the rated capacity shown on the *Load Chart*. Always check the *Load Chart* to make sure that the load to be lifted at the desired radius is within the rated capacity of the crane.

For detailed information concerning the operation and maintenance of the RCL system installed on the crane, see the appropriate section later in this manual or the RCL manufacturer's manual supplied with the crane. Manufacturers of rated capacity limiters may refer to them in their manuals as a load moment indicator (LMI), a hydraulic capacity alert system (HCAS), a safe load indicator (SLI), or an EKS5; Grove refers to these systems as a rated capacity limiter (RCL) throughout its *Operator* and *Service manuals*.

### Anti-Two-Blocking Device

This crane should have a functional Anti-Two-Block and Control Lock-Out System. Test daily for proper operation.

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

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

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

Two-blocking can be prevented. Operator awareness of the hazards of two-blocking is the most important factor in preventing this condition. An Anti-Two-Block System is

intended to assist the operator in preventing dangerous two-block conditions. It is not a replacement for operator awareness and competence.

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



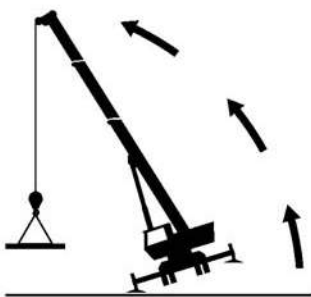
Example decal. For reference only.

### Working Area Limiter (If Equipped)

This crane may be equipped with a working area limiter as part of the RCL system, designated as either Work Area Definition System (WADS) or Working Range Limiter (WRL). You must read and understand the operator manual before operating the working area limiter system. Become familiar with all proper operating procedures and with the identification of symbol usage.

The working area limiter is intended to be used as an aid to the operator. It is not a substitute for safe crane operating practices, experience and good operator judgments.

**! DANGER**



**TIPPING HAZARD**

To avoid death or serious injury, ensure load and crane's configuration are within capacity as shown on crane's load rating chart and notes.

This crane should have a functional load moment indicator and control lock-out system. Test daily for proper operation.

POSITION CRANE ON FIRM SURFACE. EXTEND OUTRIGGERS AND LEVEL CRANE.

**TO AVOID DEATH OR SERIOUS INJURY:**


**NEVER** handle personnel with this machine unless the requirements of the applicable national, state and local regulations and safety codes are met.

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

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

**NEVER** get on or off a moving crane.

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



**TWO-BLOCKING HAZARD**

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

This crane should have a functional anti-two-block and control lock-out system. Test daily for proper operation.

DO NOT PASS LOADS OR BOOM OVER GROUND PERSONNEL.

**ELECTRONIC EQUIPMENT** on this crane is intended as an aid to the operator. Under no condition should it be relied upon to replace the use of capacity charts and operating instructions. Sole reliance upon these electronic aids in place of good operating practices can cause an accident.

Do not remove any decal, the load chart, or the Operator's and Safety Handbook from this crane.

**FOLLOW INSTRUCTIONS IN OPERATOR'S AND SAFETY HANDBOOK.**

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## CRANE STABILITY/STRUCTURAL STRENGTH

To avoid death or serious injury, make sure that the crane is on a firm surface with load and crane's configuration within capacity as shown on the crane's *Load Chart* and notes.

Make sure that all pins and floats are properly installed and outrigger beams are properly extended before lifting on outriggers. On models equipped with outriggers that can be pinned at the mid-extend position (vertical stripe, if applicable), the outriggers must also be pinned when operating from the mid-extend position.

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

Carefully follow the procedures in this *Operator Manual* when extending or retracting the outriggers. Death or serious injury could result from improper crane setup on outriggers.

The operator must select the proper *Load Chart* and Rated Capacity Limiter (RCL) System program for the outrigger position selected.

Before swinging the superstructure over the side when the outriggers are retracted, check for backwards stability under the sub-section titled *Model Specific Information* later in this section.

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

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

Unless lifting within On Rubber capacities, outrigger beams and jack cylinders (plus center front stabilizer, if equipped) must be properly extended and set to provide precise leveling of the crane. Tires must be clear of the ground before lifting on outriggers.





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

## Load Charts

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

*Load Chart* capacities are based on freely suspended loads.

You must use the appropriate *Load Chart* when determining the capability of the crane in the configuration required to perform the lift.

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

Do not remove the *Load Charts* from the crane.

## Work Site

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

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

Be aware of the danger for people entering the working area. Do not allow unnecessary personnel in the vicinity of the crane while operating.

## WIND FORCES

There are basic principles that must be followed while operating in windy conditions. This information has been provided to assist in determining safe operation in windy conditions.

Always use extreme caution when windy conditions exist. NEVER exceed the rated capacity shown on the *Load Chart*.

**Always check the *Load Chart* to make sure that the load to be lifted is within the rated capacity of the crane.**

Wind can have a significant effect on loads that may be lifted by a crane. Wind forces act differently on a crane depending upon the direction from which the wind is blowing (e.g., wind on the rear of the boom can result in decreased forward stability, wind on the underside of the boom can result in decreased backward stability, wind on the side of the boom can result in structural damages, etc.)

Wind forces can exert extreme dynamic loads. Grove recommends that a lift not be made if the wind can cause a loss of control in handling the load.

Wind forces can be determined by typical visible effects on the landscape. To assist you in determining prevailing wind conditions, refer to Table 2-1.

**NOTE:** The wind speed corresponding to the Beaufort scale in the table is mean wind speed at 10 m (33 ft) elevation over a period of 10 minutes.

**NOTE:** Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

Table 2-1 Beaufort Wind Scale

| Beaufort Number | Description     | Maximum Wind Speed |       |      | Visible Indicator<br>Effects of wind as observed on land                                                                  |
|-----------------|-----------------|--------------------|-------|------|---------------------------------------------------------------------------------------------------------------------------|
|                 |                 | m/s                | km/h  | mph  |                                                                                                                           |
| Zero (0)        | Calm            | 0.3                | 1.1   | 0.7  | Calm; smoke rises vertically                                                                                              |
| 1               | Light Air       | 1.5                | 5.4   | 3.4  | Smoke drift indicates wind direction. Leaves and wind vanes are stationary.                                               |
| 2               | Light Breeze    | 3.3                | 11.9  | 7.4  | Wind felt on exposed skin. Leaves rustle. Wind vanes begin to move.                                                       |
| 3               | Gentle Breeze   | 5.4                | 19.4  | 12.1 | Leaves and small twigs constantly moving. Light flags extended.                                                           |
| 4               | Moderate Breeze | 7.9                | 28.4  | 17.7 | Dust and loose paper raised. Small branches begin to move.                                                                |
| 5               | Fresh Breeze    | 10.7               | 38.5  | 23.9 | Branches of a moderate size move. Small trees in leaf begin to sway.                                                      |
| 6               | Strong Breeze   | 13.8               | 49.7  | 30.9 | Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic bins tip over. |
| 7               | High Wind       | 17.1               | 61.6  | 38.3 | Whole trees in motion. Effort needed to walk against the wind.                                                            |
| 8               | Gale            | 20.7               | 74.5  | 46.3 | Some twigs broken from trees. Cars veer on road. Progress on foot is seriously impeded.                                   |
| 9               | Strong Gale     | 24.4               | 87.8  | 54.6 | Some branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over.     |
| 10              | Storm           | 28.4               | 102.2 | 63.5 | Trees are broken off or uprooted, structural damage likely.                                                               |

## Wind Speeds

The maximum permissible wind speed referred to in the load charts is the 3-second wind gust speed measured at the boom tip height and is designated as  $V(z)$ . This value is either recorded at boom tip or calculated based on mean wind speed recorded at crane operation site. For lift planning purposes only, the 3-second wind gust speed,  $V(z)$ , may be calculated based on mean wind speed reported at <http://www.windfinder.com> "Super Forecast".

**NOTE:** Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

This 3-second wind gust is assumed to act on the entire crane and the load. The wind effect on the load can be conservatively estimated as:

- a) If  $V(z)$  is  $\leq 13.4$  m/s (30 mph), then the **allowable** load is the published rated capacity from the Load Chart.
- b) If  $V(z)$  is  $> 13.4$  m/s (30 mph) and is  $\leq 20.1$  m/s (45 mph), the **allowable** load is the published rated

capacity multiplied by the Capacity Reduction Factor from Table 2-4 (metric) or (non-metric).

**NOTE:** This condition is limited to operation with the main boom on fully extended outriggers only.

c) If  $V(z)$  is  $> 20.1$  m/s (45 mph), then lifting is **NOT** permitted. Cease lifting operations and lower and retract the boom.

In both cases **a)** and **b)** above, the lift may also be limited by the projected wind area of the load  $A_p$  and by the wind drag coefficient  $C_d$ : This limit can be determined by comparing the **Actual** wind resistance area with the **Allowable** wind resistance area.

Refer to Figure 2-1 for a simplified calculation method to determine permissible wind speed.

**NOTE:** Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

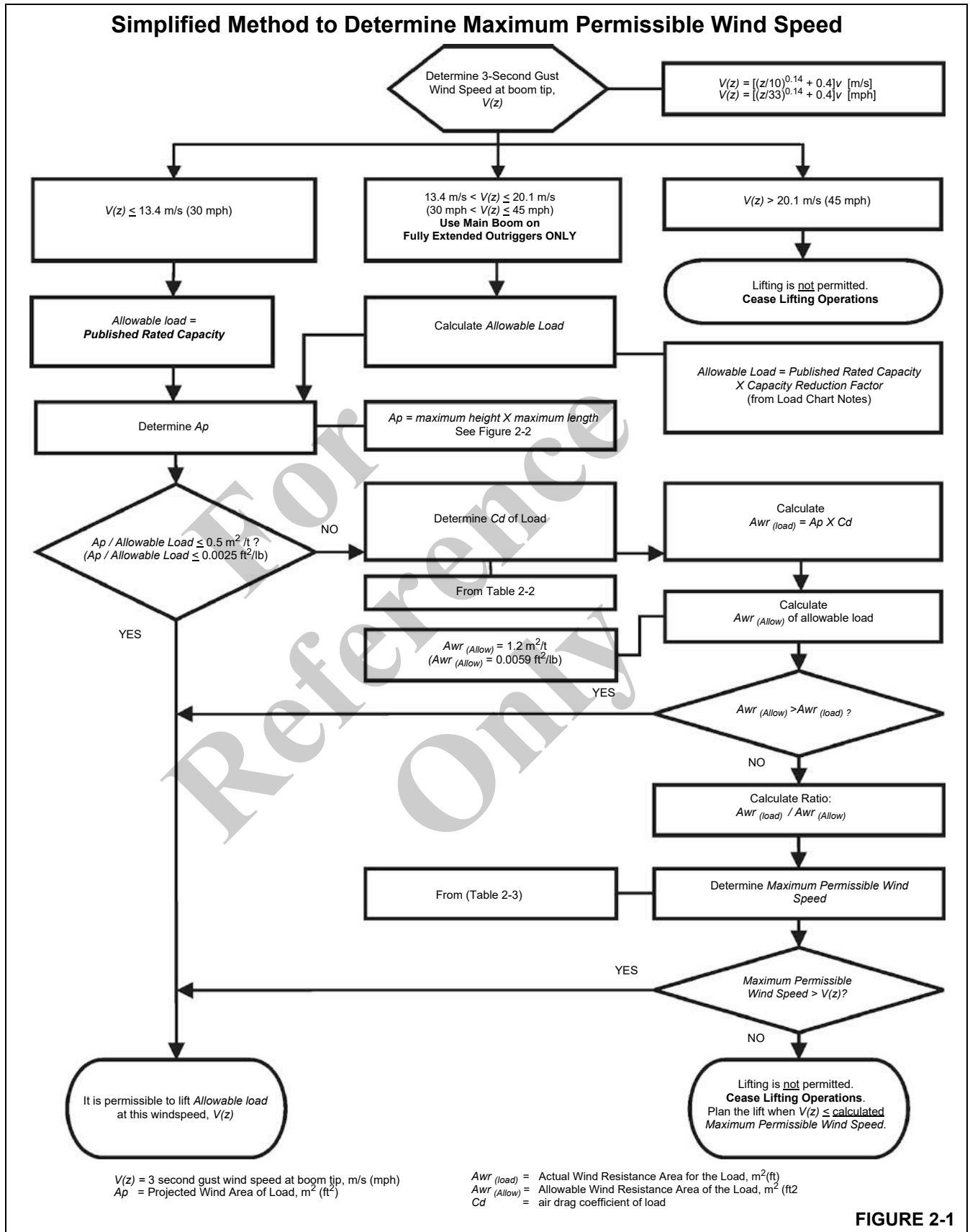


FIGURE 2-1

**Determination of 3-second wind gust speed at boom tip height:**

The following example illustrates how to calculate 3-second wind gust speed at boom tip height based on mean wind speed recorded by the device located at the crane operation site:

$V(z)$  is the 3-second wind gust speed at boom tip height  $Z$  then:

Metric, with  $Z$  [m] and  $V$  [m/s]

$$V(z) = [(Z/10)^{0.14} + 0.4] \times V \quad (2.1)$$

Non-metric, with  $Z$  [ft] and  $V$  [mph]

$$V(z) = [(Z/33)^{0.14} + 0.4] \times V \quad (2.2)$$

where:

$V$  [m/s] [mph] - Mean wind speed at 10 m (22 ft) elevation (upper limit of Beaufort scale)

**Example:** Suppose you want to lift the load with the maximum boom tip height of 30 m (100 ft) and the recorded mean wind speed by the device located at the crane operation site is 5.5 m/s (13 mph). This mean wind speed of 5.5 m/s (13 mph) corresponds to Beaufort number 4 (see Table 2-1). The maximum wind velocity according to the Beaufort scale of 4 is 7.9 m/s (17.7 mph).

The mean wind speed (upper limit of Beaufort number) at 10 m (33 ft) height, to be used for calculation is:

$$V = 7.9 \text{ m/s (17.7 mph)}$$

Boom tip height for this lift is  $Z = 30$  m (100 ft)

then:

Metric, with  $Z$  [m] and  $V$  [m/s]

$$V(z) = [(30/10)^{0.14} + 0.4] \times 7.9 = 12.4 \text{ m/s}$$

Non-metric, with  $Z$  [ft] and  $V$  [mph]

$$V(z) = [(100/33)^{0.14} + 0.4] \times 17.7 = 27.8 \text{ mph}$$

Since  $V(z)$  is  $\leq 13.4$  m/s (30 mph), the allowable loads are the published rated capacities from the Load Chart and can be lifted at this condition.

**Size and Shape of the load:**

These rated capacities are also based on the assumption that the Wind Resistance Area of load,  $Awr_{(load)}$  is not more than 0.0012 square meters per kilogram (0.0059 sq.ft per pound of load. (See below Formulas 2.4 and 2.5.)

The load capacities shall be reduced to account for the larger wind resistance area of load and 3-second wind gust speed at boom tip height. Use tag lines when the wind gust speed is above 13.4 m/s (30 mph) to help control the movement of the load. **Grove recommends that a lift not be made if the wind can cause a loss of control in handling the load.**

**NOTE:** Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

The lift may also be limited by the projected wind area of the load  $Ap$  and by the wind drag coefficient  $Cd$ . This limit can be determined by comparing the actual wind resistance area of the load with the allowable wind resistance area.

$$Awr_{(load)} = Ap \times Cd \quad (2.3)$$

where:

$Awr_{(load)}$  [m<sup>2</sup>] [ft<sup>2</sup>] - Wind resistant area of the load

$Ap$  [m<sup>2</sup>] [ft<sup>2</sup>] - projected wind area,

$Cd$  - wind drag coefficient.

$Ap$  is determined by using the calculation of maximum height x maximum length (see Figure 2-2).

For  $Cd$ , refer to Table 2-2. If the  $Cd$  cannot be calculated or estimated, use a value of 2.4.

The allowable wind resistant area of the load  $Awr_{(allow)}$  is equal to 0.0012 square meters per kilogram (0.0059 sq.ft per pound) of allowable load:

Metric, with  $m_{(load)}$  [kg] - Mass of the allowable load

$$Awr_{(allow)} = 0.0012 \times m_{(load)} \quad (2.4)$$

Non-metric, with  $m_{(load)}$  [lb] - Mass of the allowable load

$$Awr_{(allow)} = 0.0059 \times m_{(load)} \quad (2.5)$$

If  $Awr_{(load)}$  is greater than  $Awr_{(allow)}$ , then lifting this load at this wind speed  $V(z)$  is NOT permitted.



Calculation of Projected Wind Area ( $A_p$ ):

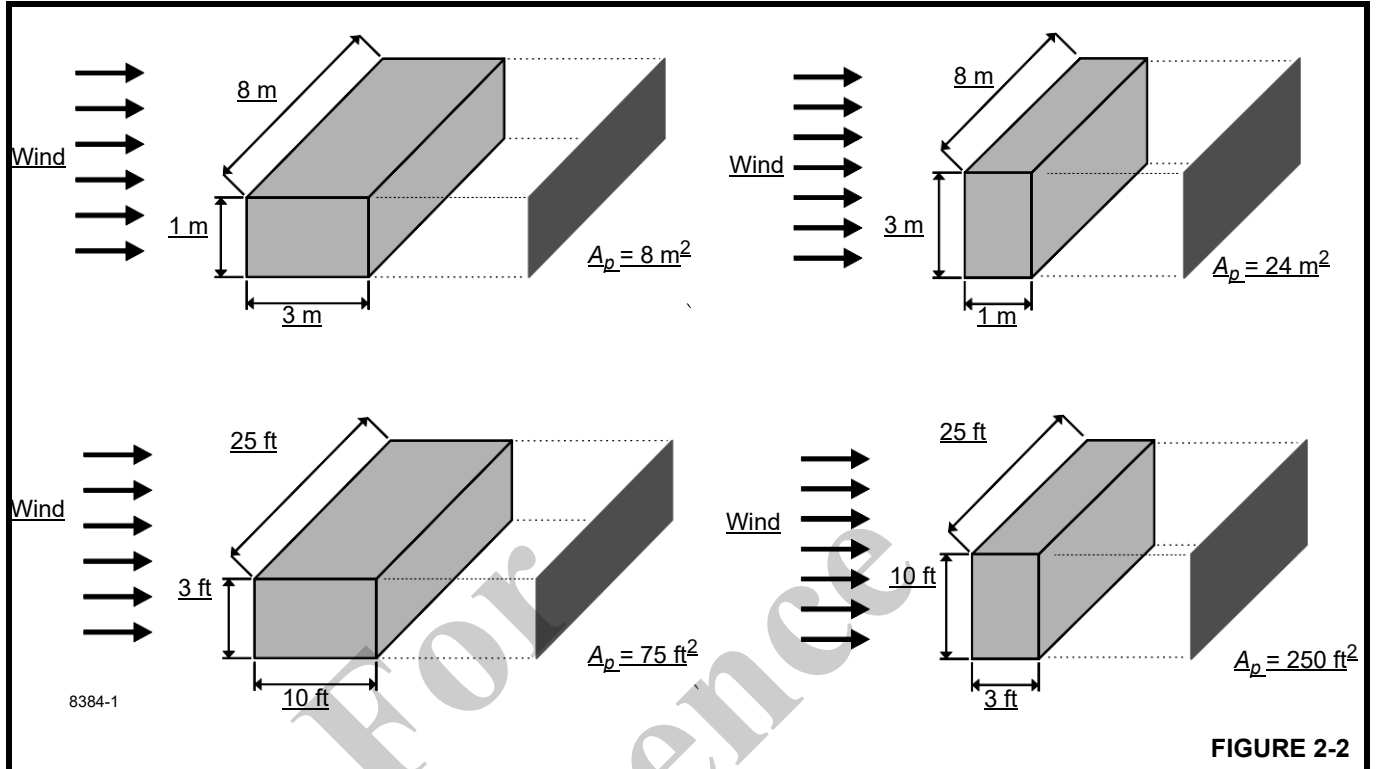


FIGURE 2-2

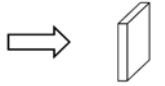
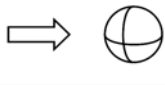
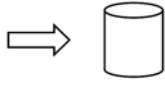
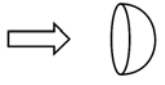



**Determining Wind Drag Coefficient ( $C_d$ )**

Table 2-2 shows the typical Shapes and corresponding Wind Drag Coefficient ( $C_d$ ) values.

If the exact Wind Drag Coefficient of a shape is not known, use the maximum value of the shape's range (Table 2-2).

If the wind drag coefficient of the load cannot be estimated or determined, it shall be assumed that ( $C_d$ ) = 2.4.

Table 2-2 Wind Drag Coefficient

| Shape                                                                             | $C_d$             |
|-----------------------------------------------------------------------------------|-------------------|
|  | 1.1 to 2.0        |
|  | 0.3 to 0.4        |
|  | 0.6 to 1.0        |
|  | 0.8 to 1.2        |
|  | 0.2 to 0.3        |
|  | 0.05 to 0.1       |
|  | Approximately 1.6 |

Turbine Blade or Complete Rotor

8384-2

**Maximum Permissible Wind Speed**

If the wind resistant area of the load  $A_{wr(loaded)}$  is greater than the allowable wind resistant area  $A_{wr(allow)}$ , the ratio can be used to determine a permissible wind speed  $V(z)$  for the load using Table 2-3.

Table 2-3  $A_{wr}$  Ratio and Permissible Wind Speed  $V(z)$  - Imperial units

|                                                                                                                                                   |                                      |      |      |      |      |
|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|------|------|------|------|
| Note: Permissible and rated wind speeds in this table are the 3-second gust wind speeds at boom tip height.                                       |                                      |      |      |      |      |
| Ratio:                                                                                                                                            | 1.2                                  | 1.4  | 1.6  | 1.8  | 2    |
|                                                                                                                                                   | Maximum Permissible Wind Speed (mph) |      |      |      |      |
| For Rated Capacity at 30 mph                                                                                                                      | 27.4                                 | 25.4 | 23.7 | 22.4 | 21.2 |
| For Allowable Capacity at 45 mph                                                                                                                  | 41.1                                 | 38.0 | 35.6 | 33.5 | 31.8 |
| <b>NOTE:</b> Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed. |                                      |      |      |      |      |

Rated Load Chart Example - Metric

RATED LIFTING CAPACITIES IN KILOGRAMS  
10.9 m - 33.5 m BOOM  
ON OUTRIGGERS FULLY EXTENDED - 360°

| Radius in Meters                                      | #001                       |                  |                  |                  |                  |                 |                  |                  |                  |                 |
|-------------------------------------------------------|----------------------------|------------------|------------------|------------------|------------------|-----------------|------------------|------------------|------------------|-----------------|
|                                                       | Main Boom Length in Meters |                  |                  |                  |                  |                 |                  |                  |                  |                 |
|                                                       | 10.9                       | 12.2             | 15.2             | **18.4           | 21.3             | 24.4            | 27.4             | 30.5             | 33.5             |                 |
| 3                                                     | +60,000<br>(69.5)          | 40,950<br>(72)   | 40,950<br>(76)   |                  |                  |                 |                  |                  |                  |                 |
| 3.5                                                   | 53,000<br>(66.5)           | 40,950<br>(69.5) | 40,950<br>(74)   | 28,350<br>(78)   |                  |                 |                  |                  |                  |                 |
| 4                                                     | 47,450<br>(63.5)           | 40,950<br>(66.5) | 40,950<br>(72)   | 28,350<br>(75.5) | *18,225<br>(78)  |                 |                  |                  |                  |                 |
| 4.5                                                   | 42,875<br>(60.5)           | 40,950<br>(64)   | 40,950<br>(70)   | 28,350<br>(73.5) | 18,225<br>(76)   |                 |                  |                  |                  |                 |
| 5                                                     | 39,050<br>(57.5)           | 39,025<br>(61.5) | 38,300<br>(67.5) | 28,350<br>(72)   | 18,225<br>(75)   | *18,225<br>(78) |                  |                  |                  |                 |
| 6                                                     | 32,950<br>(50.5)           | 32,925<br>(55.5) | 32,825<br>(63.5) | 28,350<br>(68.5) | 18,225<br>(72)   | 18,225<br>(75)  | *18,225<br>(78)  |                  |                  |                 |
| 7                                                     | 28,325<br>(42.5)           | 28,300<br>(49)   | 28,225<br>(59)   | 26,250<br>(65)   | 18,225<br>(69)   | 18,225<br>(72)  | 18,225<br>(74.5) | *16,725<br>(78)  | *11,400<br>(78)  |                 |
| 8                                                     | 24,150<br>(32.5)           | 24,150<br>(42)   | 23,975<br>(54.5) | 23,275<br>(60)   | 18,225<br>(69.5) | 18,225<br>(72)  | 16,575<br>(72)   | 15,250<br>(74.5) | 11,400<br>(76)   |                 |
| 9                                                     | 20,600<br>(16.5)           | 20,550<br>(33.5) | 20,375<br>(49.5) | 20,250<br>(55)   | 18,225<br>(63)   | 16,575<br>(67)  | 15,050<br>(70)   | 13,875<br>(72.5) | 11,400<br>(74.5) |                 |
| 10                                                    |                            | 17,200<br>(20.5) | 17,125<br>(41)   | 17,025<br>(54)   | 17,325<br>(60)   | 15,125<br>(63)  | 13,725<br>(67.5) | 12,700<br>(70.5) | 11,400<br>(72.5) |                 |
| 12                                                    |                            |                  | 14,025<br>(35)   | 12,575<br>(45.5) | 12,575<br>(53.5) | 12,125<br>(60)  | 11,600<br>(63)   | 10,725<br>(66.5) | 10,050<br>(69)   |                 |
| 14                                                    |                            |                  |                  | 9,000<br>(35)    | 9,360<br>(46)    | 9,730<br>(53.5) | 9,955<br>(58.5)  | 9,205<br>(62)    | 8,620<br>(65)    |                 |
| 16                                                    |                            |                  |                  | 6,750<br>(19)    | 7,110<br>(37.5)  | 7,470<br>(47)   | 7,920<br>(53)    | 7,980<br>(57.5)  | 7,470<br>(61.5)  |                 |
| 18                                                    |                            |                  |                  |                  | 5,960<br>(39.5)  | 6,340<br>(47)   | 6,340<br>(47.5)  | 6,525<br>(53)    | 6,530<br>(57.5)  |                 |
| 20                                                    |                            |                  |                  |                  |                  | 4,755<br>(30.5) | 5,145<br>(41)    | 5,320<br>(48)    | 5,495<br>(53)    |                 |
| 22                                                    |                            |                  |                  |                  |                  |                 | 3,790<br>(16.5)  | 4,210<br>(33.5)  | 4,380<br>(42.5)  | 4,545<br>(48.5) |
| 24                                                    |                            |                  |                  |                  |                  |                 |                  | 3,435<br>(23.5)  | 3,620<br>(36)    | 3,780<br>(43.5) |
| 26                                                    |                            |                  |                  |                  |                  |                 |                  |                  | 2,975<br>(28)    | 3,150<br>(37.5) |
| 28                                                    |                            |                  |                  |                  |                  |                 |                  |                  | 2,400<br>(16)    | 2,620<br>(31)   |
| 30                                                    |                            |                  |                  |                  |                  |                 |                  |                  |                  | 2,135<br>(22)   |
| Minimum boom angle (°) for indicated length (no load) |                            |                  |                  |                  |                  |                 |                  |                  |                  | 0               |
| Maximum boom length (m) at 0° boom angle (no load)    |                            |                  |                  |                  |                  |                 |                  |                  |                  | 33.5            |

NOTE: ( ) Boom angles are in degrees.  
#RCL operating code. Refer to RCL manual for operating instructions.  
\*This capacity is based on maximum boom angle.  
+ 9 parts line required to lift this capacity (using aux. boom nose) when using wire rope with a minimum breaking strength of 36,287 kg. Refer to Operator's & Safety Handbook for reeving diagram.  
NOTE: For allowable capacities while operating in 3-second wind gust speeds greater than 13.4 m/s and up to 20.1 m/s, refer to Capacity Reduction Factors for wind speed (3-second gust speed) V(z) greater than 13.4m/s.

| Lifting Capacities at Zero Degree Boom Angle |                            |                  |                 |                 |                 |                 |                 |                 |                 |
|----------------------------------------------|----------------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Boom Angle                                   | Main Boom Length in Meters |                  |                 |                 |                 |                 |                 |                 |                 |
|                                              | 10.9                       | 12.2             | 15.2            | **18.4          | 21.3            | 24.4            | 27.4            | 30.5            | 33.5            |
| 0°                                           | 13,775<br>(9.2)            | 11,675<br>(10.4) | 8,145<br>(13.5) | 5,930<br>(16.6) | 4,565<br>(19.6) | 3,535<br>(22.6) | 2,860<br>(25.7) | 2,220<br>(28.7) | 1,770<br>(31.8) |

NOTE: ( ) Reference radii in meters.  
\*\* Boom length is with inner-mid fully extended and outer-mid & fly fully retracted.

FIGURE 2-3

Table 2-4 Example-Capacity Reduction Factors for Wind Speed  $V(z)$  Greater than 13.4 m/s - Metric

(Only for lifting with main boom on fully extended outriggers, with or without stowed extension)

For wind speed  $V(z)$  (3-second gust speed at boom tip height)  $V(z) > 13.4 \text{ m/s} \leq 20.1 \text{ m/s}$ , the Reduced Capacity shall be calculated by multiplying the Published Rated Capacity by the following factors:

|                                                            | Main Boom Length in Meters |      |      |      |      |      |      |      |      |
|------------------------------------------------------------|----------------------------|------|------|------|------|------|------|------|------|
| Wind Speed $V(z) > 13.4 \text{ m/s} \leq 20.1 \text{ m/s}$ | 10.9                       | 12.2 | 15.2 | 18.4 | 21.4 | 24.4 | 27.4 | 30.5 | 33.5 |
| Factor                                                     | 0.9                        | 0.9  | 0.8  | 0.8  | 0.8  | 0.8  | 0.8  | 0.7  | 0.6  |

Wind resistance area of load,  $Awr_{(load)}$  shall not exceed maximum allowable wind resistance area  $Awr_{(allow)}$ .  
 Maximum allowable wind resistance area,  $[m^2] Awr_{(allow)} = 0.0012 \times \text{calculated reduced capacity in kg}$ .  
 Wind resistance area of load,  $Awr_{(load)}$  = projected wind area  $Ap$  x wind drag coefficient  $Cd$  for the load.  
 For wind resistance Area of load,  $Awr_{(load)} >$  maximum allowable wind resistance area,  $Awr_{(allow)}$  refer to crane Operator Manual.

**NOTE:** Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

Table 2-5  $Awr$  Ratio and Permissible Wind Speed  $V(z)$  - Metric

Note: Permissible and rated wind speeds in this table are the 3-second gust wind speeds at boom tip height.

| Ratio:                             | 1.2                                  | 1.4  | 1.6  | 1.8  | 2    |
|------------------------------------|--------------------------------------|------|------|------|------|
|                                    | Maximum Permissible Wind Speed (m/s) |      |      |      |      |
| For Rated Capacity at 13.4 m/s     | 12.2                                 | 11.4 | 10.6 | 10.0 | 9.5  |
| For Allowable Capacity at 20.1 m/s | 18.3                                 | 17.0 | 15.9 | 15.0 | 14.2 |

**NOTE:** Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

**Example and Sample Calculations (metric)**

The following example illustrates how to calculate allowable load while operating in wind speed (3-second wind gust speed) above 13.4 m/s (30 mph) and maximum permissible wind speeds with various combinations of lifted load and wind resistance area.

**NOTE:** Permissible and calculated wind speeds in this example are the **3-second wind gust speeds at boom tip height  $V(z)$** .

**NOTE:** Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

**Example 1: Crane Configuration:**

- boom length = 27.4 m,
- load radius = 9 m,
- wind speed is measured at  $V(z) \leq 20.1 \text{ m/s}$ .

From the ***Rated Load Chart Example - Metric*** (Figure 2-3), at maximum permissible wind speed,  $V(z) =$

13.4 m/s, the rated lifting capacity  $m_{(allow)}$  for this configuration is 15,050 kg.

The maximum allowable wind resistance area of load is:

$$Awr_{(allow)} = 0.0012 \times m_{(load)} \tag{2.4}$$

$$Awr_{(allow)} = 0.0012 \times 15,050 = 18.06 \text{ m}^2$$

***Lifting Limits at wind speed  $V(z) \leq 13.4 \text{ m/s}$***  at this configuration:

- Maximum load 15,050 kg
- Maximum wind resistance area of load 18.06 m<sup>2</sup>

For the allowable wind speed  $> 13.4 \text{ m/s}$  and  $\leq 20.1 \text{ m/s}$ , reduce the allowable load. Per Table 2-4, the Factor for main boom length of 27.4 m is 0.8, the allowable load is:

$$m_{(allow)} = 0.8 \times 15,050 = 12,040 \text{ kg}$$

This reduced capacity load has an allowable wind resistance area of:

$$Awr_{(allow)} = 0.0012 \times 12,040 = 14.45 \text{ m}^2$$

**Lifting Limits at wind speed  $V(z) > 13.4 \text{ m/s}$  and  $\leq 20.1 \text{ m/s}$ , at this configuration:**

- Maximum load 12,040 kg
- Maximum wind resistance area of load 14.45 m<sup>2</sup>

At wind speeds greater than 13.4 m/s, it is not permissible to lift a load greater than 12,040 kg, even if the wind resistance area of the load is less than 14.45 m<sup>2</sup>.

Refer to the information from the above crane configuration, examine several load conditions.

**Load example 1.1:**

With known Wind Drag Coefficient of the load **Cd**, and

- load to be lifted of 11,200 kg,
- Projected Wind Area **Ap** = 9.20 m<sup>2</sup>,
- Wind Drag Coefficient **Cd** = 1.5

wind resistance area of load can be estimated as

$$Awr_{(load)} = Ap \times Cd = 9.2 \times 1.5 = 13.8 \text{ m}^2$$

Refer to the above **Lifting Limits at wind speed  $V(z) > 13.4 \text{ m/s}$  and  $\leq 20.1 \text{ m/s}$** . Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?  
11,200 kg  $\leq$  12,040 kg YES
- Is **Awr<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>** ?  
13.8 m<sup>2</sup>  $\leq$  14.45 m<sup>2</sup> YES

**Conclusion:** This load is permissible to lift in wind speed up to 20.1 m/s.

**Load example 1.2:**

With unknown Wind Drag Coefficient of the load **Cd**,

- Load to be lifted of 10,000 kg,
- Projected Wind Area **Ap** = 5.45 m<sup>2</sup>,
- Wind Drag Coefficient **Cd** = unknown

**NOTE:** If exact Wind Drag Coefficient is not known, it shall be assumed as 2.4.

the wind resistance area of load can be estimated as

$$Awr_{(load)} = Ap \times Cd = 5.45 \times 2.4 = 13.08 \text{ m}^2$$

Refer to the above **Lifting Limits at  $V(z) > 13.4 \text{ m/s}$  and  $\leq 20.1 \text{ m/s}$** . Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?  
10,000 kg  $\leq$  12,040 kg YES
- Is **Awr<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>** ?  
13.08 m<sup>2</sup>  $\leq$  14.45 m<sup>2</sup> YES

**Conclusion:** This load is permissible to lift in wind speed up to 20.1 m/s.

**Load example 1.3a:**

With large wind resistance area of the load **Awr<sub>(load)</sub>**,

- Load to be lifted of 14,000 kg,
- Projected Wind Area **Ap** = 21.85 m<sup>2</sup>,
- Wind Drag Coefficient **Cd** = 1.2

the wind resistance area of load can be estimated as:

$$Awr_{(load)} = Ap \times Cd = 21.85 \times 1.2 = 26.22 \text{ m}^2$$

Refer to the above **Lifting Limits at wind speed  $V(z) > 13.4 \text{ m/s}$  and  $\leq 20.1 \text{ m/s}$** . Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?  
14,000 kg  $\leq$  12,040 kg NO

**Conclusion:** This load is NOT permissible to lift in wind speed up to 20.1 m/s.

Refer to the above **Lifting Limits at wind speed  $V(z) < 13.4 \text{ m/s}$** . Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?  
14,000 kg  $\leq$  15,050 kg YES

The maximum permissible wind speed for this load is 13.4 m/s, depending on the wind resistance area of the load.

- Is **Awr<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>** ?  
26.22 m<sup>2</sup>  $\leq$  18.06 m<sup>2</sup> NO

**Conclusion:** This load is NOT permissible to lift in wind speed at 13.4 m/s, but is permitted to lift at a reduced wind speed calculated as follows:

Ratio  $\frac{Awr_{(load)}}{Awr_{(allow)}} = \frac{26.22}{18.06} = 1.45$

From Table 2-5, the maximum permissible wind speed at ratio of 1.45 (rounded to next higher table value of 1.6) is 10.6 m/s.

**Conclusion:** This load is permissible to lift in wind speed up to 10.6 m/s only.

**Load example 1.3b:**

With large wind resistance area of the load **Awr<sub>(load)</sub>**,

- Load to be lifted of 8,000 kg,
- Projected Wind Area **Ap** = 15.25 m<sup>2</sup>,



- Wind Drag Coefficient  $Cd = 1.3$

the wind resistance area of load can be estimated as

$$Awr_{(load)} = Ap \times Cd = 15.25 \times 1.3 = 19.83 \text{ m}^2$$

Refer to the above **Lifting Limits at wind speed  $V(z)$  > 13.4 m/s and  $\leq 20.1$  m/s**. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?  
8,000 kg  $\leq$  12,040 kg YES
- Is  $Awr_{(load)}$  less than  $Awr_{(allow)}$ ?  
19.83 m<sup>2</sup>  $\leq$  14.45 m<sup>2</sup> NO

**Conclusion:** This load is NOT permissible to lift in wind speed up to 20.1 m/s, but permitted to lift at a reduced wind speed calculated as follows:

$$\text{Ratio} \frac{Awr_{(load)}}{Awr_{(allow)}} = \frac{19.83}{14.45} = 1.37$$

From Table 2-5, the maximum permissible wind speed at ratio of 1.37 (rounded to next higher table value of 1.4) is 17.0 m/s.

**Conclusion:** This load is permissible to lift in wind speed up to 17.0 m/s only.

For  
Reference  
Only



Rated Load Chart Example - Non-metric

RATED LIFTING CAPACITIES IN POUNDS  
36 FT. - 110 FT. BOOM  
ON OUTRIGGERS FULLY EXTENDED - 360°

| Radius in Feet                                        | #0001                    |                  |                  |                  |                  |                  |                  |                  |                  |
|-------------------------------------------------------|--------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                                                       | Main Boom Length in Feet |                  |                  |                  |                  |                  |                  |                  |                  |
|                                                       | 36                       | 40               | 50               | **60             | 70               | 80               | 90               | 100              | 110              |
| 10                                                    | 130,000<br>(69.5)        | 90,300<br>(71.5) | 90,300<br>(75.5) | *62,500<br>(78)  |                  |                  |                  |                  |                  |
| 12                                                    | 112,500<br>(65.5)        | 90,300<br>(68.5) | 90,300<br>(73)   | 62,500<br>(76.5) | *40,200<br>(78)  |                  |                  |                  |                  |
| 15                                                    | 93,250<br>(60)           | 90,300<br>(63.5) | 90,250<br>(69.5) | 62,500<br>(73.5) | 40,200<br>(76)   | *40,200<br>(78)  |                  |                  |                  |
| 20                                                    | 71,550<br>(49.5)         | 71,500<br>(55)   | 71,300<br>(63)   | 62,500<br>(68)   | 40,200<br>(71.5) | 40,200<br>(74.5) | 40,200<br>(78)   | *36,900<br>(78)  |                  |
| 25                                                    | 56,650<br>(36.5)         | 56,600<br>(45)   | 56,350<br>(56)   | 53,650<br>(63)   | 40,200<br>(67)   | 40,200<br>(70.5) | 37,950<br>(73)   | 34,900<br>(75)   | *25,150<br>(78)  |
| 30                                                    | 43,500<br>(11.5)         | 44,300<br>(32)   | 43,950<br>(48.5) | 43,650<br>(57.5) | 40,200<br>(62.5) | 37,050<br>(66)   | 32,750<br>(69.5) | 30,200<br>(72)   | 25,150<br>(74)   |
| 35                                                    |                          |                  | 33,550<br>(40)   | 33,700<br>(51.5) | 34,700<br>(58)   | 33,550<br>(62)   | 33,550<br>(66)   | 26,400<br>(69)   | 24,700<br>(71.5) |
| 40                                                    |                          |                  | 25,800<br>(28)   | 26,150<br>(44.5) | 26,300<br>(52.5) | 27,300<br>(53.5) | 25,200<br>(62.5) | 23,300<br>(66)   | 21,800<br>(68.5) |
| 45                                                    |                          |                  |                  | 20,000<br>(36.5) | 20,450<br>(47)   | 22,300<br>(54)   | 22,400<br>(59)   | 20,700<br>(62.5) | 19,400<br>(65.5) |
| 50                                                    |                          |                  |                  | 15,500<br>(25)   | 17,400<br>(41)   | 18,200<br>(49.5) | 19,100<br>(55)   | 18,550<br>(59.5) | 17,350<br>(62.5) |
| 55                                                    |                          |                  |                  |                  | 14,300<br>(33.5) | 14,300<br>(44)   | 16,000<br>(51)   | 16,400<br>(56)   | 15,600<br>(60)   |
| 60                                                    |                          |                  |                  |                  | 11,000<br>(23.5) | 12,700<br>(38)   | 13,550<br>(46.5) | 13,950<br>(52.5) | 14,100<br>(56.5) |
| 65                                                    |                          |                  |                  |                  |                  | 10,000<br>(31.5) | 11,550<br>(41.5) | 11,950<br>(48.5) | 12,300<br>(53.5) |
| 70                                                    |                          |                  |                  |                  |                  | 9,010<br>(22.5)  | 9,920<br>(36)    | 10,250<br>(44)   | 10,650<br>(50)   |
| 75                                                    |                          |                  |                  |                  |                  |                  | 8,510<br>(29.5)  | 8,890<br>(39.5)  | 9,250<br>(46)    |
| 80                                                    |                          |                  |                  |                  |                  |                  | 7,260<br>(21)    | 7,690<br>(34.5)  | 8,050<br>(42.5)  |
| 85                                                    |                          |                  |                  |                  |                  |                  |                  | 6,620<br>(28.5)  | 7,010<br>(38)    |
| 90                                                    |                          |                  |                  |                  |                  |                  |                  | 5,630<br>(20)    | 6,100<br>(33)    |
| 95                                                    |                          |                  |                  |                  |                  |                  |                  |                  | 5,240<br>(27)    |
| 100                                                   |                          |                  |                  |                  |                  |                  |                  |                  | 4,480<br>(19.5)  |
| Minimum boom angle (°) for indicated length (no load) |                          |                  |                  |                  |                  |                  |                  |                  | 0                |
| Maximum boom length (ft.) at 0° boom angle (no load)  |                          |                  |                  |                  |                  |                  |                  |                  | 110              |

NOTE: ( ) Boom angles are in degrees.  
#RCL operating code. Refer to RCL manual for operating instructions.  
\*This capacity is based on maximum boom angle.  
NOTE: For allowable capacities while operating in 3-second wind gust speeds greater than 30 mph and up to 45 mph, refer to Capacity Reduction Factors for wind speed (3-second gust speed) V(z) greater than 30 mph.

| Lifting Capacities at Zero Degree Boom Angle |                          |                  |                  |                  |                  |                 |                 |                 |                  |
|----------------------------------------------|--------------------------|------------------|------------------|------------------|------------------|-----------------|-----------------|-----------------|------------------|
| Boom Angle                                   | Main Boom Length in Feet |                  |                  |                  |                  |                 |                 |                 |                  |
|                                              | 36                       | 40               | 50               | **60             | 70               | 80              | 90              | 100             | 110              |
| 0°                                           | 30,350<br>(30.1)         | 25,700<br>(34.2) | 17,950<br>(44.2) | 13,050<br>(54.6) | 10,050<br>(64.2) | 7,790<br>(74.2) | 6,300<br>(84.2) | 4,900<br>(94.2) | 3,900<br>(104.2) |

8382-1

NOTE: ( ) Reference radii in feet.  
\*\* Boom length is with inner-mid fully extended and outer-mid & fly fully retracted.

FIGURE 2-4

Table 2-6 Example-Capacity Reduction Factors for Wind Speed  $V(z)$  Greater than 30 mph - Non-metric

(Only for lifting with main boom on fully extended outriggers, with or without stowed extension)

For wind speed  $Vz$  (3-second gust speed at boom tip height) is greater > 30 > mph ≤ 45 mph, the Reduced Capacity shall be calculated by multiplying the Published Rated Capacity by the following factors:

| Wind Speed<br>$Vz > 30$<br>mph<br>≤ 45 mph | Main Boom Length in Feet |     |     |     |     |     |     |     |     |
|--------------------------------------------|--------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
|                                            | 36                       | 40  | 50  | 60  | 70  | 80  | 90  | 100 | 110 |
| Factor                                     | 0.9                      | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.7 | 0.5 |

Wind resistance area of load,  $Awr_{(load)}$ , shall not exceed maximum allowable wind resistance area  $Awr_{(allow)}$ .

Maximum allowable wind resistance area in [ft<sup>2</sup>],  $Awr_{(allow)} = 0.0059 \times$  calculated reduced capacity in lb.

Wind resistance area of load,  $Awr_{(load)} =$  projected wind area  $Ap \times$  wind drag coefficient  $Cd$  for the load.

For wind resistance area of load,  $Awr_{(load)} >$  maximum allowable wind resistance,  $Awr_{(allow)}$ , refer to crane Operator Manual.

**NOTE:** Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

Table 2-7  $Awr$  Ratio and Permissible Wind Speed  $V(z)$  - Non-Metric

Note: Permissible and rated wind speeds in this table are the 3-second gust wind speeds at boom tip height.

| Ratio:                         | 1.2                                  | 1.4  | 1.6  | 1.8  | 2    |
|--------------------------------|--------------------------------------|------|------|------|------|
|                                | Maximum Permissible Wind Speed (mph) |      |      |      |      |
| For Rated Capacity@ 30 mph     | 27.4                                 | 25.4 | 23.7 | 22.4 | 21.2 |
| For Allowable Capacity@ 45 mph | 41.1                                 | 38.0 | 35.6 | 33.5 | 31.8 |

**NOTE:** Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

**Example and Sample Calculations** (Non-metric)

The following example illustrates how to calculate allowable load while operating in wind speed (3-second wind gust speed) above 13.4 m/s (30 mph) and maximum permissible wind speeds with various combinations of lifted load and wind resistance area.

**NOTE:** Permissible and calculated wind speeds in this example are the **3-second wind gust speeds at boom tip height  $V(z)$** .

**NOTE:** Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

**Example 2:**

A crane is configured with:

- boom length = 90 ft,
- load radius = 40 ft, and
- wind speed is measured at  $V(z) \leq 45$  mph.

The **Rated Load Chart Example - Non-metric** (Figure 2-4), at maximum permissible wind speed,  $V(z) = 30$  mph, the rated lifting capacity  $m_{(allow)}$  for this configuration is 25,200 lb.



The maximum allowable wind resistance area of load is:

$$Awr_{(allow)} = 0.0059 \times m_{(load)} \quad (2.5)$$

$$Awr_{(allow)} = 0.0059 \times 25,200 = 149 \text{ ft}^2$$

**Lifting Limits at wind speed  $V(z) < 30 \text{ mph}$**  at this configuration:

- Maximum load 25,200 lb
- Maximum wind resistance area of load 149 ft<sup>2</sup>

For the allowable wind speed  $> 30 \text{ mph}$  and  $\leq 45 \text{ mph}$ , reduce the allowable load. , the Factor for a main boom length of 90 ft is 0.8, thus the allowable load is:

$$m_{(allow)} = 0.8 \times 25,200 = 20,160 \text{ lb}$$

This reduced capacity load has an allowable wind resistance area of:

$$Awr_{(allow)} = 0.0059 \times 20,160 = 119 \text{ ft}^2$$

**Lifting Limits at wind speed  $V(z) > 30 \text{ mph}$  and  $\leq 45 \text{ mph}$**  at this configuration:

- Maximum load 20,160 lb
- Maximum wind resistance area of load 119 ft<sup>2</sup>

Example, wind speeds greater than 13.4 m/s is NOT permissible to lift a load greater than 20,160 lb, even if the wind resistance area of the load is less than 119 ft<sup>2</sup>.

Refer to the above crane configuration for the following load conditions:

**Load example 2.1:**

With known Wind Drag Coefficient of the load **Cd**,

- load to be lifted of 19,500 lb,
- Projected Wind Area **Ap** = 70 ft<sup>2</sup>,
- Wind Drag Coefficient **Cd** = 1.5

then the wind resistance area of load can be estimated as

$$Awr_{(load)} = Ap \times Cd = 70 \times 1.5 = 105 \text{ ft}^2$$

Refer to the above **Lifting Limits at wind speed  $V(z) > 30 \text{ mph}$  and  $\leq 45 \text{ mph}$** . Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?  
19,500 lb  $\leq$  20,160 lb YES
- Is **Awr<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
105 ft<sup>2</sup>  $\leq$  119 ft<sup>2</sup> YES

**Conclusion:** This load is permissible to lift in wind speed up to 45 mph.

**Load example 2.2:**

With unknown Wind Drag Coefficient of the load **Cd**,

- Load to be lifted of 18,000 lb,
- Projected Wind Area **Ap** = 45 ft<sup>2</sup>,
- Wind Drag Coefficient **Cd** = unknown

**NOTE:** If exact Wind Drag Coefficient is not known, it shall be assumed as 2.4.

the wind resistance area of load can be estimated as

$$Awr_{(load)} = Ap \times Cd = 45 \times 2.4 = 108 \text{ ft}^2$$

Refer to the above **Lifting Limits at wind speed  $V(z) > 30 \text{ mph}$  and  $\leq 45 \text{ mph}$** . Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?  
18,000 lb  $\leq$  20,160 lb YES
- Is **Awr<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
108 ft<sup>2</sup>  $\leq$  119 ft<sup>2</sup> YES

**Conclusion:** This load is permissible to lift in wind speed up to 45 mph.

**Load example 2.3a:**

With large wind resistance area of the load **Awr<sub>(load)</sub>**,

- Load to be lifted of 22,000 lb,
- Projected Wind Area **Ap** = 180 ft<sup>2</sup>,
- Wind Drag Coefficient **Cd** = 1.2

the wind resistance area of load can be estimated as:

$$Awr_{(load)} = Ap \times Cd = 180 \times 1.2 = 216 \text{ ft}^2$$

Refer to the above **Lifting Limits at wind speed  $V(z) > 30 \text{ mph}$  and  $\leq 45 \text{ mph}$** . Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?  
22,000 lb  $\leq$  20,160 lb NO

**Conclusion:** This load is NOT permissible to lift in wind speed up to 45 mph.

Refer to the above **Lifting Limits at wind speed  $V(z)$  up to 30 mph**. Comparing the load to the allowable:

Is the load to be lifted less than allowable load?  
22,000 lb  $\leq$  25,200 lb ..... YES

The permissible wind speed for this load is 30 mph, depending on the wind resistance area of the load.

- Is **Awr<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
216 ft<sup>2</sup>  $\leq$  149 ft<sup>2</sup> ..... NO

**Conclusion:** This load is NOT permissible to lift in wind speed at 30 mph, but permitted to lift at a reduced wind speed calculated as follows:

$$\text{Ratio } \frac{Awr_{(load)}}{Awr_{(allow)}} = \frac{216}{149} = 1.45$$



From Table 2-7, the maximum permissible wind speed at ratio of 1.45 (rounded to next higher table value of 1.6) is 23.7 mph.

**Conclusion:** This load is permissible to lift in wind speed up to 23.7 mph only.

### Load example 2.3b:

With large wind resistance area of the load  $Awr_{(load)}$ ,

- Load to be lifted of 12,000 lb,
- Projected Wind Area  $Ap = 125 \text{ ft}^2$ ,
- Wind Drag Coefficient  $Cd = 1.3$

the wind resistance area of load can be estimated as:

$$Awr_{(load)} = Ap \times Cd = 125 \times 1.3 = 162 \text{ ft}^2$$

Refer to the above **Lifting Limits at wind speed  $V(z) > 30 \text{ mph}$  and  $\leq 45 \text{ mph}$** . Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?  
12,000 lb  $\leq$  20,160 lb YES
- Is  $Awr_{(load)}$  less than  $Awr_{(allow)}$ ?  
162  $\text{ft}^2 \leq$  119  $\text{ft}^2$  NO

**Conclusion:** This load is NOT permissible to lift in wind speed up to 45 mph, but permitted to lift at a reduced wind speed calculated as follows:

$$\text{Ratio} \frac{Awr_{(load)}}{Awr_{(allow)}} = \frac{162}{119} = 1.37$$

From Table 2-7, the maximum permissible wind speed at ratio of 1.37 (rounded to next higher table value of 1.4) is 38.0 mph.

**Conclusion:** This load is permissible to lift in wind speed up to 38.0 mph only.

## Lifting Operations

Before lifting, position the crane on a firm surface, properly extend and set the outriggers, and level the crane. Depending on the nature of the supporting surface, adequate cribbing may be required to obtain a larger bearing surface.

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

If the boom extension, or auxiliary boom nose is to be used, make sure that the electrical cable and the weight for the Anti-Two-Block Switch are properly installed and the Rated Capacity Limiter (RCL) is programmed for the crane configuration. Refer to the RCL operator manual supplied with the crane.

Verify the crane's capacity by checking the *Load Chart* against the weight of the load. Then, lift the load slightly at first to ensure stability before proceeding with the lift.

Make sure that the load is properly rigged and attached. Always determine the weight of the load before you attempt to lift it and remember that all rigging (slings, etc.) and lifting devices (hook block, boom extension, etc.) must be considered part of the load.

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

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

**Do not overload the crane** by exceeding the capacities shown on the appropriate *Load Chart*. Death or serious injury could result from the crane tipping over or failing structurally from overload.

The crane can tip over or fail structurally if:

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

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

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

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

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

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

When lifting loads, the crane will lean toward the boom and the load will swing out, increasing the load radius. Make sure that the crane's capacity is not exceeded when this occurs.

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

Never push or pull with the crane boom.

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

Using only one hoist at a time when lifting loads is recommended. See "Tilt-Up Panel Lifting" on page 2-20 for additional lifting instructions.

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

## Multiple Crane Lifts

Multiple crane lifts are not recommended.

Any lift that requires more than one crane must be precisely planned and coordinated by a qualified person. If it is necessary to perform a multi-crane lift, the operator shall be responsible for assuring that the following minimum safety precautions are taken:

- Secure the services of a qualified person to direct the operation.
- Make sure that all signals are coordinated through the lift director or person in charge of the lift.
- Coordinate lifting plans with the operators, designated person, and signal person prior to beginning the lift.
- Maintain communication between all parties throughout the entire operation. If possible, provide approved radio equipment for voice communication between all parties engaged in the lift.
- Use outriggers on cranes so equipped.
- Calculate the amount of weight to be lifted by each crane and attach slings at the correct points for proper weight distribution.
- Make sure that the load lines are directly over the attach points to avoid side loading and transfer of loading from one crane to the other.
- Do not travel. Lift only from a stationary position.

## Lifting Multiple Loads

Grove recommends lifting only one load at a time.

Lifting two or more separately rigged loads at one time is only permitted during steel erection in accordance with 29CFR1926.753 when the following criteria are met:

1926.753(e)(1) A multiple lift shall only be performed if the following criteria are met:

- 1926.753(e)(1)(i) A multiple lift rigging assembly is used;
- 1926.753(e)(1)(ii) A maximum of five members are hoisted per lift;
- 1926.753(e)(1)(iii) Only beams and similar structural members are lifted; and
- 1926.753(e)(1)(iv) All employees engaged in the multiple lift have been trained in these procedures in accordance with § 1926.761(c)(1).
- 1926.753(e)(1)(v) No crane is permitted to be used for a multiple lift where such use is contrary to the manufacturer's specifications and limitations.

1926.753(e)(2) Components of the multiple lift rigging assembly shall be specifically designed and assembled with a maximum capacity for total assembly and for each individual attachment point. This capacity, certified by the manufacturer or a qualified rigger, shall be based on the manufacturer's specifications with a 5 to 1 safety factor for all components.

1926.753(e)(3) The total load shall not exceed:

- 1926.753(e)(3)(i) The rated capacity of the hoisting equipment specified in the hoisting equipment load charts;
- 1926.753(e)(3)(ii) The rigging capacity specified in the rigging rating chart.

1926.753(e)(4) The multiple lift rigging assembly shall be rigged with members:

- 1926.753(e)(4)(i) Attached at their center of gravity and maintained reasonably level;
- 1926.753(e)(4)(ii) Rigged from top down; and
- 1926.753(e)(4)(iii) Rigged at least 7 feet (2.1 m) apart.

1926.753(e)(5) The members on the multiple lift rigging assembly shall be set from the bottom up.

1926.753(e)(6) Controlled load lowering shall be used whenever the load is over the connectors.

## Tilt-Up Panel Lifting

Requirements and recommendations regarding operation and use of Grove cranes are stated on decals and in the Operator Manual provided with each specific model machine. Using the subject crane to perform tilt-up panel lifting with two hoist lines poses new and different hazards than does normal lifting use.

Therefore, the following additional precautions must be taken if it is necessary for the crane to be used to perform tilt-up panel lifting using a crane equipped with two hoists:

- The crane must be set up and operated in accordance with Grove's instructions in the Operator Manual, Load Capacity Chart, and decals affixed to the crane.
- The hoist rope from the main hoist shall be reeved over the main boom nose reeved for two parts of line.
- The hoist rope from the auxiliary hoist shall be reeved over the auxiliary boom nose reeved for one part of line or up to two parts of line depending on the applicable load chart ratings.
- The load shall be connected with the main hoist line connected to the end closest to crane and the auxiliary hoist line connected to the end farthest from the crane.
- The anti-two-block system shall be installed and inspected to confirm that it is active to monitor both hoist lines.
- The RCL hoist selection shall be set to main hoist and two parts of line.
- The wire rope and sheaves shall be inspected prior to and following the lifting operations for chaffing or scrubbing.
- The total gross load shall not exceed 80% of the standard load chart. The operator shall be responsible to control this as the RCL does not have a feature to set reduced lifting limits.
- The auxiliary hoist line shall be considered part of the deducts to determine net allowable load.
- The panel shall be lifted so that the hoist lines are in line with the crane.
- The load shall be controlled to prevent rotation of the load and to make sure that the load stays in line with the boom.
- The load must be balanced with the auxiliary: load line not taking more than half the load at any time during the lift. The RCL will not be providing coverage for the line pull of the auxiliary hoist line.
- The effect of wind loads on the crane and panel shall be taken into consideration. Operations shall be halted if the wind can cause a loss of control in handling the load.
- The main hoist line shall be used to raise the panel into the vertical position.

Make sure that all personnel working on and around the crane are properly trained and thoroughly familiar with operational functions of the crane and safe operating and work practices. Personnel should be thoroughly familiar with regulations and standards governing cranes and their operation. Work practices may vary slightly between

government regulations, industry standards, local and job-site rules and employer policies so a thorough knowledge of and compliance with all relevant work rules is necessary.

## Counterweight

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

Do not add material to the counterweight to increase capacity. United States Federal law prohibits modification or additions which affect the capacity or safe operation of the equipment without the manufacturer's written approval. [29CFR 1926.1434]

## Outrigger Lift Off

Regarding "lifting" of an outrigger pad during craning activities, be advised that the rated loads for these cranes, as indicated on the crane's *Load Chart*, do not exceed 85% of the tipping load on outriggers as determined by SAE J765 "Cranes Stability Test Code." An outrigger pad may lift off the ground during operation of the crane within the capacity limits of the *Load Chart*, yet the crane will not have reached instability. The "balance point" for stability testing according to SAE and Grove criteria is a condition of loading wherein the load moment acting to overturn the crane is equal to the maximum moment of the crane available to resist overturning. This balance point or point of instability for a crane does not depend on "lifting" of an outrigger but rather on comparison of the "opposing" load moments.

The occurrence of an outrigger lifting from the ground is often attributed to the natural flex in the crane's frame. This may happen when lifting a load in certain configurations within the capacity limits of the *Load Chart* and is not necessarily an indication of an unstable condition.

Provided the crane is properly set up, the crane is in good working condition, that all operator's aids are properly programmed, that the qualified crane operator adheres to the instructions found in the applicable *Load Chart*, *Operator Manual* and decals on the crane, the crane should not be unstable.

## PILE DRIVING AND EXTRACTING

Pile driving and extracting are applications approved by Grove, provided all equipment is operated within factory guidelines. The following operating requirements must be used during pile driving and extracting with a Grove mobile hydraulic crane:

Pile driving and pile extraction using a mobile crane introduces many variable and unknown factors that must be considered when using a crane for this application. Because of these factors, discretion must be exercised when pile driving or pile extraction is being considered.

It is not the intention of Grove to recommend specific types or makes of pile driving and pile extraction equipment, but rather to advise of the operational requirements to help avoid the detrimental effects that pile driving and pile extraction can have on the crane.

In addition to the operating requirements that are detailed in the operating manuals and on the load capacity chart, pile driving and extracting operations are approved by Grove, provided all guidelines outlined below are followed:

- All pile driving and extracting operations shall be restricted to fully extended outriggers with all tires clear of the ground.
- The combined weight of the driver or extractor, piling, leads, attachments, etc., shall not exceed 80% of the published load chart values for on-outriggers operation.
- The pile driver or pile extractor and attachments shall be kept clear of the boom nose at all times.
- The pile driver and piling shall be suspended from a hoist cable with sufficient line speed to meet or exceed the rate of descent of the driver and piling to preclude impact loading or vibration from being induced into the boom and crane structure.
- Pile driving or extracting shall be restricted to over the main boom only and shall not be permitted over a boom extension.
- Pile extraction using only the crane's hoist line is unsafe and not permitted since load values cannot be accurately determined. Only pile extraction devices that do not transmit vibration or shock loading into the crane are permitted. All possible precautionary measures shall be taken to prevent shock loads or vibration from being imposed on crane components, either directly through the hoist cable or indirectly from ground borne vibration.
- The load lines shall be kept vertical at all times during pile driving and pile extraction operations.
- The operator and other personnel associated with the pile driving and pile extraction operation shall have read and understood all safety standards applicable to crane operations as well as being thoroughly trained in the safe operation of pile driving and extracting equipment.

## Crane Equipment

- Hoists shall be equipped with a cable follower to aid in proper spooling of cable.
- All cable retainer pins and cable guides/retainers shall be in place.
- All boom extensions must be removed from the machine before pile driving or extraction begins.

- All hoist hooks shall be equipped with a positive locking latch.

## Crane Inspection

- In addition to the crane's frequent and periodic inspections, dated daily records shall be maintained showing inspections were performed on the crane during the time it was used for pile driving or extraction.
- All anti-two-block warning devices and RCL systems shall be inspected daily and verified to be functional.
- All areas of the crane subject to fatigue shall be inspected monthly, and before the crane is to return to lifting service.
- The boom shall be inspected daily to make sure that all wear pads remain in place. Cranes which utilize pinned boom sections shall be inspected daily to make sure that the pinning mechanism operates properly and to check for undue wear at the pins and pinning plates.
- The hoist cable shall be inspected daily to make sure that no chafing or wear is occurring.

## ELECTROCUTION HAZARD

Thoroughly read, understand, and abide by all applicable federal, state, and local regulations regarding operation of cranes near electric power lines or equipment.

**United States federal law prohibits the use of cranes closer than 6 m (20 ft) to power sources up to 350 kV and greater distances for higher voltages unless the line's voltage is known [29CFR1910.180 and 29CFR1926, subpart CC].**

**To avoid death or serious injury, Grove recommends that all parts of crane, boom, and load be kept at least 6 m (20 ft) away from all electrical power lines and equipment less than 350 kV.**



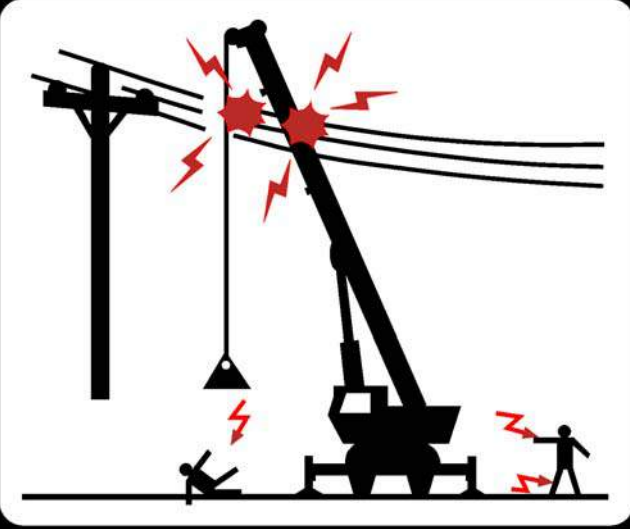
**DANGER**

### Electrocution Hazard!

Grove cranes are not equipped with all features required to operate within OSHA 29CFR1926.1408, Power Line Safety, Table A clearances when the power lines are energized.

If operation within 3 m (10 ft) of any power lines cannot be avoided, the power utility **must** be notified and the power lines **must** be de-energized and grounded **before** performing any work.

Electrocution **can occur** even without direct contact with the crane.



# ! DANGER

## ELECTROCUTION HAZARD TO AVOID DEATH OR SERIOUS INJURY

Keep **ALL** parts of the crane, rigging and load at least 20 feet (6 meters) away from any energized power line. You **MUST** follow the OSHA requirements set forth in 29CFR 1926.1407 through 1926.1411.

This crane is not designed or equipped for use within 10 feet (3 meters) of energized power lines [Refer to 29CFR1926.1410 Table A]. If operation within 10 feet (3 meters) of any power lines cannot be avoided, the power utility **MUST** be notified and the power lines **MUST** be de-energized and grounded **BEFORE** performing any work.

If contact is ever accidentally made with a power line and any part of this crane, its rigging or load, **NEVER** touch the crane or even approach or come near the crane.

Electrocution **CAN OCCUR** even without direct contact with the crane.

THIS CRANE IS NOT INSULATED.

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

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

This crane is **not insulated**. Always consider all parts of the load and the crane, including the hoist rope, wire rope, pendant cables, and tag lines, as conductors. You, the operator, are responsible for alerting all personnel of dangers associated with electrical power lines and equipment. Do not allow unnecessary personnel in the vicinity of the crane while operating. Permit no one to lean against or touch the crane. Permit no one, including riggers and load handlers, to hold the load, load lines, tag lines, or rigging gear.

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

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

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

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

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

### Set-Up and Operation

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

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

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

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



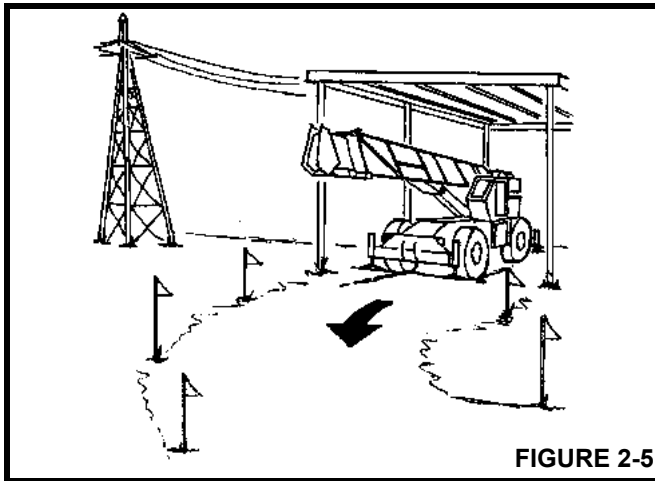


FIGURE 2-5

United States OSHA regulations require a flagman when operating in close proximity to energized power lines.

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

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

**Do not** store materials under power lines or close to electrical power sources.

### Electrocution Hazard Devices

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

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

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

Boom cages and boom guards afford limited protection from electrocution hazards. They are designed to cover only the

boom nose and a small portion of the boom. Performance of boom cages and boom guards is limited by their physical size, insulating characteristics, and operating environment (e.g. dust, dirt, moisture, etc.). The insulating characteristics of these devices can be compromised if not kept clean, free of contamination, and undamaged.

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

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

Some variables you must know and understand are:

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

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

### Electrical Contact

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

1. Stay in the crane cab. **Don't panic.**
2. Immediately warn personnel in the vicinity to stay away.
3. Attempt to move the crane away from the contacted power source using the crane's controls which may have remained functional.
4. Stay in the crane until the power company has been contacted and the power source has been de-energized. **No one** must attempt to come close to the crane or load until the power has been turned off.

Only as a last resort should an operator attempt to leave the crane upon contacting a power source. If it is absolutely necessary to leave the operator's station, **jump completely clear of the crane. Do not step off.** Hop away with both feet together. **Do not** walk or run.

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

### Special Operating Conditions and Equipment

Never operate the crane during an electrical thunderstorm.

When operating near transmitter/communication towers where an electrical charge can be induced into the crane or load:

- The transmitter shall be deenergized OR,
- Tests shall be made to determine if an electrical charge will be induced into the crane or load.
- The crane must be provided an electrical ground.
- If taglines are used, they must be non-conductive.
- Every precaution must be taken to dissipate induced voltages. Consult a qualified RF (radio frequency) Consultant. Also refer to local, state, and federal codes and regulations.

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

### Grounding the Crane

The crane may become charged with static electricity. This may occur especially when using outrigger pads made of plastic or when the outrigger pads are cribbed with insulating material (e.g., wooden planks).



### WARNING

#### Risk of accidents due to electric shock!

Ground the crane before you start to work with it

- Near strong transmitters (radio transmitters, radio stations, etc.)
- Near high-frequency switching stations
- If a thunder storm is forecast

Use electrically conducting material for grounding.

1. Hammer a metal rod (3, Figure 2-6) (length of approximately 2.0 m (6.6 ft)) at least 1.5 m (5 ft) into the ground.
2. Moisten the soil around the metal rod (3) for better conductivity.
3. Clamp an insulated cable (2) to the metal rod (3), cross-section of at least 16 mm<sup>2</sup> (0.025 in<sup>2</sup>) (AWG 5).
4. Connect the free end of the cable with a clamp (1) to a good electrically conductive location on the frame.

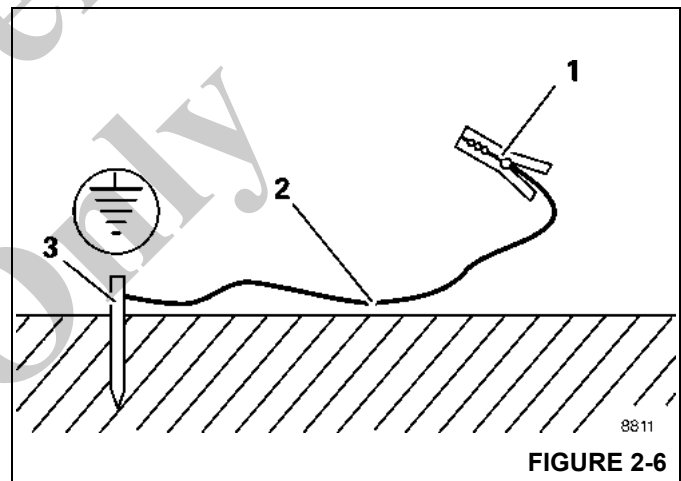


FIGURE 2-6



### WARNING

#### Risk of accidents due to electric shock!

Make sure that the connections between the cable and the clamp are electrically conductive.

Do not attach the clamp to parts that are screwed on, such as valves, covers or similar parts.



## PERSONNEL HANDLING

The American Society of Mechanical Engineers published the American National Standard entitled, *Personnel Lifting Systems*, ASME B30.23:

This Volume establishes the design criteria, equipment characteristics, and operational procedures that are required when hoisting equipment within the scope of the ASME B30 Standard is used to lift personnel. Hoisting equipment defined by the ASME B30 Standard is intended for material handling. It is not designed, manufactured, or intended to meet the standards for personnel handling equipment, such as ANSI/SIA A92 (Aerial Platforms). The equipment and implementation requirements listed in this Volume are not the same as that established for using equipment specifically designed and manufactured for lifting personnel. Hoisting equipment complying with the applicable Volumes of the ASME B30 Standard shall not be used to lift or lower personnel unless there are no less hazardous alternatives to providing access to the area where work is to be performed. The lifting or lowering of personnel using ASME B30-compliant hoisting equipment is prohibited unless all applicable requirements of this volume have been met.

This standard is consistent with the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations for Construction that state, in 29CFR1926.1431:

General requirements. The use of a crane or derrick to hoist employees on a personnel platform is prohibited, except when the erection, use, and dismantling of conventional means of reaching the worksite, such as a personnel hoist, ladder, stairway, aerial lift, elevating work platform or scaffold, would be more hazardous or is not possible because of structural design or worksite conditions.

Additional requirements for crane operations are stated in ASME B30.5, *Mobile and Locomotive Cranes*, ASME B30.8, *Floating Cranes and Floating Derricks*, and in OSHA regulations 29CFR1910.180 for *General Industry* and 29CFR1926.1431 for *Construction*.

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

- The requirements of the applicable national, state and local regulations and safety codes are met.
- A determination has been made that use of a crane to handle personnel is the least hazardous means to perform the work.
- The crane operator shall be qualified to operate the specific type of hoisting equipment used in the personnel lift.
- The crane operator must remain at the crane controls at all times when personnel are off the ground.

- The crane operator and occupants have been instructed in the recognized hazards of personnel platform lifts.
  - The crane is in proper working order.
  - The crane must be equipped with a boom angle indicator that is visible to the crane operator.
  - The crane's *Load Chart* is affixed at the operator's station and readily accessible to the operator. The total weight of the loaded personnel platform and related rigging shall not exceed 50 percent of the rated capacity for the radius and configuration of the crane.
  - The crane is level within one percent of level grade and located on a firm footing. Cranes with outriggers shall have them all deployed following manufacturer's specifications.
  - The crane's *Operator Manual* and other operating manuals are at the operator's station and readily accessible to the operator.
  - The platform meets the requirements as prescribed by applicable standards and regulations.
  - For hoist rope suspended platforms:
    - The crane is equipped with a hook that can be closed and locked, eliminating the throat opening.
    - The crane is equipped with a functional anti-two-block device.
    - The platform is properly attached and secured to the load hook.
  - For boom mounted platforms:
    - The platform is properly attached and secure.
- To avoid death or serious injury:
- NEVER use this crane for bungee jumping or any form of amusement or sport.
  - NEVER handle personnel on the loadline unless the requirements of applicable national, state and local regulations and safety codes are met.
  - NEVER permit anyone to ride loads, hooks, slings or other rigging for any reason.
  - NEVER get on or off a moving crane.
  - NEVER allow anyone other than the operator to be on this crane while the machine is operating or traveling.
  - NEVER allow anyone on the hoist access platform while traveling.

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

- *ASME (formerly ANSI) B30 Series American National Safety Standards For Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings; ASME B30.5, Mobile And Locomotive Cranes, and ASME B30.23, Personnel Lifting Systems*, are available by mail from the ASME, 22 Law Drive, Fairfield, New Jersey, 07004-2900.

- or - check online at:

<https://www.asme.org/codes-standards/find-codes-standards>

- *US DOL/OSHA Rules and Regulations* are available by mail from the Superintendent of Documents, PO Box 371954, Pittsburgh, PA, 15250-7954.

## ENVIRONMENTAL PROTECTION

**Dispose of waste properly!** Improperly disposing of waste can threaten the environment.

Potentially harmful waste used in Grove cranes includes, but is not limited to, oil, fuel, grease, coolant, air conditioning refrigerant, filters, batteries, and cloths which have come into contact with these environmentally harmful substances.

Handle and dispose of waste according to local, state, and federal environmental regulations.

When filling and draining crane components, observe the following:

- Do not pour waste fluids onto the ground, down any drain, or into any source of water.
- Always drain waste fluids into leak proof containers that are clearly marked with what they contain.
- Always fill or add fluids with a funnel or a filling pump.
- Immediately clean up any spills.

## MAINTENANCE

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

Grove continues to recommend that cranes be properly maintained, regularly inspected and repaired as necessary. Grove reminds crane owners to make sure that all safety decals are in place and legible. Grove continues to urge crane owners to upgrade their cranes with rated capacity limiter and control lever lockout systems for all lifting operations.

Shut down the crane while making repairs or adjustments.

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

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

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

Routine maintenance and inspection of this crane must be performed by a qualified person(s) according to the recommendations in the *Inspection and Lubrication Service Log*. Any questions regarding procedures and specifications should be directed to your Grove distributor.

## Service and Repairs



### WARNING

#### Fall Hazard!

Working at elevated heights without using proper fall protection can result in severe injury or death.

Always use proper fall protection as required by local, state or federal regulations.

Service and repairs to the crane must only be performed by a qualified person. All service and repairs must be performed in accordance with manufacturer's recommendations, this manual, and the service manual for this machine. If there is any question regarding maintenance procedures or specifications, contact your Grove distributor for assistance.

**Qualified person** is defined as one who by reason of knowledge, training and experience is thoroughly familiar with the crane's operation and required maintenance as well as the hazards involved in performing these tasks.

**Training and qualification of maintenance and repair personnel are crane owner's responsibility.**

All replacement parts must be Grove approved.

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

### Hydraulic Fluid

- Do not use your hand or any part of your body to check for hydraulic fluid leaks when the engine is running or the hydraulic system is under pressure. Fluid in the hydraulic system can be under enough pressure that it will penetrate the skin, causing serious injury or death. Use a piece of cardboard, or piece of paper, to search

for leaks. Wear gloves to protect your hands from spraying fluid.

- If any hydraulic fluid is injected into the skin, obtain medical attention immediately or gangrene may result.
- Do not attempt to repair or tighten any hydraulic hose or fitting while the engine is running, or when the hydraulic system is under pressure.
- Never disconnect any hydraulic lines unless the boom is fully lowered, the engine is shut off, and the hydraulic pressure is relieved. To relieve hydraulic pressure, stop the engine, turn the ignition switch to RUN and move the hydraulic controls in both directions several times.



### WARNING

#### Pressurized Fluid Hazard!

Hydraulic pressure may still be present in portions of the hydraulic system due to accumulators or trapped circuitry.

- Hot hydraulic fluid will cause severe burns. Wait for the fluid to cool before disconnecting any hydraulic lines.
- Hydraulic fluid can cause permanent eye injury. Wear appropriate eye protection.

#### Moving Parts

- Do not place limbs near moving parts. Amputation of a body part may result. Turn off the engine and wait until the fan and belts stop moving before servicing crane.
- Pinch points, which result from relative motion between mechanical parts, are areas of the machine that can cause personal injury or death. Do not place limbs or your body in contact with pinch points either on or around the machine. Care must be taken to prevent motion between pinch points when performing maintenance and to avoid such areas when movement is possible.
- Do not allow persons to stand near extending or lowering outriggers. Foot crushing could occur

#### Before maintenance or repairs

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

- The boom should be fully retracted and lowered and the load placed on the ground.
- Do not get under a raised boom unless the boom is blocked up safely. Always block up the boom before doing any servicing that requires the boom to be raised.

- Stop the engine and disconnect the battery.
- Controls should be properly tagged. Never operate the crane if it is **tagged-out** nor attempt to do so until it is restored to proper operating condition and all tags have been removed by the person(s) who installed them.

#### After maintenance or repairs

- Replace all guards and covers that have been removed.
- Remove all tags, connect the battery, and perform a function check of all operating controls.
- Consult with Manitowoc Crane Care to determine if load testing is required after a structural repair is performed.

#### Lubrication

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

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

- Follow the manufacturer's recommendations when adding oil to the system. Mixing the wrong fluids could destroy seals, causing component failure.
- Be certain all lines, components, and fittings are tight before resuming operation.

#### Tires



### WARNING

#### Possible equipment damage and/or personal injury!

Driving the crane with a tire and split-rim assembly under inflated at 80% or less of its recommended pressure can cause the wheel and/or tire to fail. Per *OSHA Standard 1910.177(f)(2)*, when a tire has been driven under inflated at 80% or less of its recommended pressure, it must first be completely deflated, removed from the axle, disassembled, and inspected before re-inflation.

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

Make sure that all lug nuts are properly torqued.

Make sure that pneumatic tires are inflated to the proper pressure (refer to the *Load Chart*). When inflating tires, use a tire gauge, clip-on inflator, and extension hose which will permit standing clear of the tire while inflating.

## HOIST ROPE

### Synthetic Hoist Rope

For detailed information concerning synthetic hoist rope, refer to K100™ Synthetic Crane Hoist Line Manual P/N 9828100734 available by contacting Manitowoc Crane Care.

During installation and setup, care must be taken to avoid overlap and crossing of wire rope and synthetic hoist ropes.

Always make daily inspections of the hoist rope, keeping in mind that all hoist rope will eventually deteriorate to a point where it is no longer usable. Refuse to work with worn or damaged hoist rope.

During regular inspections, operator shall make sure that crane surfaces such as wear pads, sheaves, etc have not been damaged in a manner that can then damage the synthetic hoist rope.

**NOTE:** Example; if usage of a wire rope has cut grooves with sharp edges in a wear pad, they need to be addressed before the synthetic hoist rope is used in that same position.

Use **only** the hoist rope specified by Grove as indicated on the crane's *Load Chart*. Substitution of an alternate hoist rope may require the use of a different permissible line pull and, therefore, require different reeving.

**NOTE:** Hoist rope may be purchased by contacting Manitowoc Crane Care.

### Wire Rope

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

- For rotation-resistant running ropes: more than two (2) broken wires in a length of rope equal to six (6) times the rope diameter, or more than four (4) broken wires in a length of rope equal to thirty (30) times the rope diameter.
- For running ropes other than rotation resistant: six (6) broken wires in one rope lay or three (3) broken wires in one strand.
- One valley break where the wire fractures between strands in a running rope is cause for removal.
- Abrasion of the rope resulting in a 5% reduction in the original wire diameter.
- Any kinking, bird caging, crushing, corrosion, or other damage resulting in distortion of the rope structure.
- Rope that has been in contact with a live power line or has been used as a ground in an electric circuit (e.g.,

welding) may have wires that are fused or annealed and must be removed from service.

- In standing ropes, more than three (3) breaks in one rope lay in sections beyond the end connection or more than two (2) broken wires at an end connection.
- Core deterioration, usually observed as a rapid reduction in rope diameter, is cause for immediate removal of the rope.

The following is a brief outline of the basic information required to safely use wire rope.

- Wire ropes wear out. The strength of a rope begins to decrease when the rope is put to use and continues to decrease with each use. Rope will fail if worn-out, overloaded, misused, damaged or improperly maintained.
- The nominal strength, sometimes called catalog strength, of a wire rope applies only to a new, unused rope.
- The nominal strength of a rope should be considered the straight line pull which will actually break a new unused rope. The nominal strength of a rope should never be used as its working load.
- Each type of fitting attached to a rope has a specific efficiency rating which can reduce the working load of the rope assembly or rope system.
- If an operator hoists the hook block up or down too fast when reeved with multiple parts of line and no hook load, the wire rope can bird cage and damage the rope.
- Never overload a rope. This means never use the rope where the load applied to it is greater than the working load determined by the rope manufacturer.
- Never "shock load" a rope. A sudden application of force or load can cause both visible external and internal damage. There is no practical way to estimate the force applied by shock loading a rope. The sudden release of a load can also damage a rope.
- Lubricant is applied to the wires and strands of a wire rope when it is manufactured. The lubricant is depleted when the rope is in service and should be replaced periodically. Refer to the *Service Manual* for more information.
- In the U.S.A., regular inspections of the rope and keeping of permanent records signed by a qualified person are required by OSHA for almost every wire rope application. The purpose of the inspection is to determine whether or not a rope may continue to be safely used on the application. Inspection criteria, including number and location of broken wires, wear and elongation, have been established by OSHA, ANSI,

ASME and similar organizations. See the *Service Manual* for inspection procedures.

When inspecting ropes and attachments, keep all parts of your body and clothing away from rotating hoist drums and all rotating sheaves. Never handle the rope with bare hands.

Some conditions that lead to problems in wire rope systems include:

- Sheaves that are too small, worn or corrugated cause damage to a wire rope.
  - Broken wires mean a loss in strength.
  - Kinks permanently damage a rope and must be avoided.
  - Ropes are damaged by knots. Rope with knots must never be used.
  - Environmental factors such as corrosive conditions and heat can damage a wire rope.
  - Lack of lubrication can significantly shorten the useful life of a wire rope.
  - Contact with electrical wires and resulting arcing will damage a wire rope.
- An inspection should include verification that none of the specified removal criteria for this usage are met by checking for such things as:
    - Surface wear; nominal and unusual.
    - Broken wires; number and location.
    - Reduction in diameter.
    - Rope stretch (elongation).
    - Integrity of end attachments.
    - Evidence of abuse or contact with another object.
    - Heat damage.
    - Corrosion.

**NOTE:** A more detailed rope inspection procedure is given in the *Service Manual*.

- ***When a rope has been removed from service because it is no longer suitable for use, it must not be reused on another application.***

#### Installing a new rope

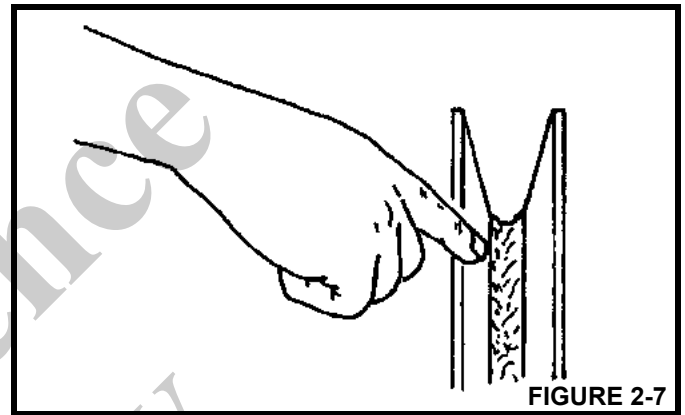
- Keep all parts of your body and clothing away from rotating hoist drums and all rotating sheaves.
- Never handle the wire rope with bare hands.
- Follow proper instructions for removing rope from a reel.
- Apply back tension to the storage/payoff reel of the new rope to ensure tight, even, spooling onto the hoist drum.

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

#### When using a wedge socket

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

#### Sheaves



Inspect the boom nose and hook block sheaves for proper operation, excessive wear, and damage every 50 hours or weekly. Inoperable, damaged and/or worn sheaves cause rapid deterioration of rope.

Make sure that sheaves carrying ropes, that can be momentarily unloaded, are equipped with close fitting guards or other devices to guide the rope back into the groove when the load is reapplied. Make sure that sheaves in the lower load block are equipped with close fitting guards that will prevent the ropes from becoming fouled when the block is lying on the ground with loose ropes.

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

The use of nylon (polyamide) sheaves, as compared with metallic sheaves, may change the replacement criteria of rotation-resistant hoist rope.

**NOTE:** The use of cast nylon (polyamide) sheaves will substantially increase the service life of rope. However, conventional rope retirement criteria based only upon visible wire breaks may prove inadequate in predicting rope failure. The user of cast nylon sheaves is therefore cautioned that a retirement criteria should be established based

upon the user's experience and the demands of his application.

## Batteries

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

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

- Wear safety glasses when servicing batteries.
- If equipped, disconnect battery with the battery disconnect switch before disconnecting the ground battery cable. For cranes with a Cummins engine using an engine ECM:
  - a. Make sure that the key switch has been off for 2 minutes.
  - b. Turn the battery disconnect switch to the OFF position.
  - c. Remove the ECM power fuse.
  - d. Remove negative battery cables.
- Do not break a live circuit at the battery terminal. Disconnect the ground battery cable first when removing a battery and connect it last when installing a battery.
- Do not short across the battery posts to check charge. Short circuit, spark, or flame could cause battery explosion.
- If applicable, maintain battery electrolyte at the proper level. Check the electrolyte with a flashlight.
- If applicable to your crane, check battery test indicator on maintenance-free batteries.
- Check battery condition only with proper test equipment. Batteries shall not be charged except in an open, well-ventilated area that is free of flame, smoking, sparks, and fire.

## Super Capacitor (If Equipped)

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

When checking and maintaining capacitor, exercise the following procedures and precautions:

- Wear safety glasses when servicing.
- If equipped, disconnect battery with the battery disconnect switch before disconnecting the ground battery cable. For cranes with a Cummins engine using an engine ECM:

1. Make sure that the key switch has been off for 2 minutes.
  2. Turn the battery disconnect switch to the OFF position.
  3. Remove the ECM power fuse.
  4. Remove negative battery cables.
  5. Remove positive capacitor cable.
- Do not short across the capacitor posts to check charge. Short circuit will cause capacitor terminal damage. Spark or flame could cause capacitor explosion.
  - Check capacitor charge level with proper test equipment.

## General Maintenance

Fuel the crane only with the engine turned off. Do not smoke while fueling the crane. Do not store flammable materials on the crane.

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

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

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

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

Do not use ether to start the engine on cranes equipped with intake manifold grid heaters.

The engine can enter into an engine exhaust cleaning mode where the exhaust temperature can be high, make sure that the exhaust is not pointed at materials that can melt, burn, or explode.

## TRANSPORTING THE CRANE

Before transporting the crane, check the suitability of the proposed route with regard to the crane height, width, length, and weight.

Check load limits of bridges on the travel route, and make sure that they are greater than the combined weight of the crane and transporting vehicle.

When loading or unloading the crane on a trailer or railroad car, use a ramp capable of supporting the weight of the crane.

Make sure that the crane is adequately secured to the transporting vehicle.

Do not use the dead end lug (1, Figure 2-8) on the boom nose for tying down the boom during transport. Damage to the lug and boom can result from usage as a tie down point.

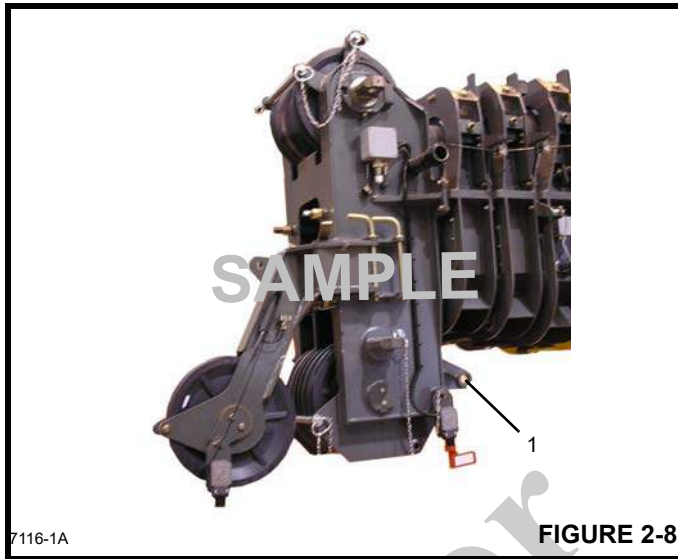


FIGURE 2-8

Before transporting the crane on a road or highway, first check state and local restrictions and regulations.

Either the hook block may be reeved over the main boom nose or the overhaul ball may be reeved over the main boom nose or auxiliary boom nose; the other must be removed. If the hook block or overhaul ball remains reeved on the boom, it must be secured at the tie down on the carrier to prevent swinging.

When using hookblock tie downs, excessive loading can be applied by pulling the cable too tight, particularly when reeved with multiple part lines. When the cable is hooked into the hookblock tie down, the cable should be merely "snugged-up" with adequate slack provided at the center line of sheave to anchor point. Do not draw cable taut. Care must be exercised anytime any crane function is being performed while the cable is hooked into the hookblock tie down.

## TRAVEL OPERATION

Only the crane operator shall occupy the crane when traveling.

When traveling, the boom should be completely retracted and lowered to the travel position and the turntable pin swing lock, if equipped, should be engaged. If equipped with boom rest, lower the boom into the boom rest and engage the turntable lock.

Strictly adhere to the guidelines and restrictions in the *Load Chart* for pick and carry operations.

RT cranes are manufactured without an axle suspension system. Traveling at high speeds, especially on rough

ground, may create a bouncing effect that can result in loss of control. If bouncing occurs, reduce travel speed.

### **WARNING** **Crushing Hazard!**

Death or serious injury could result from being crushed by revolving tires.

Keep clear of revolving tires.

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

Follow the instructions in this manual when preparing the crane for travel.

If using a boom dolly/trailer, thoroughly read and understand all the steps and safety precautions in this manual for setup and travel.

When driving the crane make sure that the cab is down, if equipped with a tilting cab.

Secure the hook block and other items before moving the crane.

Watch clearances when traveling. Do not take a chance of running into overhead or side obstructions.

When moving in tight quarters, post a signal person to help guard against collisions or bumping structures.

Before traveling a crane, check suitability of proposed route with regard to crane height, width, and length.

Never back up without the aid of a signal person to verify the area behind the crane is clear of obstructions and/or personnel.

On cranes equipped with air-operated brakes, do not attempt to move the crane until brake system air pressure is at operating level.

Check load limit of bridges. Before traveling across bridges, make sure that they will carry a load greater than the crane's weight.

If it is necessary to take an RT crane on a road or highway, check state and local restrictions and regulations.

Keep lights on, use traffic warning flags and signs, and use front and rear flag vehicles when necessary. Check state and local restrictions and regulations.

Always drive the crane carefully, obeying speed limits and highway regulations.

Stay alert at the wheel.

If equipped, make sure that the hoist access platform hand rail and step are in the travel configuration.

## Slopes

- Pick and carry on level surfaces only.
- Refer to the *Operation Section* for more detailed information on traveling on slopes.
- Driving across a slope is dangerous, as unexpected changes in slope can cause tip over. Ascend or descend slopes slowly and with caution.
- When operating on a downhill slope, reduce travel speed and downshift to a low gear, to permit compression braking by the engine, and aid the application of the service brakes.

## WORK PRACTICES

### Personal Considerations

Always adjust the seat and lock it in position, and fasten the seat belt securely before you start the engine.

Do not wear loose clothing or jewelry that can get caught on controls or moving parts. Wear the protective clothing and personal safety gear issued or called for by the job conditions. Hard hat, safety shoes, ear protectors, reflective clothing, safety goggles, and heavy gloves may be required.

### Crane Access



#### WARNING

##### Fall Hazard!

Working at elevated heights without using proper fall protection can result in severe injury or death.

Always use proper fall protection as required by local, state or federal regulations.

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

Never exit or enter the crane cab or deck by any other means than the access system(s) provided (i.e., steps and grab handles). Use the recommended handholds and steps to maintain a three-point contact when getting on or off the crane.

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

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

Do not step on surfaces on the crane that are not approved or suitable for walking and working. All walking and working surfaces on the crane should be clean, dry, slip-resistant, and have adequate supporting capacity.

Do not walk on a surface if slip-resistant material is missing or excessively worn.

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

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

Use the hoist access platform (if equipped) when working in the hoist area.

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

Do not allow ground personnel to store their personal belongings (clothing, lunch boxes, water coolers, and the like) on the crane. This practice will prevent ground personnel from being crushed or electrocuted when they attempt to access personal belongings stored on the crane.

### Job Preparation

#### Before crane use

- Barricade the entire area where the crane is working and keep all unnecessary personnel out of the work area.
- Make sure that the crane is properly equipped, including access steps, covers, doors, guards, and controls.
- Conduct a visual inspection for cracked welds, damaged components, loose pins/bolts, and wire connections. Any item or component that is found to be loose or damaged (broken, chipped, cracked, worn-through, etc.) must be repaired or replaced. Inspect for evidence of improper maintenance (consult your *Service Manual*).
- Check for proper functioning of all controls and operator aids (for example, RCL).
- Check all braking (for example, wheel, hoist, and swing brakes) and holding devices before operation.

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

Clear all personnel from the outrigger area before extending or retracting the outriggers. Carefully follow the procedures in this *Operator Manual* when extending or retracting the outriggers. Death or serious injury could result from improper crane set up on outriggers.

Be familiar with surface conditions and the presence of overhead obstructions and power lines.



## Working

Operator shall be responsible for all operations under his/her direct control. When safety of an operation is in doubt, operator shall stop the crane's functions in a controlled manner. Lift operations shall resume only after safety concerns have been addressed or the continuation of crane operations is directed by the lift supervisor.

Know the location and function of all crane controls.

Make sure that all persons are away from the crane and the Travel Select Lever is in the "N" (Neutral) position with the Parking Brake engaged before starting the engine.

Sparks from the crane's electrical system and/or engine exhaust can cause an explosion. **Do not** operate this crane in an area with flammable dust or vapors, unless good ventilation has removed the hazard.

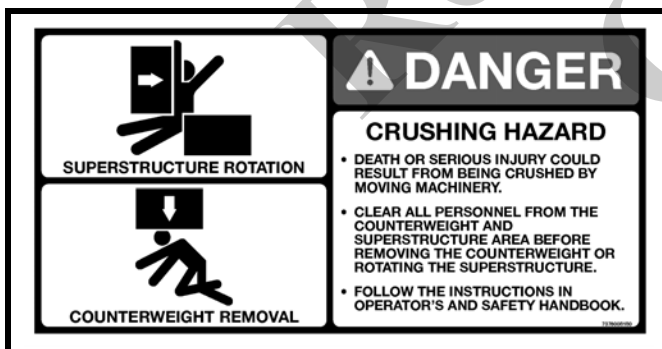
Carbon monoxide fumes from the engine exhaust can cause suffocation in an enclosed area. Good ventilation is very important when operating the crane.

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

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

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

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



Keep unauthorized personnel clear of the working area during operation.

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

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

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

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

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

Make sure that the hoist rope is properly routed on the hook block and boom nose (Figure 2-9), and that all rope guards are in place.

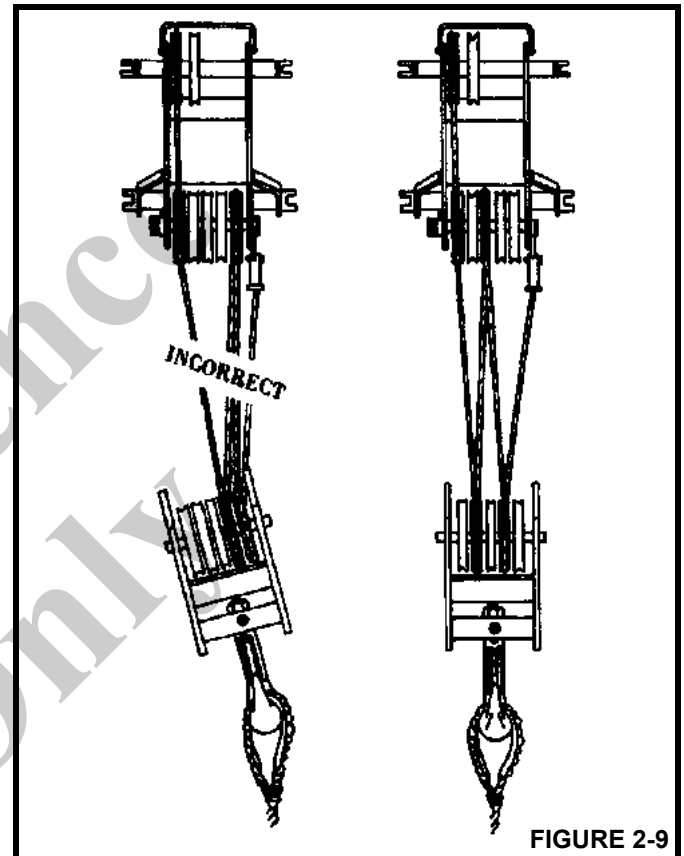


FIGURE 2-9

## Lifting

Grove Crane recommends lifting only one load at a time. See "Lifting Operations" on page 2-19.

Use enough parts of line for all lifts and check all lines, slings, and chains for correct attachment. To obtain maximum lifting capacities, the hook block must be set up with enough parts of line. Too few parts of line can result in failure of the hoist rope or hoist. **No less than three wraps of rope** should remain on the hoist drum. When slings, ties, hooks, etc., are used, make sure that they are correctly positioned and secured before raising or lowering the loads.

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

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

If using a clam bucket, do not exceed 80 percent of the crane's capacity.

Make certain the boom tip is centered directly over the load before lifting.

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

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

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

Watch the path of the boom and load when swinging. Avoid lowering or swinging the boom and load into ground personnel, equipment, or other objects. Never leave the crane with a load suspended. Should it become necessary to leave the crane, lower the load to the ground and stop the engine before leaving the operator's station.

Remember, all rigging equipment must be considered as part of the load. Lifting capacities vary with working areas. If applicable, permissible working areas are listed in the *Load Chart*. When swinging from one working area to another, make sure that *Load Chart* capacities are not exceeded. Know your crane!

Stop the hook block from swinging when unhooking a load.

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

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

Never swing or lower the boom into the carrier cab (if applicable).

Never push or pull loads with the crane's boom. Never drag a load.

Do not subject crane to side loading. A side load can tip the crane or cause it to fail structurally.

If the boom should contact an object, stop immediately and inspect the boom. Remove the crane from service if the boom is damaged.

When lifting a load the boom may deflect causing the load radius to increase—this condition is made worse when the boom is extended. Make sure that the weight of load is within the crane's capacity on *Load Chart*.

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

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

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

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

## Hand Signals

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

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

At all times use standardized hand signals (Figure 2-10) that have been previously agreed upon and completely understood by the operator and signal person.

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

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

Obey a signal to stop from anyone.

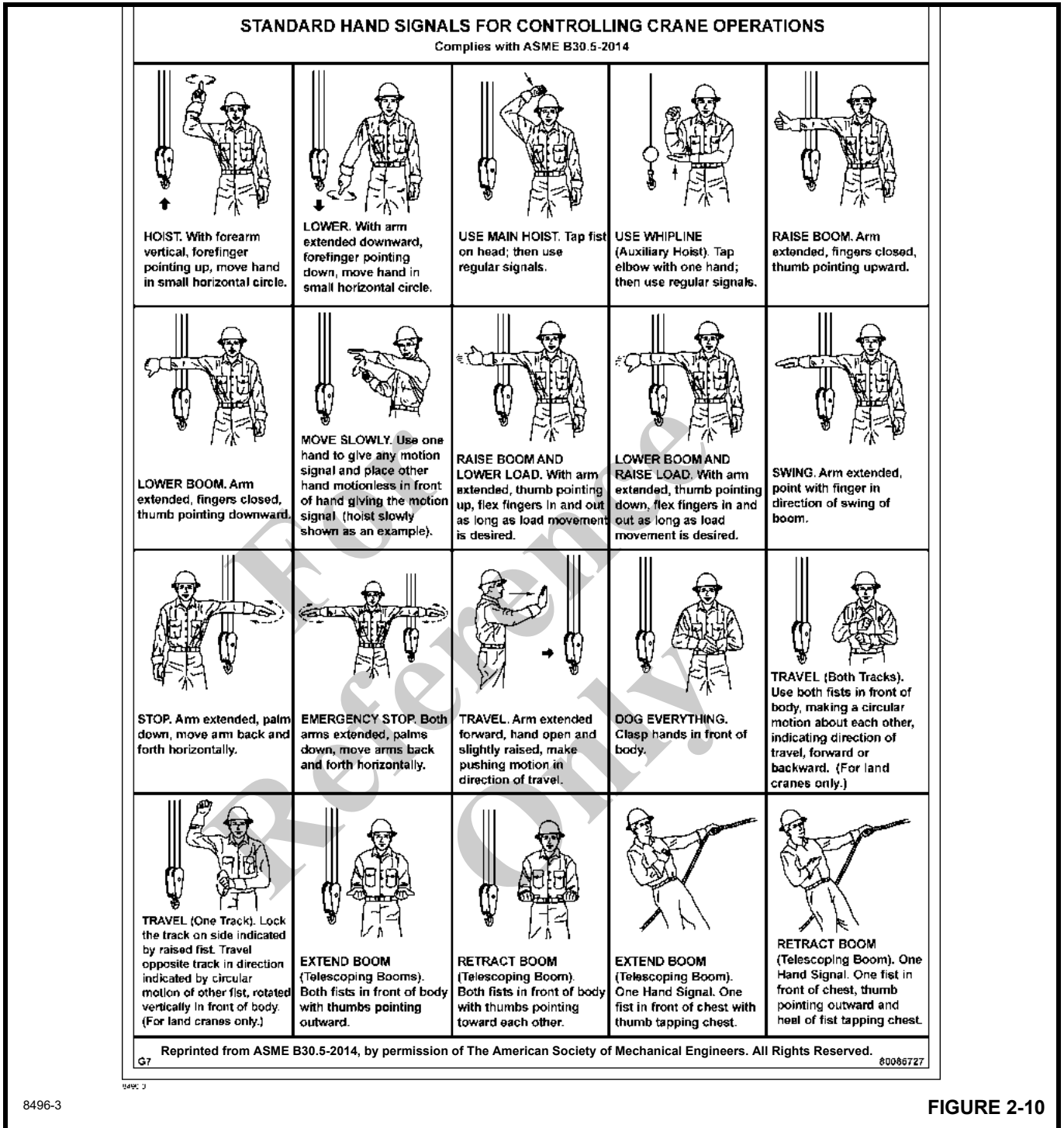


FIGURE 2-10

## BOOM EXTENSION

To avoid death or serious injury, follow the procedures in this manual during erection, stowage, and use of the boom extension.

Install and secure all pins properly.

Control movement of the boom extension at all times.

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



### DANGER

#### Boom Extension Hazard!

To avoid death or serious injury, follow procedures in *Load Chart*, safety, and operation manuals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

Do not remove the pins from the front stowage bracket unless the boom extension is pinned to the right side of the boom nose.

Properly inspect, maintain, and adjust boom extension and mounting.

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

Stay outside of boom extension sections and lattice work.

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

## PARKING AND SECURING



### DANGER

#### Tipping Hazard!

When parking the crane and leaving it unattended follow the instructions in Section 4 of this manual.

Failure to comply with these instructions may cause death or serious injury.

When parking on a grade, apply the parking brake and chock the wheels.

Section 4 of this manual provides instructions for parking and securing a crane when it is to be left unattended. These instructions are intended to allow the crane to be placed in the most stable and secure position. However, Grove recognizes that certain jobsite conditions may not permit the

boom and boom extension of a crane to be fully lowered to the ground. When a qualified person at a jobsite determines that it is not practical to lower the boom to the ground, we recommend the following additional instructions be followed:

- The crane should be left in the smallest, most stable, valid operational configuration that the job site practically allows.
- The crane can not be left running, with a load on the hook, or with the jib deployed, or in wind conditions in excess of allowed values.
- The boom should be retracted as far as is practical, the crane configured in as stable a configuration as possible (boom angle, superstructure orientation, boom extension angle, etc.)
- In high winds the boom and boom extension should be lowered, or secured. Changing weather conditions including, but not limited to, wind, ice accumulation, precipitation, flooding, lightning, etc., should be considered when determining the location and configuration of a crane when it is to be left unattended.

## SHUT-DOWN

Use the following steps when shutting down the crane:

- Engage the parking brake.
- Fully retract and lower the boom.
- Engage the swing lock pin or 360 degree swing lock (if equipped).
- Disable all crane functions using the crane function Enable/Disable switch (if equipped).
- Place controls in neutral position.
- Shut down the engine and remove the ignition key.
- Wait a minimum of 2 minutes and then turn the battery disconnect switch to the OFF position.
- Chock the wheels, if not on outriggers.
- Lock the operator's cab (if applicable) and install vandal guards, if used.

## COLD WEATHER OPERATION

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

Check operating procedures in this manual for cold weather starting.

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

Clean the crane of all ice and snow.

Allow at least 30 minutes of engine run time for hydraulic oil to warm up.

Plastic components (battery casings, heater controls, dash controls, etc.) are extremely brittle in extreme cold. Use caution handling and operating these components in sub-zero temperatures, avoiding shock loading.

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

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

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

Never store flammable materials on the crane.

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

## TEMPERATURE EFFECTS ON HOOK BLOCKS

The Hook Block Working Load Limit (WLL) is valid between 60°C (140°F) and the low temperature limit given on the hook block identification plate with normal lifting precautions.

Lifting above 75% of the Working Load Limit, at temperatures between the service temperature given on the identification plate and -40°C (-40°F), must be done at a slow and steady rate to avoid stress spikes.

75% of the Working Load Limit must not be exceeded when lifting in temperatures below -40°C (-40°F).

## TEMPERATURE EFFECTS ON HYDRAULIC CYLINDERS

Hydraulic oil expands when heated and contracts when cooled. This is a natural phenomena that happens to all liquids. The coefficient of expansion for API Group 1 hydraulic oil is approximately 0.00077 cm<sup>3</sup> per cm<sup>3</sup> of volume for 1°C of temperature change (0.00043 in<sup>3</sup> per in<sup>3</sup> of volume for 1°F of temperature change). **Thermal contraction will**

**allow a cylinder to retract as the hydraulic fluid which is trapped in the cylinder cools.**

The change in the length of a cylinder is proportional to the extended length of the cylinder and to the change in temperature of the oil in the cylinder. For example, a cylinder extended 7.6 m (25 ft) in which the oil cools 15.5°C (60°F) would retract approximately 196 mm (7 3/4 in) [see Table 2-9 and Table 2-8]. The rate at which the oil cools depends on many factors and will be more noticeable with a larger difference in oil temperature verses the ambient temperature.

Thermal contraction coupled with improper lubrication or improper wear pad adjustments may, under certain conditions, cause a "stick-slip" condition in the boom. This "stick-slip" condition could result in the load not moving smoothly. Proper boom lubrication and wear pad adjustment is important to permit the boom sections to slide freely. Slow movement of the boom may be undetected by the operator unless a load is suspended for a long period of time. To minimize the effects of thermal contraction or "Stick-slip" it is recommended that the telescope control lever is activated periodically in the extend position to mitigate the effects of cooling oil.

If a load and the boom is allowed to remain stationary for a period of time and the ambient temperature is cooler than the trapped oil temperature, the trapped oil in the cylinders will cool. The load will lower as the telescope cylinder(s) retracts allowing the boom to come in. Also, the boom angle will decrease as the lift cylinder(s) retracts causing an increase in radius and a decrease in load height.

This situation will also occur in reverse. If a crane is set up in the morning with cool oil and the daytime ambient temperature heats the oil, the cylinders will extend in similar proportions.

Table 2-8 and Table 2-9 have been prepared to assist you in determining the approximate amount of retraction/extension that may be expected from a hydraulic cylinder as a result of change in the temperature of the hydraulic oil inside the cylinder. The chart is for dry rod cylinders. If the cylinder rod is filled with hydraulic oil, the contraction rate is somewhat greater.

Table 2-8: Boom Drift Chart (Cylinder length change in inches)

| Coeff. = 0.00043 (in <sup>3</sup> /in <sup>3</sup> / °F) |                         |      |      |       |       |       |       |       |       |       |  |
|----------------------------------------------------------|-------------------------|------|------|-------|-------|-------|-------|-------|-------|-------|--|
| STROKE                                                   | Temperature Change (°F) |      |      |       |       |       |       |       |       |       |  |
| (FT.)                                                    | 10                      | 20   | 30   | 40    | 50    | 60    | 70    | 80    | 90    | 100   |  |
| 5                                                        | 0.26                    | 0.52 | 0.77 | 1.03  | 1.29  | 1.55  | 1.81  | 2.06  | 2.32  | 2.58  |  |
| 10                                                       | 0.52                    | 1.03 | 1.55 | 2.06  | 2.58  | 3.10  | 3.61  | 4.13  | 4.64  | 5.16  |  |
| 15                                                       | 0.77                    | 1.55 | 2.32 | 3.10  | 3.87  | 4.64  | 5.42  | 6.19  | 6.97  | 7.74  |  |
| 20                                                       | 1.03                    | 2.06 | 3.10 | 4.13  | 5.16  | 6.19  | 7.22  | 8.26  | 9.29  | 10.32 |  |
| 25                                                       | 1.29                    | 2.58 | 3.87 | 5.16  | 6.45  | 7.74  | 9.03  | 10.32 | 11.61 | 12.90 |  |
| 30                                                       | 1.55                    | 3.10 | 4.64 | 6.19  | 7.74  | 9.29  | 10.84 | 12.38 | 13.93 | 15.48 |  |
| 35                                                       | 1.81                    | 3.61 | 5.42 | 7.22  | 9.03  | 10.84 | 12.64 | 14.45 | 16.25 | 18.06 |  |
| 40                                                       | 2.06                    | 4.13 | 6.19 | 8.26  | 10.32 | 12.38 | 14.45 | 16.51 | 18.58 | 20.64 |  |
| 45                                                       | 2.32                    | 4.64 | 6.97 | 9.29  | 11.61 | 13.93 | 16.25 | 18.58 | 20.90 | 23.22 |  |
| 50                                                       | 2.58                    | 5.16 | 7.74 | 10.32 | 12.90 | 15.48 | 18.06 | 20.64 | 23.22 | 25.80 |  |
| 55                                                       | 2.84                    | 5.68 | 8.51 | 11.35 | 14.19 | 17.03 | 19.87 | 22.70 | 25.54 | 28.38 |  |
| 60                                                       | 3.10                    | 6.19 | 9.29 | 12.38 | 15.48 | 18.58 | 21.67 | 24.77 | 27.86 | 30.96 |  |

Length change in inches = Stroke (Ft.) X Temperature Change ( °F) X Coeff. (in<sup>3</sup>/in<sup>3</sup>/ °F) X 12 in/ft

Table 2-9 Boom Drift Chart (Cylinder length change in millimeters)

| Coeff. = 0.000774 (1/ °C) |                         | <i>Metric</i> |     |     |     |     |     |     |     |     |     |
|---------------------------|-------------------------|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| STROKE                    | Temperature Change (°C) |               |     |     |     |     |     |     |     |     |     |
| (m)                       | 5                       | 10            | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  |
| 1.5                       | 6                       | 12            | 17  | 23  | 29  | 35  | 41  | 46  | 52  | 58  | 64  |
| 3                         | 12                      | 23            | 35  | 46  | 58  | 70  | 81  | 93  | 104 | 116 | 128 |
| 4.5                       | 17                      | 35            | 52  | 70  | 87  | 104 | 122 | 139 | 157 | 174 | 192 |
| 6                         | 23                      | 46            | 70  | 93  | 116 | 139 | 163 | 186 | 209 | 232 | 255 |
| 7.5                       | 29                      | 58            | 87  | 116 | 145 | 174 | 203 | 232 | 261 | 290 | 319 |
| 9                         | 35                      | 70            | 104 | 139 | 174 | 209 | 244 | 279 | 313 | 348 | 383 |
| 10.5                      | 41                      | 81            | 122 | 163 | 203 | 244 | 284 | 325 | 366 | 406 | 447 |
| 12                        | 46                      | 93            | 139 | 186 | 232 | 279 | 325 | 372 | 418 | 464 | 511 |
| 13.5                      | 52                      | 104           | 157 | 209 | 261 | 313 | 366 | 418 | 470 | 522 | 575 |
| 15                        | 58                      | 116           | 174 | 232 | 290 | 348 | 406 | 464 | 522 | 581 | 639 |
| 16.5                      | 64                      | 128           | 192 | 255 | 319 | 383 | 447 | 511 | 575 | 639 | 702 |
| 18                        | 70                      | 139           | 209 | 279 | 348 | 418 | 488 | 557 | 627 | 697 | 766 |

Length change in mm = Stroke (m) X Temperature Change ( °C) X Coeff. (1/ °C) X 1000 mm/m

## OVERLOAD INSPECTION

When the RCL system has acknowledged an overload on your crane, you must carry out specified inspections on the crane.

The inspections given in this publication apply only to overloads up to 50%. For overloads of 50% or higher, crane

operation must be stopped immediately and Your Local Distributor or Manitowoc Crane Care must be contacted for corrective action.

The following illustrations may not be an exact representation of your crane and are to be used for reference only.

**WARNING****Overload Hazard!**

To avoid an accident caused by overload damage to your crane:

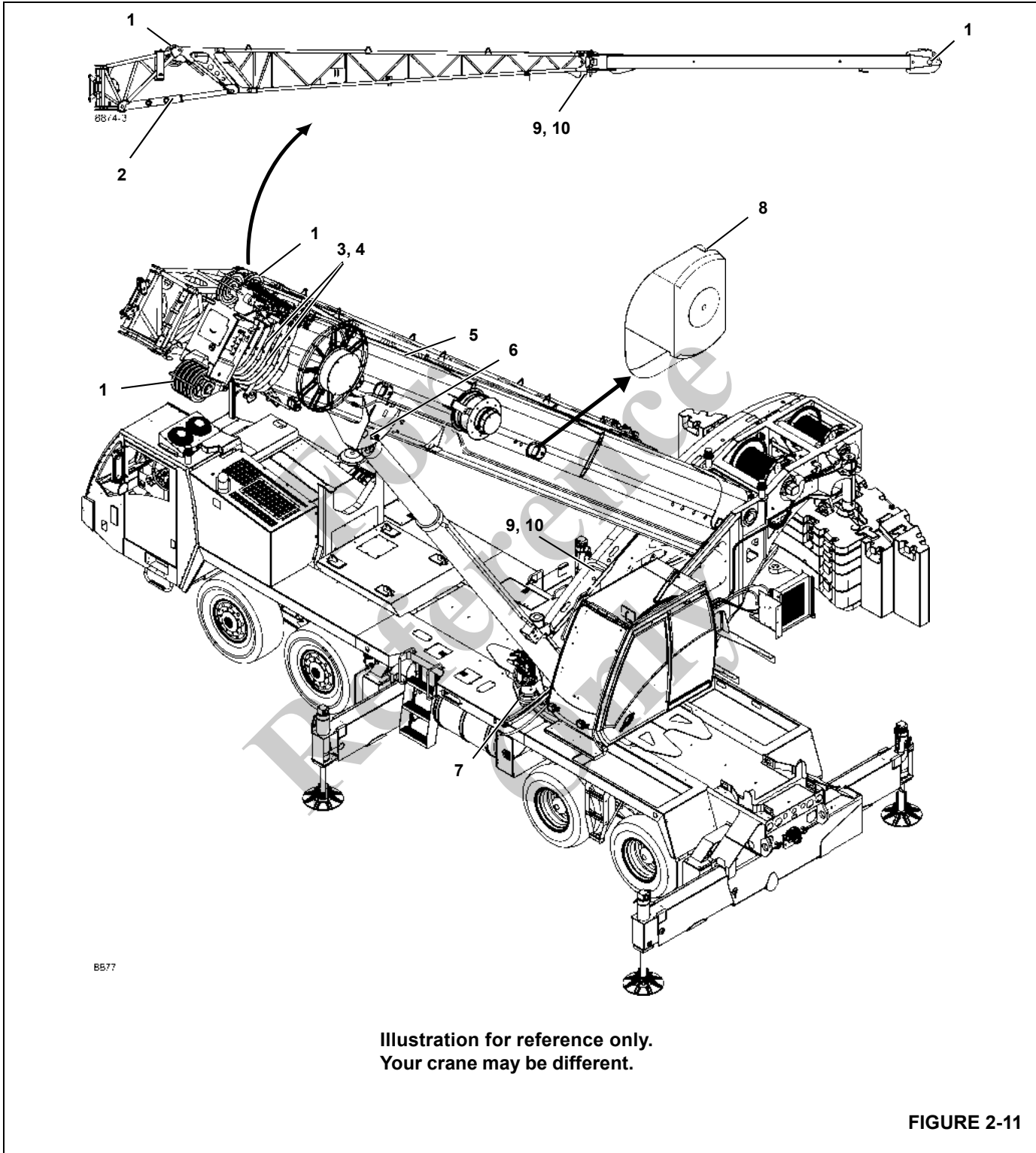
- Perform the inspections outlined in this publication for overloads up to 50%.
  - Stop operating the crane and contact Your Local Distributor or Manitowoc Crane Care immediately for overloads of 50% and higher.
- 

**NOTE:** If your crane is equipped with CraneSTAR, an overload warning will be posted to the web site for review by the crane owner.

Overload warnings in the CraneSTAR system do NOT indicate real time events! Warnings could be sent 24 hours (or more) after the actual event.

For  
Reference  
Only

## Boom Inspection





| <b>Overload less than 25%</b>   |                                |                                                                                           |  |
|---------------------------------|--------------------------------|-------------------------------------------------------------------------------------------|--|
| 1                               | Sheaves                        | Inspect all for damage.                                                                   |  |
| 2                               | Luffing Mechanism/<br>Cylinder | Inspect for damage/leaks.                                                                 |  |
| 3                               | Collar-wear pads               | Inspect all for damage.                                                                   |  |
| <b>Overload from 25% to 49%</b> |                                |                                                                                           |  |
| 1                               | Sheaves                        | Inspect all for damage.                                                                   |  |
| 2                               | Luffing Mechanism/<br>Cylinder | Inspect for damage/leaks.                                                                 |  |
| 3                               | Collar-wear pads               | Inspect all for damage.                                                                   |  |
| 4                               | Collar-welds                   | Inspect all for cracks.                                                                   |  |
| 5                               | Telescopic Sections            | Inspect for bent or twisted sections. Check the boom for straightness.                    |  |
| 6                               | Lift Cylinder Head Area        | Inspect for bends or cracked welds.                                                       |  |
| 7                               | Turret-Base Section            | Inspect for cracked welds.                                                                |  |
| 8                               | Locking Area (Pin Booms)       | Inspect for elongated holes.                                                              |  |
| 9                               | Welds                          | Inspect for cracks.                                                                       |  |
| 10                              | Paint                          | Inspect for cracked paint which could indicate twisted, stretched, or compressed members. |  |

The following checklist includes all features that can be found on Grove cranes. Your crane may not have some features.

Superstructure Inspection

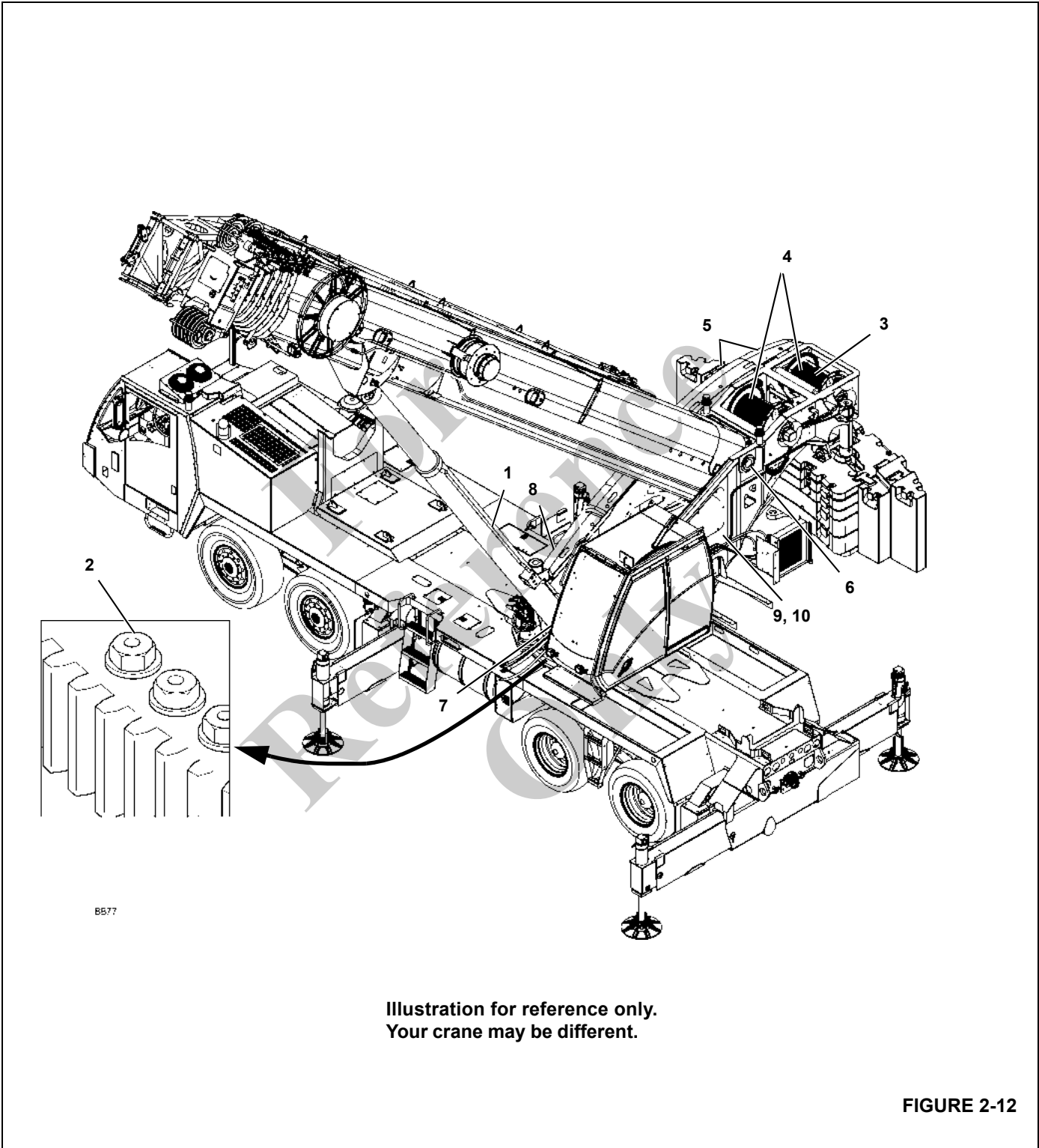


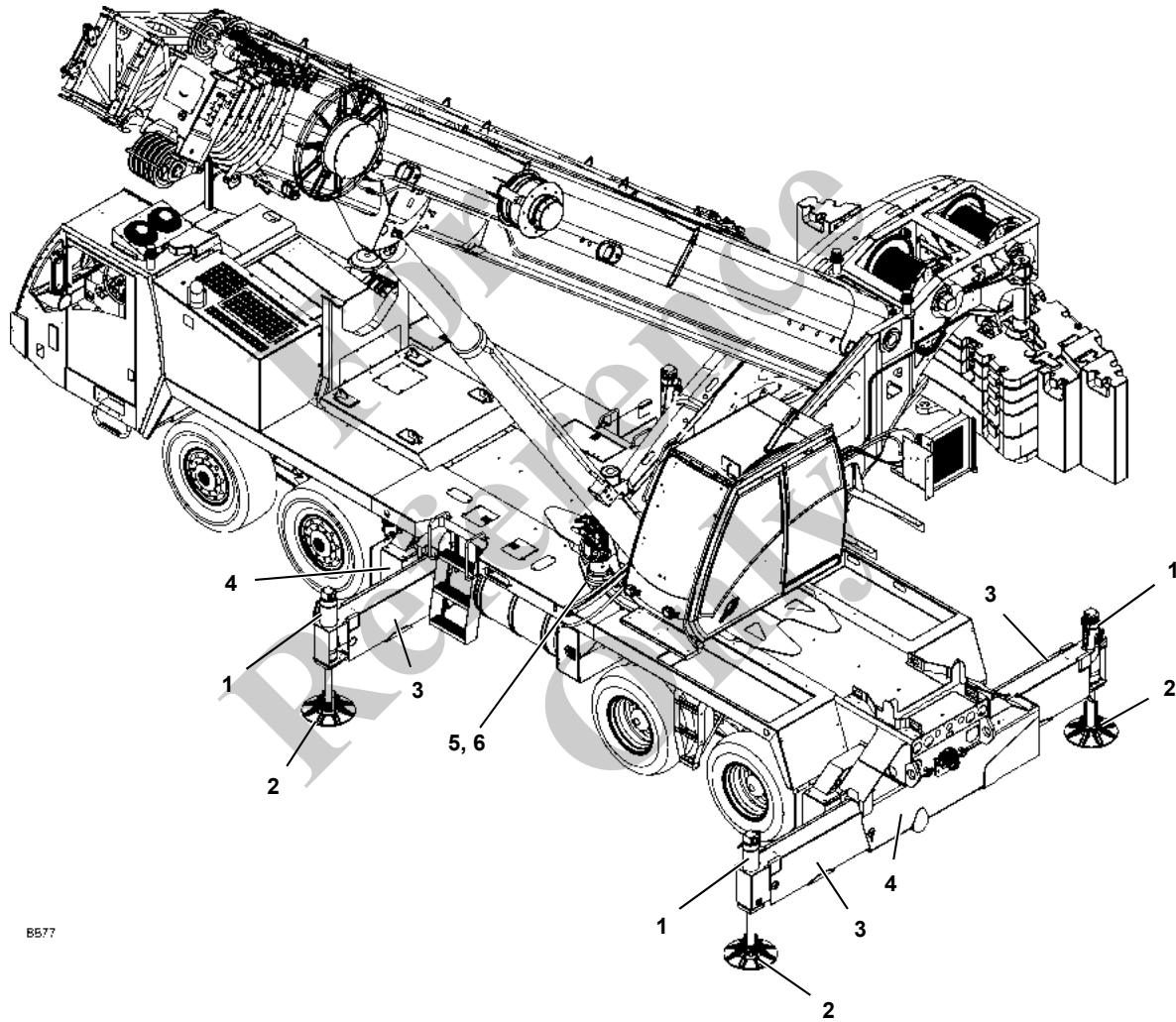
Illustration for reference only.  
Your crane may be different.

FIGURE 2-12

| <b>Overload less than 25%</b>   |                             |                                                                                           |                                                      |
|---------------------------------|-----------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------|
| 1                               | Lift Cylinder               | Inspect for leaking.                                                                      |                                                      |
| 2                               | Turntable Bearing           | Check bolts for proper torque.                                                            | See topic in Swing section of Service Manual.        |
| 3                               | Wire Rope                   | Inspect all for damage.                                                                   | See topic in Introduction section of Service Manual. |
| <b>Overload from 25% to 49%</b> |                             |                                                                                           |                                                      |
| 1                               | Lift Cylinder               | Inspect for leaking.                                                                      |                                                      |
| 2                               | Turntable Bearing           | Check bolts for proper torque.                                                            | See topic in Swing section of Service Manual.        |
| 3                               | Wire Rope                   | Inspect all for damage.                                                                   | See topic in Introduction section of Service Manual. |
| 4                               | Hoist/Drums                 | Inspect each for damage.                                                                  |                                                      |
| 5                               | Hoist Brakes                | Brakes must hold rated line pull.                                                         |                                                      |
| 6                               | Bearing Main Boom Pivot Pin | Inspect for deformation, cracked welds.                                                   |                                                      |
| 7                               | Lift Cylinder-lower mount   | Inspect pin and welds.                                                                    |                                                      |
| 8                               | Turntable                   | Inspect for deformation, cracked welds.                                                   |                                                      |
| 9                               | Welds                       | Inspect for cracks.                                                                       |                                                      |
| 10                              | Paint                       | Inspect for cracked paint which could indicate twisted, stretched, or compressed members. |                                                      |

The following checklist includes all features that can be found on Grove cranes. Your crane may not have some features.

## Carrier Inspection



B577

Illustration for reference only.  
Your crane may be different.

FIGURE 2-13

| Overload less than 25%   |                 |                                                                                           |  |
|--------------------------|-----------------|-------------------------------------------------------------------------------------------|--|
| 1                        | Jack Cylinders  | Inspect for leaking.                                                                      |  |
| 2                        | Outrigger Pads  | Inspect for deformation and cracked welds.                                                |  |
| Overload from 25% to 49% |                 |                                                                                           |  |
| 1                        | Jack Cylinders  | Inspect for leaking.                                                                      |  |
| 2                        | Outrigger Pads  | Inspect for deformation and cracked welds.                                                |  |
| 3                        | Outrigger Beams | Inspect for deformation and cracked welds.                                                |  |
| 4                        | Outrigger Boxes | Inspect for deformation and cracked welds.                                                |  |
| 5                        | Welds           | Inspect for cracks.                                                                       |  |
| 6                        | Paint           | Inspect for cracked paint which could indicate twisted, stretched, or compressed members. |  |

The following checklist includes all features that can be found on Grove cranes. Your crane may not have some features.

For Reference Only

**For  
Reference  
Only**

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## SECTION 3 OPERATING CONTROLS AND INDICATORS

### SECTION CONTENTS

|                                                          |            |                                                                        |             |
|----------------------------------------------------------|------------|------------------------------------------------------------------------|-------------|
| <b>Carrier Cab Controls and Indicators . . . . .</b>     | <b>3-4</b> | <b>Carrier Cab Control Panel Indicator and Gauge Display . . . . .</b> | <b>3-10</b> |
| Transmission Shift Lever . . . . .                       | 3-5        | Cross-Axle Locked Indicator . . . . .                                  | 3-11        |
| Spare Switch/Indicator . . . . .                         | 3-5        | Inter-Axle Locked Indicator . . . . .                                  | 3-11        |
| USB Ports . . . . .                                      | 3-5        | Suspension Deflated Indicator . . . . .                                | 3-11        |
| 12 Volt Outlet . . . . .                                 | 3-5        | Traction Control Indicator . . . . .                                   | 3-11        |
| Fire Extinguisher . . . . .                              | 3-5        | Tire Inflation ON Indicator . . . . .                                  | 3-11        |
| Horn Button . . . . .                                    | 3-5        | Left Turn Signal Indicator . . . . .                                   | 3-11        |
| Turn Signal/Headlight High Beam Low Beam Lever . . . . . | 3-5        | Lights ON Indicator . . . . .                                          | 3-11        |
| Steering Column Tilt/Telescope Lever . . . . .           | 3-5        | High Beam Indicator . . . . .                                          | 3-11        |
| Cab Circulating Fan . . . . .                            | 3-5        | Parking Brake Engaged Indicator . . . . .                              | 3-11        |
| Windshield Wiper and Washer . . . . .                    | 3-5        | Battery Charge Indicator . . . . .                                     | 3-12        |
| Carrier Camera Display . . . . .                         | 3-5        | Low Air Pressure Indicator . . . . .                                   | 3-12        |
| Dome Light . . . . .                                     | 3-5        | Emergency Stop Indicator . . . . .                                     | 3-12        |
| Air Horn . . . . .                                       | 3-5        | Right Turn Signal Indicator . . . . .                                  | 3-12        |
| Throttle Pedal . . . . .                                 | 3-6        | System Fault Indicator . . . . .                                       | 3-12        |
| Brake Pedal . . . . .                                    | 3-6        | Anti-Lock Braking System (ABS) Indicator . . . . .                     | 3-12        |
| Clutch Pedal . . . . .                                   | 3-6        | Check Transmission Indicator (Automated Transmission Only) . . . . .   | 3-12        |
| Steering Wheel . . . . .                                 | 3-6        | Malfunction Indicator Lamp (MIL) . . . . .                             | 3-12        |
| Headlights Switch . . . . .                              | 3-7        | Low Oil Pressure Indicator . . . . .                                   | 3-12        |
| Dimmer Switch . . . . .                                  | 3-7        | Engine Stop Indicator . . . . .                                        | 3-12        |
| Beacon Light Switch (Optional) . . . . .                 | 3-7        | Engine Warning Indicator . . . . .                                     | 3-12        |
| Engine Brake ON/OFF Switch . . . . .                     | 3-8        | OK Button . . . . .                                                    | 3-13        |
| Engine Brake High/Low Switch . . . . .                   | 3-8        | Menu Button . . . . .                                                  | 3-13        |
| Exhaust System Cleaning Initiate Switch . . . . .        | 3-8        | Fuel Level Gauge Indicator . . . . .                                   | 3-13        |
| Engine Idle Increment/Decrement Switch . . . . .         | 3-8        | Speedometer . . . . .                                                  | 3-13        |
| Remote Control ON/OFF Switch . . . . .                   | 3-8        | Low Fuel Level Indicator . . . . .                                     | 3-13        |
| Remote Control Indicator . . . . .                       | 3-8        | High Exhaust System Temperature Indicator . . . . .                    | 3-13        |
| ABS/ATC Switch . . . . .                                 | 3-8        | Engine Temperature Indicator . . . . .                                 | 3-13        |
| Hill Start Aid (HSA) Switch (Optional) . . . . .         | 3-8        | Cruise Control Indicator . . . . .                                     | 3-13        |
| HSA Indicator (Optional) . . . . .                       | 3-8        | Engine Coolant Temperature Gauge . . . . .                             | 3-13        |
| Inter-Axle Lock Switch . . . . .                         | 3-8        | Down Button . . . . .                                                  | 3-13        |
| Cross-Axle Lock Switch (Optional) . . . . .              | 3-8        | Up Button . . . . .                                                    | 3-13        |
| Suspension Inflation Switch . . . . .                    | 3-8        | Seat Belt Unfastened Indicator . . . . .                               | 3-14        |
| Tire Inflation Switch . . . . .                          | 3-9        | Tachometer . . . . .                                                   | 3-14        |
| Heater/Air Conditioner Fan Switch . . . . .              | 3-9        | Exhaust System Cleaning Indicator . . . . .                            | 3-14        |
| Heater/Air Conditioner Control . . . . .                 | 3-9        | LCD (Display) . . . . .                                                | 3-14        |
| Heater/Air Conditioner Select Switch . . . . .           | 3-9        | <b>Outrigger Controls and Indicators . . . . .</b>                     | <b>3-16</b> |
| Ignition Switch . . . . .                                | 3-9        | Outrigger Control Summary . . . . .                                    | 3-16        |
| Parking Brake Control . . . . .                          | 3-9        | Outrigger Control Panel . . . . .                                      | 3-17        |
| Dual Air Pressure Gauge . . . . .                        | 3-9        | Cribbing Mode . . . . .                                                | 3-17        |
| Trailing Boom Air Supply Control (Optional) . . . . .    | 3-9        | Two Methods for Activating Cribbing Mode . . . . .                     | 3-17        |
| Control Panel Indicator and Gauge Display . . . . .      | 3-9        |                                                                        |             |



|                                                           |             |                                                            |              |
|-----------------------------------------------------------|-------------|------------------------------------------------------------|--------------|
| <b>Superstructure Cab</b> . . . . .                       | <b>3-18</b> | WRL - Overall Height Menu . . . . .                        | 3-72         |
| Superstructure Cab . . . . .                              | 3-19        | WRL - Working Radius Menu . . . . .                        | 3-74         |
| Superstructure Side Panel . . . . .                       | 3-21        | WRL - Virtual Walls Menu . . . . .                         | 3-76         |
| Superstructure Cab, Rear . . . . .                        | 3-23        | Telescoping Emergency Program . . . . .                    | 3-78         |
| Superstructure Control Panels . . . . .                   | 3-24        | Access Telescoping Emergency Program Menu . . . . .        | 3-79         |
| Superstructure Control Levers . . . . .                   | 3-26        | ODM Error Code Viewer . . . . .                            | 3-87         |
| Superstructure Heating System . . . . .                   | 3-27        | Resetting the Current Telescoping . . . . .                | 3-88         |
| Operator Display Module (ODM)/Crane                       |             | RDM (RCL Display Module) . . . . .                         | 3-90         |
| Control System (CCS) Control Unit . . . . .               | 3-28        | RCL – Menu Groups . . . . .                                | 3-91         |
| Crane Control System (CCS) – Home Screen . . . . .        | 3-30        | Inclination Indicator . . . . .                            | 3-95         |
| Alert Icons . . . . .                                     | 3-32        | Anemometer Display . . . . .                               | 3-95         |
| <b>Short Description of the Operating Elements</b>        |             | Counterweight Menu . . . . .                               | 3-96         |
| <b>of the Crane Control System (CCS)</b> . . . . .        | <b>3-34</b> | ODM Display . . . . .                                      | 3-99         |
| Definition of Direction Information . . . . .             | 3-34        | Auxiliary Hoist . . . . .                                  | 3-100        |
| General Rules for Buttons and Symbols on the              |             | Swing . . . . .                                            | 3-100        |
| Display . . . . .                                         | 3-35        | Boom Lifting/Lowering Mechanism . . . . .                  | 3-101        |
| <b>Crane Control System (CCS)</b> . . . . .               | <b>3-36</b> | Telescoping Mechanism . . . . .                            | 3-102        |
| Display CCS . . . . .                                     | 3-36        | Hydraulic System . . . . .                                 | 3-106        |
| Engine Speed Display . . . . .                            | 3-37        | Superstructure House Lock Menu . . . . .                   | 3-106        |
| Seat Contact Switch and Dead-Man Switches . . . . .       | 3-39        | <b>Remote Control</b> . . . . .                            | <b>3-107</b> |
| Settings Menu Groups . . . . .                            | 3-42        | Remote Control Icon . . . . .                              | 3-107        |
| Control Lever Characteristic Curve Menu . . . . .         | 3-43        | <b>Remote Control Operation</b> . . . . .                  | <b>3-107</b> |
| Setting the Control Lever Characteristic Curves . . . . . | 3-43        | Scope . . . . .                                            | 3-107        |
| Crane Functions Speeds Menu . . . . .                     | 3-44        | System Overview . . . . .                                  | 3-107        |
| Adjusting the Wiper Stroke Interval of the                |             | System Components . . . . .                                | 3-108        |
| Windshield and Skylight Wipers . . . . .                  | 3-44        | Remote Control Components . . . . .                        | 3-110        |
| Economy Mode Menu . . . . .                               | 3-45        | Display Components . . . . .                               | 3-112        |
| Aircraft Warning Light (Optional) . . . . .               | 3-46        | Preparing for Remote Control Operation . . . . .           | 3-113        |
| Exhaust System Cleaning Menu . . . . .                    | 3-47        | Operating Remote Control . . . . .                         | 3-114        |
| Setting the Time Menu . . . . .                           | 3-48        | Telescoping Mode Number Entry . . . . .                    | 3-133        |
| Adjusting Display Brightness . . . . .                    | 3-48        | <b>Economy Mode</b> . . . . .                              | <b>3-139</b> |
| Switch Units Menu . . . . .                               | 3-50        | Terminology . . . . .                                      | 3-140        |
| Power Unit Speeds Menu . . . . .                          | 3-51        | Requirements . . . . .                                     | 3-140        |
| Operating Hours Menu . . . . .                            | 3-52        | Operation . . . . .                                        | 3-140        |
| Crane Operation Error Menu . . . . .                      | 3-54        | Benefits . . . . .                                         | 3-140        |
| Software Version Menu . . . . .                           | 3-55        | <b>Electrical System</b> . . . . .                         | <b>3-140</b> |
| CCS – Overview Menu Groups . . . . .                      | 3-56        | Voltage Monitoring Warning . . . . .                       | 3-140        |
| Camera Display Options . . . . .                          | 3-58        | 12 Volt Outlet . . . . .                                   | 3-140        |
| Telescoping Semi-Automation Menu . . . . .                | 3-59        | <b>Lighting, Windshield Wiper/Washing System</b> . . . . . | <b>3-141</b> |
| Boom Configurator Menu . . . . .                          | 3-60        | Lighting . . . . .                                         | 3-141        |
| Manual Telescoping Menu . . . . .                         | 3-61        | Windows . . . . .                                          | 3-143        |
| Outrigger Menu . . . . .                                  | 3-62        | Superstructure Cab Door . . . . .                          | 3-143        |
| Superstructure Lock Menu . . . . .                        | 3-63        | <b>CraneSTAR® System</b> . . . . .                         | <b>3-144</b> |
| Bi-Fold Boom Extension Menu . . . . .                     | 3-64        | Overview . . . . .                                         | 3-144        |
| Working Range Limiter (WRL) . . . . .                     | 3-65        | Position of the Components . . . . .                       | 3-144        |
| WRL - Swing Angle Menu . . . . .                          | 3-68        |                                                            |              |
| WRL - Boom Angle Limits Menu . . . . .                    | 3-70        |                                                            |              |



**CARRIER CAB CONTROLS AND INDICATORS**

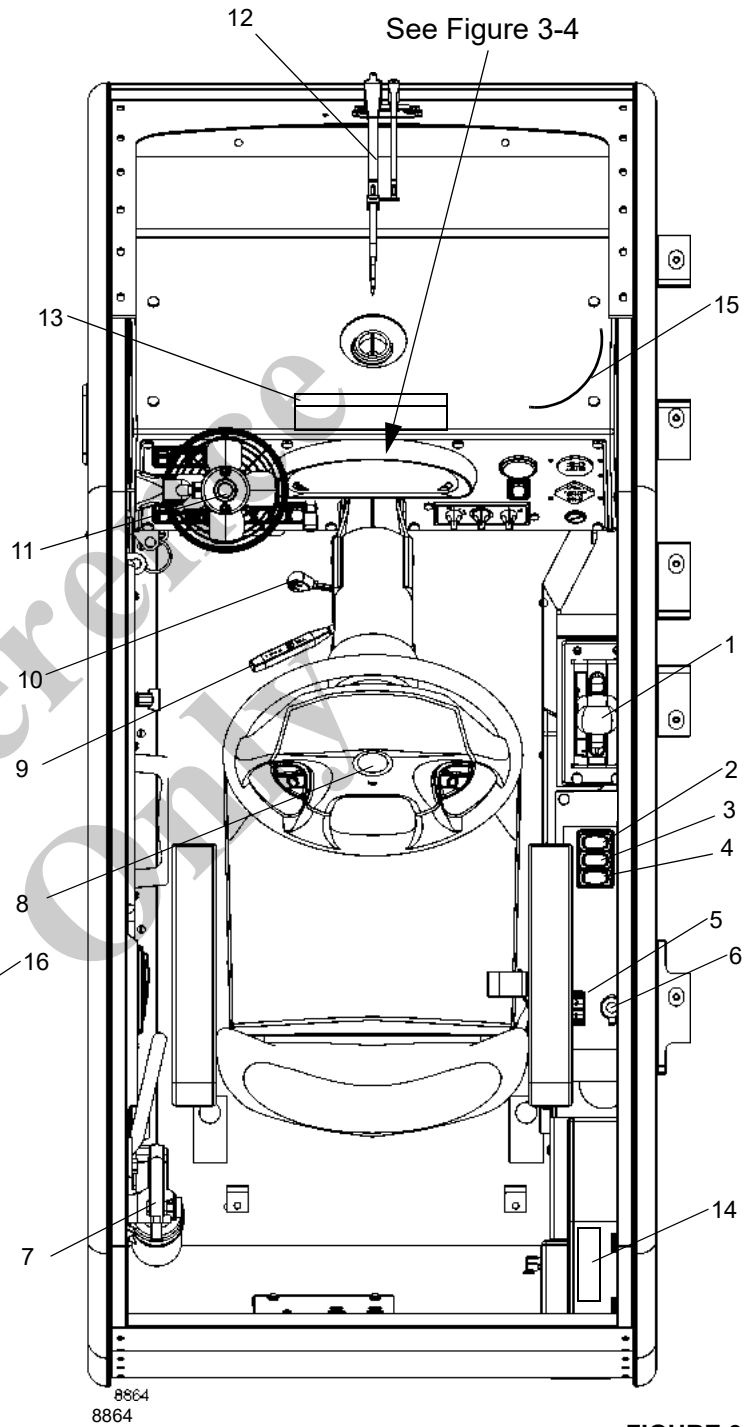
- 1. Transmission Shift Lever
- 2. Spare
- 3. Spare
- 4. Spare
- 5. USB Ports
- 6. 12 Volt Outlet
- 7. Fire Extinguisher
- 8. Horn
- 9. Turn Signal/High Beam-Low Beam Lever
- 10. Steering Column Tilt and Telescope Adjustment Lever
- 11. Cab Circulating Fan
- 12. Windshield Wiper and Washer
- 13. Camera Display
- 14. Dome Light and Switch
- 15. Air Horn Control
- 16. Throttle Pedal
- 17. Brake Pedal
- 18. Clutch Pedal Location



9097

18

17



**FIGURE 3-1**

### Transmission Shift Lever

The Transmission Shift Lever (1), (Figure 3-1)) is located on the right side of the cab. It is used to select the transmission gears. Refer to *Shifting Gears - Manual Transmission*, page 4-25 of this *Operator Manual*.

### Spare Switch/Indicator

The Spare Switch/Indicators (2, 3, 4), (Figure 3-1) may be populated with future options.

### USB Ports

The USB Ports (5), (Figure 3-1) are used to download system information from the data logger.

### 12 Volt Outlet

The 12 Volt Outlet (6), (Figure 3-1) provides a place to plug in a 12 Volt accessory with a maximum current draw of 3 amps.

### Fire Extinguisher

The Fire Extinguisher (7), (Figure 3-1) is mounted on the left inside rear of the cab.

### Horn Button

The Horn Button (8), (Figure 3-1) is located in the center of the steering wheel. Depressing the horn button energizes the circuit sounding the horn.

### Turn Signal/Headlight High Beam Low Beam Lever

The Turn Signal Lever (9), (Figure 3-1) is located on the steering column. Positioning the lever down causes the indicator light on the console and the left front and left rear signals to flash. Positioning the lever up causes the indicator light on the console and the right front and right rear signals to flash. Pull back for high beam and push forward for low beam.

### Steering Column Tilt/Telescope Lever

The Steering Column Tilt/Telescope Lever (10), (Figure 3-1) is located on the steering column behind the turn signal lever. Pulling back on the lever allows the steering column to be tilted to seven positions. Pushing the lever allows the steering column to be telescoped.

### Cab Circulating Fan

The Cab Circulating Fan (11), (Figure 3-1) is mounted on the left front of the cab and is controlled by a two speed rocker switch on the base of the fan.

### Windshield Wiper and Washer

The Windshield Wiper (12), (Figure 3-1) removes moisture from the windshield. The washer applies a liquid to the windshield so the wiper can clean it. Controls for the Windshield Wiper and Washer are located on the steering wheel.

### Carrier Camera Display

The Carrier Camera Display (13), (Figure 3-1) can be configured to display either the back up camera or the right turn camera or both, see *Carrier Camera Display Set-Up*, page 4-93.

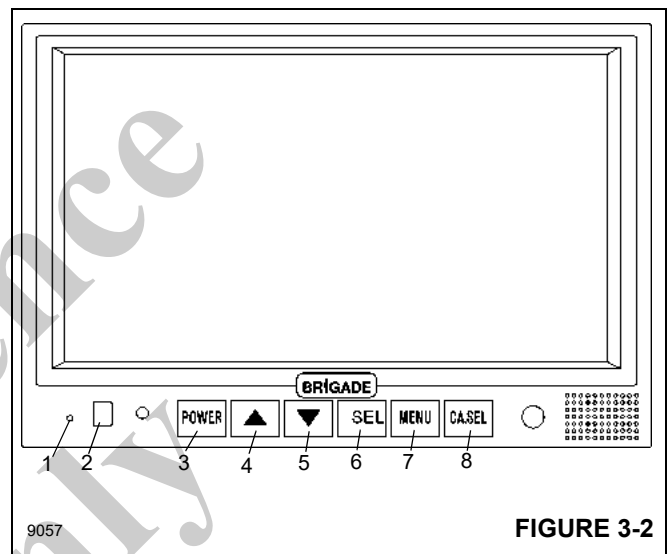


FIGURE 3-2

| Item | Description                |
|------|----------------------------|
| 1    | Automatic low light sensor |
| 2    | Remote control receiver    |
| 3    | Power switch               |
| 4    | Scroll up/left             |
| 5    | Scroll down/right          |
| 6    | Select                     |
| 7    | Menu                       |
| 8    | Camera select              |

### Dome Light

The Dome Light (14), (Figure 3-1) with integral switch is used to illuminate the cab.

### Air Horn

Pull down on the Air Horn Control (15), (Figure 3-1) to sound the air horn.

### Throttle Pedal

The Throttle Pedal (16), (Figure 3-1) is located on the right side of the cab floor. It is used to increase the engine speed.

### Brake Pedal

The Brake Pedal (17), (Figure 3-1) is located on the right side of the cab floor and is used to apply the service brakes.

### Clutch Pedal

The Clutch Pedal (18), (Figure 3-1) manual transmission only, is located on the left side of the cab floor and is used to disengage and engage the engine with the transmission.

### Steering Wheel

The Steering Wheel (Figure 3-3) includes cruise control buttons, the flash headlights switch, windshield wiper switch, windshield wiper speed control switch, windshield washer switch and the flash marker lights switch. To sound the horn press the center of the steering wheel.



1. Flash Marker Lights
2. Windshield Washer
3. Intermittent Speed Control
4. Windshield Wiper Off
5. Hi-Low Constant Speed Control
6. Horn
7. Cruise Control On/Off
8. Cancel Set Speed
9. Set Speed/Coast
10. Resume Set Speed/Accelerate
11. Flash Headlights

FIGURE 3-3

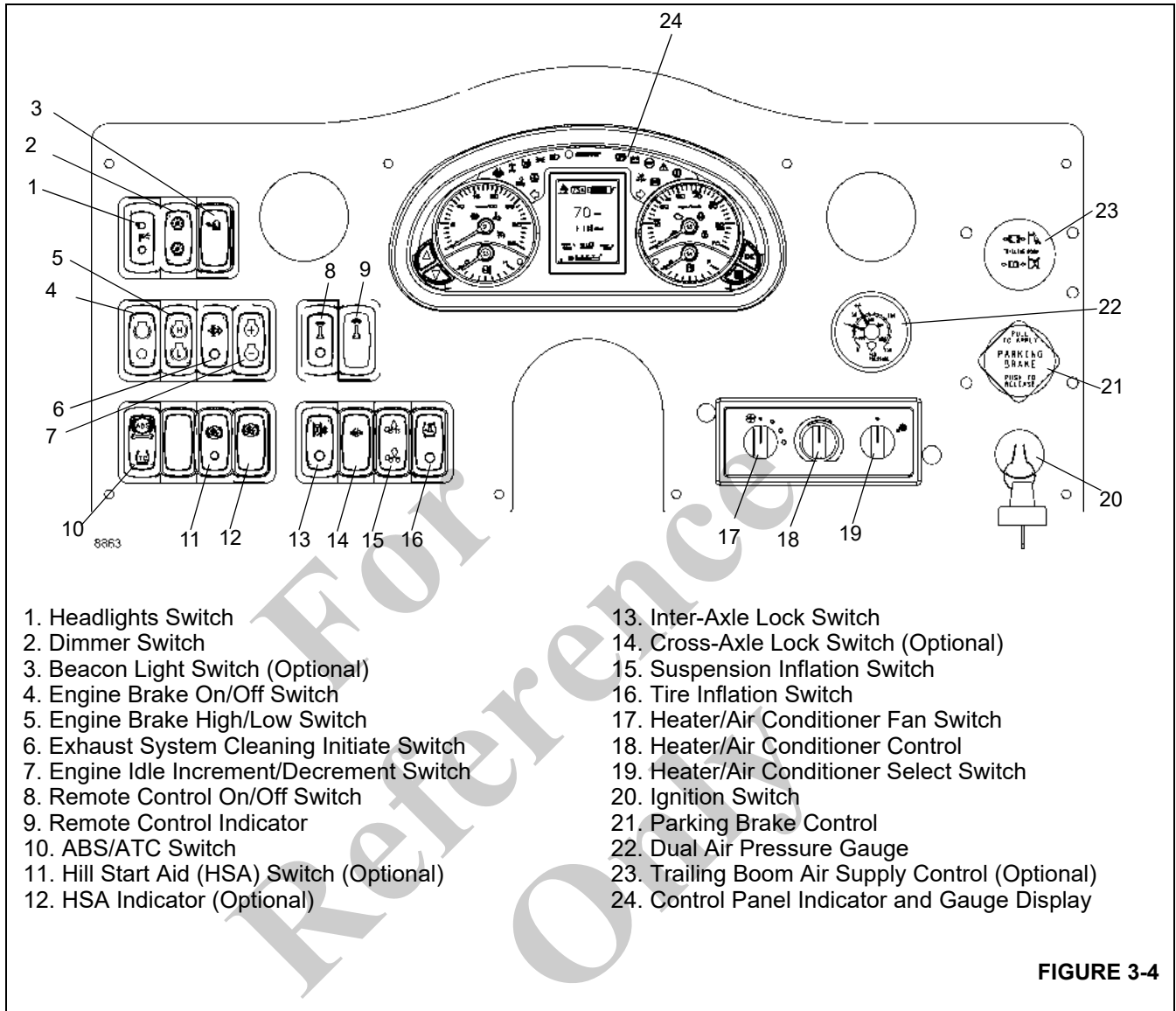


FIGURE 3-4

**Headlights Switch**

The Headlights Switch (1), (Figure 3-4) is a three position switch located on the top left side of the front console. The bottom position is off. The center position will illuminate marker, clearance and gauge lights. The top position will turn on the headlights in addition to the marker, clearance and gauge lights.

**Dimmer Switch**

The Dimmer Switch (2), (Figure 3-4) is located on the left top side of the front console. The switch controls the brightness of the dual air pressure gauge and automated transmission shift lever back lighting. The Control Panel Indicator and Gauge Display (24), (Figure 3-4) back lighting brightness is not controlled by this switch. The back lighting controls for it

can be accessed by selecting the menu button located on the Control Panel and Gauge Display. See Item (22), (Figure 3-5) for the location of the Menu Button.

**NOTE:** The Headlight Switch (1), (Figure 3-4) must be in the center or top position before the dual air pressure gauge and automated transmission shift lever back lighting will be illuminated and the dimmer switch becomes functional.

**Beacon Light Switch (Optional)**

The Beacon Light Switch (3), (Figure 3-4) is a two-position, ON/OFF Switch located on the left side of the front console that controls the beacon light on the top of the carrier cab and both superstructure beacon lights.

## Engine Brake ON/OFF Switch

The Engine Brake ON/OFF Switch is located on the left side of the front console. The two-position (ON/OFF) Switch (4), (Figure 3-4) energizes the engine brake. When the top of the switch is pushed, the switch is in the ON position.

## Engine Brake High/Low Switch

The Engine Brake High/Low Switch is located on the left side of the front console. The two-position Engine Brake High/Low Switch (5), (Figure 3-4) controls the amount of engine braking. When the top of the switch is pushed, the switch is in the high position.

## Exhaust System Cleaning Initiate Switch

The Exhaust System Cleaning Initiate Switch (6), (Figure 3-4) is located on the left side of the front console in the carrier cab, is used to initiate a stationary exhaust system cleaning. The switch must be cycled ON and OFF to initiate cleaning. The Exhaust System Cleaning Switch is a maintained ON switch.

The brake and throttle pedals (and clutch pedal for cranes with a manual transmission) must also be released. The engine will automatically change speed as needed. The cycle will take approximately 20 minutes.

## Engine Idle Increment/Decrement Switch

The Engine Idle Increment/Decrement Switch (7), (Figure 3-4) located on the left side of the front console, is used to set the engine idle operating speed. Each push of the top of the switch (+) increases engine idle speed by 25 rpm to a maximum of 800 rpm. Each push of the bottom of the switch (-) decreases engine idle speed by 25 rpm to a minimum of 600 rpm. Idle speed will revert to the factory setting two minutes after shutting the engine down.

## Remote Control ON/OFF Switch

The Remote Control ON/OFF Switch (8), (Figure 3-4) is on the left side of the console. Push the top of the switch to enable the hand-held remote control.

## Remote Control Indicator

The Remote Control Indicator (amber) (9), (Figure 3-4) will illuminate solid when the remote control switch is ON and permissions for enabling have been met. It will flash if the switch is ON but all permissions have not been met.

## ABS/ATC Switch

The Anti-Lock Braking System/Automatic Traction Control (ABS/ATC) Switch (10), (Figure 3-4) is on the bottom left row of the front console. The top half of this switch is used for ABS fault code diagnosis. The bottom deactivates the ATC for off-road operation.

The switch is programmed for momentary operation. ATC reverts to normal operation when the switch is cycled a second time and whenever the system goes through a power-up cycle. See *Anti-Lock Brake System (ABS)*, page 4-11 or *Automatic Traction Control (ATC) Functional Overview*, page 4-12 for more information on the operation of these switches.

## Hill Start Aid (HSA) Switch (Optional)

The HSA Switch (11), (Figure 3-4) is located on the lower left of the console. Push the top of the switch to de-activate the HSA system. Refer to *Hill Start Aid (HSA) (Optional)*, page 4-31.

**NOTE:** The HSA Switch and Indicator are for the Automated Transmission.

## HSA Indicator (Optional)

The Hill Start Aid (HSA) Indicator (12), (Figure 3-4) illuminates amber when the HSA system is inactive.

## Inter-Axle Lock Switch

The Inter-Axle Differential Lock Switch (13), (Figure 3-4) is located on the left side of the front console. In the lock (press top of switch) position, both rear axles are locked together and turning at the same speed. In the unlocked (press bottom of switch) position, the axles operate independently of each other.

---

### CAUTION

Do not operate the inter-axle lock on dry roads as damage could occur.

---

## Cross-Axle Lock Switch (Optional)

The Cross-Axle Lock Switch (14), (Figure 3-4) is located on the left side of the front console and is used to lock the right and left wheels in a tandem set. The cross-axle lock increases traction on slippery roads. It is a two position lock/unlock switch. Press top of switch for the lock position or bottom of switch for the unlock position.

---

### CAUTION

Do not operate the cross axle lock while crane wheels are spinning or at speeds over approximately 16 km/h (10 mph) as damage may occur.

---

## Suspension Inflation Switch

The Suspension Inflation Control Switch (15), (Figure 3-4) is located on the left side of the console. Push the top of the

switch to inflate the suspension air bags. Push the bottom of the switch to deflate the suspension air bags.

**NOTE:** The suspension air bags should be inflated at all times except when on outriggers, or when traveling at less than 4 km/h (2.5 mph) on job site.

**NOTE:** While the superstructure key switch is on, the suspension solenoid will be energized, deflating the air bags regardless of the carrier cab rocker switch position.

### Tire Inflation Switch

The Tire Inflation Switch (16), (Figure 3-4) is located on the left side of the console. It is a two position switch that activates the tire inflation system. Push the top of the switch to activate the tire inflation system. An amber indicator will illuminate and a warning buzzer will sound when the switch is in the ON position.

### Heater/Air Conditioner Fan Switch

The Heater/Air Conditioner Fan Switch (17), (Figure 3-4) is located on the right of the console. The switch controls the speed which in turn regulates the volume of air output of the heater and air conditioner fan by positioning switch to one of three speeds.

### Heater/Air Conditioner Control

The Heater/Air Conditioner Control (18), (Figure 3-4) is located on the right side of the console. Turn the knob fully to the right for maximum heat and turn the knob fully to the left for maximum cooling.

### Heater/Air Conditioner Select Switch

The Heater/Air Conditioner Select Switch (19), (Figure 3-4) is located on the right side of the console. Turn the switch straight up for heater or to the right for air conditioner.

### Ignition Switch

The Ignition Switch (20), (Figure 3-4) is located on the right side of the front console. The switch is key operated with three positions: OFF (vertical position), IGN (position between vertical and right), and START (right position).

With ignition switches in both cabs in the OFF position, all electrical power is off except for the headlights, marker lights,

gauge lights, turn and stop light, carrier and superstructure cab dome lights, superstructure cab work lights, and carrier horn when one of these battery hot functions are on.

The IGN position energizes all electrical components including the engine ECM. The START position energizes the starter relay which in turn energizes the cranking motor solenoid and cranks the engine for starting. The switch will return to IGN when the switch is released after the engine is started. Turn the switch to OFF to shut down the engine.

### Parking Brake Control

**NOTE:** The parking brake must be set before the outrigger controls will operate.

The Parking Brake Control (21), (Figure 3-4) is located on the right side of the front console. The control is a push-pull type air valve used to apply and release the parking brakes on all four rear wheels. Push to release the parking brakes, pull to apply the parking brakes.

### Dual Air Pressure Gauge

The Dual Air Pressure Gauge (22), (Figure 3-4) is located on the right side of the front console. The gauge is a direct reading pressure gauge with two indicating pointers, red for the primary system and green for the secondary system. The gauge has a dual scale calibrated from 100 to 1000 kPa and 0 to 150 psi. The gauge is connected to each air system separately through tubing.

### Trailing Boom Air Supply Control (Optional)

The Trailing Boom Air Supply (Trailer Emergency) brake control (23), (Figure 3-4) is a push-pull type air valve located on the right side of the front console. The control is used to set and release the brakes on the trailing boom dolly. Push the control to release the brakes, pull the control out to apply the brakes.

### Control Panel Indicator and Gauge Display

The Control Panel Indicator and Gauge Display (24), (Figure 3-4) and detailed in (Figure 3-5) is located in the center of the front console. It includes indicator lamps and gauges that provide information on the engine, transmission, brakes, and other systems.

**CARRIER CAB CONTROL PANEL  
INDICATOR AND GAUGE DISPLAY**

As a system check, the indicators will come on for two seconds when the ignition switch is turned to the RUN position, also called IGN.

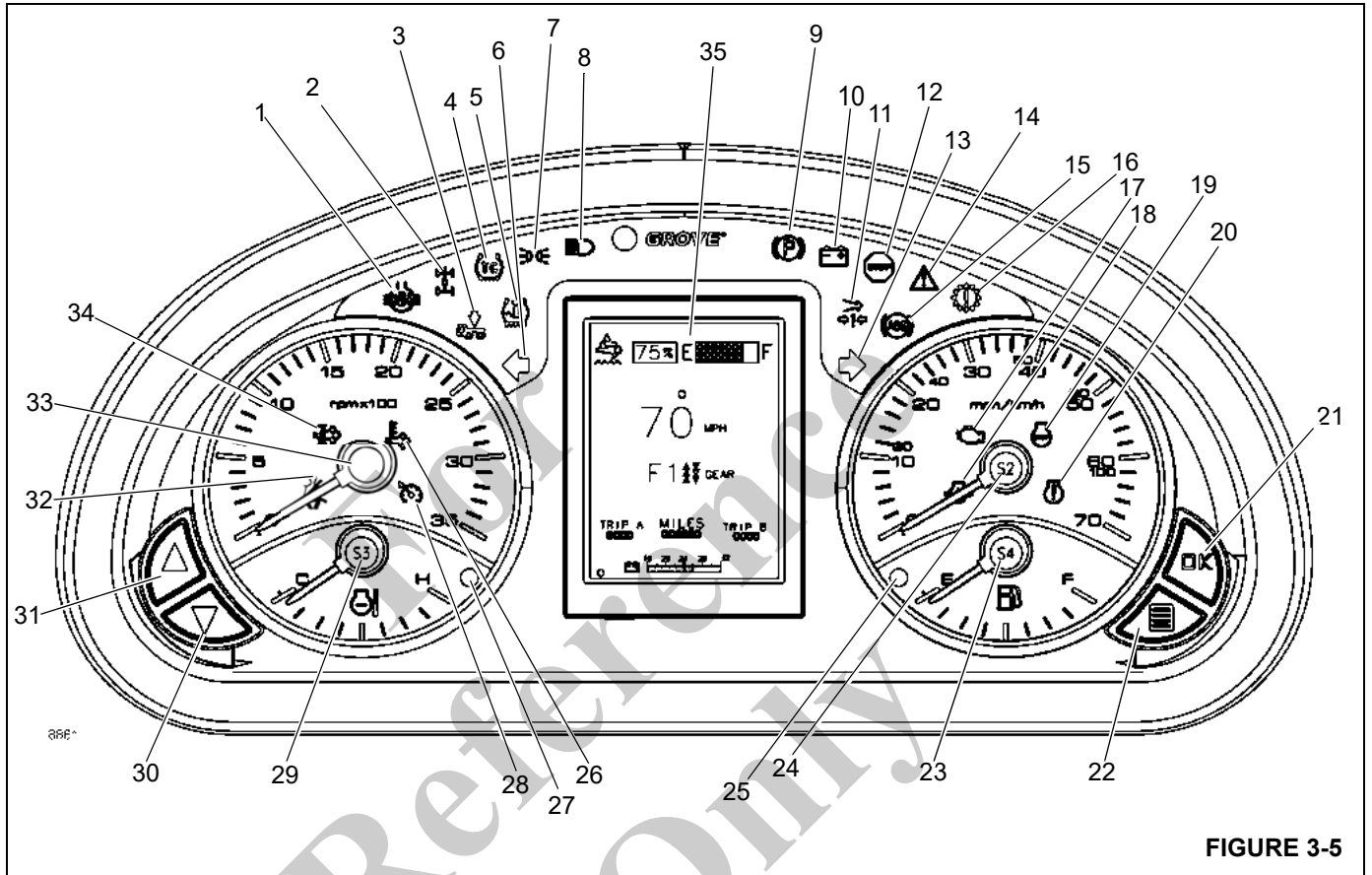


FIGURE 3-5

3

| ITEM | DESCRIPTION                                                 | INDICATOR COLOR |
|------|-------------------------------------------------------------|-----------------|
| 1    | Cross-Axle Locked Indicator / Differential Locked Indicator | AMBER           |
| 2    | Inter-axle Locked Indicator                                 | AMBER           |
| 3    | Suspension Deflated Indicator                               | AMBER           |
| 4    | Traction Control Indicator                                  | AMBER           |
| 5    | Tire Inflation ON Indicator                                 | AMBER           |
| 6    | Left Turn Signal Indicator                                  | GREEN           |
| 7    | Lights ON Indicator                                         | GREEN           |
| 8    | High Beam Indicator                                         | BLUE            |
| 9    | Park Brake Engaged Indicator                                | RED             |
| 10   | Battery Charge Indicator                                    | RED             |
| 11   | Low Air Pressure Indicator                                  | AMBER           |
| 12   | Emergency Stop Indicator                                    | RED             |
| 13   | Right Turn Signal Indicator                                 | GREEN           |
| 14   | System Fault Indicator                                      | AMBER           |
| 15   | Anti-lock Braking System (ABS) Indicator                    | AMBER           |
| 16   | Check Transmission Indicator                                | RED             |
| 17   | Malfunction Indicator Lamp (MIL)                            | AMBER           |

| ITEM | DESCRIPTION                               | INDICATOR COLOR |
|------|-------------------------------------------|-----------------|
| 18   | Low Oil Pressure Indicator                | RED             |
| 19   | Engine Stop Indicator                     | RED             |
| 20   | Engine Warning Indicator                  | AMBER           |
| 21   | OK Button                                 | NONE            |
| 22   | Menu Button                               | NONE            |
| 23   | Fuel Level Gauge Indicator                | NONE            |
| 24   | Speedometer                               | NONE            |
| 25   | Low Fuel Level Indicator                  | AMBER           |
| 26   | High Exhaust System Temperature Indicator | AMBER           |
| 27   | Engine Temperature Indicator              | RED             |
| 28   | Cruise Control Indicator                  | AMBER           |
| 29   | Engine Coolant Temperature Gauge          | AMBER           |
| 30   | Down Button                               | NONE            |
| 31   | Up Button                                 | NONE            |
| 32   | Seat Belt Unfastened Indicator            | AMBER           |
| 33   | Tachometer                                | RED at 2600     |
| 34   | Exhaust System Cleaning Needed Indicator  | AMBER           |
| 35   | LCD Display                               |                 |

### Cross-Axle Locked Indicator

The Cross-Axle Locked Indicator (1), (Figure 3-5) (aka Differential Locked Indicator) is located at the left side of the gauge cluster. The indicator illuminates Amber to show that the differential is locked.

### Inter-Axle Locked Indicator

The Inter-Axle Locked Indicator (2), (Figure 3-5) is located at the left side of the gauge cluster. The indicator illuminates Amber to show that the inter-axle is locked.

### Suspension Deflated Indicator

The Suspension Deflated Indicator (3), (Figure 3-5) is located on the left side of the gauge cluster. The Amber indicator illuminates when the air is removed from the suspension air bags.

### Traction Control Indicator

The Traction Control Indicator Lamp (4), (Figure 3-5) is the primary indicator of the traction control status.

- Lights at key-ON and turns off after a two second lamp check. Traction control is active after the lamp check.
- Flashes rapidly when traction control is operating.
- Flashes slowly when the off-road mode is selected and then flashes more rapidly when the automatic traction control system operates.
- Remains ON if an engine data link failure occurs.

**NOTE:** The parking brake must be set before the outrigger

### Tire Inflation ON Indicator

The Tire Inflation ON Indicator (5), (Figure 3-5) is located on the left side of the gauge cluster. The indicator illuminates Amber when the pressure switch in the tire inflation system is activated. In addition to illuminating the indicator, a warning buzzer will sound.

### Left Turn Signal Indicator

The Left Turn Signal Indicator (6), (Figure 3-5) is located on the left side of the gauge cluster. It is a Green indicator light that flashes when the turn signal lever or hazard switch is activated.

### Lights ON Indicator

The Lights ON Indicator (7), (Figure 3-5) is located on the left side of the gauge cluster. It illuminates Green when the headlights or marker lights are on.

### High Beam Indicator

The Headlight High Beam Indicator (8), (Figure 3-5) is located at the top left center of the gauge cluster. The indicator illuminates Blue when the headlights are on high beam.

### Parking Brake Engaged Indicator

The Parking Brake Engaged Indicator (9), (Figure 3-5) is located at the top right of the gauge cluster. The indicator illuminates Red when the crane parking brakes are applied.

controls will operate.



### Battery Charge Indicator

The Battery Charge Indicator (10), (Figure 3-5) will illuminate Red when any of the following conditions are met, key switch is OFF but the headlights or turn signals are left on, the key switch is turned to the IGNITION position, the engine is running and the alternator charge signal is missing, or the system battery voltage or engine ECM voltage falls below 18V or goes above 30V. If both the carrier and superstructure key switches are OFF this light will not be on.

### Low Air Pressure Indicator

The Low Air Pressure Indicator (11), (Figure 3-5) is located on the right side of the gauge cluster. It illuminates Red when the pressure in the dual accumulator charge valve falls below normal operating requirements. A warning buzzer will also sound.

### Emergency Stop Indicator

The Emergency Stop Indicator (12), (Figure 3-5) is located on the right side of the gauge cluster. It illuminates Red when the Emergency Stop Switch is pushed in (refer to Emergency Stop Switch, page 3-16) and a warning buzzer will sound.

### Right Turn Signal Indicator

The Right Turn Signal Indicator (13), (Figure 3-5) is located on the right side of the gauge cluster. It is a Green indicator light that flashes when the turn signal lever or hazard switch is activated.

### System Fault Indicator

The System Fault Indicator (14), (Figure 3-5) is located on the right side of the gauge cluster. It illuminates amber when any crane system fault is active.

### Anti-Lock Braking System (ABS) Indicator

The Anti-Lock Braking System (ABS) Indicator Lamp (15), (Figure 3-5) is the primary indicator of the ABS status.

- The ABS lamp illuminates steadily for a two second lamp check whenever the ignition is switched ON. The lamp will remain ON until the brake pedal has been pressed and the system senses the activation.
- If the indicator lamp remains ON, after the lamp check, there is an ABS diagnostic trouble code that requires service. This lamp will blink the diagnostic fault codes when the ECU is in the self-diagnostic mode.

**NOTE:** In the case of a speed sensor failure which has been corrected, the indicator lamp will remain on until sensor output has been verified by the control unit. In this case it is necessary to move the vehicle above 5 mph before the indicator lamp will turn off.

### Check Transmission Indicator (Automated Transmission Only)

The Check Transmission Indicator (16), (Figure 3-5) is located on the right side of the gauge cluster. It illuminates Red when commanded by the TCU (transmission control unit) via SAE J1939 serial communications. A warning buzzer will also sound.

### Malfunction Indicator Lamp (MIL)

The Malfunction Indicator Lamp (MIL) (17), (Figure 3-5) illuminates Amber when there is an emission related system error. When this indicator illuminates have the crane serviced as soon as possible.

Note that, per EPA requirement, the MIL will stay illuminated until three successful cycles have occurred after the fault is cleared. If neither the Engine Stop nor the Engine Warning lamp is illuminated but the MIL is illuminated, the fault is no longer valid and the vehicle is attempting to get three successful cycles.

### Low Oil Pressure Indicator

The Low Oil Pressure Indicator (18), (Figure 3-5) is located in the speedometer. It illuminates Red as commanded by the engine ECM via SAE J1939 serial communications.

### Engine Stop Indicator

The Engine Stop Indicator (19), (Figure 3-5) is located in the speedometer. The indicator illuminates Red when energized by a signal from the engine ECM that signifies a serious engine problem that requires the vehicle and the engine to be stopped as soon as safely possible. In addition, a warning buzzer will also sound.

When either the engine red stop lamp or amber warning lamp is on solid or flashing, an engine fault code will be available on the superstructure cab Operating Display. This code will be a SAE J1939 SPN, accompanied with an engine manufacturer FMI (Failure Mode Identifier) value. With these two values the exact engine fault code may be looked up through engine manufacturer documentation or by contacting Manitowoc Crane Care.

### Engine Warning Indicator

The Engine Warning Indicator (20), (Figure 3-5) is located in the speedometer. It illuminates Amber when energized by a signal from the engine ECM that signals the operator of an engine problem which must be corrected.

### OK Button

The OK Button (21), (Figure 3-5) is used to accept the current display screen on the LCD display.

## Menu Button

The Menu Button (22), (Figure 3-5) is used to scroll through the LCD display screens.

## Fuel Level Gauge Indicator

The Fuel Level Gauge Indicator (23), (Figure 3-5) is located on the right side of the gauge cluster. The gauge indicates the quantity of fuel in the fuel tank and has a scale calibrated from E (Empty 0%) to F (Full 100%). The fuel gauge receives a signal from the engine ECM via SAE J1939 serial communications.

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### CAUTION

#### Engine Damage Hazard!

Ultra low sulfur diesel fuel is required in On-Highway engines.

If "Ultra Low Sulfur" fuel is not used in engines that require it, the Cummins warranty will be void and the engine performance will quickly deteriorate and may stop running.

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## Speedometer

The Speedometer (24), (Figure 3-5) is located on the right side of the gauge cluster. The speedometer indicates road speed in both kph (kilometers per hour) and mph (miles per hour).

## Low Fuel Level Indicator

The low Fuel Level Indicator (25), (Figure 3-5) illuminates Amber when the fuel level goes below 45 L (12 gal). This is based on calculated fuel level from engine ECM

## High Exhaust System Temperature Indicator

The High Exhaust System Temperature (HEST) Indicator (26), (Figure 3-5) illuminates Amber and is located in the tachometer.



### WARNING

#### Extreme Heat Hazard!

During the cleaning process the exhaust becomes very hot. Do not park the vehicle near objects that are flammable.

Use caution near the exhaust tailpipe as it will also become very hot.

During cleaning it is possible for the engine exhaust to reach temperatures exceeding 649°C (1200°F). The HEST indicator will illuminate red to warn the operator of when

temperatures reach 640°C (1184°F) and will stay on until the temperature falls below 625°C (1157°F).

For more information on the cleaning process, refer to *Exhaust System Cleaning Indicator*, page 3-12

## Engine Temperature Indicator

The Engine Temperature Indicator (27), (Figure 3-5) is located in the temperature gauge. The indicator illuminates red when the cooling system water temperature reaches 107°C (225°F). This indicator is controlled by a multiplexed message from the engine ECM.

## Cruise Control Indicator

The Cruise Control Indicator (28), (Figure 3-5) is located in the tachometer. The indicator illuminates Amber when the cruise control system is active.

**NOTE:** Cruise control is not operational below 56 km/h (35 mph).

## Engine Coolant Temperature Gauge

The Engine Coolant Temperature (TEMP) Gauge (29), (Figure 3-5) is located on the lower left of the gauge cluster. The gauge illuminates Amber and indicates the engine coolant temperature on a scale from cold (C) to hot (H). The gauge is controlled by a multiplexed message from the engine ECM.

## Down Button

The Down Button (30), (Figure 3-5) is used to scroll down through the screens on the LCD display.

## Up Button

The Up Button (31), (Figure 3-5) is used to scroll up through the screens on the LCD display.

## Seat Belt Unfastened Indicator

The Seat Belt Unfastened Indicator (32), (Figure 3-5) is located in the tachometer. The indicator illuminates Amber when the ignition is on and the seat belt is not fastened. A buzzer will sound until the seat belt is fastened.

## Tachometer

The Tachometer (33), (Figure 3-5) is located on the left side of the gauge cluster. The Tachometer is calibrated in RPM x 100 with a range of zero (0) to 35. The gauge is controlled by a multiplexed message from the engine ECM and illuminates Red at 2600.

## Exhaust System Cleaning Indicator

The Exhaust System Cleaning Needed Indicator (34), (Figure 3-5) is located in the Tachometer. This indicator

illuminates Amber when the exhaust system is in need of cleaning.

The indicator will be lit continuously during the early stages of required cleaning. If this condition continues, the lamp will begin to flash and a slight engine derate will occur.

If this condition continues further, the Engine Warning Indicator (20), (Figure 3-5) will illuminate in addition to the Cleaning Indicator (33), (Figure 3-5) and a severe engine derate will occur.



## WARNING

### Extreme Heat Hazard!

During exhaust system cleaning, exhaust temperatures may reach 800°C (1500°F) which is hot enough to ignite or melt common materials. Do not park the vehicle near combustible materials and keep all materials at least 0.6 m (2 ft) away from the exhaust outlet.

Use caution near the exhaust tailpipe as it will also become very hot.

The only way in which either of these conditions can occur is if cleaning has been inhibited or a manual cleaning was interrupted. Refer to *Exhaust System Cleaning Initiate Switch*, page 3-7, for more detail on these.

The cleaning process can take place in three different modes:

**Passive:** The exhaust is hot enough during normal working operation to burn off any hydrocarbon (soot) accumulation.

**Active:** Active cleaning occurs when there is not sufficient heat in the exhaust to perform the cleaning operation when it is required. Exhaust temperatures are raised by the system sufficiently high to enable a cleaning to occur. This is all done without any operator intervention.

**Manual:** Manual or stationary, cleaning is the same as active cleaning but takes place while the equipment is not being operated. It offers the equipment operator the option, if needed, of performing cleaning outside the normal duty cycle. When the Cleaning Switch (6), (Figure 3-4) is momentarily placed in the manual cleaning position, manual cleaning is initiated.

## LCD (Display)

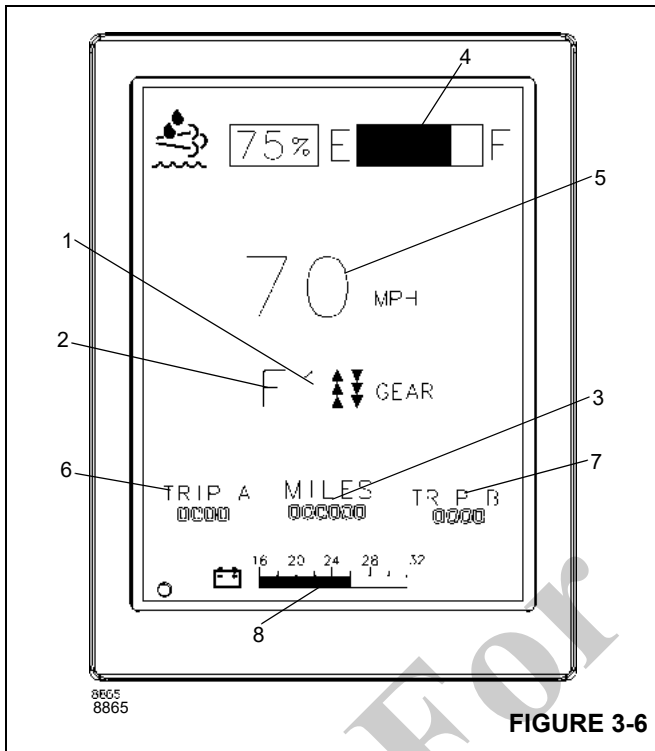
The LCD (Display) (35), (Figure 3-5) includes the following:

- Diesel Exhaust Fluid (DEF) percent/gauge
- Vehicle speed
- Transmission gear (automatic transmission only)
- Battery voltage level

- Depending on which screen is active
  - Odometer
  - Engine hours
  - Reset trip odometer A
  - Reset trip odometer B
  - Units of measure
  - Brightness of display
  - Cluster software version

Use the Up and Down buttons (Figure 3-5), Items 30 and 31) along with the Menu and OK buttons (Figure 3-5), Items 21 and 22) to open the various screens and options available. The following procedures will access the various options:

- At any time, pressing and holding the Menu button the display will return to the default Main Screen with Odometer.
- Pressing and holding the OK button will switch between Main Screen with Odometer and Main Screen with Engine Hours.
- Pressing the Up/Down buttons will scroll the Reset Trip A/Reset Trip B/Units/Brightness/Software Version. With the Reset Trip A option displayed, pressing and holding the OK button will reset the Trip A value.
- Pressing the Up/Down buttons will scroll the Reset Trip A/Reset Trip B/Units/Brightness/Software Version. With the Reset Trip B option displayed, pressing and holding the OK button will reset the Trip B value.
- Pressing the Up/Down buttons will scroll the Reset Trip A/Reset Trip B/Units/Brightness/Software Version. With the Units option displayed, pressing and holding the OK button will reset the Units value.
- Pressing and holding OK button a line appears below brightness value, so brightness is in Edit Mode.
- **Edit Mode:**
  - Pressing Up/Down buttons brightness value will change.
  - Press and hold OK button brightness value will be saved and the display will exit from Edit Mode.
  - Keeping the Menu button pressed, brightness value will be discarded and the display will exit from Edit Mode.
- Pressing Up/Down buttons scroll to SW Version. The software version will be displayed as four individual numbers.



| Item | Description                                                                                                          |
|------|----------------------------------------------------------------------------------------------------------------------|
| 3    | Odometer, Engine Hours, Reset Trip A, Reset Trip B, Units of Measure, Brightness of Display, Master Software Version |
| 4    | DEF Level/Gauge                                                                                                      |
| 5    | Speedometer                                                                                                          |
| 6    | Trip A Distance Traveled                                                                                             |
| 7    | Trip B Distance Traveled                                                                                             |
| 8    | Voltmeter                                                                                                            |

| Item | Description                                               |
|------|-----------------------------------------------------------|
| 1    | Transmission Gear (Auto Transmission Only)                |
| 2    | Forward or Reverse, Transmission (Auto Transmission Only) |

Reference Only

**OUTRIGGER CONTROLS AND INDICATORS**

The following paragraphs describe the additional controls and indicators located on the carrier to operate the

outriggers. The numbers in parentheses in each paragraph represents the index number from the outrigger panel illustration (Figure 3-7).

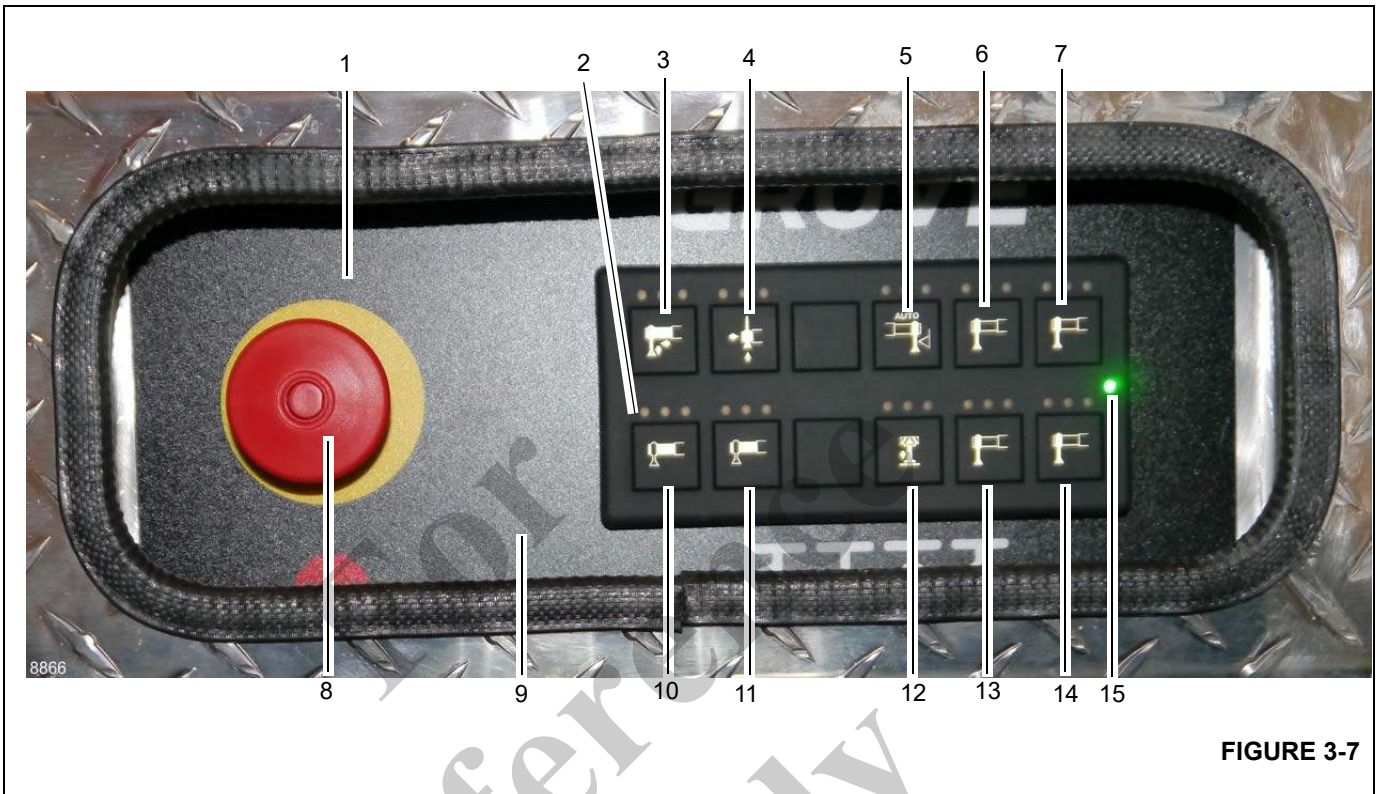


FIGURE 3-7

| Item | Description                                               |
|------|-----------------------------------------------------------|
| 1    | Outrigger Control Panel                                   |
| 2    | Outrigger Operation Indicator Lights (Green, Yellow, Red) |
| 3    | Extend Push Button                                        |
| 4    | Retract Push Button                                       |
| 5    | Auto-Level Push Button                                    |
| 6    | Jack Selector Front Right Push Button                     |
| 7    | Jack Selector Rear Right Push Button                      |
| 8    | Emergency Stop Switch                                     |
| 9    | Bubble-Level Indicator (Not Shown)                        |
| 10   | Outrigger Front Beam Selector Push Button                 |
| 11   | Outrigger Rear Beam Selector Push Button                  |
| 12   | Center Front Stabilizer (CFS) Push Button                 |
| 13   | Jack Selector Front Left Push Button                      |
| 14   | Jack Selector Rear Left Push Button                       |
| 15   | Keypad Power Indicator Light                              |

**Outrigger Control Summary**

**NOTE:** The two ground outrigger control panels **ONLY** operate when the carrier ignition is ON and the parking brake is set. The operator can only operate the outrigger beams on the side he/she is operating from. The jacks can be operated from either side.

There is an outrigger control panel located on each side of the crane carrier. Each control panel contains push buttons for extending and retracting the outrigger beams on that side of the crane, and for raising and lowering the outrigger jack cylinders on both sides of the crane. Each control panel also contains a control push button for raising and lowering the center front stabilizer.

A push button emergency stop switch (8), (Figure 3-7) is installed on the panel.

A bubble level indicator (not shown) (9), (Figure 3-7) is installed at the bottom of the outrigger panel.

**NOTE:** Outrigger functions on the controller are deactivated when the emergency stop switch is activated, which also turns off the engine and all hydraulic functions.

## Outrigger Control Panel

There is one Outrigger Control Panel (1), (Figure 3-7) on each side of the crane's frame. The panel on the right side operates the outrigger beams for that side only. The panel on the left side operates the outrigger beams for that side only. The jacks may be operated from the left or right side of the crane.

The Green LED (15), (Figure 3-7) illuminated is the keypad "Power" LED meaning that the keypad is properly powered (power and ground).

### Outrigger Beam Selector Push Buttons (Front/Rear)

The Outrigger Beam Selector Push Buttons (Front and Rear) (10 and 11), (Figure 3-7) are used to select the desired operation of the front or rear outrigger beams for the side of the unit the control panel is on.

### Extend Push Button

The Extend Push Button (3), (Figure 3-7) will operate both the outrigger beams or the jacks. While depressing the desired combination of selector buttons, pushing the Extend Push Button will move the selected component in the extend direction.

**NOTE:** More than one selector may be operated concurrently, and the selector must be depressed and held while the Extend Push Button is depressed.

### Center Front Stabilizer (CFS) Push Button



When Cribbing Mode is **NOT** active, the Center Front Stabilizer will retract automatically when any main outrigger jack is retracted. Continued operation without resetting the center front stabilizer could result in loss of stability.

Always reset the center front stabilizer after adjusting the main outriggers.

The Center Front Stabilizer Push Button (12), (Figure 3-7) is located in the center of the outrigger control panel. It must be used in conjunction with the Extend (3), (Figure 3-7) and Retract (4), (Figure 3-7) Push Buttons to control the operation of the Center Front Stabilizer. The Center Front Stabilizer will retract automatically when **NOT** in the Cribbing Mode. For additional information on Cribbing Mode, refer to *Methods and Requirements for Activating Cribbing Mode*, page 4-35 and/or *Methods and Requirements for Activating Cribbing Mode*, page 4-35.

If any of the other four jacks are retracted, it must be reset if lifting is to be continued. Refer to *Methods and*

*Requirements for Activating Cribbing Mode*, page 4-35; and *Activating Cribbing Mode from Outrigger Keypads*, page 4-36; and/or *Activating Cribbing Mode from Superstructure Cab ODM*, page 4-37.

## Cribbing Mode

Under normal outrigger operations, the Center Front Stabilizer (CFS), (12), (Figure 3-12) will automatically retract upon any of the outrigger jacks being retracted. Cribbing mode allows the CFS to remain extended while retracting the front outrigger jacks, allowing for additional cribbing. Refer to *Methods and Requirements for Activating Cribbing Mode*, page 4-35 and *Activating Cribbing Mode from Outrigger Keypads*, page 4-36.

## Two Methods for Activating Cribbing Mode

There are two methods for activating the Cribbing Mode:

1. Using the Carrier Outrigger Keypad Center Front Stabilizer (CFS) Push Buttons.

OR

2. Navigating the Superstructure Cab ODM Outrigger Screen and selecting the Cribbing Mode Icon.

For additional information on the Cribbing Mode and the two Methods for Activating Cribbing Mode, refer to *Methods and Requirements for Activating Cribbing Mode*, page 4-35.

### Jack Selector Push Buttons (Front/Rear)

The Jack Selector (Front/Rear) Left and Right Push Buttons (6, 7, 13, and 14), (Figure 3-7) selects which jack is to be operated.

### Emergency Stop Switch

The Emergency Stop Switch (8), (Figure 3-7) is located on the left center side of the outrigger panel. Push the switch to stop the engine and all hydraulic functions.

Pulling the switch out, will allow the crane to return to normal operating conditions.

**NOTE:** If the emergency stop switch on either outrigger control panel or in the superstructure cab is not pulled out for normal operation, the emergency stop indicator in the carrier cab will illuminate red, a buzzer will be turned on, and the engine will be shut down (if running) and starting prohibited.

### Retract Push Button

The Retract Push Button (4), (Figure 3-7) will operate both the outrigger beams or the jacks. While depressing the desired combination of selector push buttons, pushing the Retract Push Button will move the selected component in the retract direction.

**NOTE:** More than one selector button may be operated concurrently, and the selector button must be depressed and held while the Retract Push Button is depressed. The center front stabilizer will automatically retract when any other main jack is retracted when Cribbing Mode is **NOT** active.

### **Outrigger Keypad Power Indicator**

The Power Indicator (15), (Figure 3-7) illuminates green when power is available to the control panel.

### **Auto-Level Push Button**

The Auto-Level Push Button (5), (Figure 3-7) is used to automatically level the crane. The auto leveling algorithm adjusts the crane carrier angle while retracting the outrigger jacks. Thus, it is necessary to fully extend the outrigger jacks prior to pushing the auto level button.

To activate auto level, press and hold the auto level button and the retract button. The system will make a series of retracting movements of the outrigger jacks, pausing between each movement to assess the levelness of the crane. When the movements have been completed, verify visually that all tires are off the ground. If any of the tires have made contact with the ground, consider adding cribbing under the outriggers, or leveling the crane manually.

Also refer to *Auto-Level Procedure from Carrier / Superstructure (ODM)*, page 4-40.

**NOTE:** The auto level should be checked periodically. This procedure should be done by a trained technician using the Crane Service Tool.

### **Bubble-Level Indicator (Not Shown)**

The Bubble-Level Indicator (9), (Figure 3-7) (Not Shown) is located at the bottom of each outrigger control panel. If suspected that the bubble-level indicator is out of adjustment, refer to *Bubble-Level Indicator Adjustment*, page 4-34.

### **Outrigger Operation Indicator Lights**

Each button on the Outrigger Control Panel has three (3) LED lights (2), (Figure 3-7) above it: (one Green; one Yellow; and one Red).

- The Green LED will illuminate when the button is activated and the function is not blocked or no error for that function is active.
- The Yellow LED will illuminate if the button pushed is associated with an output and that output has an error that is active (STB = Short to Battery; STG = Short to Ground; and Over-current OR Open Load/Cable Break).
- The Red LED will illuminate if that button function is blocked or locked out. **NOTE:** There are many different combinations to this blocked or lock-out list.

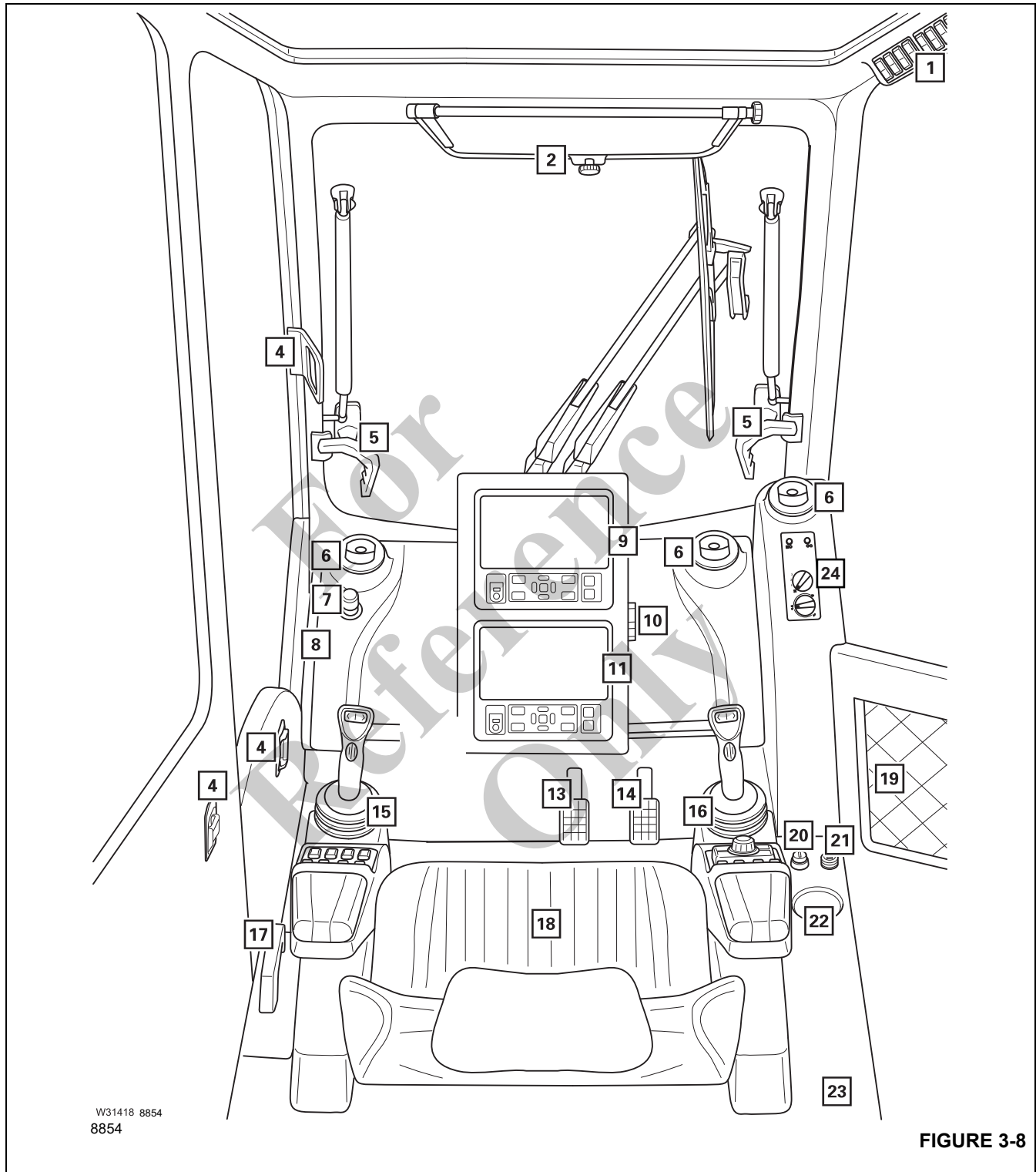
## **SUPERSTRUCTURE CAB**

This section shows the position and designations of the operating elements for crane operation. This also includes display elements such as lights or displays.

**NOTE:** Operating elements available only with optional equipment are designated accordingly. These designations are made in this section only and are not repeated in the following sections.



Superstructure Cab





| Item | Description                    | Refer to   |
|------|--------------------------------|------------|
| 1    | Superstructure Side Panel      | page 3-20  |
| 2    | Sun visor                      |            |
| 3    | Not used                       |            |
| 4    | Inside door operation          | page 3-143 |
| 5    | Lock/unlock windows            | page 3-142 |
| 6    | Air vents                      | page 4-7   |
| 7    | Emergency stop switch          | page 3-11  |
| 8    | Windshield washing system tank | page 3-141 |
| 9    | RCL Display Module (RDM)       | page 3-89  |
| 10   | Adjusting the Front panel      | page 4-44  |
| 11   | Operator Display Module (ODM)  | page 3-27  |
| 12   | Not used                       |            |

| Item | Description                                      | Refer to               |
|------|--------------------------------------------------|------------------------|
| 13   | Swing brake pedal                                |                        |
| 14   | Throttle pedal                                   | page 3-5               |
| 15   | Left-hand control panel                          | page 3-23              |
| 16   | Right-hand control panel                         | page 3-24              |
| 17   | Handle                                           |                        |
| 18   | Superstructure cab seat with Seat contact switch | page 3-39<br>page 4-46 |
| 19   | Stowage Pouch                                    |                        |
| 20   | Ignition Switch                                  | page 3-8               |
| 21   | 24 Volt outlet                                   |                        |
| 22   | Ashtray                                          |                        |
| 23   | Superstructure cab, Rear                         | page 3-22              |
| 24   | Air conditioning system                          | page 4-10              |

For Reference Only

Superstructure Side Panel

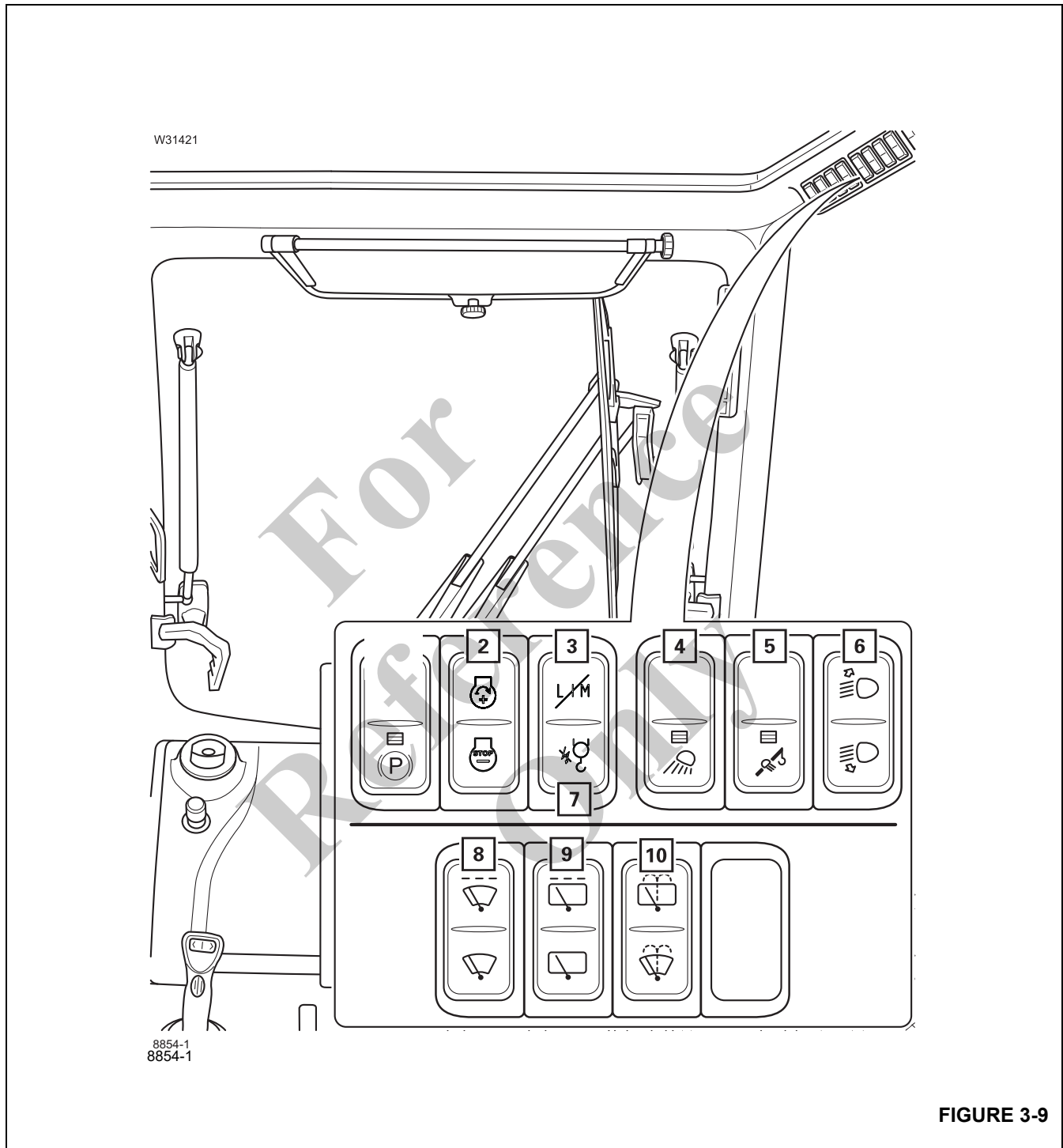


FIGURE 3-9

**Superstructure Side Panel (Continued)**

<sup>2)</sup>Optional equipment

<sup>3)</sup> Anti Two-Block Lockout, Min Wraps Lockout

| Item | Description                               | Refer to   |
|------|-------------------------------------------|------------|
| 1    | Spare                                     |            |
| 2    | RPM Increment/Decrement Switch            | page 3-7   |
| 3    | Limits override <sup>1)</sup>             | page 3-136 |
| 4    | Superstructure Cab Work lights            | page 3-140 |
| 5    | Boom lights                               | page 3-140 |
| 6    | Boom light rotation control <sup>2)</sup> | page 3-140 |
| 7    | Hoist limits override <sup>3)</sup>       | page 3-136 |
| 8    | Windshield wiper on/off                   | page 3-141 |
| 9    | Skylight wiper on/off                     | page 3-141 |
| 10   | Windshield and skylight washer            | page 3-141 |

<sup>1)</sup> RCL lockout, WRL lockout, Carrier Avoidance, Counterweight too Low Lockout, Boom Extension Stowage Lockout, Anti Two-Block Lockout, Minimum Wrap Lockout.

Reference Only

Superstructure Cab, Rear

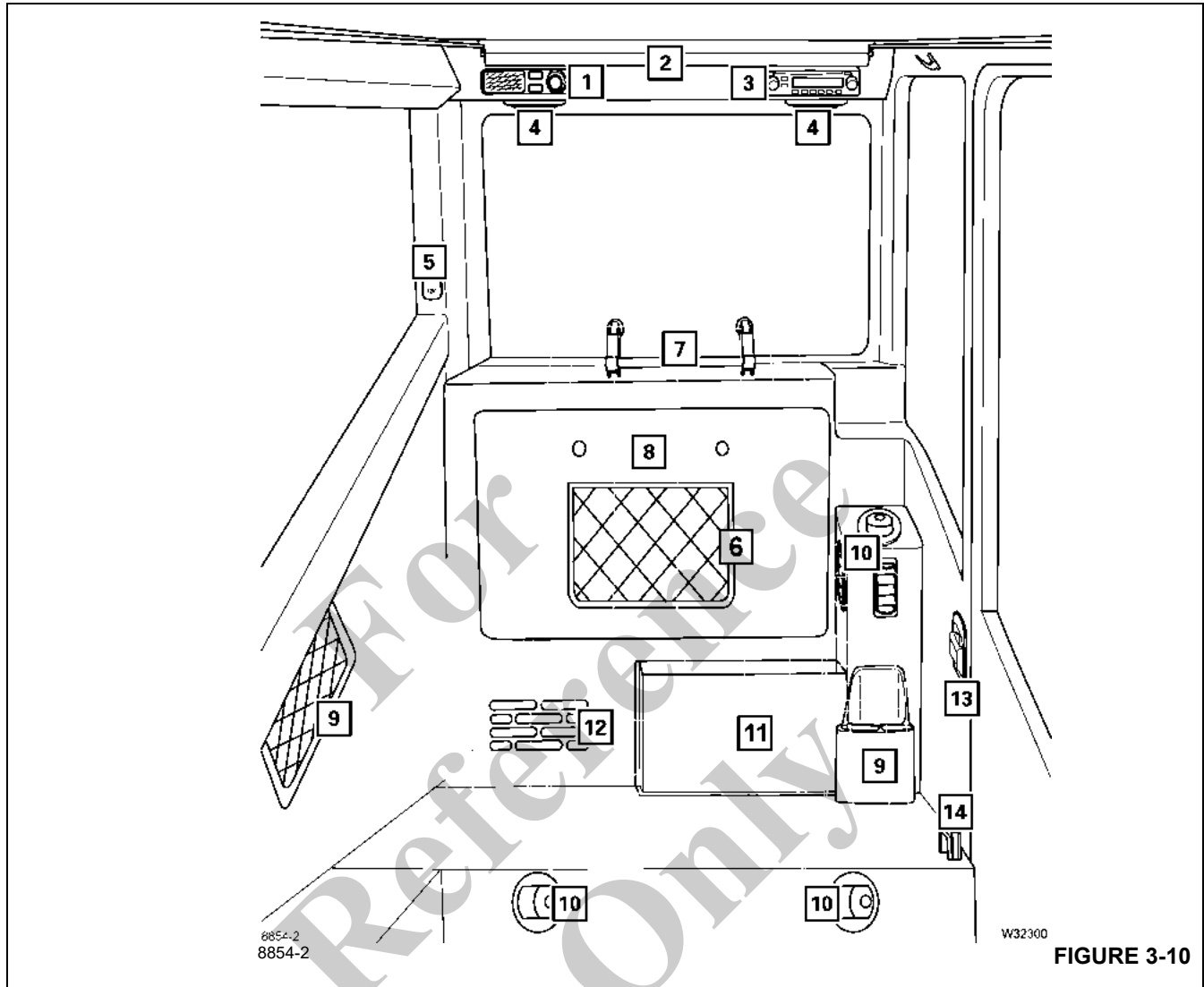


FIGURE 3-10

Table 3-10

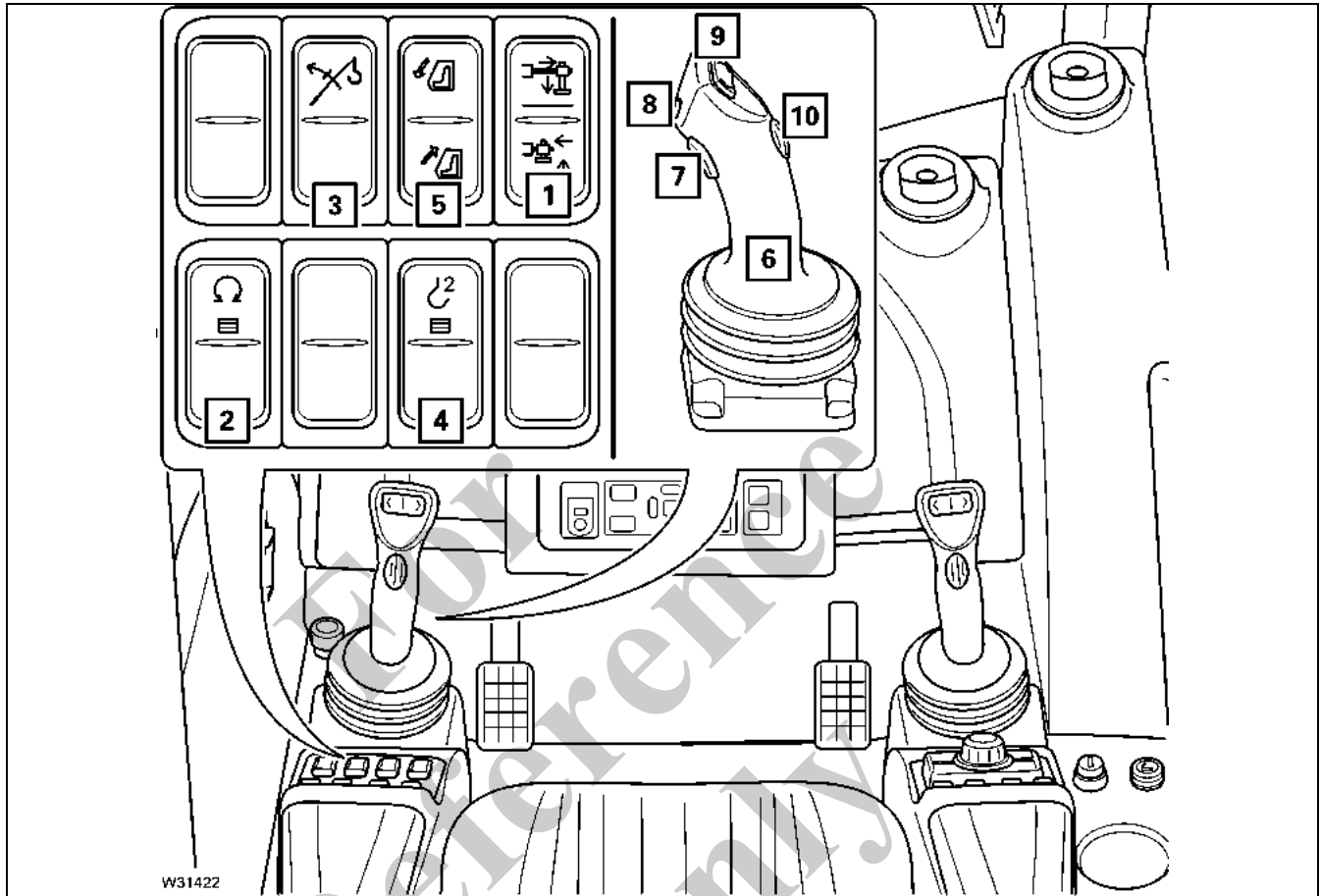
| Item | Description    | Refer to   |
|------|----------------|------------|
| 1    | Cab lighting   | page 3-140 |
| 2    | Sun screen     |            |
| 3    | Radio-CD/USB   |            |
| 4    | Speakers       |            |
| 5    | 12 V outlet    |            |
| 6    | Document Pouch |            |
| 7    | Rear window    | page 3-142 |

| Item | Description                                           | Refer to   |
|------|-------------------------------------------------------|------------|
| 8    | Electrical Panel                                      |            |
| 9    | Cover for:<br>Fuses<br>CraneSTAR system <sup>1)</sup> |            |
| 10   | Air vents                                             | page 4-8   |
| 11   | Document Holder                                       |            |
| 12   | Air vents                                             | page 4-8   |
| 13   | Door unlocking mechanism                              | page 3-143 |
| 14   | Handle                                                |            |

<sup>1)</sup>Optional equipment

Superstructure Control Panels

Left Hand Armrest Controls



W31422  
8854-3  
8854-3

| Item | Description                                                | Refer to   |
|------|------------------------------------------------------------|------------|
| 1    | Button for Outrigger Pre-selection                         | page 3-39  |
| 2    | Swing Enable                                               | page 3-99  |
| 3    | Boom Up Override Switch                                    | page 3-100 |
| 4    | Auxiliary Hoist Enable                                     | page 3-99  |
| 5    | Cab Tilt                                                   | page 3-105 |
| 6    | Left-hand control lever (configuration depends on version) | page 3-99  |
| 7    | Seat Contact Switch and Dead-man Switches                  | page 3-38  |
| 8    | Free Swing                                                 | page 3-99  |
| 9    | Auxiliary Hoist Speed Selection                            | page 3-97  |
| 10   | Auxiliary Hoist Rotation Indicator                         | page 3-99  |

FIGURE 3-11

Right Hand Armrest Controls

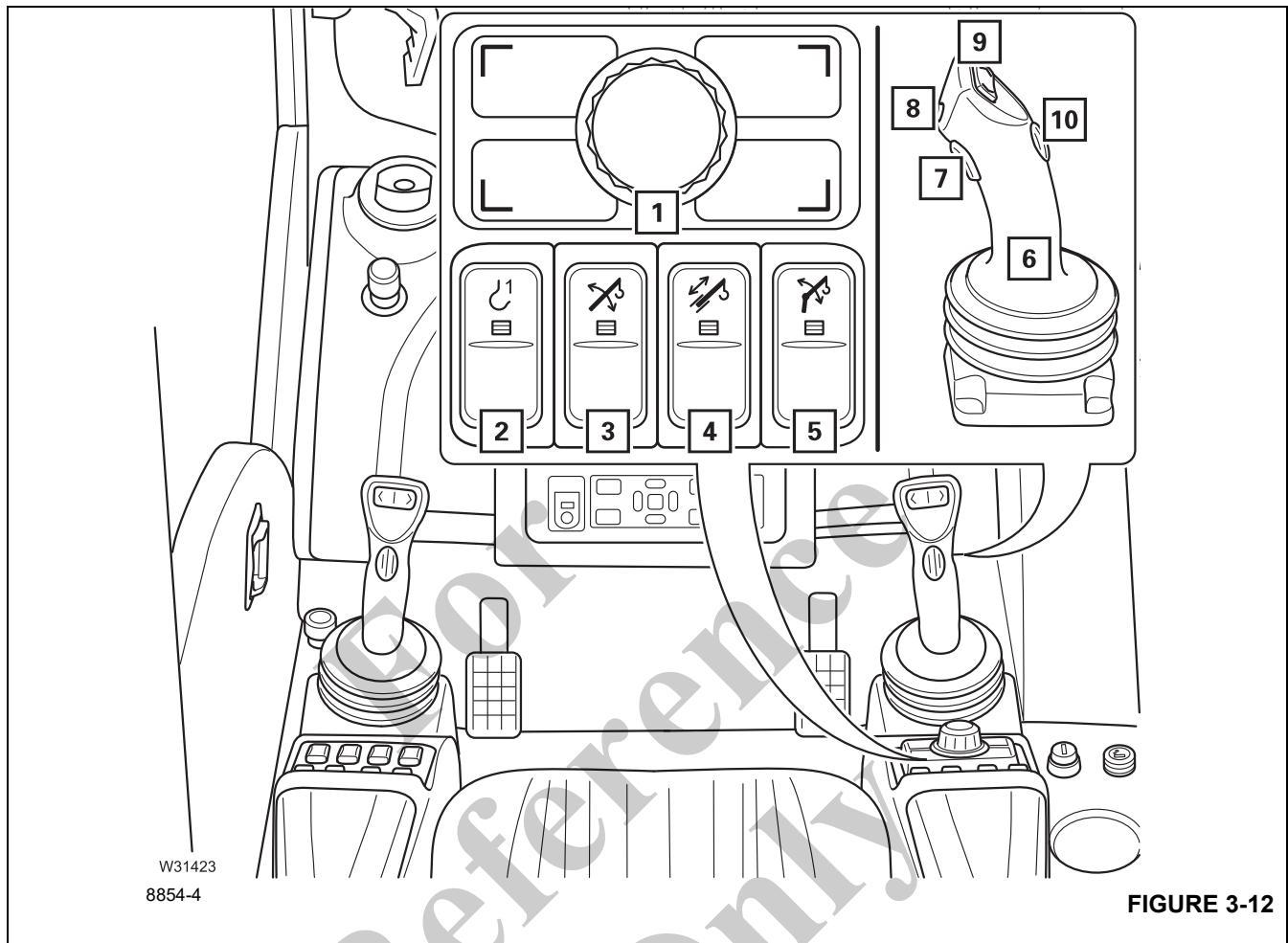


FIGURE 3-12

| Item | Description                                                  | Refer to   |
|------|--------------------------------------------------------------|------------|
| 1    | Jog dial                                                     | page 3-37  |
| 2    | Main hoist enable                                            | page 3-98  |
| 3    | Boom up/down enable                                          | page 3-70  |
| 4    | Telescoping enable                                           | page 3-101 |
| 5    | Hydraulic Offsetable Boom Extension Enable <sup>1), 2)</sup> |            |

| Item | Description                                                 | Refer to   |
|------|-------------------------------------------------------------|------------|
| 6    | Right-hand control lever (configuration depends on version) | See below. |
| 7    | Dead-man switch                                             | page 3-38  |
| 8    | Horn button                                                 |            |
| 9    | Main hoist high-speed mode ON/OFF                           | page 3-97  |
| 10   | Main hoist rotation indicator                               | page 3-98  |

<sup>1)</sup>Optional equipment

<sup>2)</sup>Setting an Angle between 0° and 45°

Superstructure Control Levers

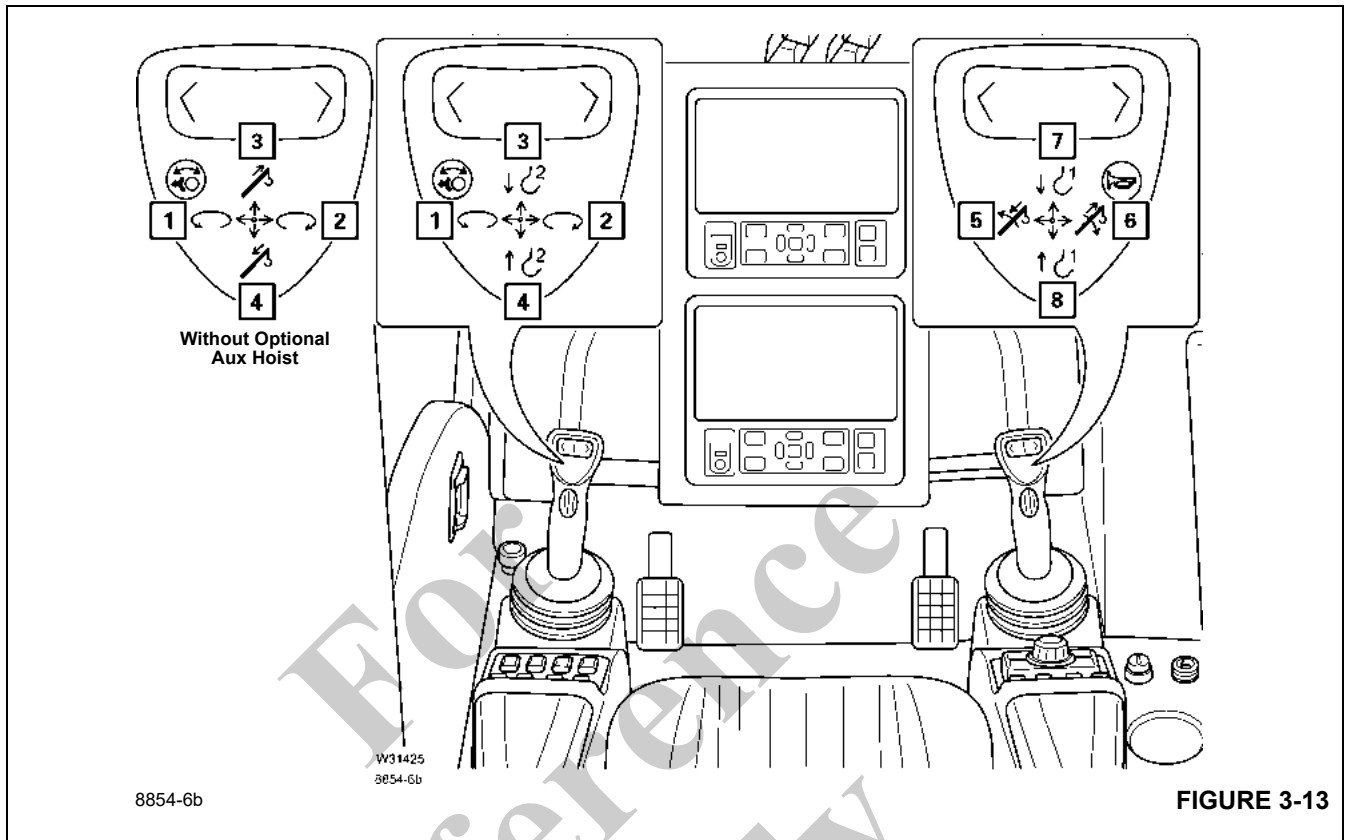
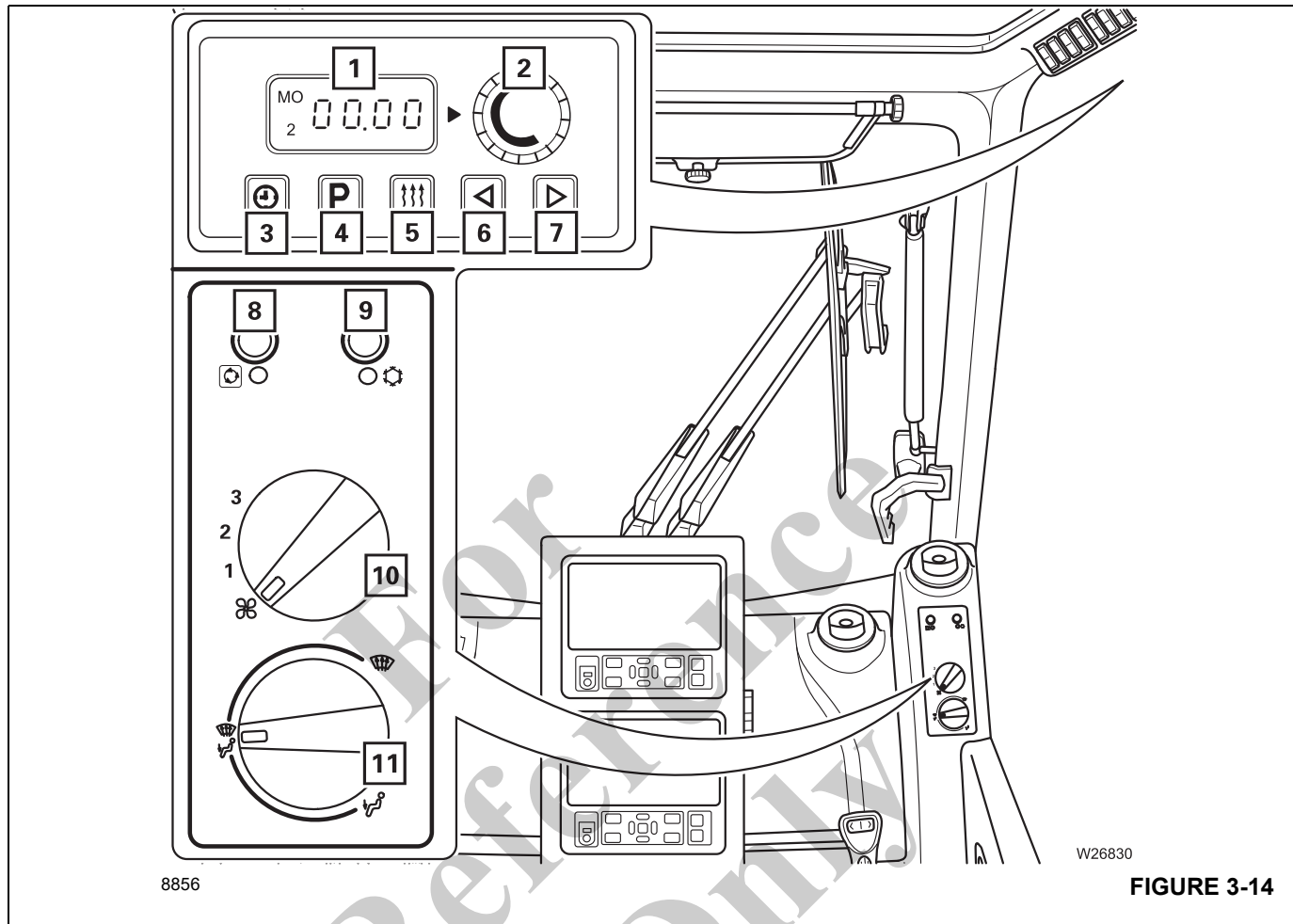


FIGURE 3-13

| Left Control Lever |                                                                                       | Right Control Lever |                                                                                                                      |
|--------------------|---------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------------------------------------------|
| 1                  | Swing left                                                                            | 5                   | Boom raise (If boom function is enabled).<br>Telescope retract (If Telescope is enabled and aux hoist is installed). |
| 2                  | Swing right                                                                           | 6                   | Boom lower (If boom function is enabled).<br>Telescope extend (If Telescope is enabled and aux hoist is installed).  |
| 3                  | Auxiliary hoist lower (if aux hoist is installed) <sup>1)</sup> or Telescope extend.  | 7                   | Main hoist lower                                                                                                     |
| 4                  | Auxiliary hoist raise (if aux hoist is installed) <sup>1)</sup> or Telescope retract. | 8                   | Main hoist raise                                                                                                     |

<sup>1)</sup>Optional equipment

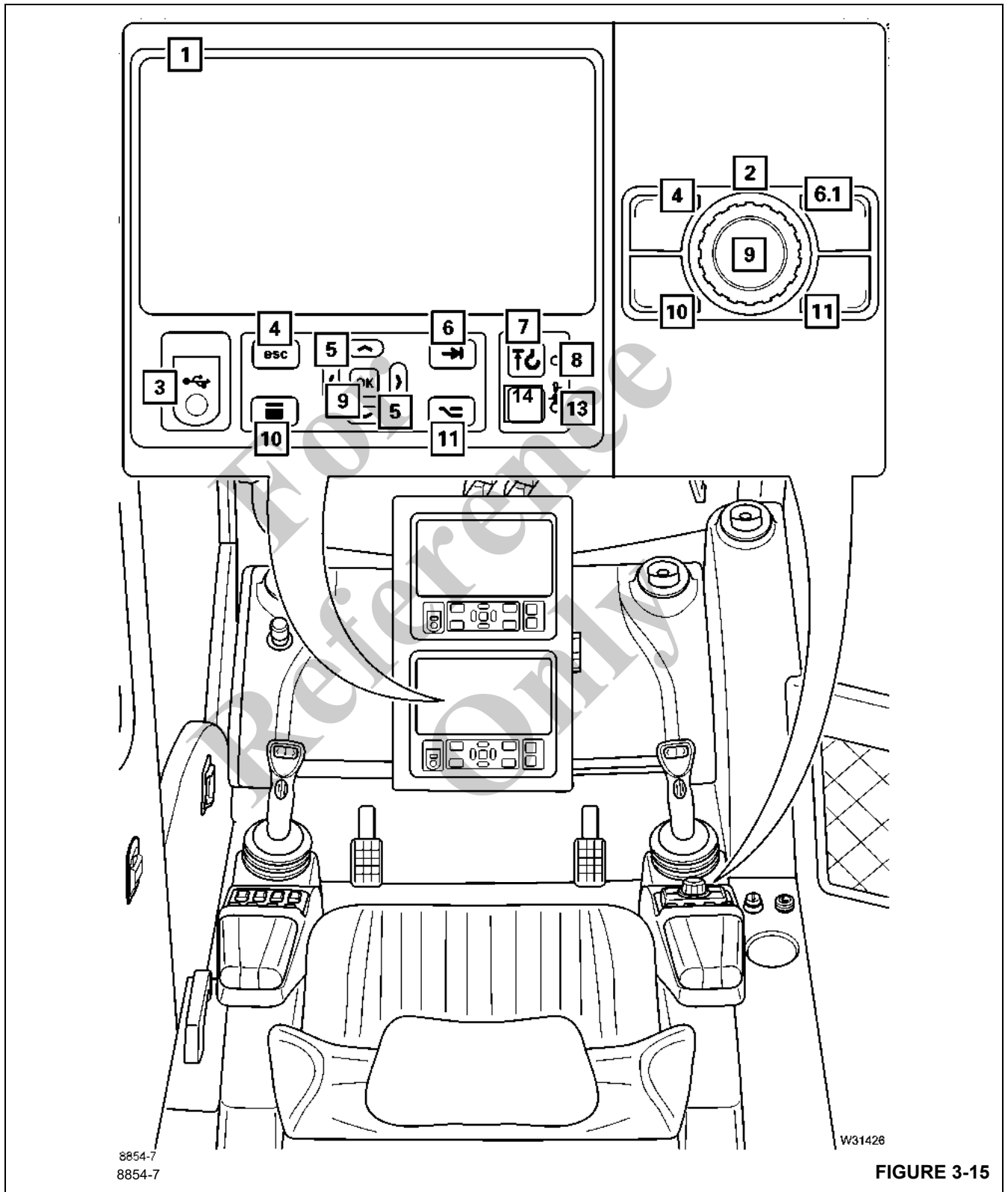
Superstructure Heating System



| Item | Description                         | Refer to  |
|------|-------------------------------------|-----------|
| 1    | Heating system display              | page 4-6  |
| 2    | Regulating temperature              | page 4-10 |
| 3    | Setting the time/day                | page 4-9  |
| 4    | Retrieving storage locations        |           |
| 5    | Switching the heating system on/off | page 4-10 |
| 6    | Input –                             |           |
| 7    | Input +                             |           |
| 8    | Fresh air/recirculated air          | page 4-8  |
| 9    | Air-conditioning on/off             | page 4-10 |
| 10   | Fan speed control                   | page 4-7  |
| 11   | Air distribution                    | page 4-8  |



Operator Display Module (ODM)/Crane Control System (CCS) Control Unit



3

FIGURE 3-15

| Item      | Description                                | What Item Does                                                                                                      | Refer to   |
|-----------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------|
| 1         | ODM Screen                                 | ODM Screen                                                                                                          | page 3-29  |
|           | Overview of the CCS Start Menu             | Overview of Start Menu                                                                                              |            |
|           | Overview of the CCS Menu Groups            | Overview of CCS Menu Groups                                                                                         | page 3-55  |
| 2         | Jog Dial                                   | Jog Dial for turning Forward / Backward                                                                             |            |
| 3         | Service/Diagnosis Connection <sup>1)</sup> |                                                                                                                     |            |
| 4         | ESCAPE                                     | Takes Operator back to Main Information Screen                                                                      | page 3-37  |
| 5         | Selector Buttons                           | Used to Select Buttons                                                                                              | page 3-34  |
| 6 and 6.1 | TAB                                        | Used to Silence the Buzzer                                                                                          |            |
| 7         | Hoist Limit Lockout Indicator              |                                                                                                                     | page 3-98  |
| 8         | Lighting Sensor                            |                                                                                                                     | page 3-129 |
| 9         | Input Confirmation                         | Confirms Input Selection                                                                                            | page 3-37  |
| 10        | MENU                                       | Takes Operator back to Menu Screen                                                                                  | page 3-35  |
| 11        | ALT                                        | Switch between Jog Dial Focus between Displays, and to Retrieve additional Fault Code data when on the Fault Screen | page 3-38  |
| 12        | Not Used                                   | Not Used                                                                                                            |            |
| 13        | Sensor Temperature Display                 | Sensor for Temperature Display                                                                                      | page 3-37  |
| 14        | Swing Brake Indicator                      |                                                                                                                     | page 3-100 |

<sup>1)</sup>For Service personnel only, not suitable for external devices, e.g. mobile phone

### Crane Control System (CCS) – Home Screen

The home screen shows the key measured values and a Table Description of each item.

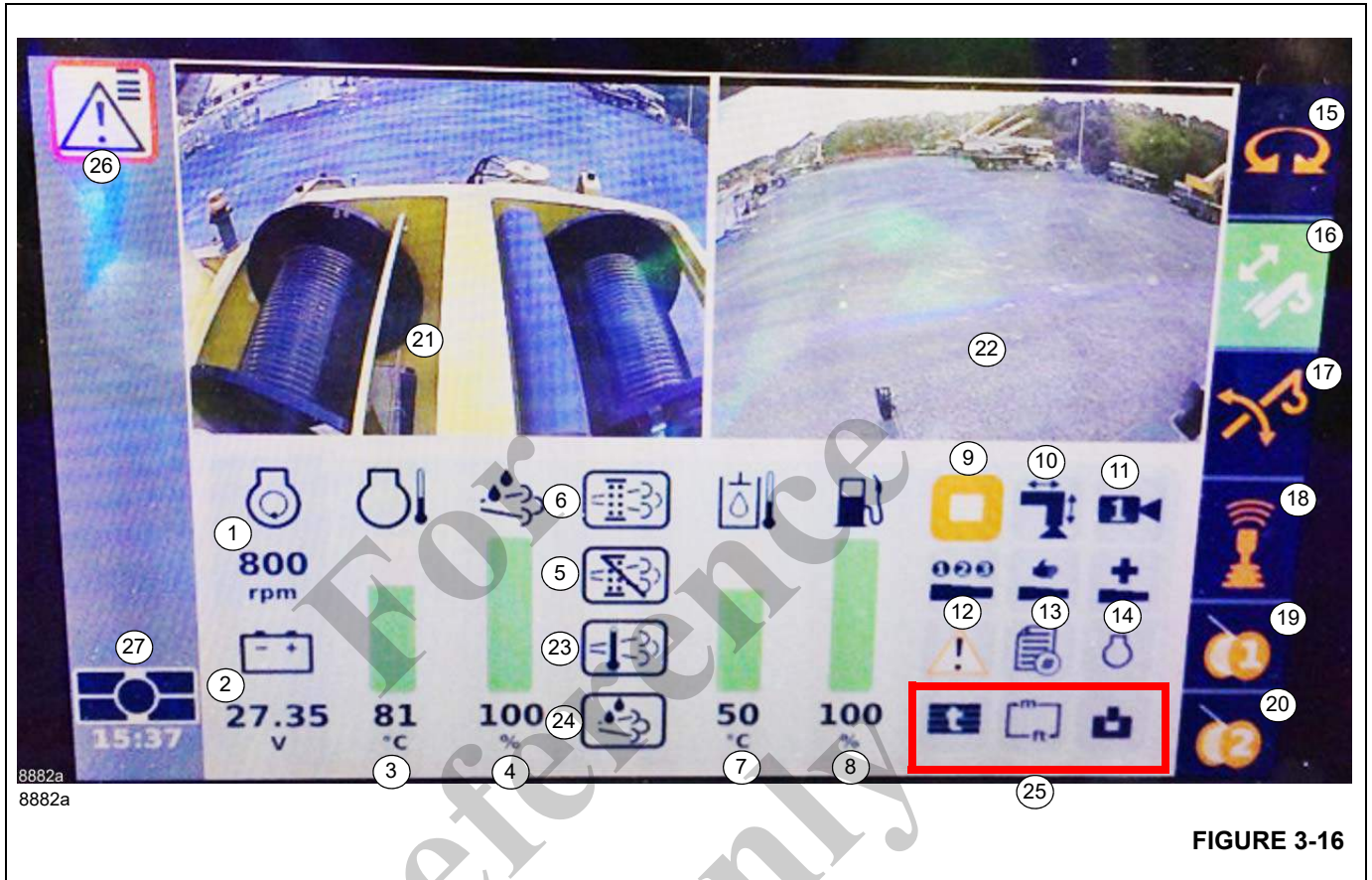


FIGURE 3-16









3












| Item | Item                                                     | Description                                                                                 |
|------|----------------------------------------------------------|---------------------------------------------------------------------------------------------|
| 1    | Engine Speed Display                                     | Current engine RPM                                                                          |
| 2    | Voltage Monitoring Display                               | System voltage                                                                              |
| 3    | Coolant Temperature Display                              | Engine coolant temperature                                                                  |
| 4    | DEF Level                                                | Amount of DEF in reservoir                                                                  |
| 5    | Exhaust System Cleaning Inhibited                        | Indicates exhaust system cleaning function is prevented                                     |
| 6    | Exhaust System Cleaning Needed                           | Indicates the exhaust system needs to be cleaned                                            |
| 7    | Hydraulic Oil Temperature                                | Temperature of the hydraulic oil                                                            |
| 8    | Fuel Level Display                                       | Amount of fuel in the reservoir                                                             |
| 9    | Menu Selection                                           | Opens sub-menu                                                                              |
| 10   | Outrigger Menu                                           | Opens the outrigger menu                                                                    |
| 11   | Camera Display                                           | Opens the camera menu                                                                       |
| 12   | Telescoping Semi-Automation Menu                         | Opens the telescoping semi-automation menu, refer to page 3-58                              |
| 13   | Telescoping Manual Mode                                  | Opens telescoping manual mode menu                                                          |
| 14   | Telescoping Emergency Mode                               | Opens telescoping emergency mode menu                                                       |
| 15   | Swing Function Status Indication                         | Indicates when the swing function is active                                                 |
| 16   | Telescoping Function Status Indication                   | Indicates when the telescoping function is active                                           |
| 17   | Lift Function Status Indication                          | Indicates when the lift function is active                                                  |
| 18   | Remote Controller Status Indication                      | Indicates when the remote controller function is active                                     |
| 19   | Main Hoist Function Status Indication                    | Indicates when the main hoist function is active                                            |
| 20   | Auxiliary Hoist Function Status Indication <sup>1)</sup> | Indicates when the auxiliary hoist function is active                                       |
| 21   | Hoist Camera                                             | View of hoists                                                                              |
| 22   | Right Side View Camera                                   | View of the right side of the crane                                                         |
| 23   | High Exhaust System Temperature                          | Indicates that the exhaust system temperature is high                                       |
| 24   | DEF Low Warning                                          | Indicates that the DEF is getting low in the tank                                           |
| 25   | Most Often Used Menus                                    | Shows the menus that are used most often so they can be opened                              |
| 26   | Alert Icon                                               | Displays up to five icons when errors are present, refer to <i>Alert Icons</i> , page 3-31. |
| 27   | Display Active                                           | Only appears on the active display.                                                         |











<sup>1)</sup>Optional equipment









**Alert Icons**



The Alert Icons appear on the left side of the Home Screen when an error is present during the operation of the crane. This is an all-inclusive list of Alert Icons and this crane may or may not have some of these Icons. If equipped, the Icon will appear in the bottom Alerts Area of the ODM Main Screen.

| Name                                       | Icon                                                                                | Description                                                   |
|--------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------|
| <b>New fault</b>                           |    | A new fault was added to the list.                            |
| <b>Fault</b>                               |    | There is at least one fault on the list.                      |
| <b>Malfunction indicator lamp-critical</b> |    | Engine critical alarm lamp. This is commanded by the engine.  |
| <b>Malfunction indicator lamp-warning</b>  |  | Engine warning alarm lamp. This is commanded by the engine.   |
| <b>Engine stop</b>                         |  | Engine Stop lamp (red). This is commanded by the engine.      |
| <b>Engine warning</b>                      |  | Engine Warning lamp (amber). This is commanded by the engine. |
| <b>New engine fault</b>                    |  | A new engine fault was added to the list.                     |
| <b>Engine fault</b>                        |  | There is at least one engine fault on the list.               |

| Name                                    | Icon                                                                                  | Description                                                                                               |
|-----------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>Engine oil pressure low</b>          |    | The engine oil pressure is low. This is commanded by the engine.                                          |
| <b>Engine temperature high</b>          |    | The engine coolant temperature is high. This is commanded by the engine.                                  |
| <b>Engine overspeed</b>                 |    | The engine speed (rpm) is above the max expected value.                                                   |
| <b>Engine wait to start</b>             |    | The engine is warming up before starting. This is commanded by the engine.                                |
| <b>Engine data invalid</b>              |    | The engine RPM data is not valid.                                                                         |
| <b>Emergency stop</b>                   |   | One of the emergency stop switches is pressed.                                                            |
| <b>System voltage</b>                   |  | The supply voltage measured at the main control module is less than 22V or more than 30V.                 |
| <b>Transmission temperature</b>         |  | The transmission oil temp is heated up to the warning level.                                              |
| <b>Transmission temperature invalid</b> |  | The transmission oil temp is invalid.                                                                     |
| <b>Transmission not in neutral</b>      |  | The transmission is not in neutral when it is required to be (starting engine, running outriggers, etc).  |
| <b>Parking brake</b>                    |  | The park brake is required to be secured but is not. This could be engine start, running outriggers, etc. |

| Name                                  | Icon                                                                                | Description                                                                                                             |
|---------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Alternator charge error</b>        |    | The engine is running but the alternator is not charging –OR– the engine is not running but the alternator is charging. |
| <b>Alternator charge low or high</b>  |    | The battery voltage is too low (about 22V or less) or too high (30V or more).                                           |
| <b>Carrier key on</b>                 |    | The carrier cab key is in the ON or START position.                                                                     |
| <b>Cab not down</b>                   |    | Cab tilt is blocked. This could be during engine start, or because the seat switch is not active.                       |
| <b>Center stabilizer overload</b>     |    | The pressure in the center front stabilizer cylinder is too high.                                                       |
| <b>Fuel level</b>                     |  | The fuel level is low.                                                                                                  |
| <b>Counterweight blocking swing</b>   |  | The counterweight is blocking swinging because the cylinders are not fully up.                                          |
| <b>Settings speed or Speed adjust</b> |  | The speed settings or joystick curves are not at their default value (100% or linear joystick).                         |
| <b>Boom extension too low</b>         |  | The boom is near the driving cab and motion is blocked.                                                                 |
| <b>Forbidden zone blocking range</b>  |  | The boom is near the driving cab and motion is blocked.                                                                 |

| Name                                         | Icon                                                                                  | Description                                                                                                                                                                                                                                                                  |
|----------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Forbidden zone bypassed</b>               |    | The boom is near the driving cab and motion would be blocked but the bypass switch is allowing motion.                                                                                                                                                                       |
| <b>Third wrap aux. hoist</b>                 |    | Only 3 wraps remain on the aux hoist. Hoist lowering is blocked.                                                                                                                                                                                                             |
| <b>Third wrap main hoist</b>                 |    | Only 3 wraps remain on the main hoist. Hoist lowering is blocked.                                                                                                                                                                                                            |
| <b>Hydraulic oil temp high</b>               |    | The hydraulic oil temp is heated up to the warning level.                                                                                                                                                                                                                    |
| <b>Hydraulic oil temp invalid</b>            |   | The hydraulic oil temp cannot be read correctly.                                                                                                                                                                                                                             |
| <b>Level sensor not OK</b>                   |  | The level sensor is not communicating, is not calibrated, or is self-reporting an error.                                                                                                                                                                                     |
| <b>Tele cylinder at boom nose</b>            |  | The telescoping cylinder has extended too far and reached the boom nose. Tele extension is blocked.                                                                                                                                                                          |
| <b>High Exhaust System Temperature Alert</b> |  | Indicates the exhaust temperature is above 640°C (1184°F) during the active exhaust system cleaning process. Indicator remains on until the temperatures falls below 625°C (1157°F).<br><br>Indicator also is on constant during the manual exhaust system cleaning process. |

| Name                                                | Icon                                                                                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Exhaust System Clogged Alert</b></p>          |    | <p>Constant On – Indicates the exhaust system requires cleaning. When possible, stop and perform a manual exhaust system cleaning.</p> <p>Constant On while Engine Warning Indicator is on constant – Indicates the exhaust system requires cleaning or the engine will begin to derate. Immediately stop and perform a manual exhaust system cleaning.</p> <p>Flashing – Indicates the manual exhaust system cleaning is active or there is a communication loss with the engine ECM.</p> |
| <p><b>Inhibit Exhaust System Cleaning Alert</b></p> |  | <p>Constant On – Indicates the Exhaust System Cleaning Switch is set to the Inhibit Cleaning position, which prevents the exhaust cleaning process from automatically occurring.</p> <p>Flashing – Indicates there is a communication loss with the engine ECM.</p>                                                                                                                                                                                                                        |

**SHORT DESCRIPTION OF THE OPERATING ELEMENTS OF THE CRANE CONTROL SYSTEM (CCS)**

**WARNING**

**An Untrained Operator Subjects Him/Herself and Others to Death or Serious Injury. Do not Operate this Crane Unless:**

- You are trained in the safe operation of this crane. Grove is not responsible for qualifying personnel.
- You read, understand, and follow the safety and operating recommendations contained in the crane manufacturer’s manuals and load charts, your employer’s work rules, and applicable government regulations.
- You are sure that all safety signs, guards, and other safety features are in place and in proper condition.
- The Operator’s Manual and Load Chart are in the holder provided on crane.

**Definition of Direction Information**

**Basic Rule**

Direction information always depends on whether the carrier or the superstructure is being operated.

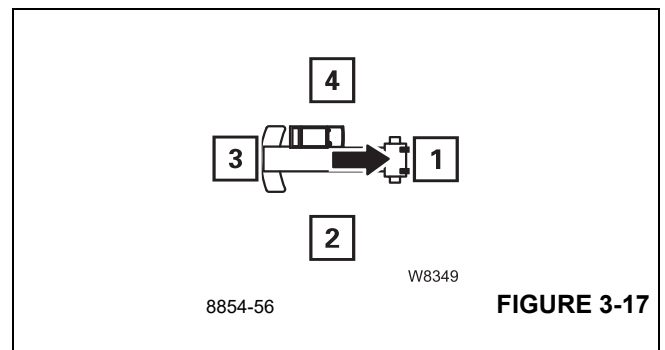
**On the Carrier**

The driver’s cab is always at the front, which means that sitting in the driver’s seat looking forward left is on your left side, right is on your right side, forward is the front and the rear is behind you.

**On the Superstructure**

The main boom head is always at the front (Figure 3-17), which means that:

|   |       |   |       |
|---|-------|---|-------|
| 1 | Front | 2 | Right |
| 3 | Rear  | 4 | Left  |



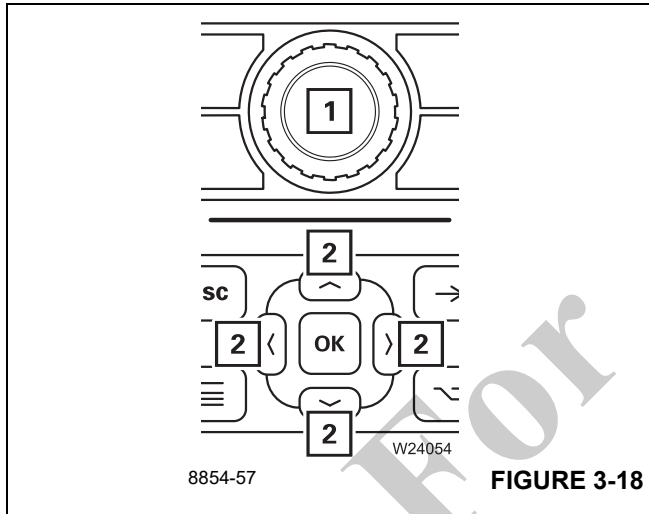
**FIGURE 3-17**



**General Rules for Buttons and Symbols on the Display**

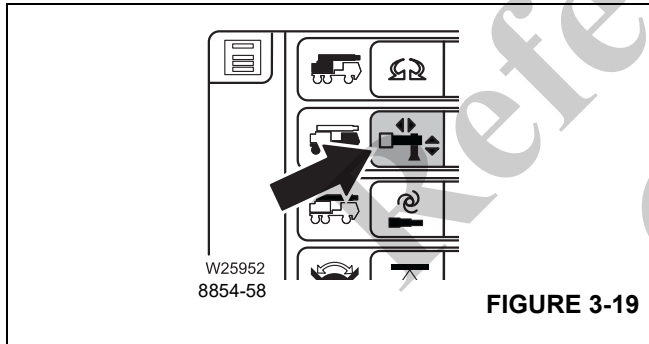
The symbols shown as an example are not present on all crane types. The following rules apply in all menus:

- A menu can only be opened if the relevant symbol has been selected with the jog dial (1), (Figure 3-18) or direction buttons (2), (Figure 3-18).



**FIGURE 3-18**

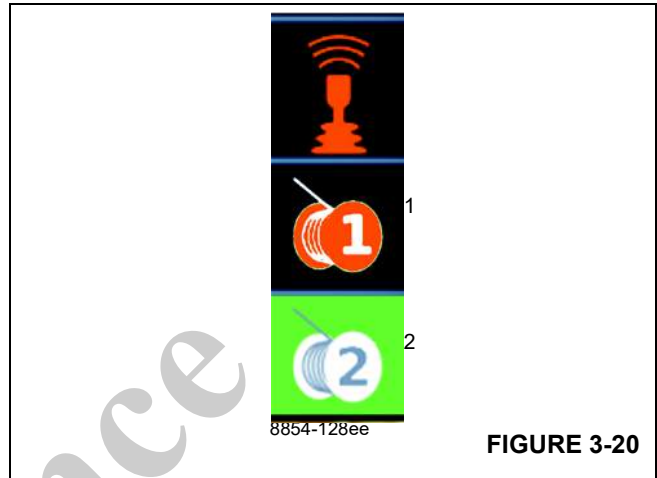
- A selected menu is marked in color and can be opened (Figure 3-19).



**FIGURE 3-19**

Symbols can be shown in different colors (Figure 3-20). The color of the symbol indicates the current switching state of the relevant power unit:

|   |        |                           |
|---|--------|---------------------------|
| 1 | Grey:  | e.g. main hoist – OFF     |
| 2 | Green: | e.g. auxiliary hoist – ON |



**FIGURE 3-20**

For the ODM crane function status column as shown, the possibilities are:

- Not enabled: Blue background, orange icon (this is at first key on without pushing any buttons)
- Enabled: Green background, white icon (this is after the enable button has been selected)
- Standby: Yellow background, white icon (this is after the function has been enabled, and you get out of the seat)
- Standby function actuated: Yellow background flashing, white icon (this occurs when a function is presently in standby and a joystick is actuated – before sitting back in the seat, to prevent unwanted movement)
- Disabled: Blue background, gray icon (function is disabled – this is set by going into the ODM screen and setting the function speed to '0'. While at 0, a function can not be enabled)

In these operating instructions, we always refer to colors in terms of "The symbol is red", for instance.

Regardless of whether the background (1), (Figure 3-21) of a symbol is red or whether only parts (2), (Figure 3-21) of a symbol are red. This applies to all symbols and all colors.



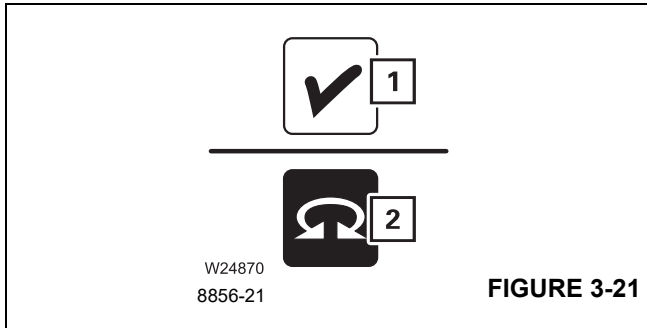


FIGURE 3-21

If the instruction given in this section is to “Press the button once...”, for instance, this always refers to the button (1), (Figure 3-22) or (2), (Figure 3-22). This is the case if a menu is opened or a function is to be carried out.

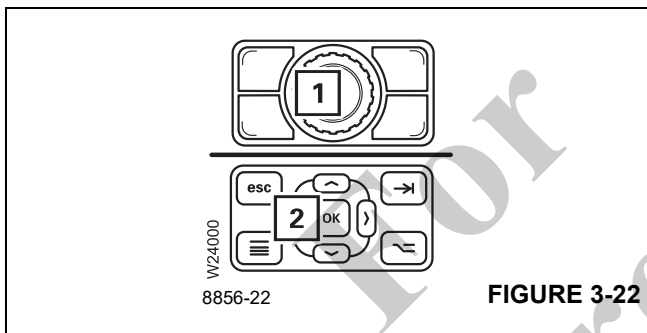


FIGURE 3-22

**Changing Menus**

Buttons (1), (Figure 3-22) and (2), (Figure 3-22) denote that the active menu can change displays by either using the Jog Dial (1), (Figure 3-22) or by using the lower left Button on EITHER display (Figure 3-23).

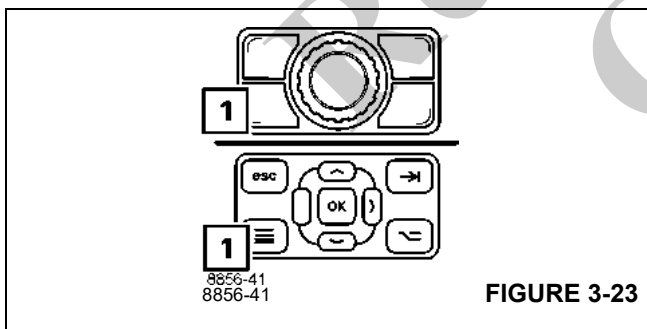


FIGURE 3-23

**CRANE CONTROL SYSTEM (CCS)**

The truck crane is equipped with the crane control system (CCS). The crane control system consists of a monitor and control buttons and jog dial in the superstructure cab.

**Display CCS**

The start menu appears after switching on the ignition (1), (Figure 3-24).

After pressing a button on the CCS control panel, the main menu (2), (Figure 3-25) appears.

A symbol is selected with the arrow buttons in order to call up a menu. The selected symbol is shown in red.

The OK button on the control panel is pressed in order to open a menu.

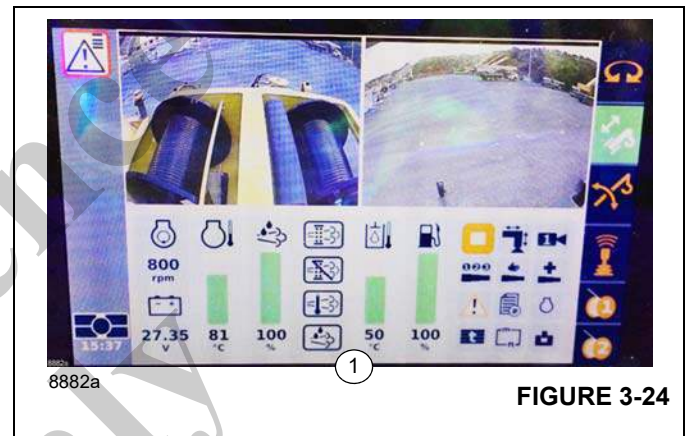


FIGURE 3-24

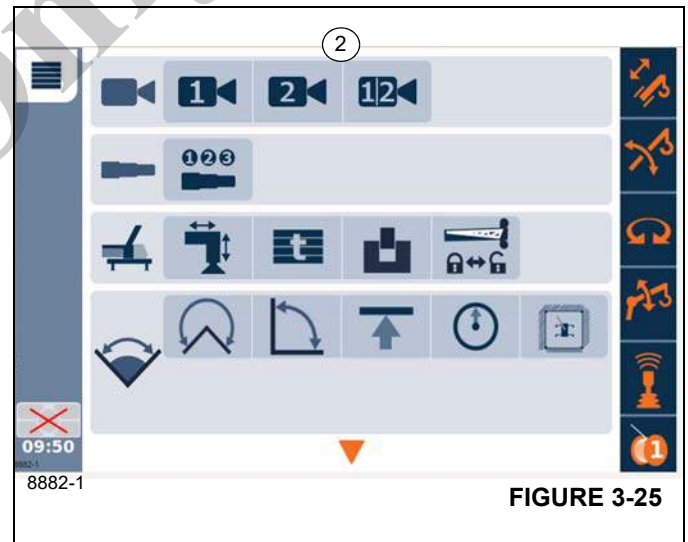


FIGURE 3-25

3

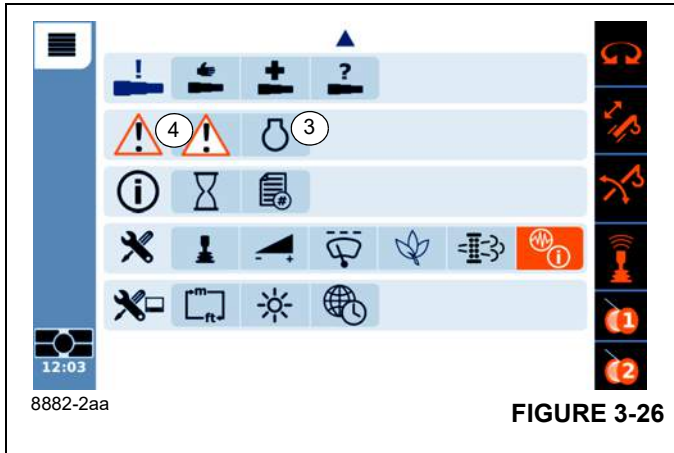


FIGURE 3-26

**Warning Message/Error Message Display Area**

Error messages will appear on the left side of the display with a red border around the icon. The icon will disappear when the error is resolved:

|     |                                            |
|-----|--------------------------------------------|
| Red | Warning message / error message            |
| OFF | No warning message / error message present |

**Open Error Menu**

When an error message appears, go to error message menu on the second page of the main menu and select the appropriate sub menu based on the error being displayed. Select symbol (Figure 3-26) and confirm:

|   |                   |
|---|-------------------|
| 3 | For engine        |
| 4 | For Crane control |

**Engine Speed Display**

**Side Panel**

Starting the engine – from the superstructure cab.

**Ignition Lock**

|   |                                                                                           |
|---|-------------------------------------------------------------------------------------------|
| 0 | Ignition off, key off, key can be removed (Figure 3-27)                                   |
| 1 | Ignition on and power supply on for: instrument lighting, CCS, engine control system, RCL |

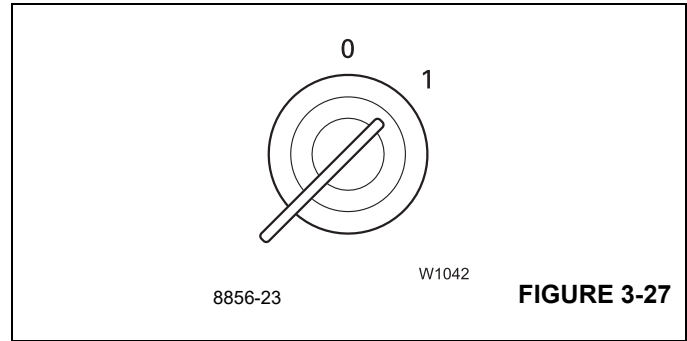


FIGURE 3-27

To start the engine:

1. Turn the ignition key to position 1. Then,
2. Press and hold the top of the Increment/Decrement Switch (Figure 3-28).

To turn the engine to position 0:

1. Turn the ignition key to position 0, **OR**
2. Press and hold the bottom of the increment/decrement switch.

These do not depend on the carrier ignition key. They will turn the engine on or off with the carrier key in either position. Turning the carrier key from ON to OFF will stop the engine no matter what position the superstructure key is in.

**Set Idling Speed**

With the engine OFF:

|                                          |                                       |
|------------------------------------------|---------------------------------------|
| Press up once and release (Figure 3-28): | Engine starts, idling speed is normal |
|------------------------------------------|---------------------------------------|

With the engine running:

|                                             |                                                                                                 |
|---------------------------------------------|-------------------------------------------------------------------------------------------------|
| Press up and release top portion of switch: | To incrementally increase the engine speed                                                      |
| Press down and hold:                        | To decrease idling speed, engine shuts off after approximately 2 seconds after idle is reached. |

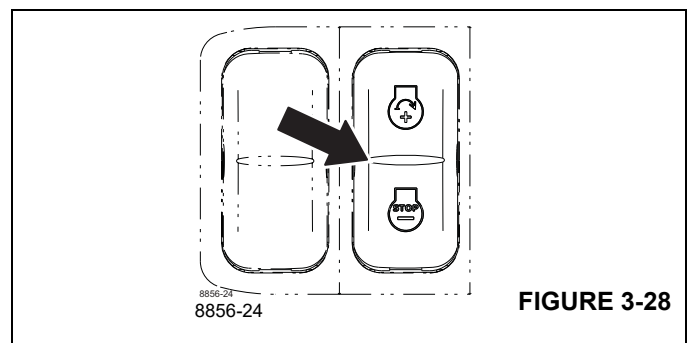
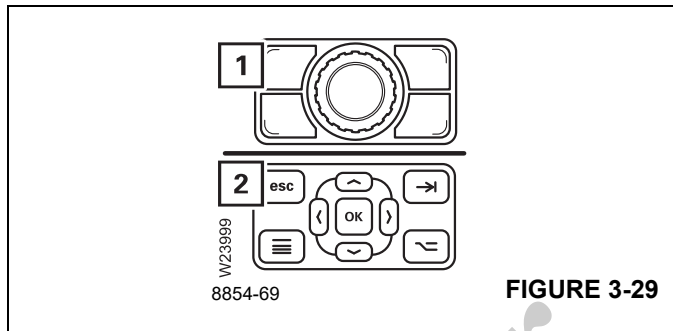


FIGURE 3-28

**Exiting the Menu/Input Mode**

Press button (1), (Figure 3-29) on the jog dial or button (2) on the display to exit the menu or input mode.

|                        |                                                                                                     |
|------------------------|-----------------------------------------------------------------------------------------------------|
| Press the button once: | The opened menu closes – the menu from the next higher level is opened<br>Input mode is deactivated |
|------------------------|-----------------------------------------------------------------------------------------------------|



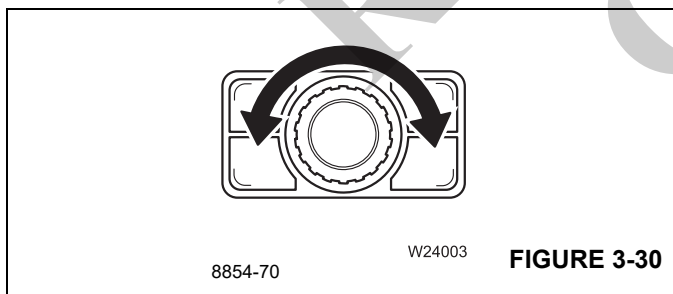
**FIGURE 3-29**

**Enter the Values with Jog Dial**

When you depress the input confirmation button after highlighting a selection on the screen, the input mode is active (Figure 3-30).

|                            |                     |
|----------------------------|---------------------|
| Turn the knob to the right | Increases the value |
| Turn the knob to the left  | Decreases the value |

To enter values with the jog dial, rotate dial until desired icon is highlighted. Depress the input confirmation button to highlight the input field. Rotate the jog dial clockwise to increase or counterclockwise to decrease the value slowly. Depressing and holding the input confirmation button while rotating it will cause the value to change more rapidly.

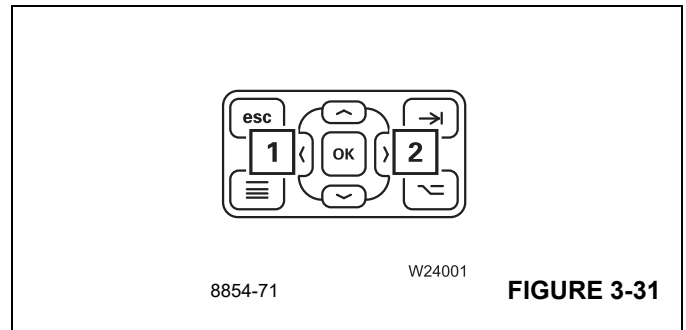


**FIGURE 3-30**

**Enter Values on the Control Panel CCS**

When the input mode is active (Figure 3-31):

|                                       |                     |
|---------------------------------------|---------------------|
| Arrow pointing to the right, Button 2 | Increases the value |
| Arrow pointing to the left, Button 1  | Decreases the value |

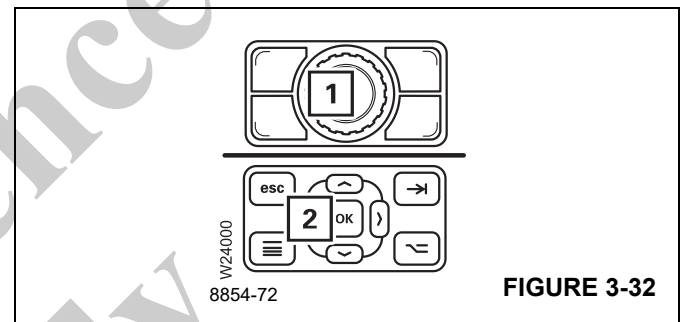


**FIGURE 3-31**

**Input Confirmation**

An input can be confirmed with Button (1), (Figure 3-32) or (2), (Figure 3-32) (labeled OK).

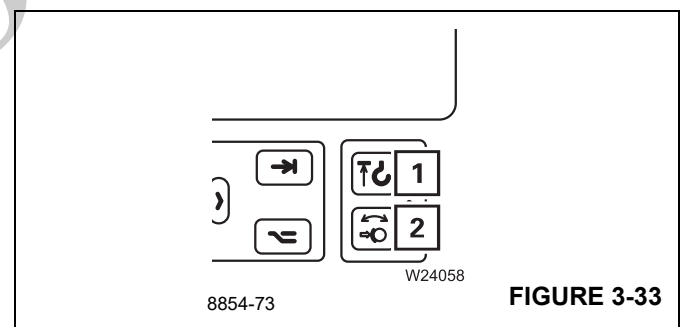
|                        |                                    |
|------------------------|------------------------------------|
| Press the button once: | A newly entered value is confirmed |
|------------------------|------------------------------------|



**FIGURE 3-32**

**Other Indicators on the ODM CCS Display**

|   |                                               |
|---|-----------------------------------------------|
| 1 | Hoist Limits lockout Indication (Figure 3-33) |
| 2 | Swing Brake Indication (Figure 3-33)          |



**FIGURE 3-33**

**Display Temperature Sensor**

The display temperature sensor (Figure 3-34) monitors the temperature and the brightness will be adjusted when the display temperature is too hot.

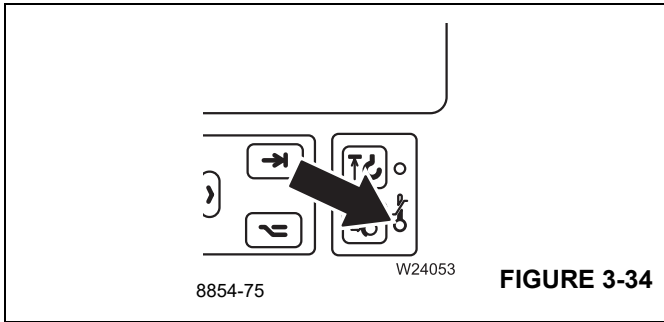


FIGURE 3-34

**Emergency Stop Switch**

The emergency stop switch is provided as a means to shut off the engine and stop crane functions in the case of an emergency (Figure 3-35).

Press the switch until it latches (Figure 3-35), the engine will shut off and all crane functions will stop.

Turn the latched switch clockwise (Figure 3-35) to enable engine start and crane functions.

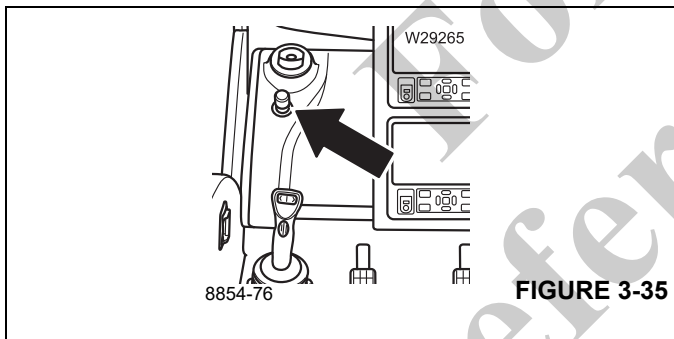


FIGURE 3-35

**To Switch Displays**

The symbol (3), (Figure 3-36) will appear at the bottom left hand corner of the active display, no symbol will be displayed on the inactive display. Use button (5), (Figure 3-36) of the jog dial or control panel to switch between screens.

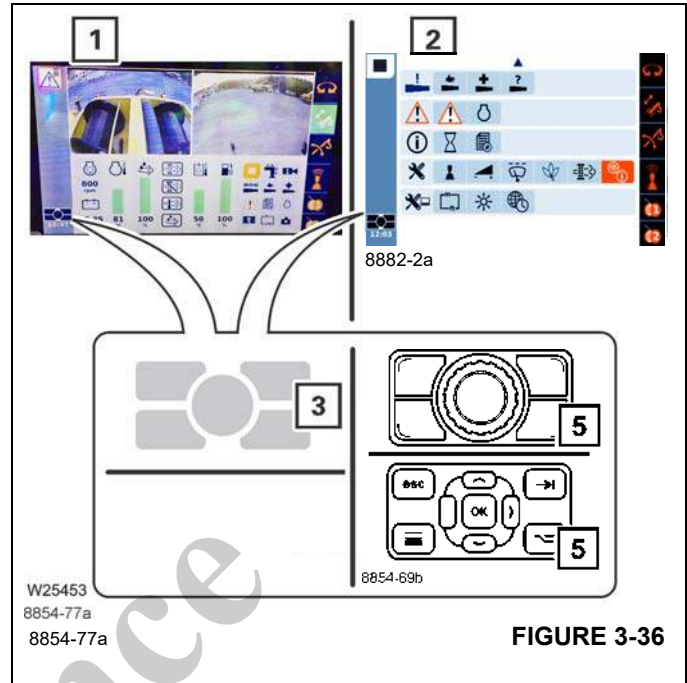


FIGURE 3-36

**Seat Contact Switch and Dead-Man Switches**

The seat contact switch and the dead-man switch are for enabling crane functions.

**Enabling Crane Functions**

- Activate the rocker switch of the desired crane function(s).

**AND**

- Activate seat switch (2), (Figure 3-37) or either dead-man switch (1), (Figure 3-37).

**Disabling Crane Functions**

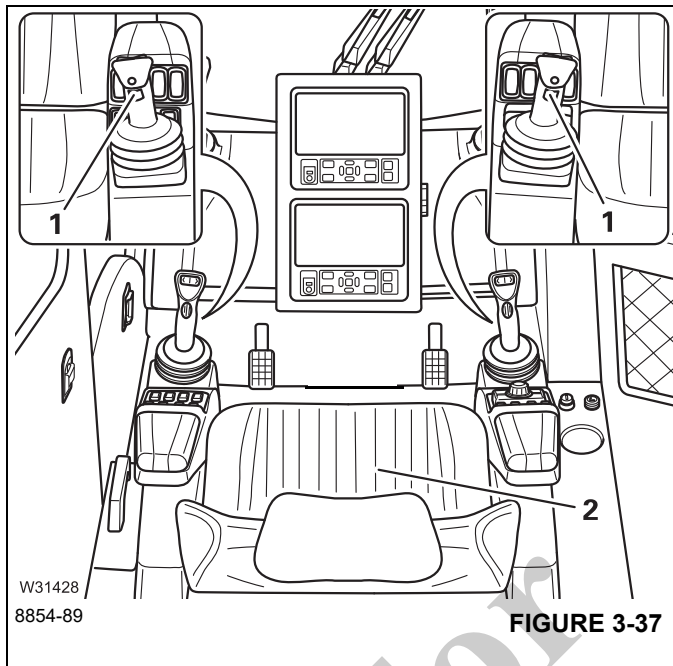
- Activate the rocker switch of the desired crane function(s) a second time.

**OR**

- De-activate seat switch and dead-man switches.

All operating elements for crane functions in the superstructure cab are locked.

Any crane movements are slowed down to standstill within 3 seconds and then locked.



**Superstructure Cab Seat**

The seat contact switch is very sensitive. It is recommended that you also press the dead man's switch in order to avoid unintentional lockout.

Refer to, *Seat Contact Switch*, page 4-46.

**Cribbing Mode**

Cribbing Mode is an outrigger mode that will allow the Center Front Stabilizer (CFS) to be locked in position while the right and left front jacks are raised to allow for additional cribbing. For additional information on Cribbing Mode, refer to *Methods and Requirements for Activating Cribbing Mode*, page 4-35.

**NOTE:** Outrigger controls are only active when the engine is running and the park brake is set.

*Extend/Retract Outrigger Beams*, page 4-39.

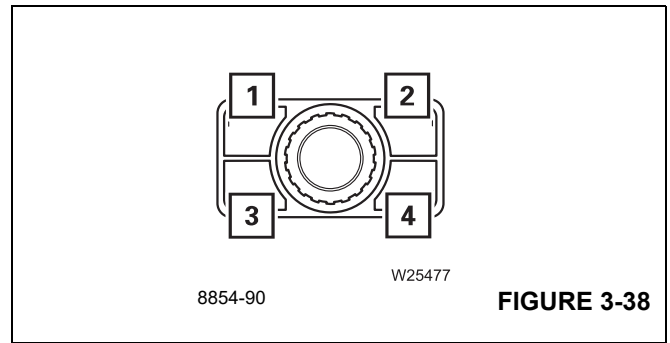
*Extend/Retract Outrigger Jack Cylinders*, page 4-39.

**Right-Hand Armrest Control Panel**

**Button for Outrigger Pre-selection**

The following functions are pre-selected in the same way (Figure 3-38).

|   |                                                                |
|---|----------------------------------------------------------------|
| 1 | Left Front beam/Jack Select and Center Front Stabilizer select |
| 2 | Right Front Beam/Jack Select                                   |
| 3 | Left Rear Beam/Jack Select                                     |
| 4 | Right Rear Beam/Jack Select                                    |



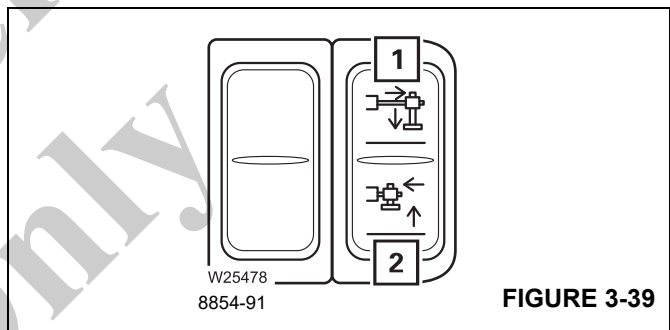
**Left-Hand Armrest Control Panel**

**Retracting/Extending Outrigger Beams Selection**

To extend or retract the outrigger beams, from the Left-Hand Armrest Control Panel, see below:

|   |               |                                    |
|---|---------------|------------------------------------|
| 1 | Press button: | Extend pre-selection (Figure 3-39) |
| 2 | Press button: | Retract pre-selection              |

The movement stops after the button is released or when an end position is reached.



**In the Outrigger Menu**

**Outrigger Span Display**

To open: Select symbol (1), (Figure 3-40) and confirm.



The outrigger span is shown in percent (%) (Figure 3-41) and has four positions as noted in the following table. Also, refer to *Outrigger Span Display*, page 4-52 and *Outrigger Span*, page 4-52.

| Outrigger Positions | Percentage |
|---------------------|------------|
| 1                   | 0%         |
| 2                   | 57%        |



|   |      |
|---|------|
| 3 | 79%  |
| 4 | 100% |

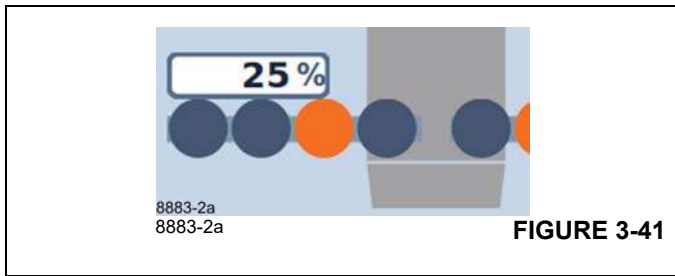


FIGURE 3-41

**Swing Gear/Movements Locked Display**

|        |                                                                        |
|--------|------------------------------------------------------------------------|
| Red:   | Swing gear switched OFF <b>OR</b> Park Brake NOT enabled (Figure 3-42) |
| Green: | Swing gear switched ON – outrigger movement disabled (Figure 3-42)     |

The highlighted green symbol (1), (Figure 3-42) is pointing to the Swing Status Indication.

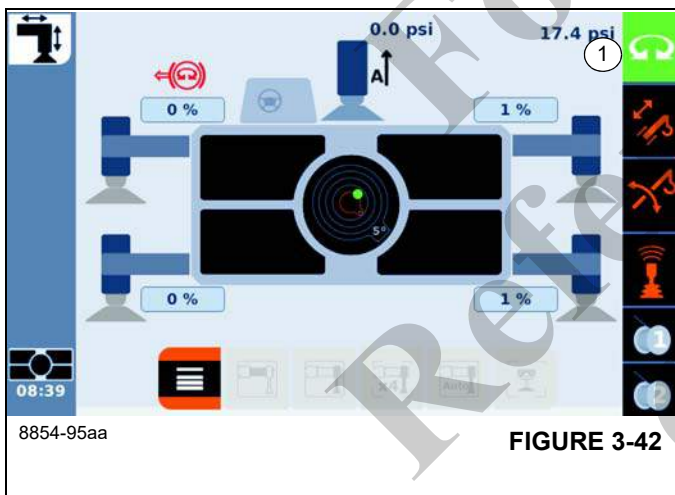


FIGURE 3-42

**Parking Brake/Movements Locked Display**

|      |                                                                   |
|------|-------------------------------------------------------------------|
| Red: | Parking brake released – outrigger movements locked (Figure 3-43) |
| OFF: | Parking brake applied – outrigger movements enabled               |

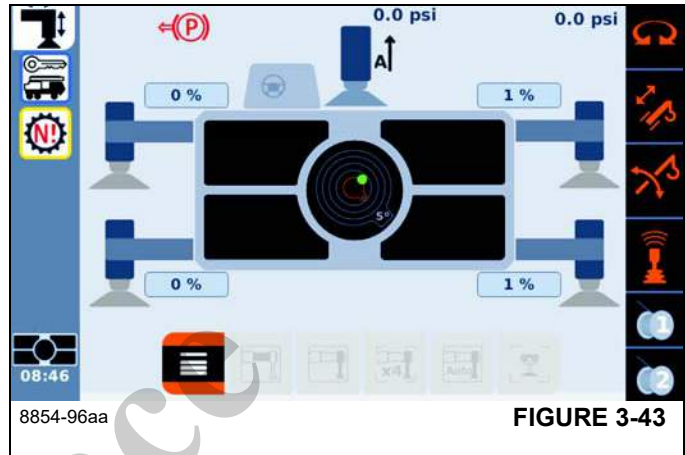
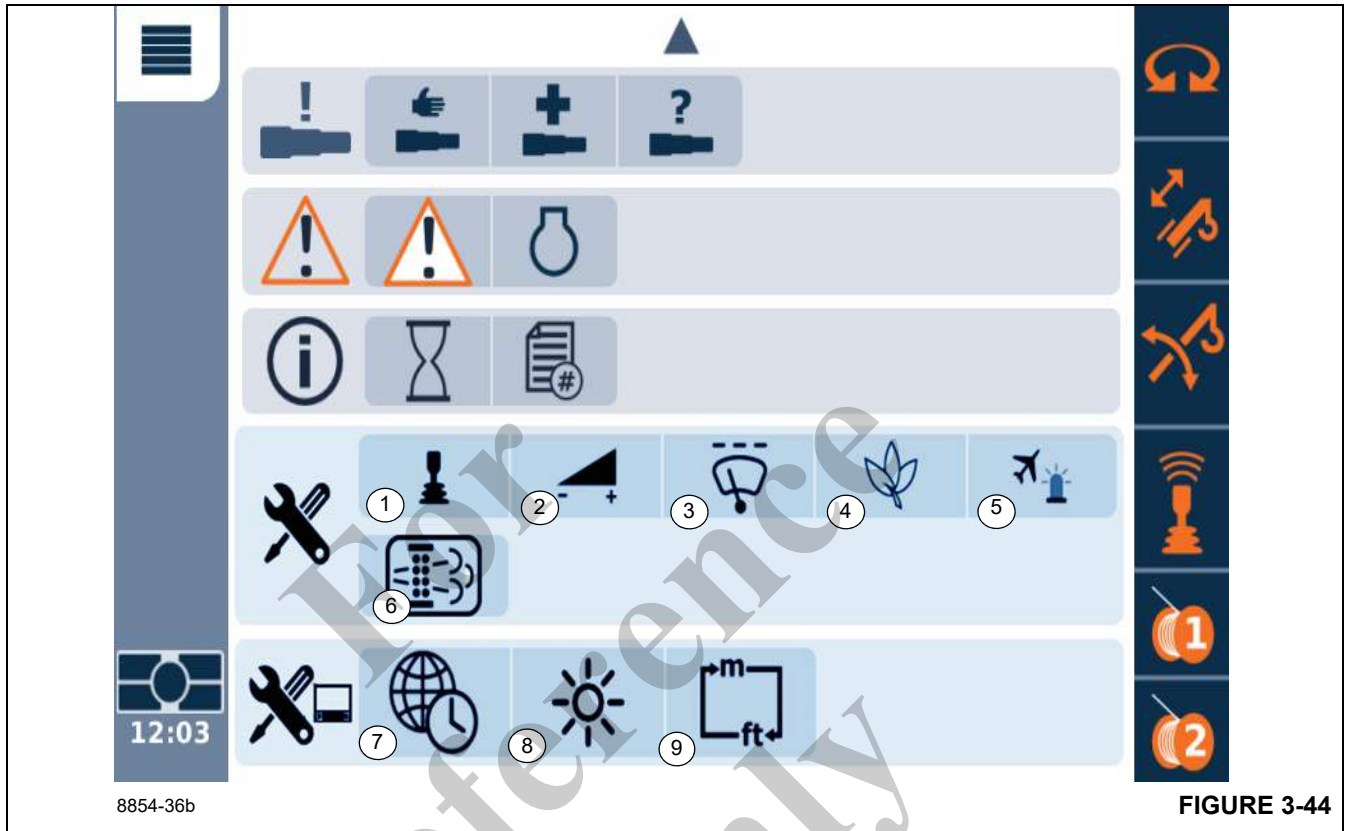


FIGURE 3-43

### Settings Menu Groups

This menu (Figure 3-44) allows the operator to select sub-menus to adjust parameters, set display options, and control options.



| Item | Description                             | Refer to  |
|------|-----------------------------------------|-----------|
| 1    | Control Lever Characteristic Curve Menu | page 3-42 |
| 2    | Crane Function Speeds Menu              | page 3-43 |
| 3    | Adjust Wiper Stroke Interval Menu       | page 3-43 |
| 4    | Economy Mode Menu                       | page 3-44 |
| 5    | Aircraft Warning Light (Optional)       | page 3-45 |
| 6    | Exhaust System Cleaning Menu            | page 3-46 |
| 7    | Setting the Time Menu                   | page 3-47 |
| 8    | Adjusting Display Brightness            | page 3-47 |
| 9    | Switch Units Menu                       | page 3-49 |

### Control Lever Characteristic Curve Menu

This menu (Figure 3-45) allows the operator to set the amount of stroke the control levers require to initiate a response.

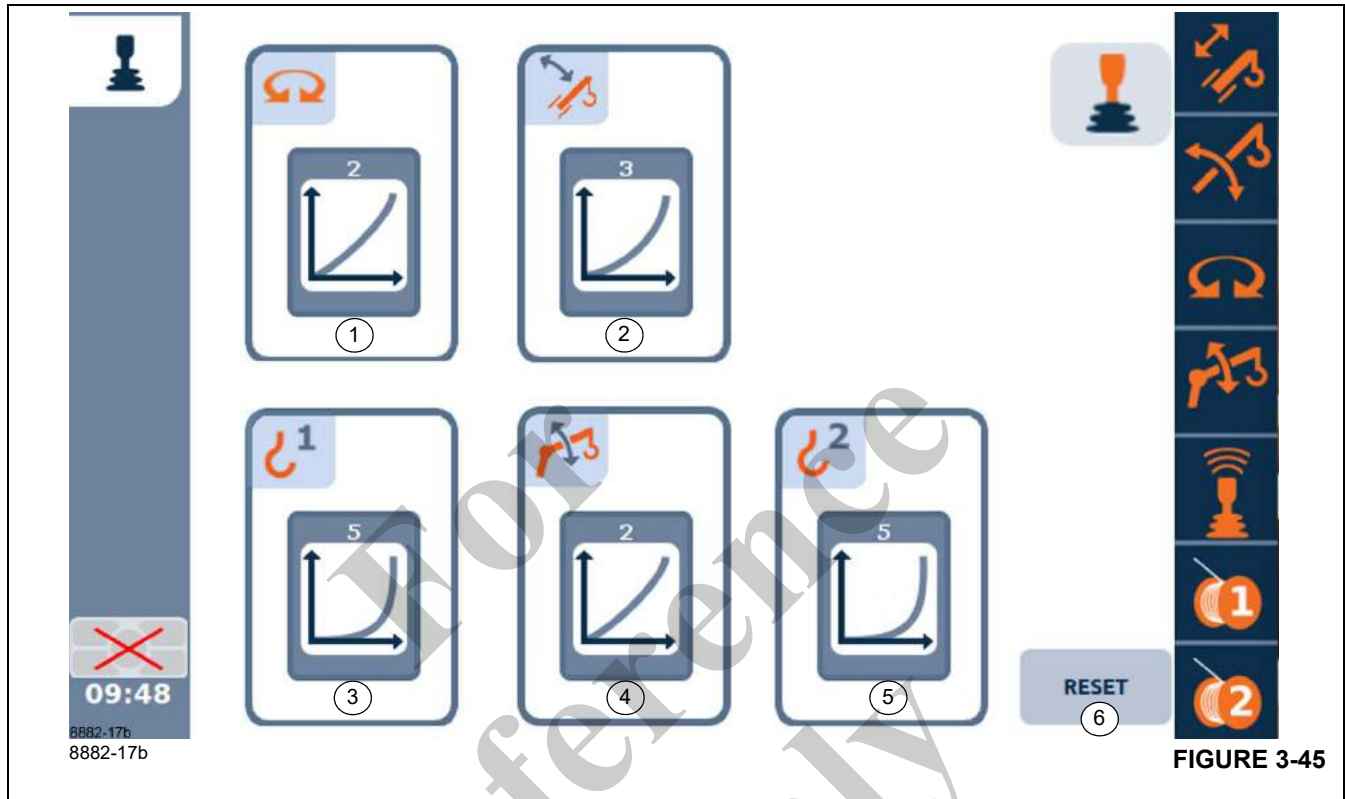


FIGURE 3-45

| Item | Description                                          | Refer to    |
|------|------------------------------------------------------|-------------|
| 1    | Swing function curve                                 | Figure 3-48 |
| 2    | Boom lift function curve                             | Figure 3-48 |
| 3    | Main hoist curve                                     | Figure 3-48 |
| 4    | Luffing boom extension function curve <sup>(1)</sup> | Figure 3-48 |
| 5    | Auxiliary hoist function curve <sup>(1)</sup>        | Figure 3-48 |
| 6    | Reset function curves                                | Figure 3-48 |

<sup>1)</sup>Optional Equipment

### Setting the Control Lever Characteristic Curves

This menu allows the operator to set the amount of stroke the control levers require to initiate a response.

You can assign different control lever characteristic curves to the crane functions.

- Open the Settings Menu (1), (Figure 3-46).



FIGURE 3-46

The symbols (2), (Figure 3-47) show the set characteristic curves of the crane functions (1), (Figure 3-47).

- Select the crane function for which you would like to change the characteristic curve.
- Set the desired characteristic curve.



- Select and confirm symbol (3), (Figure 3-47) to reset all crane functions to characteristic curve 1.

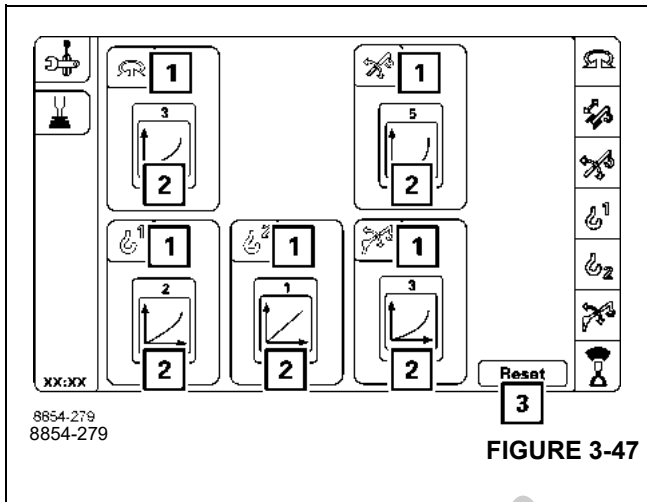


FIGURE 3-47

There are five characteristic curves:

The higher the number of the characteristic curve, (1), (Figure 3-48) to (5), the further the control lever must be moved to get an increase in speed.

With characteristic curve (5), you can work with a high degree of sensitivity with the control lever.

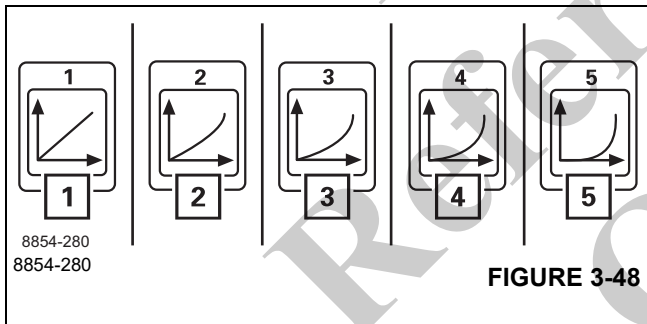


FIGURE 3-48

**Crane Functions Speeds Menu**

You can enter what percentage of the maximum speed should be enabled for each crane function.

- Select and confirm the symbol (1), (Figure 3-49).  
The crane function speeds menu opens.



FIGURE 3-49

The values below the symbols (1), (Figure 3-50) to (5) indicate the currently set crane function speeds.

The symbol (5), (Figure 3-50) is only active when the auxiliary hoist is connected.

- Symbol (6), (Figure 3-50) resets all values without prior selection.

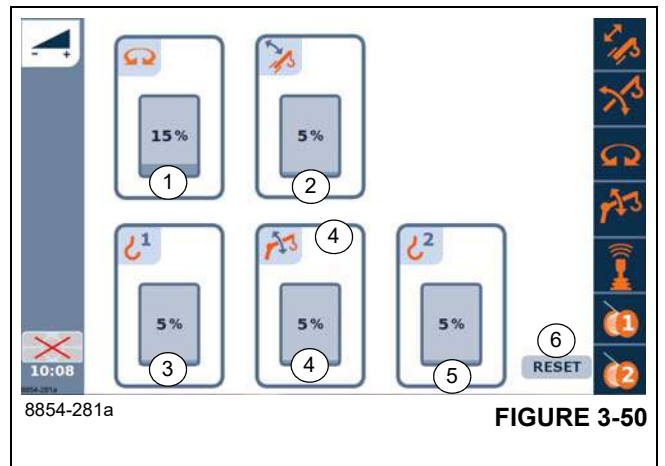


FIGURE 3-50

**Changing Values**

- Select and confirm the symbol for the relevant function speed – symbol red.
- Change the value using switch (2), (Figure 3-51) or the buttons (3), (Figure 3-51).

To cancel the input – press button (1), (Figure 3-51) once.

- Confirm the changed values – press switch (2), (Figure 3-51) or button (4), (Figure 3-51) once. The changed values for the power unit are applied.

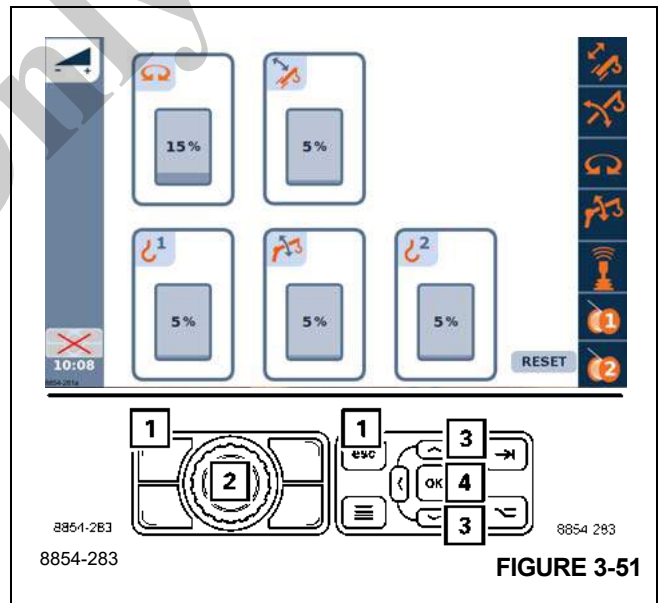


FIGURE 3-51

**Adjusting the Wiper Stroke Interval of the Windshield and Skylight Wipers**

You can set a value between 3 and 30 seconds for the front and skylight window wiper stroke interval.



**NOTE:** The higher the selected value is, the longer the pauses between the strokes of the wiper are.

Select and confirm the symbol (1), (Figure 3-52).

The Windshield Wiper Menu opens.

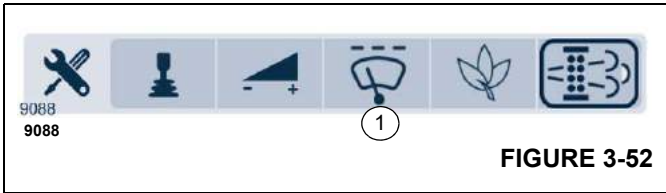


FIGURE 3-52

- The displays (1), (Figure 3-53) and (2) show the current values.

|   |                                    |
|---|------------------------------------|
| 3 | Interval for windshield wiper      |
| 4 | Interval for skylight window wiper |

- Select and confirm the symbol:

|   |                                                      |
|---|------------------------------------------------------|
| 1 | For the windshield wiper – symbol (5) displayed      |
| 2 | For the skylight window wiper – symbol (6) displayed |

- Select and confirm the symbol (7), (Figure 3-53). Symbol is orange – input on.

To cancel the input – press button (9), (Figure 3-53) once.

- Change the value using buttons (8), (Figure 3-53) or (10), (Figure 3-53).
- Confirm the changed value.

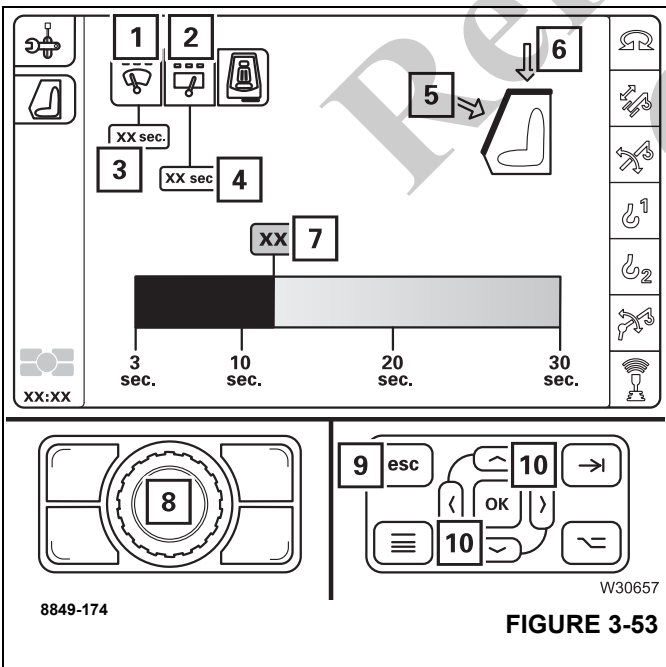


FIGURE 3-53

### Economy Mode Menu

To open: Select symbol (1), (Figure 3-54) and confirm.

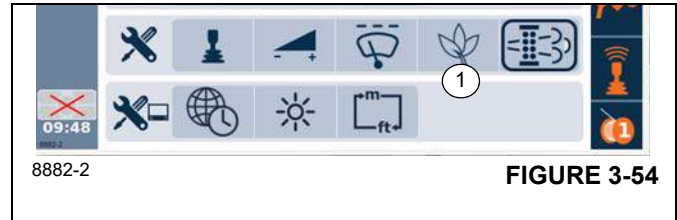


FIGURE 3-54

Select symbol and confirm for (Figure 3-55):

|   |                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------|
| 1 | Switching Economy Mode ON/OFF. Refer to <i>Seat Contact Switch and Dead-Man Switches</i> , page 3-38. |
| 2 | Set interval 1                                                                                        |
| 3 | Set interval 2                                                                                        |
| 4 | Average fuel consumption                                                                              |

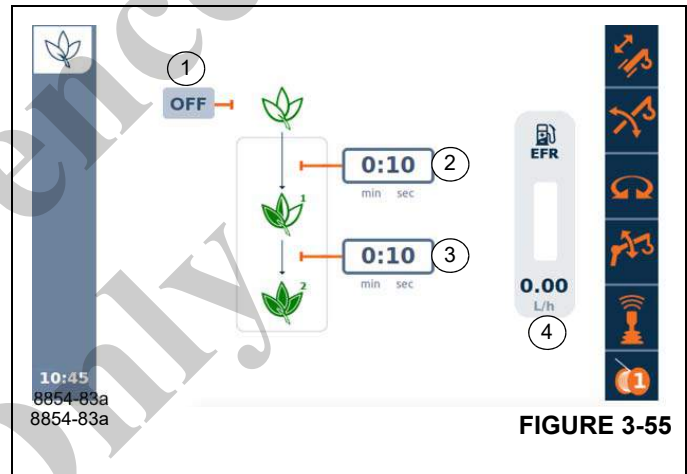


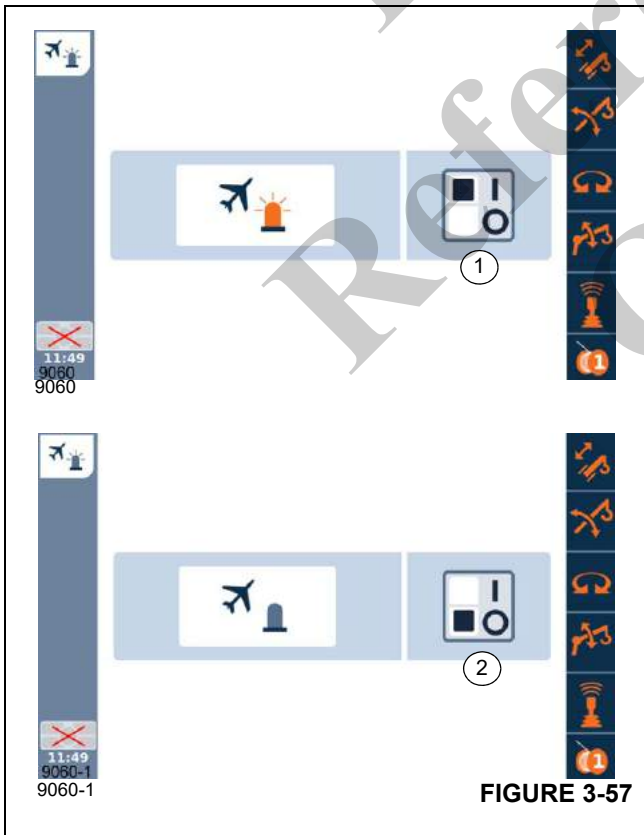
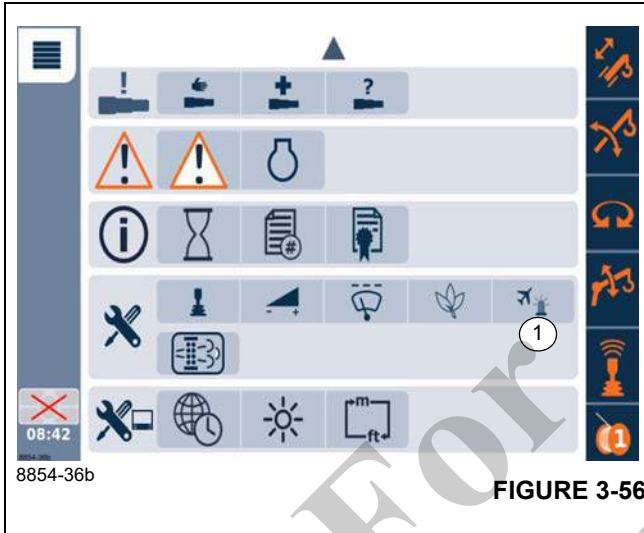
FIGURE 3-55

### Aircraft Warning Light (Optional)

On the main menu select Item (1), (Figure 3-56).

Switching ON: Select symbol (1), (Figure 3-57) and confirm.

Switching OFF: Select symbol (2), (Figure 3-57) and confirm.



### Exhaust System Cleaning Menu

The Exhaust System Cleaning Menu (Figure 3-58) allows the operator to either initiate an exhaust system cleaning or inhibit an exhaust system cleaning.

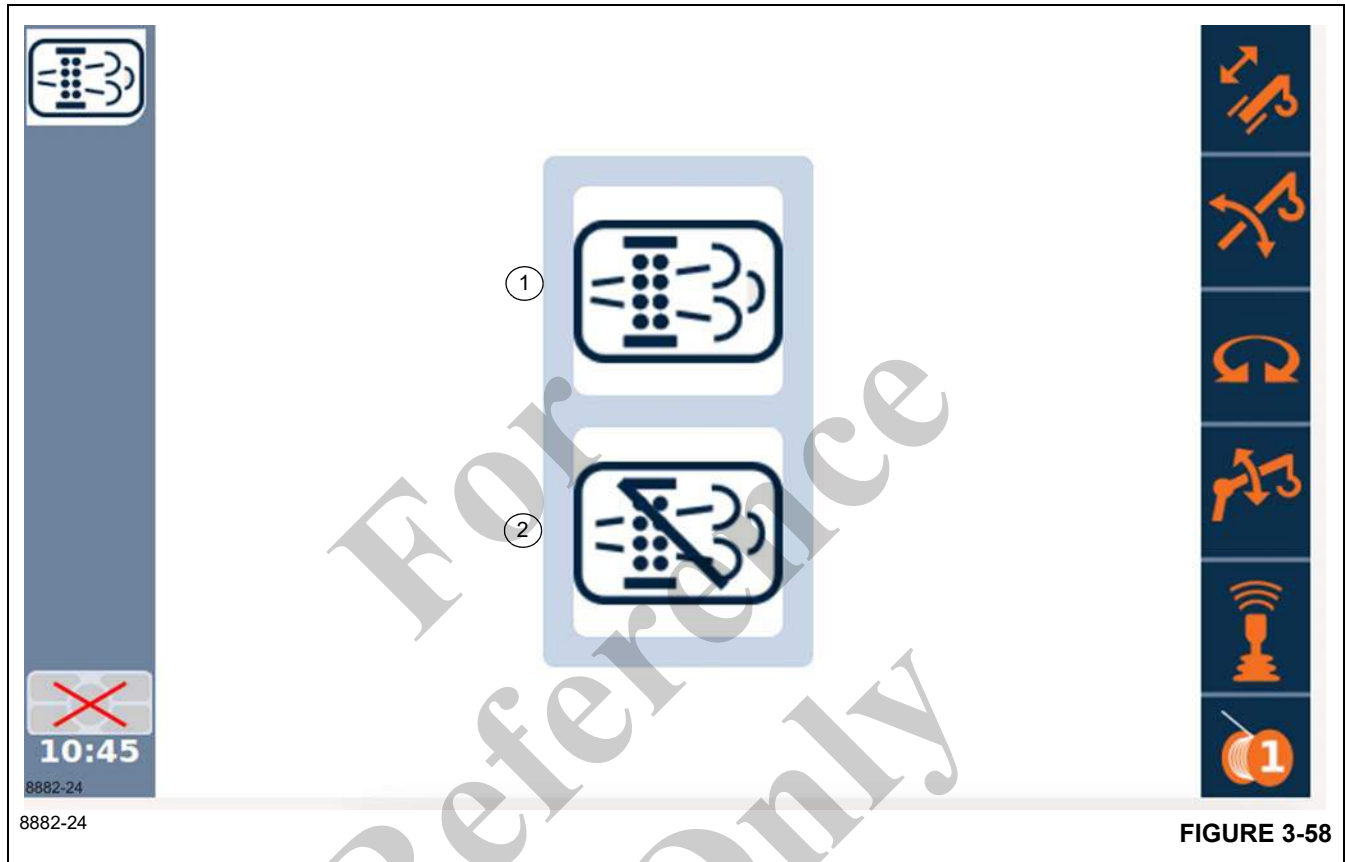


FIGURE 3-58

| Item | Description                       | Refer to  |
|------|-----------------------------------|-----------|
| 1    | Initiate exhaust system cleaning  | page 3-7  |
| 2    | Exhaust system cleaning Inhibited | page 3-30 |

Setting the Time Menu

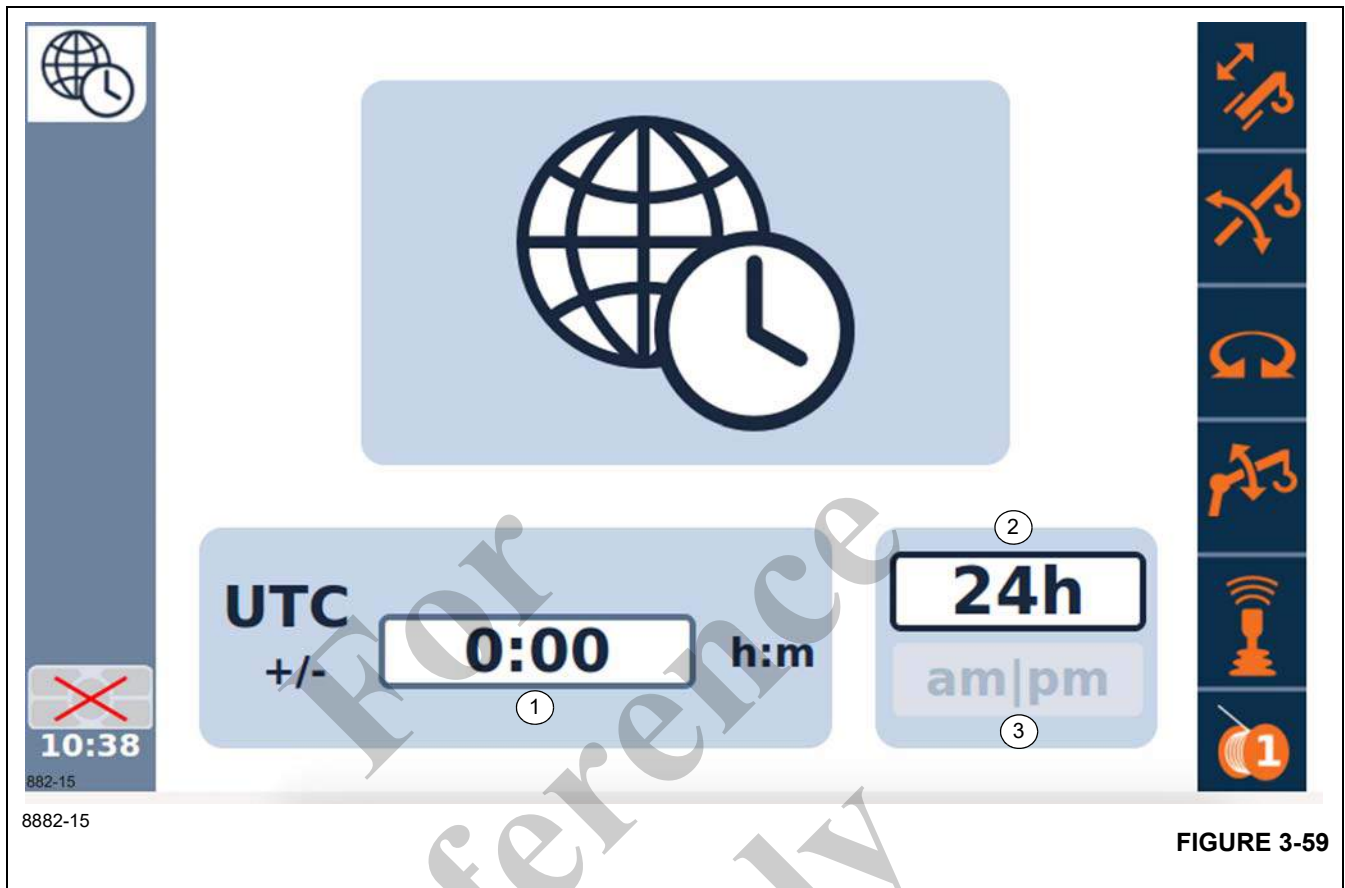


FIGURE 3-59

| Item | Description                    |
|------|--------------------------------|
| 1    | Setting the time               |
| 2    | Select clock type              |
| 3    | Select am/pm for 12 hour clock |

Using the control pad or jog dial, highlight the hours number, then use the up or down arrows or jog dial and enter the Coordinated Universal Time (UTC). UTC is considered interchangeable with Greenwich Mean Time (GMT) plus or minus time zone and push enter. Highlight the minutes number and using the up or down arrows or jog dial set the current minute value and press enter. Now highlight the 24h or 12h option and press enter. Now select either am or pm and press enter. **Note:** AM or PM will not be available for selection if the 24h time setting is selected.

Adjusting Display Brightness

The brightness of the displays is regulated automatically by the display, depending on the ambient brightness. You can

set a minimum degree of brightness manually, which is always observed when the brightness is regulated.

- Display Settings (1), (Figure 3-60) menu.

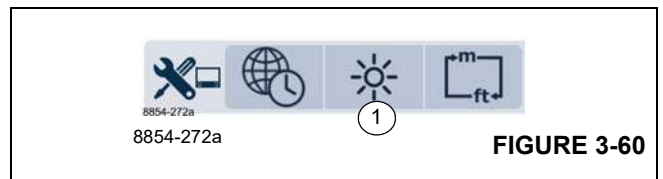


FIGURE 3-60

- Select the symbol (1), (Figure 3-61).
- Confirm the selection.

An arrow appears on the left and right of the percentage (2), (Figure 3-61).

- Set the desired minimum brightness.
- Confirm the selection.

The brightness of the display changes while setting and you can view the set value (0 to 100%) on the display (2), (Figure 3-61).

The brightness set here is the minimum value for automatic regulation.

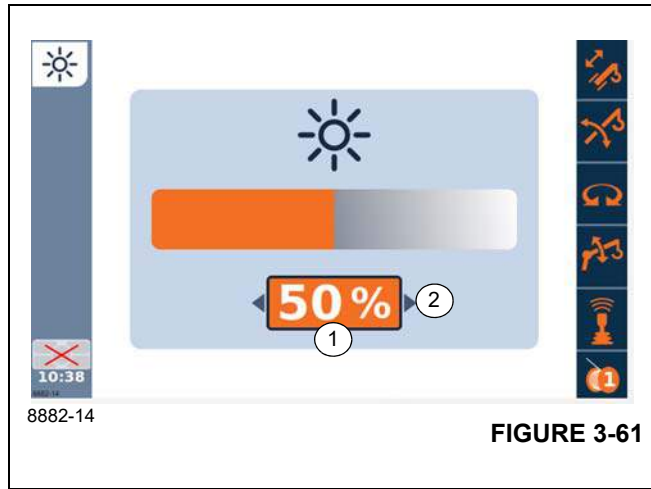


FIGURE 3-61

**NOTE:** There is no automatic regulation if you set the brightness to 100%.

The displays then always show maximum brightness.

You can cancel the entry at any time using the (1), (Figure 3-62) or (2) buttons. The settings are then reset.

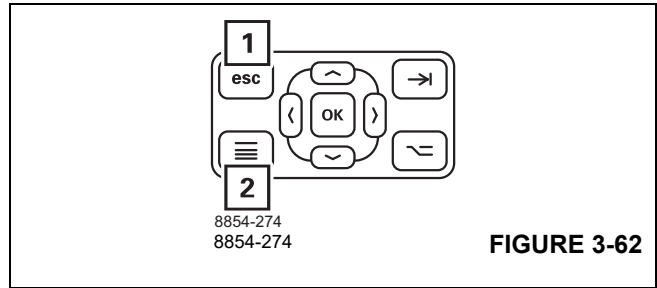


FIGURE 3-62

If the temperature on the display is too high, the brightness is reduced automatically – lamp (1), (Figure 3-63) lights up.

When the temperature falls, the specified brightness is restored – lamp (1), (Figure 3-63) goes out.

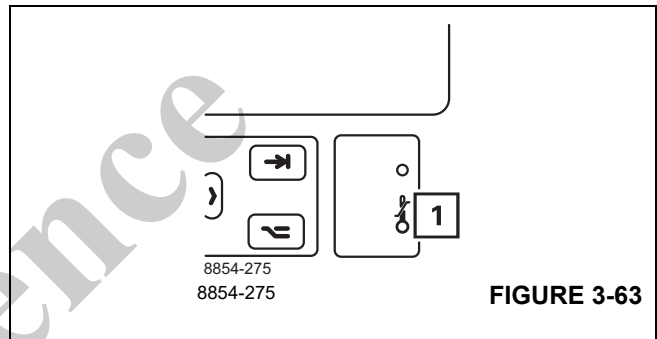


FIGURE 3-63

Reference Only

### Switch Units Menu

Use the Switch Units Menu (Figure 3-64) to select either Metric Units of Measure or Imperial units of measure.



FIGURE 3-64

| Item | Description                                                                                                                                            |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <b>Display Metric Units:</b> <ul style="list-style-type: none"> <li>• Meters</li> <li>• Degrees Celsius</li> <li>• Kilograms</li> <li>• Bar</li> </ul> |
| 2    | <b>Display Imperial Units:</b> <ul style="list-style-type: none"> <li>• Feet</li> <li>• Degrees Fahrenheit</li> <li>• lbs</li> <li>• PSI</li> </ul>    |



### Power Unit Speeds Menu

This menu (Figure 3-65) allows the operator to set the maximum speed for each power unit.

Swing and Lifting/Lowering speeds do not work well when the speed is set too low, so they jump from a low value to zero.

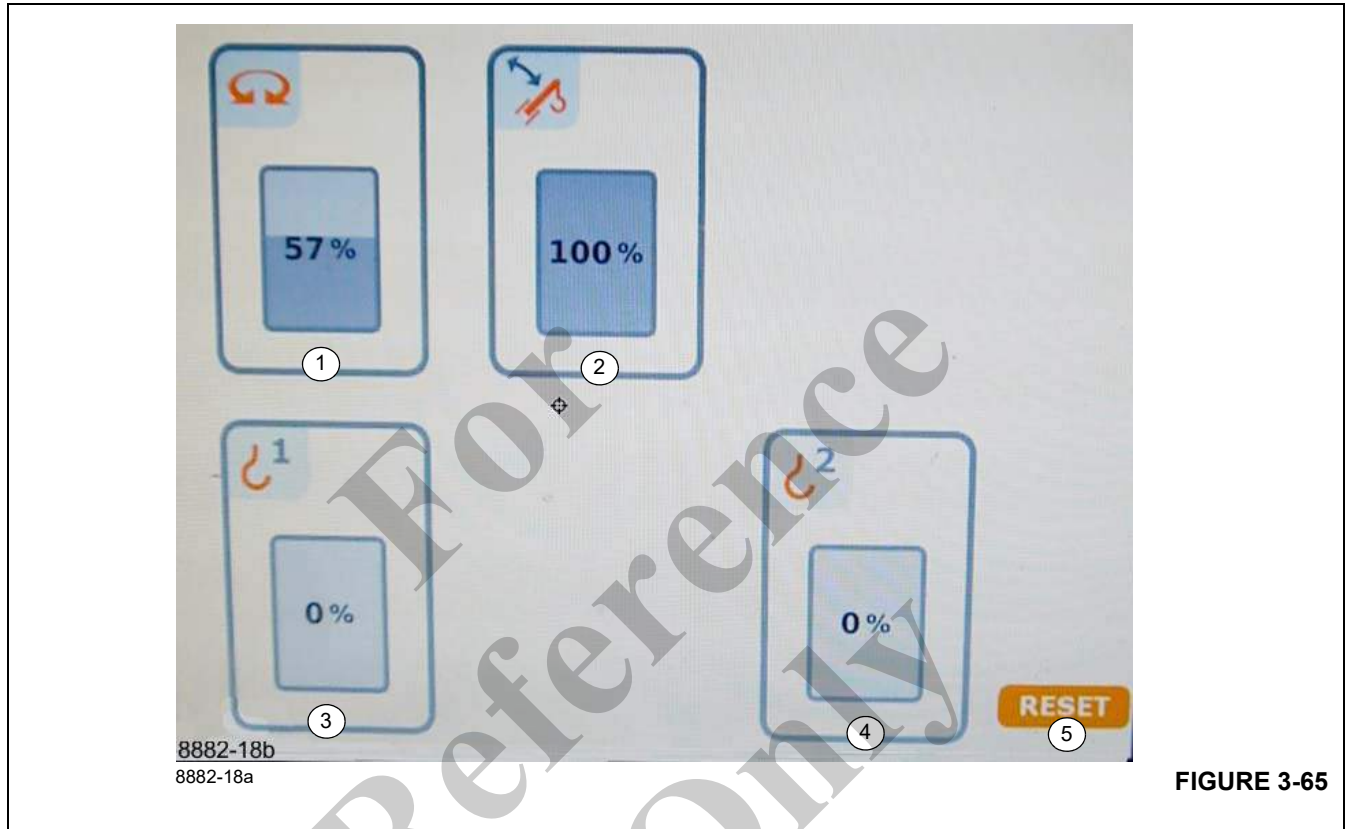


FIGURE 3-65

| Item | Description                                    | Refer to   |
|------|------------------------------------------------|------------|
| 1    | Swing speed percentage                         | page 3-99  |
| 2    | Lifting/lowering speed percentage              | page 3-100 |
| 3    | Main hoist speed percentage                    | page 3-97  |
| 4    | Auxiliary hoist speed percentage <sup>1)</sup> | page 3-97  |
| 5    | Reset all speed percentages                    | page 3-97  |

<sup>1)</sup>Optional equipment



### Operating Hours Menu

This menu (Figure 3-66) allows the operator to view the total operating hours for all crane functions in the Operating Hours Menu. You can also reset the recorded operating hours.



FIGURE 3-66

| item | Description               |
|------|---------------------------|
| 1    | Swing                     |
| 2    | Telescoping               |
| 3    | Lift                      |
| 4    | Main hoist                |
| 5    | Auxiliary hoist           |
| 6    | Engine                    |
| 7    | Transmission              |
| 8    | Boom Pinning              |
| 9    | Superstructure            |
| 10   | Reset all operating hours |

#### Displaying the Operating Hours

For each crane function, the control system will record total operating hours and current operating hours.

The total operating hours **cannot** be reset.

Open the Operating Hours Menu (1), (Figure 3-67).

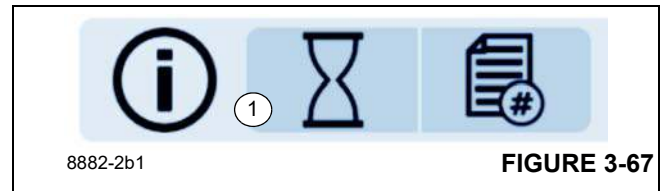


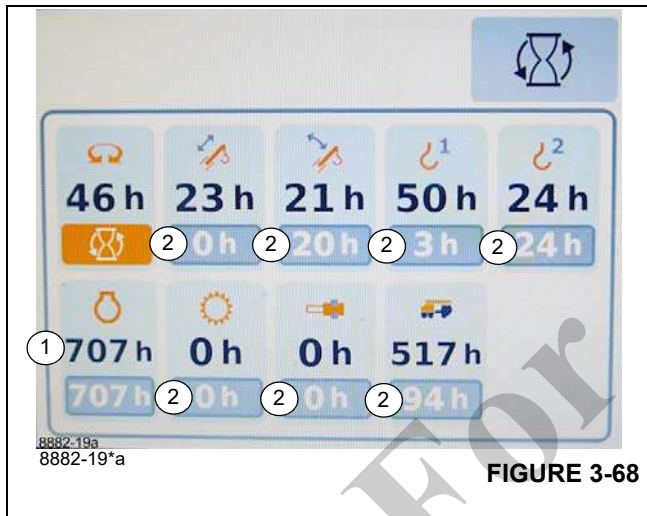
FIGURE 3-67

### Recording Operating Hours

The operating hours are recorded as follows:

The value (1), (Figure 3-68) indicates the total engine operating hours, e.g. 707 hours.

The value (2), (Figure 3-68) shows the operating hours, which can be reset.



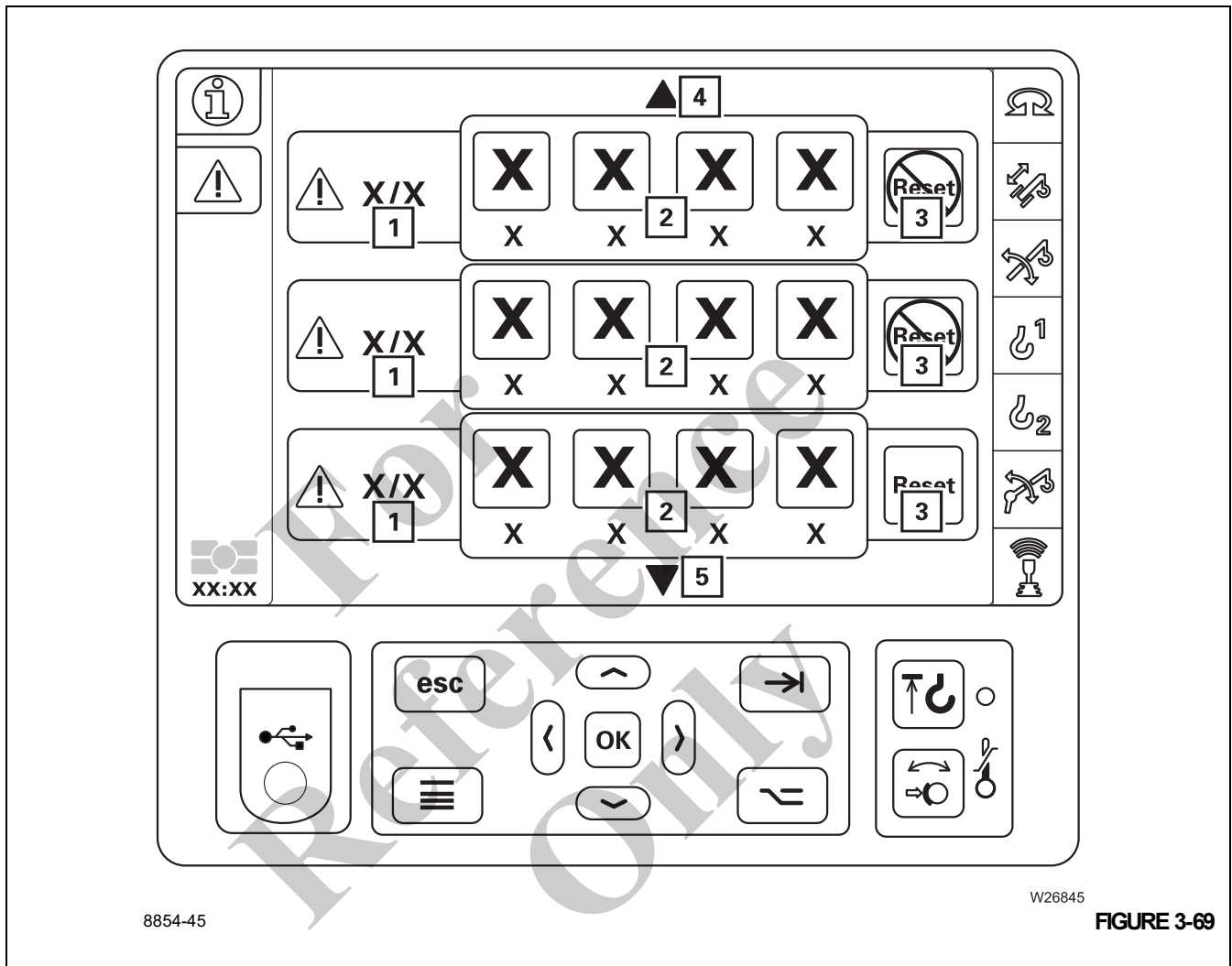
To reset an individual hour meter use the jog dial to select the time to reset. The selected function will show the icon orange.

Pressing Enter with the jog dial will reset the hours to zero. If the jog dial is used to select the large hourglass at the top then pressing Enter will reset all the hour timers

The value (8), (Figure 3-66) shows the number of times that the pinning system has started and then completed an unlocking procedure (cylinder unlocking or section unlocking).

### Crane Operation Error Menu

This menu (Figure 3-69) allows the operator to view Fault Error Codes and types of Errors.



8854-45

W26845

FIGURE 3-69

| Item | Description                     |
|------|---------------------------------|
| 1    | Display of Error / Total Errors |
| 2    | Error Message Display           |
| 3    | Acknowledging the Error         |
| 4    | Previous Error                  |
| 5    | Next Error                      |

Item 1 (Figure 3-69) is the error code and the total number of errors for that instance. Item 2 (Figure 3-69) is the type of error(s). Item 3 (Figure 3-69) allows the operator to reset and acknowledge the error or if there is a prohibition symbol error that is not resettable. The prohibition symbol error cannot be cleared without cycling the key ON/OFF. Items 4 and 5 (Figure 3-69) allow the operator to scroll to other errors.

A list of all fault codes and their definitions are available through Manitowoc Crane Care to those service technicians who have attended the Grove New Technology training course.

Software Version Menu



FIGURE 3-70

Displayed Information Only:

| Item | Description           |
|------|-----------------------|
| 1    | Module                |
| 2    | Manual Input Variable |
| 3    | CCS Software Version  |

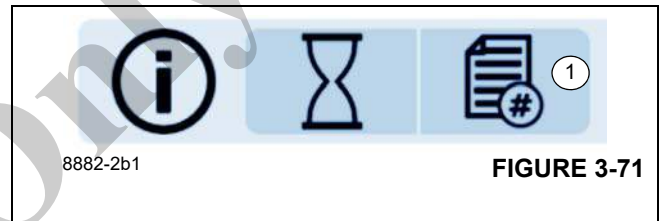


FIGURE 3-71

To open the software version menu select the Icon (1), (Figure 3-71).

### CCS – Overview Menu Groups

The Overview Menu (Figure 3-72) shows the menu groups and symbols for the power units.



FIGURE 3-72

| Item | Description                                | Refer to  |
|------|--------------------------------------------|-----------|
| 1    | Warning message/error message display area | page 3-36 |
| 2    | Camera display options                     | page 3-57 |
| 3    | Tele-automation menu group                 | page 3-58 |
|      | Telescoping semi-automation menu           | page 3-58 |
|      | Boom Configurator menu                     | page 4-85 |
| 4    | Crane function menu group                  |           |
|      | Outrigger menu                             | page 3-61 |
|      | Counterweight menu                         | page 3-96 |
|      | Superstructure lock sub-menu <sup>1)</sup> | page 3-62 |
|      | Folding boom extension menu                | page 3-63 |
| 5    | Active working range limiter menu group    |           |
|      | Swing angle menu                           | page 3-67 |
|      | Boom angle menu                            | page 3-69 |
|      | Overall height menu                        | page 3-71 |
|      | Working radius menu                        | page 3-73 |
|      | Virtual walls menu                         | page 3-75 |
| 6    | Swing Angle Calibration Zero Point         |           |
| 7    | Telescoping emergency program menu group   |           |
|      | Manual telescoping menu                    | page 3-60 |
|      | Telescoping emergency program menu         | page 3-78 |
|      | Request Reset Telescope Screen             | page 4-84 |
| 8    | Error menu group                           |           |
|      | Crane operation error menu                 | page 3-53 |
|      | Engine error menu                          | page 3-86 |

| Item | Description                            | Refer to   |
|------|----------------------------------------|------------|
| 9    | Information menu group                 |            |
|      | Operating hours menu                   | page 3-51  |
|      | Software versions                      |            |
| 10   | Settings menu group                    |            |
|      | Joystick curves menu                   | page 3-42  |
|      | Crane function speeds menu             | page 3-43  |
|      | Wiper delay menu                       | page 3-141 |
|      | Economy mode menu                      | page 3-44  |
|      | Aircraft Warning Lights (Optional)     |            |
| 11   | Exhaust system cleaning menu           | page 3-46  |
|      | Display settings menu group            |            |
| 12   | Setting time menu                      | page 3-47  |
|      | Setting brightness of the display menu | page 3-47  |
|      | Switch units menu                      | page 3-49  |
|      | Show next menu group                   |            |
| 13   | Show previous menu group               |            |

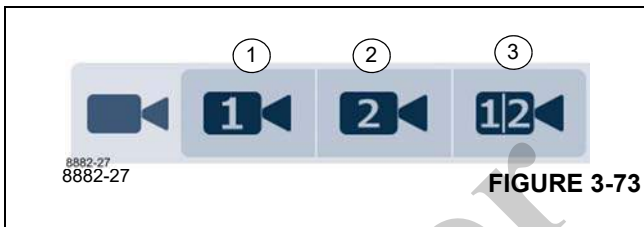
### Camera Display Options

#### Switching the Camera

Switching the Camera allows the operator to select a specific camera.

- Open the Camera Menu (Figure 3-73).
- Select and confirm the symbol to change the camera.

|    |                |
|----|----------------|
| 1: | Camera 1       |
| 2: | Camera 2       |
| 3: | Camera 1 and 2 |



For Reference Only



### Telescoping Semi-Automation Menu

The Telescoping Semi-Automation Menu is used to select the amount of telescoping for each boom section.

**NOTE:** Important information about the use of the semi-auto mode is found on page 4-67.

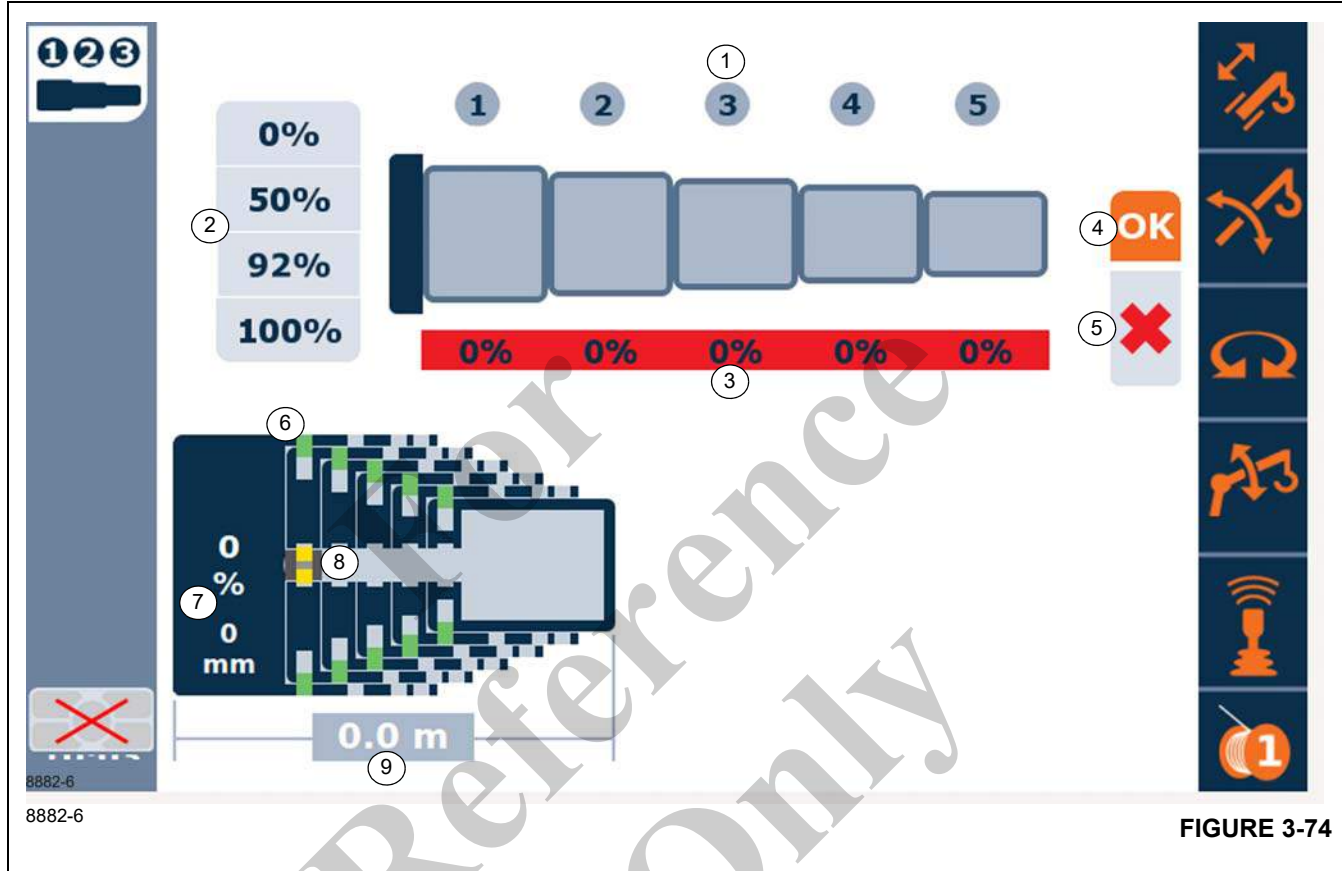


FIGURE 3-74

| Item | Description                                  | Refer to   |
|------|----------------------------------------------|------------|
| 1    | Telescopic sections display                  | page 3-103 |
| 2    | Pre-selection individual telescopic sections | page 3-103 |
| 3    | Current telescope status display             | page 3-103 |
| 4    | Input confirmation                           | page 3-37  |
| 5    | Telescoping permitted/not permitted display  |            |
| 6    | Locking status telescopic section display    |            |
| 7    | Telescoping cylinder length display          |            |
| 8    | Locking status telescoping cylinder display  |            |
| 9    | Main boom length display                     |            |



Boom Configurator Menu

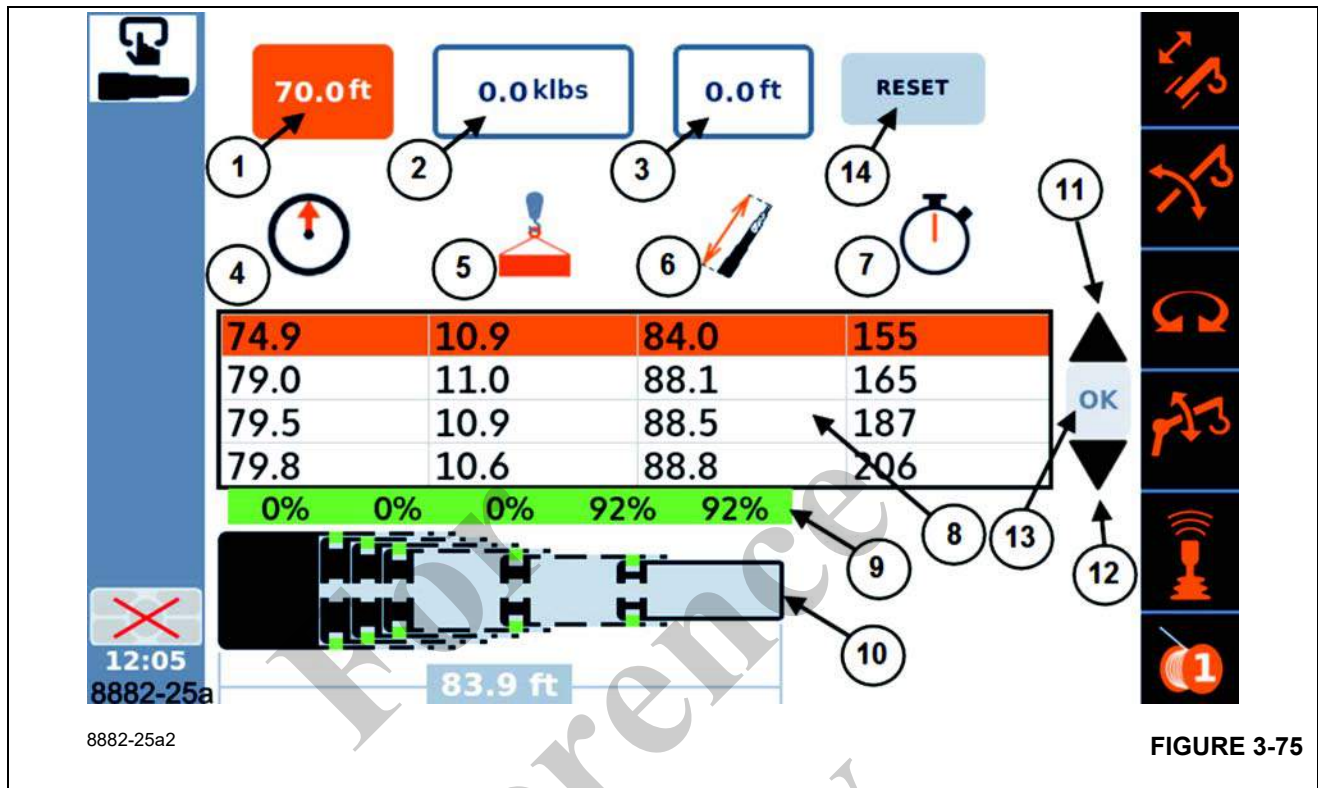


FIGURE 3-75

| Item | Description                                                                                                                                                                                                   |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Lift plan radius entry box                                                                                                                                                                                    |
| 2    | Lift plan hook load entry box                                                                                                                                                                                 |
| 3    | Lift plan boom length entry box                                                                                                                                                                               |
| 4    | Symbol indicating radius.                                                                                                                                                                                     |
| 5    | Symbol indicating hook load.                                                                                                                                                                                  |
| 6    | Symbol indicating boom length.                                                                                                                                                                                |
| 7    | Symbol indicating approximate time (in seconds) for boom configuration ("tele pictures") to be completed.                                                                                                     |
| 8    | Table of possible boom configurations ("tele pictures") that meet the lift plan criteria.                                                                                                                     |
| 9    | For the row in the table that is highlighted, this is the boom configuration ("tele picture").                                                                                                                |
| 10   | For the row in the table that is highlighted, this is a schematic view of the boom configuration.                                                                                                             |
| 11   | Up arrow, when selected and select Enter, the highlighted row moves up in the table.                                                                                                                          |
| 12   | Down arrow, when selected and select Enter, the highlighted row moves down in the table.                                                                                                                      |
| 13   | OK button; when selected and select Enter, the highlighted row's boom configuration is accepted and sent to the Semi-automatic mode screen, and the boom commences to attempt to use this boom configuration. |
| 14   | Reset option; when selected and select Enter, the lift plan entry values are set to 0 and boom configurations cleared.                                                                                        |

### Manual Telescoping Menu

The Manual Telescoping Menu allows the operator to manually telescope the boom by manually pinning and unpinning the section and cylinder pins and then extending or retracting the hydraulic cylinder.

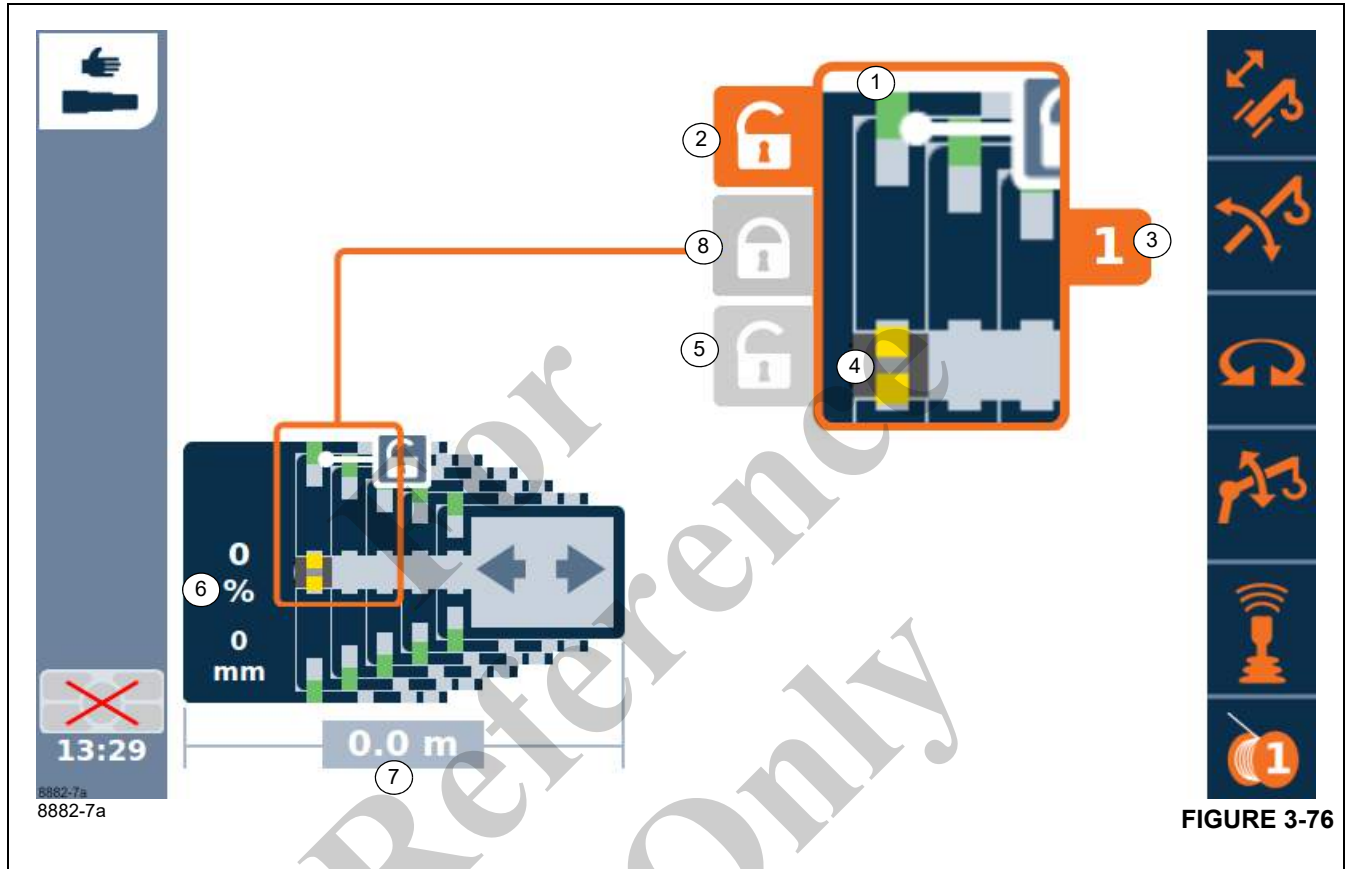


FIGURE 3-76

| Item | Description                                            | Refer to   |
|------|--------------------------------------------------------|------------|
| 1    | Telescopic section locking status                      |            |
| 2    | Telescopic section symbol unlock                       | page 3-104 |
| 3    | Current telescopic section                             | page 3-103 |
| 4    | Telescoping cylinder locking status                    |            |
| 5    | Telescoping cylinder symbol unlock                     | page 3-104 |
| 6    | Telescoping cylinder length display                    |            |
| 7    | Main boom length display                               |            |
| 8    | Telescopic section symbol lock or telescoping cylinder |            |

### Outrigger Menu

The Outrigger Menu (Figure 3-77) is used to deploy and monitor the outriggers.

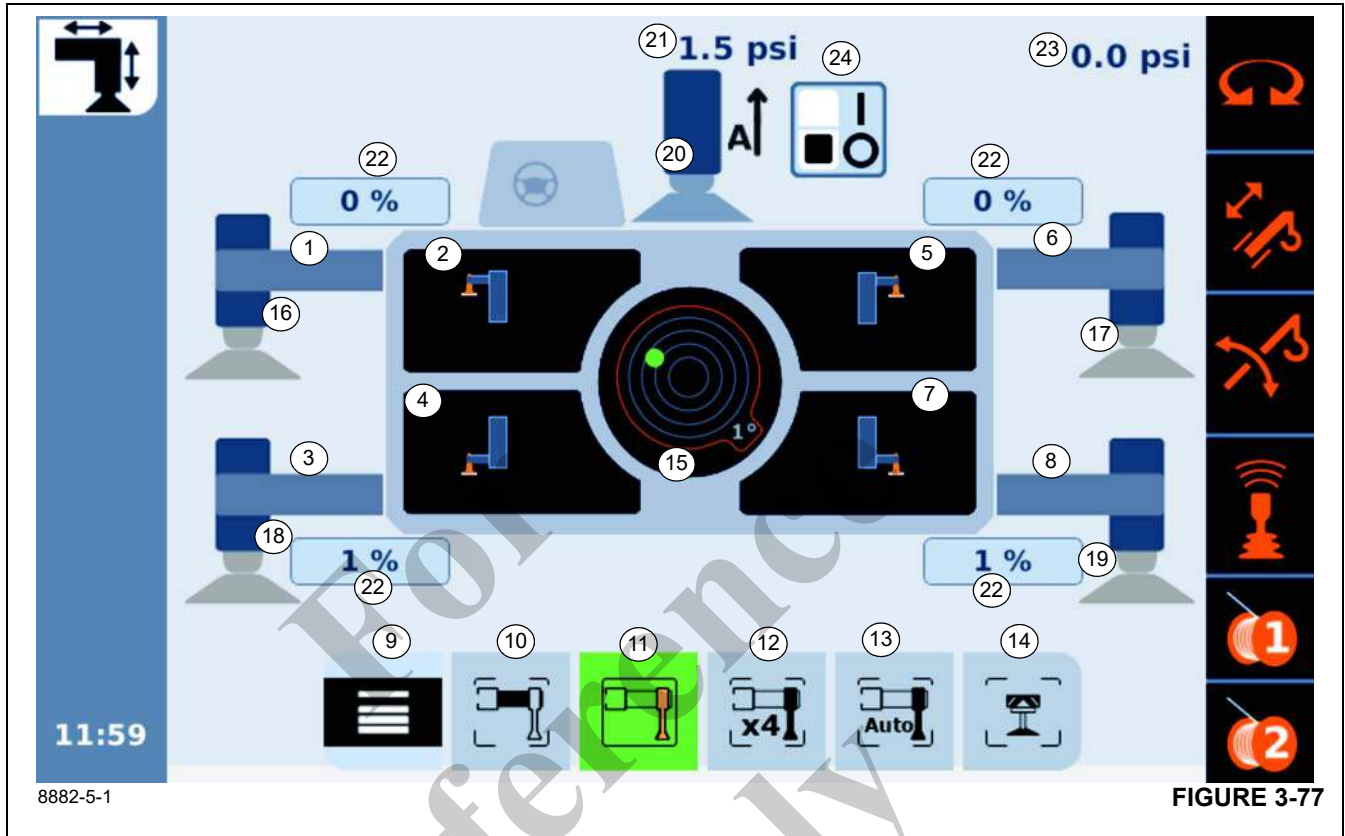


FIGURE 3-77

3

| Item | Description                                                                                                                    |
|------|--------------------------------------------------------------------------------------------------------------------------------|
| 1    | Left Front Beam                                                                                                                |
| 2    | Jog Dial Top Left Button - left front beam/jack select. This will turn into center front stabilizer when item #12 is selected. |
| 3    | Left Rear Beam                                                                                                                 |
| 4    | Jog Dial Bottom Left Button - left rear beam/jack select                                                                       |
| 5    | Jog Dial Top Right Button - right front beam/jack select                                                                       |
| 6    | Right Front Beam                                                                                                               |
| 7    | Jog Dial Right Bottom Button - Right Rear Beam/jack select                                                                     |
| 8    | Right Rear Beam                                                                                                                |
| 9    | Exiting the Menu                                                                                                               |
| 10   | Outrigger Beams Select                                                                                                         |
| 11   | Outrigger Jacks Select                                                                                                         |

| Item | Description                               |
|------|-------------------------------------------|
| 12   | O/R Jack x4 Icon                          |
| 13   | Automatic Level Select                    |
| 14   | Center Front Stabilizer Select            |
| 15   | Current Inclination Indicator             |
| 16   | Left Front Jack                           |
| 17   | Right Front Jack                          |
| 18   | Left Rear Jack                            |
| 19   | Right Rear Jack                           |
| 20   | Center Front Stabilizer                   |
| 21   | Center Front Stabilizer Pressure          |
| 22   | Percentage the Outrigger Beam is Extended |
| 23   | Outrigger Circuit Supply Pressure         |
| 24   | Cribbing Mode Switch                      |

### Superstructure Lock Menu

The Superstructure Lock Menu (Figure 3-78) is used to lock or unlock the 360 degree swing lock. This screen provides indication of the swing angle (1) the swing lock status (locked/unlocked/intermediate/error) and provides selections (2 and 3) to actuate the lock.

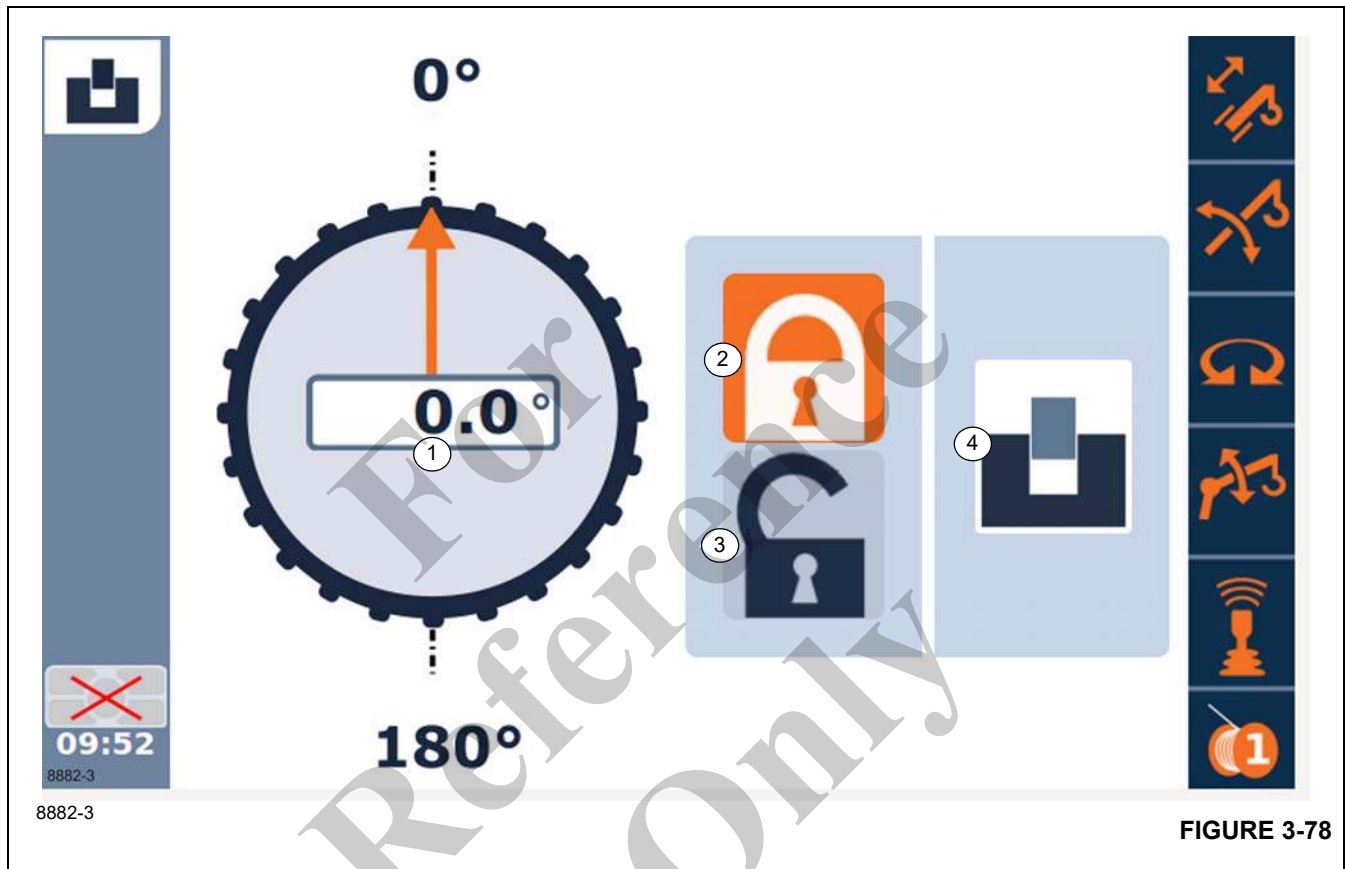


FIGURE 3-78

| Item | Description                |
|------|----------------------------|
| 1    | Current Swing Angle        |
| 2    | Lock                       |
| 3    | Unlock                     |
| 4    | Superstructure Lock Status |

### Bi-Fold Boom Extension Menu

The Bi-Fold Boom Extension Menu allows the operator to lock or unlock two connections between the main boom and the bi-fold boom extension (Figure 3-79).



FIGURE 3-79

| Item | Description                               | Refer to                          |
|------|-------------------------------------------|-----------------------------------|
| 1    | Boom extension attachment point           | <i>Boom Extensions, page 6-43</i> |
| 2    | Boom extension attachment and pivot point |                                   |








## Working Range Limiter (WRL)

### Introduction

The Working Range Limiter (WRL) is a feature of the crane control system that allows for the definition of obstacles or limits for crane operation. This definition can then be used by the crane control system to assist the operator with identifying the motion of crane with respect to these obstacles and limits.

In addition, if the WRL is configured to do so, the crane functions can be affected to slow and stop with respect to limitations; this behavior is referred to as lockout.

The following limitations are available for the WRL:

- 
• Height Limitation active symbol: boom height limit can be defined for a maximum boom elevation.
- 
• Boom Up/Down Limitation active symbol: boom up/down limits can be defined for a minimum and maximum boom angle.
- 
• Radius Limitation active symbol: boom radius limits can be defined for minimum and maximum radius working zones.
- 
• Swing Limitation active symbol: swing angle limits for swing left and swing right directions can be defined.
- 
• Virtual Wall Limitation active symbol: up to five virtual walls can be defined to be job site objects or warning zones.

**NOTE:** The Working Range Limiter feature is an operator aide, it can assist the operator by alerting when limits are approached or reached. The WRL should not be relied upon in place of good operating practice, they are there to assist, not direct operation. All appropriate techniques such as other personnel providing visual guidance to the crane operator are to be employed. In addition, when the lockout capability is utilized, crane functions are expected to be used with the same caution as if the lockout capability was not present. In particular, it must be noted that the swing function has a coasting or free-swing characteristic that will not be affected by the slow-down and lockout of the swing

function. As such, swing speeds are to be no more than 1 degree of swing per second.

Turning off the power to the control system disables any WRL limitations.

### WRL Limitations

For each of the limitations, the limitation must first be ENABLED within the WRL feature of the crane control system software. This is done with particular screens and buttons on the operating display. Once the limitation is enabled, then it can be DEFINED (in terms of specific angles, locations, etc.). This is also done with the screen and buttons on the operating display, as well as usually operating the boom to define particular locations. With the limitation enabled and defined, the control system can then provide the needed feedback and warnings. When the crane is in such a position to cause warning, then the WRL limitation is considered to be ACTIVE. In summary, then, the use of the WRL involves steps to enable the limitation, define the limitation, and then limitations can become active once warnings are generated for the operator (based on the crane position).

There is no icon for WRL when it is enabled, but alerts show up on the left side alert bar when a limit is reached. (Figure 3-80) shows the Main Screen.

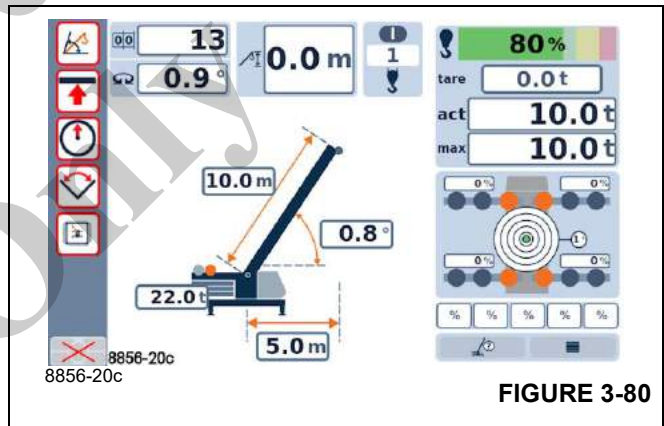


FIGURE 3-80

When a limitation is active, the Main Screen shows an indicator for the limitation (in addition to audible alarms). There are similar symbols for the other limitations; (Table 3-1) shows the active indicator symbols for the WRL limitations.

When a limitation is active, audible alarms are generated. (Table 3-2) indicates the behavior of the audible alarm for the various limitations.

The operator should notice that all the audible alarm triggers use the values of 10 and 5. This may be 10 or 5 degrees, or it may be 10 or 5 ft distance. This is intentional so that the operator can continue to watch the crane operation and not have to look at the display (assuming the 10 and 5 values are remembered). Whenever slow beeping is heard, this will be

a 10 threshold. Whenever fast beeping is heard, this will be a 5 threshold. Whenever there is a solid sound, this will signify being at the limitation.

**Table 3-1. Alarm Characteristics**

| LIMITATION        | POSITION                  | ALARM        |
|-------------------|---------------------------|--------------|
| Height Limitation | 3 m (10 ft) before limit  | Slow beeping |
|                   | 1.5 m (5 ft) before limit | Fast beeping |
|                   | At limit                  | Solid sound  |
| Boom Up/Down      | 10 deg before limit       | Slow beeping |
|                   | 5 deg before limit        | Fast beeping |
|                   | At limit                  | Solid sound  |
| Radius            | 3 m (10 ft) before limit  | Slow beeping |
|                   | 1.5 m (5 ft) before limit | Fast beeping |
|                   | At limit                  | Solid sound  |
| Swing             | 10 deg before limit       | Slow beeping |
|                   | 5 deg before limit        | Fast beeping |
|                   | At limit                  | Solid sound  |
| Virtual wall      | 3 m (10 ft) before limit  | Slow beeping |
|                   | 1.5 m (5 ft) before limit | Fast beeping |
|                   | At limit                  | Solid sound  |

**NOTE:** The audible alarm can be canceled by pressing the Tab Button on the display. Refer to Item 1 in (Figure 3-81). It can only be canceled once the boom is no longer being moved. When boom motion again becomes apparent in the control system, the audible alarm will be restored.

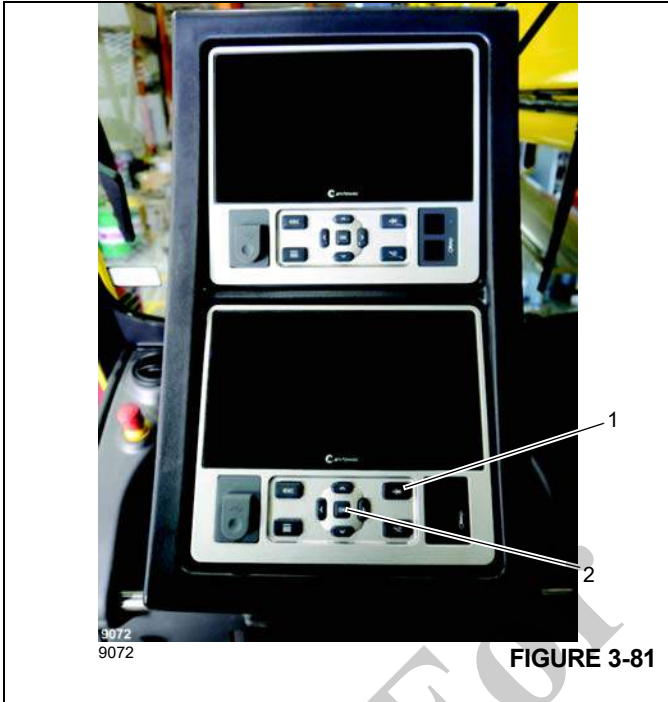


FIGURE 3-81

When a limit is reached, the Main Screen shows an indicator for this condition (again in addition to audible alarms). (Figure 3-80) shows the Main Screen example.

**Setting WRL Limitations**

There is a separate display screen to allow for enabling and setting limitations for the WRL options. The WRL limitations are shown as a group on the main menu screen, each limitation can then be selected to work with that limitation screen. (Figure 3-82) shows the WRL options on the main menu screen.

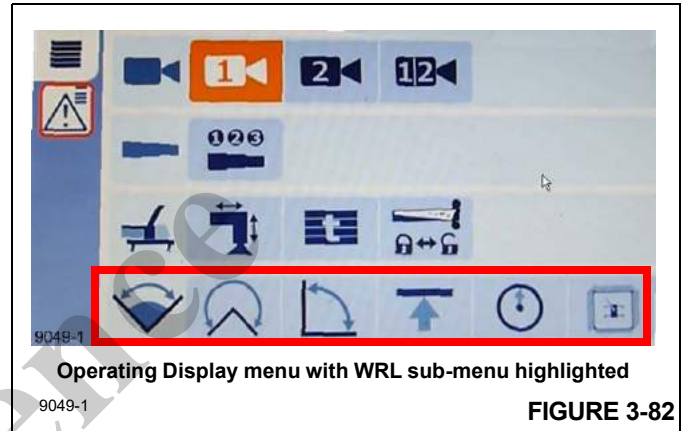


FIGURE 3-82

| Item | Description |
|------|-------------|
| 1    | Tab Button  |
| 2    | OK Button   |

Reference Only



### WRL - Swing Angle Menu

The Swing Angle Menu (Figure 3-83) allows the operator to set limits for the boom angles which the boom can operate within.

**NOTE:** 0 degrees is boom over the rear of the machine.

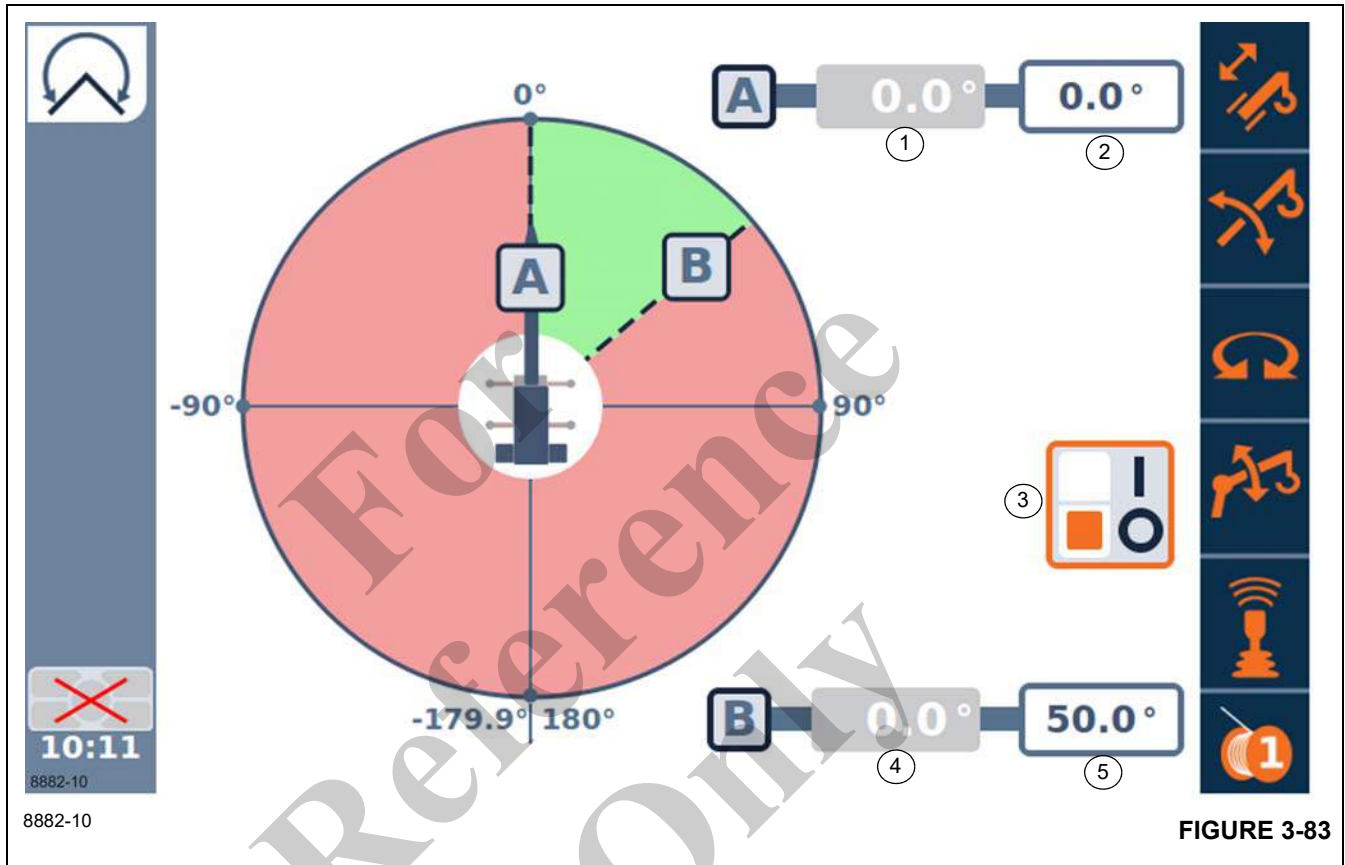


FIGURE 3-83

| Item | Description                      |
|------|----------------------------------|
| 1    | Current swing angle A            |
| 2    | Input maximum swing angle A      |
| 3    | Swing monitoring function ON/OFF |
| 4    | Current swing angle B            |
| 5    | Input maximum swing angle B      |

#### Setting Swing Angle by Crane Position

To define and enable the Swing Angle Limitation using the crane position to indicate the swing angle left and right limitation, the following steps can be used:

1. Position the boom to the desired swing angle for the A limitation.
2. Select the Swing Angle Screen (Figure 3-82) on the Main Menu Screen.

3. Use the Right Arrow function to highlight the switch symbol (3).
4. Use an OK button to enable swing lockout.
5. Use the Right Arrow function to highlight the current swing left position (1). Use an OK button to accept the current crane position to be the limitation value. The limitation value for swing left should now be updated on the screen. **Note** that the boom is now at the limitation, so alarms will sound. The boom can now be moved away from the current swing angle to cease the alarm.
6. Position the crane to have the desired swing angle position for the swing right limitation.
7. Use the Right Arrow function to highlight the current swing right crane position symbol (4). Use an OK button to accept the current crane position to be the limitation value. The limitation value for swing right should now be updated on the screen. Again, note that the boom is now at the limitation, so alarms will sound. The boom can

now be moved away from the current swing angle to cease the alarm.

8. The Swing Limitation is now defined and enabled.

### Setting Swing Angle Menu by Value

To define and enable the Swing Angle Menu using a “typed in” value as the limitation, the following steps can be used:

1. Select the Swing Angle Menu screen (Figure 3-83) on the Main Menu Screen.
2. Use the Right Arrow function to highlight the Switch symbol (3).
3. Use an OK button to toggle the switch ON.
4. Use the Right Arrow function to highlight the maximum swing angle A Value (2). Use an OK button to begin entering the value. Use the Up Arrow or the Down Arrow or jog dial to change the value (in tenths) to the desired swing angle value. Use an OK button to finish entering the value. **Note** that the boom may now be at the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.
5. Use the same procedure to set the Maximum Swing Angle B.

### Swing Limitation Disable Procedure

To disable an active Swing Limitation, the following steps are to be used (note that turning off the power to the control system also disables the WRL limitations):

1. Select the Swing Limitation Screen (Figure 3-83) on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow function to highlight the switch symbol.
3. Use an OK button to disable the limitation.

Reference Only

### WRL - Boom Angle Limits Menu

The Boom Angle Limits Menu (Figure 3-84) allows the operator to set upper and lower limits for the boom to operate within.

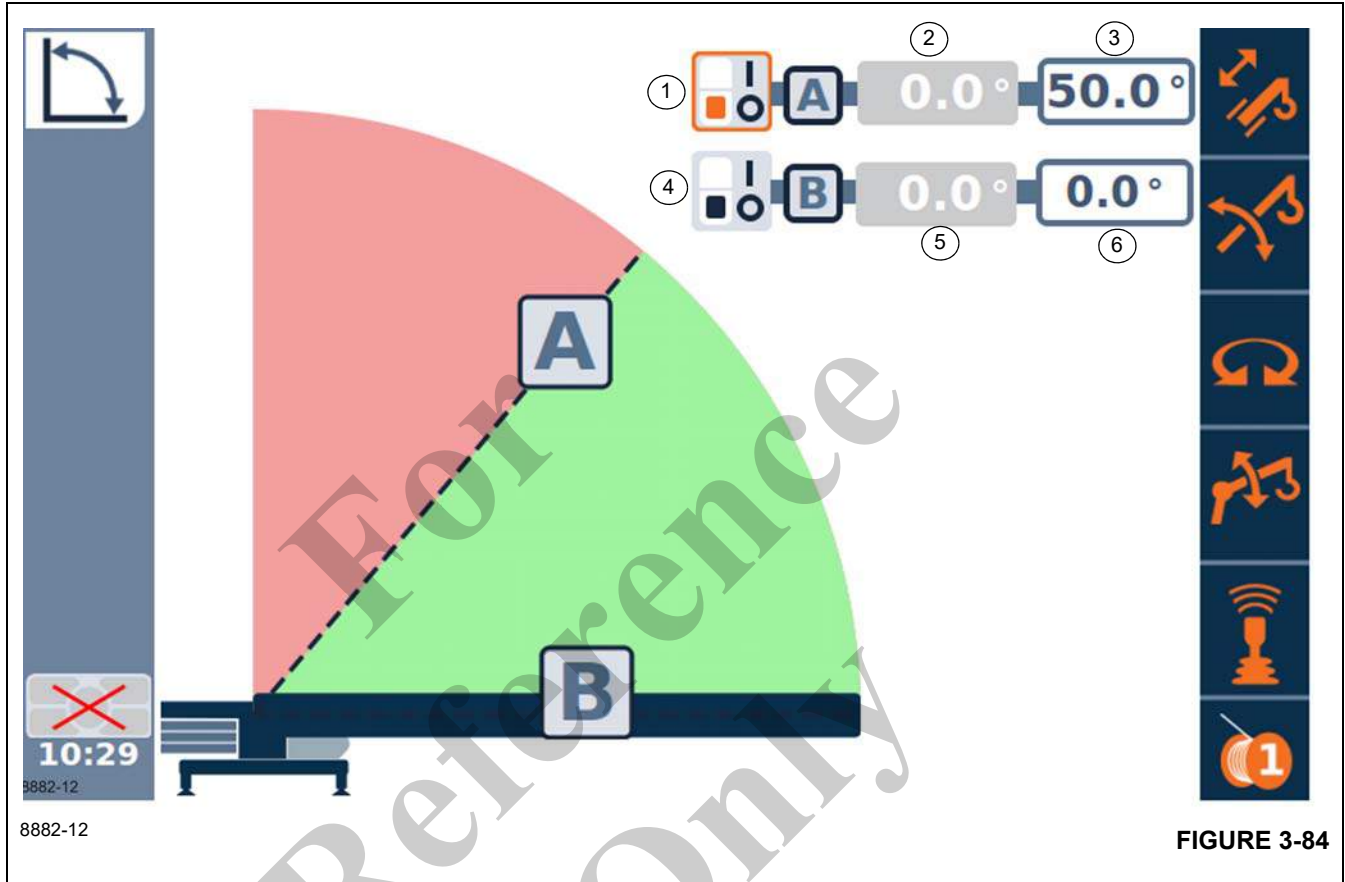


FIGURE 3-84

| Item | Description                 |
|------|-----------------------------|
| 1    | Upper A limit ON/OFF        |
| 2    | Current upper lifting limit |
| 3    | Enter upper lifting limit   |
| 4    | Lower B limit ON/OFF        |
| 5    | Current lower lifting limit |
| 6    | Enter lower lifting limit   |

3. Use the Right Arrow function to highlight the Switch symbol.
4. Use an OK button to enable the limitation.
5. Use the Right Arrow function once to highlight the upper boom angle accept crane position symbol. Use an OK button to accept the current crane position to be the Limitation Value. The Limitation Value should now be updated on the screen. Note that the boom is now at the limitation, so alarms will sound. The boom can now be moved away from the current boom angle to cease the alarm.

#### Setting Boom Up Limitation by Crane Position

To define and enable the Boom Up Limitation using the crane current boom angle as the limitation, the following steps can be used:

1. Position the boom to the desired boom angle.
2. Select the Boom elevation limits menu screen (Figure 3-82) on the Main Menu Screen.

#### Setting Boom Down Limitation by Crane Position

To define and enable the Boom Elevation Limits Menu using the crane current boom angle as the limitation, the following steps can be used:

1. Position the boom to have the desired position.
2. Select the Boom Elevation Limits Menu Screen (Figure 3-84) on the Main Menu Screen.

3. Use the Right Arrow function to skip the Boom Up Limitation symbols and then highlight the Boom Down Switch symbol.
4. Use an OK button to enable the limitation. (**Note:** alarm will sound as boom down will be set to limit).
5. Use the Right Arrow function once to highlight the lower boom angle. Use an OK button to accept the current crane position. The Limitation Value should now be updated on the screen. Note that the boom is now at the limitation, so alarms will sound. The boom can now be moved away from the current boom angle to cease the alarm.

#### Setting Boom Up Elevation Limits Menu by Value

To define and enable the Boom Up Elevation Limits Menu using a “typed in” value as the limitation, the following steps can be used:

1. Select the Boom Elevation Limits Menu screen (Figure 3-84) on the Main Menu Screen.
2. Use the Right Arrow function to highlight the Switch symbol (1).
3. Use an OK button to enable the limitation. (**Note:** alarm will sound if boom tip is above limit, when enabled).
4. Use the Right Arrow function to highlight the Enter Upper Lifting Limit value (3).
5. Use an OK button to begin entering the value. Use the Up Arrow or the Down Arrow or jog dial to change the value (in tenths) to the desired boom elevation value. Use an OK button to finish entering the value. Note that the boom may now be at the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.
6. The Boom Up Elevation Limits Menu is now defined and enabled.

#### Setting Boom Down Elevation Limits Menu by Value

To define and enable the Boom Down Elevation Limits Menu using a “typed in” value as the limitation, the following steps can be used:

1. Select the Boom Elevation Limits Menu screen (Figure 3-84) on the Main Menu Screen.
2. Use the Right Arrow function to highlight the Switch symbol (4).
3. Use an OK button to enable the limitation. (**Note:** alarm will sound if boom tip is below limit, when enabled).
4. Use the Right Arrow function to highlight the Enter Upper Lifting Limit value (6).
5. Use an OK button to begin entering the value. Use the Up Arrow or the Down Arrow or jog dial to change the value (in tenths) to the desired boom elevation value. Use an OK button to finish entering the value. Note that the boom may now be at the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.
6. The Boom Down Elevation Limits Menu is now defined and enabled.

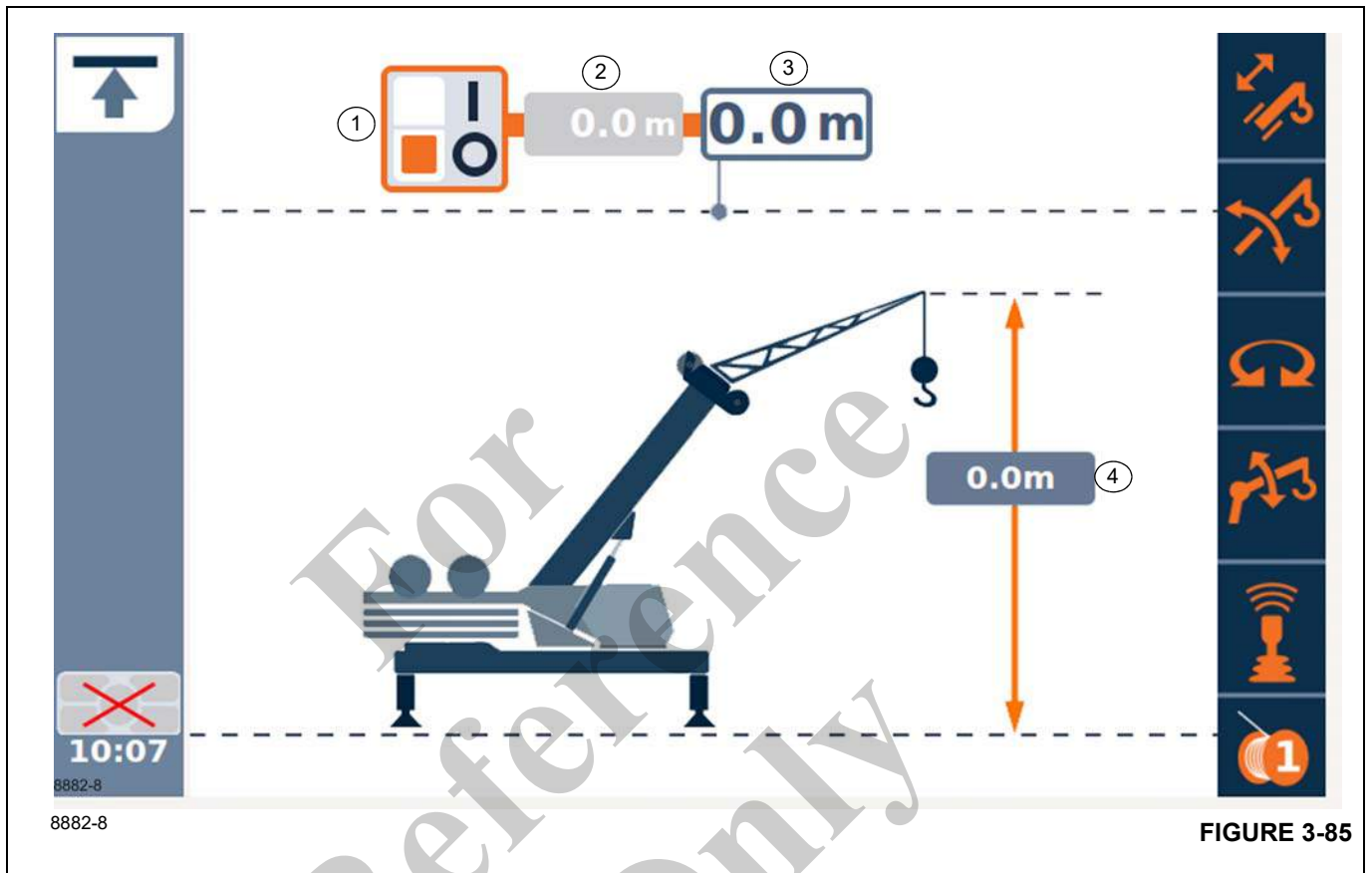
#### Boom Up/Down Limitation Disable Procedure

To disable an active Boom Up or Boom Down Limitation, the following steps are to be used (note that turning off the power to the control system also disables the WRL limitations):

1. Select the Boom Elevation Limits Menu Screen (Figure 3-84) on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow function to highlight the desired switch symbol.
3. Use an OK button to disable the limitation.

### WRL - Overall Height Menu

The Overall Height Menu (Figure 3-85) allows the operator to set a limit for the maximum boom height.



| Item | Description                               |
|------|-------------------------------------------|
| 1    | Overall Height Monitoring Function ON/OFF |
| 2    | Apply Current Overall Height              |
| 3    | Input Maximum Overall Height              |
| 4    | Current Height                            |

#### Setting Height Limitation Using Crane Position

To define and enable the Height Limitation using the crane current tip height as the limitation, the following steps are used:

1. Position the boom tip at the desired position.
2. Select the Overall Height Menu (Figure 3-85) on the main menu screen.
3. Use the Right Arrow function to highlight the Enable symbol (1), (Figure 3-85).

4. Use an OK button to enable the limitation - it will have the green color when enabled. (**Note:** Alarm will sound if boom tip is above limit when enabled). The boom can now be moved away from the current tip height to cease the alarm.

5. The Height Limitation is now defined and enabled.

#### Setting Height Limitation by Value

To define and enable the Height Limitation using a “typed in” value of tip height as the limitation, the following steps can be used:

1. Select the Overall Height Menu screen (Figure 3-85) on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow function or jog dial to highlight the Enable symbol.
3. Use an OK button to enable the limitation. (**Note:** alarm will sound if boom tip is above limit, when enabled).
4. Use the Right Arrow function to highlight the Limitation Value. Use an OK button to begin entering the value.

Use the Up Arrow or the Down Arrow or jog dial to change the value (in tenths) to the desired tip height value. Use an OK button to finish entering the value. Note that the boom may now be at the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current tip height to cease the alarm, if needed.

5. The Overall Height is now defined and enabled.

#### Height Limitation Disable Procedure

To disable an active Overall Height, the following steps can be used (note that turning off the power to the control system also disables the WRL limitations):

1. Select the Overall Height menu screen on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow function to highlight the Enable symbol.
3. Use an OK button to disable the limitation.

For  
Reference  
Only

**WRL - Working Radius Menu**

The Working Radius Menu (Figure 3-86) allows the operator to set minimum and maximum radius limits for the boom.

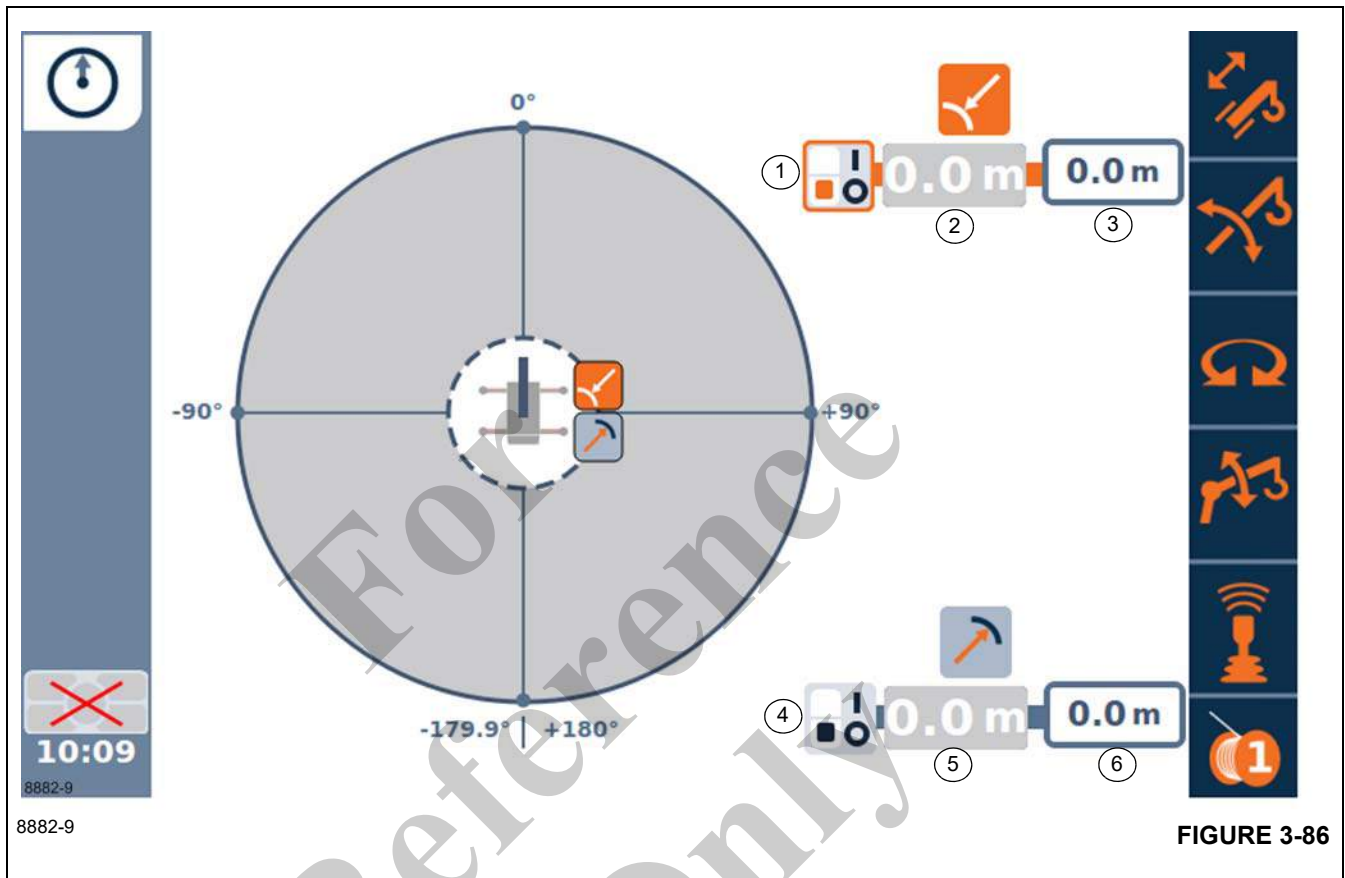


FIGURE 3-86

| Item | Description                               |
|------|-------------------------------------------|
| 1    | Minimum radius monitoring function ON/OFF |
| 2    | Current working radius                    |
| 3    | Enter minimum working radius              |
| 4    | Maximum radius monitoring function ON/OFF |
| 5    | Current working radius                    |
| 6    | Enter maximum working radius              |

- Use the Right Arrow function to highlight the inner radius switch symbol.
- Use an OK button to enable the limitation (note: alarm will sound as the boom is at the limit).
- Use the Right Arrow function once to highlight the current inner radius (2). Use an OK button to accept the current crane position to be the Limitation Value. The Limitation Value should now be updated on the screen. Note that the boom is now at the limitation, so alarms will sound. The boom can now be moved away from the current radius to cease the alarm.
- The Inner Radius Limitation is now defined and enabled.

**Setting Inner Radius Limitation by Crane Position**

To define and enable the Inner Radius Limitation using the crane current hook radius as the limitation, the following steps can be used:

- Position the boom to have the desired position.
- Select the ON/OFF Symbol to enable Working Radius function (Figure 3-86) on the Main Menu Screen.

**Setting Outer Radius Limitation by Crane Position**

To define and enable the Outer Radius Limitation using the crane current hook radius as the limitation, the following steps can be used:

1. Position the boom to have the desired position.
2. Select the Radius Limitation Screen (Figure 3-86) on the Main Menu Screen.
3. Use the Right Arrow function to skip the Inner Radius symbols and then highlight the Outer Radius Enable Switch symbol.
4. Use an OK button to enable the limitation. (**Note:** alarms will sound as the boom is at the limit).
5. Use the Right Arrow function once to highlight the current outer radius (5). Use an OK button to accept the current crane position to be the Limitation Value. The Limitation Value should now be updated on the screen. **Note** that the boom is now at the limitation, so alarm will sound. The boom can now be moved away from the current radius to cease the alarm.
6. The Outer Radius Limitation is now defined and enabled.

### Setting Working Radius by Value

To define and enable the Working Radius Limits Menu using a "typed in" value as the limitation, the following steps can be used:

1. Select the Working Radius Menu screen (Figure 3-86) on the Main Menu Screen.
2. Use the Right Arrow function to highlight the Switch symbol (1).

3. Use an OK button to enable the limitation. (**Note:** alarm will sound if boom tip is above limit, when enabled).
4. Use the Right Arrow function to highlight the Maximum Working Outside Radius Value (3). Use an OK button to begin entering the value. Use the Up Arrow or the Down Arrow or jog dial to change the value (in tenths) to the desired boom elevation value. Use an OK button to finish entering the value. **Note** that the boom may now be at the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.
5. Use the same procedure to set the Inner Radius Limitation.

### Radius Limitation Disable Procedure

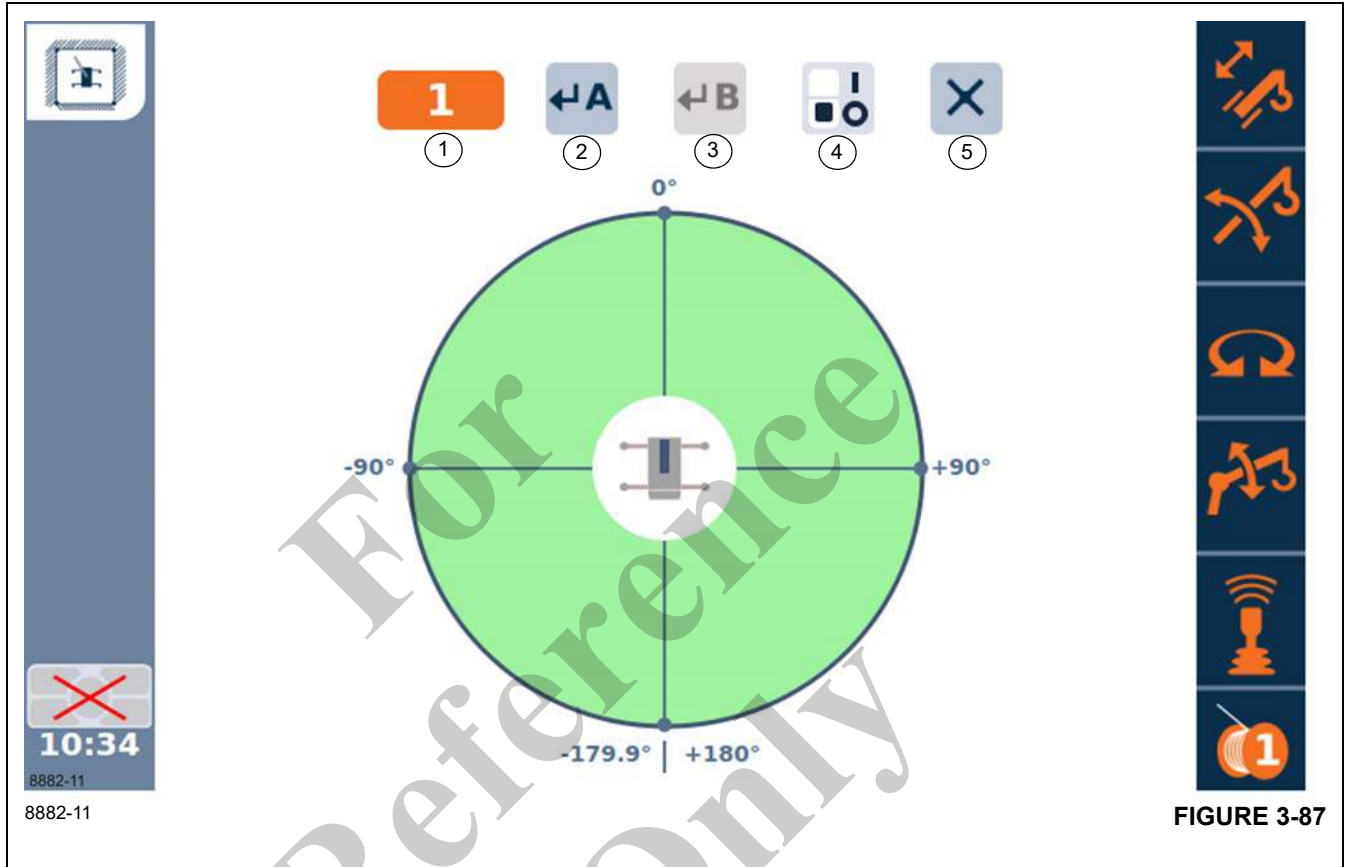
To disable an active Inner or Outer Radius Limitation, the following steps are to be used (note that turning off the power to the control system also disables the WRL limitations):

1. Select the Radius Limitation Screen (Figure 3-86) on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow function to highlight the desired switch symbol (1 or 4).
3. Use an OK button to disable the limitation.



**WRL - Virtual Walls Menu**

The Virtual Walls Menu (Figure 3-87) allows the operator to define up to five locations where the crane is not allowed to operate.



**FIGURE 3-87**

| Item | Description                              |
|------|------------------------------------------|
| 1    | Virtual wall number                      |
| 2    | Virtual wall start point A               |
| 3    | Virtual wall end point B                 |
| 4    | Virtual walls monitoring function ON/OFF |
| 5    | Delete virtual wall                      |

**Defining the First Virtual Wall**

To define and enable the first Virtual Wall (assuming no Virtual Walls are already defined), the following steps can be used:

1. Select the Wall Limitation Screen (Figure 3-87) on the Main Menu Screen (and in this case there would not be any virtual walls shown as defined or active). Position the

crane so that the hook is located at the position to define the first point of the Virtual Wall (Point A).

2. Use the Right Arrow function to highlight the Accept Crane Position Point A symbol (2).
3. Use an OK button to accept the current crane position to be Point A. The location of the point should now be shown on the screen with a label of '1a'.
4. Position the crane so that the hook is located at the position to define the second point of the Virtual Wall (Point B). The 2 points may not be so close to each other that a virtual wall is not clearly defined; the 2 points should be at least 3.3m (10 ft) apart.
5. Use the Right Arrow function, if needed, to highlight the Accept Crane Position Point B symbol (3). The Virtual Wall is now defined and automatically active/enabled.
6. Use an OK button to accept the current crane position to be Point B. The location of the point should now be shown on the screen with a label of '1b'. The screen should also show a maroon-colored "forbidden zone" for

the area beyond the Virtual Wall. Use a visual inspection of the screen and the area around the crane to verify that the Virtual Wall is providing the desired zone correctly. Also, note that the boom is now at the wall limitation, so alarms will sound. The boom can now be moved away from the wall to cease the alarm.

7. The Virtual Wall #1 is now defined and enabled. Crane operations can be resumed with the WRL working with this specified limitation. **Note** that the Virtual Wall Number on the display increments to 2 so that it is ready to define a subsequent virtual wall, if so desired.

### Defining Subsequent Virtual Walls

To define and enable further Virtual Walls (such as Virtual Wall 2 through 5), the following steps can be used:

1. Select the Wall Limitation Screen (Figure 3-87) on the Main Menu Screen.
2. Use the Right Arrow function to highlight the Virtual Wall Number.
3. If the wall number shown is not the correct number for the new wall (**Note** that it increments automatically when the previous wall was defined), use an OK button to allow modifying the value. Use the Up/Down Arrows to alter the Virtual Wall number to the desired value. Use an OK button to finish entering the value.
4. Position the crane so that the hook is located at the position to define the first point of the Virtual Wall (Point A).
5. Use the Right Arrow function to highlight the Accept Crane Position Point A symbol (2).
6. Use an OK button to accept the current crane position to be Point A. The location of the point should now be shown on the screen with a label that shows the wall number and the letter 'a'.
7. Position the crane so that the hook is located at the position to define the second point of the Virtual Wall (Point B). The 2 points may not be so close to each other that a virtual wall is not clearly defined; the 2 points should be at least 10 ft apart.
8. Use the Right Arrow function, if needed, to highlight the Accept Crane Position Point B symbol (3).
9. Use an OK button to accept the current crane position to be Point B. The location of the point should now be

shown on the screen with a label. The screen should also show another maroon-colored "forbidden zone" for the area beyond the Virtual Wall. Use a visual inspection of the screen and the area around the crane to verify that the Virtual Walls are providing the desired zone correctly. Again, note that the boom is now at the wall limitation, so alarms will sound. The boom can now be moved away from the wall to cease the alarm.

10. The multiple Virtual Walls are now defined and enabled.

### Wall Limitation Disable Procedure

To disable the active Wall Limitation, the following steps can be used:

1. Select the Wall Limitation Screen (Figure 3-87) on the Main Menu Screen.
2. Use the Right Arrow function to highlight the Virtual Wall Number.
3. If the wall number shown is not the correct number for wall to be disabled, use an OK button to allow modifying the value. Use the Up/Down Arrows to alter the Virtual Wall number to the desired value. Use an OK button to finish entering the value.
4. Use the Left Arrow and/or Right Arrow function or the jog dial to highlight the switch symbol (4).
5. Use an OK button to toggle the symbol to the limitation being disabled.

### Delete Wall Limitation Procedure

To delete a Virtual Wall the following steps can be used:

1. Select the Wall Limitation Screen (Figure 3-87) on the Main Menu Screen.
2. Use the Right Arrow function to highlight the Virtual Wall Number (1).
3. If the wall number shown is not the correct number for wall to be deleted, use an OK button to allow modifying the value. Use the Up/Down Arrows to change the Virtual Wall number to the desired value. Use an OK button to finish entering the value.
4. Use the Left Arrow and/or Right Arrow function to highlight the Remove Virtual Walls symbol (5). Use an OK button to delete the wall.

## Telescoping Emergency Program

In the event of a malfunction in the telescoping mechanism, or if maintenance is needed for the tele cylinder mechanism, you can manipulate the main boom with the Telescoping emergency program (Figure 3-88).

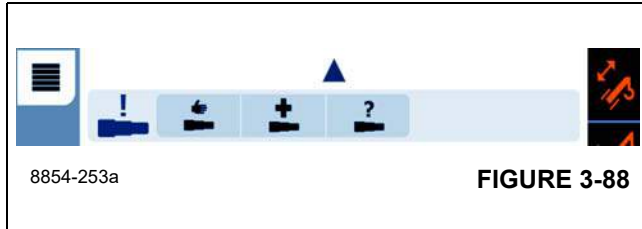


FIGURE 3-88

The emergency program is not intended for crane operation and is therefore restricted to approximately 1000 seconds (or 16 minutes). After that allotted time, the password must be entered again.

If possible, set down the load before starting the emergency program.

There is a standard control level for the emergency program, and there is an extended control level for the emergency program. The standard control level or standard emergency program is accessed with the password as shown (HELP). The extended control level or extended emergency program is accessed with the passcode (a set of numbers provided to the customer as described below).

The standard emergency program is intended for standard maintenance, such as bringing the telescoping cylinder to the access hole. In this case, all boom sections are fully retracted, the T1 telescoping section can be unlocked, and then this boom section can be extended to the first locking position, and then this boom section can be locked there, and then the telescoping cylinder can be retracted to the hole. The standard emergency program will only allow extending the telescoping cylinder if the boom length is not longer than this particular configuration (i.e. T1 at first locking position and all other boom sections fully retracted and

locked). If the boom is completely retracted, then the telescoping cylinder can be manipulated between the boom sections; this can be used to test the operation of the locking mechanism and the telescoping cylinder.

The extended emergency program has no logical restrictions for the operation of the locking mechanism or the motion of the telescoping cylinder. This level of control is expected to be used when there has been a condition that is not handled by the control system (such as difficulties with hardware, communication loss, or entrapped air in the telescoping system). It is entirely the responsibility of the operator to be aware of the location of the boom components and to use the appropriate commands and motions.

### Open Sub Menu Emergency Program

- Select and confirm the letters H-E-L-P (1), (Figure 3-89) – the screen to access the Telescoping emergency program is opened.
- If Manitowoc Crane Care or Local Distributor has provided a pass-code for the extended emergency program, then the pass-code can be entered by using the down-arrow on the display, or the jog-dial rotation, to find the numbers for entry prior to the letter A.
- Confirm the entry with the symbol (2), (Figure 3-89).

You can cancel the entry at any time.

After the correct entry has been made, the Telescoping emergency program is started.

The emergency program has a time limit. The display (1), (Figure 3-90) shows the remaining time for operating the emergency program.

It runs for approx. 1000 seconds (or 16 minutes).

The telescoping mechanism can be operated with the emergency program within this time.

If the time is not sufficient, then you must restart the emergency program.

**Access Telescoping Emergency Program Menu**

Enter a password to open the Telescoping Emergency Program Menu (Figure 3-89).

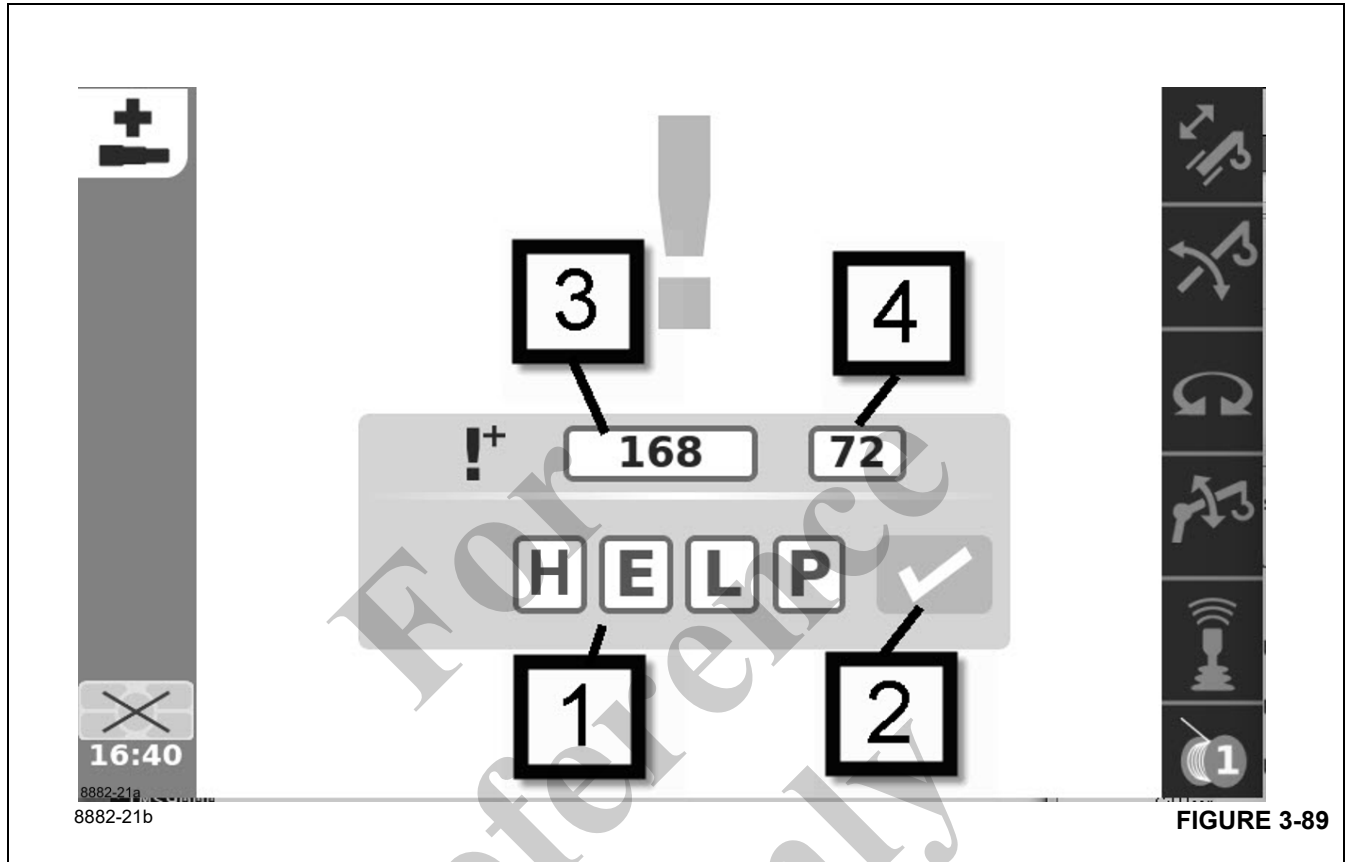


FIGURE 3-89

| Item | Description                                                                                                                                                                                                                      |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Enter the password HELP to access the Telescoping emergency program with basic controls. To enter the password, highlight a letter, select Enter to alter the letter, dial the new letter, and select Enter again. <sup>1)</sup> |
| 2    | Select the check-mark after entering the password.                                                                                                                                                                               |
| 3    | Telescoping emergency program seed value.                                                                                                                                                                                        |
| 4    | Counter for time limit for entering pass-code.                                                                                                                                                                                   |

first position (the H position for H-E-L-P) until a selection is shown prior to the letter A, then the digits 0 to 9 will appear.

<sup>1)</sup> In order to enter a pass-code (numbers), instead of a password (letters), manipulate the standard letters for the

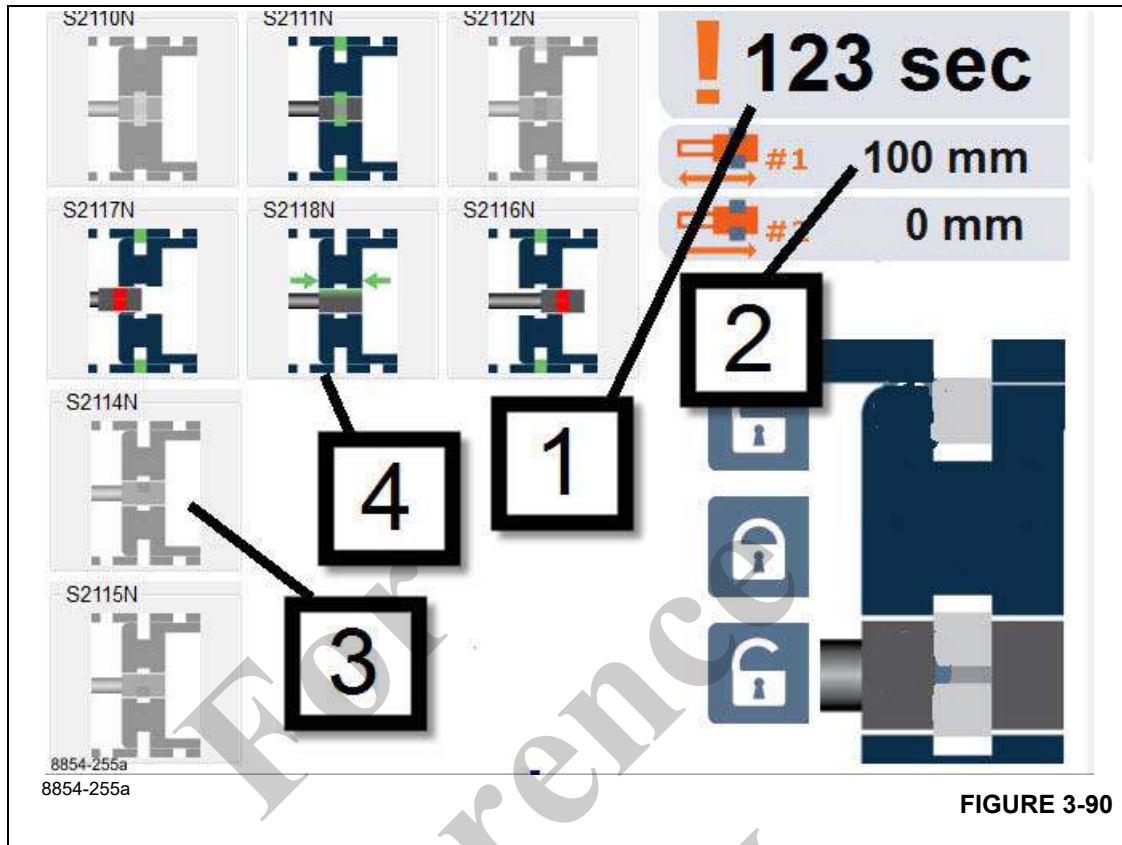


FIGURE 3-90

**Determining the Error Type**

**CAUTION**

**Machine Damage Hazard!**

Make sure that you always have an overview of the current status of the telescoping mechanism before you initiate locking or unlocking.

In emergency mode, there maybe no monitoring of prerequisites – the function is performed immediately after pressing the button.

- Check which emergency program procedure is suitable for the current error:

**CAUTION**

**Machine Damage Hazard!**

Never telescope the main boom if it is not possible to monitor the length of the tele cylinder by some means.

It would then not be possible for you to monitor operations, and components in the main boom could be damaged, or a situation could arise in which the main boom can no longer be extended or retracted.

If the display (2), (Figure 3-90) shows an obviously unrealistic value, such as -1100 mm, then there is an error on the precision length sensor length indicator of the CCS.

Contact with Manitowoc Crane Care or your Local Distributor to determine if you are permitted to start the telescoping process. Item 1 is the time remaining to correct the error.

In the display, items 3 and 4 (Figure 3-90) are examples of indicators for proximity switches. Item 3 is switch S2114N, and it is shown in a dimmed fashion. This means the switch has been considered OFF. Item 4 is switch S2118N, and it is shown in active colors; this switch is considered ON.

These switches are shown in a logical fashion based on their function. The top row (S2110N, S2111N, and S2112N) is the switches near the hydraulic actuator. S2111N is physically located between S2110N and S2112N, so these indicators are arranged in the same manner.

The next row (S2117N, S2118N, and S2116N) are indicators for the tele cylinder being aligned with a boom section. S2117N is shown to the left; when the tele cylinder is nearly aligned (for instance within 50 mm of the connection), and S2117N is ON, then the cylinder needs to extend slightly (moving the right joystick to the right, if using the standard joystick arrangement). If S2116N is ON in this near connection condition, then the cylinder needs to retract slightly (moving the previously mentioned joystick to the left). These motions are logical with respect to what is shown on the screen.

The remaining proximity switches, S2114N and S2115N, are for the cylinder pins being retracted, so they are shown in a

column format to be logical with respect to their location on the tele cylinder.

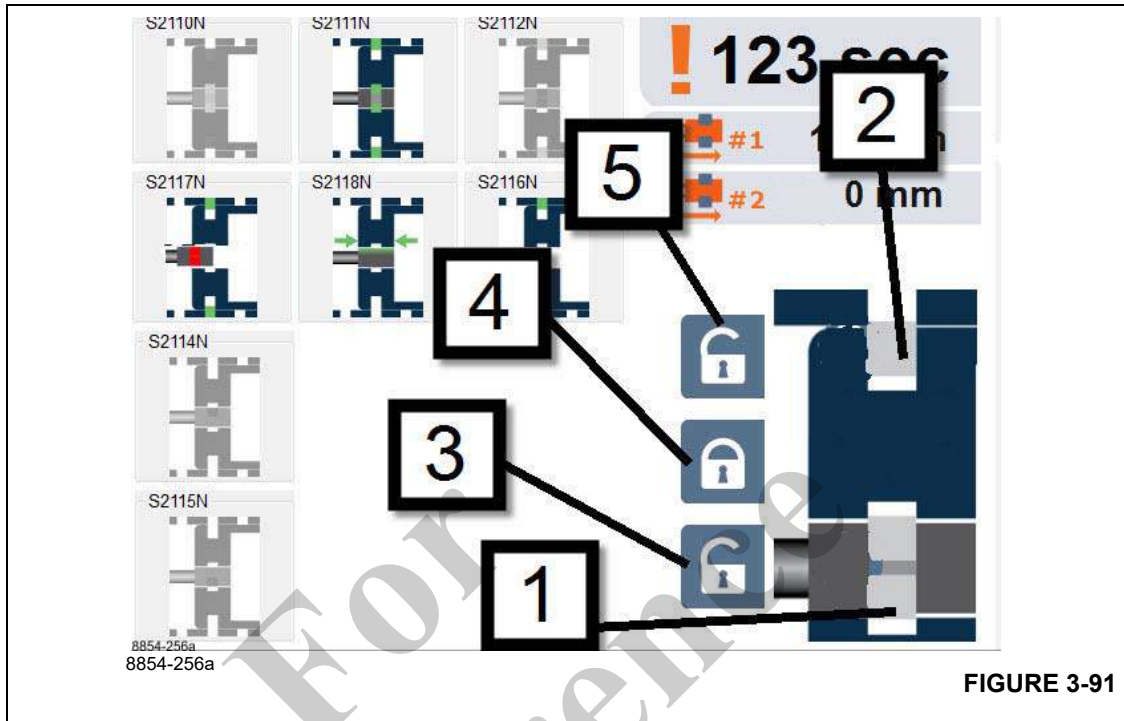


FIGURE 3-91

(Figure 3-91) has further explanation for the telescoping emergency program screen. Item 1 is the graphical representation of the tele cylinder pins that connect to a telescoping boom section. When these cylinder pins are considered retracted, an unlock symbol will appear in this location.

Item 2 is the graphical representation of the boom section and its pins that connect to the next telescoping boom section. Note that in the telescoping emergency program, the actual boom section is no longer able to be determined; the crane operator must determine this. When these section pins are considered retracted (at least the actuator has moved to attempt this), an unlock symbol will appear in this location.

Item 3 is the indicator for a command to attempt to retract the cylinder pins. The arrow buttons on the display or the jog dial can be used to highlight this, and hitting the OK/Enter button will then attempt to execute the command. The lock/unlock symbol on the button does not change based on the cylinder operations (refer to Items 1 and 2).

Item 4 is the indicator for a command to release or re-extend pins. This command works for both the cylinder pin retracting and the section pin retracting; they are connected to the same double-acting hydraulic actuation cylinder, so it can only release the pins that had been previously retracted

(whichever they were). The arrow buttons on the display or the jog dial can be used to highlight this, and hitting the OK/Enter button will then attempt to execute the command. The lock/unlock symbol on the button does not change based on the cylinder operations (refer to Items 1 and 2).

Item 5 is the indicator for a command to attempt to retract the section pins. The arrow buttons on the display or the jog dial can be used to highlight this, and hitting the OK/Enter button will then attempt to execute the command. The lock/unlock symbol on the button does not change based on the cylinder operations (refer to Items 1 and 2).

## CAUTION

### Machine Damage Hazard!

Telescoping the main boom when there is an error on the precision length indication and malfunctioning proximity switches can result in damage to the main boom, contact Manitowoc Crane Care or your Local Distributor to determine if you are permitted to start the telescoping process. They can provide the passcode to use in the telescoping emergency program with extended capabilities.

A situation could arise in which the main boom can no longer be extended or retracted.



**CAUTION**

**Machine Damage Hazard!**

When a override switch is used there is no monitoring of boom up and down, swing, telescoping, or hoist operation.

**NOTE:** In the Telescoping emergency program, all functions for retracting the main boom remain enabled as long as there are no other errors (hydraulic or mechanical). However, extending boom sections may require use of a override switch, and only the telescoping emergency program with extended capabilities can be expected to extend any boom section at any time. The telescoping emergency program with basic

capabilities is intended to be able to get the tele cylinder to the configuration where the tele cylinder pinning head can be serviced from the access hole in the base section, not to fully retract the boom after failures of sensors or mechanical components.

**NOTE:** The speed is restricted to approx. 30% of the maximum speed.

**Error on Length Indicator**

- If the precision length sensor for the tele cylinder does not show a reasonable value, then the second length sensing can be referred to (6), (Figure 3-92). This is typically from a length potentiometer from the power cable reel in the boom (it is separate from the precision length sensor).

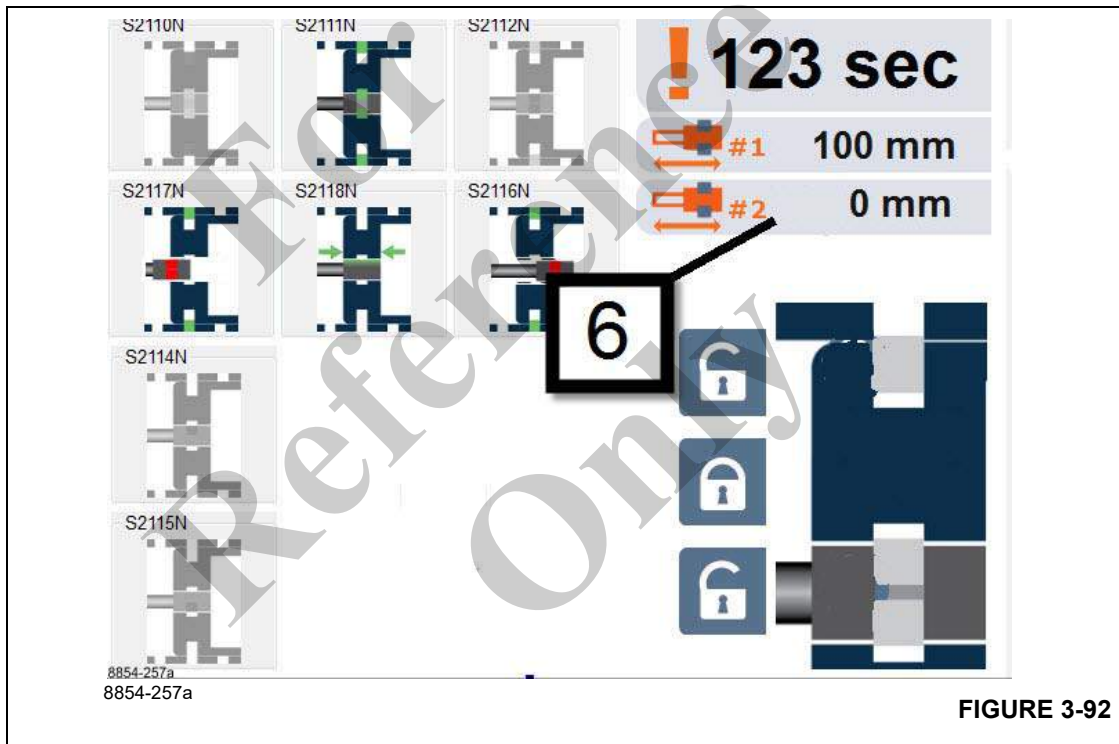


FIGURE 3-92

**Checks Before Telescoping**

Before telescoping, the following conditions are expected to be met (but depending on what components may have failed the conditions may not be met):

The telescoping emergency program screen should appear as in (Figure 3-93).

The telescoping cylinder is locked to a telescoping boom section (no unlock symbol shown near the graphical

representation of the tele cylinder - refer to Item 1 in (Figure 3-91).

The telescoping boom section is unlocked (the unlock symbol is shown near the graphical representation of the section pins - refer to Item 2 in (Figure 3-91).

In the top row of the proximity switches (Figure 3-93), S2110N is ON, the others in the row are OFF. In the middle row of the proximity switches (Figure 3-93), S2118N is ON, and the others in the row are OFF.

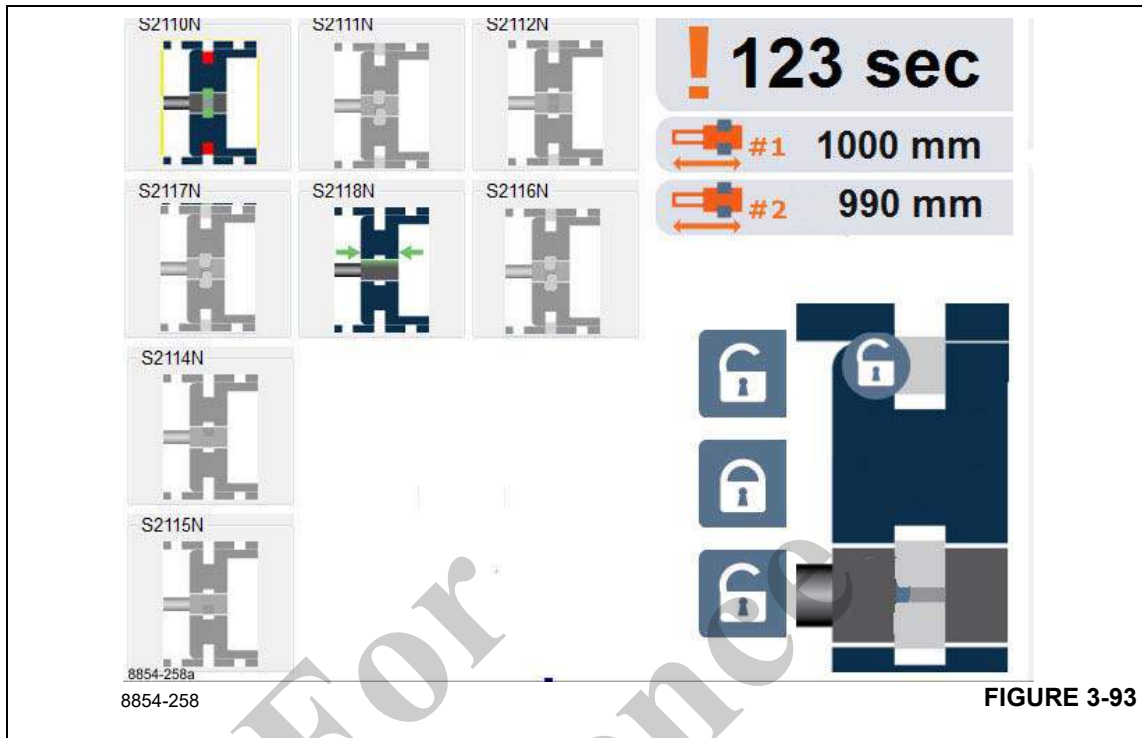


FIGURE 3-93

**Retracting and Locking a Telescopic Section**

During telescoping motion you are not to select Lock. Under no circumstances, while the tele cylinder is moving, should you select and press the symbol (4), (Figure 3-91).

**CAUTION**

**Machine Damage Hazard!**

If you select Lock during telescoping, the locking pins on the telescopic section are slid out immediately and they can damage or tear the electrical or hydraulic components in the main boom.

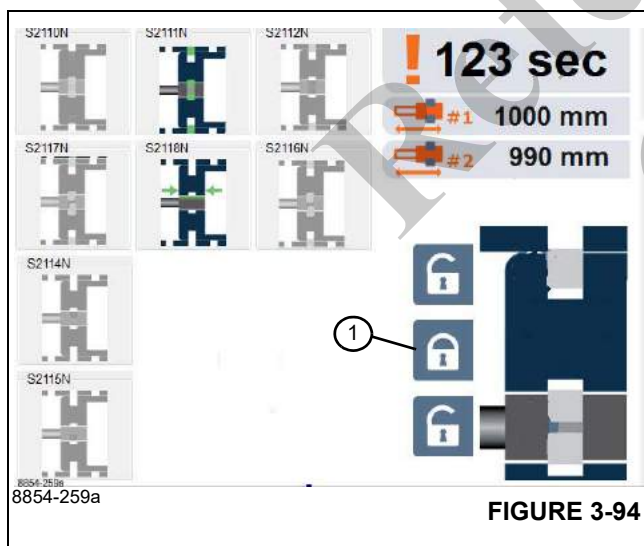


FIGURE 3-94

- Retract the telescopic section slowly and as far as possible, refer to (Table 3-2.) for the expected value for the precision length sensor (Item 2 in (Figure 3-90)) when the boom sections are fully retracted.
- Now select and confirm the symbol (1), (Figure 3-91).

The telescopic section can be locked (if the actuator is able to release the section pins, and the telescoping boom section is actually aligned with a pinning hole). The screen should appear as shown in (Figure 3-94). In particular, S2111N should be ON.



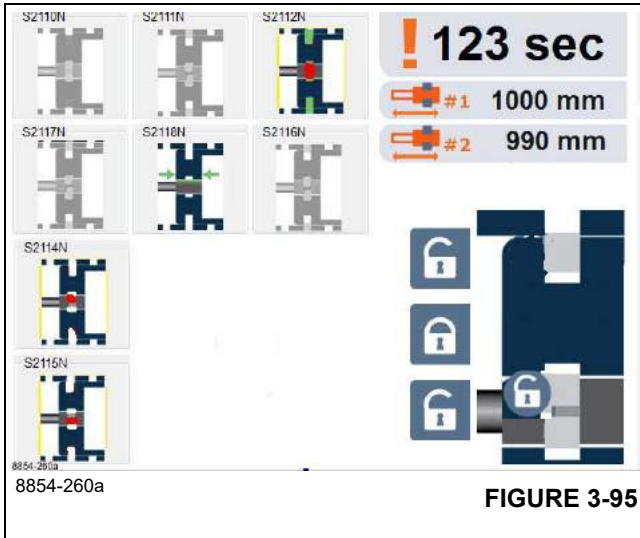


FIGURE 3-95

Table 3-2. Locking Point Distances for Telescopic Boom Sections

|      | T1 (mm) | T2 (mm) | T3 (mm) | T4 (mm) | T5 (mm) |
|------|---------|---------|---------|---------|---------|
| 0%   | 0       | 263     | 526     | 788     | 1008    |
| 50%  | 4176    | 4431    | 4656    | 4794    | 4903    |
| 92%  | 7659    | 7906    | 8099    | 8134    | 8149    |
| 100% | 8321    | 8568    | 8754    | 8770    | 8767    |

|      | T1 (ft) | T2 (ft) | T3 (ft) | T4 (ft) | T5 (ft) |
|------|---------|---------|---------|---------|---------|
| 0%   | 0.00    | 0.86    | 1.73    | 2.59    | 3.31    |
| 50%  | 13.70   | 14.54   | 15.28   | 15.73   | 16.09   |
| 92%  | 25.13   | 25.94   | 26.57   | 26.69   | 26.74   |
| 100% | 27.30   | 28.11   | 28.72   | 28.77   | 28.76   |

**Unlocking the Telescoping Cylinder**

If the telescopic section is locked (typically indicated by (Figure 3-94), you can now attempt to unlock the telescoping cylinder.



**WARNING**

**Risk of Damage to Main Boom!**

You can select and confirm the symbol for unlocking the telescopic section. If this does not start the unlocking procedure, contact your local distributor or Manitowoc Crane Care.

- Select and confirm the symbol (3), (Figure 3-91).

The telescoping cylinder is unlocked. In the unlocked position, the screen should appear as indicated by (Figure 3-95). The telescoping cylinder is unlocked from any telescoping boom section (unlock symbol shown near the graphical representation of the tele cylinder - refer to Item 1 in (Figure 3-91).

The telescoping boom section is locked (the unlock symbol is not shown near the graphical representation of the section pins - refer to Item 2 in (Figure 3-91).

In the top row of the proximity switches (Figure 3-95), S2112N is ON, the others in the row are OFF. In the middle row of the proximity switches, S2118N is ON, but the others are ON or OFF depending on the location of the tele cylinder with respect to telescoping boom sections.

You can now move the telescoping cylinder into the next telescopic section, refer to (Table 3-3.) for the expected

value for the precision length sensor (Item 2 in (Figure 3-90)) when the tele cylinder is near a connection to a boom section.

**Table 3-3. Locking Point Distances for Telescoping Cylinder**

|      | T1 (mm) | T2 (mm) | T3 (mm) | T4 (mm) | T5 (mm) |
|------|---------|---------|---------|---------|---------|
| 0%   | 0       | 263     | 526     | 788     | 1008    |
| 50%  | 4146    | 4401    | 4626    | 4764    | 4873    |
| 92%  | 7629    | 7876    | 8069    | 8104    | 8119    |
| 100% | 8291    | 8538    | 8724    | 8740    | 8737    |

|      | T1 (ft) | T2 (ft) | T3 (ft) | T4 (ft) | T5 (ft) |
|------|---------|---------|---------|---------|---------|
| 0%   | 0.00    | 0.86    | 1.73    | 2.59    | 3.31    |
| 50%  | 13.60   | 14.44   | 15.18   | 15.63   | 15.99   |
| 92%  | 25.03   | 25.84   | 26.47   | 26.59   | 26.64   |
| 100% | 27.20   | 28.01   | 28.62   | 28.67   | 28.66   |

**Extending and Locking the Telescoping Cylinder**

Under no circumstances should you select and press the lock symbol (1), (Figure 3-94) while the tele cylinder is in motion.

**CAUTION**

**Machine Damage Hazard!**

If you select Lock while the telescoping cylinder is moving, the locking pins on the telescopic section are slid out immediately and they can damage or tear the electrical or hydraulic components in the main boom.

Slowly move the telescoping cylinder into the next extended telescopic section.

At the locking point:

- The display (2), (Figure 3-90) shows the length for the current locking point, refer to (Table 3-3.).
- The proximity switch indicators for S2117N, S2118N, and S2116N are used to align the tele cylinder to the hole in the boom section. S2118N is ON whenever the tele cylinder pins are in the “foot section” or the near end of the boom section weldment where the hole is located. S2116N goes ON when the tele cylinder has extended beyond the hole. S2117N goes ON when the tele cylinder is not extended enough to reach the hole. Therefore, one would operate the tele cylinder until S2118N is ON, and S2116N and S2117N are OFF. This is what is shown in (Figure 3-95).

- Select and confirm the symbol shown as Item 4 in (Figure 3-91).

The telescoping cylinder is locked, if the actuator is able to release the cylinder pins, and the tele cylinder is actually aligned with a pinning location hole in the boom section. The screen should appear as shown in (Figure 3-94).

- You can now operate this telescopic section, refer to *Retracting and Locking a Telescopic Section*, page 3-82.

**Tables for Approaching the Locking Points**

The extent to which the telescoping cylinder has to be extended in order to reach a locking point depends on whether you want to lock:

- the telescoping cylinder

**OR**

- a telescopic section.

**Locking Points for the Telescoping Cylinder**

(Table 3-3.) shows the extended length for locking the telescoping cylinder.

**Locking Points for the Telescopic Sections**

(Table 3-2.) shows the extended length for locking the telescopic boom sections. The telescopic section should not be set down for locking or unlocking it.

The cutout (1), (Figure 3-96) must be clear. That is why you have to extend the telescoping cylinder further than with a return run.

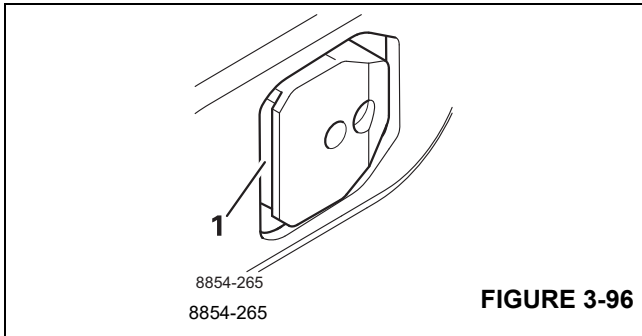


FIGURE 3-96

**Telescoping Cylinder Boom Nose Switch**

A whisker-style trigger switch is installed at the boom nose to detect the tele cylinder barrel being too close to the boom nose. This switch is shown as triggered in (Figure 3-97).



FIGURE 3-97

When this switch is triggered, the symbol shown in (Figure 3-98) should appear on the left side of the ODM display or in the middle of the Emergency Mode screen (Figure 3-98).



FIGURE 3-98

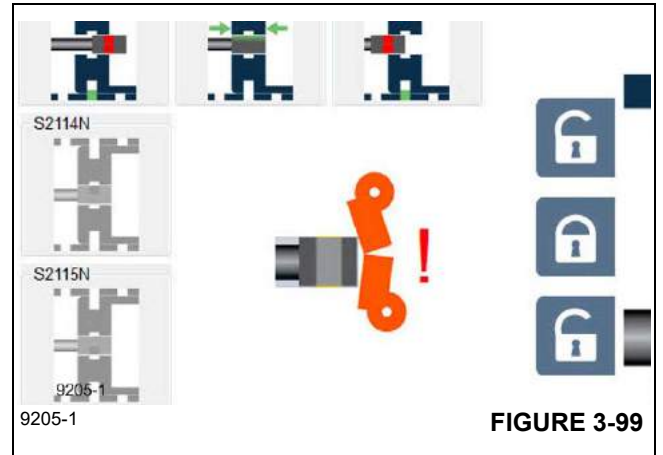


FIGURE 3-99

In this triggered condition, the telescoping cylinder is no longer expected to be able to extend. If the telescoping emergency program is being used, then it is still possible to still extend the cylinder (such as when the switch is malfunctioning or disconnected), but this should only be done with physical verification of the location of the telescoping cylinder with respect to the boom nose. If the telescoping cylinder impacts the boom nose, the boom system will be damaged.

With the telescoping cylinder not moving, and with the joystick not being used, then the bypass switch (Figure 3-100) can be used. The telescoping cylinder will now extend, but when the telescoping cylinder stops moving, or if the joystick is no longer used, then the same steps must be repeated to use the bypass switch.

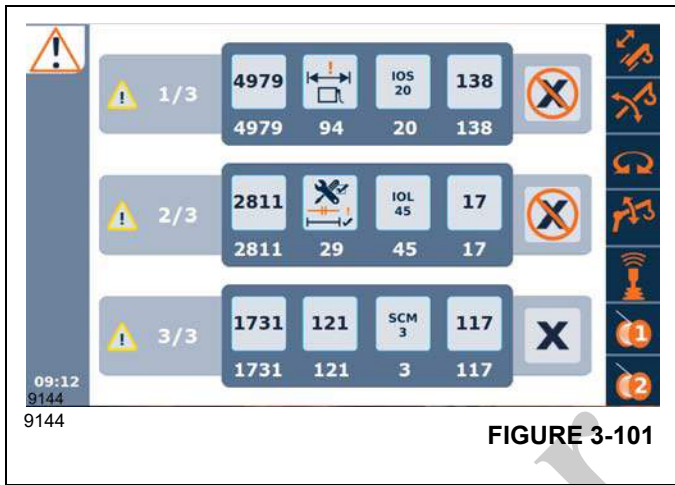


FIGURE 3-100

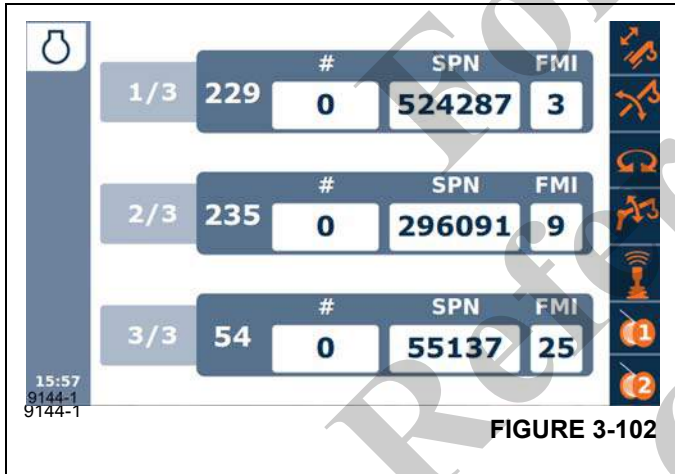
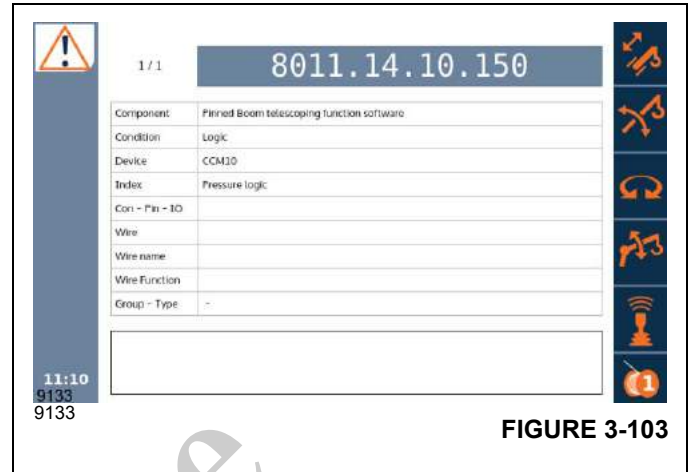
3

**ODM Error Code Viewer**

1. Open the fault list screen (Figure 3-101) or the engine faults screen (Figure 3-102) and highlight the fault you're interested in getting more information about.



2. Press the ALT Key (11), (Figure 3-15) on the Display to show additional crane fault information.
3. The ODM error code viewer (Figure 3-103) opens.



### Resetting the Current Telescoping

CCS no longer displays the current telescoping if

- you telescoped in emergency mode,
- **OR**
- the power supply was interrupted in the course of saving data.

In these cases, you must enter the current telescoping (also called resetting the actual “tele picture”, or fixing the “lost tele picture”). The position of each boom section must be determined by knowing the location of the tele cylinder, as well as knowing the current locking positions of each of the telescoping boom sections.

When entering the new values for these positions for each boom section, you can select from the display values such as 0%, 50%, 92%, and 100%. If one boom section is unlocked (locked to the tele cylinder and that boom section is able to be extended/retracted), then the display buttons or jog-dial can be used to select “less than” 0% and then an unlock symbol appears. This unlock symbol is the proper selection for the boom section that can be extended/retracted.

Select and confirm the symbol (1), (Figure 3-104) – for the Access Reset Telescoping screen.

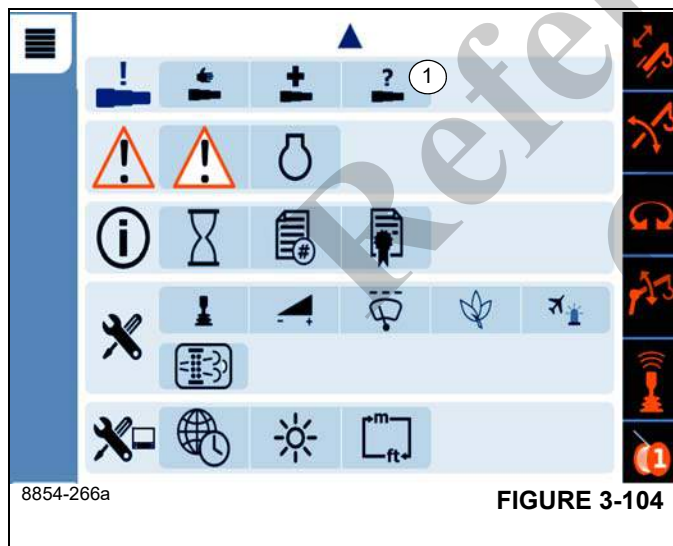


FIGURE 3-104

- Select and confirm the L-O-S-T password using Items 1 to 4 in (Figure 3-105).
- Confirm the entry with the symbol (5), (Figure 3-105).

You can cancel the entry at any time using the (6) or (7) buttons (Figure 3-105).

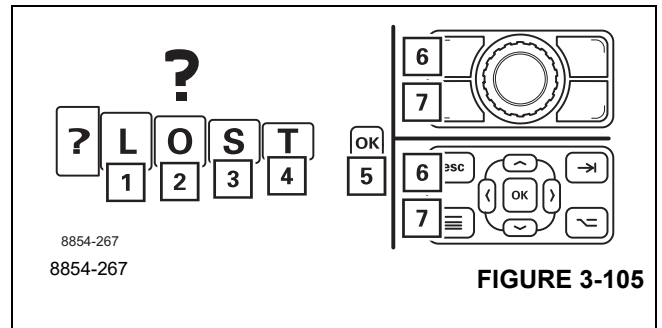


FIGURE 3-105

Once the entry has been made correctly, the Sub-menu Reset current telescoping is opened.

#### Entering Current Telescope Position Values

- Referring to (Figure 3-106), there are numerical values from 1 to 5 (in the call out circles). These indicate the telescoping boom sections (1 is T1, 2 is T2, etc.). Select each boom section, in turn, and select Enter to begin changing the value.
- Use the arrow buttons on the display or the jog-dial to alter the value as needed (such as 100% for a boom section locked at its 100% position). Recall that going “less than” 0% shows the unlock symbol (as mentioned above). It is essential that the physical locations of these boom sections are known for this process, e.g. unlocked, 100%, 100%, 100%, etc.
- After all the boom sections have a reset telescoping value, then this pattern can be confirmed with Item 1 in (Figure 3-106). If the check-mark (Item 2) appears, then the control system software has accepted the values and normal operation can resume. If the question-mark remains, then it has not been accepted. Further attempts can be used, or it may be necessary to correct malfunctions.

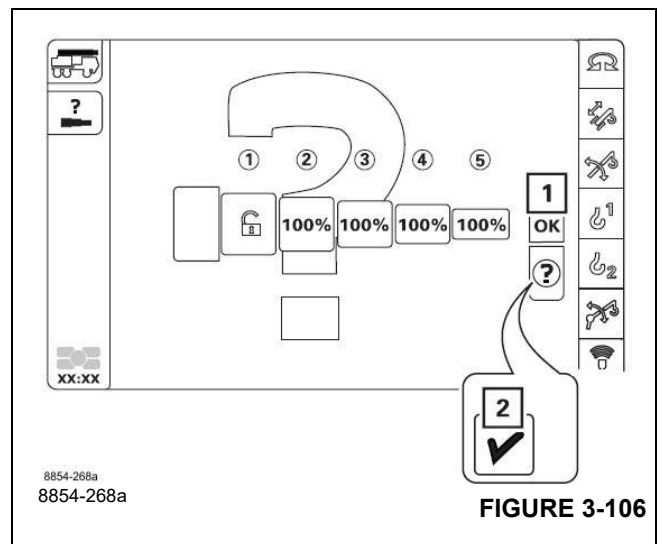
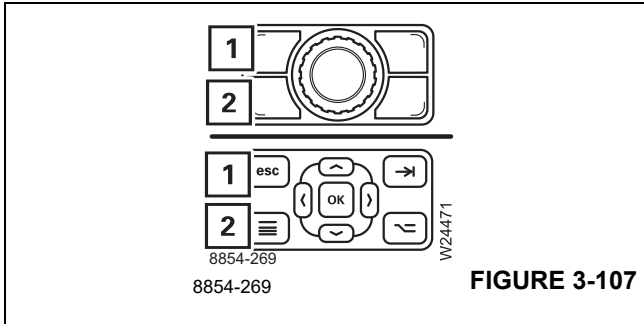


FIGURE 3-106

You can cancel the entry at any time using the (1), (Figure 3-107) or (2) buttons.



**CAUTION**

**Risk of Damage Due to Incorrect Input!**

Before working with the crane, check whether CCS indicates the current telescoping and correct if this is not the case. This is indicated by the standard error symbol (exclamation point in a triangle) shown in the normal telescoping control screens. The error symbol should not be shown.

Entering incorrect values can cause malfunctions and may result in damage to the telescoping mechanism.

For Reference Only

RDM (RCL Display Module)

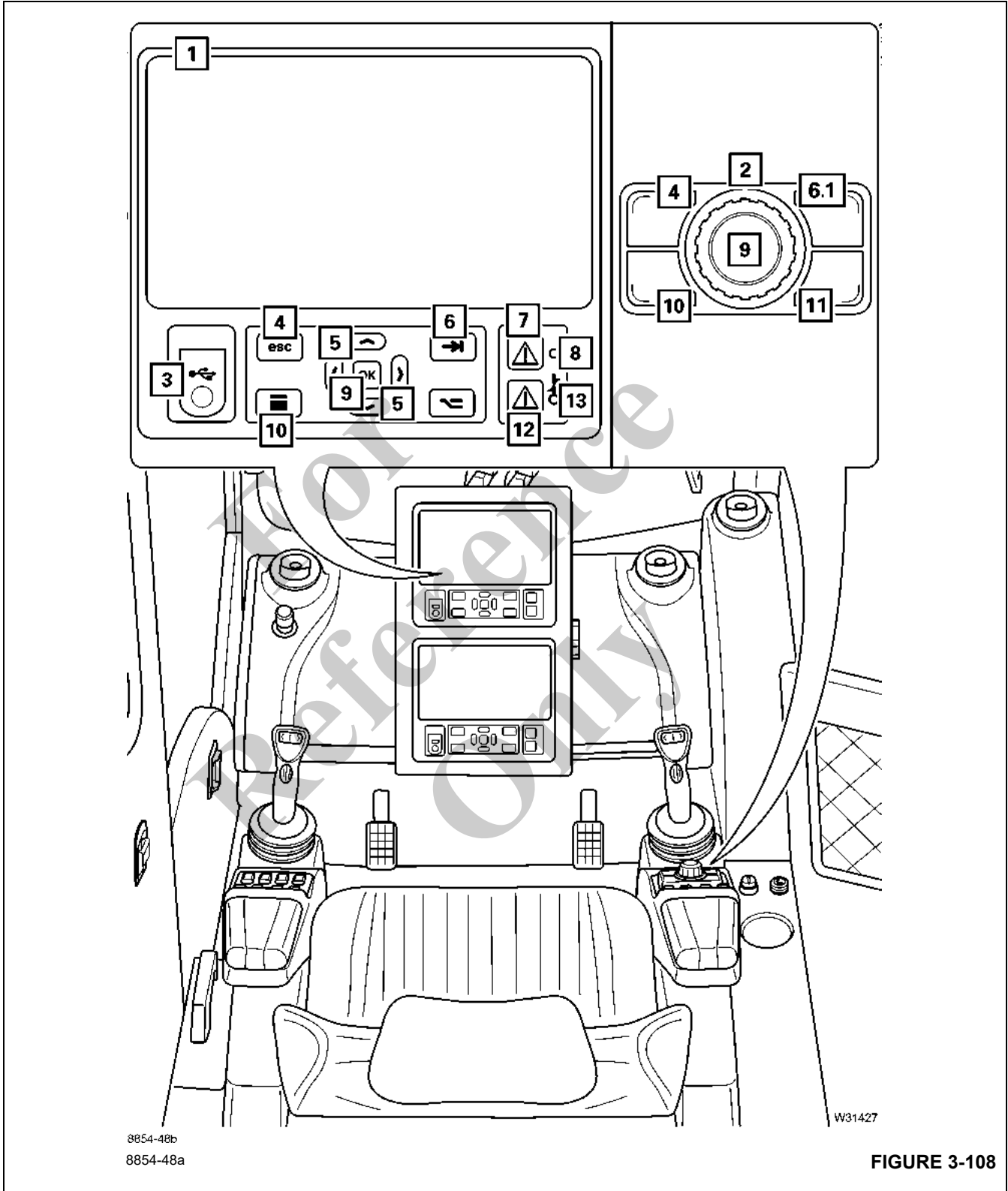


FIGURE 3-108

3



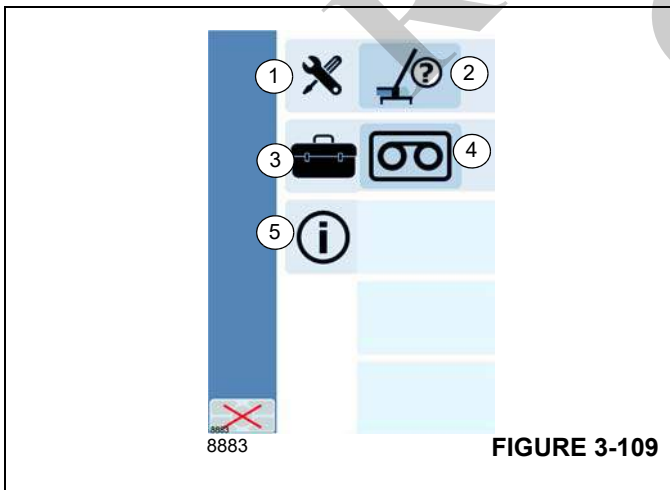
| Item | Description                                                                                   | Refer to   |
|------|-----------------------------------------------------------------------------------------------|------------|
| 1    | RCL Display Module (RDM)<br>Overview of the RCL start menu<br>Overview of the RCL menu groups | page 3-90  |
| 2    | Jog dial                                                                                      | page 3-37  |
| 3    | Service/diagnosis connection <sup>1)</sup>                                                    |            |
| 4    | Exiting the menu/input mode                                                                   | page 3-128 |
| 5    | Selector buttons                                                                              | page 3-37  |
| 6    | Tare Button/Function                                                                          | page 3-134 |
| 6.1  | Tare Button/Function                                                                          | page 3-134 |
| 7    | RCL Overload Indication                                                                       | page 3-129 |
| 8    | Lighting Sensor                                                                               | page 3-140 |
| 9    | Input confirmation                                                                            | page 3-37  |
| 10   | Changing menus                                                                                | page 3-35  |
| 11   | To Switch Display                                                                             | page 3-38  |
| 12   | RCL Warning Indication                                                                        | page 3-129 |
| 13   | Display temperature warning display                                                           | page 3-37  |

<sup>1)</sup>For Service personnel only, not suitable for external devices, e.g. mobile phone.

### RCL – Menu Groups

The RCL Main Menu Groups (Figure 3-109) shows symbols for further menus and symbols for current displays.

| Item | Description             | Refer to   |
|------|-------------------------|------------|
| 1    | Crane setup group       |            |
| 2    | Enter rigging mode menu | page 3-91  |
| 3    | Export data             |            |
| 4    | Data logger             | page 3-135 |
| 5    | Information group       |            |





Enter Rigging Mode Menu

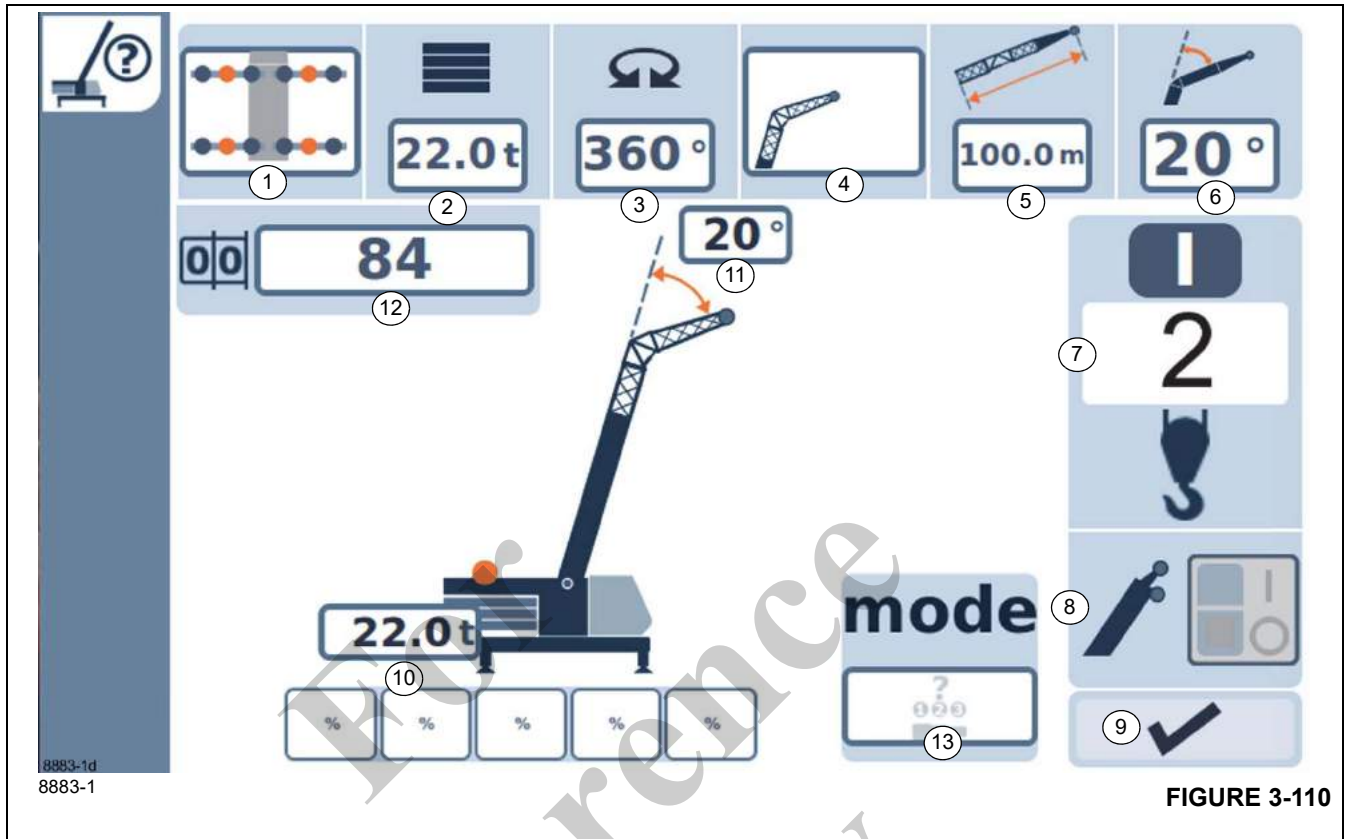


FIGURE 3-110

| Item | Description                                           | Refer to   |
|------|-------------------------------------------------------|------------|
| 1    | Outrigger setup                                       | page 3-131 |
| 2    | Enter counterweight                                   | page 3-131 |
| 3    | Enter swing range                                     | page 4-53  |
| 4    | Main boom or boom extension                           | page 3-132 |
| 5    | Boom Extension length including inserts <sup>1)</sup> |            |
| 6    | Boom extension offset angle <sup>1)</sup>             | page 3-133 |
| 7    | Parts of line for each hoist                          | page 3-130 |
| 8    | Aux nose used/not used                                |            |
| 9    | OK selections/return to main screen                   |            |
| 10   | Counterweight                                         |            |
| 11   | Boom Extension offset angle                           | page 3-133 |
| 12   | Rigging code number                                   | page 3-131 |
| 13   | Selector for Telescoping Mode Number <sup>2)</sup>    |            |

1) Optional equipment.

2) Available when RCL enabled and boom fully retracted and locked.

**NOTE:** All of the Items on this screen are data entries, except for Items 10 and 11. Items 10 and 11 are data displays.

Monitoring Menu

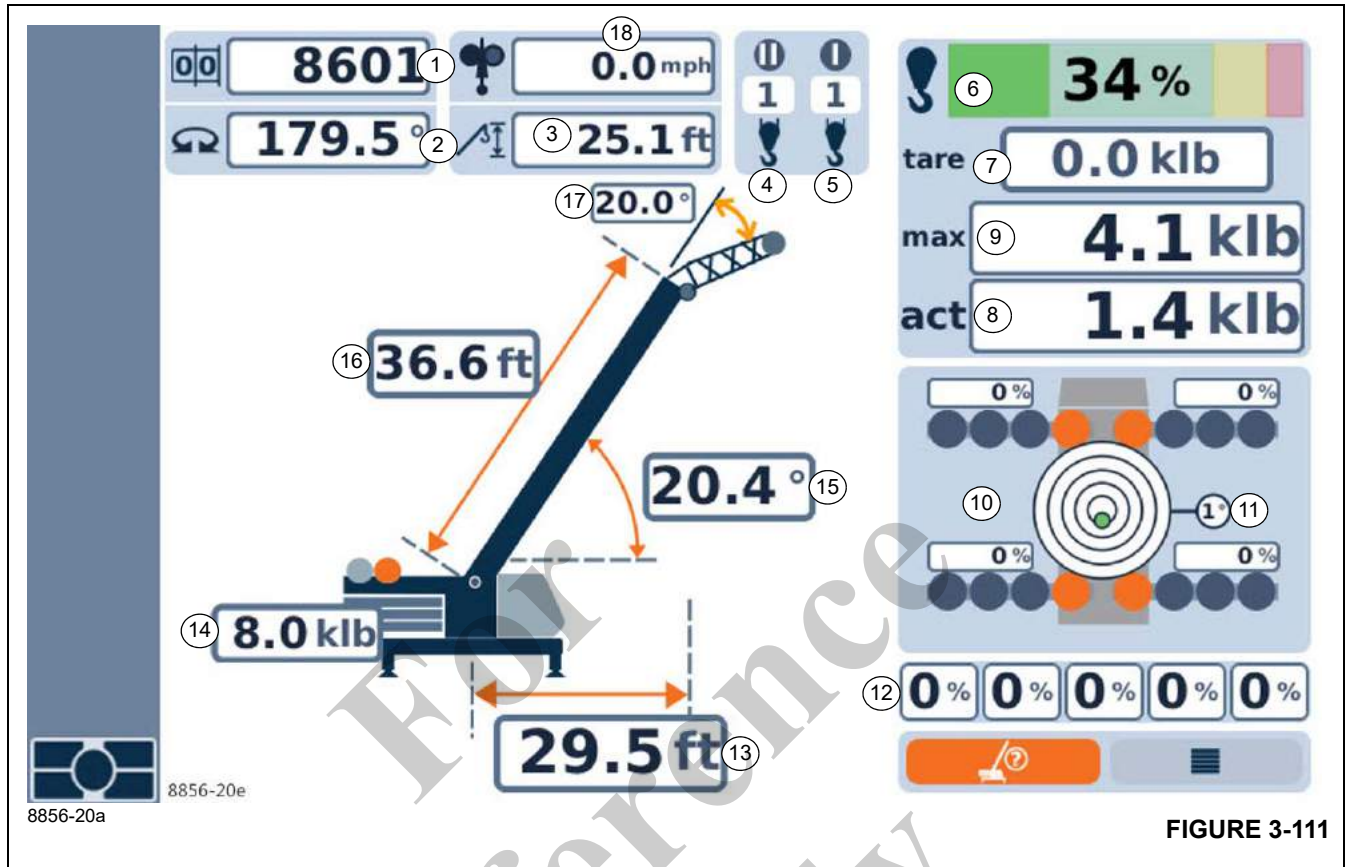


FIGURE 3-111

| Item | Description                                   | Refer to   |
|------|-----------------------------------------------|------------|
| 1    | Rigging code number                           | page 3-131 |
| 2    | Current swing angle display                   | page 3-134 |
| 3    | Current overall height                        |            |
| 4    | Current auxiliary hoist reeving <sup>1)</sup> | page 3-130 |
| 5    | Current main hoist reeving                    | page 3-130 |
| 6    | Current degree of utilization display         | page 3-135 |
| 7    | Weight of the rigging                         |            |
| 8    | Current weight of the load                    | page 3-134 |
| 9    | Allowable maximum load                        | page 3-135 |

| Item | Description                                  | Refer to   |
|------|----------------------------------------------|------------|
| 10   | Outrigger span display                       | page 3-39  |
| 11   | Current inclination                          | page 3-94  |
| 12   | Current telescoping status                   | page 3-87  |
| 13   | Current working radius                       | page 3-73  |
| 14   | Current counterweight                        | page 3-95  |
| 15   | Current main boom angle                      | page 3-134 |
| 16   | Current main boom length                     | page 3-100 |
| 17   | Lattice extension offset angle <sup>1)</sup> | page 3-133 |
| 18   | Current wind speed <sup>1)</sup>             | page 3-98  |

<sup>1)</sup>Optional equipment

Outrigger Rigging Code Verification

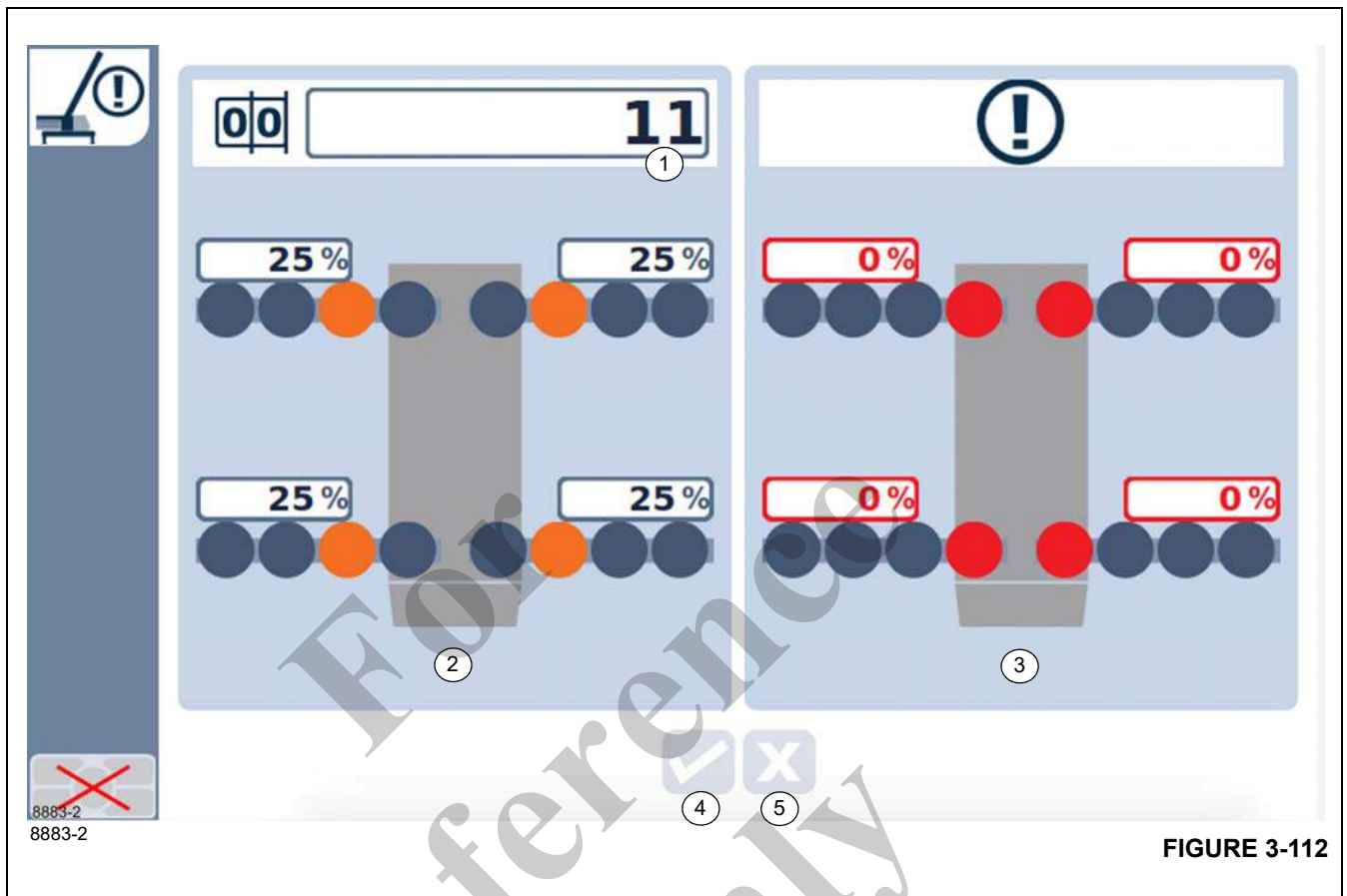


FIGURE 3-112

| Item | Description                  |
|------|------------------------------|
| 1    | Rigging code                 |
| 2    | Required outrigger positions |
| 3    | Measured outrigger positions |
| 4    | Accept rigging code          |
| 5    | Reject rigging code          |

When on this screen the operator has the choice between the check mark to confirm awareness of the difference in actual outrigger position to that required for the rigging code, or using the X to return to select a new rigging code.

This is the screen (Figure 3-112) that will be displayed after the operator accepts a new rigging code if the measured outrigger positions do not match the required outrigger positions. The rigging code and required outrigger positions are shown on the left. The actual positions are shown on the right, and are red if they do not match the required positions.

If the outrigger positions match the rigging code selected, this screen is skipped and the display goes directly from the setup screen to the main operating screen.

### Inclination Indicator

On the RCL Operating Menu:

|   |                                      |
|---|--------------------------------------|
| 1 | Inclination indicator (Figure 3-113) |
| 2 | Measuring range display              |
| 3 | Directional indicator                |

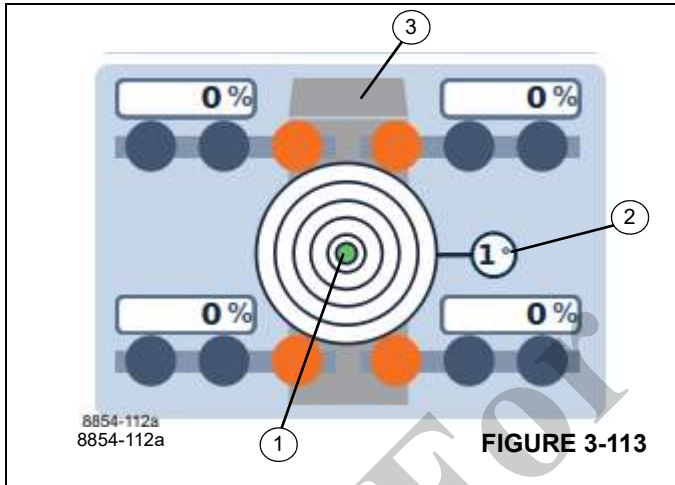


FIGURE 3-113

### Anemometer Display

When the anemometer is connected it will display on the RCL screen.

$V_{max}$  = maximum permissible/reduced wind speed as shown in the lifting capacity table

|   |                                                                                             |
|---|---------------------------------------------------------------------------------------------|
| 1 | Display in meters per second (m/sec) or feet per second (ft/sec) as shown in (Figure 3-114) |
|---|---------------------------------------------------------------------------------------------|

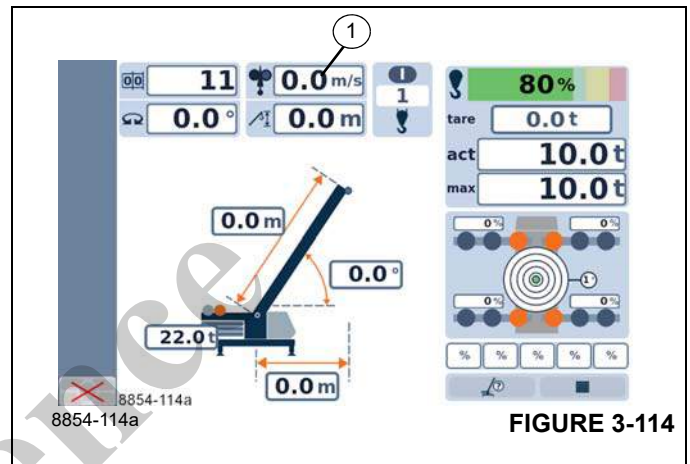


FIGURE 3-114

Reference Only

### Counterweight Menu

The Counterweight Menu (Figure 3-115) shows the status of the swing angle, counterweight cylinders, and pre-tensioning pressure (error menu shown).

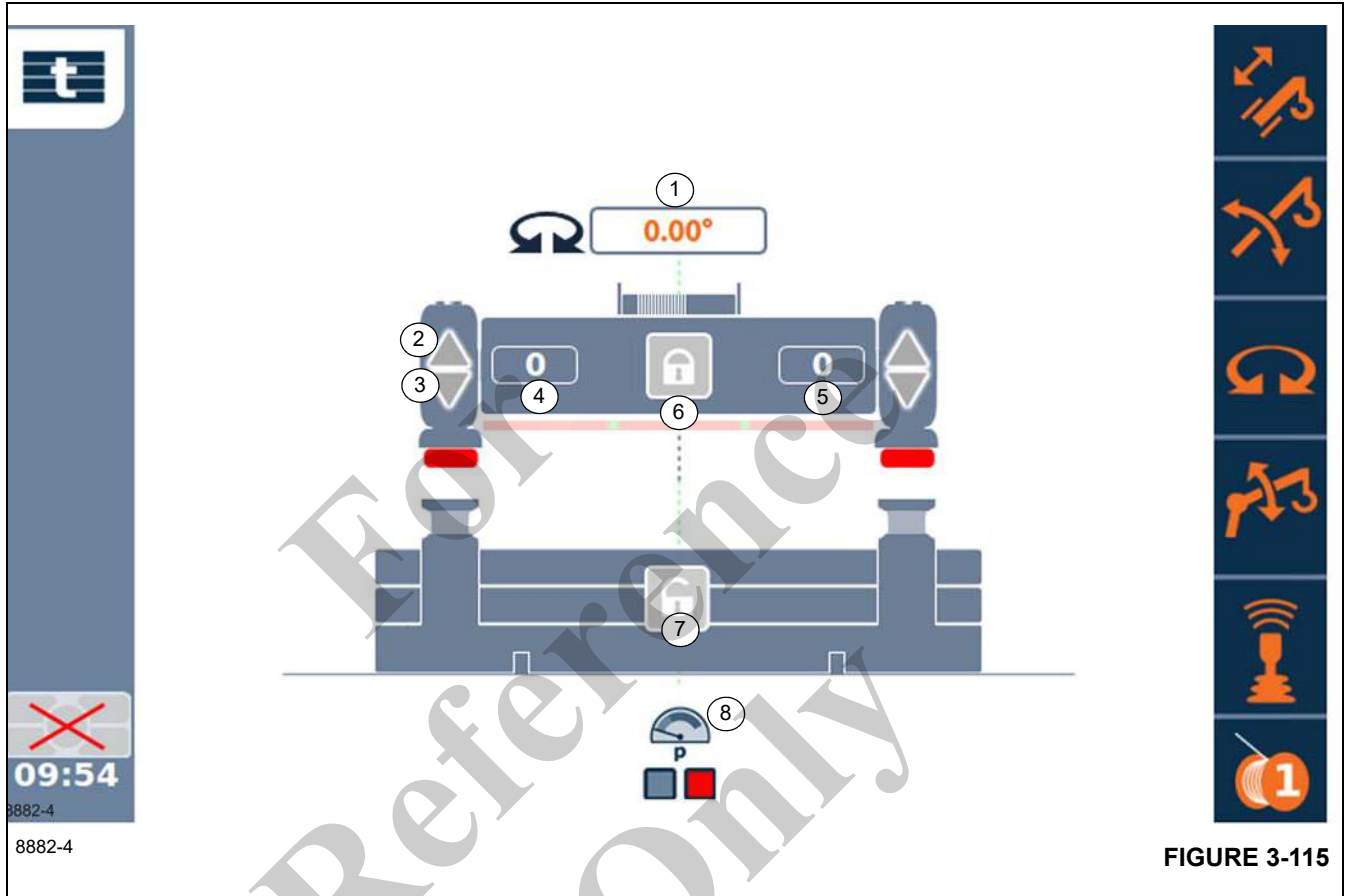


FIGURE 3-115

| Item | Description                                    | Refer to   |
|------|------------------------------------------------|------------|
| 1    | Current Swing Angle                            | page 3-134 |
| 2    | Retracting the Lifting Cylinders               | page 3-96  |
| 3    | Extending the Lifting Cylinders                | page 3-96  |
| 4    | Left Counterweight Cylinder Length Percentage  | page 3-96  |
| 5    | Right Counterweight Cylinder Length Percentage | page 3-96  |
| 6    | Lock the Counterweights                        | page 3-96  |
| 7    | Unlock the Counterweights                      | page 3-96  |
| 8    | Pre-tensioning Pressure                        | page 3-96  |

Counterweight Menu

**CAUTION**

**Machine Damage Hazard!**

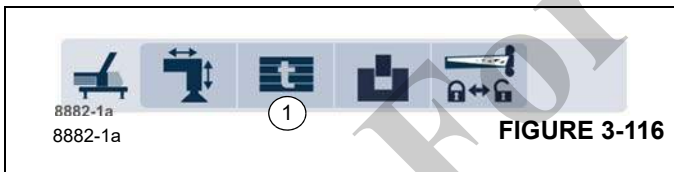
Potential damage to the superstructure if swinging with the 2268 kg or 1361 kg (5000 lb or 3000 lb) slab sitting on the rear mounted counterweight support bracket.

The rear counterweight support bracket is intended to give the option to shift weight from the front axles to the rear axles in a trailing boom configuration only.

The front deck is where the counterweight is assembled and then installed onto the superstructure.

The counterweight menu is used to add or remove counterweights to the superstructure.

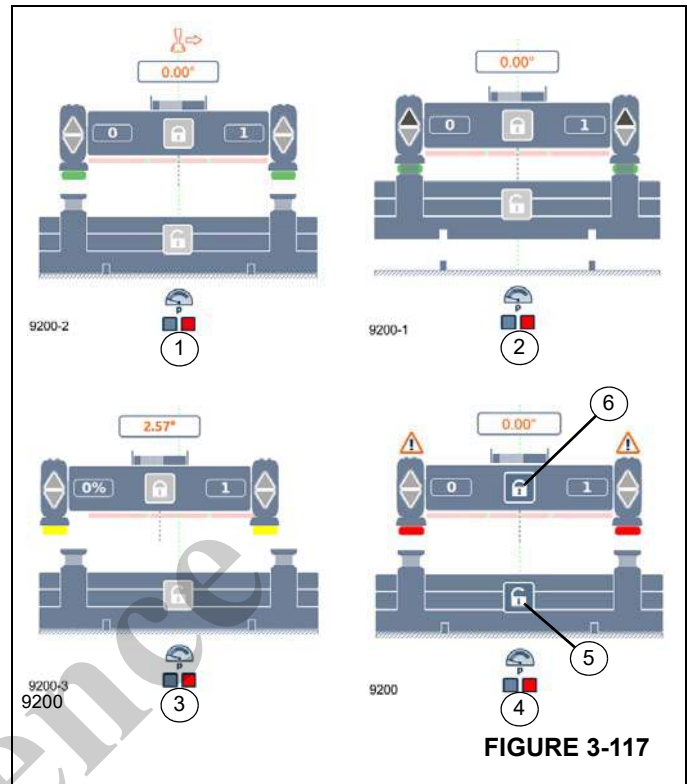
To open: Select symbol (1), (Figure 3-116) and confirm.



**Counterweight Locking Display**

The current status of the counterweight locking is shown by different symbols (Figure 3-117):

|   |                                |
|---|--------------------------------|
| 1 | Green – unlocked               |
| 2 | Green – raised                 |
| 3 | Yellow – intermediate position |
| 4 | Red – error                    |



The cylinders are only considered unlocked (able to be raised/lowered freely) at +4.0 or -4.0 degrees. When lowered at that position the crane is then swung to 0.0 degrees where they are raised to lift the counterweight. To unload the counterweight the reverse happens: crane is swung to 0.0 degrees, cylinders extend to lower counterweight onto the deck, crane swings with cylinders extended to +4.0 or -4.0 degrees, cylinders raise without counterweight.

**Locking/Unlocking the Counterweight**

With the lifting cylinders extended:

|            |                                |
|------------|--------------------------------|
| To Unlock: | Select symbol 5 (Figure 3-117) |
| To Lock:   | Select symbol 6 (Figure 3-117) |

The movement stops after the LOCK or UNLOCK button is released on the display, or when an end position is reached.

**Extending/Retracting the Lifting Cylinders**

With the turntable locked prior to raising the counterweight.

|   |          |                                                                                   |
|---|----------|-----------------------------------------------------------------------------------|
| 1 | Retract: | After reaching the end position the counterweight is pre-tensioned (Figure 3-118) |
| 2 | Extend   |                                                                                   |

The movement stops after the button is released, or when an end position is reached.



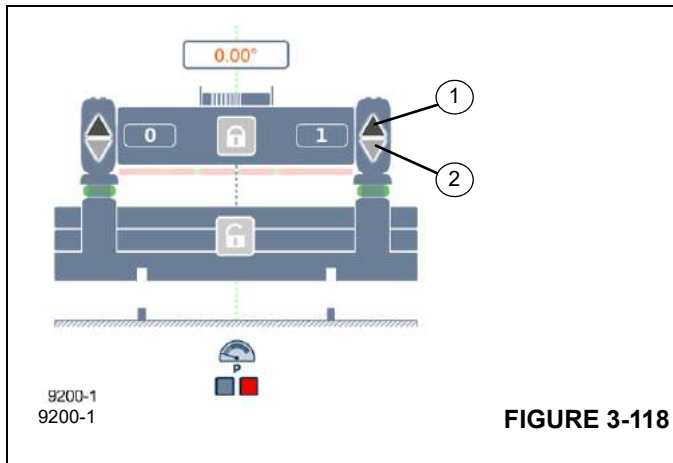


FIGURE 3-118

**Pre-Tensioning Pressure Display**

|   |        |                                                             |
|---|--------|-------------------------------------------------------------|
| 1 | Green: | Pre-tensioning pressure reached (Figure 3-119)              |
| 2 | Red:   | Pre-tensioning pressure too low – pre-tension counterweight |

For driving the counterweights should be pinned. For lifts on the job site it is not necessary to pin them. The cylinder pressure may be used to keep them up. The cylinders have a check valve and accumulator which will hold pressure on for several hours. There is no indication to the operator if the cylinders drift down, but the accumulator automatically charges to keep the pressure high - about 190 bar (2756 psi).

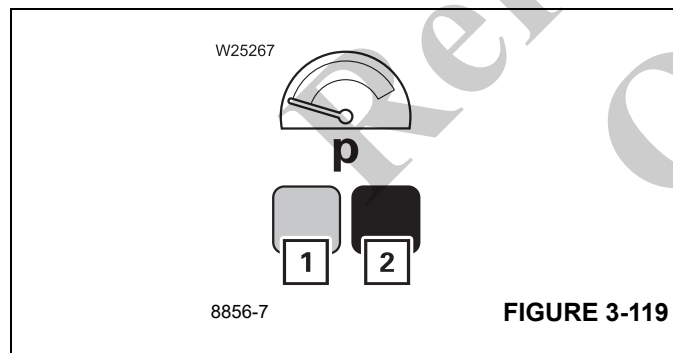


FIGURE 3-119

**Main Hoist**

Refer to *Main Hoist*, page 4-61 for information on operating the main hoist.

**Right Control Lever**

|          |                                 |
|----------|---------------------------------|
| Back:    | Main hoist raise (Figure 3-120) |
| Forward: | Main hoist lower                |

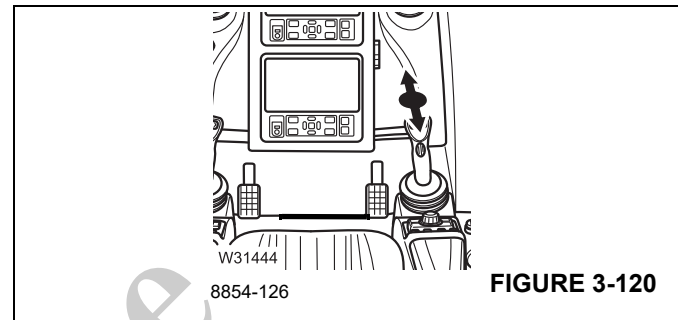


FIGURE 3-120

**Hoist High-Speed Mode ON/OFF**

|                                |                                                      |
|--------------------------------|------------------------------------------------------|
| Left:                          | High-speed mode on, off when released (Figure 3-121) |
| Once to the right:             | High-speed mode on – continuous operation            |
| Once to right or once to left: | High-speed mode off                                  |

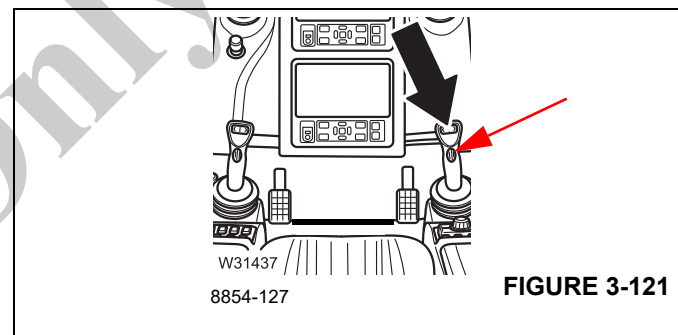


FIGURE 3-121

**Hoist Speed Range Selection**

For dual axis joysticks use the following:

- Press and hold the thumb toggle switch to the side towards the seat. High speed is on when pressed, turns off when released.
- Press and release the thumb toggle switch away from the seat. High speed status is toggled each time it is pressed (on with 1st press, off with 2nd)
- Do a long press (about 2 seconds) when enabling hoist with the armrest switches. High speed will be enabled. Disabling hoist with the armrest switch disables high speed.

- Do a double press when enabling hoist with the armrest switches (within about 1 second). High speed will be enabled. Disabling hoist with the armrest switch disables high speed.

**Hoist Rotation Indicator**

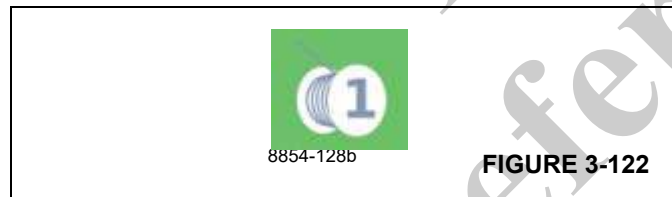
The Hoist Rotation Indicators for the auxiliary and main hoist are located on the controller. The high speed switch is at the top of the controller as shown by the black arrow (Figure 3-121). The rotation indicators are on the back face of the controller as shown by the red arrow or vertical oval below the high speed switch (Figure 3-121). Each indicator is electronically driven by an input signal from a sensor attached to its related hoist and an output signal from a control module. Each hoist control lever pulses when its hoist is running so the operator’s thumb can sense it.

An indicator (Figure 3-124) on the ODM screen shows which direction the hoist is operating.

**ODM Display**

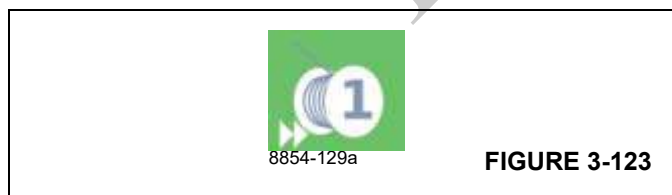
**Main Hoist Enable**

|        |                                        |
|--------|----------------------------------------|
| Green: | Main hoist ON / Enabled (Figure 3-122) |
| Red:   | Main hoist OFF                         |



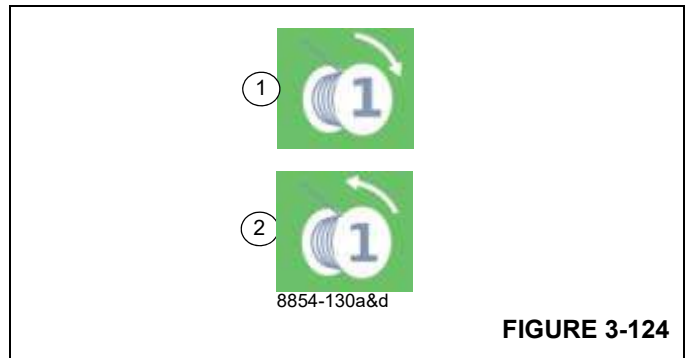
**High Speed Mode for the Hoist**

|     |                                   |
|-----|-----------------------------------|
| ON: | High-speed mode on (Figure 3-123) |
|-----|-----------------------------------|



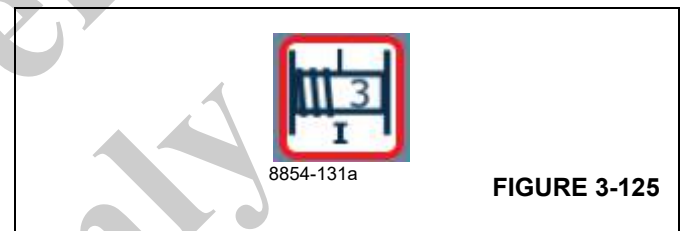
**Lift/Lower the Hoist Rope**

|             |       |
|-------------|-------|
| Symbol (1): | Lift  |
| Symbol (2): | Lower |



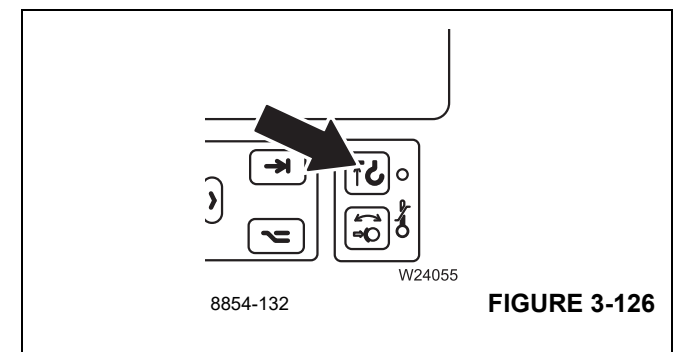
**Warning for Lowering Limit Switch Lockout**

|             |                                                                                                                         |
|-------------|-------------------------------------------------------------------------------------------------------------------------|
| Icon shown: | Lowering limit switch triggered – main hoist stop (Figure 3-125). <b>NOTE:</b> This Icon is in Warning Area of the ODM. |
| No icon:    | Lowering limit switch not triggered                                                                                     |



**Hoist Lifting Limit Lockout Indication**

|           |                                                                                       |
|-----------|---------------------------------------------------------------------------------------|
| ON:       | Hoisting is locked out due to Anti Two-Block or minimum wrap condition (Figure 3-126) |
| Flashing: | Hoist Limit Lockout Override Active                                                   |
| OFF:      | Anti Two-Block switch not triggered                                                   |





### Auxiliary Hoist

Auxiliary Hoist, page 4-63.

The auxiliary hoist uses the same icons except they are labeled “2” instead of “1” and the left control lever actuates the auxiliary hoist.

### Swing

#### Control Panels

#### Swing Enable

Swing is enabled with a switch (Figure 3-127) on the left hand armrest control panel.

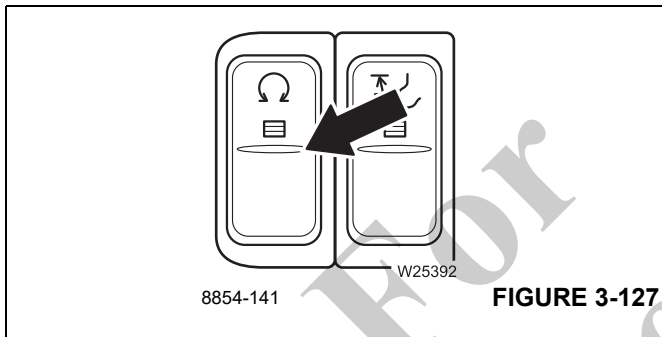


FIGURE 3-127

There is an icon on the right side of the display.

|        |                         |
|--------|-------------------------|
| Green: | Swing on (Figure 3-128) |
| Red:   | Swing off               |

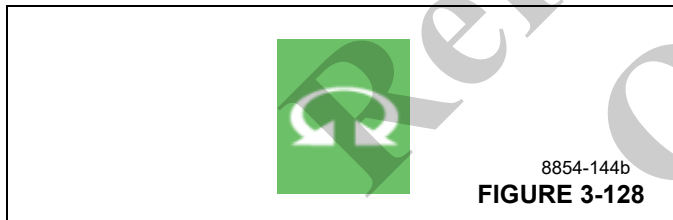


FIGURE 3-128

### Left Control Lever

|                                      |                                                     |
|--------------------------------------|-----------------------------------------------------|
| Push the control lever to the left:  | Swing the superstructure to the left (Figure 3-129) |
| Push the control lever to the right: | Swing the superstructure to the right               |

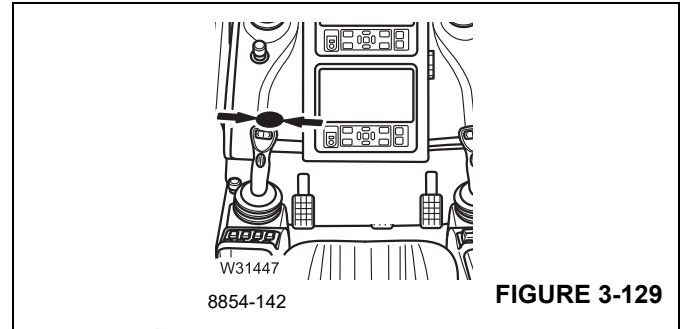


FIGURE 3-129

### Free Swing Button

|                |                                                                                |
|----------------|--------------------------------------------------------------------------------|
| To switch on:  | Press and hold the button on the joystick (Figure 3-130) to engage free swing. |
| To switch off: | Release the button – to turn free swing OFF.                                   |

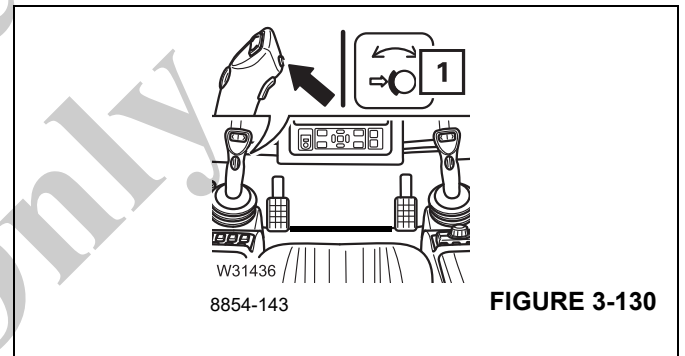


FIGURE 3-130

### ODM Display

#### Swing Function Display

**NOT ENABLED:** Blue background, orange icon (Figure 3-131) (this is at first key on without pushing any buttons)

**ENABLED:** Green background, white icon (this is after the enable button has been selected)

**STAND BY:** Yellow background, white icon (this is after the function has been enabled, and you get out of the seat)

**STANDBY FUNCTION ACTUATED:** Yellow background flashing, white icon (this occurs when a function is presently in standby and a joystick is actuated – before sitting back in the seat, to prevent unwanted movement)

**DISABLED:** Blue background, gray icon (function is disabled – this is set by going into the ODM screen and setting the

function speed to '0'. While at 0, a function can not be enabled)



FIGURE 3-131

**Swing Brake Applied/Released**

|   |      |                                    |
|---|------|------------------------------------|
| 1 | ON:  | Swing brake applied (Figure 3-132) |
| 1 | OFF: | Swing brake released               |

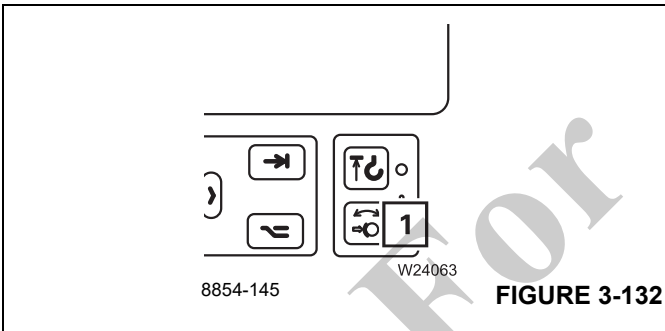


FIGURE 3-132

**Boom Lifting/Lowering Mechanism**

**Control Panels**

**Boom Lifting/Lowering Mechanism ON/OFF**

|             |                                                                                        |
|-------------|----------------------------------------------------------------------------------------|
| Press once: | Boom Lifting/lowering mechanism ON (Figure 3-133), press the switch again to turn OFF. |
|-------------|----------------------------------------------------------------------------------------|

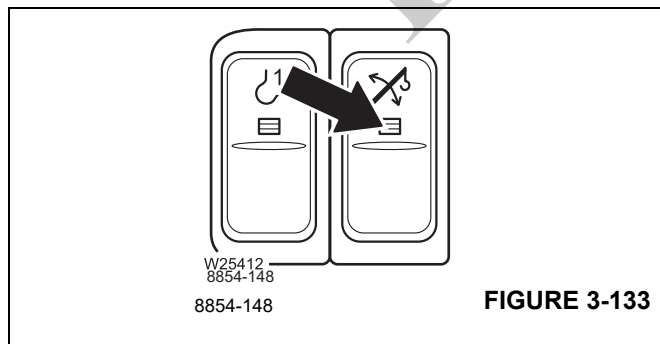


FIGURE 3-133

**Right Control Lever**

|               |                                       |
|---------------|---------------------------------------|
| To the left:  | Raise – lift main boom (Figure 3-134) |
| To the right: | Lower – lower main boom               |

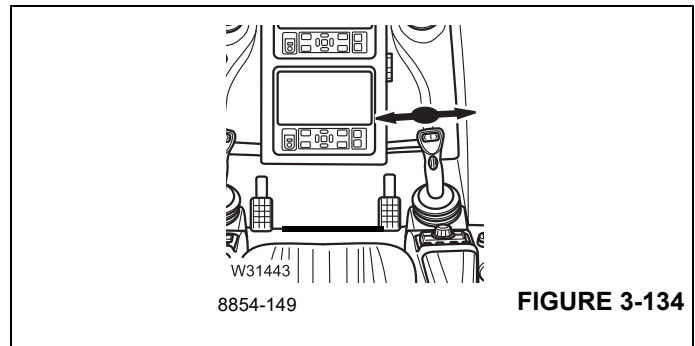


FIGURE 3-134

**ODM Display**

**Lifting/Lowering Crane Function Display**

|        |                                              |
|--------|----------------------------------------------|
| Green: | Lifting/lowering mechanism on (Figure 3-135) |
| Red:   | Lifting/lowering mechanism off               |

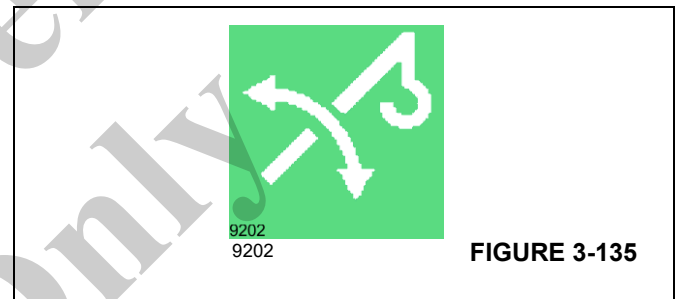


FIGURE 3-135

**Boom Up Override Switch**

When overloaded, pressing and holding the switch allows the operator to boom up even though the RCL normally blocks that motion. This reduces the radius which usually increases the allowed load.

|      |                                   |
|------|-----------------------------------|
| ON:  | Lockout overridden (Figure 3-136) |
| OFF: | Lockout not overridden            |

The button is located on the left armrest control panel.

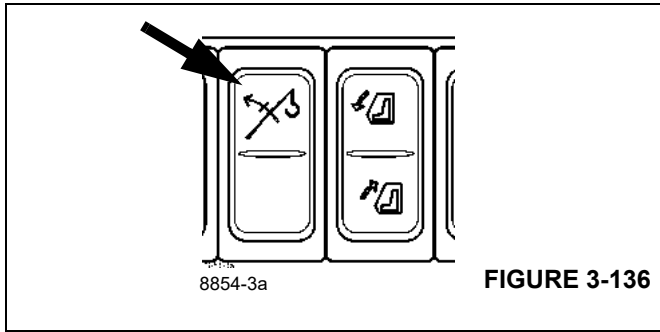


FIGURE 3-136

**Telescoping Mechanism**

**Control Panels**

**Telescoping Enable Switch**

The button (Figure 3-137) is used to enable the telescoping mechanism.

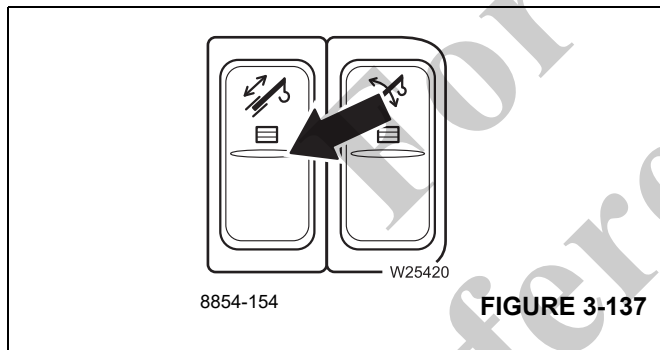


FIGURE 3-137

**Right Control Lever**

Control lever configuration

|   |                        |
|---|------------------------|
| 1 | Retract (Figure 3-138) |
| 2 | Extend                 |

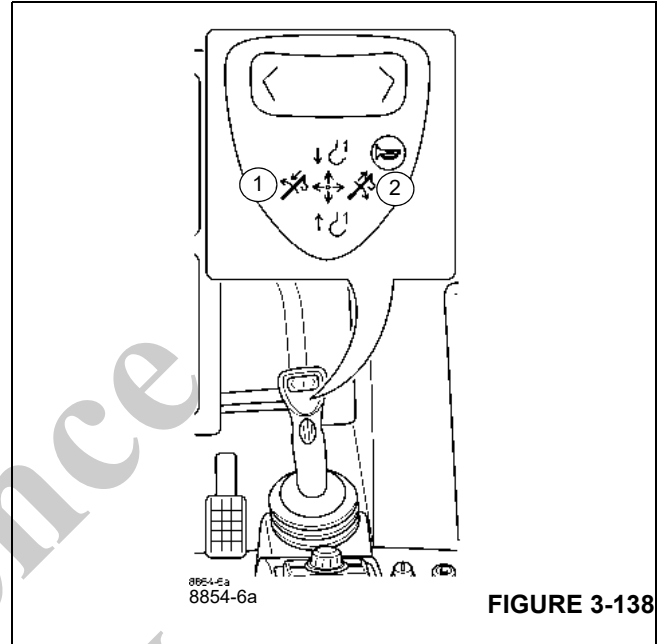


FIGURE 3-138

**Left Control Lever - Optional**

Control lever configuration when the crane is not equipped with an auxiliary hoist.

|         |                        |
|---------|------------------------|
| Back    | Retract (Figure 3-139) |
| Forward | Extend                 |

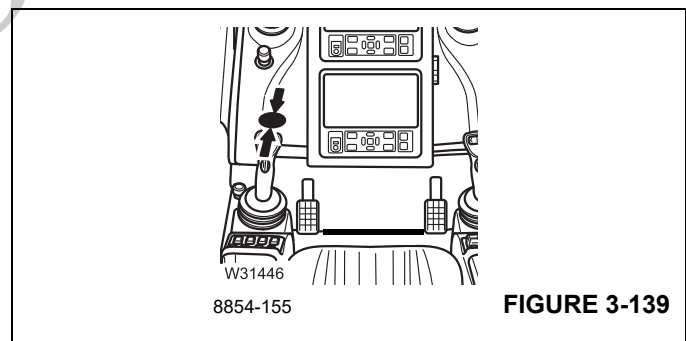


FIGURE 3-139

The right control lever will be used for boom lift/lower and luffing boom extension raise and lower.

**Telescoping Crane Function Display**

Refer to (Figure 3-140). **NOT ENABLED:** Blue background, orange icon (this is at first key-on without pushing any buttons).

**ENABLED:** Green background, white icon (this is after the enable button has been selected).

**STAND BY:** Yellow background, white icon (this is after the function has been enable, and you get out of the seat).

**STANDBY FUNCTION ACTUATED:** Yellow background flashing, white icon (this occurs when a function is presently in standby and a joystick is actuated – before sitting back in the seat, to prevent unwanted movement).

**DISABLED:** Blue background, gray icon.

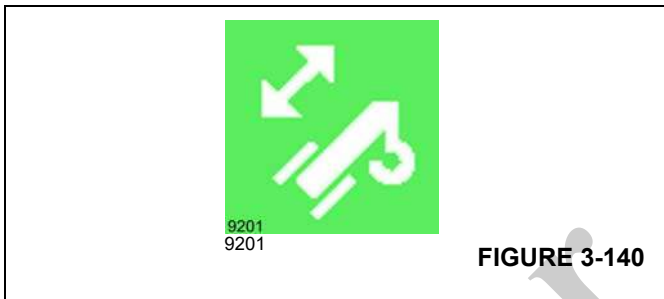


FIGURE 3-140

**Telescoping Semi-Automation Menu**

**NOTE:** For more information about telescoping with semi-automation refer to *Telescoping Mechanism*, page 4-67.

**Open Menu**

To open: Select symbol (1), (Figure 3-141) and confirm – menu is opened.

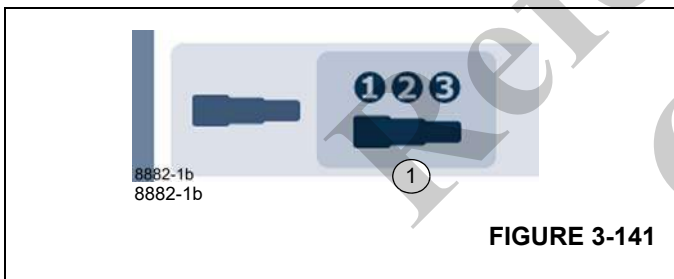


FIGURE 3-141

**Telescope Diagram Display**

Current relation of the telescopic sections to each other – section of top view (Figure 3-142).

The image shown in (Figure 3-142) shows the status of the section and cylinder pins. Green (1) indicates that the pin is locked, Yellow (2) shows that it is in an intermediate position

and Red is unlocked. Additionally, if the hazard triangle (3) is present, an error exists.

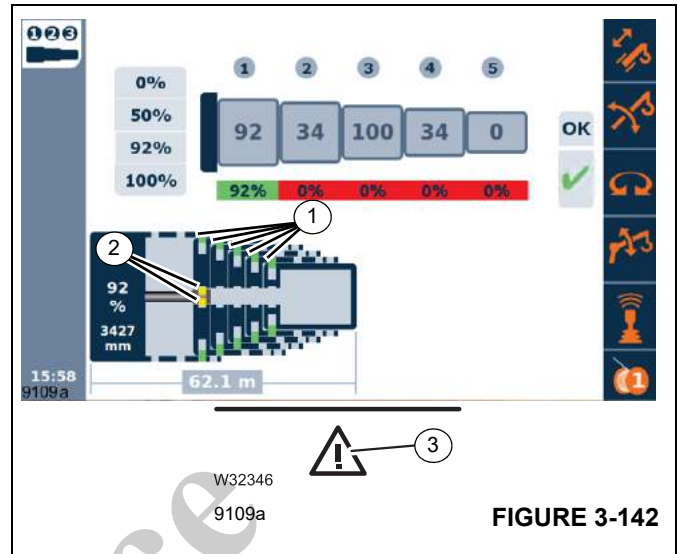


FIGURE 3-142

**Telescoping Cylinder Length Display**

|                      |                                                                                                                                                                                                                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Display:             | Current extended length of the telescoping cylinder (Figure 3-143)                                                                                                                                                                                                                                     |
| Unit of measurement: | (Figure 3-143) displays 3427 mm (millimeters) telescoping cylinder length value. 62.1 m is the main boom length value. <b>NOTE:</b> when you change the unit system to imperial, the main boom length changes to ft., but the telescoping cylinder does not (it stays in mm for internal calibration). |

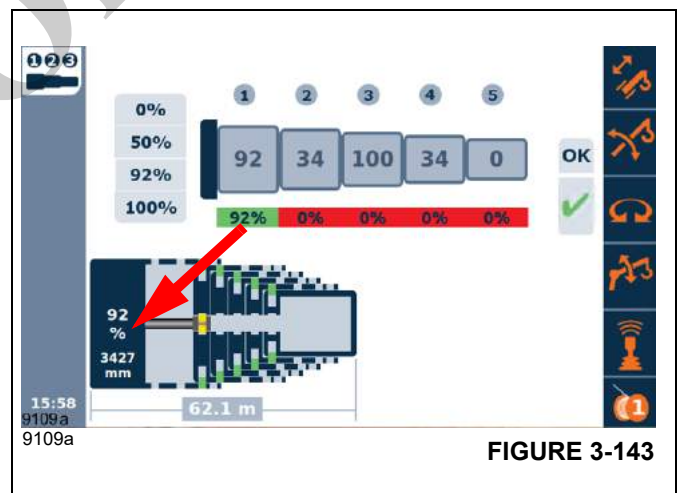


FIGURE 3-143

**Main Boom Length Display**

|                      |                                                          |
|----------------------|----------------------------------------------------------|
| Display:             | Current extended length of the main boom (Figure 3-144). |
| Unit of measurement: | Displayed depending on setting.                          |

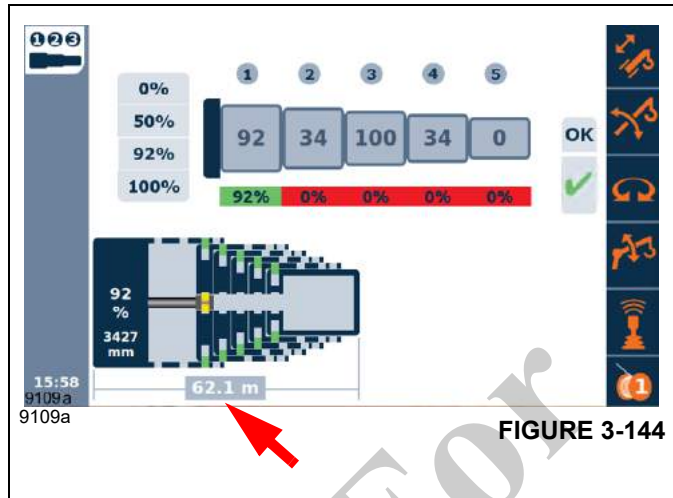


FIGURE 3-144

**Telescopic Sections Display**

|       |                                                                        |
|-------|------------------------------------------------------------------------|
| 1 - 5 | Display of telescopic sections 1 to 5 as shown in (1), (Figure 3-145). |
|-------|------------------------------------------------------------------------|

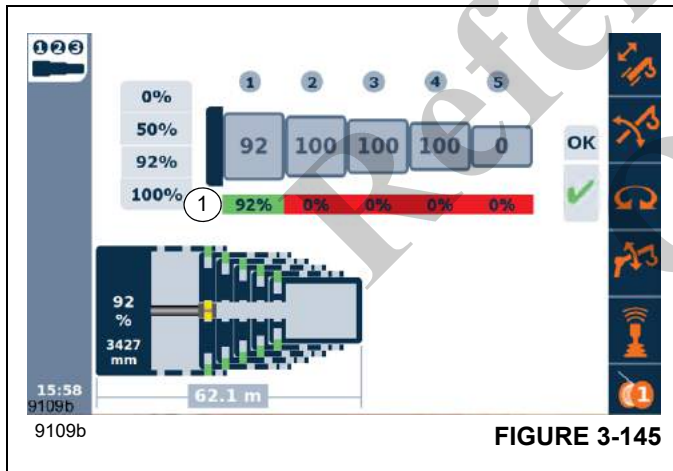


FIGURE 3-145

Refer to Pre-selection for all telescopic sections.

**Current Telescope Status Display**

Extended length of the telescopic sections in percentage

|       |                                                       |
|-------|-------------------------------------------------------|
| 1 - 5 | Display of telescopic sections 1 to 5 (Figure 3-146). |
|-------|-------------------------------------------------------|

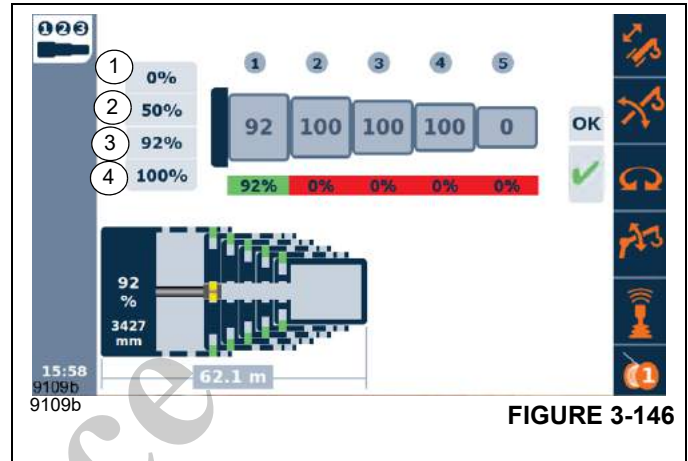


FIGURE 3-146

**Pre-Selection for all Telescopic Sections**

|   |                                |
|---|--------------------------------|
| 1 | Pre-selection telescoping 0%   |
| 2 | Pre-selection telescoping 50%  |
| 3 | Pre-selection telescoping 92%  |
| 4 | Pre-selection telescoping 100% |

**Pre-Selection Individual Telescopic Sections**

|       |                                                      |
|-------|------------------------------------------------------|
| 1 - 5 | Display of telescopic sections 1 to 5 (Figure 3-146) |
|-------|------------------------------------------------------|

**Tele-Automation Direction Display**

|   |                                               |
|---|-----------------------------------------------|
| 1 | Start telescoping with Retract (Figure 3-147) |
| 2 | Start telescoping with Extend                 |

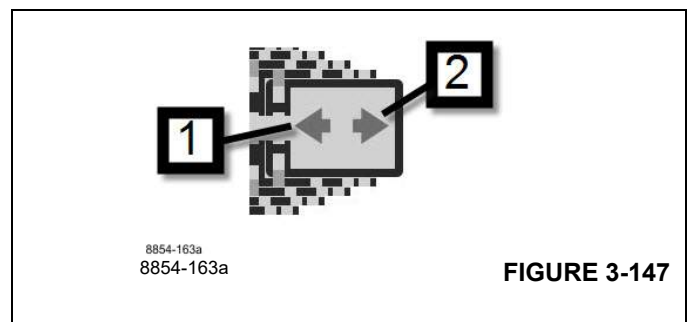
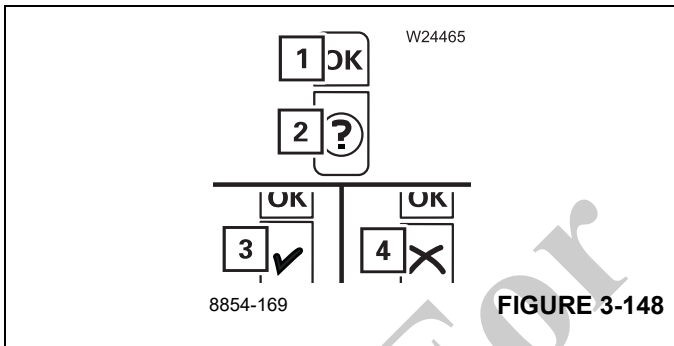


FIGURE 3-147

3

**Confirm Pre-Selection**

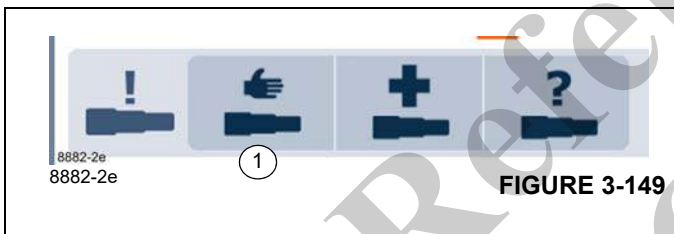
|   |                                                                                                                                                                                      |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Confirm request to use entered telescoping values (Figure 3-148)                                                                                                                     |
| 2 | Once a new set of values are entered for telescoping, the question-mark (2), (Figure 3-148) appears until the OK (1) is confirmed. Then the check-mark (3) or the red-X (4) is shown |
| 3 | Requested telescoping is accepted symbol                                                                                                                                             |
| 4 | Requested telescoping not accepted symbol                                                                                                                                            |



**FIGURE 3-148**

**Manual Telescoping Menu**

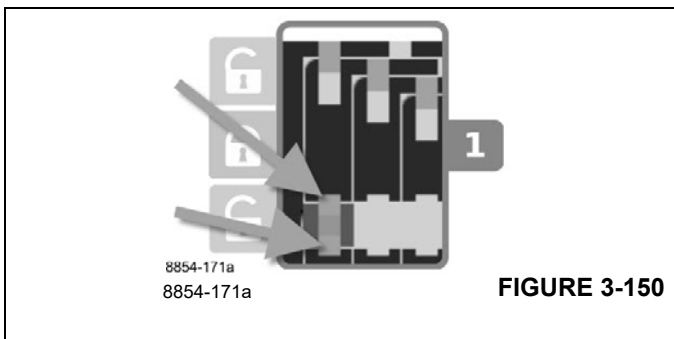
To open: Select symbol (1) and confirm – menu is opened (Figure 3-149).



**FIGURE 3-149**

**Telescoping Cylinder Locked/Released**

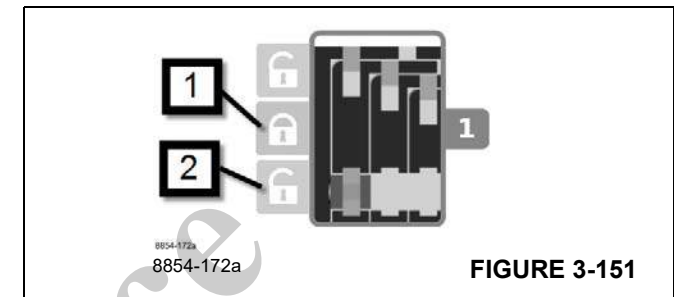
|         |         |                                                   |
|---------|---------|---------------------------------------------------|
| Display | Yellow: | Locking pins intermediate position (Figure 3-150) |
|         | Green:  | Telescoping cylinder locked                       |
|         | Red:    | Telescoping cylinder unlocked                     |



**FIGURE 3-150**

**Locking/Releasing the Telescoping Cylinder**

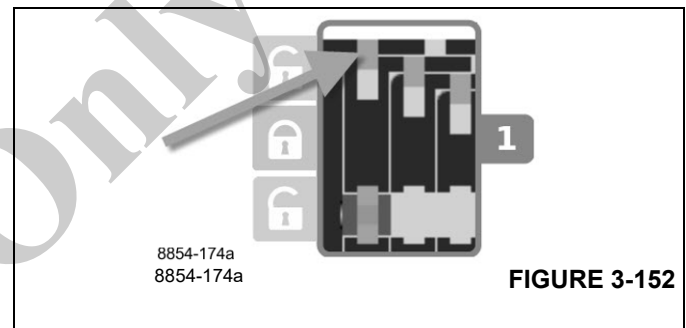
|            |                                                                                                             |
|------------|-------------------------------------------------------------------------------------------------------------|
| To lock:   | Telescopic section locked:<br>Select symbol (1), (Figure 3-151) and confirm – telescoping section is locked |
| To unlock: | Telescopic section locked:<br>Select symbol (2) and confirm – telescoping section is unlocked               |



**FIGURE 3-151**

**Lock/Release Telescopic Section Indication**

|         |         |                                                   |
|---------|---------|---------------------------------------------------|
| Display | Yellow: | Locking pins intermediate position (Figure 3-152) |
|         | Green:  | Telescopic section locked                         |
|         | Red:    | Telescopic section unlocked                       |

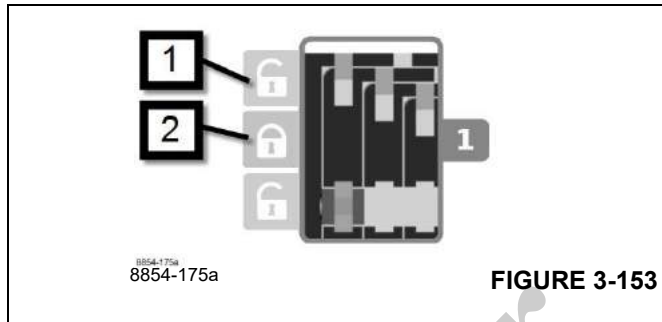


**FIGURE 3-152**



**Locking/Releasing the Telescopic Section**

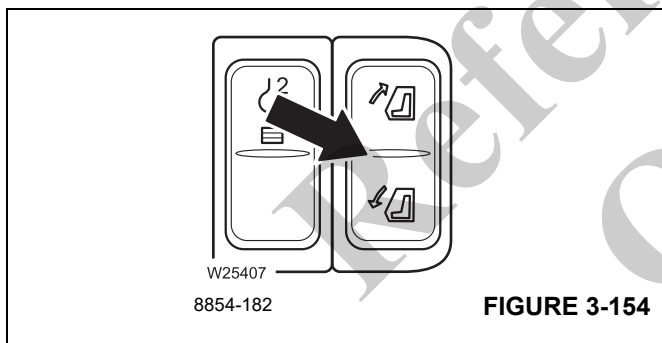
|            |                                                                                |
|------------|--------------------------------------------------------------------------------|
| To lock:   | Select symbol (2), (Figure 3-153) and confirm – telescopic section locked      |
| To unlock: | Select symbol (1), (Figure 3-153) and confirm – telescopic section is unlocked |



**Hydraulic System**

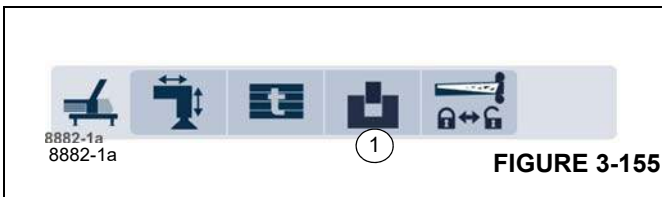
**Cab Tilt**

This switch is located in the left hand armrest control panel.  
 Press top of switch to raise the cab (Figure 3-154).  
 Press the bottom of the switch to lower the cab.



**Superstructure House Lock Menu**

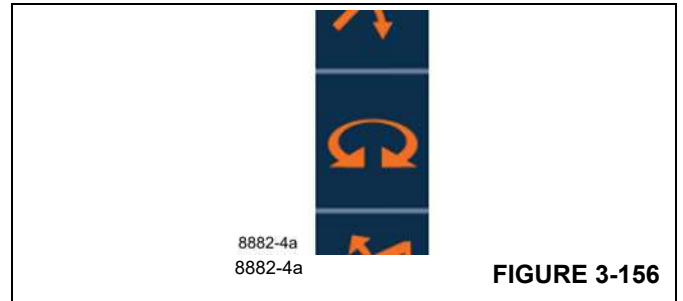
To open: Select symbol (1), (Figure 3-155) and confirm.



**Swing Gear Display**

**NOTE:** The Swing Gear Display color means the background color of the icon.

|        |                               |
|--------|-------------------------------|
| Green: | Swing enabled                 |
| Blue:  | Swing disabled (Figure 3-156) |



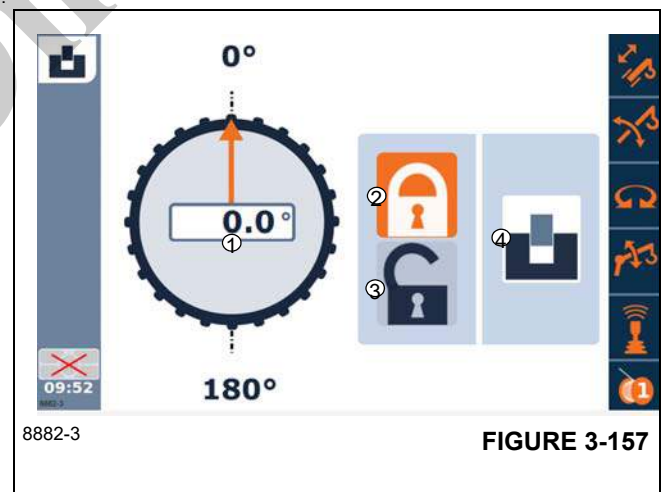
**360 Degree Swing Lock**

Switching ON the 360° Lock, page 4-47.

**Locking Status Displays**

The current position of the locking mechanism is shown by different symbols: (Figure 3-157).

|   |                            |
|---|----------------------------|
| 1 | Current Swing Angle        |
| 2 | Lock                       |
| 3 | Unlock                     |
| 4 | Superstructure Lock Status |



- Lock function highlighted, pin locked (1), (Figure 3-158).
- Unlock function highlighted, pin locked (2).
- Unlock function highlighted, pin in between (3).
- Lock function highlighted, pin unlocked (4).
- Lock function highlighted, pin in between error (5).

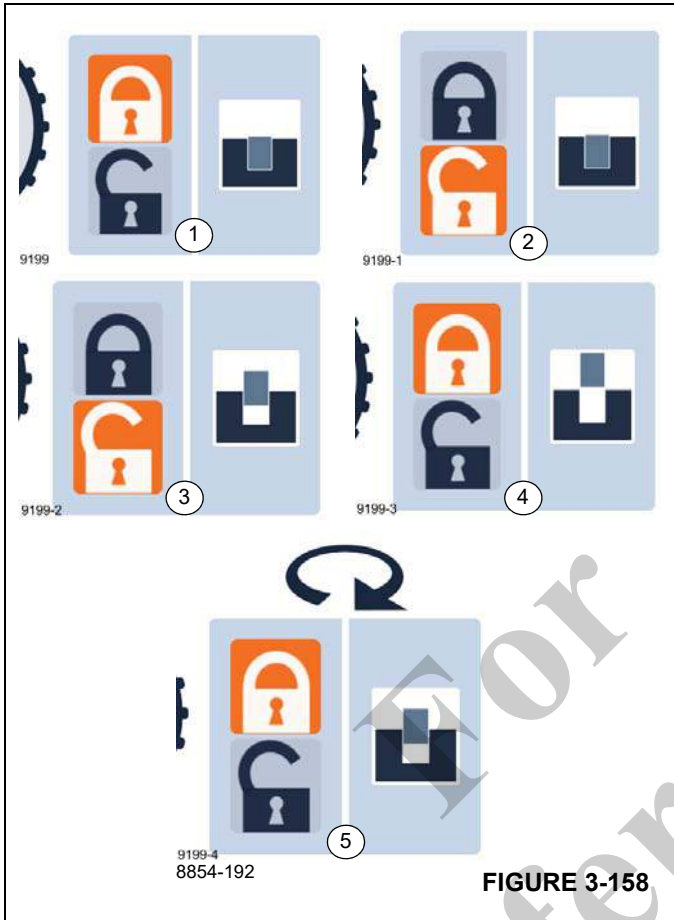


FIGURE 3-158

**REMOTE CONTROL**

**Remote Control Icon**

With remote control switched on, crane operation from the superstructure cab is blocked. Icon (Figure 3-159) is shown green on all menus.

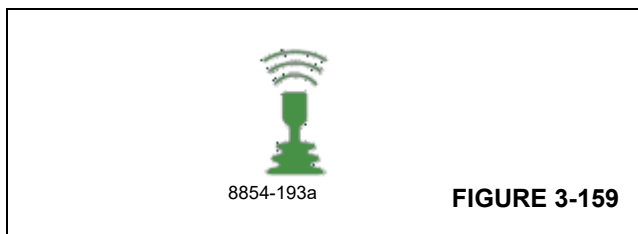


FIGURE 3-159

**REMOTE CONTROL OPERATION**

**Scope**

This section specifies system requirements and theory of operation for the Hand-Held, Wireless Remote Control available for the TMS9000-2.



**WARNING**

**Tipping/Overload Hazard!**

RCL lockouts and limiters are not functional when remote control is used.

When operating functions from remote control, operator must be positioned to see crane movement.

Read the Operator Manual.

This section does not contain:

- Operating instructions for the controls on the crane
- Setup and installation instructions

Before using the remote control, the operator shall read and become thoroughly familiar with the instructions in the TMS9000-2 Operator Manual.

**System Overview**

The remote control has been provided to operate the following crane functions during *crane set-up only*:

- Superstructure horn
- Engine start/stop and throttle control
- Outrigger beams and jacks
- Hoists (aux and main hoist)
- Boom lift
- Swing and 360° swing lock
- Luffing boom extension
- Boom Extension stowage actuators
- Counterweight system cylinders

The remote control is not intended to operate crane functions during normal crane operation.

When the remote control is used during crane set-up, the RCL is disabled and associated lockouts and limiters are not functional, to include:

- Anti Two-Block
- Hoist minimum wrap
- Carrier avoidance



System Components



Table 3-1 System Components

| Item | Component (Figure 3-160)     | Description                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Remote Control (transmitter) | <p>The remote control communicates with the receiver to control the crane functions identified in this publication.</p> <ul style="list-style-type: none"> <li>Powered by a 3.2Ah Lithium-Po rechargeable battery (4b)</li> <li>Stored in a pocket on the inside of the carrier cab door</li> </ul>                                                                                                                                |
| 2    | Receiver Module              | <p>Communicates with the remote control and the CCS (crane control system) over the CAN network.</p> <ul style="list-style-type: none"> <li>Mounted on the cab wall behind the driver's seat</li> </ul>                                                                                                                                                                                                                            |
| 3    | Battery Charger              | <p>Charges the batteries (quantity 2) supplied with the remote control. The charger is active whether the carrier engine is running or off.</p> <ul style="list-style-type: none"> <li>Mounted on the cab wall behind the driver's seat</li> </ul> <p>The charger lights (3a) indicate the following:</p> <ul style="list-style-type: none"> <li>Four red lights = CHARGING</li> <li>Three green lights = FULLY CHARGED</li> </ul> |

Table 3-2 Operating Conditions

|                        |                                                                       |
|------------------------|-----------------------------------------------------------------------|
| Working range          | Approximately 30 m (100 ft) depending on obstructions and environment |
| Battery operating time | Approximately 10 hours                                                |
| Operating temperature  | -20°C to 70°C (-4°F to 158°F)                                         |
| Storage temperature    | -40°C to 75°C (-40°F to 167°F)                                        |

Remote Control Components



FIGURE 3-161

Table 3-3 Remote Control Components

| Item | Component (Figure 3-161) | Description                                                                                                                                                                                                                                                                    |
|------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Programming Port         | For Grove factory authorized use only.                                                                                                                                                                                                                                         |
| 2    | Color Display            | Displays information for the selected function.                                                                                                                                                                                                                                |
| 3    | Power Button             | ON/OFF switch which activates and deactivates the remote control.                                                                                                                                                                                                              |
| 4    | Indicator LED            | Amber, solid = remote control in boot-loader mode (ready to be programmed)<br>Green, slow blink = wireless communication OK<br>Red, slow blink = E-stop relay open or wireless communication stopped<br>Red, fast blink = battery low<br>Red, solid = remote controlling error |

|        |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5      | Function Selector Buttons (qty 10)        | <p>Momentary buttons that activate the selected function in the display:</p> <ul style="list-style-type: none"> <li>5a - Outrigger beams</li> <li>5b - Outrigger jacks</li> <li>5c - Boom lift</li> <li>5d - Option: luffing boom extension, boom extension assist, counterweight</li> <li>5e - Horn (activates the superstructure horn)</li> <li>5f - Escape: exits the selected function screen</li> <li>5g - Information (software version/revision and crane serial number)</li> <li>5h - Engine</li> <li>5i - Swing</li> <li>5j - Main/aux hoist</li> </ul> |
| 6<br>7 | Left Motion Button<br>Right Motion Button | <p>Holding down either button operates the selected function in the desired direction (for example: turn a drum up or down, extend or retract a jack or beam, swing right or left, engage or disengage a pin).<br/>Speed depends on how far either button is depressed.</p>                                                                                                                                                                                                                                                                                      |
| 8      | Left Enable Button                        | <p>Holding down either button allows (enables) a selected function to be operated in the desired direction by the corresponding motion button.</p>                                                                                                                                                                                                                                                                                                                                                                                                               |
| 9      | Right Enable Button                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 10     | Battery                                   | 3.2Ah Lithium-Po rechargeable battery                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 11     | E-Stop Knob                               | <p>Pull out = allow operation of the crane functions from the remote control<br/>Push in = STOP engine and current function</p>                                                                                                                                                                                                                                                                                                                                                                                                                                  |

For Reference Only

Display Components

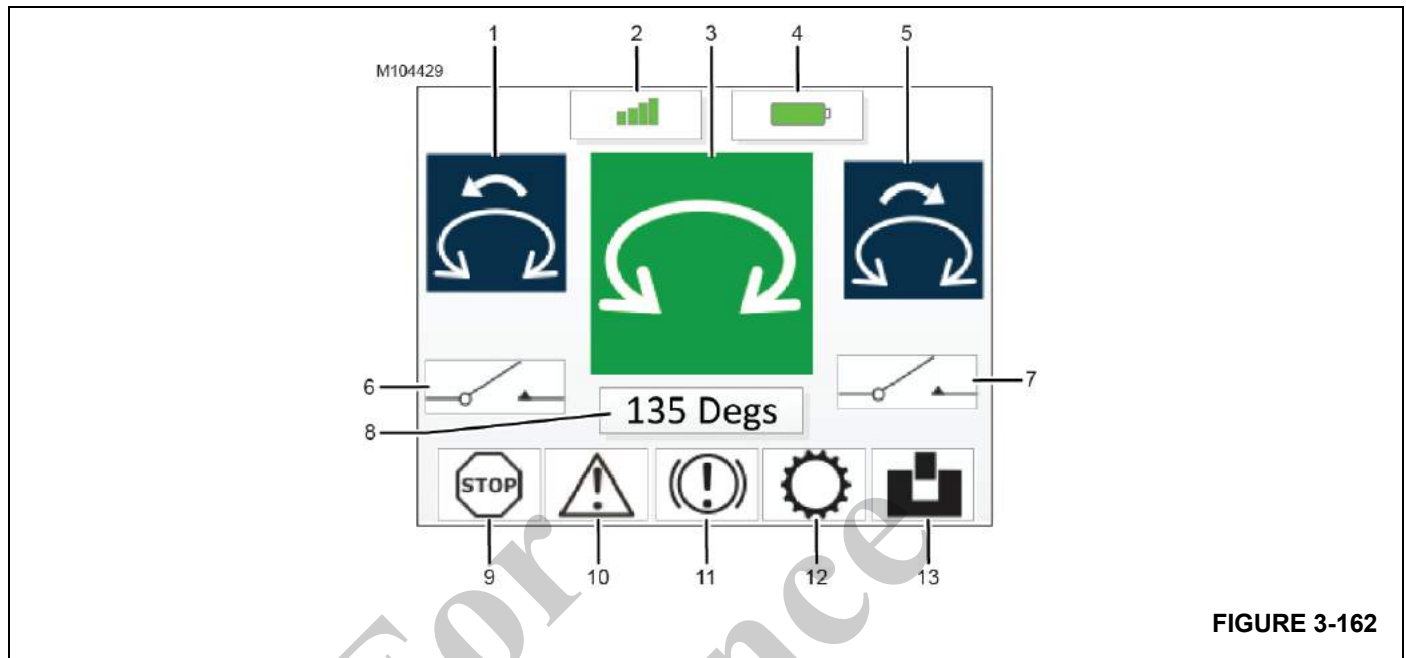


FIGURE 3-162

Table 3-4 Display Components

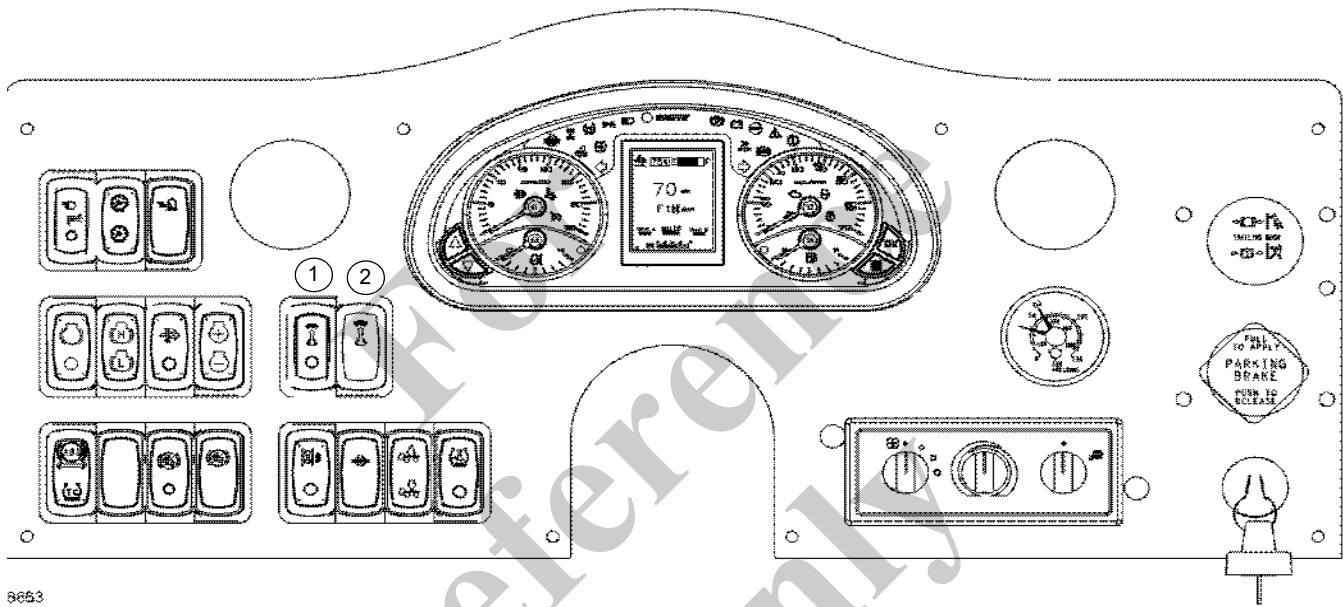
| Item | Component (Figure 3-162) | Description                                                                                                           |
|------|--------------------------|-----------------------------------------------------------------------------------------------------------------------|
| 1    | Left Motion Command      | Depicts the operation that is controlled by the left motion command button                                            |
| 2    | Transmission Strength    | More bars = greater strength, and vice versa                                                                          |
| 3    | Function Screen          | Depicts the function that is being operated (swing in this example)                                                   |
| 4    | Battery Power            | Green = full charge<br>Amber = discharging                                                                            |
| 5    | Right Motion Command     | Depicts the operation that is controlled by the right motion command button                                           |
| 6    | Left Enable              | White = neither enable button is depressed (function cannot be operated)                                              |
| 7    | Right Enable             | Green = either enable button is depressed (function can be operated)                                                  |
| 8    | DEG or RPM               | When appropriate, shows the position of the superstructure in degrees or the rotational speed of the selected motion. |
| 9    | E-Stop                   | White = not active (operation allowed)<br>Red = active (operation not allowed until E-stop is pulled out)             |
| 10   | Crane Fault              | White = not active (operation allowed)<br>Red = active (take corrective action as indicated in Crane Operator Manual) |
| 11   | Carrier Park Brake       | White = brake applied<br>Red = brake released                                                                         |
| 12   | Carrier Transmission     | White = transmission in neutral<br>Red = transmission in gear (must be in neutral)                                    |
| 13   | 360° Swing Lock          | White = swing LOCK position<br>Red = swing UNLOCK position                                                            |

**Preparing for Remote Control Operation**

1. Position the crane in the desired location.
2. Apply the carrier parking brake.
3. Shift the carrier transmission to neutral.
4. Stop the engine with the carrier ignition switch (the engine will be re-started with the remote control).
5. Set the carrier ignition switch to ON.
6. Set the remote control switch (1), (Figure 3-163) on the carrier control console to ON.

**NOTE:** Note: In this mode, power is supplied to the remote module and the E-Stop relay (in remote module) is added in series to the E-Stop electrical circuit.

|   |                              |
|---|------------------------------|
| 1 | Remote Control ON/OFF Switch |
| 2 | Remote Control Indicator     |



**FIGURE 3-163**

7. The amber remote control indicator (2) next to remote control switch indicates the following:
  - Amber ON = remote control has control of crane functions
  - Amber OFF = remote control powered off
  - Amber FLASHING = A crane condition is preventing the remote from gaining control of the crane functions. For example:
    - Carrier park brake not applied
    - Carrier transmission is in gear
    - Active fault codes exist
    - Superstructure is in control of crane functions
8. Turn ON the remote control, as follows:
  - a. Press the power button on the top of the remote control.
  - b. Make sure the E-stop button on the remote control is pulled out and then press any button on the

remote control. This action closes the E-stop relay in the receiver module.

- c. The SPLASH screen will appear for a few seconds, followed by the WARNING screen, See (Figure 3-164).
- d. Press the ESC button on the remote control to acknowledge that you have read the warning.
- e. The MAIN screen appears.
- f. Press the engine button on the remote control. The engine screen appears in the display.

The operator must start the engine from the remote control. See *Engine Start/Stop/Throttle*, page 3-115.

Once the engine is started, the operator can operate the crane functions from the remote control.

The remote control remains ON until one of the following occurs:

- Operator presses the power button on the remote control.
- Battery power is too low to operate the display.

**NOTE:** If no buttons are pressed on the remote control for 5 minutes while a function screen is active, the remote control will timeout and go back to the main screen.

- d. If you want to keep the engine running:
  - First, set the remote control switch on the carrier control console to OFF.
  - Then, turn off the remote control by pressing the power button on the top of the remote control. If you fail to perform this step the remote control will remain ON (not operable) and its battery will discharge.



FIGURE 3-164



FIGURE 3-165

9. Turn OFF the remote control, as follows:
  - a. If desired, stop the engine with the remote control See *Engine Start/Stop/Throttle*, page 3-115.
  - b. Turn off the remote control by pressing the power button on the top of the remote control.
  - c. Set the remote control switch on the carrier control console to OFF.

### Operating Remote Control

#### Superstructure Horn



Press and hold the horn button on the remote control to sound the superstructure horn. The superstructure horn button can also be used to sound the horn.

#### Emergency Stop

When the E-stop knob (see Figure 3-161) is pushed in:

- The engine stops
- The function being operated stops
- The STOP screen appears.



FIGURE 3-166

To restart the engine, the E-stop knob must be pulled out. For more information on the Engine Start/Stop/Throttle Function Screen, refer to Table 3-5 on page 115 and (Figure 3-167).



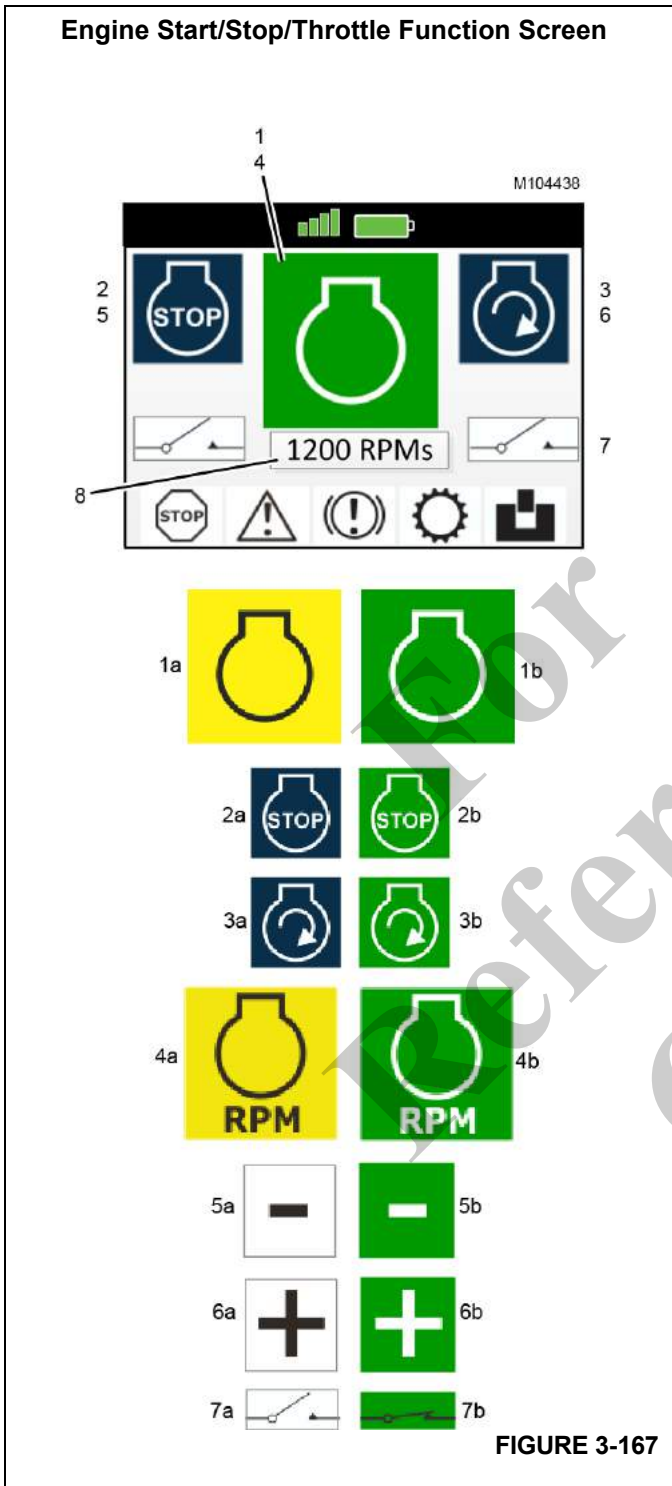





Table 3-5 Engine Start/Stop/Throttle Function Screen

| Item | Indicator Name               | Description                                                                                                                                                  |
|------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Engine (start/stop) Function | 1a - Yellow = engine cannot be started or stopped due to a crane fault<br>1b - Green = engine can be started or stopped                                      |
| 2    | Stop Engine                  | 2a - Blue = engine cannot be stopped until either enable button is held down<br>2b - Green = engine can be stopped with left motion button                   |
| 3    | Start Engine                 | 3a - Blue = engine cannot be started until either enable button is held down<br>3b - Green = engine can be started with right motion button                  |
| 4    | Engine Speed Function        | 4a - Yellow = engine speed cannot be changed due to a crane fault<br>4b - Green = engine speed can be changed                                                |
| 5    | Decrease Speed               | 5a - White = engine speed cannot be decreased until either enable button is held down<br>5b - Green = engine speed can be decreased with left motion button  |
| 6    | Increase Speed               | 6a - White = engine speed cannot be increased until either enable button is held down<br>6b - Green = engine speed can be increased with right motion button |
| 7    | Enable Button Status         | 7a - White = both enable buttons released (operation disabled)<br>7b - Green = either enable button held down (operation enabled)                            |
| 8    | Speed Screen                 | Shows the engine speed                                                                                                                                       |

### Engine Start/Stop/Throttle

See (Figure 3-167).


#### Starting/Stopping Engine

1. Press the engine button  on the remote control ONCE. The engine screen (1) appears.
2. To START the engine, hold down either enable button and the right motion button at the same time. Release both buttons as soon as the engine starts.

If a condition exists that prevents the engine from being started, information will be provided in the display. Common conditions that prevent the engine from being started are: the carrier transmission is in gear or the carrier park brake is released.

3. To STOP the engine, hold down either enable button and the left motion button at the same time. Release both buttons once the engine stops.

#### Changing Engine Speed

1. Press the engine button  on the remote control ONCE if already at the engine screen, or TWICE if at the main screen. The throttle screen (4) appears.
2. To INCREASE engine speed, hold down either enable button and the right motion button at the same time.
3. To DECREASE engine speed, hold down either enable button and the left motion button at the same time.

The engine's speed is shown in the RPM screen (8).

When the remote control is on, engine speed cannot be controlled from the crane.

#### Exiting Start/Stop/Throttle Screen

To exit this screen, press the ESC button  on the remote control. The main screen appears.

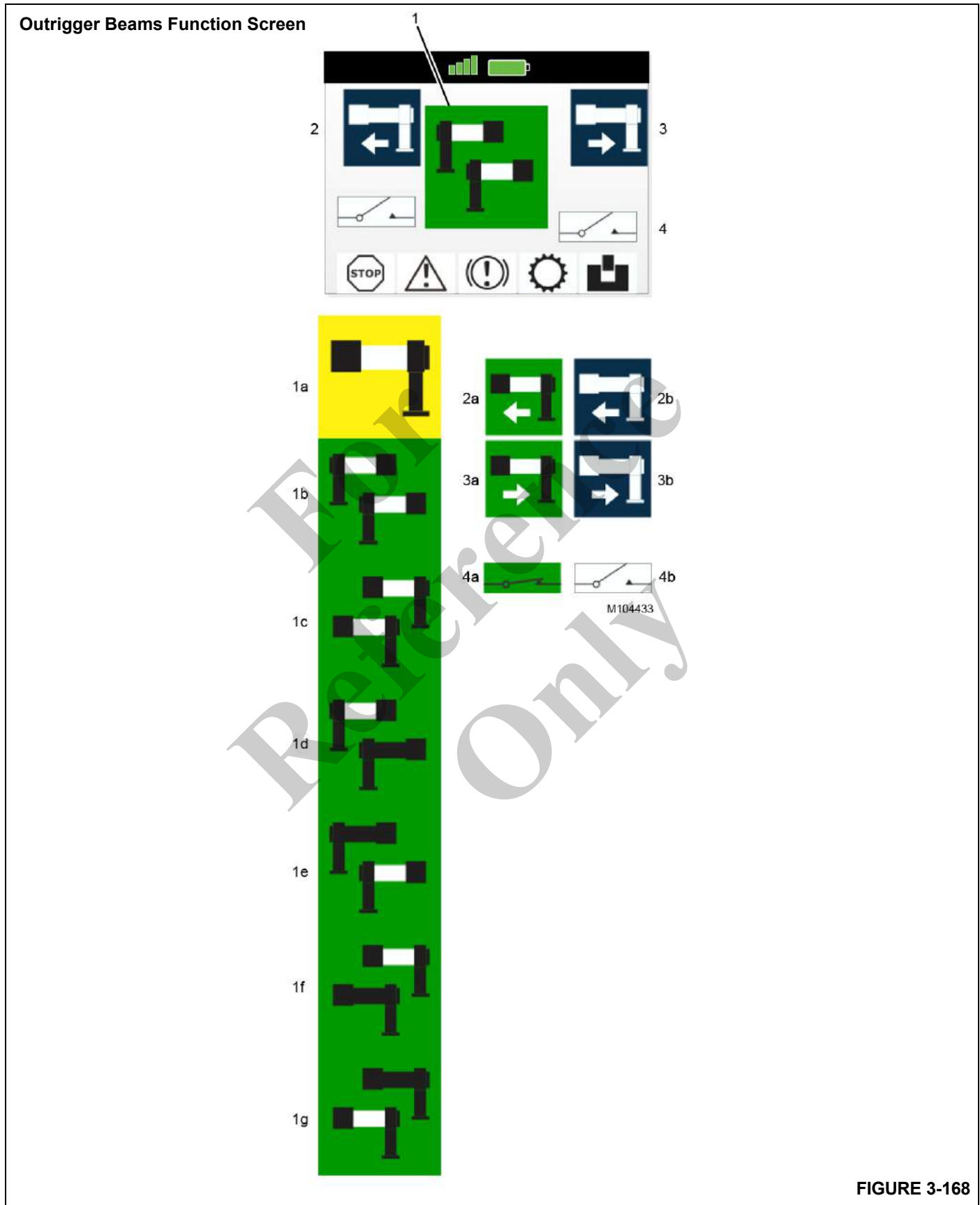


FIGURE 3-168

Table 3-6 Outrigger Beams Function Screen



| Item | Indicator Name           | Description                                                                                                                                                                                                                                                                                                                  |
|------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Outrigger Beams Function | 1a - Yellow = beams cannot be operated due to a crane fault<br>1b - Both left side beams will be operated<br>1c - Both right side beams will be operated<br>1d - Left front beam will be operated<br>1e - Left rear beam will be operated<br>1f - Right front beam will be operated<br>1g - Right rear beam will be operated |
| 2    | Retract Beams            | 2a - Green = beams can be retracted with left motion button<br>2b - Blue = beams cannot be retracted until either enable button is held down                                                                                                                                                                                 |
| 3    | Extend Beams             | 3a - Green = beams can be extended with right motion button<br>3b - Blue = beams cannot be extended until either enable button is held down                                                                                                                                                                                  |
| 4    | Enable Button Status     | 4a - Green = either enable button held down (operation enabled)<br>4b - White = both enable buttons released (operation disabled)                                                                                                                                                                                            |

**NOTE:** The top of the remote control corresponds to the front of the crane (carrier cab is at front). The terms left and right correspond to the operator's left and right sides when looking forward from the front of the crane.

**Outrigger Beams**

**NOTE:** Outrigger controls are only active when the engine is running and the park brake is set.

See (Figure 3-168).

1. Press the outrigger beams button  on the remote control as many times as needed until the desired beam screen (1) appears.
2. To RETRACT the selected beams, hold down either enable button and the left motion button at the same time. Release both buttons to stop the beams at the desired position.
3. To EXTEND the selected beams, hold down either enable button and the right motion button at the same time. Release both buttons to stop the beams at the desired position.
4. To exit this screen, press the ESC button  on the remote control. The main screen appears.

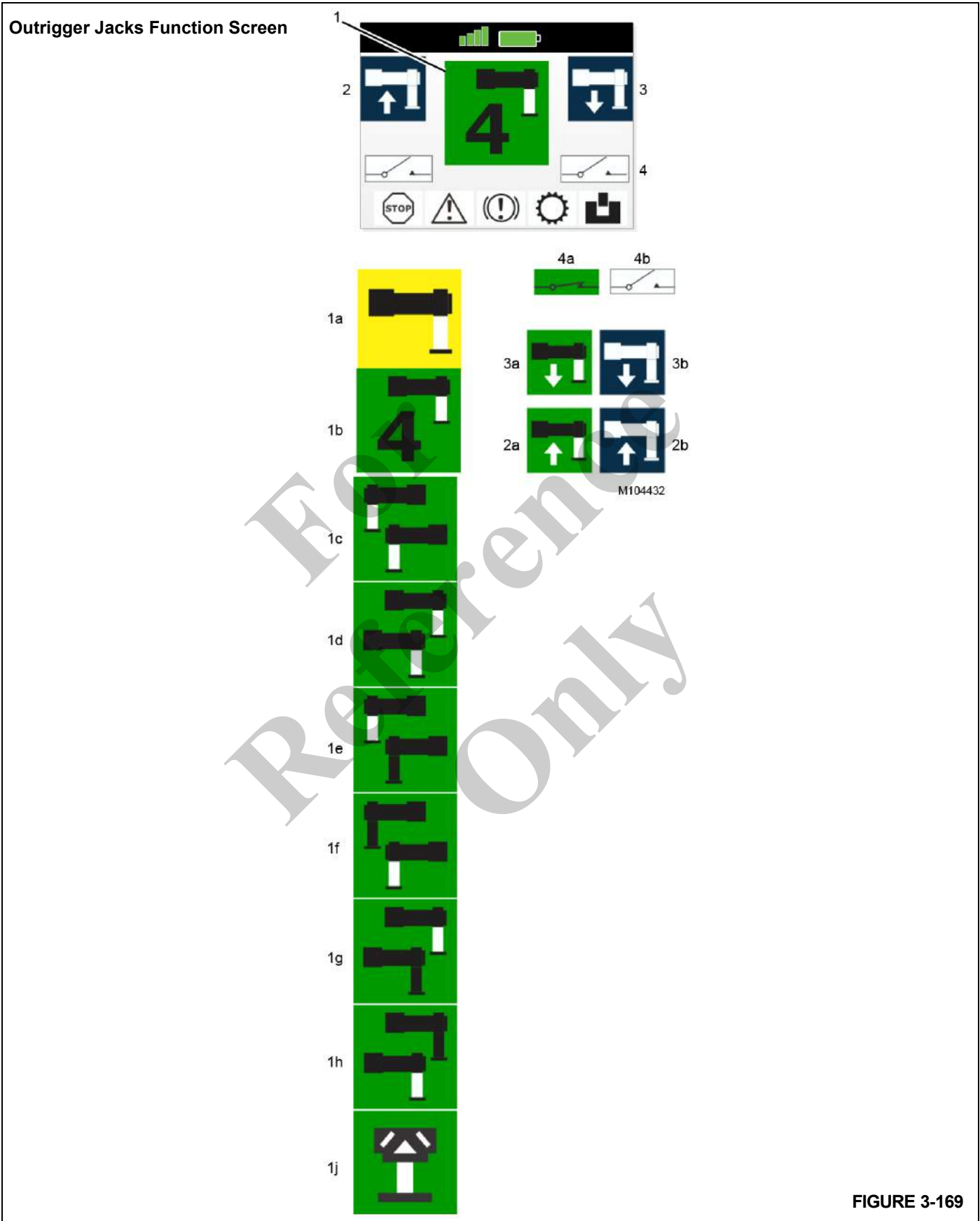


FIGURE 3-169

Table 3-7 Outrigger Jacks Function Screen


| Item | Indicator Name           | Description                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Outrigger Jacks Function | 1a - Yellow = jacks cannot be operated due to a crane fault<br>1b - All four jacks will be operated at same time<br>1c - Both left side jacks will be operated<br>1d - Both right side jacks will be operated<br>1e - Left front jack will be operated<br>1f - Left rear jack will be operated<br>1g - Right front jack will be operated<br>1h - Right rear jack will be operated<br>1j - Front (stabilizer) jack will be operated |
| 2    | Retract Jack             | 2a - Green = jacks can be retracted with left motion button<br>2b - Blue = jacks cannot be retracted until either enable button is held down                                                                                                                                                                                                                                                                                       |
| 3    | Extend Jack              | 3a - Green = jacks can be extended with right motion button<br>3b - Blue = jacks cannot be extended until either enable button is held down                                                                                                                                                                                                                                                                                        |
| 4    | Enable Button Status     | 4a - Green = either enable button held down (operation enabled)<br>4b - White = both enable buttons released (operation disabled)                                                                                                                                                                                                                                                                                                  |

**NOTE:** The top of the remote control corresponds to the front of the crane (carrier cab is at front). The terms left and right correspond to the operator’s left and right sides when looking forward from the front of the crane.

**NOTE:** The Cribbing Mode is only available from the cab; **NOT** through the remote control.

**Outrigger Jacks**


See (Figure 3-169).

1. Press the outrigger jacks button  on the remote control as many times as needed until the desired jack screen (1) appears.
2. To RETRACT the selected jacks, hold down either enable button and the left motion button at the same

time. Release both buttons to stop the jacks at the desired position.

**NOTE:** The front outrigger jack will retract any time a main outrigger jack is retracted.

3. To EXTEND the selected jacks, hold down either enable button and the right motion button at the same time. Release both buttons to stop the jacks at the desired position.

4. To exit this screen, press the ESC button  on the remote control. The main screen appears.

Hoist Control (Main and Aux) Function Screen

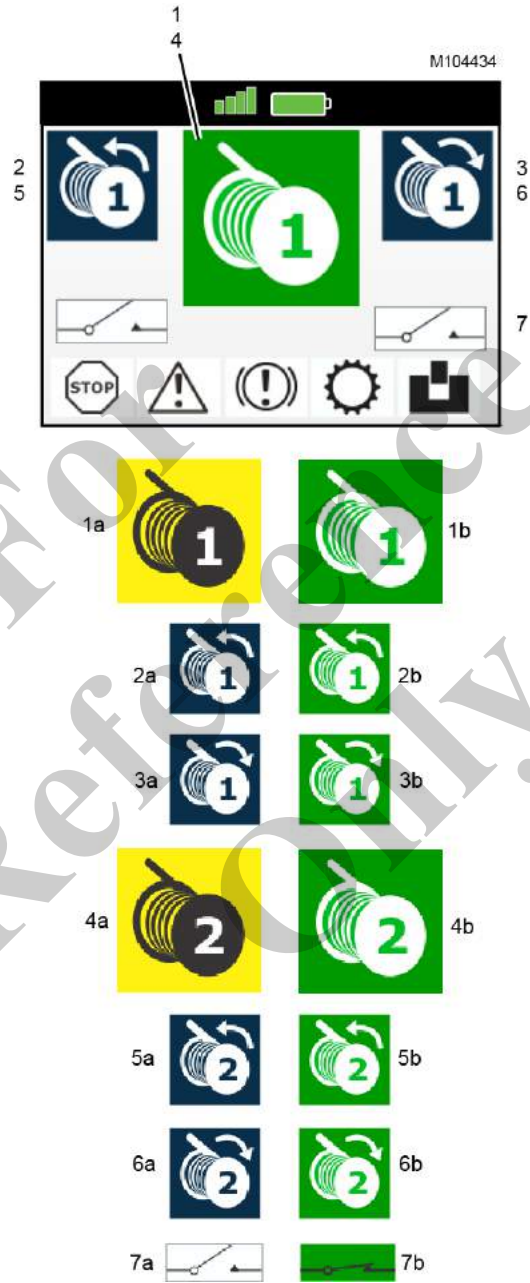



FIGURE 3-170

Table 3-8 Main/Aux Hoist Function Screen


| Item | Indicator Name       | Description                                                                                                                                                          |
|------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Main Hoist Function  | 1a - Yellow = main hoist cannot be operated due to a crane fault<br>1b - Green = main hoist can be operated                                                          |
| 2    | Pay Out (lower)      | 2a - Blue = main hoist cannot be operated until either enable button is held down<br>2b - Green = wire rope can be payed out from main hoist with left motion button |
| 3    | Haul In (hoist)      | 3a - Blue = main hoist cannot be operated until either enable button is held down<br>3b - Green = wire rope can be hauled in on main hoist with right motion button  |
| 4    | Aux Hoist Function   | 4a - Yellow = aux hoist cannot be operated due to a crane fault<br>4b - Green = aux hoist can be operated                                                            |
| 5    | Pay Out (lower)      | 5a - Blue = aux hoist cannot be operated until either enable button is held down<br>5b - Green = wire rope can be payed out from aux hoist with right motion button  |
| 6    | Haul In (hoist)      | 6a - Blue = aux hoist cannot be operated until either enable button is held down<br>6b - Green = wire rope can be hauled in on aux hoist with right motion button    |
| 7    | Enable Button Status | 7b - White = both enable buttons released (operation disabled)<br>7a - Green = either enable button held down (operation enabled)                                    |

**Hoist Control (Main and Aux)**

See (Figure 3-170).

1. Press the hoist button  on the remote control ONCE. The main hoist screen appears.
2. Press the hoist button on the remote control TWICE. The aux hoist screen appears.

**NOTE:** The main hoist screen is the default.  
Speed in either direction is proportional to how far the motion button is depressed.

3. To PAY OUT wire rope from the selected hoist, hold down either enable button and the left motion button at the same time. Release both buttons to stop the hoist.
4. To HAUL IN wire rope on the selected hoist, hold down either enable button and the right motion button at the same time. Release both buttons to stop the hoist.
5. To exit this screen, press the ESC button  on the remote control. The main screen appears.



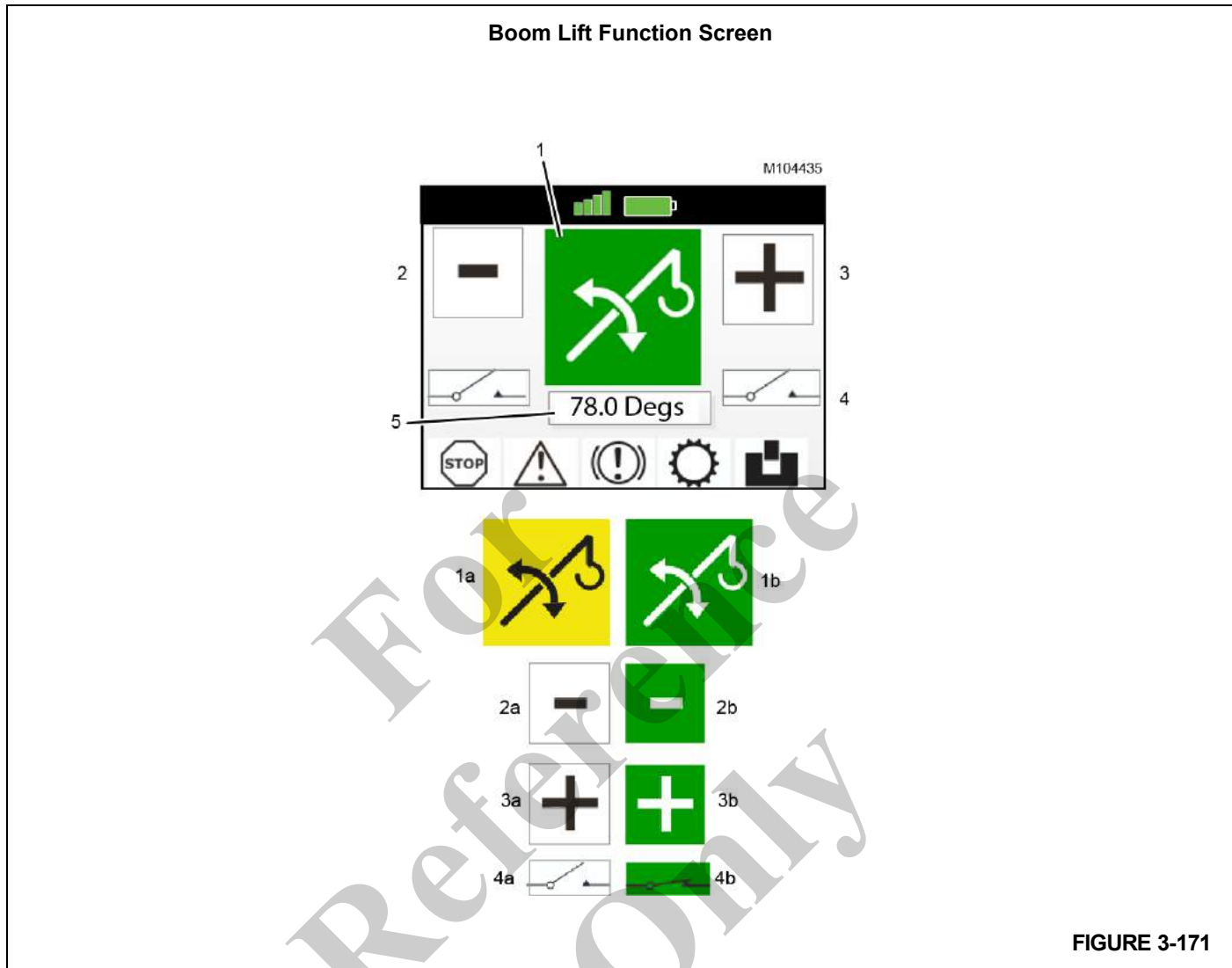


FIGURE 3-171


Table 3-9 Boom Lift Function Screen

| Item | Indicator Name       | Description                                                                                                                              |
|------|----------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Boom Lift Function   | 1a - Yellow = boom cannot be operated due to a crane fault<br>1b - Green = boom can be operated                                          |
| 2    | Boom Down            | 2a - White = boom cannot be operated until either enable button is held down<br>2b - Green = boom can be lowered with left motion button |
| 3    | Boom Up              | 3a - White = boom cannot be operated until either enable button is held down<br>3b - Green = boom can be raised with right motion button |
| 4    | Enable Button Status | 7a - White = both enable buttons released (operation disabled)<br>7b - Green = either enable button held down (operation enabled)        |
| 5    | DEG Screen           | Shows the boom angle in degrees                                                                                                          |




**Boom Lift**

See (Figure 3-171).

1. Press the boom lift button  on the remote control. The boom lift screen (1) appears.

**NOTE:** Speed in either direction is proportional to how far the motion button is depressed.

2. To LOWER the boom, hold down either enable button and the left motion button at the same time. Release both buttons to stop the boom.
3. To RAISE the boom, hold down either enable button and the right motion button at the same time. Release both buttons to stop the boom.
4. The boom's angle is shown in the DEG screen (5).
5. To exit this screen, press the ESC button  on the remote control. The main screen appears.

For  
Reference  
Only

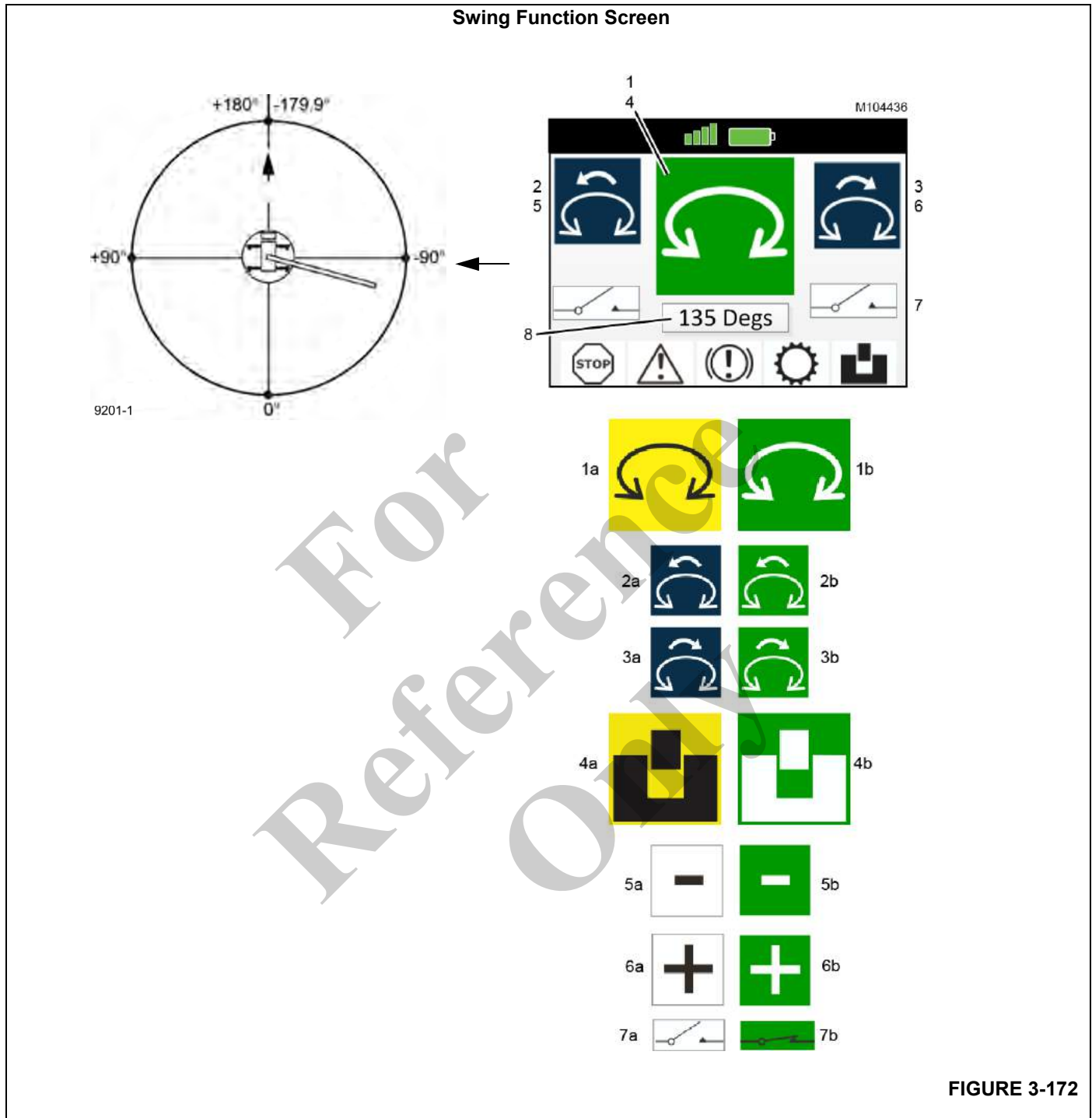


FIGURE 3-172

Table 3-10 Swing Function Screen

| Item | Indicator Name           | Description                                                                                                                                        |
|------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Swing Function           | 1a - Yellow = swing cannot be operated due to a crane fault<br>1b - Green = swing can be operated                                                  |
| 2    | Swing Left               | 2a - Blue = cannot swing left until either enable button is held down<br>2b - Green = can swing left with left motion button                       |
| 3    | Swing Right              | 3a - Blue = cannot swing right until either enable button is held down<br>3b - Green = can swing right with right motion button                    |
| 4    | 360° Swing Lock Function | 4a - Yellow = swing lock cannot be operated due to a crane fault<br>4b - Green = swing lock can be operated                                        |
| 5    | Lock                     | 5a - White = cannot engage swing lock until either enable button is held down<br>5b - Green = can engage swing lock with left motion button        |
| 6    | Unlock                   | 6a - White = cannot disengage swing lock until either enable button is held down<br>6b - Green = can disengage swing lock with right motion button |
| 7    | Enable Button Status     | 7a - White = both enable buttons released (operation disabled)<br>7b - Green = either enable button held down (operation enabled)                  |
| 8    | DEG Screen               | Shows the swing angle in degrees                                                                                                                   |

**NOTE:** The top of the remote control corresponds to the front of the crane (carrier cab is at front). The terms left and right correspond to the operator's left and right sides when looking forward from the front of the crane.

**Swing and 360° Swing Lock**

See (Figure 3-172).

**Swinging**


1. Press the swing button  on the remote control ONCE. The swing screen (1) appears.

**NOTE:** Speed in either direction is proportional to how far the motion button is depressed.


2. To swing LEFT, hold down either enable button and the left motion button at the same time.
3. To swing RIGHT, hold down either enable button and the right motion button at the same time.

4. The swing angle is shown in the DEG screen (8).

**Operating 360° Swing Lock**

1. Press the swing button  on the remote control ONCE if already at the swing screen or TWICE if at the main screen. The 360° swing lock screen (4) appears.
2. To LOCK the 360° swing lock, hold down either enable button and the left motion button at the same time.
3. To UNLOCK the 360° swing lock, hold down either enable button and the right motion button at the same time.

**Exiting Swing/360° Swing Lock Screen**

To exit this screen, press the ESC button  on the remote control. The main screen appears.

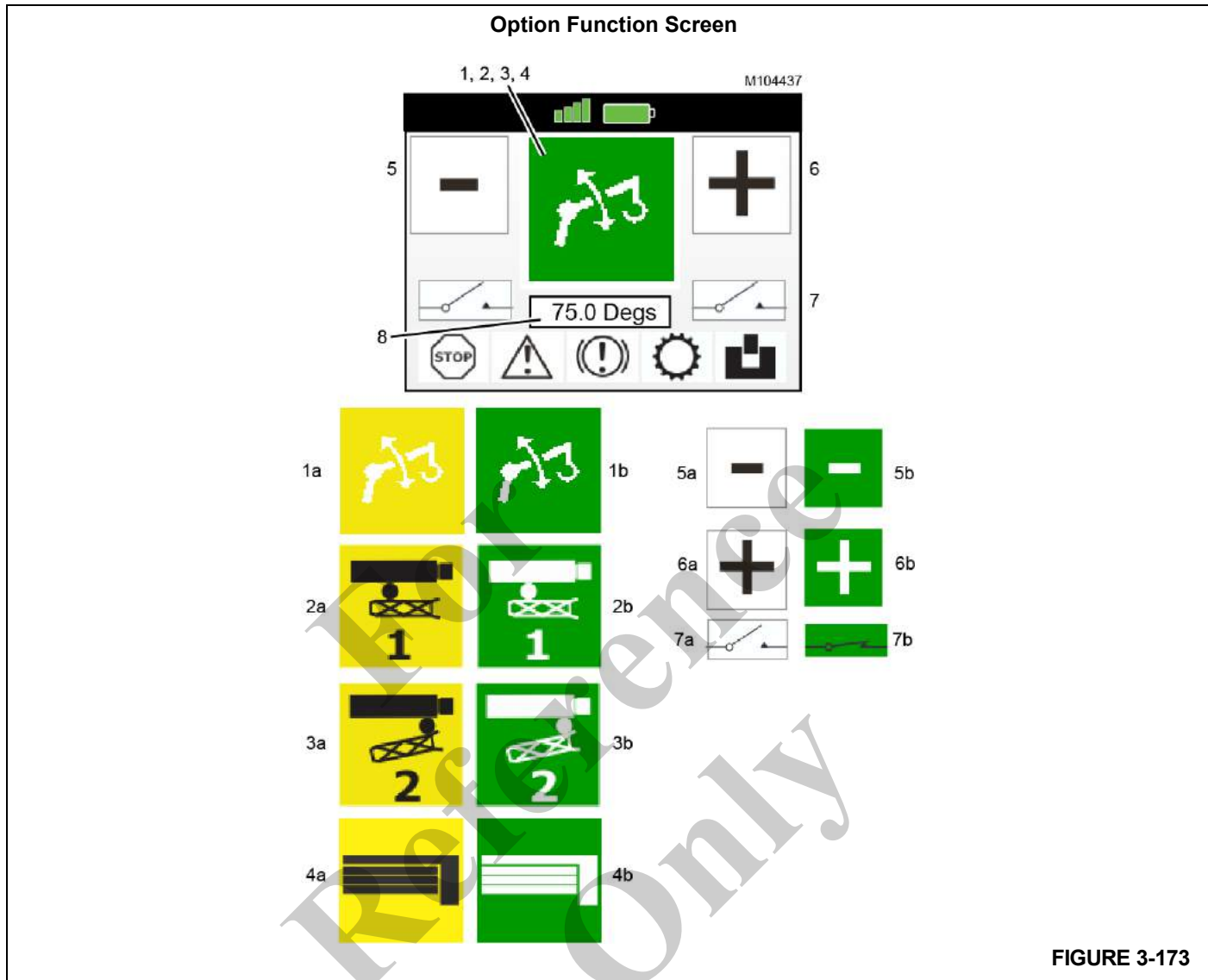


FIGURE 3-173

Table 3-11 Option Function Screen

| Item | Indicator Name                                            | Description                                                                                                                                           |
|------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Luffing Boom Extension Function                           | a - Yellow = function cannot be operated due to a crane fault<br>b - Green = function can be operated                                                 |
| 2    | Rear Boom Extension Stowage Actuator Function             |                                                                                                                                                       |
| 3    | Front Boom Extension Stowage Actuator Function            |                                                                                                                                                       |
| 4    | Counterweight (Cwt) Function                              |                                                                                                                                                       |
| 5    | Retract Actuator Lower Cwt Cylinders Lower Boom Extension | 5a - White = operation cannot be performed until either enable button is held down<br>5b - Green = operation can be performed with left motion button |

|   |                                                                |                                                                                                                                                        |
|---|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6 | Extend Actuator<br>Raise Cwt Cylinders<br>Raise Boom Extension | 6a - White = operation cannot be performed until either enable button is held down<br>6b - Green = operation can be performed with right motion button |
| 7 | Enable Button Status                                           | 7a - White = both enable buttons released (operation disabled)<br>7b - Green = either enable button held down (operation enabled)                      |
| 8 | DEG Screen                                                     | Shows the boom extension angle in degrees                                                                                                              |

**OPT (Options)**


See (Figure 3-173).

The options function screen controls the following optional crane functions:

- Luffing boom extension
- Boom Extension assist
- Counterweight

**Luffing Boom Extension**

Refer to *Mechanical Luffing Boom Extension (Adjustable Boom Extension)*, page 6-64 for more information.

1. Press the option button  on the remote control as many times as needed to access the luffing boom extension screen (1).
2. To LOWER the luffing boom extension, hold down either enable button and the left motion button at the same time.
3. To RAISE the luffing boom extension, hold down either enable button and the right motion button at the same time.


**NOTE:** Speed in either direction is proportional to how far the motion button is depressed.

4. The boom extension angle is shown in the DEG screen (8).

**Boom Extension Assist**

Refer to Step 8, page 6-47 and/or Step 14, page 6-48.

The boom extension stowage feature has two actuators to assist the operator in deploying and stowing the boom extension option.

1. Press the option button  on the remote control (Reference Figure 3-174), as many times as needed to

access the rear boom extension stowage actuator screen (2). See (Figure 3-175).



FIGURE 3-174


2. To RETRACT the rear actuator, hold down either enable button and the left motion button at the same time.
3. To EXTEND the rear actuator, hold down either enable button and the right motion button at the same time.

**NOTE:** Speed in either direction is proportional to how far the motion button is depressed.

4. Repeat the above steps for the front boom extension stowage actuator screen (3).


**Counterweight**

Refer to *Removable Counterweight*, page 6-14.

1. Press the option button  on the remote control as many times as needed to access the counterweight screen (4).
2. To LOWER the counterweight cylinders, hold down either enable button and the left motion button at the same time.
3. To RAISE the counterweight cylinders, hold down either enable button and the right motion button at the same time.

**NOTE:** The counterweight cylinders can be raised at any swing position outside of -3.9 to +3.9 degrees, or at 0.0 degrees. They can only be lowered at -4.0 degrees and +4.0 degrees if no counterweight is mounted, or at 0 degrees if a counterweight is mounted.

**Exiting OPT Screen**

To exit this screen, press the ESC button  on the remote control. The main screen appears.

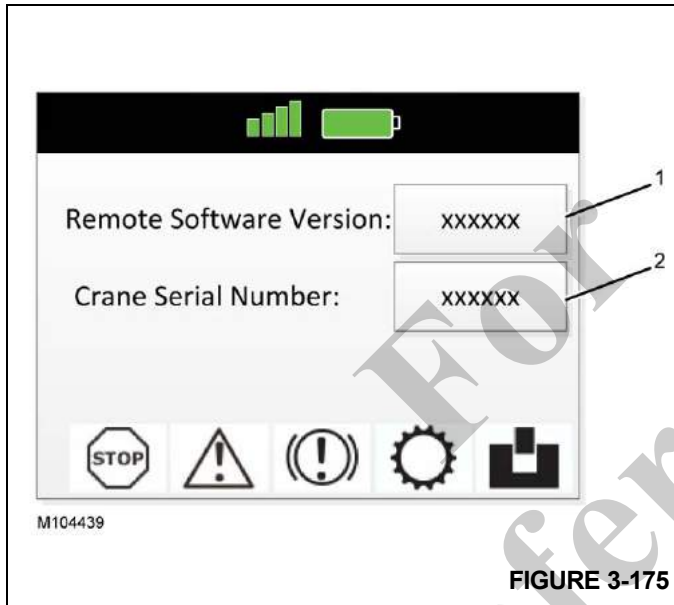



FIGURE 3-175

**Information**

To access the information screen, press the info button  on the remote control

See (Figure 3-175).

The information screen shows the following:

- Remote control's software version (1)  
You will need to know the software version when communicating with your Grove dealer or Manitowoc Crane Care.
- Crane Serial Number (2)  
The remote control must remain with the crane it was supplied with. The serial number in the information screen must match the serial number on the crane.

**Control Unit Control Console**

**Exiting the Menu/Input Mode**

|                   |                                                                                                     |
|-------------------|-----------------------------------------------------------------------------------------------------|
| Press button (1): | The opened menu is closed – the main menu is opened (Figure 3-176)<br>Input mode is deactivated     |
| Press button (2): | The opened menu closes – the menu from the next higher level is opened<br>Input mode is deactivated |

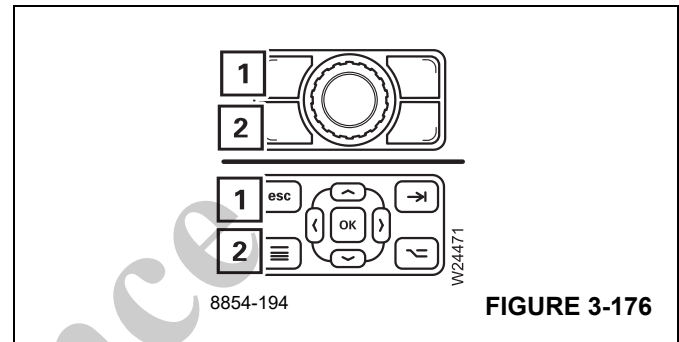


FIGURE 3-176

**Entering Values**

The input mode for the RCL code is switched on.

|           |                                                |                    |
|-----------|------------------------------------------------|--------------------|
| 1         | Clockwise (Figure 3-177):                      | Next greater value |
|           | Counterclockwise:                              | Next smaller value |
|           | Slowly turning – changes the value gradually   |                    |
|           | Hold down and turn - changes the value quickly |                    |
| <b>OR</b> |                                                |                    |
| 2         | Next greater value                             |                    |
| 3         | Next smaller value                             |                    |

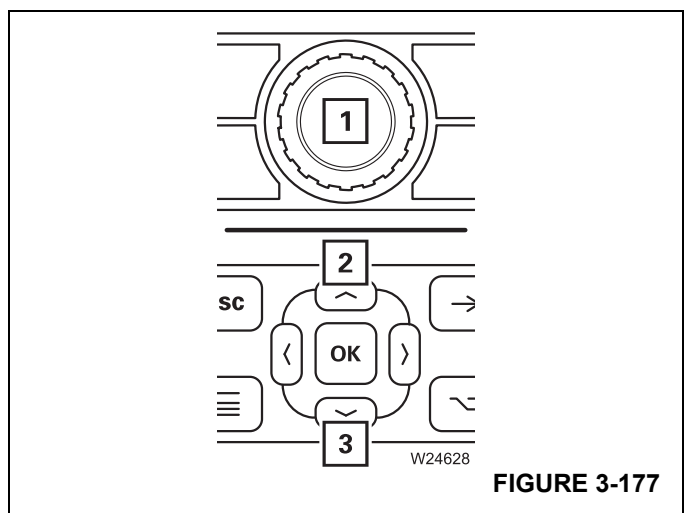


FIGURE 3-177

RCL and ODM Features

|                                              |                                                                    |
|----------------------------------------------|--------------------------------------------------------------------|
| Red Indicator (1) on solid                   | Degree of utilization approx. 100% – buzzer tone on solid– lockout |
| Amber Indicator on solid (2), (Figure 3-178) | Degree of utilization 90 – 100% – buzzer tone pulsates             |
| Both indicators off                          | Degree of utilization 0 – 89.9%                                    |

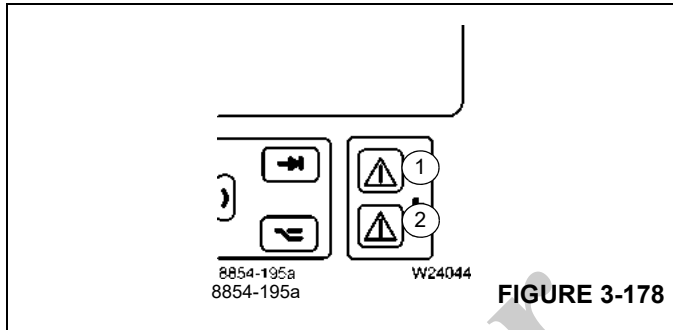


FIGURE 3-178

Sensor for Brightness

The brightness of the displays is regulated automatically by the display, depending on the ambient brightness. You can set a minimum degree of brightness manually, which is always observed when the brightness is regulated.

- Display Settings (1), (Figure 3-179) menu.



FIGURE 3-179

- Select the symbol (1), (Figure 3-180).
- Confirm the selection.

An arrow appears on the left and right of the percentage (2), (Figure 3-180).

- Set the desired minimum brightness.
- Confirm the selection.

The brightness of the display changes while setting and you can view the set value (0 to 100%) on the display (2).

The brightness set here is the minimum value for automatic regulation.

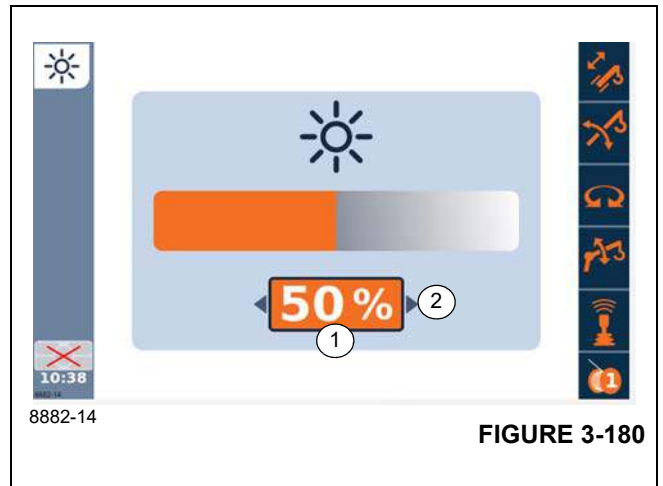


FIGURE 3-180

**NOTE:** There is no automatic regulation if you set the brightness to 100%.

The displays then always show maximum brightness.

You can cancel the entry at any time using the (1), (Figure 3-181) or (2) buttons. The settings are then reset.

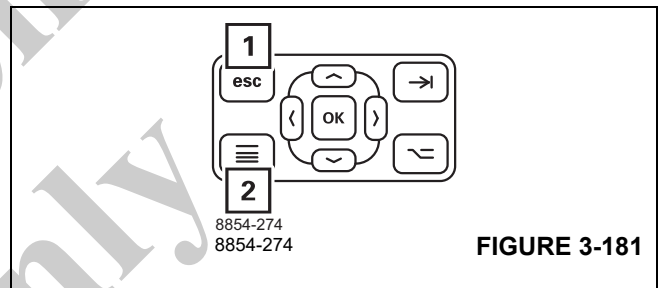


FIGURE 3-181

If the temperature on the display is too high, the brightness is reduced automatically – lamp (1), (Figure 3-182) lights up.

When the temperature falls, the specified brightness is restored – lamp (1) goes out.

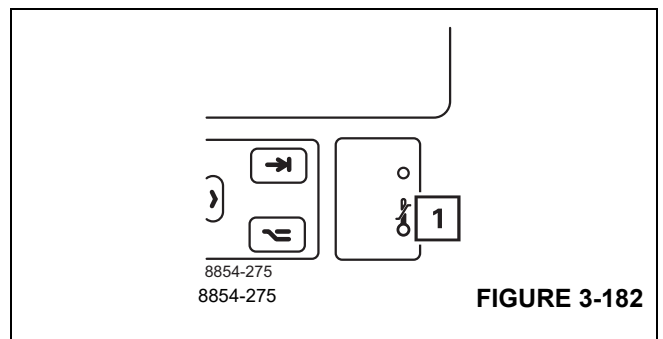
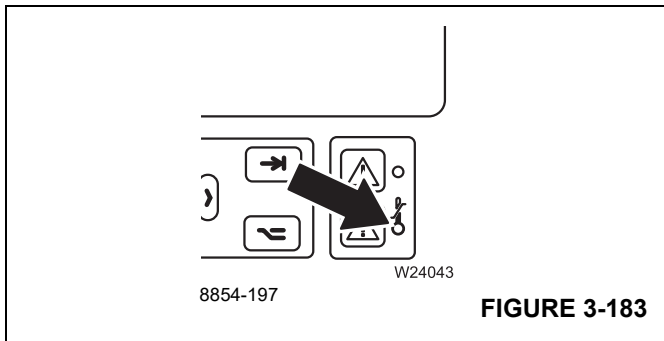


FIGURE 3-182



**Sensor for Temperature**

Records the display temperature (Figure 3-183). If the temperature is too high, the brightness of the display is reduced, refer to *Display Temperature Sensor*, page 3-37.



**FIGURE 3-183**

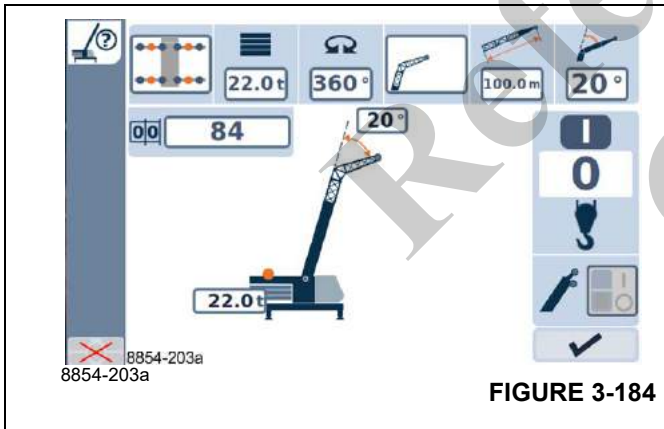
**Display RCL**

**After a Standstill of Up to 2 Hours**

- Ignition on – Enter rigging mode menu opens (Figure 3-184).
- The last saved rigging mode is shown.

**After a Standstill of More than 2 Hours**

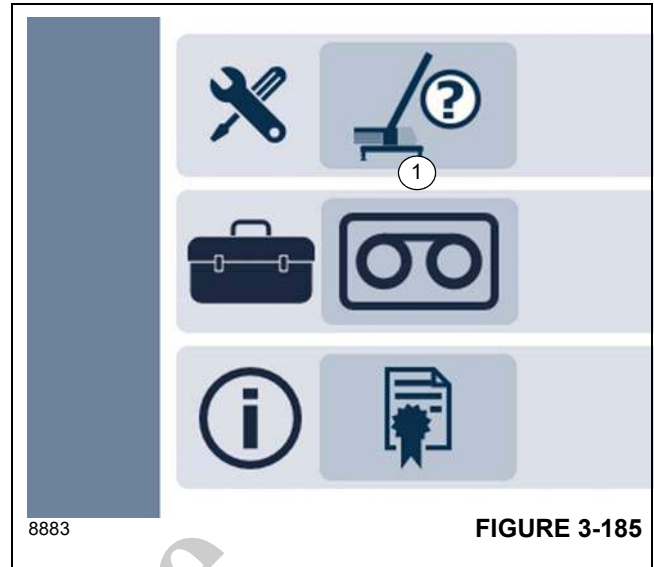
- Ignition on – Enter rigging mode menu opens.
- A rigging mode with the lowest lifting capacities is shown.



**FIGURE 3-184**

**Enter Rigging Mode Menu**

Select symbol (1), (Figure 3-185) and confirm – menu is opened.

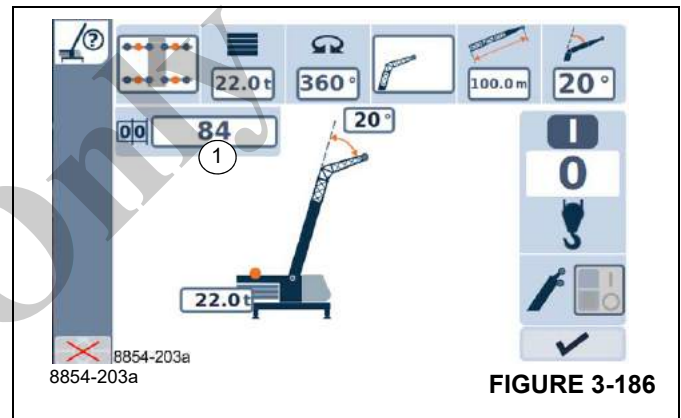


**FIGURE 3-185**

**Enter RCL Code**

When the RCL code is known, enter it in the following manner:

Select number (1), (Figure 3-186) and using the arrow buttons on the control panel or the jog dial enter the RCL code and confirm.



**FIGURE 3-186**

**Enter Reeving**

In input mode (Figure 3-187)

|   |                                                               |
|---|---------------------------------------------------------------|
| 1 | For main hoist:<br>Select reeving symbol (3) and confirm      |
| 2 | For auxiliary hoist:<br>Select reeving symbol (4) and confirm |



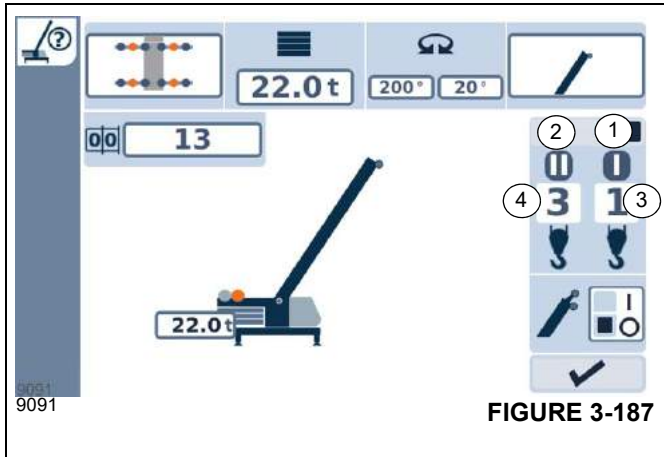


FIGURE 3-187

**Enter Outrigger Span**

In the input mode (display according to the equipment).  
 Select outrigger span symbol (Figure 3-188) and confirm

| Description | Outrigger Span   | Percent Extended |
|-------------|------------------|------------------|
| Full        | 7.00 m (23.0 ft) | 100%             |
| Mid 2       | 6.00 m (19.7 ft) | 79%              |
| Mid 1       | 5.00 m (16.5 ft) | 57%              |
| Retracted   | 2.32 m (7.6 ft)  | 0%               |

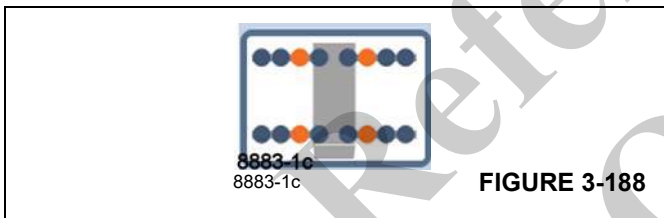


FIGURE 3-188

To change between selections, press ENTER to choose the outrigger selections and rotate the jog dial, or use the arrow buttons on the control panel, until the desired outrigger position is highlighted, then press ENTER again.

If the OMS does not match the selected positions an additional screen opens after selecting the check mark at the bottom right corner of this screen. There, the detected positions and selected positions are shown side by side (Figure 3-189). The operator has the choice of 1) Returning to this setup screen to change the selection --OR-2) Verifying that the chosen outrigger position is the one to use even though it doesn't match the OMS, in which case the screen transitions to the main viewing screen.

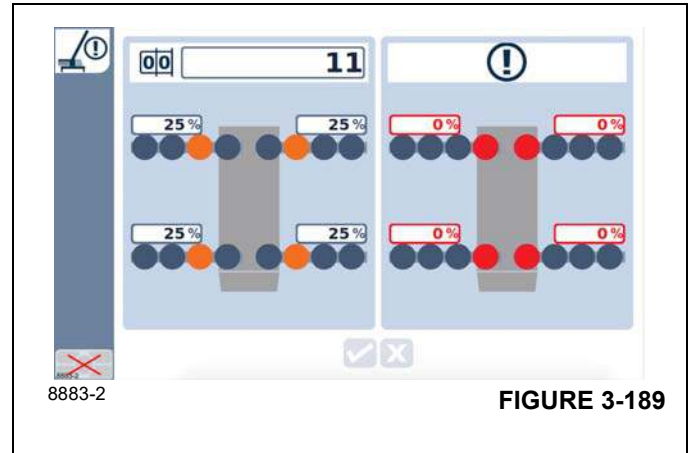
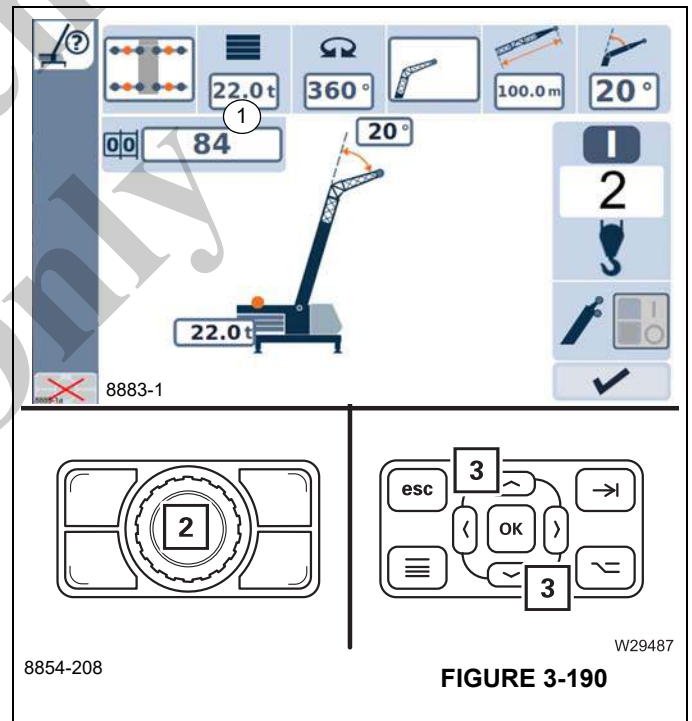


FIGURE 3-189

**Enter Counterweight**

- Select symbol (1), (Figure 3-190) and confirm – Input mode on
- Select combination with (2) or (3), refer to *Counterweight Versions/Combinations*, page 6-16. Confirm selection.



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FIGURE 3-190

**Confirming the Rigging Mode**

Select symbol (1), (Figure 3-191) and after configuring all the necessary information on the rigging mode screen select the confirm input button.

3

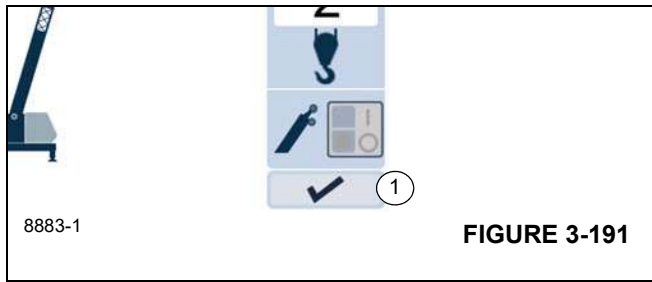


FIGURE 3-191

When the check mark is selected on the setup screen, the RDM automatically goes back to the monitoring menu or outrigger verification menu.

**Boom System Entry**

There are 5 choices: main boom, fixed boom extension, luffing boom extension (1), (Figure 3-192), heavy duty extension and auxiliary nose. Then, if a boom extension is selected, the operator chooses the boom extension length (2) which includes inserts and stinger.

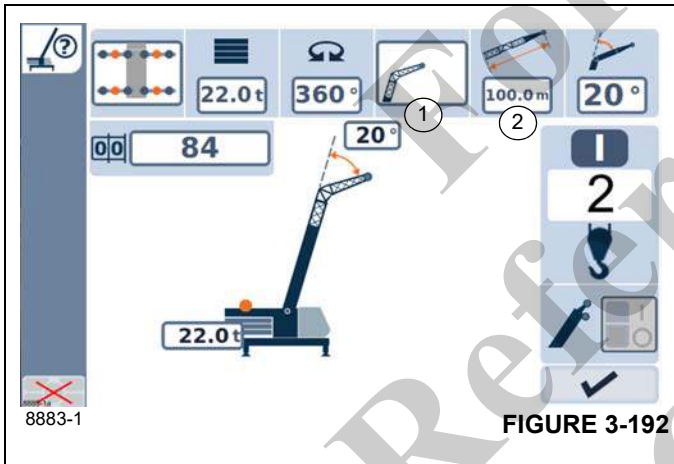


FIGURE 3-192

**Boom System Setup Display**

|   |                                                                                                                    |
|---|--------------------------------------------------------------------------------------------------------------------|
| 1 | Main boom/auxiliary single-sheave boom top (Figure 3-193)                                                          |
| 2 | Main boom with lattice extension, standard lattice extension or heavy load lattice extension, which can be angled. |

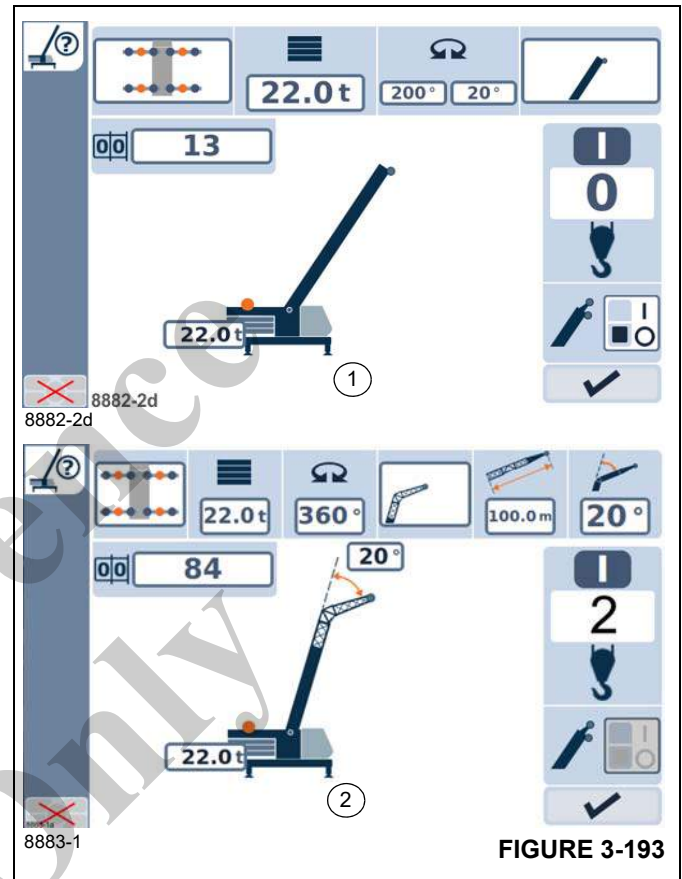


FIGURE 3-193

**Telescoping Mode Number Entry**

The telescoping status or pinned boom configuration can be selected from the RDM (RCL display). This is done by selecting a Telescoping Mode Number. Refer to (1), (Figure 3-194). There are 6 available pre-selected Mode Numbers. Referring to (Figure 3-194), the Telescoping Mode Number is available to be selected since this option on the display is selectable. However, this is only selectable after the RCL has been initialized once (having previously used the check-mark on this screen), the telescoping function has been enabled, and the boom is fully retracted and locked.

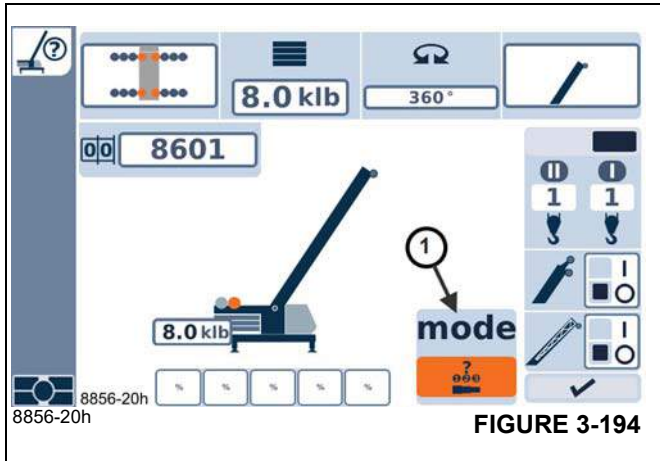


FIGURE 3-194

With the Telescoping Mode Number option available, and using Enter on this item on the screen, the up/down arrows or jog dial can be used to select from 1 to 6. (Figure 3-194) shows the appearance for Mode 1. It is seen that Mode 1 has the requested pinned boom configuration of 100-100-100-100-100. If this is the desired configuration, then Enter can be used to select it. Then, when the check-mark is used on this screen, the new requested telescoping status will be used and the semi-automatic telescoping function commences. The ODM (operating display) can then be used to select a telescoping screen and the requested telescoping status should be shown on the ODM, as well.

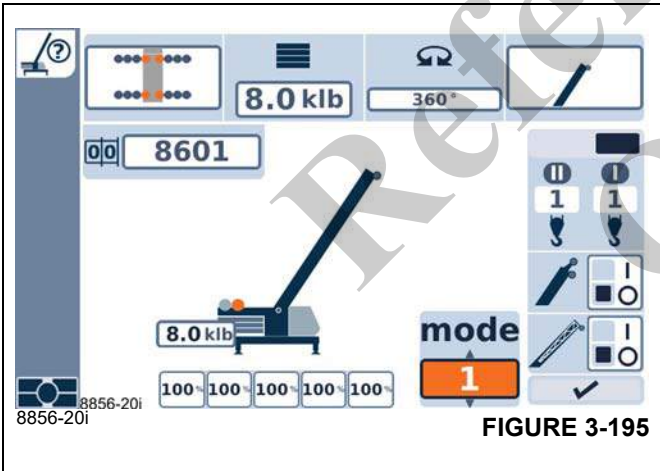


FIGURE 3-195

Note that when the RCL configuration screen is used (such as shown in Figures 3-194 and 3-195), the telescoping function is paused (unable to extend, retract, lock or unlock the boom). Once the check-mark is used, the telescoping function resumes.

**Monitoring Menu**

Displays – depend on rigging mode.

This menu opens when the Rigging information is entered and confirmed. To open: Select symbol (1), (Figure 3-196) and confirm

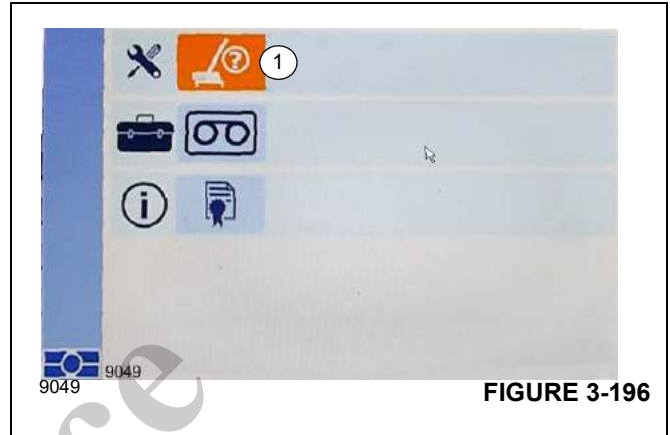


FIGURE 3-196

**Counterweight Display**

Required counterweight combination in tons (t) – for displayed RCL code (Figure 3-197). **NOTE:** Units will be metric tons or kilo-pounds. (Kilo-pounds is shown on the figure.)

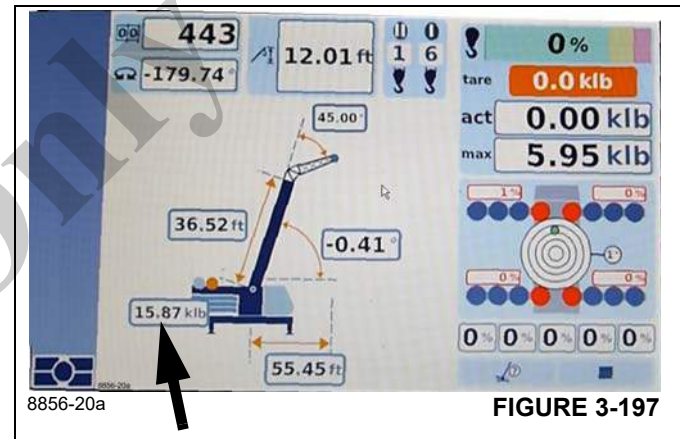


FIGURE 3-197

**Display of the Lattice Extension Offset Angle**

When the RCL is programmed for a lattice extension, the lattice extension offset angle (current angle between the lattice extension and main boom in degrees) will be displayed.

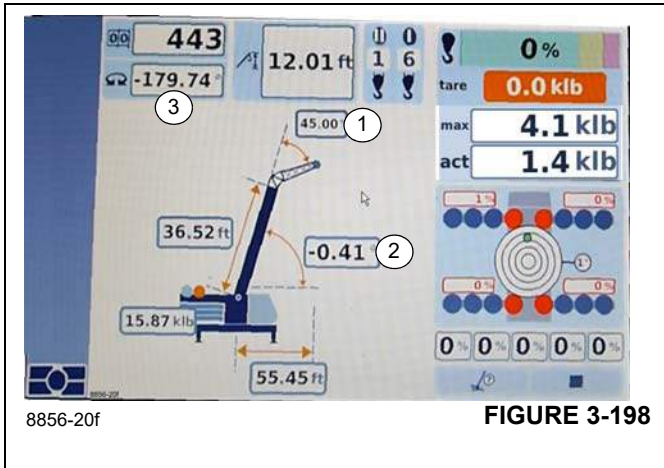


FIGURE 3-198

**Current Main Boom Angle Display**

|          |                                                                                            |
|----------|--------------------------------------------------------------------------------------------|
| Display: | Current angle between main boom and horizontal position in degrees (°) (2), (Figure 3-198) |
|----------|--------------------------------------------------------------------------------------------|

**Current Swing Angle Display**

|                  |                                             |
|------------------|---------------------------------------------|
| 0°:              | Position 0° to the rear (3), (Figure 3-198) |
| 180°:            | Position 180° to the front                  |
| +0.1 to +180.0°: | Turned to the right from 0°                 |
| -0.1 to -179.9°: | Turned to the left from 0°                  |

**Current Load Display**

|          |                                                                                                                 |
|----------|-----------------------------------------------------------------------------------------------------------------|
| Display: | Lifted load (1), (Figure 3-199) in metric tons (t) or kilo-pounds (klbs)<br>Example: 5.95 klb equals 5,950 lbs. |
|----------|-----------------------------------------------------------------------------------------------------------------|

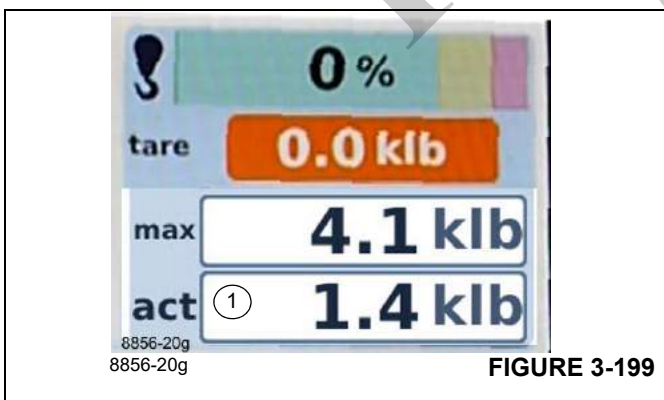


FIGURE 3-199

**Tare Functionality/Instructions**

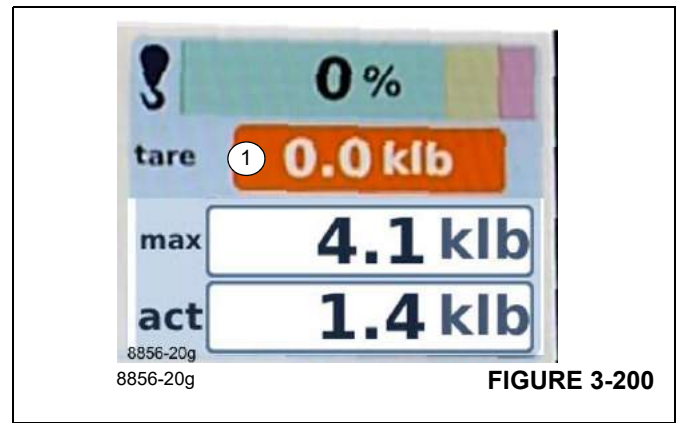


FIGURE 3-200

Display: The Actual Load is 1.4klb, if you set the Tare Value to 1.2klb, the Actual Load would then be displayed as 0.2klb.

**RCL Display Operating Screen: Tare Function**

- By default, the Tare function is displayed on the RCL.
- To enable the Tare function the operator has two ways of doing this.
  - Using the RDM Key pad or the Jog dial,
    - press the Tab button.
  - Using the Jog Dial,
    - adjust the Tare Value. When adjusting the Tare value, the Actual Weight will decrease proportionately with the increased Tare value.
- After setting the Tare Function, if the Operator changes the rigging code, the Tare weight will not be reset, and the Tare value will still be deducting the Actual Weight.
- To disable the Tare function, set the tare value to "0.0".

Note: The Tare Function is used only as an Operator aid and does not change or override the RCL and Load Chart Cutoffs.

In the below example:

The Actual Load is 1.4klb, if you set the Tare Value to 1.2klb, the Actual Load would then be displayed as 0.2klb.



**Maximum Load Display**

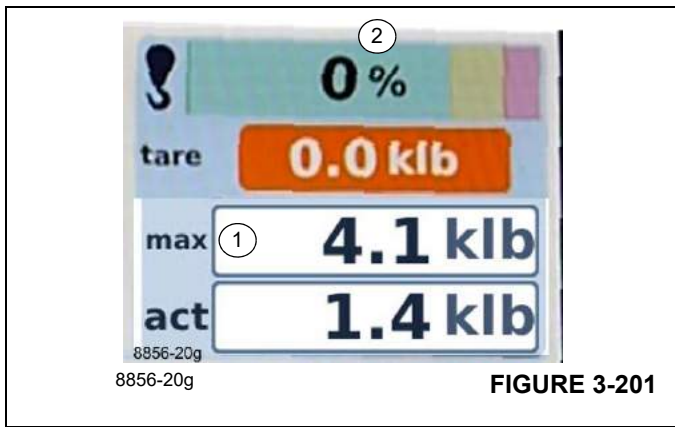


FIGURE 3-201

Display: Maximum load (1), (Figure 3-201) in metric tons (t) or kilo-pounds (klbs) for the displayed RCL code

**Current Degree of Utilization Display**

Degree of utilization = 100 x current load/maximum load (2), (Figure 3-201).

|   |                       |                                   |
|---|-----------------------|-----------------------------------|
| 1 | Color display:        |                                   |
|   | • Green:              | 0 - 90%                           |
|   | • Yellow:             | approx. 90 - 100% – early warning |
|   | • Red:                | greater than 100% – lockout       |
| 2 | Display in percentage |                                   |

**Data Logger**

The data logger is used to download the status of the machine.

1. Select the data logger icon (1), (Figure 3-202) on the RDM.

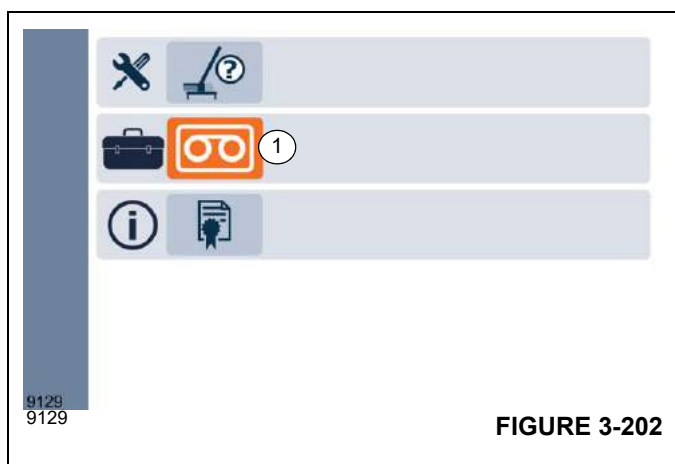


FIGURE 3-202

2. Insert USB drive into the USB port of RDM (Figure 3-203).

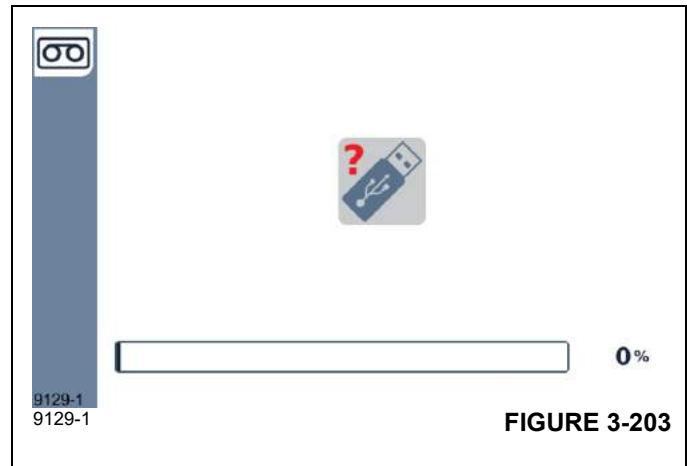


FIGURE 3-203

3. Press USB Button once drive is detected to start download (Figure 3-204).

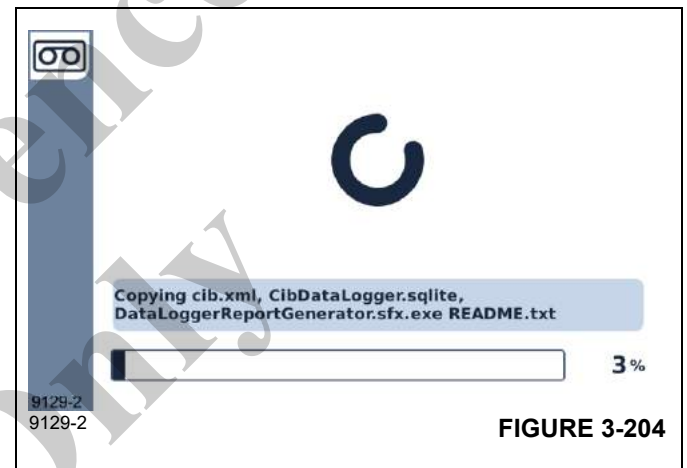


FIGURE 3-204

4. Once writing reaches 100% remove the USB drive and plug it into a laptop computer, the following files will have been created:
  - CibDataLogger.sqlite
  - DataLoggerReportGenerator.sfx.exe
  - cib.xml
5. If running the data logger report program for the first time, select DataLoggerReportGenerator.sfx.exe and follow the setup screens to install the report generator. If the data logger report generator has been previously installed or after installing the report generator, select CibDataLogger.sqlite to generate the report.
6. Choose the time span for the report (Figure 3-205), the default is the maximum amount of time possible. After the report is generated the disk save icon (1) will be highlighted. Select the Save Icon and choose the directory to save the report to (Figure 3-205).

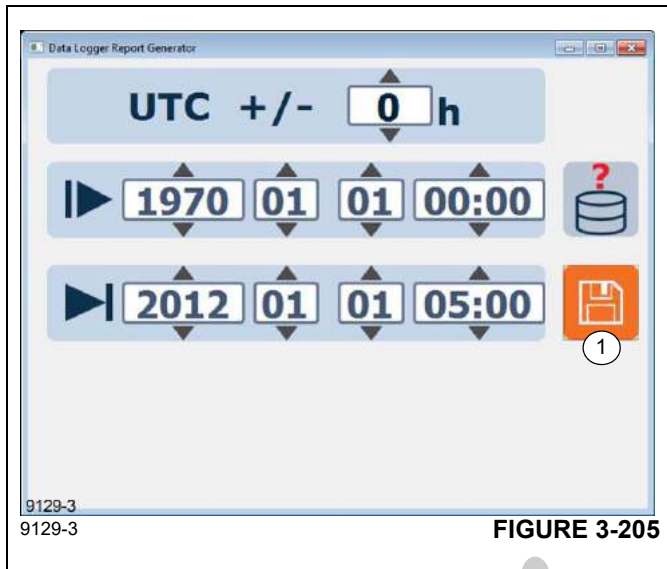


FIGURE 3-205

7. Open Microsoft Excel and import the.csv file(s) into it. There will be at least one file and possibly an additional fault codes file.
8. Open the cib.xml file to see all the possible loggable items and their descriptions.

**Exiting the Menu**

Press button (1), (Figure 3-206) on the Jog Dial or press the ESC Button (2), (Figure 3-206) on the control panel.

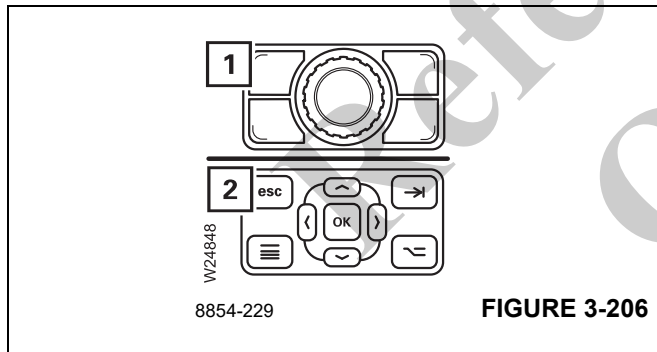


FIGURE 3-206

**Limits Override**

Switch (1), (Figure 3-207) for overriding the following lockouts:

- RCL Lockout
- WRL Lockout
- Carrier Avoidance Lockout
- Counterweight too low Lockout
- Boom Extension Stowage Lockout
- Anti Two-Block Lockout

- Minimum wrap Lockout

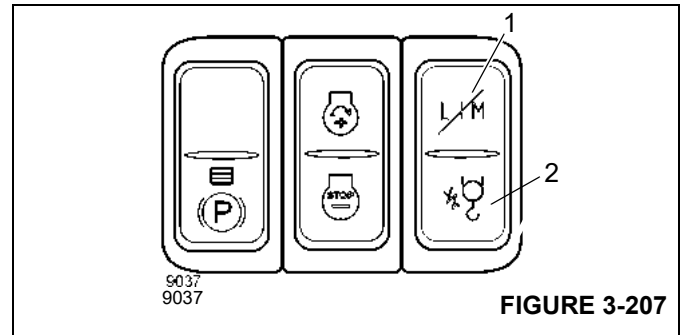


FIGURE 3-207

**Hoist Limits Override**

Switch (2), (Figure 3-207) for overriding the following lockouts:

- Anti Two-Block Lockout
- Minimum Wrap Lockout

**External Limit Bypass Switch**

There is a limits bypass key switch on the outside of the cab, under the right hand bottom corner of the front windshield. Turn the key to override the RCL lockout for 30 minutes.

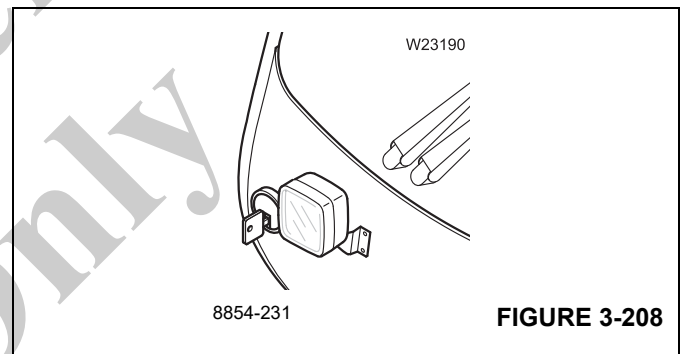


FIGURE 3-208

The Limit Override Switch (Figure 3-208) is a two-position, momentary type key switch. In an emergency situation only, turn switch clockwise and hold to override the different limiter systems on the crane. The override will last for 30 minutes or until the engine is stopped.

Turn key switch clockwise and hold to override the following limiter systems and their craning function lockouts:

- Anti Two-Block System (boom up/down, telescope extend, hoist up).
- Minimum wrap limiter system (hoist down).
- RCL system (boom up/down, telescope extend, hoist up).
- Working range limiter (WRL) system.
- Carrier avoidance system.

**External Displays**

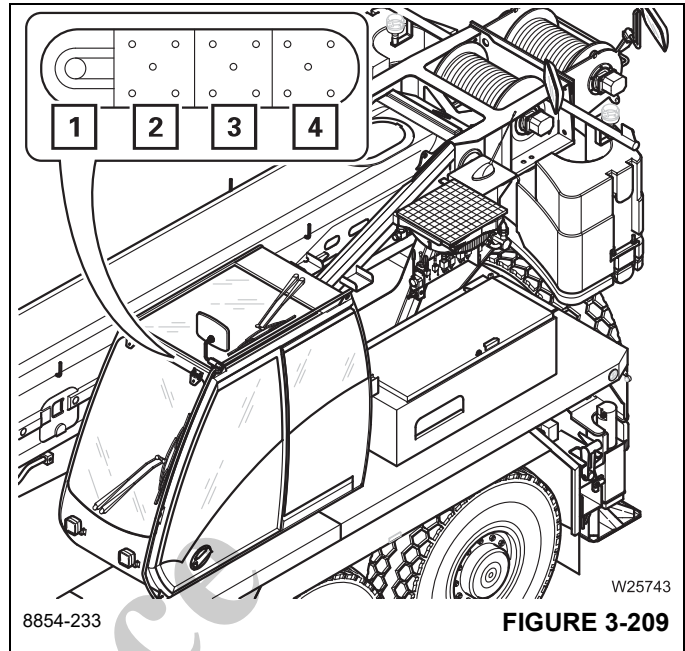
**Status Display**

To inform people in the danger area of the truck crane.

|   |                                             |
|---|---------------------------------------------|
| 1 | Loudspeaker (warning signal) (Figure 3-209) |
| 2 | Lamp, green                                 |
| 3 | Lamp, yellow                                |
| 4 | Lamp, red                                   |

The displays light up or flash depending on

- the current degree of utilization,
- RCL lockout/early warning,
- RCL override.



For Reference Only

## ECONOMY MODE

In Economy (ECO) Mode the crane software will control the throttle command to the engine over J1939. Based on the state of the crane and inputs from the throttle pedal and the Increment/Decrement Switch, ECO mode will reduce the throttle command when crane functions are not being used. This is intended to encourage the operator to run crane functions with enough power provided by the engine and reduce the fuel consumption when the crane is not doing any work.

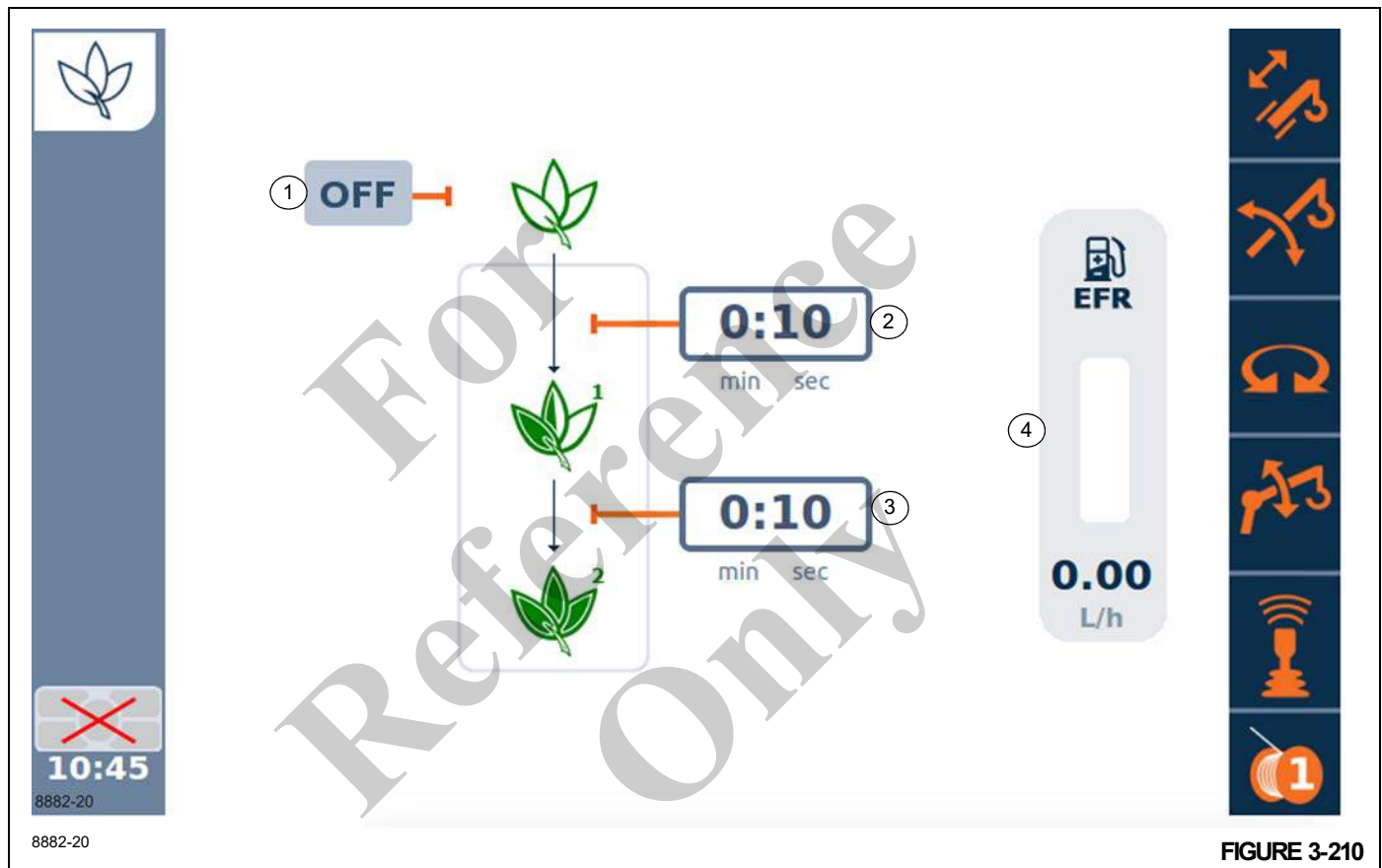


FIGURE 3-210

The OFF button (1), (Figure 3-210) enables/disables ECO mode. When turned OFF there is no RPM reduction. The engine RPM follows the increment / decrement switch and throttle pedal.

The first setting (2) is the time delay the engine will derate to a preset idle speed from the operator selected RPM level. Activating any joystick will return the crane to the operator selected idle speed.

The second setting (3) is the time after ECO mode has been activated due to inactivity when the engine RPM will be reduced to an even lower idle speed. Also, the hydraulic oil cooler operation will be reduced to also reduce fuel consumption.

The graph (4) is only to display the fuel usage rate in Liters per hour (gallons per hour).



**Terminology**

| Term                         | Definition                                                                                                            |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Disabled ECO Mode            | ECO mode is OFF (throttle command percent is always 0% in this mode)                                                  |
| Enabled ECO mode             | ECO mode is ON and can be operated at commanded throttle percentage                                                   |
| Active ECO mode              | ECO mode has commanded a throttle percent greater than 0% (Must be enabled to become active)                          |
| Inactive ECO mode            | ECO mode is active and the command throttle percentage is 0%                                                          |
| Throttle Setpoint (Setpoint) | The throttle percentage set by crane operator by pressing the Increment/Decrement Switch in the superstructure cabin. |

**Requirements**

ECO mode can be enabled by the crane operator on the Operating Display (ODM). The default is for ECO mode to be disabled when shipped from the factory. Once enabled, the system stays enabled until disabled through the ODM.

**NOTE:** ECO mode stays disabled (or enabled) independent of ignition key cycles and disconnect switch cycles.

When enabled the throttle setpoint will be set to the ECO mode throttle percent setpoint unless the operator had previously set it to a higher value using the Increment / Decrement switch.

The operator can increase the throttle command using the throttle pedal independent if ECO mode is active or inactive.

ECO mode is forced to inactive when the crane's transmission is being shifted to Forward or Reverse, or all crane functions are enabled.

When active, ECO mode will ramp the throttle percent from 0 to setpoint when any crane function command goes above 5% command. Once ECO mode's output is at the setpoint, the output will stay at the setpoint until no crane functions are being commanded for the set time interval. Then the ECO mode's throttle command is to be set to 0% (step down).

**NOTE:** Ramp time for increasing throttle percent is 2 seconds from 0% to 100% throttle (slope = 50% per second).

**Operation**

- Crane is able to idle at 600 RPM when crane functions are not enabled.
- Crane idles at 800 RPM when any crane function has been enabled.
- When user turns ECO mode ON:
  - Crane ramps engine from idle to operating speed using the first 15% of the joystick movement to control the ramp.
  - Crane maintains operating speed while crane functions are active and for a set period of time after crane functions go inactive.
  - Crane ramps engine speed back down to idle point.

**Benefits**

- Less noise and less fuel consumption versus maintaining crane at fixed "operating speed".
- Set point for engine operating speed is easily changed by the user.
- User can command additional engine speed at any time using the throttle or lower pedal.

**ELECTRICAL SYSTEM**

**Voltage Monitoring Warning**

|                 |                                                              |
|-----------------|--------------------------------------------------------------|
| Display symbol: | Engine on – power failure – switch off engine (Figure 3-211) |
| OFF:            | Engine on – no fault                                         |



**12 Volt Outlet**

|   |                      |
|---|----------------------|
| 1 | Socket 12 V/max. 3 A |
|---|----------------------|

Only connect electrical devices with the matching specification to the outlet (Figure 3-212).

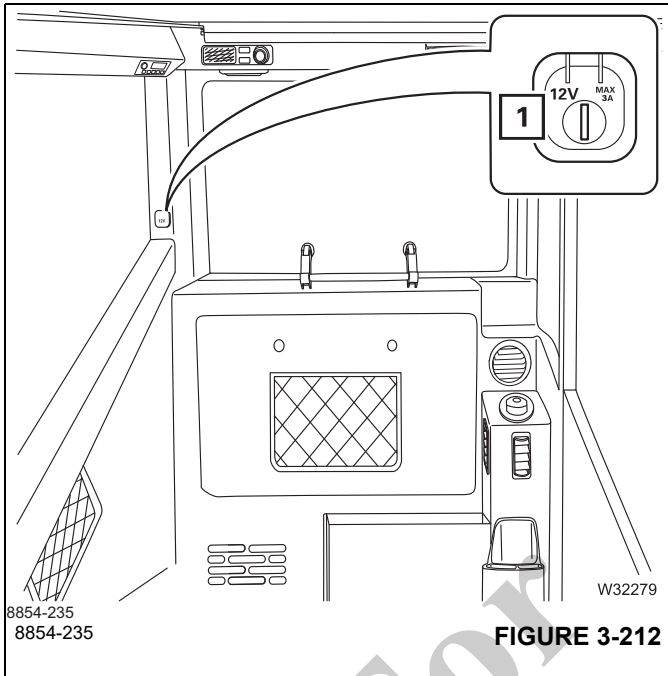


FIGURE 3-212

**Boom Lights**

|                |                                                  |
|----------------|--------------------------------------------------|
| To switch on:  | Push down – lamp in the button on (Figure 3-214) |
| To switch off: | Push up – lamp in the button off                 |

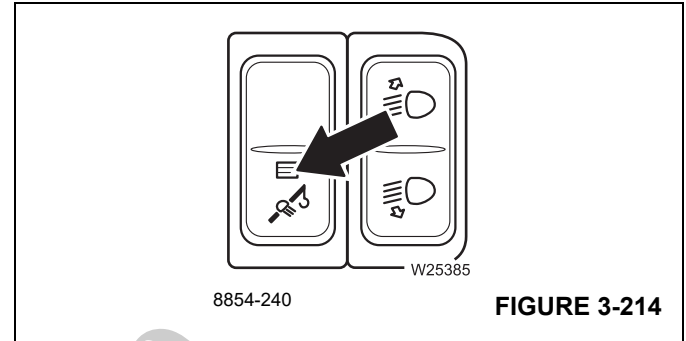


FIGURE 3-214

**LIGHTING, WINDSHIELD WIPER/WASHING SYSTEM**

**Lighting**

**Superstructure Cab Work Lights ON/OFF**

|                |                                                  |
|----------------|--------------------------------------------------|
| To switch ON:  | Push down – lamp in the button on (Figure 3-213) |
| To switch OFF: | Push up – lamp in the button off                 |

**Rotating Boom Lights Control**

|       |                          |
|-------|--------------------------|
| Down: | Push down (Figure 3-215) |
| Up:   | Push up                  |

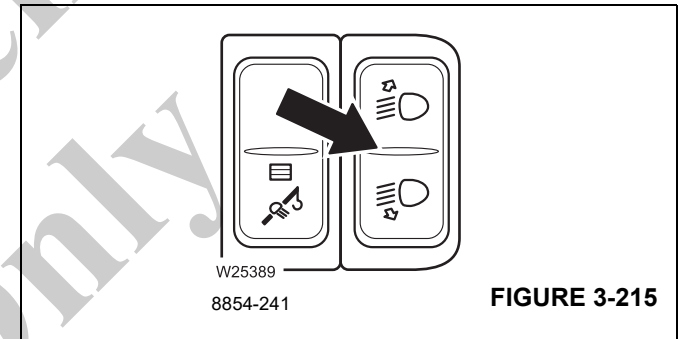


FIGURE 3-215

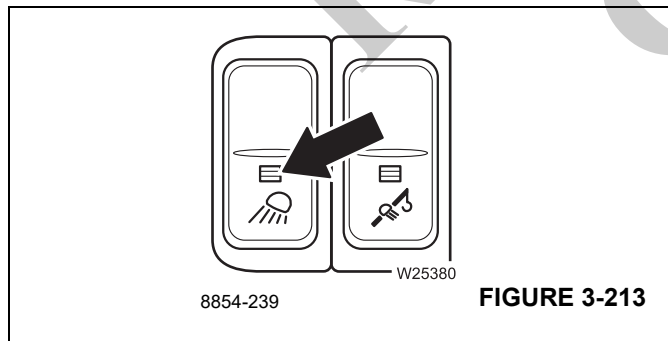


FIGURE 3-213

**Cab Lighting**

|   |                          |
|---|--------------------------|
| 1 | Always on (Figure 3-216) |
| 2 | Always off               |
| 3 | On/off via door contact  |

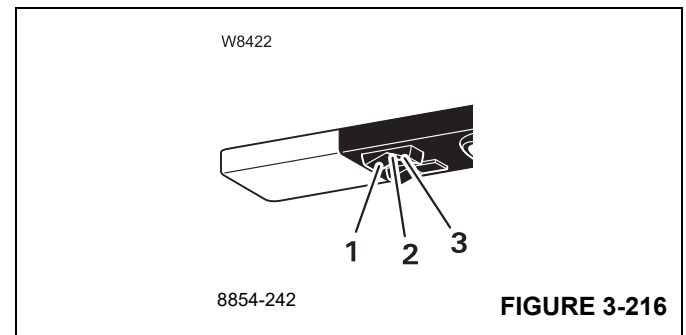
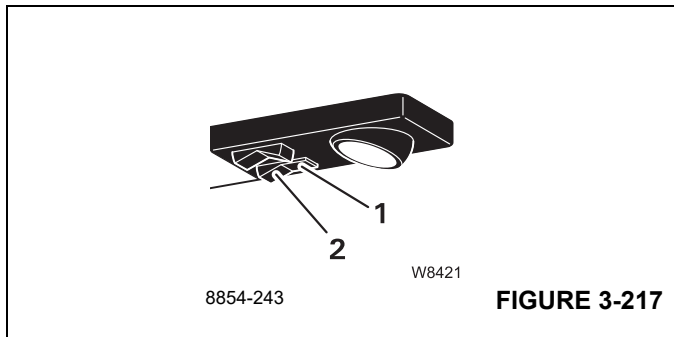


FIGURE 3-216

**Reading Lamp**

|   |                   |
|---|-------------------|
| 1 | ON (Figure 3-217) |
| 2 | OFF               |

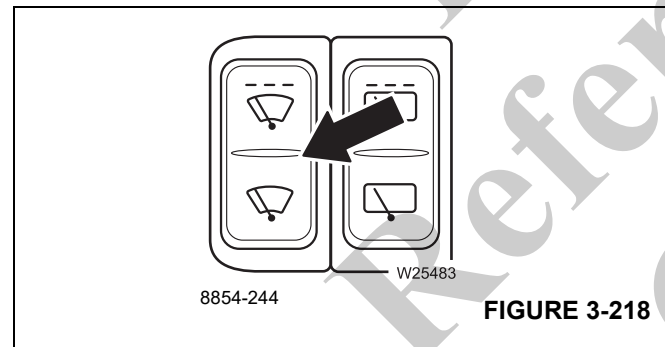


**FIGURE 3-217**

**Windshield Wiper/Washing System**

**Windshield Wiper ON/OFF**

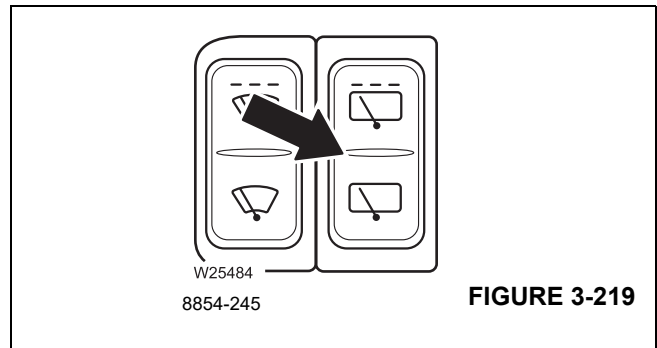
|                       |                                      |
|-----------------------|--------------------------------------|
| OFF:                  | Middle position (Figure 3-218)       |
| Intermittent:         | Push up (speeds are adjusted in ODM) |
| Continuous operation: | Push down                            |



**FIGURE 3-218**

**Skylight Wiper ON/OFF**

|                       |                                      |
|-----------------------|--------------------------------------|
| OFF:                  | Middle position (Figure 3-219)       |
| Intermittent:         | Push up (speeds are adjusted in ODM) |
| Continuous operation: | Push down                            |

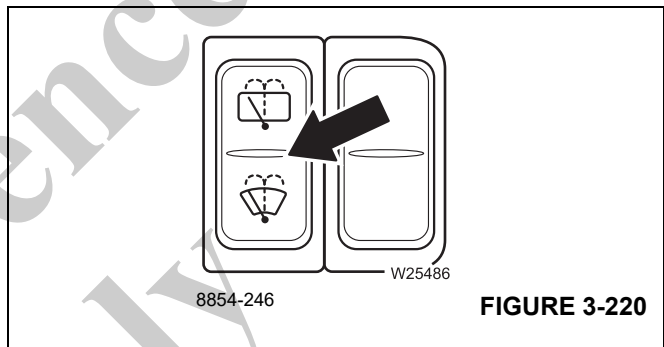


**FIGURE 3-219**

**Windshield/Skylight Washing System**

|             |                          |
|-------------|--------------------------|
| Windshield: | Push down (Figure 3-220) |
| Skylight:   | Push up                  |

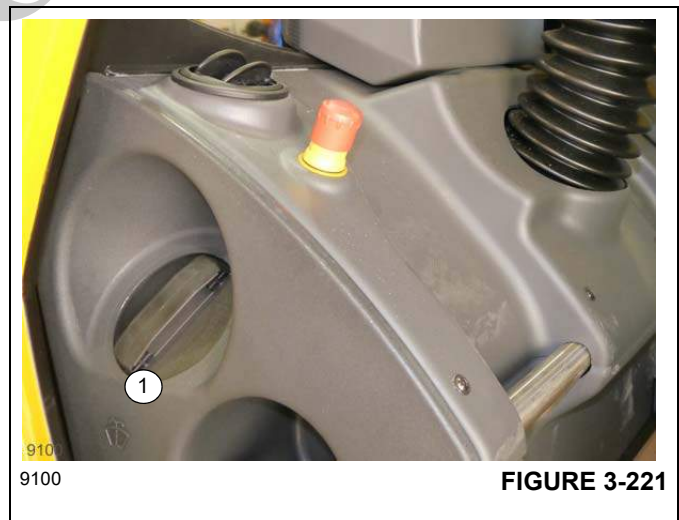
Press the appropriate wiper on/off button to remove washing fluid,



**FIGURE 3-220**

**Windshield Wiper Fluid Tank**

The windshield wiper fluid tank (1), (Figure 3-221) is located on the left side of the instrument panel. Remove the cap to fill the tank.



**FIGURE 3-221**

**Wiper Stroke Interval Menu**

To open: Select symbol (1), (Figure 3-222) and confirm – menu is opened.

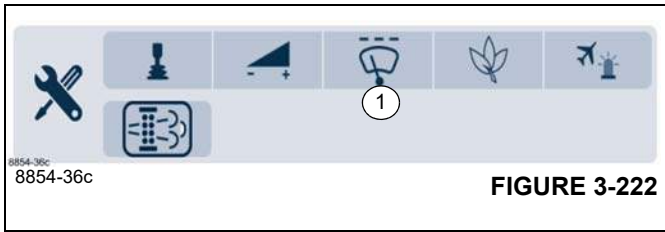


FIGURE 3-222

**Adjusting the Wiper Stroke Interval**

Refer to *Seat Contact Switch and Dead-Man Switches*, page 3-38.

**Windows**

**Front and Rear Windows**

The handles on the windshield and the rear window have the same function.

**Open Window (A)**

- Turn both handles (1), (Figure 3-223) inward.
- Push the window forward.

**Close Window (B)**

- Pull the window closed.
- Turn both handles down – pegs (2) located behind the holder (3).

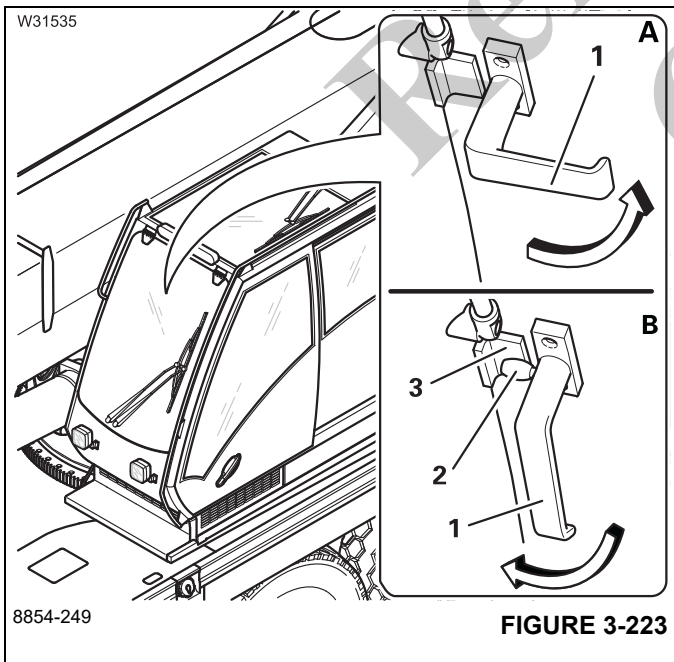


FIGURE 3-223

**Rear Window**

**Opening**

- Raise the handle (1), (Figure 3-224).
- Push window outwards.

**Closing**

- Pull in window.
- Push down handle (1).

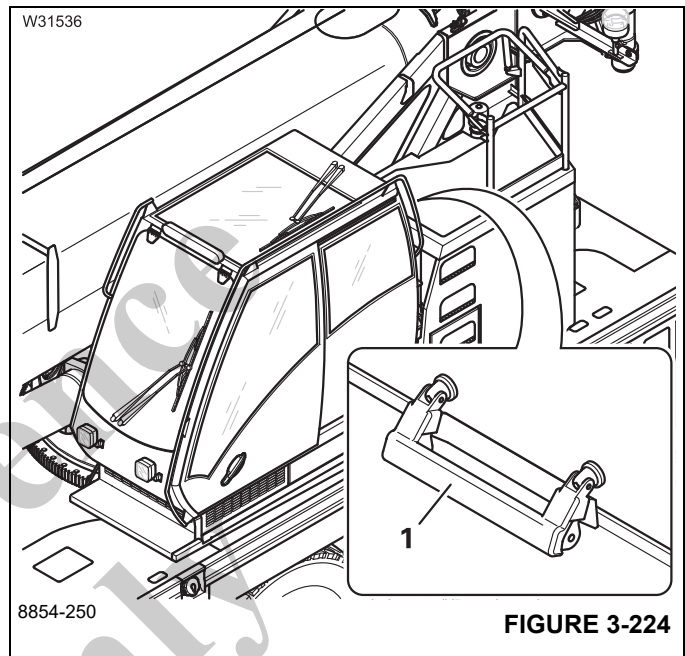


FIGURE 3-224

**Superstructure Cab Door**

**From Outside**

**Unlock**

- Turn the key in direction A (Figure 3-225).

**Lock**

- Turn the key in direction B.

**Open/Close**

- Pull the handle (1).
- Slide the door until it latches in the open or closed position.

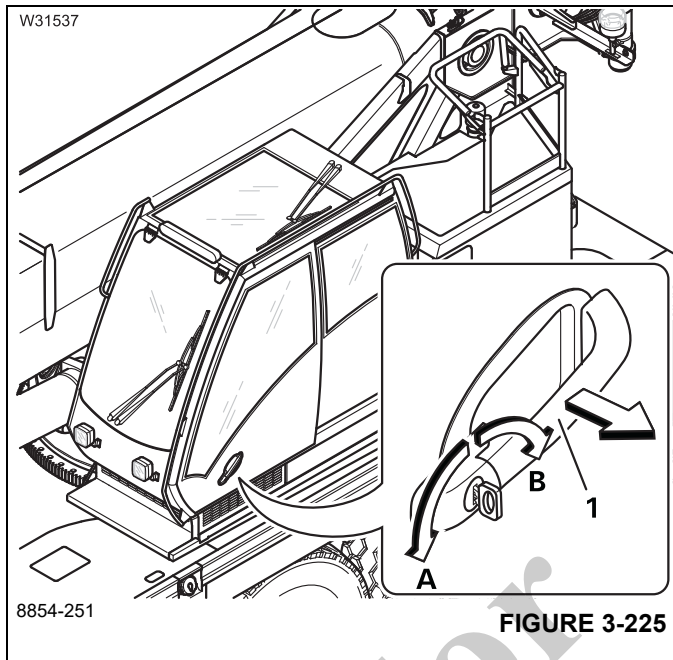


FIGURE 3-225

**Inside Door Operation**

**Closing**

Pull unlocking lever (3), (Figure 3-226), push door forwards by handle (1) – until it latches.

Locking from inside not possible.

**Opening**

Pull unlocking lever (2), pull door back by handle (1) – until it latches.

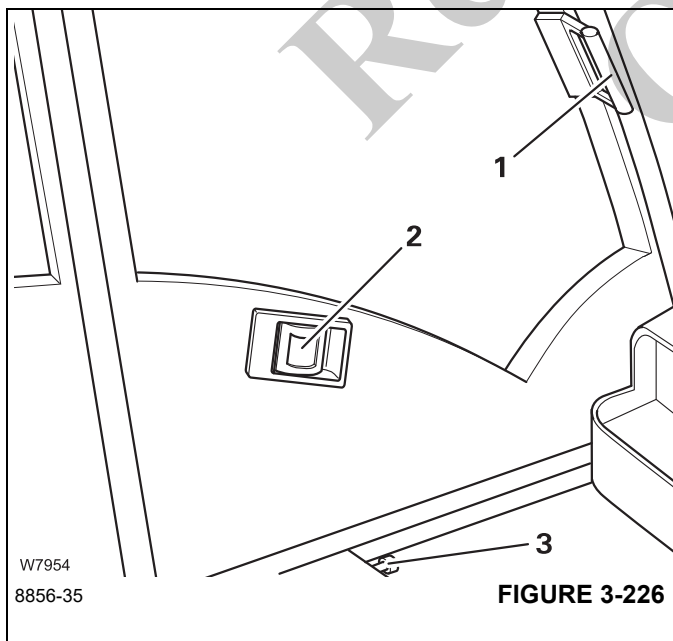


FIGURE 3-226

**CRANESTAR® SYSTEM**

**Overview**

Your truck crane maybe equipped with the optional CraneSTAR system.

The CraneSTAR system is used to transmit crane data via mobile phone or satellite and thus offers various possibilities for remote diagnostics and for locating the truck crane.

Transmission is primarily via mobile phone (GSM). If transmission via mobile phone is disrupted, the device will automatically switch to transmission via satellite.

The CraneSTAR® system works automatically, no controls must be operated. This document just shows the position of the associated components and gives tips on troubleshooting.

The CraneSTAR system will only be activated at the request of the crane owner.

Information on viewing the transmitted data in the Internet can be found in the separate CraneSTAR Operating instructions and at:

[www.cranestar.net](http://www.cranestar.net) – here, you will find all of the information about activating the CraneSTAR system.

**Position of the Components**

The CraneSTAR system includes two antennas and a Telematic Control Unit (TCU), the control unit for data transmission.

The satellite antenna (1), (Figure 3-227) is located on the rear right or left of the turntable.

The antenna (2) is a combined GSM/GPS antenna for transmission via mobile phone (GSM) and for the navigation system (GPS).

The antennas are connected to the TCU (4).

The lights (3) are used for troubleshooting.

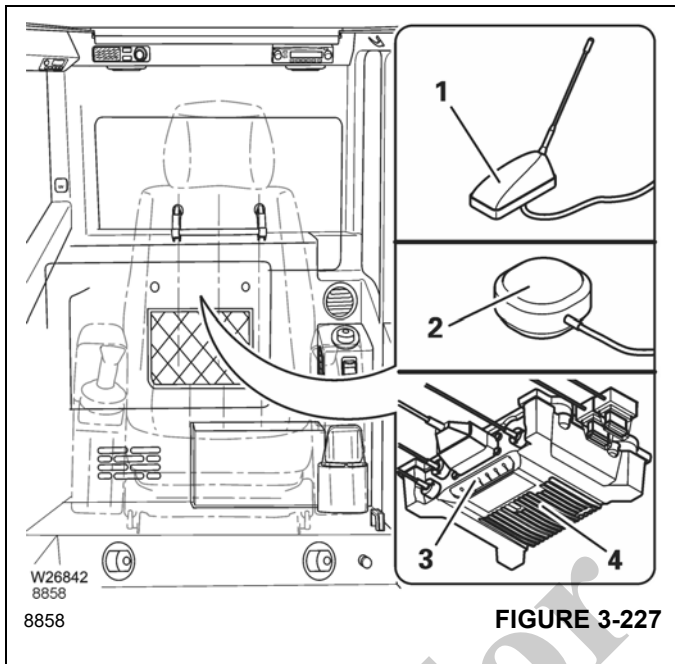


FIGURE 3-227

For Reference Only

## SECTION 4 OPERATING PROCEDURES

### SECTION CONTENTS

|                                                             |             |                                                     |             |
|-------------------------------------------------------------|-------------|-----------------------------------------------------|-------------|
| <b>Breaking-In a New Crane</b> .....                        | <b>4-2</b>  | Traction Control Switch Operation .....             | 4-13        |
| <b>Pre-Starting Checks</b> .....                            | <b>4-2</b>  | Thermal (Brake Heat) Protection .....               | 4-13        |
| Fuel Supply .....                                           | 4-2         | ABS/ATC Partial Shutdown .....                      | 4-13        |
| Engine Oil .....                                            | 4-3         | <b>Engine Operation</b> .....                       | <b>4-13</b> |
| DEF Fluid Level .....                                       | 4-3         | Engine Starting Procedure .....                     | 4-13        |
| Engine Coolant .....                                        | 4-3         | Cold Weather Starting .....                         | 4-14        |
| Batteries .....                                             | 4-3         | Jump Starting the Crane .....                       | 4-14        |
| Hydraulic Reservoir and Filter .....                        | 4-3         | Idling the Engine .....                             | 4-14        |
| Wire Rope .....                                             | 4-3         | Racing the Engine .....                             | 4-15        |
| Hook Block and Overhaul Ball .....                          | 4-3         | Shutdown Procedure .....                            | 4-15        |
| Seats .....                                                 | 4-3         | Exhaust System Cleaning .....                       | 4-15        |
| Seat Belts .....                                            | 4-3         | <b>Crane Travel Operation</b> .....                 | <b>4-16</b> |
| Signal and Running Lights .....                             | 4-3         | Traveling - General .....                           | 4-17        |
| Service and Parking Brakes .....                            | 4-3         | Jobsite Travel Configurations .....                 | 4-17        |
| Tires .....                                                 | 4-3         | Axle Weight Distribution Table .....                | 4-23        |
| Wheels .....                                                | 4-3         | Manual Transmission Clutch Operation .....          | 4-25        |
| Other Equipment .....                                       | 4-3         | Shifting Gears - Manual Transmission .....          | 4-25        |
| Daily Lubrication .....                                     | 4-4         | Automatic Transmission (Optional) .....             | 4-28        |
| <b>Cold Weather Operation</b> .....                         | <b>4-4</b>  | Differential Control Switches .....                 | 4-32        |
| Derated Capacities for Each °F Below -40°F .....            | 4-4         | Brakes .....                                        | 4-32        |
| Derated Capacities for Each °C Below -40°C .....            | 4-4         | Engine Brake .....                                  | 4-33        |
| <b>Cold Climate Operation</b> .....                         | <b>4-4</b>  | Recommended Crane Shutdown Procedures .....         | 4-33        |
| Crane Warm-Up Procedures .....                              | 4-4         | <b>Unattended Crane</b> .....                       | <b>4-34</b> |
| Engine .....                                                | 4-5         | <b>Superstructure Cab Platform</b> .....            | <b>4-34</b> |
| Transmission .....                                          | 4-5         | <b>Proper Leveling of the Crane</b> .....           | <b>4-34</b> |
| Hoist .....                                                 | 4-5         | Bubble-Level Indicator Adjustment .....             | 4-34        |
| Swing Drive and Turntable Bearing .....                     | 4-5         | <b>Using the Outriggers</b> .....                   | <b>4-34</b> |
| Axles .....                                                 | 4-6         | Setting the Outriggers from Outrigger Keypads ..... | 4-35        |
| Hydraulic Oil System .....                                  | 4-6         | Additional Cribbing Needed to Increase              |             |
| <b>Heating and Ventilating the Superstructure Cab</b> ..... | <b>4-6</b>  | Ground Clearance .....                              | 4-35        |
| Heating System .....                                        | 4-6         | Prior to Entering Cribbing Mode .....               | 4-35        |
| Heating System Manual Operation .....                       | 4-7         | Methods and Requirements for Activating             |             |
| Heating System Automatic Operation .....                    | 4-9         | Cribbing Mode .....                                 | 4-35        |
| Air-Conditioning System .....                               | 4-10        | Activating Cribbing Mode from Outrigger             |             |
| <b>Anti-Lock Brake System (ABS)</b> .....                   | <b>4-11</b> | Keypads .....                                       | 4-36        |
| ABS Power-Up Sequence .....                                 | 4-12        | Activating Cribbing Mode from                       |             |
| ABS Switch Operation .....                                  | 4-12        | Superstructure Cab ODM .....                        | 4-37        |
| <b>Automatic Traction Control (ATC) Functional</b>          |             | Exiting Cribbing Mode .....                         | 4-40        |
| <b>Overview</b> .....                                       | <b>4-12</b> | Auto-Level Procedure from Carrier /                 |             |
| ATC Operation .....                                         | 4-13        | Superstructure (ODM) .....                          | 4-40        |
| System Operation .....                                      | 4-13        | Engaging Outrigger Beam Extension Lock Pins .....   | 4-40        |
| Component Function .....                                    | 4-13        | Outrigger Monitoring System (OMS) .....             | 4-41        |
| Traction Control Power-Up Sequence .....                    | 4-13        | Stowing the Outriggers .....                        | 4-42        |
|                                                             |             | Stowage of Outriggers Using Cribbing Mode .....     | 4-42        |





|                                                            |             |                                                                                        |              |
|------------------------------------------------------------|-------------|----------------------------------------------------------------------------------------|--------------|
| Stowing the Partial/Mid Extension Lock Pin . . . . .       | 4-42        | Setting the Characteristic Curves for the Control Levers . . . . .                     | 4-91         |
| Stowing the Center Front Stabilizer. . . . .               | 4-43        | Limiting the Power Unit Speeds . . . . .                                               | 4-92         |
| <b>Crane Operation . . . . .</b>                           | <b>4-43</b> | Carrier Camera Display Set-Up . . . . .                                                | 4-93         |
| Before Operating the Crane . . . . .                       | 4-43        | Using the Slewable Spotlights . . . . .                                                | 4-94         |
| Preheating the Hydraulic Oil . . . . .                     | 4-47        | Warnings in the Start Menu . . . . .                                                   | 4-94         |
| Switching the 360° Lock ON/OFF . . . . .                   | 4-47        | <b>Mechanical Emergency Unlocking and Locking of the Telescopic Sections . . . . .</b> | <b>4-95</b>  |
| <b>Operation of the Rated Capacity Limiter . . . . .</b>   | <b>4-48</b> | Maintenance. . . . .                                                                   | 4-96         |
| Enter Rigging Mode. . . . .                                | 4-50        | <b>Work Break . . . . .</b>                                                            | <b>4-97</b>  |
| Crane Operation with Main Boom . . . . .                   | 4-61        | In Case of Short Work Breaks . . . . .                                                 | 4-97         |
| Telescoping Mechanism . . . . .                            | 4-67        | In Case of Work Breaks of More than 8 Hours . . . . .                                  | 4-97         |
| Semi-Auto Mode . . . . .                                   | 4-78        | <b>Trailing Boom Carrier Option . . . . .</b>                                          | <b>4-97</b>  |
| Boom Configurator . . . . .                                | 4-85        | Description . . . . .                                                                  | 4-97         |
| High-Speed Mode . . . . .                                  | 4-87        | Operation . . . . .                                                                    | 4-98         |
| Swing Gear . . . . .                                       | 4-88        | Returning to Normal Crane Operation . . . . .                                          | 4-101        |
| Possible Movement Combinations . . . . .                   | 4-90        | Parking the Trailing Boom Carrier . . . . .                                            | 4-101        |
| <b>Settings and Displays for Crane Operation . . . . .</b> | <b>4-91</b> | <b>Tilt-Up Panel Procedure Using the Heavy Duty Boom Extension . . . . .</b>           | <b>4-101</b> |
| Inclining the Crane Cab. . . . .                           | 4-91        |                                                                                        |              |
| Switching Units of Measure. . . . .                        | 4-91        |                                                                                        |              |

**BREAKING-IN A NEW CRANE**

Your new Grove crane has been thoroughly tested, adjusted, lubricated, and inspected prior to delivery. For detailed engine conditioning, refer to the applicable engine manual.

Some important rules to follow to establish conditions for long service life are listed below.

- Operate as much as possible in half to three-quarters throttle or load range.
- Avoid long periods of operation at engine idle speeds or at continuous maximum horsepower levels.
- Observe instruments often and shut down at the first indication of an abnormal reading.
- Operate to a power requirement that allows acceleration to governed speed when conditions require more power.
- Check all components frequently for proper operation, unusual noises, or excessive heating.
- Check the engine oil and the coolant levels frequently.

These rules should not be considered as limitations in putting your equipment to work at maximum capacity, but rather to serve as a guide to familiarization and development of good operating habits.

**PRE-STARTING CHECKS**

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

**Fuel Supply**

Ensure the fuel tank is full and the cap is on tight.  
Use only approved fuels. The X12 engine requires the use of Ultra Low Sulfur Diesel (ULSD) fuel.



**WARNING**

Never mix gasoline, alcohol, or gasohol with diesel fuel. This mixture can cause an explosion.

**CAUTION**

In X12 engines, use only ultra low sulfur diesel fuel, Failure to do so may cause damage to the exhaust catalyst.

## Engine Oil

---

### CAUTION

DO NOT OVERFILL the engine crankcase. Damage to engine components will result.

---

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

## DEF Fluid Level

Check the DEF fluid level in the DEF tank; fill to the proper level. An engine derate will occur when the fluid level is low.



### WARNING

#### Inhalation/Irritation Hazard!

Ammonia vapors can irritate mucous membranes, skin and eyes.

Use caution when opening the DEF tank in high ambient temperatures as ammonia vapor can be released. Avoid breathing vapors or allowing vapors to contact face and skin.

---



---

### CAUTION

#### Machine Damage!

DEF can cause corrosion of these surfaces. Clean up spilled DEF with water immediately.

---

## Engine Coolant

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

## Batteries

Some cranes use maintenance-free type batteries. When applicable, check the state-of-charge indicator on these type batteries. On cranes not using the maintenance-free batteries, check each cell for the correct electrolyte level. Add only clean, distilled water. Do not overfill. On either type battery, ensure the cables and clamps are tight and not corroded.

## Hydraulic Reservoir and Filter

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

Check breather for cleanliness and security.

## Wire Rope

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

## Hook Block and Overhaul Ball

Inspect for nicks, gouges, cracks, and evidence of any other damage. Replace a hook that has cracks or shows evidence of excessive deformation of the hook opening (including twist). Be sure the safety latch is free and aligned.

## Seats

Adjust seat and mirrors for clear vision and safe driving.

## Seat Belts

### Seat Belt Maintenance

Seat belt assemblies are maintenance-free; however, they should be periodically inspected to ensure that they have not become damaged and they remain in proper operating condition, particularly if they have been subjected to severe stress.

### Cleaning Seat Belt Webbing

To clean the webbing, wash with any mild soap or detergent. Do not clean seat belts with commercial solvents. Also, bleaching or re-dyeing the webbing is not recommended because of possible loss of webbing strength.

## Signal and Running Lights

Check all signal and running lights for proper operation. Replace burned out lamps with those of the same number, or equivalent.

## Service and Parking Brakes

Check for proper operation.

## Tires

Check pressure and condition of all tires before starting.

**NOTE:** For tire inflation pressures, refer to the Tire Inflation Decal on the crane.

## Wheels

Maintain proper torque on wheel lugs and check for proper wheel mounting.

## Other Equipment

Check all lights, windshield wipers, washers, washer liquid supply, horn, instruments, signaling devices, etc.

## Daily Lubrication

Ensure all components requiring daily lubrication have been serviced. (Refer to the Section on "LUBRICATION" on page 5-1).

## COLD WEATHER OPERATION

**NOTE:** This crane is equipped with a Cold-Weather Starting Ether System. The operator should crank the engine normally in all temperatures.

The following recommendations are for operating Grove cranes in regions with ambient temperatures below -9°C (15°F) which are considered arctic.

**NOTE:** Additional information regarding cold weather operation is available through your Cummins dealer/service center under Service Bulletin 3379009.

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

Operation of cranes at full rated capacities in temperatures between -18°C (0°F) and -29°C (-20°F) or lower should be accomplished only by competent operators who possess the skill, experience, and dexterity to ensure smooth operation. Shock loading shall be avoided. Refer to the following paragraphs for cold weather operation of cranes down to -40°C (-40°F).

### Derated Capacities for Each °F Below -40°F

Derate the rated load shown on the capacity charts 2 percent for each degree Fahrenheit below -40°F.

**NOTE:** Contact your local distributor or Manitowoc Crane Care to determine requirements and lift solution for operation down to -40°C (-40°F).

### Derated Capacities for Each °C Below -40°C

Derate the rated load shown on the capacity charts 3.67 percent for each degree Celsius below -40°C.

Grove recommends the crane be equipped with the following cold weather accessories:

#### Down to -29°C (-20°F)

- Battery heater
- Fuel line heater
- Engine hood insulation

- Fan clutch
- Radiator air shutters
- Air diverter
- Diesel fired cab heater
- Cold weather alternator
- Fluids suitable to -29°C (-20°F)

#### Down to -40°C (-40°F)

- Coolant heater (to circulate warm coolant through heaters and engine)
- Transmission heater
- Swivel heater
- Battery heater
- Fuel line heater
- Engine hood insulation
- Fan clutch
- Radiator shutters
- Air diverter
- Diesel fired cab heater
- Cold weather alternator
- Super-capacitor starting system
- Fluids suitable to -40°C (-40°F)

Individual crane functions should be operated to ensure they are sufficiently warmed prior to performing a lift. Allow at least 30 minutes of engine run time for warm up.

## COLD CLIMATE OPERATION

**NOTE:** Additional information regarding cold weather engine operation is available through your Cummins dealer/service center under Service Bulletin 3379009.

### Crane Warm-Up Procedures

The following procedures detail the actions that must be taken to properly warm the different crane components before operating the crane.

**NOTE:** For temperatures below -9°C (15°F) refer to arctic lubricants and conditions in the Operator and Service Manuals.

Before starting the crane, ensure the appropriate lubricants are used to provide lubrication for the prevailing ambient temperatures in which the crane will operate in (a list of lubricants and their temperature ranges can be found in the Lubrication section of your crane's *Operator Manual*, by

contacting your local Manitowoc distributor, or by contacting Manitowoc Crane Care directly).

## CAUTION

### Crane Damage Hazard!

Operating the crane with the incorrect lubricants and fluids for the prevailing ambient temperature and/or failing to adequately warm the crane prior to cold weather operation can lead to a failure of a crane component or system.

Always use Manitowoc recommended lubricants and fluids for the prevailing ambient temperature and properly start and warm the crane using the cold weather procedures found in this Operator's Manual and supplement before operating the crane at full load.

## Engine

### Warm-up Procedures for All Temperature Ranges:

1. Upon startup, allow the engine to idle for 3 to 5 minutes before operating with a load.
2. Cold Engine Startup: After allowing the engine to warm by idling it for 3 to 5 minutes, slowly increase the engine speed to provide adequate lubrication to the bearings and to allow the oil pressure to stabilize.

## Transmission

Operating the transmission with a sump temperature below normal operating temperature is limited to:

- operating in the neutral gear or
- driving with an unloaded crane while not exceeding 1500 engine RPM and not exceeding half throttle.

### Warm-up Procedures for Rough Terrain (RT) and Industrial Cranes:

1. Engage the parking brake and apply the service brake.
2. Shift the transmission into the highest gear and increase the engine RPM to 1500 for 15 seconds, then allow the engine RPM to return to idle.
3. Repeat Step 2 until the temperature of the transmission sump reaches normal operating temperature.

### Alternate Warm-up Procedures for Rough Terrain (RT) and Industrial Cranes:

1. Setup the crane on outriggers.
2. Engage the transmission with 4-wheel drive selected (if equipped) and allow crane to run at idle until the

temperature of the transmission sump reaches normal operating temperature.

**NOTE:** Warm-up operation of 4-wheel drive transmission engaged in 2-wheel drive only could cause transmission damage.

### Alternate Warm-up Procedures for Truck Mount (TM/TMS) Cranes:

1. Setup the crane on outriggers.
2. Engage the transmission and allow crane to run at idle until the temperature of the transmission sump reaches normal operating temperature.

## Hoist

Performing a warm-up procedure is recommended at every startup and is required at ambient temperatures below 4°C (40°F).

### Warm-up Procedures:

1. Without operating the hoist function, warm the hydraulic oil (see the following section).
2. Once the hydraulic system is warm, operate the unloaded hoist, in both directions, at low speeds several times to prime all hydraulic lines with warm hydraulic oil and to circulate gear lubricant through the planetary gear sets.

## Swing Drive and Turntable Bearing

### Warm-up Procedures for Temperatures Above -7°C (20°F):

1. Setup the crane on fully extended outriggers, with the boom fully retracted and near maximum lift angle with no load applied.
2. Rotate the superstructure at a speed of less than one RPM for at least one complete revolution in one direction, then rotate the superstructure at a speed of less than one RPM for at least one complete revolution in the opposite direction.

### Warm-up Procedures for Temperatures Below -7°C (20°F):

1. Ensure the boom is fully retracted and near maximum lift angle with no load applied.
2. Rotate the superstructure at a speed of less than one-half RPM for at least two complete revolutions in one direction, then rotate the superstructure at a speed of less than one-half RPM for at least two complete revolutions in the opposite direction.

## Axles

### Warm-up Procedures for Temperatures Below -35°C (-30°F):

1. Setup the crane on outriggers.
2. Engage the transmission and allow crane to run at idle until the temperature of the transmission sump reaches normal operating temperature.

## Hydraulic Oil System

### Operating Limits and Warm-up Procedures:

- **From 4°C to -10°C (40°F to 15°F):** Crane operation without a load is allowed with medium engine RPM and medium function speed (joystick position) until the fluid reaches at least 10°C (50°F). It is then recommended that all crane functions be cycled to remove cold fluid from all components and cylinders of the hydraulic system. If there is any unusual sound coming from the crane's hydraulic pumps or motors, stop the operation and engine immediately and contact a Manitowoc distributor.
- **From 10°C to 4°C (50°F to 40°F):** Crane operation with a load is allowed with medium engine RPM and medium function speed (joystick position) until the fluid reaches at least 10°C (50°F).
- **From 95°C to 10°C (200°F to 50°F):** Crane operation with a load is allowed with no restrictions.

Above 95°C (200°F): No crane operation is allowed. Let the crane's hydraulic oil cool by running the engine at idle with no functions actuated.

## HEATING AND VENTILATING THE SUPERSTRUCTURE CAB

The superstructure cab is heated and cooled by a heater and air conditioner. There are vents to direct the air and grilles that return the air to the heater/air conditioner. Refer to (Figure 4-1).

Do not cover the grilles (1), (2) and (3).

- Air is drawn in through grilles (2) and (3).
- The grille (1) is used to ventilate the electronics.

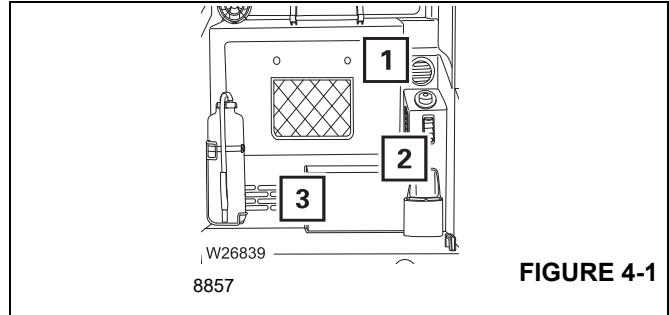


FIGURE 4-1

## Heating System

The heating system can be operated when the engine is switched off or running.

The heater fuel tank must be adequately filled in order to operate the heater.

### CAUTION

#### Accelerated Discharging of Battery When the Engine is Switched OFF!

The batteries will run down if you operate the heater with the engine switched off. The batteries will need to be recharged more frequently.

### Switching ON

Before switching on the heating system, check whether it is allowed to be operated at the current site of the truck crane. Find out whether there are any possible sources of danger that could result in an explosion.



### DANGER

#### Explosion Hazard!

The diesel heater includes a flame. Operation where flammable/explosive fumes are present may result in fire/explosion.

The heating system may not be operated:

- At service stations and tank farms
- At places where flammable gases or vapors can be found or formed (e.g. at places where fuel is stored and in chemical factories)
- At locations where explosive dust is found or can be formed (e.g. coal dust, wood dust, grain dust).

**! DANGER**  
**Suffocation Hazard!**

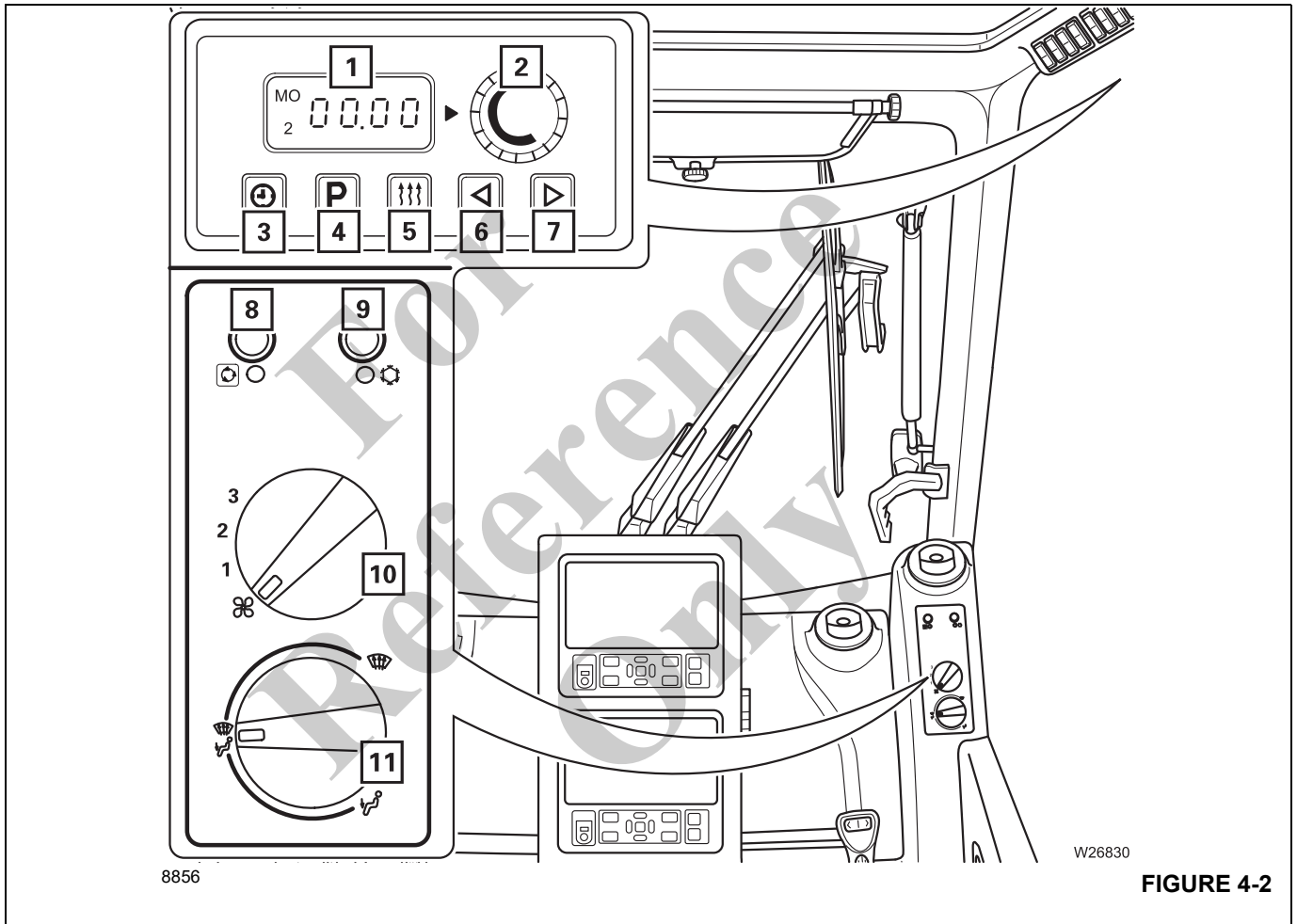
Carbon monoxide fumes from the heater exhaust can cause suffocation in an enclosed area (e.g. garages). Good ventilation is very important when operating the heater.

**Heating System Manual Operation**

**NOTE:** This section describes how to switch on the heater manually. The heater can also be switched on automatically.

- Turn on the ignition.
- Press the button (5), (Figure 4-2) once.

The heater switches itself on and the control field lights up.



**FIGURE 4-2**

The fan also switches on with the heater in order to avoid overheating.

**Temperature**

You can preselect a temperature. The preselected temperature is automatically set and maintained.

**To Increase the Temperature**

Turn the knob (2), (Figure 4-2) clockwise.

**To Reduce the Temperature**

Turn the knob (2), (Figure 4-2) counterclockwise.

**Fan**

You can set the air volume that is delivered to the superstructure cab.

**Increasing the Air Volume**

Turn the switch (10), (Figure 4-2) clockwise.

The switch engages in three different positions.

**Reducing the Air Volume**

Turn the switch (10), (Figure 4-2) counterclockwise.

When the heater is switched on the fan comes on at slow speed.

**Fresh Air/Recirculated Air**

You can set which air is sucked in by the heating system.

**Fresh Air**

Press the button (8), (Figure 4-2) – lamp goes out.

**Recirculated Air**

Press the button again – lamp illuminates. Only the superstructure cab air is extracted.

**Air Distribution**

You can make the heating air flow from the different air vents.

**Air Vents on the Windshield and in the Center**

Turn the switch (11), (Figure 4-2) clockwise.

**Air Vents on the Cab Floor**

Turn the switch counterclockwise.

**All Air Vents**

Turn the switch as shown. Refer to (Figure 4-3).

The heated air blows out at the following positions

- Windscreen and middle from the air vents (1), (Figure 4-3).
- Foot area from the air vents (3).
- All air vents (1) to (3).

You can additionally set the direction of the air flow on the air vents (1) and (3).

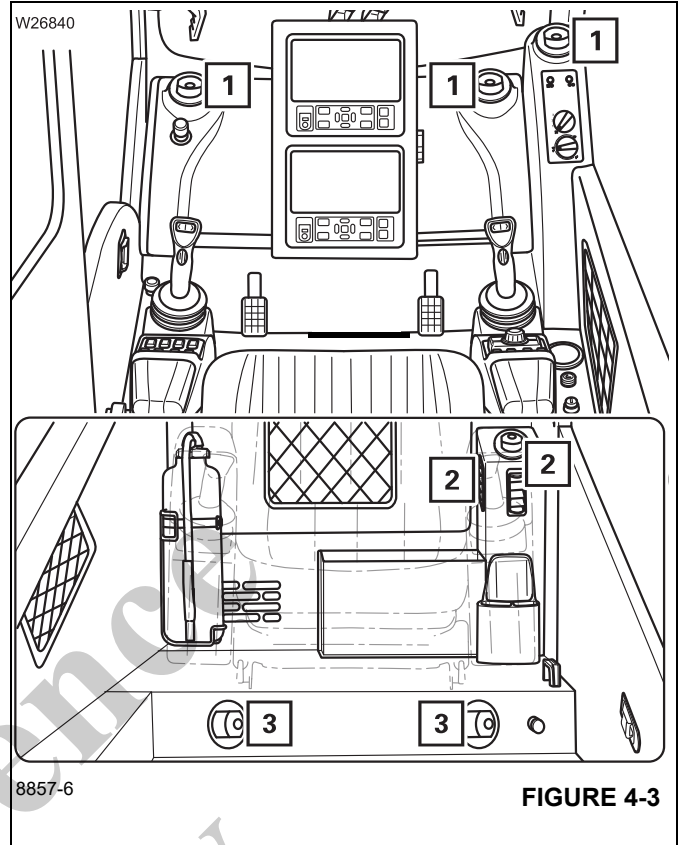


FIGURE 4-3

**Adjusting the Air Vents**

**Round Vents**

|                         |                                                               |
|-------------------------|---------------------------------------------------------------|
| To open the vent:       | Press the fins (1), (Figure 4-4) down and set them lengthwise |
| To direct the air flow: | Turn the ring (2), adjust fins                                |
| To close the vent:      | Fold fins (1) to the side                                     |



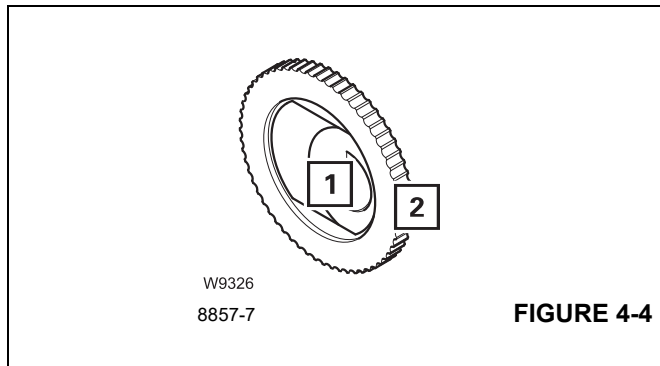


FIGURE 4-4

**Rectangular Vents**

|                         |                                  |
|-------------------------|----------------------------------|
| To open the vent:       | Raise the fins (2), (Figure 4-5) |
| To direct the air flow: | Turn the ring (1), adjust fins   |
| To close the vent:      | Lower the fins (2)               |

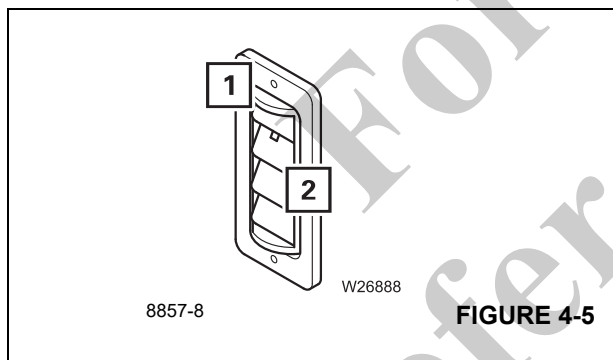


FIGURE 4-5

**Heating System Automatic Operation**

**Setting the Day and Time**

Always set the current time and current day of the week. These settings are required for the correct activation point of the automatic start.

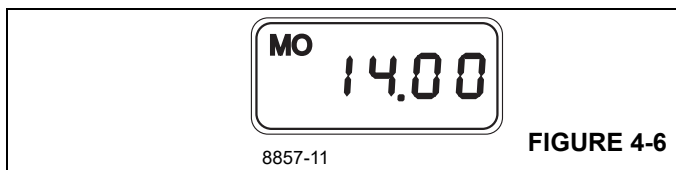
If the power supply is interrupted, all symbols in the display will flash and you must set the time and day again.

Press the button (3), (Figure 4-2) for longer than 2 seconds.

The displayed time flashes.

Set the current time on the flashing display, e.g. 14:00 – button (6) or (7).

Wait for 5 seconds. The new time is saved and then the weekday flashes, e.g. MO for Monday (Figure 4-6).



Set the current weekday on the flashing display – button (6), (Figure 4-2) or (7), (Figure 4-2).

After 5 seconds, the display stops flashing and the current time is displayed. The weekday goes out.

The time and weekday have now been set.

**Storing the Heating Start**

Heating is started automatically on schedule only if the time and the day of the week have been correctly set refer to page 4-9.

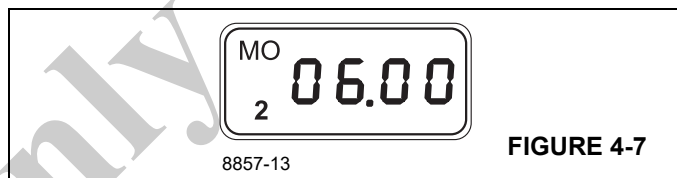
You can set three different automatic heating starts – up to seven days in advance.

**NOTE:** If you call up values in order to change them during the following setting process, they flash for 5 seconds. The entry must be made within this period. The value stops flashing after 5 seconds and is saved as the new value.

To retrieve a storage location, press the button (4), (Figure 4-2) once.

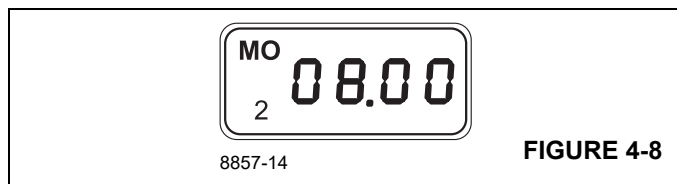
The following flash:

- the retrieved storage location, e.g. 2 (Figure 4-7)
- the last saved heating start, e.g. 6:00.



Set the time for the desired heating start e.g. 8:00 – button (6), (Figure 4-2) or (7), (Figure 4-2).

Wait for approx. 5 seconds until the weekday for the heating start flashes, e.g. MO for Monday (Figure 4-8).



Set the weekday for the desired heating start – button (6), (Figure 4-2) or (7), (Figure 4-2).

Wait for approximately 5 seconds until the current time is displayed, e.g. 14:00 (Figure 4-9).

Now, the new heating start has been saved and switched on.

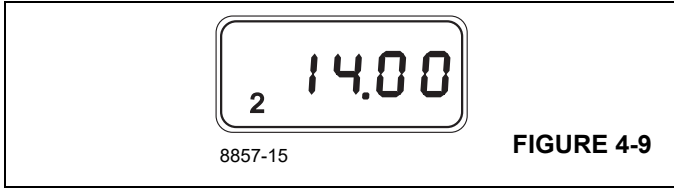


FIGURE 4-9

**NOTE:** If you wish to store one or two more heating starts, retrieve a new storage location using the button (3) and repeat the procedure. Refer to (Figure 4-7).

After you have saved the heating start, you can also set the heating period, by doing the following procedure.

**Setting the Heating Period**

After an automatic start, the heating system will switch off automatically as soon as the set heating period has elapsed.

The heating period applies to all saved heating starts.

Switch off the heating system using the button (5), (Figure 4-2).

Press the button (6) for longer than 3 seconds.

The last set heating period, e.g. 27 minutes (Figure 4-10), now flashes for 5 seconds in the display field.



FIGURE 4-10

Set the desired heating period with the buttons (6) and (7). You can set a heating period of 10 to 120 minutes.

Wait for approximately 5 seconds until the current time is displayed.

A new heating period has now been set.

**Switching the Heating Start ON and OFF**

To switch on an automatic heating start, you must retrieve the corresponding storage location.

To retrieve a storage location, press the button (1), (Figure 4-7) once.

The display field flashes for 5 seconds and a storage location is shown (e.g. 2) (Figure 4-11). The heating start at this storage location is now switched on.

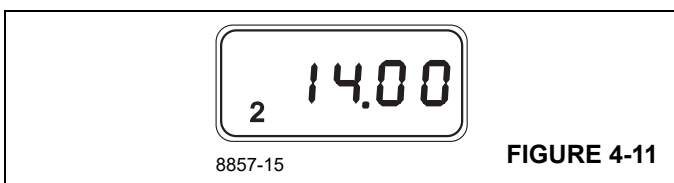


FIGURE 4-11

To switch on a different heating start, press the button (6) repeatedly until the desired storage location is displayed. This heating start is switched on as soon as the display stops flashing.

To switch off the automatic heating start, press the button (6) repeatedly until a storage location is no longer displayed.

**Switching OFF**

This section only describes how to switch off the heater manually. If the heater is switched on automatically, it switches off after the set heating period has elapsed, refer to the procedure above.

To switch off, press the button (5), (Figure 4-2) once. The heater goes off immediately.

**NOTE:** If you turn off the ignition while the heater is in operation, the heater will continue running for a certain period. You can set this remaining time by performing the following procedure.

**Setting the Remaining Time**

If the ignition is turned off with the heater turned on, the heater will remain switched on for the remaining time.

Switch on the heating system using button (4), (Figure 4-2).

Switch off the ignition.

The heating system will continue to run and the last set remaining time will flash, e.g. 48 minutes (Figure 4-12).



FIGURE 4-12

Set the desired remaining heating period with the buttons (6), (Figure 4-2) and (7) in the flashing display. You can set a remaining time of 1 to 120 minutes.

Wait for 5 seconds until the current time is displayed.

The remaining time is now set.

**Air-Conditioning System**

You can use the air-conditioning system to cool and dry the air in the superstructure cab when the engine is running.

**Switching ON**

At the heating/air conditioning control panel:

Press button (2), (Figure 4-13) once, heating off

Turn the knob (1) as far as it will go to cold position,

Turn the switch (5) to the required level.

For faster cooling, press in button (3) for Recirculation.

Switch the air conditioning on – press in button (4).

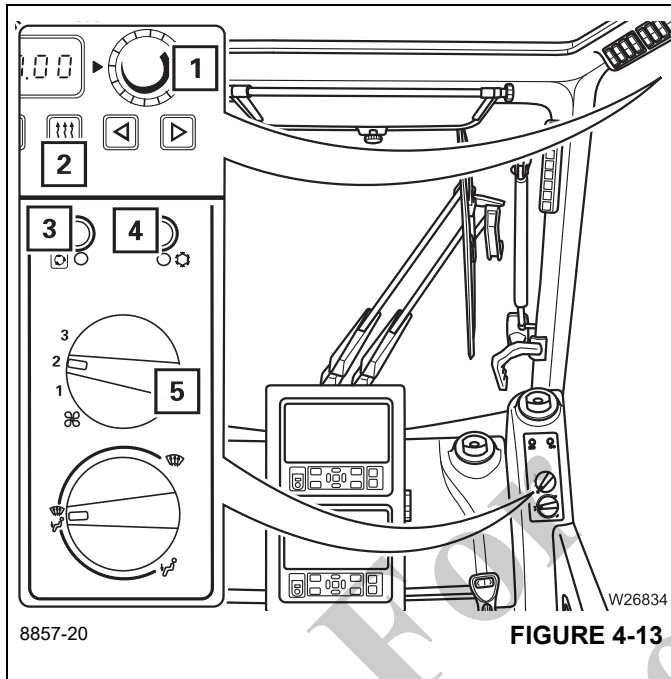


FIGURE 4-13

Set the air distribution and ventilation nozzles.

### Operation

Adjust the temperature and air flow as preferred by the operator.

If the truck crane has been exposed to strong sunlight for a long period of time, for example, the air conditioning system should initially be operated at the highest blower level with the engine running.

The door or at least the windows should be left open for a short while to air thoroughly. The cooling-down procedure can be accelerated by increasing the engine speed.

If the air-conditioning system is operated continuously, close the windows and the door to ensure sufficient cooling.

Set the fan to a lower level once the inside temperature has reached the desired temperature.

### Drying the Air

You can dry the air in the superstructure Cab.

Switch the air conditioning on – press button (4), (Figure 4-13) – the button will illuminate.

At the heater control panel:

- Press button (2) once, heating on,
- Switch (1) as far as it will go to warm.
- Turn the switch (5) to the required level.

- Button (3) on the Recirculated air symbol – lamp on.

When drying, the air conditioning system and the heating system work against each other. After drying, switch off the device that you do not require.

### Switching OFF

Switch the air-conditioning system off:

Press the button (4), (Figure 4-13) – button lamp goes out,

If you do not wish air to be circulated, turn the switch (5) to the off position.

### ANTI-LOCK BRAKE SYSTEM (ABS)

The crane has a standard brake system, equipped with an electronic speed monitoring and control system, Anti-Lock Brake System (ABS). ABS monitors wheel speed continuously but is not involved in controlling the wheel speed unless there is a reduction in traction. In normal braking applications, the standard air brake system is in effect.

**NOTE:** For more information on the ABS/ATC systems refer to the *Service Manual*.



### WARNING

For proper ABS operation, do not change tire sizes. The size of the tires installed during production are programmed into the electronic control unit. Installing different size tires could result in a reduced brake force, leading to longer stopping distances, which may cause serious injury or death.

There is a sensor installed in each wheel. Due to system constraints, only axles 2, 3 and 4 are monitored. The first steer axle has sensors installed but they are not connected. The sensors transmit information to the EC-60™ Premium electronic control unit (ECU). The ECU interprets the signals and calculates wheel speed, wheel retardation and a crane reference speed. If the calculations indicate a wheel lock-up situation, a signal is sent from the ECU to the appropriate ABS modulator valve to reduce braking pressure. During emergency braking, the modulator valve alternately reduces, increases or maintains air pressure in the brake chamber to prevent wheel lock-up.

During emergency or reduced-traction stops, fully depress the foot brake pedal until the crane comes to a safe stop. DO NOT PUMP the brake pedal. With the brake pedal fully depressed, the ABS will control all wheels to provide steering control and a reduced braking distance.

Although the ABS improves crane control during emergency braking situations, the operator still has the responsibility to change driving styles depending on the existing traffic, road

and/or weather conditions. For example, the ABS cannot prevent an accident if the driver is speeding or following too closely on slippery surfaces.

The ABS control unit contains a self-testing program that is engaged each time the ignition is turned on. The operator can verify the testing by listening for the burst of air from the ABS modulator valves actuating twice in series. To increase the sound, hold down the foot brake pedal when the ignition is turned on. The self-test is not finished and the indicator will stay on until the brake pedal has been pressed. The wheel speed sensors are tested when the crane starts to move.



**CAUTION**

If the ABS indicator comes on during driving or does not go out after a short time after turning on the ignition, take the crane to a Grove distributor to repair the ABS or brake system. The crane will not have full function of the ABS system making it harder for the crane to stop which could cause moderate to minor injury.

**ABS Power-Up Sequence**

When ignition power is applied, the ECU will illuminate the ABS indicator lamp (1), (Figure 4-14) for approximately three seconds, after which the lamp will extinguish if no diagnostic trouble codes are detected.

The ECU will cause the ABS indicator lamp to remain on whenever full ABS operation is not available due to a diagnostic trouble code, Refer to the *Service Manual* for trouble code information.

**ABS Switch Operation**

The ABS/Traction Control switch (3), (Figure 4-14) is used to diagnose system problems along with blink codes displayed on the ABS indicator, see the *Service Manual* for more information.

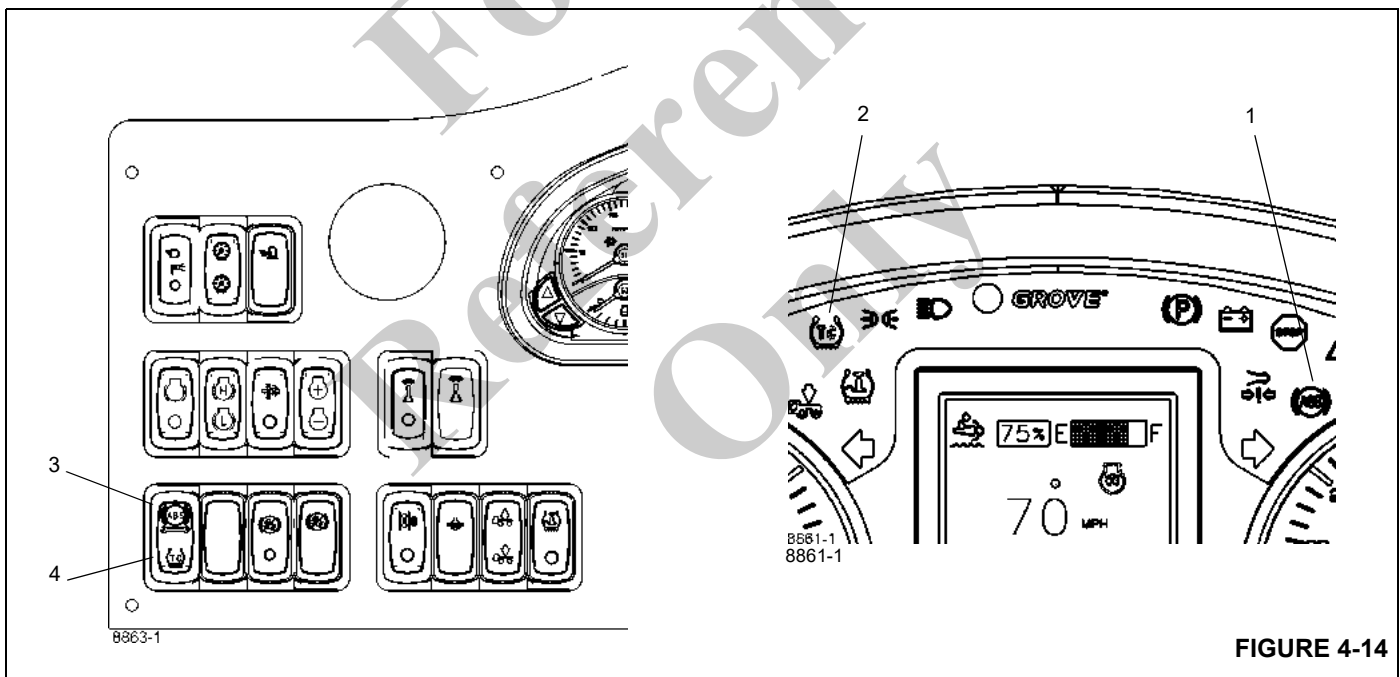


FIGURE 4-14

**AUTOMATIC TRACTION CONTROL (ATC) FUNCTIONAL OVERVIEW**

Just as ABS improves vehicle stability during braking, ATC improves vehicle stability and traction during vehicle acceleration. The EC-60™ Premium controller (ECU) ATC function uses the same wheel speed information and modulator control as the ABS function. The ECU detects excessive drive wheel speed, compares the speed of the front, non-driven wheels, and reacts to help bring the wheel

spin under control. The ECU is configured to use engine torque limiting and differential braking to control wheel spin. The ATC system is controlled by the ABS ECU. It helps improve traction on slippery or unstable driving surfaces by preventing excessive wheel spin. ATC also enhances vehicle stability by prevention of initial loss of traction.

**NOTE:** For more information on the ABS/ATC systems refer to the *Service Manual*.

## ATC Operation

During periods of wheel slip, the Electronic Control Unit enters an Automatic Traction Control mode. There are various modes of Automatic Traction Control.

### System Operation

- At speeds above 40 km/h (25 mph), the engine is throttled back via the data link to control wheel spin.
- At speeds below 40 km/h (25 mph), both engine control and differential brake control are activated as required to control wheel slip. Once triggered, differential braking mode remains active regardless of vehicle speed.
- The ATC off-road switch (4), (Figure 4-14) allows greater wheel spin (more torque) when activated. It is intended for adverse conditions, usually off-highway. The switch turns on ATC off-road when pushed once and off when pushed a second time and whenever the system goes through a power-up cycle.

The ATC Indicator (2), (Figure 4-14) will flash rapidly when ATC is operating.

### Component Function

When brake control is utilized, the ATC valve is activated, diverting supply tank air to the modulator valves on the drive axle(s). The ECU then activates the appropriate solenoids in order to apply a brake force to the spinning wheel. The Automatic Traction Control System cannot increase traction to a particular wheel; it can only utilize the available traction.

### Traction Control Power-Up Sequence

The ECU will illuminate the Automatic Traction Control (ATC) lamp (2), (Figure 4-14) for approximately 2.5 seconds when ignition power is applied, after which the lamp will extinguish, if no diagnostic trouble codes are detected.

The ECU will illuminate the ATC Indicator Lamp whenever ATC is disabled due to a diagnostic trouble code or when the ECU has been placed in the off-road mode. Refer to the *Service Manual* for trouble code information.

### Traction Control Switch Operation

To activate ATC off-road mode, push the bottom of the ABS/Traction Control Switch (4), (Figure 4-14) once. When the ECU is placed in the ATC off-road mode, the ATC indicator lamp will flash slowly at a rate of 1.0 seconds ON, 1.5 seconds OFF to notify the vehicle operator that the off-road mode is active.

Pushing the switch again will turn off the ATC off-road mode.

## Thermal (Brake Heat) Protection

To prevent excessive brake and drum temperature resulting from brake activity, ATC incorporates a brake temperature estimation algorithm to determine when differential braking mode should be suspended. The differential braking function is re-enabled after a cool-down period.

### ABS/ATC Partial Shutdown

Depending which component the trouble code is detected on, the ABS and ATC functions may be fully or partially disabled. Even with the ABS indicator lamp on, the ECU may still provide ABS function on wheels that are not affected. The ECU should be serviced as soon as possible. Refer to the *Service Manual* for more information.

## ENGINE OPERATION

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

### Engine Starting Procedure

**NOTE:** This crane is equipped with a Cold-Weather Starting Ether System. The operator should crank the engine normally in all temperatures.



### CAUTION

Before starting the engine, ensure the transmission is in neutral and the parking brake is applied.

### CAUTION

Never crank the engine for more than 30 seconds during an attempted start. If the engine fails to start after 30 seconds, allow the starter motor to cool for approximately two minutes before attempting another start.

If the engine fails to start after four attempts, correct the malfunction before attempting any further starts.

1. Set the parking brake to ON, position the transmission to neutral, and depress the service brake foot pedal.

**NOTE:** The engine will not crank unless the transmission shift lever is in neutral.

2. Turn the ignition switch to START and release immediately when the engine starts.
3. When starting has been accomplished, check the engine instruments for proper indications.

**WARNING**

Make sure that both air system pressures are in the normal operating range prior to disengaging the parking brake.

**CAUTION**

If oil pressure and/or temperature indicator(s) do not display the proper readings, shut down the engine and correct the malfunction before resuming operation.

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

**Cold Weather Starting**

**NOTE:** This crane is equipped with a Cold-Weather Starting Ether System. The operator should crank the engine normally in all temperatures.

The correct grade of oil for the prevailing temperature should be used in the crankcase to prevent hard cranking. Diesel fuel should have a pour point of 5°C (10°F) less than the lowest expected temperature.

**WARNING**

The cold start system on the engine operates automatically. If the engine does not start immediately, do not use cold starting fluid which could result in a minor explosion.

When the engine is cold, the symbol (Figure 4-15) goes out as soon as the engine is preheated (duration of up to 20 seconds).

**FIGURE 4-15**

Start the engine within the next 30 seconds; otherwise, you must switch on the ignition again and wait until the symbol (1) goes out.

**Particulate Filter Maintenance at Idle — Unexpected Idle Speed Increase**

If the engine is left at idle for significant periods of time

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

**Jump Starting the Crane**

Do not attempt to jump start the crane.

**CAUTION**

It is strongly recommended that the batteries not be “jumped” with a different vehicle, portable power pack, etc. The surge of power from these sources can irreparably damage the various electronic controls and computer systems. Jump starting the crane batteries with a different vehicle while the engine is running can damage the donor vehicle electronics as well if done improperly.

All crane models, particularly those produced since 2000, have multiple computer systems (crane control, RCL, engine and transmission control) that are highly susceptible to voltage/amperage surges in the electrical system.

The batteries should be completely disconnected from the crane electrical system and charged using a battery charger of appropriate voltage level or replace the batteries with fully charged batteries.

**Charging**

When charging the batteries, do not turn on the battery charger until the charging leads have been connected to the battery(s). Also, if the battery(s) are found to be frozen, do not attempt to charge them. Remove the battery(s) from the crane, allow them to thaw, and then charge the battery(s) to full capacity.

“Slow charging” is preferred to “fast charging”. Fast charging saves time but risks overheating the battery(s). Slow charging at six (6) amps or less develops less heat inside the battery and breaks up the sulfate on the battery plates more efficiently to bring the battery up to full charge. The use of a “smart charger” that automatically adjusts the charging amperage rate should be used.

**Idling the Engine**

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

**NOTE:** When prolonged engine idling is necessary, maintain at least 1200 rpm.

without reaching the minimum exhaust operating temperatures, the engine will automatically increase the engine idle speed to 760 rpm for 10 minutes to maintain the condition of the particulate filter. Unexpected idle speed

increase will occur if the crane's speed is zero, the clutch, brake and throttle pedals are released, the transmission is out of gear and after four continuous idle hours with exhaust temperature less than 120°C (248°F) or after eight continuous idle hours with exhaust temperature less than 250°C (482°F).

**NOTE:** The standard idle speed is 800 rpm, so unexpected idle speed increase is only an issue if the operator intentionally lowered the idle speed to a setting below 760 rpm.

## Racing the Engine

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

## Shutdown Procedure

1. Allow the engine to operate at fast idle speed for approximately five minutes to avoid high internal heat rise and allow for heat dissipation.
2. Position the ignition switch to OFF (vertical position).
3. Drain the fuel filter-water separator.



### WARNING

If an overheating condition necessitates an emergency shutdown, use caution when checking the radiator coolant. When loosening the radiator cap to relieve pressure, use a heavy cloth or gloves. Allow the engine to cool before removing the cap from the radiator.

### CAUTION

Correct the problem that caused the emergency shutdown before attempting a restart of the engine.

## Exhaust System Cleaning

For more information, refer to *Exhaust System Cleaning Indicator*, page 3-12.

The engine utilizes a particulate filter in the exhaust system for the reduction of emissions. Under normal operation, the

engine runs hot enough to turn soot into carbon dioxide and the particulates do not clog the filter. If the exhaust is not hot enough, the filter begins to clog and the exhaust filter light illuminates. If possible, the crane can be run at a road duty cycle at normal highway speeds to increase engine temperature and engage the automatic exhaust system cleaning process. If exhaust system cleaning does not occur, the exhaust system cleaning light will begin to flash. Eventually, if exhaust system cleaning does not occur, the Check Engine light will also illuminate and exhaust system cleaning will occur.



### WARNING

#### Burn Hazard!

During exhaust system cleaning, exhaust temperatures may reach 800°C (1500°F) which is hot enough to ignite or melt common materials. Do not park the vehicle near combustible materials and keep all materials at least 0.6 m (2 ft) away from the exhaust outlet.



Use caution near the exhaust tailpipe as it will also become very hot.

Exhaust system cleaning is automatic and can occur while parked or driving. Engine speed will increase and possibly reach between 1000 and 1500 rpm.

The exhaust system cleaning inhibit mode should be used if the crane cannot be parked in safe area regarding exhaust temperatures. Return the switch to the neutral position as soon as it is safe to do so.



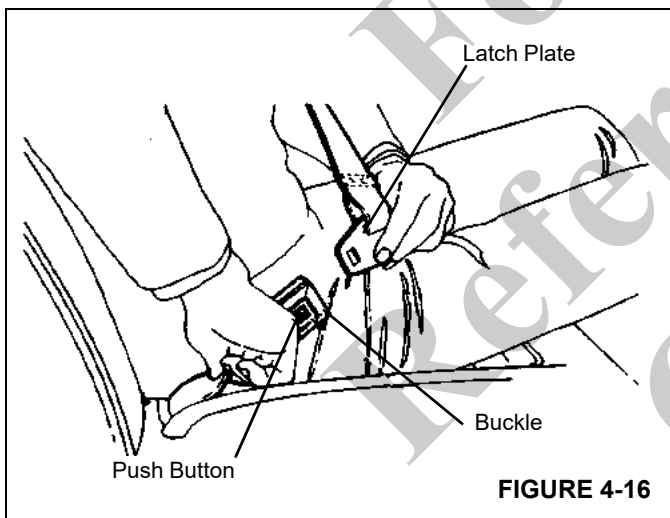
**Faults on the DEF System**

| Malfunction          |                                                                                   | Cause                                                                                                                                                                   | Solution                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lights up<br>Flashes |  | DEF level in tank at reserve level<br>DEF tank empty                                                                                                                    | Refuel DEF.                                                                                                                                            |
| Light up             |  | DEF reservoir sensor faulty<br>Error in the DEF dosing unit<br>DEF lines blocked<br>Temperature sensor faulty<br>Cable break in DEF system<br>Exhaust gas sensor faulty | Have the exhaust system checked by your local distributor or Manitowoc Crane Care, an authorized GROVE retailer or an authorized specialized workshop. |

**CRANE TRAVEL OPERATION**

**Active Restraints**

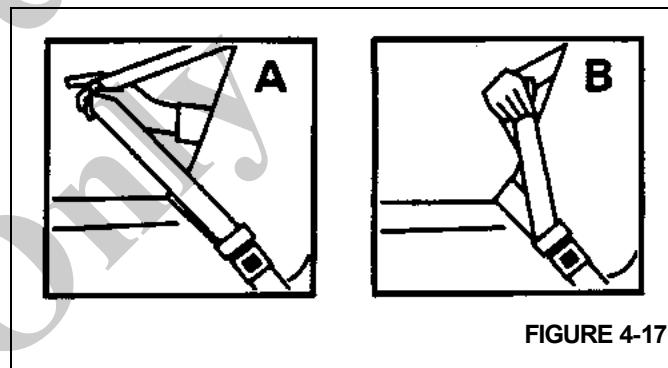
**Seat Belts**



1. Before fastening a seat belt, always adjust the driver's seat to the position in which you will drive.
2. Pull the belt across your lap and push the latch plate into the buckle until it clicks (Figure 4-16).
3. To reduce the risk of sliding under the belt during a collision, position the belt across your lap as low on your hips as possible and pull it toward the door to a snug fit so the retractor can take up the slack.

**NOTE:** The lap/shoulder belt is designed to lock only during a sudden stop or impact. At other times it should move freely.

4. If the shoulder belt is too snug, do the following:
  - a. Pull the shoulder belt out (A) at least 130 mm (5 in) so that when it is let go, it returns to your chest (Figure 4-17).
  - b. Then pull down on the shoulder belt (B) the least amount needed to ease pressure but no more than 25 mm (1 inch) and let go.



5. To reduce slack in the belt, pull the belt out as you did in Step 4a (above).



**DANGER**

Keep any shoulder belt slack to a minimum, no more than 25 mm (1 inch). Belt slack beyond the specified amount could significantly reduce the amount of protection in an accident because the belt is too loose to restrain you as intended.

6. To unfasten the belt, push in on the button in the center of the buckle. To store the belt, pull out about 180 mm (7 in) and let go. The belt should retract when the buckle is unlatched. To help prevent damage to the seat belt and



interior, before closing the door, be sure the belt is fully retracted and the latch plate is out of the way.

## Traveling - General

### CAUTION

Check cold tire pressure daily. Refer to tire inflation decal on crane.

Job site travel with deflated suspension must be limited to 8 km/h (5 mph). Attempting to travel at higher speeds may cause drive train component failure.

Do not move the crane until the superstructure has been secured as outlined below.

- Make sure that the axles and/or suspension are not overloaded. Refer to *Axle Weight Distribution Table*, page 4-23.
- Make sure that all boom sections are fully retracted or set to whatever extension is necessary for a balanced load on the axles.
- Make sure that the boom is fully lowered into the boom rest.
- If equipped, engage the optional 360° swing lock, except for trailing boom mode.
- Make sure that the swingaway, if so equipped, is properly stowed and secured.
- Remove the hook block or overhaul ball from the hoist cable(s) and stow securely before traveling or ensure overhaul ball is properly secured to the tie down provided for that purpose.
- Make sure that the outrigger jacks and outrigger beams are fully retracted and the floats are removed. Install outrigger beams locking stirrups for retracted position.
- Make sure that the jack floats are properly stowed in their holding racks.
- Make sure that the center front stabilizer is fully retracted.
- Make sure that the cover doors on the outrigger control panels, battery box, and sling box are closed.

- Close and/or install all superstructure cab windows and door.

## Jobsite Travel Configurations

When traveling on jobsites with moderate slope the crane shall be configured as shown in Table 1.

**NOTE:** The axle loadings are not evenly distributed for all configurations. These unbalanced axle load configurations should only be used occasionally and are not intended for extended travel distances.

- Crane Operator must ensure proper tire inflation and condition.
- For all the conditions, it is mandatory that the user verify that the slewing system is set for crane operation and not for trailing boom or boom dolly operation.
- Swing park brakes must be engaged and the swing brake hydraulic bypass valve must be closed.
- If the crane is equipped with an optional 360 swing lock it is recommended that this be engaged.
- Main Boom shall be fully retracted.
- When traveling with the boom over the front it is recommended to keep the boom in the boom rest.
- When required, the 3-sheave hook block or overhaul ball should be hanging 3 ft. below the sheaves and secured to prevent swinging. No loads shall be lifted.
- When traveling with the boom over the rear it is recommended that the boom elevation angle shall be between 0 degree and 10 degrees maximum.
- The travel surface should be firm with no holes or bumps exceeding a 4-inch variation over 3 ft. of travel (100 mm over 1 m).
- Maximum travel speed is restricted to 2.5 MPH (4 km/h).
- Take care that turning maneuvers are performed using the largest turning circle possible. Do not make any sudden movements.
- Travel with 26.2 ft. (8 m) lattice insert erected is not permitted.

Table 1

Driving Rigged Crane with Boom at 0° Angle – 3-Sheave Hook Block Reeved Stowed Boom Extension or with Boom Extension Removed

| Counterweight (LBS.) | Superstructure Position | Main Boom Angle (°) | Maximum Side Slope (%) | Maximum Side Slope (°) | Front Axle Loads (LBS.) | Rear Axle Loads (LBS.) |
|----------------------|-------------------------|---------------------|------------------------|------------------------|-------------------------|------------------------|
| < 16,000             | Over Front              | 0                   | 10.0                   | 5.8                    | See Weight Sheets       |                        |
| 16,000               | Over Front              | 0                   | 10.0                   | 5.8                    | 20,050                  | 31,300                 |
| 18,000*              | Over Front              | 0                   | 10.0                   | 5.8                    | 19,600                  | 32,700                 |
| 26,000               | Over Front              | 0                   | 6.0                    | 3.4                    | 17,000                  | 38,100                 |
| 36,000               | Over Front              | 0                   | 0.6                    | 0.3                    | 16,200                  | 45,550                 |
|                      | Over Rear               | 0                   | 4.8                    | 2.7                    | 22,900                  | 39,350                 |
| 48,500               | Over Rear               | 0                   | 3.9                    | 2.2                    | 28,250                  | 40,250                 |

For Reference Only

Table 1 Continued

**Driving Rigged Crane with 11.4 ft. (3.48 m) Extension Erected at 0° Offset Angle Overhaul Ball Reeved Over Extension, 3-Sheave Hook Block Removed**

| Counterweight (LBS.) | Superstructure Position | Main Boom Angle (°) | Maximum Side Slope (%) | Maximum Side Slope (°) | Front Axle Loads (LBS.) | Rear Axle Loads (LBS.) |
|----------------------|-------------------------|---------------------|------------------------|------------------------|-------------------------|------------------------|
| < 16,000             | Over Front              | 0                   | 10.0                   | 5.8                    | See Weight Sheets       |                        |
| 16,000               | Over Front              | 0                   | 10.0                   | 5.8                    | 20,600                  | 30,750                 |
| 18,000*              | Over Front              | 0                   | 10.0                   | 5.8                    | 20,150                  | 32,200                 |
| 26,000               | Over Front              | 0                   | 6.1                    | 3.5                    | 18,450                  | 37,950                 |
| 36,000               | Over Front              | 0                   | 0.9                    | 0.5                    | 16,750                  | 45,050                 |
|                      | Over Rear               | 0                   | 3.8                    | 2.2                    | 21,700                  | 40,600                 |
| 48,500               | Over Rear               | 0                   | 2.5                    | 1.4                    | 27,050                  | 41,500                 |

Table 1 Continued

**Driving Rigged Crane with 34.5 ft. (10.52 m) Extension Erected at 0° Offset Angle Overhaul Ball Reeved Over Extension, 3-Sheave Hook Block Removed**

| Counterweight (LBS.) | Superstructure Position | Main Boom Angle (°) | Maximum Side Slope (%) | Maximum Side Slope (°) | Front Axle Loads (LBS.) | Rear Axle Loads (LBS.) |
|----------------------|-------------------------|---------------------|------------------------|------------------------|-------------------------|------------------------|
| < 16,000             | Over Front              | 0                   | 10.0                   | 5.8                    | See Weight Sheets       |                        |
| 16,000               | Over Front              | 0                   | 10.0                   | 5.8                    | 22,450                  | 29,300                 |
| 18,000*              | Over Front              | 0                   | 10.0                   | 5.8                    | 22,050                  | 30,700                 |
| 26,000               | Over Front              | 0                   | 7.4                    | 4.3                    | 20,300                  | 36,450                 |
| 36,000               | Over Front              | 0                   | 1.7                    | 1.0                    | 18,100                  | 43,650                 |
|                      | Over Rear               | 0                   | 3.1                    | 1.8                    | 20,300                  | 41,550                 |
| 48,500               | Over Rear               | 0                   | 2.4                    | 1.4                    | 25,650                  | 42,450                 |



Table 1 Continued

Driving Rigged Crane with 57.6 ft. (17.56 m) Extension Erected at 0° Offset Angle Overhaul Ball Reeved Over Extension, 3-Sheave Hook Block Removed

| Counterweight (LBS.) | Superstructure Position | Main Boom Angle (°) | Maximum Side Slope (%) | Maximum Side Slope (°) | Front Axle Loads (LBS.) | Rear Axle Loads (LBS.) |
|----------------------|-------------------------|---------------------|------------------------|------------------------|-------------------------|------------------------|
| < 16,000             | Over Front              | 0                   | 10.0                   | 5.8                    | See Weight Sheets       |                        |
| 16,000               | Over Front              | 0                   | 10.0                   | 5.8                    | 23,750                  | 28,000                 |
| 18,000*              | Over Front              | 0                   | 10.0                   | 5.8                    | 23,300                  | 29,400                 |
| 26,000               | Over Front              | 0                   | 8.7                    | 5.0                    | 21,550                  | 35,150                 |
| 36,000               | Over Front              | 0                   | 2.6                    | 1.5                    | 19,400                  | 42,350                 |
|                      | Over Rear               | 0                   | 2.0                    | 1.1                    | 18,600                  | 43,200                 |
| 48,500               | Over Rear               | 0                   | 1.4                    | 0.8                    | 23,950                  | 44,100                 |

\* If Equipped

When traveling on jobsites with firm and level grades the crane shall be configured as shown in Table 2. The configurations provided have been calculated to evenly distribute crane axle loads.

- Crane Operator must ensure proper tire inflation and condition.
- Travel with the boom extension erected requires that the hook block be removed from the boom nose.
- The overhaul ball may be suspended from the end of the boom extension, but it is preferred that the overhaul ball be removed or secured to prevent swinging.
- For all the conditions, it is mandatory that the user verify that the slewing system is set for crane operation and not for trailing boom or boom dolly operation.
- Swing park brakes must be engaged and the slew brake hydraulic bypass valve must be closed.
- If the crane is equipped with an optional 360 swing lock it is recommended that this be engaged.
- The travel surface should be firm with no holes or bumps exceeding a 4-inch variation over 3 ft. of travel (100 mm over 1 m).
- Maximum travel speed is restricted to 1.0 MPH (1.6 km/h).
- Take care that turning maneuvers are performed using the largest turning circle possible. Do not make any sudden movements.
- Extend outrigger beams to Mid position, or farther if space allows during travel.
- Maintain clearance between ground and outrigger floats while traveling.
- Travel with 26.2 ft. (8 m) lattice insert erected is only permitted with counterweight configurations 36,000 lbs. and 48,500 lbs. (refer to last section of Table 2, (page 6).

Table 2

**Driving Rigged Crane Balanced Axle Load on Firm, Level Surface Stowed Boom Extension or 11.4 ft. (3.48 m) Boom Extension Erected at 0° Offset Angle 3-Sheave Hook Block Hanging from Boom Nose or Overhaul Ball Reeved Over Extension**

| Counterweight (LBS.) | Superstructure Position | Main Boom Angle (°) | Main Boom Length (ft.) | Boom Configuration |        |        |        |        | Front Axle Loads (LBS.) | Rear Axle Loads (LBS.) |
|----------------------|-------------------------|---------------------|------------------------|--------------------|--------|--------|--------|--------|-------------------------|------------------------|
|                      |                         |                     |                        | Tele 1             | Tele 2 | Tele 3 | Tele 4 | Tele 5 |                         |                        |
| 16,000               | Over Front              | 40                  | 63.8                   | 50                 | 50     | 0      | 0      | 0      | 26,400                  | 26,300                 |
|                      | Over Rear               | 81                  | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 26,400                  | 26,500                 |
| 18,000*              | Over Front              | 37                  | 63.8                   | 50                 | 50     | 0      | 0      | 0      | 26,800                  | 26,900                 |
|                      | Over Rear               | 80                  | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 27,000                  | 26,900                 |
| 26,000               | Over Front              | 18                  | 63.8                   | 50                 | 50     | 0      | 0      | 0      | 28,900                  | 28,800                 |
|                      | Over Rear               | 74                  | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 28,800                  | 29,100                 |
| 36,000               | Over Front              | 0                   | 77.2                   | 50                 | 50     | 50     | 0      | 0      | 31,000                  | 31,800                 |
|                      | Over Rear               | 67                  | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 31,300                  | 31,600                 |
| 48,500               | Over Rear               | 59                  | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 34,700                  | 34,500                 |

Table 2 Continued

**Driving Rigged Crane Balanced Axle Load on Firm, Level Surface 34.5 ft. (10.52 m) Boom Extension Erected at 0° Offset Angle Overhaul Ball Reeved Over Extension, 3-Sheave Hook Block Removed**

| Counterweight (LBS.) | Superstructure Position | Main Boom Angle (°) | Main Boom Length (ft.) | Boom Configuration |        |        |        |        | Front Axle Loads (LBS.) | Rear Axle Loads (LBS.) |
|----------------------|-------------------------|---------------------|------------------------|--------------------|--------|--------|--------|--------|-------------------------|------------------------|
|                      |                         |                     |                        | Tele 1             | Tele 2 | Tele 3 | Tele 4 | Tele 5 |                         |                        |
| 16,000               | Over Front              | 35                  | 50.2                   | 50                 | 0      | 0      | 0      | 0      | 26,000                  | 26,200                 |
| 18,000*              | Over Front              | 32                  | 50.2                   | 50                 | 0      | 0      | 0      | 0      | 26,500                  | 26,600                 |
| 26,000               | Over Front              | 34                  | 63.8                   | 50                 | 50     | 0      | 0      | 0      | 28,500                  | 28,700                 |
|                      | Over Rear               | 81.5                | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 29,400                  | 27,100                 |
| 36,000               | Over Front              | 20                  | 63.8                   | 50                 | 50     | 50     | 0      | 0      | 31,000                  | 31,800                 |
|                      | Over Rear               | 70                  | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 31,200                  | 31,200                 |
| 48,500               | Over Rear               | 62                  | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 34,300                  | 34,300                 |



Table 2 Continued

| Driving Rigged Crane Balanced Axle Load on Firm, Level Surface 57.6 ft. (17.56 m) Boom Extension Erected at 0° Offset Angle Overhaul Ball Reeved Over Extension, 3-Sheave Hook Block Removed |                         |                     |                        |                    |        |        |        |        |                         |                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------------|------------------------|--------------------|--------|--------|--------|--------|-------------------------|------------------------|
| Counterweight (LBS.)                                                                                                                                                                         | Superstructure Position | Main Boom Angle (°) | Main Boom Length (ft.) | Boom Configuration |        |        |        |        | Front Axle Loads (LBS.) | Rear Axle Loads (LBS.) |
|                                                                                                                                                                                              |                         |                     |                        | Tele 1             | Tele 2 | Tele 3 | Tele 4 | Tele 5 |                         |                        |
| 16,000                                                                                                                                                                                       | Over Front              | 24                  | 49.3                   | 0                  | 0      | 0      | 0      | 50     | 26,300                  | 26,200                 |
| 18,000*                                                                                                                                                                                      | Over Front              | 17                  | 49.3                   | 0                  | 0      | 0      | 0      | 50     | 26,800                  | 26,700                 |
| 26,000                                                                                                                                                                                       | Over Front              | 18                  | 50.2                   | 50                 | 0      | 0      | 0      | 0      | 28,700                  | 28,800                 |
| 36,000                                                                                                                                                                                       | Over Front              | 24                  | 63.8                   | 50                 | 50     | 0      | 0      | 0      | 31,200                  | 31,300                 |
|                                                                                                                                                                                              | Over Rear               | 81.5                | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 34,500                  | 28,200                 |
| 48,500                                                                                                                                                                                       | Over Front              | 14                  | 77.2                   | 50                 | 50     | 50     | 0      | 0      | 34,500                  | 34,400                 |
|                                                                                                                                                                                              | Over Rear               | 65                  | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 34,500                  | 34,500                 |

Table 2 Continued

| Driving Rigged Crane Balanced Axle Load on Firm, Level Surface 83.8 ft. (25.54 m) Insert + Boom Extension Erected at 0° Offset Angle Overhaul Ball Reeved Over Extension, 3-Sheave Hook Block Removed |                         |                     |                        |                    |        |        |        |        |                         |                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------------|------------------------|--------------------|--------|--------|--------|--------|-------------------------|------------------------|
| Counterweight (LBS.)                                                                                                                                                                                  | Superstructure Position | Main Boom Angle (°) | Main Boom Length (ft.) | Boom Configuration |        |        |        |        | Front Axle Loads (LBS.) | Rear Axle Loads (LBS.) |
|                                                                                                                                                                                                       |                         |                     |                        | Tele 1             | Tele 2 | Tele 3 | Tele 4 | Tele 5 |                         |                        |
| 36,000                                                                                                                                                                                                | Over Front              | 20                  | 50.2                   | 50                 | 0      | 0      | 0      | 0      | 31,500                  | 31,600                 |
|                                                                                                                                                                                                       | Over Rear               | 81.5                | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 34,200                  | 29,200                 |
| 48,500                                                                                                                                                                                                | Over Front              | 19                  | 63.8                   | 50                 | 50     | 0      | 0      | 0      | 34,700                  | 34,700                 |
|                                                                                                                                                                                                       | Over Rear               | 70                  | 36.6                   | 0                  | 0      | 0      | 0      | 0      | 34,900                  | 34,800                 |

Requirements and recommendations regarding operation and use of Grove Cranes are stated on decals and in this Operator Manual and other manuals provided with each specific model machine.

The crane owner must make sure that all personnel working on and around the crane are properly trained and thoroughly familiar with operational functions of the crane and safe operating and work practices. Personnel should be

thoroughly familiar with regulations and standards governing cranes and their operation. Work practices may vary slightly between government regulations, industry standards, local and job-site rules and employer policies so a thorough knowledge of and compliance with all relevant work rules is necessary.

## Axle Weight Distribution Table

| Description                                                                                                                                                                                              | CG To CL<br>Rear Bogie<br>cm (in) |          | Weight<br>kg (lb) |         | Front Axle<br>kg (lb) |         | Rear Axle<br>kg (lb) |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|----------|-------------------|---------|-----------------------|---------|----------------------|---------|
|                                                                                                                                                                                                          |                                   |          |                   |         |                       |         |                      |         |
| Maximum Tire & Wheel Loads Allowed                                                                                                                                                                       |                                   |          |                   |         | 23224                 | (51200) | 27216                | (60000) |
| Maximum Axle Loads Allowed                                                                                                                                                                               |                                   |          |                   |         | 23224                 | (51200) | 27216                | (60000) |
|                                                                                                                                                                                                          |                                   |          |                   |         |                       |         |                      |         |
| Standard Carrier Assy (8x4x4)                                                                                                                                                                            | 282.58                            | (111.25) | 18787             | (41417) | 9441                  | (20813) | 9346                 | (20604) |
| Superstructure Assy with both hoists, cables, lwr lift cyl pin                                                                                                                                           | -15.80                            | (-6.22)  | 5946              | (13108) | -167                  | (-368)  | 6113                 | (13476) |
| Boom Assy w/pivot pins                                                                                                                                                                                   | 454.36                            | (178.88) | 10578             | (23320) | 8547                  | (18843) | 2031                 | (4477)  |
| Lift Cylinder                                                                                                                                                                                            | 347.90                            | (136.97) | 1005              | (2216)  | 622                   | (1371)  | 383                  | (845)   |
| Complete Basic Machine: Carrier Assy, S/S Assy, 6-Section Boom, Cummins X12 Engine, 445/65R22.5 Michelin Front Tires, 315/80R22.5 Michelin Rear Tires, Full Fuel and Hydraulic Oil, cable on both hoists | 285.57                            | (112.43) | 36315             | (80061) | 18443                 | (40659) | 17873                | (39402) |
| <b>Boom Extensions</b>                                                                                                                                                                                   |                                   |          |                   |         |                       |         |                      |         |
| 10.5 - 17.6 m (34.5 - 57.6 ft) Manual Bi-fold Boom Extension                                                                                                                                             | 572.90                            | (225.55) | 1529              | (3370)  | 1557                  | (3433)  | -29                  | (-63)   |
| 10.5 - 17.6 m (34.5 - 57.6 ft) Hydraulic Bi-fold Boom Extension                                                                                                                                          | 585.88                            | (230.66) | 1603              | (3535)  | 1671                  | (3683)  | -67                  | (-148)  |
| 10.5 - 17.6 m (34.5 - 57.6 ft) Manual Integrated Heavy-Duty Bi-fold Boom Extension                                                                                                                       | 584.23                            | (230.01) | 1640              | (3615)  | 1704                  | (3756)  | -64                  | (-141)  |
| 10.5 - 17.6 m (34.5 - 57.6 ft) Hydraulic Integrated Heavy-Duty Bi-fold Boom Extension                                                                                                                    | 595.86                            | (234.59) | 1715              | (3780)  | 1817                  | (4006)  | -103                 | (-226)  |
| Boom Extension Carrier Brackets                                                                                                                                                                          | 474.50                            | (186.81) | 218               | (480)   | 184                   | (405)   | 34                   | (75)    |
| Boom Extension Carrier Brackets for Integrated Heavy Duty Extensions                                                                                                                                     | 497.36                            | (195.81) | 235               | (518)   | 208                   | (458)   | 27                   | (60)    |
| Hose Reel for Hydraulic Boom Extension                                                                                                                                                                   | 738.66                            | (290.81) | 212               | (468)   | 279                   | (615)   | -67                  | (-147)  |
| Aux Boom Nose                                                                                                                                                                                            | 1054.74                           | (415.25) | 86                | (190)   | 161                   | (356)   | -75                  | (-166)  |
| <b>Counterweights</b>                                                                                                                                                                                    |                                   |          |                   |         |                       |         |                      |         |
| 3000 lb counterweight (pin on with pins) on S/S                                                                                                                                                          | -246.05                           | (-96.87) | 1369              | (3019)  | -599                  | (-1321) | 1969                 | (4340)  |
| 5000 lb counterweight (pin on with pins) on S/S                                                                                                                                                          | -246.05                           | (-96.87) | 2277              | (5019)  | -996                  | (-2196) | 3273                 | (7215)  |
| 5000 lb counterweight (pin on with pins) on S/S                                                                                                                                                          | -246.05                           | (-96.87) | 2277              | (5019)  | -996                  | (-2196) | 3273                 | (7215)  |
| 3000 lb counterweight (pin on with pins) on S/S                                                                                                                                                          | -246.05                           | (-96.87) | 1369              | (3019)  | -599                  | (-1321) | 1969                 | (4340)  |

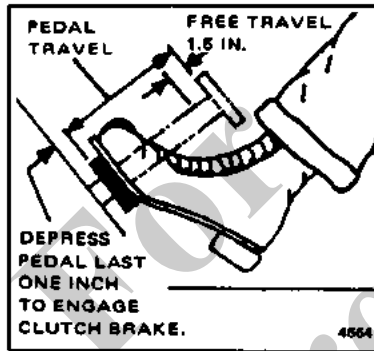
| Description                                                           | CG To CL<br>Rear Bogie<br>cm (in) |          | Weight<br>kg (lb) |         | Front Axle<br>kg (lb) |        | Rear Axle<br>kg (lb) |         |
|-----------------------------------------------------------------------|-----------------------------------|----------|-------------------|---------|-----------------------|--------|----------------------|---------|
|                                                                       |                                   |          |                   |         |                       |        |                      |         |
| 2000 lb counterweight (pin on) on S/S                                 | -246.05                           | (-96.87) | 907               | (2000)  | -397                  | (-875) | 1304                 | (2875)  |
| 3000 lb counterweight (pin on with pins) on carrier deck              | 481.97                            | (189.75) | 1369              | (3019)  | 1174                  | (2588) | 196                  | (431)   |
| 3000 lb counterweight (pin on with pins) on carrier deck              | 481.97                            | (189.75) | 1369              | (3019)  | 1174                  | (2588) | 196                  | (431)   |
| 2000 lb counterweight (pin on) on carrier deck                        | 481.97                            | (189.75) | 907               | (2000)  | 777                   | (1714) | 130                  | (286)   |
| 3000 lb counterweight (tray) on carrier deck                          | 481.97                            | (189.75) | 1361              | (3000)  | 1166                  | (2571) | 195                  | (429)   |
| 5000 lb counterweight (pin on with pins) on carrier deck              | 481.97                            | (189.75) | 2277              | (5019)  | 1951                  | (4302) | 325                  | (717)   |
| 10000 lb counterweight (non pin on) on carrier deck                   | 481.97                            | (189.75) | 4536              | (10000) | 3888                  | (8571) | 648                  | (1429)  |
| <b>Rigging Equipment</b>                                              |                                   |          |                   |         |                       |        |                      |         |
| 11 t (12 USt) Overhaul Weight - in stowage tray                       | 830.58                            | (327.00) | 294               | (648)   | 435                   | (958)  | -140                 | (-309)  |
| 11 t (12 USt) Overhaul Weight - tied to front bumper                  | 942.34                            | (371.00) | 294               | (648)   | 493                   | (1086) | -199                 | (-438)  |
| 10.9 t (12 USt) Overhaul Ball (Swivel) - in stowage tray              | 830.58                            | (327.00) | 253               | (558)   | 374                   | (824)  | -121                 | (-266)  |
| 10.9 t (12 USt) Overhaul Ball (Swivel) - tied to front bumper         | 942.34                            | (371.00) | 253               | (558)   | 424                   | (935)  | -171                 | (-377)  |
| 26 t (29 USt) Hookblock (1 sheave) - tied to front bumper             | 955.04                            | (376.00) | 323               | (712)   | 548                   | (1209) | -225                 | (-497)  |
| 45 t (50 USt) Hookblock (3 sheave) - tied to front bumper             | 955.04                            | (376.00) | 560               | (1235)  | 952                   | (2098) | -391                 | (-863)  |
| 75 t (83 USt) Hookblock (5 sheave) - tied to front bumper             | 955.04                            | (376.00) | 722               | (1592)  | 1227                  | (2704) | -504                 | (-1112) |
| 100 t (112 USt) Hookblock (7 sheave) - tied to front bumper           | 955.04                            | (376.00) | 1140              | (2513)  | 1936                  | (4268) | -796                 | (-1755) |
| Rigging                                                               | 170.18                            | (67.00)  | 45                | (100)   | 14                    | (30)   | 32                   | (70)    |
| Cribbing (in rear troughs)                                            | -35.56                            | (-14.00) | 181               | (400)   | -11                   | (-25)  | 193                  | (425)   |
| <b>Optional Equipment</b>                                             |                                   |          |                   |         |                       |        |                      |         |
| Driver                                                                | 762.00                            | (300.00) | 113               | (250)   | 154                   | (339)  | -40                  | (-89)   |
| Rear Frame Counterweight Mount                                        | -165.10                           | (-65.00) | 39                | (87)    | -12                   | (-26)  | 51                   | (113)   |
| Trailing Boom - Carrier Components                                    | -83.82                            | (-33.00) | 33                | (73)    | -5                    | (-11)  | 38                   | (84)    |
| Trailing Boom - Boom Brackets (use with trailing boom w/dolly option) | 822.40                            | (323.78) | 87                | (192)   | 127                   | (281)  | -40                  | (-89)   |
| Rear Access Ladder                                                    | -198.12                           | (-78.00) | 28                | (61)    | -10                   | (-21)  | 37                   | (82)    |
| 360° Swing Lock                                                       | 117.91                            | (46.42)  | 40                | (88)    | 8                     | (18)   | 32                   | (70)    |
|                                                                       |                                   |          |                   |         |                       |        |                      |         |



| Description                                             | CGToCL<br>Rear Bogie<br>cm (in) |           | Weight<br>kg (lb) | FrontAxle<br>kg (lb) | RearAxle<br>kg (lb)    |
|---------------------------------------------------------|---------------------------------|-----------|-------------------|----------------------|------------------------|
| <b>Substitutions and Removals</b>                       |                                 |           |                   |                      |                        |
| REM: Main Hoist Cable (820' of 3/4" Bridon Dyform 34LR) | -176.91                         | (-69.65)  | -483              | (-1065)              | 152 (335) -635 (-1400) |
| REM: Aux Hoist Cable (581' of 3/4" Bridon Dyform 34LR)  | -271.91                         | (-107.05) | -342              | (-754)               | 166 (365) -508 (-1119) |
| SUB: Automated Manual Transmission                      | 439.42                          | (173.00)  | 68                | (149)                | 53 (116) 15 (33)       |

**Manual Transmission Clutch Operation**

Clutch pedal adjustment (Figure 4-18) provides for approximately 38.1 mm (1.5 in) for free travel movement of the pedal after the first free travel of 12.7 mm (0.5 in) is passed before engaging the release bearing fully. It is important that this free travel be maintained to avoid possible excessive wear on the bearing and/or clutch slippage. Approximately the last 25 mm (one inch) of downward clutch pedal travel engages the clutch brake which overcomes the tendency of the clutch to rotate at high speed when the clutch is disengaged. A slight but definite resistance to clutch pedal downward movement will be felt at the last 25 mm (one inch) of travel.



Clutch Travel  
**FIGURE 4-18**

The clutch brake is particularly useful for initial gear engagement in the lower gears when going uphill, when the road speed drops off more quickly than the engine speed, requiring rapid shifts. The clutch brake **MUST NOT BE USED** when making a downshift.

**CAUTION**

Never fully depress the clutch pedal before the transmission is put in neutral. If the clutch brake is applied with the transmission still in gear, a reverse load will be put on the gears making it difficult to get the transmission out of gear. At the same time, it will have the effect of trying to stop or decelerate the crane with the clutch brake, with resultant rapid wear and generation of excessive heat, necessitating frequent replacement of the brake friction discs.

Clutch engagement should always be made smoothly while synchronizing accelerator movement necessary to move the crane.

Double clutching is a means of bringing the speed of the transmission gears into synchronization so the shift can be made without clash. The engine is used to speed up the countershaft for a downshift and to slow it down for an upshift. Double clutching operation is accomplished as follows.

1. Depress the clutch (do not engage clutch brake) and shift into neutral.
2. Release clutch pedal and accelerate the engine (when making downshift) or allow the engine to slow down (when upshifting) until engine speed approximately corresponds to road speed of the gear ratio selected.
3. Depress the clutch pedal (do not engage clutch brake) and shift into gear.
4. Release the clutch pedal. Always use the double clutching technique.

**NOTE:** Never allow your foot to ride the clutch pedal when the clutch is engaged. This causes premature release bearing failure and short clutch disc life.

**Shifting Gears - Manual Transmission**

Next to concern for safety, good shifting habits are probably the most important capability a driver can have. Knowing how and when to shift can return savings in trip time and operating expense.

In the early stage of moving the crane, keep the engine speed down to the actual power requirement but anticipate the next shift demand and do not cause the engine to labor with the next shift. Start the crane in the lowest gear necessary and with the first few shifts, develop only the engine speed (RPM) needed to get rolling. Then as you upshift, increase crane speed in each gear with a progressive increase in engine speed. It should seldom be necessary to go to governed engine speed in the lower gears except in a peak load situation, such as starting up a grade.



The biggest task when climbing a grade generally will be maintaining a reasonable rate of speed. When possible, pre-plan the climb and probable shift requirements according to traffic conditions and grade to be climbed.

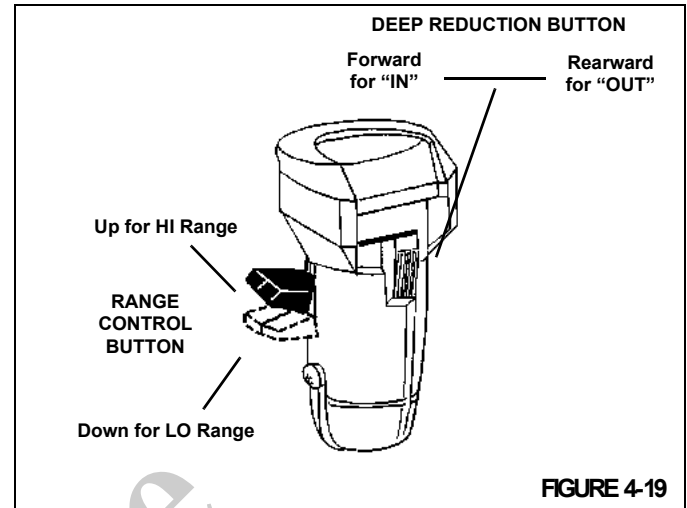
When approaching a hill, gradually move the throttle all the way down, if necessary, to maintain governed engine speed (RPM) and remain at full throttle as the crane starts up the grade. If there is sufficient power to maintain satisfactory road speed without the engine laboring, remain in that gear for the entire grade. Whenever a grade proves too great for the gear that you are in and the engine begins to labor, ease off the throttle as necessary and allow speed to drop off to the next lower shift point before downshifting to the next gear. Speed usually drops off quickly while shifting so the shift should be made rapidly. Additional downshifting should be performed in the same way, as necessary. By riding each gear down to the next shift point, you will get over your grades in the best possible time with minimum shifts.

On downhill operation, the engine provides most efficient braking when run at or near top engine speed in the operating range, BUT REMEMBER, the governor has no control over the engine speed when it is being pushed by a heavy crane. When the engine exceeds the rated governed engine speed while descending a grade or downshifting at the high end of the operating range, engine overspeed can result in serious damage. On downhill operation, use the vehicle brakes and gears in combination to keep crane speed under control and the engine below rated governed engine speed.

The transmission has 11 forward speeds and three reverse, consisting of a five speed front section and a three speed auxiliary section. The auxiliary section contains low and high range ratios, plus three deep reduction gears. The three lowest (LL1, LO, LL2) gear sets are used for road speed control and are not intended to be used as progressive shifts. The other four ratios are used twice, once in low (LO) range and once in high (HI) range.

As with any transmission gearing, shifting depends on proper synchronization. Never try to force the gear lever. During regular shifts, when moving the gear lever into the next gear position for engagement, the lever should be held lightly against the gear to be engaged. If gears are synchronized, engagement will be made immediately. If not synchronized, the flat gear teeth will rotate against each other until synchronization is reached. Do not jerk the shift lever into the next gear position or try to force gear engagement. If gears are out of synchronization, no amount

of force is going to make the engagement before synchronization.



All shifts are made with one lever and a Range Control Button (Figure 4-19) which is used only once during an upshift sequence, and only once during a downshift sequence. Always preselect the range shift. After preselection, the transmission will automatically make the synchronizer range shift as the shift lever passes through neutral.

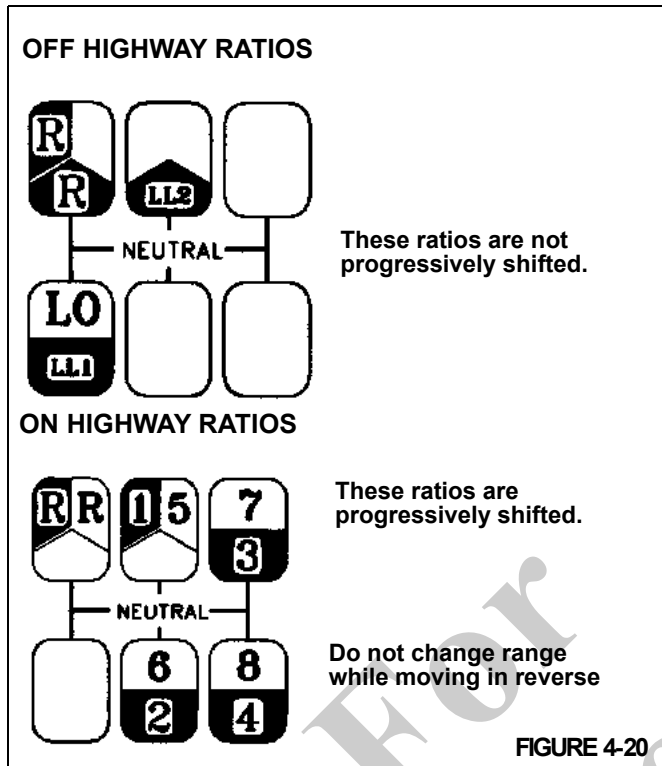
In the following instructions, it is assumed that the driver is familiar with motor trucks and tractors, and that he can coordinate the necessary movements of the shift lever and clutch pedal to make progressive and selective gear engagements in either direction, up or down.

### Initial Start-Up

#### CAUTION

Before moving the crane, make sure you understand the shift pattern configuration (Figure 4-20).

1. Make sure that the shift lever is in neutral and the parking brake is set.
2. Start the engine.
3. Allow air pressure to build up.
4. Apply the service brakes.



5. Make sure that the range button is down in the LO position.
6. If the crane is to be started in deep reduction (LL2 or LL1), move the deep reduction button forward to IN.
7. Depress the clutch pedal to the floor.
8. Move the shift lever to the desired initial gear.
9. Release the parking brakes.
10. Slowly release the clutch pedal and depress the foot throttle pedal.

### Up-Shifting

Refer to (Figure 4-21).

### CAUTION

Never move the deep reduction button or the range button with the shift lever in neutral while the crane is moving.

To make a deep reduction button shift from LL2 to 1st, proceed as follows:

1. Just before making the upshift, move the deep reduction button rearward to OUT while maintaining foot throttle position.
2. Immediately release the foot throttle pedal, depress the clutch pedal once to brake torque, release the pedal to

engage the clutch, allow the engine to decelerate until the shift is complete. Continue driving or up-shifting. The transmission shifts from LL2 to 1st when synchronous is reached.

3. To shift in LO range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (1st to 2nd to 3rd to 4th).

4. To shift from LO (4th) to HI (5th) range, proceed as follows.

When in the last gear position for LO range and ready for the next upshift, pull the range button up to HI and move the shift lever, double clutching, to the next higher gear position. As the shift lever passes through neutral, the transmission will automatically shift from LO to HI range.

### CAUTION

Never move the shift lever to the lower speed gear position after HI range preselection, or anytime the transmission is in HI range.

5. To shift in HI range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (5th to 6th to 7th to 8th).

### Down-Shifting

Refer to (Figure 4-21).

1. To shift in HI range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (8th to 7th to 6th to 5th).

2. To shift from HI (5th) to LO (4th) range, proceed as follows.

When in the 5th gear position for HI range and ready for the next downshift, push the range button down to LO and move the shift lever, double clutching, to the next lower gear position. As the shift lever passes through neutral, the transmission will automatically shift from HI to LO range.

3. To shift in LO range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (4th to 3rd to 2nd to 1st).

4. To make a deep reduction button shift from 1st to LL2, proceed as follows:

- a. Just before making the downshift, move the deep reduction button forward to IN while maintaining foot throttle position.

- b. Immediately release the foot throttle pedal, depress the clutch pedal once to brake torque, release the pedal to engage the clutch, and depress the foot

throttle pedal. The transmission shifts from 1st to LL2 when synchronous is reached.

### Shifting to Reverse

#### CAUTION

Never make a range shift or deep reduction shift while moving in reverse.

1. With the transmission in neutral, determine which reverse range is to be used. Move the range control button up for HI reverse or down for LO reverse.
2. Move the shift lever to the reverse position.
3. To engage deep low reverse, position the range control button in the down (LO) position. Move the deep reduction button to the forward (IN) position.
4. Carefully release the clutch, making sure deep reverse is fully engaged.

### Driving Tips

- For a smooth start, always select an initial starting gear that will provide sufficient reduction for the load and terrain.
- On later model cranes, do not progressively shift the road control ratios.
- Always use normal double clutching procedures when making lever shifts.
- Never slam or jerk the shift lever to complete gear engagement.
- Never coast with the gear shift lever in the neutral position.
- Never move the Deep Reduction Button or the Range Control Button with the gear shift lever in the neutral position while the vehicle is moving.
- Never make a range shift while operating in reverse.
- Never downshift at too high of a road speed.
- When slowing down, the proficient operator can downshift through all the individual gear speeds to prolong the life of the brakes.
- In most cases, depending on the engine and axle ratios, fuel can be saved by operating the crane at less than governed RPM while cruising in 8th gear.

### Automatic Transmission (Optional)

The optional automatic transmission has eleven speeds forward and three speeds reverse. The shift lever (Figure 4-21) has five positions; Reverse, Neutral, Drive,

Manual, and Low. The unlock trigger must be pressed to shift the lever. It has an upshift/downshift button to be used when in the manual or reverse modes.

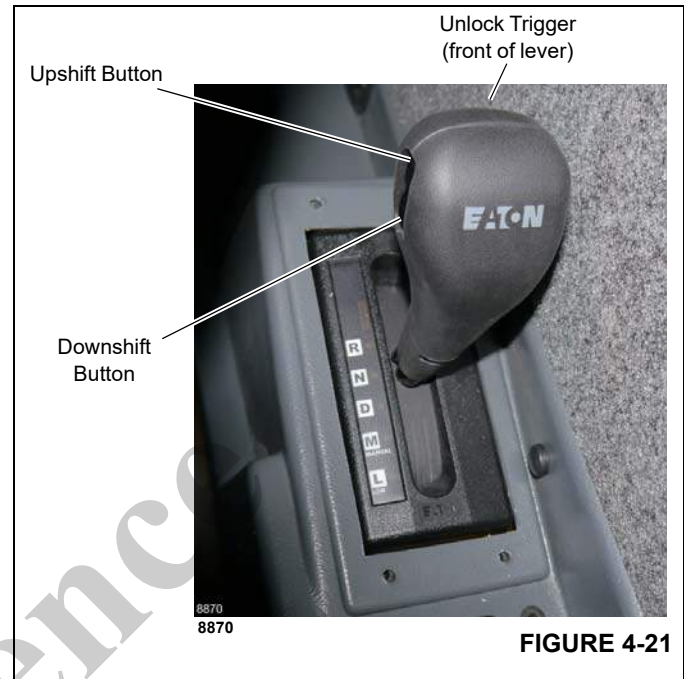


FIGURE 4-21



#### WARNING

Do not release the parking brake or attempt to select a gear until the air pressure is at the correct level

**NOTE:** If engine cranks in any gear other than neutral, service vehicle immediately.

Before working on a vehicle, parking the vehicle, or leaving the cab with the engine running, place the transmission in neutral, set the parking brakes, and block the wheels.

For safety reasons, always engage the service brakes prior to selecting gear positions from "N".

#### CAUTION

Battery (+) and (-) must be disconnected prior to any type of welding on any UltraShift® PLUS transmission equipped vehicle.

### Gear Display

The Gear Display, located in the front gauge cluster, indicates the current gear position of the transmission. During an upshift or downshift the gear display may momentarily flash the target gear position (Figure 4-22).

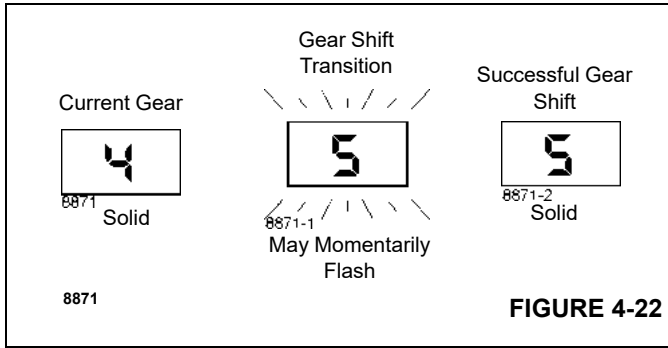


FIGURE 4-22

The “DASH” (Figure 4-23) indicates the transmission may be torque locked in gear. See Service Manual for more information.

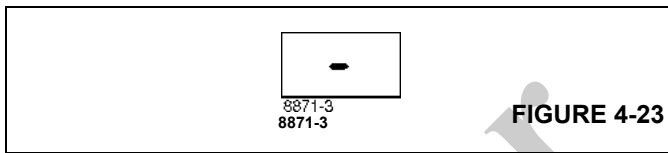


FIGURE 4-23

“CA” will appear in the gear display if a clutch abuse event is occurring (Figure 4-24).

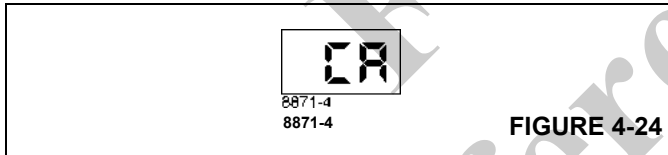


FIGURE 4-24

“AN” will appear in the gear display if the transmission goes into Auto Neutral (Figure 4-25).

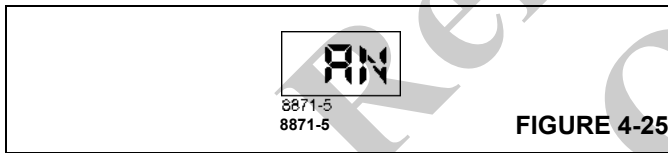


FIGURE 4-25

“F” will appear in the gear display if the transmission experiences a fault (Figure 4-26).

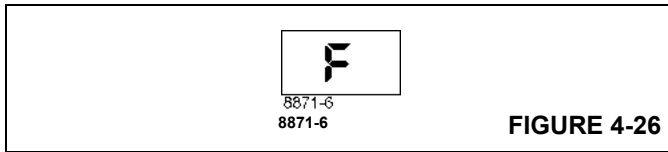


FIGURE 4-26

**Start-Up**

1. Turn the ignition key to “ON” and allow the transmission to power-up.

Engine cranking is delayed until the transmission power-up is complete and the gear display shows a solid “N.”

2. Start the engine.
3. Apply service brake.

With the Auto-Neutral feature, you need to release the park brake before selecting a gear. Otherwise the transmission will stay in Neutral.

4. Select the desired mode and starting gear on the shift console.

**NOTE:** The transmission will over-ride inappropriate start gear selections to avoid driveline damage.

5. Release the vehicle parking brakes.
6. Release service brake and apply accelerator.

**Power Down**

1. Select Neutral on the shift control.

If gear display does not show solid “N,” neutral has not yet been obtained.

**NOTE:** Neutral should always be reached before the transmission power down is performed except in cases of emergency.

2. Set the vehicle parking brakes.
3. Turn off the ignition key and allow the engine to shut down.

**Reverse Mode**

- Selects default Reverse gear (see Note).
- Each time Reverse is selected from Neutral, the default Reverse gear is engaged.
- The vehicle will not engage Reverse above 2 mph.

**NOTE:** If the driver attempts to select a non-neutral mode without depressing the service brakes the transmission will not shift into gear and transmission will have to be returned to Neutral. Depress the brakes before selecting the desired mode again.

**CAUTION**

Important: Launching the vehicle in high range increases the likelihood of clutch abuse, and depending on the level of usage, could have a detrimental impact on clutch life.

**Drive Mode**

- Automatically selects the start gear (see Note). The selected start gear will vary depending on several vehicle inputs like load, grade, and axle/transmission ratio. This start gear can be changed by using the up/down buttons, as long as the selection still falls into a gear that would allow the vehicle to launch without allowing the transmission to obtain damage.

- If the start gear is changed using the up/down buttons, it will remain as the default until the vehicle is powered down or the selection is changed with the buttons again.
- Automatically performs all up-shifts and down-shifts in all gears except 1st and Reverse.
- A shift can be advanced by pressing the up/down buttons when the transmission is near the shift point.
- The transmission may also deny a shift while ascending or descending grades if the load of the vehicle, and grade of the terrain in combination with the drivetrain ratio and engine torque will fall outside of the acceptable range to perform a shift. If the shift is denied it will sound a tone.

**NOTE:** Multiple gear up-shifts and down-shifts may be allowed when the shift buttons are pushed multiple times (Each button push equals one gear change request).

---

### CAUTION

Prior to ascending a steep grade the driver should reduce default start gear by one or ensure full throttle is applied for the duration of the grade so the vehicle maintains the proper engine and vehicle speed during the entire grade. Driver can button down by using the down arrow on the shift lever.

**NOTE:** If the driver attempts to select a non-neutral mode without depressing the service brakes the transmission will not shift into gear and the driver will have to return to Neutral and depress the brakes before selecting the desired mode again.

---

### CAUTION

If the driver depresses and holds both pedals (even if done accidentally) the launch will be abrupt and the engine and brake forces may rock and bounce the vehicle. Releasing either pedal will stop this immediately.

---

#### Manual Mode

MANUAL mode should be used whenever the driver wants to select the shifts instead of letting the transmission select them automatically. For example, when the driver is moving around the yard, over railroad tracks, or on steep grades.

- Driver manually selects the start gear and uses the up/down buttons to shift (see Note).
- System holds current gear unless otherwise prompted by using up / down-shift buttons, except for the "Transmission Override" conditions noted below.

**NOTE:** Multiple gear up-shifts and down-shifts may be allowed when the shift buttons are pushed multiple times (Each button push equals one gear change request).

**NOTE:** For optimal vehicle performance, it is recommended the vehicle be operated in "D" Drive mode.

#### Manual / Hold Mode

- The ability to restrict driver use of MANUAL mode is configurable. The default setting for this configuration is "Disabled" which allows standard MANUAL mode operation in all gears.
- When configured the MANUAL mode becomes a Hold gear function only (i.e. up/down buttons have no effect). In addition, provides an alert tone every 10 seconds.
- If the driver has selected MANUAL mode, and the transmission is in a gear equal to or greater than the configured Hold Gear; the transmission will remain in the current gear, up/down buttons are disabled (except for "Transmission Override" conditions).
- Gears lower than the configured hold gear will allow standard MANUAL mode operation.

---

### CAUTION

The transmission initiates upshifts from MANUAL and LOW for engine over speed protection. Some engines do not use the Eaton engine overspeed protection.

- The system will automatically shift or inhibit shifts to prevent over-speed or under-speed of the engine.
- The transmission may also deny a shift while ascending or descending grades if the load of the vehicle, and grade of the terrain in combination with the drivetrain ratio and engine torque will fall outside of the acceptable range to perform a shift. If the shift is denied it will sound a tone.

#### Transmission Manual Override

- If the vehicle is being back driven and the engine is approaching a higher than normal level, the transmission system will override the MANUAL position and perform an upshift.
- If the start gear is changed and it causes the engine to lug at takeoff, the transmission system will override the MANUAL position and select the best available gear.

**NOTE:** If the driver attempts to select a non-neutral mode without depressing the service brakes the transmission will not shift into gear and the driver will have to return to Neutral and depress the brakes before selecting the desired mode again.

---

### CAUTION

If the driver depresses and holds both pedals (even if done accidentally) the launch will be abrupt and the engine and brake forces may rock and bounce the vehicle. Releasing either pedal will stop this immediately.

---

#### Low Mode

LOW mode should be used to maximize engine braking and minimize the use of the brake pedal. For example, when driving down long grades or when coming to a stop.

- Selects lowest available gear for start gear. (see Note). The starting gear cannot be changed in LOW mode.
- If LOW is selected while moving, the transmission will not upshift (except for the Transmission Override conditions noted below). The transmission system will downshift at the earliest opportunity to provide maximum engine braking.

#### Transmission Low Override

If the vehicle is being back driven and the engine is approaching a higher than normal level, the transmission system will override the MANUAL position and perform an upshift.

---

### CAUTION

The transmission initiates upshifts from MANUAL and LOW for engine over speed protection. Some engines do not use the Eaton engine overspeed protection.

---

**NOTE:** At higher engine speeds additional engine braking in LOW Mode could cause a loss of traction when on slippery surfaces.

**NOTE:** LOW is the only means to achieve the curbing gear or 1st on the UltraShift PLUS Vocational Multipurpose Series (VMS) mixer models.

**NOTE:** If the driver attempts to select a non-neutral mode without depressing the service brakes the transmission will not shift into gear and the driver will have to return to Neutral and depress the brakes before selecting the desired mode again.

---

### CAUTION

If the driver depresses and holds both pedals (even if done accidentally) the launch will be abrupt and the engine and brake forces may rock and bounce the vehicle. Releasing either pedal will stop this immediately.

---

#### Hill Start Aid (HSA) (Optional)

##### (Optional Only Available with Automatic Transmission)

Prevents vehicle from rolling in an unintended direction for up to 3 seconds when launching vehicle on a grade.

Hill Start Aid defaults to the "ON" position. It can be turned "OFF" for a single launch by pressing and releasing the Hill Start Aid switch, refer to "Hill Start Aid (HSA) Switch (Optional)" on page 3-7.

When stopped on an incline, the Bendix system will apply the brakes on the rear axles. When you begin to pull away again, it will keep the brakes applied until the transmission tells the Bendix system to release them. The transmission won't tell Bendix to release the brakes until it senses the engine has produced enough torque to pull up the incline without drifting backwards. This is done to protect the drivetrain components downstream of the transmission.

## Differential Control Switches

There are two differential switches for controlling the tandem axle differentials, the Inter-Axle Control Switch and the Cross-Axle Control Switch.

The Inter-Axle Control Switch is used to control the locking capability between the front and rear axles in the tandem set. The switch has two positions, LOCK and UNLOCK.

The Cross-Axle Control Switch is used to control the locking capability between the right and left wheels in the tandem set. The switch has two positions, LOCK and UNLOCK.

---

### CAUTION

Do not engage the Inter-Axle Control Switch or Cross-Axle Control Switch while the wheels are actually slipping or spinning. This will result in damage to the drive train components.

Operation of the vehicle with differentials locked increases wear on tires, axles, drive shafts, and the transmission. These features should only be utilized as required for mobility.

#### Operating the Differential Locks

The Inter-Axle and Cross-Axle differential locks should preferably be engaged when the crane is STATIONARY but may be engaged when moving if the following conditions are met.

1. The crane is moving very slowly (creep speed).
2. The wheels are not spinning at the time of engagement.

When traveling with the lock(s) engaged do not deviate from a straight path more than is absolutely necessary.

1. When operating the differential lock(s), position the appropriate switch to the LOCKED position with the crane stationary or at slow speed.
2. If moving at slow speed, let up momentarily on the accelerator. This will engage the differential lock(s).
3. Proceed over the poor road condition cautiously.

When the adverse condition has passed, adhere to the following:

1. Position the appropriate differential lock(s) switch to the UNLOCKED position while maintaining slow speed.
2. Let up momentarily on the accelerator to allow the shift.
3. Resume driving at a safe speed.

## Brakes

---

### CAUTION

#### Avoid Crane Damage!

Do not engage the parking brake while the vehicle is moving. Damage to the crane can occur.

Disengage the parking brake before driving. Damage to the crane can occur.

---



### WARNING

If low pressure occurs and the buzzer sounds during operation, stop immediately and determine the cause of air loss. Downshift, use the engine as a brake, and make the final stop using a single brake pedal movement to avoid excessive loss of air and consequent sudden engagement of the automatic spring brakes.

Ensure the brakes are released before making any attempt to drive or drive train damage will result. The parking brake is to be used for parking only. Do not use the parking brake for stopping the crane except in case of an emergency, as a severe sudden stop will occur.

**NOTE:** If the pressure drops below 14 kPa/0.14 bar (2 psi) per minute with the engine stopped, have the air system checked for leaks.

This Grove crane is equipped with an anti-lock braking system (ABS) which controls the braking for all four axles.

For most effective braking and for maximum life from brake system components, the following suggestions are made.

- Air brakes have light pedal operation and the driver is cautioned to use extreme care in application until a good feel is achieved.
- With ABS, push the brake pedal while steering normally and keep your foot firmly on the brake pedal until the crane comes to a complete stop. Don't take your foot off the brake pedal or pump the brakes, because that will disengage the anti-lock system. It is normal to feel a pulsing sensation from the brake pedal with ABS brakes.
- Remember that you can steer while you are braking with anti-lock brake systems. Steer clear of hazards while keeping your foot firmly on the brake pedal. Be aware that your vehicle will not turn as quickly on a slippery road as it would on dry pavement.
- Use the engine as a brake when approaching a stop or when going down a long grade. On a downgrade, use the same transmission gear as would be needed to go up the same grade.



- When necessary to use brakes to reduce crane speed on a downgrade, use on-and-off application to minimize heat and wear. Do not hold a continuous brake application or slide the wheels.
- When driving on slippery pavement or under icy conditions, alternately and smoothly apply and release the brakes to prevent skidding. DO NOT pump the brakes.
- Keep the tires properly inflated. Improperly inflated tires can reduce the efficiency of the brakes.
- After driving through water, dry the brakes by applying them lightly while maintaining a slow forward speed with an assured clear distance ahead until brake performance returns to normal.
- Regularly check the air pressure gauge indication. System air pressure should never be allowed to fall below 310 kPa (45 psi). If both systems drop below 310 kPa (45 psi), the automatic spring brakes will actuate. Normal operating pressure range is 724 to 827kPa (115 to 135 psi).

**NOTE:** If the pressure drops below 14 kPa (2 psi) per minute with the engine stopped, have the air system checked for leaks.

- Parking brakes are controlled by a readily identified push-pull knob on the dash panel. To apply the parking brake, pull the knob out. To release the parking brake, push the knob in.

## Engine Brake

**NOTE:** Do not keep a foot lightly on the throttle pedal. This will cause the engine brake not to come on.

Pressing the clutch pedal will disable the engine brake.

By energizing the engine brake, the power producing diesel engine, in effect, becomes a power absorbing air compressor. To retard a crane on a downgrade using the Engine Brake, the operator selects a gear which will provide a balance between engine speed and road speed, then engages the engine brake. If the engine speed exceeds maximum rated RPM for a desired speed, a lower gear can be selected or intermittent use of the service brakes can be made. This selection of a lower gear will generally allow complete control of the crane by the engine brake, leaving the service brakes in reserve to be used for emergency

stops. With the engine brake turned on, the engine brake will not be energized until the momentum is driving the engine.

## Recommended Crane Shutdown Procedures

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



### WARNING

Never park the crane near holes, or on rocky or extremely soft surfaces. This may cause the crane to overturn, resulting in injury to personnel.

1. Park the crane on a proper surface with the outrigger jacks and beams fully retracted. Do not park in a location where it may become frozen to the ground or may settle unevenly and overturn.
2. Apply parking brakes and, if necessary, chock the wheels.
3. Make sure that all controls are in neutral or off.
4. Shut down the engine using the proper procedures as specified by this manual and the engine manual.
5. Perform any other specified procedures required at the end of the workday, i.e., drain water from the fuel filter/water separator, refueling, etc.
6. Close all windows.
7. Remove the keys from the crane.
8. Lock up the crane. Install vandal guards, if used.



### CAUTION

Step 9 does not take the place of the prestarting checks which must be performed just prior to using the crane at the next working day.

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

## UNATTENDED CRANE

### **WARNING** Tipping Hazard!

Changing weather conditions including but not limited to: wind, ice accumulation, precipitation, flooding, lightning, etc. should be considered when determining the location and configuration of a crane when it is to be left unattended.

Failure to comply with these instructions may cause death or serious injury.

The configuration in which the crane should be left while unattended shall be determined by a qualified, designated individual familiar with the job site, configuration, conditions, and limitations.

## SUPERSTRUCTURE CAB PLATFORM

To pull out the cab platform, pull a retaining pin (1), (Figure 4-27) out on one end of the platform while pulling on the lip of the platform. Do the same on the other end of the platform. Now use both hands to fully pull out the platform.



FIGURE 4-27

## PROPER LEVELING OF THE CRANE

The load capacity chart developed in accordance with ASME B30.5 is based upon the crane being level to within 1% of grade. If the crane is not level to 1% of grade, the capacity will be reduced. Therefore, whether lifting on rubber or outriggers, it is essential that the crane is level to within 1% of grade. The bubble level that is provided on the crane is calibrated to be accurate within 1% of grade.

To properly level the crane, the boom must be positioned over the front of the crane, fully lowered to horizontal and fully retracted (for cranes fitted with a boom rest, the boom should be stowed in the boom rest or boom dolly). Raise and level the crane using the outriggers; refer to *Setting the Outriggers from Outrigger Keypads*, page 4-35.

A working crane may settle during lifting operations. Frequently check the crane for level. When rechecking the crane for level, the boom must be positioned over the front of

the crane, fully lowered to horizontal and fully retracted (for cranes fitted with a boom rest, the boom shall be stowed onto the rest). If necessary, re-level the crane using the procedures under *Setting the Outriggers from Outrigger Keypads*, page 4-35.

## Bubble-Level Indicator Adjustment

**NOTE:** To check and adjust the auto level, refer to the *Auto-Level Procedure from Carrier / Superstructure (ODM)*, page 4-40.

The Bubble-Level Indicator should be checked periodically; if it is suspected that the bubble level indicator is out of adjustment. Verify and adjust the bubble level as follows:

1. Position the crane on a firm, level surface.
2. Extend and set the outriggers. Level the crane, as indicated by the bubble level indicator, using the outriggers.
3. Place a miracle pointer level, carpenter level, or similar type device on a machined surface such as the turntable bearing or bearing mounting surfaces.
4. Using the outriggers, level the crane as indicated on the leveling device used in Step 3.
5. Using the bubble level indicator mounting screws, adjust the bubble level indicator to show level.
6. Repeat the process, if necessary, on opposite side.

## USING THE OUTRIGGERS

Besides the remote control and superstructure cab, the carrier is equipped with remote mounted outrigger panels on each side of the carrier to allow the outriggers to be operated from the ground.

### **WARNING**

The Parking Brake must be engaged to run the Outriggers.

### **WARNING**

The outriggers and the center front stabilizer must be properly extended and set before any other operation of the crane is attempted. The center front stabilizer must be checked and properly set after any main jack is extended or retracted.

**NOTE:** The center front stabilizer will automatically retract when any main jack is retracted and the Cribbing Mode is not active.

## Setting the Outriggers from Outrigger Keypads

1. Set the parking brake before operating the outriggers.

**NOTE:** The two ground outrigger control panels **ONLY** operate when the carrier ignition is ON and the parking brake is set. The operator can only operate the outrigger beams on the side he is operating from. The jacks can be operated from either side.

Make sure the air suspension is deflated before raising machine on outriggers.

2. Position the outrigger floats directly out from each outrigger to where the outriggers will be properly extended.
3. Push the appropriate outrigger selector push button to operate the preferred main outrigger beam and push the outrigger extension/retraction push button to extend. The appropriate outrigger beam should begin to extend. Refer to "Engaging Outrigger Beam Extension Lock Pins" on page 4-40 if the crane is to be operated at one of the mid-extend positions.

**NOTE:** More than one outrigger beam may be extended at one time. However, to make sure that each outrigger is fully extended, each outrigger push button should be depressed individually and the outrigger extension/retraction push button momentarily pushed to EXTEND after multi-outrigger extension.

4. After all four outrigger beams have been fully extended, position the appropriate outrigger selector push button to FRONT JACK or REAR JACK and position the outrigger extension/retraction button to EXTEND.
5. Pick up outrigger float and slide onto the stud end of jack cylinder. Extend the jack cylinder to the ground. Insert both locking pins into the holes provided.

**NOTE:** More than one jack may be extended at one time.

6. With each jack float firmly touching the ground, push the front outrigger selector buttons to FRONT JACK and push the extension/retraction button to EXTEND. Extend the front jacks approximately 76 to 102 mm (3 to 4 in).
7. Push the rear outrigger selector button to REAR JACK and push the extension/retraction button to EXTEND. Extend the rear jacks approximately 76 to 102 mm (3 to 4 in).
8. Repeat the procedures in Steps 6 and 7 (above) until all wheels are clear of the ground and the crane is level, as indicated by the bubble-level indicator located at the bottom of each outrigger control box. If suspected that

the bubble level indicator is out of adjustment, refer to *Bubble-Level Indicator Adjustment*, page 4-34.

9. Then lower the center front stabilizer until it just contacts ground.
10. **OPTIONAL STEP:** If additional cribbing is required to obtain necessary ground clearance, use the Cribbing Mode, "Methods and Requirements for Activating Cribbing Mode" on page 4-35 (below).

## Additional Cribbing Needed to Increase Ground Clearance

Cribbing Mode is an outrigger mode that will allow the center front stabilizer (CFS) to be locked in position while the front jacks are raised to allow for additional cribbing to be inserted.

### Prior to Entering Cribbing Mode

Before entering the Cribbing Mode, set the crane up by following Steps 1 thru 5 under Section, *Setting the Outriggers from Outrigger Keypads*, page 4-35.

### Methods and Requirements for Activating Cribbing Mode

**NOTE:** The Remote Control does **NOT** have a Cribbing Mode Icon/Setting to activate Cribbing Mode.

There are two methods for activating Cribbing Mode:

1. Using the Carrier Outrigger Keypad Center Front Stabilizer (CFS) Push Buttons.

**OR**

2. Navigating the Superstructure Cab ODM Outrigger Screen and selecting the Cribbing Mode Icon.

The following are required for the Cribbing Mode to be activated:

- Boom must be directly over the front or over the rear (slew angle at 0 +/-2 degrees or 180 +/- 2 degrees).
- Boom to be elevated as needed to make sure that the load on the CFS is less than 4,500 psi. **NOTE:** The pressure indicator is presented on the ODM Outrigger Menu. On the Carrier, the pressure indicator is shown on the status of the CFS LED. Flashing RED LED indicates CFS pressure > 4500 psi (Solid RED LED for 1000 - 4500 psi).
- The Swing Brake must also be applied for Cribbing Mode to be active. **NOTE:** This occurs when Swing is disabled **OR** the operator has not slewed in the past 7 seconds (secures automatically). On the ODM Outrigger Screen, a flashing red "swing brake" Icon will appear to indicate when the swing brake is not engaged.

### Activating Cribbing Mode from Outrigger Keypads

On the Outrigger Keypad(s), to activate or deactivate Cribbing Mode (Figure 4-28), push the Center Front Stabilizer (CFS) push button twice.

**NOTE:** The red LEDs (1 thru 4), (Figure 4-29) over the Center Front Stabilizer (CFS), Auto-Level, and both rear jack push buttons are on when the Cribbing

Mode is active because the CFS motion is blocked. These LEDs also light if the pressure limit is reached in the CFS.

For additional information on the Outrigger Panel, refer to *Outrigger Controls and Indicators*, page 3-15 and the *Outrigger Control Panel*, page 3-16 and (Figure 3-7).

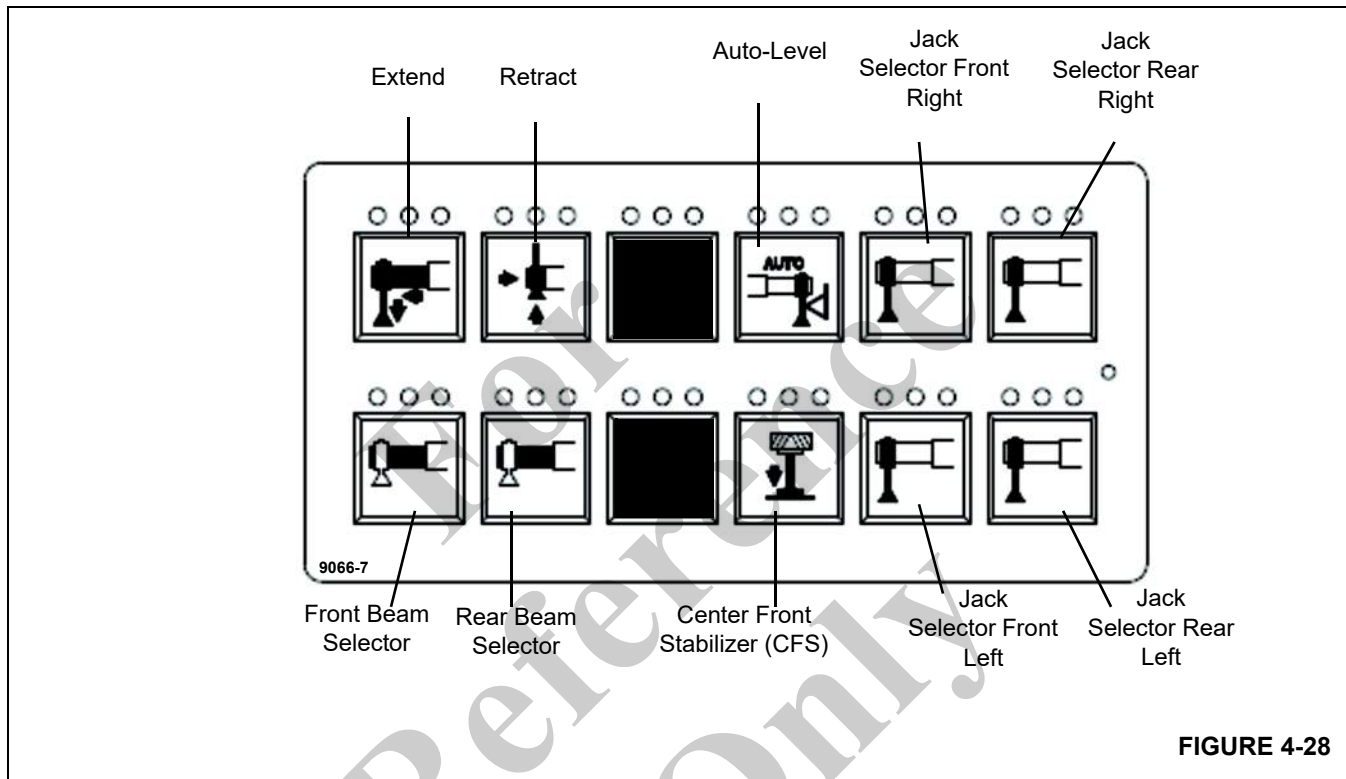


FIGURE 4-28

#### Enter Cribbing Mode from Outrigger Keypads

Use either side of the Outrigger Keypads.

1. Park the crane and lock the swing brake and the parking brake.
2. Fully extend the four outrigger jacks and level the crane.
3. Place cribbing beneath the Center Front Stabilizer (CFS).
4. Extend CFS until movement ceases.
5. Enter Cribbing Mode by quickly pressing the **Center Front Stabilizer** (Figure 4-29) push button twice. Cribbing Mode is now activated.

**NOTE:** During the course of operation on the Outrigger Panels, you will see the function colors during the operation. These are the Outrigger Operation Indicator Lights: **Green, Yellow and Red**. Refer to *Outrigger Operation Indicator Lights*, page 3-17. Red indicates something is wrong, STOP

(Prohibited). Yellow indicates an electrical issue and Green indicates Normal Operation.

**NOTE:** Cribbing Mode will automatically time out after 30 seconds if no jack operation is performed. If Cribbing Mode becomes disabled during this procedure, simply re-enable it by starting with Step 5.

6. Retract the main front outrigger jacks off the ground, by pushing the **Retract** push button and the **Jack Selector** push buttons together to move the main front outrigger jacks off the ground (Figure 4-28).

**NOTE:** If you are locked out of the Cribbing Mode due to over pressurization of the CFS, re-level the crane on the outriggers and rearrange your counterweight configuration or raise the boom.

7. Add cribbing under the main front outriggers.
8. Extend the main front outrigger jacks so that the Center Front Stabilizer (CFS) is unloaded and comes off the

ground/cribbing by pressing the Extend push button and both the Left and Right Front Jack Selector push buttons together (Figure 4-28).

9. Exit Cribbing Mode by double-tapping the CFS Button or let the Cribbing Mode time out.
10. Level the crane. Refer to *Proper Leveling of the Crane*, page 4-34 and proceed with crane setup.
11. Extend the CFS until movement ceases by pressing the Extend push button and the Center Front Stabilizer push buttons together (Figure 4-28).

**CFS Overload Condition Alert**



**WARNING**

**CFS Over Pressure Hazard!**

If at any time during this operation, the CFS is greater than 1000 psi, you will get a CFS overloaded ALERT (solid RED).

If the LEDs on the control panel illuminate, an alert will be given to indicate that there is a CFS overload condition.

**NOTE:** Flashing RED LED indicates CFS pressure > 4500 psi (Solid RED LED for 1000 - 4500 psi).

The LED's on the control panel will illuminate to indicate that the Center Front Stabilizer (CFS) is greater than 1000 psi.

1. If not pressing Outrigger Extend or Retract - red LEDs above the CFS and Auto Level will illuminate as shown in (1) and (3), (Figure 4-29).
2. If pressing Outrigger Extend - red LEDs above the CFS, Auto Level and both rear jacks will illuminate (same as with the Cribbing Mode Active Indicator) as shown in (Figure 4-29). Extending the front main jacks or retracting the rear main jacks will reduce CFS pressure.
3. If pressing Outrigger Retract - red LEDs above the CFS, Auto Level and both front jacks will illuminate (Figure 4-29). STOP, raise the CFS to adjust.

**NOTE:** An operator must be pressing either Extend or Retract for conditions in Steps 2 and 3 above.

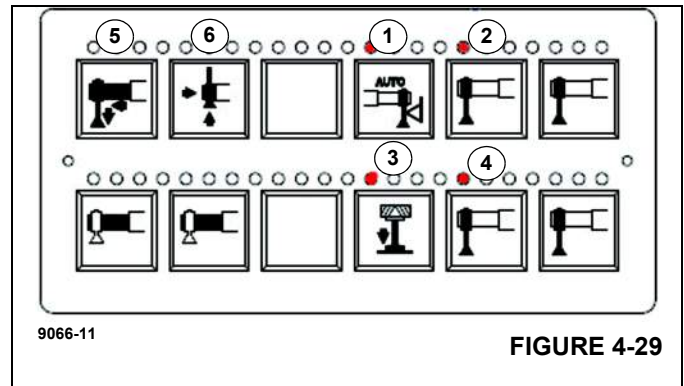


FIGURE 4-29

**Activating Cribbing Mode from Superstructure Cab ODM**

To activate Cribbing Mode from the Superstructure Cab ODM, select the Outrigger Menu (1), (Figure 4-30), select the Outrigger Jack (2), (Figure 4-31), and then toggle the Cribbing Mode Switch, that appears next to the Center Front Stabilizer (CFS) to the ON position (2), (Figure 4-32). For additional information on the Outrigger Menu, refer to *Outrigger Menu*, page 3-61.

**NOTE:** Cribbing Mode will automatically time out after 30 seconds if no jack operation is performed. If Cribbing Mode becomes disabled during this procedure, simply re-enable it by starting with Step 6 below.

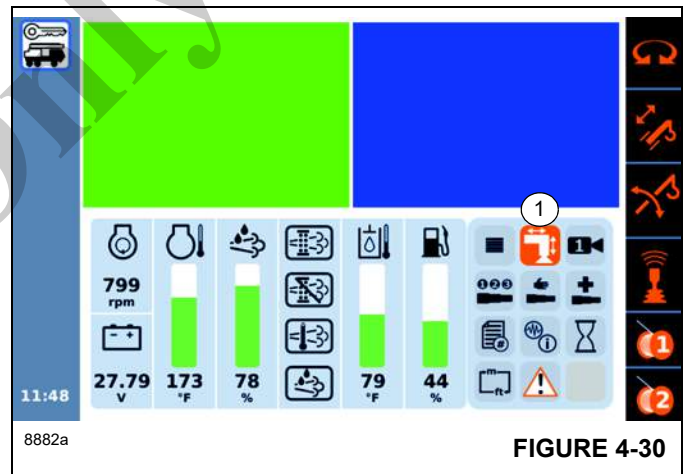


FIGURE 4-30



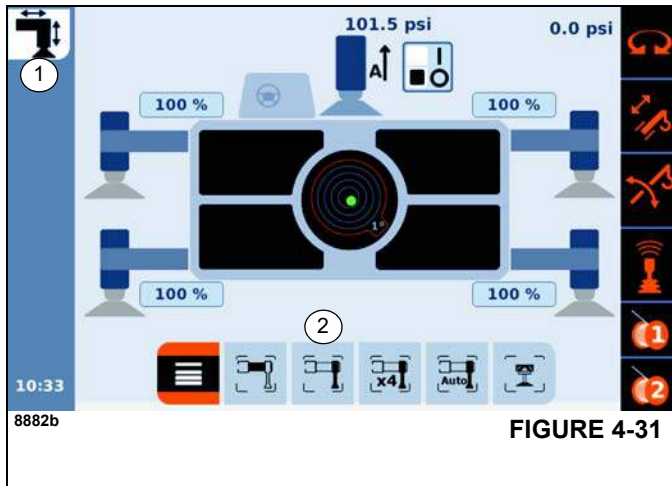


FIGURE 4-31

1. Start the engine from the Superstructure cab.
2. Go to the ODM, CCS Home Screen, Main Menu. Scroll to the Outrigger Icon (1), (Figure 4-30).
3. Open the Outrigger Screen (1), (Figure 4-31), scroll to, and select the Outrigger Jack Select (2), (Figure 4-31) from the Radio Buttons across the bottom of the Screen.
4. The Cribbing Mode Enable Switch (2), (Figure 4-32) will now appear next to the Center Front Stabilizer (CFS) at the top of the screen.

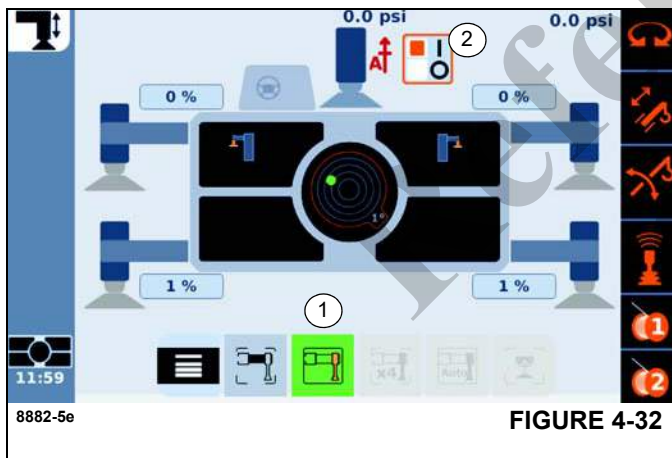


FIGURE 4-32

5. Fully extend all outrigger beams until the ODM reads 100% (1), (Figure 4-31). Fully extend the four outrigger jacks and level the crane.
6. Press the Center Front Stabilizer (CFS) (1), (Figure 4-33) to raise the CFS into place. Place cribbing beneath the CFS.
7. Extend CFS until movement ceases. **NOTE:** You will also see an increase in the CFS pressure (Figure 4-37).
8. Activate Cribbing Mode by using the Cribbing Mode Enable Switch:

- **Cribbing Mode Enable Switch:** Toggle the Cribbing Mode Enable Switch (2), (Figure 4-32) to the ON position (Orange indicates ON position), then press the Cribbing Mode on the ODM (1), (Figure 4-33).

Cribbing Mode is now activated.

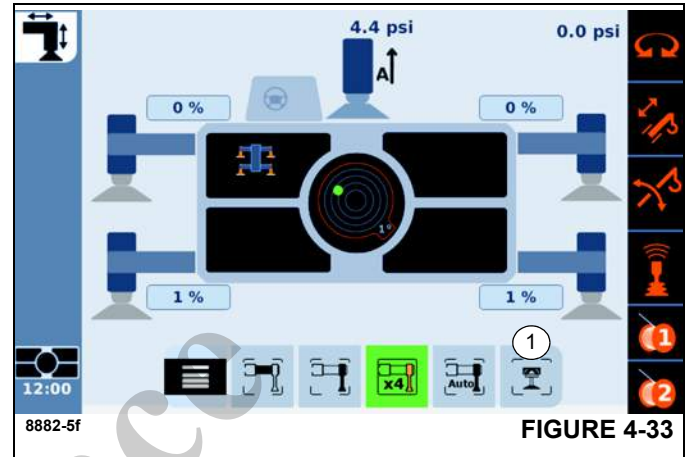


FIGURE 4-33

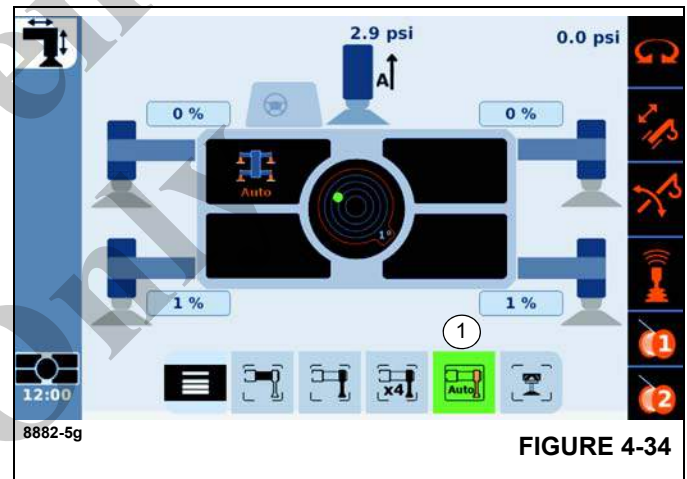


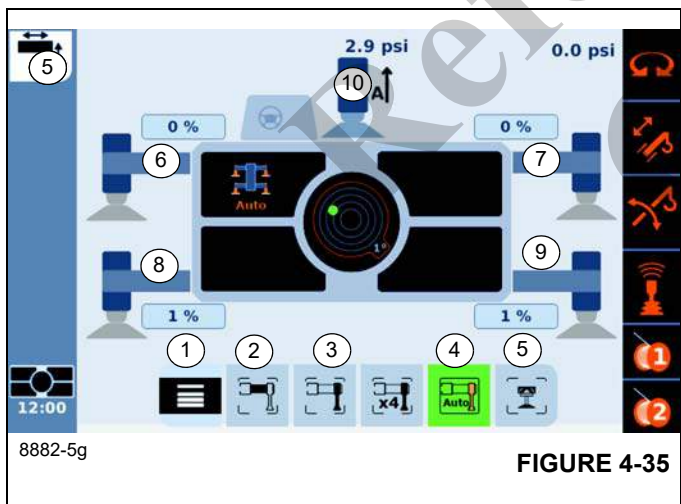
FIGURE 4-34

9. Retract the main front outrigger jacks off the ground by selecting the Retract push button and the Jack Selector (1), (Figure 4-32) push buttons together to raise the main front outrigger jacks off the ground.
10. Add cribbing under the main front outriggers.
11. Extend the main front outrigger jacks so that the Center Front Stabilizer (CFS) is unloaded and comes off the ground/cribbing by pressing the Extend push button and the Jack Selector push buttons together (Figure 4-32).
12. Level the crane. Refer to *Proper Leveling of the Crane*, page 4-34 and proceed with crane setup.
13. Extend the CFS until movement ceases by pressing the Extend push button and the Center Front Stabilizer push buttons together (Figure 4-33).

**Running Outriggers from the Superstructure Cab ODM**

Select the appropriate icon on the Outrigger Control Display to perform the function as noted in the table below (Figure 4-35).

|                               |                                               |
|-------------------------------|-----------------------------------------------|
| Exiting the Menu:             | Select symbol (1), (Figure 4-35) and confirm  |
| Outrigger Beam:               | Select symbol (2), (Figure 4-35) and confirm  |
| Outrigger Jack:               | Select symbol (3), (Figure 4-35) and confirm  |
| Auto Level                    | Select symbol (4), (Figure 4-35) and confirm  |
| Center Front Stabilizer (CFS) | Select symbol (5), (Figure 4-35) and confirm  |
| Front Left                    | Select symbol (6), (Figure 4-35) and confirm  |
| Front Right                   | Select symbol (7), (Figure 4-35) and confirm  |
| Rear Left                     | Select symbol (8), (Figure 4-35) and confirm  |
| Rear Right                    | Select symbol (9), (Figure 4-35) and confirm  |
| Center Front                  | Select symbol (10), (Figure 4-35) and confirm |



**Extend/Retract Outrigger Beams**

1. To extend or retract an outrigger beam or jack, select the beam/jack with the jog dial or control panel. (Left rear beam is selected and beam icon is green, meaning it is active).
2. Press and hold the outrigger beam/jack extend/retract pre-select switch (1), (Figure 4-35) on the left hand armrest control panel.
3. Release the switch when the extension/retraction is reached.



**Extend/Retract Outrigger Jack Cylinders**

To extend or retract the outrigger jack cylinder, refer to (Figure 4-35) and Table function.

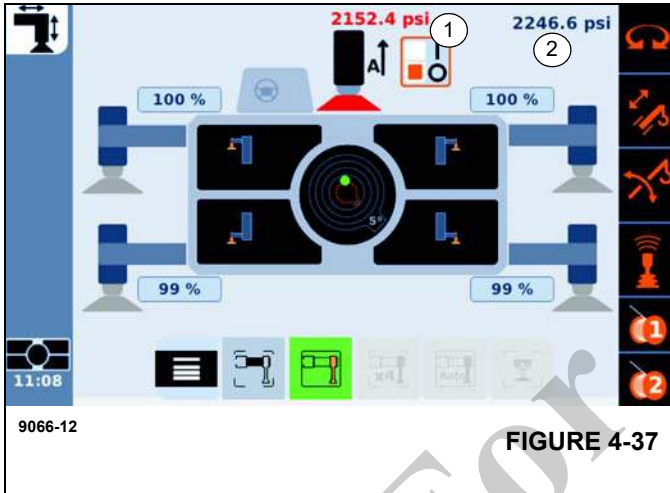
**CFS Overload Alert**

1. The ODM Outrigger Screen will indicate that the CFS is overloaded. Extending the front main jacks or retracting the rear main jacks will reduce CFS pressure.
2. The ODM CFS Overloaded ALERT will be on solid RED when the CFS is greater than 1000 psi (1), (Figure 4-37). The ALERT will be ON Flashing when the pressure is greater than 4500 psi and the ODM not on outrigger screen. Operator should reduce CFS pressure using means described in Step 1 above.
3. The Outrigger Circuit Supply Pressure value shows the pressure of the entire circuit (beams and jacks of all outriggers, including the CFS) and will be shown on the Outrigger Screen as shown in (2), (Figure 4-37).



- The Center Front Stabilizer (CFS) pressure value will also be shown on the Outrigger Screen.

**NOTE:** Cribbing Mode may be canceled by the user at any time by scrolling the selection to (1), (Figure 4-37) and pressing OK. Cribbing Mode reverts to inactive when the user exits the outrigger operating screen.



### Exiting Cribbing Mode

Exiting the Cribbing Mode may be accomplished by allowing the Cribbing Mode to automatically time out. Time out happens approximately 30 seconds after no outrigger functioning; OR simply by turning **OFF** on the ODM when that section is added.

### Auto-Level Procedure from Carrier / Superstructure (ODM)

To activate auto-level, press and hold the auto-level button and the retract button. The system will make a series of retracting movements of the outrigger jacks, pausing between each movement to assess the levelness of the crane. When the movements have been completed, verify visually that all tires are **OFF** the ground. If any of the tires are still in contact with the ground, consider adding cribbing under the outriggers, or leveling the crane manually.

Once the crane has been leveled and tire lift-off verified, extend the center front outrigger jack. Verify visually that the center front outrigger jack has made contact with the ground

or outrigger mat. Also refer to *Auto-Level Push Button*, page 3-17.

- Position the outrigger beams to the desired length and make sure that the pads are properly installed.
- Fully extend all four main jacks.
- A.** From either the Carrier outrigger keypad, press and hold the auto-level button (1), (Figure 4-29) and either extend/retract (5), (6), (Figure 4-29) keys,

- OR -

- From the Superstructure Cab ODM, select the auto-level button (1), (Figure 4-34). The crane will:
  - Briefly extend all 4 jacks.
  - Briefly retract all 4 jacks.
  - Begin adjusting by lowering 2 jacks at once until level position is reached.
  - There may be several long pauses after lowering for the level sensor to stabilize – keep holding the buttons through these.
- Leveling is complete when out-of-level by less than 0.1 degrees. And, on the outrigger control panels, green and yellow LED's will alternate - this is intended as a reminder to proceed to set the center front stabilizer.

**NOTE:** After using auto level, the center front stabilizer must be lowered.

- Extend the Center Front Stabilizer (CFS) as shown in (4), (Figure 4-29).

### Engaging Outrigger Beam Extension Lock Pins



#### WARNING

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

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

Partial extend positions can be located at 57 or 79 percent position (Figure 4-38).



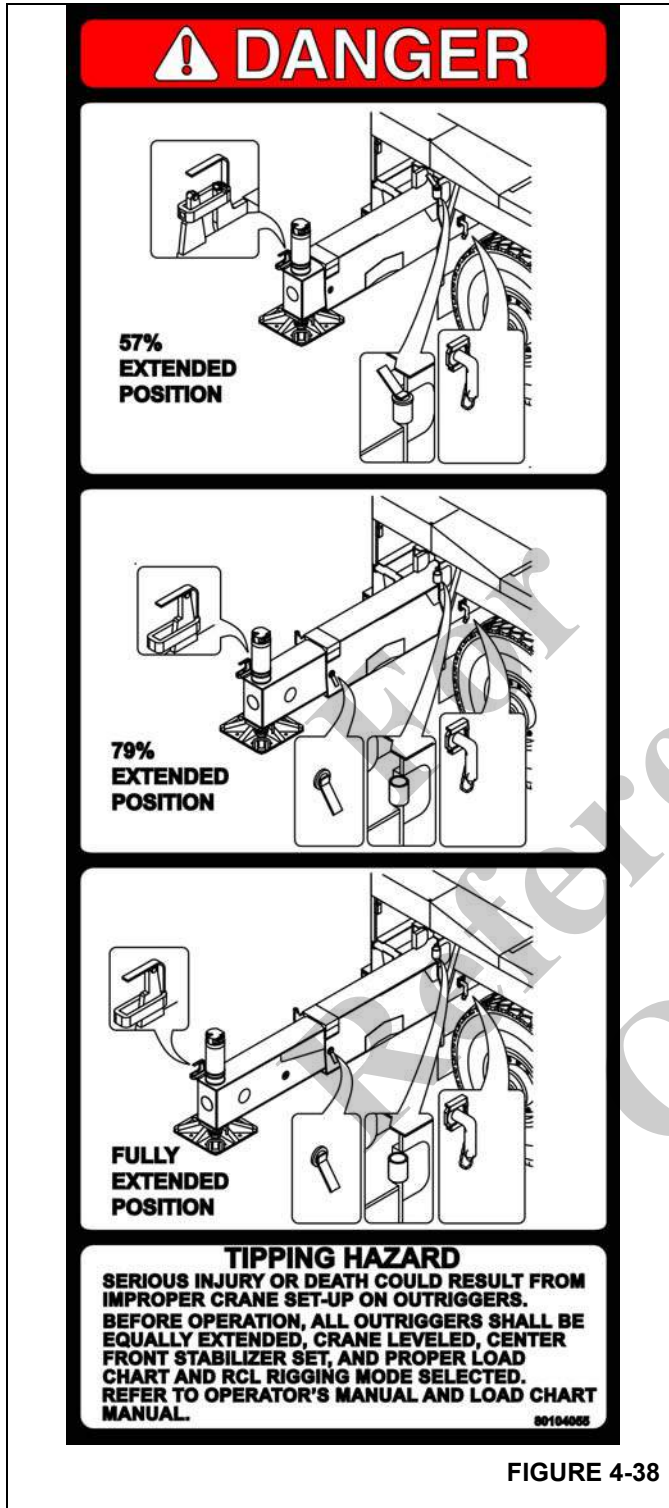
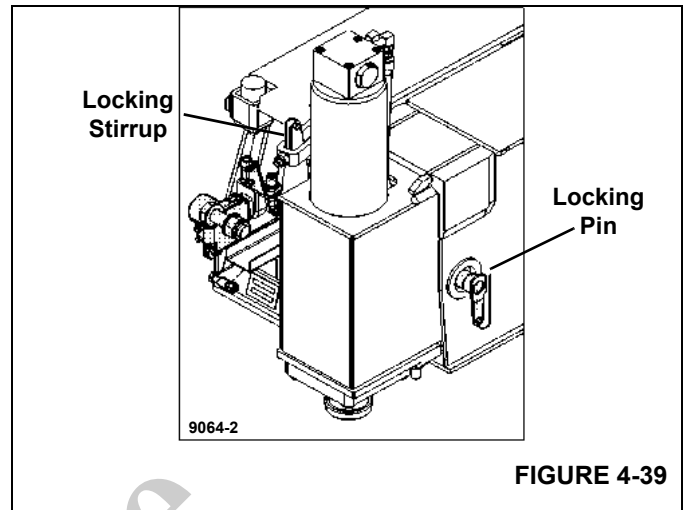


FIGURE 4-38

1. With the outriggers fully retracted, disengage the locking stirrup from its stowed position, refer to (Figure 4-39).



2. Slowly extend the outriggers to the partial extend position until the outer extension beam and inner extension beam holes align.
3. Remove locking pin from stowage bracket located next to the frame.
4. Insert locking pin into Partial/Mid Extension locking holes. If pin will not freely slip into the hole, slowly extend or retract the outrigger beam to allow the locking pin to engage into the holes.
5. Rotate pin until retention pin aligns with slot in locking hole of outrigger beam.

**NOTE:** Rotate handle on the lock pin until lug is pointing downward to lock pin in secured position.

### Outrigger Monitoring System (OMS)

**! WARNING**  
Tipping Hazard!

The crane can overturn, causing death or serious injury or sustain serious damage from operating the crane from outrigger positions other than the position specified on the selected load chart.

The OMS is an operator's aid only, measurements from the OMS system are not used by the crane control system. The operator must select the proper rigging code.

The Outrigger Monitoring System (OMS) aids the operator by automatically identifying the horizontal position of each outrigger beam. The OMS uses four sensors, one per outrigger beam, to identify when an outrigger beam is positioned to one of four pre-defined locations, including retracted, partial extend, mid-extend, and full extend.

Set up of the outriggers is the same for cranes equipped with OMS; refer to *Outrigger Controls and Indicators*, page 3-15 or *In the Outrigger Menu*, page 3-39. The CCS only indicates the horizontal position of the outrigger beam and should not be used to confirm proper crane setup.

When an outrigger is not properly deployed the outrigger symbol will light up red and the operator will need to properly deploy the outriggers for the rigging code selected.

**NOTE:** If an outrigger symbol and its associated distance number does not display then that sensor is not properly calibrated or has failed.

## Stowing the Outriggers

**NOTE:** Park the crane. Lock the swing brake and the parking brake.

1. Push the center front stabilizer control button to **ACTIVATE** and retract the center front stabilizer.
2. Press both the left rear jack button and the right rear jack button, plus the retract button until the rear jacks have retracted several inches.
3. Press both the left front jack button and the right front jack button, plus the retract button until the front jacks have retracted several inches.
4. Repeat steps 2 and 3 until the crane is resting on all wheels and the jack floats are several inches off the ground.



### CAUTION

Keep feet and hands clear of the floats when unlocking them from the jacks.

5. Release the locking levers and allow the floats to drop to the ground.
6. Continue to retract the jacks until fully retracted.
7. Refer to "Stowing the Partial/Mid Extension Lock Pin" on page 4-42 if the crane was operated at the partial or mid-extend position. Push the appropriate outrigger selector button to **FRONT EXTENSION** or **REAR EXTENSION** and push the Extension/Retraction Switch to **RETRACT** to retract each outrigger beam.

**NOTE:** More than one outrigger beam may be retracted at a time.

8. Stow the outrigger floats.

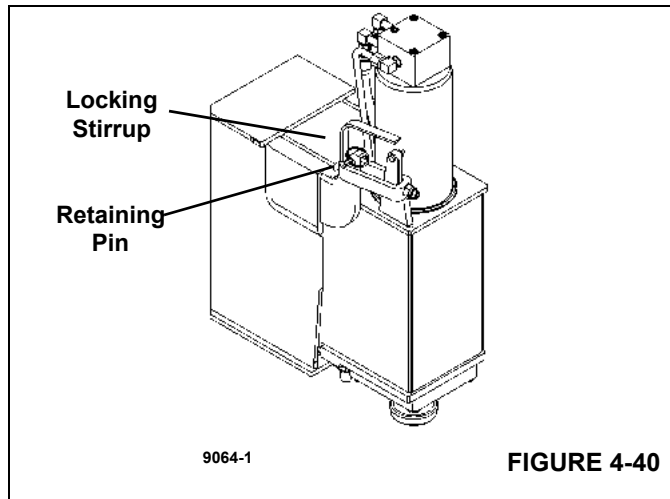
## Stowage of Outriggers Using Cribbing Mode

1. Start with the crane properly supported on all outriggers on cribbing which requires the use of Cribbing Mode.
2. Retract all jacks normally (the CFS retracts completely), and as much as possible.
3. Extend the front jacks a minimal amount (1-2") to allow room to create clearance once the center front stabilizer is extended in the next step.
4. Extend the center front stabilizer until movement ceases.
5. Enter the Cribbing Mode. Refer to *Methods and Requirements for Activating Cribbing Mode*, page 4-35.
6. Retract the main front outrigger jacks off the cribbing (this uses the allowance created in Step #3 above).
7. Remove the cribbing from the main front outriggers.
8. Extend the main front outrigger jacks so that the center front stabilizer is unloaded and comes off the ground/cribbing.
9. Exit Cribbing Mode, then fully retract all jacks.

## Stowing the Partial/Mid Extension Lock Pin

**NOTE:** If the lock pin is wedged in the hole in the outrigger beam, it may be necessary to jog the outrigger Extension/Retraction pushbutton slightly while pulling on the pin.

1. Rotate handle of lock pin to align guide pin with slot in hole while pulling on pin and return pin to stowed position.
2. Remove locking pins from side of the outrigger beam. If the pin will not freely disengage from the hole, slowly extend or retract the outrigger beam to allow the locking pin to disengage from the holes.
3. Fully retract outriggers.
4. Install the locking stirrup over the retainer lug and install retaining pin. Refer to (Figure 4-40).
5. Stow locking pin in the pin stowage bracket located at the frame.
6. Install travel locking pin in outrigger box before traveling to prevent beam creep. Refer to (Figure 4-40).



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

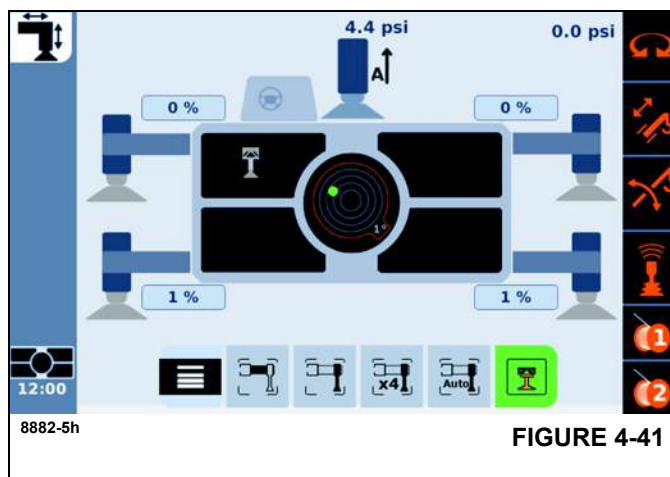
### Stowing the Center Front Stabilizer



#### CAUTION

Except for operation of the CFS during Cribbing Mode, never operate the center front stabilizer unless the boom is retracted and in the boom rest position. Always retract the center front stabilizer before retracting the main jacks and outriggers. The center front stabilizer is a vital factor in the stability of the crane.

1. **From the Carrier:** Position the center front stabilizer control switch to ACTIVATE and position the outrigger extension/retraction switch to RETRACT.
- **From the ODM:** HOLD Retract and hit the center front jack Icon as shown in green in (Figure 4-41).



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

## CRANE OPERATION

### Before Operating the Crane

**NOTE:** This procedure only applies to working with a rigged truck crane (supported and rigged with counterweight). If the truck crane is not yet rigged refer to *Set-up and Installation*, page 6-1.

Perform the inspections as outlined in *Pre-Starting Checks*, page 4-2.

1. Inspect the truck crane, looking out in particular for any leaking fluids (oil, fuel or water).

### CAUTION

#### Environmental Hazard!

Fluid spills can result in environmental damage. Immediately repair all oil, fuel and coolant leaks detected during inspection.

2. Adjust crane cab seat and front panel, refer to *Adjusting the Crane Cab Seat and Front Control Panel*, page 4-44.
3. Switch on the cameras for the operation of the crane, refer to *Cameras for Crane Operation*, page 6-41.
4. Adjust the slewable spotlights if necessary, refer to *Using the Slewable Spotlights*, page 4-94.
5. Start the engine for crane operation.

Check the operation of all crane functions. If any malfunctions are noted, do not use the crane until the issues are corrected.

6. Check the position of the hoist ropes, refer to *Checking the Position of the Hoist Ropes*, page 4-44.
7. Compare current rigging mode to display on RCL – enter current rigging mode, if necessary, refer to *Enter Rigging Mode*, page 4-50.
8. Compare current reeving of hoist used against the display on the RCL – enter current reeving, if necessary, refer to *Entering the Reeving*, page 4-54.
9. Check telescoping, refer to *Inspections Prior to Starting Operations*, page 4-71.
10. Switch off the swing gear if working at 0° or 180° positions – symbol (1), (Figure 4-42) red, refer to *Switching OFF the Swing Gear*, page 4-90.
11. Switch off houselock (if fitted) for other working positions – symbol (2), (Figure 4-42) is red, refer to *Switching OFF the 360° Lock*, page 4-47.

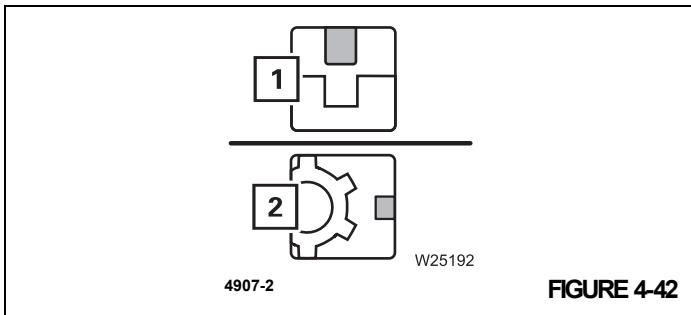


FIGURE 4-42

12. Check the electrical system for correct operation, refer to *Checking the Electrical System*, page 4-44.

13. Check hydraulic oil temperature.

14. Adjust the brightness of the CCS displays as required.

**NOTE:** See additional information on inspections during crane operation, on permissible working positions and on how to operate the individual power units, refer to *Crane Operation with Main Boom*, page 4-61.

### Checking the Position of the Hoist Ropes



#### DANGER

#### Entanglement Hazard!

Contact with rope being spooled onto the hoist drum could result in entanglement causing death or serious injury.

Stay clear of the rope and drum while the hoist is in operation.

- When possible check the entire length of the winding of the ropes (1), (Figure 4-43).

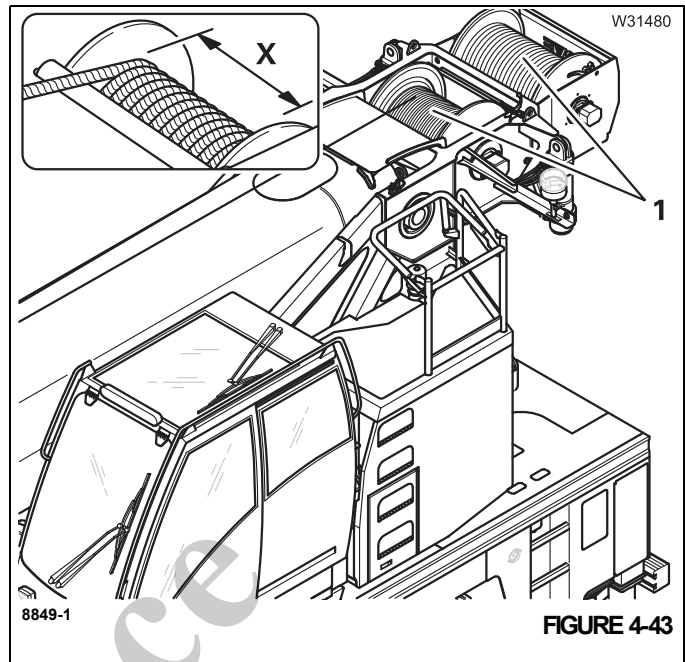


FIGURE 4-43

- Slowly perform the lowering movement until the rope has moved over a complete width (X) of the rope drum.
  - The rope must be evenly wound.
  - The rope turns on the drum must be evenly spaced, 0 to 2 mm (0 to 0.08 in) apart.
  - The cross-over points must be offset by approximately 180°.

**NOTE:** Daily inspection of the rope is to inspect the length of rope to be used that day.

### Checking the Electrical System

Check the following functions and have faulty parts repaired.

- Working area spotlight
- Boom position indicator light, rotating beacons
- Windshield wipers, windshield washing system
- Horn.

### Adjusting the Crane Cab Seat and Front Control Panel

#### Crane Cab Seat

You can adjust the crane cab seat to your preference. Refer to (Figure 4-44).

1. Adjust angle of seat back and lower seat cushion by pushing or pulling on control (1) in desired direction.
2. Adjust height of seat by pushing or pulling control (2) in desired direction.

3. Adjust the distance to the control panels by pulling up on control (3).
4. Adjust angle of seat back by pushing or pulling on control (4) control in desired direction.
5. Adjust angle of control panels by pushing button on rear (underneath) of the right hand armrest (5) and (6) to provide ease of entrance to the seat.

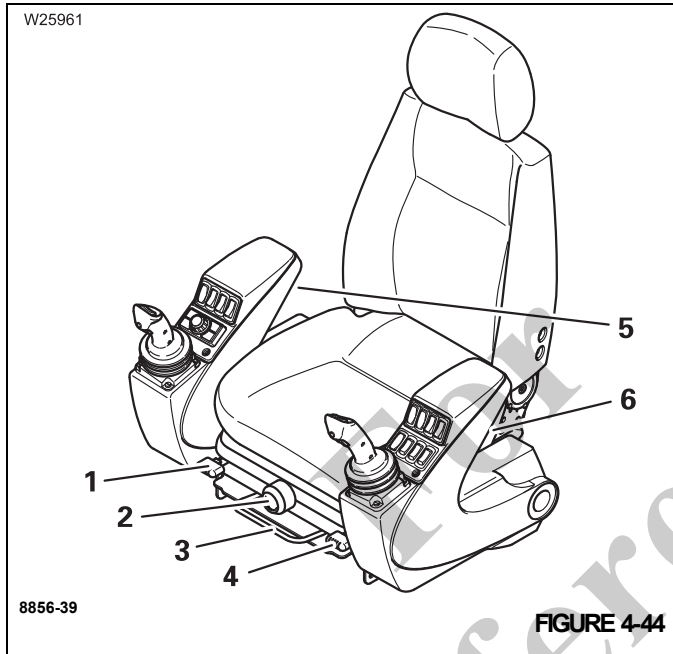


FIGURE 4-44

|   |                                                 |
|---|-------------------------------------------------|
| 1 | Seat –tilt adjustment<br>Without control panels |
| 2 | Seat- height adjustment                         |
| 3 | Seat – length adjustment<br>With control panels |
| 4 | Back rest – angle                               |
| 5 | Control panel right – angle adjustment button   |
| 6 | Control panel left – angle adjustment button    |

**Front Panel**

You can adjust the height, inclination, and clearance to the seat of the front panel.

Release the handle counterclockwise (1), (Figure 4-45).

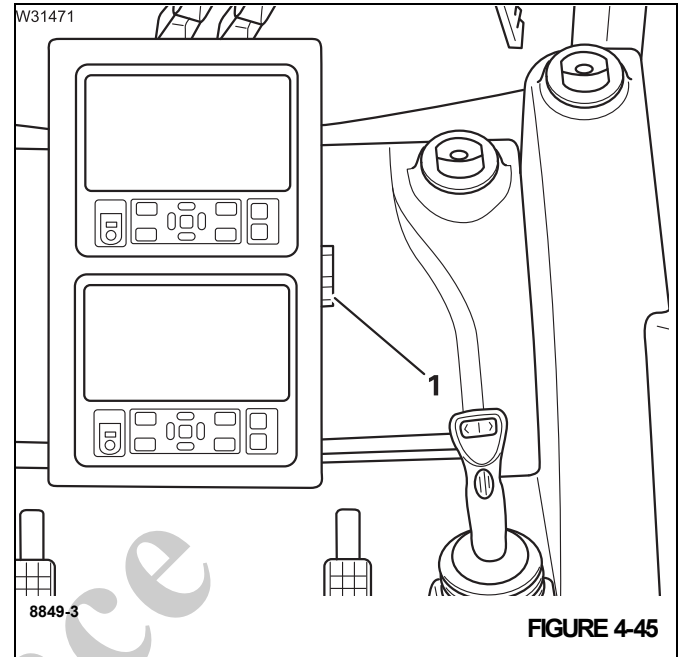


FIGURE 4-45

Adjust the front panel to suit your requirements.

Turn the handle (1) firmly – clockwise.

**Checking Operator Aids**

**Rated Capacity Limiter**

- Turn on the ignition to start the rated capacity limiter (RCL), do all of the checks and enter the current rigging mode, refer to *Switching ON the RCL*, page 4-48.
- The RCL is working correctly at this point in time if no error message is pending and if crane movements have been enabled.

If the RCL is not working correctly, do not start work with the crane but notify your local distributor or Manitowoc Crane Care. Refer to *Rated Capacity Limiter (RCL) Systems*, page 2-4.

**Anti Two-Block Switch**

- Raise the main boom until the hook block is lifted off the ground.
- Hoist up slowly until the hook block lifts the Anti Two-Block Switch weight.
- Make sure that hoist up, boom lower and tele extend are locked out, the hoist limit indication (1), (Figure 4-46) is illuminated, and the operator display buzzer is on. If so the anti-two-block switch is determined to be functioning properly.
- Make sure that hoist lower, boom raise and tele retract are still operational.



**NOTE:** Anti Two-Block switches on auxiliary boom nose or boom extension (if installed) also need to be checked in a similar manner.

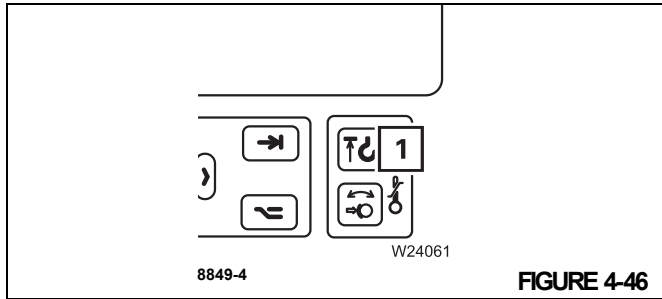


FIGURE 4-46

If the anti-two-block switch is not working correctly, do not start work with the crane but notify your local distributor or Manitowoc Crane Care. Refer to *Anti-Two-Blocking Device*, page 2-5.

**Emergency Stop Switch**

- Set down the hook block and let go of both control levers.
- Press the emergency stop switch (Figure 4-47) so that it engages.



FIGURE 4-47

- Check whether the engine stops.
- Turn the emergency stop switch until it disengages again.
- Repeat the checks with the emergency stop switches in the superstructure cab and both outrigger control panels.

If the emergency stop switch is not working correctly, do not start work with the crane but notify your local distributor or Manitowoc Crane Care.

**Seat Contact Switch**

This check is carried out together with the dead man's switch.

**! DANGER**  
**Crush Hazard!**

Never operate the controls unless seated properly at the control station. Operation of the controls from outside the cab could result in being struck by the moving superstructure causing death or serious injury.

**Checks While Stationary**

1. Sit down.
2. Enable control levers functions
3. Exit the seat
4. Do not press either dead man's switch (1), (Figure 4-48).
5. Function both control levers in all directions.

No functions should operate if any control malfunctions. Have the problem diagnosed.

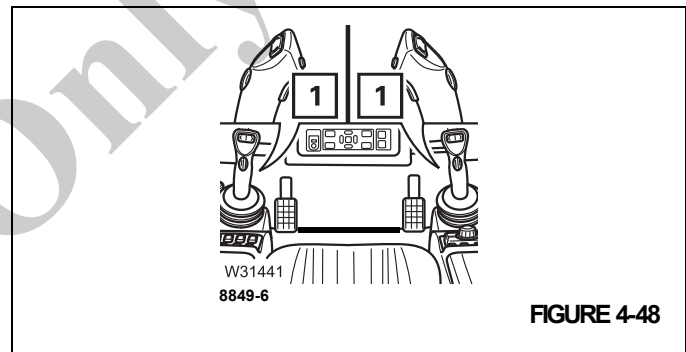
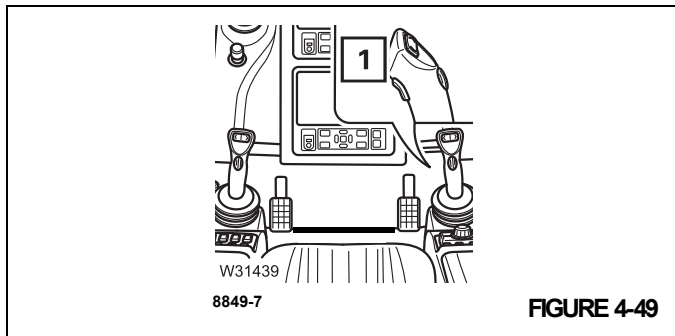


FIGURE 4-48

**Checks During Operation**

**Dead Man's Switch**

- For the following tests, a crane function will need to be enabled.
- Do not sit down on the crane cab seat.
- Press and hold the right dead man's switch (1), (Figure 4-49) and slowly lift the hook block.



- With the control lever actuated, let go of the right dead man's switch and check whether the crane movement comes to a standstill within approximately 3 seconds.
- Repeat the check with the dead man's switch on the left control lever.

If the dead man's switch system is not working correctly, do not start work with the crane but notify your local distributor or Manitowoc Crane Care.

### Preheating the Hydraulic Oil

**NOTE:** It may take some time for the solenoid valves to be switched or the hydraulic devices may be started abruptly if the oil is cold.

The current hydraulic oil temperature is displayed in the start menu.

#### Above 10 °C (50 °F)

Crane operation with load is permissible without speed restriction.

#### From 10°C to 4°C (50°F to 40°F)

To preheat, carry out crane movements with loads only in normal operation mode, at medium engine speed and at medium operating speed.

#### From 4°C to -10°C (40°F to 15°F)

To preheat, only carry out crane movements without a load. Only operate at normal speed, at low engine speed and low operating speed.

#### Below -15 °C (5 °F)

Crane movements are not permitted without changing to a Grove approved cold weather fluid, and then only until oil is heated to normal operating temperature. Contact a Grove distributor or Manitowoc Crane Care.

### Using the Swing System

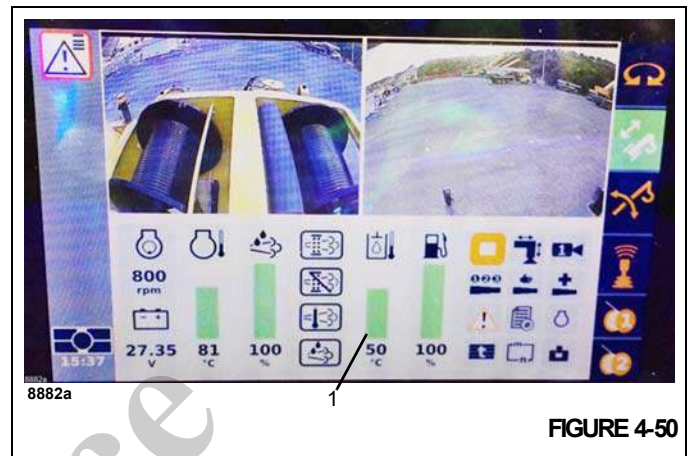
Set the swing gear to a maximum speed of 30%, refer to *Switching ON the Swing Gear*, page 4-88.

Lock the turntable, refer to *Switching the 360° Lock ON/OFF* below.

Depress the brake pedal.

Perform the crane function, swing against the swing brake.

The hydraulic oil is preheated when the display (5), (Figure 4-50) shows a temperature of at least 10 °C (50 °F).



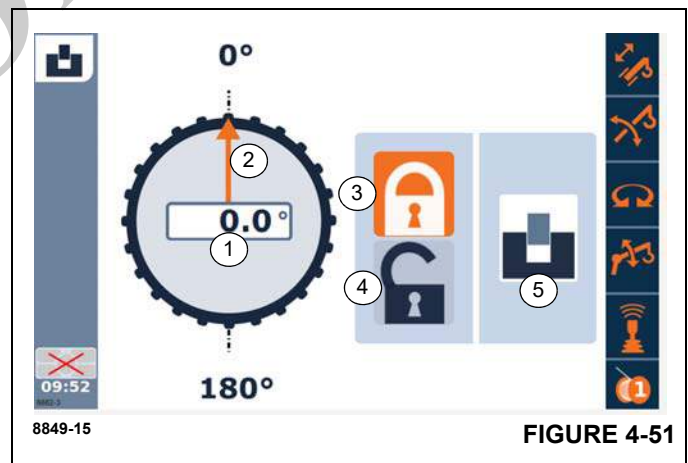
### Switching the 360° Lock ON/OFF

The turntable can be locked in the entire swing range. For locking, a pin extends and blocks the swing gear.

#### Switching ON the 360° Lock

- To secure the 360° lock, use the jog dial to highlight (3), (Figure 4-51) and press Enter. #4 should change from showing unlocked to locked (3).

It might be necessary to swing the crane very slightly & slowly due to friction of the locking gear teeth against the swing gear teeth.



#### Switching OFF the 360° Lock

Check that the swing gear is switched OFF. If it is NOT off, switch it off. Refer to *Switching OFF the Swing Gear*, page 4-90.

**CAUTION**

**Machine Damage!**

Always switch off the swing gear before you operate the 360° lock. The system will be damaged if the superstructure is slewed during the locking procedure.

The control system will prompt with a swing command symbol if small movements of the slewing ring are necessary to engage or disengage the 360° locking mechanism.

- Select the symbol (4), (Figure 4-51).
- Press the button until the symbol (5), (Figure 4-51) is displayed with the pin out.

**OPERATION OF THE RATED CAPACITY LIMITER**

The rated capacity limiter is abbreviated RCL (Rated-Capacity-Limiter) in these operating instructions.

If the truck crane's current rigging mode is registered properly, the RCL will prevent the permissible lifting capacity from being exceeded and the truck crane from being overloaded.

The current rigging mode is determined by:

- measured values,
- manual entry.

| Determination Based on Measured Values | Determination Based on Manually Entered Values |
|----------------------------------------|------------------------------------------------|
| Main boom length                       | Counterweight                                  |
| Main boom angle                        | Length of lattice extension                    |
| Current load                           | Angle of the lattice extension <sup>1)</sup>   |
| Outrigger span <sup>2)</sup>           | Reeving                                        |
|                                        | Outrigger span <sup>3)</sup>                   |

<sup>1)</sup>Lattice extension – inclinable

<sup>2)</sup>For versions with outrigger span monitoring

<sup>3)</sup>For versions without outrigger span monitoring

During the operation of the crane, a visual and acoustic early warning is issued before the load limit is reached and then the functions are shut down that would lead into the overload range.

**Switching ON the RCL**

**NOTE:** The RCL will not be switched off if you turn the ignition key to position **R** instead of position **0** to restart the engine. This means that the test program will not run and you will not have to acknowledge the settings again.

**Switching ON**

The RCL is switched on together with the ignition.

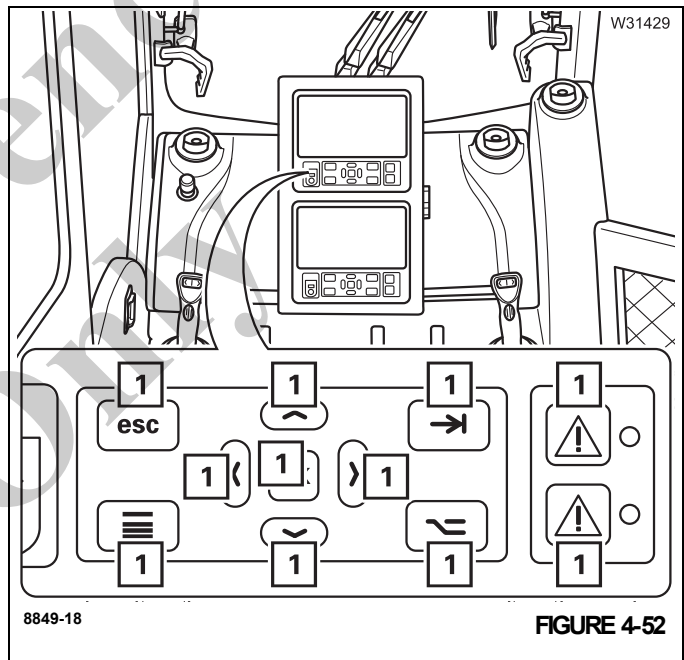
- Switch on the ignition.

A test program runs after switching on the ignition. A continuous buzzer tone sounds for approximately 2 seconds and a lamp test is performed.

- Check whether you can hear a buzzer tone.

**Lamp Test**

Check that lamps (1), (Figure 4-52) light up briefly after turning on the ignition.



**FIGURE 4-52**

If one or more lamps do not light up do not use the crane for lifting service until appropriate measures are taken to ensure safe operation. Contact your local distributor or Manitowoc Crane Care for assistance if necessary.

After the test program:

- the lamps (1), (Figure 4-53) and (2), (Figure 4-53) light up,
- all power units are disabled.



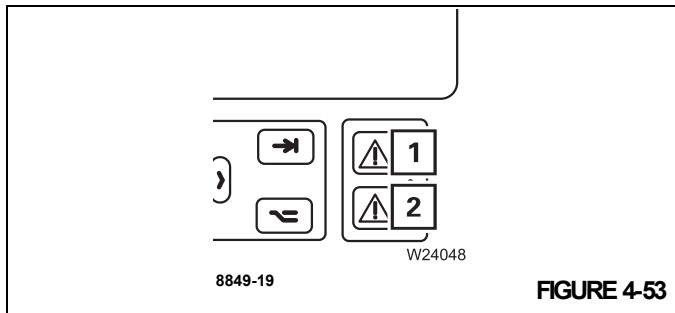


FIGURE 4-53

The current display depends on whether the RCL either:

- was switched off for up to 2 hours, or
- was switched off for more than 2 hours.

**After a Standstill of Up to 2 Hours**

The Monitoring menu opens.

The last set rigging mode will be displayed, and symbols (1), (Figure 4-54) and (2), (Figure 4-54) will be green and flashing.

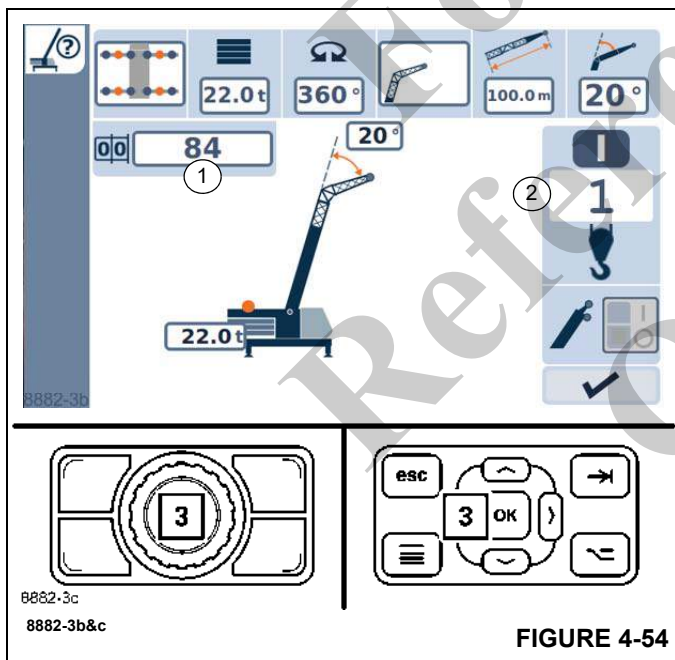


FIGURE 4-54

You can accept the displayed values if they correspond to the current rigging mode:

- Press button (3), (Figure 4-54) once – symbols (1), (Figure 4-54) and (2), (Figure 4-54) will stop flashing.

Lamps (1), (Figure 4-55) and (2), (Figure 4-55) will go out. The RCL code has been applied.

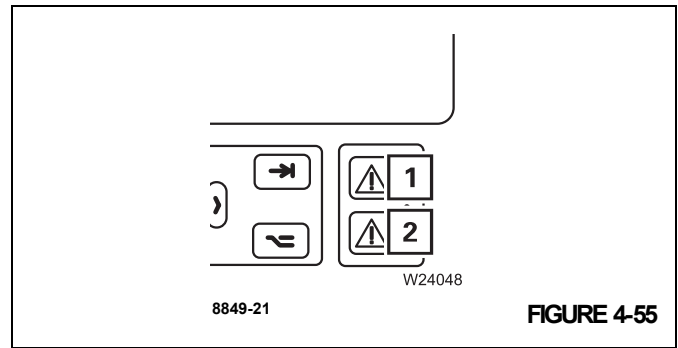


FIGURE 4-55

If no error message is displayed, the RCL is set for crane operation and crane movements are enabled. Refer to *Checks Before Operating the Crane*, page 4-55.

If an error is present, a symbol (1), (Figure 4-56) is shown. Refer to *Display in the Event of Errors*, page 4-59.

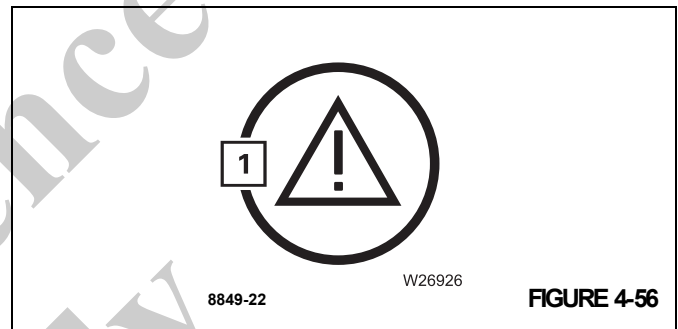


FIGURE 4-56

You must re-enter the current rigging mode if the displayed values do not correspond to the current rigging mode of the crane. Refer to *Enter Rigging Mode*, page 4-50.

**After a Standstill of More than 2 Hours**

The Enter rigging mode menu opens.

Display (1), (Figure 4-57) will show RCL code 1100 – the corresponding rigging mode will be displayed.

The display (2), (Figure 4-57) shows the last reeving entered, e.g. 1.

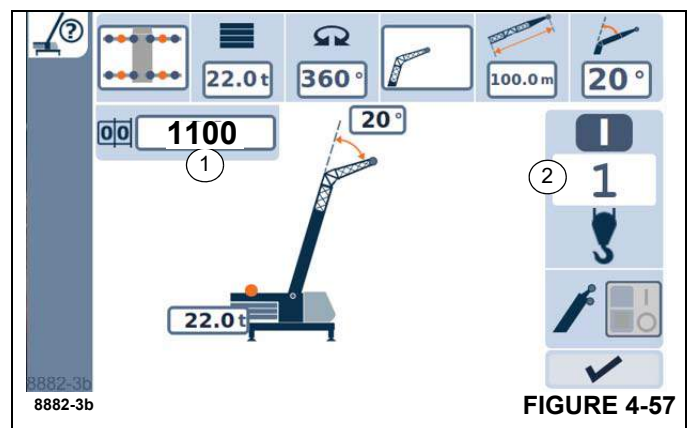


FIGURE 4-57

Enter the current rigging mode. Refer to *Enter Rigging Mode* below.

**Enter Rigging Mode**

For a complete rigging mode input, you must enter, confirm and accept the rigging mode and the reeving.

Open the Enter rigging mode (1), (Figure 4-58) menu if necessary.



FIGURE 4-58

There are two ways of entering the current rigging mode.

- Either enter the individual components (1), (Figure 4-59) to (6), (Figure 4-59) one after the other.
- Or enter the RCL code (8), (Figure 4-59) and the reeving (7), (Figure 4-59).

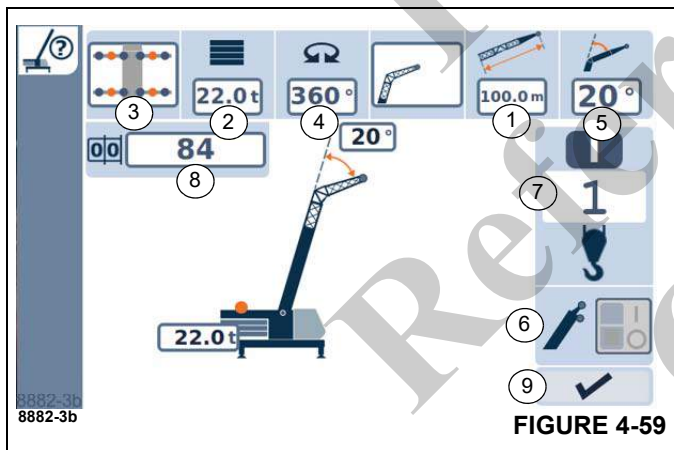


FIGURE 4-59

The newly entered rigging mode must then be confirmed

- with (9), (Figure 4-59).

The following section describes the input procedure based on the individual components. If you want to enter the rigging mode based on the RCL code, refer to *Entering the RCL Code*, page 4-53.

**Entering Individual Components**

With this type of input, select all the components of the rigging mode one after the other.



**DANGER**

**Overload/Tip Over Hazard!**

The RCL is an operator aid. If it is programmed incorrectly, the system may not warn the operator of impending overload and may not activate function lockouts.

Make sure that the RCL is properly programmed to correspond to the actual crane configuration being used.

When re-entering the rigging mode completely, you can prevent already entered components from changing by making entries in the following order:

- Counterweight (2), (Figure 4-60).
- Boom system (1), (Figure 4-60).
- Outrigger span (3), (Figure 4-60).

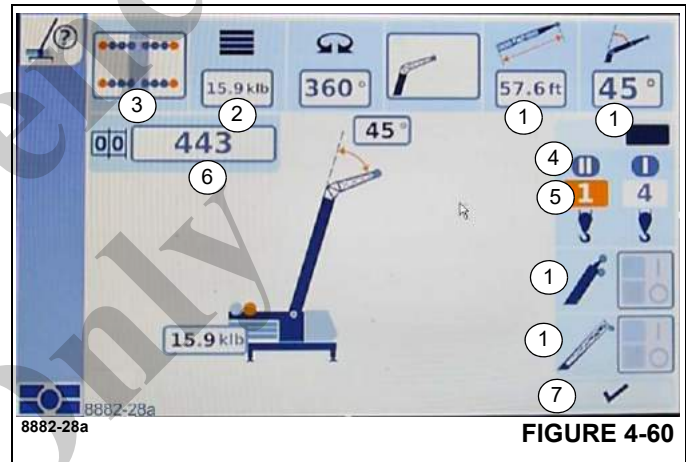


FIGURE 4-60

In this order, the values that can be selected for the current entry are always restricted by the previous entry. As a result, already entered values do not change.

When entering the components, the corresponding RCL code (6), (Figure 4-60) is displayed at the same time.

Then you must enter the current reeving (5), (Figure 4-60) and accept the indicated rigging mode.

**Switching ON Input Mode**

- Select one of the desired components (1), (Figure 4-60) to (4), (Figure 4-60).

The corresponding symbol goes orange.

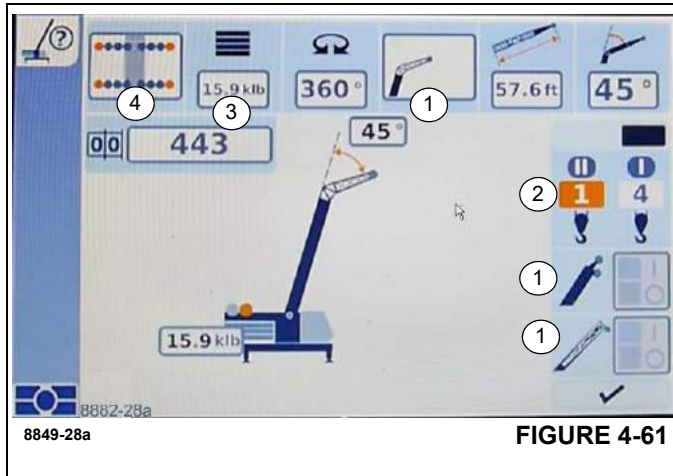


FIGURE 4-61

- Confirm the selection.
- Direction arrows appear on the display.
- Input mode is switched on.

**Selecting Values**

With the input mode switched on, you can select values that are permissible according to the Lifting Capacity Table.

The selection process is described using reeving as an example.

- Select and confirm the symbol (1), (Figure 4-62) – arrows on the left and right are displayed.
- Select using the left or right buttons on the control panel until the display shows the rigged reeving.

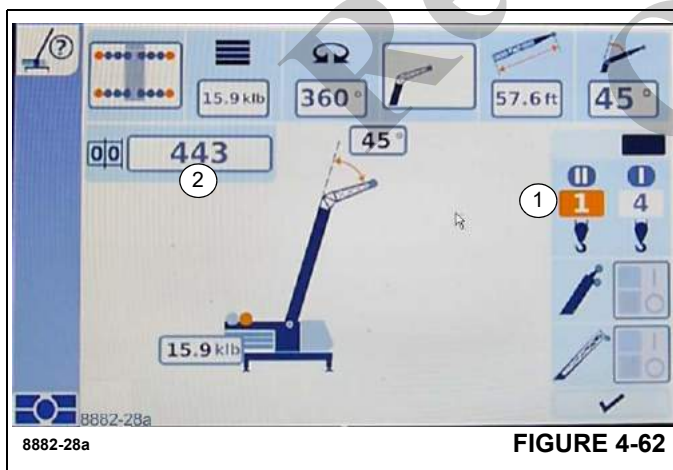


FIGURE 4-62

- Confirm the selection.

The display (2), (Figure 4-62) shows the corresponding RCL code.

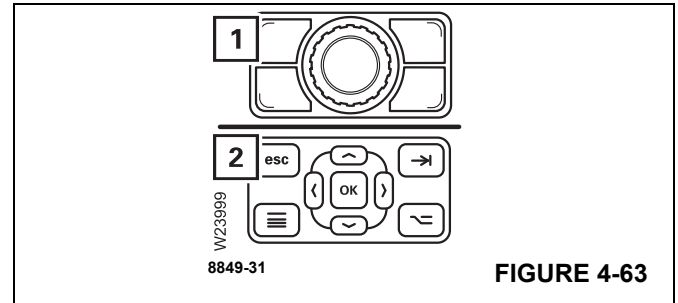


FIGURE 4-63

You can cancel the input at any time. Press button (1), (Figure 4-63) or (2), (Figure 4-63).

After the selection procedure, there are three options:

- Cancel input mode:
  - Press the button (3), (Figure 4-64) or (4), (Figure 4-64) once – the config menu is opened.

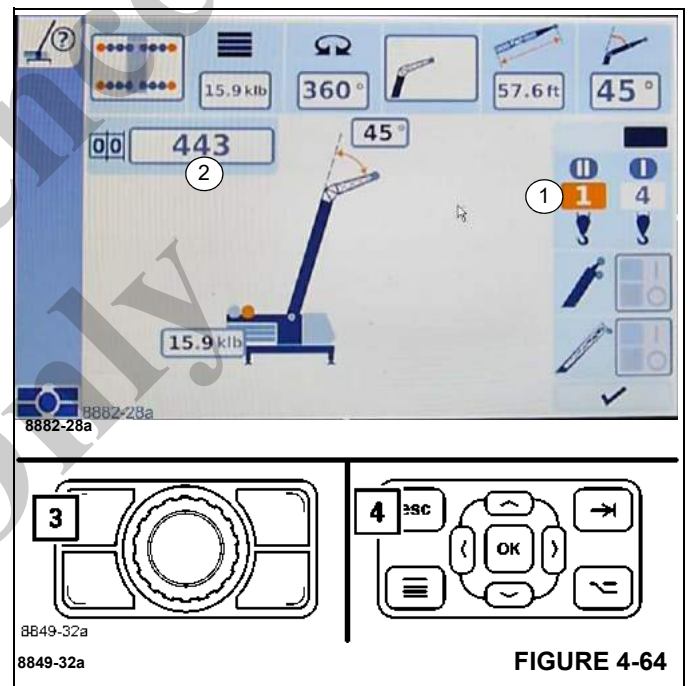


FIGURE 4-64

- Switching over the input mode:
  - Select and confirm a symbol (1), (Figure 4-64) for the next component – symbol red.
- Accept the displayed rigging mode:
  - Select and confirm the symbol (2), (Figure 4-64). Refer to *Accepting the Rigging Code*, page 4-54.

Enter the other components of the current rigging mode in the same way.

**Counterweight**

- Select and confirm the symbol (1), (Figure 4-65).

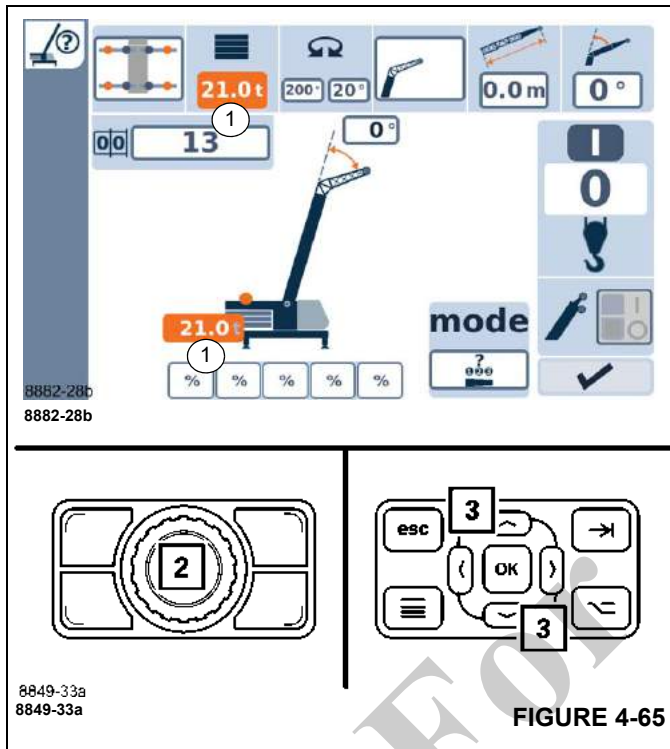


FIGURE 4-65

- Use the buttons (2), (Figure 4-65) or (3), (Figure 4-65) to select the required counterweight combination, e.g. 21.0 klb.
- Confirm the selection.

**Boom System**

- Select and confirm the symbol (1), (Figure 4-66).

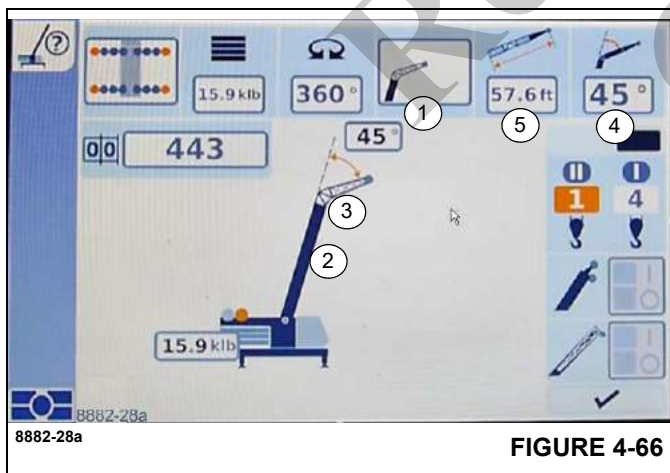


FIGURE 4-66

- Use symbol (1), (Figure 4-66) to select the rigged boom system.

|   |                                  |
|---|----------------------------------|
| 2 | Main boom                        |
| 3 | Main boom with lattice extension |

|   |                                       |
|---|---------------------------------------|
| 4 | Angle of the manual lattice extension |
| 5 | Length of lattice extension           |

- Confirm each selection.

**Outrigger Span Display**

Depending on the equipment of the truck crane, the outrigger span (Figure 4-67) is shown in meters, feet or percent (%).

**Outrigger Span**

- Select and confirm the symbol (1), (Figure 4-67).
- Use the jog dial buttons (2), (Figure 4-67) or (3), (Figure 4-67) to select the rigged outrigger span.
- Confirm the selection.
- Press the extend/retract button to position the outriggers to the desired position (4), (Figure 4-67).

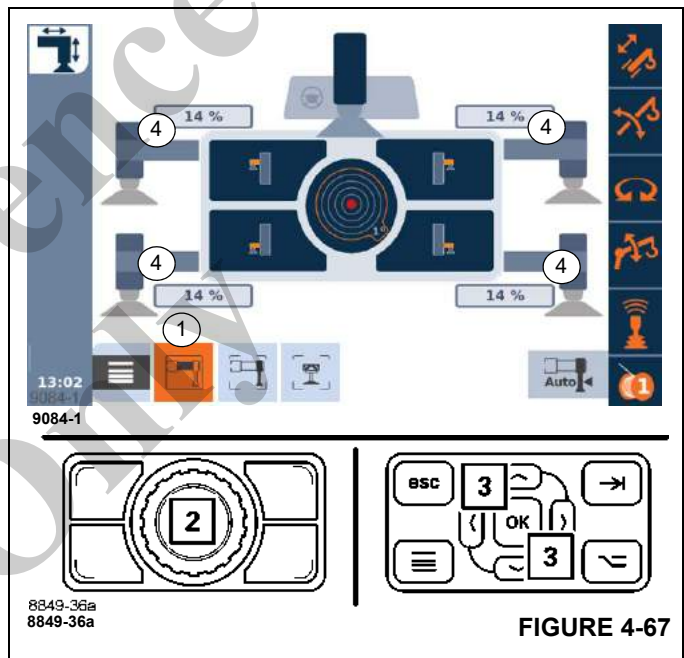


FIGURE 4-67

The outrigger span is monitored when outrigger monitoring is installed. You must check the outrigger span when entering the Rigging Mode.

If the OMS does not match the selected positions, an additional screen opens after selecting the check mark (4), (Figure 4-69) at the bottom right corner of this screen. There, the detected positions and selected positions are shown side by side (1), (Figure 4-68).

The operator has the choice of:

- 1) Returning to this setup screen to change the selection

--OR--

- 2) Verifying that the chosen outrigger position is the one to use even though it does not match the OMS, in which case



the screen transitions to the main viewing screen. Also, refer to *Outrigger Menu*, page 3-61 and *Outrigger Monitoring System (OMS)*, page 4-41.

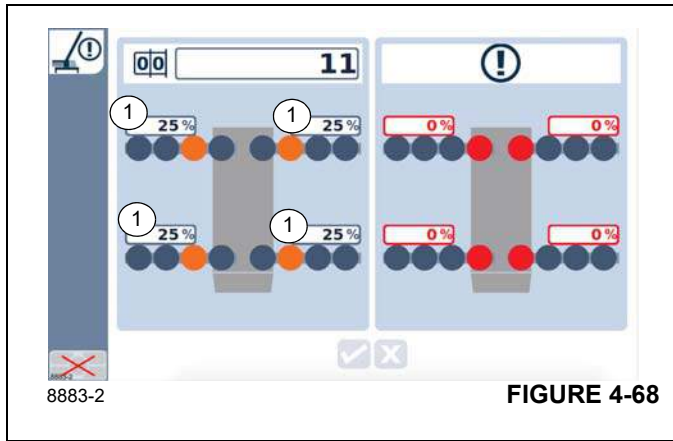


FIGURE 4-68

**Swing Range**

- Select and confirm the symbol (1), (Figure 4-69).
- Use the buttons (2), (Figure 4-69) or (3), (Figure 4-69) to select the required swing range, e.g. 360°.
- Confirm the selection.

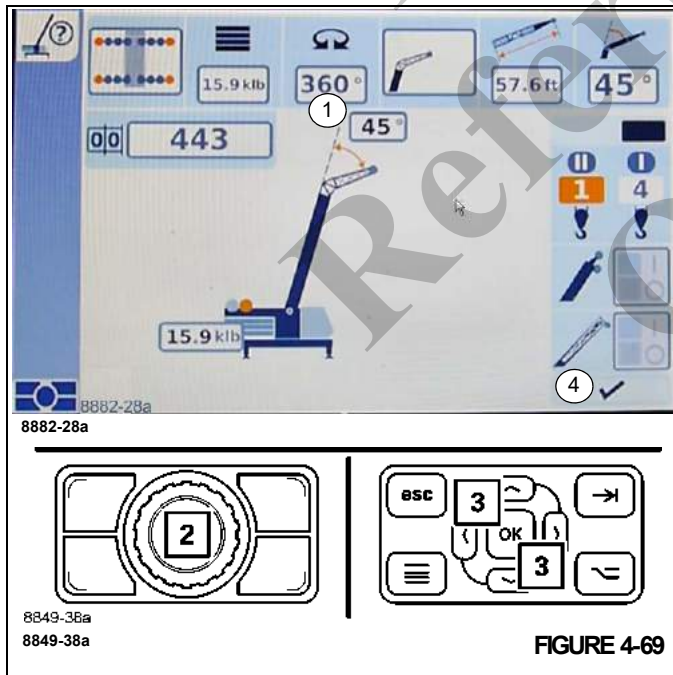


FIGURE 4-69

**Entering the RCL Code**

You may enter the RCL Code for the rigging mode according to the Lifting capacity table.

Refer to the Lifting capacity table for the current rigging mode. The corresponding RCL Code is specified at the top of the table (e.g. 1100).

- Select and confirm the symbol (1), (Figure 4-70)).
- Use the buttons (2), (Figure 4-70) or (3), (Figure 4-70) to select the required RCL Code.
- Confirm the selection.

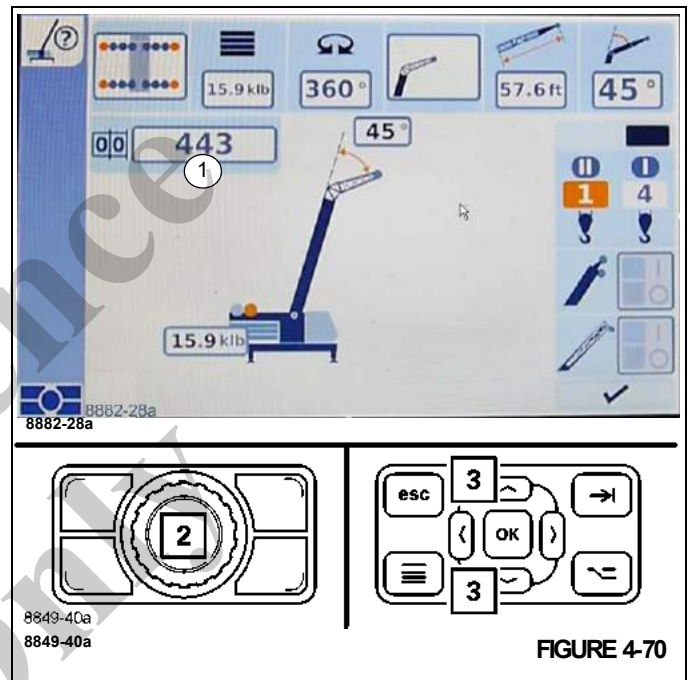


FIGURE 4-70

The other displays will show the corresponding rigging mode.

Now you can enter the reeving and accept the rigging mode.

**Entering the Reeving**

Entering the reeving does not have an effect on any other component that has already been entered.

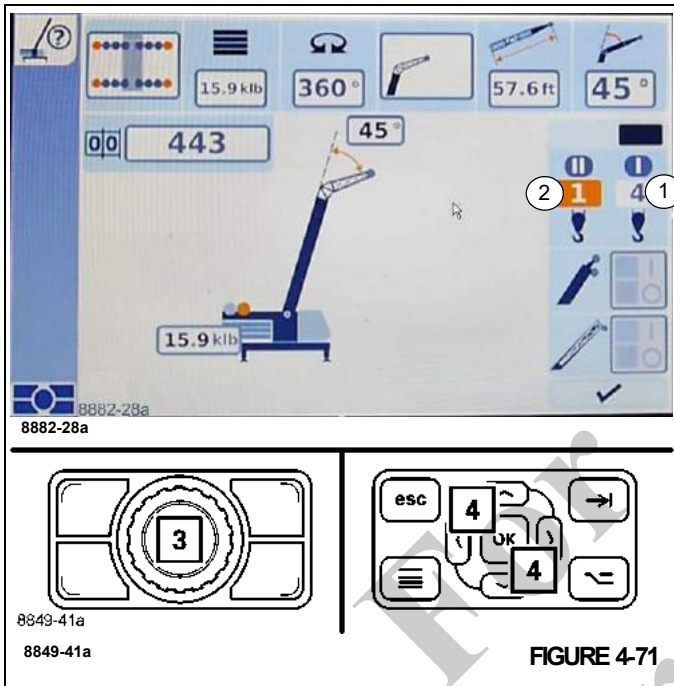


FIGURE 4-71

- Select the symbol for the hoist with which you wish to lift the load.

|   |                            |
|---|----------------------------|
| 1 | Symbol for main hoist      |
| 2 | Symbol for auxiliary hoist |

- Confirm the selection.
- Use the buttons (3), (Figure 4-71) or (4), (Figure 4-71) to select the rigged reeving.
- Confirm the selection.

**Accepting the Rigging Code**

Prior to crane operation, you must confirm and accept the newly entered rigging code.

**Confirming and Applying the Rigging Code**

- Select the symbol (1), (Figure 4-72).
- Confirm the selection.

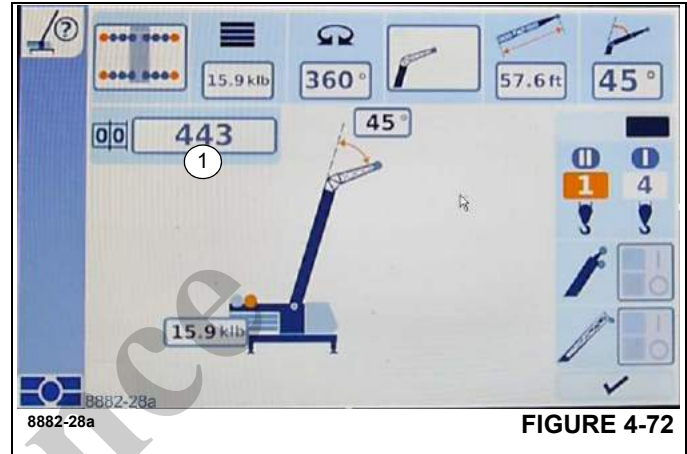


FIGURE 4-72

The Monitoring Menu is opened and the rigging code is applied.

If the rigging code is not permissible, the display stays on the setup screen.



**WARNING**

**Overload/Tip Over Hazard!**

The RCL is an operator aid. If it is programmed incorrectly, the system may not warn the operator of impending overload and may not activate function lockouts.

Make sure that the RCL is properly programmed to correspond to the actual crane configuration being used.

**Entering the Telescoping Mode Number**

After the RCL has been initialized, and the rigging mode screen is re-entered, and the telescoping function has been enabled, and the boom is fully retracted and locked, then a Telescoping Mode Number may be selected (1), (Figure 4-73). Entering this option allows the up/down or jog dial to be used to select from an available list of these mode numbers. After this selection and using the check-mark again on the rigging screen, the telescoping function will commence for the requested telescoping status based on the mode number.

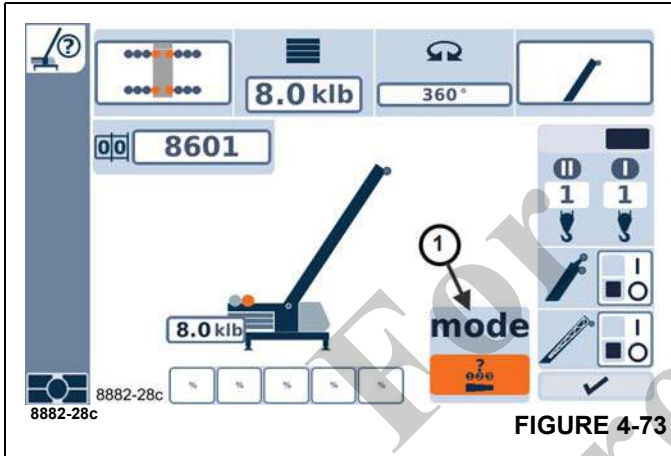


FIGURE 4-73

**Checks Before Operating the Crane**

**Open the Menu**

Crane operation is only enabled when the Monitoring Menu is open. The monitoring menu opens automatically after the rigging code is configured and confirmed.

**Checks**

- Check whether the current rigging mode of the truck crane corresponds to the displayed rigging mode.



**WARNING**

**Overload/Tip Over Hazard!**

The RCL is an operator aid. If it is programmed incorrectly, the system may not warn the operator of impending overload and may not activate function lockouts.

Make sure that the RCL is properly programmed to correspond to the actual crane configuration being used.

- Check (Figure 4-74):

|   |                                             |
|---|---------------------------------------------|
| 1 | the lattice extension angle where necessary |
| 2 | the boom system where necessary             |

|   |                                                  |
|---|--------------------------------------------------|
| 3 | the length of the lattice extension if necessary |
| 4 | the rigged counterweight                         |
| 5 | the hoist that is switched on                    |
| 6 | the number of reeved hoist rope lines            |
| 7 | the rigged outrigger span                        |

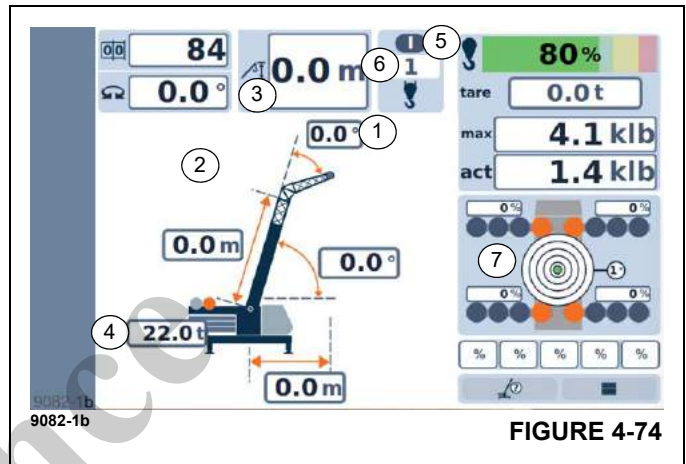


FIGURE 4-74

**Hoists Display**

The symbol (Figure 4-75) for the hoist with which the load is to be lifted must be shown in green:

|             |                                                                                  |
|-------------|----------------------------------------------------------------------------------|
| Symbol (1): | must be shown in green if the load is to be controlled with the main hoist.      |
| Symbol (2): | must be shown in green if the load is to be controlled with the auxiliary hoist. |

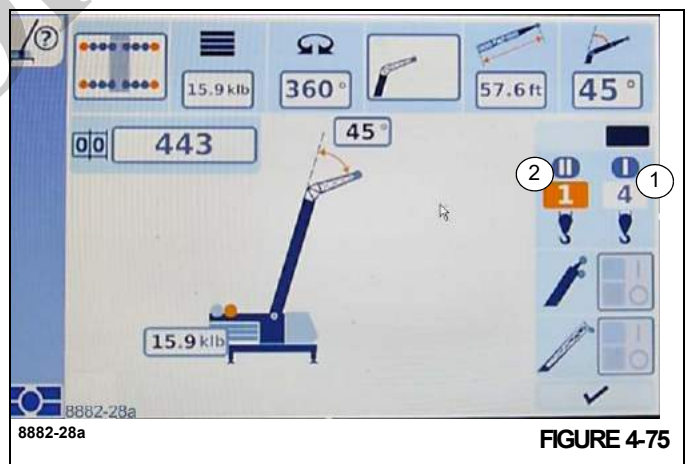


FIGURE 4-75

Switch over the display if necessary. Refer to *Example of How to Switch Over the Display*, page 4-56.

If you need to correct values, press the button (1), (Figure 4-76) or (2), (Figure 4-76) and open the Enter rigging mode (3), (Figure 4-76) menu.





You can start working with the crane if the correct rigging mode of the crane is displayed.

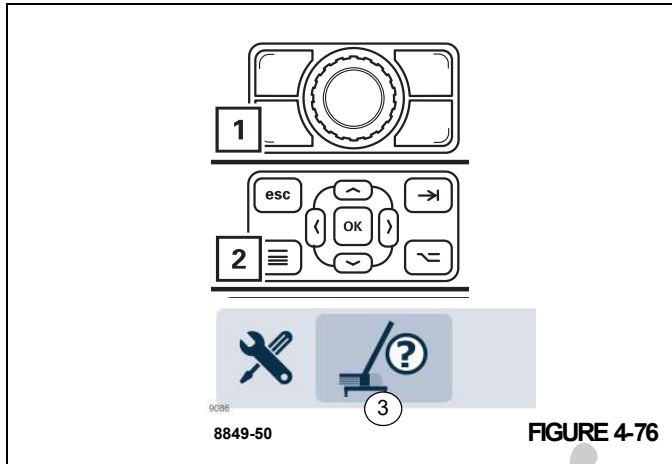


FIGURE 4-76

**Example of How to Switch Over the Display**

The load should be raised with the auxiliary hoist, for example. However, the hoist indicator (2), (Figure 4-77) for the main hoist is ON and the indicator (1), (Figure 4-77) for the auxiliary hoist is OFF.



FIGURE 4-77

Switch over the display as follows:

- Switch off both hoists by selecting no hoist indicator.

Switch on the auxiliary hoist indicator.

The hoist indicator will no be displayed above the auxiliary hoist icon.



**WARNING**

**Overload Hazard!**

When operating the crane with two hoists reeved, make sure that the hoist in use is identified in the RCL configuration. Failure to do so may result in overload of the hoist line or crane. Death or Serious Injury could occur.

**Displays During Crane Operation**

The following information is constantly displayed in addition to the displays of the rigging mode:

**The Current Overall Height**

Overall height = vertical distance between the lower edge of the outrigger pad and the highest point of the main boom or lattice extension. The displayed value (Figure 4-78) applies to fully extended outrigger cylinders on the largest outrigger span.

The value is displayed either in meters (m) or in feet (ft), depending on the setting.

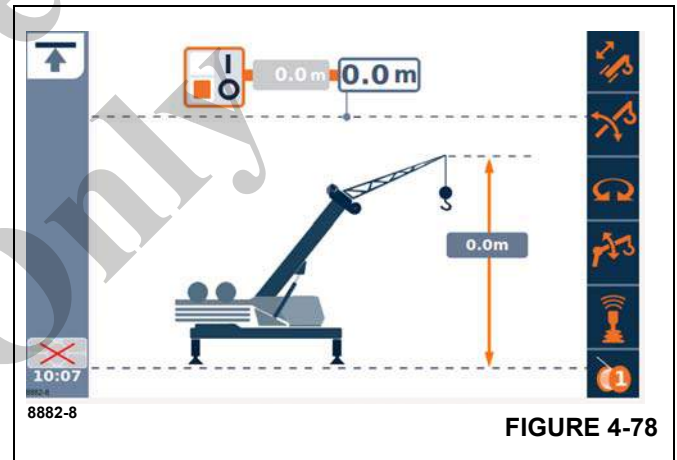


FIGURE 4-78

**The Current Lattice Extension Angle**

- **Lifting/Lowering Lattice Extension:** Shows the current lattice extension angle (1), (Figure 4-79) in relation to the main boom in degrees.
- **Lattice Extension, Can be Angled:** Shows the angle of the lattice extension corresponding to the RCL code in degrees (1), (Figure 4-79).

If the displayed RCL code does not apply to a lattice extension, nothing will be displayed.

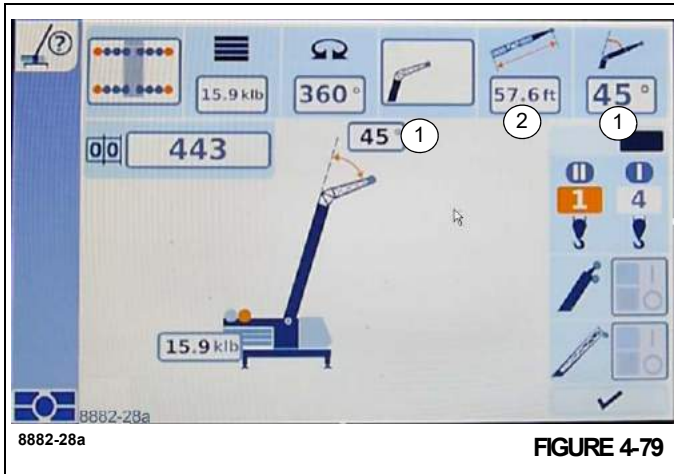


FIGURE 4-79

**The Current Lattice Extension Length**

Shows the current lattice extension length (2), (Figure 4-79) in meters (m) or feet (ft).

**The Counterweight**

Shows the counterweight (1), (Figure 4-80) in tonnes (t).

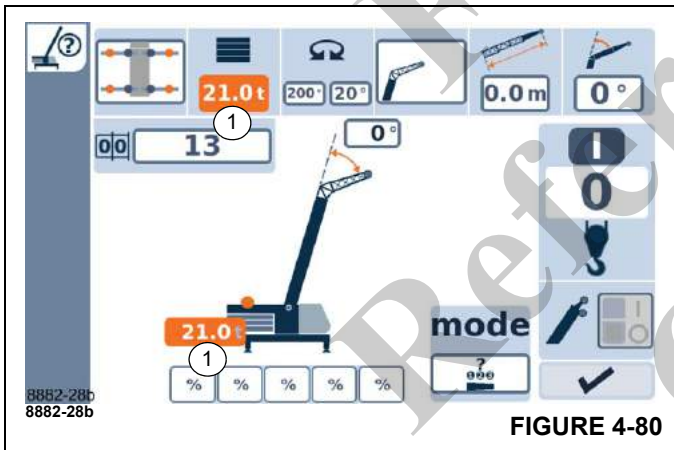


FIGURE 4-80

**The Current Swing Angle**

Shows the angle(1), (Figure 4-81) of the current superstructure position.

0° means that the superstructure is slewed to the rear.

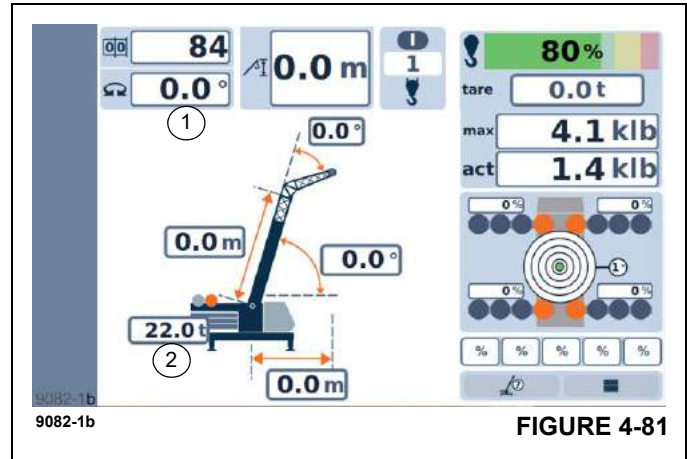


FIGURE 4-81

A full turn from this working position is divided into two semi-circles (Figure 4-82).

Angles in the left semi-circle are displayed as positive values (0° to 180.0°),

Angles in the right semicircle will be shown as negative (0° to -179.9°).

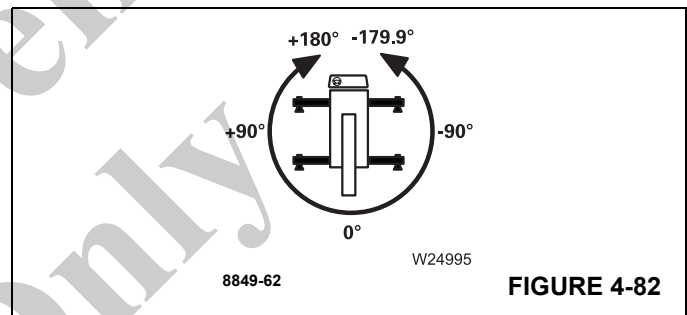


FIGURE 4-82

**The Currently Raised Load**

The display (Figure 4-83) shows the sum of the payload + lifting gear + hook block.

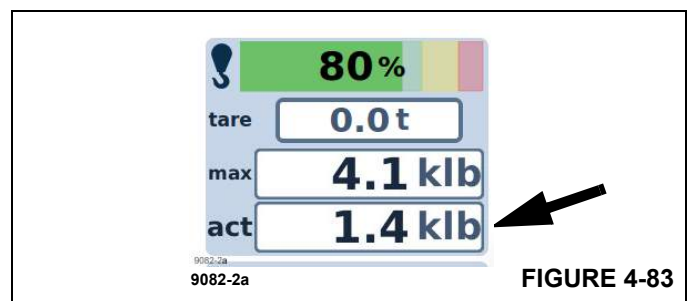
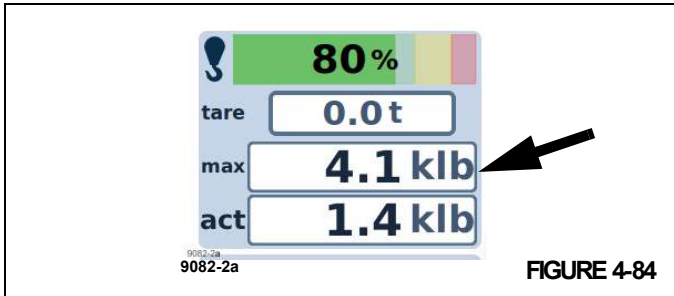


FIGURE 4-83

**The Maximum Load**

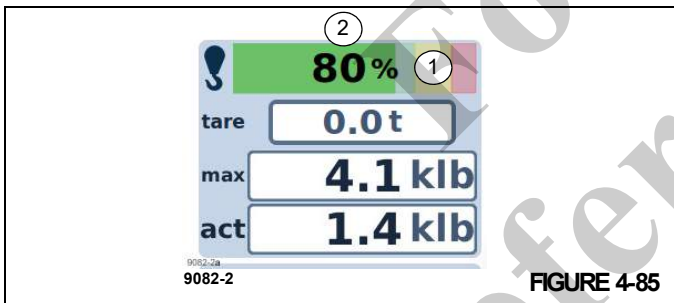
The display (Figure 4-84) shows the maximum load that can be lifted in the current rigging mode with the current working radius.



**The Degree of Utilization**

The degree of utilization shows the weight of the current load as a percentage of the maximum possible load. Display (2), (Figure 4-85) shows the percentage value. Display (1), (Figure 4-85) shows the ranges in different colors:

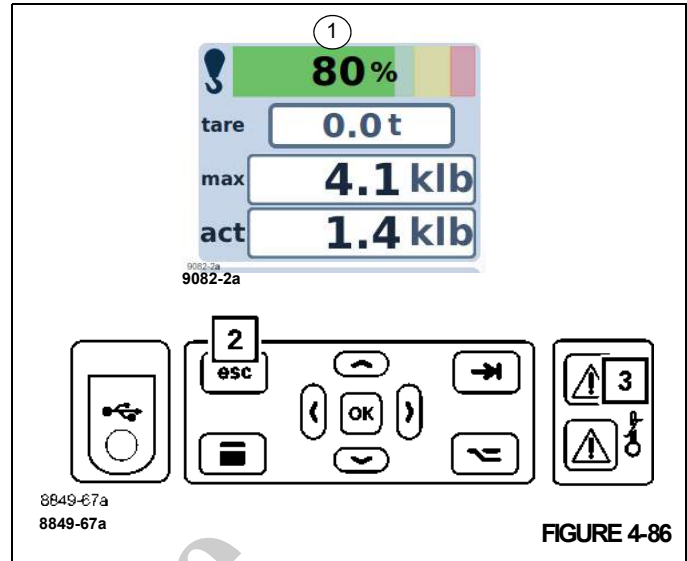
|         |                   |
|---------|-------------------|
| Green:  | 0 – 90%           |
| Yellow: | approx. 90 – 100% |
| Red:    | greater than 100% |



**RCL Early Warning**

If approximately 90% of the maximum permissible load is exceeded, an RCL early warning will be issued.

- An intermittent buzzer tone will sound. After five seconds, you can switch off the buzzer tone using button (2), (Figure 4-86).
- The lamp (3), (Figure 4-86) lights up.
- Display (1), (Figure 4-86) shows the current degree of utilization, e.g. 80%; the bar is green.



**NOTE:** If the capacity continues to increase, the RCL will reach an overload state and a RCL shutdown will occur.

**RCL Shutdown**

There are different types of RCL shutdowns:

- Shutdown due to overload,
- Shutdown due to an error.

**Shutdown Due to Overload**

If the maximum permissible load is exceeded, shutdown will occur due to overload.

- All crane movements which increase the load moment will be switched off.
- A continuous buzzer tone will sound.
- After five seconds, you can switch off the buzzer tone using button (4), (Figure 4-87).
- Greater than 100%, indicator 5 will illuminate solid
- Lamp (6), (Figure 4-87) will illuminate.
- Display (3), (Figure 4-87) shows the current degree of utilization, e.g. 100%; the bar is red.
- The value on display (2), (Figure 4-87) is equal to or greater than the value on display (1), (Figure 4-87).

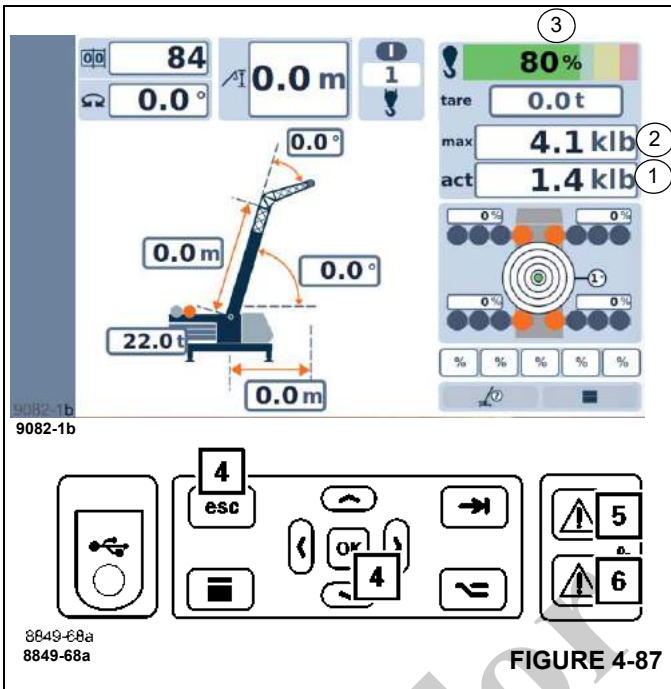


FIGURE 4-87

**Canceling a Shutdown**

- Turn off the buzzer tone if necessary.
- Leave the shutdown range by moving the crane according to the following table.

| Switched OFF Crane Movements | Permitted Crane Movements           |
|------------------------------|-------------------------------------|
| Lift loads                   | Lower loads                         |
| Lower the main boom          | Raising the main boom <sup>1)</sup> |
| Extend the main boom         | Retracting the main boom            |
| Swing to the left            | Swing to the right                  |
| Swing to the right           | Swing to the left                   |
| Lower the lattice extension  | Raise the lattice extension         |

<sup>1)</sup>In some cases, the RCL will also switch off these movements. In this case, leave the shutdown range through other enabled movements. If this is not possible, set down the load.

When booming down the load limit decreases and can eventually lock out crane motions including boom up. Using the boom up bypass key to boom up then causes the load limit to increase again, and quickly eliminates the lockout condition.

The crane movements are reactivated when you have returned to a normal operating state below the maximum permissible load capacity – lamps (1), (Figure 4-88) and (2), (Figure 4-88) go out.

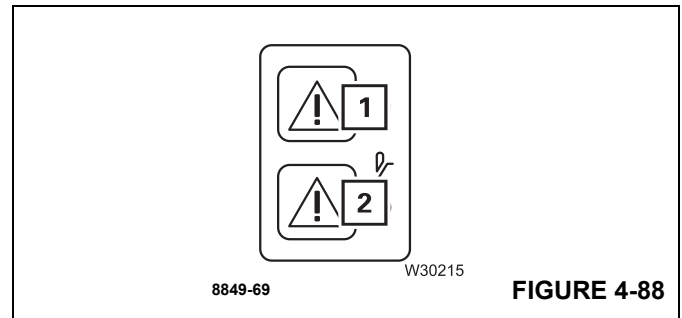


FIGURE 4-88

**Display in the Event of Errors**

If an error occurs, it will be displayed as follows.

- The (1), (Figure 4-89) symbol is displayed in the display area.
- Depending on the type of error, the buzzer tone sounds once or as a continuous buzzer tone.
- Lamps (2), (Figure 4-89) and (3), (Figure 4-89) light up.

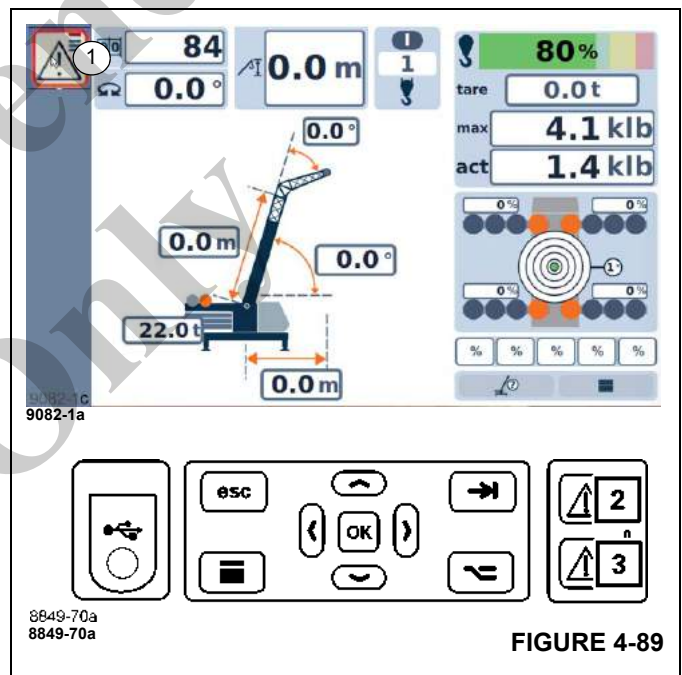


FIGURE 4-89

**RCL Override**

If the RCL is overridden, the lockouts are disabled (depending on which switch is used) and the switched off crane movements are enabled again. Once a limit is reached and crane functions are switched off, there are three options for overriding:

- During rigging, you can override the RCL shutdown or the Anti Two-Block Switch for rigging work, refer to *When Rigging*, page 4-60.

- You can release the raise boom function to leave the shutdown area. Refer to *To Raise the Boom*, page 4-60.
- In an emergency you can override the RCL shutdown completely. Refer to *In Emergencies*, page 4-61.

**External Light Bar (Optional)**

The lamps (5), (Figure 4-90) to (7), (Figure 4-90) of the external light bar (4), (Figure 4-90) light up or flash depending on the RCL degree of utilization and button confirmations.

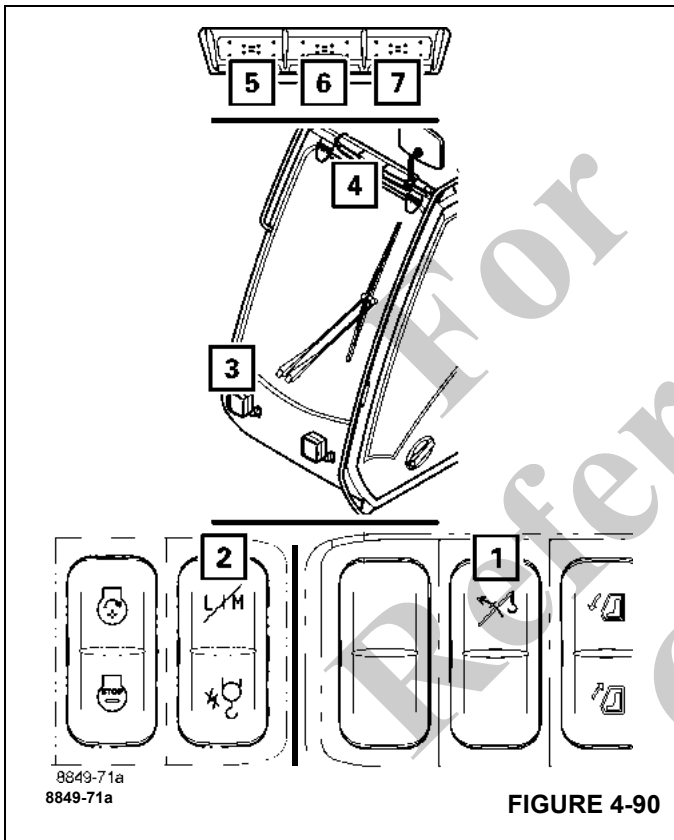


FIGURE 4-90

**When Rigging**

For rigging work, you can:

- override the Anti Two-Block Switch
- OR**
- override the RCL.

**RCL Override**

- Push the button (1), (Figure 4-91) up, and hold it.

**Anti Two-Block Switch Override**

Push the button (1), (Figure 4-91) down, and hold it.

As long as the button (1), (Figure 4-91) is kept pushed, the Anti Two-Block Switch is overridden. This is also true for the RCL override.

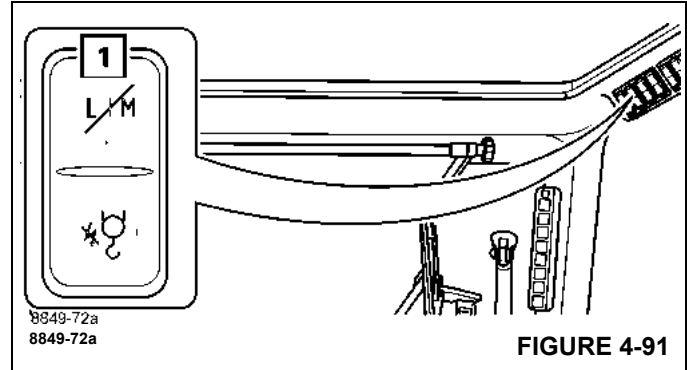


FIGURE 4-91

**After Overriding**

- The status indicator will light up red.
- The RCL display will show an information code.

**Canceling the Override**

The override will be canceled when you:

- release the switch, or
- switch off the ignition.

**To Raise the Boom**

You can release the raise boom function for lifting/lowering again within the permitted working range.

The button (1), (Figure 4-92) is only active if the current degree of utilization lies above 100% and the crane movements are switched off.

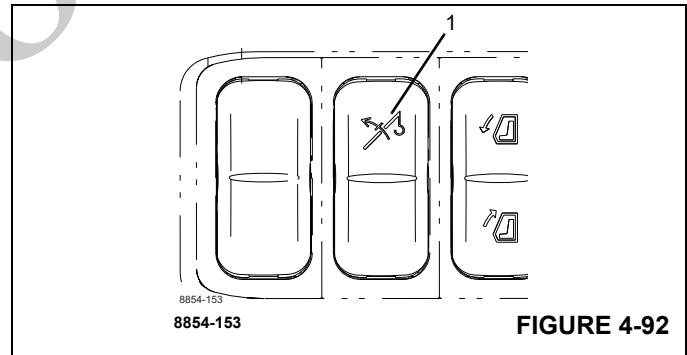


FIGURE 4-92

**Raise Main Boom**

- Push the (1), (Figure 4-92) button and hold it.
  - Raising is enabled.
  - The RCL display will show an information code.
- Raise the main boom until the degree of utilization is less than 100%.



- The crane movements will then be enabled again.
- The button (1), (Figure 4-92) will no longer need to be used.

**NOTE:** The raising of the main boom will be shut down if the main boom angle is too great. Then all you can do is set the load down.

**Switch OFF Function**

- Release switch (1), (Figure 4-93).

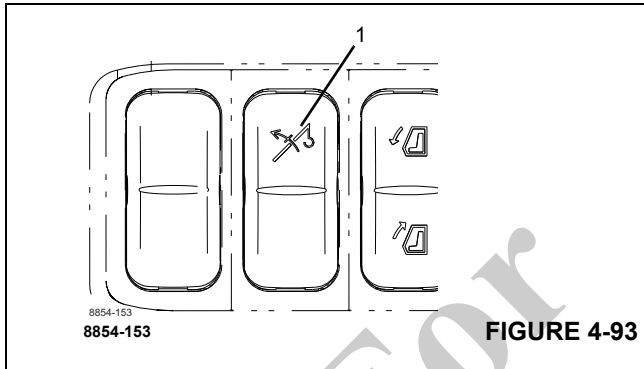


FIGURE 4-93

**In Emergencies**

During this type of override, the complete shutdown of the RCL is canceled and no monitoring takes place.

**Canceling a Shutdown**

- Insert the key into the key-operated switch (1), (Figure 4-94).
- Turn the key to the left or right once.
  - All crane movements are enabled for 30 minutes.
  - The status display (2), (Figure 4-94) will flash red.

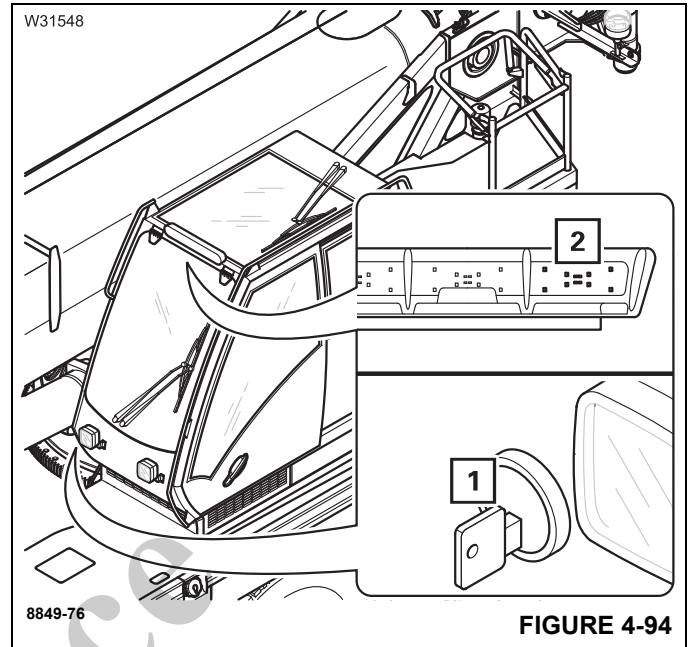


FIGURE 4-94

**Canceling the Override**

The override will be canceled when you:

- Switch off the ignition
- Press the key-operated switch again.

The override will automatically be canceled 30 minutes after the key-operated switch has been pressed.

**Crane Operation with Main Boom**

Make sure that the crane is level before lifting operation begins.

If the crane is found to be out of level during operation, stop operation, set the load down, return the boom to the travel position and re-level the crane.

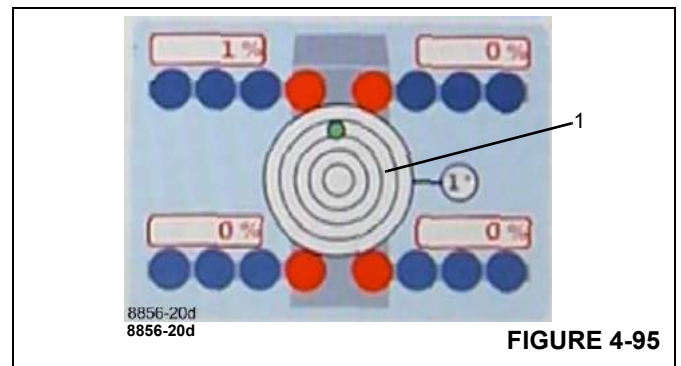


FIGURE 4-95

**Main Hoist**

You can reeve the hoist rope of the main hoist on the main boom or on the lattice extension.

**! WARNING**  
**Rope Damage Hazard!**

Use of hookblocks that do not have sufficient overhaul weight could result in spooling problems causing damage to the rope. Death or Serious injury could occur if the rope breaks. Always make sure that the overhaul weight is sufficient to keep tension on the rope even when no load is being lifted.



FIGURE 4-98

**Lifting and Lowering**

You can adjust the sensitivity of the control levers to suit the operating conditions. Refer to *Setting the Characteristic Curves for the Control Levers*, page 4-91.

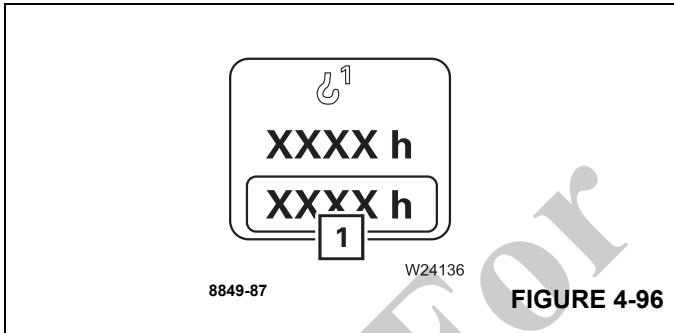


FIGURE 4-96

**Switching on the Main Hoist**

After the ignition is switched on, all of the power units will be switched off and the lamps in the corresponding buttons will light up only dimly.

- Check whether the auxiliary hoist is switched off and therefore secured against unintentional operation.

**NOTE:** Be aware that the auxiliary hoist could two-block when operating the main hoist.

- Symbol (3), (Figure 4-97) must be red.
- Press the button on the right armrest (1), (Figure 4-97) once.
  - Symbol (2), (Figure 4-97) is green when the main hoist is switched on.

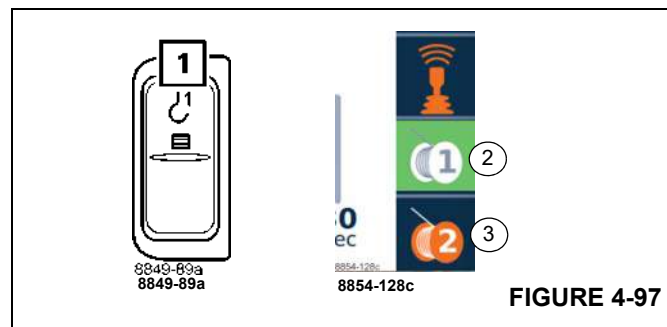


FIGURE 4-97

- Check that the current reeving (Figure 4-98) of the main hoist is displayed, e.g. 1. Correct the reeving if necessary. Refer to *Entering the Reeving*, page 4-54.

**! WARNING**  
**Rope Damage Hazard!**

Use of hookblocks that do not have sufficient overhaul weight could result in spooling problems causing damage to the rope. Death or Serious injury could occur if the rope breaks. Always make sure that the overhaul weight is sufficient to keep tension on the rope even when no load is being lifted.

|           |                                                                               |
|-----------|-------------------------------------------------------------------------------|
| Raising:  | Pull the control lever to the rear – symbol (3), (Figure 4-99) is displayed.  |
| Lowering: | Pull the control lever to the front – symbol (2), (Figure 4-99) is displayed. |

When the hoist drum is turning, you will notice a pulse on the rotation indicator (1), (Figure 4-99).

You can regulate the speed by moving the control lever or changing the engine speed.

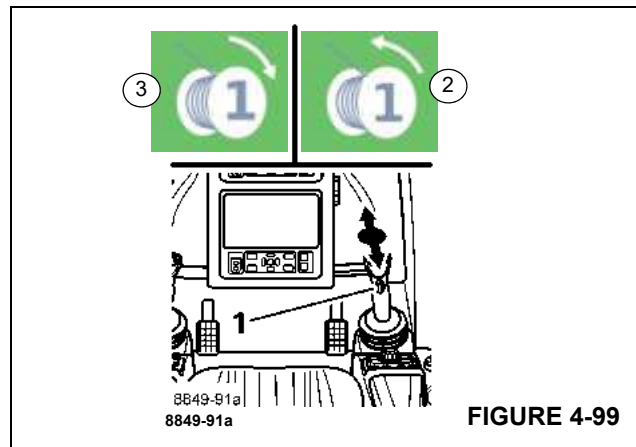


FIGURE 4-99

You can set the desired engine speed (idling speed) with button (1), (Figure 4-100). Refer to *Engine Idle Increment/Decrement Switch*, page 3-7.



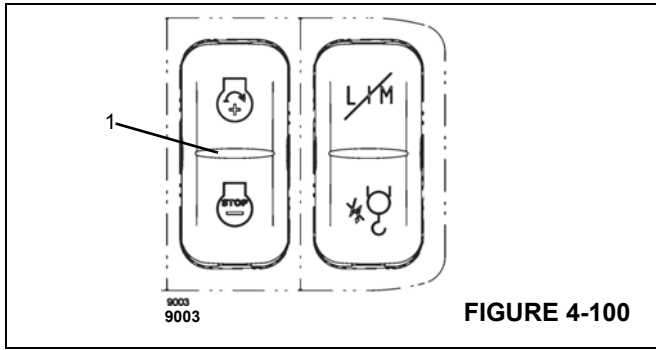


FIGURE 4-100

You can limit the maximum hoist speed (Figure 4-101). Refer to *Limiting the Power Unit Speeds*, page 4-92.

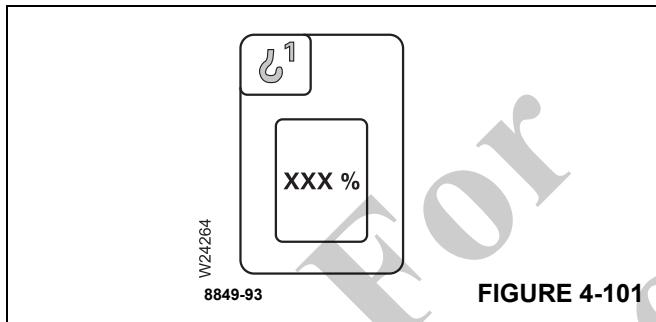


FIGURE 4-101

You can switch on high-speed mode for a higher speed (Figure 4-102). Refer to *High-Speed Mode*, page 4-87.

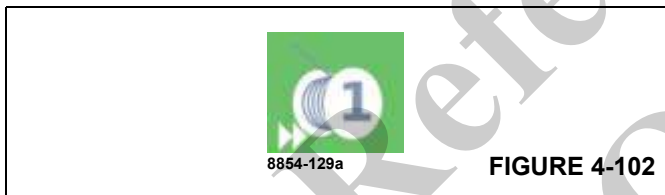


FIGURE 4-102

**Switching OFF the Main Hoist**

If you no longer require the main hoist, you should switch it off to avoid unintentional use.

- Press the button (1), (Figure 4-103) once.
  - Symbol (2), (Figure 4-103) is red when the main hoist is switched OFF.

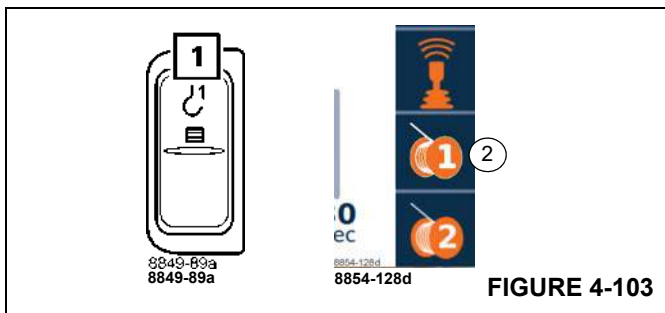


FIGURE 4-103

**Auxiliary Hoist**

**WARNING**  
**Wire Rope Damage!**

When both hoists are reeved, ensure that the ropes do not rub or contact each other or the other hoist during operation. Should this contact occur, the rope could be damaged causing the rope to break, resulting in Death or Serious Injury.

You can have the operating hours (1), (Figure 4-104) of the hoist displayed. Refer to *Operating Hours Menu*, page 3-51.

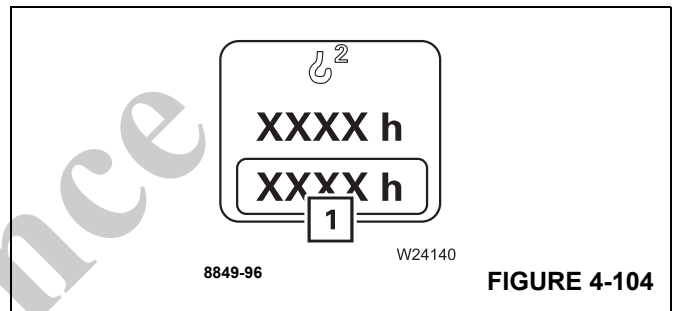


FIGURE 4-104

**Switching ON the Auxiliary Hoist**

After the ignition is switched on, all of the power units will be switched off and the lamps in the corresponding buttons will light up only dimly.

- Check whether the main hoist is switched OFF and therefore secured against unintentional operation.
  - Press the button on the right armrest (1), (Figure 4-105) once. Symbol (2), (Figure 4-105) must be red.

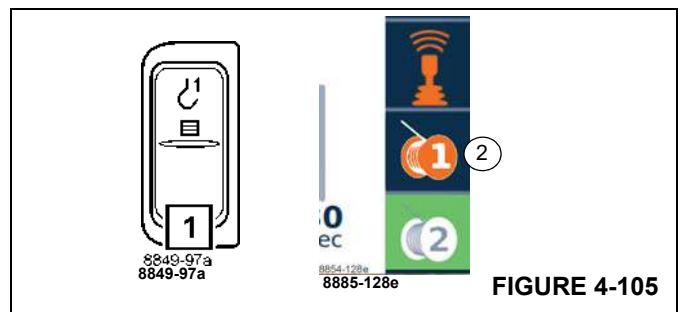


FIGURE 4-105

Press the button on the right armrest (1), (Figure 4-106) once.

Symbol (2), (Figure 4-106) is green when the auxiliary hoist is switched ON.

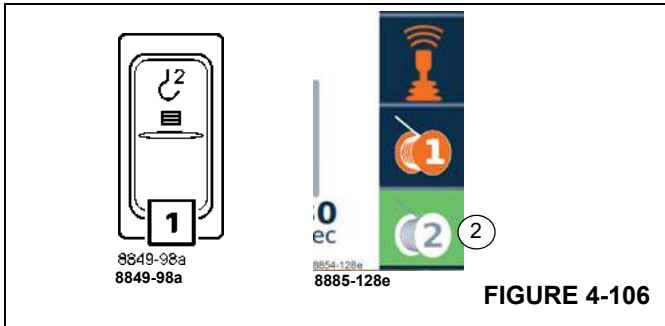


FIGURE 4-106

Check whether the current reeving of the auxiliary hoist is displayed (Figure 4-107). Correct the reeving if necessary. Refer to *Entering the Reeving*, page 4-54.

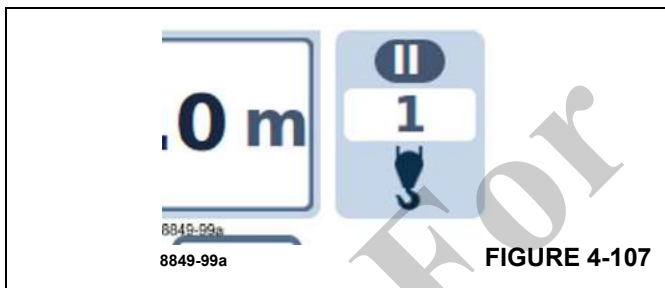


FIGURE 4-107

**Lifting and Lowering**

You can adjust the sensitivity of the control levers to suit the operating conditions. Refer to *Setting the Characteristic Curves for the Control Levers*, page 4-91.

|           |                                                                                |
|-----------|--------------------------------------------------------------------------------|
| Raising:  | Pull the control lever to the rear – symbol (3), (Figure 4-108) is displayed.  |
| Lowering: | Push the control lever to the front – symbol (2), (Figure 4-108) is displayed. |

When the hoist drum is turning, you will notice a pulse on the rotation indicator (1), (Figure 4-108).

You can regulate the speed by moving the control lever or changing the engine speed.

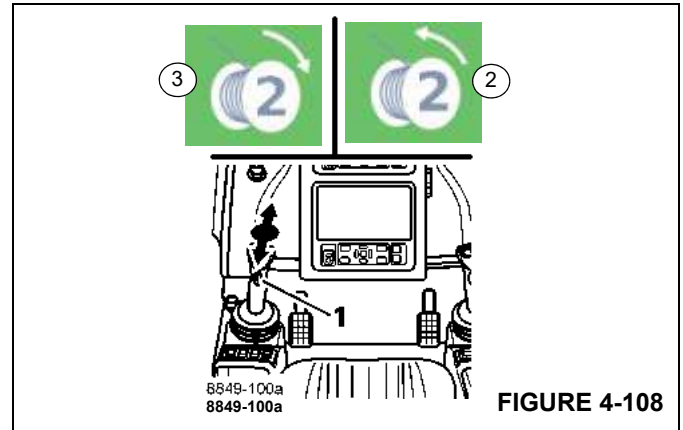


FIGURE 4-108

You can set the desired engine speed (idling speed) with the button located on the overhead control panel (1), (Figure 4-109). Refer to *Boom Extension Assist*, page 3-127.

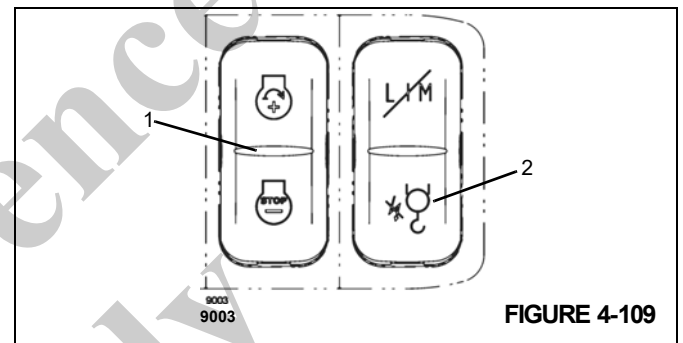


FIGURE 4-109

You can limit the maximum hoist speed (Figure 4-110). Refer to *Limiting the Power Unit Speeds*, page 4-92.

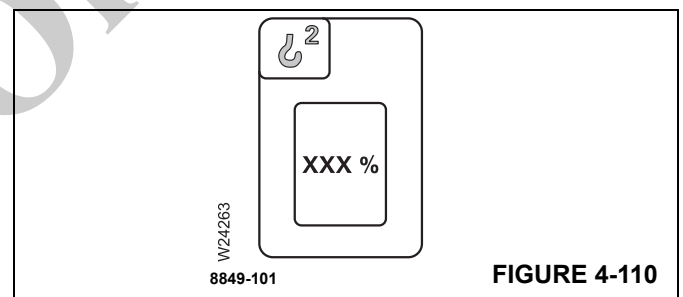


FIGURE 4-110

You can switch on high-speed mode (Figure 4-111) for a higher speed. Refer to *High-Speed Mode*, page 4-87.

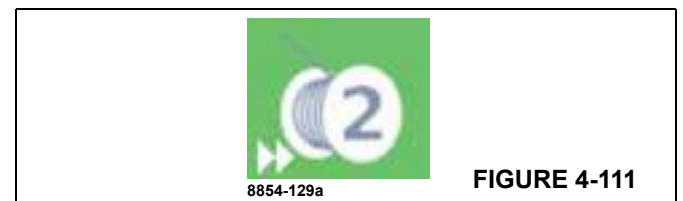


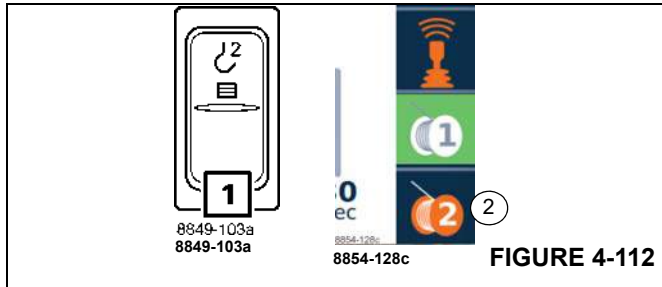
FIGURE 4-111

**Switching OFF the Auxiliary Hoist**

If the auxiliary hoist is not required, it should be switched OFF to avoid unintentional use.

Press the button (1), (Figure 4-112) once.

Symbol (2), (Figure 4-112) is red when the auxiliary hoist is switched OFF.



**FIGURE 4-112**

**Anti Two-Block Switch and Lowering Limit Switch**

**Anti Two-Block**

To install/remove the Anti Two-Block switch, refer to *Installing/Removing the Anti Two-Block Switch*, page 6-36.

The Anti Two-Block switch prevents the hook block from being lifted up to the main boom head and damaging it.

The Anti Two-Block switch only works if it has been unlocked. Refer to *Removing the Lock*, page 6-40.



**DANGER  
Two-Blocking Hazard!**

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

This crane should have a functional Anti Two-Block and control lock-out system. Test daily for proper operation.

**DO NOT PASS LOADS OR BOOM OVER GROUND PERSONNEL.**

The Anti Two-Block switch will be triggered if:

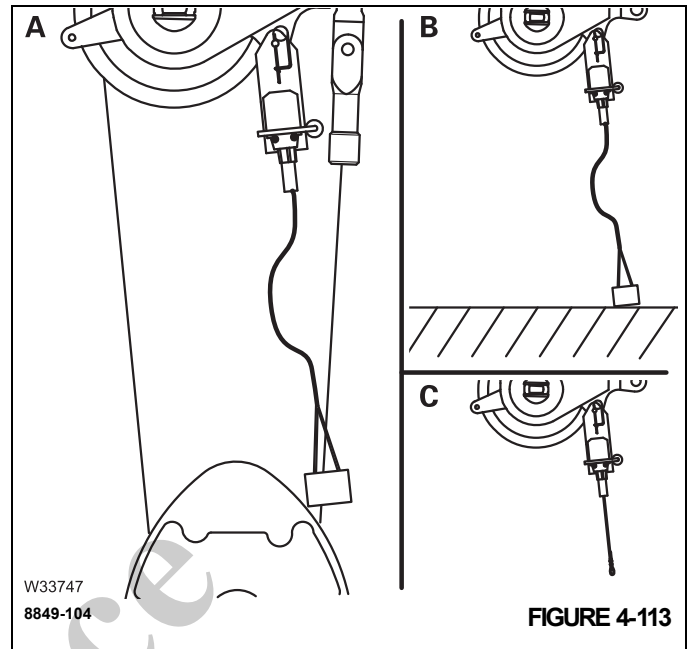
(A), (Figure 4-113) – the hook block raises the Anti Two-Block Switch weight,

**OR**

(B), (Figure 4-113) – the Anti Two-Block Switch weight touches the ground upon lowering,

**OR**

(C), (Figure 4-113) – the Anti Two-Block Switch weight is not attached.

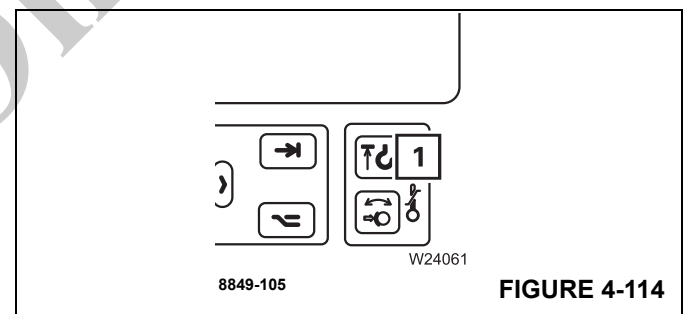


**FIGURE 4-113**

The lamp (1), (Figure 4-114) will light up if the Anti Two-Block Switch has been triggered.

At the same time, all movements which would bring the load closer to the nose will be switched OFF – Lifting, Boom Lowering, Extending and Lowering the Lattice Extension, if necessary.

To cancel the shutdown, leave the shutdown range by performing a different crane movement or by setting down the load.



**FIGURE 4-114**

**Anti Two-Block Switch Override**

When overriding, the system continues to monitor the crane and provides information on the displays. Only the lockout is disabled when the crane is bypassed.

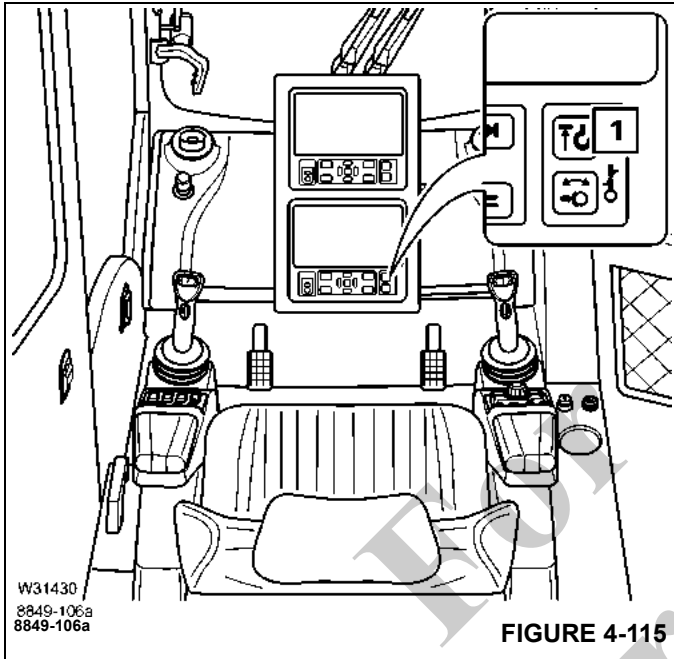
Press the button located on the overhead control panel (2), (Figure 4-109) and keep it depressed – the anti two-block switch is overridden.

If the anti two-block switch is triggered now, the crane movement is stopped once and the lamp (1), (Figure 4-115) flashes.

- The lamp (1), (Figure 4-115) goes out, when you release the button (override removed),

OR

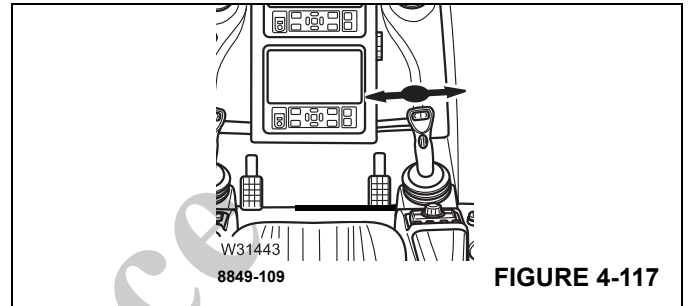
- If you leave the shutdown range.



**Raising and Lowering**

You can adjust the sensitivity of the control levers to suit the operating conditions. Refer to *Setting the Characteristic Curves for the Control Levers*, page 4-91.

|           |                                                                                |
|-----------|--------------------------------------------------------------------------------|
| Lowering: | Push the control lever (Figure 4-117) to the right – the main boom is lowered. |
| Raising:  | Push the control lever to the left – the main boom is raised.                  |



You can regulate the speed by moving the control lever or changing the engine speed.

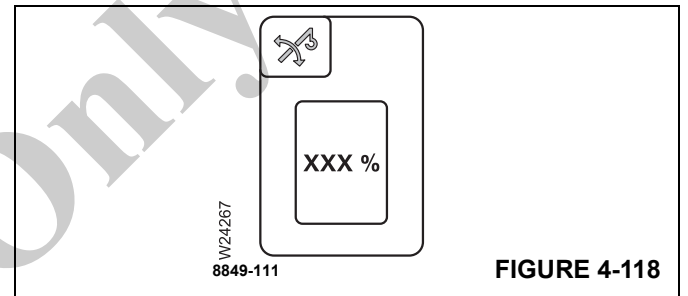
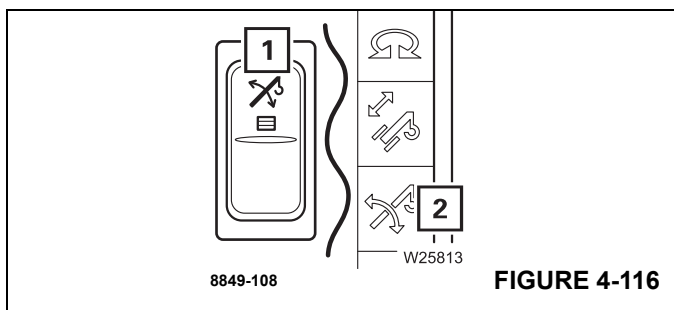
You can limit the maximum lifting/lowering speed (Figure 4-118). Refer to *Limiting the Power Unit Speeds*, page 4-92.

**Switching ON the Lifting/Lowering Mechanism**

After the ignition is switched ON, all of the power units will be switched OFF and the lamps in the corresponding buttons will light up only dimly.

- Press the button on the right-hand armrest (1), (Figure 4-116) once.
  - Symbol (2), (Figure 4-116) will be green if the lifting/lowering mechanism is switched ON.

If the control lever is assigned more than one function, all other power units which are assigned the same control lever operation are switched OFF.



**Switching OFF the Lifting/Lowering Mechanism**

If the lifting/lowering mechanism is not required, it should be switched OFF to avoid unintentional use.

Press the button (1), (Figure 4-119) once.

Symbol (2), (Figure 4-119) will be red if the lifting/lowering mechanism is switched OFF.

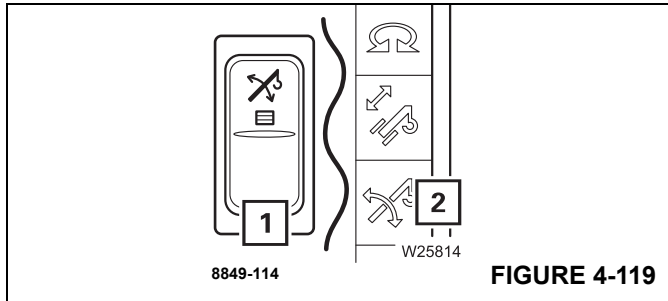


FIGURE 4-119

**Telescoping Mechanism**

A telescoping process requires locking and unlocking processes in the main boom. You can telescope the main boom in different ways.

**Manual Telescoping**

For manual telescoping, you must initiate all locking and unlocking processes at the right time.

**Telescoping with Semi-Automation**

When telescoping with semi-automation, you enter a telescoping value and CCS controls all the locking and unlocking processes automatically. You can also use this mode for intermediate lengths.

**NOTE:** For more information on telescoping with semi-automation refer to *Telescoping with Semi-Automation*, page 4-78.

**Extending with the Main Boom Configuration**

The CCS display shows various sectional views of the main boom. To make you familiar with these representations more quickly, the following section begins with an overview of the telescoping mechanism and a telescoping process.

**Overview**

The illustration (Figure 4-120) shows the completely retracted main boom with the base section (9) and the first three telescopic sections I to III (1) to (3).

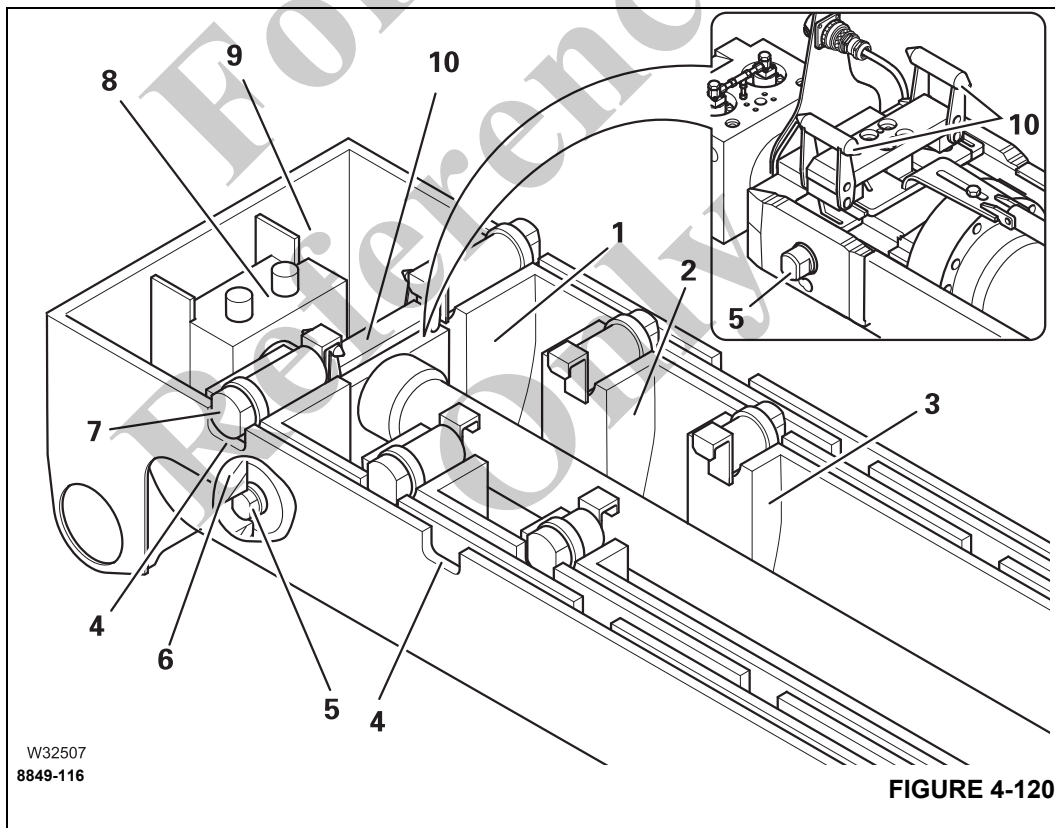


FIGURE 4-120

Refer to (Figure 4-120). Each telescopic section is equipped with two-section locking pins (7) which are extended by spring force.

The section locking pins (7) are pushed into the cutouts (4) of the telescopic section at the locking points – the telescopic section is locked.

The telescoping cylinder is attached to the base section (9) with the piston rod (8). The telescoping cylinder has two cylinder locking pins (5) at the bottom and a mechanism at the top (10).

When the telescoping cylinder is positioned at a locking point:

The locking pins (5) can be extended into the cutouts (6) – the telescoping cylinder is locked.

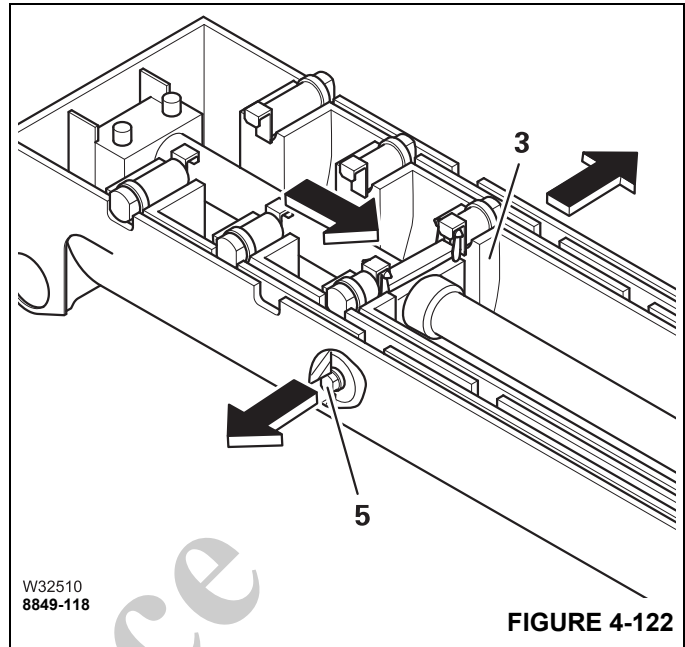
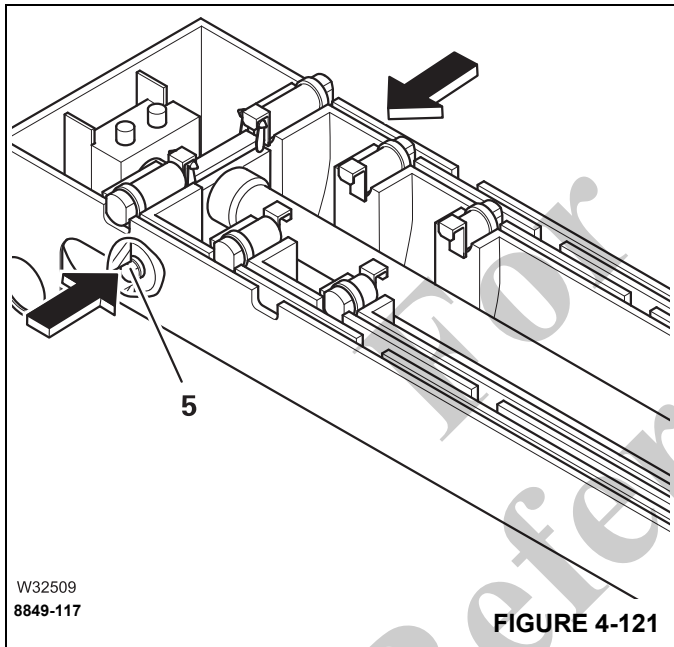
The mechanism (10) engages into the locking pins (7) and can retract them – the telescopic section is unlocked.

**Telescoping Process**

A telescoping processes consist of 4 Steps:

**1. Unlocking the telescoping cylinder.**

The locking pins (5), (Figure 4-121) retract – the telescoping cylinder is unlocked.



**3. Unlocking the telescopic section.**

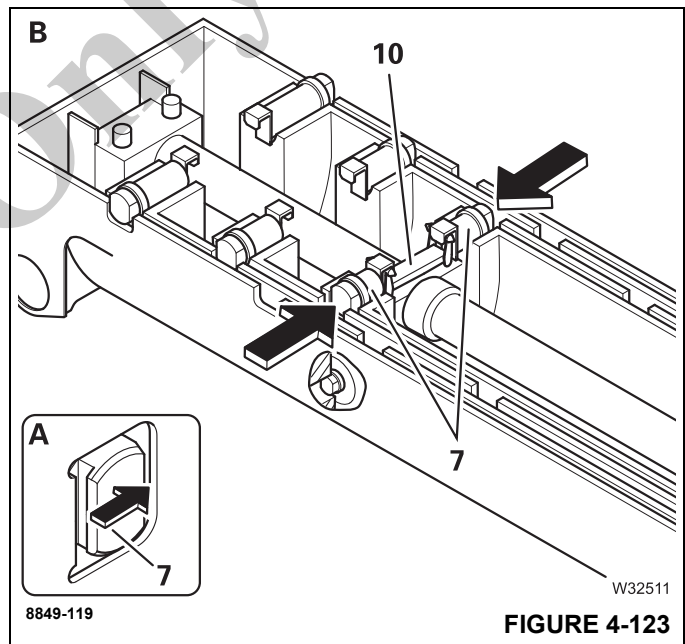
(A), (Figure 4-123) – The telescoping cylinder extends until the locking pins (7), (Figure 4-123) are clear.

(B), (Figure 4-123) - The mechanism (10), (Figure 4-123) retracts the locking pins (7), (Figure 4-123) – the telescopic section is unlocked.

**2. Moving and locking the telescoping cylinder.**

The telescoping cylinder moves into the section to be telescoped, e.g. telescopic section III (3), (Figure 4-122).

The cylinder locking pins (5), (Figure 4-122) extend – the telescoping cylinder is locked.

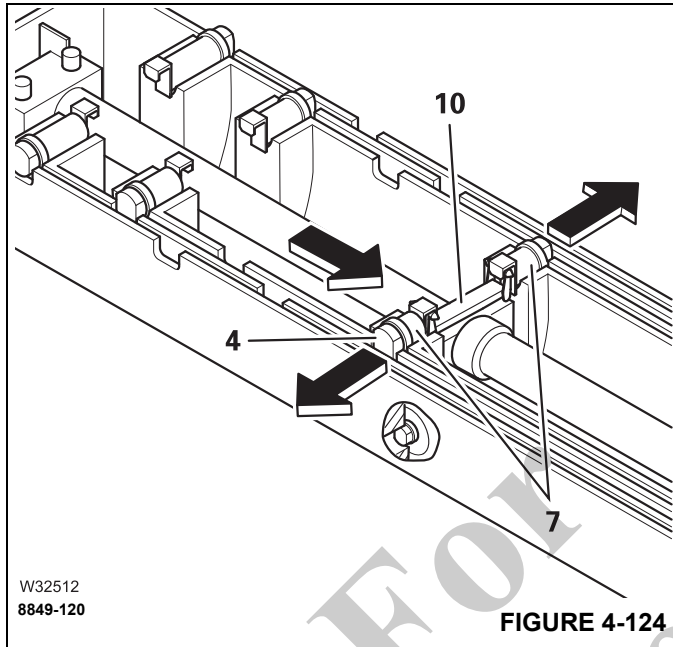


**4. Telescoping, locking and setting down a telescopic section.**

The telescoping cylinder pushes the telescopic section to a locking point.



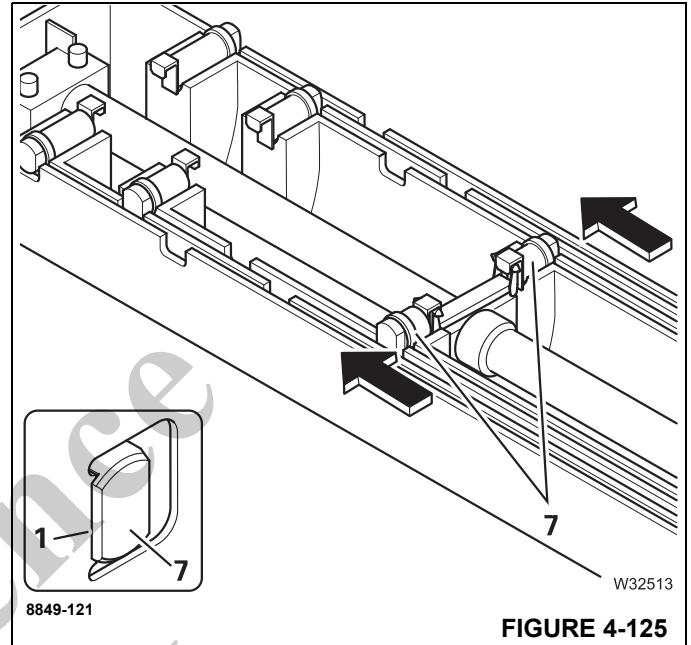
The weight is taken off the mechanism (10), (Figure 4-124). The locking pins (7), (Figure 4-124) extend into the cutouts (4).



The telescopic section is automatically set down.

The telescoping cylinder retracts until the locking pins (7), (Figure 4-125) are positioned on the above telescopic section (1), (Figure 4-125).

The weight of the load is now on the telescopic sections and not on the telescoping cylinder.



Reference Only



**Assignment for Display**

The CCS display shows a sectional view of the main boom in the menus.

The following elements are displayed (Figure 4-126):

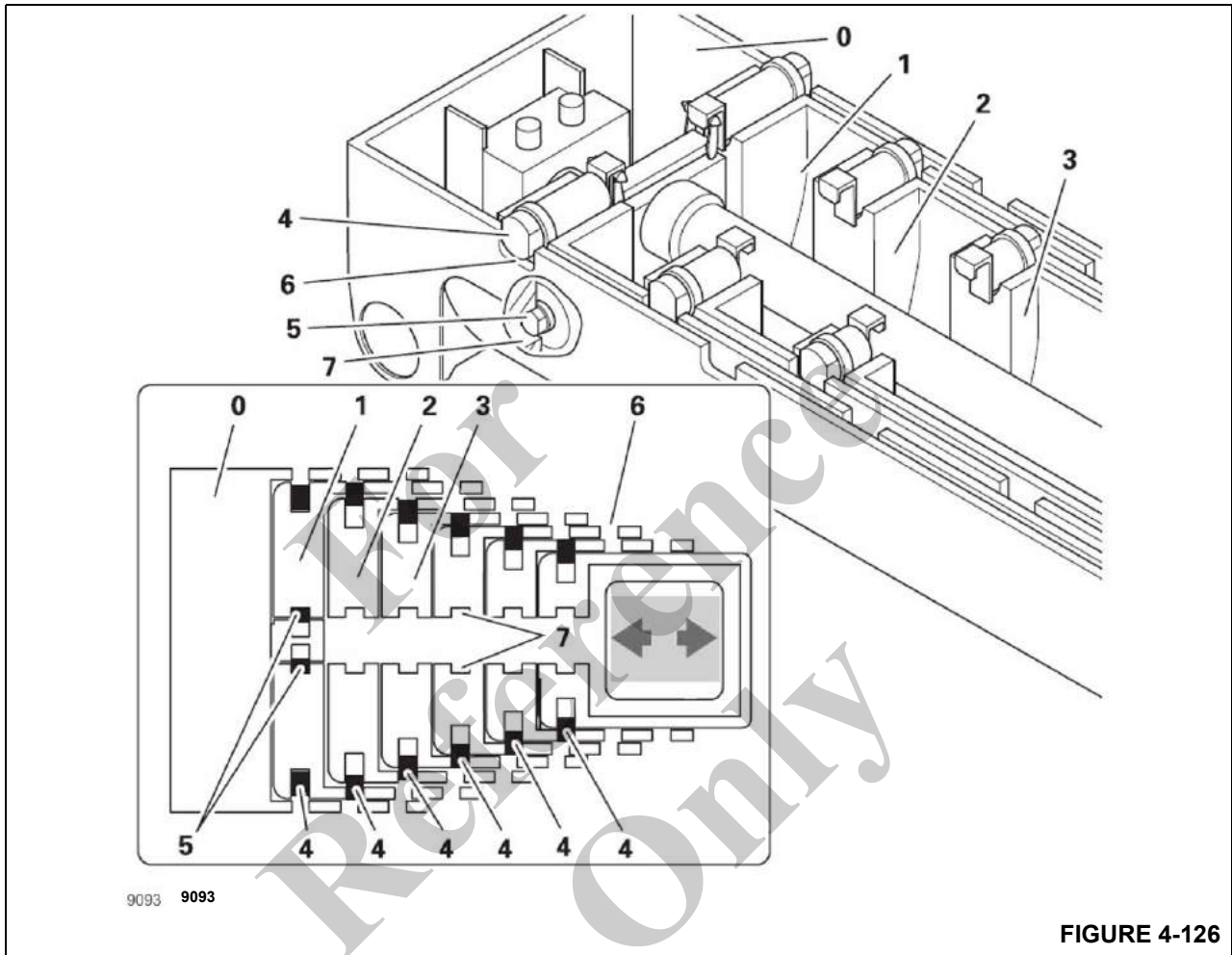


FIGURE 4-126

|   |                                                   |
|---|---------------------------------------------------|
| 0 | Base section                                      |
| 1 | Telescopic section I                              |
| 2 | Telescopic section II                             |
| 3 | Telescopic section III                            |
| 4 | Section locking pin on the telescopic section     |
| 5 | Cylinder locking pins on the telescoping cylinder |
| 6 | Section pin cutouts (holes)                       |
| 7 | Cylinder pin engagement cutouts (holes)           |

**Fixed Length, Intermediate Length, Telescoping Length**

There are lifting capacity tables for main boom fixed lengths, main boom intermediate lengths and main boom telescoping lengths.

The lengths are automatically detected by the RCL, and the corresponding lifting capacities according to the Lifting capacity table are enabled and displayed automatically.

### Main Boom Fixed Length

Main boom fixed lengths have the greatest lifting capacities. A main boom fixed length is reached if:

- All telescopic sections are locked to a fixed length
- All telescopic sections are set down.

### Main Boom Intermediate Length

A main boom intermediate length is reached if not all telescopic sections are locked to fixed lengths.

Extend the main boom to the required length before hoisting the load.

### Main Boom Telescoping Length

The main boom is at a telescoping length if it is extended to an intermediate length and may be telescoped with the current load. The size of the load that can be telescoped depends on the angle of inclination and on the degree of lubrication of the main boom.

### Telescoping

The position of the telescopic sections, i.e. which telescopic section is extended to what extent, is referred to as telescoping or the actual telescope picture.

This section only deals with the displays on the RCL. The telescoping is also shown on the CCS Display. Refer to *Telescoping the Telescopic Section*, page 4-77.

The RCL displays main boom fixed lengths and main boom intermediate/telescoping lengths in different ways.

### Telescoping Sequence

The telescopic sections can only be telescoped individually, one after the other.

When extending you must always extend the telescopic section with the highest numbering first, then the telescopic section with the second highest numbering, etc. (e.g. IV, III, II, I).

The telescopic sections are always retracted in the reverse order of extending.

### Inspections Prior to Starting Operations

When the ignition is turned on, CCS registers the displayed telescoping status from the current status of the telescoping mechanism and the previously saved locking and unlocking procedures.

Normally, CCS detects differences between the current and the displayed telescoping and displays the corresponding error message.

If a malfunction results in saved values being deleted, CCS can no longer calculate the current telescoping and may not issue an error message.

## CAUTION

### Telescope Mechanism Damage!

If the telescope system position is different from the current telescoping shown on the display, damage could occur during operation of the telescope system.

Make sure that the actual indicated telescope status matches the current telescope position.

Before the first telescoping, compare the telescoping indicated on the CCS display with the current telescoping.

### Switching ON the Telescoping Mechanism

After the ignition is switched ON, all of the power units will be switched off and the lamps in the corresponding buttons will light up only dimly.

- Press the button on the right hand armrest (1), (Figure 4-127) once.
  - The lamp in button (1), (Figure 4-127) will light up brightly.
  - The symbol (2), (Figure 4-127) will be green if the telescoping mechanism is switched ON.

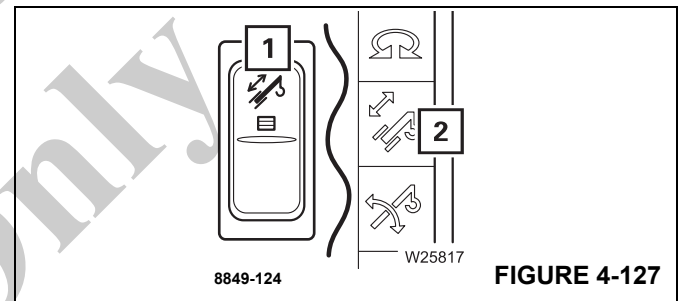


FIGURE 4-127

### Function of the Control Lever

This section only describes the function of the control lever. Before telescoping, a number of prerequisites need to be fulfilled as well.



## WARNING

### Risk of Accidents Due to Unexpected Crane Movements!

In the case of multiple configuration, check whether the control lever function Telescoping is switched on before you move the control lever.

This prevents accidents caused by unexpected lifting/lowering.

The distance between the hook block and the boom nose changes during telescoping. Make sure that the hook block does not trigger the anti-two block switch or touch the ground.

- To prevent two-blocking or slack rope conditions, perform the following functions as required:
  - Lower hoist when extending
  - Lift hoist when retracting.

The control lever movements for telescoping vary depending on the configuration.

**With Telescoping Assigned to the Right-Hand Lever**

|             |                                                     |
|-------------|-----------------------------------------------------|
| To Extend:  | Push the control lever to the right (Figure 4-128). |
| To Retract: | Push the control lever to the left.                 |

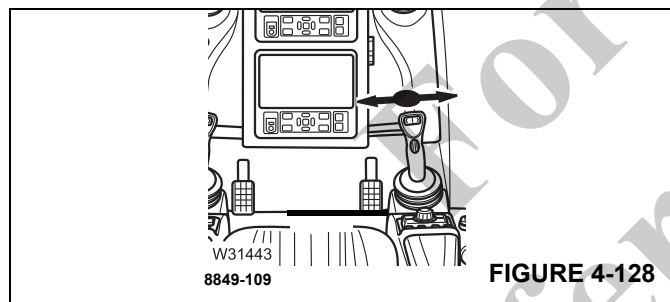


FIGURE 4-128

**With Telescoping Assigned to the Left-Hand Lever**

|             |                                                 |
|-------------|-------------------------------------------------|
| To extend:  | Push the control lever forwards (Figure 4-129). |
| To retract: | Pull the control lever backwards.               |

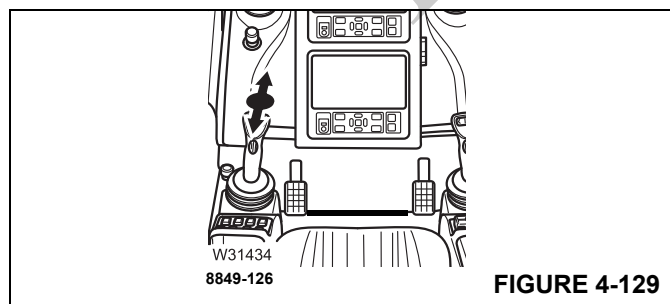


FIGURE 4-129

Telescoping will only start if left arrow for retracting (1), (Figure 4-130) or right arrow for extending (2), (Figure 4-130) is shown in the indicated location of the operating display screen (either the semi-automation or manual telescoping screen).

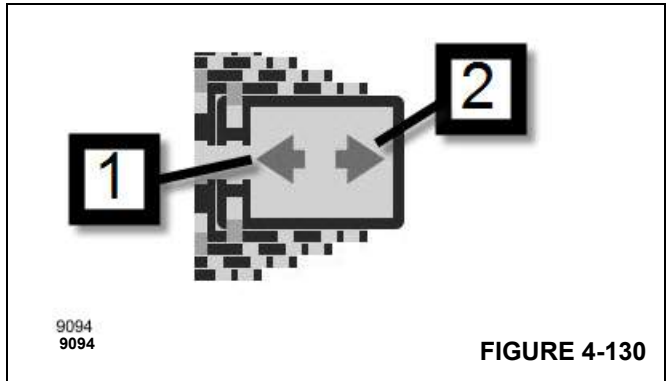


FIGURE 4-130

You can regulate the speed by moving the control lever or changing the engine speed.

**NOTE:** With certain telescoping states, the RCL will switch telescoping off, e.g. when you leave the telescoping lengths or when the working range limit has been reached. Refer to *RCL Shutdown*, page 4-58.

**Switching OFF the Telescoping Mechanism**

If the telescoping mechanism is not required, it should be switched off to avoid unintentional use.

- Press the button (1), (Figure 4-131) once.
  - The lamp in the button (1), (Figure 4-131) will light up dimly.
  - The symbol (2), (Figure 4-131) is red if the telescoping mechanism is switched OFF.

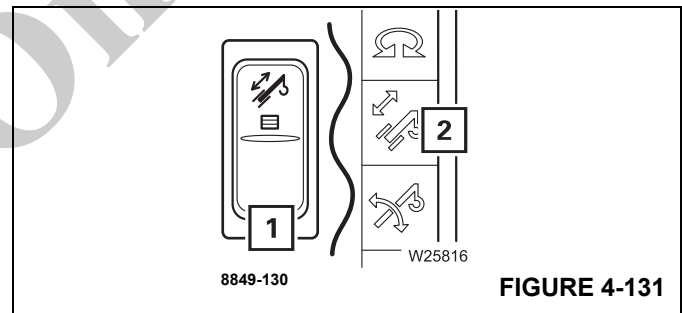


FIGURE 4-131

**Manual Telescoping**

To telescope manually, you must initiate all locking and unlocking processes. The locking and unlocking processes are carried out automatically.

The following sections describe the operating procedures:

- Checking the initial position,
- Unlocking the telescoping cylinder. Refer to *Unlocking the Telescoping Cylinder*, page 4-74

- Moving the telescoping cylinder (without telescopic section). Refer to *Extending/Retracting the Telescoping Cylinder*, page 4-74.
- Locking the telescoping cylinder. Refer to *Lock Telescoping Cylinder*, page 4-75.
- Unlocking the telescopic section. Refer to *Unlocking the Telescopic Section*, page 4-76.
- Telescoping the telescopic section. Refer to *Telescoping the Telescopic Section*, page 4-77.
- Locking the telescopic section. Refer to *Locking the Telescopic Section*, page 4-77.

**NOTE:** The operating order depends on the current initial position. For an overview of a telescoping process (example), refer to *Telescoping Process*, page 4-68.

**NOTE:** The lengths given in the following illustrations are purely sample values, and may differ from the current display.

**Checking the Initial Position**

Before telescoping, you must check the following statuses:

- the current telescope status,
- the position of the telescoping cylinder,
- the position of the locking pins.
- To do so, open the main menu and press the button (1), (Figure 4-132) or (2), (Figure 4-132) once.

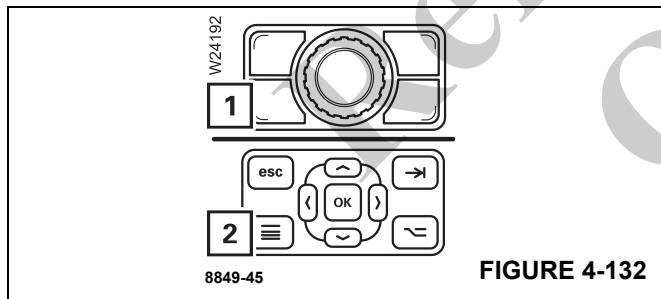


FIGURE 4-132

Open the Manual Telescoping Menu (1), (Figure 4-133).

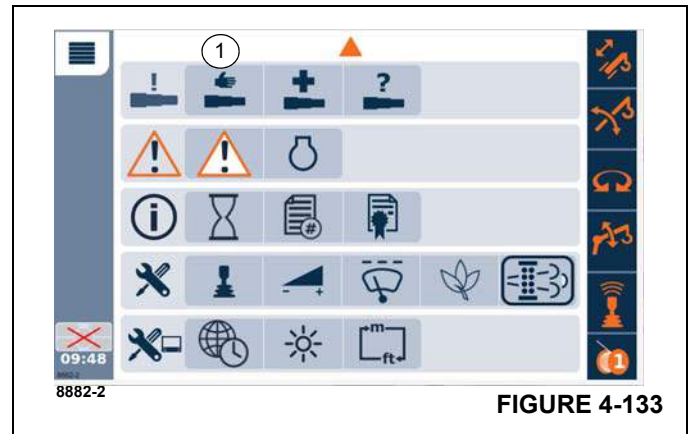


FIGURE 4-133

**Current Telescoping**

The display (1), (Figure 4-134) shows how far the telescoping cylinder is extended, e.g. 0%.

The display (2), (Figure 4-134) shows the current main boom length.

The display (3), (Figure 4-134) shows the corresponding telescopic section, e.g. telescopic section 1.

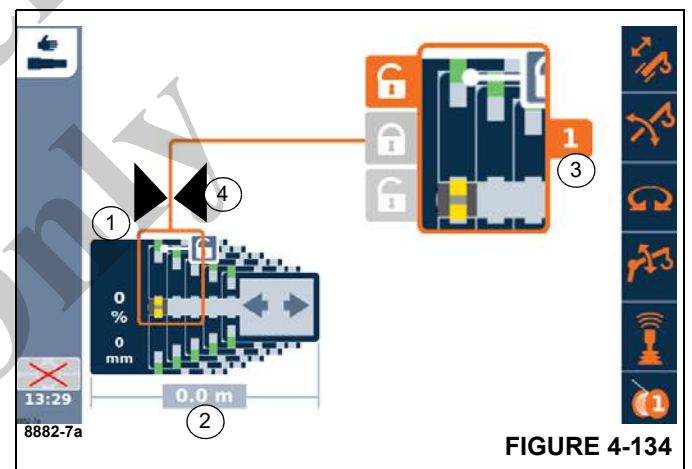


FIGURE 4-134

**Position of the Telescoping Cylinder**

The display (1), (Figure 4-134) shows how far the telescoping cylinder is extended, e.g. 0%.

If the telescoping cylinder is near a locking point:

- The display (3), (Figure 4-134) shows the corresponding telescopic section, e.g. telescopic section 1.
- The display (4), (Figure 4-134) shows one or two arrows, depending on the distance to the locking point.

**Position of the Locking Pins**

The current positions of the locking pins are (Figure 4-135):

|   |                             |
|---|-----------------------------|
| 1 | on the telescopic section   |
| 2 | on the telescoping cylinder |

The area (3), (Figure 4-135) shows an enlarged cut-out.

The current settings are shown in different colors.

|         |                       |
|---------|-----------------------|
| Red:    | Unlocked              |
| Green:  | Locked                |
| Yellow: | Intermediate position |

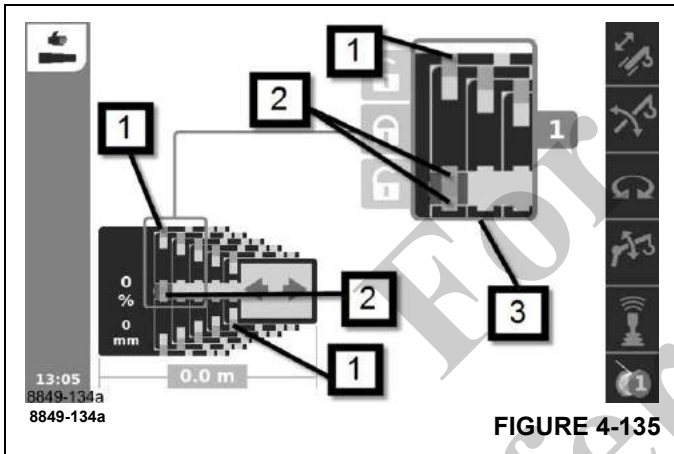


FIGURE 4-135

**Unlocking the Telescoping Cylinder**

Unlocking the telescoping cylinder is required for the telescoping cylinder to be moved separately (without telescopic section).

The telescoping cylinder and the telescopic section cannot be unlocked simultaneously.

**Prerequisites:**

- Telescoping mechanism on – symbol (3), (Figure 4-136) green.
- Telescoping cylinder locked – symbol (2), (Figure 4-136) green.
- Telescopic section locked – symbol (1), (Figure 4-136) green.

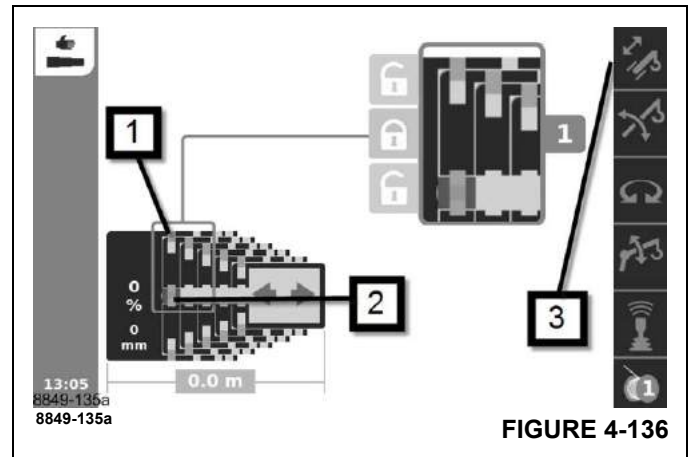


FIGURE 4-136

**Unlock**

Select the symbol (1), (Figure 4-137).

Confirm the selection – the locking pins (2), (Figure 4-137) will retract.

|         |                       |
|---------|-----------------------|
| Yellow: | Intermediate position |
| Red:    | Unlocked              |

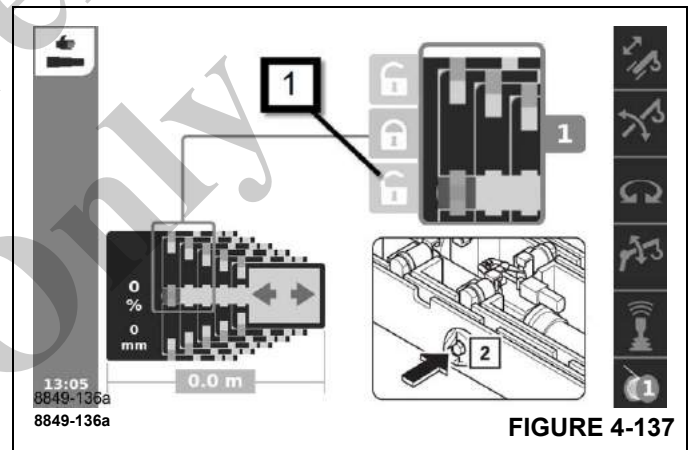


FIGURE 4-137

**Extending/Retracting the Telescoping Cylinder**

**Prerequisites:**

- Telescoping mechanism on – symbol (3), (Figure 4-138) green.
- Telescopic section locked – symbol (1), (Figure 4-138) green.
- Telescoping cylinder unlocked – symbol (2), (Figure 4-138) red.



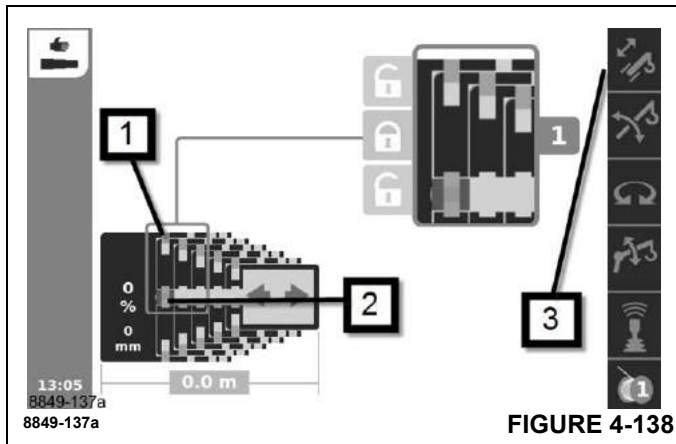


FIGURE 4-138

**Extending/Retracting**

- Move the control lever in the corresponding telescoping direction:

|          |         |
|----------|---------|
| Extend:  | Extend  |
| Retract: | Retract |

The telescoping cylinder (2), (Figure 4-139) extends/retracts.

The display (1), (Figure 4-139) shows the currently extended length, e.g. 80%.

Near a locking point, the symbols (3), (Figure 4-139) show:

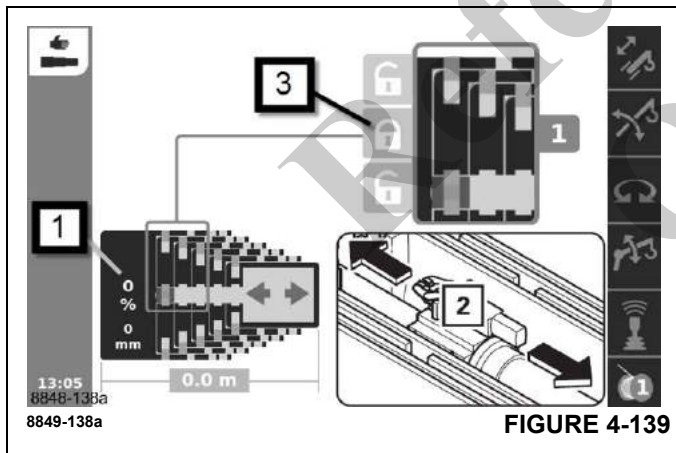


FIGURE 4-139

The direction of travel to the locking point (Figure 4-140):

|   |                      |
|---|----------------------|
| 1 | Extending            |
| 2 | Retracting           |
| 3 | At the locking point |

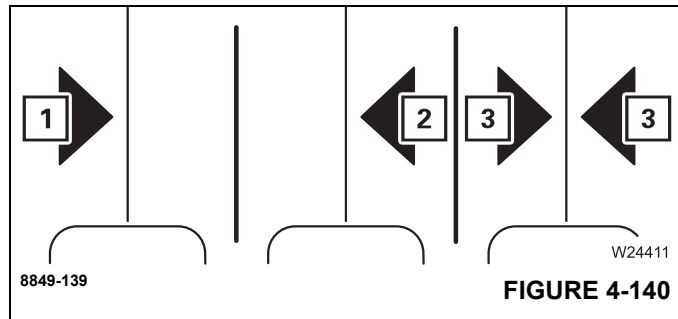


FIGURE 4-140

**CAUTION**

**Boom System Damage!**

If extending and retracting several times does not lead to the lock being released, you must not telescope any further against the stop.

If removing the load does not cause the lock to be released, you must lock the telescoping cylinder and then restart unlocking.

**Lock Telescoping Cylinder**

The telescoping cylinder must be locked to a telescopic section so that the telescopic section can be telescoped.

**Prerequisites:**

- Telescoping mechanism on – symbol (3), (Figure 4-141) green.
- Telescopic section locked – symbol (1), (Figure 4-141) green.

**NOTE:** Lock command available – symbol (4), (Figure 4-141) orange.

Telescoping cylinder unlocked – symbol (2), (Figure 4-141) red.

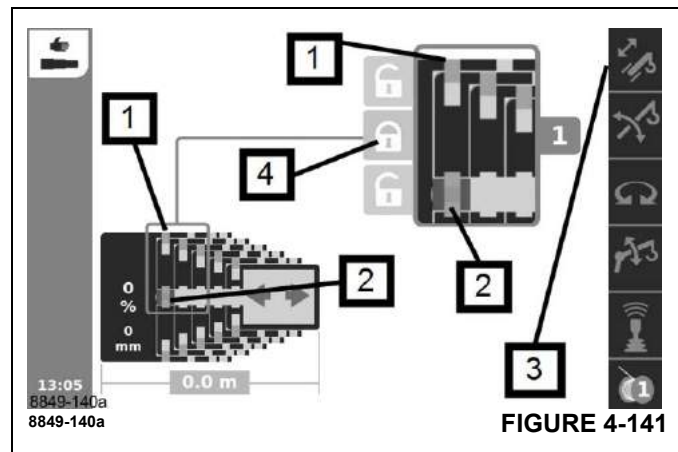


FIGURE 4-141

**Lock**

Refer to (Figure 4-142).

- Move the telescoping cylinder to the desired locking point, e. g. to telescopic section (1) (Figure 4-142). Wait until the display:
  - shows the desired telescopic section (1);
- and
  - the symbols (4) are shown.
- Select the symbol (3).
- Confirm the selection – the locking pins (2) will extend – symbol (4) green.

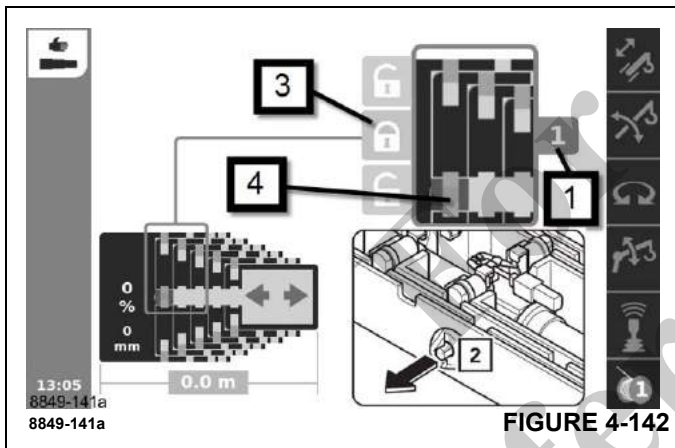


FIGURE 4-142

**Unlocking the Telescopic Section**

Unlocking a telescopic section is required for the telescopic section to be telescoped.

The telescoping cylinder and the telescopic section cannot be unlocked simultaneously.

**Prerequisites:**

- Telescoping mechanism ON – symbol (3), (Figure 4-143) green.
- Telescopic section locked – symbol (1) green.
- Telescoping cylinder locked – symbol (2) green.

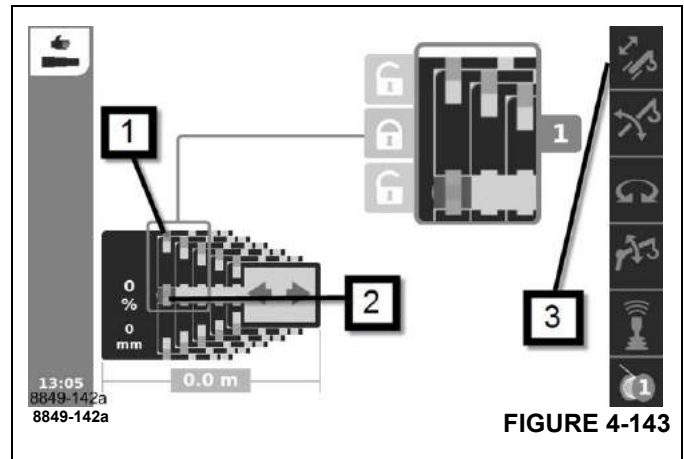


FIGURE 4-143

**Unlock**

For Unlocking, refer to (Figure 4-144). Select the symbol (1).

Confirm the selection – the locking pins will retract. Symbol (2) red.

If symbol (2) is not red after approx. 10 seconds, this means that the locking pins are under load.

To relieve the load, carefully retract and extend a little.

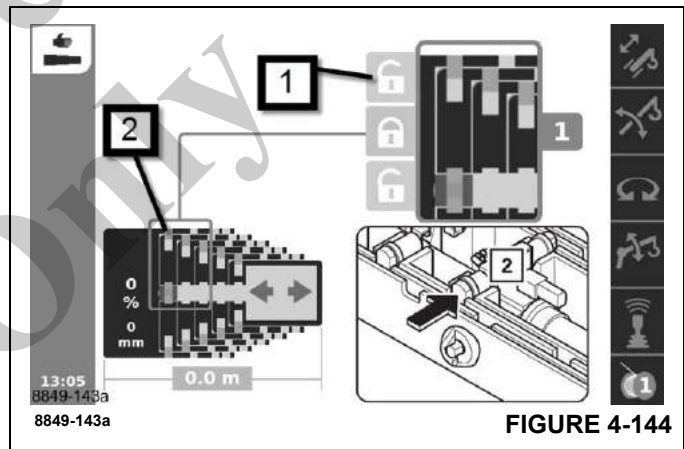


FIGURE 4-144

**CAUTION**

**Boom System Damage!**

If extending and retracting several times does not lead to the lock being released, you must not telescope any further against the stop.

If removing the load does not cause unlocking, you must lock the Telescopic Section. Refer to *Locking the Telescopic Section*, page 4-77 and restart unlocking.



**Telescoping the Telescopic Section**

You can telescope the telescopic section once it is unlocked.

**Prerequisites:**

- Refer to (Figure 4-145).
- Telescoping mechanism ON – symbol (3), (Figure 4-145) green.
- Telescoping cylinder locked – symbol (2) green.
- Telescopic section unlocked – symbol (1) red.

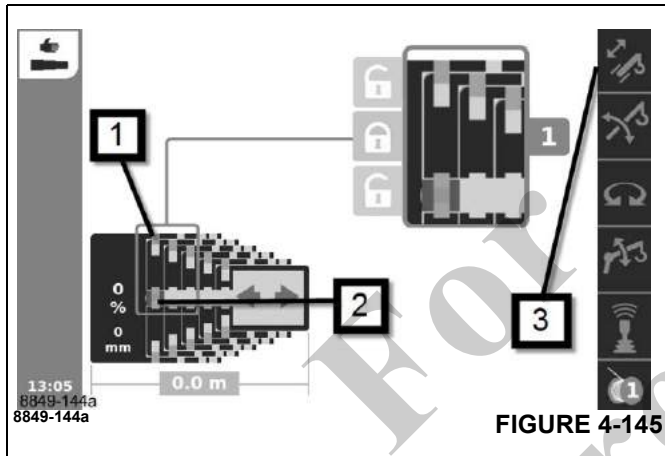


FIGURE 4-145

**Locking the Telescopic Section**

Every telescopic section can be locked at the fixed lengths. refer to *Fixed Length, Intermediate Length, Telescoping Length*, page 4-70.

**Prerequisites:**

- Telescoping mechanism on – symbol (3), (Figure 4-147) green.
- Telescopic section unlocked – symbol (1) red.
- Telescoping cylinder locked – symbol (2) green.

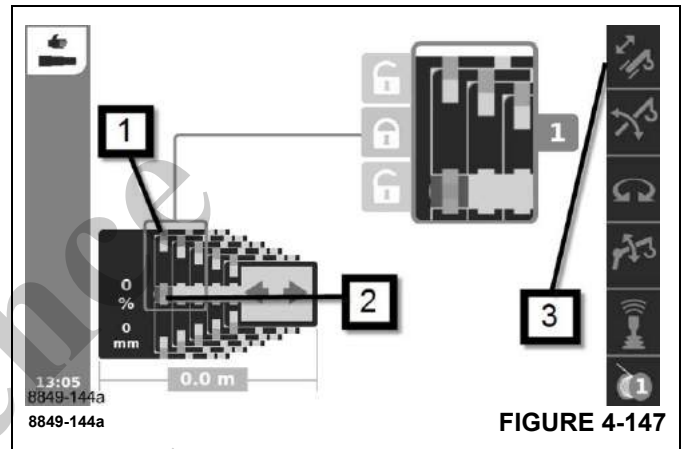


FIGURE 4-147

**Telescoping**

Refer to (Figure 4-146).

If the requirements for telescoping are met, the symbol (2) is shown.

- Move the control lever in the desired telescoping direction.

The display (1) shows the current extended length (telescoping in meters).

The current telescope diagram on the display (2) will change continually.

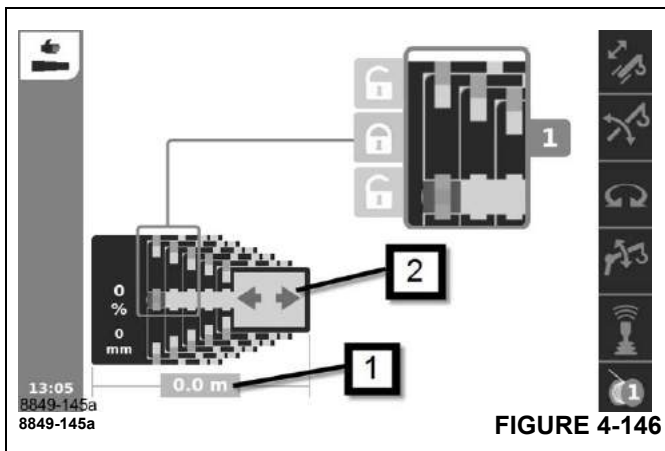


FIGURE 4-146

**Lock**

- Refer to (Figure 4-148).
- Telescope to the desired fixed length, e. g. telescopic section (1) 1 to 100%.

If the symbol (4) is displayed, the telescopic section must be locked.

- Select the symbol (3).
- Confirm the selection – the locking pins will extend – symbol (2) green.

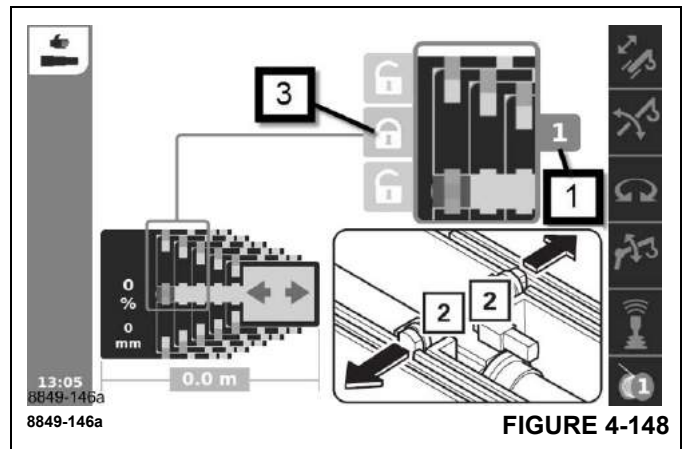


FIGURE 4-148

### Locking the Telescopic Section for On-Road Driving

Once you have retracted the main boom, you might lock the telescoping cylinder in telescopic section I to achieve the proper axle loads.

### Telescoping with Semi-Automation

When telescoping with semi-automation (or the semi-auto mode), the operator enters, on the display, the pinning location for each of the boom sections (a target or requested “tele picture”). If this pinning configuration is accepted by CCS, then the joystick controller is used to move the boom sections to the pre-determined configuration. The telescoping cylinder moves between the boom sections automatically as needed.

**NOTE:** The entered boom configuration (“tele picture”) does not have to be completed for normal operation of the boom. For instance, if the requested boom configuration is 100-100-0-0-0, and just the T2 section is locked at 100% (T1 section still at 0%), then the boom can be operated as if the configuration 0-100-0-0-0 was entered. The operator can just stop the telescoping function with the boom at 0-100-0-0-0.

If the boom is desired to be fully or partially retracted after just reaching 0-100-0-0-0 (and when 100-100-0-0-0 had originally been entered), the operator can just reverse the direction of the joystick and the boom will retract. That is, it is not necessary to enter a boom configuration of 0-0-0-0-0 to retract the boom. The entered boom configuration (target or requested “tele picture”) is ALWAYS only a final destination or configuration.

The joystick is ALWAYS used to indicate extending or retracting the boom itself, NEVER to indicate the extending or retracting of the telescoping cylinder. The allowed motion for the boom with the joystick is indicated by arrows shown on the display. The telescoping direction arrow to the right is always extending the boom. The telescoping arrow to the left is always retracting the boom.

When a boom section is first unlocked, the boom section may automatically extend 50 mm (2 inches). The operator must be aware of this motion and have the crane in a position to anticipate this motion.

**NOTE:** Switch on the telescoping mechanism. Refer to *Telescoping Mechanism*, page 4-67.

**NOTE:** Open the Telescoping Semi-Automation Menu (1), (Figure 4-149).

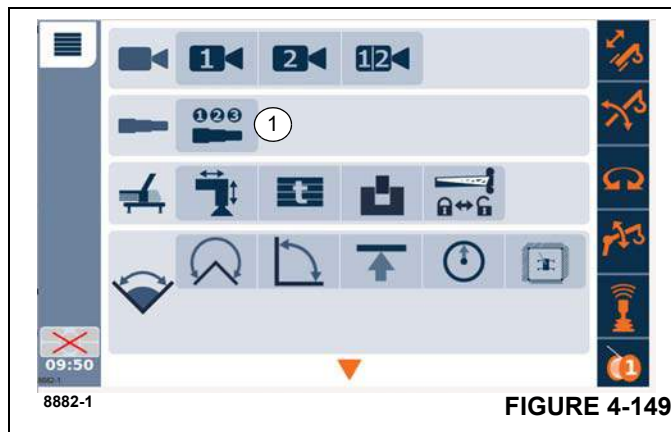


FIGURE 4-149

## Semi-Auto Mode

### Introduction

The Semi-auto Mode is typically the standard method for telescoping the pinned boom.

It is important to understand that a pinned boom has a telescoping cylinder that can disconnect and reconnect (unlock/lock) to boom sections, as well as disconnect and connect (unlock/lock) boom sections to each other. This is accomplished by a pinning mechanism or pinning “head” at the near end of the barrel of the telescoping cylinder (the rod is fixed to the base section and the barrel extends within the boom). This pinning mechanism has a set of sensors and an electronic module to communicate with the crane control system. Using these sensors, as well as a precision length sensor for the location of the telescoping cylinder within the boom, the crane control system commands the pinning mechanism to perform the locking operations. The Semi-auto Mode is the simplest approach to operating the pinned boom, since it automatically handles the most complicated aspects of the pinning.

It is important to realize that the control system is performing automated motions within the boom at some points in the telescoping process. At other times the operator is able to move the boom components. Then the automated motions can occur once again after the operator has indicated the appropriate next action for telescoping the boom.

The Semi-Auto screen (Figure 4-150) of the operating display shows a graphic schematic near the bottom of the screen that indicates the current status of the boom computed by the control system (however the operator must continue to monitor the status of the physical boom to compare with this schematic). In (1), (Figure 4-150), there is a 100% shown for the position of the telescoping cylinder (above the 9703 mm distance value). The graphical representation of the telescoping cylinder rod protrudes horizontally from the left end of the schematic (near item 1). The end of the graphical representation of the rod at the T1 boom section which is at the 100% pinning location. The

slightly larger rectangular entity at the right end of the telescoping cylinder rod represents the pinning mechanism.

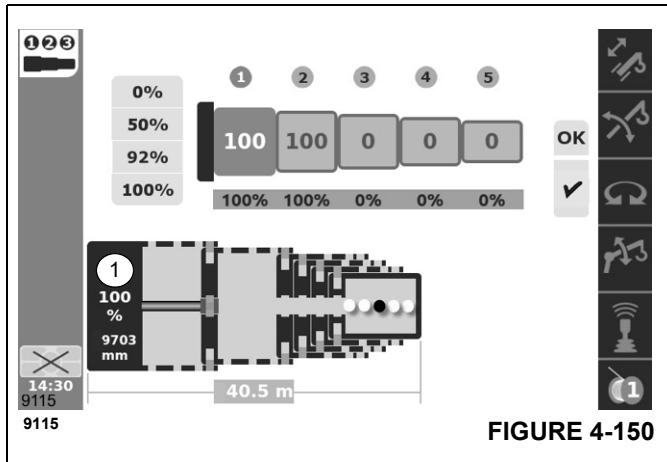


FIGURE 4-150

The example in (Figure 4-150) shows the value of 9703 mm for the extension of the telescoping cylinder within the boom. This is the value from the precision length sensor. The example also shows a value of 40.5 meters as the overall boom length. The example shows the T2 boom section had been previously extended and locked at its 100% pinning location. The remaining boom sections are locked at their 0% pinning location (and they were all extended as the T2 boom section extended).

As mentioned earlier, there are times when the control system is performing automated motions. The example in (Figure 4-150) shows some dots at the end of the schematic graphic. These dots, as well as the one dark dot cycling back and forth to the left and right, indicates that automated motions are occurring.

(Figure 4-151) shows the same screen when the operator is able to control motions of the boom sections. In this case, there is a left and/or right pointing arrow (instead of the dots shown in (Figure 4-150)). As is consistent with the schematic's orientation, the left arrow indicates retracting the boom, the right arrow indicates extending the boom. The control device (typically the joystick in the standard joystick option) would be moved to the left to retract the boom, and it would be moved to the right to extend the boom (while keeping in mind that only one boom section - the boom section the telescoping cylinder is locked to - would be moving).

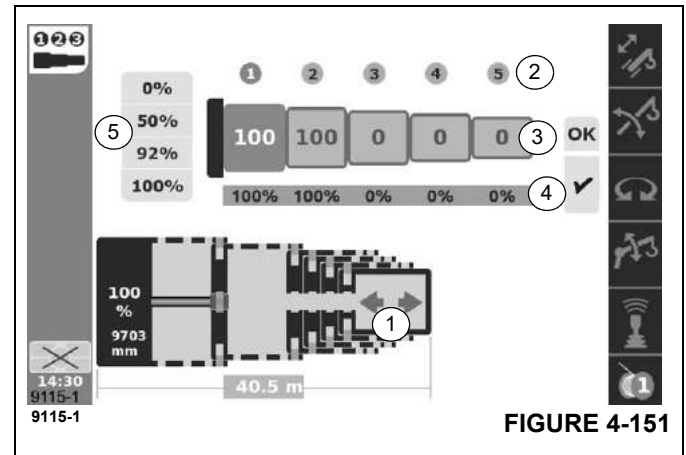


FIGURE 4-151

As highlighted in a previous note in this document, the arrows (1), (Figure 4-151), at some point in the telescoping process, will blink. The blinking is an indication that an unlocking or locking event will occur if the operator holds the joystick in the direction of that arrow for at least 1 second. If this event begins, then the screen will change to the dots (as described for (Figure 4-150) so that the operator knows that an automated motion or action is again occurring.

The RCL must be configured and activated in order to have automated motions or to have operator control of the telescoping function. If the Enter Rigging Mode screen on the RCL display is used (accessed with the '?' icon on the RCL display), then the telescoping action is paused. When the check-mark (4), (Figure 4-151) is used on the RCL display to re-activate the RCL, then the telescoping action resumes (whether automated motion or operator control).

As seen in (Figure 4-151), there are sets of numerical values at the top portion of the screen above the graphical schematic of the boom.

First, there is a set of values in a top row with values of 1 to 5 in circles (2). The 1 to 5 in the circles indicate the telescoping boom sections (or "tele sections"). The 1 is for the boom section that is the largest and closest to the base section. This is referred to as T1. This then proceeds from T2 to T5 for the 2 to 5 values.

The values under these boom section indication numbers represent the requested final boom configuration (or "target tele picture"). (Figure 4-151) shows this set of values as 100-100-0-0-0 (3). This means that T1 is to be extended to its 100% pinning location, T2 is to be extended to its 100% pinning location, and the remaining boom sections remain at their fully retracted, 0%, pinning locations. It is vital that the operator understand that this requested final boom configuration is the first step in operating the pinned boom in the Semi-auto Mode. Everything the control system performs with the Semi-Auto Mode is dependent on this requested final boom configuration.



Second, there is a set of percentage values shown under the requested final boom configuration values. In (Figure 4-151), these are shown as 100%-100%-0%-0%-0% (4). This represents the control system's currently computed actual boom configuration (or "actual tele picture"). This can be understood as what the boom likes "now" (but as mentioned above the operator must be aware of the physical boom to compare to these values). As the boom is operated this computed boom configuration will change (just as the schematic graphic for the boom system will change on the display). But the operator should realize that the requested final boom configuration will not be changing as the boom is operated (it is the final destination for the boom motion).

Third, there is a list of percentages on the left (0%, 50%, 92%, 100%) (5), (Figure 4-151). These percentages are the available pinning locations for the boom sections. They represent an extent of the distance along the next larger boom section where the boom section can be pinned - i.e. locked to the next larger and encompassing boom section. The 100% is not the extreme end of the next larger boom section, but the farthest available pinning location (there will always be some overlap between boom sections). The list of percentages are command buttons in the control system interface; a value can be highlighted, and then an Enter button used to actually select the value in the list. When an Enter button is used in this manner, it sets all the values for the boom sections for the requested final boom configuration to that value. For example, if Enter is used on the 50% button, then all the values in the top row of the display will be set to 50 (thus requesting the final boom configuration of 50-50-50-50).

### Semi-Auto Mode Basic Operating Procedures

The following steps would be expected for extending the boom in Semi-Auto Mode:

- Enter the Semi-Auto screen on the operating display. The icon for this screen is (1), (Figure 4-152).

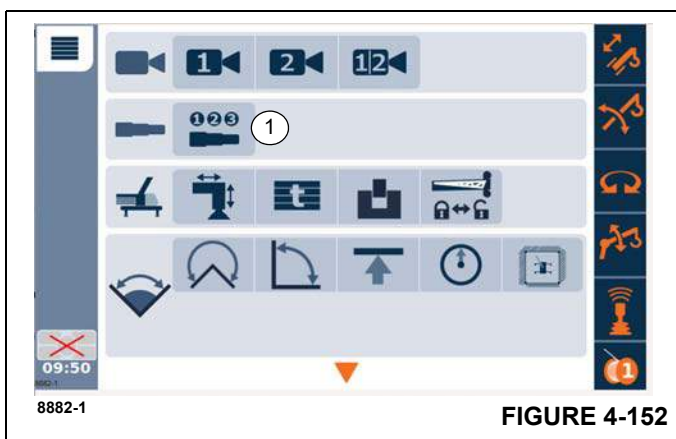


FIGURE 4-152

- Verify that the telescoping function is enabled. This is confirmed by the green background for the icon for the

telescoping function in the right margin area of the operating display. Refer to (Figure 4-153).

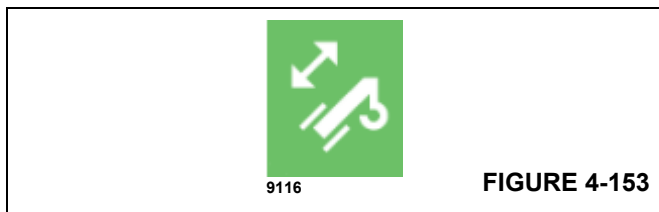
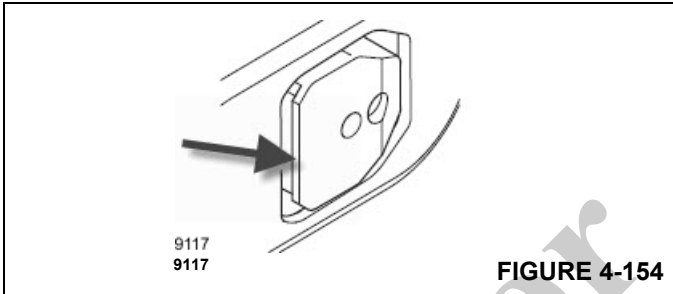


FIGURE 4-153

- Using the operating display, enter the values for the requested final boom configuration (such as 100-100-0-0).
- Using the operating display, the Enter button is used for the OK shown on the screen. This sends the requested data to the control system. If this configuration is considered acceptable, a check-mark will be shown below the OK (as is seen in (Figure 4-151)). If the configuration is not considered acceptable, a red X will be shown instead of the check-mark. As an example, a requested final boom configuration of 0-50-0-50-0 is not allowed (the T3 section was "skipped" for having a non-0% pinning location).
- Depending on the current location of the telescoping cylinder, the cylinder may need to move to a different boom section. If this is needed, the automated motions will immediately occur.
- Once the telescoping cylinder is considered locked to the boom section that is to be first moved (T2 in the current example) by the control system, the boom section will be unlocked (this is an automated action).
- Once the boom section is unlocked, the telescoping direction arrows, as shown in (Figure 4-151), will appear.
- With the arrows present, the operator can telescope the first boom section to be moved (T2 in this example).
- The operator uses the joystick (or other control device) to extend the boom section. The boom motion will slow down near the 100% pinning location (for this example). It can continue to be extended by the operator until it arrives at its 100% pinning location. At this point, the motion will be stopped and the right arrow will be blinking. If the joystick is used in the extend direction for at least 1 second after the arrow is blinking, then the boom section will be locked at this pinning location. If the joystick is not used in this time interval, then the boom section can remain at that location and not locked (note that the boom section could also now be retracted and the boom fully retracted, if desired, without changing the target tele picture / requested final boom configuration).
- Assuming that the boom section is requested to be locked, it is important to know that there are a few phases to the automated motion to lock the boom

section. In particular, (Figure 4-154) shows that there is a “lip” on the boom section pins (pointed to by the arrow in figure). The first phase for boom section locking is to release/extend the pins into the hole/cutout in the encompassing boom section. If this is successful, then there is a second phase of automated motion to set down the boom section on the proper flat surface of the pins that is next to the lip. In a final phase, the pin is confirmed to be engaged and the boom section locked by the control system command the telescoping cylinder to retract and then checking for no boom motion. If there is no motion, then it is confirmed as locked.



The following steps would be expected for fully retracting the boom in Semi-auto Mode:

- DO NOT ENTER a new boom configuration or “target tele picture” (such as 0-0-0-0-0) just to be able to fully retract the boom.
- At any point in the boom extending procedure (described above), when the left arrow is shown, the joystick (or other control device) can be used in the retract direction to retract the boom (partially or fully).
- Using the previous example for extending the boom, the boom motion would end at the boom configuration of 100-100-0-0-0. And, the left arrow would be blinking.
- The operator can use the joystick in the retract direction for at least 1 second, and then the automated motion to unlock the boom section (T1 in the example) will start. It is important to know that there are two phases for unlocking a boom section. As mentioned previously, and shown in (Figure 4-154), there is a lip on the boom section pins. Therefore, the first phase of the automated motion is to lift up the boom section to have clearance from this lip. After the lift up is completed, then the pins are retracted. The boom section is now able to be retracted.
- The operator can retract the first boom section to move (T1). But note that the retract and extend arrows are again shown. It is possible for the operator to change direction once again and return to extending the boom, if desired.
- Assuming the boom is to be fully retracted, the operator would retract the first section. The boom section will slow down near the 0% pinning location. If the operator continues to retract the boom section to the 0% pinning location, the boom motion stops. The left arrow is shown blinking.
- The operator can command the retract direction for at least 1 second, and then the boom section will lock at 0%.
- The left and right arrows would be shown blinking.
- The operator can continue to command the retract direction for at least 1 second, and then the telescoping cylinder will automatically unlock from the boom section, extend to the next boom section to be retracted, and lock to that boom section. Then the automated motion to unlock the boom section will be used (now for boom section T2 in this example). When unlocked, the left and right arrows will appear again.
- The operator can continue to command the retract direction and the second boom section to move will be retracted. And, as before, it can be locked at its 0% pinning location.

- After the boom section is locked, the left AND right arrows are shown blinking. This indicates to the operator that the boom can be retracted or extended, and that in either case, there will be automated motions and to be aware that it will take some time (the blinking is an indication to the operator that this time will be needed).
- Assuming the boom is to continue to be extended, the operator would use the joystick (or other control device) in the extend direction for at least 1 second. This is interpreted as the indication to change to extending the next boom section (T1 in this example). Therefore, the telescoping cylinder will automatically unlock from the T2 boom section, retract to the T1 boom section, lock to the T1 boom section, and then unlock the T1 boom section.
- When the T1 boom section is unlocked, the left and right telescoping direction arrows will appear again (as is shown in Figure 4-151).
- The operator can telescope the next boom section (T1).
- The T1 boom section operating process is the same as for the T2 boom section described above. When the T1 boom section is at its 100% pinning location, then it can be locked in the same manner (using the extend direction of the joystick for at least 1 second when the right arrow is blinking).
- With the T1 boom section at its requested final location, only the left arrow would be blinking. This is indicating that it is impossible to telescope the boom any further (the boom has arrived at its final configuration as requested).



**NOTE:** When the boom is fully retracted, the telescoping cylinder does not automatically move to another boom section (such as automatically moving to the T1 boom section). The telescoping cylinder will remain at the boom section that was the last to be retracted. However, this cylinder can be moved to another boom section with the Semi-Auto Mode. Refer to the section (below) *Semi-Auto Mode for Shifting Cylinder Within Fully Retracted Boom*, page 4-82.

### **Semi-Auto Mode for Shifting Cylinder Within Fully Retracted Boom**

It may be desirable to have the telescoping cylinder locked to a particular boom section while the boom is fully retracted. This might be particularly useful for weight distribution changes for roading the crane.

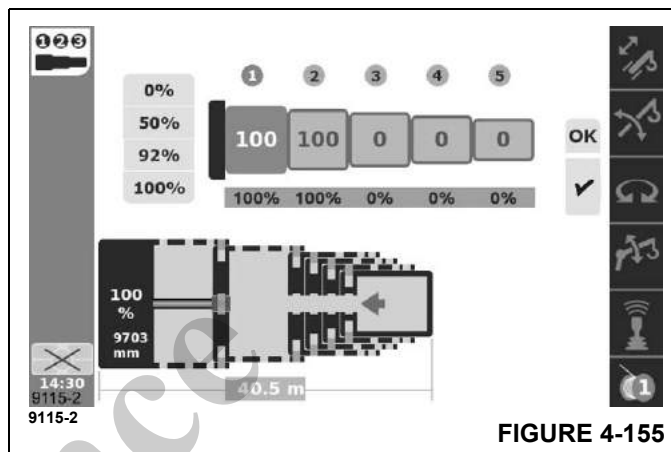
The following procedure can be used:

- Enter the Semi-auto screen of the operating display.
- Verify that the telescoping function is enabled.
- Enter a requested final boom configuration with 0% for each of the boom sections, EXCEPT for the boom section where the tele cylinder is desired to be locked to. For this one boom section, enter 50% (any non-0 value will actually work, though). For example, if the telescoping cylinder is desired to be locked to the T1 boom section (and it is not located there currently), then 50-0-0-0-0 would be entered.
- If the telescoping cylinder is not at the boom section desired, it will shift to that boom section.
- When the telescoping cylinder is locked to the desired boom section, that boom section will be automatically unlocked (as if it is to be operated).
- Use the joystick (or other control device) to retract for at least 1 second. The boom section will re-lock, and the boom should still be fully retracted and locked, and the telescoping cylinder will be in the position desired (such as locked to T1 boom section).

### **Semi-Auto Mode Requiring Boom to be Retracted**

It is important to understand that a new requested final boom configuration (“target tele picture”) may require the boom to be retracted first. For example, if the requested final boom configuration is currently 100-100-0-0-0, and the boom is extended to this configuration, and then a new requested final boom configuration (such as 0-0-0-100-100) is entered, it is impossible to use the new configuration unless the existing boom sections are retracted first. When this condition arises, only the left telescoping direction arrow will be shown on the display (as seen in Figure 4-155). When the

boom is fully retracted, then the automated motions should proceed to the new configuration. That is, for the example, when T2 is locked at 0% (after using the joystick to retract everything), then telescoping cylinder can move to the T5 boom section to be unlocked (since it is the first boom section to move for the new final boom configuration of 0-0-0-100-100).



**FIGURE 4-155**

### **Semi-Auto Mode Screen Refresh**

When the Semi-auto screen of the operating display is entered, the final boom configuration (“target tele picture”) that is shown is the one most recently ACCEPTED and is actually being used to control/operate the boom. If the screen is exited and re-entered, what is shown may not be the most recently REQUESTED final boom configuration.

As noted in the section of the document 'Semi-auto Mode requiring boom to be retracted', there are cases where a newly requested final boom configuration can not be accepted until the current boom configuration is completed to have the boom fully retracted. If the Semi-auto Mode is currently requiring the boom to be retracted, and the ESC is used to leave the Semi-auto screen, and then Semi-auto screen is entered again, the values shown for boom sections will revert to the original boom configuration, the ACCEPTED boom configuration (until the boom is fully retracted and the control system can then “shift” to the new REQUESTED final boom configuration).

### **Semi-Auto Mode Warning Indications**

The control system manages a fault indication system. This is characterized by a set of error codes or fault codes. When a fault condition is noted by the control system, the icon in (Figure 4-156) is seen (at least in the left margin of the operating display). There is also a screen of the operating display that uses this icon, and that screen will show the fault codes.



FIGURE 4-156

For the pinned boom control (such as in Semi-Auto Mode), a fault may be noted that is momentary. For instance, there is a calculation of the difference between the calculated boom length (based on the calculated boom section positions in the control system) and the measured boom length (from the boom outer cable reel sensor). If this difference is too large, there is a fault condition. However, if the cable on the outer cable reel sensor is just moved momentarily by something near the boom, the cable may suddenly move and then return to the proper tension. In this case, the fault condition can appear momentarily. The icon in (Figure 4-156) will appear, and this fault code could be viewed on the operating display, but it does not cause the telescoping function to shut-down, and the fault code can be cleared.

For the proximity switches that sense the position of the telescoping cylinder components and pinning mechanism, similar momentary conditions may appear. There may also be fault codes that appear when automated motions take longer than expected, but the control system automatically recovers from the condition.

For these momentary and warning conditions, the telescoping function will continue to be available. If the left and/or right arrows appear, then the boom can be moved in the directions indicated by the arrows. The momentary or warning conditions might also be helpful in diagnosing faults that eventually cause the telescoping function to shut-down (refer to the section in the document 'Semi-auto Mode telescoping function shut-down').

There are sensors in the telescoping cylinder that detect elevated pressure conditions for extending the boom (particularly for telescoping with significant hook loads). If the pressure is beyond a threshold (depending on the distance the telescoping cylinder has been extended), then the extend motion is slowed down. If the pressure approaches another threshold, then the extend motion is stopped. When these conditions are apparent, the icon shown in (Figure 4-157) will be shown in the left margin of the operating display (ODM).



FIGURE 4-157

**Semi-Auto Mode Telescoping Function Shut-Down**

If the control system detects a fault that is not momentary and not a warning indication, then the telescoping function will be shut-down. In this case, the error icon (as seen in (Figure 4-158)) will appear in the graphical schematic for the boom (instead of the dots or the direction arrows described previously).

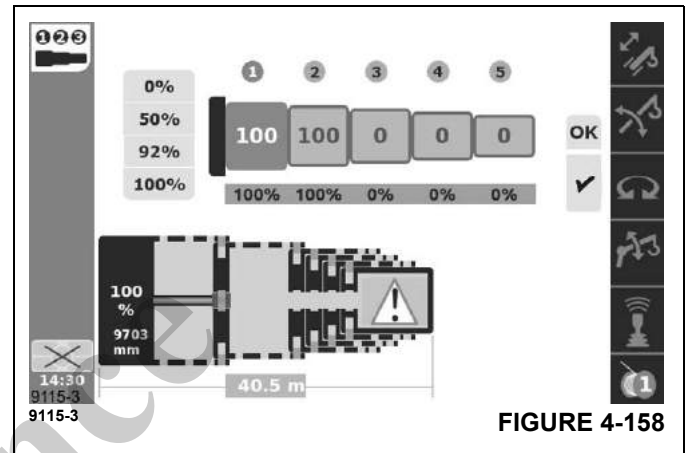


FIGURE 4-158

Typically shut-down condition indicates a failure in the components of the control system (such as sensors or modules or communications). If the only indication of faults is for the telescoping function, then the following steps can be used:

Cycle the power for the control system. When the power is restored, the control system will attempt to repeat the same procedure or automated motion that was interrupted by the fault condition. If the fault condition was not permanent, this may correct the condition, and if the error icon does not appear again, then the telescoping function can continue to be used.

If cycling the power for the control system is not effective, and there is a load on the hook while the control system is attempting an automated action or motion (such as unlocking the telescoping cylinder or a boom section), then lower the load, if possible. Without the load on the hook, cycle the power again to attempt the automated action or motion.

If the telescoping function is still not operable, then the manual telescoping mode can be attempted. In this mode, it is possible to command slight telescoping cylinder motions to assist with locking or unlocking.

If telescoping function is still not operable, then the fault can be assumed to be in the control system components, and control system diagnostic procedures should be utilized.

**Semi-Auto Mode Lost Boom Configuration**

The Semi-Auto Mode is expected to continuously monitor and record the positions of the telescoping boom sections. If this process is interrupted, perhaps by communication



interruption or repairing a component in the control system, then this recorded boom configuration (or “tele picture”) may be lost. The control system will not find components in the expected position. When this occurs, a question mark icon will appear in the screen as shown in (Figure 4-159).

The operator can attempt to correct this condition by the procedure in section (below) *Reset Telescoping Configuration*, page 4-84.

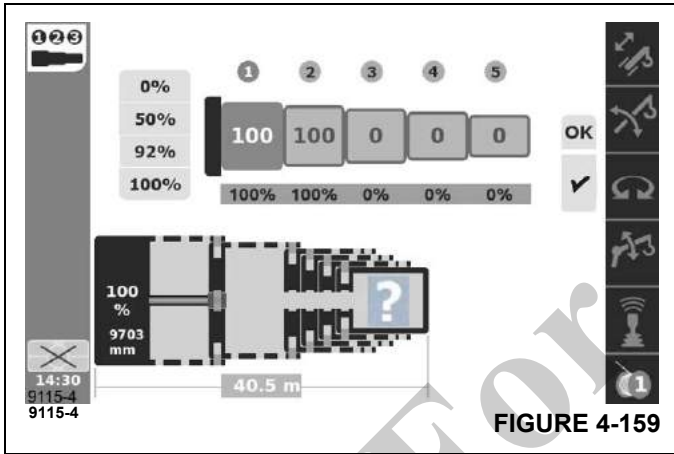


FIGURE 4-159

**Reset Telescoping Configuration**

If the actual boom configuration (or “actual tele picture”) is no longer considered valid by the control system, the question mark icon appears in the Semi-Auto screen as shown below in (Figure 4-160), then the following procedure can be used to reset (or “teach”) the telescoping configuration:

- Enter the request reset telescoping screen. (Figure 4-160) shows the icon for this screen.

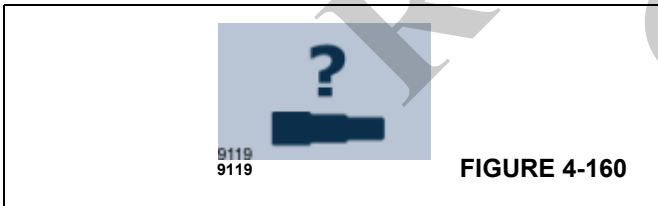


FIGURE 4-160

- The request reset telescoping screen appears as shown in (Figure 4-161). This screen is for entering a confirmation code. The confirmation code is L-O-S-T. When these letters are entered on the screen, then an Enter button can be used on the OK shown on the screen. If this is the correct code, then the reset telescoping screen appears as shown in (Figure 4-162).

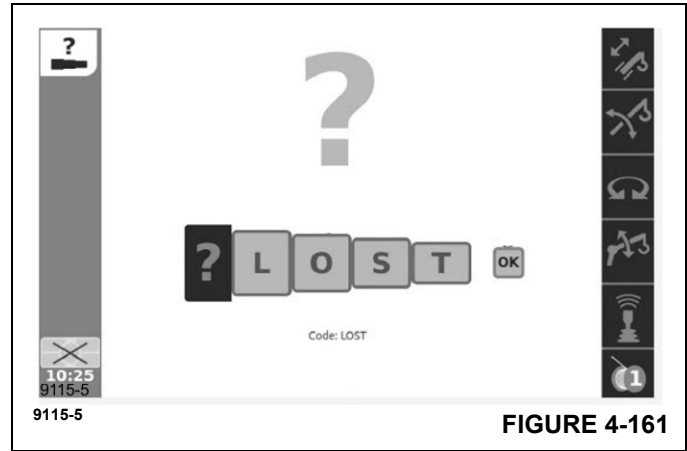


FIGURE 4-161

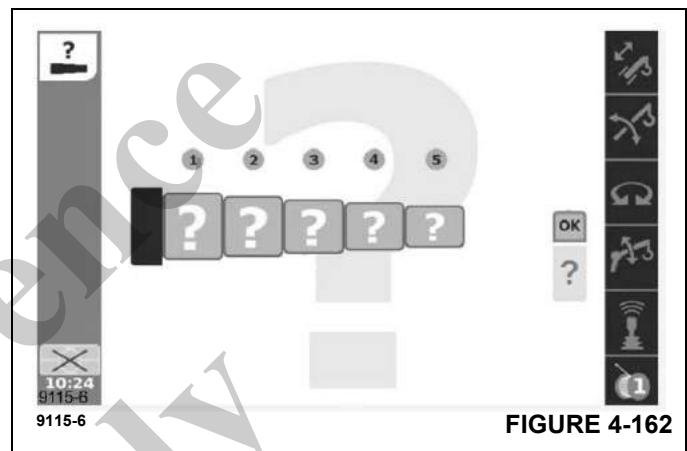


FIGURE 4-162

- In the reset telescoping screen, as shown in (Figure 4-162), the operator can indicate the current boom configuration (“actual tele picture”). It is seen that there are 5 available boxes (for the 5 telescoping boom sections). Each of these spin boxes can be used to change to one of the following:
  - 0%
  - 50%
  - 92%
  - 100%
  - Unlock icon (appears when the 0% value is shown and then the jog dial or operating display arrow button is used to get a value below 0%).
- Each of the spin boxes needs to be set to a value or indication of the current actual configuration of the boom. If a boom section is locked at a 50% location, then that boom section spin box is to be set to the 50%. If a boom section is unlocked (and able to be operated by the telescoping cylinder), then that boom section spin box is to be set to the Unlock icon).
- When each of the spin boxes is set to the correct value or indication, then an Enter button can be used on the

OK in the screen. If the control system confirms this boom configuration, then a check-mark appears below the OK. Otherwise, the question mark shown under the OK (as in Figure 4-162) will remain; in this case, the operator should exit the screen and repeat an attempt to enter the actual boom configuration.

### Semi-Auto Mode vs. Manual Mode

The pinned boom can also be controlled with a Manual Mode. Although the Manual Mode allows some additional capabilities, the Manual Mode still requires some automated motions. The Manual Mode screen includes the same schematic graphical representation of the boom, and it uses the same dots indication for automated motions (as shown in Figure 4-149), as well as the telescoping direction arrows for operator control (as shown in Figure 4-150).

The following outlines differences between the Semi-auto Mode and the Manual Mode:

- The Manual Mode screen does not show the final boom configuration values (“target tele picture” or “actual tele picture”). In Manual Mode, the operator requests lock and unlock procedures and telescopes boom sections to desired pinning locations without an initial indication of the final destination. However, the control system internally still creates such a final boom configuration for the instance where the operator changes to the Semi-auto Mode after using the Manual Mode. The control system sets the final destination for all boom sections not yet moved to 100%. Thus, when changing from Semi-auto Mode (where the operator may have entered 50-50-50-0-0) to Manual Mode (where only boom sections T2 and T3 were operated), and then changing back to Semi-Auto Mode, the Semi-auto screen can show 100-50-50-0-0 (thus the control system automatically changed the destination of T1 from 50% to 100%). This is expected behavior. The operator can use the Semi-auto screen to change the 100% back to 50%, and in some cases, the boom can continue to be operated (but in other cases, the boom may have to be fully retracted first).
- The Manual Mode shows an expanded view of the telescoping cylinder pinning mechanism with the same unlock icons and a lock icon, as seen in (Figure 4-163) (instead of the requested final boom configuration values for the Semi-auto Mode). When one of the unlock or lock icons becomes available to be selected (changes from the basic gray color to the focus color), then the operator can request the unlock command or the lock command. The top unlock icon is for the boom section unlocking, and at the proper time the lock icon would be used to again lock the boom section (the lock icon will become available as a command when the control system allows it). The bottom unlock icon is for the telescoping cylinder unlocking, and again at the proper time the lock icon would be used to again lock the

telescoping cylinder (again the lock icon will become available as a command when the control system allows it). There is only one lock icon since the pinning mechanism is designed to either unlock the boom section or the telescoping cylinder (but not both at the same time). In this manner, the boom configuration and pinning locations are “built up” by the operator as the boom is operated.

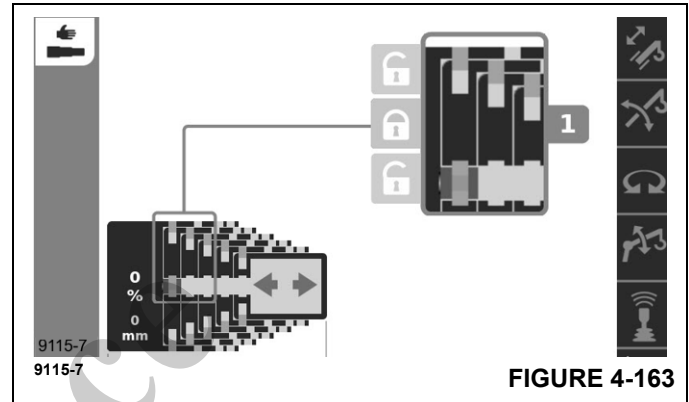


FIGURE 4-163

- In the Semi-Auto Mode, the unlocking of the telescoping cylinder and boom sections is entirely automated. And when locking is completed in the Semi-auto Mode, the joystick (or other control device) does not affect the position of the telescoping cylinder (the joystick is used to confirm the next command when there is a blinking arrow). In the Manual Mode, the command buttons indicate the unlocking and locking, and the joystick can affect the position of the telescoping cylinder; however, with the components already in a locked condition, the position of the cylinder can only be slightly affected. But, making slight adjustments to the position of the cylinder can assist with the unlocking process.

### Boom Configurator

There are many boom or pinning configurations available. The Boom Configurator can assist with previewing these boom configurations and making an appropriate selection. This screen is used when the boom is fully retracted. Switch on the telescoping mechanism. Refer to *Switching ON the Telescoping Mechanism*, page 4-71.

The Boom Configurator is selected from the menu system as shown in (Figure 4-164). Once selected, the Boom Configurator screen is shown (refer to Figure 4-165). This screen allows lift plan information such as hook radius, hook load, and boom length to be entered. The screen will then present a table of possible boom configurations to select from. The table will show the load chart based information for the configurations, as well as an approximate time (in seconds) to complete the telescoping to the boom configuration. Note that the boom configurations shown are dependent on the rigging information already entered on the RCL display, so be certain to set this rigging information

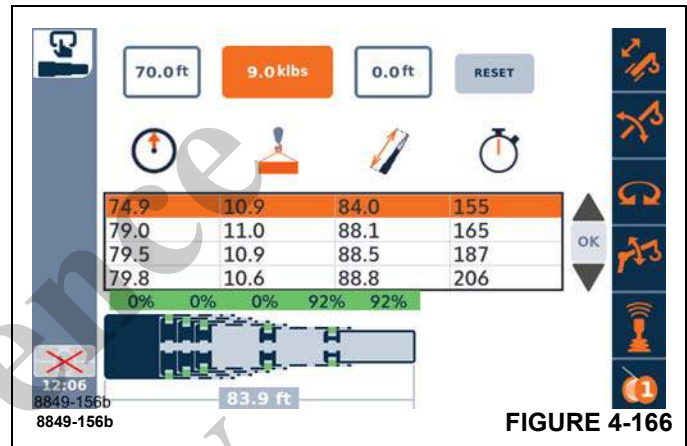
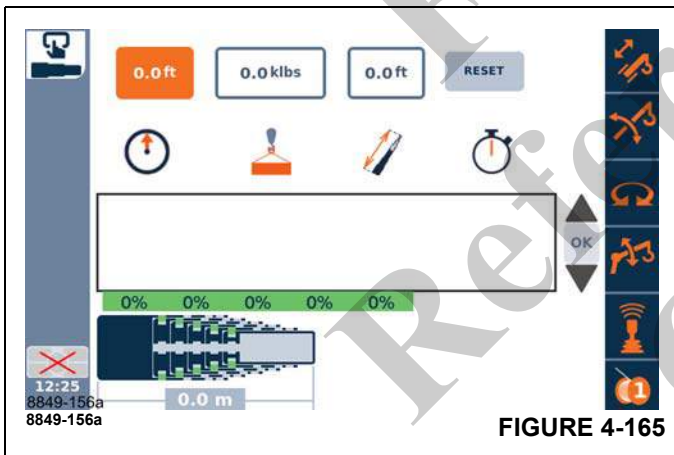
correctly. If the rigging information is changed, all the selections on the Boom Configurator and data on the Boom Configurator may change. When the Boom Configurator data is updating (a waiting circle is shown on the screen), do not interact with the screen/display; wait until the data is completely updated before selecting the next action (although Escape (ESC) can be used at any time to cancel the operation).



- Counterweight of 11,000 lbs.
- 4 parts of line on main hoist (no aux nose).
- Boom extension stowed.

Enter the Boom Configurator screen (should appear similar to Figure 4-165).

Now highlight the first selection box at the top of the screen (for radius), and select Enter. The value in the box can now be changed. Increase the value until 70.0 ft is shown. Select Enter. After a few moments, the boom configurations are searched and sorted and then shown in the table similar to (Figure 4-166).



After a table of boom configurations is displayed, the arrow icons on the right side of the screen can be used to highlight a particular row in the table. For this highlighted row, the details of the boom configuration (“tele picture”) is shown below the table. If the OK button is pressed with a particular row highlighted, then the boom configuration is sent directly to the Semi-auto screen and the control system begins to work that selection and can begin unlocking the boom.

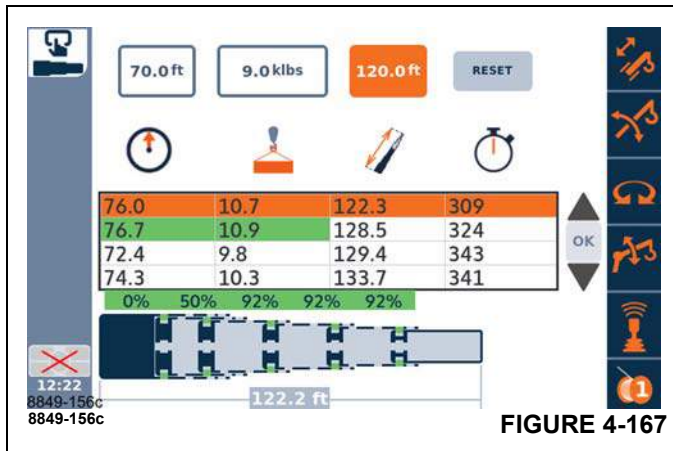
Next, highlight the second selection box (for hook load), and select Enter. The value in the box can now be changed. Increase the value until 9.0 klbs is shown. Again select Enter. The boom configurations are now a shorter list (since now matching for both radius and load).

Next, highlight the third selection box (for boom length), and select Enter. The value in the box can now be changed. Increase the value until 120.0 (ft) is shown. Again select Enter. The boom configurations are now an even shorter list.

(Figure 4-167) shows the expected typical boom configurations for the three criteria that have been entered. Note that the second row has the radius and load highlighted in green. These green values indicate the maximum values in the table; the 128.5 ft boom length pinning combination has the highest possible radius and load. For the column with the approximate time to extend the boom, the green highlighted value is actually the minimum value (since a shorter time is expected to be the most desirable). Also, note that the orange color for highlighting/selecting a row can “hide” the green color, but the italics is also used to try to distinguish these items. Use the up and down arrow icons at the right side of the screen to change the highlighted row and then see all the green colored items.

As an example, the RCL rigging information can be set as follows (including using the check-mark to activate this selection):

- Outriggers at 100% extension.



Again referring to (Figure 4-167), the second row could be highlighted using the up and down arrows at the right side of the screen. This would be pinning combination 0-50-100-100-100. This may be considered the best selection since it can also proceed to fully extended, if desired. The first row might also be desirable since the approximate time to extend is the fastest. Once a selection is made, the OK button can be used (if the telescoping function has been activated) to proceed to use the boom configuration in the Semi-auto mode. Another option is to change the rigging information as explained next.

The rigging information on the RCL display can be changed as follows:

- Counterweight of 36,000 lbs.
- Use the check-mark to activate new rigging.

If the Boom Configurator screen is still shown, the table of values should update.

Enter the following values with the selection boxes (the values in the selection boxes may show values within 0.1 of the desired value - just changing Load if retaining example from above):

- Radius = 70 (70.1 being acceptable)
- Load = 18.0 (a higher load than above)
- Length = 120.0

A new table of available boom configurations can appear and a new selection can be made and sent to the Semi-auto telescoping mode.

Finally, if it is desired to keep lifts within a criterion such as 75% of the maximum values for the load chart data, then the search can be based on a modified hook load. The modified hook load value would be the hook load divided by the decimal value for the desired limitation such as the following:

$$P_{\text{modified}} = P / 0.75$$

For example, if hook load is 10,000 lbs, and 0.75 is the modification desired, then the value to enter on the Boom Configurator screen would be the following:

$$P_{\text{modified}} = 10,000 / 0.75$$

$$P_{\text{modified}} = 13,333$$

Thus, enter the value of 13.5 klbs for the Boom Configurator.

### High-Speed Mode

**NOTE:** The telescoping mechanism cannot be operated at high speed.

### Hoists

#### CAUTION

#### Machine Damage!

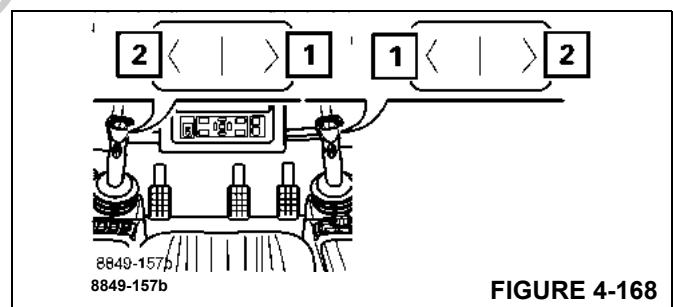
Operation in high speed mode with a large number of parts of line and/or very light loads could result in the cable becoming slack causing mis-spooling and damage to the rope.

#### To Switch on High Speed Mode Briefly

- Press the button (1), (Figure 4-168). High-speed mode will be active until you release the button.

#### Continuous Operation

- Press the button (2), (Figure 4-168). High-speed mode will be enabled until you press the button again.
- Press button (1), (Figure 4-168) to turn high speed on momentarily.



The icon indicates the current status:

|      |                                                  |
|------|--------------------------------------------------|
| ON:  | (1), (Figure 4-169) High-speed mode switched ON  |
| OFF: | (2), (Figure 4-169) High-speed mode switched OFF |



FIGURE 4-169

The symbols show the direction of rotation of the hoist (Figure 4-170):

|   |                   |
|---|-------------------|
| 1 | Lifting the load  |
| 2 | Lowering the load |

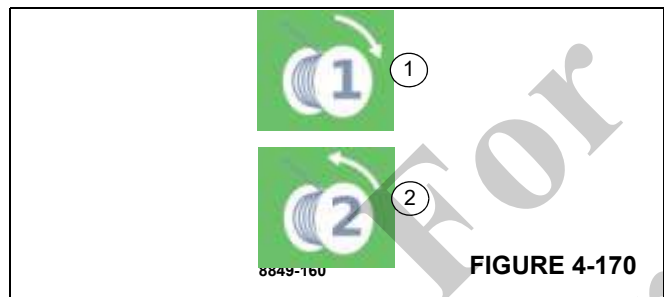


FIGURE 4-170

**NOTE:** The speed of the hoists will only be significantly increased by switching to high-speed mode if you have moved the control lever by more than 70%.

**Swing Gear**

**WARNING**  
Tip Over Hazard!

Always check before swing whether swing is permitted in the truck crane's current rigging mode (counterweight, outrigger span, working radius).

Correct the rigging mode if necessary. Refer to *Swinging with Rigged Counterweight*, page 6-29.

**Swing Brake**

The swing gear is braked with the brake pedal.

**Switching ON the Swing Gear**

After the ignition is switched on, all of the power units will be switched off and the lamps in the corresponding buttons will light up only dimly.

- Press the button (1), (Figure 4-171) once.
  - Symbol (2), (Figure 4-171) is green if the swing gear is switched on.

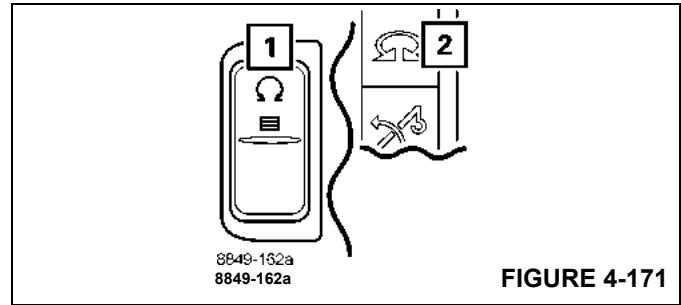


FIGURE 4-171

**Releasing the Swing Brake**

- With the brake pedal function  
The swing brake is released when you switch on the swing gear.

Lamp (1), (Figure 4-172) will extinguish if the swing brake has been released.

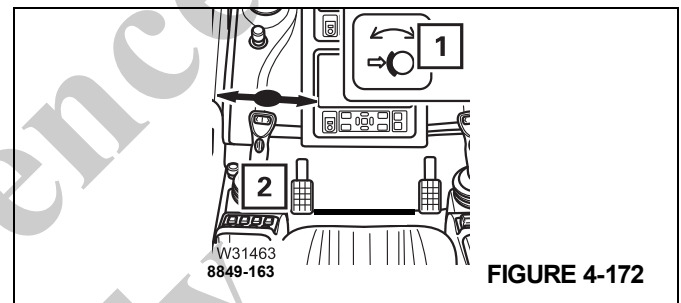


FIGURE 4-172

**Applying the Swing Brake**

**NOTE:** The swing brake is applied when you switch OFF the swing gear. Refer to *Switching OFF the Swing Gear*, page 4-90.

The lamp (1), (Figure 4-173) will light up if the swing brake has been applied.

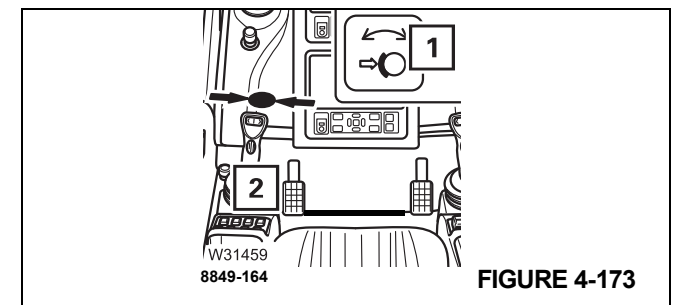


FIGURE 4-173

**Swing**

The following requirements must be fulfilled before swinging:

- The houselock must be disengaged. Refer to *Switching OFF the 360° Lock*, page 4-47.
- Swing must be permissible with the current rigging mode.



- The current rigging mode must have been entered on the RCL display.

**Releasing Locked Swing Gear**

You can unlock the swing gear if it has been locked.

Press and hold the button (1), (Figure 4-174) – the swing gear is unlocked. The speed will then be reduced to 10%.

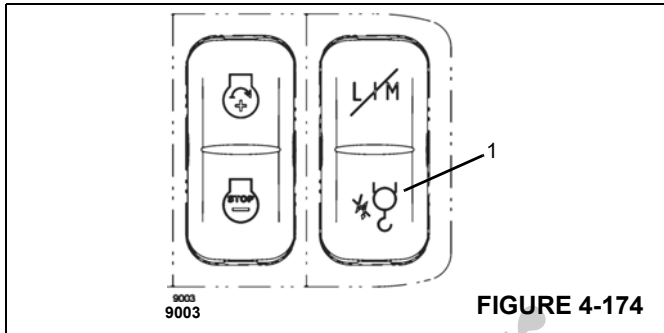


FIGURE 4-174

The anti two-block bypass can override swing lockout in the case of:

- Counterweight cylinders not up.
- Carrier avoidance (boom low enough and close enough to hit the carrier cab or exhaust stack).

**WARNING**  
**Tip Over Hazard!**

Before swinging, always check whether the RCL code is valid for the current rigging mode displayed.

This prevents swing operations from being enabled within the impermissible ranges, which would cause the truck crane to overturn.

**DANGER**  
**Crush Hazard!**

Death or Serious Injury could occur if struck by moving machinery.

You can adjust the sensitivity of the control levers to suit the operating conditions. Refer to *Setting the Characteristic Curves for the Control Levers*, page 4-91.

**NOTE:** Slewing movements are not braked automatically. If you let go of the control lever or move it to initial position, the swing movement will gradually slow down. Refer to *Braking the Swing Movement*, page 4-89.

You can limit the maximum swing speed (1), (Figure 4-185). Refer to *Limiting the Power Unit Speeds*, page 4-92.

|                        |                                                       |
|------------------------|-------------------------------------------------------|
| To swing to the left:  | • Push the control lever to the left (Figure 4-175).  |
| To swing to the right: | • Push the control lever to the right (Figure 4-175). |

You can regulate the speed by moving the control lever or changing the engine speed.

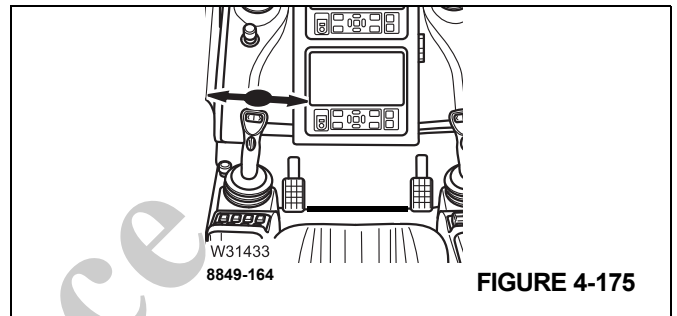
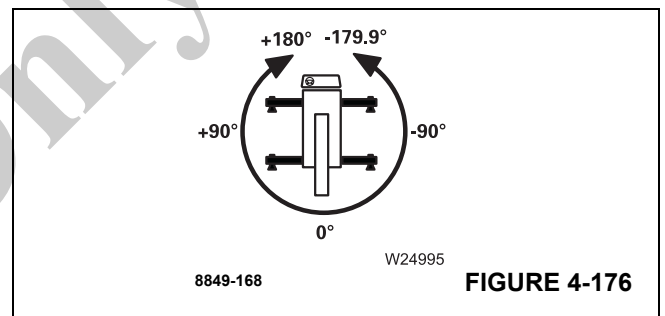


FIGURE 4-175

0° means that the superstructure is slewed to the, boom over the rear (Figure 4-176).

- Angles in the left semi-circle are displayed as positive values (0° to +180.0°).
- Angles in the right semicircle will be shown as negative (0° to -179.9°).



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FIGURE 4-176

**Braking the Swing Movement**

You may only brake the swing movement with the swing gear brake.

**WARNING**  
**Boom Damage Hazard!**

Switching off the swing drive will activate the swing brake immediately. If the crane is swinging, abrupt stopping will create a shock load that could result in damage or buckling of the boom. Death or Serious injury may occur.

- Depress the brake pedal (1), (Figure 4-177). Do not brake to such a degree that the load starts swinging.

If you only move the control lever to initial position, the swing movement will slowly run down.

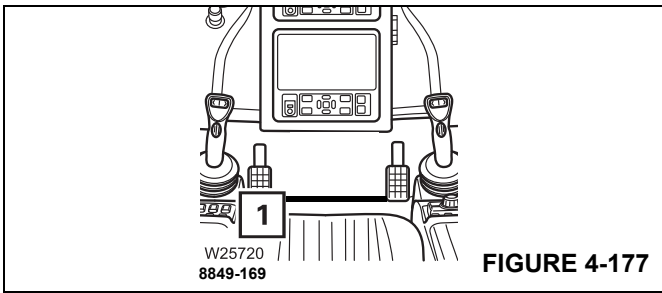


FIGURE 4-177

At the initial position, the swing movement will be stopped. At the same time the swing gear hydraulic brake will be applied.

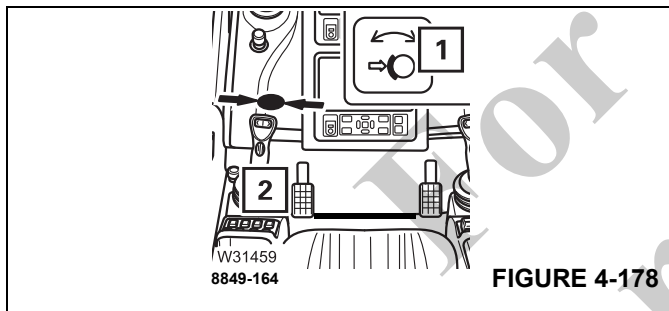


FIGURE 4-178

**Free Swing Mode**

In free swing mode, the swing brake and swing drive are released and the crane can swing freely when external forces act upon the load or boom. To activate free swing mode:

- Switch on the swing gear. The swing gear brake is released – lamp (1), (Figure 4-179) lights up.
- Shift the control lever (2), (Figure 4-179) to its initial position.
- Press the button (3), (Figure 4-179). The swing gear hydraulic brake is released.

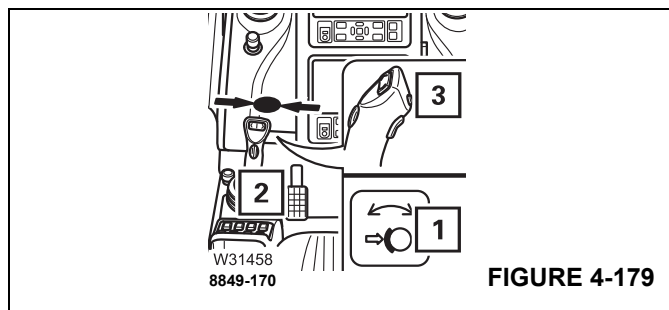
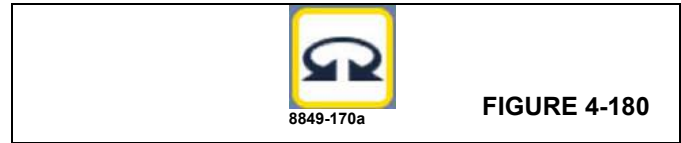


FIGURE 4-179

- When the free swing mode is active, the icon shown in (Figure 4-180) (swing function icon with yellow border)

will be shown in the left margin of the operating display (ODM).



**Switching OFF the Swing Gear**

If the swing gear is not required, it should be switched OFF to avoid unintentional use.



**WARNING**

**Boom Damage Hazard!**

Switching off the swing drive will activate the swing brake immediately. If the crane is swinging, abrupt stopping will create a shock load that could result in damage or buckling of the boom. Death or Serious injury may occur.

- Press the button (1), (Figure 4-181) once.
  - The lamp in the button (1), (Figure 4-181) will light up dimly.
  - Symbol (2), (Figure 4-181) will turn red if the swing gear is switched off.
  - The swing gear brake is applied – lamp (3), (Figure 4-181) lights up.

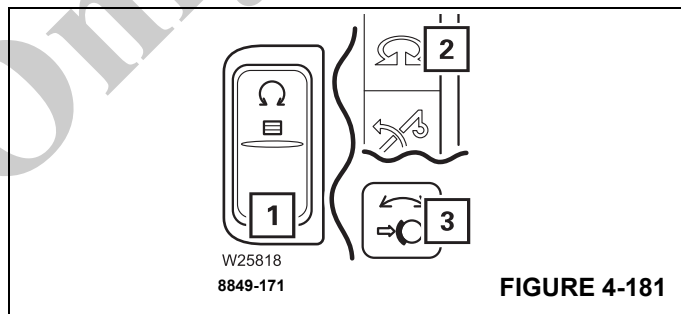


FIGURE 4-181

**Possible Movement Combinations**

- The main hoist, telescoping mechanism, lifting/lowering mechanism and swing gear can be operated in almost any combination simultaneously. Restrictions are specified for the specific power units.
- The auxiliary power units – Superstructure lock, tilt crane cab, counterweight lifting unit – cannot be operated with the Telescoping movement. Moving the auxiliary power units in combination with other power units can result in reductions of speed.



- Lattice extension lifting/lowering mechanism. The lattice extension lifting/lowering mechanism cannot be operated in combination with the Extending movement.

**SETTINGS AND DISPLAYS FOR CRANE OPERATION**

This section only describes settings and displays needed during crane operation. Operating elements that can be assigned to other procedures are described with the corresponding procedures.

**Inclining the Crane Cab**

With the appropriate equipment, you can incline the crane cab to the rear in order to attain a better sitting position when working at great heights.

**NOTE:** Prior to inclining the cab, make sure the door is latched into position and that all loose items are secured.

**(A) – Raise the Cab (See Figure 4-182)**

- Close the crane cab door.
- Push the button (1) down.

**(B) – Lower the Cab (See Figure 4-182)**

- Close the crane cab door.
- Push the button (1) up.

The crane cab will tilt as long as you hold the button down or until its end position is reached.

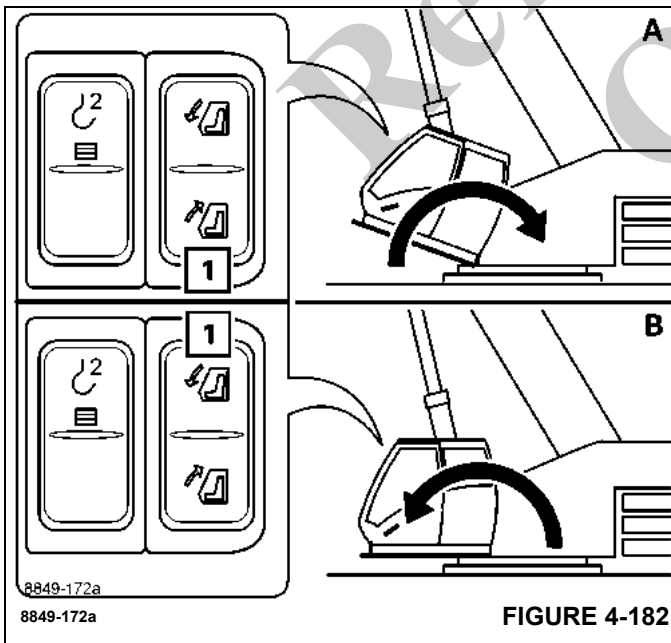


FIGURE 4-182

**Switching Units of Measure**

You can display the crane control values in metric units or imperial units.

- Open the Switch Units Menu (1), (Figure 4-183).

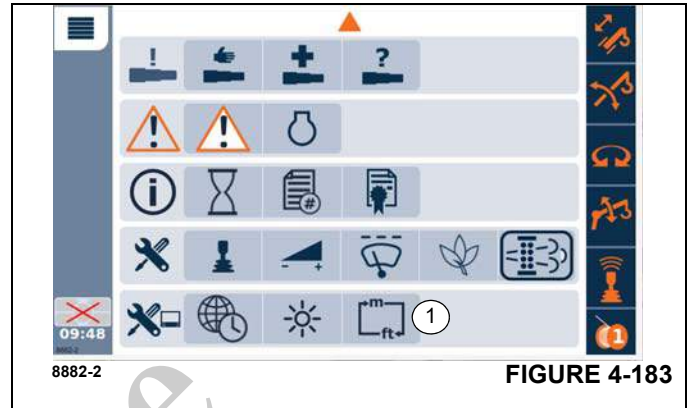


FIGURE 4-183

- Select and confirm the symbol (Figure 4-184):

|   |                           |
|---|---------------------------|
| 1 | To display metric units   |
| 2 | To display imperial units |

The symbol (3), (Figure 4-184) shows the respective confirmed selection as shown with a check mark.

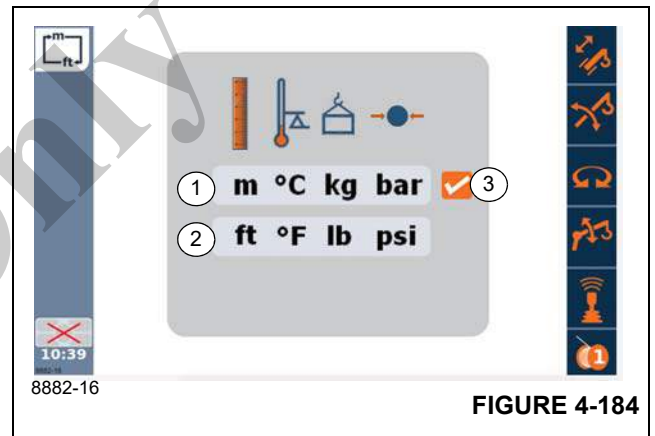


FIGURE 4-184

**Setting the Characteristic Curves for the Control Levers**

The control lever characteristic curve determines how high the power unit speed should be for a particular control lever movement.

You can assign different control lever characteristic curves to the power units.

Open the Settings (1), (Figure 4-185) Menu.

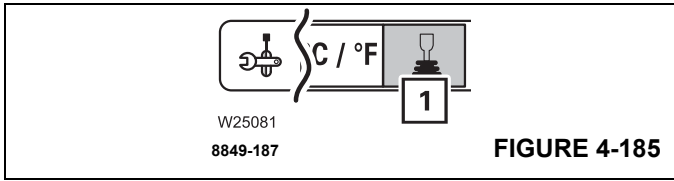


FIGURE 4-185

The symbols (2), (Figure 4-186) show the set characteristic curves of the power units (1), (Figure 4-186).

- Select the power unit for which you would like to change the characteristic curve.
- Set the desired characteristic curve.

Select and confirm symbol (3), (Figure 4-186) to reset all power units to characteristic Curve 1.

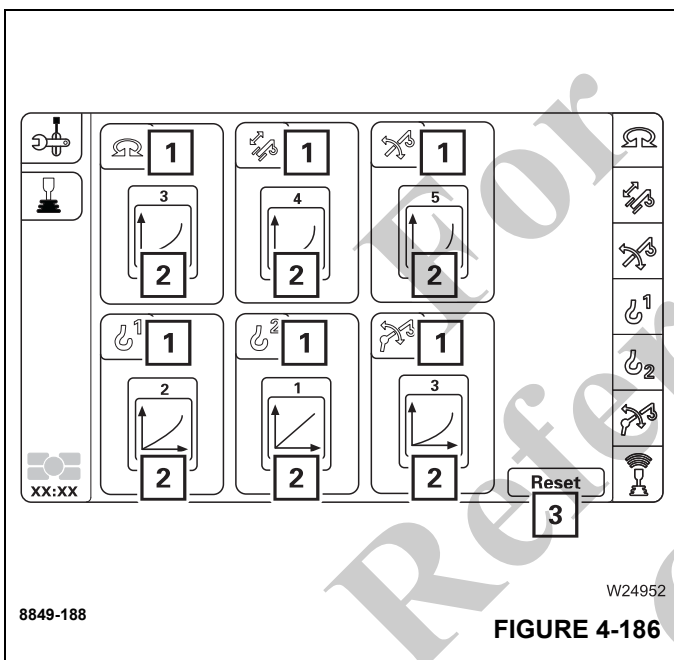


FIGURE 4-186

There are five characteristic curves: 1 to 5.

The higher the number of the characteristic curve, (1 to 5), (Figure 4-187), the further the control lever must be moved to get a clear increase in speed.

With characteristic Curve 5, you can work particularly sensitively with the control lever.

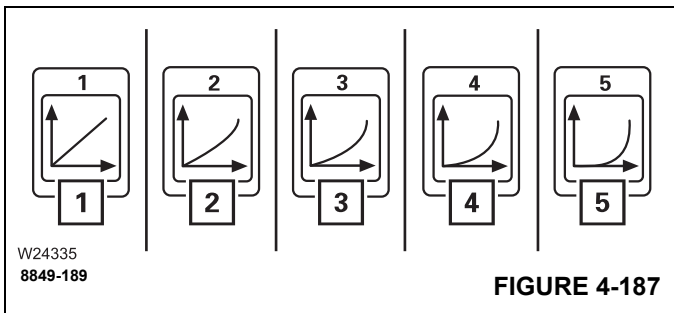


FIGURE 4-187

When default characteristic curves are not used, the icon shown in (Figure 4-188) will be shown in the left margin of the operating display (ODM).



FIGURE 4-188

### Limiting the Power Unit Speeds

You can enter a percentage of maximum speed for some power units. This reduces or limits the crane function speed achieved when the joystick or other control device is moved to its full extent.

Select and confirm the symbol (1), (Figure 4-189).

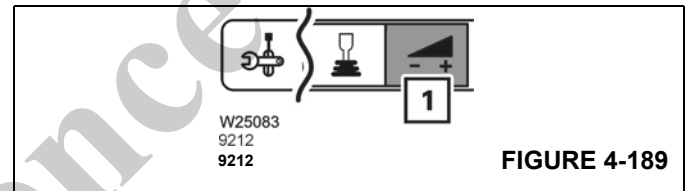


FIGURE 4-189

The power unit Speeds Menu opens.

The values below the symbols (1 to 5), (Figure 4-190) indicate the currently set power unit speeds, and these indicators on the screen can be used to alter the power unit speeds.

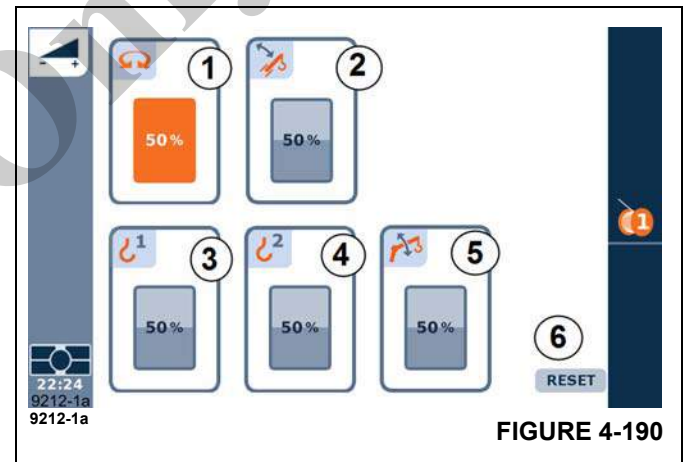


FIGURE 4-190

The symbol (4), (Figure 4-190) is only active when the auxiliary hoist is installed.

The symbol (6), (Figure 4-190) is a command button for resetting all the power unit speeds to their default value.

Some of the power units have a minimum threshold value for the speed. When the value is changed below this threshold, it automatically changes to 0. For instance, a function may

allow reducing the speed to 99% and down to 20%, but not below 20% (automatically set to 0%).

When a power unit speed has been set to 0% and accepted, the crane function is temporarily disabled, and the crane function icon in the right margin of the ODM (operating display) has a gray background to indicate to the operator that the crane function is disabled.

When a power unit speed has been reduced below 100%, but not disabled (at 0%), then the icon shown in (Figure 4-191) will be shown in the left margin of the ODM to indicate to the operator that the crane function is not set to the default speed.



FIGURE 4-191

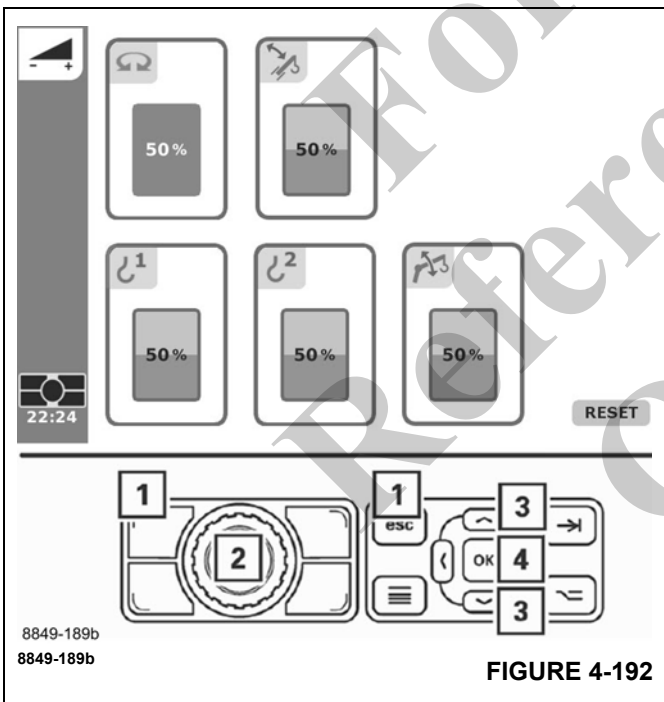


FIGURE 4-192

**Changing Values**

Select and confirm the symbol for the relevant power unit – symbol red.

Change the value using the Jog Dial (2), (Figure 4-193) or the buttons (3), (Figure 4-193).

To cancel the input – press the Escape Button (1), (Figure 4-193) once.

Confirm the changed values – press the Jog Dial (2), (Figure 4-193) or the OK Button (4), (Figure 4-193) once. The changed values for the power unit are applied.

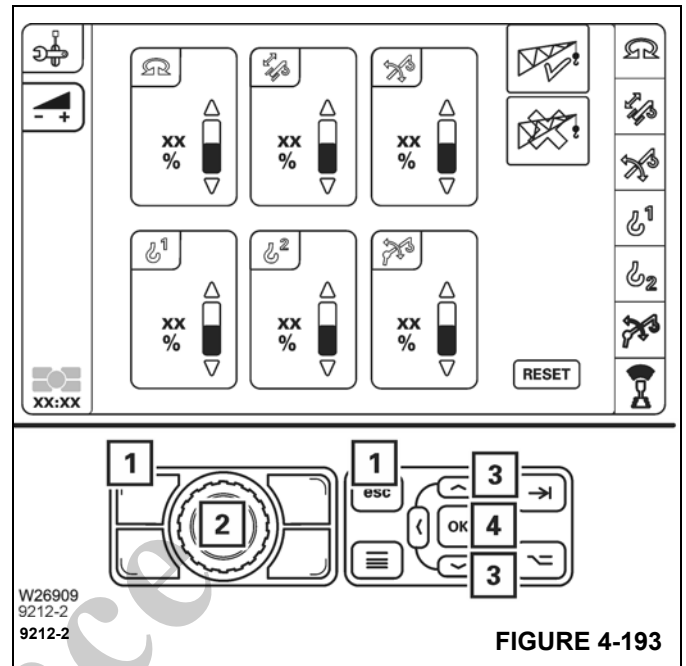


FIGURE 4-193

**Carrier Camera Display Set-Up**

The carrier camera display can be configured to display either the back up camera or the right turn camera or both.

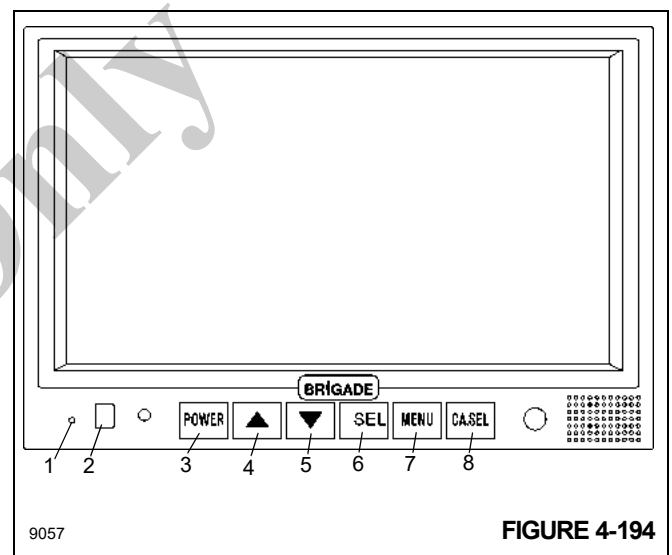


FIGURE 4-194

| Item | Description                |
|------|----------------------------|
| 1    | Automatic Low Light Sensor |
| 2    | Remote Control_Receiver    |
| 3    | Power Switch               |
| 4    | Scroll UP/Left             |
| 5    | Scroll Down/Right          |
| 6    | Select                     |

| Item | Description   |
|------|---------------|
| 7    | Menu          |
| 8    | Camera Select |

To display the two cameras side-by-side do the following:

1. Press the Menu Button (7), (Figure 4-194).
2. Select Camera Setup (8), (Figure 4-194).
3. Press the Select Button (6), (Figure 4-194).
4. Select Split Setup.
5. Press the Scroll Down Button (5), (Figure 4-194) to select Double Screen 1.
6. Press the Scroll Down Button (5), (Figure 4-194) to select Left CA1, Right CA2.

### Using the Slewable Spotlights

With the relevant equipment, the slewable spotlights (1), (Figure 4-195) are located on the main boom. They are controlled from the crane cab.

#### Switching ON

- Push the switch (1), (Figure 4-195) down – the lamp (2), (Figure 4-195) lights up.

#### Switching OFF

- Push the switch (1), (Figure 4-195) up – the lamp (2), (Figure 4-195) goes out.

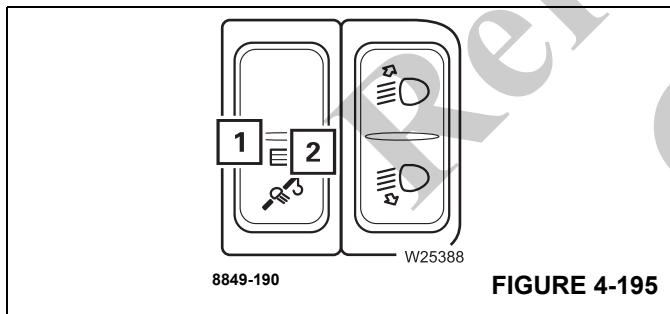


FIGURE 4-195

#### Turn Upwards

- Push the button (1), (Figure 4-196) up.

#### Turn Downwards

- Push the button (1), (Figure 4-196) down.

The direction of the spotlights will be adjusted until you let go of the button or they reach their end position.

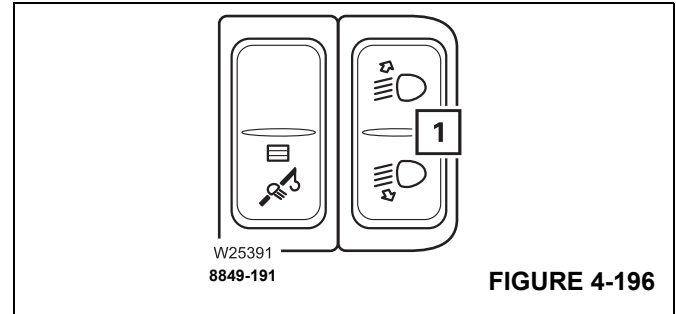


FIGURE 4-196

### Warnings in the Start Menu

When the Crane Control System (CCS) detects a fault, then the display area (1), (Figure 4-197) shows an error or warning symbol as indicated in the red box.

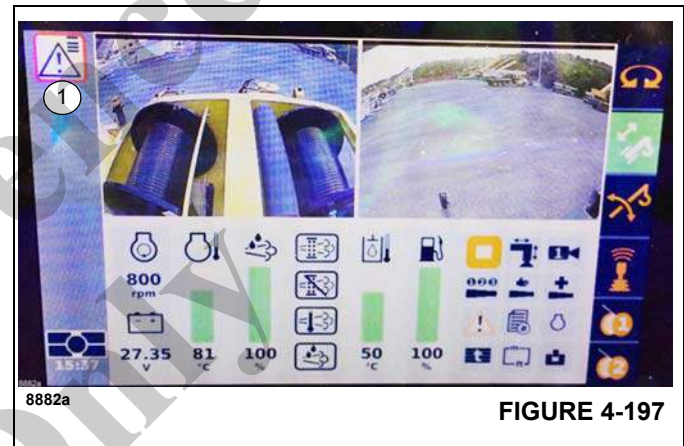


FIGURE 4-197

### Meaning of the Symbols

Perform the following checks if a symbol is displayed:

- **Voltage Monitoring:**
  - The voltage in the electrical system is too high or too low (Figure 4-198).

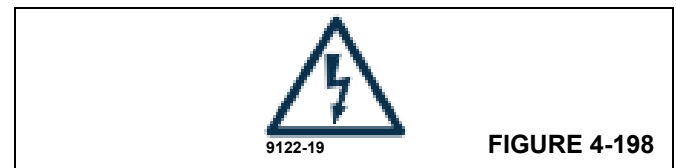
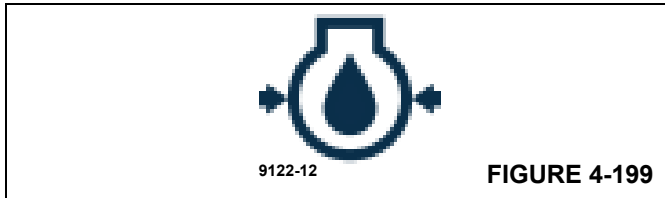


FIGURE 4-198

- **Engine Oil Pressure Too Low:**
  - Switch off the crane operation as soon as possible and switch off the engine (Figure 4-199).
  - Check the oil level; refer to the Service Manual.
  - If the oil level is correct, then start the engine and check the warning messages that are present.



- **Engine Malfunction:**
  - Switch off the engine immediately and open the Engine Error Menu, (Figure 4-200).
  - If necessary, note the Error messages and contact your local distributor or Manitowoc Crane Care.



- **Fuel Level in the Tank Too Low:**
  - The fuel tank is filled only to a level of approx. 5% (Figure 4-201).
  - If the fuel tank is almost empty, air will be sucked in and you will have to bleed the fuel system. Refer to the Service Manual.



- **Emergency Stop Switch Actuated:**
  - To reset the switch, rotate and pull (Figure 4-202).



### MECHANICAL EMERGENCY UNLOCKING AND LOCKING OF THE TELESCOPIC SECTIONS

The mechanical emergency operation must be used whenever the telescoping cylinder can no longer be moved.

For manual unlocking and locking of the telescopic sections, a screw is inserted into each side in the locking pins. When screwed in, the screw collapses the spring internal to the locking pin, thus pulling the locking pin which pulls the locking pin into the telescopic section and thus unlocks the section.

The screw is screwed out again to lock the section manually.

The main boom is designed in such a way that the locks can be operated in emergency mode from the outside for most fixed lengths.

**NOTE:** If the telescoping cylinder is in the foot section of a telescopic section, this telescopic section cannot be locked or unlocked manually.

**Prerequisites:**



**WARNING**

**Risk of Crushing from Retracting Boom!**

Failure to follow these prerequisites could allow a boom section to retract uncontrolled resulting in injury or equipment damage.

The following prerequisites must be fulfilled before unlocking a telescopic section manually:

- The telescopic section to be unlocked is attached to an auxiliary crane with sufficient load bearing capacity and, in this way, is secured against independent retraction.

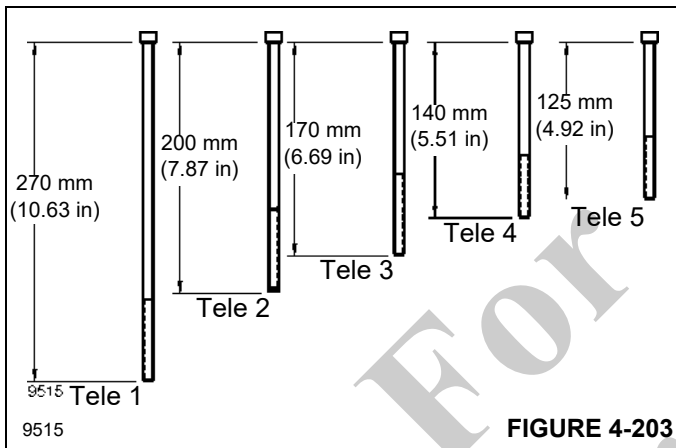
**Or**

- The main boom is lowered into a horizontal position so that the telescopic section is unable to retract independently.

**Maintenance**

For manual unlocking, two screws are supplied for each telescopic section (Figure 4-203):

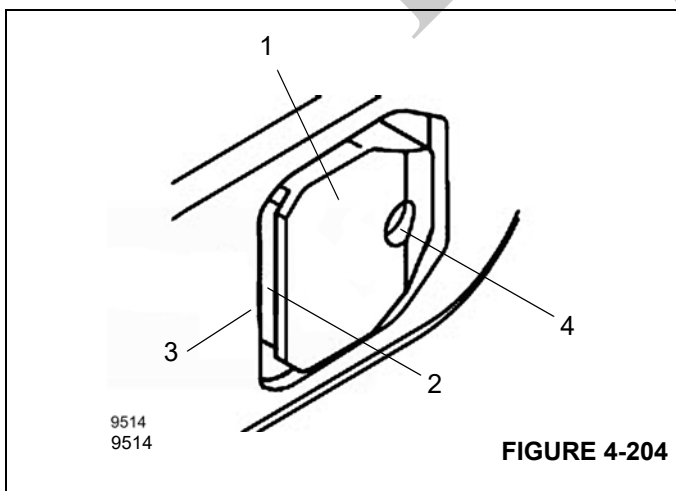
- 125 mm (4.92 in) length for telescopic Section 5.
- 140 mm (5.51 in) length for telescopic Section 4.
- 170 mm (6.69 in) length for telescopic Section 3.
- 200 mm (7.87 in) length for telescopic Section 2.
- 270 mm (10.63 in) length for telescopic Section 1.



**FIGURE 4-203**

Refer to (Figure 4-204). You can only lock or unlock a Telescopic Section manually if the recess (2), in the locking pin (1) no longer engages in the Telescopic Section (3) above it.

Extend the Telescopic Section approximately 20 mm (0.79 in) (with an auxiliary crane, forklift or other means of external force). The locking pin (1) must be centered in the opening and the recess (2) may no longer engage in the Telescopic Section (3) above it.



**FIGURE 4-204**

**Unlocking Telescopic Sections**

When unlocking sections, start with Tele 5 (fly) and work your way in towards Tele 1 as far as possible. Unlock and lock only one section at a time.

1. Remove the grease fitting from the bore hole (4), (Figure 4-204).
2. Insert a screw into the hole (4), (Figure 4-204). The locking pin (1), (Figure 4-204) is retracted in the process. You can assist this process by lightly hammering on the locking pins.
3. Tighten the screw against the spring load until the locking pin (1), (Figure 4-204) is pulled in as far as it will go and is situated behind the side wall of the Telescopic Section.
4. Unlock the other side of the Telescopic Section using the same procedure.

**CAUTION**

**Risk of Damage in the Event of a Mechanically Released Lock!**

Under no circumstances may you operate the telescoping cylinder as long as the lock is mechanically released. Therefore unscrew all screws out of the bore holes immediately after finishing the repair work. In this way, you prevent the telescoping cylinder from hitting the locking system and consequently damaging it. Do not unlock a section and then boom up until it slides in. Damage to equipment will result.

Once the pins are retracted, use your external means (second crane, forklift, etc.) to retract that section and then remove the bolts to pin that section in a retracted state. Move to the next section to be retracted (as necessary).

**Locking Telescopic Sections**

1. Retract the telescopic section until the locking pin (1), (Figure 4-204) is in the middle of the opening.
2. Remove the screw from the bore hole (4), (Figure 4-204).

The locking pin (1), (Figure 4-204) is then pushed out of the opening due to spring tension.

3. Install the grease fitting into the bore hole.
4. Retract the telescopic section until the recesses (2), (Figure 4-204) have been set down on the telescopic section (3), (Figure 4-204) above it.



**WORK BREAK**

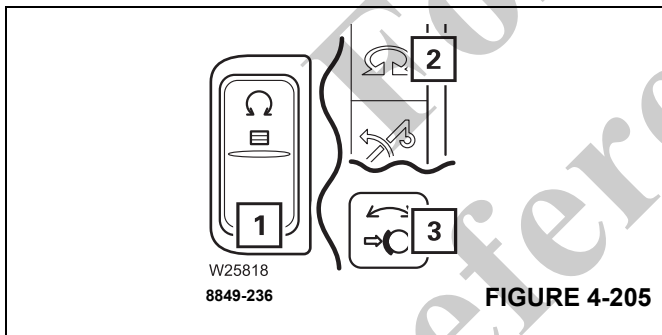
**In Case of Short Work Breaks**



**WARNING**

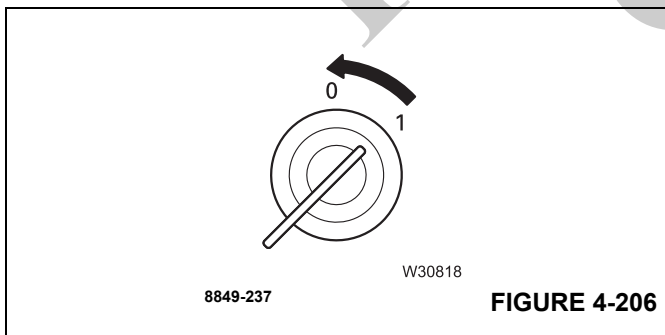
Never leave the crane with a load suspended. Should it become necessary to leave the crane, lower the load to the ground and stop the engine before leaving the operator's station.

- Switch off the swing gear.
  - The lamp in the switch (1), (Figure 4-205) must be dimly lit.
  - Then symbol (2), (Figure 4-205) turns red – swing gear switched OFF.
  - Lamp (3), (Figure 4-205) must light up – swing gear brake applied.



**FIGURE 4-205**

Switch the engine off, turn the ignition key to position 0 and remove it (Figure 4-206).



**FIGURE 4-206**

Make sure that no unauthorized persons can operate the truck crane. Refer to *To Secure the Truck Crane*, page 4-97.

**In Case of Work Breaks of More than 8 Hours**

- Retract all telescopic sections.
- Lower the main boom.
- Switch off the swing gear.
  - The lamp in the switch (1), (Figure 4-205) must be dimly lit.
  - Then symbol (2), (Figure 4-205) turns red – swing gear switched OFF.
  - Lamp (3), (Figure 4-205) must light up – swing gear brake applied.

Switch the engine OFF, turn the ignition key to position 0 and remove it (Figure 4-206).

Switch OFF all current devices.

**To Secure the Truck Crane**

- Secure the truck crane against unauthorized use by:
  - Stowing away the hand-held control in the crane cab,
  - Removing the ignition key, and
  - Locking both cabs.



**WARNING**

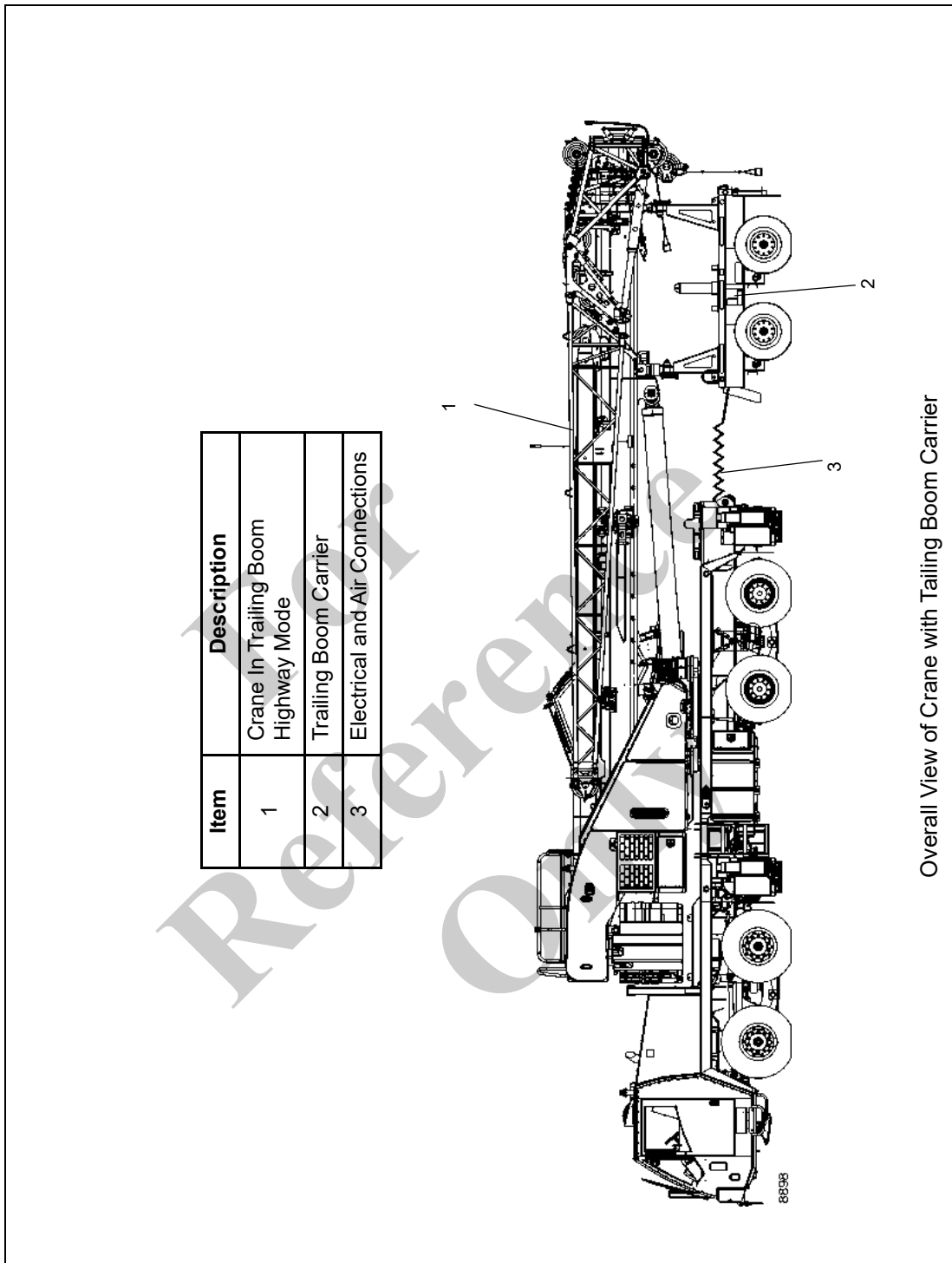
To prevent unauthorized use of the remote control, turn OFF and store the remote control in its storage holder and lock the cab.

**TRAILING BOOM CARRIER OPTION**

**Description**

The trailing boom carrier provides a means of distributing the cranes total travel weight over a greater area and more axles to allow for reduced individual axle loads for highway travel. The components include a trailer, swing brake release valve assembly and a lift cylinder relief valve.





**Operation**

**Preparation for Highway Travel**

1. Determine the highway route to be taken, the states to be crossed and the allowable axle weights for the crane with trailing boom and carrier. Consult with your local Grove Cranes distributor or Manitowoc Crane Care for

weight distribution with or without removable components. Obtain the necessary permits.

2. Configure the crane to achieve allowable axle weight distribution with trailing boom and boom carrier installed.
3. Swing the boom over the rear.

4. Make sure that the Trailer Air Supply Control in the crane carrier cab is applied. Refer to *Trailing Boom Air Supply Control (Optional)*, page 3-8.

5. Make sure that the Air Locking Pin Valve Knob at the rear of the trailing boom carrier is turned to the RETRACT position. Refer to (Figure 4-207).

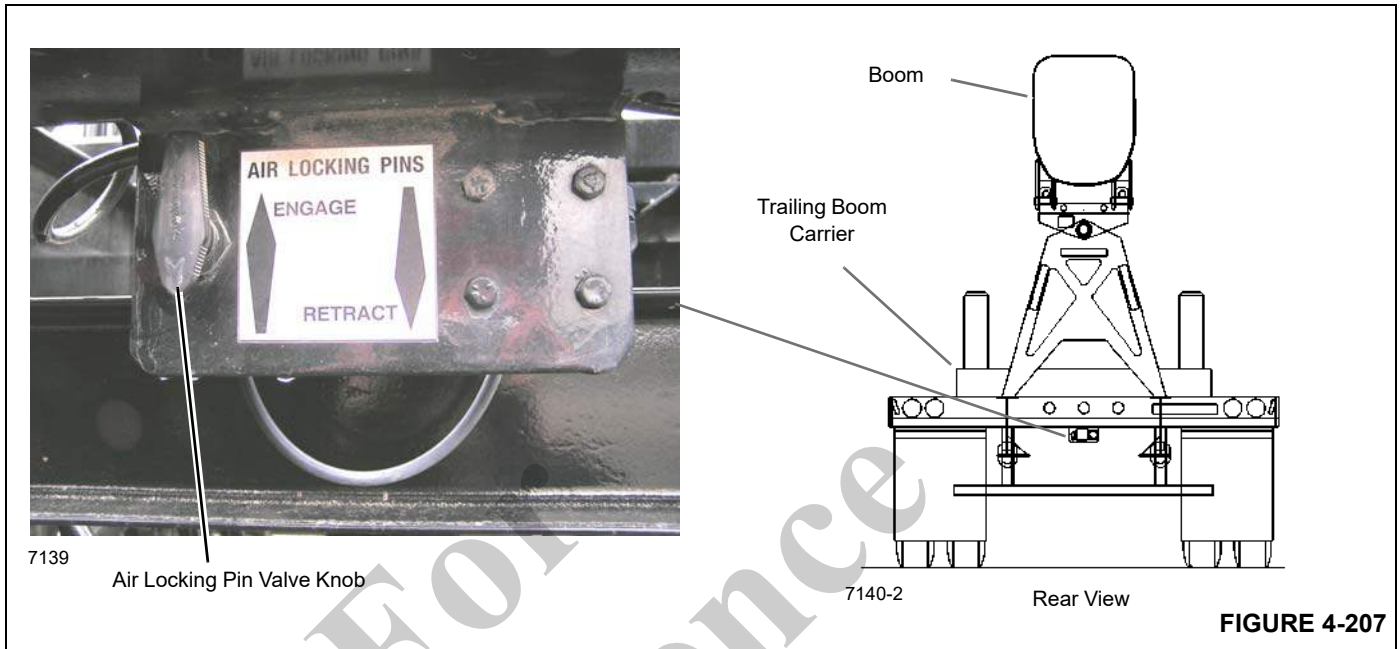


FIGURE 4-207

6. Visually check locking pins to make sure that they are retracted.

**NOTE:** When the air cylinders are extended, the locking pins are disengaged. When the air cylinders are retracted, the locking pins are engaged. Refer to (Figure 4-208).

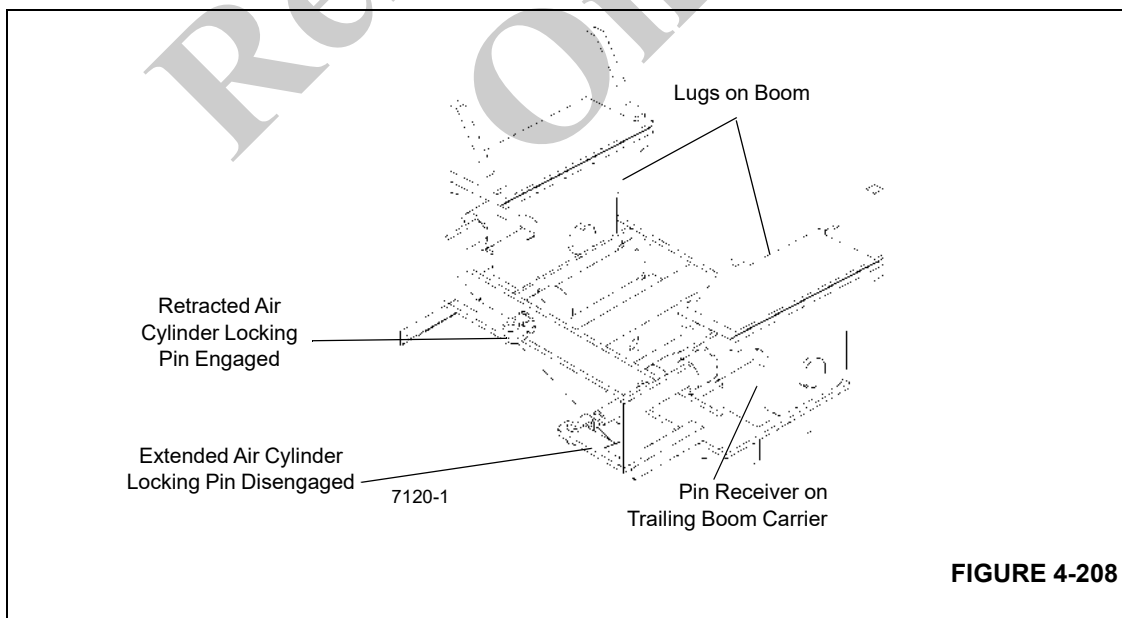


FIGURE 4-208

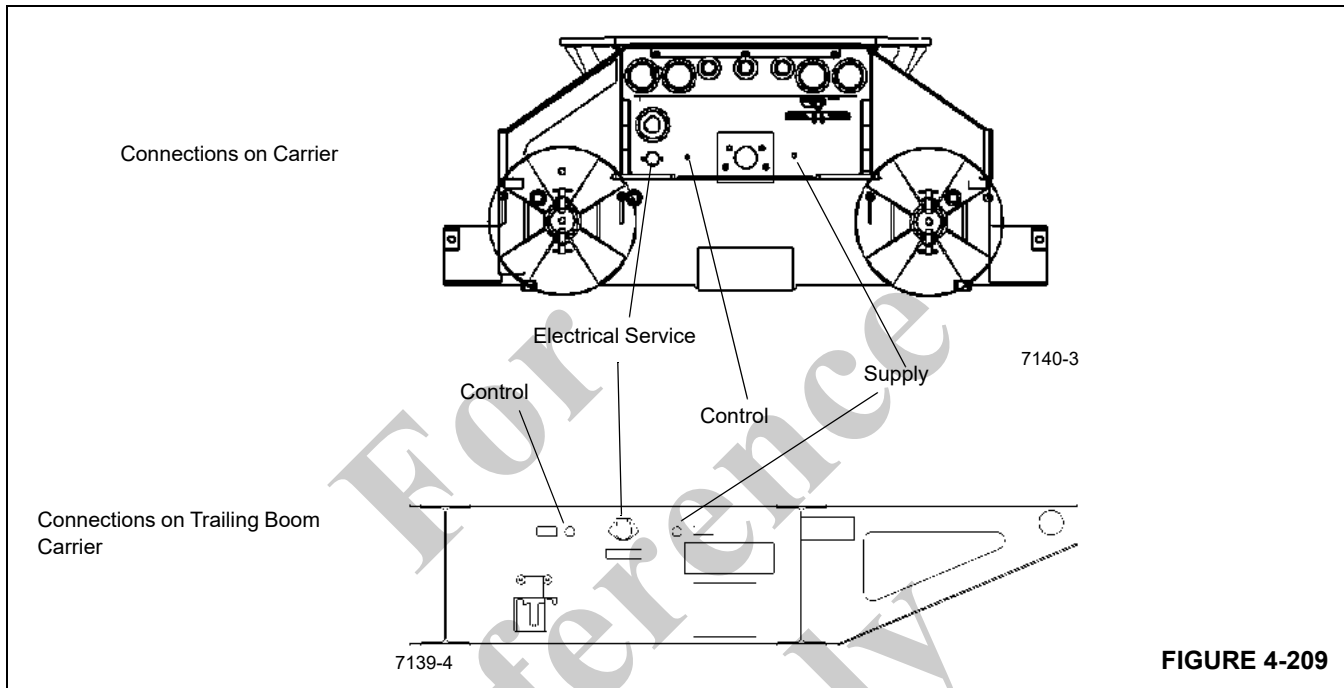
**WARNING**

Prior to moving the crane and trailing carrier, make sure that all four of the two-inch diameter pins are engaged or the trailing carrier can separate from the boom.

7. Lower the boom onto the trailing carrier until lugs on boom seat into pin receivers on the trailing carrier as shown in (Figure 4-209).

**NOTE:** Chock the wheels of the trailing carrier.

8. Connect the air and electrical lines between the crane carrier and the trailing carrier as shown in (Figure 4-209).

**FIGURE 4-209**

9. Turn the Locking Pin Air Valve knob to the ENGAGE position.
10. Visually check locking pins to ensure all four pins are engaged.
11. Turn the lift cylinder float valves counterclockwise to open them for trailing boom operation as shown in (Figure 4-210).
12. Release the turntable swing brakes by pushing in on the knobs. Secure the knobs in the released position with the padlocks.
13. Verify the 360° swing lock is disengaged. Refer to *Switching the 360° Lock ON/OFF*, page 4-47.
14. Install flags and oversize load placards as required.

**WARNING**

The superstructure is free to swing when the trailing boom swing brake release valve is released.

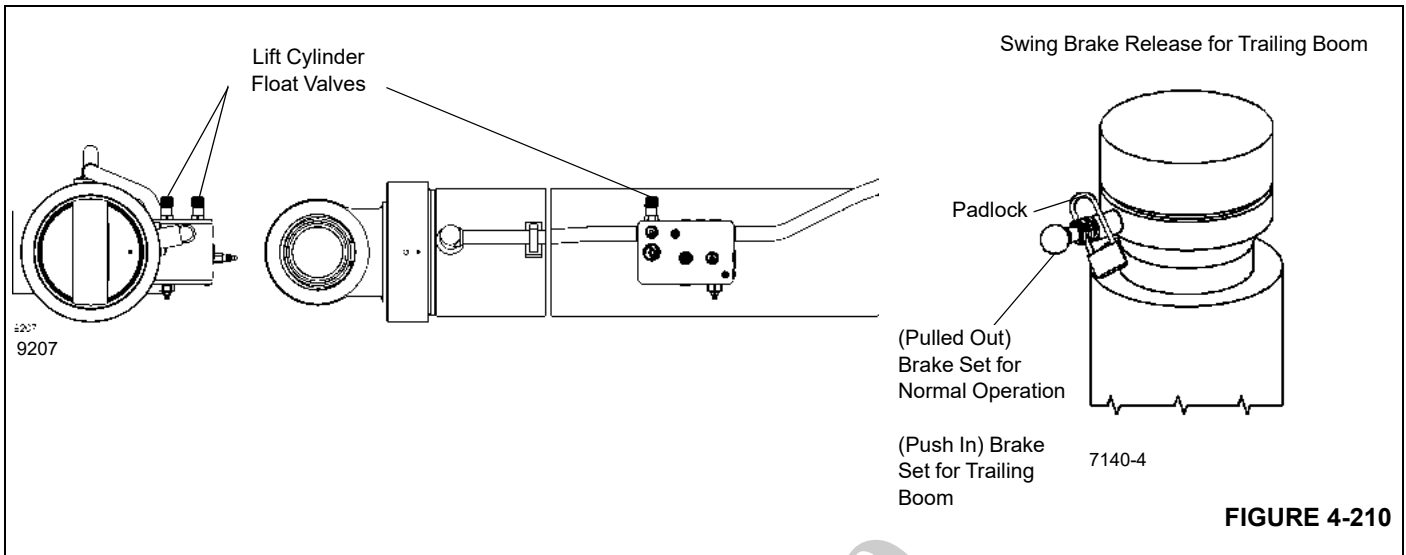


FIGURE 4-210

### Travel Precautions

**NOTE:** The following paragraphs list several important travel precautions which must be taken into consideration when traveling with the crane in the trailing boom configuration.

- Use of the trailing boom feature may require reducing travel speeds. Adjust travel speed to suit driving conditions (i.e. traffic, highway, weather).
- The crane boom and trailer combination requires a wide turning radius. When turning during driving, allow extra space on both the left and right sides of the carrier.
- The superstructure will rotate and stick out past the side of the carrier that is opposite the direction the carrier is being steered/turned when traveling.
- Reduce travel speed to avoid undesired weight transfer between the carrier and the boom trailer at abrupt crests and undulating terrain.

### Returning to Normal Crane Operation

1. Position the crane and trailing boom carrier on a firm level surface with the boom carrier directly behind the crane.
2. Block the wheels and apply the parking brakes.
3. Turn the lift cylinder float valves clockwise to the normally closed position.
4. Pull out the knobs on the swing brakes to set for normal brake operation and padlock.
5. Turn air locking pin valve knob to the RETRACT position. Visually check locking pins to ensure they are disengaged.

6. Raise the boom from the trailing boom carrier.
7. Disconnect all air and electrical lines from the rear of the crane.

### Parking the Trailing Boom Carrier



#### WARNING

The superstructure is free to swing when the trailing boom swing brake release valve is released.

Use the following procedure when parking the trailing boom carrier.

1. Apply the emergency/parking brake in the carrier cab. Refer to *Trailing Boom Air Supply Control (Optional)*, page 3-8.

2. Check the tires on the trailing boom carrier.

**NOTE:** The trailing boom carrier brakes are air pressure applied and may bleed off.

3. Disconnect the boom from the trailing boom carrier as described under Returning to Normal Crane Operation.

### TILT-UP PANEL PROCEDURE USING THE HEAVY DUTY BOOM EXTENSION

Refer to *Installing Manual Off-Settable Heavy Duty Boom Extension*, page 6-79, *Tilt-Up Panel Lifting*, page 2-21, in the *Safety Information*, page 2-1 for more information.

**! DANGER**

Death or serious injury may result if the permissible working loads and RCL programs are not observed.

Only lift loads weighing less than/or equal to the permissible load of the heavy duty boom extension in the appropriate working radius.

The load's center of gravity must move towards the crane (Figure 4-211), (A & B). Any other use is considered non-intended use and is prohibited. For examples see (Figure 4-212), (C & D).

Movement of the load during tilting shall be done such that the moment decreases.

**Tilting from Vertical to Horizontal**

1. Lift the load on the heavy duty boom extension (**Detail A**). Refer to *Installing Manual Off-Settable Heavy Duty Boom Extension*, page 6-79.
2. The hoisting rope on the main boom remains unloaded at first but the rope must not become slack. Then lift the load via the main boom until the load is horizontal. Then lower the load uniformly using the two hoists.

**Tilting from Horizontal to Vertical**

1. Lift the load horizontally using the two hoists (**Detail B**) as shown in (Figure 4-211).
2. Then slacken the lifting rope of the boom extension until the load is suspended vertically. Lower the load via the main boom and pay-out the lifting rope of the boom extension. Make sure that the rope does not have slack.

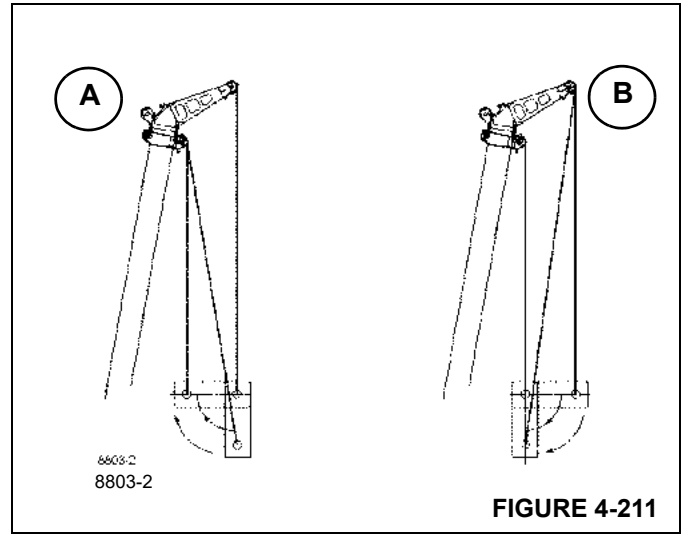


FIGURE 4-211

**! DANGER**

Death or serious injury may result if the boom is overloaded.

If you proceed in accordance with **Detail C / Detail D** (Figure 4-212), the load will swing outward and the load torque will increase. This work method can cause the machine to tip or the boom system to become overloaded and is therefore strictly prohibited!

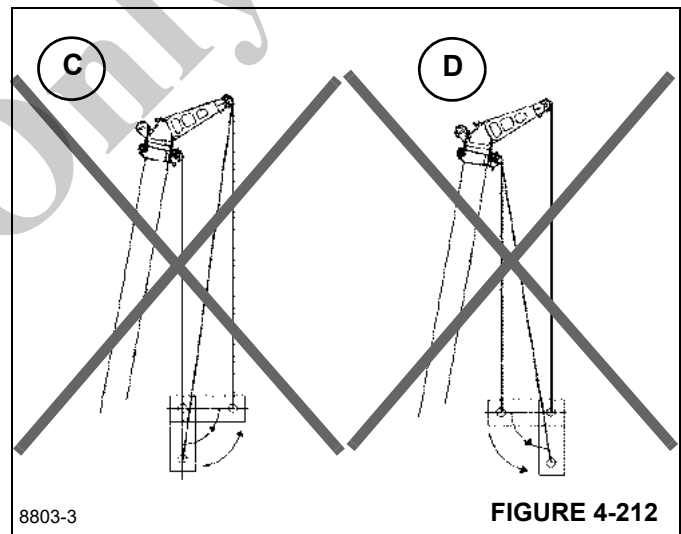


FIGURE 4-212

## SECTION 5 LUBRICATION

### SECTION CONTENTS

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>General</b> . . . . . <b>5-1</b></p> <p>    Environmental Protection . . . . . 5-1</p> <p>    Cummins Oil Registration List . . . . . 5-1</p> <p>    Arctic Conditions Below -18° C (0° F) . . . . . 5-2</p> <p><b>Lubrication Points</b> . . . . . <b>5-2</b></p> <p>    Standard Lubricants . . . . . 5-3</p> <p>    Cold Weather Lubricants . . . . . 5-5</p> <p>    Arctic Lubricants and Conditions . . . . . 5-7</p> <p>    Drivetrain Lubrication . . . . . 5-9</p> <p>    Clutch Release Bearing Grease Interval . . . . . 5-12</p> <p>    Steering Lubrication . . . . . 5-14</p> <p>    Axle Lubrication . . . . . 5-15</p> <p>    Outrigger Lubrication . . . . . 5-19</p> | <p>Miscellaneous Lubrication . . . . . 5-20</p> <p>Turntable &amp; Cab Tilt Lubrication . . . . . 5-21</p> <p>Hoist Lubrication . . . . . 5-23</p> <p>Turntable Central Lubrication . . . . . 5-24</p> <p>Boom Lubrication . . . . . 5-25</p> <p>Monthly Lubrication Work . . . . . 5-30</p> <p><b>Carwell® Rust Inhibitor</b> . . . . . <b>5-31</b></p> <p>    Protecting Cranes From Corrosion . . . . . 5-31</p> <p>    Cleaning Procedures . . . . . 5-31</p> <p>    Inspection and Repair . . . . . 5-32</p> <p>    Application . . . . . 5-32</p> <p>    Areas of Application . . . . . 5-32</p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### GENERAL

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

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

Potentially harmful waste used in Grove cranes includes — but is not limited to — oil, fuel, grease, coolant, air conditioning refrigerant, filters, batteries, and cloths which have come into contact with these environmentally harmful substances.

Handle and dispose of waste according to local, state, and federal environmental regulations.

When filling and draining crane components, observe the following:

- Do not pour waste fluids onto the ground, down any drain, or into any source of water.
- Always drain waste fluids into leak proof containers that are clearly marked with what they contain.
- Always fill or add fluids with a funnel or a filling pump.
- Immediately clean up any spills.

### CAUTION

#### Possible Equipment Damage!

Chassis grease lubricants must not be applied with air pressure devices as this lubricant is used on sealed fittings.

The multipurpose grease installed during manufacture is of a lithium base. Use of a non-compatible grease could result in damage to equipment.

### Cummins Oil Registration List

Cummins has a program that lists engine oils that it has tested to meet its engineering specifications. Listing of recommended oils is on QuickServe® Online. Log on to quickserve.cummins.com and login with a current username and password or create a new account by selecting “Create an Account” under information, choose Limited Owners Plan and register. Once logged in, click on the “Service” Tab in the top red bar, “Service Tools” mini-tab and “Oil Registration Lists” link within the Service Tools list. This will load a list of the different Cummins Engineering Specification numbers.

### Environmental Protection

**Dispose of Waste Properly!** Improperly disposing of waste can threaten the environment.

Select the one that applies to your engine to view the registered oils.

### Arctic Conditions Below -18° C (0° F)

In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results. However, certain fluids, such as halogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, might not be compatible with hydraulic system seals and wear bands. If you are in doubt about the suitability of a specific fluid, check with your authorized Grove Cranes distributor or Manitowoc Crane Care.

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

### LUBRICATION POINTS

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

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

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

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

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

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

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

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

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

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



**Standard Lubricants**

Standard lubricants are used on all Grove cranes unless the crane is ordered with a cold weather package. These

standard lubricants are effective in ambient temperatures down to -9°C (15°F). Refer to (TABLE 5-1:) for a list of the recommended standard lubricants.

**TABLE 5-1: Standard Lubricants/Fluids [Down to -9°C (15°F)]**

| Lubricant/Fluid                                 | Grove Spec. | Recommended Lubricant                                                                                                                                                                                                                                      |              |                |
|-------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
|                                                 |             | Type                                                                                                                                                                                                                                                       | Grade        | Classification |
| <b>Extreme Pressure 3% Moly Grease</b>          | 6829015304  | Citgo: Lithoplex CM2<br>Mobil: Mobilgrease CM-P<br>Ipiranga: IPIFLEX LI-COMP Moly 2                                                                                                                                                                        | NLGI Grade 2 |                |
| <b>Synthetic Gear Lube SAE 40</b>               | 80078954    | Emgard MTF 7000 (BASF)<br>Phillips 66 Triton Synthetic MTF<br>Kendall SHP Synthetic MTF                                                                                                                                                                    |              |                |
| <b>Gear Lube (GL-5)</b>                         | 6829014058  | CITGO, Synthetic Gear Lube 75W-90<br>Eaton, Roadranger EP75W-90<br>Mobil, Mobilube SHC 75W-90<br>Shell, Spirax® S 75W-90<br>Sunoco®, Duragear EP75W-90<br>Petro-Canada, Traxon E Synthetic 75W-90                                                          | 75W-90       |                |
| <b>Extended Service Interval Gear Lubricant</b> | 6829012964  | Century Unigear Semi-synthetic<br>Texaco Multigear SS<br>Chevron DELO                                                                                                                                                                                      | 80W-90       |                |
| <b>Engine Oil</b>                               | 6829104182  | Conoco Fleet Supreme EC (non-current, replaced by Phillips 66 Product)<br>Mobil Delvac 1300 Super<br>Mobil Delvac MX ESP<br>Mobil HDEO<br>Phillips 66 Fleet Supreme EC 15W-40<br>Other Products listed on Cummins' "Oil Recommendation List" for CES-20086 | 15W-40       | CJ-4           |
| <b>Engine Oil</b>                               | 6829003483  | Exxon XD-3<br>Conoco Fleet Supreme<br>Phillips 66 Super HD II<br>Phillips 66 Power-D Engine Oil                                                                                                                                                            | 15W-40       | CI-4           |

TABLE 5-1: Standard Lubricants/Fluids [Down to -9°C (15°F)]

| Lubricant/Fluid                     | Grove Spec. | Recommended Lubricant                                                                                                                                                                             |           |                                    |
|-------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------------------------|
|                                     |             | Type                                                                                                                                                                                              | Grade     | Classification                     |
| Hydraulic/Transmission Oil          | 6829006444  | Kendall Hyken 052<br>Exxon Torque Fluid 56<br>Esso Torque Fluid 56<br>BP-Eldoran UTH & Trak-Tran 9<br>BP- Blend- 7367<br>Phillip 66 PowerTran XP                                                  | 10W-20    | Must Meet John Deere Std. JDM J20c |
|                                     |             | Exxon Mobil 424                                                                                                                                                                                   | 10W-30    |                                    |
| Hoist Gear/Swing Drive Oil          | 6829014058  | CITGO, Synthetic Gear Lube 75W-90<br>Eaton, Roadranger EP75W-90<br>Mobil, Mobilube SHC 75W-90<br>Shell, Spirax® S 75W-90<br>Sunoco®, Duragear EP75W-90<br>Petro-Canada, Traxon E Synthetic 75W-90 | 75W-90    | GL-5                               |
| Grease, Multipurpose                | 6829003477  | Citgo: Lithoplex Red MP Grease<br>Chevron: Starplex EP 2<br>Phillips 66: Multiplex Red<br>Mobil: Mobilgrease XHP 222<br>Ipiranga: IPIFLEX LI-COMP EP 2                                            | NLGI 2    |                                    |
| Open Gear Lube                      | 6829102971  | Fuchs Ceplattyn 300 Spray                                                                                                                                                                         | NLGI 1-2  |                                    |
| Anti-Seize Compound (ASC)           | 6829003689  | Jet Lube Kopr Kote<br>Loctite C5-A Compound                                                                                                                                                       |           |                                    |
| Antifreeze Coolant                  | 6829101130  | Old World Industries, Inc. Fleet Charge SCA<br>Caterpillar DEAC<br>Fleetguard Complete EG                                                                                                         | Mix 50/50 |                                    |
| Supplemental Coolant Additive (SCA) | 6829012858  | Fleetguard DCA4<br>Fleetguard DCA2<br>Penray Pencool 3000                                                                                                                                         |           |                                    |
| Diesel Fuel                         |             | Ultra Low Sulfur Diesel Fuel                                                                                                                                                                      | #2-D      |                                    |
| Diesel Exhaust Fluid (DEF)          | 80019225    | Fleetguard StableGuard™ Urea 32 Premix<br>AdBlue®<br>TerraCair Ultrapure® DEF                                                                                                                     |           |                                    |
| Bechem High--Lub LM2 EP (400g)      | 03313195    | Bechem High-Lub LM2 EP (400g)                                                                                                                                                                     |           |                                    |
| Multi-purpose Grease                | 01373458    | Berulub PAL 1                                                                                                                                                                                     |           |                                    |
| Hydraulic Oil - ATF 66M Avia Fluid  | 01930670    | Avia 66M                                                                                                                                                                                          |           |                                    |

**Cold Weather Lubricants**

Cold weather lubricants are used on all Grove cranes when the crane is ordered with a cold weather package. These

optional lubricants are effective in ambient temperatures down to -29°C (-20°F). Refer to (TABLE 5-2:) for a list of the recommended optional lubricants.

**TABLE 5-2: Optional Lubricants/Fluids [Down to -29°C (-20°F)]**

| Lubricant/Fluid                                 | Grove Spec. | Recommended Lubricant                                                                                                                                                                             |              |                |
|-------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
|                                                 |             | Type                                                                                                                                                                                              | Grade        | Classification |
| <b>Extreme Pressure 3% Moly Grease</b>          | 6829104275  | Mobil: Mobilith SHC 220 (Red)<br>Petro-Canada: Precision Synthetic EP1 ( )<br>Phillips 66: Triton 220 (replaced by Multiplex FS220) (Purple)<br>Phillips 66: Multiplex FS 220 (Purple)            | NLGI Grade 2 |                |
| <b>Synthetic Gear Lube SAE 40</b>               | 80078954    | Emgard MTF 7000 (BASF)<br>Phillips 66 Triton Synthetic MTF<br>Kendall SHP Synthetic MTF                                                                                                           |              |                |
| <b>Gear Lube (GL-5)</b>                         | 6829014058  | CITGO, Synthetic Gear Lube 75W-90<br>Eaton, Roadranger EP75W-90<br>Mobil, Mobilube SHC 75W-90<br>Shell, Spirax® S 75W-90<br>Sunoco®, Duragear EP75W-90<br>Petro-Canada, Traxon E Synthetic 75W-90 | 75W-90       |                |
| <b>Extended Service Interval Gear Lubricant</b> | 6829014058  | CITGO, Synthetic Gear Lube<br>Eaton, Roadranger EP75W-90<br>Mobil, Mobilube SHC 75W-90<br>Shell, Spirax® S 75W-90<br>Sunoco®, Duragear EP75W-90<br>Petro-Canada, Traxon E Synthetic 75W-90        | 75W-90       |                |
| <b>Engine Oil</b>                               | 80056036    | Shell Rotella® T6 0W-40<br>Mobil Delvac 1 ESP 0W-40<br>Caterpillar Cat DE0-ULS Cold Weather                                                                                                       | 0W-40        | CJ-4           |
| <b>Hydraulic Fluid</b>                          | 6829006993  | Exxon Mobil Univis HVI 26                                                                                                                                                                         |              |                |
| <b>Extreme Pressure Gear Lube</b>               | 6829103636  | Mobil SHC629<br>Petro-Canada; Enduratex Synthetic EP 150                                                                                                                                          |              | AGMA No. 4 EP  |
| <b>Extreme Pressure Multipurpose Grease</b>     | 6829104275  | Mobil: Mobilith SHC 220<br>Petro-Canada; Precision Synthetic EP1                                                                                                                                  | NLGI 2       |                |
| <b>Open Gear Lube</b>                           | 6829102971  | Fuchs Ceplattyn 300 Spray                                                                                                                                                                         | NLGI 1-2     |                |
| <b>Multipurpose Grease</b>                      | 01373458    |                                                                                                                                                                                                   |              |                |



TABLE 5-2: Optional Lubricants/Fluids [Down to -29°C (-20°F)]

| Lubricant/Fluid                     | Grove Spec. | Recommended Lubricant                                                                     |           |                |
|-------------------------------------|-------------|-------------------------------------------------------------------------------------------|-----------|----------------|
|                                     |             | Type                                                                                      | Grade     | Classification |
| Extreme Pressure Gear Lube          | 02313611    | Aral Getriebeöl EP Synth. SAE 75W-90                                                      |           |                |
| Hydraulic Oil - ATF 66M Avia Fluid  | 01930670    | Avia Fluid ATF 66 M                                                                       |           |                |
| Bechem High-Lub LM2 EP (400g)       | 03313195    |                                                                                           |           |                |
| Anti-Seize Compound (ASC)           | 6829003689  | Jet Lube Kopr Kote<br>Loctite C5-A Compound                                               |           |                |
| Antifreeze Coolant                  | 6829101130  | Old World Industries, Inc. Fleet Charge SCA<br>Caterpillar DEAC<br>Fleetguard Complete EG | Mix 50/50 |                |
| Supplemental Coolant Additive (SCA) | 6829012858  | Fleetguard DCA4<br>Fleetguard DCA2<br>Penray Pencool 3000                                 |           |                |
| Diesel Fuel                         | 80069407    | Ultra Low Sulfur Diesel Fuel                                                              | #1-D      |                |
| Diesel Exhaust Fluid (DEF)          | 80019225    | Fleetguard StableGuard™ Urea 32 Premix<br>AdBlue®<br>TerraCair Ultrapure® DEF             |           |                |

## Arctic Lubricants and Conditions

### Temperatures Below -9°C (15°F)

Regions with ambient temperatures below -9°C (15°F) are considered arctic. In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results in these temperatures. However, certain fluids, such as halogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, may not be compatible with hydraulic system seals and wear bands. Therefore, always check with an authorized Grove distributor or Manitowoc Crane Care if in doubt of the suitability of a specific fluid or lubricant.

When operating in cold weather and regardless of the oil viscosity of the crane's lubricants, always follow the cold weather start-up and operating procedures described in the *Operator Manual* to ensure adequate lubrication during system warm-up and proper operation of all crane functions.

### Cold Weather Package and Lubricants

Grove recommends cold weather lubricants for use with ambient temperatures down to -29°C (-20°F) (TABLE 5-2:). The following lube intervals are to be used as a guideline only. Actual lube intervals should be formulated by the operator to correspond according to conditions such as continuous duty cycles and/or hazardous environments.

#### Notes Listed in the Following Tables

1. All points requiring periodic lubrication shall be lubricated as required at assembly.
2. Final fluid levels shall be adjusted to indicating arrows, dipstick markings, or to filler plugs.
  - a. **Caution:** axle fluid levels shall be adjusted to "bottom of fill plug threads". Check with crane on level ground, at normal ride height, cold or room temperature oil only!
3. Change filter when changing gear oil.
4. Capacities indicated are for a fully formulated mixture of 50% AFC and 50% water.
5. Brush lubricant on top and bottom of outrigger beams contact area.
6. The hydraulic oil shall meet or exceed ISO 4406 class 17/14 cleanliness level (ref J-SAE J1165).
7. Brush lubrication on the I.D. of the center front stabilizer cylinder support tube and wear bands before installing jack cylinder.
8. Use grease fittings provided.
9. Fill radiator to bottom of filler neck per Engineering Specification 80029046. Run engine through (2) thermal cycles. check level and refill as required.

10. Fill through dipstick opening.
11. Check fluid level using sight gauge on the side of the tank with boom retracted and in boom rest and all outrigger cylinders retracted.
12. Engine shall be running during lubrication to ensure equal distribution of grease.
13. Clean magnetic drain plug when changing lubricant.
14. Service by whichever interval occurs first.
15. Air conditioner - refer to applicable air conditioner manual.
16. See operator's manual when ambient temperatures are expected between +4°C (+40°F) and -62°C (-80°F).
17. Generously coat the wheel pilot or hub pads with lubricant. Do not lubricate the face of the wheel or the hub.
18. Apply lubricant during assembly and reapply lubricant whenever wheels are removed for service.
19. Clean coolant strainer after first 100 hours of use and at 2000 hrs/1 yr intervals thereafter.
20. Replace air cleaner element when indicator shows red (25" H<sub>2</sub>O).
21. Change filter at first 200 hours. thereafter, at normal intervals. Drain with oil temperature at 65°C - 95°C (150°F - 200°F).
22. Change filter when changing gear oil.
23. Drain water trap every ten hours or daily.
24. QSM T3 engine can also use CJ-4 oil when fueled with ultra low sulfur diesel (less than 15ppm).
25. Only use on X12 engine machines.
26. When using CJ-4 engine oil, service hours must be reduced as follows:
  - a. 500 (0-55 ppm sulfur fuel)
  - b. 400 (500-5000 ppm sulfur fuel)
  - c. 250 (>5000 ppm sulfur fuel. Not recommended.)
27. Extend boom for access.
28. Lubricate more frequently than interval indicated in table if environmental conditions and/or operating conditions necessitate.
29. Access through hole in base section.
30. Access through hole in tele 1 section.
31. Access through hole in tele 2 section.
32. Access through hole in tele 3 section.
33. Access through hole in tele 4 section.

34. **CAUTION:** DEF is corrosive to certain metals and paint and should be washed off with mild soap and water if spilled.

35. Fill turntable gearbox until oil level is at middle to top of sight gauge.

36. Fill turntable gear brake until oil level is at top of sight gauge.

37. Fill grease container until grease level is at the "max" mark.

38. Brush lubricant on top and bottom wear pads of outrigger beams.

39. Replace the hydraulic filter element when the restriction indicator gauge on the filter head is in the red with the oil at a minimum of 100°F. When replacing the filter, also replace the breather.

40. Access through hole in the boom nose with the boom fully retracted.

The following describes the lubrication points and gives the lube type, lube interval, lube amount and application of each. Each lubrication point is numbered, and this number corresponds to the index number shown in the following figures.

For  
Reference  
Only

## Drivetrain Lubrication

| ITEM NUMBER       | LOCATION NAME                             | APPROXIMATE CAPACITY | LUBE SPEC  | NOTES    | SERVICE POINTS | SERVICE       | SERVICE HOURS                                                       |
|-------------------|-------------------------------------------|----------------------|------------|----------|----------------|---------------|---------------------------------------------------------------------|
| <b>DRIVETRAIN</b> |                                           |                      |            |          |                |               |                                                                     |
| 1                 | ENGINE CRANKCASE X12                      | -----                | 6829104182 | 2, 14    | 1              | CHECK & FILL  | 10 HRS/DAILY                                                        |
|                   | WITH FILTER                               | 47.3 L (12.5 GAL)    | 6829104182 | 2        | 1              | DRAIN & FILL  | 750 HRS                                                             |
| 2a                | ENGINE COOLING SYSTEM                     | -----                | 6829101130 | 4, 9, 14 | 1              | CHECK & FILL  | 10 HRS/DAILY                                                        |
|                   | ENGINE COOLING SYSTEM - X12               | 70.0 L (18.5 GAL)    | 6829101130 |          | 1              | DRAIN & FILL  | SEE SERVICE MANUAL                                                  |
| 2b                | ENGINE COOLING SYSTEM - X12               | AS REQUIRED          | 6829012858 |          | 1              | TEST AND ADD  | 750 HRS                                                             |
| 2c                | COOLANT STRAINER                          | -----                | -----      | 14, 19   | 1              | CHANGE FILTER | 2000 HRS/ 1 YR                                                      |
| 3a                | TRANSMISSION - MANUAL                     | -----                | 80078954   | 2, 14    | 1              | CHECK & FILL  | 500 HRS/6 MONTHS/ 9000 MI                                           |
|                   |                                           | 16.1 L (17.0 QT)     | 80078954   | 2, 14    | 1              | DRAIN & FILL  | 2 YRS/50000 MI                                                      |
| 3b                | TRANSMISSION - AUTOMATED MANUAL           | -----                | 80078954   | 2, 14    | 1              | CHECK & FILL  | 500 HRS/6 MONTHS/ 9000 MI                                           |
|                   |                                           | 16.1 L (17.0 QT)     | 80078954   | 2, 14    | 1              | DRAIN & FILL  | 2 YRS/50000 MI                                                      |
| 3c                | TRANSMISSION FILTER                       | -----                | -----      | 2, 21    | 1              | CHANGE FILTER | 3000 HRS                                                            |
| 4a                | PUMP DRIVE SHAFT U-JOINTS                 | -----                | 6829003477 | 8        | 2              | LUBE          | 250 HRS                                                             |
| 4b                | PUMP DRIVE SHAFT SPLINE                   | -----                | 6829003477 | 8        | 1              | LUBE          | 500 HRS                                                             |
| 5                 | CLUTCH RELEASE BEARING                    | -----                | 6829003477 | 8, 12    | 1              | LUBE          | 250 HRS<br>See "Clutch Release Bearing Grease Interval" on page 12. |
| 6                 | CLUTCH LINKAGE (MANUAL TRANSMISSION ONLY) | -----                | 6829003477 | 8        | 3              | LUBE          | 500 HRS                                                             |



| ITEM NUMBER | LOCATION NAME                                      | APPROXIMATE CAPACITY | LUBE SPEC  | NOTES | SERVICE POINTS | SERVICE          | SERVICE HOURS     |
|-------------|----------------------------------------------------|----------------------|------------|-------|----------------|------------------|-------------------|
| 7           | TRANSMISSION<br>SHIFT<br>U-JOINTS/<br>CONTROL UNIT | -----                | 6829003477 | 8     | 3              | LUBE             | 500 HRS           |
| 26          | AIR CLEANER<br>FILTER                              | -----                | -----      | 20    | 1              | CHANGE<br>FILTER | SEE NOTE 20       |
| 27          | FUEL FILTER -<br>PRIMARY                           | -----                | -----      | 23    | 1              | CHANGE<br>FILTER | 1000 HRS/6 MONTHS |
| 8           | DRIVELINE SLIP                                     | -----                | 6829003477 | 8, 14 | 2              | LUBE             | 500HRS/10000 MI   |

For  
Reference  
Only

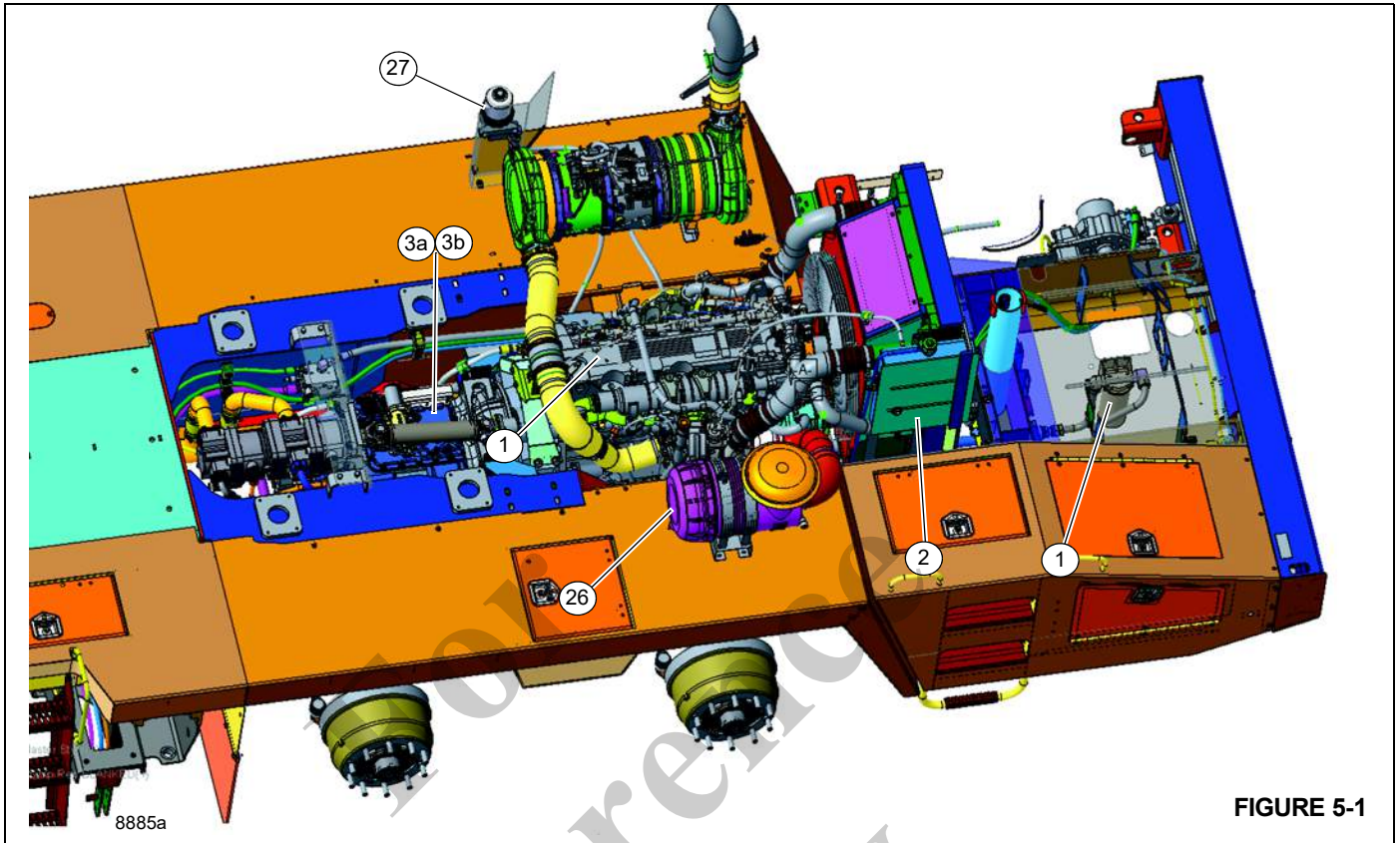


FIGURE 5-1

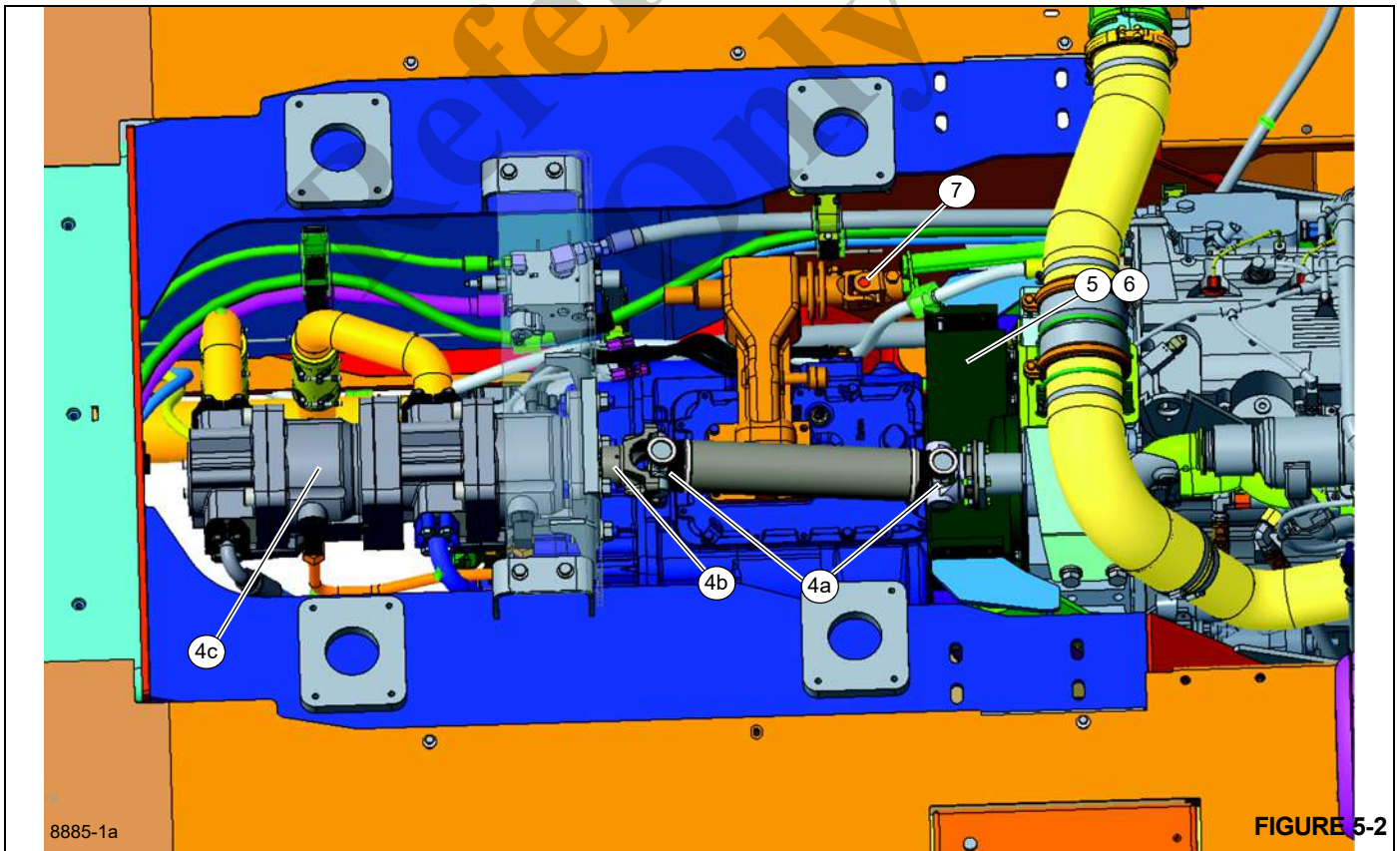


FIGURE 5-2

### Clutch Release Bearing Grease Interval

The transmission has an optional prognostic feature that notifies the operator when the clutch release bearing needs greasing. At the appropriate grease interval and after each engine start, "GI" will momentarily appear in the gear display, along with an audible tone. This will continue to occur at each engine start until clutch service has been completed.

**NOTE:** "GI" stands for GREASE INTERVAL and may be mis-read as "G1" on the gear display.

The operator can choose to follow this automated lube schedule or lubricate every 250 hours (See Item 5, page 5-9). It is important to reset the grease interval count every time the release bearing is greased.

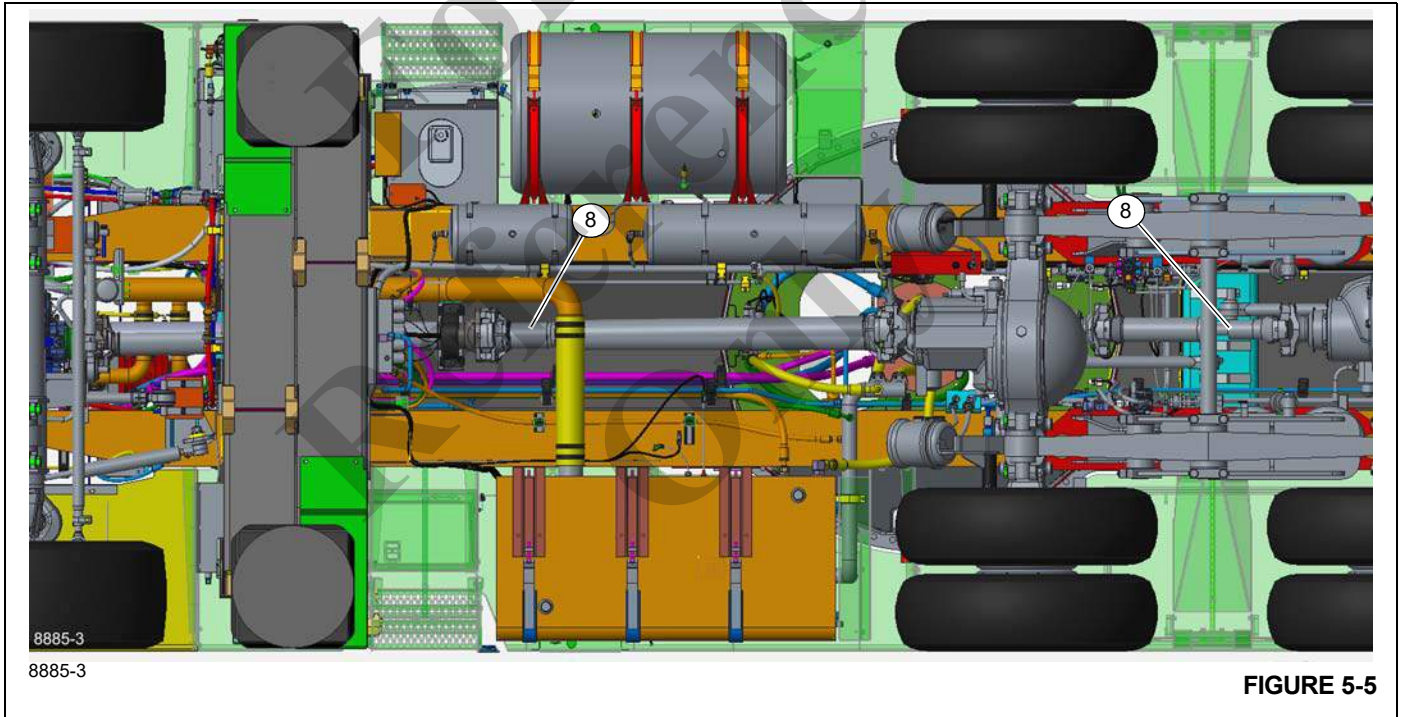
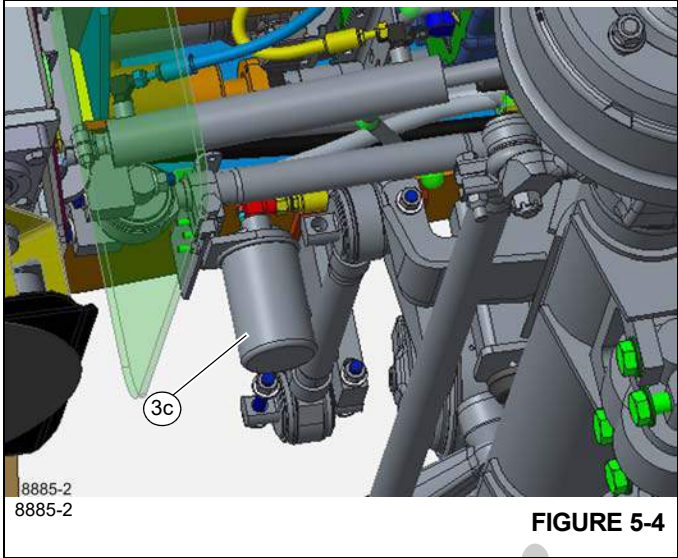
### Clutch Release Grease Interval Reset

1. From the **OFF** position, turn ignition **ON** without cranking engine.
2. Move the transmission shift lever to **LOW**. Do not apply the brake pedal.
3. Press the manual up-shift button (1) until the gear display shows "**3**" (2), (Figure 5-3).
4. Press Accelerator to the floor. Gear display will show a "**Down**" arrow.
5. Release the Accelerator. Gear display will a "**0**".
6. Select **NEUTRAL**.
7. Turn ignition to **OFF** in order to save the reset.



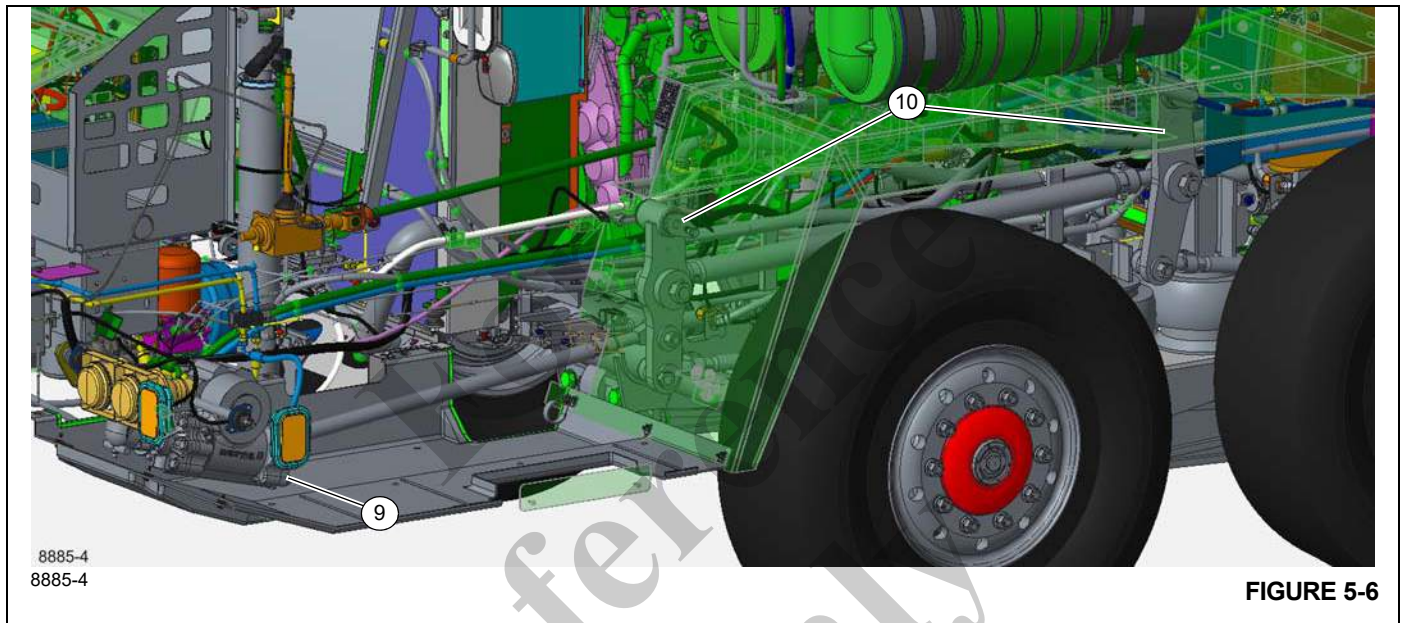
FIGURE 5-3





Steering Lubrication

| ITEM NUMBER | LOCATION NAME          | APPROX. CAPACITY | LUBE SPEC  | NOTES | SERVICE POINTS | SERVICE | SERVICE HOURS |
|-------------|------------------------|------------------|------------|-------|----------------|---------|---------------|
| STEERING    |                        |                  |            |       |                |         |               |
| 9           | POWER STEERING GEARBOX | -----            | 6829003477 | 8     | 1              | LUBE    | 1000 HRS      |
| 10          | STEERING RELAY ARMS    | -----            | 6829003477 | 8     | 2              | LUBE    | 250 HRS       |



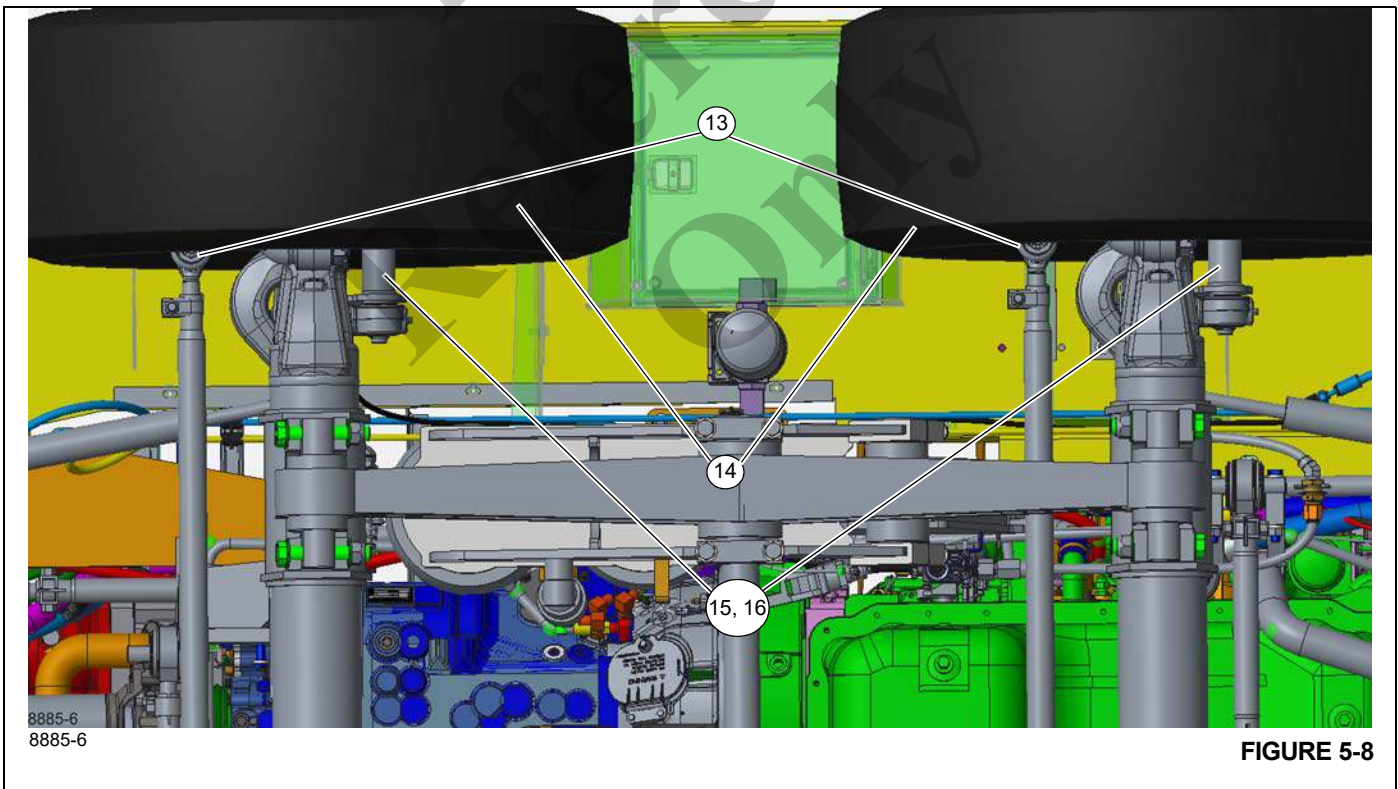
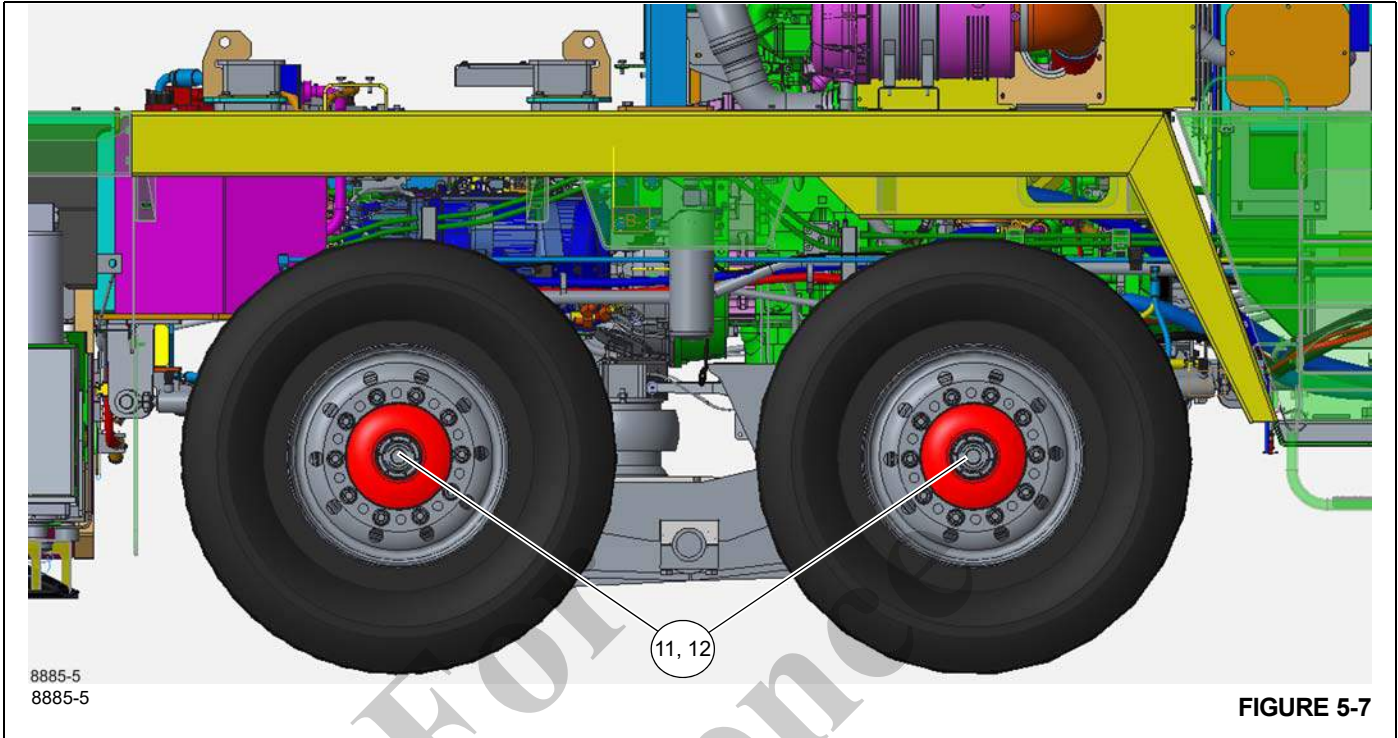
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## Axle Lubrication

| ITEM NUMBER | LOCATION NAME                    | APPROX. CAPACITY  | LUBE SPEC  | NOTES | SERVICE POINTS | SERVICE      | SERVICE HOURS |
|-------------|----------------------------------|-------------------|------------|-------|----------------|--------------|---------------|
| FRONT AXLES |                                  |                   |            |       |                |              |               |
| 11          | FRONT WHEEL PILOTS               | -----             | 6829003689 | 17    | 4              | BRUSH ON     | SEE NOTE 18   |
| 12          | FRONT AXLE HUBS                  | .47 L (1 PT) EACH | 6829012964 | 2     | 4              | CHECK & FILL | 250 HRS       |
| 13          | FRONT AXLE TIE ROD ENDS          | -----             | 6829003477 | 8     | 4              | LUBE         | 1000 HRS      |
| 14          | FRONT AXLE KING PINS             | -----             | 6829003477 | 8     | 8              | LUBE         | 1000 HRS      |
| 15          | FRONT AXLE BRAKE SLACK ADJUSTERS | -----             | 6829003477 | 8     | 4              | LUBE         | 1000 HRS      |
| 16          | FRONT AXLE BRAKE CAMSHAFTS       | -----             | 6829003477 | 8     | 4              | LUBE         | 1000 HRS      |

For Reference Only

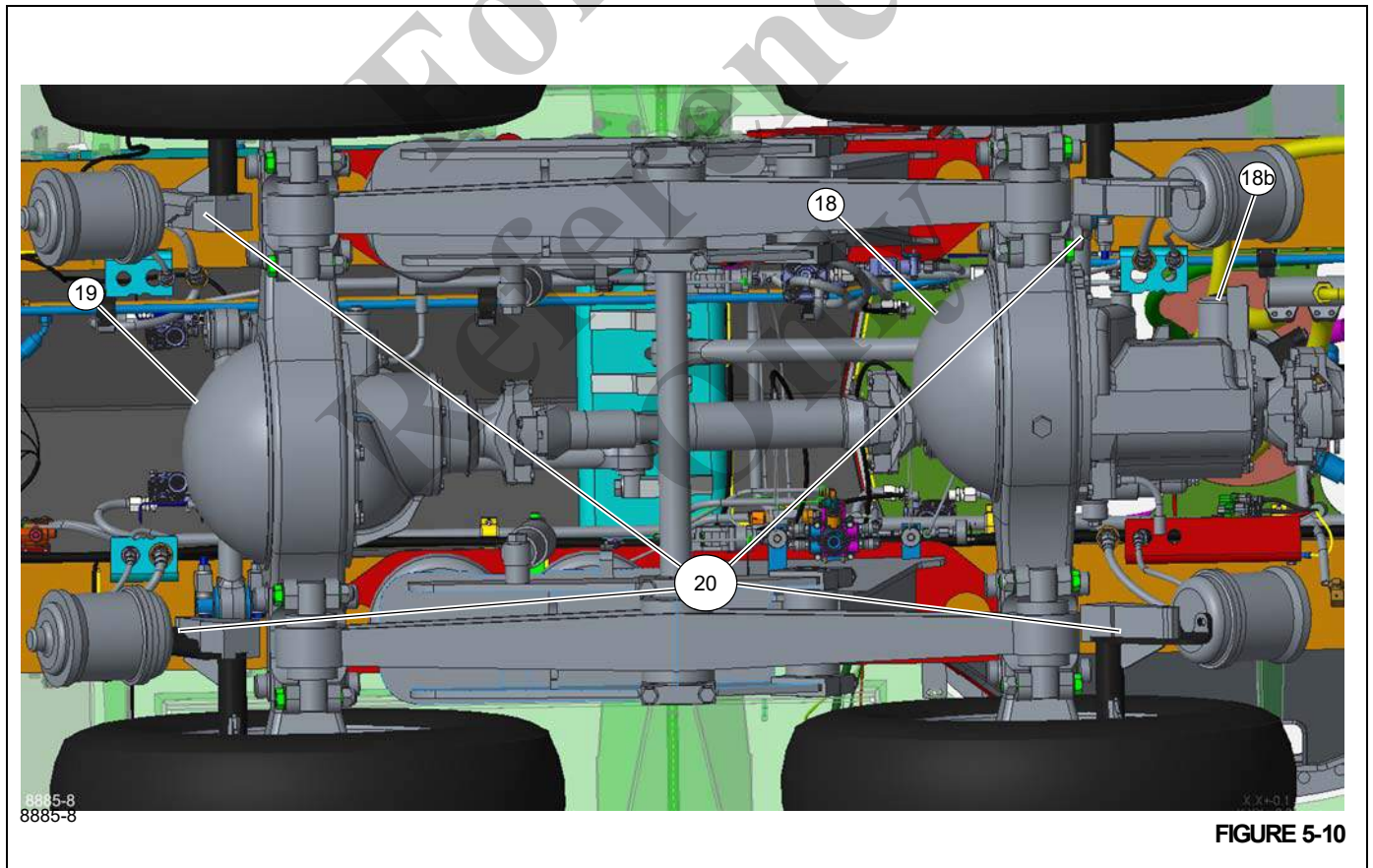
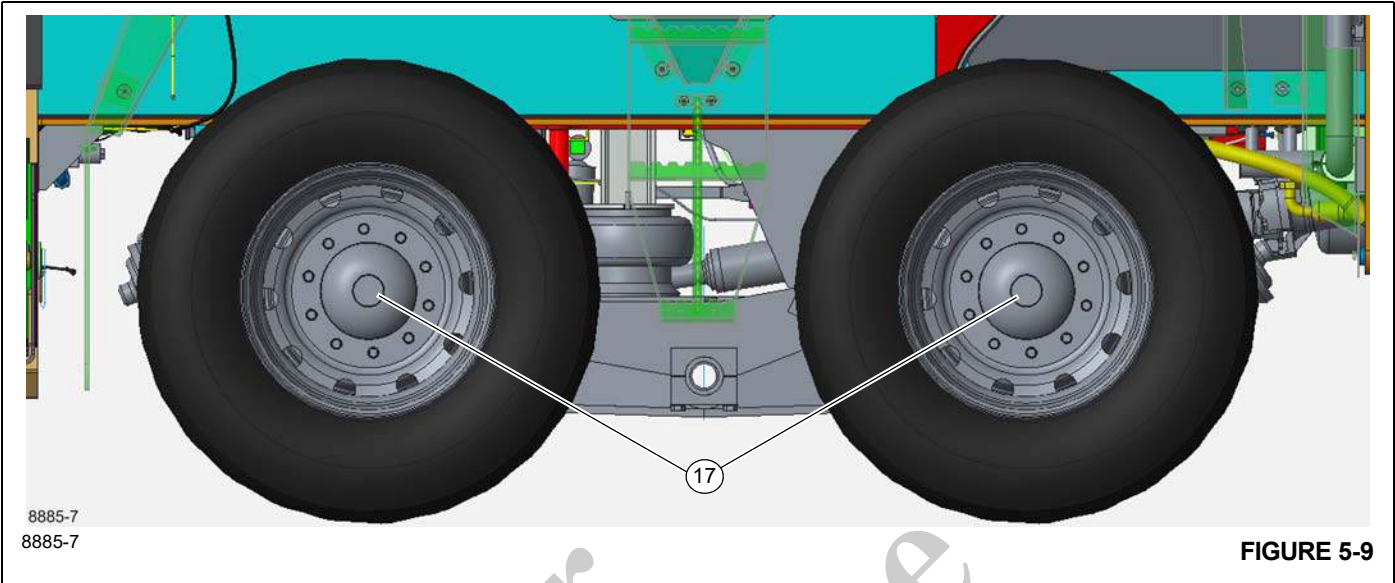






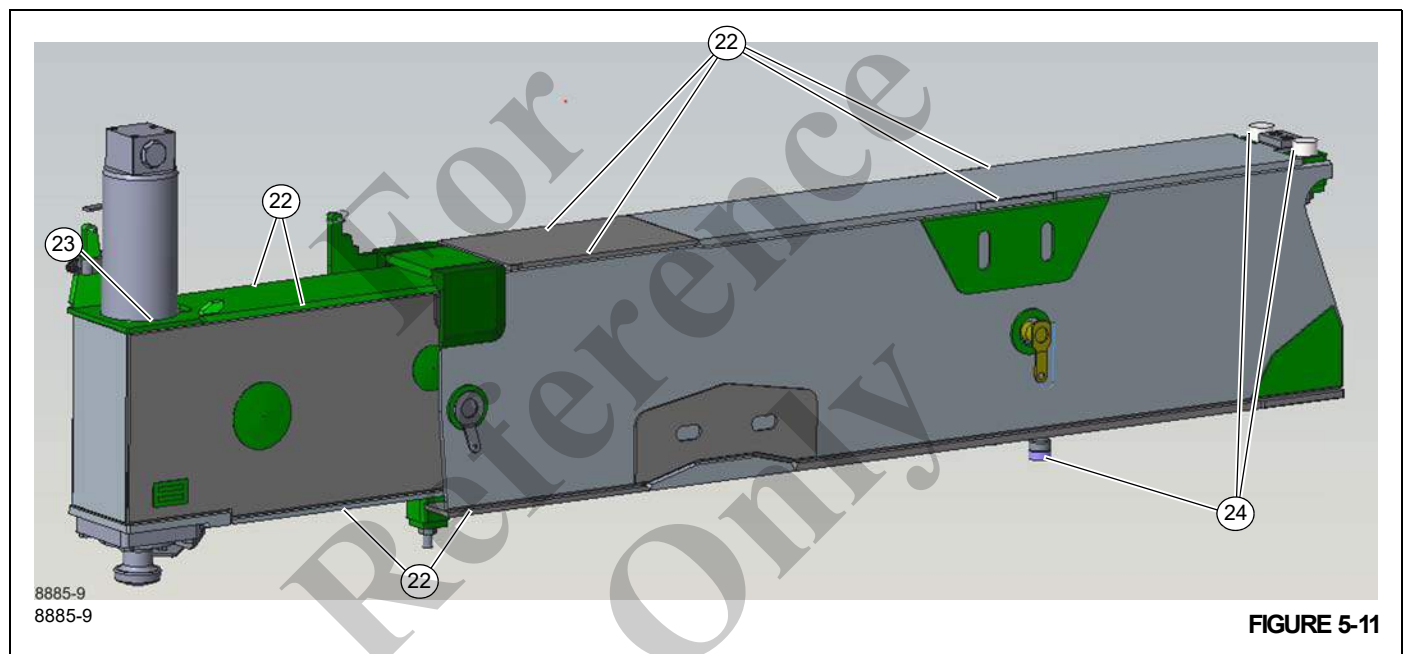
| ITEM NUMBER       | LOCATION NAME                   | APPROX. CAPACITY | LUBE SPEC  | NOTES        | SERVICE POINTS | SERVICE       | SERVICE HOURS  |
|-------------------|---------------------------------|------------------|------------|--------------|----------------|---------------|----------------|
| <b>REAR AXLES</b> |                                 |                  |            |              |                |               |                |
| 17                | REAR WHEEL PILOTS               | -----            | 6829003689 | 17           | 8              | BRUSH ON      | SEE NOTE 18    |
| 18                | FRONT REAR AXLE BOWL            | -----            | 6829012964 | 2            | 1              | CHECK & FILL  | 250 HRS        |
|                   |                                 | 20.5 QTS         | 6829012964 | 2, 3, 13, 14 | 1              | DRAIN & FILL  | 2 YRS/50000 MI |
| 18b               | DIFFERENTIAL FILTER             | -----            | -----      | 22           | 1              | CHANGE FILTER | 2 YRS/50000 MI |
| 19                | REAR REAR AXLE BOWL             | -----            | 6829012964 | 2            | 1              | CHECK & FILL  | 250 HRS        |
|                   |                                 | 19.5 QTS         | 6829012964 | 2, 13, 14    | 1              | DRAIN & FILL  | 2YRS/50000 MI  |
| 20                | REAR AXLE BRAKE SLACK ADJUSTERS | -----            | 6829003477 | 8            | 4              | LUBE          | 1000 HRS       |

For Reference Only



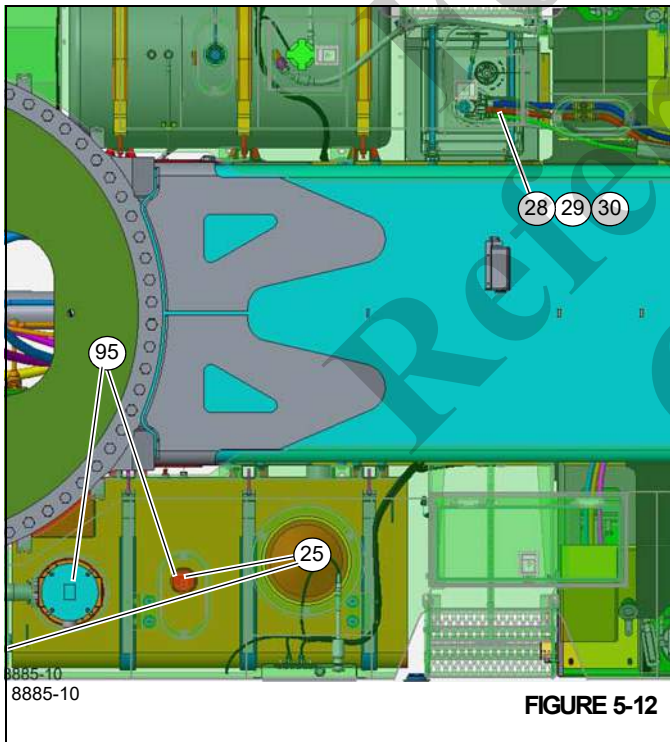
Outrigger Lubrication

| ITEM NUMBER | LOCATION NAME                                              | APPROX. CAPACITY | LUBE SPEC  | NOTES  | SERVICE POINTS | SERVICE  | SERVICE HOURS |
|-------------|------------------------------------------------------------|------------------|------------|--------|----------------|----------|---------------|
| OUTRIGGERS  |                                                            |                  |            |        |                |          |               |
| 22          | O/R BEAMS                                                  | -----            | 6829015304 | 5, 14  | 8              | BRUSH ON | 50/1 WEEK     |
| 23          | CENTER FRONT STABILIZER CYLINDER SUPPORT TUBE  (Not Shown) | -----            | 6829015304 | 7      | 5              | BRUSH ON | SEE NOTE 7    |
| 24          | WEAR PADS                                                  | -----            | 6829015304 | 38, 14 | 24             | BRUSH ON | 50/1 WEEK     |



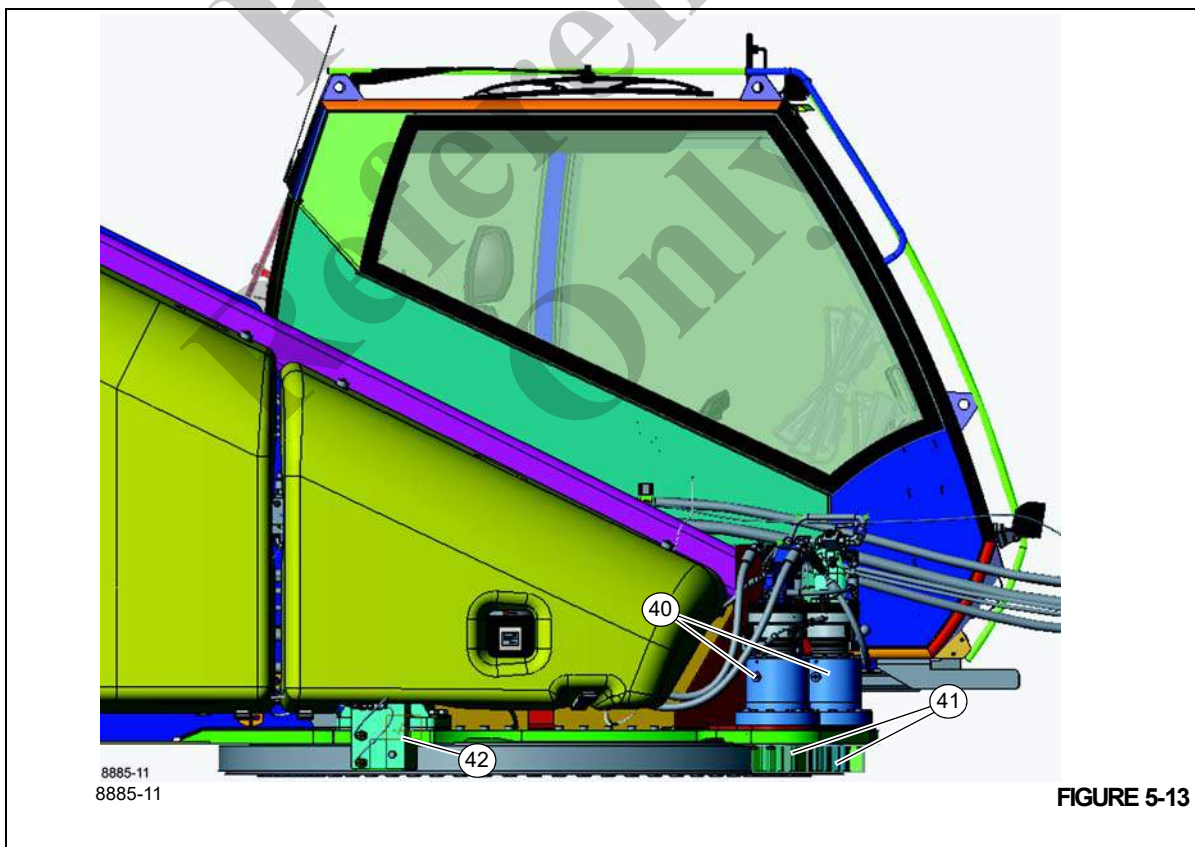
Miscellaneous Lubrication

| ITEM NUMBER   | LOCATION NAME               | APPROX. CAPACITY            | LUBE SPEC  | NOTES     | SERVICE POINTS | SERVICE                  | SERVICE HOURS          |
|---------------|-----------------------------|-----------------------------|------------|-----------|----------------|--------------------------|------------------------|
| MISCELLANEOUS |                             |                             |            |           |                |                          |                        |
| 25            | HYDRAULIC RESERVOIR         | 507 L (134 GAL) (TANK ONLY) | 6829006444 | 6, 11, 14 | 1              | CHECK & FILL             | 10 HRS/DAILY           |
| 95            | HYDRAULIC FILTER & BREATHER | -----                       | -----      | 39        | 1              | CHANGE FILTER & BREATHER | SEE NOTE 39            |
| 28            | DEF SUPPLY MODULE FILTER    | -----                       | -----      | -----     | 1              | CHANGE FILTER            | 4500 HRS/<br>200000 MI |
| 29            | DIESEL EXHAUST FLUID TANK   | 37.9 L (10 GAL) (TANK ONLY) | 80019225   | 34        | 1              | CHECK & FILL             | -----                  |
| 30            | DEF TANK FILTER             | -----                       | -----      | -----     | 1              | CHECK FILTER             | 1 YEAR                 |

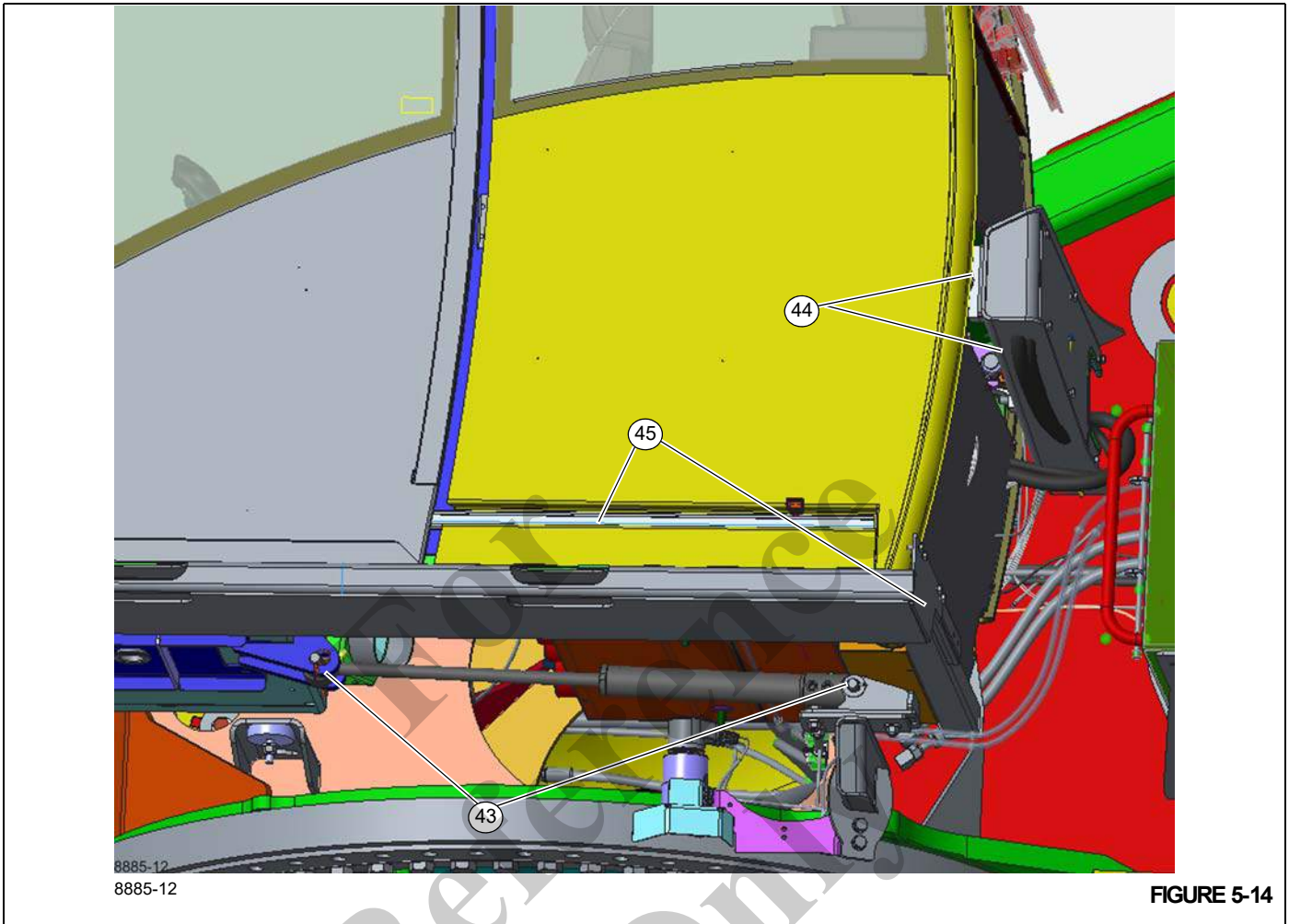


**Turntable & Cab Tilt Lubrication**

| ITEM NUMBER                     | LOCATION NAME                 | APPROX. CAPACITY | LUBE SPEC  | NOTES  | SERVICE POINTS | SERVICE      | SERVICE HOURS      |
|---------------------------------|-------------------------------|------------------|------------|--------|----------------|--------------|--------------------|
| <b>TURNTABLE &amp; CAB TILT</b> |                               |                  |            |        |                |              |                    |
| 40                              | TURNTABLE GEAR BOX            | 0.9 L (.95 QT)   | 6829014058 | 35     | 2              | CHECK & FILL | 50 HRS/1 WEEK      |
|                                 |                               | 0.9 L (.95 QT)   | 6829014058 | 14, 35 | 2              | DRAIN & FILL | 1000 HRS/12 MONTHS |
| 41                              | TURNTABLE GEAR & DRIVE PINION | -----            | 6829102971 | 1, 14  | 2              | SPRAY ON     | 500 HRS/6 MONTHS   |
| 42                              | TURNTABLE 360° SWIVEL LOCK    | -----            | 6829003477 | 1, 14  | 1              | LUBE         | 500 HRS/6 MONTHS   |
| 43                              | TILT CYLINDER PIVOT PINS      | -----            | 6829003477 | 1, 14  | 2              | LUBE         | 500 HRS/3 MONTHS   |
| 44                              | PILLOW BEARING                | -----            | 6829003477 | 1, 14  | 2              | LUBE         | 500 HRS/3 MONTHS   |
| 45                              | CAB TRACK & ROLLERS           | -----            | LIGHT OIL  |        |                |              |                    |

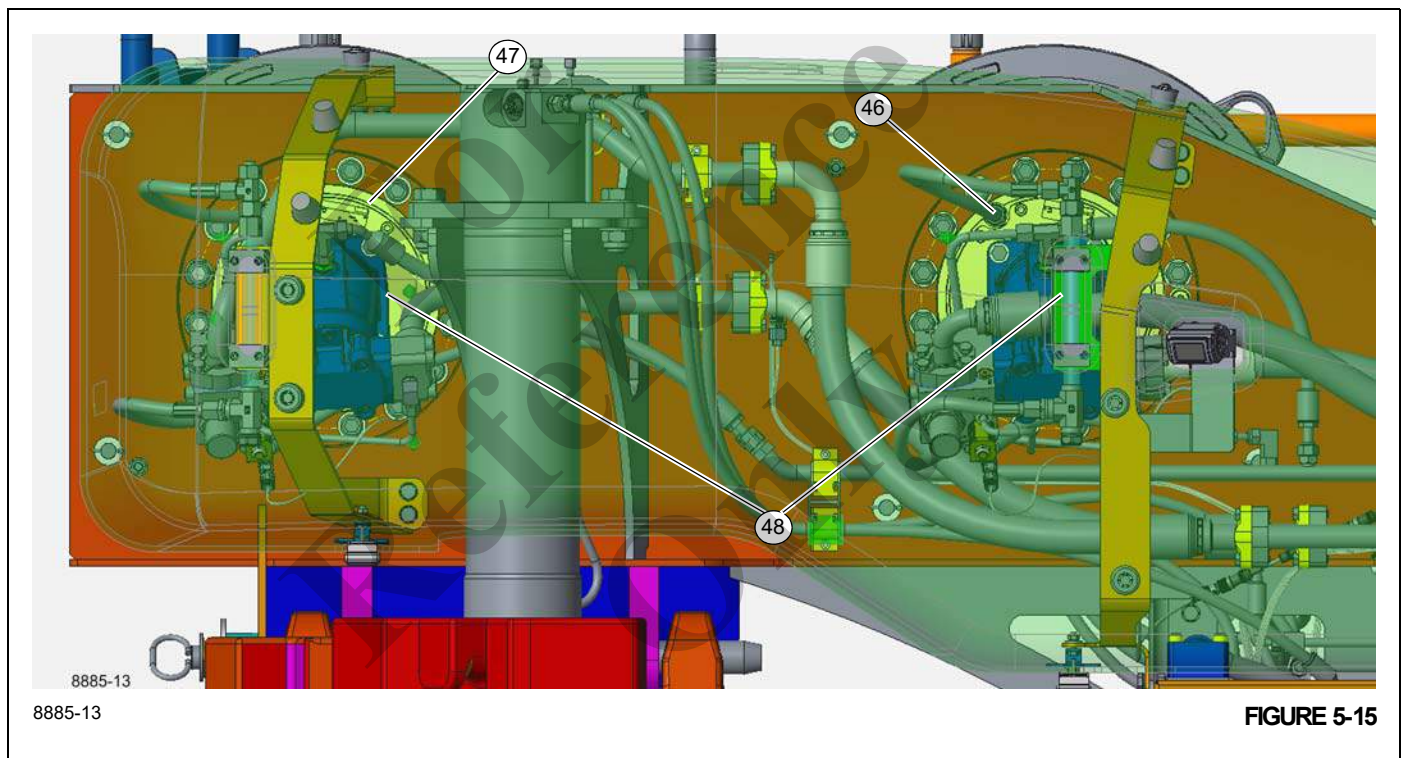






Hoist Lubrication

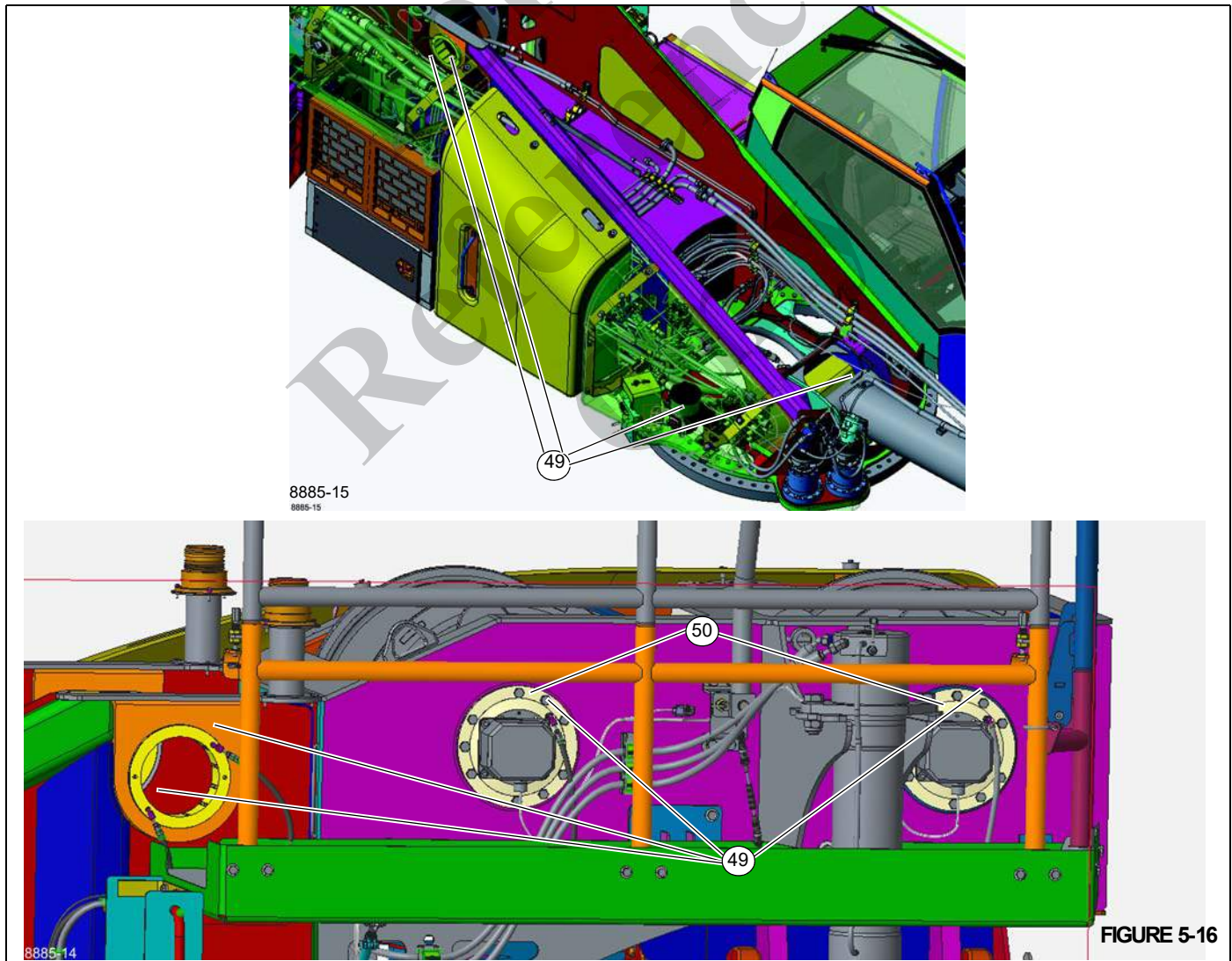
| ITEM NUMBER  | LOCATION NAME             | APPROX. CAPACITY | LUBE SPEC  | NOTES | SERVICE POINTS | SERVICE      | SERVICE HOURS      |
|--------------|---------------------------|------------------|------------|-------|----------------|--------------|--------------------|
| <b>HOIST</b> |                           |                  |            |       |                |              |                    |
| 46           | MAIN HOIST - TRANSMISSION | -----            | 6829014058 | 2, 14 | 1              | CHECK & FILL | 50 HRS / WEEKLY    |
|              |                           | 4.0 L (1 GAL)    | 6829014058 | 2, 14 | 1              | DRAIN & FILL | 1000 HRS/12 MONTHS |
| 47           | AUX HOIST- - TRANSMISSION | -----            | 6829014058 | 2, 14 | 1              | CHECK & FILL | 50 HRS / WEEKLY    |
|              |                           | 4.0 L (1 GAL)    | 6829014058 | 2, 14 | 1              | DRAIN & FILL | 1000 HRS/12 MONTHS |
| 48           | HOIST BRAKE (MAIN & AUX)  | -----            | 01930670   | 2, 14 | 1              | CHECK & FILL | 1000 HRS/12 MONTHS |





Turntable Central Lubrication

| ITEM NUMBER  | LOCATION NAME                         | APPROX. CAPACITY | LUBE SPEC  | NOTES | SERVICE POINTS | SERVICE     | SERVICE HOURS     |
|--------------|---------------------------------------|------------------|------------|-------|----------------|-------------|-------------------|
| <b>HOIST</b> |                                       |                  |            |       |                |             |                   |
| 49           | TURNTABLE (SLEW) BEARING - INNER RACE | -----            | 6829003477 | 37    | 4              | LUBE (AUTO) | 50 HRS/1 WEEK     |
|              | LIFT CYLINDER PINS                    | -----            | 6829003477 | 37    | 1              | LUBE (AUTO) | 50 HRS/1 WEEK     |
|              | BOOM PIVOT PIN                        | -----            | 6829003477 | 37    | 4              | LUBE (AUTO) | 50 HRS/1 WEEK     |
|              | MAIN HOIST - GEARS                    | -----            | 6829003477 | 37    | 1              | LUBE (AUTO) | 50 HRS/1 WEEK     |
|              | AUX HOIST - GEARS                     | -----            | 6829003477 | 37    | 1              | LUBE (AUTO) | 50 HRS/1 WEEK     |
| 50           | HOIST LOWER LIMIT SWITCH              | -----            | 01373458   |       | 2              | LUBE        | 250 HRS/ 3 MONTHS |



**Boom Lubrication**

**Crane Setup**

- Machine to be set up on firm level surface with fully extended outriggers and a minimum of 6000 lbs counterweight installed. Make sure that the crane is level.
- Boom must be directly over the rear.

- Set boom angle at zero degrees (horizontal).
- Disable the swing function to engage the swing brakes, and engage the 360-swing lock, if applicable.
- To grease each of the rear upper wear pads (Items 71-75), extend the boom to the Tele sequence in the Table below to expose the grease fittings.

| LUBRICATION OF TELE SECTION | TO GREASE TELE 5 | TO GREASE TELE 4 | TO GREASE TELE 3 | TO GREASE TELE 2 | TO GREASE TELE 1 |
|-----------------------------|------------------|------------------|------------------|------------------|------------------|
| TELE 1                      | 0                | 0                | 0                | 50               | 100              |
| TELE 2                      | 0                | 0                | 50               | 100              | 0                |
| TELE 3                      | 0                | 50               | 100              | 0                | 0                |
| TELE 4                      | 50               | 100              | 0                | 0                | 0                |
| TELE 5                      | 100              | 0                | 0                | 0                | 0                |

**Greaseless Boom**

The operator should ensure that each of the telescoping boom sections are clean during operation. Any dirt that is on the painted boom sections can get stuck in the wear pads, and this will lead to scoring of the paint. Eventually, the telescoping of a section with damaged paint will become more difficult to complete as the paint damage becomes more severe. Each of the telescoping boom sections should

be cleaned and wiped down with a non-solvent cleaning agent at least once a month or as required.

The operator has the option to grease the boom if they so choose. All of the grease fittings still exist in the boom. However, from that point forward, the boom will always need to be greased on a typical interval.

| ITEM NUMBER | LOCATION NAME              | APPROX. CAPACITY | LUBE SPEC | NOTES                 | SERVICE POINTS | SERVICE  | SERVICE HOURS    |
|-------------|----------------------------|------------------|-----------|-----------------------|----------------|----------|------------------|
| <b>BOOM</b> |                            |                  |           |                       |                |          |                  |
| 70          | TELESCOPIC SLIDE FACES     | -----            | 01373458  | 1, 14, 27, 28         | 5              | BRUSH ON | 500 HRS/6 MONTHS |
| 71          | TELE 1 REAR UPPER WEAR PAD | -----            | 01373458  | 1, 14, 27, 28, 29, 34 | 2              | LUBE     | 500 HRS/6 MONTHS |
| 72          | TELE 2 REAR UPPER WEAR PAD |                  | 01373458  | 1, 14, 27, 28, 30, 34 | 2              | LUBE     | 500 HRS/6 MONTHS |
| 73          | TELE 3 REAR UPPER WEAR PAD |                  | 01373458  | 1, 14, 27, 28, 31, 34 | 2              | LUBE     | 500 HRS/6 MONTHS |
| 74          | TELE 4 REAR UPPER WEAR PAD |                  | 01373458  | 1, 14, 27, 28, 32, 34 | 2              | LUBE     | 500 HRS/6 MONTHS |
| 75          | TELE 5 REAR UPPER WEAR PAD |                  | 01373458  | 1, 14, 27, 28, 33, 34 | 2              | LUBE     | 500 HRS/6 MONTHS |
| 76          | TELE 5 LOCK PIN            | -----            | 03313195  | 1, 14, 28, 34         | 2              | LUBE     | 250 HRS/3 MONTHS |
| 77          | TELE 4 LOCK PIN            | -----            | 03313195  | 1, 14, 28, 34         | 2              | LUBE     | 250 HRS/3 MONTHS |
| 78          | TELE 3 LOCK PIN            | -----            | 03313195  | 1, 14, 28, 34         | 2              | LUBE     | 250 HRS/3 MONTHS |
| 79          | TELE 2 LOCK PIN            | -----            | 03313195  | 1, 14, 28, 34         | 2              | LUBE     | 250 HRS/3 MONTHS |

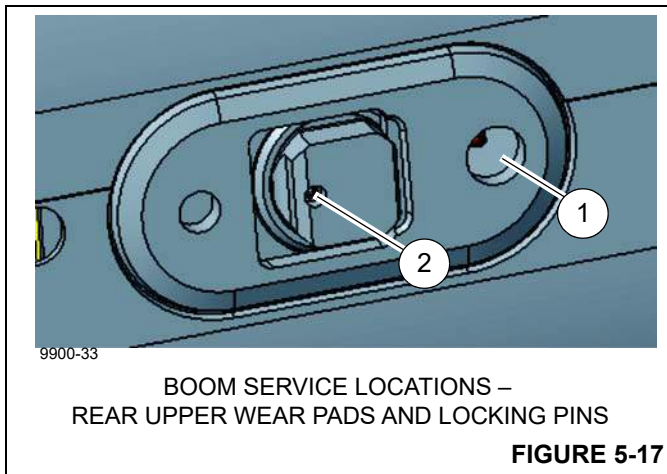
| ITEM NUMBER | LOCATION NAME                                   | APPROX. CAPACITY | LUBE SPEC  | NOTES              | SERVICE POINTS | SERVICE  | SERVICE HOURS    |
|-------------|-------------------------------------------------|------------------|------------|--------------------|----------------|----------|------------------|
| <b>BOOM</b> |                                                 |                  |            |                    |                |          |                  |
| 80          | TELE 1 LOCK PIN                                 | -----            | 03313195   | 1, 14, 28, 34      | 2              | LUBE     | 250 HRS/3 MONTHS |
| 81          | TELE-CYLINDER SLED                              | -----            | 01373458   | 14, 27, 28, 34, 40 | 1              | BRUSH ON | 500 HRS/6 MONTHS |
| 82          | DERRICKINGCYL PIVOT PIN                         | -----            | 6829003477 | 1, 8, 14           | 2              | LUBE     | 100 HRS/MONTHLY  |
| 83          | ADAPTER SECTION PIVOT PIN                       | -----            | 6829003477 | 1, 8, 14           | 2              | LUBE     | 100 HRS/MONTHLY  |
| 84          | BOOM EXTENSION SHEAVE                           | -----            | 6829003477 | 1                  | 2              | LUBE     | DURING REPAIR    |
| 85          | MAST SHEAVE                                     | -----            | 6829003477 | 1                  | 2              | LUBE     | DURING REPAIR    |
| 86          | BOOM NOSE SHEAVES                               | -----            | 6829003477 | 1                  | 7              | LUBE     | DURING REPAIR    |
| 87          | AUX BOOM NOSE SHEAVE                            | -----            | 6829003477 | 1                  | 1              | LUBE     | DURING REPAIR    |
| 88          | HEAVY BOOM EXTENSION SHEAVES                    | -----            | 6829003477 | 1                  | 2              | LUBE     | DURING REPAIR    |
| 89          | BOOM EXTENSION SCREW                            | -----            | 6829003477 | 1, 14, 28          | 1              | BRUSH ON | 250 HRS/3 MONTHS |
| 90          | HOOK BLOCK - 102 TON (6 SHEAVES) SWIVEL BEARING | -----            | 6829003477 | 8, 14              | 3              | LUBE     | 250 HRS/3 MONTHS |
| 91          | HOOK BLOCK - 66 TON (5 SHEAVE) SWIVEL BEARING   | -----            | 6829003477 | 8, 14              | 3              | LUBE     | 250 HRS/3 MONTHS |
| 92          | HOOK BLOCK - 50 TON (3 SHEAVE) SWIVEL BEARING   | -----            | 6829003477 | 8, 14              | 3              | LUBE     | 250 HRS/3 MONTHS |
| 93          | HOOK BLOCK - 29 TON (1 SHEAVE) SWIVEL BEARING   | -----            | 6829003477 | 8, 14              | 3              | LUBE     | 250 HRS/3 MONTHS |
| 94          | OVERHAUL BALL - SWIVEL                          | -----            | 6829003477 | 8, 14              | 1              | LUBE     | 250 HRS/3 MONTHS |

### Telescope Section 5 (Tele 5)

1. Make sure that the Tele cylinder is locked to Tele 5.
2. Extend and lock Tele 5 to the 100% pinning location.
3. Extend and lock Tele 4 to the 50% pinning location.
4. Lower the boom to 0° and perform the following greasing in this position:

- a. Grease outer sides of Tele 5 in the areas that touch the front wear pads of Tele 4.
- b. Grease the rear upper wear pads of Tele 5 on both sides, at the grease fittings (1), (Figure 5-17), through the openings in Tele 4.
- c. Grease locking pins on both sides (2), (Figure 5-17).

**NOTE:** To grease the rear upper wear pads of Tele 5 at the 50% or 92% pinning locations, extend and lock Tele 5 to these pinning locations and repeat **Step 4b** greasing.



5. While in the horizontal position, first retract Tele 4, and then retract and extend Tele 5 several times to make sure that grease is properly distributed.
6. When Tele 5 greasing is complete, retract and lock Tele 5 to the 0% pinning location.
7. Raise boom to 70°.

#### Telescope Section 4 (Tele 4)

1. Make sure that the Tele cylinder is locked to Tele 4.
2. Extend and lock Tele 4 to the 100% pinning location.
3. Extend and lock Tele 3 to the 50% pinning location.
4. Lower the boom to 0° and perform the following greasing in this position:
  - a. Grease outer sides of Tele 4 in the areas that touch the front wear pads of Tele 3.
  - b. Grease the rear upper wear pads of Tele 4 on both sides, at the grease fittings (1), (Figure 5-17), through the openings in Tele 3.
  - c. Grease locking pins on both sides (2), (Figure 5-17).

**NOTE:** To grease the rear upper wear pads of Tele 4 at the 50% or 92% pinning locations, extend and lock Tele 4 to these pinning locations and repeat **Step 4b** greasing.

5. While in the horizontal position, first retract Tele 3, and then retract and extend Tele 4 several times to make sure that grease is properly distributed.
6. When Tele 4 greasing is complete, retract and lock Tele 4 to the 0% pinning location.
7. Raise boom to 70°.

#### Telescope Section 3 (Tele 3)

1. Make sure that the Tele cylinder is locked to Tele 3.
2. Extend and lock Tele 3 to the 100% pinning location.

3. Extend and lock Tele 2 to the 50% pinning location.
4. Lower the boom to 0° and perform the following greasing in this position:
  - a. Grease outer sides of Tele 3 in the areas that touch the front wear pads of Tele 2.
  - b. Grease the rear upper wear pads of Tele 3 on both sides, at the grease fittings (1), (Figure 5-17), through the openings in Tele 2.
  - c. Grease locking pins on both sides (2), (Figure 5-17).

**NOTE:** To grease the rear upper wear pads of Tele 3 at the 50% or 92% pinning locations, extend and lock Tele 3 to these pinning locations and repeat **Step 4b** greasing.

5. While in the horizontal position, first retract Tele 2, and then retract and extend Tele 3 several times to make sure that grease is properly distributed.
6. When Tele 3 greasing is complete, retract and lock Tele 3 to the 0% pinning locations.
7. Raise boom to 70°.

#### Telescope Section 2 (Tele 2)

1. Make sure that the Tele cylinder is locked to Tele 2.
2. Extend and lock Tele 2 to the 100% pinning location.
3. Extend and lock Tele 1 to the 50% pinning location.
4. Lower the boom to 0° and perform the following greasing in this position:
  - a. Grease outer sides of Tele 2 in the areas that touch the front wear pads of Tele 1.
  - b. Grease the rear upper wear pads of Tele 2 on both sides, at the grease fittings (1), (Figure 5-17), through the openings in Tele 1.
  - c. Grease locking pins on both sides (2), (Figure 5-17).

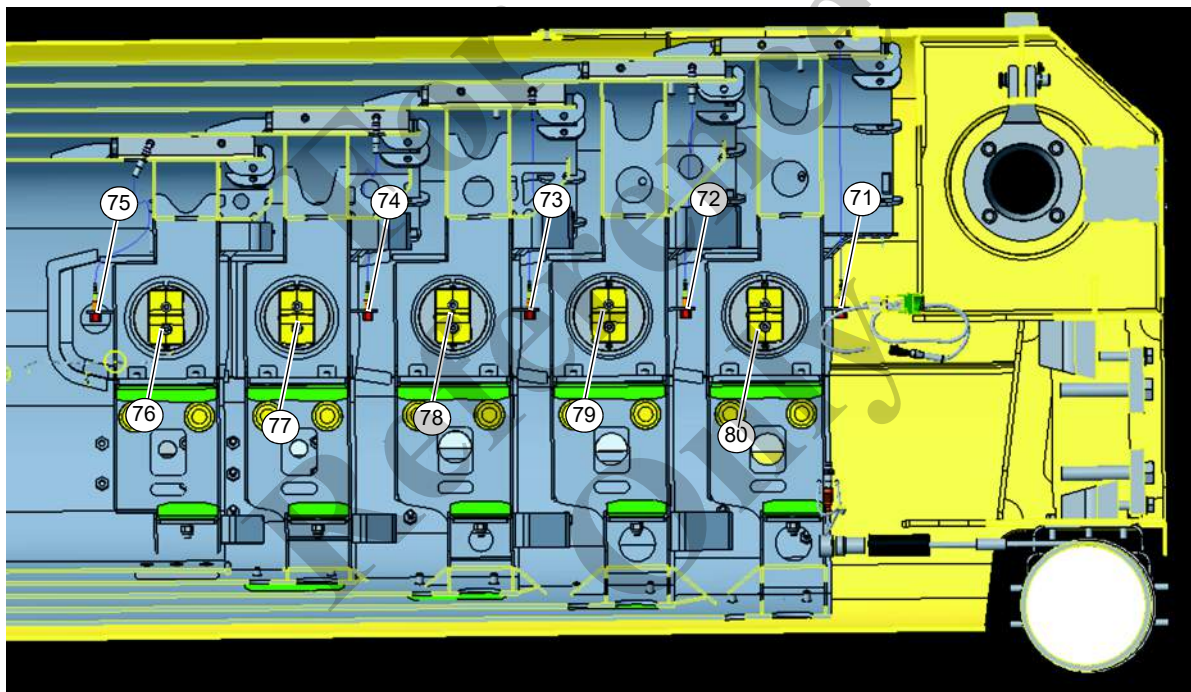
**NOTE:** To grease the rear upper wear pads of Tele 2 at the 50% or 92% pinning locations, extend and lock Tele 2 to these pinning locations and repeat **Step 4b** greasing.

5. While in the horizontal position, first retract Tele 1, and then retract and extend Tele 2 several times to make sure that grease is properly distributed.
6. When Tele 2 greasing is complete, retract and lock Tele 2 to the 0% pinning location.
7. Raise boom to 70°.

#### Telescope Section 1 (Tele 1)

1. Make sure that the Tele cylinder is locked to Tele 1.
2. Extend and lock Tele 1 to the 100% pinning location.

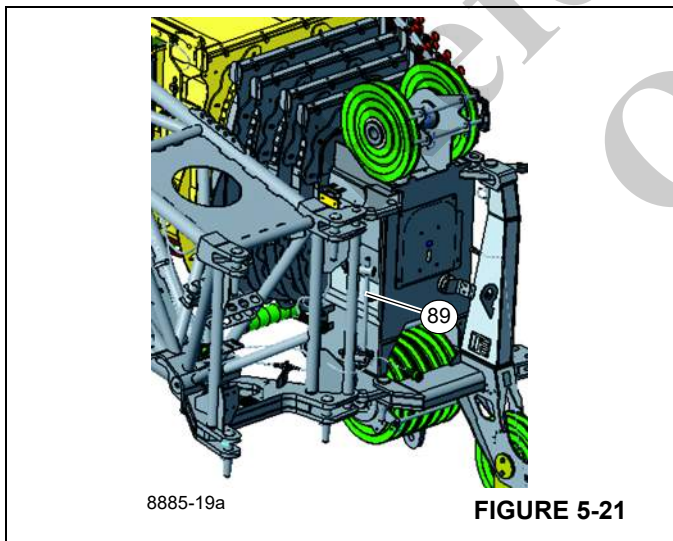
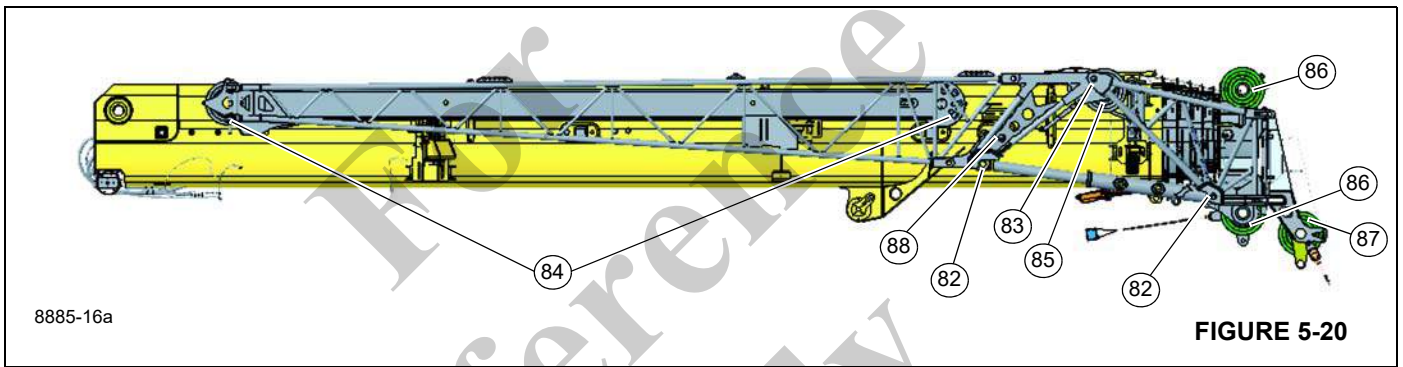
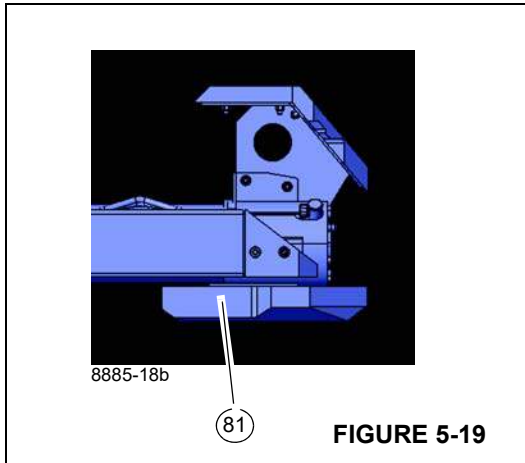
3. Lower the boom to 0° and perform the following greasing in this position:
    - a. Grease outer sides of Tele 1 in the areas that touch the front wear pads of the base section.
    - b. Grease the rear upper wear pads of Tele 1 on both sides, at the grease fittings (1), (Figure 5-17), through the openings in the base section.
    - c. Grease locking pins on both sides (2), (Figure 5-17).
  - NOTE:** To grease the rear upper wear pads of Tele 1 at the 50% or 92% pinning locations, extend and lock Tele 1 to these pinning locations and repeat **Step 3b** greasing.
  4. While in the horizontal position, extend and retract Tele 1 several times to make sure that grease is properly distributed.
  5. When Tele 1 greasing is complete, retract and lock Tele 1 to the 0% pinning location.
- Boom Tele Section Lubrication procedures are complete.



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FIGURE 5-18





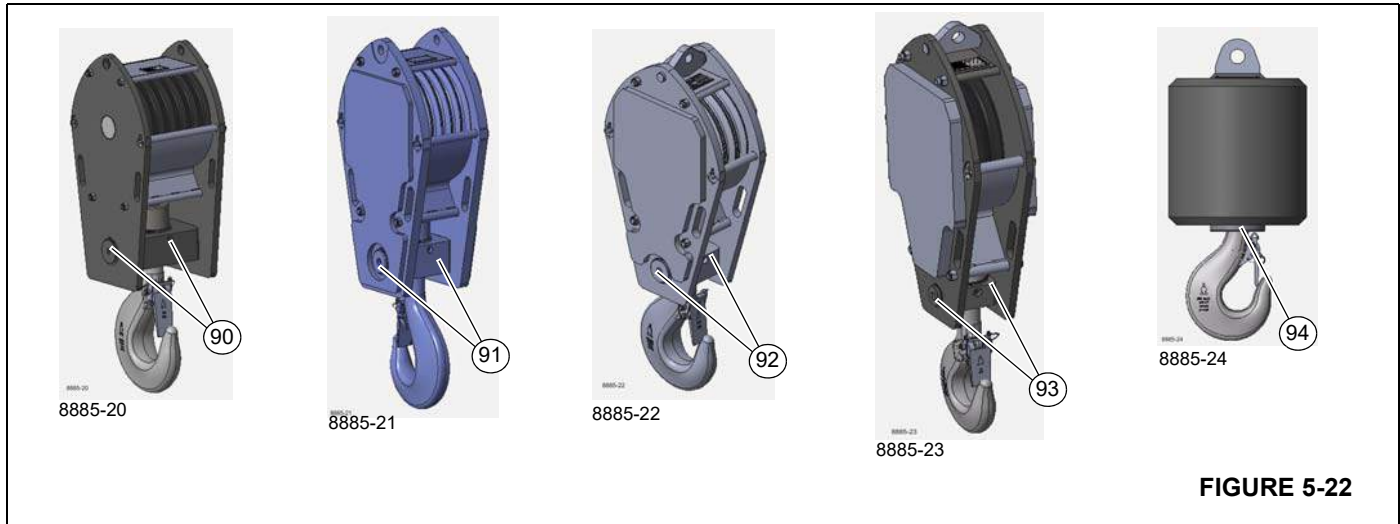


FIGURE 5-22

## Monthly Lubrication Work

### Pins

Lubricate the following:

- the pins for the pin connection on the lattice extension,
- the retaining pins on the return pulleys,

- the retaining pins used for fastening the lattice extension sections for transport,
- the spring latch on the run-up rail.

**NOTE:** The lubrication interval applies to average operation. Also, lubricate the pins after high-pressure cleaning and generally at an interval that will prevent them getting dry.

For Reference Only



## CARWELL® RUST INHIBITOR

### Protecting Cranes From Corrosion

Grove cranes are manufactured to high quality standards, including the type of paint finish demanded by today's industry. In partnership with our paint supplier, we are also doing our part to help prevent premature corrosion of cranes.

Grove cranes will be treated with a rust inhibitor called Carwell T32-CP-90. While a rust inhibitor cannot guarantee that a machine will never rust, this product will help protect against corrosion on Grove cranes that are treated with this product.

Carwell is a treatment, not a coating. It contains no silicones, solvents, CFCs or anything that would be classified as hazardous under OSHA Regulation 29CFR1910.1200. The product is a liquid blend of petroleum derivatives, rust inhibitors, water-repelling and water-displacing agents.

Special equipment is used to spray a light film onto the entire undercarriage and various other areas of each new crane prior to shipment. When applied the product has a red tint to allow applicators to view coverage during application. This red tint will turn clear on its own within approximately 24 hours after application.

Once applied, treatment can appear to leave a slightly "oily" residue on painted surfaces and until the red tinting fades could initially be mistaken for a hydraulic oil leak. While the product is not harmful to painted surfaces, glass, plastic or rubber, it must be removed using standard steam-cleaning techniques.

This treatment works in various ways: (1) it eliminates the moisture containing salt, dirt and other pollutants by lifting and removing them from the metal surface; (2) the film creates a barrier to repel further moisture from coming in contact with the metal; and (3) it penetrates crevices.

In addition to the factory-applied treatment, Grove crane owners must provide proper maintenance and care to help ensure long-term protection of their crane against corrosion. This procedure provides information and guidelines to help maintain the paint finish on Grove cranes.

The most common causes of corrosion include the following:

- Road salts, chemicals, dirt, and moisture trapped in the hard-to-reach areas;
- Chipping or wear of paint, caused by minor incidents or moving components;
- Damage caused by personal abuse, such as using the decks to transport rigging gear, tools, or cribbing; and
- Exposure to harsh environmental hazards such as alkaline, acids, or other chemicals that can attack the crane's paint finish.

While the surfaces of the crane that are easily seen have the biggest impact on the appearance of the crane, particular attention should be given to the undercarriage of the crane to minimize the harmful effects of corrosion.

Exercise special care and increase the frequency of cleaning if the crane is operated:

- on roads where large quantities of salt or calcium are applied to treat icy and snowy road surfaces;
- in areas that use dust control chemicals;
- anywhere there are increased levels of wetness - especially near salt water;
- during prolonged periods of exposure to damp conditions (e.g., moisture held in mud), where certain crane parts may become corroded even though other parts remain dry; or
- in high humidity, or when temperatures are just above the freezing point.

### Cleaning Procedures

To help protect against corrosion of Grove cranes, Manitowoc Crane Care recommends washing the crane at least monthly to remove all foreign matter. More frequent cleaning may be needed when operating in harsh environmental conditions. To clean the crane, follow these guidelines:

- High pressure water or steam is effective for cleaning the crane's undercarriage and wheel housings. Keeping these areas clean will not only help retard the effects of corrosion, but will also improve the ability to identify potential issues before they grow into larger problems.

#### CAUTION

##### Possible Machine Damage!

High pressure water can be forced into spaces and infiltrate beyond seals. Avoid pressure washing in the vicinity of electrical controls, panels, wiring, sensors, hydraulic hoses and fittings, or anything that can be damaged by high pressure cleaning/spraying.

- Rinse the dirt and dust off before washing the crane. Dirt can scratch the crane's finish during washing/cleaning.
- Hard to clean spots caused by road tar or bugs should be treated and cleaned after rinsing and prior to washing. Do not use solvents or gasoline.
- Wash using only soaps and detergents recommended for automotive paint finishes.
- Rinse all surfaces thoroughly to prevent streaking caused by soap residue.

- Allow the crane to dry thoroughly. You can accelerate drying by using compressed air to remove excess water.

Polishing and waxing (using an automotive-type wax) is recommended to maintain the original paint finish.

## Inspection and Repair

- Immediately following cleaning, Manitowoc Crane Care recommends an inspection to detect areas that may have become damaged by stone chips or minor mishaps. A minor scratch (one that has not penetrated to the substrate surface) can be buffed with an automotive-type scratch remover. It is recommended that a good coat of automotive wax be applied to this area afterwards.
- All identified spots and/or areas that have been scratched through to the metal should be touched up and repaired as soon as possible to prevent flash rusting. To repair a major scratch (down to bare metal) or minor damage, follow these procedures:

Manitowoc Crane Care recommends that a qualified body repairman prepare, prime and paint any major scratch(es) or minor damage.

**NOTE:** To the extent any damage is structural in nature, Manitowoc Crane Care must be contacted and consulted as to what repairs may be required.

For scratches and marks in highly visible areas:

- Sand to remove the scratch and feather outward from the mark to blend the repair into the original surface. Body putty may be applied as necessary to hide the defect; then sand smooth.
- Cover all bare metal with a primer that is compatible with the original paint finish and allow to dry thoroughly.
- Prepare the surface prior to applying the finish coat of paint.
- Apply a finish coat of paint using accepted blending techniques. Use of original paint colors is recommended to insure the best color match possible.

For scratches and marks in areas of low visibility:

- Consider touching up the spots with a brush technique to cover the bare metal. This will retard the effects of corrosion and enable you to do the repair at a later time during a normal maintenance interval.

Spots should be touched up with quality paint. Primers tend to be porous; using a single coat of primer only will allow air and water to penetrate the repair over time.

## Application

Depending upon the environment in which a crane is used and/or stored, the initial factory application of Carwell T32-

CP-90 should help inhibit corrosion for up to approximately 12 months.

It is recommended that the treatment be periodically reapplied by the crane owner after that time to help continue to protect against corrosion of the crane and its components.

However, if a crane is used and/or stored in harsh environments (such as islands, coastal regions, industrial areas, areas where winter road salt is regularly used, etc.), reapplication of treatment is recommended sooner than 12 months, e.g., repeat treatment in 6-9 months.

- Do not apply to recently primed and painted areas for at least 48 hours after paint is properly dried and cured. For minor touch up areas a 24 hour period is needed for cure time before applying treatment.

**NOTE:** Unit must be completely dry before applying treatment.

- Do not allow product to puddle or build-up on weather stripping, rubber gaskets, etc. Unit should not have puddles or runs evident anywhere.
- To ensure proper coverage of treatment, the product needs to be fogged on the unit.
- Use of pressure pots to apply the treatment to the unit being processed is recommended.
- Carwell treatment is available in 16 ounce spray bottles from Manitowoc Crane Care (order part number 8898904099).
- After application of the treatment is complete, wash or clean film residue from lights, windshield, grab handles, ladders/steps and all access areas to crane, as necessary.

Please contact Manitowoc Crane Care should you have any questions.

## Areas of Application

Reference (Figure 5-23).

- The underside of the unit will have full coverage of the rust inhibitor. These are the only areas that a full coat of the rust inhibitor is acceptable on the painted surfaces. Areas include; valves, hose ends and fittings, swivel, pumps, axles, drivelines, transmission, slew ring fasteners and all interior surfaces of the frame.
- Frame application areas are; hose ends and fittings, all unpainted fasteners and hardware, all bare metal surfaces, outrigger pads, and back up alarm hardware.
- Superstructure applications are; hose ends and fittings, wire rope on hoists, roller tensioning springs on hoists, all unpainted fasteners and hardware, valves, slew ring fasteners and all bare metal surfaces.

- Boom applications areas are; pivot pins, hose ends and fittings, boom extension pins and shafts, all bare metal surfaces, overhaul ball pins/ hook block pins and fasteners.
- All hardware, clips, pins, hose connections not painted will have treatment applied.

For  
Reference  
Only



FIGURE 5-23

| Item | Description                       | Item | Description                                                             |
|------|-----------------------------------|------|-------------------------------------------------------------------------|
| 1    | Hoist Hose Connections            | 11   | All Hardware, Clips, Pins, Hose Connections not painted O/R Pins, Clips |
| 2    | Boom Extension Pins, Clips        | 12   | Powertrain Hardware Inside Compartment                                  |
| 3    | Valve Bank                        | 13   | O/R Pins, Clips                                                         |
| 4    | Hose Connections Inside Turntable | 14   | Entire Underside of Unit                                                |
| 5    | Boom Extension Hanger Hardware    | 15   | Turntable Bearing Fasteners                                             |
| 6    | Boom Nose Pins, Clips             | 16   | Counterweight Pins                                                      |
| 7    | Hook Block Tie-down Cable         | 17   | Wire Rope                                                               |
| 8    | Overhaul Ball/Hook Block          | 18   | Tension Spring                                                          |
| 9    | Mirror Mounting Hardware          | 19   | Outrigger Beam Wear Pad Adjustment Hardware                             |
| 10   | O/R Hose Connections              |      |                                                                         |

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## SECTION 6

### SET-UP AND INSTALLATION

#### SECTION CONTENTS

|                                                                                             |             |                                                                                                |             |
|---------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------|-------------|
| <b>General</b> .....                                                                        | <b>6-2</b>  | Extension Electrical Connections .....                                                         | 6-57        |
| <b>Installing Cable On The Hoist</b> .....                                                  | <b>6-2</b>  | Connecting the Anti-Two Block Switch .....                                                     | 6-58        |
| <b>Cable Reeving</b> .....                                                                  | <b>6-2</b>  | Extension Hydraulic Connections<br>(Optional Hydraulic Extension) .....                        | 6-59        |
| <b>Dead-End Rigging/Wedge Sockets</b> .....                                                 | <b>6-3</b>  | Folding Deflection Sheaves .....                                                               | 6-61        |
| Installing Wedge and Socket .....                                                           | 6-4         | Positioning/Removing the Hoist Cable .....                                                     | 6-62        |
| Positioning/Removing the Hoist Cable .....                                                  | 6-5         | Mechanical Luffing Boom Extension<br>(Adjustable Boom Extension) .....                         | 6-64        |
| Possible Reevings on the Main Boom .....                                                    | 6-6         | Stowing the Folding Boom Extension .....                                                       | 6-65        |
| <b>Rigging Work for Crane Operation With<br/>the Main Boom</b> .....                        | <b>6-12</b> | Boom Extension Removal .....                                                                   | 6-72        |
| Rigging .....                                                                               | 6-12        | Installing and Removing the 26 ft (8 m)<br>Extension Insert .....                              | 6-73        |
| Unrigging .....                                                                             | 6-13        | <b>3.5 m (11.4 ft) Manual Off-Settable Heavy<br/>Duty Boom Extension</b> .....                 | <b>6-79</b> |
| Removable Counterweight .....                                                               | 6-14        | Separating Manual Off-Settable Heavy<br>Duty Boom Extension from Lattice Extension ...         | 6-79        |
| Counterweight Versions/Combinations .....                                                   | 6-16        | Installing Manual Off-Settable Heavy<br>Duty Boom Extension .....                              | 6-79        |
| Lifting Individual Counterweight Sections .....                                             | 6-16        | Setting Heavy Duty Boom Extension<br>Manual Offset .....                                       | 6-80        |
| Rigging the Counterweight .....                                                             | 6-18        | Removing the Manual Off-Settable Heavy<br>Duty Extension .....                                 | 6-80        |
| Unrigging the Counterweight .....                                                           | 6-19        | <b>3.5 m (11.4 ft) Hydraulic Off-Settable Heavy<br/>Duty Boom Extension</b> .....              | <b>6-80</b> |
| Lower 3,000 lb Tray Plate on the Counter-<br>weight Platform .....                          | 6-19        | Separating Hydraulic Off-Settable Heavy Duty<br>Boom Extension from Lattice Base Extension ... | 6-80        |
| Check the Position of the Locking Pins for<br>3,000 & 5,000 lb Counterweight Sections ..... | 6-20        | Removing the Hydraulic Off-Settable Heavy<br>Duty Extension .....                              | 6-83        |
| Assembling Counterweight Versions/<br>Combinations .....                                    | 6-21        | <b>Auxiliary Single-Sheave Boom Nose (Optional<br/>Equipment)</b> .....                        | <b>6-84</b> |
| Counterweight Hoist Unit .....                                                              | 6-23        | Identification .....                                                                           | 6-84        |
| Rotating With the Rigged Counterweight .....                                                | 6-24        | Installing/Removing Auxiliary Single-Sheave<br>Boom Nose .....                                 | 6-84        |
| Unlocking/Locking the Rear Counterweight<br>Platform .....                                  | 6-28        | Removing the Auxiliary Single-Sheave<br>Boom Nose .....                                        | 6-85        |
| <b>Rigging Work on the Main Boom</b> .....                                                  | <b>6-30</b> | <b>Rigging the Auxiliary Single-Sheave<br/>Boom Nose</b> .....                                 | <b>6-85</b> |
| Hook Block on the Bumper .....                                                              | 6-30        | Rigging in Transport Position .....                                                            | 6-85        |
| Hook Block on a Separate Vehicle .....                                                      | 6-30        | Rigging in Working Position .....                                                              | 6-86        |
| Installing/Removing the Anti Two-Block Switch ..                                            | 6-36        | Attaching and Removing Hoist Cable .....                                                       | 6-86        |
| Locking/Unlocking the Anti-Two Block Switch ..                                              | 6-40        | Possible Reeving Methods on the Auxiliary<br>Single-Sheave Boom Nose .....                     | 6-86        |
| Anemometer and Boom Position Indicator Light.                                               | 6-40        | Anti-Two Block Switch .....                                                                    | 6-86        |
| Switching the Boom Position Indicator<br>Light ON and OFF .....                             | 6-41        | <b>Raising and Setting Down the Main Boom<br/>with Rigged Lattice Extension</b> .....          | <b>6-86</b> |
| <b>Other Rigging Work</b> .....                                                             | <b>6-41</b> | <b>Telescoping with Rigged Lattice Extension</b> ....                                          | <b>6-86</b> |
| Cameras for Crane Operation .....                                                           | 6-41        |                                                                                                |             |
| Hoist Maintenance Platform .....                                                            | 6-42        |                                                                                                |             |
| Slings Points for Personal Protective<br>Equipment .....                                    | 6-42        |                                                                                                |             |
| <b>Boom Extensions</b> .....                                                                | <b>6-43</b> |                                                                                                |             |
| Installing the Folding Boom Extension .....                                                 | 6-44        |                                                                                                |             |
| Extension Erecting Warnings and Requirements                                                | 6-45        |                                                                                                |             |
| Erecting Procedure - 35 ft (10.5 m) Base<br>Extension .....                                 | 6-45        |                                                                                                |             |
| Erecting Procedure - 58 ft (17.7 m) Extension ..                                            | 6-50        |                                                                                                |             |



Operating with the Lattice Extension . . . . . 6-86  
 Procedure IF the Permissible Wind Speed

is Exceeded . . . . . 6-87  
 Anti-Two Block Troubleshooting . . . . . 6-87

**GENERAL**

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

**NOTE:** For information on synthetic rope refer to the separate manual.

**INSTALLING CABLE ON THE HOIST**

Refer to (Figure 6-1).

**CAUTION**

If cable is wound from storage drum, rotate reel in same direction as hoist.

**NOTE:** Straighten cable before installing on hoist drum.

1. Place cable (1) over boom nose sheave and route to hoist drum (2).
2. Rotate hoist drum so cable slot located on left side of drum is easily accessible.
3. Insert cable through slot (3) and wedge block (4). Loop around anchor wedge (6) and route back through wedge block to clamp (5). Make sure that the cable is routed over guide in side of drum. The end of the cable should extend approximately 50 mm (2 in) beyond clamp. Tighten clamp.
4. Adjust the cable so clamp side is snug against guide. Position anchor wedge in wedge block. Pull firmly on inside hoist side of cable to secure the wedge.
5. If wedge does not seat securely in slot, carefully tap cable and top of wedge (7) with a mallet.
6. Slowly rotate drum and evenly wind first layer of cable.
7. Install remainder of cable as required.

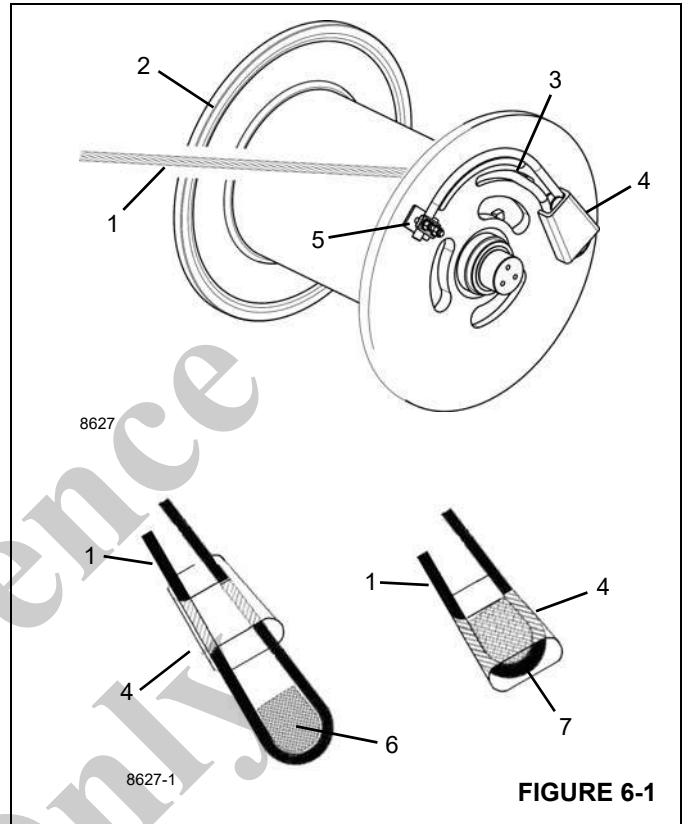


FIGURE 6-1



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**CABLE REEVING**

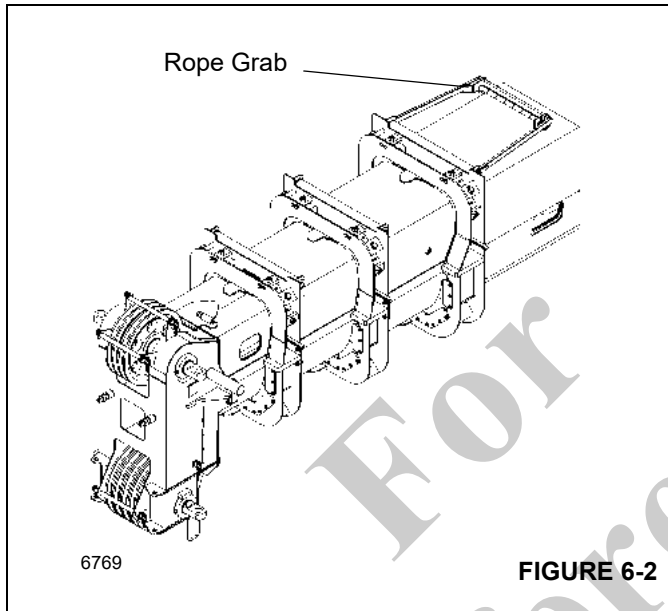
**NOTE:** There are two types of cable (rope) available on this crane; 35 x 7 (non-rotating) and 22 mm synthetic.

Within the limits of the load and range charts and permissible line pull, multi-part lines allow the operator to raise a greater load than can be raised with a single part line. Various cable reeving (part line) is possible with the boom nose and hook block (Figure 6-8 through Figure 6-14). This reeving should be accomplished by a qualified rigger using standard rigging procedures.

**CAUTION**

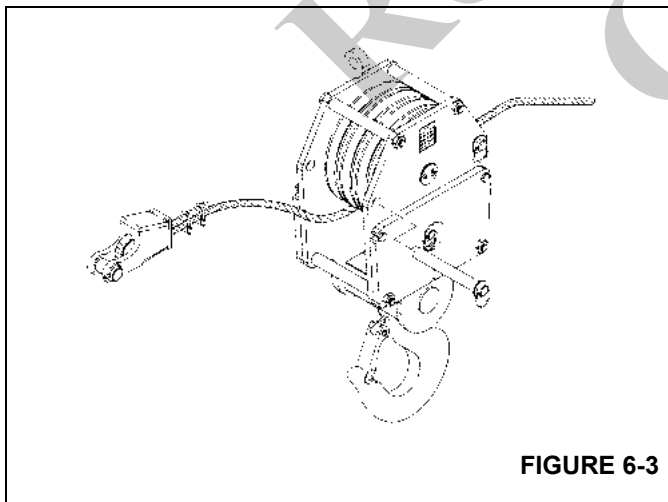
Only reeve the main hoist rope through the rope grab. Do not reeve the auxiliary rope through the rope grab.

Never reeve multiple ropes through the rope grab at the same time. Rope damage can occur.

**FIGURE 6-2**

**NOTE:** Also use the rope grab when using the Main Hoist with lattice extensions.

To quick reeve the hook block without removing the wedge socket on the end of the cable refer to (Figure 6-3).

**FIGURE 6-3****DEAD-END RIGGING/WEDGE SOCKETS**

Wedge socket assemblies are popular rigging accessories and have been successfully used for decades to terminate wire ropes on mobile cranes. A wedge socket assembly is easily installed and dismantled but it must be installed and used correctly. It is essential to use only a wedge and socket of the correct size for the rope fitted. Failure to do so may result in the rope pulling through the fitting.

Since state and local laws may vary, alternate attachment methods may be necessary depending upon work conditions. If alternate methods are selected, the user is responsible and should proceed in compliance with the regulations in force. If there are any questions, contact your local Grove Distributor or Manitowoc Crane Care.

Do not mix components from different manufacturers. The selection, installation and use of a wedge socket assembly must be in accordance with the requirements of the wedge socket manufacturer and the wire rope manufacturer upon whose wire rope the wedge socket assembly will be used.

Grove Crane specifies the size, type, class and line pulls for wire rope, predominately rotation resistant wire rope, and rigging accessories such as overhaul balls and hook blocks for use with each new crane that it manufactures. Other wire ropes and rigging accessories are available from various vendors. Different wire rope manufacturers have differing requirements for the construction, handling, cutting, seizing, installation, termination, inspection and replacement of the wire ropes they produce. Their advice should be sought for each specific type of wire rope a crane user intends to install on a mobile crane.

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

**CAUTION**

If the socket is not positioned with the flat face away from the boom sections, structural damage will occur.

When anchoring the socket to the boom, make sure that the flat face of the socket is in position (Figure 6-4), away from the boom sections.

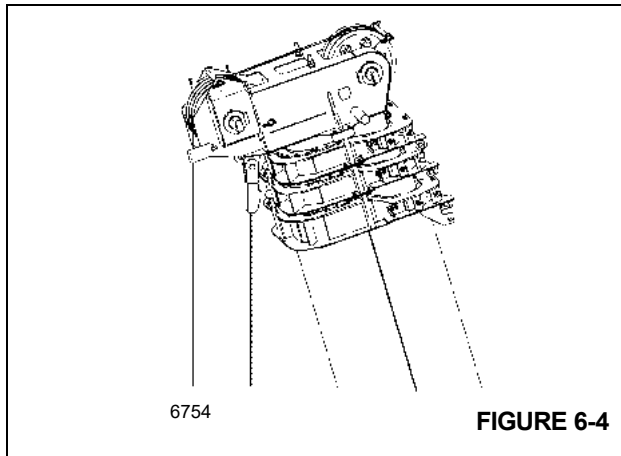


FIGURE 6-4

socket. It is recommended that the wedge be seated inside the socket to properly secure the wire rope by using the crane's hoist to first apply a light load to the live line.

6. After final pin connections are made, increase the loads gradually until the wedge is properly seated.
7. The wire rope and wedge must be properly secured inside the socket before placing the crane into lifting service. It is the wedge that secures the wire rope inside the socket whereas the dead-end treatment is used to restrain the wedge from becoming dislodged from the socket should the rope suddenly become unloaded from the overhaul ball or hook block striking the ground, etc.

Sketches A through F (Figure 6-6) illustrate various methods for treating the dead-ends of wire ropes which exit a wedge socket assembly. While use of the loop-back method is acceptable, care must be exercised to avoid the loop becoming entangled with tree branches and other components during crane transport and with the anti-two block system and other components during use of the crane.

Of the methods shown below, Grove prefers that method A or F be used on Grove cranes, that is, clipping a short piece of wire rope to the dead-end or using a commercially available specialty wedge. It is required that the tail length of the dead-end should be a minimum of 6 rope diameters but not less than 15.2 cm (6 in) for standard 6 to 8 strand ropes and 20 rope diameters but not less than 15.2 cm (6 in) for rotation resistant wire ropes.

When using method A, place a wire rope clip around the dead end by clamping a short extra piece of rope to the rope dead end. **DO NOT CLAMP THE LIVE END.** The U-bolt should bear against the dead end. The saddle of the clip should bear against the short extra piece. Torque the U-bolts according to the figures listed in the chart titled Wire Rope Clip Torque Values (Table 4-1).

Other sources for information with which crane users should be familiar and follow is provided by the American Society of Mechanical Engineers, American National Standard, ASME B30.5, latest revised. ASME (formerly ANSI) B30.5 applies to cableways, cranes, derricks, hoists, hooks, jacks, and slings. It states, in section 5-1.7.3, "(c) Swagged, compressed, or wedge socket fittings shall be applied as recommended by the rope, crane or fitting manufacturer." Wire ropes are addressed in ASME B30.5, section 5-1.7.2, ROPES, It states, in pertinent part, "(a) The ropes shall be of a construction recommended by the rope or crane manufacturer, or person qualified for that service." Additional information is published by the Wire Rope Technical Board in the Wire Rope Users Manual, latest revision.

### Installing Wedge and Socket

1. Inspect the wedge and socket. Remove any rough edges and burrs.
2. For rotation resistant rope, the end needs to remain welded.

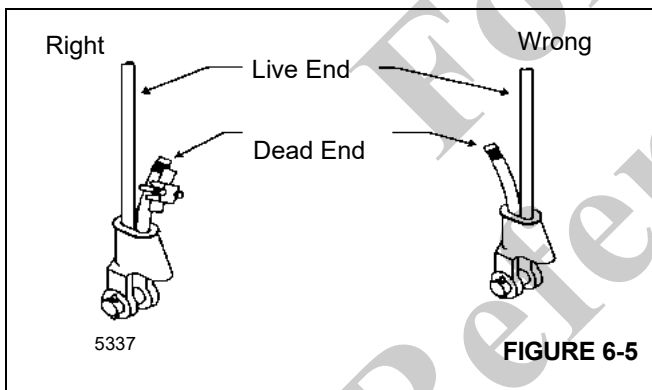


FIGURE 6-5

3. Make sure the live-loaded side (Figure 6-5) of the rope is directly in line with the ears of the socket and the direction of pull to which the rope will be subjected. If the rope is loaded into the socket incorrectly, under a load the rope will bend as it leaves the socket, and the edge of the socket will wear into the rope causing damage to the rope and eventual failure.
4. Insert the end of a wire rope into the socket, form a loop in the rope, and route the rope back through the socket allowing the "dead" end (Figure 6-5) to protrude from the socket. Make sure that the dead end of the rope is of sufficient length to apply end treatment to the dead end after the wedge has been seated.
5. Insert the wedge into the loop and pull the live end of the rope until the wedge and rope are snug inside the

Table 6-1: Wire Rope Clip Torque Values

| WIRE ROPE CLIP TORQUE VALUES |        |         |        |
|------------------------------|--------|---------|--------|
| Clip Sizes                   |        | *Torque |        |
| mm                           | Inches | Nm      | Ft-Lbs |
| 3.18                         | 1/8    | 6       | 4.5    |
| 4.76                         | 3/16   | 10      | 7.5    |
| 6.35                         | 1/4    | 20      | 15     |
| 7.94                         | 5/16   | 40      | 30     |
| 13.28                        | 3/8    | 60      | 45     |
| 11.11                        | 7/16   | 90      | 65     |
| 12.70                        | 1/2    | 90      | 65     |
| 14.29                        | 9/16   | 130     | 95     |
| 15.88                        | 5/8    | 130     | 95     |
| 19.05                        | 3/4    | 175     | 130    |
| 22.23                        | 7/8    | 300     | 225    |
| 25.40                        | 1      | 300     | 225    |
| 28.58                        | 1-1/8  | 300     | 225    |
| 31.75                        | 1-1/4  | 490     | 360    |
| 38.68                        | 1-3/8  | 490     | 360    |
| 38.10                        | 1-1/2  | 490     | 360    |

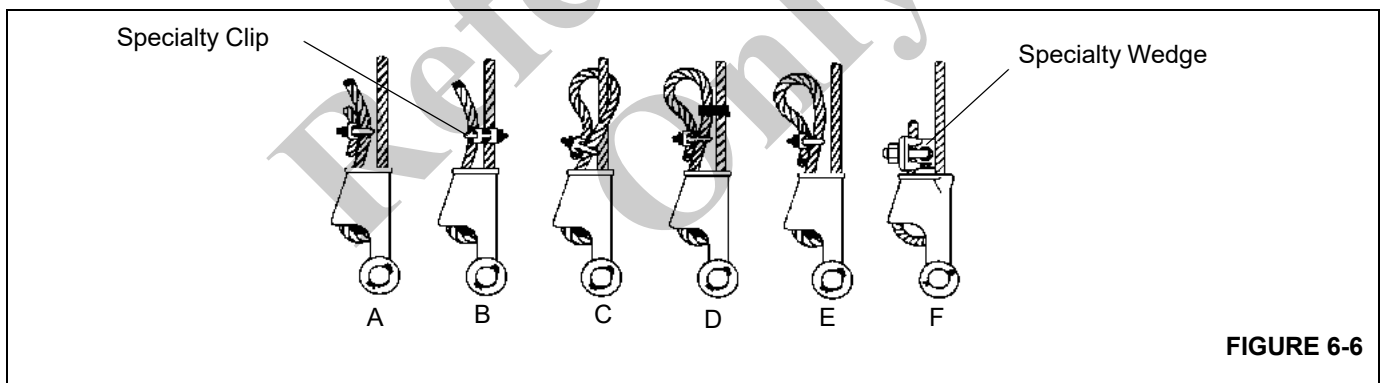


FIGURE 6-6

**Positioning/Removing the Hoist Cable**

**Positioning the Hoist Cable**



**CAUTION**

**Falling Objects Hazard!**

Always make sure sheaves and pins that secure the hoist cable are secured with clips. This prevents components from coming loose, falling and causing injury.

1. Remove the retaining rods (1), (Figure 6-7).
2. Guide the rope over the upper boom nose sheaves (2), (Figure 6-7).
3. Guide the rope over the lower boom nose sheave (3), (Figure 6-7).
4. Reinstall all the retaining rods and secure with retaining clips.
5. Install the hook tackle or the hookblock. The rope may now be reeved.

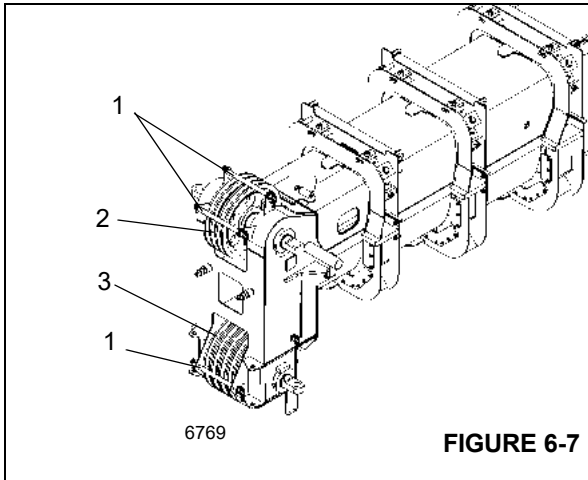


FIGURE 6-7

**Removing the Hoist Cable**

1. Unreeve the hookblock.
2. Remove the retaining rods (1), (Figure 6-7).
3. Take the wire rope off the upper boom nose sheave (2), (Figure 6-7) and place it on the ground on the left side.
4. Replace all retaining rods and secure them with retaining clips.

**Possible Reeving on the Main Boom**

**NOTE:** The maximum load bearing capacity of individual hook blocks does not correspond to the maximum load bearing capacity of the TMS9000-2 together with this hook block. The load bearing capacity of the TMS9000-2 depends on the rope pull, the reeving and friction force. It is lower than the load bearing capacity of the hook block.

**NOTE:** Please note that the maximum load bearing capacities already include the weight of the hook block and the lifting gear. You must subtract these weights in order to obtain the actual payload.

**NOTE:** The recommended hook-blocks are designed to be of sufficient weight to overhaul the rope properly when using the parts of line required for the allowed load at the chosen boom length. Operating with a higher number of parts of line than is necessary for

a particular boom length may result in poor rope spooling behavior and loosely stored rope, which can result in future rope damage. If operation in these extended ranges is desired, extra weight should be carried by the hookblock or a heavier hookblock should be used.

**With 5 Head Sheaves**

**5-Sheave Hook Block**

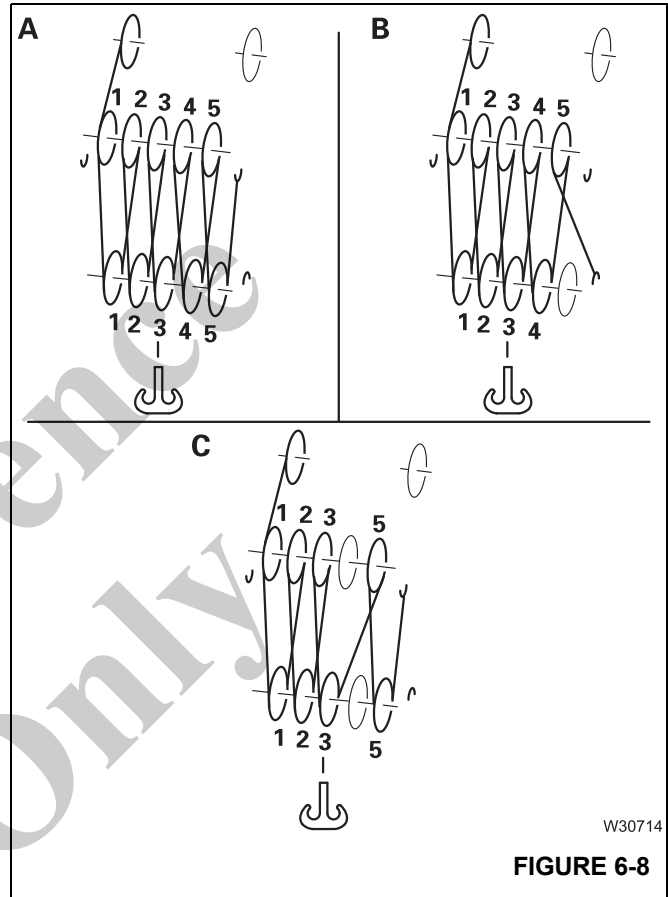
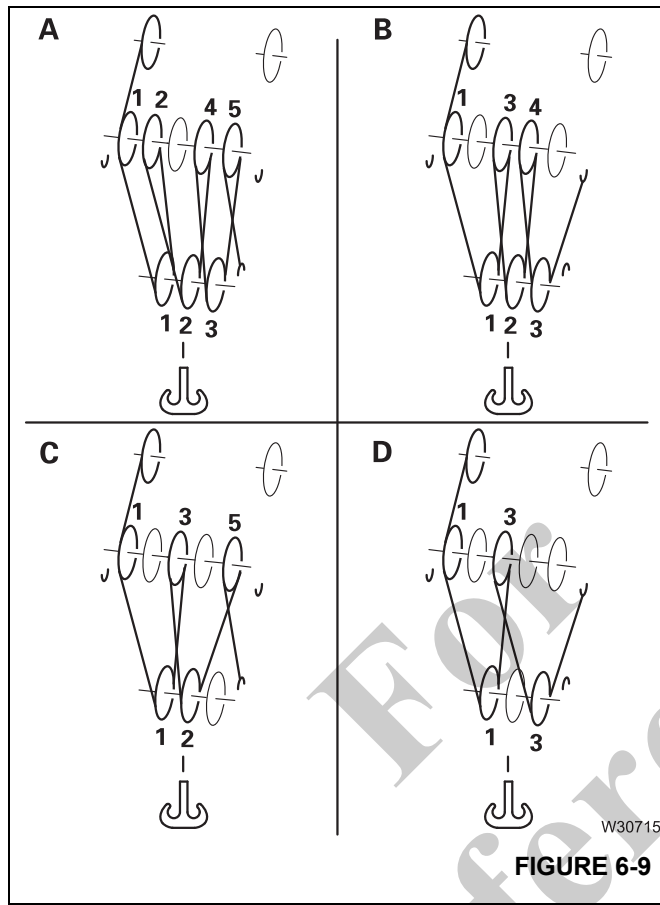


FIGURE 6-8

| Reeving |               |
|---------|---------------|
| A       | 10-parts line |
| B       | 9-parts line  |
| C       | 8-parts line  |

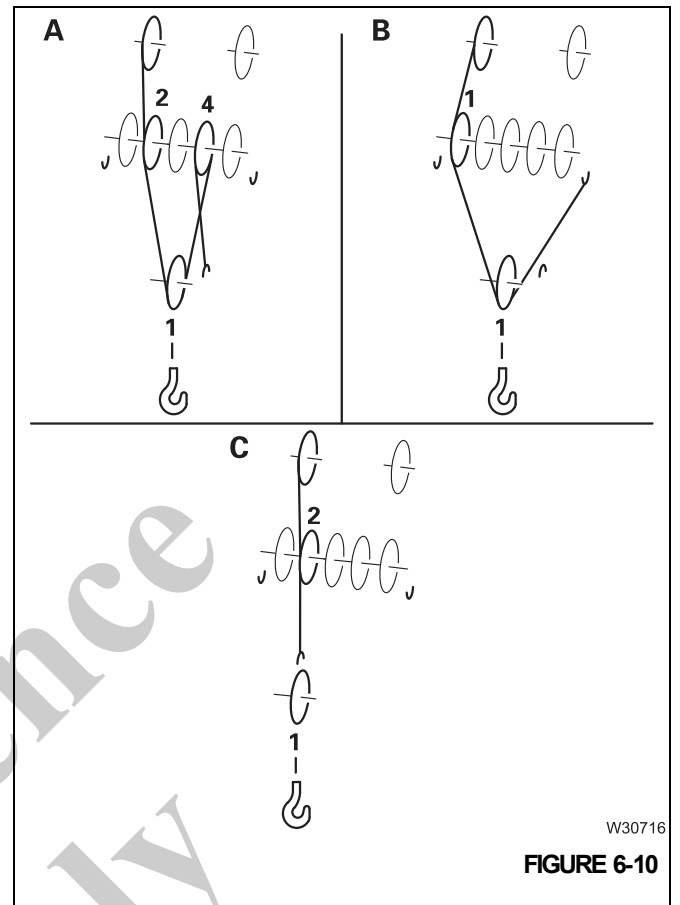
3-Sheave Hook Block



Reeving

|          |              |
|----------|--------------|
| <b>A</b> | 7-parts line |
| <b>B</b> | 6-parts line |
| <b>C</b> | 5-parts line |
| <b>D</b> | 4-parts line |

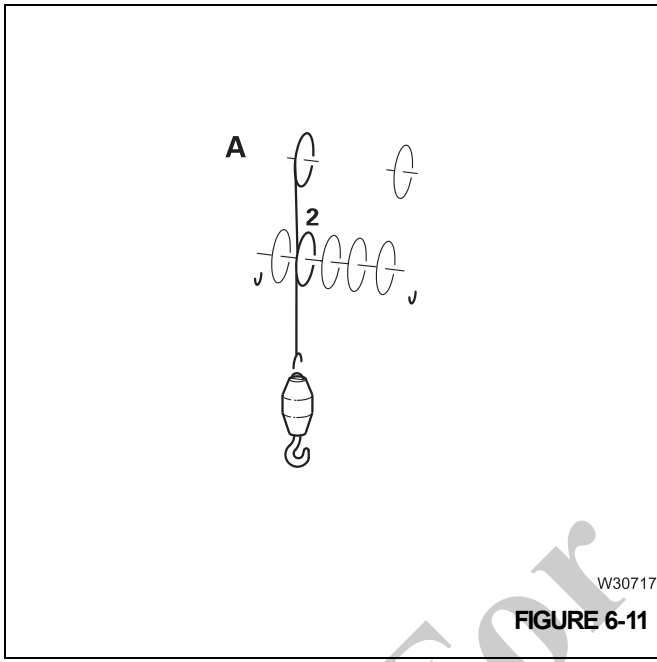
1-Sheave Hook Block



Reeving

|          |              |
|----------|--------------|
| <b>A</b> | 3-parts line |
| <b>B</b> | 2-parts line |
| <b>C</b> | 1-parts line |

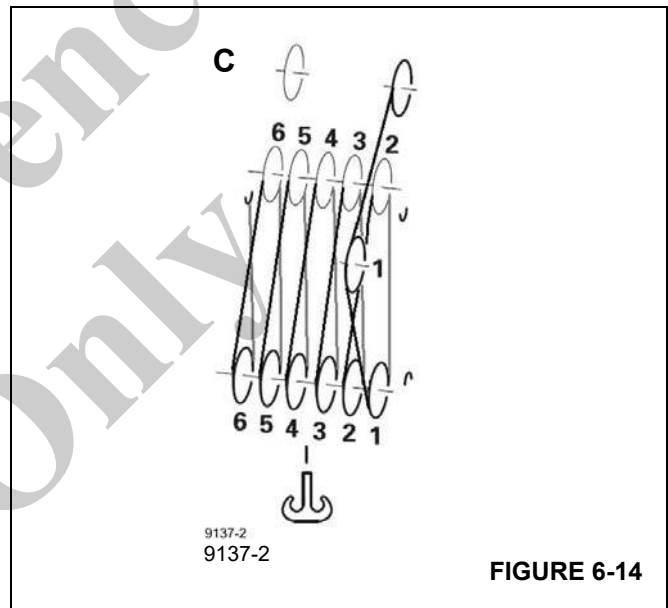
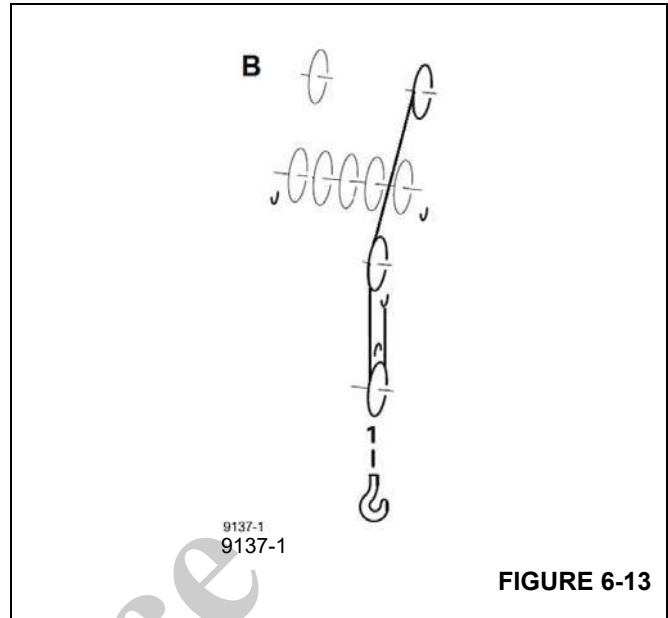
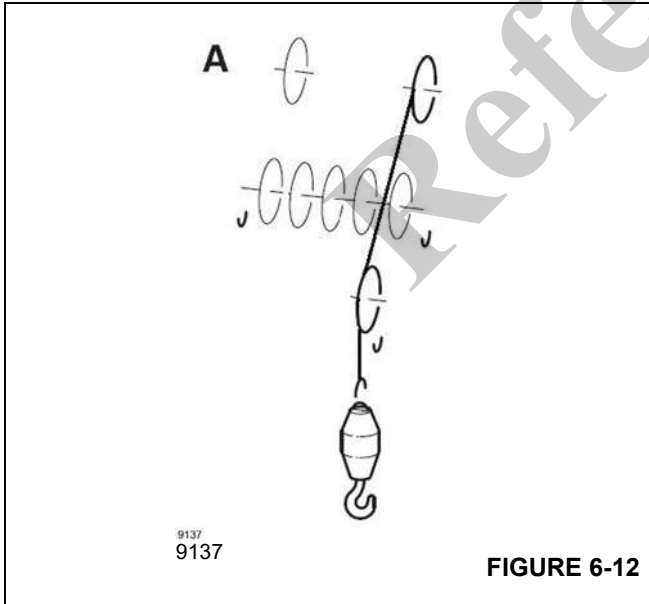
Hook Tackle



**Reeving**

|   |             |
|---|-------------|
| A | 1-part line |
|---|-------------|

Auxiliary Boom Nose



**Reeving**

|   |              |
|---|--------------|
| A | 1-part line  |
| B | 2-part line  |
| C | 12-part line |



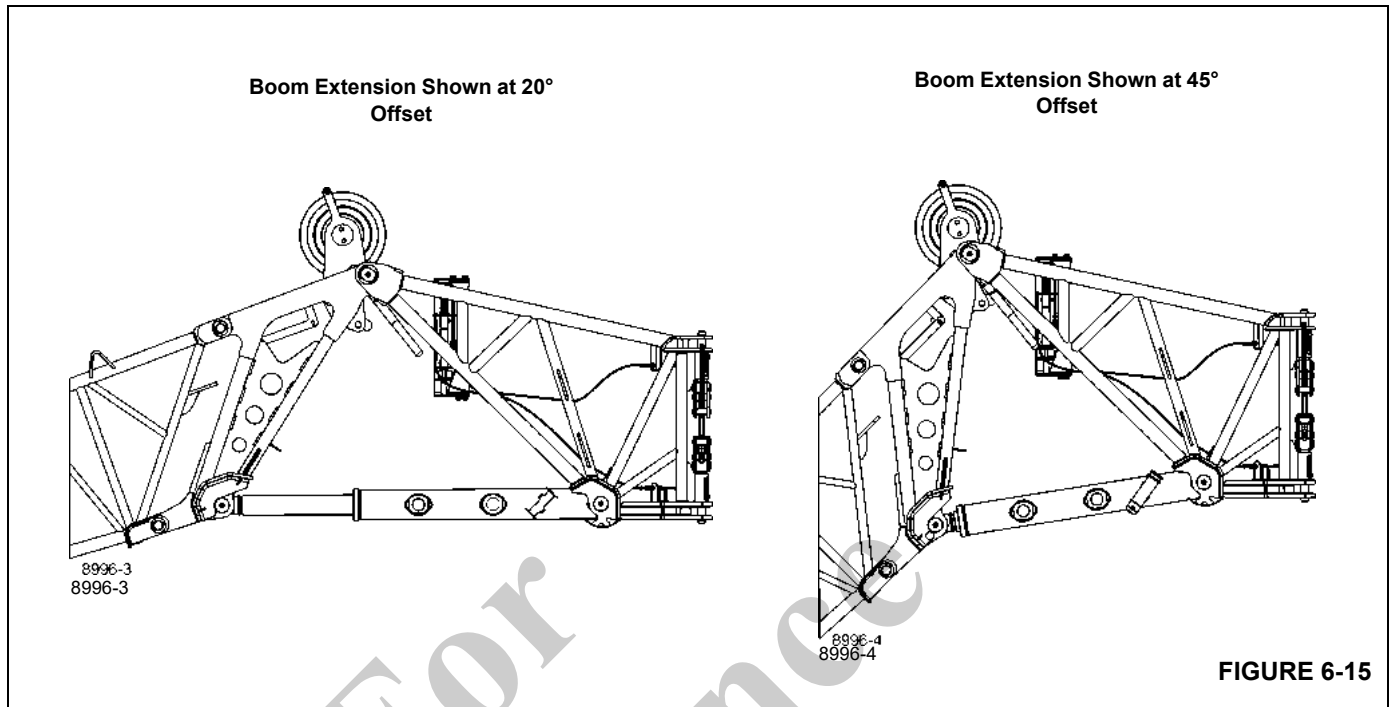
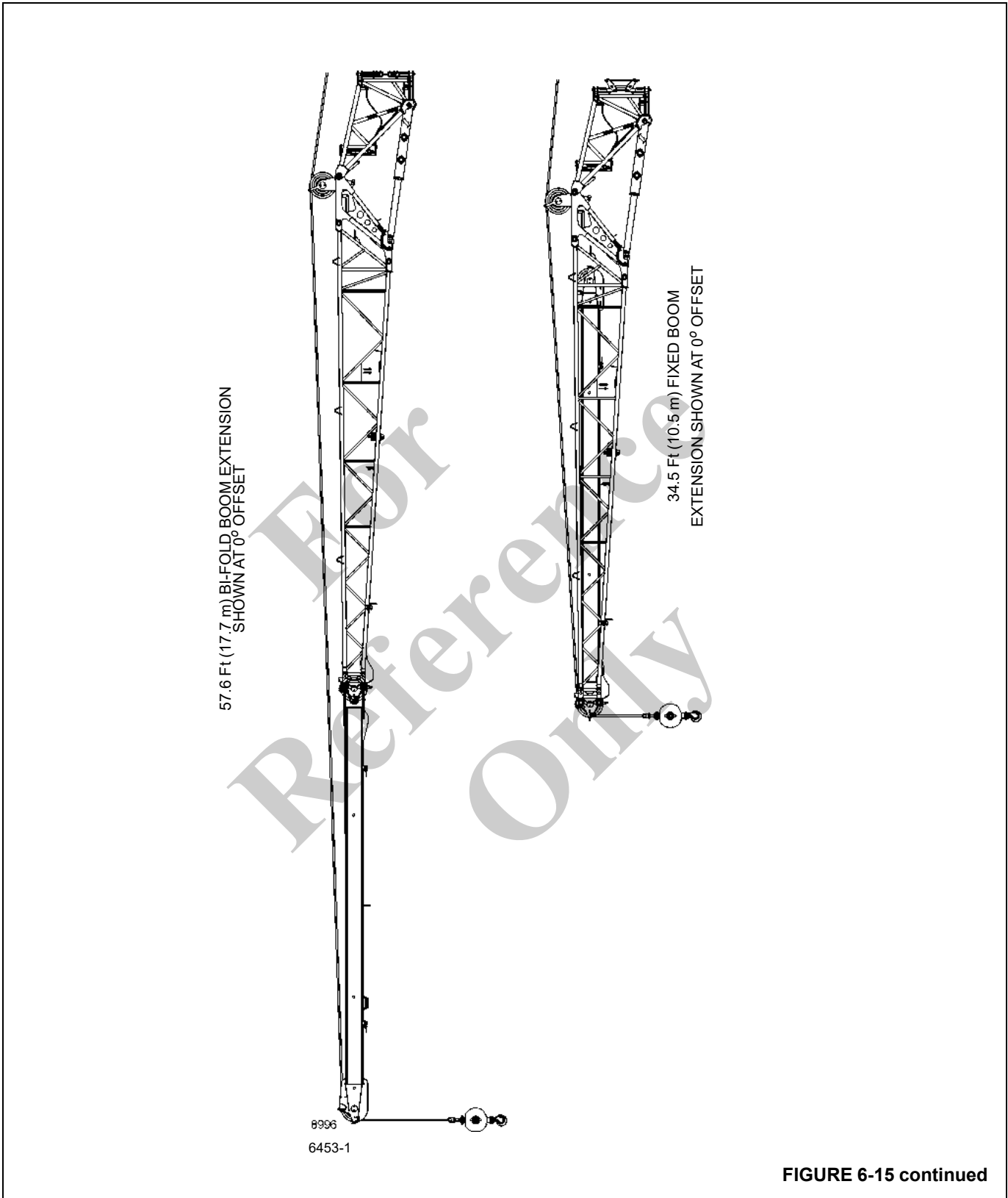
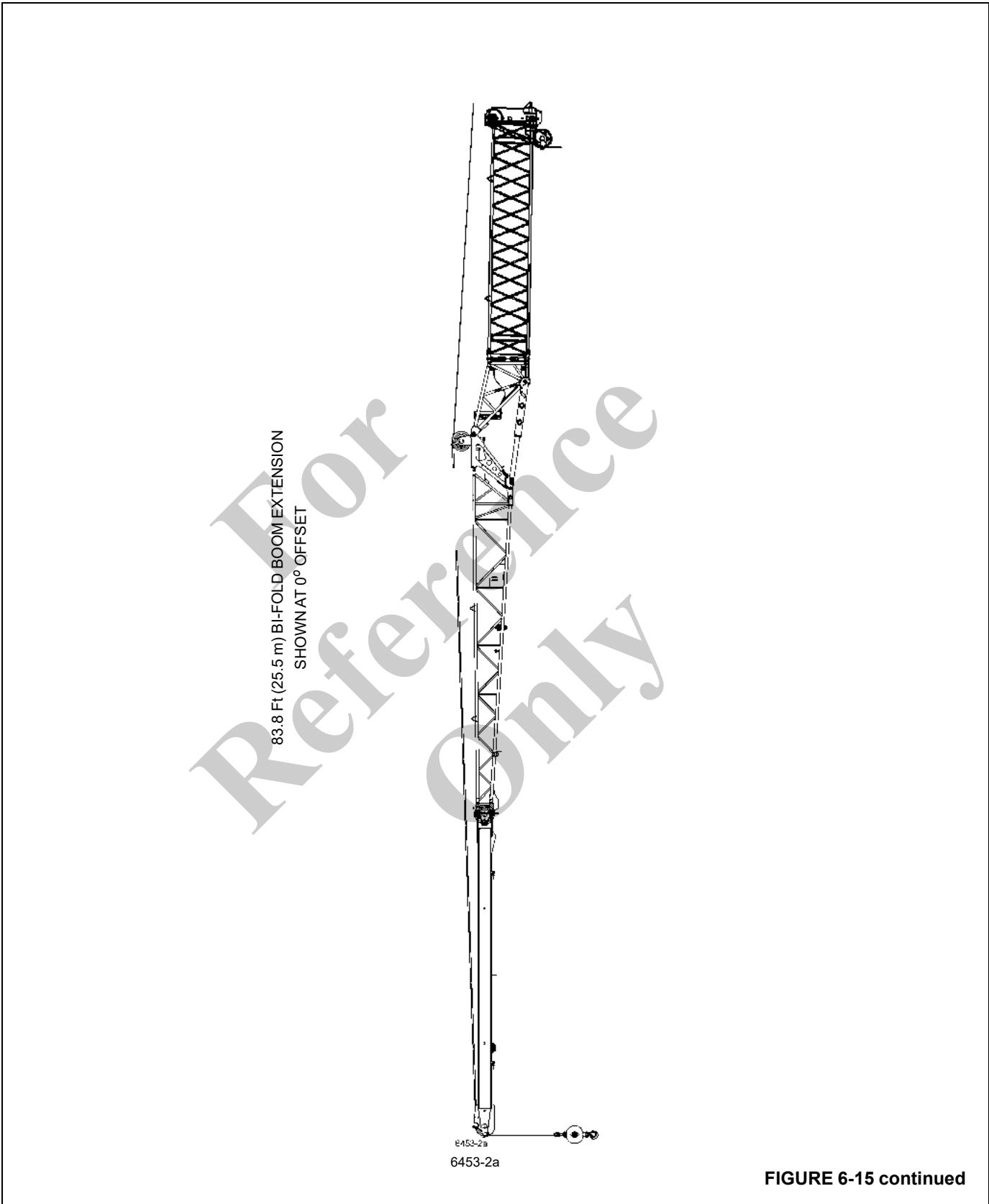


FIGURE 6-15





## RIGGING WORK FOR CRANE OPERATION WITH THE MAIN BOOM

If the truck crane on the site has already been rigged, proceed according to: *Checks Before Operating the Crane*, page 4-55.

**NOTE:** This procedure is not complete. There are accompanying operating instructions which are indicated by cross-references.

Ensure the cross-referenced warnings and instructions are followed.

### Rigging

1. Check that the parking brake is applied – if necessary, apply the parking brake.

2. If the main boom is resting on a trailer:

- Switch off the boom floating position.
- Switch off the swing gear freewheel.

**NOTE:** The following points only apply to rigging in Free on wheels working position. Continue the procedure at point 7 when rigging the truck crane on outriggers.

3. For the free on wheels working position:

**NOTE:** Working on free on wheels position is not allowed, unless optional rubber charts are specified, and these are only for directly over the rear of the machine.

- Check that the tire pressure is correctly set.
- Check that the ground can support the maximum axle loads.

4. Align the truck crane horizontally with the level adjustment system.

5. On the outriggers:

- Deflate suspension before extending outriggers.
- Extend all outrigger beams as far as possible.
- Move all outrigger pads into the working position.
- Extend all outrigger cylinders far enough so that the outrigger pads are just above the ground.

**NOTE:** The following points only apply when rigging the truck crane on outriggers. To continue rigging in the Free on wheels working position, continue the procedure at point 11.

6. Check that the ground will support the maximum occurring outrigger pressures.

7. Deflate the suspension.

8. Support the truck crane with the outrigger span required for the job according to the Lifting capacity table and raise until none of the wheels is touching the ground.
9. Align the truck crane horizontally (Figure 6-16).

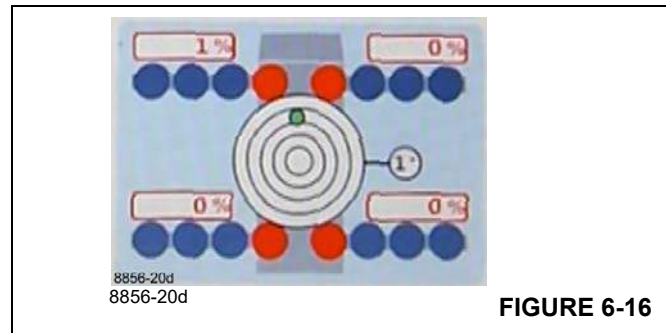


FIGURE 6-16

10. Switch the engine off.

11. Inspect the truck crane, while looking out in particular for any leaking fluids (oil, fuel or water).

12. Extend the Step (Figure 6-17) if necessary. Refer to *Superstructure Cab Platform*, page 4-34.

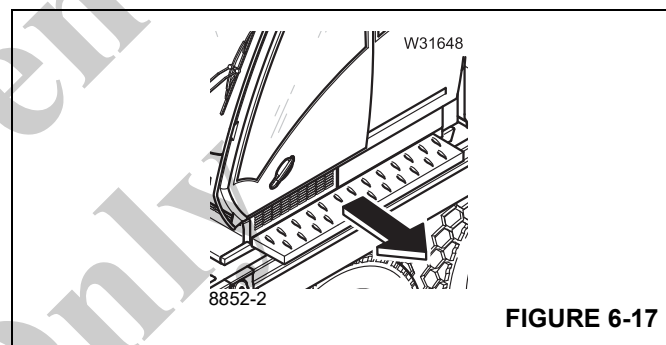


FIGURE 6-17

13. Start the engine for crane operation.

14. Unlock the turntable and, if necessary, switch OFF the 360° lock. Refer to *Switching the 360° Lock ON/OFF*, page 4-47.

15. If necessary reeve the hook block then pick up the hook block;

- *Hook Block on a Separate Vehicle*, page 6-30.
- *Hook Block on the Bumper*, page 6-30.
- *Reeving the Hoist Rope*, page 6-32.

16. Install the anti-two block switch. Refer to *Installing/Removing the Anti Two-Block Switch*, page 6-36.

17. Install the anemometer and, if necessary, the boom position indicator light. Refer to *Anemometer and Boom Position Indicator Light*, page 6-40.

18. Fold out and adjust all mirrors for crane operation.

19. Perform all the required checks prior to crane operation. Refer to *Before Operating the Crane*, page 4-43.

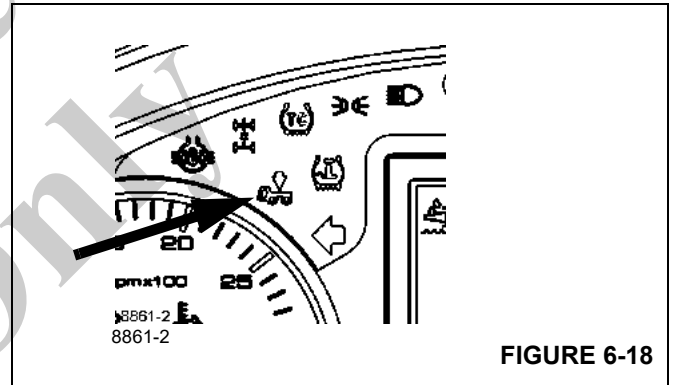
20. Enter the current rigging mode on the RCL. Refer to *Enter Rigging Mode*, page 4-50.
21. With the RCL adjusted accordingly, rig the counterweight combination required for the operation according to the Lifting Capacity Table. Refer to *Rigging the Counterweight*, page 6-18.
22. Enter the current rigging mode with the newly rigged counterweight combination on the RCL. Refer to *Enter Rigging Mode*, page 4-50.

## Unrigging

**NOTE:** This procedure is not complete. There are accompanying operating instructions which are indicated by cross-references.

Ensure the cross-referenced warnings and instructions are followed.

1. With the RCL set correspondingly, unrig the counterweight. Refer to *Unrigging the Counterweight*, page 6-19.
2. Enter the current rigging mode with the newly rigged counterweight combination on the RCL. Refer to *Enter Rigging Mode*, page 4-50.
3. Depending on transport:
  - Attach the hook block to the bumper. Refer to *Hook Block on the Bumper*, page 6-30 **OR**
  - Set down the hook block and unreeve the hoist rope. Refer to *Setting Down the Hook Block*, page 6-31 and *Unreeving the Hoist Rope*, page 6-36.
4. Retract the main boom. Refer to *Unlocking the Telescoping Cylinder*, page 4-74.
5. For on-road driving without trailer:
  - Turn the superstructure to the 180° position to the front with the RCL adjusted accordingly.
  - Place the main boom on the boom rest.
6. For on-road driving with a trailer:
  - Unrig the counterweight on the rear counterweight platform. Refer to *Unrigging the Counterweight*, page 6-19.
- Set down the boom on a trailer with the RCL adjusted accordingly and switch on the boom floating position.
- Switch on the swing gear freewheel.
- If necessary, switch on the boom pre-tensioning.
- Switch OFF the 360° lock. Refer to *Switching the 360° Lock ON/OFF*, page 4-47.
7. Switch OFF the engine for crane operation.
8. If necessary, remove the anemometer and boom position indicator light. Refer to *Anemometer and Boom Position Indicator Light*, page 6-40.
9. Fold in all mirrors for crane operation.
  - Swing the slewable spotlights. Refer to *Using the Slewable Spotlights*, page 4-94.
10. Retract the Step as shown in (Figure 6-17).
11. After operating the truck crane on outriggers:
  - Retract the outriggers.
12. Inflate the suspension.
  - The symbol must be OFF (suspension inflated).



**FIGURE 6-18**

13. Switch the engine OFF.
  - If there is no further work for the truck crane, refer to *In Case of Work Breaks of More than 8 Hours*, page 4-97.

**Removable Counterweight**

For the TMS9000-2 truck crane, the counterweight combinations are assembled from eight removable counterweight sections. Use the following table, *Table 6-2: Standard Counterweight Combinations*, page 6-14 and (Figure 6-19) to determine the correct counterweight combinations.

**Table 6-2: Standard Counterweight Combinations**

|                  | ITEM NUMBER |      |       |           |         |         |         |         |
|------------------|-------------|------|-------|-----------|---------|---------|---------|---------|
|                  | 1           | 2    | 3     | 4         | 5       | 6       | 7       | 8       |
| WEIGHT (lbs)     | 3000        | 5000 | 10000 | 3000 Tray | 4000 LH | 4000 RH | 2250 RH | 2250 LH |
| CWT Combinations |             |      |       |           |         |         |         |         |
| 6,000 lb         | 1           |      |       | 1         |         |         |         |         |
| 8,000 lb         |             | 1    |       | 1         |         |         |         |         |
| 8,000 lb         |             | 1    |       | 1         |         |         |         |         |
| 11,000 lb        | 1           | 1    |       | 1         |         |         |         |         |
| 16,000 lb        | 1           | 2    |       | 1         |         |         |         |         |
| 21,000 lb        | 1           | 1    | 1     | 1         |         |         |         |         |
| 26,000 lb        | 1           | 2    | 1     | 1         |         |         |         |         |
| 36,000 lb        | 1           | 2    | 2     | 1         |         |         |         |         |
| 48,500 lb        | 1           | 2    | 2     | 1         | 1       | 1       | 1       | 1       |

To help identify individual counterweight components, the final weight has been steel stamp on each counterweight in kilograms and pounds.

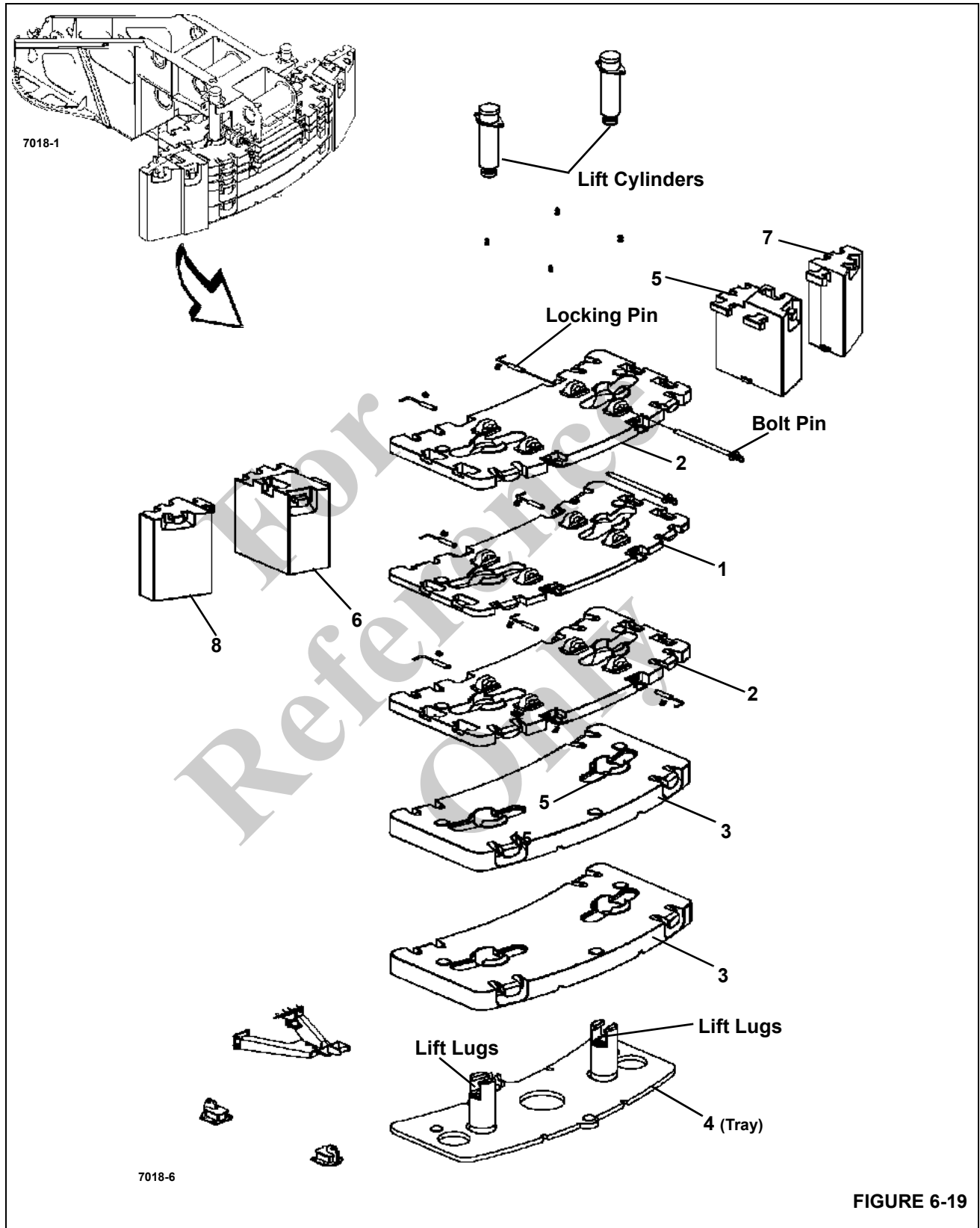


FIGURE 6-19



Counterweight Versions/Combinations



**WARNING**

**Crush Hazard!**

Only assemble the counterweights in the proper order, failure to do so could allow the wing weights to fall. The 3000 lb counterweight tray, the two 10,000 lb counterweight sections, the 3000 lb counterweight section, and the two 5000 lb counterweight sections must be rigged BEFORE the wing counterweights can be assembled.



**WARNING**

**Crush Hazard!**

Do not install the bolt pins while the 2250 lb and 4000 lb wing counterweights are rigged. The wing counterweights may be pushed off of the stack if the counterweight assembly is raised and lowered while the bolt pins are installed.



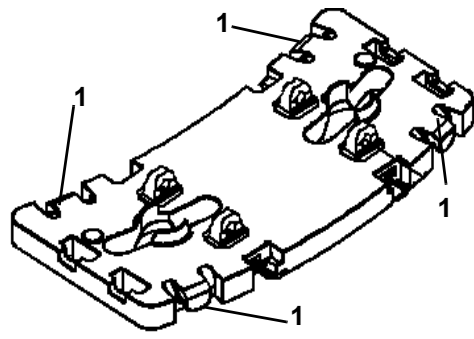
**WARNING**

**Risk of Accidents Due to Incompletely Rigged Machine!**

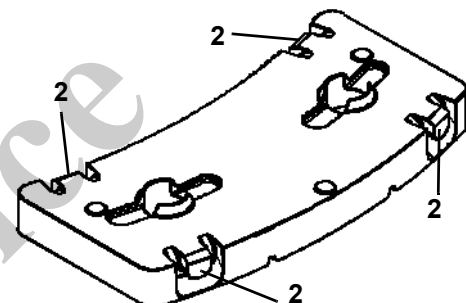
Only operate the truck crane when the auxiliary hoist is installed. In this way you prevent the RCL using an incorrect value for calculations and the truck crane overturning during work.

**Lifting Individual Counterweight Sections**

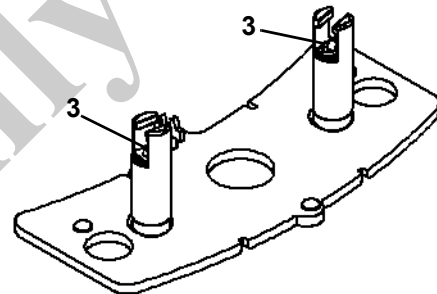
(Figure 6-20) identifies the lift sling points for the four different counterweight plates used on this machine. When lifting the counterweights onto the carrier platform, attach the lifting sling at the points identified.



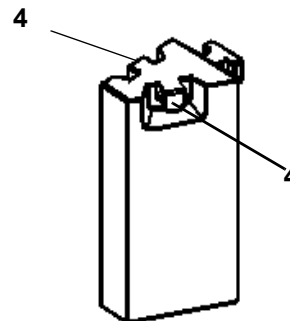
3,000/5,000 lb CW



10,000 lb CW



Tray (tray) CW



2,250/4,000 lb CW

7018-6

FIGURE 6-20

Lift the 3,000 lb and two 5,000 lb counterweight sections using the four casted sling points (1), (Figure 6-20). These three counterweight plates can be lifted onto the carrier platform together. Be sure to install the locking pins into the plates before lifting these plates together.

Lift the 10,000 lb counterweight sections using the four casted sling points (2), (Figure 6-20).

The 3000 lb tray section has two lifting lugs (3), (Figure 6-20) welded to the counterweight post for lifting.

Each of the 2250 lb and 4000 lb left and right hand wing counterweight sections have two lifting points (4), (Figure 6-20).

### Lifting Stacked Counterweight Sections

Each counterweight plate can be lifted individually onto the crane platform using the lifting points shown in (Figure 6-20). The only combination of counterweight plates that can be lifted together are the 3,000 lb (2,) (Figure 6-19) and the two 5,000 lb sections (2), (Figure 6-19). All other sections must be lifted individually.



### WARNING

#### Tip Over Hazard!

With a free on wheels truck crane, the superstructure may not be turned. With an outrigger spread of 7.6 ft, the superstructure may only be turned when a maximum of 6000 lbs counterweight is rigged. This prevents the truck crane from overturning when turning.

The 3,000 lb and two 5,000 lb counterweights can be combined and lifted as shown in (Figure 6-21). Make sure that all locking pins are in the locked position as shown in (Figure 6-25). Place the sling straps on the top counterweight.

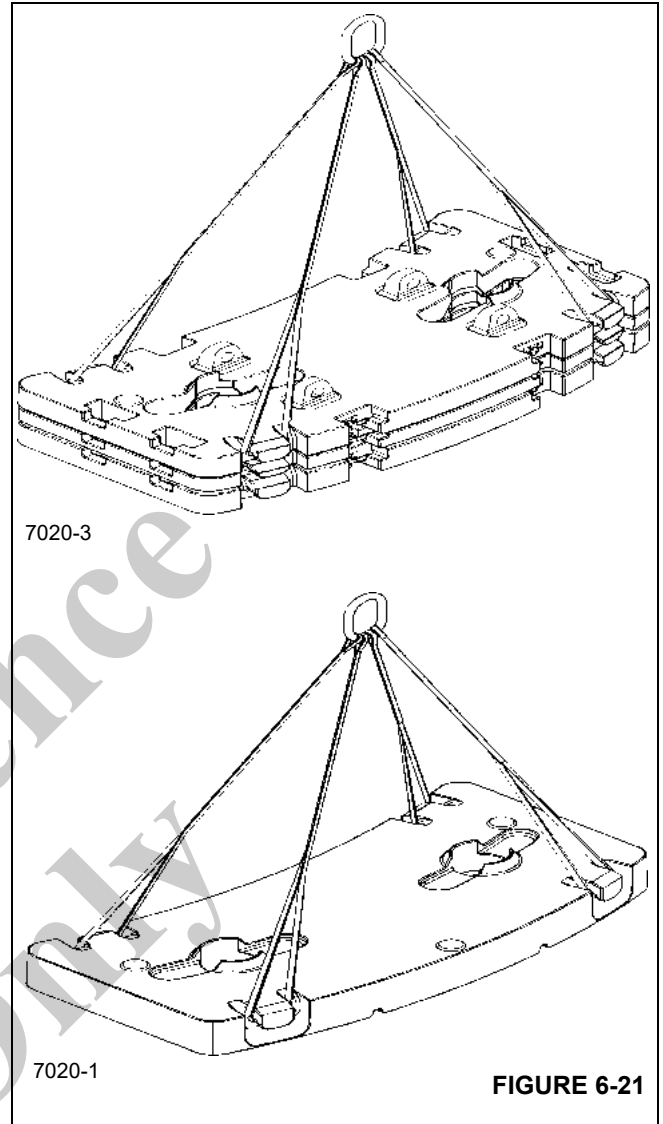


FIGURE 6-21

### CAUTION

#### Locking Pin Damage!

When lifting the 3000 lb and 5000 lb counterweights, make sure that ALL locking pins are completely installed in the lock position (Figure 6-25) before lifting the counterweight sections on and off of the crane.

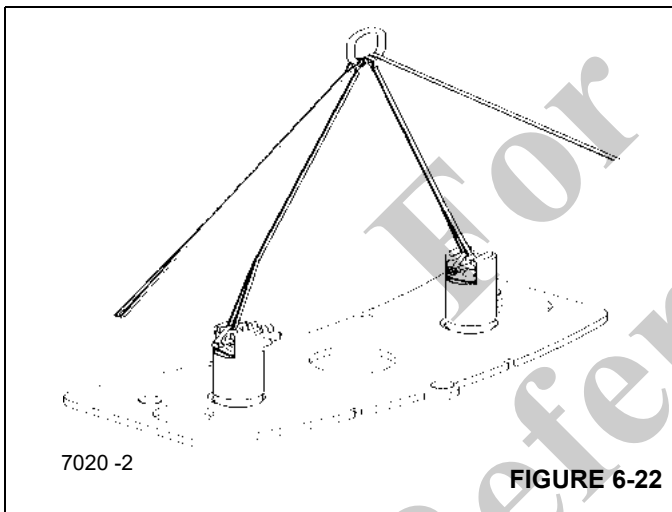
DO NOT leave the locking pins in the unlocked position while lifting the counterweight sections on and off of the crane. This ensures the counterweight sections are properly locked together when lifting the 3000 lb and 5000 lb sections at the same time. This also ensures that the locking pins do not contact the boom rest or other objects in the work area and become entangled.

**Slinging Points at the Counterweight Sections****DANGER****Crush Hazard!**

Only attach the various counterweight sections to the appropriate slinging point and use lifting gear with sufficient lifting capacity.

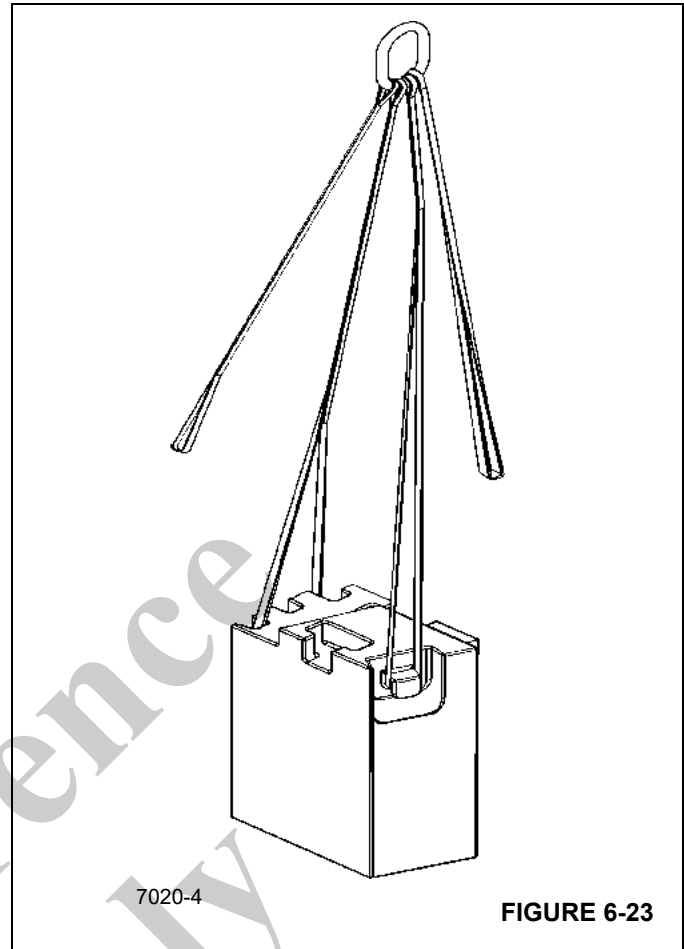
Lifting of the counterweight sections positioned on each other is only possible under certain conditions.

Use two of the sling straps with shackles (Figure 6-22) attached to each strap, to lift the 3,000 lb tray counterweight section.

**WARNING**

Do not lift this plate combined with any other plate. The lifting lugs are designed to lift only this counterweight.

Each of the 2,250 lb and 4,000 lb left and right hand wing counterweight plates (not shown) have two lifting points. Use two of the sling straps to lift these counterweights. Do not use the shackles (Figure 6-23).



The 10,000 lb counterweight section can be lifted as shown in (Figure 6-21). Do not lift this plate with the 3,000 lb, two 5,000 lb sections or with the 3,000 lb tray. Lift each 10,000 lb plate separately.

**Rigging the Counterweight**

With a free on wheels truck crane, the superstructure may NOT be turned.

**Prerequisites:**

- With the outrigger span required for crane work, the truck crane is stabilized according to the Load Capacity Chart.
- The RCL is set to the current rigging mode with the currently rigged counterweight.
  - a. The RCL is set to the proper rigging mode for the currently rigged counterweight.
  - b. Lift the 3000 lb tray plate from the separate vehicle and place it onto the counterweight platform.

**WARNING**

The 3000 lb counterweight tray plate must be lowered onto the counterweight platform for counterweight rigging work.

Make sure that the lifting lugs on the 3000 lb counterweight tray are folded in the horizontal position after rigging is complete. This ensures that the lift lugs do not come into contact with the counterweight hoisting unit.

Depending on the desired counterweight version, lift the required counterweight sections onto the 3,000 lb tray plate; assembling the counterweight version.

**CAUTION****Locking Pin Damage!**

When lifting the 3000 lb and 5000 lb counterweights, ensure ALL locking pins are completely installed in the lock position (Figure 6-25) before lifting the counterweight sections on and off of the crane. DO NOT leave the locking pins in the unlocked position while lifting the counterweight sections on and off of the crane. This ensures the counterweight sections are properly locked together when lifting the 3000 lb and 5000 lb sections at the same time. This also ensures that the locking pins do not contact the boom rest or other objects in the work area and become entangled.

**WARNING****Tip Over Hazard!**

Always check before swinging whether swinging is permitted in the truck crane's current rigging mode (counterweight, outrigger span, working radius).

Correct the rigging mode if necessary.

- c. Check whether the truck crane is supported with the required outrigger span as specified in the Lifting Capacity Table.
- d. Enter the current rigging mode on the RCL.
- e. Assemble required counterweight version – lift counterweight parts one after the other.
- f. Open the Counterweight Sub-Menu.
  - Correct the rigging mode, if necessary.

- Swing the superstructure into the rigging range and lift counterweight to the turntable (automatic) and pre-charge.
- g. Enter the current rigging mode with the newly rigged counterweight version on the RCL.

**Unrigging the Counterweight****DANGER**

Before unrigging the wing counterweights, ensure that the two bolt pins (Figure 6-19) are removed from the turntable and stowed in a location away from the superstructure. NEVER unrig the wing counterweights (5,6,7,8), (Figure 6-19) with the bolt pins installed.

**WARNING****Tip Over Hazard!**

Before swinging with the rigged counterweight, check whether swinging is permissible with the rigged outrigger span or with the truck free on wheels.

Check whether the truck crane is supported with the required outrigger span as specified in the Lifting Capacity Table.

1. Enter the current rigging mode on the RCL.
2. Open the Counterweight sub-menu.
  - Swing the superstructure into the rigging range and set down the counterweight onto the counterweight platform (automatic).
3. Enter the current rigging mode with the presently rigged counterweight version on the RCL.
4. Lift the counterweight parts off the counterweight platform, as required by the respective driving mode.

**Lower 3,000 lb Tray Plate on the Counterweight Platform**

The 3,000 lb tray plate must be placed on the counterweight platform for on-road driving, depending on driving mode. Further counterweight sections can be lowered on the 3,000 lb tray plate. Consult all over the road driving regulations before driving on the highway with counterweights on the crane platform.

Select the current rigging mode on the RCL with the current rigged counterweight on the turntable or enter the corresponding RCL code.

**WARNING****Tip Over Hazard!**

With a free on wheels truck crane, the superstructure may NOT be turned. With an outrigger spread of 7.6 ft., the superstructure may only be turned when a maximum of 6000 lbs counterweight is rigged. This prevents the truck crane from overturning when turning.

**WARNING****Crushing Hazard!**

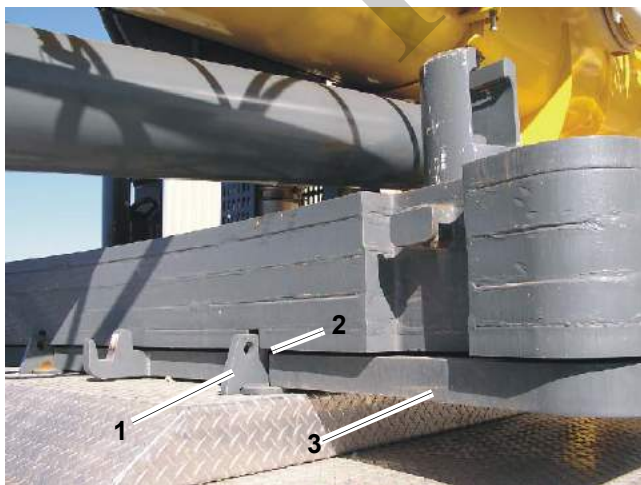
Make sure that helpers maintain sufficient clearance from the 3,000 lb tray plate with all parts of their bodies during placement.

Remove all objects from the counterweight platform which could become clamped or crushed.

**DANGER****Crushing Hazard!**

Make sure that no one is permitted in the swing radius of the crane while they are lifting a counterweight section from the separate vehicle onto the carrier.

Anyone who climbs onto the carrier is in the rotating range of the superstructure.

**FIGURE 6-24**

On the counterweight platform, there are four retaining brackets (1), (Figure 6-24), which brings the 3,000 lb tray plate (3), (Figure 6-24) into proper position for rigging and for secure driving.

1. Sling the 3,000 lb tray plate and lift it onto the counterweight platform.
2. Position the 3,000 lb tray plate (3), (Figure 6-24) in such a way that the four retaining brackets (1), (Figure 6-24) fit into the four cut outs (2), (Figure 6-24).

### Check the Position of the Locking Pins for 3,000 & 5,000 lb Counterweight Sections

There are three counterweight sections that require locking pins during rigging; the 3000 lb counterweight plate and the two 5000 lb counterweight plates. The locking pins allow the 3000 lb and 5000 lb counterweight sections to be assembled and secured together. Care must be taken to ensure that the locking pins are in the proper positions during rigging work.

The crane can travel on the highway with up to a maximum of 16,000 lbs attached to the superstructure.

Ensure all the locking pins are in the Locked position when:

- Lifting the 3000 lb and/or the 5000 lb counterweight sections onto and off of the crane.
- Raising and lowering the counterweight assemblies with the counterweight hoisting unit.
- Swinging the turntable with the counterweight attached.
- Traveling with the crane while the 3000 lb and/or the 5000 lb counterweight sections are secured to the turntable.

**NOTE:** It is permissible to travel on the highway with the 3,000 lb counterweight tray attached to the superstructure provided the pin that secures the tray to the wishbone bracket is in place.

Make sure that all the locking pins are in the Unlocked position when:

- Assembling the 3000 lb and 5000 lb counterweight sections together.
- Disassembling the 3000 lb and 5000 lb counterweight sections from each other.

#### Locking Pin Position

The locking pins (Figure 6-25) are shown in both the Locked (1) and Unlocked (2) position. To place the pin in the Unlocked position, disengage the spring-loaded retainer pin (3), (Figure 6-25). Rotate and remove the locking pin from the holder.

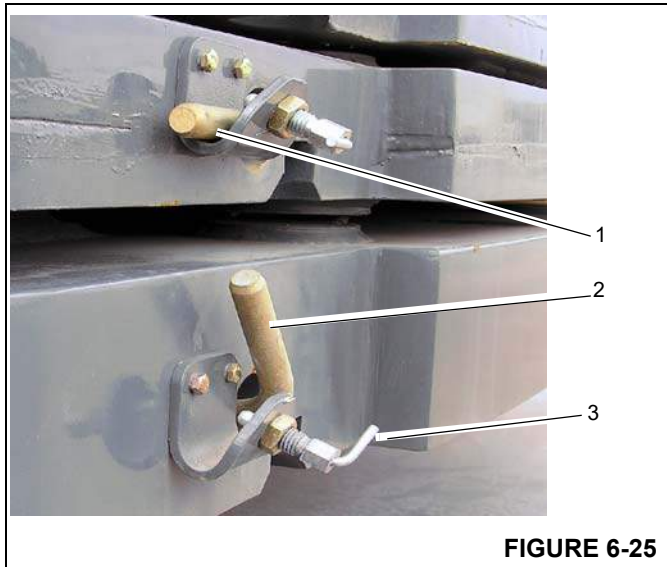


FIGURE 6-25

**CAUTION****Locking Pin Damage!**

After assembling the 3000 lb and 5000 lb counterweight sections together, always place the locking pins in the Locked position before rigging the counterweights onto the crane. This prevents the locking pins from protruding or coming free and protruding over the superstructure during crane work.

**Assembling Counterweight Versions/Combinations**

**!** **DANGER**  
**Crushing Hazard!**

Make sure that no one is permitted in the swing radius of the crane while they are lifting a counterweight section from the separate vehicle onto the carrier.

Anyone who climbs onto the carrier is in the rotating range of the superstructure.

**!** **DANGER**  
**Tip Over Hazard!**

With a free on wheels truck crane, the superstructure may not be turned.

With an outrigger spread of 7.6 ft, the superstructure may only be turned when a maximum of 8,000 lb counterweight is rigged. This prevents the truck crane from overturning when turning.

**!** **WARNING**  
**Falling Parts Hazard!**

Lifting of the stacked counterweight sections is only possible under certain conditions. Not all counterweight sections are designed for lifting stacked sections.

**!** **WARNING**

**Risk of Accident and Damage to Machine!**

Only assemble the left and right wing counterweights as prescribed in this chapter and as shown in (Figure 6-19). The left and right wing counterweights must only be rigged to the 3000 lb or 5000 lb counterweight section that is on top of the counterweight assembly.

**!** **WARNING**

**Risk of Accident and Damage to Machine!**

Only rig the wing counterweights to the top 3000 lb or 5000 lb counterweight section while the counterweight assembly (1, 2, 3, and 4), (Figure 6-19) is setting on the counterweight platform. NEVER rig any of the wing counterweights while the 3000 lb and/or the 5000 lb counterweights are secured to the turntable with the bolt pins (Figure 6-19).

**!** **WARNING**

**Risk of Accident and Damage to Machine!**

Before rigging the left and right wing counterweights, ensure the two bolt pins (Figure 6-19) are stowed in a location away from the superstructure. NEVER secure the 3000 lb or 5000 lb counterweight sections to the turntable while any of the left and right wing counterweights are rigged to the crane.

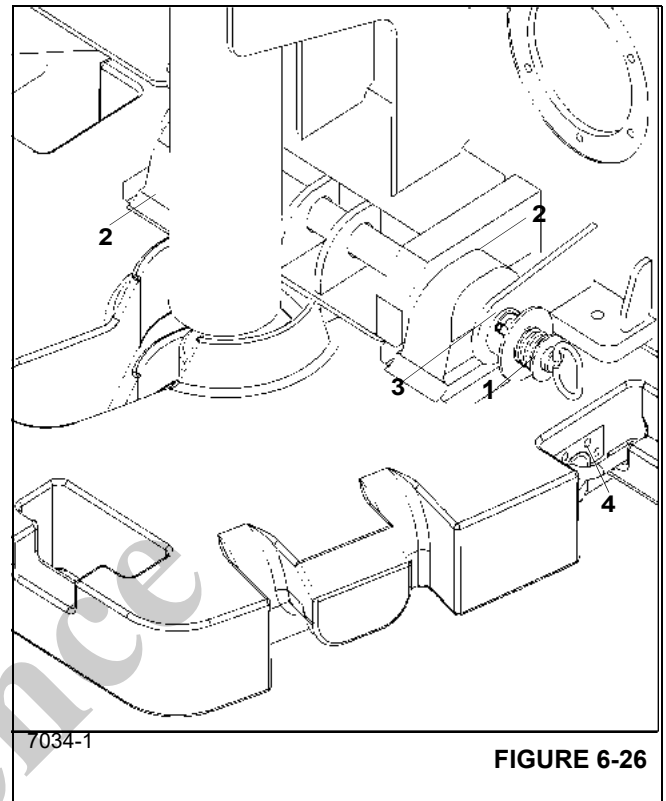
**Procedures**

All recommended counterweight combinations for this machine are identified in *Table 6-2: Standard Counterweight Combinations*, page 6-14. Refer to this table and (Figure 6-19) to select the required combinations of counterweight plates.

1. Use the 3000 lb tray counterweight plate for all counterweight combinations as noted in the *Table 6-2: Standard Counterweight Combinations*, page 6-14,

except as noted in Step 5 below. Load the 3,000 lb tray plate onto the counterweight platform first and then the remaining plates on top of it.

2. The two 10,000 lb counterweight plates must be rigged with the 3000 lb counterweight tray plate. They must be rigged on top of the 3000 lb tray plate and under the 3000 lb and two 5000 lb counterweight plates.
3. The 2,250 lb and 4,000 lb winged counterweights can only be attached to the 3,000 lb or the two 5,000 lb plates. The wing counterweights can only be attached to the plate that is on top of the assembly. The wing counterweights can not be attached to the lower plates in the assembly. The winged counterweights require a notch cut-out for rigging, only the 3,000 lb and 5,000 lb plates have this cut out.
4. The two 10,000 lb counterweight plates must be rigged with the 3000 lb tray plate.
5. The 3,000 lb and two 5,000 lb counterweight plates can be secured to the turntable. To do this, assemble the 3,000 lb counterweight plate, the two 5,000 lb counterweight plates, the two 10,000 lb counterweight plates, and the 3,000 lb counterweight tray onto the counterweight platform according to (Figure 6-19). Move the turntable into position and raise the counterweight assembly with the counterweight hoisting unit. Secure the top counterweight plate (3,000 lb or 5,000 lb) to the turntable with the two bolt pins (1), (Figure 6-26). Place the bolt pins through the two mounting brackets (2), (Figure 6-26) and rotate the role pins (3), (Figure 6-26) into the slots on the mounting bracket. Make sure that all the locking pins (4), (Figure 6-26) are in the locked position as shown in (Figure 6-25).



**NOTE:** **DO NOT** install the two bolt pins while any of the 4,000 lb or 2,250 lb wing counterweights are rigged to the crane.



### WARNING

#### Risk of Accident and Damage to Machine!

Before rigging the left and right wing counterweights, ensure the two bolt pins (Figure 6-19) are stowed in a location away from the superstructure. **NEVER** secure the 3000 lb or 5000 lb counterweight sections to the turntable while any of the left and right wing counterweights are rigged to the crane.



### Counterweight Hoist Unit

The counterweight hoist unit consists of two lifting cylinders which are attached to the turntable.

The lifting cylinders raise the 3,000 lb tray plate and the assembled counterweights into position on the turntable. When the counterweight plates are ready to be removed from the turntable the lifting cylinders lower the counterweights back onto the crane counterweight platform.

**! WARNING**  
**Crush Hazard!**

Before lifting the 3,000 lb tray plate, remove all objects from the top counterweight section which could be crushed.

Be sure that no person is on the counterweight platform while the counterweight is being lifted or lowered.

The lifting cylinders (1), (Figure 6-27) can be extended and retracted.

To lift and lower the counterweight, the lifting cylinders are rotated into the posts on the 3000 lb counterweight tray.

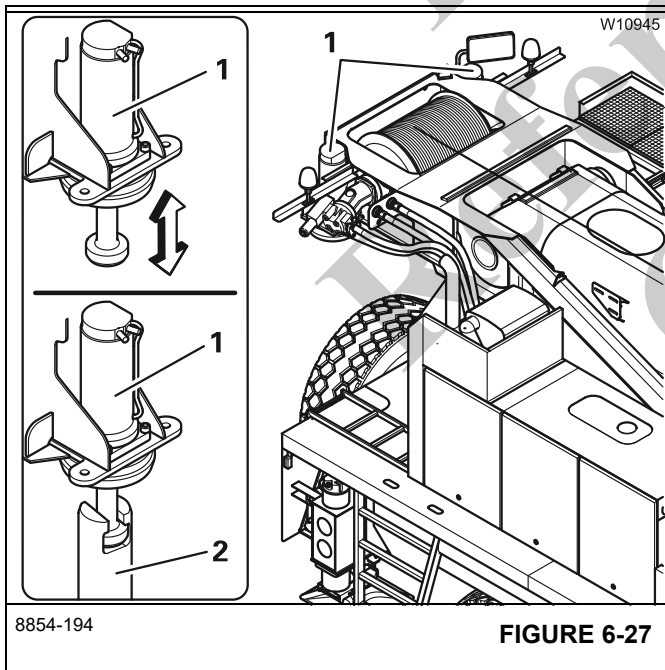


FIGURE 6-27

If necessary, open the main menu and press the button (1), (Figure 6-28) once.

The Counterweight sub-menu opens.

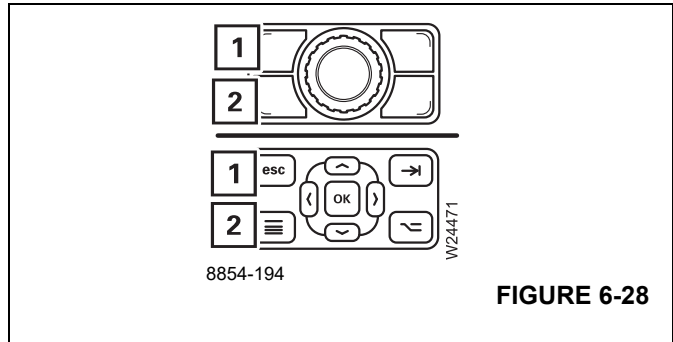


FIGURE 6-28

#### Extending/Retracting the Lifting Cylinders

This section describes how to operate the lifting cylinders manually,

- for correcting the displayed rigging mode, and
- for pre-charging the counterweight afterwards.

**NOTE:** Always lift and lower the counterweight in Automatic Mode, otherwise swing with extended lifting cylinders will be blocked.

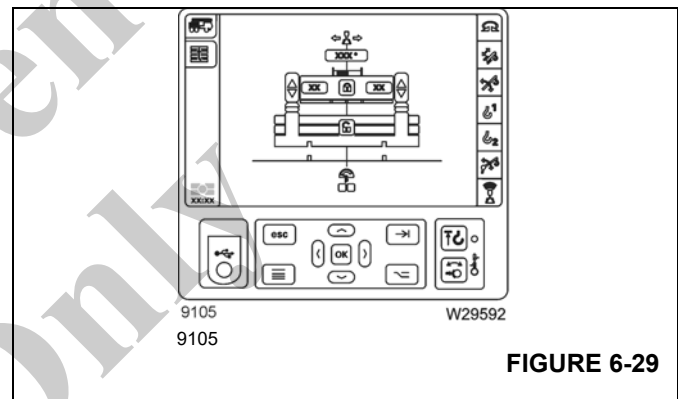


FIGURE 6-29

#### Pre-Charge

Use the UP arrows (Figure 6-29) to fully raise the cylinders. This is needed if the cylinders were operated manually and not fully raised.

#### OR

The accumulator will charge automatically if the pressure is low, the engine is on, and no other function is using the valves.

#### Automatic Mode, Rigging

While the automatic process is being performed, you can always

- Cancel the automatic process, **OR**
- Interrupt the automatic process by letting go of the control lever. After moving the lever in the displayed direction once more, the automatic process is continued.

**Rotating With the Rigged Counterweight**



**WARNING**

**Tip Over Hazard!**

You may only rotate the superstructure with rigged counterweight if the truck crane is stabilized with a sufficient outrigger span. If this minimum outrigger span is not observed, the truck crane can overturn during rotating.

For small counterweights, the main boom must be raised to one of the angles permitted in the operating area. With larger working radius, the truck crane can overturn during rotating.

The following table shows, depending on counterweight and outrigger span, whether rotating the superstructure is permitted or whether the superstructure must be locked after rigging the counterweight.

|                  | Support Condition             |                               |                    |                    |                    |
|------------------|-------------------------------|-------------------------------|--------------------|--------------------|--------------------|
|                  | On Tires                      | 0% Retracted                  | 57% Mid 1-Extended | 79% Mid 2-Extended | 100% Full-Extended |
| No Counterweight | Rotation <b>NOT</b> permitted | Rotation permitted            | Rotation permitted |                    |                    |
| 6,000 lb         |                               |                               |                    |                    |                    |
| 8,000 lb         |                               | Rotation <b>NOT</b> permitted |                    |                    |                    |
| 11,000 lb        |                               |                               |                    |                    |                    |
| 16,000 lb        |                               |                               |                    |                    |                    |
| 21,000 lb        |                               |                               |                    |                    |                    |
| 26,000 lb        |                               |                               |                    |                    |                    |
| 36,000 lb        |                               |                               |                    |                    |                    |
| 48,500 lb        |                               |                               |                    |                    |                    |



**WARNING**

**Tip Over Hazard!**

Use the table to check whether sufficient outrigger span is set for the rigged counterweight or the free-standing truck crane, before you unlock and rotate the superstructure. Only rotate the superstructure if the truck crane is sufficiently stabilized. This prevents the truck crane from overturning during rotating because of too much or too less counterweight mass.

**Extending/Retracting the Lifting Cylinders**

This section describes how to operate the lifting cylinders manually,

- For correcting the displayed rigging mode, and
- For pre-charging the counterweight afterwards.

**CAUTION**

**Machine Damage!**

With the override switch actuated, the functions are always enabled.

Swing the superstructure only when the lifting cylinders are fully retracted.

**NOTE:** Always lift and lower the counterweight in Automatic Mode, otherwise; swinging with extended lifting cylinders will be blocked. Refer to *Automatic Mode Rigging*, page 6-25, and *Automatic Mode Unrigging*, page 6-27.

**Correct the Rigging Mode**

You can use the automatic mode only if the current rigging mode is displayed (Figure 6-30).

|   |                        |
|---|------------------------|
| A | Counterweight rigged   |
| B | Counterweight unrigged |

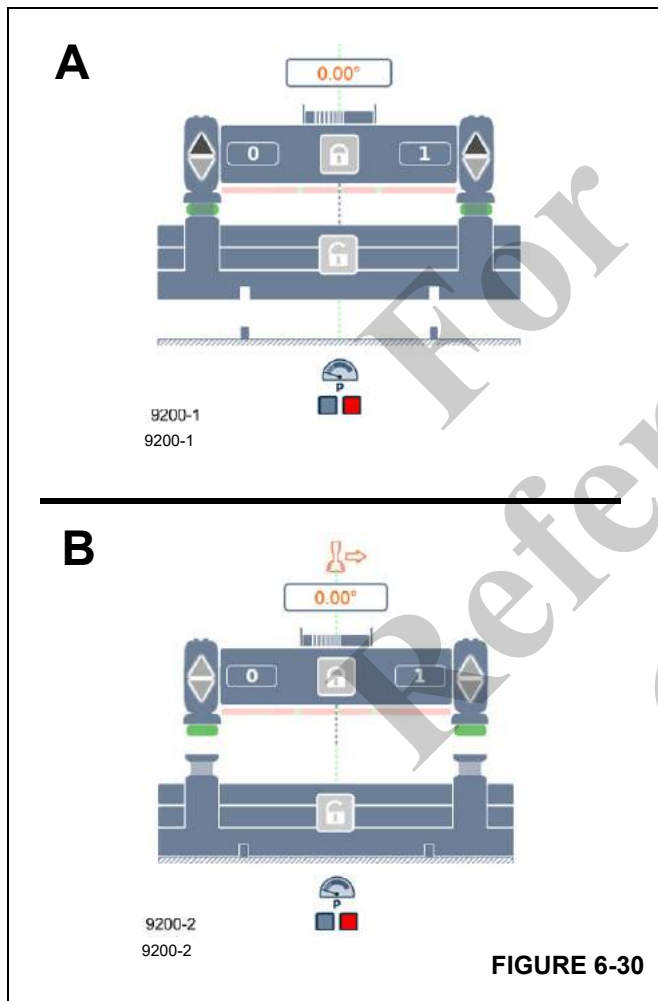


FIGURE 6-30

If necessary, correct the displayed rigging mode as follows:

- Swing the superstructure out of the rigging range so that the lifting cylinders can be freely extended.

Assuming the symbol (4), (Figure 6-31) is yellow with the counterweight unrigged:

- Press the override button (3), (Figure 6-31).

- Fully extend the lifting cylinders – symbol (1), (Figure 6-31).
- Release the override button (3), (Figure 6-31).
- Fully retract the lifting cylinders – button (2), (Figure 6-31).

The symbols (4), (Figure 6-31) become green.

You can now use the Automatic Mode.

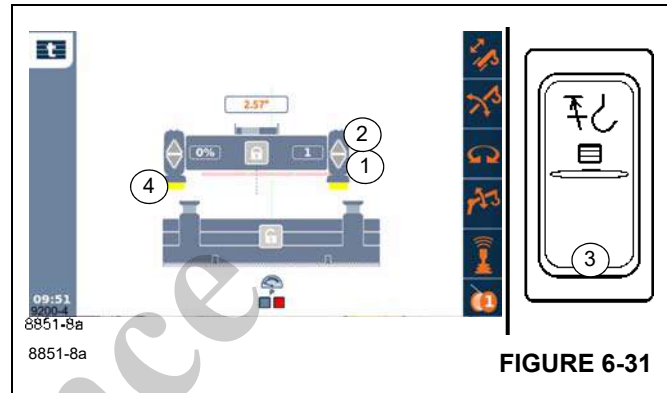


FIGURE 6-31

**Pre-Tensioning**

When the symbol (3), (Figure 6-32) is red, you must pre-tension the counterweight.

- Select and confirm the symbol (1), (Figure 6-32) until the symbol (2), (Figure 6-32) becomes green.

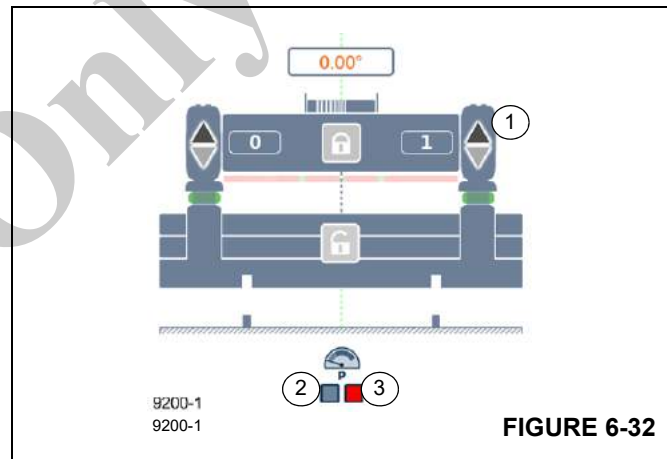


FIGURE 6-32

**Automatic Mode Rigging**

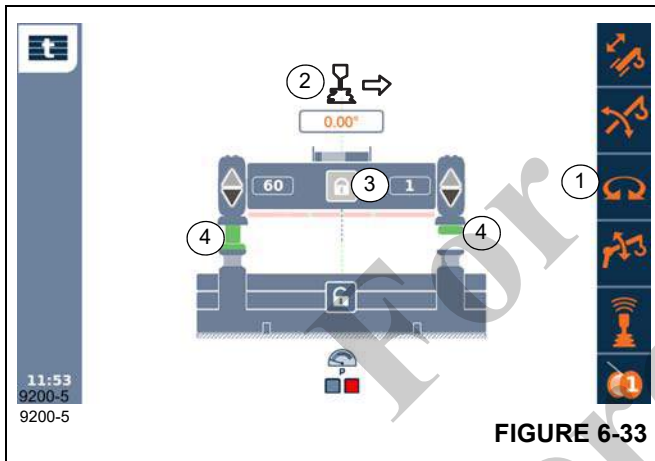
While the automatic mode is being executed, you can always:

- **Cancel** the automatic mode. Refer to *Cancel Automatic Mode*, page 6-28.
- **Interrupt** the automatic mode by letting go of the control lever. After moving the lever in the displayed direction once more, the automatic mode is continued.

**Prerequisites:**

- The counterweight combination must be assembled.
- The lifting cylinders must be fully retracted – symbol (4), (Figure 6-33) green.
- The swing gear must be switched ON – symbol (1), (Figure 6-33) green.
- The superstructure must be in the rigging range:
  - Symbol (3), (Figure 6-33) active,
  - Symbol (2), (Figure 6-33) displayed.

- The superstructure turns into position (A), (Figure 6-34).
- The lifting cylinders are extended (B), (Figure 6-34).
- Release the control lever.



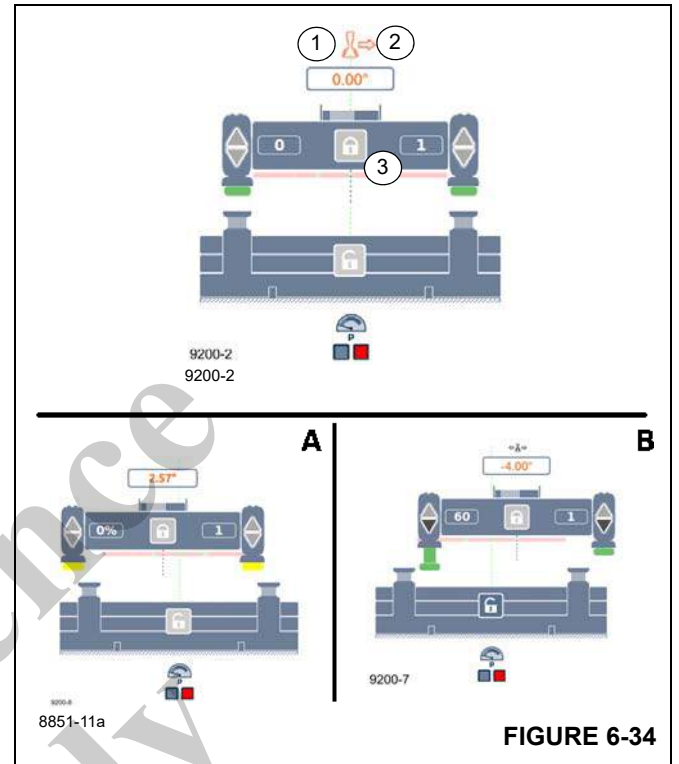
**FIGURE 6-33**

**Switch on Automatic Mode**

- Select and confirm the symbol (3), (Figure 6-34).

**Execute the Automatic Mode**

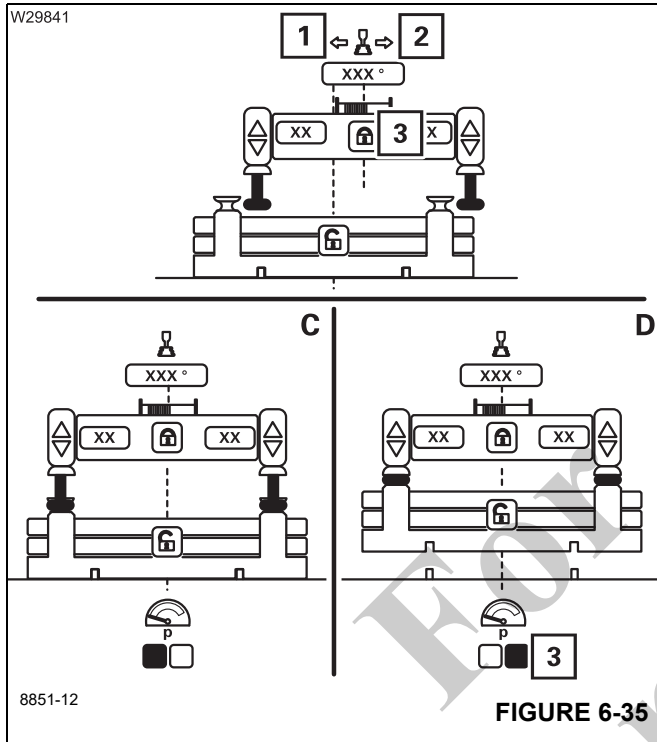
- To swing, move the control lever in the displayed direction (1) or (2), (Figure 6-34) – the automatic mode starts.



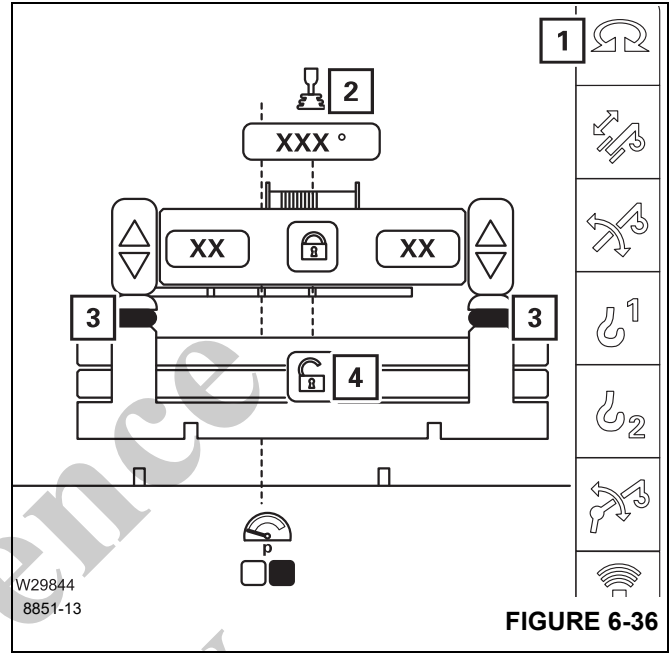
**FIGURE 6-34**

- To swing, move the control lever in the displayed direction (1), (Figure 6-35) or (2), (Figure 6-35) – the automatic mode continues.
  - The superstructure turns into position (C), (Figure 6-35).
  - The lifting cylinders are retracted (D), (Figure 6-35).

- The counterweight is pre-charged – symbol (3), (Figure 6-35) green.
- Release the control lever.



- The swing gear must be switched on – symbol (1), (Figure 6-36) green.
- The superstructure must be in the rigging range:
  - Symbol (4), (Figure 6-36) active,
  - Symbol (2), (Figure 6-36) displayed.



**Automatic Mode Unrigging**

While the automatic mode is being executed, you can always:

- **Cancel** the automatic mode. Refer to *Cancel Automatic Mode*, page 6-28.
- **Interrupt** the automatic mode by letting go of the control lever. After moving the lever in the displayed direction once more, the automatic mode is continued.

**Prerequisites:**

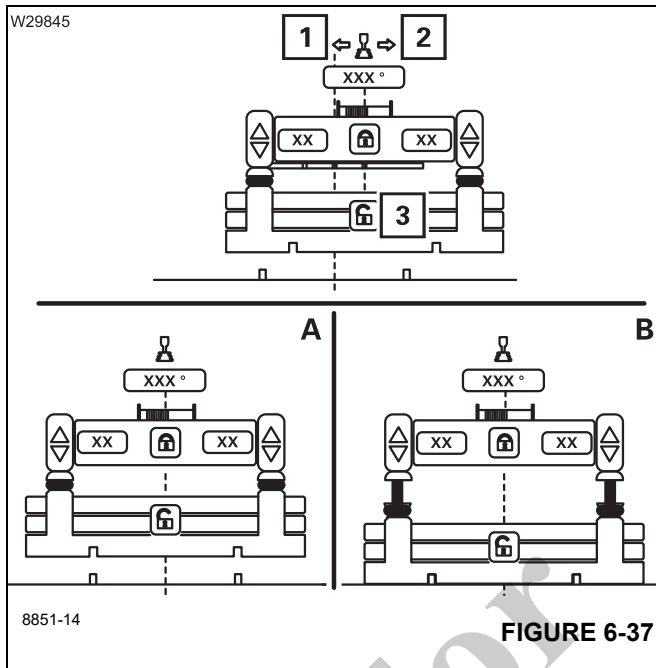
- The lifting cylinders must be fully retracted – symbol (3), (Figure 6-36) green.

**Switch on Automatic Mode**

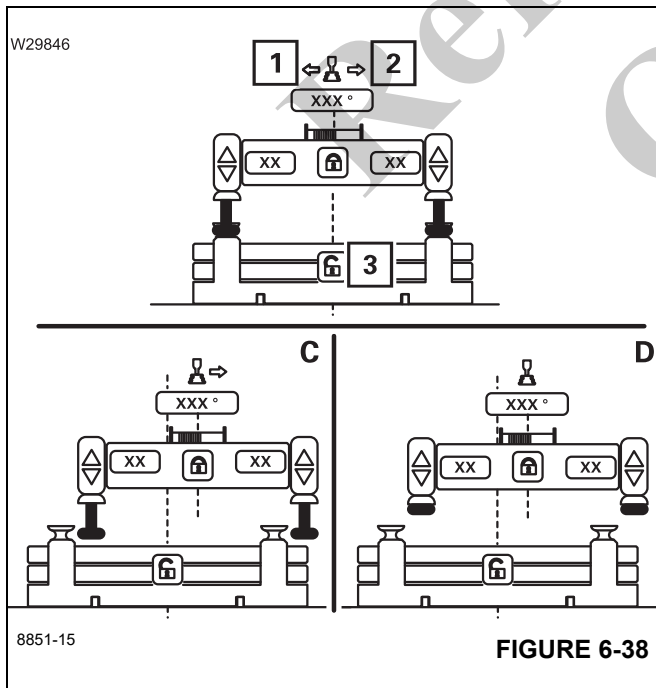
- Select and confirm the symbol (3), (Figure 6-37).

**Execute Automatic Mode**

- To swing, move the control lever in the displayed direction (1), (Figure 6-37) or (2), (Figure 6-37) – the Automatic Mode starts.
  - The superstructure turns into position (A), (Figure 6-37).
  - The lifting cylinders are extended (B), (Figure 6-37).
- Release the control lever.



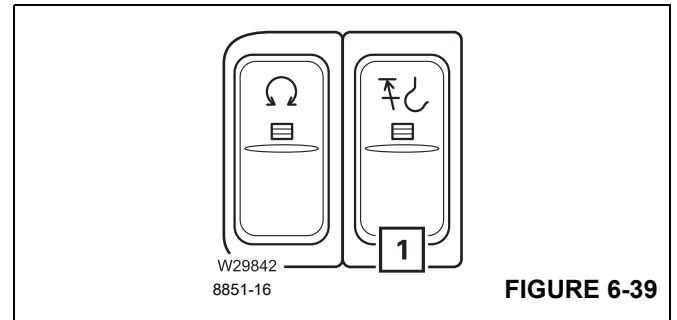
- To swing, move the control lever in the displayed direction (1), (Figure 6-38) or (2), (Figure 6-38) – the automatic mode continues.
  - The superstructure turns into position (C), (Figure 6-38).
  - The lifting cylinders are retracted (D), (Figure 6-38).
- Release the control lever.



**Cancel Automatic Mode**

You can cancel the Automatic Mode any time.

Press in the override button (1), (Figure 6-39) – the Automatic Mode is canceled.



**CAUTION**

**Machine Damage!**

With the override switch actuated, the functions are always enabled.

Swing the superstructure only when the lifting cylinders are fully retracted.

If you have canceled the automatic operation, then you must:

**In Position (A), (Figure 6-40):**

- Fully retract the lifting cylinders – symbol (1).

**In Position (B), (Figure 6-40):**

- Turn the superstructure into position (A).
- Fully retract the lifting cylinders – symbol (1).

**Unlocking/Locking the Rear Counterweight Platform**

**Unlocking**

You must unlock the rear counterweight platform:

- Before you lift the counterweight combination on to the turntable,
- Before you set down or pick up the 3,000 lb base plate,
- If no counterweight is to be transported on the counterweight platform.

**CAUTION**

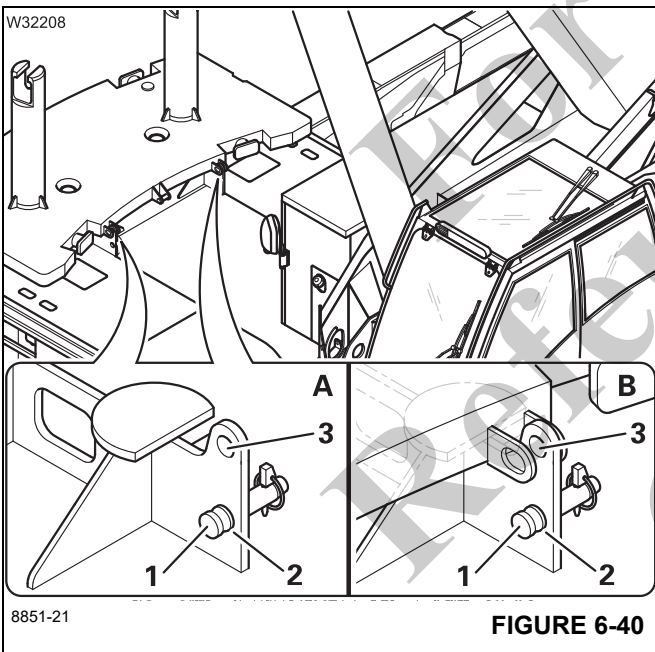
**Machine Damage!**

Always unlock the counterweight platform before you pick up the counterweight.

This prevents damage to the counterweight platform and the base plate.

The procedure is applicable irrespective of whether

- (A), (Figure 6-40) – no counterweight is set down or
- (B), (Figure 6-40) – a counterweight is set down
- Remove the pins (1), (Figure 6-40) from the connecting points (3), (Figure 6-40) and plug them into the clamps (2), (Figure 6-40).
- Secure the pins.



**Locking**

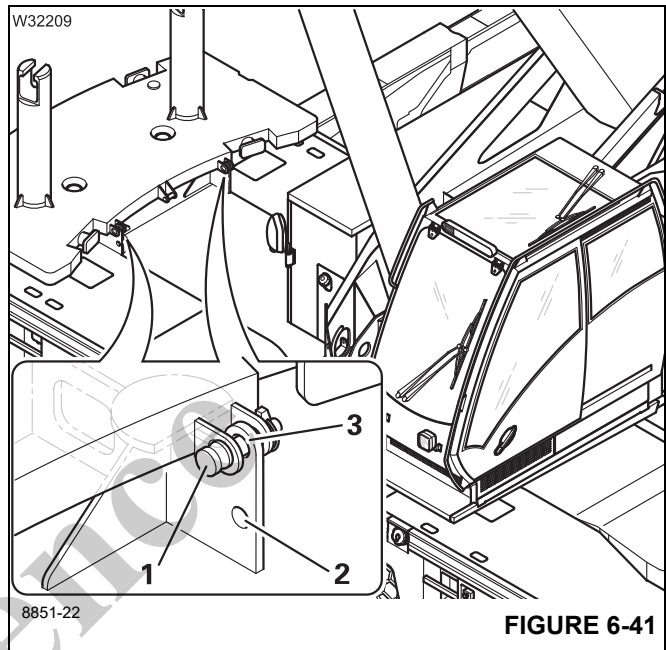
You must lock the rear counterweight platform after the counterweight has been set down for transport.

**! DANGER**  
**Crush Hazard!**

You must always lock the counterweight platform after the counterweight has been set down for transport.

This will prevent the unsecured counterweight falling and resulting in death or serious injury.

- Remove the pins (1), (Figure 6-41) from the clamps (2), (Figure 6-41) and insert them into the connecting points (3), (Figure 6-41).
- Secure the pins.



**Swinging with Rigged Counterweight**

Swinging with a rigged counterweight is only permissible when:

- The necessary outrigger span is rigged,
- The respective RCL code is shown, and
- The permissible working radius according to Lifting capacity table is maintained.



**WARNING**

**Tipping/Overload Hazard!**

RCL lockouts and limiters are not functional when remote control is used.

When operating functions from remote control, operator must be positioned to see crane movement.

Read the Operator Manual.

The following table specifies (depending on the counterweight and outrigger span) whether swinging the superstructure is:

- Permitted
- Only permitted for certain working radii
- Disabled (with the correct rigging mode)



|                  | Support Condition             |                               |                    |                     |                     |
|------------------|-------------------------------|-------------------------------|--------------------|---------------------|---------------------|
|                  | On Tires                      | 0% Retracted                  | 57% Mid 1-Extended | 79% Mid 2 -Extended | 100% Full- Extended |
| No Counterweight | Rotation <b>not</b> permitted | Rotation permitted            | Rotation permitted |                     |                     |
| 6,000 lb         |                               | Rotation permitted            |                    |                     |                     |
| 8,000 lb         |                               | Rotation permitted            |                    |                     |                     |
| 11,000 lb        |                               | Rotation <b>not</b> permitted |                    |                     |                     |
| 16,000 lb        |                               |                               |                    |                     |                     |
| 21,000 lb        |                               |                               |                    |                     |                     |
| 26,000 lb        |                               |                               |                    |                     |                     |
| 36,000 lb        |                               |                               |                    |                     |                     |
| 48,500 lb        |                               |                               |                    |                     |                     |

## RIGGING WORK ON THE MAIN BOOM

### Hook Block on the Bumper

When the hook block is transported on a separate vehicle, refer to *Hook Block on a Separate Vehicle*, page 6-30.

### Picking Up the Hook Block

Depending on the driving mode, you must pick up the hook block from the front bumper.

The main boom must be fully retracted.

Enter the current rigging mode on the RCL.

- Slacken the hoist rope and lower the main boom simultaneously.
- Lower the main boom until the boom head is in a vertical position above the hook block.
- Detach the hook block from the retaining rope (1), (Figure 6-42).

### Attaching the Hook Block

Depending on the driving mode, you can attach the hook block to the front bumper.

- Set down the main boom on to the boom rest and pull the hoist rope tight only to the extent that the hook block is stabilized in its position.

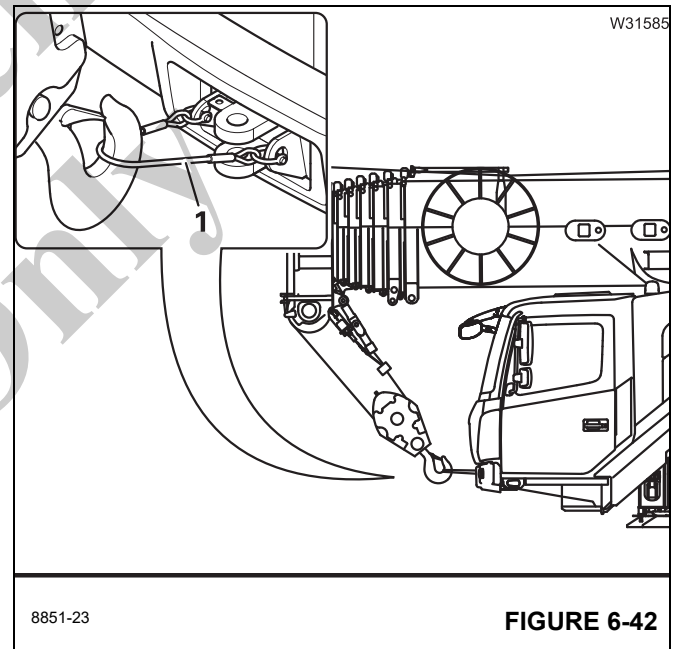


FIGURE 6-42

**NOTE:** If the anti-two block switch is deactivated while you tighten the hoist rope, you can override the lockout of the anti-two block switch, refer to *Anti Two-Block Switch and Lowering Limit Switch*, page 4-65.



### WARNING

Ensure that the hookblock does not block the operator's vision for driving when attached to the front bumper.

- Raise the hook block vertically above the retaining rope (1), (Figure 6-42).
- Lower the hook block and attach the hook block to the retaining rope (1), (Figure 6-42).

## Hook Block on a Separate Vehicle

### Picking Up the Hook Block

Depending on the driving mode, the hook block can be placed on a separate vehicle.

- If the respective setting has been made in the RCL, swing the superstructure and lower the main boom until

the boom head is directly above the hook block (1), (Figure 6-43).

- Unreel the hoist rope.
- Reeve the hoist rope into the hook block (1), (Figure 6-43). Refer to *Reeving the Hoist Rope*, page 6-32.
- Raise the hook block off the separate vehicle.
- Install the anti-two block switch. Refer to *Installing/Removing the Anti Two-Block Switch*, page 6-36.

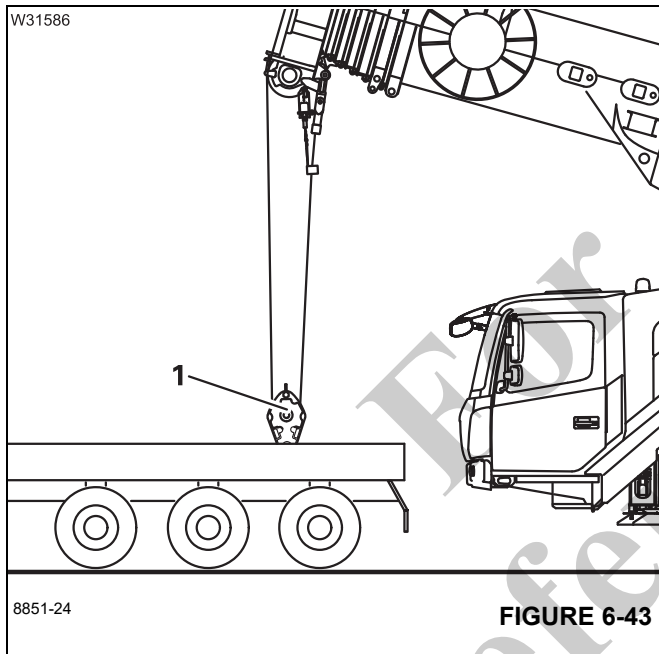


FIGURE 6-43

**Setting Down the Hook Block**

Depending on the driving mode, the hook block must be placed on a separate vehicle.

- With the RCL set accordingly, fully retract the main boom.
- Raise the hook block until it is approx. 1 m (3.3 ft) below the main boom.
- Lower the main boom and set the hook block (1), (Figure 6-43) down on the separate vehicle.
- Detach the anti-two block switch weight (2), (Figure 6-44) from the hoist rope. Refer to *Removing the Anti-Two Block Switch Weight.*, page 6-39.
- Unreeve the hoist rope. Refer to *Unreeving the Hoist Rope*, page 6-36.
- Secure the hook block (1), (Figure 6-45) for transport.
- Set down the main boom on the boom rest.

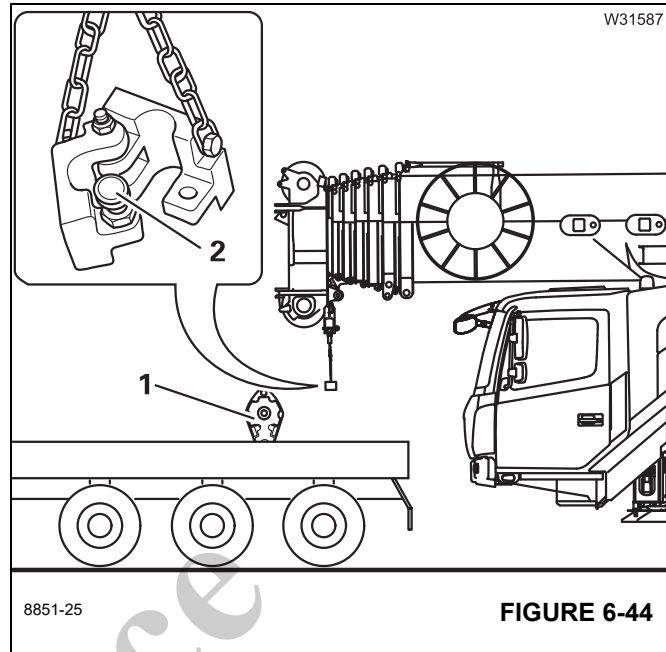


FIGURE 6-44

**Fastening the Hoist Rope to the Bumper**

Do not attach the rope end clamp to the front towing coupling! The towing coupling must be free for a tow-rod in emergencies.

- Attach the rope end clamp to the retaining rope (1), (Figure 6-45).
- Pull the hoist rope slightly taut.
- Fasten the anti-two block switch weight to the hoist rope.

The hoist rope and anti-two block switch weight are now secured for driving.

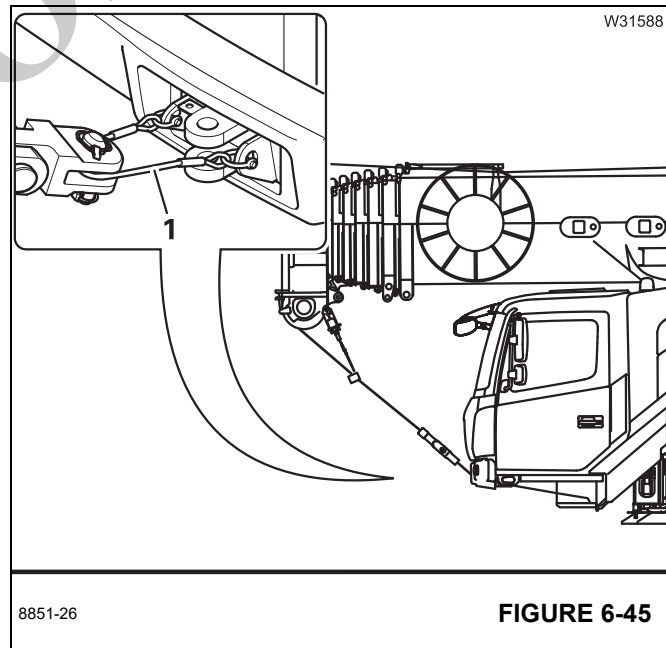


FIGURE 6-45

**Reeving the Hoist Rope**

**CAUTION**

**Wire Rope Damage!**

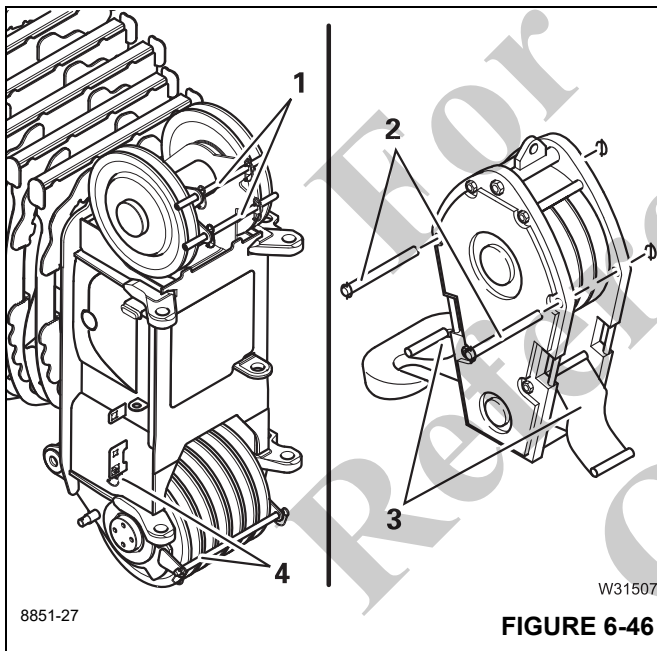
Ensure that the hookblock being used has sufficient overhaul weight to prevent the hoist rope from becoming slack when operating with no load on the hook.

**Opening the Hook Block:**

- Pull out the rods (2), (Figure 6-46).
- Fold down the plates (3), (Figure 6-46).

**Positioning the Hoist Rope:**

- Pull out the rods (1), (Figure 6-47) and (4), (Figure 6-47).



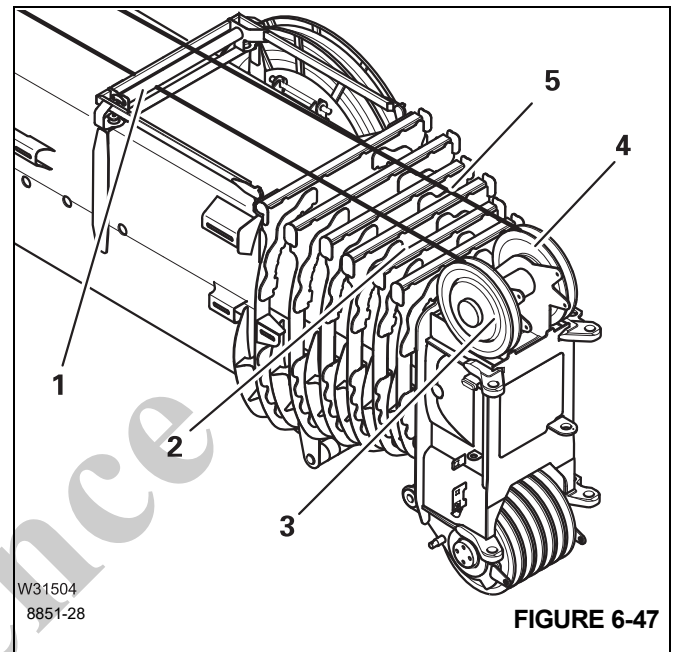
- Feed the main hoist rope (2), (Figure 6-47) under the rope grab (1), (Figure 6-47).

If two hoist ropes are reeved, you must feed the auxiliary hoist rope (5), (Figure 6-47) over the rope grab.

- Feed the main hoist rope to the head sheave (3), (Figure 6-47).

- Feed the auxiliary hoist rope to the head sheave (4), (Figure 6-47).

Use the rope grab also when working with the lattice extension.



**Reeving the Hoist Rope:**

|   |                              |
|---|------------------------------|
| A | for the main hoist rope      |
| B | for the auxiliary hoist rope |

- Guide the hoist rope over the upper head sheave (1), (Figure 6-48) to the lower head sheave (2), (Figure 6-48).
- Guide the hoist rope from the front around the outer pulley (3), (Figure 6-48) of the hook block, upwards to the main boom head.
- Guide the hoist rope from the rear over the next required head sheave (4), (Figure 6-48), etc.
- Reeve the hoist rope with the required number of lines.

Possible reevings, refer to *Possible Reeving on the Main Boom*, page 6-6.

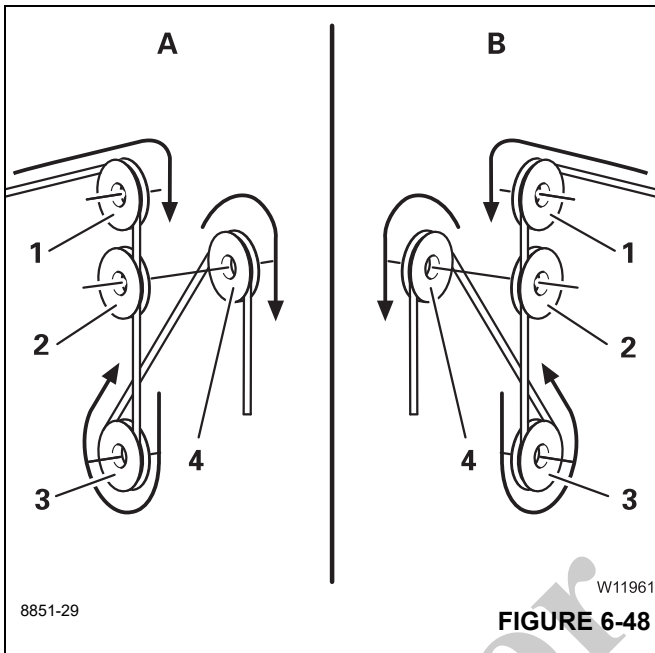


FIGURE 6-48

The hoist rope can be reeved differently depending on the required lifting capacity.

The lifting capacity of the crane depends, among other things, on the tractive force of the hoist and the number of reevings on the hook block. The lifting capacity is never greater than the tractive force of the hoist times the number of rope lines between the boom head and the hook block (minus the amount of friction);

When determining the required lifting capacity, please note that the weight of the hook block and the lifting gear must be added to the load. The actual useful load is therefore less than the value specified in the table.

**Rope End Clamp**

A rope end clamp is fastened to the end of the hoist rope. The rope end clamp can be attached to the hoist rope end; it is also possible to reeve the rope with the clamp attached.

If the hoist rope is bearing a load, the rope end clamp always

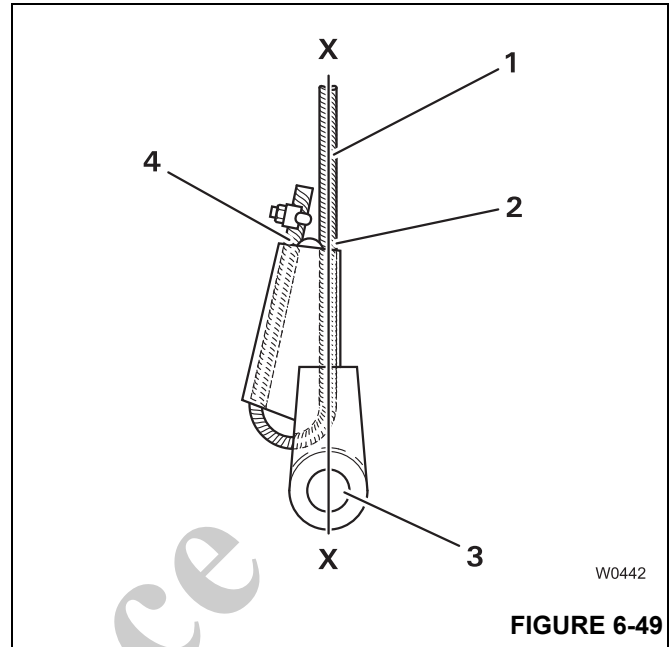


FIGURE 6-49

aligns itself so that the point (2) at which the carrying rope (1) ends in the rope end clamp is on the same axis (X-X) as the slinging point (3) (pulling axis).

Always thread the hoist rope so that the carrying rope runs along this pulling axis and is not kinked when under a load.

The hoist rope is correctly threaded if it runs into the rope clamp at position (2) and the free end projects out of the rope end clamp at position (4).

**! DANGER**  
**Crush Hazard!**

The use of an incorrectly sized wedge can allow the rope to slip and the block and load to fall. Death or serious injury could occur.

A rope wedge is needed for attaching the rope end clamp. The rope end clamp and rope wedge are labeled with their respective sizes and corresponding rope diameters. Ensure that the rope wedge inserted into the rope end clamp is labeled with the same size and rope diameter as the rope end clamp.

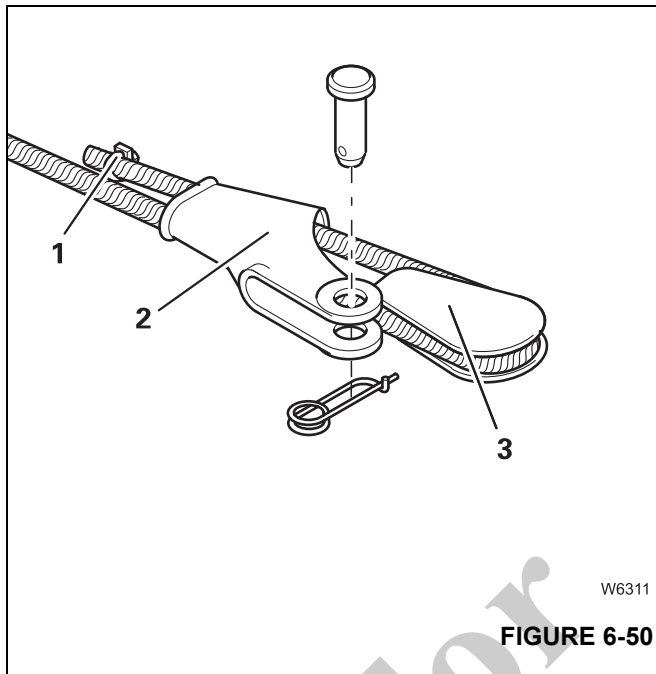


FIGURE 6-50

### Attaching the Rope End Clamp

- Insert the hoist rope and rope wedge (3) into the rope end clamp (2).
- Secure the rope clamp (1) to the loose end of the rope.

The rope clamp prevents the hoist rope from slipping out of the rope end clamp.

- Pull the rope end taut until the hoist rope fits snugly in the rope end clamp.
1. Inspect the wedge and socket. Remove any rough edges and burrs.
  2. The end of the wire rope should be seized using soft, or annealed wire or strand. If the end of the rope is welded, the welded end should be cut off. Do not weld on size 6X37 rope. This will allow the distortion of the rope strands, caused by the bend around the wedge, to adjust themselves at the end of the line. Refer to SECTION 1 - INTRODUCTION in the Service Manual for wire rope procedures.
  3. Make sure the live-end (Figure 6-51) of the rope is directly in line with the ears of the socket and the direction of pull to which the rope will be subjected. If the rope is loaded into the socket incorrectly, under a load the rope will bend as it leaves the socket, and the edge of the socket will wear into the rope causing damage to the rope and eventual failure.

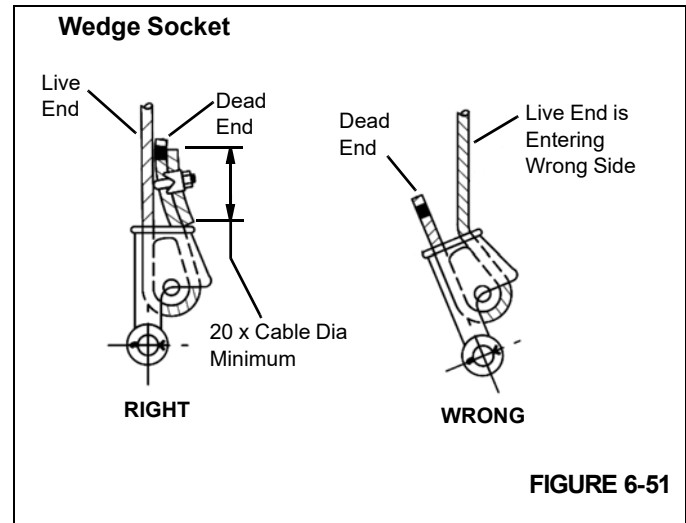


FIGURE 6-51

4. Insert the end of the wire rope into the socket, form a loop in the rope, and route the rope back through the socket allowing the dead-end (Figure 6-51) to protrude from the socket. Ensure the dead-end of the rope is of sufficient length to apply end treatment to the dead-end after the wedge has been seated.
5. Insert the wedge into the loop and pull the live-end of the rope until the wedge and rope are snug inside the socket. It is recommended that the wedge be seated inside the socket to properly secure the wire rope by using the crane's hoist to first apply a light load to the live-end.
6. After final pin connections are made, increase the loads gradually until the wedge is properly seated.
7. The wire rope and wedge must be properly secured inside the socket before placing the crane into lifting service. It is the wedge that secures the wire rope inside the socket. The dead-end treatment is used to restrain the wedge from becoming dislodged from the socket should the rope suddenly become unloaded due to the overhaul Ball or hook block striking the ground, etc; refer to *Dead-end Rigging*, below.

### Dead-End Rigging

Sketches A through F (Figure 6-52) illustrate various ANSI approved methods for treating the dead-ends of wire ropes which exit a wedge socket assembly. While use of the loop-back method is acceptable, care must be exercised to avoid the loop becoming entangled with tree branches and other components during crane transport and with the anti-two block system and other components during use of the crane.

Of the methods shown below, Grove prefers that method A or F be used, i.e., clipping a short piece of wire rope to the dead-end or using a commercially available specialty wedge. Typically, it is recommended that the tail length of the dead-end should be a minimum of 6 rope diameters but not less than 6 in (15.2 cm) for standard 6 to 8 strand ropes and 20

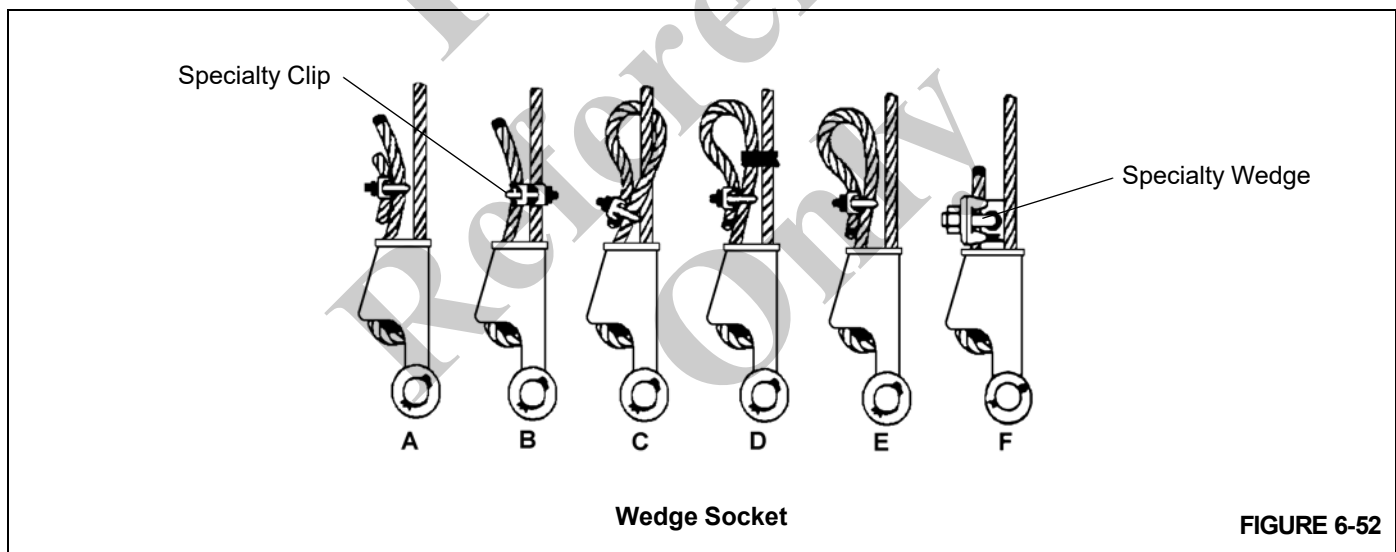
rope diameters but not less than 6 in (15.2 cm) for rotation resistant wire ropes.

When using method A, place a wire rope clip around the dead end by clamping a short extra piece of rope to the rope dead end. DO NOT CLAMP THE LIVE END. The U-bolt should bear against the dead end. The saddle of the clip should bear against the short extra piece. Torque the U-bolts according to the table titled Wire Rope Clip Torque Values (Table 6-2).

Other sources for information with which crane users should be familiar and follow is provided by the American Society of Mechanical Engineers, American National Standard, ASME B30.5, latest revised. ASME (formerly ANSI) B30.5 applies to cableways, cranes, derricks, hoists, hooks, jacks, and slings. It states, in section 5-1.7.3, "(c) Swagged, compressed, or wedge socket fittings shall be applied as recommended by the rope, crane or fitting manufacturer." Wire ropes are addressed in ASME B30.5, section 5-1.7.2, ROPES, it states, in pertinent part, "(a) The ropes shall be of a construction recommended by the rope or crane manufacturer, or person qualified for that service." Additional information is published by the Wire Rope Technical Board in the Wire Rope Users Manual, latest revised edition.

Table 6-2

| Wire Rope Clip Torque Values |       |        |     |
|------------------------------|-------|--------|-----|
| Clip Sizes                   |       | Torque |     |
| Inches                       | mm    | lb-ft  | Nm  |
| 1/8                          | 3.18  | 4.5    | 6   |
| 3/16                         | 4.76  | 7.5    | 10  |
| 1/4                          | 6.35  | 15     | 20  |
| 5/16                         | 7.94  | 30     | 40  |
| 3/8                          | 13.28 | 45     | 60  |
| 7/16                         | 11.11 | 65     | 90  |
| 1/2                          | 12.70 | 65     | 90  |
| 9/16                         | 14.29 | 95     | 130 |
| 5/8                          | 15.88 | 95     | 130 |
| 3/4                          | 19.05 | 130    | 175 |
| 7/8                          | 22.23 | 225    | 300 |
| 1                            | 25.40 | 225    | 300 |
| 1-1/8                        | 28.58 | 225    | 300 |
| 1-1/4                        | 31.75 | 360    | 490 |
| 1-3/8                        | 38.68 | 360    | 490 |
| 1-1/2                        | 38.10 | 360    | 490 |



**Securing the Hoist Rope**

- Insert the rods (1), (Figure 6-53) and (4), (Figure 6-53).
- Secure all the rods.

**Closing the Hook Block**

- Fold up the sheet metals (3), (Figure 6-53) on both sides.
- Insert the rods (2), (Figure 6-53) and secure them.



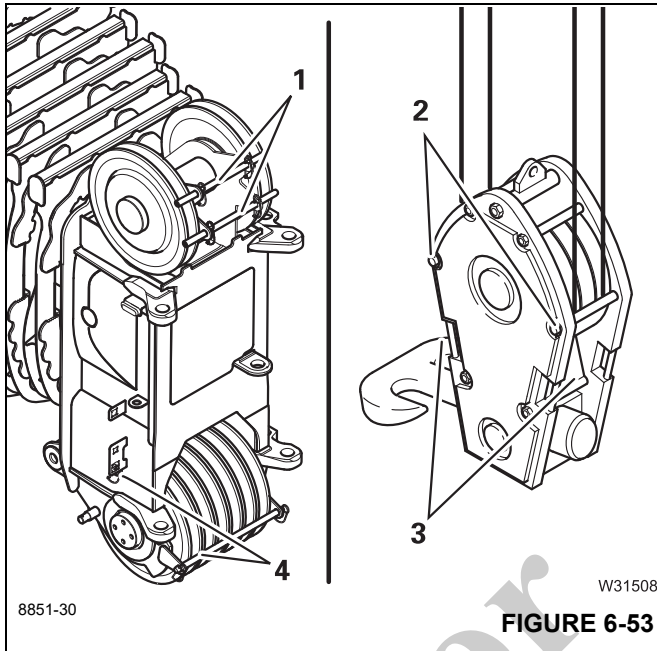


FIGURE 6-53

**Unreeving the Hoist Rope**

Refer to (Figure 6-54).

- Pull out the rods (5) and (3).
- Fold down the plates (1).
- Remove the rope end fitting from the fixed point (2) or (4).
- Unreeve the hoist rope.
- Insert the rods (5) and (3) and secure them.

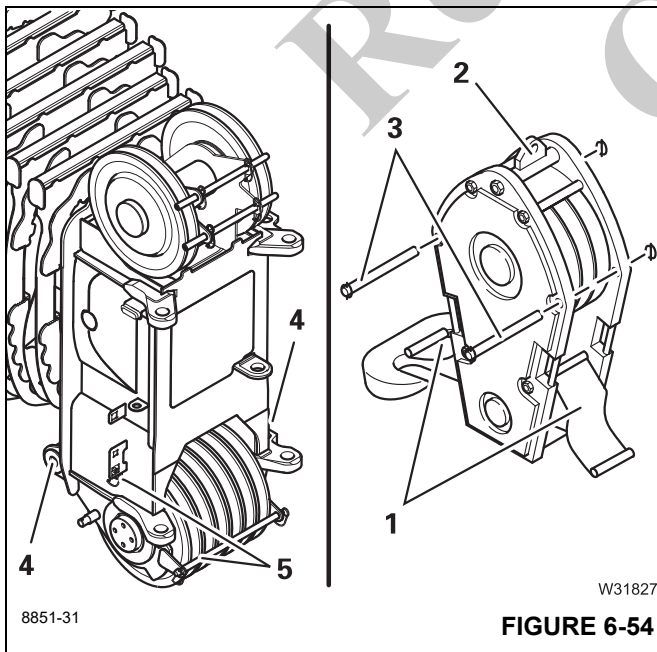


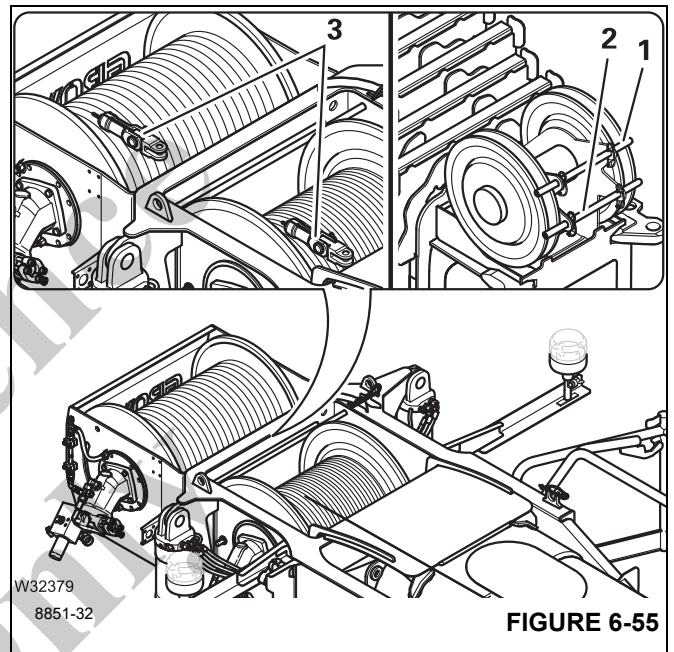
FIGURE 6-54

Depending on the driving mode, you can:

- Fasten the hoist rope to the bumper. Refer to *Hook Block on the Bumper*, page 6-30

OR

- Pull out the rods (1), (Figure 6-55), (2), (Figure 6-55) and roll the hoist rope (3), (Figure 6-55) on to the drum.
- Insert the rods (1), and (2), (Figure 6-55) and secure them.
- Secure the hoist rope (3), (Figure 6-55).



**Installing/Removing the Anti Two-Block Switch**

For every reeved hoist rope, you must install a anti-two block switch, attach a anti-two block switch weight and place it around the hoist rope.

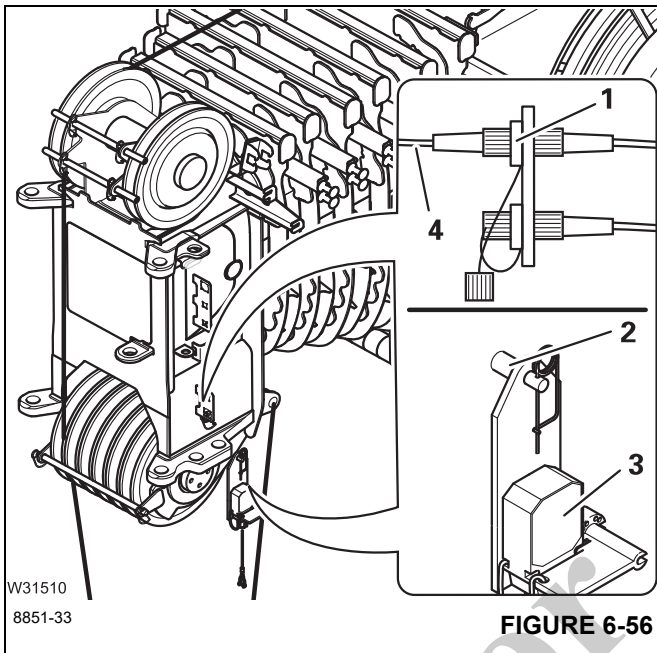
**Installing the Anti-Two Block Switch**

You can attach the anti-two block switch on the right or left side of main boom head. Install the switch on the side that is closer to the last rope line leading upwards. There can also be one anti-two block switch installed on each side.

**On the Left Side:**

- Plug the anti-two block switch (3), (Figure 6-56) onto the bracket (2), (Figure 6-56) and secure it with the retaining pin.
- Lay the cable (4), (Figure 6-56) in such a way that it will not be damaged during crane operation, and insert the anti-two block switch into the socket (1), (Figure 6-56).





**On the Right Side:**

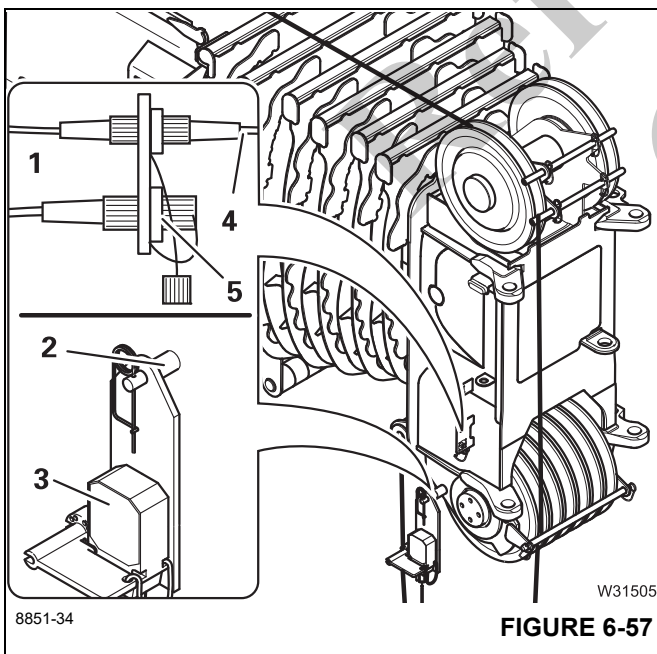
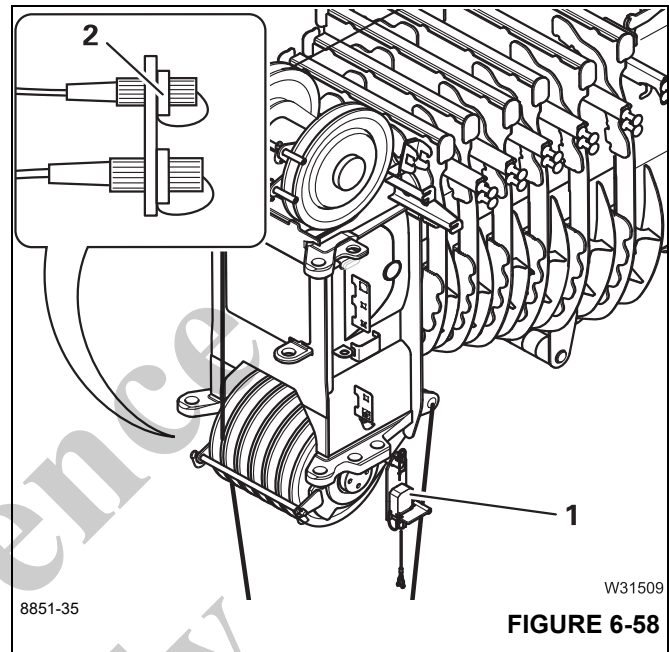
Refer to (Figure 6-57).

- Plug the anti-two block switch (3) onto the bracket (2) and secure it with the retaining pin.
- Lay the cable (4) in such a way that it will not be damaged during crane operation, and insert the anti-two block switch into the socket (1).

**If Only One Anti-Two Block Switch has Been Installed:**

Refer to (Figure 6-58).

- Cover the unused socket with the protective cap (2).
- Check whether the lock on the used anti-two block switch, e.g. (1), is released. Refer to *Removing the Lock*, page 6-40.



**! DANGER**  
**Two Block Hazard!**

Do not operate the crane with the anti-two block switch locked in the travel position.

Failure to unlock the anti-two block switch will prevent the system from working correctly and could result in Death or Serious injury if the rope breaks.

**If Two Anti-Two Block Switches Have Been Installed:**

- Lock the anti-two block switch to which no anti-two block switch weight has been attached.

If the anti-two block switch weight has, for example, been attached to the left anti-two block switch (1), (Figure 6-59), you must lock the right anti-two block switch (2), (Figure 6-59). Refer to *Locking*, page 6-40.

Otherwise the movements to Raise Hoisting Gear, Telescope Out, and Lower the Boom will be locked.

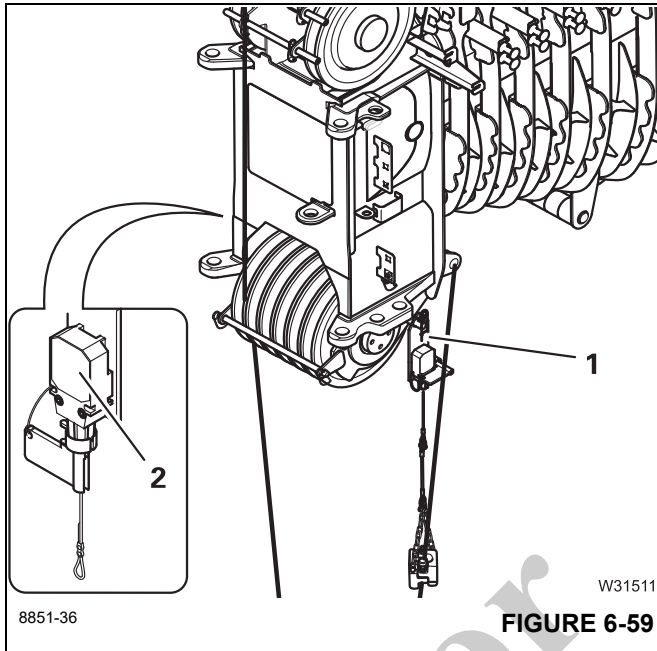


FIGURE 6-59

**Attaching the Anti-Two Block Switch Weight:**

- Attach the anti-two block switch weight (1), (Figure 6-60).

This anti-two block switch must not be locked. Refer to *Removing the Lock*, page 6-40.

If two hoist ropes are reeved, you must attach a anti-two block switch weight to each of the two anti-two block switches.

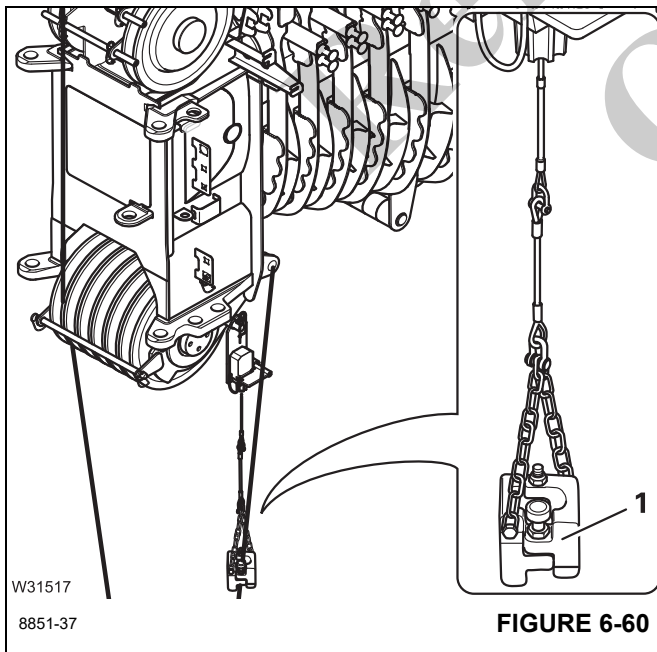


FIGURE 6-60

**Placing the Anti-Two Block Switch Weight Around the Hoist Rope:**

- (A), (Figure 6-61) – Pull the safety pin (1) out and fold the two halves of the weight apart.
- (B), (Figure 6-61) – Place the two halves of the weight around the last rope line leading upwards.
- Pull the safety pin (1), (Figure 6-61) out and fold the two halves of the weight back together.
- Make sure that the safety pin locks into place and the two halves of the weight are securely attached to each other.

If two hoist ropes are reeved, you must also place an anti-two block switch weight around the second hoist rope.

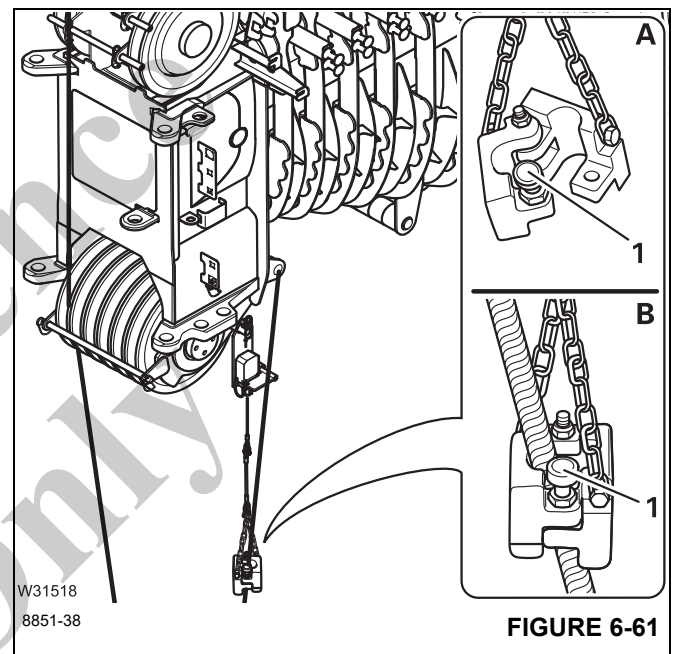


FIGURE 6-61

**NOTE:** If you place the anti-two block switch weight around the last rope line leading upwards, less rope will run through the anti-two block switch weight, especially if there is a high number of reevings per lifting operation. This rope line will even be at a standstill if the number of rope lines is even.

This allows you to reduce the wear of the hoist rope and anti-two block switch weight and prevent unintentional deactivation procedures that may be caused by the running hoist rope lifting the anti-two block switch weight.

**Removing the Anti-Two Block Switch**

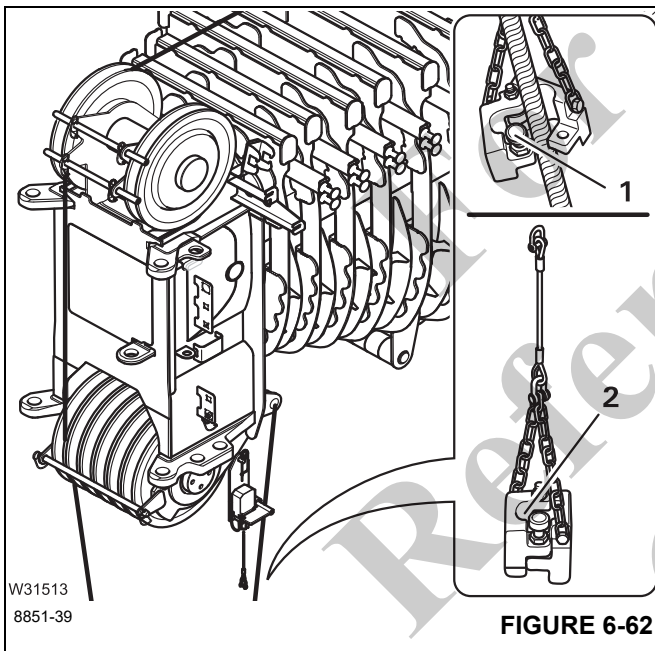
This section describes complete removal.

If the hook block is to be attached to the bumper at a later point, you will need to detach the anti-two block switch weight from the hoist rope, so that you can unreeve or reeve

when unrigging the hoist rope. You can place the anti-two block switch weight around the hoist rope again before driving.

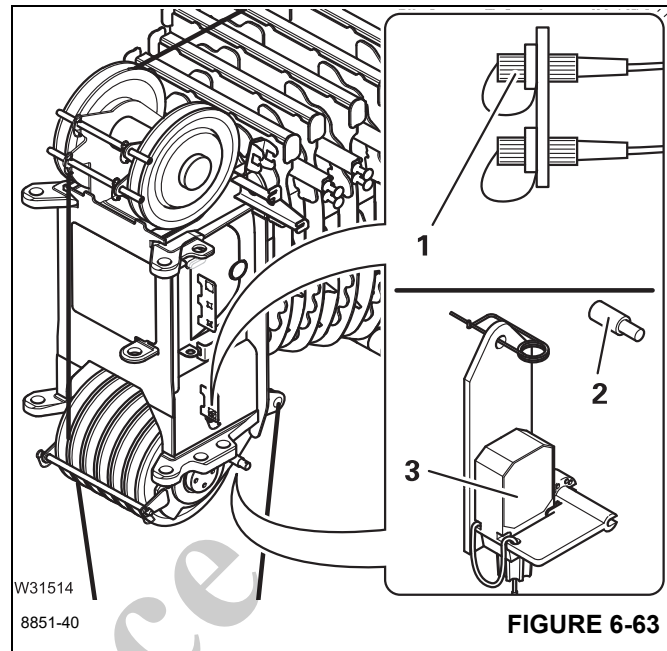
**Removing the Anti-Two Block Switch Weight:**

- Pull the safety pin (1), (Figure 6-62) out and fold the two halves of the weight apart.
- Remove the halves of the weight from the rope line.
- Pull the safety pin (1), (Figure 6-62) out, fold the two halves of the weight back together and let the safety pin engage.
- Remove the anti-two block switch weight (2), (Figure 6-62).
- Remove the anti-two block switch weight on the other side too, if necessary.



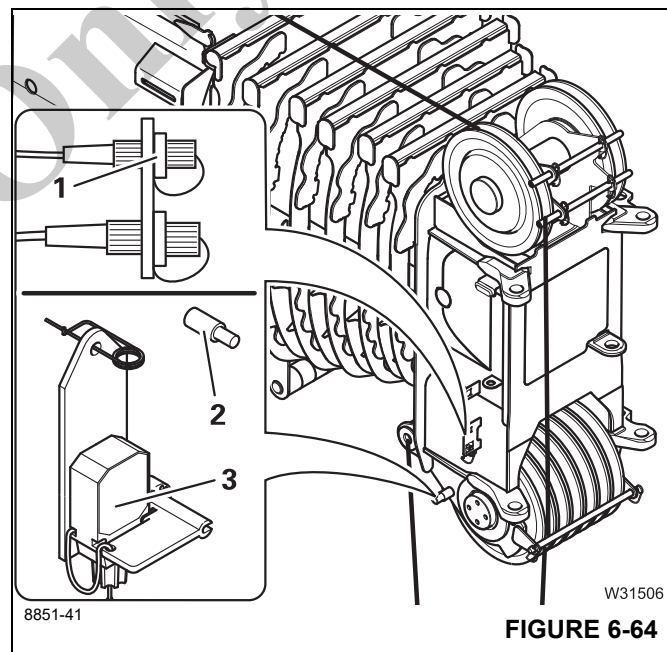
**Removing the Left Anti-Two Block Switch:**

- Pull out the plug and close the socket with the protective cap (1), (Figure 6-63).
- Remove the anti-two block switch (3), (Figure 6-63) from the bracket (2), (Figure 6-63).
- Attach the retaining pin (4), (Figure 6-63) to the anti-two block switch.



**Removing the Right Anti-Two Block Switch:**

- Pull out the plug and close the socket with the protective cap (1), (Figure 6-64).
- Remove the anti-two block switch (4), (Figure 6-64) from the bracket (2), (Figure 6-64).
- Attach the retaining pin (3), (Figure 6-64) to the anti-two block switch.



### Locking/Unlocking the Anti-Two Block Switch

#### Locking

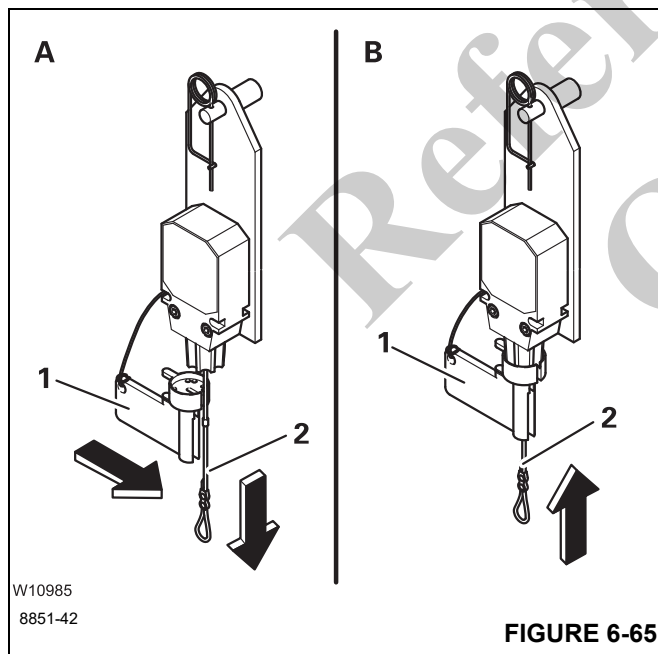
If two anti-two block switches are installed, you must lock the anti-two block switch not used in order to enable all crane operations unless, both hoists are reeved and being used.

**! DANGER**  
**Two Block Hazard!**

Do not operate the crane with the anti-two block switch locked in the travel position.

Failure to unlock the anti-two block switch will prevent the system from working correctly and could result in Death or Serious injury if the rope breaks.

- Remove the anti-two block switch weight.
- (A), (Figure 6-65) – Remove the cap (1).
- Pull the rope (2) down; the anti-two block switch is triggered.
- (B), (Figure 6-65) – Secure the rope (2) in this position using the cap (1).

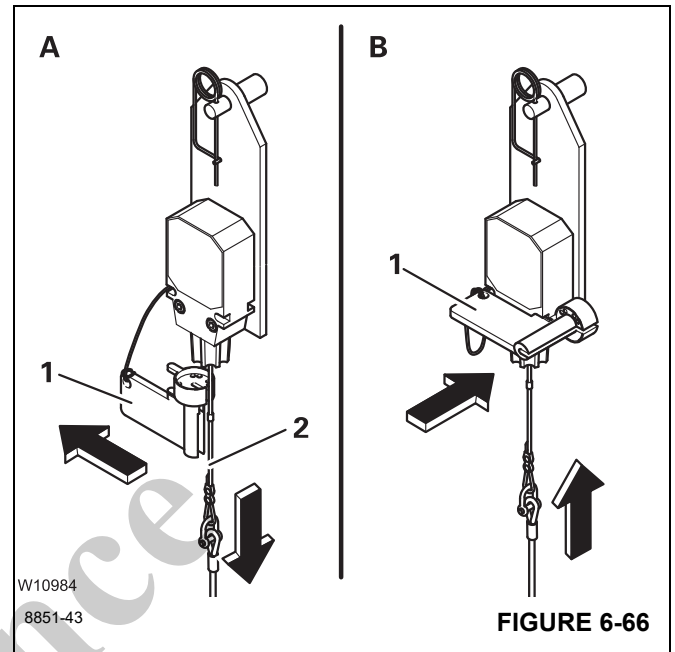


#### Removing the Lock

You must always release the locking before you place an anti-two block switch weight around the hoist rope.

- (A), (Figure 6-66) – Pull the rope (2) down and take off the cap (1) – the locking is released.

- (B), (Figure 6-66) – Fit the cap (1) onto the anti-two block switch.



### Anemometer and Boom Position Indicator Light

**CAUTION**

**Machine Damage!**

Always remove the anemometer and boom position indicator light before on-road driving.

This prevents the specified overall height being exceeded at on-road level, and the anemometer from getting damaged by being rotated too fast.

#### Installing

The anemometer and the boom position indicator light – if provided – are located on the same rod.

- Insert the rod (1), (Figure 6-67) into the holder (3), and secure it with the retaining pins.
- Remove the cable from the holders (2), (Figure 6-67) and connect:
  - the anemometer to socket (4), (Figure 6-67).
  - the boom position indicator light to the socket (5), (Figure 6-67).
- Lay the cables in such a way that they will not be damaged during crane operation.
- Check that the anemometer is able to swing so that it hangs vertically even when the main boom is raised.



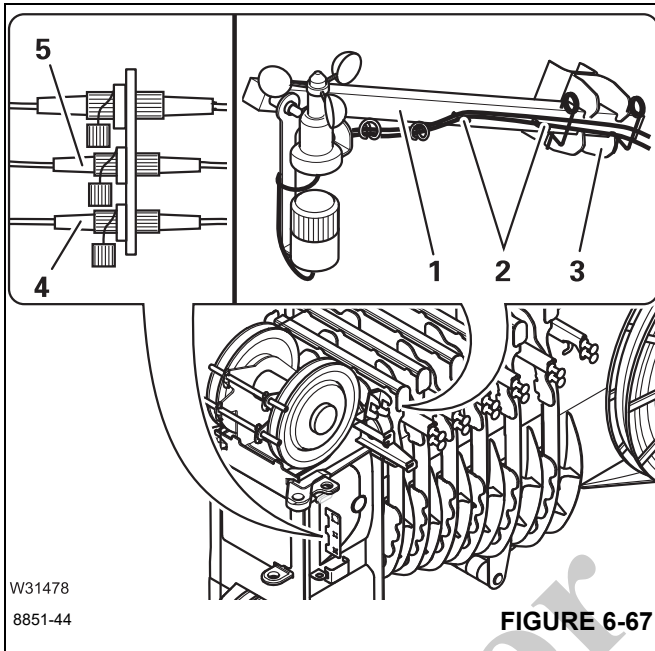


FIGURE 6-67

**Switching the Boom Position Indicator Light ON and OFF**

|                |                                                                        |
|----------------|------------------------------------------------------------------------|
| To switch ON:  | Select symbol (1), (Figure 6-68) and confirm – symbol ON is displayed  |
| To switch OFF: | Select symbol (2), (Figure 6-68) and confirm – symbol OFF is displayed |

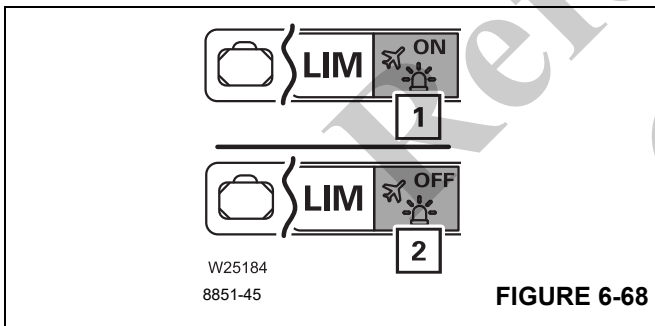


FIGURE 6-68

**Removing**

You must remove the rod with the anemometer/boom position indicator light before driving on the road.

- Switch OFF the boom position indicator light.
- Remove the plug and close the sockets (4), (Figure 6-69) and (5), (Figure 6-69) with the protective caps.
- Wind the cables onto the holders (2), (Figure 6-69).

- Remove the rod (1), (Figure 6-69) from the holder (3), (Figure 6-69).
- For transportation, fasten the retaining pins to the rod (1).

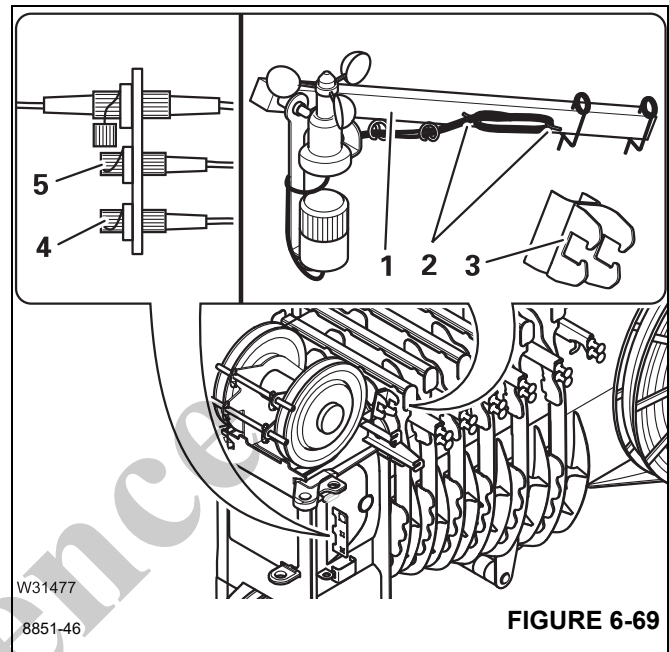


FIGURE 6-69

**OTHER RIGGING WORK**

**Cameras for Crane Operation**

**Camera on the Hoists**

**CAUTION**

**Machine Damage!**

Always retract the camera before driving. When the camera is extended, the overall height specified for on-road driving is exceeded.

A camera transmits an image of the main and auxiliary hoists to the display in the crane cab.

**Operating the Camera**

**Switching ON**

- Switch on the ignition.  
The image appears on the display after a few seconds.

**Switching the Cameras**

- Select and confirm a symbol (Figure 6-70) to switch over between the cameras.

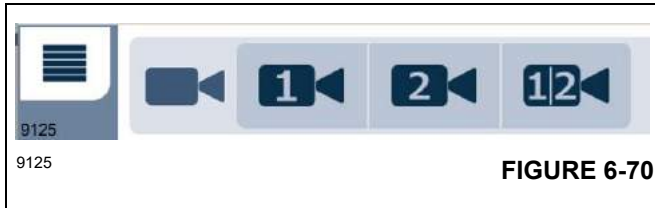


FIGURE 6-70

### Hoist Maintenance Platform

The turntable is equipped with extendable/retractable handrails.

**! DANGER**  
**Fall Hazard!**

Ensure the railings are erected and secured before entering the hoist maintenance platform. Failure to do so could result in death or serious injury.

**CAUTION**  
**Machine Damage!**

Fold in the railings before driving. When the railings are unfolded, the overall height specified for on-road driving is exceeded.

Always fold out the railings when you are working on the hoists. Always fold in the railings before driving.

#### (A) – Folding OUT

- Fold the handrail (1), (Figure 6-71) upwards until the pins (2), (Figure 6-71) latch into place.

#### (B) – Folding IN

- Open the locking pins (2), (Figure 6-71).
- Fold the handrail (1), (Figure 6-71) in until the pins (2), (Figure 6-71) latch into place.

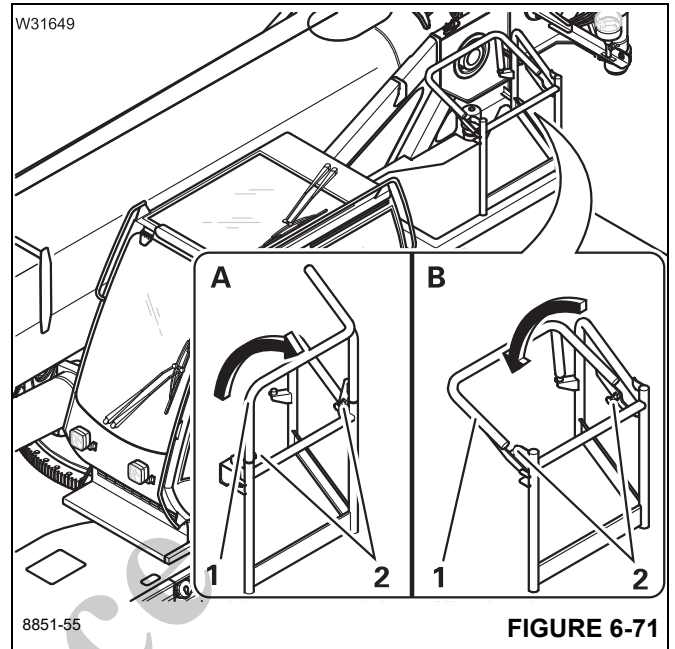


FIGURE 6-71

### Slings Points for Personal Protective Equipment

The approved slinging points for personal protective equipment are marked with special labels (2), (Figure 6-72).

#### On the Main Boom

For rigging work on the main boom, always secure yourself using the slinging points (1), (Figure 6-72) and your personal protective equipment harness.

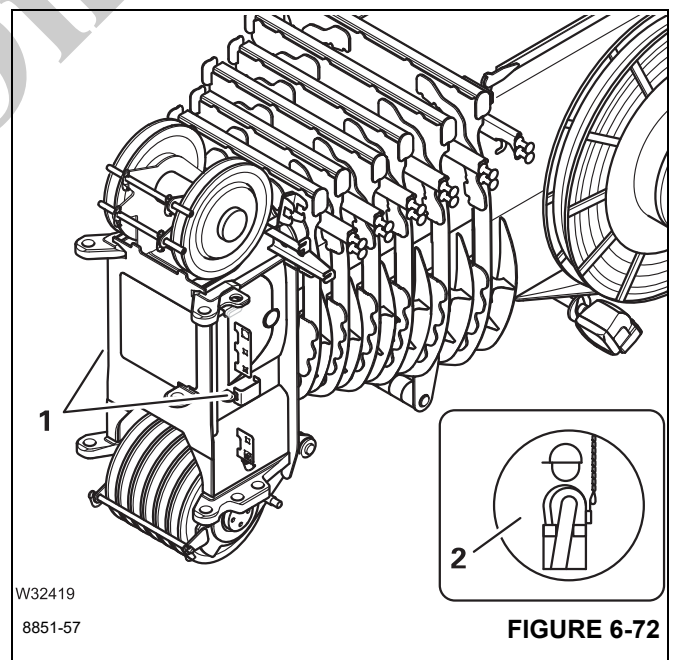


FIGURE 6-72

**BOOM EXTENSIONS**

**! DANGER**

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

Refer to (Figure 6-73) for a diagram of the boom extensions available for this crane.

The TMS9000-2 can be used with the following boom extensions:

- 35 ft to 58 ft (10.5 m to 17.7 m) manual off-settable bi-fold swingaway boom extension (folding manual luffing extension), with mechanical offset mechanism for offsets of 0, 20, & 45 degrees, as standard—unless it was explicitly not ordered.
- 35 ft to 58 ft (10.5 m to 17.7 m) hydraulic off-settable bi-fold swingaway boom extension (folding hydraulic luffing extension), with hydraulic off-set mechanism for offsets of 0 to 45 degrees.

- 11.4 ft (3.5 m) heavy duty two-sheave manual off-settable boom extension (heavy duty extension), with manual offset mechanism for offsets of 0, 20 and 45 degrees.
- 11.4 ft (3.5 m) heavy duty two-sheave hydraulic off-settable boom extension (heavy duty extension), with hydraulic offset mechanism for offsets of 0 to 45 degrees.
- 26 ft. (8 m) base extension insert (26 ft insert) to use with any of the 36 ft. to 59 ft. (11 m to 18 m) folding extensions.

All boom extensions are built specifically for the crane with which they were sold. Each extension is stamped with the crane's serial number.

**CAUTION**

**Equipment Damage Hazard!**

Operate the crane only with extensions which have the same serial number as the crane, to prevent malfunctions and damage to the equipment.

To use a single boom extension on several Grove cranes, contact Manitowoc Crane Care or your authorized Grove Distributor.

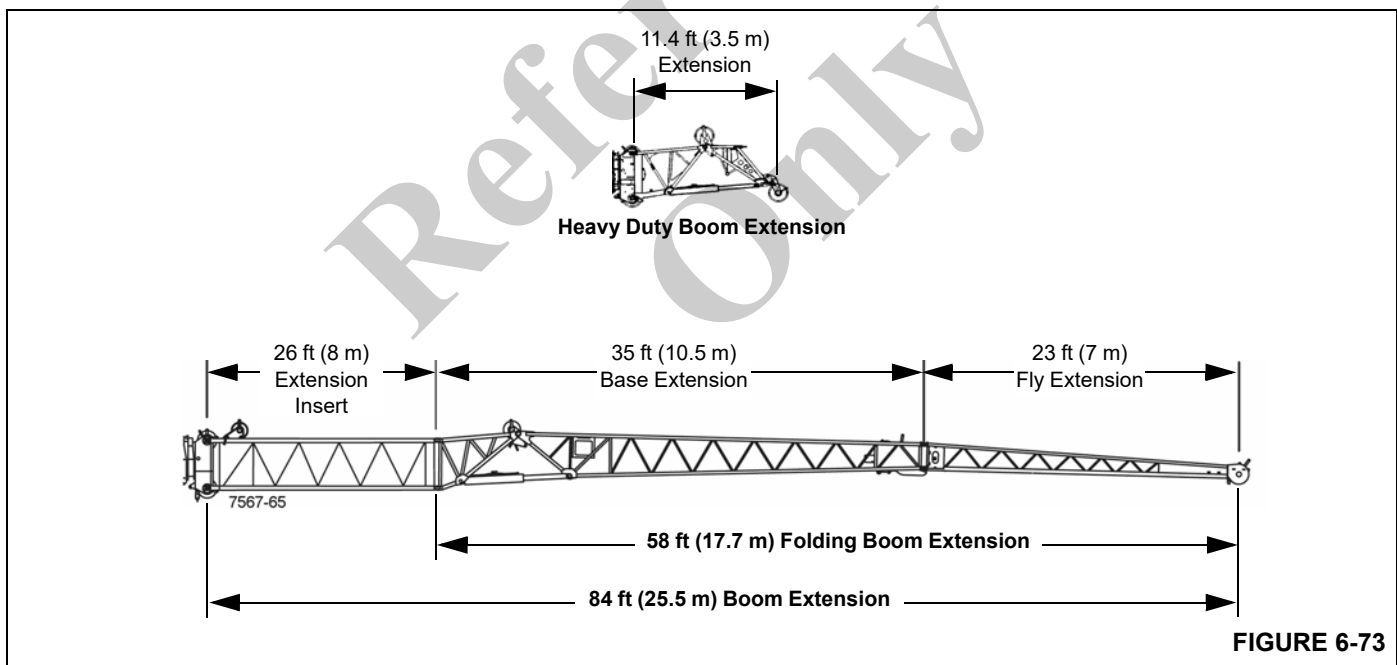


FIGURE 6-73



## Installing the Folding Boom Extension



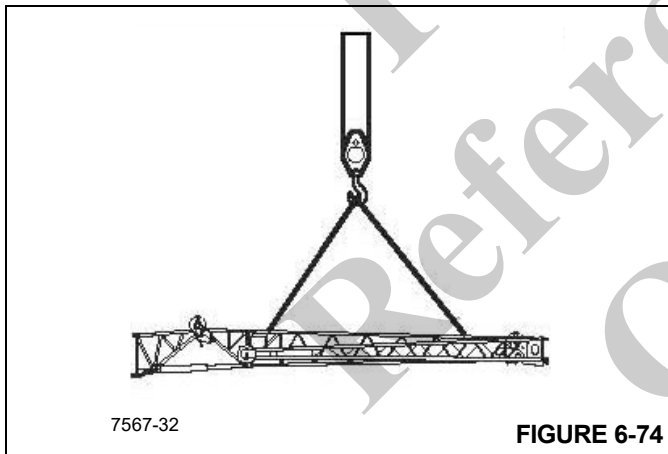
### DANGER

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

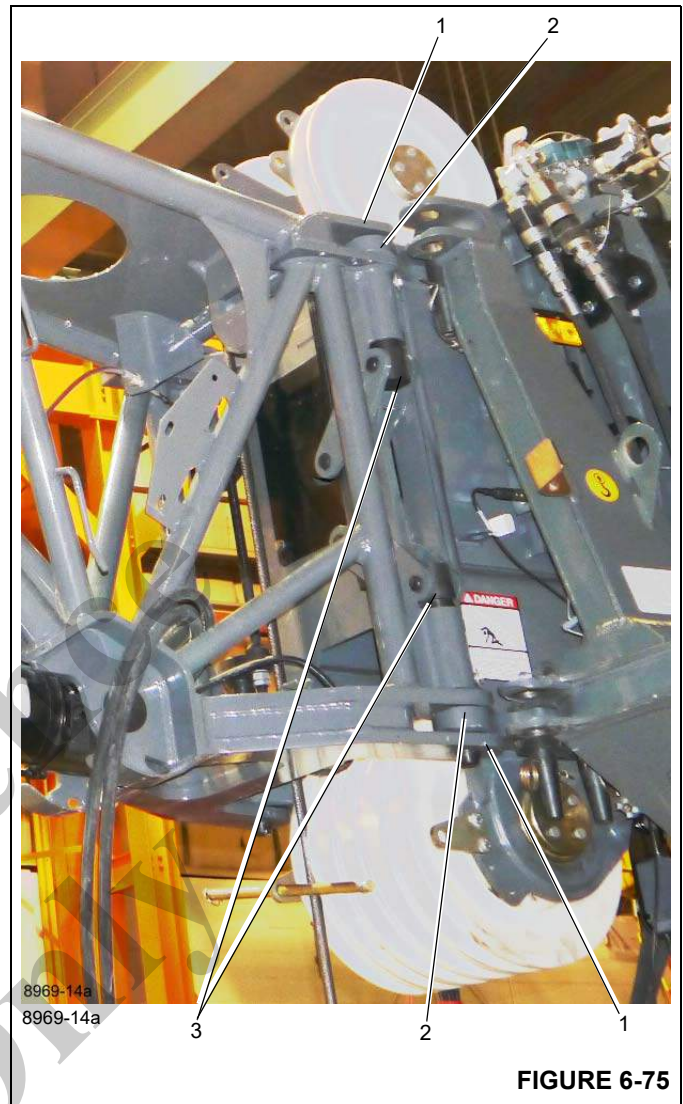
1. Before installing the boom extension make sure the crane is set up on outriggers using normal setup procedures. Refer to *Setting the Outriggers from Outrigger Keypads*, page 4-35.

**NOTE:** An auxiliary crane with sling is required to install the boom extension.

2. Rotate the superstructure so the boom is over the rear.
3. Retract and lower the boom to horizontal.
4. Attach a tag line to the junction of the 35 ft and 23 ft extensions.
5. Using a sling attached to an auxiliary crane, lift the extension in front of the main boom (Figure 6-74).



6. Align the extension anchor fittings (1), (Figure 6-75) to the boom nose attachment fittings (2), (Figure 6-75).



7. On both sides of the boom nose install the pins (3), (Figure 6-75) through the fittings using an impact driver turning the jack screw counterclockwise.
8. Remove the sling from the boom extension.

To stow the entire 58 ft (17.7 m) folding extension on the main boom, refer to the *Stowing Procedure: 58 ft (17.7 m) Extension*, page 6-67.

To erect the 58 ft extension, refer to *Erecting Procedure - 58 ft (17.7 m) Extension*, page 6-50.

To erect the 35 ft (10.5 m) extension, refer to *Erecting Procedure - 35 ft (10.5 m) Base Extension*, page 6-45. For stowing, refer to *Stowing Procedure: 23 ft (7 m) Boom Fly Extension*, page 6-65.

**Securing Extension with Tag Line (Rope)**

Refer to (Figure 6-91).



**DANGER**  
**Crushing Hazard!**

Always use a tag line (Figure 6-91) to control the movement of the boom extension during the erection and stowing process.

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

The extension must be secure before beginning the erection procedure.

Secure the extension as follows:

- Attach a tag line at the front of the extension.
- Guide the tag line underneath the extension and through a bracket on the main boom and back again.
- Have a helper hold the tag line tight while removing the last connection.

**NOTE:** If alone, secure the other end of the tag line on the crane (e.g. on the steps of the access ladder to the carrier or to the hole in the superstructure).

### Extension Erecting Warnings and Requirements



**DANGER**  
**Crushing Hazard!**

Before attempting to erect or stow the boom extension, read and strictly adhere to all danger decals installed on the extensions and stowage brackets.



**DANGER**  
**Crushing Hazard!**

During installation and removal, always use the proper equipment with sufficient load bearing capacities.



**DANGER**  
**Crushing Hazard!**

Main boom angles are used to control speed at which extensions swing during erecting and stowing procedure. Improper boom angles will cause uncontrollable swing speeds of the extension, which may cause death or serious injury.

Before you erect a boom extension, the following requirements must be met:

- The folding extension is mounted on the side of the main boom and is secured in the transport condition.
- The crane is level, supported on outriggers according to the Load Chart for the planned operation with the configured extension.
- The main boom is completely retracted and has been lowered into a horizontal position.

### Erecting Procedure - 35 ft (10.5 m) Base Extension

This procedure is for erecting just the 35 ft base extension, leaving the 23 ft fly extension attached to the main boom.



**WARNING**  
**Falling Hazard!**

To prevent serious injury or death, do not stand on decking until extensions are secure.

1. Visually check to make sure that all pins securing the extension are installed.

**NOTE:** The crane should be setup on outriggers according to the configuration for the planned operation.

2. Retract and lower boom to horizontal for erecting over the rear of the crane.
3. Attach a tag line to the junction of the 35 ft and 23 ft extensions (Figure 6-79).
  - a. Guide the tag line around the end of the extension and through the bracket on the main boom and back again.
  - b. If possible, have a helper hold the tag line tight while releasing the connections. If a helper is not available, secure the tag line to the main boom. Release the spring latch (1), (Figure 6-76). Fold out the guide ramp (2), (Figure 6-76) until the spring

latch (1), (Figure 6-77) engages the tab (2), (Figure 6-77).

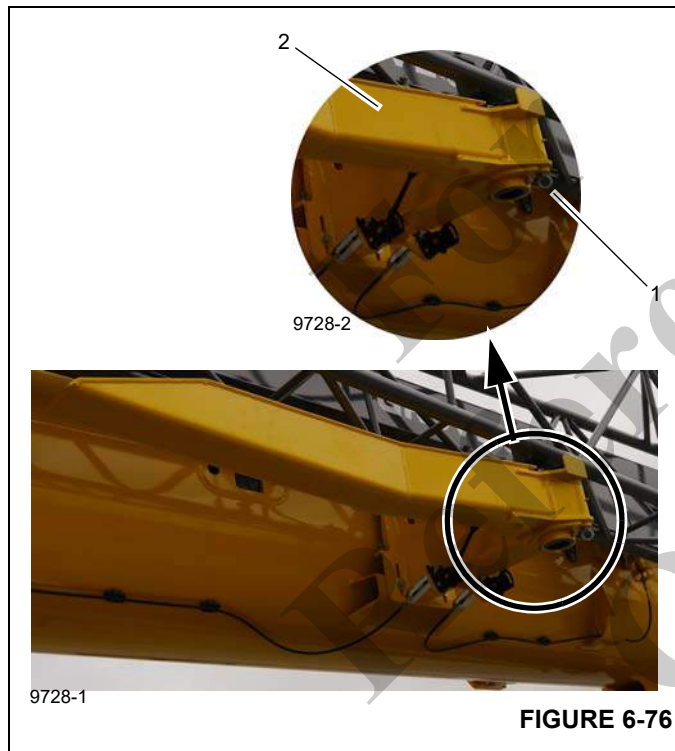


**DANGER**

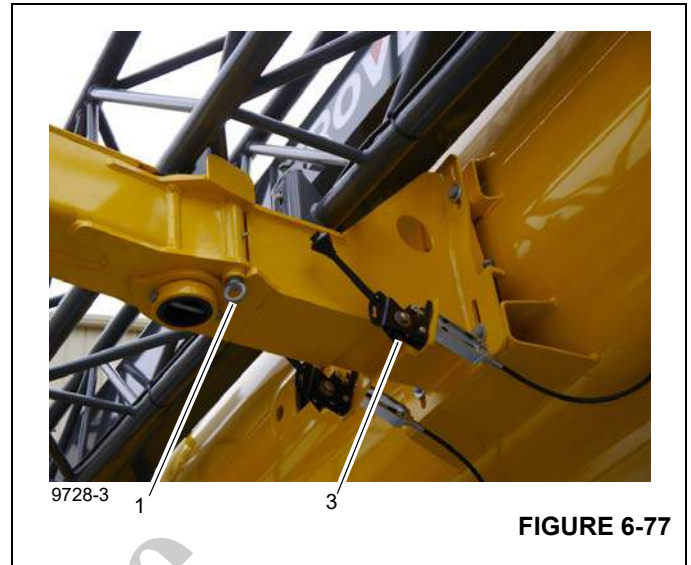
**Boom Extension Hazard!**

Make sure that the fly extension is secured to the extension base before releasing it from the main boom. Failure to do so could result in death or serious injury.

4. Verify that the vertical actuated hand levers (3), (Figure 6-77) are pushed fully upwards. This engages the two pins securing the fly extension to the main boom.

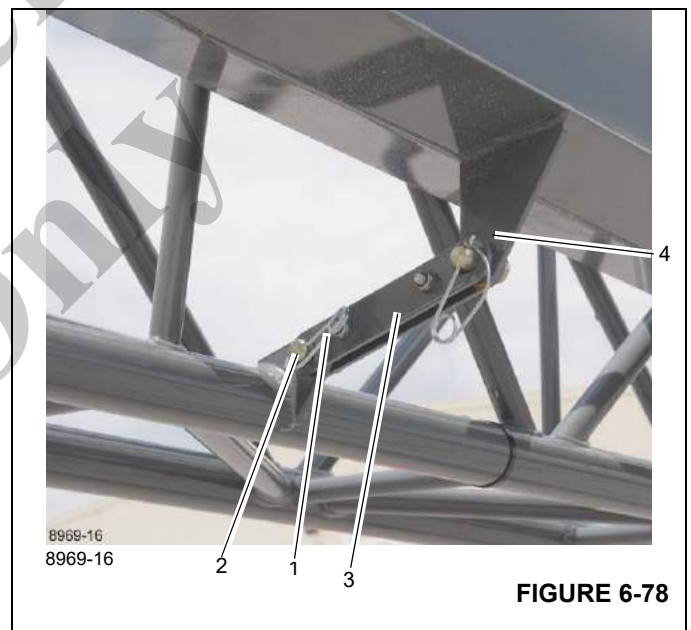


**FIGURE 6-76**



**FIGURE 6-77**

5. Remove the retaining clip (1), (Figure 6-78) and remove the pin (2), (Figure 6-78) from the locking bar (3), (Figure 6-78) and the fly extension (4), (Figure 6-78). Insert the pin in the locking bar and secure with the retaining clip.



**FIGURE 6-78**

6. Remove the retaining clip (1), (Figure 6-79) from the pin (2), (Figure 6-79) installed in the fly extension attachment fittings and the base extension anchor fittings. Remove the pin and insert in stowage lugs in base extension, secure with retaining clip.





FIGURE 6-79

7. In the cab on the CCS Display (1), (Figure 6-80) press menu and then select the extension menu as shown by the black arrow (Figure 6-80). To use the hand-held remote controller (2), (Figure 6-80), refer to *Boom Extension Assist*, page 3-127.

8. Select pin #1, unlock as shown by the black arrow in (Figure 6-81).



FIGURE 6-81

9. The icons turn green, verifying pin #1 is unlocked as shown by the black arrows in (Figure 6-82).



FIGURE 6-80



FIGURE 6-82

**NOTE:** Pin #1 will not unlock if pin #2 is unlocked.

10. Verify pin #1 is unlocked (1), (Figure 6-83). (Figure 6-83) shows the locked position.

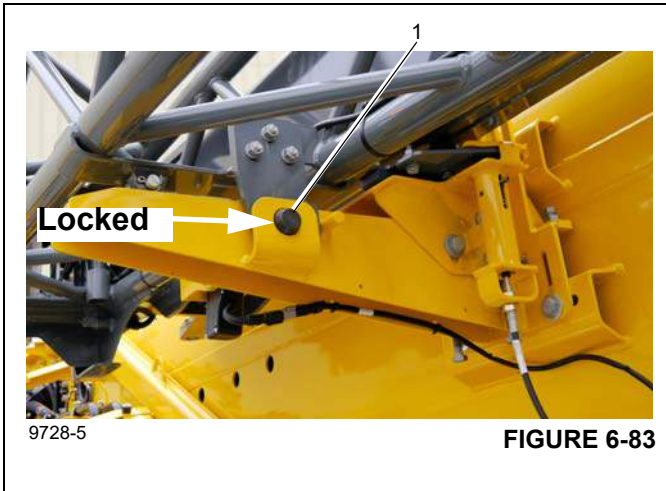


FIGURE 6-83

11. Using the tag line, swing the extension out to engage the base extension anchor fittings (1), (Figure 6-84) with the main boom attachment fittings (2), (Figure 6-84).



FIGURE 6-84

12. Install the pins (1), (Figure 6-85) through the fittings using an impact driver turning the jack screw (2), (Figure 6-85) counterclockwise. The jack screw drive bolt will bottom out when the pins are fully engaged. The

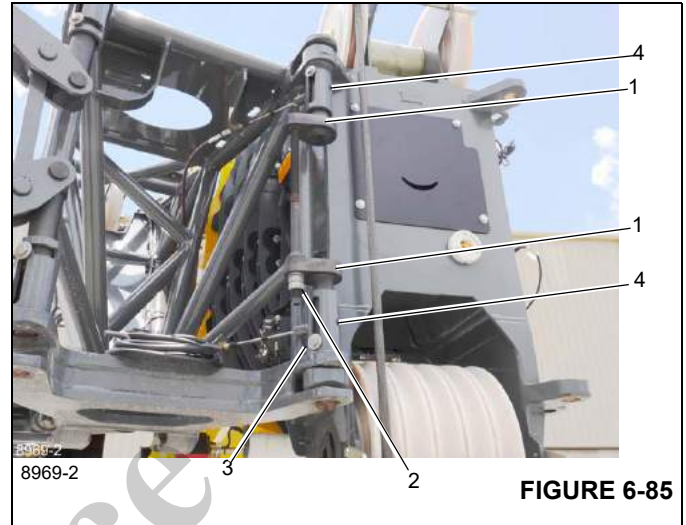


FIGURE 6-85

13. On the CCS Display, select pin #2 (Figure 6-86). Unlock as shown by the black arrow (Figure 6-86).



FIGURE 6-86

14. The icons turn green, verifying pin #2 is unlocked as shown by the black arrows in (Figure 6-87).





FIGURE 6-87

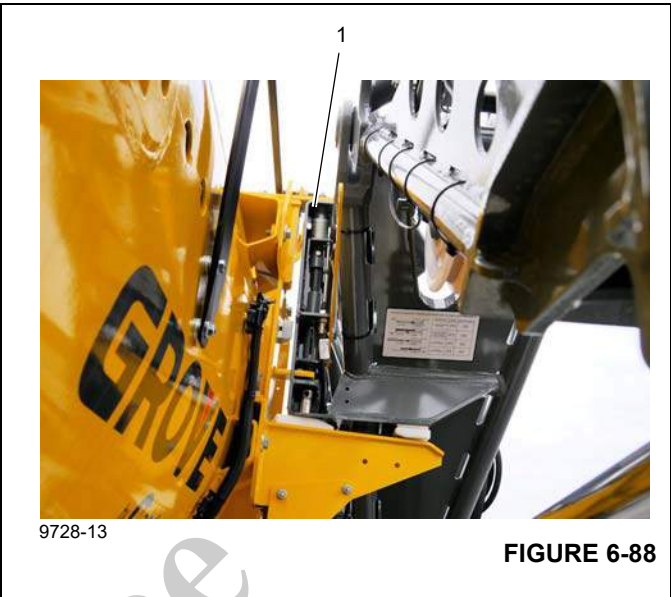


FIGURE 6-88

15. Verify pin #2 is unlocked (1), (Figure 6-88). The handle (1), (Figure 6-89) should be in the down position.

**NOTE:** Pin #2 will **NOT** unlock unless the right side boom nose pins are fully engaged. If Pin #2 does **NOT** unlock, make sure the right side boom nose pins are fully engaged and the cable ends are inserted through the pins. Refer to (4), (Figure 6-85).

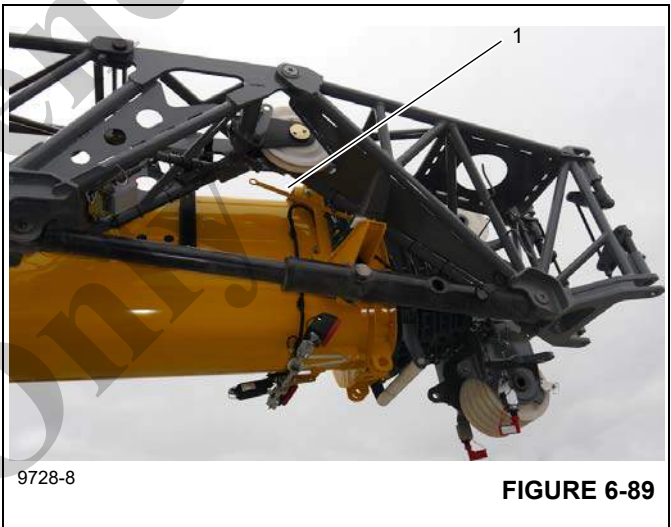
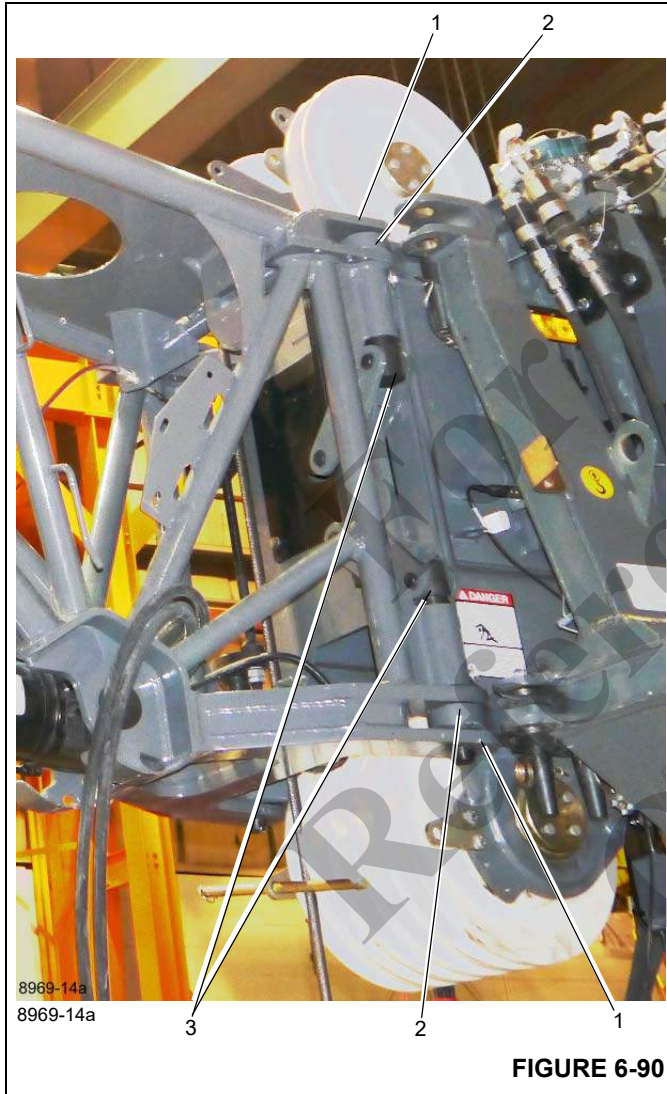


FIGURE 6-89

16. Swing the extension around to engage the left extension anchor fittings (1), (Figure 6-90) with the left main boom attachment fittings (2), (Figure 6-90). Insert the pins (3), (Figure 6-90) through the fittings using an impact driver turning the jack screw counterclockwise. The jack screw drive bolt will bottom out when the pins are fully engaged.



17. The base extension is ready to be rigged with the fly extension stowed on the side of the main boom.

### Erecting Procedure - 58 ft (17.7 m) Extension

The 58 ft extension includes the 35 ft extension base section with the 23 ft extension fly section unfolded and attached to the nose of the 35 ft extension base section.

#### **WARNING**

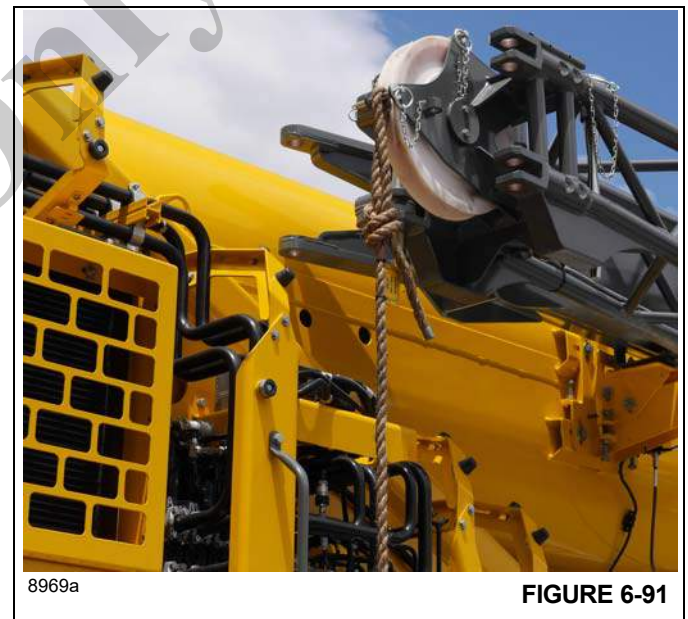
##### **Falling Hazard!**

To prevent serious injury or death, do not stand on decking until extensions are secure.

1. Visually check to make sure that all pins securing the extensions are installed.

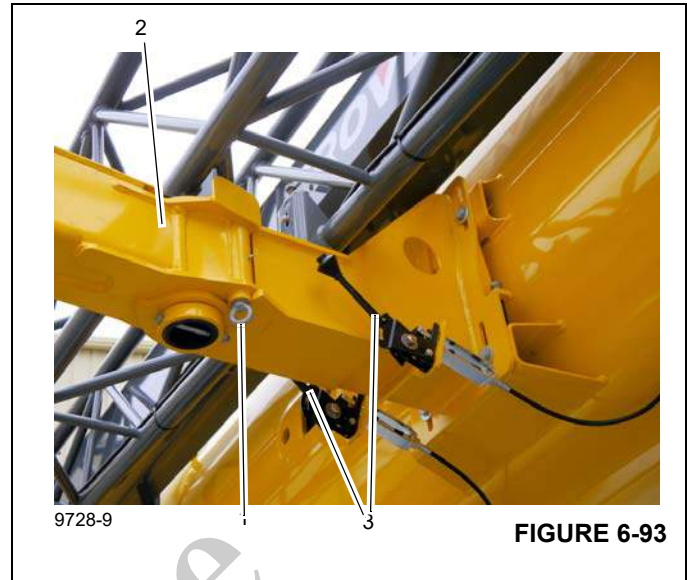
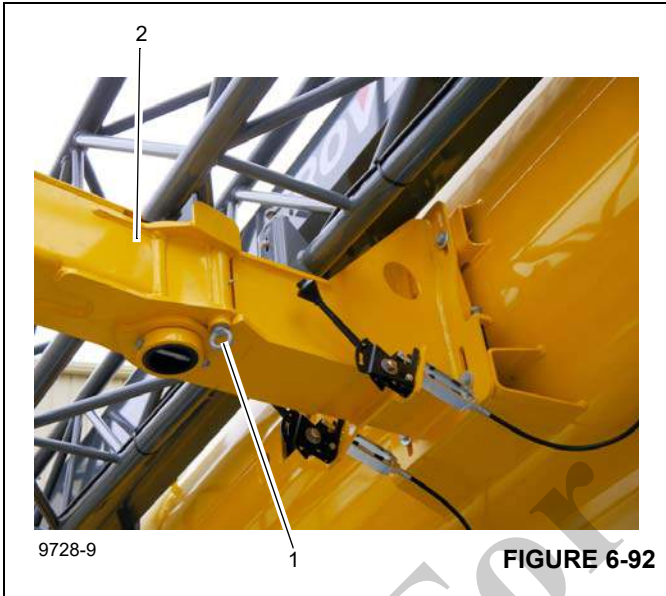
**NOTE:** The crane should be setup on outriggers according to the configuration for planned operation.

2. Retract and lower the boom to horizontal for erecting over the rear of the crane.
3. Attach a tag line (Figure 6-91) at the front of the extension.
  - a. Guide the tag line around the end of the extension and through the bracket on the main boom and back again.
  - b. If possible, have a helper hold the tag line tight while releasing the connections. If a helper is not available, secure the tag line to the main boom.





4. Release the spring latch (1), (Figure 6-92). Fold out the guide ramp (2), (Figure 6-92) until the spring latch (1), (Figure 6-93) engages the tab (2), (Figure 6-93).



5. Make sure that the extension base and fly sections are connected at the tip and with the connecting bar before releasing it from the main boom.



**DANGER**

**Boom Extension Hazard!**

Make sure that the fly extension is secured to the main boom before removing connections to base extension. Failure to do so could result in death or serious injury.

6. Push the vertical actuated hand levers (3), (Figure 6-93) fully downwards. This disengages the pins that secure the fly extension to the main boom (1), (Figure 6-94).

Reference Only





- In the cab on the CCS Display, press menu and then select the extension menu (Figure 6-95). To use the hand-held remote controller, refer to *Boom Extension Assist*, page 3-127.



FIGURE 6-95

- Select pin #1, unlock as shown by the black arrow in (Figure 6-96).



FIGURE 6-96

- The icons turn green, verifying pin #1 is unlocked as shown by the black arrow in (Figure 6-97).



FIGURE 6-97

**NOTE:** Pin #1 will not unlock if pin #2 is unlocked.

- Verify pin #1 is unlocked (1), (Figure 6-98).

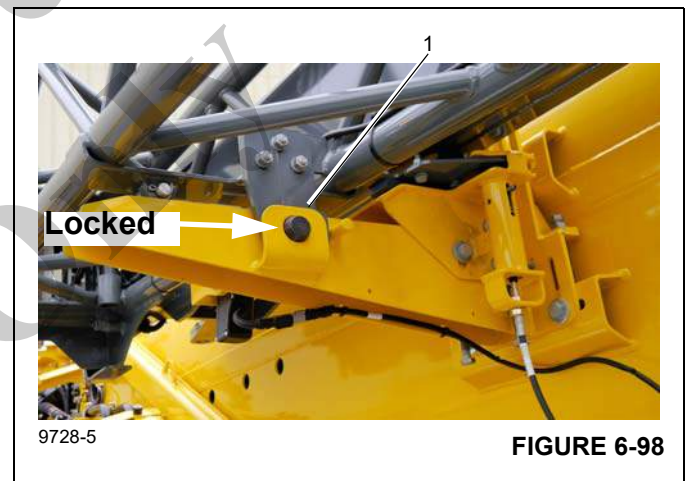
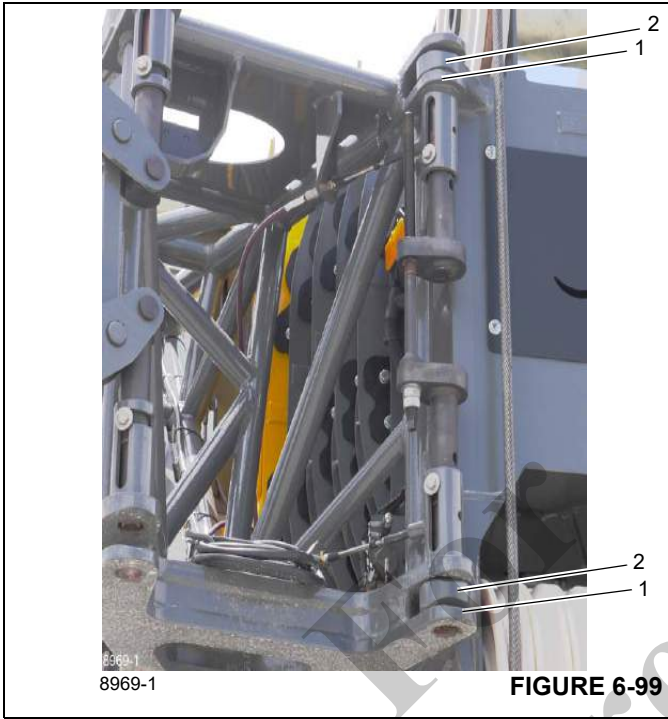


FIGURE 6-98

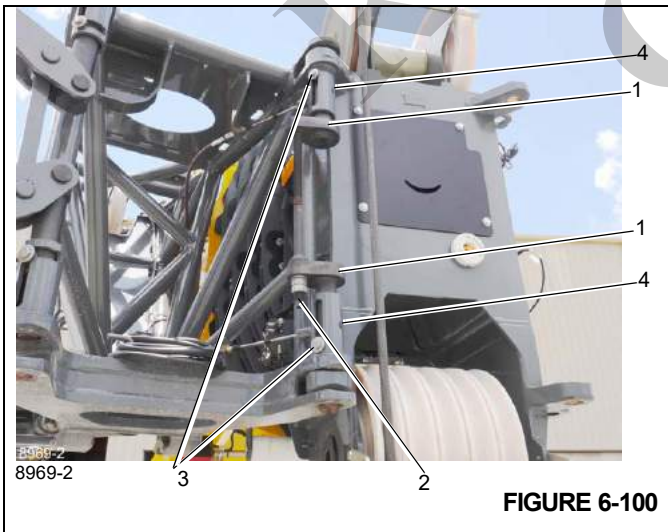
11. Using the tag line, swing the extension out to engage the base extension anchor fittings (1), (Figure 6-99) with the main boom attachment fittings (2), (Figure 6-99).



13. On the CCS Display select pin #2, unlock as shown by the black arrow in (Figure 6-101).



12. Install the pins (1), (Figure 6-100) through the fittings using an impact driver turning the jack screw (2), (Figure 6-100) counterclockwise. The jack screw drive bolt will bottom out when the pins are fully engaged. The bolts and washers (3), (Figure 6-100) are at the end of the slots. Verify that the pins are fully engaged and that the bolts and washers are at the end of the slots.



14. The icons turn green, verifying pin #2 is unlocked as shown by the black arrows (Figure 6-102).





15. Verify pin #2 is unlocked (1), (Figure 6-103). The handle (1), (Figure 6-104) should be in the down position.

**NOTE:** Pin #2 will **NOT** unlock unless the right side boom nose pins are fully engaged. If Pin #2 does **NOT** unlock, make sure the right side boom nose pins are fully engaged and the cable ends are inserted through the pins. Refer to (4), (Figure 6-100).



FIGURE 6-103

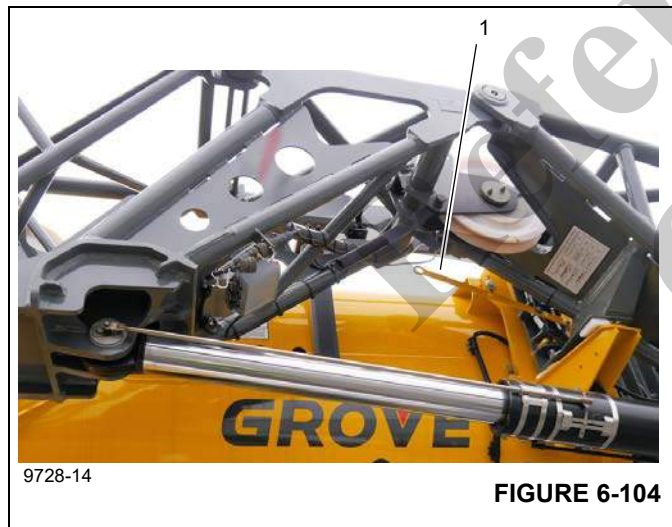


FIGURE 6-104

16. Swing the extension around to engage the base extension anchor fittings (1), (Figure 6-105) with the main boom attachment fittings (2), (Figure 6-105). Insert the pins (3), (Figure 6-105) through the fittings using an

impact driver turning the jack screw (4), (Figure 6-105) counterclockwise. The jack screw drive bolt will bottom out when the pins are fully engaged.

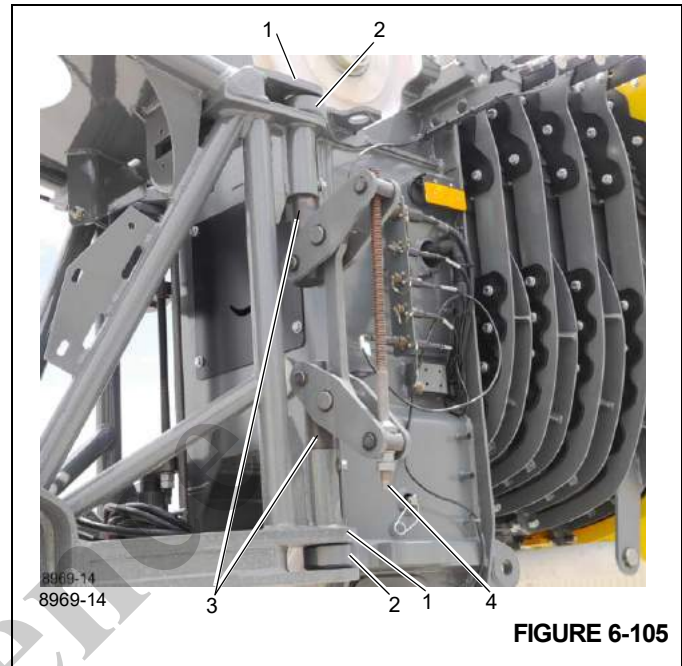


FIGURE 6-105

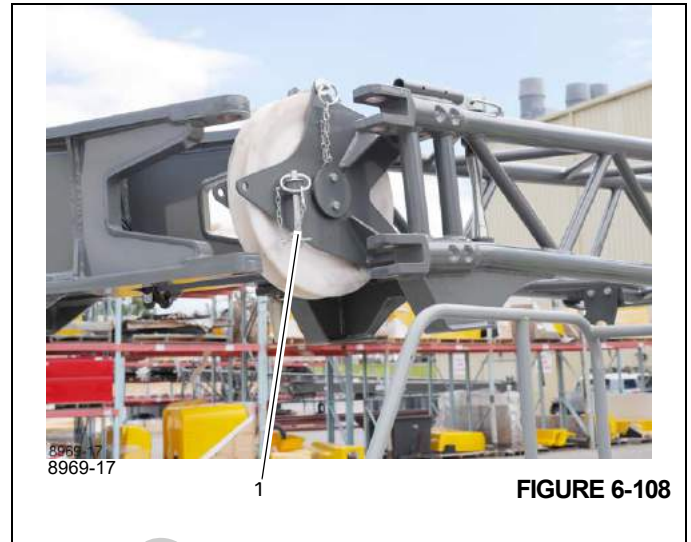
17. Remove the cable retainer pin (1), (Figure 6-108) from the nose of the base extension and insert it into the holder.

18. Attach the tag line to the nose of the fly extension. Secure the tag line to the base extension (Figure 6-106).

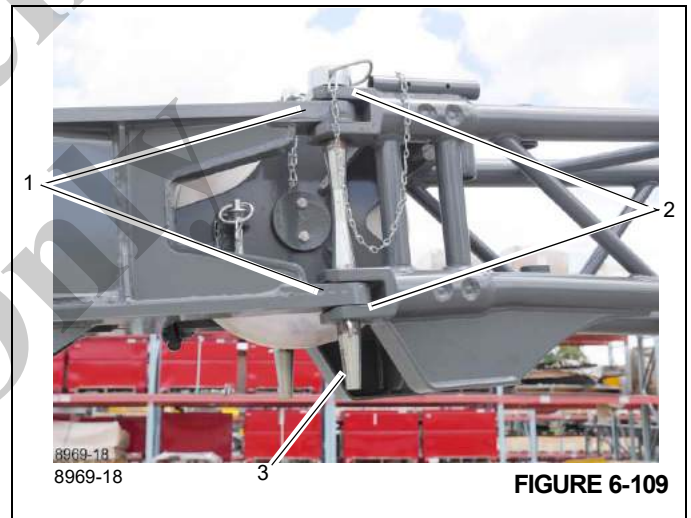


FIGURE 6-106

19. Remove the retaining clip from pin (1), (Figure 6-107) and remove the pin from the locking bar (2), (Figure 6-107) and the fly extension (3), (Figure 6-107). Insert the pin in the locking bar and secure with the retaining clip.



20. Using the tag line, swing the fly extension around and engage the fly attachment fittings (1), (Figure 6-109) with the base extension anchor fittings (2), (Figure 6-109). Install the pin (3), (Figure 6-109) into the fittings and secure with a retaining clip.



**CAUTION**  
**Equipment Damage!**

If the cable retainer pin is not removed, it will come into contact with the fly extension causing damage. Refer to (Figure 6-108) and Step 17.

21. Establish electrical connections between the base extension and the main boom. Refer to *58 ft (17.7 m) Extension Electrical Connections*, page 6-57.
22. Install the Anti-Two Block Switch. Refer to *58 ft (17.7 m) Extension Anti-Two Block Installation*, page 6-59.

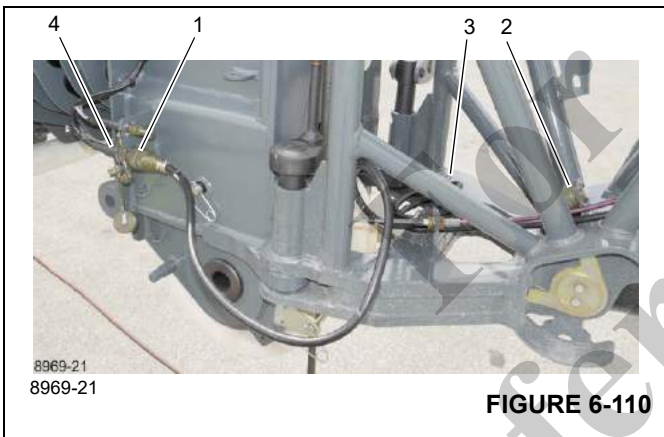
**Extension Electrical Connections**

To connect the anti-two block switch, boom position indicator light or anemometer to boom extensions the following procedures must be performed.

**35 ft (10.5 m) Extension Electrical Connections**

The following procedure connects the 35 ft base extension wiring to the main boom circuits. This connection must be made in order to connect the 59 ft extension wiring and to connect to an anti-two block switch.

1. Remove the plug (1), (Figure 6-110) from the storage socket (2), (Figure 6-110) and unwind the cable from the storage location (3), (Figure 6-110). Connect the plug (1), (Figure 6-110) to the socket (4), (Figure 6-110). This connects the extension to the main boom circuit.



**FIGURE 6-110**

2. Wind the cable around the storage location (3), (Figure 6-110) such that it will not be damaged during crane operation.

**58 ft (17.7 m) Extension Electrical Connections**

The following procedure connects the 23 ft (7 m) extension wiring to the 35 ft (10.5 m) extension wiring for operation of the 58 ft (17.7 m) extension. This connection must be made in order to connect any electrical devices and an anti-two block switch.

1. Before swinging the fly extension in front of the base extension, remove the wires (1), (Figure 6-111) from their stowed location.



**FIGURE 6-111**

2. Connect the plugs (1), (Figure 6-112) to the sockets making sure the plug wire number corresponds to the socket number.

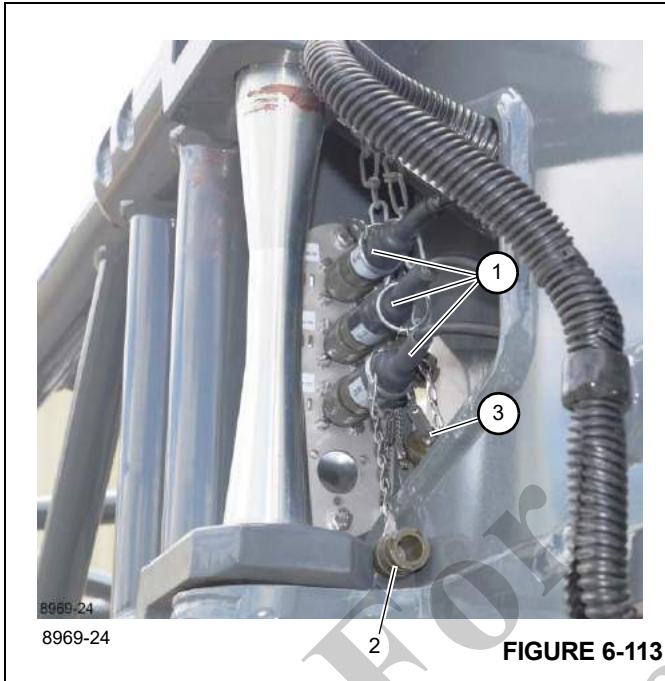


**FIGURE 6-112**



**Disconnect Electrical Connections to the 58 ft (17.7 m) Base Extension**

Refer to *35 ft (10.5 m) Extension Electrical Connections*, page 6-57.



**FIGURE 6-113**

1. Remove the plugs (1), (Figure 6-113) from the sockets and seal the plugs with their caps (2), (Figure 6-113). Seal the sockets with their caps (3), (Figure 6-113).
2. Remove the bridging plug from the dummy socket and plug it into the socket.

**Connecting the Anti-Two Block Switch**

**35 ft (10.5 m) Extension Anti-Two Block Installation**

To electrically connect the anti-two block switch, the electrical connections to this extension must be completed.



**FIGURE 6-114**

1. Install the anti-two block switch assembly onto the pin (1), (Figure 6-114) and secure it with a retaining clip.
2. Route the cable so that it will not be damaged during crane operation, and connect the anti-two block connector to the socket, with the same number.

**35 ft (10.5 m) Extension Anti-Two Block Removal**

When the extension is no longer needed or if installing the 23 ft fly extension for 58 ft extension operation, the anti-two block switch must be removed.

1. Remove the anti-two block connector from the socket.
2. Install the cap on the storage socket.
3. Remove the retaining clip from the mounting pin and remove the anti-two block switch assembly.

The anti-two block switch can now be moved to another location and connected.

### 58 ft (17.7 m) Extension Anti-Two Block Installation

To electrically connect the anti-two block switch, the electrical connections to this extension must be completed. Refer to *58 ft (17.7 m) Extension Electrical Connections*, page 6-57.



FIGURE 6-115

1. Install the anti-two block switch (1), (Figure 6-115) onto the pin (2), (Figure 6-115) and secure it with a retaining clip.
2. Route the anti-two block cable (3), (Figure 6-115) such that it will not be damaged during crane operation, and connect the anti-two block switch to socket (4), (Figure 6-115).

### 58 ft (17.7 m) Extension Anti-Two Block Removal

1. Remove the plug from the socket (4), (Figure 6-115).
2. Remove the anti-two block switch assembly (1), (Figure 6-115) from the pin (2), (Figure 6-115).
3. Fasten the retaining clip to the anti-two block switch.

### Extension Hydraulic Connections (Optional Hydraulic Extension)

Disconnect the hydraulic lines from the boom nose whenever the operation of the crane does not require hydraulic power. This will extend the life of the hose drum, hoses, and associated hardware.

### Checking the Locking Device on the Hose Drum

The hose drum on the side of the main boom provides the hydraulic supply to the boom nose/luffing boom extension. The hose drum is equipped with a locking device. The drum must be unlocked before operation.

If the hose drum has to be removed, the drum must be locked.

### CAUTION

#### Equipment Damage Hazard!

Always verify the drum is unlocked before using extensions or other equipment that require hydraulic power. Damage to hydraulic hoses or the boom may occur.



### CAUTION

#### Spring Loaded Equipment Hazard!

The drum must be locked before removal. The drum is spring loaded and must be locked to prevent damage or injury.

Holes (1), (Figure 6-116) are distributed on the inner wheel of the hose drum. Rotating the latch (2), (Figure 6-116) engages one of the holes to lock the drum, preventing it from turning.

### Unlocking the Drum

Rotate the latch (2), (Figure 6-116) clockwise (A), to disengage it from the hole.

### Locking the Drum

1. Turn the hose drum until a hole is aligned with the latch (2), (Figure 6-116).
2. Rotate the latch (2), (Figure 6-116) counterclockwise to position (B), until the latch fully engages the hole.

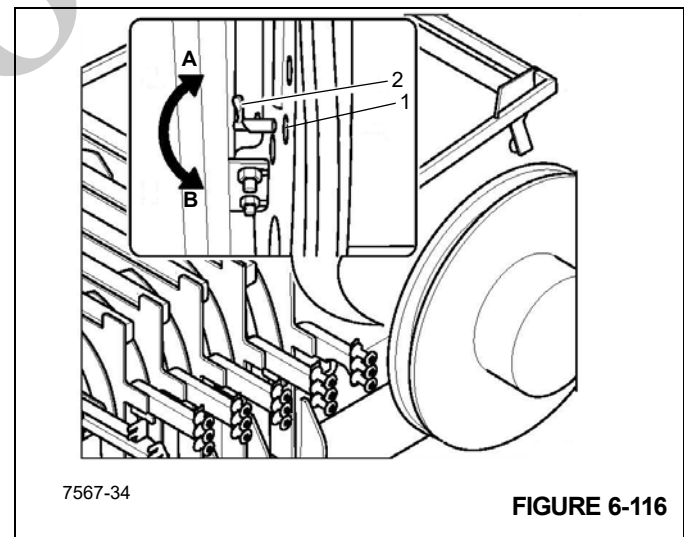


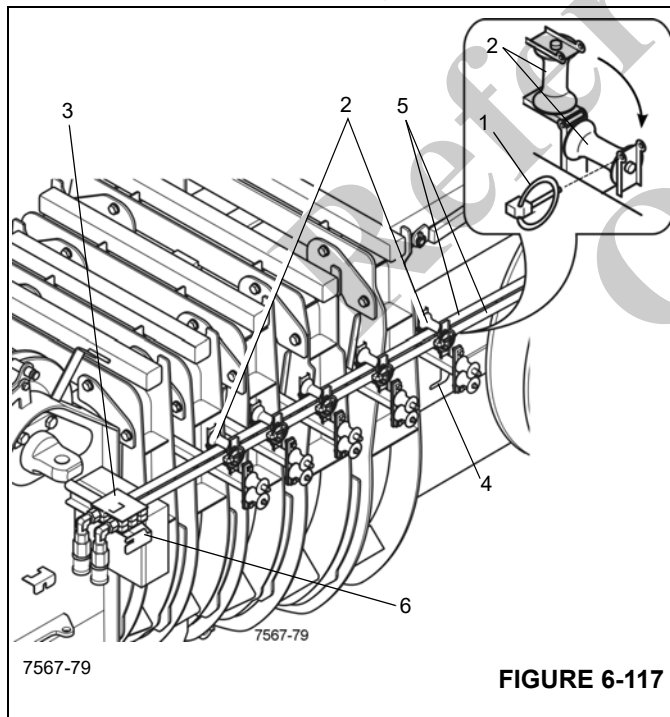
FIGURE 6-116

**CAUTION****Spring Loaded Equipment Hazard!**

If the strain relief is detached after the locking device has been released, do not under any circumstances let go of the strain relief before it has been re-attached. If you let go of the strain relief, the hydraulic hoses will spring back uncontrollably due to the spring force in the hose drum and may injure persons or damage parts of the crane.

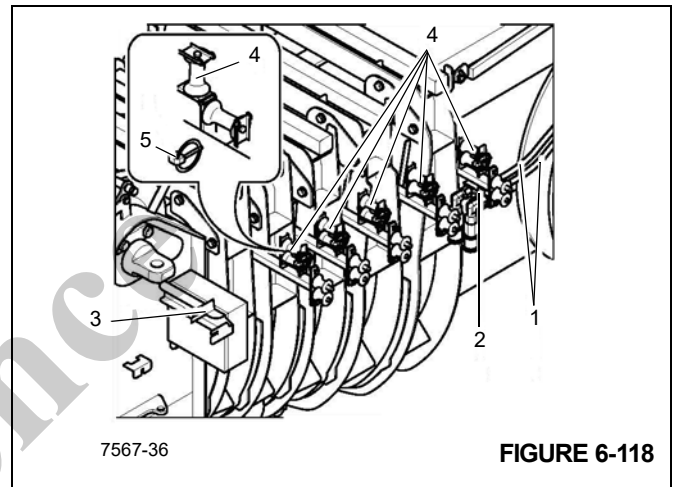
**Hydraulic Hose Installation**

1. Unlock the hose drum.
2. Remove the hinged pins (1), (Figure 6-117) and fold up the guide sheaves (2), (Figure 6-117).
3. Remove the strain relief (3), (Figure 6-117) from its main boom mounting bracket (4), (Figure 6-117) and pull the hydraulic hoses (5), (Figure 6-117) towards the boom nose.
4. Hook the strain relief onto the boom nose mounting bracket (6), (Figure 6-117).
5. Fold down the guide sheaves (2), (Figure 6-117) and secure them with the hinged pins (1), (Figure 6-117).

**FIGURE 6-117****Position for Main Boom Operation**

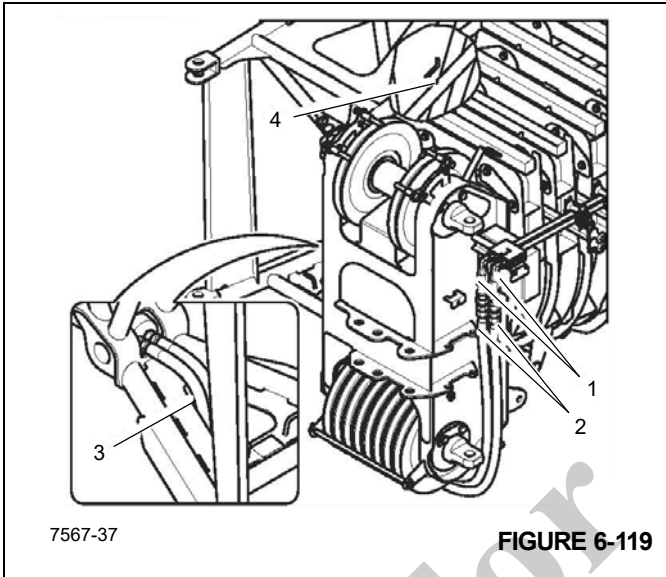
The locking device on the hose drum must be undone:

1. Loosen the hinged pins (5), (Figure 6-118) and fold up the guide sheaves (4), (Figure 6-118).
2. Detach the strain relief from the holder (3), (Figure 6-118) and attach it to the holder (2), (Figure 6-118).
3. Fold down the guide sheaves (4), (Figure 6-118) and secure them with the hinged pins (5), (Figure 6-118).

**FIGURE 6-118****Establishing the Hydraulic Connection**

1. If necessary, bring the connections (1), (Figure 6-119) into the position for boom extension operations.
2. Remove the hose line (2), (Figure 6-119) from the clamp (4), (Figure 6-119).
3. Feed the hose lines towards the left hand side through the lower opening (3), (Figure 6-119) in the 35 ft (10.5 m) section under the boom head.

4. Remove the protective caps to the connections (1), (Figure 6-119) and attach the hose lines (observe color code).



1. Remove the hose lines (2), (Figure 6-120) from the connections (1), (Figure 6-120).
2. Close off the hose lines and the connections (1), (Figure 6-120) with the protective caps.
3. Secure hoses in holder (3), (Figure 6-120) on the 10.5 m (35 ft) extension.

**Folding Deflection Sheaves**

**CAUTION**

**Machine Damage!**

The deflection sheave must be stowed before adjusting the offset angle of the extension. Failure to stow the deflection sheave may result in damage to the extension or sheave.

**Deploying the Rear Deflection Sheave**

The deflection sheave shall be deployed when the boom extension is used. The sheave must be lowered for travel.

**CAUTION!**

**Machine Damage!**

Feed the hydraulic hoses under the main boom head in such a way that they hang freely. Take care that the hoses are not torn off when folding the lattice extension. This prevents damage to the hydraulic hoses.

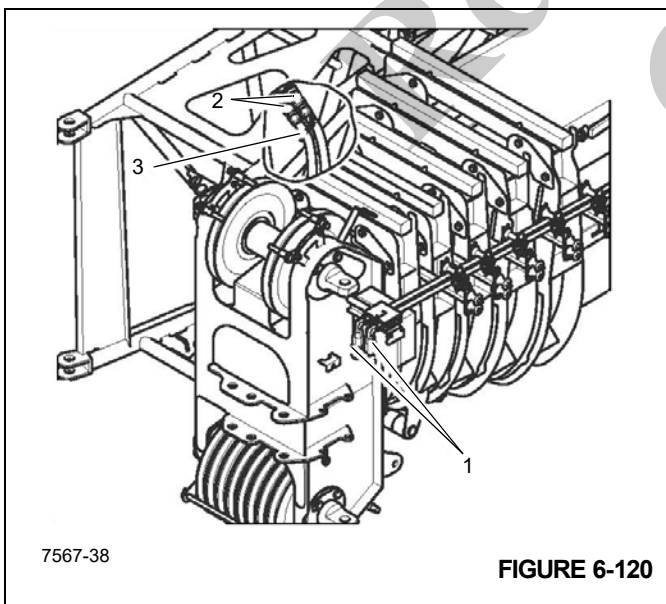


**CAUTION**

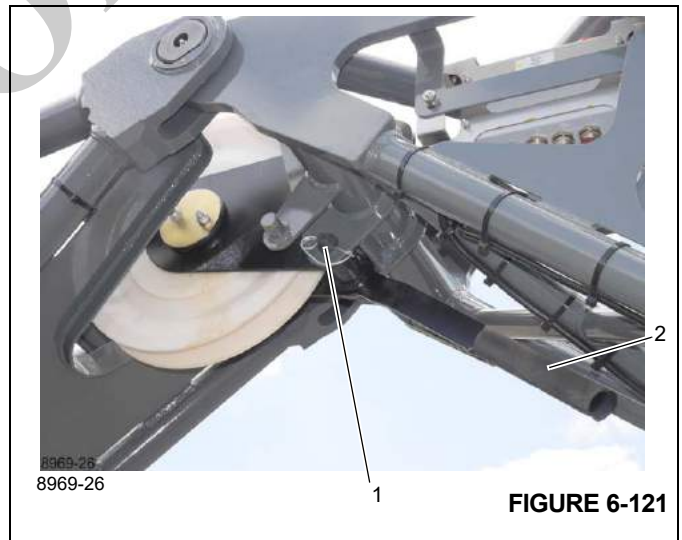
**Pinch Hazard!**

Keep hands clear of the moving deflection sheave during deployment and stowing. Always use the handle provided to control the movement.

**Disconnecting the Hydraulic Connection**

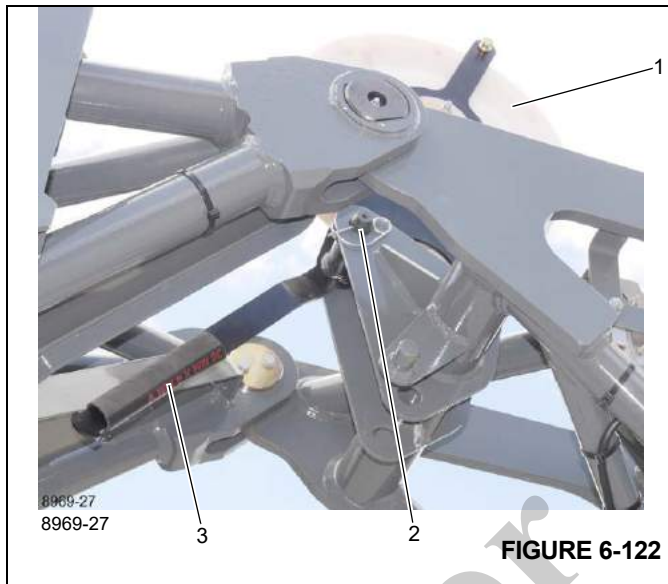


1. Remove the retaining clip from the pin (1), (Figure 6-121).





2. Hold the deflection sheave by the handle (2), (Figure 6-121) and pull out the pin (1), (Figure 6-121).



3. Fold the deflection sheave (1), (Figure 6-122) up and fasten it in this position with the pin (2), (Figure 6-122).
4. Secure the pin (2), (Figure 6-122) using the retaining clip.

#### Stowing Rear Deflection Sheave

1. Remove the retaining clip from the pin (2), (Figure 6-122).
2. Hold the deflection sheave by the handle (3), (Figure 6-122) and pull out the pin (2), (Figure 6-122).
3. Fold the deflection sheave (1), (Figure 6-122) down and fasten it in position with the pin (2), (Figure 6-122).

4. Secure the pin (2), (Figure 6-122) using the retaining clip.

### Positioning/Removing the Hoist Cable

#### Positioning Hoist Cable



#### CAUTION

#### Falling Objects Hazard!

Always make sure sheaves and pins that secure the hoist cable are secured with clips. This prevents components from coming loose, falling and causing injury.

1. Remove the retaining sheaves (1), (Figure 6-123).
2. Guide the rope over the deflection sheaves (4), (Figure 6-123) and (3), (Figure 6-123) and over the nose sheave (2), (Figure 6-123) of the extension.
3. Reinstall all the retaining sheaves (1), (Figure 6-123) and secure with retaining clips.
4. Install the hook tackle or the hookblock. The rope may now be reeved for one or two parts of line, depending on the length of the section.

#### Removing Hoist Cable

1. Unreeve the hookblock.
2. Remove the retaining sheaves (1), (Figure 6-123).
3. Take the wire rope off the head sheave (2), (Figure 6-123) and deflection sheaves (4), (Figure 6-123) and (3), (Figure 6-123) and place it on the ground on the left side.
4. Replace all retaining sheaves and secure them with retaining clips.

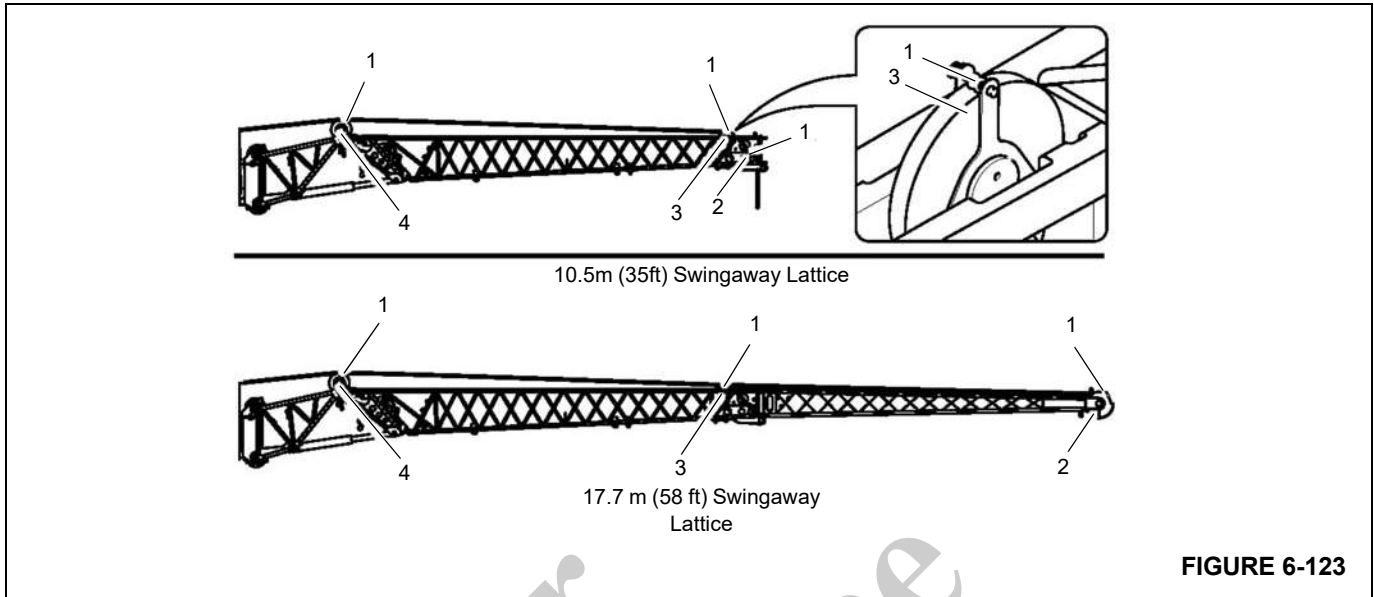


FIGURE 6-123

For Reference Only



## Mechanical Luffing Boom Extension (Adjustable Boom Extension)



### DANGER

#### Crushing Hazard!

During installation and removal, always use the proper equipment with sufficient load bearing capacities.

### Extension Angle Adjusting Mechanism



### WARNING

#### Crushing Hazard!

Uncontrolled movement of the boom extension can result in death or serious injury. The boom extension must be supported before removing the adjusting pins.

Support the extension with an assist crane or set the tip of the extension on the ground before adjusting the angle.

### CAUTION

#### Machine Damage!

The deflection sheave must be stowed before adjusting the offset angle of the extension. Failure to stow the deflection sheave may result in damage to the extension or sheave.

Refer to (Figure 6-124).

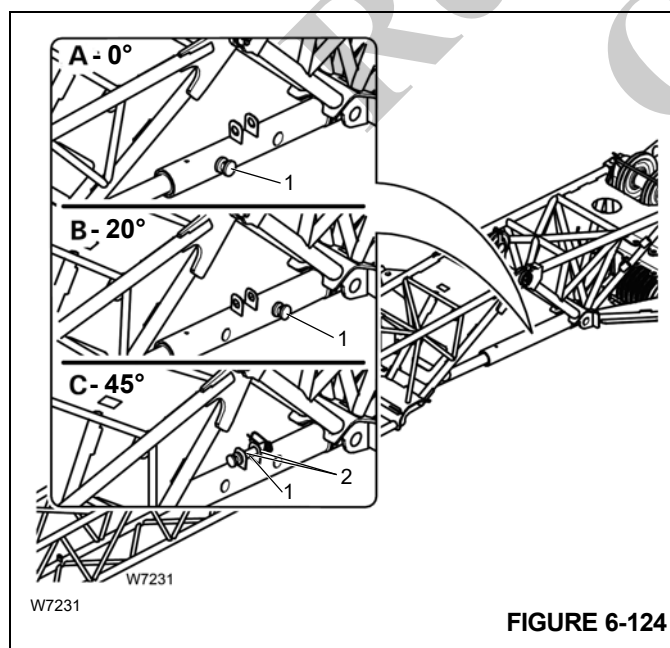


FIGURE 6-124

The boom extension angle is determined by the position of the adjusting pin. There are three positions:

- **0° angle: (A)** – For a 0° angle, the pin (1) is installed in the front location and is secured with the retaining clip.
- **20° angle: (B)** – For a 20° angle, the pin (1) is installed in the rear location and is secured with the retaining clip.
- **45° angle: (C)** – For a 45° angle, the pin (1) is removed and stored in the holder (2) and secured with the retaining clip.

### Setting the Offset Angle With an Auxiliary Crane

**NOTE:** The information in this section only applies to the mechanical luffing boom extension.

1. Lift the extension with the auxiliary crane until the pin (1), (Figure 6-124) is relieved of load.
2. Lift or lower the extension with the auxiliary crane until the adjusting pin can be installed into the position for the required angle. Refer to *Extension Angle Adjusting Mechanism*, page 6-64.
3. Lower the extension with the auxiliary crane and remove the lifting gear.

If the lattice extension now touches the ground at the current angle, the angle will set itself when the main boom is raised.

### Setting the Offset Angle Without an Auxiliary Crane

If an auxiliary crane is not available, the extension head must rest on the ground before the angle is changed.

### CAUTION

#### Rope Damage!

The hoist cable can be damaged if it is reeved while the extension nose is on the ground. Unreeve the hoist cable from the extension nose before adjusting the offset angle.

### Entering the RCL Code

Enter the RCL rigging code for the boom extension offset angle in accordance with the current rigging mode of the crane. Refer to the *Chapter Remarks, Load Charts*, page 2-7.

When adjusting the angle without an auxiliary crane, you must enter an RCL rigging code. The RCL rigging code depends on:

- The rigged outrigger span.
- The rigged counterweight.
- The working position.

The superstructure must be in a working position permitted by the *Load Charts*, page 2-7 for the RCL rigging code that was entered.

### Inclining the Crane

In order to set the offset angle of the adjustable extension, you must set it down on the ground by extending and lowering the main boom over the rear.

Depending on the space available, the condition of the terrain or a limitation on the telescoping due to the current rigging mode, it may be that the head of the extension cannot be set on the ground by telescoping and lowering the main boom.

In this case, you can use the outriggers to incline the crane.

1. Fully extend the front outriggers and jack cylinders.
2. Fully extend the rear outriggers.
3. Extend the rear jack cylinders until the rear wheels are just off the ground.

---

 **WARNING**  
**Tipping Hazard!**

Make sure that the wheels do not touch the ground when the crane has been inclined. This prevents a reduction in the stability of the crane, which could lead to it tipping over when setting the angle of the lattice extension or overloading the axles, causing serious injury or death.

---

### Stowing the Folding Boom Extension

#### Requirements for Stowing the Boom Extensions

Before lowering a boom extension into a horizontal position, the following requirements must be met:

- No other load is raised apart from the hookblock.
- The counterweight required, according to the *Load Charts*, page 2-7 for the planned operation with the configured extension, is rigged.
- The crane is supported with the outriggers prescribed for operation with the extension according to the *Load Charts*, page 2-7.
- The main boom is fully retracted.

---

 **DANGER**  
**Crushing Hazard!**

To prevent serious injury or death, do not stand on decking until extensions are secure.

---

 **DANGER**  
**Tipping Hazard!**

Do not override the RCL when lowering the boom into a horizontal position.

If the RCL is overridden, lockouts will be bypassed and the crane may overturn if outside of the permissible working range.

- 
- Retract the main boom completely, and lower boom to the horizontal position.
  - Remove the anti-two block switch weight and anti-two block switch. Refer to *Connecting the Anti-Two Block Switch*, page 6-58.
  - Unreeve the cable and remove it from the extension. Refer to *Positioning/Removing the Hoist Cable*, page 6-62.
  - Fold in the deflection sheaves at the front and rear. Refer to *Folding Deflection Sheaves*, page 6-61.

#### Stowing Procedure: 23 ft (7 m) Boom Fly Extension

The 23 ft fly extension can be folded to the side of the 36 ft base extension.

1. Attach tag line to the nose of the 23 ft (7 m) fly extension. Have a helper hold the tag line to prevent the fly from moving.

---

 **WARNING**  
**Crushing Hazard!**

To prevent injury or death, ensure there are no people or objects in the swing area of the extension.

- Remove the retaining clip from the pin (1), (Figure 6-125) and remove the pin from the connecting lug on the left side.

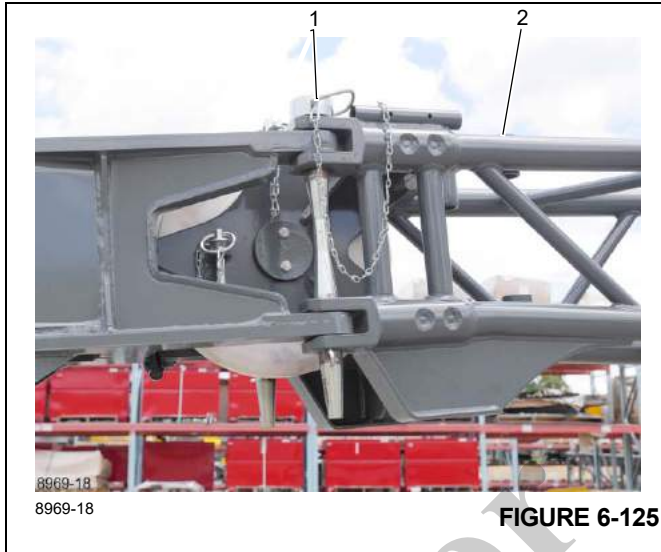


FIGURE 6-125



FIGURE 6-126

- Install the pin (1), (Figure 6-125) into the holder (2), (Figure 6-125) and secure with retaining clip.
- Using the tag line to control movement of the extension, swing it into the stowed position on the side of the 35 ft (10.5 m) base extension.
- Secure the 23 ft (7 m) fly extension to the 35 ft (10.5 m) base extension with the locking bar (1), (Figure 6-126) and pins (2), (Figure 6-126).
- Secure the pins with the retaining clips.

**NOTE:** If the 23 ft (7 m) fly extension is being stowed on the main boom and the 35 ft (10.5 m) base extension will continue to be used, follow the next procedure for stowing the 58 ft (17.7 m) base extension in order to attach the 23 ft (7 m) fly extension onto the main boom. Then refer to *Erecting Procedure - 35 ft (10.5 m) Base Extension*, page 6-45 to deploy the 35 ft base extension.

**! WARNING**  
**Crushing Hazard!**

Always use a tag line to control the movement of the boom extension during the erection and stowing process. Have a helper hold the tag line to prevent the extension from moving or tie it to the extension base section.

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

**Stowing Procedure: 58 ft (17.7 m) Extension**

In order to stow the 58 ft extension first perform the previous procedure to stow the 23 ft (7 m) fly extension onto the 35 ft (10.5 m) base extension.

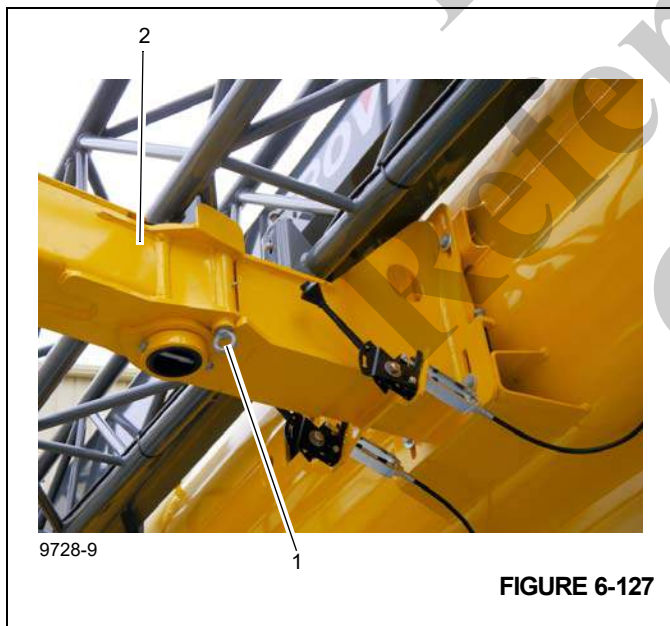
**! DANGER**  
**Crushing Hazard!**

Make sure that the extension is pinned to the front of the main boom or is secured against swinging around.

This will prevent the extension from swinging inadvertently to the side of the main boom, causing severe injury or death.

Before stowing the extension, make sure that all electrical and hydraulic lines are disconnected.

1. Lower the boom and attach a tag line to the front of the 35 ft (10.5 m) section. Have a helper hold the tag line to prevent the extension from moving.
2. Release the retaining pin (1), (Figure 6-127) and fold out the guide ramp (2), (Figure 6-127) until the locking pin engages in the lug.



**! DANGER**

**Boom Extension Hazard!**

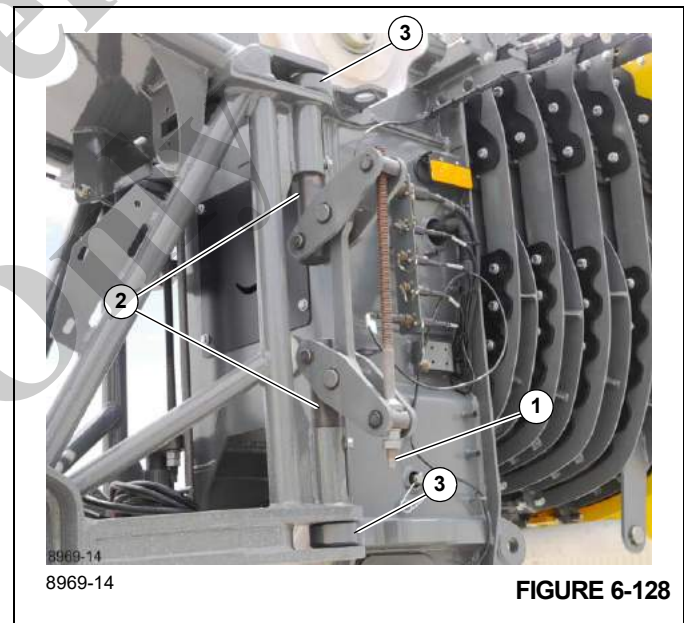
Make sure that the fly extension is secured to the main boom before removing connections to base extension. Failure to do so could result in death or serious injury.

**! DANGER**

**Crushing Hazard!**

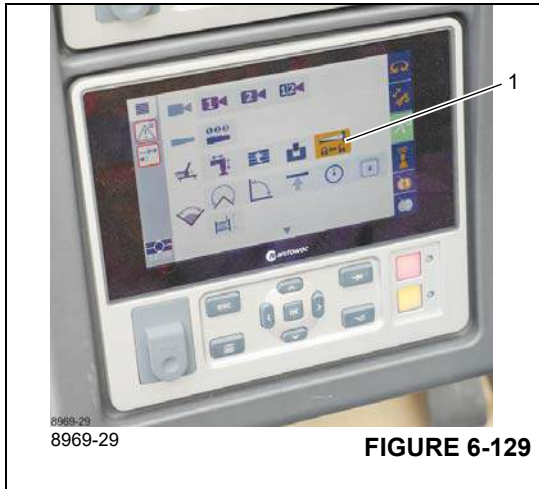
Make sure that the pins on the right side are properly installed and the extension is secured from swinging around before disconnecting the left side pins. Death or serious injury could occur.

3. Using the impact driver, turn the jack screw (1), (Figure 6-128) clockwise to remove the pins (2), (Figure 6-128) from the attachment lugs (3), (Figure 6-128) on the left side.

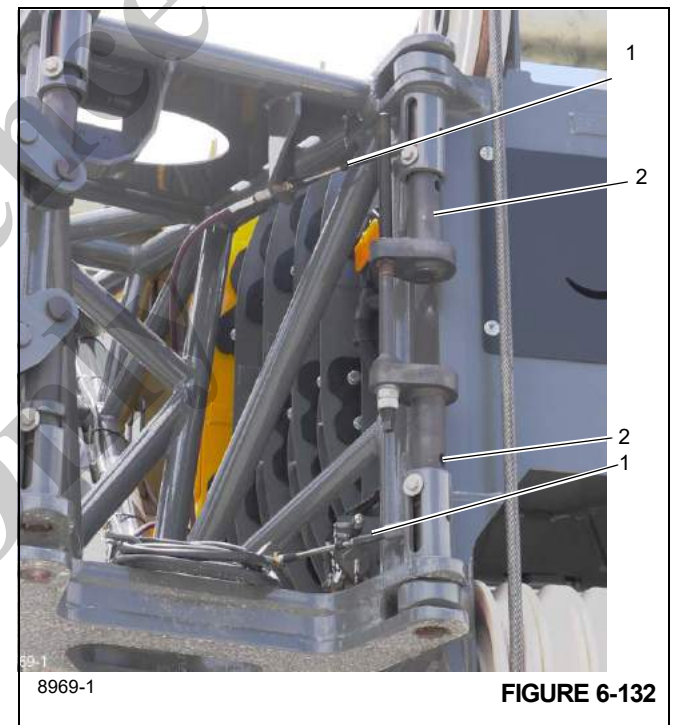


4. Using the tag line, swing the boom extension around until the extension is on the guide ramp. **Note:** Raise the main boom to aid extension to fully engage the pin #2 (Figure 6-128) location.

- On the CCS screen, navigate to the boom extension icon (1), (Figure 6-129).



- Select pin #2 lock (1), (Figure 6-130), the pin #2 icons turn green (1), (Figure 6-133). The lever handle (1), (Figure 6-131) should move up and the cable pins (1), (Figure 6-132) should retract from the attachment pins (2), (Figure 6-128).





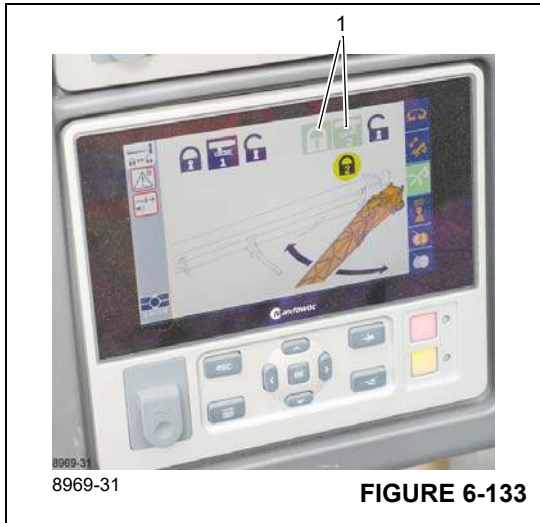


FIGURE 6-133

7. Verify pin #2 (1), (Figure 6-134) has engaged the extension.

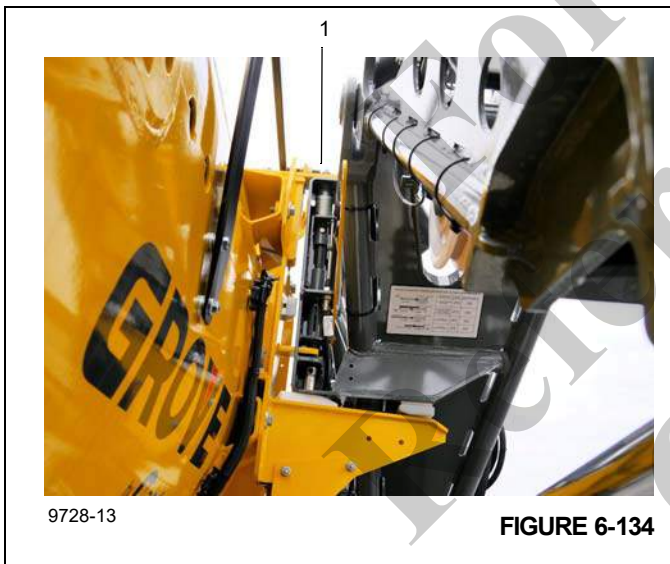


FIGURE 6-134

**! DANGER**

If pin #2 (1), (Figure 6-134) does not engage the 35 ft (10.5 m) extension, **STOP**. DO NOT continue to stow the boom extensions until pin #2 has properly engaged the extension.

DO NOT climb onto decking or walk under boom extensions.

Severe injury or death may occur if the front latching mechanism is not properly attached to the boom extensions; the boom extensions may fall or swing away from the main boom stowage brackets.

Refer to the Service Manual to align the extension with the spring pin or the locking pin.

8. Using the impact driver, turn the jack screw (1), (Figure 6-135) clockwise until the pins (2), (Figure 6-135) are fully out of the lugs (3), (Figure 6-135).

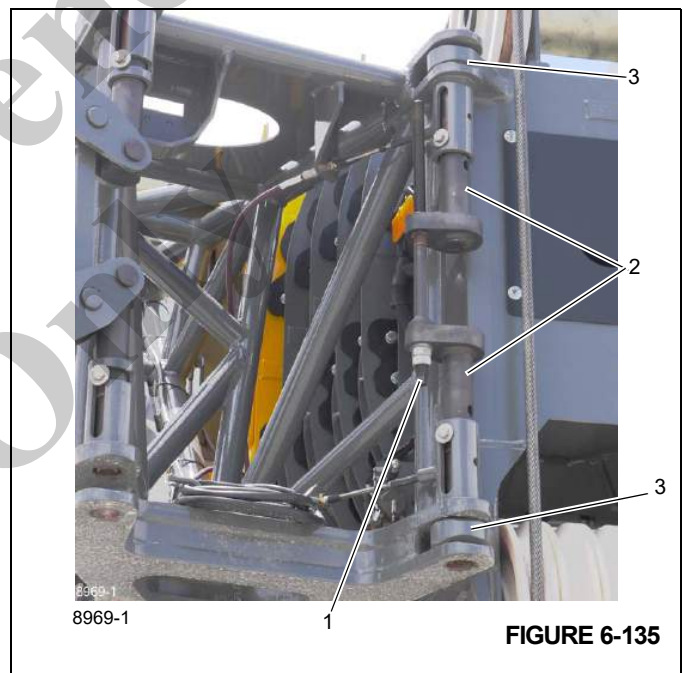


FIGURE 6-135

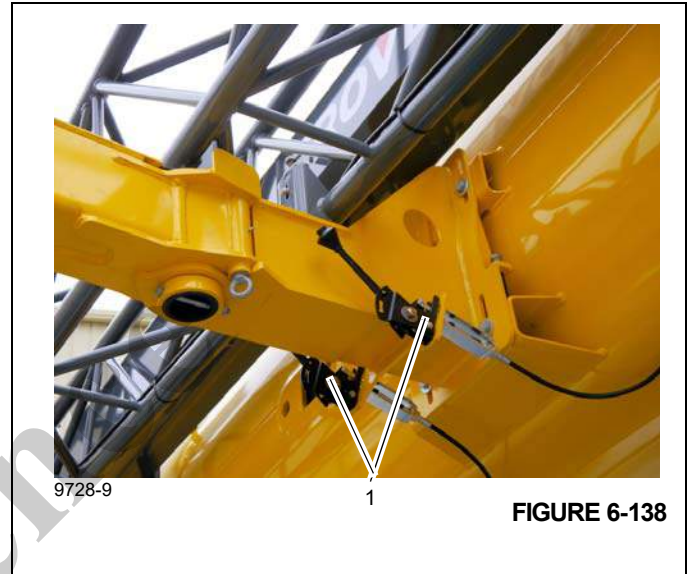
9. Raise the main boom to assist in causing the boom extension to fully engage the guide ramp then lower the main boom.



10. On the CCS screen, select pin #1 lock (1), (Figure 6-136), the pin #1 icons turn green (1), (Figure 6-137). You can also use the hand held remote to secure pin #1. Refer to *Camera Display Options*, page 3-57.



11. Actuate pin #1 before moving handles so that the extension is fully secured before moving under it to operate the handles.
12. Push the vertical actuated hand levers (1), (Figure 6-138) fully upwards. This engages the pins that secure the fly extension to the main boom (1), (Figure 6-139).



**! DANGER**

**Boom Extension Hazard!**

Make sure that the fly extension is secured to the main boom before removing connections to base extension. Failure to do so could result in death or serious injury.

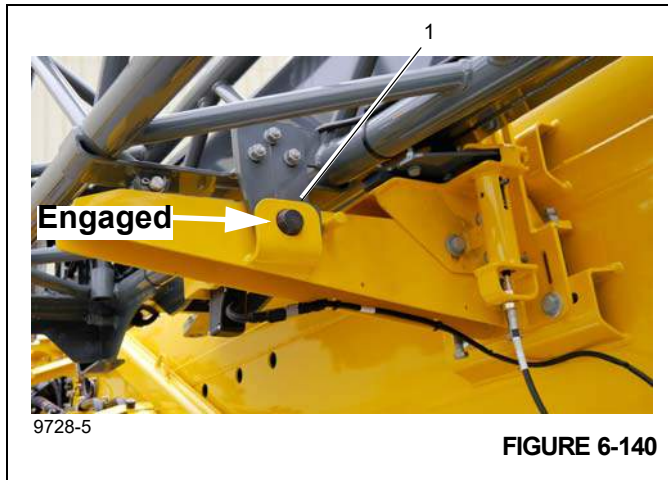


FIGURE 6-139

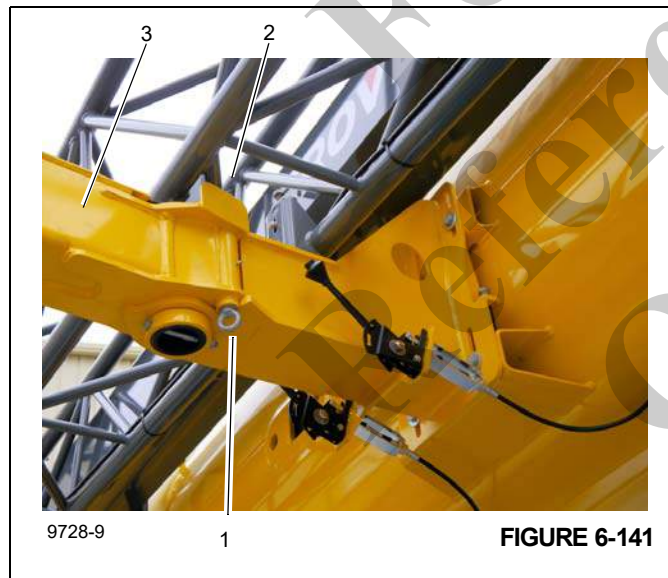
13. Verify the pins (1 and 2), (Figure 6-139) are engaged with the lugs.



- Verify pin #1 (1), (Figure 6-140) is engaged.



- Pull the locking pin (1), (Figure 6-141) down against spring force, and out of the attachment lug (2), (Figure 6-141). Fold the guide ramp (3), (Figure 6-141) around until it can be secured with the spring latch (1), (Figure 6-141).



- Remove all tag lines.
- Reeve the hoist cable over the main or aux boom nose as preferred.

### Boom Extension Removal

To remove the 35 ft (10.5 m) base extension, begin by erecting the 35 ft base extension using the *Erecting Procedure - 35 ft (10.5 m) Base Extension*, page 6-45. The 35 ft extension includes the 35 ft extension base section with the 23 ft extension fly section remaining alongside the main boom base section and secured to the main boom.

To remove the 58 ft (17.7 m) extension, begin by erecting the 58 ft base extension using the *Erecting Procedure - 58 ft (17.7 m) Extension*, page 6-50. The 58 ft extension includes the 35 ft extension base section with the 23 ft extension fly section folded alongside the 35 ft base extension and secured with the locking bar.



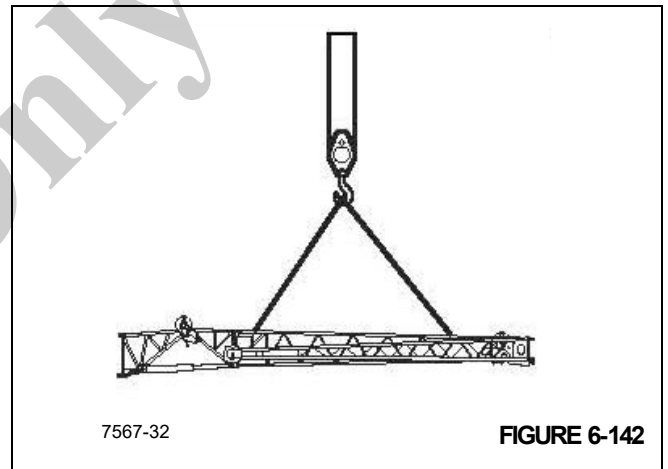
**DANGER**

#### Boom Extension Fall Hazard!

The Boom Extension must be properly supported by the assist crane.

#### From the Nose of the Main Boom

- Attach a sling (Figure 6-142) to the boom extension and an auxiliary crane. Adjust the tension in the sling to support the weight of the extension while not putting upward pressure on the extension.



- Disconnect any electrical or hydraulic cables/hoses from the boom extension.

3. Lift handle (1), (Figure 6-143) to raise pin (2), (Figure 6-143) fully in its bracket. Secure in place. Pushing the handle up manually moves Pin #2 to the locked position, which will retract the interlock cables out of the two pins that the boom extension is swinging on.

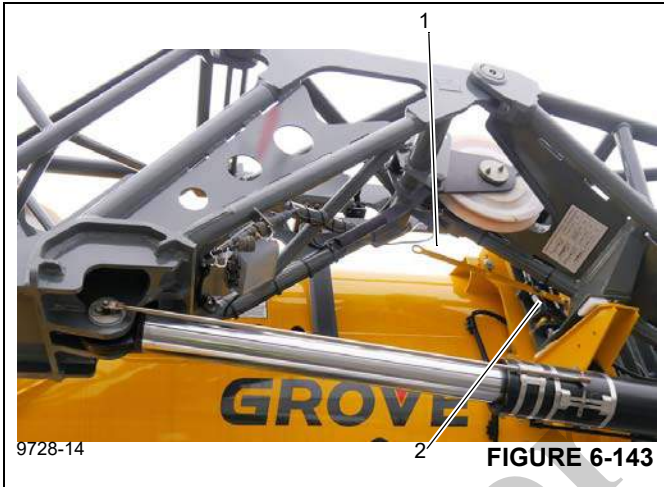


FIGURE 6-143

4. On the left side of the boom nose, use an impact driver to turn the jack screw (1), (Figure 6-144) clockwise to remove the pins (2), (Figure 6-144) from the attachment lugs (3), (Figure 6-144).

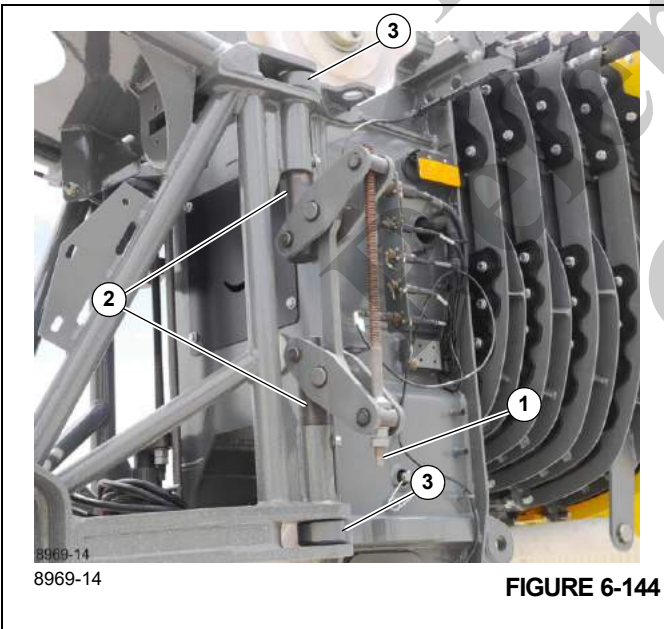


FIGURE 6-144

5. On the right side of the boom nose, use the impact driver to turn the jack screw (1), (Figure 6-135) clockwise until the pins (2), (Figure 6-135) are fully out of the lugs (3), (Figure 6-135).

**NOTE:** When these two pins are retracted, the boom extension will then be supported only by the assist crane that was connected to it earlier. With the boom extension completely disconnected from the machine, it can now be lifted away.

6. Lift the boom extension away from the main boom nose.

### Installing and Removing the 26 ft (8 m) Extension Insert

**! DANGER**  
Crushing Hazard!

During installation and removal, always use the proper equipment with sufficient load bearing capacities.

#### Installation

1. Using another crane or lifting device, remove the 35 ft (10.5 m) or 58 ft (17.7 m) extension from the boom.
2. Use another crane or suitable lifting device to install the insert.
3. Connect a sling to the two lifting lugs (1), (Figure 6-145).

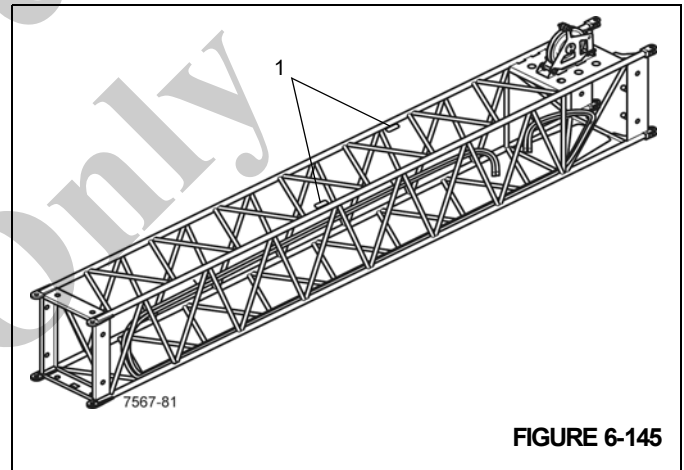


FIGURE 6-145

4. Lift the insert in front of the main boom head so that the four connecting points (1), (Figure 6-146) align on both sides.
5. Remove the pins from the holders.
6. Insert the pins into the connecting points (1), (Figure 6-146) and secure them with retaining clips.

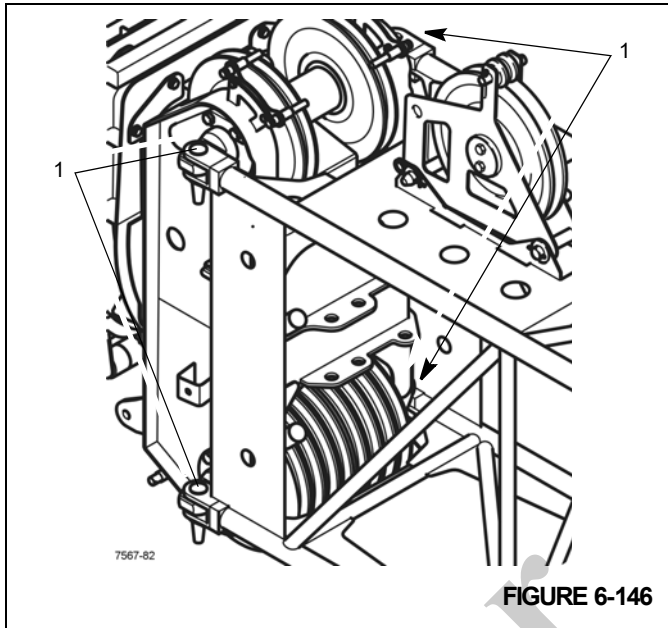


FIGURE 6-146

7. Reinstall the 35 ft (10.5 m) or 58 ft (17.7 m) extension onto the insert.
8. Refer to *Insert Electrical Connection*, page 6-75 and *Connecting the Folding Extension Electrical Circuit*, page 6-76 to connect the electrical connections.
9. Refer to *Connecting Main Boom Hydraulics*, page 6-77 and *Connecting the Folding Extension Hydraulics*, page 6-77 to connect the hydraulic lines.

### Removal

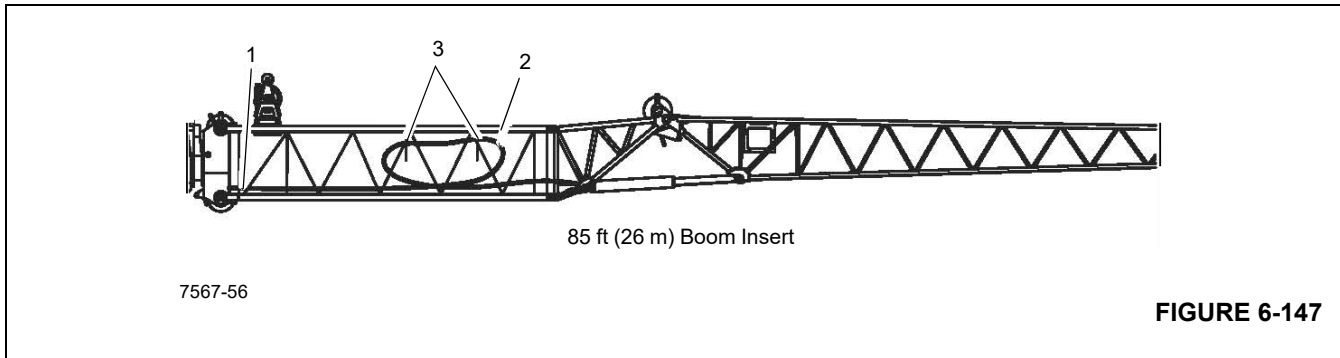
#### CAUTION

##### Equipment Damage Hazard!

Before removing an extension, make sure that the electrical and hydraulic connections have been disconnected and properly stowed to prevent damaging the cable and hydraulic hoses.

1. With the 35 ft (10.5 m) or 58 ft (17.7 m) extension already removed.
2. Use another crane or suitable lifting device to remove the insert.
3. Connect a sling to the two lifting lugs (1), (Figure 6-145) and lift the insert enough to take the load off the connecting pins.
4. Verify the electrical and hydraulic connections have been disconnected. Refer to *Extension Hydraulic Connection*, page 6-76 and *Disconnecting Main Boom Electrical Connection*, page 6-75.
5. Remove the pins from the connecting points (1), (Figure 6-146).
6. Insert the pins into the holders and secure them with retaining clips.
7. Remove the insert.

**Insert Electrical Connection**



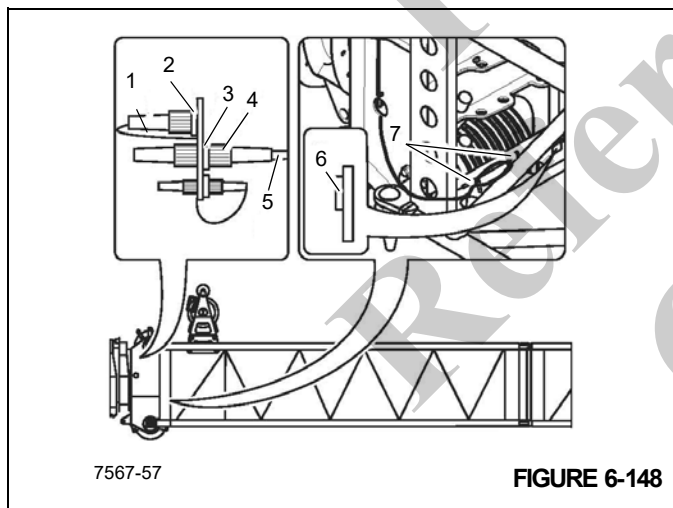
The electric cable (1), (Figure 6-147) is installed in the 26 ft (8 m) insert (2), (Figure 6-147) with the long end of the cable wound on the stowage lugs (3), (Figure 6-147).

When the 105 ft (32 m) boom insert is rigged, the cable is routed through the 20 ft (6 m) insert (4).

**Connecting the 26 ft (8 m) Insert to the Main Boom**

**Establishing a Connection**

Refer to (Figure 6-148).

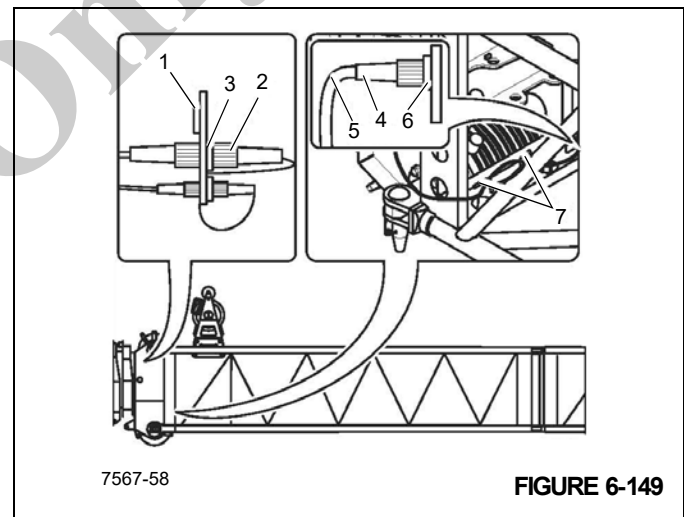


1. Remove the bridging plug (1), (Figure 6-148) from the socket (3), (Figure 6-148) and plug it into the dummy socket (2), (Figure 6-148).
2. Unwind the cable (5), (Figure 6-148) from the holder (7), (Figure 6-148).

3. Remove plug (4), (Figure 6-148) from the dummy socket (6), (Figure 6-148) and plug into the socket (3), (Figure 6-148).
4. Wind up the cable (5), (Figure 6-148) far enough on the holder (7), (Figure 6-148) so that it will not be damaged during operation.

**Disconnecting Main Boom Electrical Connection**

1. Remove the plug (4), (Figure 6-149) from the socket (3), (Figure 6-149) and plug into the dummy socket (6), (Figure 6-149).
2. Wind the cable (5), (Figure 6-149) onto the holder (7), (Figure 6-149).
3. Remove the plug (2), (Figure 6-149) from the dummy socket (1), (Figure 6-149) and plug it into the socket (3), (Figure 6-149).





Connecting the Folding Extension Electrical Circuit

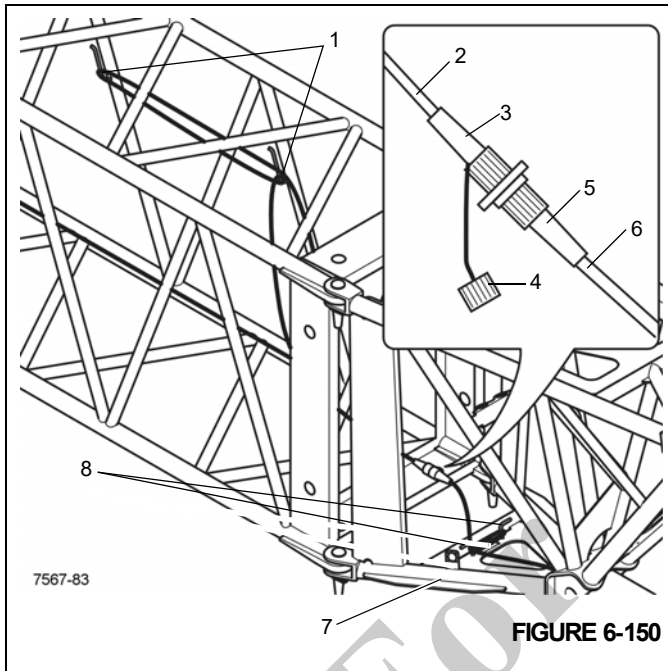


FIGURE 6-150

1. Unwind the cable (2), (Figure 6-150) from the holder (1), (Figure 6-150).
2. Remove the cap (4), (Figure 6-150) off the socket (3), (Figure 6-150).
3. Unwind the cable (6), (Figure 6-150) from the holder (8), (Figure 6-150).
4. Remove the bridging plug (5), (Figure 6-150) from the dummy socket (7), (Figure 6-150) and plug it into the socket (3), (Figure 6-150).
5. Wind up the cable (8), (Figure 6-150) far enough on the holder (7), (Figure 6-150) so it will not be damaged during operation.
6. Wind up the cable (2), (Figure 6-150) far enough on the holder (1), (Figure 6-150) so it will not be damaged during operation.

Disconnecting the Folding Extension Electrical Circuit

1. Remove the bridging plug (5), (Figure 6-151) from the socket (3), (Figure 6-151) and plug it into the dummy socket (7), (Figure 6-151).
2. Wind the cable (6), (Figure 6-151) on to the holder (8), (Figure 6-151).
3. Install the protective cap on the socket (3), (Figure 6-151).
4. Wind the cable (2), (Figure 6-151) onto the holder (1), (Figure 6-151).

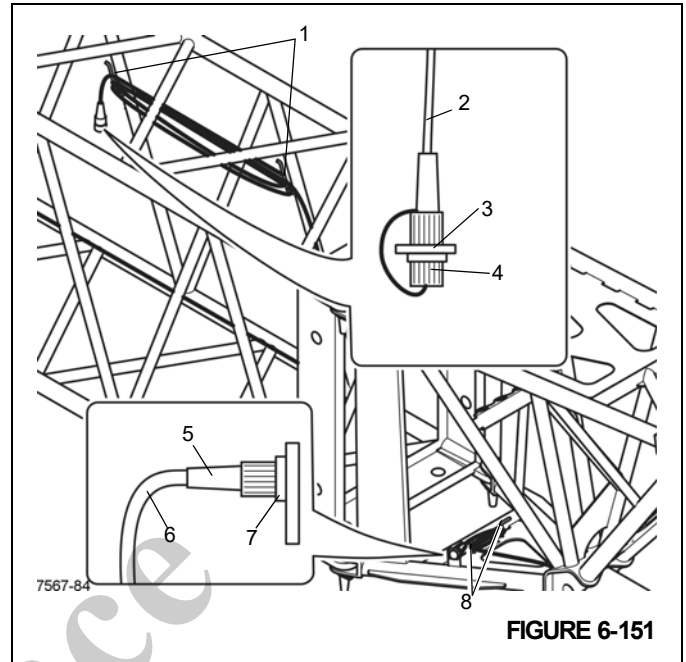


FIGURE 6-151

Extension Hydraulic Connection

All hydraulic lines are located in the 26 ft (8 m) extension (Figure 6-152). The hose lines are installed so that short ends are located to the rear and long ends to the front of the extension.

The long ends (1), (Figure 6-152) of the hoses are suspended from clamps.

The short ends (2), (Figure 6-152) of the hoses are positioned at the rear of the lower cross-strut.

**NOTE:** Connecting the hydraulic lines from the boom nose to the hydraulic luffing boom extension through the 26 ft (8 m) and 20 ft (6 m) inserts are the same as connecting to the 26 ft (8 m) insert only.

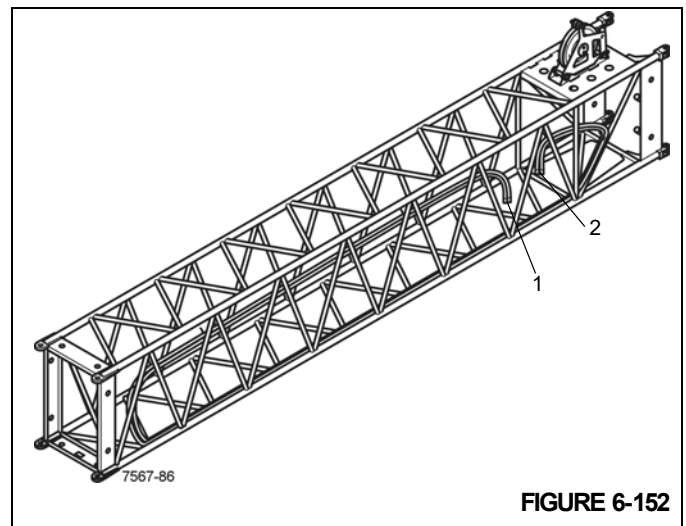


FIGURE 6-152

### Connecting Main Boom Hydraulics

1. If necessary, install the hydraulic hoses (1), (Figure 6-153) on the boom nose. Refer to *Extension Hydraulic Connections (Optional Hydraulic Extension)*, page 6-59.
2. Route the short ends (2), (Figure 6-153) to the main boom head.
3. Remove the protective caps and connect the short ends (2), (Figure 6-153) to the boom nose connectors (1), (Figure 6-153).

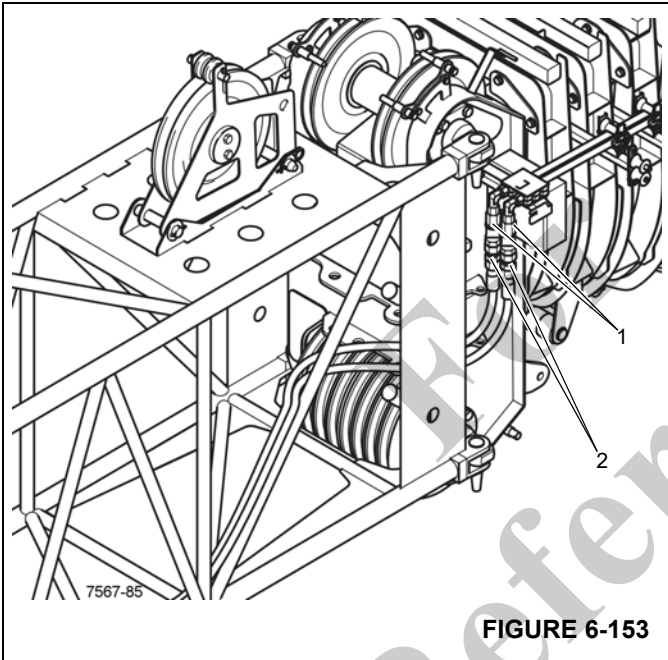


FIGURE 6-153

### Disconnecting Main Boom Hydraulics

1. Disconnect the short hose ends (2), (Figure 6-153) from the boom nose connectors (1), (Figure 6-153).
2. Cover the short end and boom nose connectors with the protective caps.
3. Route the short ends (2), (Figure 6-153) inside and place them in front of the lower cross-strut so that they do not hang down.

### Connecting the Folding Extension Hydraulics

1. Remove the long hose (1), (Figure 6-154) from the holders (2), (Figure 6-154) on the insert.
2. Route the hoses to the front of the insert.
3. Remove the protective caps and connect the folding extensions hoses (3), (Figure 6-154) to the long hose ends (4), (Figure 6-154).

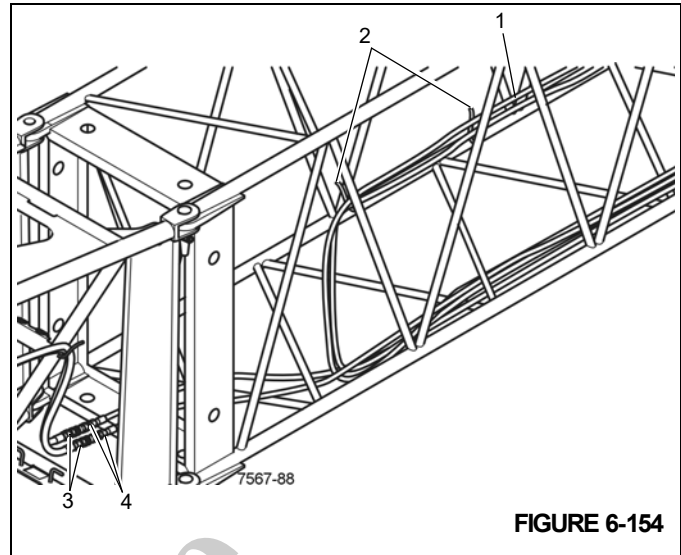


FIGURE 6-154

4. Secure the hoses (1), (Figure 6-154) to the holders (2), (Figure 6-154) to make sure that the hoses are not damaged during operation.

### Disconnecting the Folding Extension Hydraulics

1. Disconnect the hoses (3), (Figure 6-155) from the long hose ends (4), (Figure 6-154).
2. Install protective caps (1), (Figure 6-155) on the hose ends.

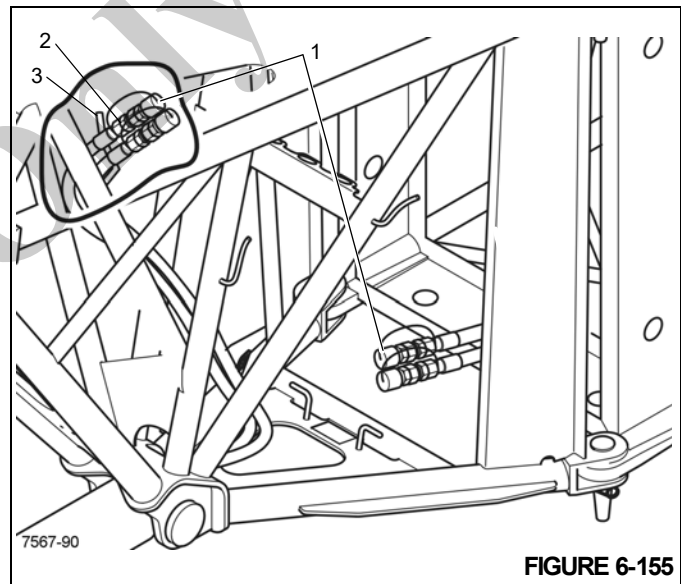


FIGURE 6-155

3. Secure the hoses (2), (Figure 6-155) to the holder (3), (Figure 6-155) in the 35 ft (10.5 m) section.
4. Stow the long hoses (1), (Figure 6-155) on the holders (2), (Figure 6-155) provided.

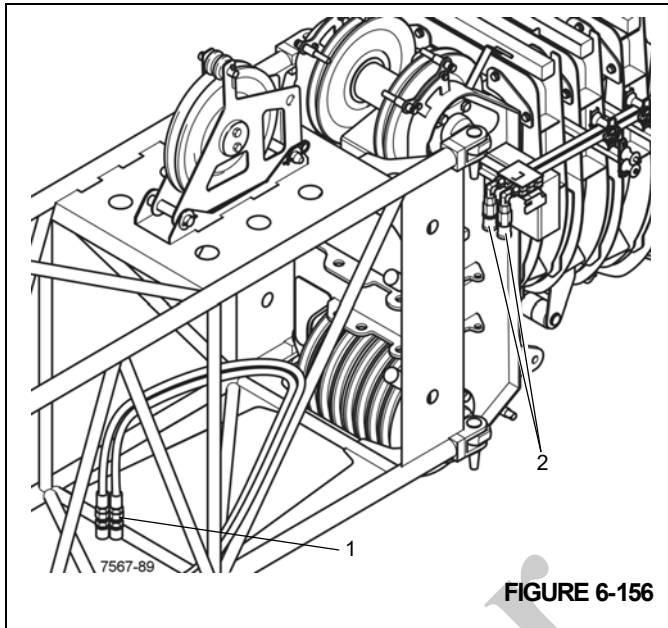


FIGURE 6-156

5. Disconnect the short end hoses (1), (Figure 6-156) from the 26 ft (8 m) extension from the boom nose connectors (2), (Figure 6-156).
6. Install protective caps on the hose ends.

**Folding the Deflection Sheave on the 26 ft (8 m) Extension**

**NOTE:** For folding and unfolding the deflection sheaves on the 36 ft section, refer to *Folding Deflection Sheaves*, page 6-61.

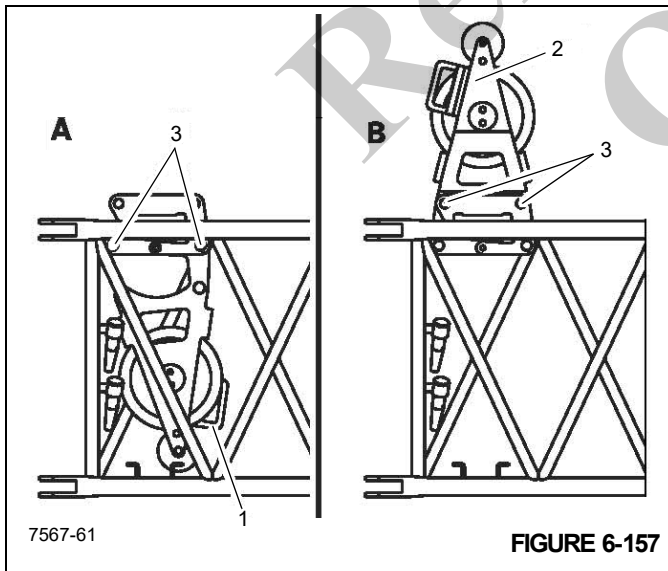


FIGURE 6-157

**Folding OUT the Deflection Sheave**

1. Remove the retaining clips from the pins (3), (Figure 6-157).
2. Hold the deflection sheave by the handle (1), (Figure 6-157) and pull out the pins (3), (Figure 6-157).
3. Fold the deflection sheave up by the handle (1), (Figure 6-157) and insert the pins (3), (Figure 6-157).
4. Secure the pins using the retaining clips.

**Folding IN the Deflection Sheave**

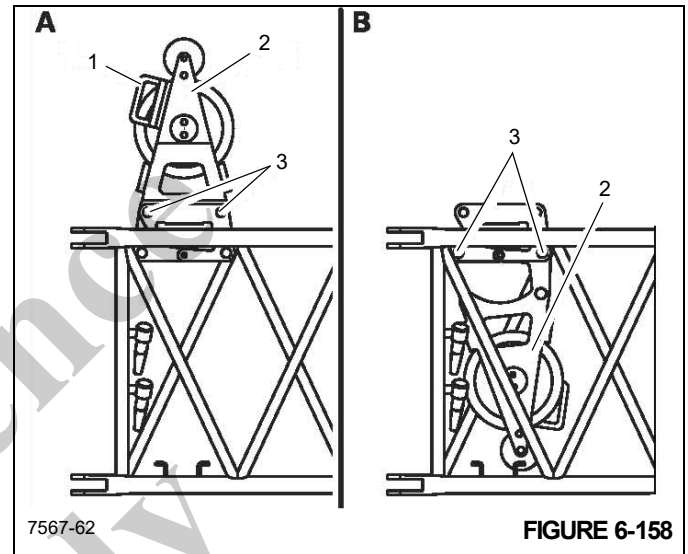


FIGURE 6-158

1. Remove the retaining clips from the pins (3), (Figure 6-158).
2. Hold the deflection sheave by the handle (1), (Figure 6-158) and pull out the pins (3), (Figure 6-158).
3. Fold the deflection sheave (2), (Figure 6-158) downwards and fasten it in this position with the pins (3), (Figure 6-158).
4. Secure the pins (3), (Figure 6-158) using retaining clips.

### 3.5 M (11.4 FT) MANUAL OFF-SETTABLE HEAVY DUTY BOOM EXTENSION



#### DANGER

##### Crushing Hazard!

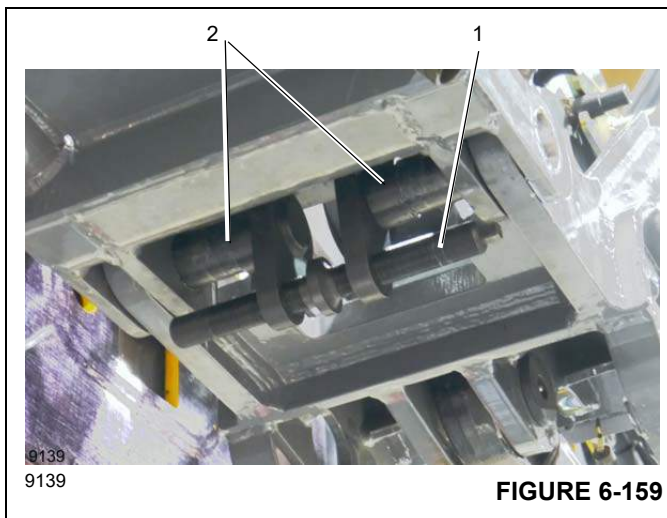
During installation and removal, always use the proper equipment with sufficient load bearing capacities.

#### Description

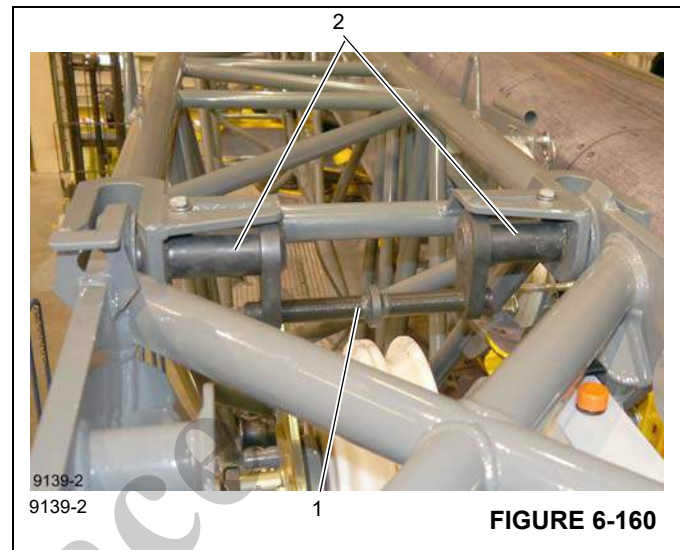
A 3.5 m (11.4 ft) manual off-settable heavy duty boom extension provides additional boom reach designed for tilt-up panel operations. The extension weighs approximately 700 kg (1,543 lb).

#### Separating Manual Off-Settable Heavy Duty Boom Extension from Lattice Extension

1. With the boom extension connected to the main boom nose.
2. Using another crane or suitable lifting device, attach straps to the base extension.
3. Release the connections between the base extension and the main boom.
4. Lift the base extension away from the main boom and place it on the ground.
5. Remove the pins between the heavy duty boom extension and the lattice extension, using the impact driver.
6. Using an impact driver, turn the jack screw (1), (Figure 6-159) counterclockwise to disconnect the bottom pins (2), (Figure 6-159) between the heavy duty boom extension and the lattice base extension.



7. Using the impact driver, turn the jack screw (1), (Figure 6-160) counterclockwise to disconnect the top pins (2), (Figure 6-160) between the heavy duty boom extension and the lattice base extension.



The manual offsetable heavy duty boom extension is now ready to be lifted in front of the main boom nose and installed.

#### Installing Manual Off-Settable Heavy Duty Boom Extension

1. Fully extend and set outriggers.
2. Position boom over rear of crane.
3. Fully retract all boom sections.
4. Lower boom to minimum elevation.
5. Using a suitable lifting device, lift the heavy duty boom extension in front of the boom nose aligning the anchor fittings with boom attachment fittings.
6. Using an impact driver attached to the right side attachment pins jack screw, turn the screw counterclockwise until both pins are fully engaged in the anchor fittings and attachment fittings of the boom nose.
7. Using the impact driver, turn the jack screw of the left side attachment pins mechanism counterclockwise until the pins are fully engaged with the anchor and attachment fittings.
8. Using the handle fold up the upper deflection sheave and secure with the pin. Secure the pin with the retaining clip.
9. Using the hand hold fold the front sheave out and secure with the pin. Secure the pin with the retaining clip.
10. As required, rig main hoist or optional auxiliary hoist cable for single through four part line.

11. Install the anti-two block switch on the pin and secure with the retaining clip.
12. Connect anti-two block cable:
  - a. Attach anti-two block cable to the junction box.
  - b. Route the cable from the junction box to the junction box on the boom nose and connect to the plug.

### Setting Heavy Duty Boom Extension Manual Offset



#### **DANGER**

#### **Crushing Hazard!**

Make sure that the blocking material is adequate to support the weight of the extension assembly without tipping or falling.

To set the offset, use the procedure for the folding boom extension, refer to *Extension Angle Adjusting Mechanism*, page 6-64.

### Removing the Manual Off-Settable Heavy Duty Extension

1. Disconnect the cable from the junction box on the boom nose.
2. Disconnect the anti-two block switch cable from the junction box on the extension.
3. Remove the clip (2), (Figure 6-170) securing the anti-two block switch (1), (Figure 6-170) to the pin, and remove the anti-two block switch.
4. Remove the retaining clip and pin (1), (Figure 6-169).
5. Rotate the sheave up into the stowed position (Figure 6-168).
6. Remove the retaining clip and pin securing the upper sheave and lower the sheave into the stowed position. Secure the sheave with the pin and retaining clip.
7. Attach a lifting device to the heavy duty extension.
8. Use the impact driver (3), (Figure 6-167) to turn the jack screw (4), (Figure 6-167) clockwise to remove the pins (5), (Figure 6-167) from the fittings.
9. Use the impact driver to turn the jack screw clockwise to remove the pins from the extension attachment fittings and the main boom anchor fittings.

10. With the heavy duty extension supported by the lifting device, lay the extension down on the ground behind the lattice base extension so the fittings align to connect the heavy duty extension to the lattice base extension.
11. Install the pins to secure the heavy duty extension to the lattice base extension and secure with clips.
12. Raise the base extension and position it in front of the main boom.
13. Align the left base extension fittings with the main boom right side anchor fittings.
14. Using the impact driver, turn the jack screw counterclockwise to engage the fittings.
15. The base extension can now be swung to the side of the main boom.

### 3.5 M (11.4 FT) HYDRAULIC OFF-SETTABLE HEAVY DUTY BOOM EXTENSION



#### **DANGER**

#### **Crushing Hazard!**

During installation and removal, always use the proper equipment with sufficient load bearing capacities.

#### **Description**

A 3.5 m (11.4 ft) hydraulic off-settable heavy duty boom extension provides additional boom reach designed for tilt-up panel operations. The extension weighs approximately 700 kg (1,543 lb).

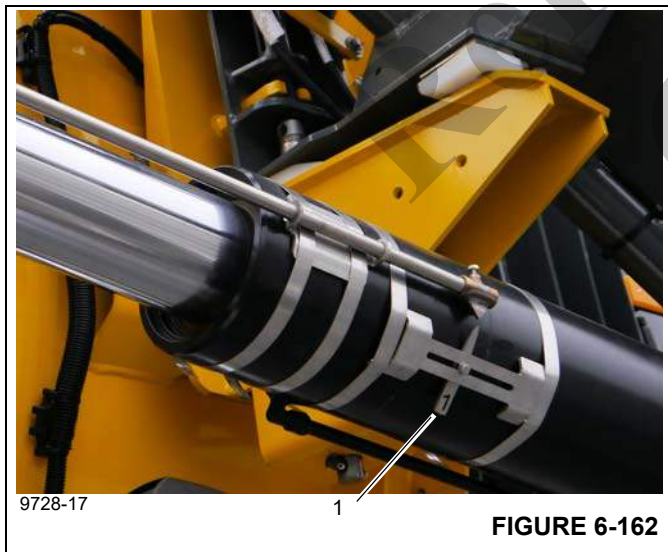
#### **Separating Hydraulic Off-Settable Heavy Duty Boom Extension from Lattice Base Extension**

1. Verify the base extension is mounted to the main boom in the transport position.
2. Verify pin #1 and linkage between base and fly are also engaged.
3. Verify pin #2 (1), (Figure 6-161) is fully engaged with the heavy duty boom extension portion of the base extension.
4. Engage the spring loaded pin by hand.



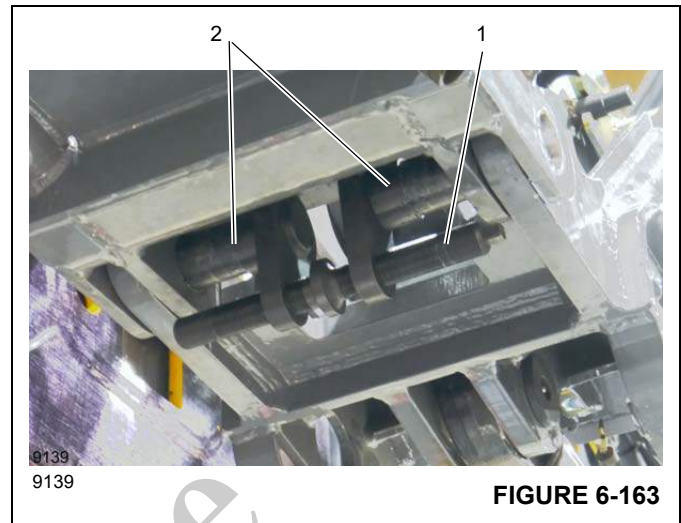


5. Verify the barrel pointer #1 (1), (Figure 6-161) is lined up with the rod pointer when the boom extension is stowed on the side of the boom. If equipped with Pointer #2, the barrel pointer should be located to line up with the rod pointer when the extension has boom luffed down enough to clear the base boom extension hanging on the boom carrier brackets.

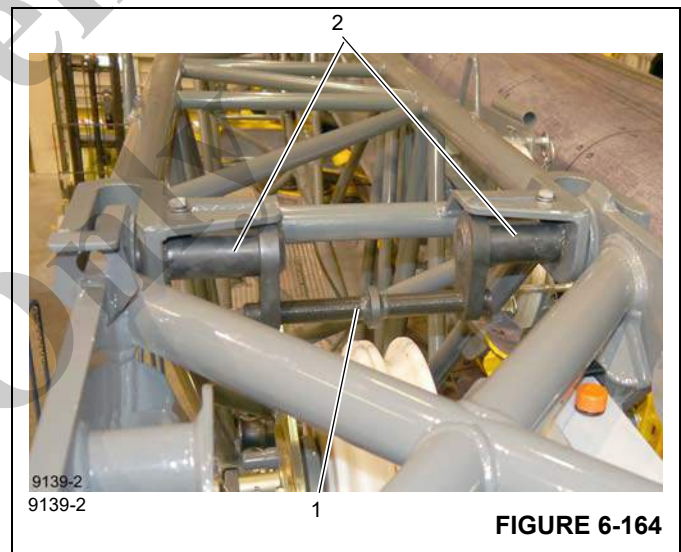


6. Using an impact driver, turn the jack screw (1), (Figure 6-162) counterclockwise to disconnect the

bottom pins (2), (Figure 6-163) between the heavy duty boom extension and the lattice base extension.



7. Using the impact driver, turn the jack screw (1), (Figure 6-164) counterclockwise to disconnect the top pins (2), (Figure 6-164) between the heavy duty boom extension and the lattice base extension.



8. See the remote controller *Remote Control Operation*, page 3-106 for operation and also reference (1), (Figure 6-171) to fully retract the luffing cylinder.
9. Swing the heavy duty boom extension so the attachment fittings (2), (Figure 6-165) align with the main boom anchor fittings (1), (Figure 6-165).
10. Use the impact driver to turn the jack screw (3), (Figure 6-165) counterclockwise to insert the pins (4), (Figure 6-165) into the fittings.



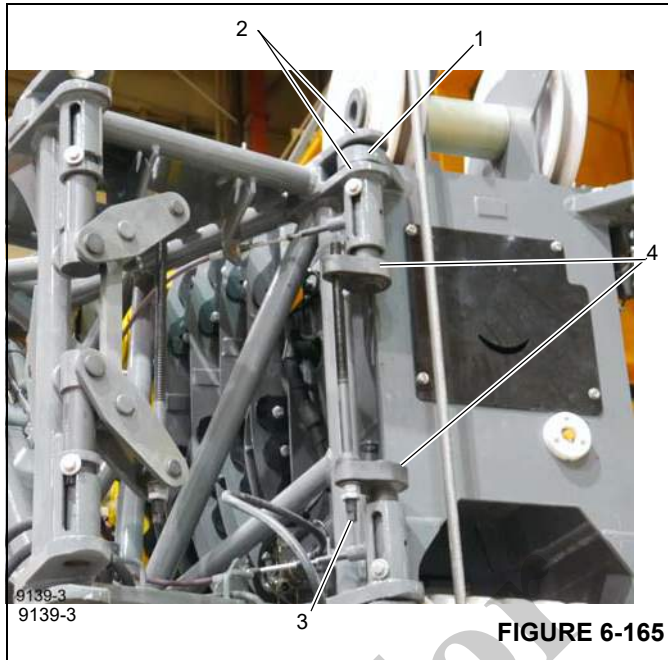


FIGURE 6-165

11. Using the remote controller, retract pin #2 (1), (Figure 6-166).
12. Move the handle (2), (Figure 6-166) down to release the pin (handle shown in the up position).



FIGURE 6-166

13. Swing the heavy duty extension around the boom nose and align the extension attachment fittings (1), (Figure 6-167) with the main boom anchor fittings (2), (Figure 6-167).

14. Use the impact driver (3), (Figure 6-167) to turn the jack screw (4), (Figure 6-167) counterclockwise to insert the pins (5), (Figure 6-167) into the fittings.

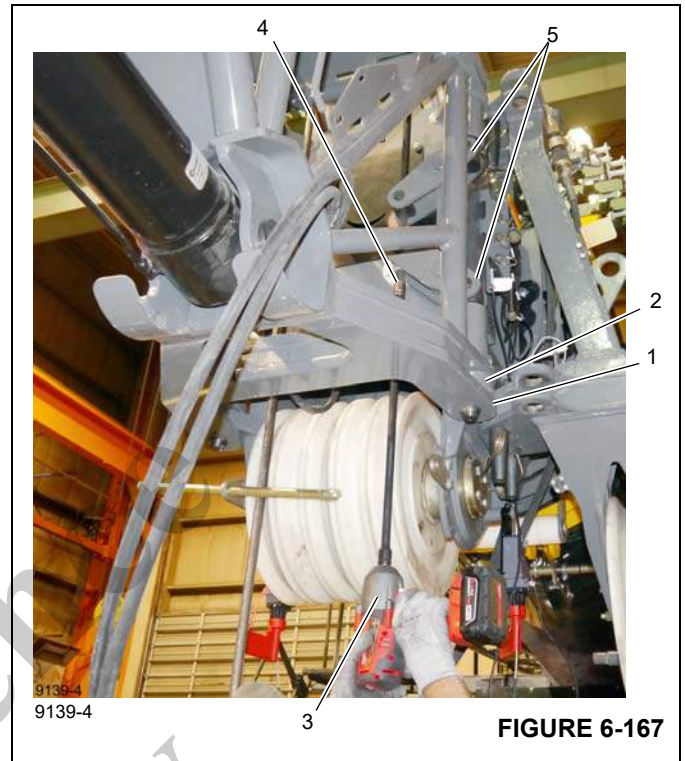


FIGURE 6-167

15. Using the handle, fold up the upper deflection sheave and secure with the pin. Secure the pin with the retaining clip.
16. Using the hand hold, fold the front sheave out (Figure 6-168).



FIGURE 6-168

17. Secure the sheave with the pin (1), (Figure 6-169). Secure the pin with the retaining clip.

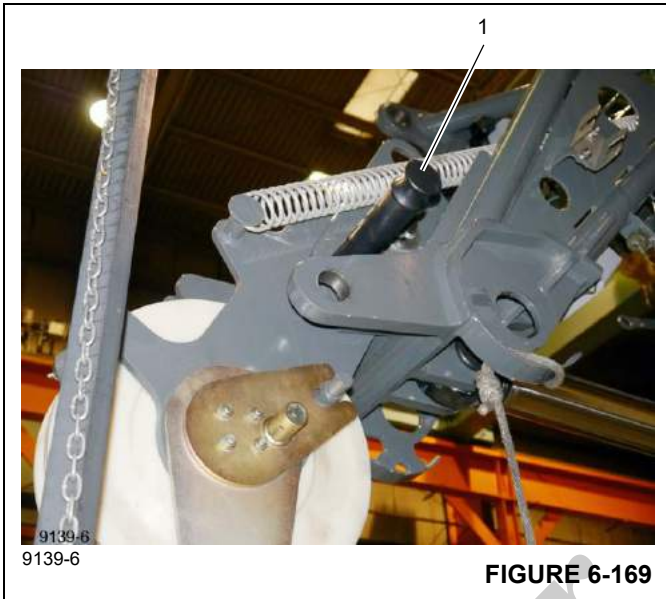


FIGURE 6-169

- 18. As required, rig main hoist or optional auxiliary hoist cable for single through four part line.
- 19. Install the anti-two block switch (1), (Figure 6-170) on the pin and secure with the retaining clip (2), (Figure 6-170).

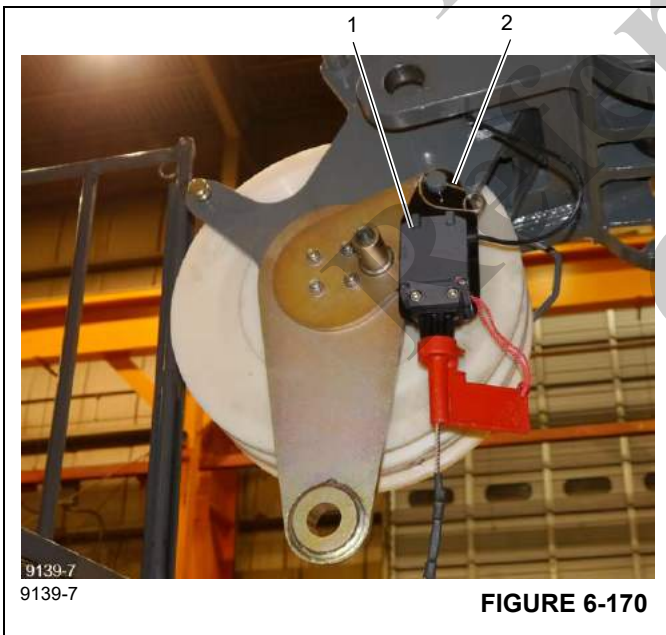


FIGURE 6-170

- 20. Connect anti-two block cable:
  - a. Attach anti-two block cable to the junction box.
  - b. Route the cable from the junction box to the junction box on the boom nose and connect the plug.

### Removing the Hydraulic Off-Settable Heavy Duty Extension

- 1. Disconnect the cable from the junction box on the boom nose.
- 2. Disconnect the anti-two block switch cable from the junction box on the extension.
- 3. Remove the clip (2), (Figure 6-170) securing the anti-two block switch (1), (Figure 6-170) to the pin, and remove the anti-two block switch.
- 4. Remove the retaining clip and pin (1), (Figure 6-169).
- 5. Rotate the sheave up into the stowed position (Figure 6-168).
- 6. Remove the retaining clip and pin securing the upper sheave and lower the sheave into the stowed position. Secure the sheave with the pin and retaining clip.
- 7. Use the impact driver (3), (Figure 6-167) to turn the jack screw (4), (Figure 6-167) clockwise to remove the pins (5), (Figure 6-167) from the fittings.
- 8. Swing the heavy duty extension around to the right side of the main boom. Engage the extension with the lug on the main boom.
- 9. Using the remote controller (Figure 6-171) engage pin #2 (1), (Figure 6-166) with the extension and lug.

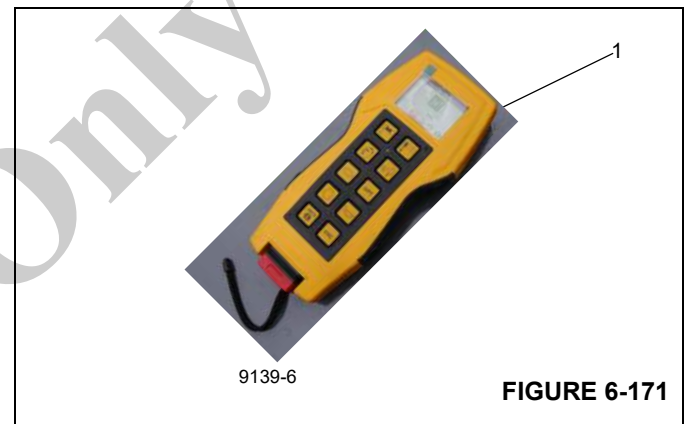


FIGURE 6-171

- 10. Use the impact driver to turn the jack screw clockwise to remove the pins from the extension attachment fittings and the main boom anchor fittings.
- 11. Using the remote controller (Figure 6-171), fully retract the luffing cylinder. The barrel pointer #2 if equipped, should be located to line up with the rod pointer when the extension has boom luffed down enough to clear the base boom extension hanging on the boom carrier brackets.
- 12. Rotate the heavy duty extension slightly to align the lattice base extension fittings with the heavy duty extension fittings.

13. Using the remote controller (Figure 6-171), extend the luffing cylinder so the heavy duty extension fittings engage the lattice base extension fittings.
14. Using the impact driver, turn the jack screw (1), (Figure 6-164) clockwise to connect the top pins (2), (Figure 6-164) between the heavy duty boom extension and the lattice base extension.
15. Using the impact driver, turn the jack screw (1), (Figure 6-163) clockwise to connect the bottom pins (2), (Figure 6-163) between the heavy duty boom extension and the lattice base extension.
16. Disengage the manual pull down pin that locks the base boom extension portion of the boom extension to the boom. Move the handle (2), (Figure 6-166) down to release the pin (handle shown in the up position).

### AUXILIARY SINGLE-SHEAVE BOOM NOSE (OPTIONAL EQUIPMENT)

#### Identification

The auxiliary single-sheave boom nose is designed for the crane it was delivered with.

#### CAUTION

Operate the crane only with the auxiliary single-sheave boom nose that has the identical serial number.

If you wish to use the auxiliary single-sheave boom nose on several Grove cranes, contact Manitowoc Crane Care.

#### CAUTION

The auxiliary single-sheave boom nose should only be adjusted by your Grove distributor or Manitowoc Crane Care.

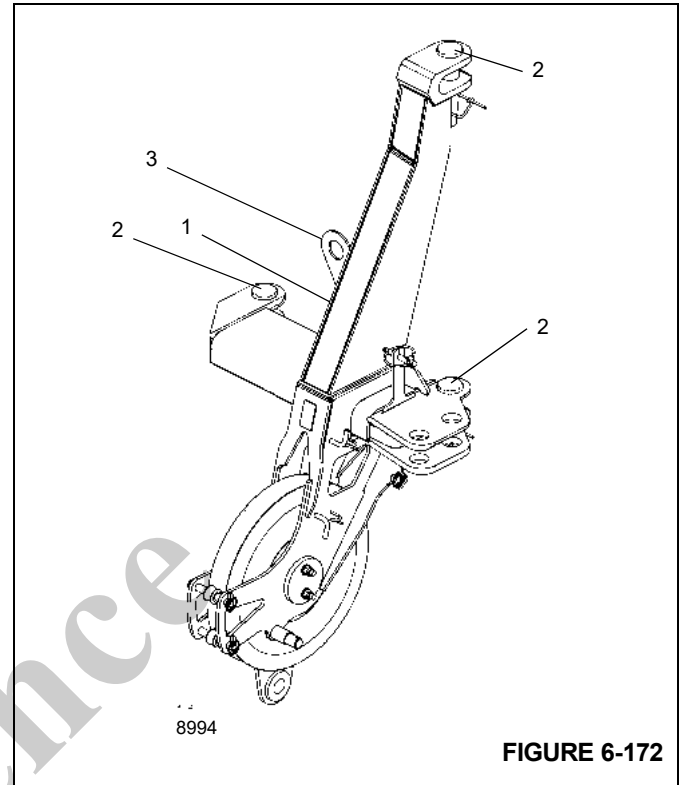


FIGURE 6-172

The serial number (1), (Figure 6-172) is on a plate on the right side on the auxiliary single-sheave boom nose.

### Installing/Removing Auxiliary Single-Sheave Boom Nose

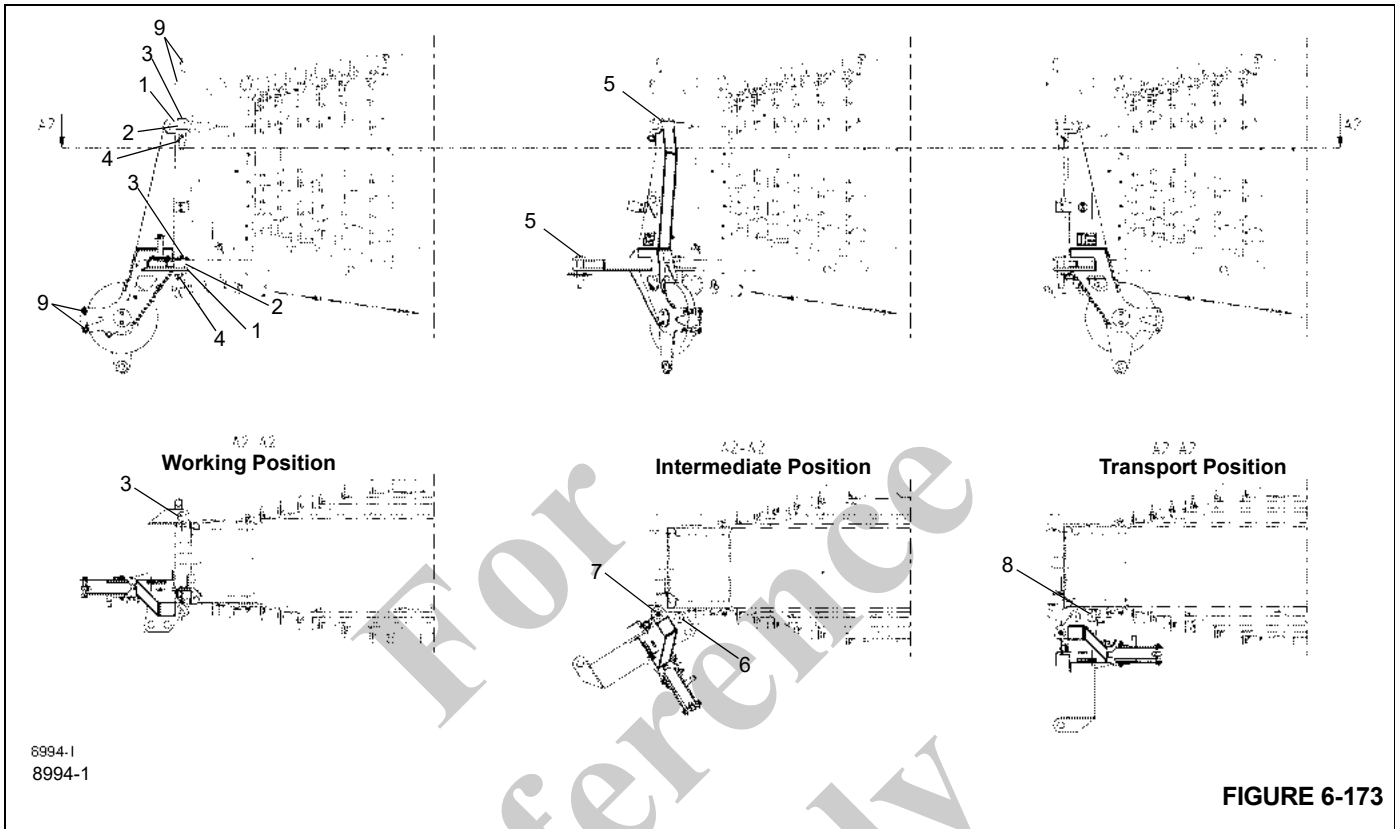
#### DANGER Crushing Hazard!

During installation and removal, always use the proper equipment with sufficient load bearing capacities.

#### Installing Auxiliary Single-Sheave Boom Nose

1. Remove the retaining clips from the pins (2), (Figure 6-172) and remove the pins from the attachment lugs (Figure 6-172).
2. Use an auxiliary crane attached to the lifting eye (3), (Figure 6-172) on the auxiliary boom nose and lift it to the front of the main boom head.
3. Align the auxiliary single-sheave boom nose so that the attachment lugs (1), (Figure 6-173) line up to the boom nose attachment lugs (2), (Figure 6-173).
4. Secure the auxiliary single-sheave boom nose to the main boom nose using pins (3), (Figure 6-173).

5. Secure the pins (3), (Figure 6-173) with retaining clips (4), (Figure 6-173).
6. Depending on the application, bring the auxiliary single-sheave boom nose into transport position or working position.



### Removing the Auxiliary Single-Sheave Boom Nose

In the working position, the auxiliary single-sheave boom nose is positioned in front of the main boom head and is fastened with three pins (3), (Figure 6-173).

In the transport position, the auxiliary single-sheave boom nose is positioned to the side of the main boom head and is fastened with two pins.

1. Attach an auxiliary crane to the lifting eye of the boom nose.
2. Remove the retaining clips and remove all the pins out of the bores and lugs.
3. Lift the auxiliary single-sheave boom nose from the head of the main boom.

### RIGGING THE AUXILIARY SINGLE-SHEAVE BOOM NOSE

#### Rigging in Transport Position

1. Remove the retaining clips and take pins (5), (Figure 6-173) out of the lugs at the front of the main boom head (Figure 6-173).
2. Rotate the auxiliary boom nose to the side of the main boom head.
3. Insert pin (6), (Figure 6-173) into lugs and secure with retaining clip.
4. Remove the retaining clip from the pin (7), (Figure 6-173) and remove the pin.
5. Rotate the auxiliary boom nose further to the side of the main boom nose. Insert pin (8), (Figure 6-173) into the lugs and secure with the retaining clip.



## Rigging in Working Position

1. Remove the retaining clip from the pin (8), (Figure 6-173) and remove the pin from the lugs.
2. Swing the auxiliary single-sheave boom nose to the front of the main boom head so the pin (7), (Figure 6-173) can be inserted and secured with a retaining clip.
3. Remove the retaining clip and take out the pin (6), (Figure 6-173).
4. Swing the auxiliary boom nose into position in front of the main boom head. Insert pins (3), (Figure 6-173) into the lugs and secure with the retaining clips.

The auxiliary single-sheave boom nose is now in working position.

## Attaching and Removing Hoist Cable

1. Remove the cable holding rods from the head of the main boom and from the auxiliary single-sheave boom nose (9), (Figure 6-173).
2. When reeving, guide the hoist cable over the left hand upper sheave of the main boom.
3. Insert the rope holding rods into the appropriate bore holes and secure them with the corresponding retaining clips.
4. Fasten the cable end clamp on the overhaul ball or the hook block.

Reverse the sequence of operations to remove the hoist cable before rotating the auxiliary boom nose into transport position.

## Possible Reeving Methods on the Auxiliary Single-Sheave Boom Nose

**NOTE:** The hoist cable may be reeved for single part of line and two parts of line.

Maximum load bearing capacity for single-reeving, 7.3 t (16,000 lb). Maximum load bearing capacity for two parts of line is 17.2 t (34,320 lbs).

## Anti-Two Block Switch

### In Operation

1. Pull the plug of the connecting cable from the storage socket.
2. Unwind the connecting cable from the holders.
3. Insert the plug of the connecting cable into the socket on the main boom head.
4. Guide the hoist cable through the anti-two block switch weight.

## During Transport

1. Insert the plug of the connecting cable into the storage socket.
2. Wind the connecting cable onto the holders.
3. Plug the short-circuit plug into the socket.

## RAISING AND SETTING DOWN THE MAIN BOOM WITH RIGGED LATTICE EXTENSION

**NOTE:** The information in this section also applies for raising and setting down the main boom with a rigged boom extension.

To raise and lower the main boom with a rigged lattice extension, the main boom must be fully retracted.

For raising and lowering, the following prerequisites must be fulfilled:

- Apart from the hook block there is no load on the lattice extension.

## TELESCOPING WITH RIGGED LATTICE EXTENSION



### CAUTION

#### Overload Hazard!

The main boom may become overloaded!

If you telescope the main boom with a rigged lattice extension or boom extension, you must not rotate the superstructure at the same time. This prevents the main boom being subjected to additional side forces and increased vibration and becoming overloaded.

**NOTE:** Do not actuate the swing gear when telescoping.

Telescoping is permitted only at main boom angles of approximately 75° - 80°, depending on the length of the lattice extension.

## OPERATING WITH THE LATTICE EXTENSION

**NOTE:** The information in this section also applies to operation with the boom extension. Ensure the cross-referenced warnings and instructions are followed.

**NOTE:** The hoisting, lowering, swinging, lifting and telescoping movements are done in the same way as when operating with the main boom.

**Procedure IF the Permissible Wind Speed is Exceeded**

Strong winds can over-strain the crane. Therefore, closely observe the instructions in Table 6-3.

If the maximum permissible wind speed according to the lifting capacity table is exceeded during the main boom operation, proceed per the following Table:

**Table 6-3**

| With Wind Speed<br>UP to 48 km/h (30 mph)                                                                                                                                       | With Wind Speed<br>Over 48 km/h (30 mph)                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Set down the load.</li> <li>• Swing the superstructure so that the main boom creates as little wind resistance as possible.</li> </ul> | <ul style="list-style-type: none"> <li>• Set down the load.</li> <li>• Fully retract the main boom.</li> <li>• Set down the lattice extension.</li> </ul> |

**Anti-Two Block Troubleshooting**

**NOTE:** The information in (Table 6-4) applies to malfunctions during operation with the 7/10.5 m (23/35 ft) lattice extension.

**Table 6-4**

| Malfunction                                                                             | Cause                                                                                                                                                       | Remedy                                                             |
|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| No function of the anti-two block switch                                                | Anti-two block switch not connected                                                                                                                         | Connect the anti-two block switch.                                 |
|                                                                                         | Electrical connection between the boom head and lattice extension and between 10.5 m (35 ft) section and 7 m (23 ft) section is not established.            | Establish electrical connection.                                   |
|                                                                                         | Anti-two block switch on the main boom head not overridden.                                                                                                 | Override the anti-two block switch on the main boom head.          |
|                                                                                         | When operating with a 17.7 m (58 ft) lattice extension or boom extension, the short-circuit plug is not inserted on the head of the 10.5 m (35 ft) section. | Insert short-circuit plug.                                         |
| The main boom cannot be telescoped with the rigged lattice extension or boom extension. | The main boom is lifted to such an angle at which telescoping is not permissible                                                                            | Lower the main boom to the required angle.                         |
| The lattice extension angle can not be changed.                                         | Lifting/lowering mechanism of the lattice extension is switched off.                                                                                        | Switch ON the lifting/lowering mechanism of the lattice extension. |



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## Alphabetical Index

|                                                                                 |       |
|---------------------------------------------------------------------------------|-------|
| 3.5 m (11.4 ft) Hydraulic Off-Settable Heavy Duty Boom Extension . . . . .      | 6-80  |
| 3.5 m (11.4 ft) Manual Off-Settable Heavy Duty Boom Extension . . . . .         | 6-79  |
| Accidents . . . . .                                                             | 2-2   |
| Anti-Lock Brake System (ABS) . . . . .                                          | 4-11  |
| Automatic Traction Control (ATC) Functional Overview . . . . .                  | 4-12  |
| Auxiliary Single-Sheave Boom Nose (Optional Equipment) . . . . .                | 6-84  |
| Boom Extension . . . . .                                                        | 2-38  |
| Boom Extensions . . . . .                                                       | 6-43  |
| Breaking-In a New Crane . . . . .                                               | 4-2   |
| Cable Reeving . . . . .                                                         | 6-2   |
| Carrier Cab Control Panel Indicator and Gauge Display . . . . .                 | 3-9   |
| Carrier Cab Controls and Indicators . . . . .                                   | 3-3   |
| Carwell® Rust Inhibitor . . . . .                                               | 5-31  |
| Cold Climate Operation . . . . .                                                | 4-4   |
| Cold Weather Operation . . . . .                                                | 2-38  |
| Cold Weather Operation . . . . .                                                | 4-4   |
| Crane Control System (CCS) . . . . .                                            | 3-35  |
| Crane Operation . . . . .                                                       | 4-43  |
| Crane Stability/Structural Strength . . . . .                                   | 2-6   |
| Crane Travel Operation . . . . .                                                | 4-16  |
| CraneSTAR® System . . . . .                                                     | 3-143 |
| Dead-End Rigging/Wedge Sockets . . . . .                                        | 6-3   |
| Economy Mode . . . . .                                                          | 3-138 |
| Electrical System . . . . .                                                     | 3-139 |
| Electrocution Hazard . . . . .                                                  | 2-23  |
| Engine Operation . . . . .                                                      | 4-13  |
| Environmental Protection . . . . .                                              | 2-28  |
| General . . . . .                                                               | 1-1   |
| General . . . . .                                                               | 2-2   |
| General . . . . .                                                               | 5-1   |
| General . . . . .                                                               | 6-2   |
| Heating and Ventilating the Superstructure Cab . . . . .                        | 4-6   |
| Hoist Rope . . . . .                                                            | 2-30  |
| Installing Cable On The Hoist . . . . .                                         | 6-2   |
| Lighting, Windshield Wiper/Washing System . . . . .                             | 3-140 |
| Lubrication Points . . . . .                                                    | 5-2   |
| Maintenance . . . . .                                                           | 2-28  |
| Mechanical Emergency Unlocking and Locking of the Telescopic Sections . . . . . | 4-95  |
| Operating with the Lattice Extension . . . . .                                  | 6-86  |
| Operation of the Rated Capacity Limiter . . . . .                               | 4-48  |
| Operational Aids . . . . .                                                      | 2-4   |
| Operator Information . . . . .                                                  | 2-3   |
| Operator Qualifications . . . . .                                               | 2-3   |
| Other Rigging Work . . . . .                                                    | 6-41  |
| Outrigger Controls and Indicators . . . . .                                     | 3-15  |
| Overload Inspection . . . . .                                                   | 2-40  |
| Parking and Securing . . . . .                                                  | 2-38  |
| Personnel Handling . . . . .                                                    | 2-27  |
| Pile Driving and Extracting . . . . .                                           | 2-22  |
| Pre-Starting Checks . . . . .                                                   | 4-2   |
| Proper Leveling of the Crane . . . . .                                          | 4-34  |
| Raising and Setting Down the Main Boom with Rigged Lattice Extension . . . . .  | 6-86  |
| Remote Control Operation . . . . .                                              | 3-106 |
| Remote Control . . . . .                                                        | 3-106 |

Rigging the Auxiliary Single-Sheave Boom Nose . . . . . 6-85

Rigging Work for Crane Operation With the Main Boom . . . . . 6-12

Rigging Work on the Main Boom . . . . . 6-30

Safety Messages . . . . . 2-2

Settings and Displays for Crane Operation . . . . . 4-91

Short Description of the Operating Elements of the Crane Control System (CCS) . . . 3-33

Shut-Down . . . . . 2-38

Superstructure Cab Platform . . . . . 4-34

Superstructure Cab . . . . . 3-17

Telescoping with Rigged Lattice Extension . . . . . 6-86

Temperature Effects on Hook Blocks . . . . . 2-39

Temperature Effects on Hydraulic Cylinders . . . . . 2-39

Tilt-Up Panel Procedure Using the Heavy Duty Boom Extension . . . . . 4-101

Trailing Boom Carrier Option . . . . . 4-97

Transporting the Crane . . . . . 2-32

Travel Operation . . . . . 2-33

Unattended Crane . . . . . 4-34

Using the Outriggers . . . . . 4-34

Wind Forces . . . . . 2-7

Work Break . . . . . 4-97

Work Practices . . . . . 2-34

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Reference  
Only

For  
Reference  
Only