Grove RT9150E

Operator Manual

Manitowoc

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

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

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.

The original language of this publication is English.

CHANGE OF OWNERSHIP REGISTRATION

Manitowoc Crane Care strives to maintain up-to-date contact information for crane owners so that we can readily communicate information about improvements and/or engineering developments for cranes that have been in the field for several years.

Manitowoc Crane Care is pleased to announce that we have developed a QR code to allow the customer to register their crane remotely or re-register their crane if it was purchased used.

To register your crane scan the QR code below or visit https://www.manitowoc.com/warranty-registration-form to register your crane.

Manitowoc Cranes

1565 Buchanan Trail East PO Box 21
Shady Grove, PA 17256-0021 T
717 597 8121 F 717 593 5999
www.manitowoc.com

CHANGE OF OWNERSHIP FORM

Constant improvements, engineering progress or manufacturing information may arise after this crane has been in the field for several years that will make it necessary for us to contact future owners of this machine. It is important to you that Manitowoc Crane have up-to-date records of the current owners of the crane should the need arise for us to contact you. Manitowoc Crane is interested in safe efficient operation of its cranes for their lifetime. Therefore, if you are the second, third, or subsequent owner of this crane, please fill out the form below relating the new owner, model of crane and crane serial number information and e-mail or send to the below address.

PREVIOUS COMPANY NAME: _____

CURRENT COMPANY NAME: _____

CONTACT NAME: _____

ADDRESS: _____

CITY/STATE: _____ _____POSTAL CODE: _____

TELEPHONE NUMBER: _____

EMAIL ADDRESS: _____

DATE PURCHASED_____CRANE MODEL_____CRANE SERIAL NUMBER_____

Please e-mail to: warranty.team@manitowoc.com or visit
https://www.manitowoc.com/support/change-ownership

GROVE
by Manitowoc

OPERATOR MANUAL

This manual has been prepared for and is considered part of -

RT9150E

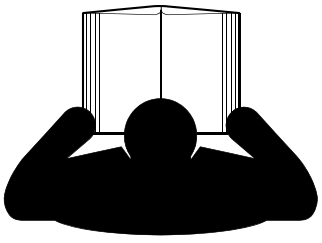
Crane Model Number

This Manual is divided into the following sections:

NOTICE

The crane serial number is the only method your distributor or the factory has of providing you with correct parts and service information.

The crane serial number is identified on the builder's decal attached to the operator cab. ***Always furnish crane serial number*** when ordering parts or communicating service problems with your distributor or the factory.



⚠DANGER

An untrained operator subjects himself 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 Manual and Load Chart are in the holder provided on crane.

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SECTION 1
INTRODUCTION

SECTION CONTENTS

GENERAL

This Manual provides important information concerning your Grove Crane.

Overview of Manuals

Before placing the crane in service, take time to thoroughly familiarize yourself with the contents of this manual. After all sections have been read and understood, keep the manual on the crane for future reference.

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 seat with the superstructure facing forward over the front of the carrier frame.

Engine and routine maintenance procedures are supplied in separate manuals with each crane, and should be referred to for detailed information. A separate safety manual is also provided with each crane. See *Safety Information, page 2-1* for other safety related issues.

Delivery Report

A Delivery Report must be filled out by the Grove distributor, signed by the purchaser, and returned to Grove Cranes once the crane is sold, leased or rented. This report activates the warranty period, assuring that your claims during the warranty period will be honored and processed expediently. To guarantee full warranty service, make sure your Grove distributor has returned the report to Grove Cranes. An engine warranty form must also be filled out, signed and returned to the engine manufacturer for full warranty coverage.

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.

A compact disc or USB flash drive, which includes sections on Operation, Safety and Maintenance for crane operators and owners, is supplied when the crane is purchased new. Additional copies are available from your Grove 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/Parts_Services/ServiceAndSupport/ChangeOfOwnershipForm and complete the form.

Safety Information

A Safety CD which includes sections on operation, safety and maintenance for crane operators and owners is supplied when the crane is purchased new. Additional copies are available from your local distributor.

General Crane Design

The Grove crane has been designed for maximum performance with minimum maintenance. With proper care, years of trouble-free service can be expected.

Constant improvement and engineering progress makes it necessary that we reserve the right to make specification and equipment changes without notice.

Specific Crane Description

The crane incorporates an all welded steel frame, using planetary drive axles to provide four-wheel drive. Axle steering is accomplished utilizing hydraulic steer cylinders. The engine is mounted at the rear of the crane and provides motive power through a six speed forward and three speed reverse transmission. Hydraulic, double box, sliding beam outriggers are removable.

The carrier frame incorporates an integral fifth wheel, to which the rear axle is mounted, to provide axle oscillation. Axle oscillation lockout is automatic when the superstructure rotates from the travel position.

The superstructure is capable of 360° rotation in either direction. All crane functions are controlled from the fully-enclosed cab mounted on the superstructure.

The crane is equipped with a six-section, pinned boom. Additional reach is obtained by utilizing an optional swingaway boom extension. Lifting is provided by a main and auxiliary hoists.

Lifting Capacities (*Load Chart*)

Lift Capacities are listed on the *Load Chart* in the cab.

Basic Components

For basic crane component locations, see Figure 1-2.

Axle Weight Distribution

For axle weight distribution, see Table 1-1.

Serial Number Location

See Figure 1-1 for your crane's serial number location: stamped on left side of front frame (1), on the manual in the cab (2), and inside the cab in front of the seat on the right side (3).

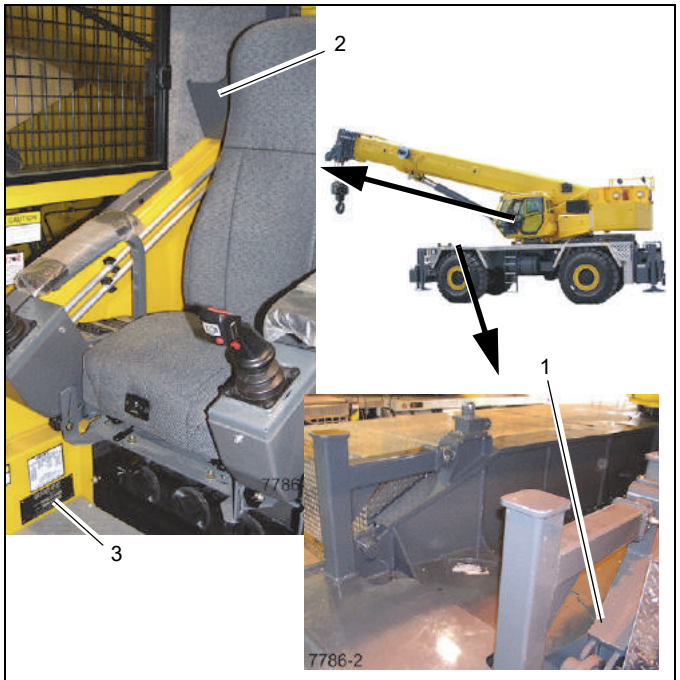

FIGURE 1-1

Transportation and Lifting Data

Transportation and lifting information is located on the hydraulic tank on the right side of the crane. For more information refer to Figure 1-2.

NOISE/VIBRATION TEST RESULTS

Noise Level Test Results

- When equipped with the CE certification package, the guaranteed sound power level is L_{wa} 105 dB(A) and 80 dB(A) at the crane operator position as measured by directive 2000/14/EC.

Vibration Level Test Results

- At the operator station with closed cab operation, vibration levels are less than 0.5 m/s/s for Whole Body Vibration exposure and are less than 2.5 m/s/s for Hand Arm Vibration exposure when measured according to 89/392/EEC Community Legislation on Machinery per standard ISO 2631/1 - Evaluation of Human Exposure to Work Body Vibration, ISO 5349 - Guidelines for the Measurement and Assessment of Human Exposure to Hand Transmitted Vibrations, and ISO/DIS 8041 - Human Response Vibration Measuring Instrumentation.

LIST OF SPECIFICATIONS

General

Model . . . . . RT9150E Series
Rated Capacity . . . . . See Load Chart in cab
Drive . . . . . 4 x 4 x 4
Gross Weight . . . . . See Axle Weight
. . . . . Distribution Table

Dimensions

NOTE: Dimensions listed are for a crane with all components fully retracted in the travel mode with 33.25 x 29 tires.

Wheelbase . . . . . 16 ft 2.5 in (4.94 m)
Overall Crane Length . . . . . 51 ft (15.545 m)
Overall Crane Width . . . . . 12 ft 5.5 in (3.80 m)
Overall Crane Height . . . 13 ft 8.2 in (4.17 m) (Std)
Tail-Swing . . . . . 15 ft 3.8 in (4.64 m)
Outrigger Spread
- Retracted . . . . . 11 ft 8 in (3.56 m)
- Mid Extend . . . . . 19 ft 9 in (6.02 m)
- Fully Extended . . . . . 27 ft 10 in (8.49 m)

Capacities

Fuel Tank . . . . . 100 gal (378 l)
Diesel Exhaust Fluid (DEF) . . . . . 10 gal (37.9 l)
Coolant System . . . . . See Engine Specifications
Engine Lubrication System . . . . . See Engine
. . . . . Specifications
Hydraulic Tank (Reservoir Capacity)
- Total . . . . . 198 gal (750 l)
- at Full Level . . . . . 173 gal (655 l)
- at Low Level . . . . . 163 gal (617 l)
- Expansion Space . . . . . 25 gal (95 l)

Hoists . . . . . 4.2 qt (4 l)
Swing Gearbox . . . . . 1 qt (0.9 l)
Axle Planetary Hubs . . . . . 7.2 qt (6.8 l)
Axle Differentials . . . . . 65.1 qt (61.6 l)
Transmission (Includes Torque Converter)
. . . . . 34 qt (32 l)

Torque Converter

Stall Ratio 2.29:1
Charge Pump Capacity . . . . . 31 gpm (117.3 l/min) @ 2000 rpm

Transmission

Gear Ratios:
Forward
- 1st 7.87
- 2nd 5.94
- 3rd 2.98
- 4th 2.25
- 5th 0.95
- 6th 0.73

Reverse
- 1st 7.87
- 2nd 2.98
- 3rd 0.95

Engine

Cummins QSL (Tier 4)

HP Rating . . . . . 320 hp @ 2200 rpm
Peak Torque . . . . . 1050 pounds @ 1400 rpm
Lube Amount. . . . . 21 qt (19.9 l)
Coolant System . . . . . 36 qt (34.1 l)

Cummins QSC (Tier 3)

HP Rating . . . . . 300 hp @ 2200 rpm
Peak Torque . . . . . 1000 pounds @ 1400 rpm
Lube Amount. . . . . 21 qt (19.9 l)
Coolant System . . . . . 36 qt (34.1 l)

Axles

Total Ratio (w/differential lock) 33.43:1
Total Ratio (standard) 31.94:1
Carrier Ratio (w/differential lock) 6.429:1
Carrier Ratio (standard) 6.143:1
Planetary Ratio 5.20:1

Brakes

Type . Hydraulic/Split system acting on all four wheels
Size . . . . . 18.5 x 1.575 in (470 x 40 mm)

Wheels and Tires

Lugs 24
Torque . . . . . 450 to 500 lb-ft (610 to 678 Nm)
Tire Size
- Standard . . . . . 33.25 x 29-38 ply rating

NOTE: For roading and lifting pressures, refer to the *Load Chart Book* in the cab.

Swing Gearbox

Reduction Ratio 63:1
Output Torque . . . . . 4071 lb-ft

Boom

Length
- Retracted . . . . . 42 ft (12.9 m)
- Extended . . . . . 196.8 ft (60 m)

Power . . . . . 6 Section, Full Power
Elevation . . . . . -3 to +82 degrees
Extensions
- Fixed* . . . . . 36.1 ft (11 m)
- Folding* . . . . . 36.1 or 59.1 ft (11 or 18 m)
- *Extensions are offsettable at 0, 20, or 40 degrees.

Extension Insert . . . . . 26.2 ft (8 m)
Extension Insert . . . . . 19.7 ft (6 m)

Swivel Assembly

Electrical . . . . . 46 Slip Rings
Hydraulic. . . . . 10 ports
Water . . . . . 2 ports
Air Conditioning . . . . . 2 ports

Hydraulic Pumps

NOTE: Pump output figures are theoretical.

Pump #1

Type . . . . . .Piston
Sections 1
Output @ 2303 rpm . . . . . 64.2 gpm (243 l/min)

Pump #2

Type . . . . . .Piston
Sections 1
Output @ 2303 rpm . . . . . .46.7 gpm (176.8 l/min)

Pump #3

Type . . . . . .Gear
Sections 1
Output @ 2303 rpm . . . . . 16.9 gpm (64 l/min)

Pump #4

Type . . . . . .Gear
Sections 1
Output @2486 rpm . . . . . .18.3 gpm (69.3 l/min)

Hoists

Drum Dimensions
Length. . . . . 22.5 in (569 mm)
Diameter . . . . . .15 in (381 mm)
Cable
Diameter . . . . . 0.75 in (19 mm)
Length-Main . . . . . .837 ft (255 m)
Length-Aux. . . . . .738 ft (225 m)
Max. Permissible Line Pull
. . . . . 15,700 lb (7121 kg)
Max. Single Line Speed. . . .394 fpm (120.1 m/min)
Hoist Motor Displacement
. . . . . 90 cc per revolution
Oil Capacity . . . . . .4.2 qt (4 l)

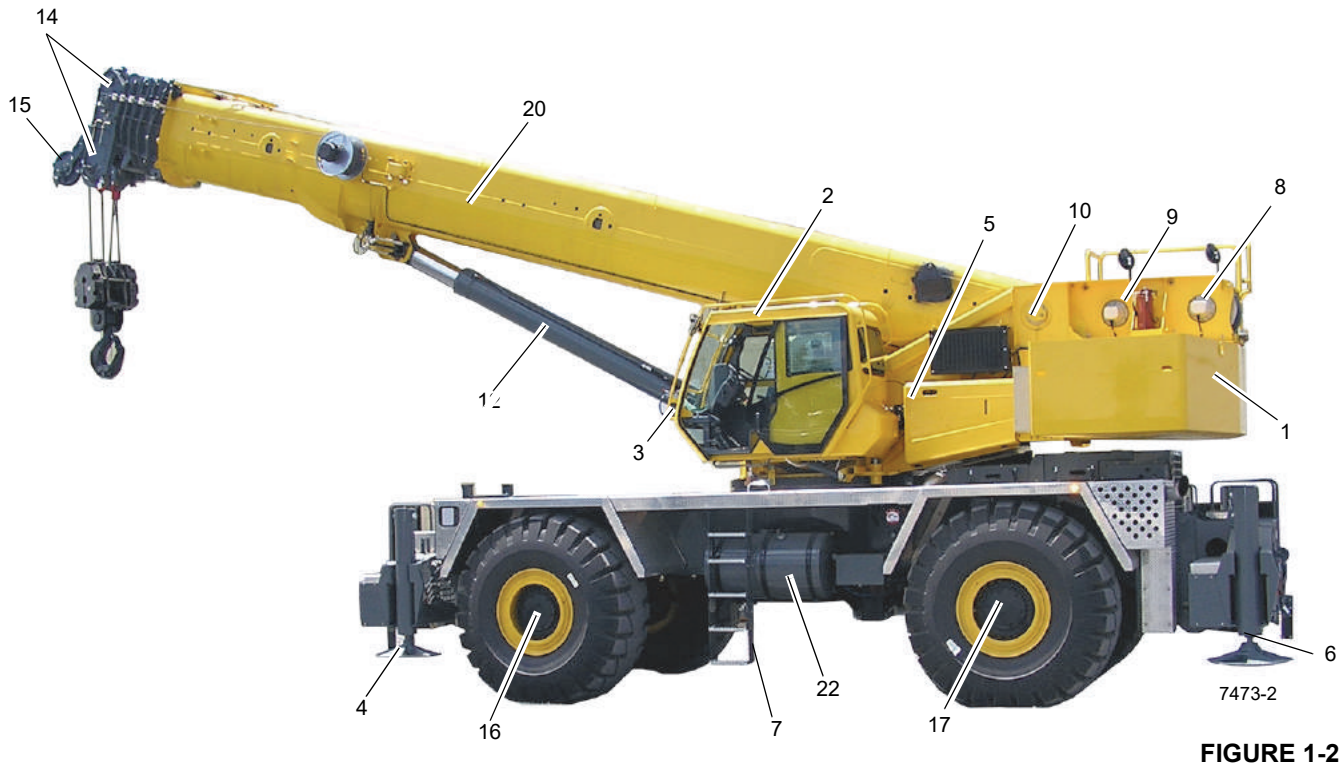

FIGURE 1-2

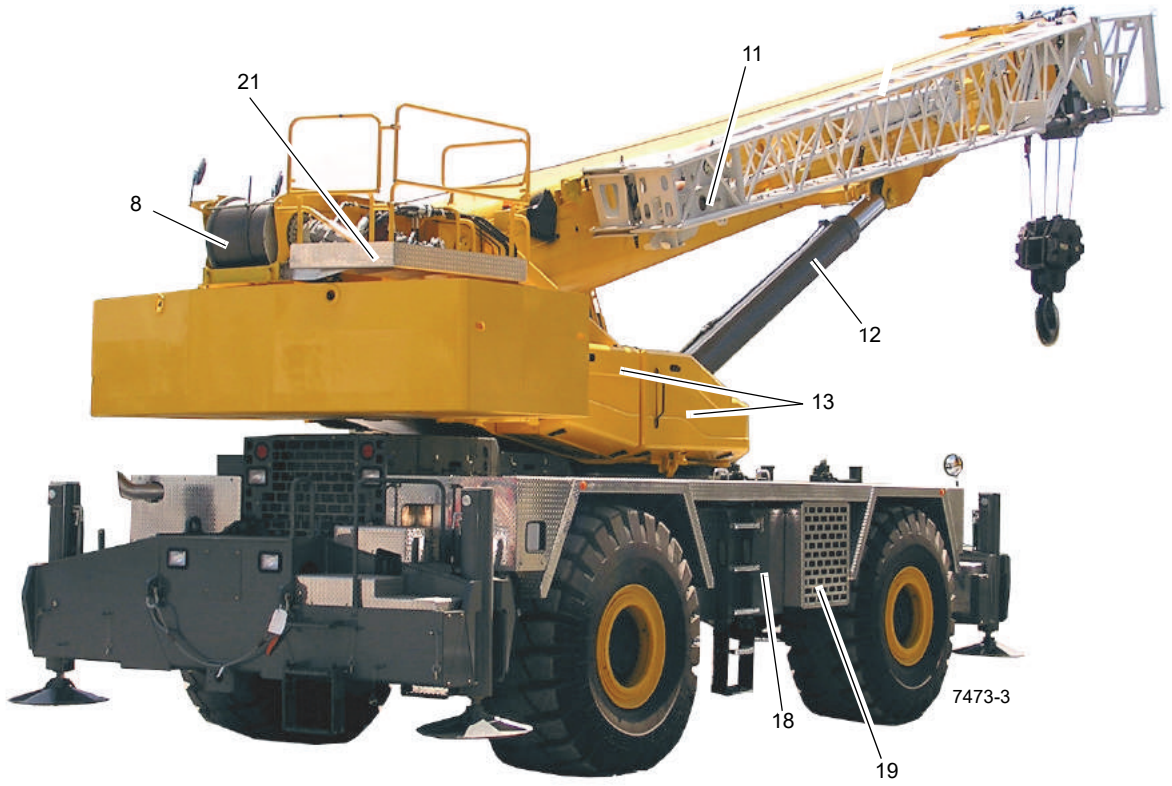

FIGURE 1-2 continued

Item	Description
1	Counterweight
2	Cab
3	Work Light
4	Outrigger Float
5	Left Hand Valve Cover
6	Outrigger Jack Cylinder
7	Steps
8	Auxiliary Hoist
9	Main Hoist
10	Boom Pivot
11	Bi-fold Boom Extension
12	Lift Cylinder

Item	Description
13	Right Hand Valve Covers
14	Boom Nose Sheaves
15	Auxiliary Boom Nose
16	Front Axle
17	Rear Axle
18	Hydraulic Tank
19	Oil Cooler
20	Boom Assembly
21	Hoist Access Platform
22	Fuel Tank

Table 1-1: Axle Weight Distribution Table

Description	CG		Weight		Front Axle		Rear Axle	
	in	cm	lb	kg	lb	kg	lb	kg
Maximum Tire Loads Allowed at 15 mph (With no Counterweight Installed)	-		-		90000	40823	90000	40823
Maximum Tire Loads Allowed at 10 mph (With Standard Counterweight Installed)	-		-		98832	44829	98832	44829
Maximum Tire Loads Allowed at 2.5 mph (With Heavy Counterweight Installed)	-		-		130640	59257	130640	59257
Carrier 4x4 with all Fluids	83.13	211.15	52293	23720	22350	10138	29943	13582
Front outrigger box and beam assembly	266.00	675.64	9427	4276	12892	5848	-3465	-1572
Rear outrigger box and beam assembly	-82.00	-208.28	9427	4276	-3974	-1803	13401	6079
Superstructure with cable on both hoists	21.10	53.59	16177	7338	1755	796	14422	6542
Superstructure with cable on main hoist only	26.50	67.31	15300	6940	2085	946	13215	5994
Install Standard Counterweight	-52.17	-132.51	39000	17690	-10461	-4745	49461	22435
Install Heavy Counterweight	-52.17	-132.51	63000	28576	-16898	-7665	79898	36241
Main Boom	239.87	609.27	33438	15167	41238	18705	-7800	-3538
Lift Cylinder at 0º	201.91	512.85	2883	1308	2993	1358	-110	-50
Complete basic machine, including all of the above with the standard counterweight and cable on main hoist only.	80.70	204.98	161767	73376	67119	30445	94648	42932
Add to Basic Unit								
36/59 ft (11-18 m) Bi-fold Boom Extension (includes brackets on boom)	286.92	728.78	3477	1577	5129	2327	-1652	-749
36/59 ft (11-18 m) Bi-fold Hydraulic Boom Extension (includes brackets and hydraulic components on boom)	305.46	775.87	4023	1825	6318	2866	-2295	-1041
36/59 ft (11-18 m) Bi-fold Heavy Hydraulic Boom Ext. (includes brackets and hydraulic components on boom)	312.63	794.08	4547	2062	7309	3315	-2762	-1253
Brackets and hydraulic components on boom for hydraulic boom extension	358.30	910.08	666	302	1227	557	-561	-254
Brackets for manual boom extension	247.31	628.17	251	114	319	145	-68	-31
10 ton (9.0 t) Overhaul Ball (Swivel) attached to outrigger box	310.00	787.40	727	330	1159	526	-432	-196
100 Ton Domestic Hookblock - Stowed in trough	185.00	469.90	2535	1150	2411	1094	124	56
130 Ton Domestic Hookblock - Stowed in trough	185.00	469.90	2530	1148	2406	1092	124	56
90 Metric Tonne CE Hookblock - Stowed in trough	185.00	469.90	2555	1159	2430	1102	125	57
120 Metric Tonne CE Hookblock - Stowed in trough	185.00	469.90	2544	1154	2420	1098	124	56
Auxiliary Boom Nose Installed	513.75	1304.93	133	60	351	159	-218	-99

Description	CG		Weight		Front Axle		Rear Axle	
	in	cm	lb	kg	lb	kg	lb	kg
Driver	92.00	233.68	250	113	118	54	132	60
Rear mounted pintle hook	-83.50	-212.09	30	14	-13	-6	43	19
Remove tires for transport	97.25	247.02	-9520	-4318	-4760	-2159	-4760	-2159
Remove main hoist cable	-38.31	-97.31	-884	-401	174	79	-1058	-480
Lift cylinder travel support	221.00	561.34	117	53	133	60	-16	-7
Counterweight stand (pinned to carrier)	247.00	627.38	170	77	216	98	-46	-21

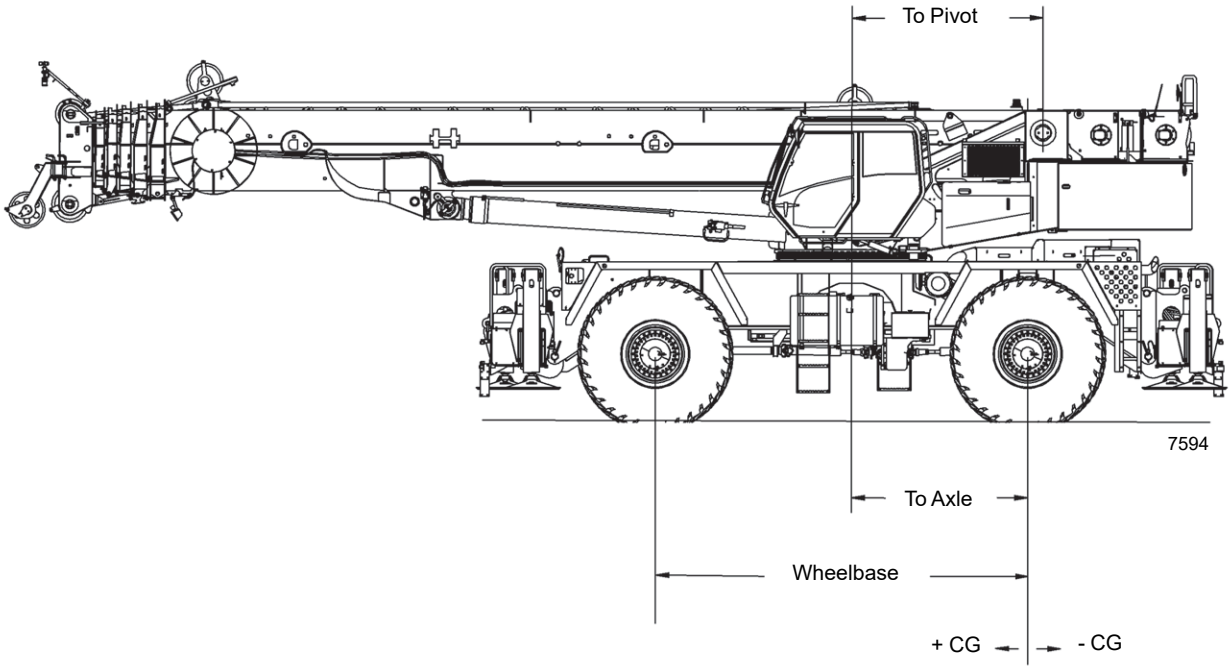

FIGURE 1-3

WIRE ROPE (HOIST CABLE)

General

The following information is a compendium of information from various wire rope manufacturers and includes inspection, replacement, and maintenance guidelines for wire rope as established by ANSI/ASME B30.5, federal regulations, and Grove. The inspection interval shall be determined by a qualified person and shall be based on such factors as expected rope life as determined by experience on the particular installation or similar installations, severity of environment, percentage of capacity lifts, frequency rates of operation, and exposure to shock loads. Periodic Inspections need not be at equal calendar intervals and should be performed at shorter time intervals as the wire rope approaches the end of its useful life. A periodic inspection shall be performed at least once a year. The following provides inspection and maintenance procedures for wire ropes used on Grove products (e.g. wire rope used as load lines [hoisting cables], boom extension and retraction cables, pendant cables, tow winch cables, and hook block tie down cables).

Environmental Conditions

The life expectancy of wire rope may vary due to the degree of environmental hostility and other conditions to which these mechanical devices are subjected. Variation in temperature, continuous excessive moisture levels, exposure to corrosive chemicals or vapors or subjecting the wire rope to abrasive material may shorten normal wire rope life. Frequent/ periodic inspections and maintenance of your wire rope is recommended for preventing premature wear and to insure long-term satisfactory performance.

Dynamic Shock Loads

Subjecting wire rope to abnormal loads beyond the endurance limit will shorten the wire ropes life expectancy. Examples of this type of loading are listed below.

1. High velocity movement e.g.; hoisting or swinging of a load followed by abrupt stops.
2. Suspending loads while traveling over irregular surfaces such as railroad tracks, potholes, and rough terrain.
3. Moving a load that is beyond the rated capacity of the lifting mechanism, i.e.; overloading.

Lubrication

A wire rope cannot be lubricated sufficiently during manufacture to last it's entire life. Therefore, new lubricant must be added throughout the life of a rope to replace factory lubricant which is used or lost. It is important that lubricant applied as part of a maintenance program shall be compatible with the original lubricant, and to this end, the rope manufacturer should be consulted. Lubricant applied shall be of the type which does not hinder visual inspection. Those sections of rope which are located over sheaves or otherwise hidden during inspection and maintenance procedures require special attention when lubricating rope. The object of rope lubrication is to reduce internal friction and to prevent corrosion.

During fabrication, ropes receive lubrication; the kind and amount depends on the rope's size, type, and anticipated use. This in-process treatment will provide the finished rope with ample protection for a reasonable time if it is stored under proper conditions. But, when the rope is put into service, the initial lubrication may be less than needed for the full useful life of the rope. Because of this possibility, periodic applications of a suitable rope lubricant are necessary.

The following are important characteristics of a good wire rope lubricant:

1. It should be free from acids and alkalis.
2. It should have sufficient adhesive strength to remain on the ropes.
3. It should be of a viscosity capable of penetrating the interstices between wires and strands.
4. It should not be soluble in the medium surrounding it under the actual operating conditions (i.e. water).
5. It should have a high film strength.
6. It should resist oxidation.

Before applying lubrication, accumulations of dirt or other abrasive material should be removed from the rope. Cleaning can be accomplished by using a stiff wire brush and solvent, compressed air, or live steam. Immediately after the wire rope is cleaned, it should be lubricated. Many techniques may be used; these include bath, dripping, pouring, swabbing, painting or pressure spray methods. Whenever possible, the lubricant should be applied at the top of a bend in the rope, because at that point the strands are spread by bending and are more easily penetrated. There should be no load on the rope while it is being lubricated. It should be noted, the service life of wire rope will be directly proportional to the effectiveness of the method used and amount of lubricant reaching the working parts of the rope.

Precautions and Recommendations During Inspection or Replacement

1. Always lock out equipment power when removing or installing wire rope assemblies.
2. Always use safety glasses for eye protection.
3. Wear protective clothing, gloves, and safety shoes as appropriate.
4. Use supports and clamps to prevent uncontrolled movement of wire rope, parts, and equipment.

5. When replacing fixed length cable assemblies (e.g. pendants) having permanently attached end fittings use only pre-assembled lengths of wire rope as supplied from Grove. Do not build lengths from individual components.
6. Replace an entire wire rope assembly. Do not attempt to rework damaged wire rope or wire rope ends.
7. Never electroplate wire rope assemblies.
8. Do not weld any wire rope assembly or component unless welding is recommended by the wire rope manufacturer. Welding spatter shall never be allowed to come in contact with the wire rope or wire rope ends. In addition, be sure that the wire rope is not an electrical path during other welding operations.
9. Wire ropes are manufactured from special steels. If heating a wire rope assembly is absolutely necessary for removal, the entire wire rope assembly shall be discarded.
10. On systems equipped with two or more wire rope assemblies operating as a matched set, they shall be replaced as an entire set.
11. Do not paint or coat wire ropes with any substance except approved lubricants.
12. Measure the rope's diameter across crowns (1) of the strands when determining if rope has become damaged (Figure 1-4).

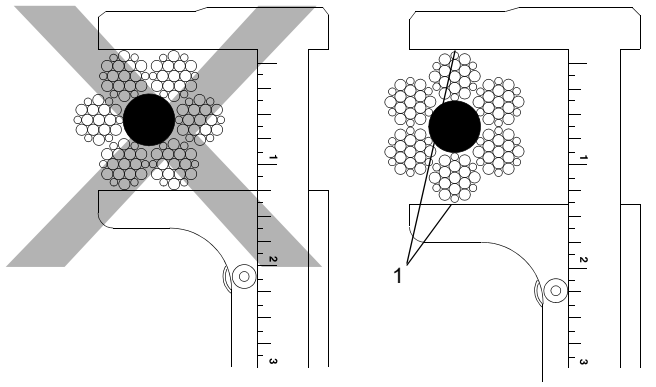

FIGURE 1-4

Wire Rope Inspection (Running Ropes and Pendant Cables)

Wire rope should be inspected frequently/daily and periodically/yearly in accordance with the following information excerpted from a National Consensus Standard as referenced by Federal Government Agencies. Recommended inspection intervals may vary from crane to crane and may vary based on environmental conditions, frequency of lifts, and exposure to shock loads. The inspection time intervals may also be predetermined by state and local regulatory agencies.

NOTE: Wire rope may be purchased through Manitowoc Crane Care.

Any deterioration observed in the wire rope should be noted in the equipment inspection log and an assessment concerning wire rope replacement should be made by a qualified person.

Keeping Records

A signed and dated report of the wire rope's condition at each periodic inspection must be kept on file at all times. The report must cover all inspection points listed in this section. The information in the records can then be used to establish data which can be used to determine when a wire rope should be replaced.

It is recommended that the wire rope inspection program include reports on the examination of wire rope removed from service. This information can be used to establish a relationship between visual inspection and the rope's actual internal condition at the time of removal from service.

Frequent Inspection

A frequent daily visual inspection is recommended for all running ropes in service. This inspection should be made on all wire rope which can be expected to be in use during the day's operation. This inspection should be used to monitor progressive degradation and to discover severe damages necessitating wire rope replacement such as:

- Distortion, kinking, crushing, un-stranding, bird caging, reduction of diameter, etc.
- General corrosion.
- Broken or cut strands.
- Number, distribution and type of broken wires.
- Evidence of core failure.
- End fitting wear/abrasion.

Pay particular attention to areas of the rope where wear and other damage is likely to occur:

- Pick-up Points: Sections of wire rope that are repeatedly stressed during each lift, such as those sections in contact with sheaves.
- End Attachments: The point where a fitting is attached to the wire rope or the point where the wire rope is attached to the drum.
- Abuse Points: The point where the wire rope is subjected to abnormal scuffing and scraping.

Periodic Inspection

Wire rope should be inspected periodically/annually or at a shorter time interval if necessitated by environmental or other adverse conditions, and shall cover the entire length of the wire rope. Only the outer surface of the wire rope need be inspected, and no attempt should be made to open the rope. Periodic inspection should include all items listed under frequent inspection plus the following:

1. Inspect for reduction of rope diameter below nominal diameter.
2. Inspect for severely corroded or broken wires at end connections.
3. Inspect for severely corroded, cracked, bent, worn, or improperly applied end connections.
4. Inspect wire rope in areas subjected to rapid deterioration such as:
   - Sections in contact with saddles, equalizer sheaves, or other sheaves where wire rope travel is limited.
   - Sections of wire rope at or near terminal ends where corroded or broken wires may protrude.
5. Inspect boom nose sheaves, hook block sheaves, boom extension/jib sheaves, auxiliary boom nose sheaves, and hoist drums for wear. Damaged sheaves or hoist drums can accelerate wear and cause rapid deterioration of the wire rope.

Wire Rope Inspection/Replacement (All Wire Rope)

No precise rules can be given for determination of the exact time for replacement of wire rope since many variable factors are involved. Determination regarding continued use or replacement of wire rope depends largely upon the good judgement of an appointed and qualified person who evaluates the remaining strength in a used rope after allowance for any deterioration disclosed by inspection.

Wire rope replacement should be determined by the following information excerpted from a National Consensus Standard as referenced by Federal Government Agencies and as recommended by Grove. All wire rope will eventually deteriorate to a point where it is no longer usable. Wire rope shall be taken out of service when any of the following conditions exist:

- Kinking, crushing, birdcaging, or any other damage resulting in distortion of the rope structure.
- Evidence of any heat damage from any cause.
- Reductions from nominal diameter of more than 5%.
- In running ropes, six randomly distributed broken wires in one lay or three broken wires in one strand in one lay.
- In standing ropes, more than two broken wires in one lay in sections beyond end connections or more than one broken wire at an end connection.
- In rotation resistant rope, two randomly distributed broken wires in six rope diameters or four randomly distributed broken wires in 30 rope diameters.
- Severe corrosion as evidenced by pitting.
- Grove recommends that for cable extended booms, a single damaged wire rope assembly shall require replacement of the entire set of extension cables.
- Grove recommends for cable extended booms, that boom extension cables be replaced every seven (7) years.

Seizing Wire Rope

It is important to seize the ends of rotation resistant wire ropes to prevent the displacement and unraveling of the individual wires and strands at the ends. All preformed and non-preformed styles of wire rope should be seized prior to cutting. Seizings must be placed on both sides of the point where the wire rope is to be cut.

The two preferred methods for seizing wire ropes are:

Method 1

Using a length of soft annealed wire (Figure 1-5), place one end in the groove between two strands of the wire rope. Turn the long end of the annealed wire at right angles to the wire and wrap it tightly over the portion in the groove.

The two ends of the annealed wire should be twisted together tightly. Cut off the excess wire and pound the twist flat against the wire rope.

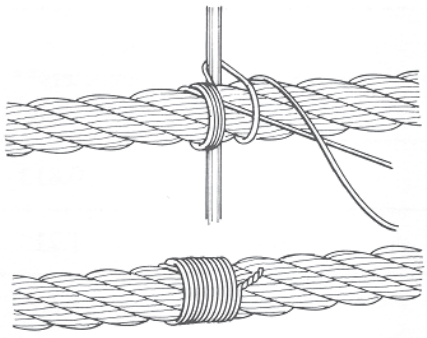

FIGURE 1-5

Method 2

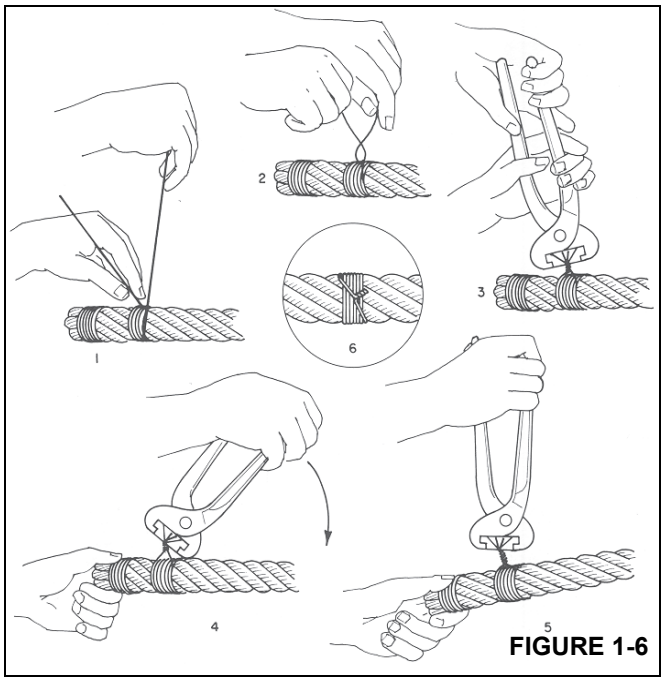

FIGURE 1-6

Wind a length of soft annealed wire (Figure 1-6) around the wire rope at least seven times. The two ends should be twisted together in the center of the seizing. Tighten the seizing by alternately prying and twisting. Cut off both ends of the wire and pound the twist flat against the rope.

NOTE: Non-preformed wire rope (1) (Figure 1-7) should have three seizings (3) located on each side of the cut (4) as compared to preformed wire rope (2).

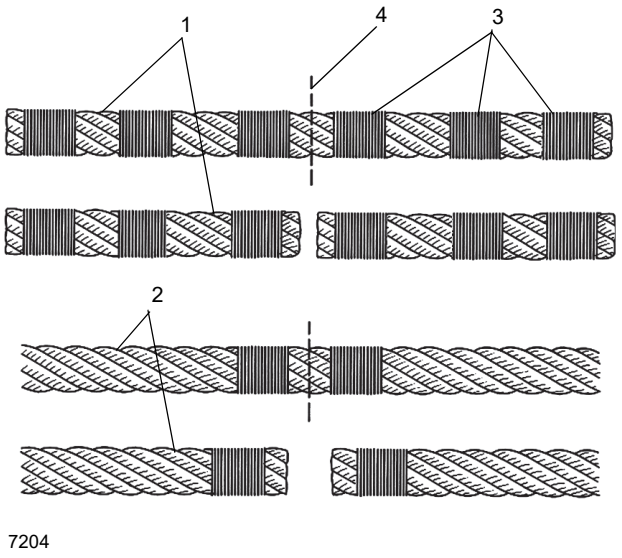

FIGURE 1-7

Installing 35x7 Class Wire Rope

CAUTION

Any cutting of this specific wire rope is not recommended. If 35x7class wire rope must be cut for any reason, it is necessary to follow the following instructions. Also, unlike other types of wire rope, the ends on this wire rope must be welded to retain the rotation resistant characteristics.

1. Unload properly and relieve any twists. Pull the rope off the shipping reel or unroll it from a shipping coil. (If done improperly, you may kink the rope, which will result in permanent damage to the rope.) Then, lay the rope on the ground in direct line with the boom. This helps release any twist in the rope.
2. Pull the rope over the point sheave and attach the end to the hoist drum. Be sure not to remove the welded end.
3. Wind rope onto drum slowly and carefully. At this point, it isn't necessary to provide additional load other than the weight of the rope being pulled across the ground.
4. Spool first layer tightly. It is essential on smooth-faced drums that the first layer is spooled with wraps tight and close together since the first layer forms the foundation for succeeding layers. If need be, use a rubber, lead or brass mallet (but never a steel hammer) to tap the rope into place.
5. Spool multiple layers with sufficient tension. It's very important to apply a tensioning load to the ropes during the rope breaking-in process. (If not, the lower layers may be loose enough that the upper layers become wedged into the lower layers under load, which can seriously damage the rope.) The tensioning load should range from 1 to 2% of the rope's minimum breaking force.
6. For ropes in multi-part systems: Reeve the traveling block and boom tip sheaves so the rope spacing is maximized and the traveling (hook) block hangs straight and level to help assure block stability.
7. Breaking in new 35x7 class rope—After installation, properly break in the rope, which allows the rope's component parts to adjust themselves to the operating conditions:

   With the boom fully raised and fully extended, attach a light load at the hook and raise it a few inches off the ground. Allow to stand for several minutes. Then cycle the load between the full "up" and "down" positions several times. Observe the drum winding and rope travel for any potential problems.

   After making the lifts with a light load, increase the load and cycle it up and down a few times. This procedure will

train the rope and help assure smooth operation during its useful life.

Ideally, you should run these loads with reeving that lets you place the loads on the block with all rope off the drum except the last three wraps. If this is not possible, alternate methods must be used to assure proper tensioning of the rope on the drum.

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SECTION 2
SAFETY INFORMATION

SECTION CONTENTS

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 a **professional** and follow the **rules of safety**.

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

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

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.

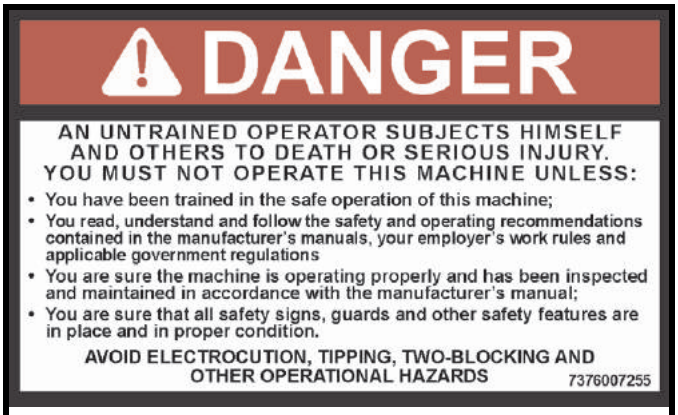
OPERATOR QUALIFICATIONS

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.

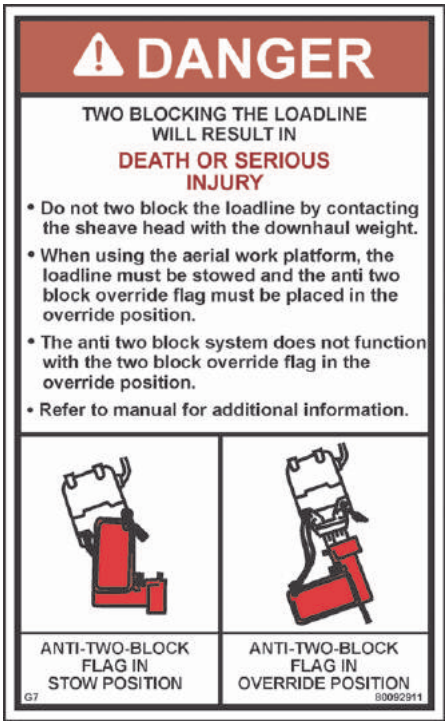
Two-blocking occurs when the load block (hook block, overhaul ball, rigging, etc.) comes into physical contact with the boom (boom nose, sheaves, boom extension, etc.). Two-blocking can cause hoist rope (wire rope or synthetic rope), rigging, reeving, and other components to become highly stressed and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

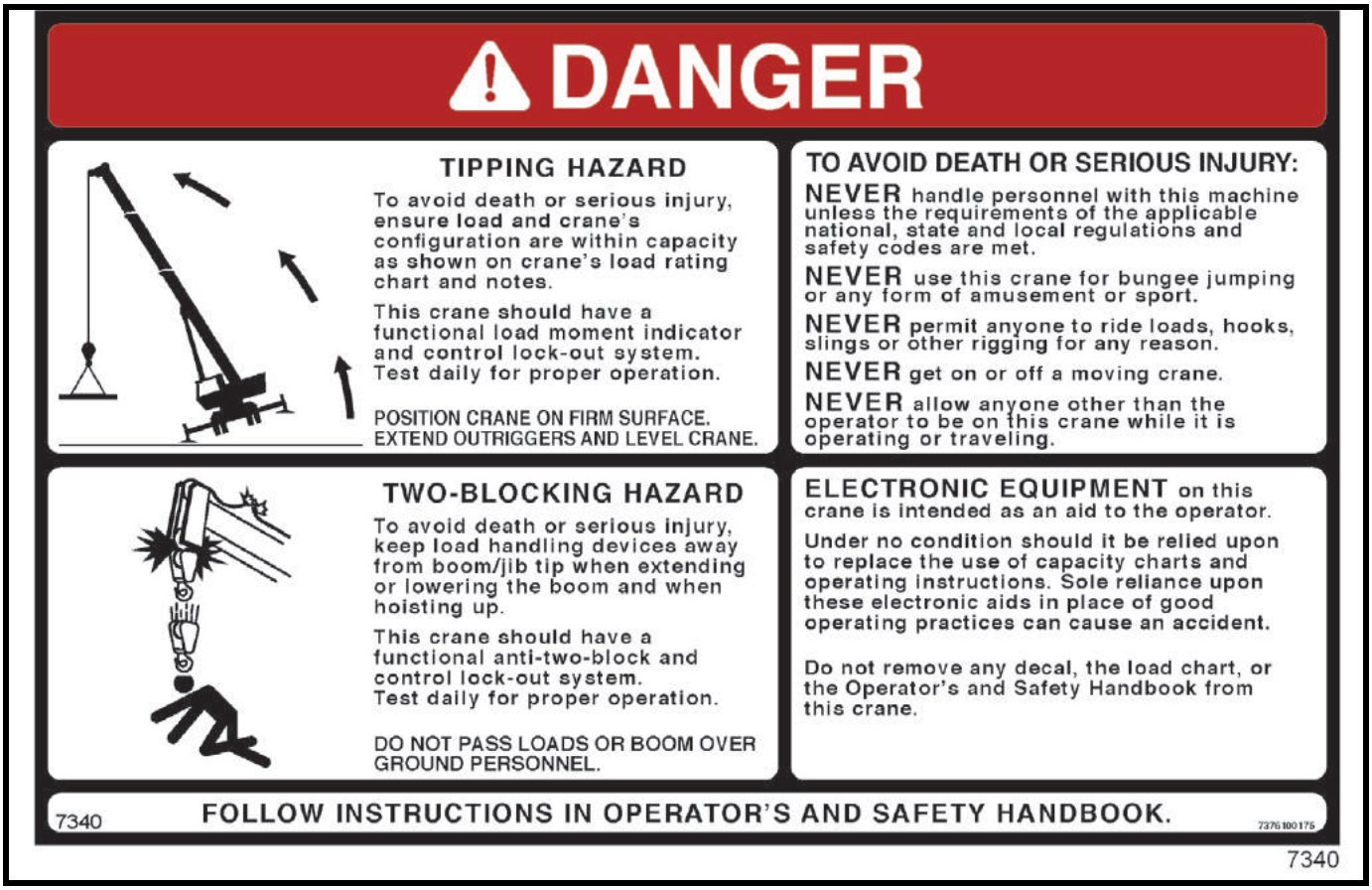


9250 **Example decal. For reference only.**

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.



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.

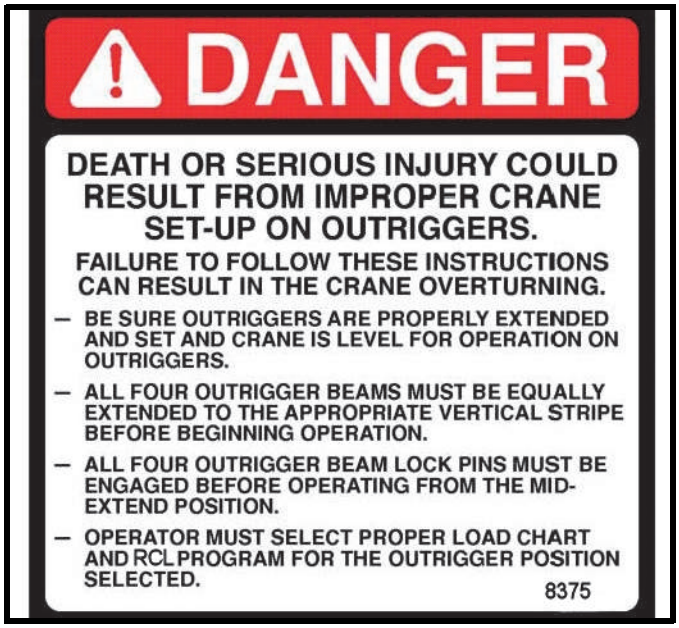
The operator must select the proper *Load Chart* and Rated Capacity Limiter (RCL) System program for the outrigger position selected.

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.

Table 2-1 Beaufort Wind Scale

Beaufort Number	Description	Maximum Wind Speed m/s	Maximum Wind Speed km/h	Maximum Wind Speed mph	Visible Indicator Effects of wind as observed on land
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”.

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 ≤ 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 ≤ 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).

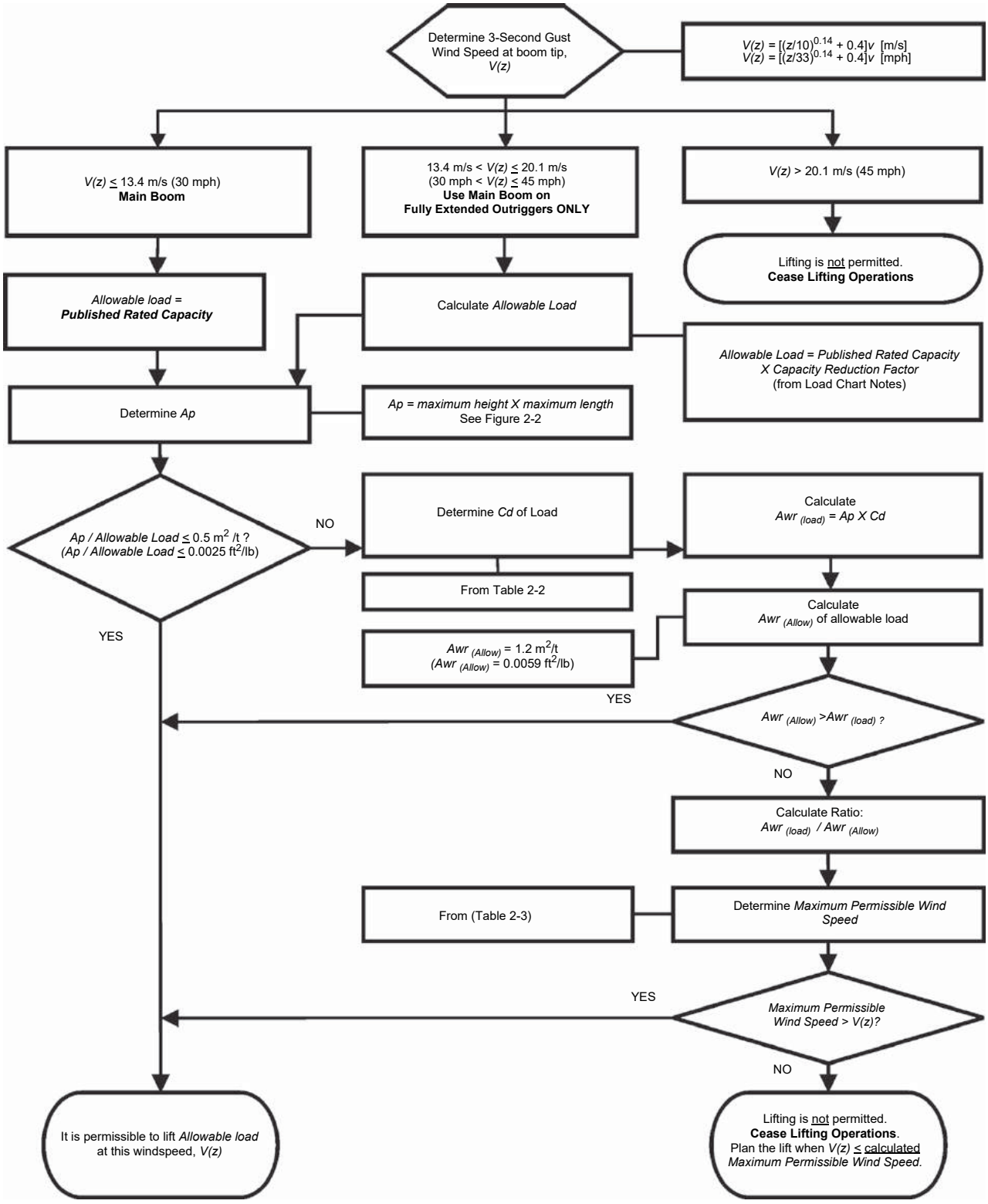
NOTE: This condition is limited to operation with the main boom on fully extended outriggers only.

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 ***Ap*** and by the wind drag coefficient ***Cd***: 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.

Simplified Method to Determine Maximum Permissible Wind Speed



V(z) = 3 second gust wind speed at boom tip, m/s (mph)
Ap = Projected Wind Area of Load, m^2 (ft^2)

$Awr_{(load)}$ = Actual Wind Resistance Area for the Load, m^2(ft)
$Awr_{(Allow)}$ = Allowable Wind Resistance Area of the Load, m^2 (ft2
Cd = air drag coefficient of load

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 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 ≤ 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.**

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^2] [ft^2] . - Wind resistant area of the load

Ap [m^2] [ft^2] - 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 (Ap):

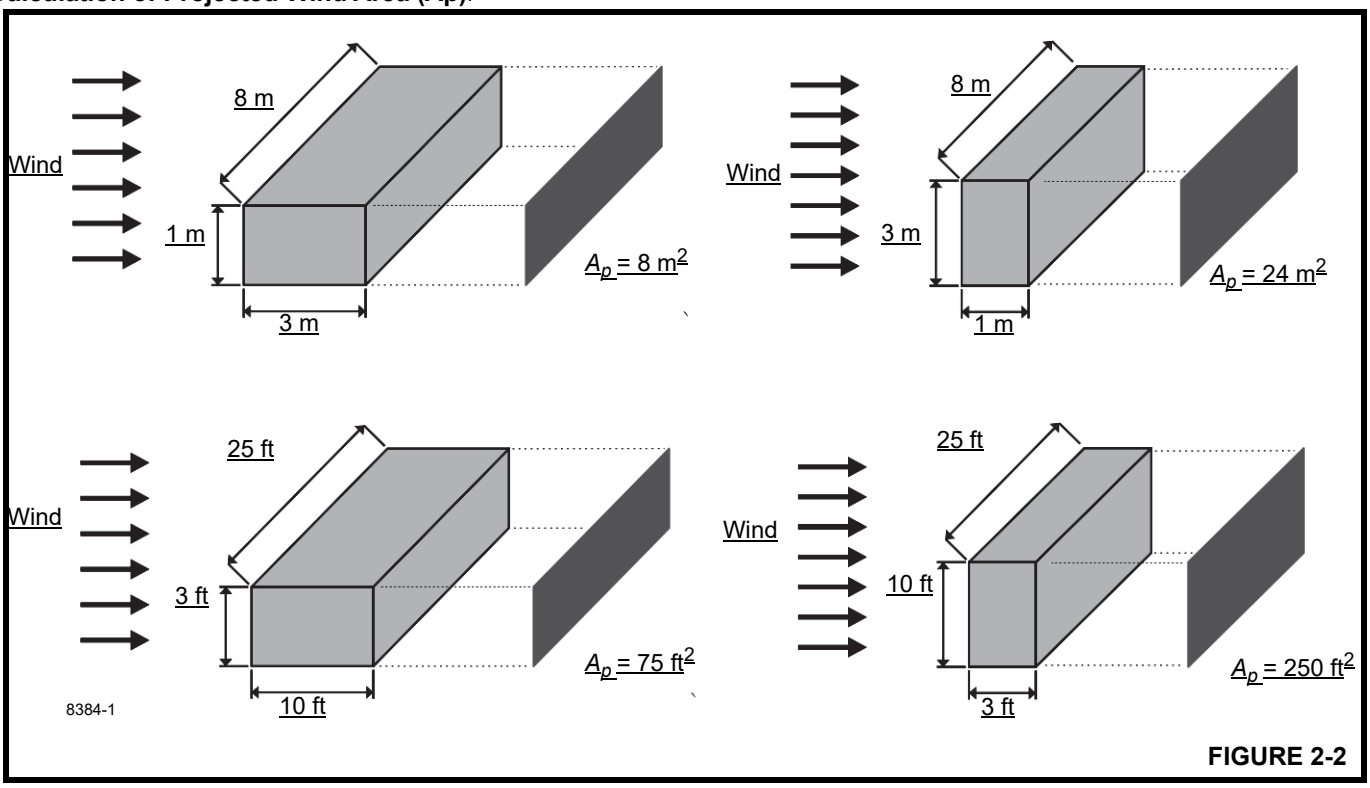


FIGURE 2-2

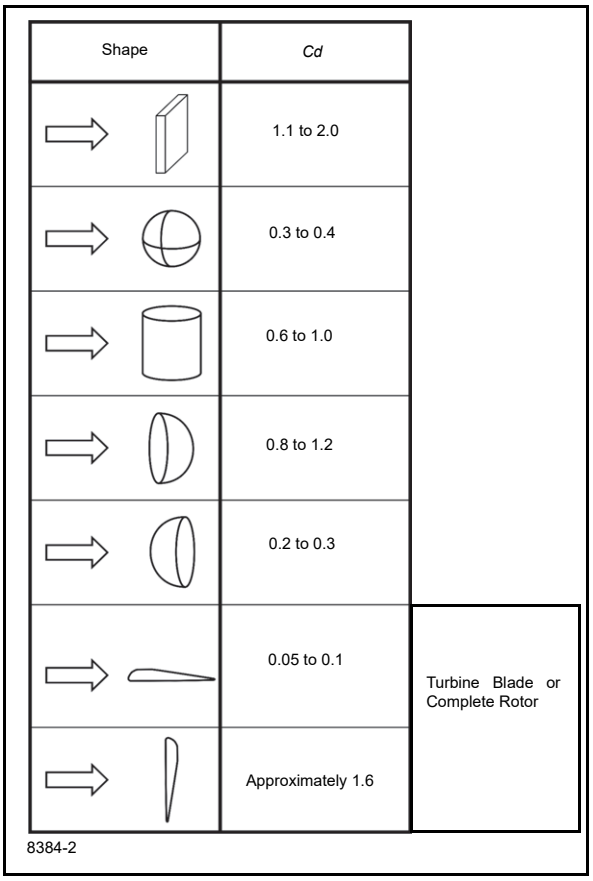
Determining Wind Drag Coefficient (Cd)

Table 2-2 shows the typical Shapes and corresponding Wind Drag Coefficient ***(Cd)*** 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 ***(Cd)*** = 2.4.

Table 2-2 Wind Drag Coefficient



Maximum Permissible Wind Speed

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

Table 2-3 *Awr* 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

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	#0001								
	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 (69.5)	40,950 (72)	40,950 (76)						
3.5	53,000 (66.5)	40,950 (69.5)	40,950 (74)	28,350 (78)					
4	47,450 (63.5)	40,950 (66.5)	40,950 (72)	28,350 (75.5)	*18,225 (78)				
4.5	42,875 (60.5)	40,950 (64)	40,950 (70)	28,350 (73.5)	18,225 (76)				
5	39,050 (57.5)	39,025 (61.5)	38,300 (67.5)	28,350 (72)	18,225 (75)	*18,225 (78)			
6	32,950 (50.5)	32,925 (55.5)	32,825 (63.5)	28,350 (68.5)	18,225 (72)	18,225 (75)	*18,225 (78)		
7	28,325 (42.5)	28,300 (49)	28,225 (59)	26,250 (65)	18,225 (69)	18,225 (72)	18,225 (74.5)	*16,725 (78)	*11,400 (78)
8	24,150 (32.5)	24,150 (42)	23,975 (54.5)	23,275 (60)	18,225 (69.5)	16,575 (72)	15,250 (74.5)	11,400 (76)	
9	20,600 (16.5)	20,550 (33.5)	20,375 (49.5)	20,25 (56)	18,22 (63)	16,575 (67)	15,050 (70)	13,875 (72.5)	11,400 (74.5)
10		17,200 (20.5)	17 (4	17, (54)	17,325 (60)	15,125 (6)	13,725 (67.5)	12,700 (70.5)	11,400 (72.5)
12			1 (45.5)	12,575 (53.5)	12,	11,600 (63)	10,725 (66.5)	10,050 (69)	
14				9,000 (35)	9,360 (6)	9,730 (53.5)	9,955 (58.5)	9,205 (62)	8,620 (65)
16				6,75 (19)	7, (37.5)	7, (47)	7,920 (53)	7,980 (57.5)	7,470 (61.5)
18					(2	5,960 (39.5)	6,340 (47.5)	6,525 (53)	6,530 (57.5)
20						4,755 (30.5)	5,145 (41)	5,320 (48)	5,495 (53)
22						3,790 (16.5)	4,210 (33.5)	4,380 (42.5)	4,545 (48.5)
24							3,435 (23.5)	3,620 (36)	3,780 (43.5)
26								2,975 (28)	3,150 (37.5)
28								2,400 (16)	2,620 (31)
30									2,135 (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 (9.2)	11,675 (10.4)	8,145 (13.5)	5,930 (16.6)	4,565 (19.6)	3,535 (22.6)	2,860 (25.7)	2,220 (28.7)	1,770 (31.8)

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

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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 m/s ≤ 20.1 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 m/s ≤ 20.1 m/s	10.9	12.2	15.2	18.4	21.3	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, $Awr_{(allow)}$ = 0.0012 x 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.

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

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)***.

Example 1: Crane Configuration:

- boom length = 27.4 m,
- load radius = 9 m,
- wind speed is measured at ***V(z)*** ≤ 20.1 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:

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

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

Lifting Limits at wind speed V(z) ≤ 13.4 m/s at this configuration:

- Maximum load 15,050 kg
- Maximum wind resistance area of load 18.06 m^2

For the allowable wind speed > 13.4 m/s and ≤ 20.1 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 m/s **and ≤ 20.1 m/s,** at this configuration:

- Maximum load 12,040 kg
- Maximum wind resistance area of load 14.45 m^2

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^2.

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^2,
- Wind Drag Coefficient ***Cd*** = 1.5

wind resistance area of load can be estimated as

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

Refer to the above ***Lifting Limits at wind speed V(z) > 13.4 m/s and ≤ to 20.1 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 ≤ 12,040 kg YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  13.8 m^2 ≤ 14.45 m^2 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^2,
- 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
  $Awr_{(load)} = Ap \times Cd = 5.45 \times 2.4 = 13.08\ m^2$

Refer to the above ***Lifting Limits at V(z) > 13.4*** **m/s** ***and ≤ 20.1*** **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 ≤ 12,040 kg YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  13.08 m^2 ≤ 14.45 m^2 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 $Awr_{(load)}$,

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

the wind resistance area of load can be estimated as:

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

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

- Is the load to be lifted less than allowable load?
  14,000 kg ≤ 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) < 3.4*** **m/s**. Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?
  14,000 kg ≤ 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 $Awr_{(load)}$ less than $Awr_{(allow)}$?
  26.22 m^2 ≤ 18.06 m^2 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 $Awr_{(load)}$,

- Load to be lifted of 8,000 kg,
- Projected Wind Area ***Ap*** = 15.25 m^2,
- Wind Drag Coefficient ***Cd*** = 1.3

the wind resistance area of load can be estimated as

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

Refer to the above ***Lifting Limits at wind speed V(z) > 13.4* m/s *and ≤ 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 ≤ 12,040 kg YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  19.83 m^2 ≤ 14.45 m^2 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:

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.

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 (69.5)	90,300 (71.5)	90,300 (75.5)	*62,500 (78)					
12	112,500 (65.5)	90,300 (68.5)	90,300 (73)	62,500 (76.5)	*40,200 (78)				
15	93,250 (60)	90,300 (63.5)	90,250 (69.5)	62,500 (73.5)	40,200 (76)	*40,200 (78)			
20	71,550 (49.5)	71,500 (55)	71,300 (63)	62,500 (68)	40,200 (71.5)	40,200 (74.5)	40,200 (78)	*36,900 (78)	
25	56,650 (38.5)	56,600 (45)	56,350 (56)	53,650 (63)	40,200 (67)	40,200 (70.5)	37,950 (73)	34,900 (75)	*25,150 (78)
30	43,500 (11.5)	44,300 (32)	43,950 (48.5)	43,650 (57.5)	40,200 (62.5)	[illegible]	32,750 (69.5)	30,200 (72)	25,150 (74)
35			33,550 (40)	33,700 (51.5)	34,700 (58)	[illegible]	[illegible] (66)	26,400 (69)	24,700 (71.5)
40			25,800 (28)	26,150 (44.5)	[illegible]	[illegible]	25,200 (62.5)	23,300 (66)	21,800 (68.5)
45				[illegible]	[illegible] (47)	22,300 (54)	22,400 (59)	20,700 (62.5)	19,400 (65.5)
50				[illegible]	[illegible] (41)	[illegible] (49.5)	19,100 (55)	18,550 (59.5)	17,350 (62.5)
55					14,300 (33.5)	[illegible] (44)	16,000 (51)	16,400 (56)	15,600 (60)
60					[illegible]	12,700 (38.5)	13,550 (46.5)	13,950 (52.5)	14,100 (56.5)
65						[illegible] (31.5)	11,550 (41.5)	11,950 (48.5)	12,300 (53.5)
70						9,010 (22.5)	9,920 (36)	10,250 (44)	10,650 (50)
75							8,510 (29.5)	8,890 (39.5)	9,250 (46)
80							7,260 (21)	7,690 (34.5)	8,050 (42.5)
85								6,620 (28.5)	7,010 (38)
90								5,630 (20)	6,100 (33)
95									5,240 (27)
100									4,480 (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 (30.1)	25,700 (34.2)	17,950 (44.2)	13,050 (54.6)	10,050 (64.2)	7,790 (74.2)	6,300 (84.2)	4,900 (94.2)	3,900 (104.2)

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

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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> ... 45 mph, the Reduced Capacity shall be calculated by multiplying the Published Rated Capacity by the following factors:

	Main Boom Length in Feet								
Wind Speed *Vz*> 30 mph ≤ 45 mph	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, ***Awr*** $_{(allow)}$ = 0.0059 x calculated reduced capacity in lb.

Wind resistance area of load, ***Awr*** = projected wind area ***Ap*** x 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.

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

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)***.

Example 2:

A crane is configured with:

- boom length = 90 ft,
- load radius = 40 ft, and
- wind speed is measured at ***V(z)*** ≤ 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:

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

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

Lifting Limits at wind speed V(z) < 30 mph at this configuration:

- Maximum load 25,200 lb
- Maximum wind resistance area of load 149 ft^2

For the allowable wind speed > 30 mph and ≤ 45 mph, reduce the allowable load. , the Factor for a main boom length of 90 ft is 0.8, thus the allowable load is:

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

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

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

Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph at this configuration:

- Maximum load 20,160 lb
- Maximum wind resistance area of load 119 ft^2

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^2.

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^2,
- Wind Drag Coefficient ***Cd*** = 1.5

then the wind resistance area of load can be estimated as

$Awr_{(load)}$ = ***Ap*** x ***Cd*** = 70 x 1.5 = 105 ft^2

Refer to the above ***Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph***. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
  19,500 lb ≤ 20,160 lb YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  105 ft^2 ≤ 119 ft^2 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^2,
- 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*** x ***Cd*** = 45 x 2.4 = 108 ft^2

Refer to the above ***Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph***. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
  18,000 lb ≤ 20,160 lb YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  108 ft^2 ≤ 119 ft^2 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 $Awr_{(load)}$,

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

the wind resistance area of load can be estimated as:

$Awr_{(load)}$ = ***Ap*** x ***Cd*** = 180 x 1.2 = 216 ft^2

Refer to the above ***Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph***. Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?
  22,000 lb ≤ 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 ≤ 25,200 lb . . . . . YES

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

- Is $Awr_{(load)}$ less than $Awr_{(allow)}$,?
  216 ft^2 ≤ 149 ft^2 . . . . . 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 ft^2,
- Wind Drag Coefficient ***Cd*** = 1.3

the wind resistance area of load can be estimated as:

$Awr_{(load)}$ = ***Ap*** x ***Cd*** = 125 x 1.3 = 162 ft^2

Refer to the above ***Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph***. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
  12,000 lb ≤ 20,160 lb YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$,?
  162 ft^2 ≤ 119 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:

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 2-21 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.

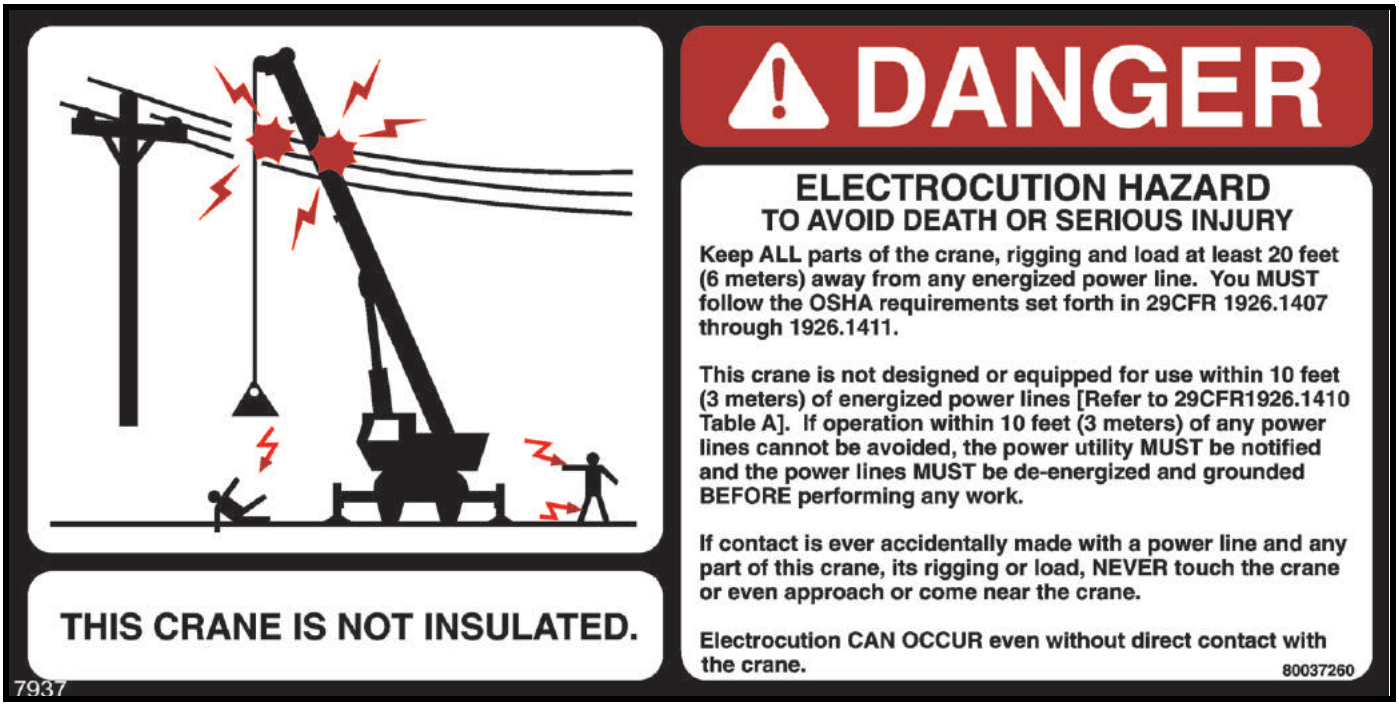
DANGER

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.



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.

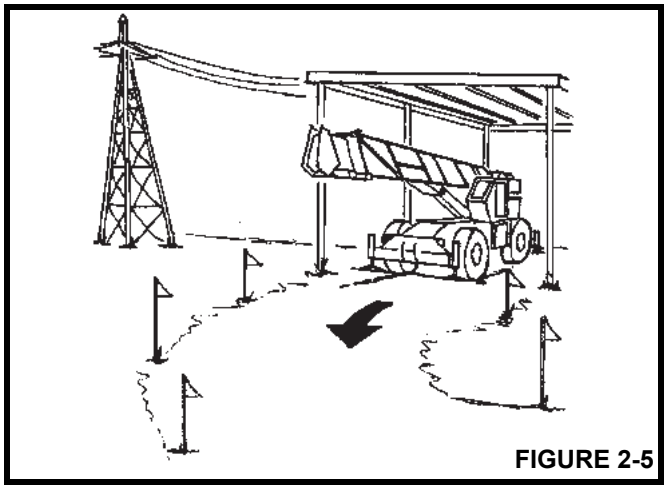


FIGURE 2-5

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 mm² (0.025 in²) (AWG 5).
4. Connect the free end of the cable with a clamp (1) to a good electrically conductive location on the frame.

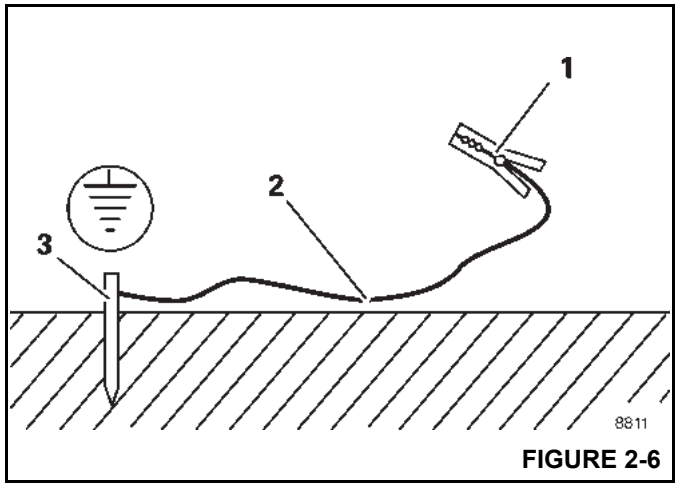


FIGURE 2-6

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, 07007-2900.

  - 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

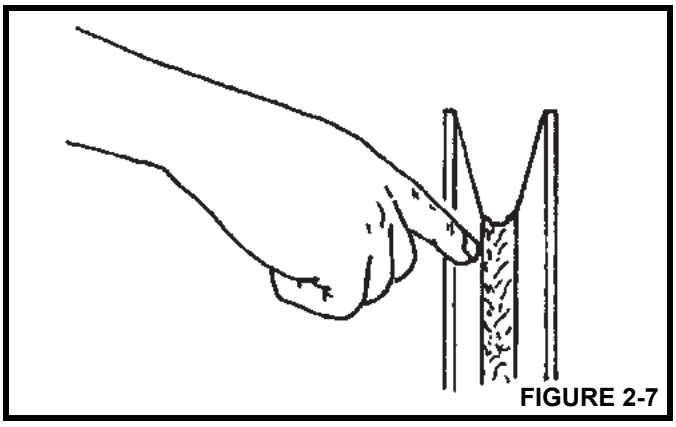


FIGURE 2-7

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

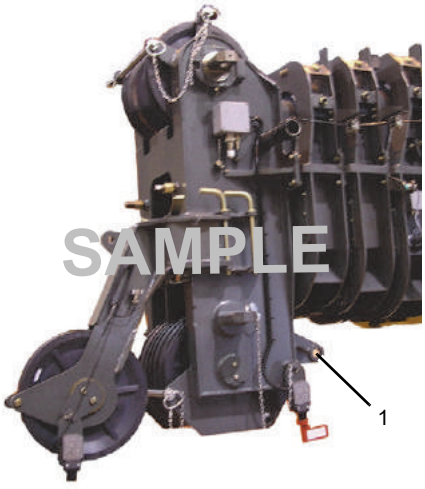
Before transporting the crane, check the suitability of the proposed route with regard to the crane height, width, length, and weight.

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.



7116-1A **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.

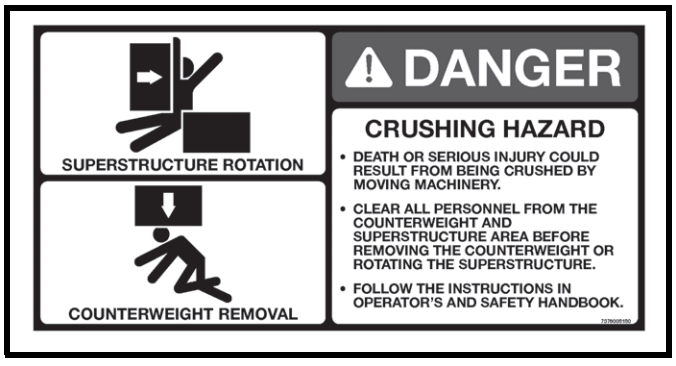
Carbon monoxide fumes from the engine exhaust can cause suffocation in an enclosed area. Good ventilation is very important when operating the crane.

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.

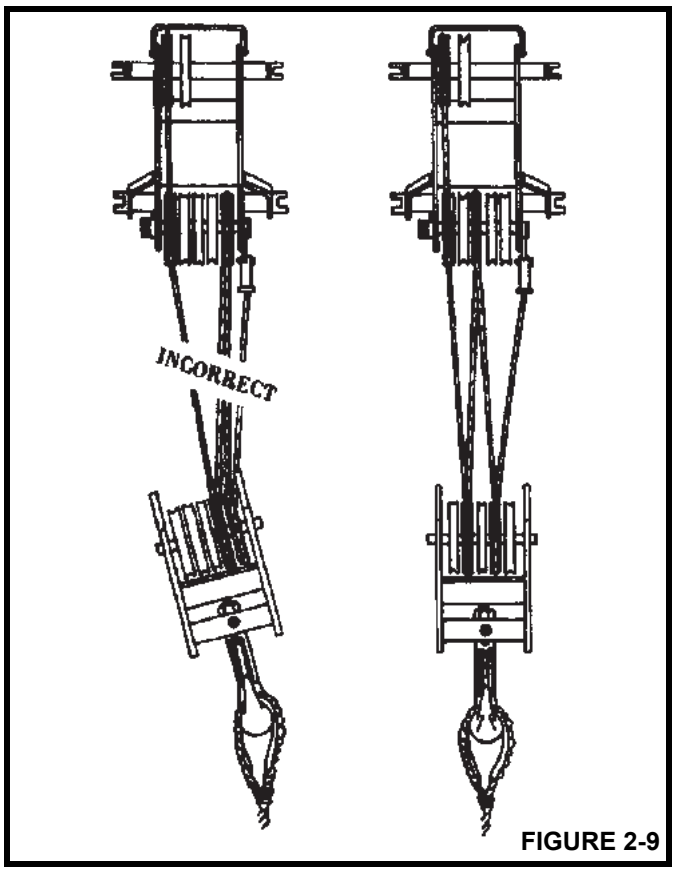


FIGURE 2-9

Lifting

Grove Crane recommends lifting only one load at a time. See "Lifting Operations" on page 2-20.

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.

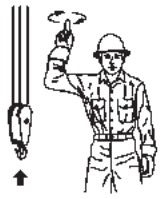
If communication with the signal person is lost, crane movement must be stopped until communications are restored.

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.

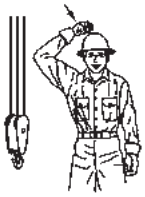
STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS

Complies with ASME B30.5-2014



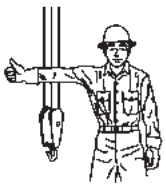
HOIST. With forearm vertical, forefinger pointing up, move hand in small horizontal circle.

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

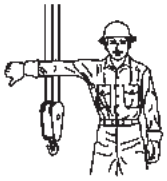


USE MAIN HOIST. Tap fist on head; then use regular signals.

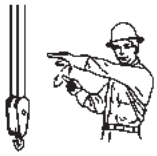
USE WHIPLINE (Auxiliary Hoist). Tap elbow with one hand; then use regular signals.



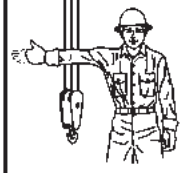
RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.



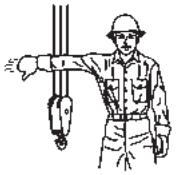
LOWER BOOM. Arm extended, fingers closed, thumb pointing downward.



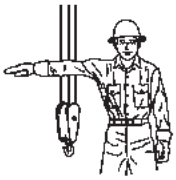
MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal (hoist slowly shown as an example).



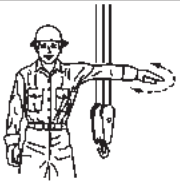
RAISE BOOM AND LOWER LOAD. With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.



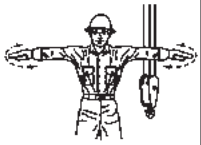
LOWER BOOM AND RAISE LOAD. With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.



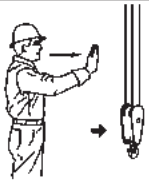
SWING. Arm extended, point with finger in direction of swing of boom.



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

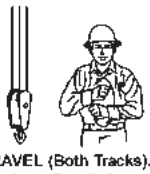


EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally.



TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.

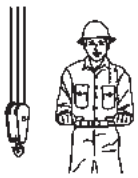
DOG EVERYTHING. Clasp hands in front of body.



TRAVEL (Both Tracks). Use both fists in front of body, making a circular motion about each other, indicating direction of travel, forward or backward. (For land cranes only.)

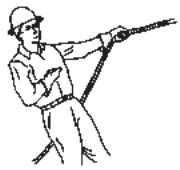
TRAVEL (One Track). Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body. (For land cranes only.)

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



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

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



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

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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^3 per cm^3 of volume for 1°C of temperature change (0.00043 in^3 per in^3 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^3/in^3/ °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^3/in^3/ °F) X 12 in/ft										

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

Coeff. =	0.000774	(1/ °C)		***Metric***							
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											

CRANE ACCESS

Use the hoist access platform (1) (Figure 2-11) when working in the hoist area.Overload Inspection

FIGURE 2-11

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

These inspections apply only to overloads up to 50%. For overloads of 50% or higher, crane operation must be stopped immediately and Crane Care must be contacted for corrective action.

WARNING

Overload Hazard!

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

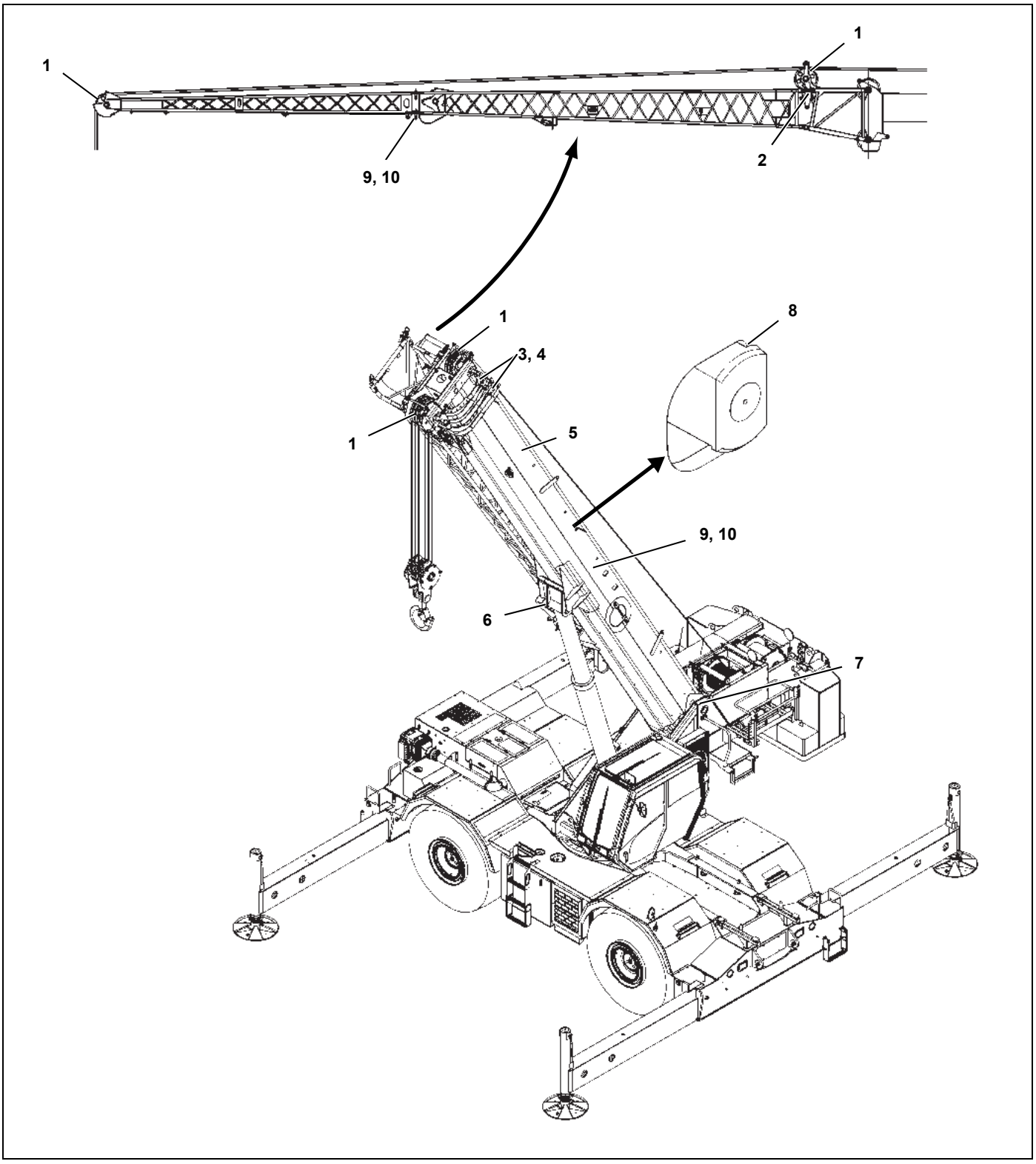
- Perform the inspections outlined in this publication for overloads up to 50%.
- Stop operating the crane and contact Manitowoc Crane Care immediately for overloads of 50% and higher.

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

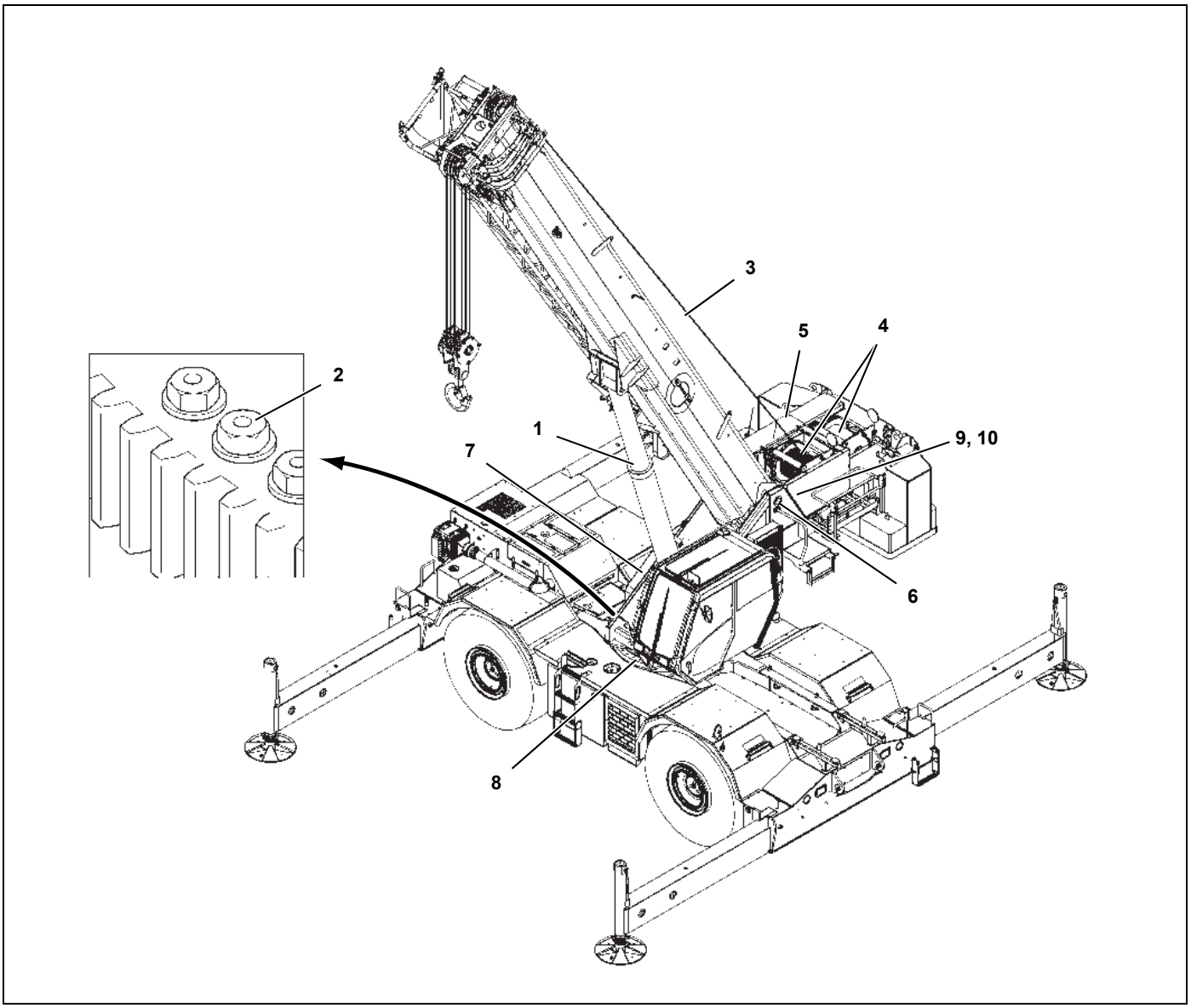
2

Boom Inspection



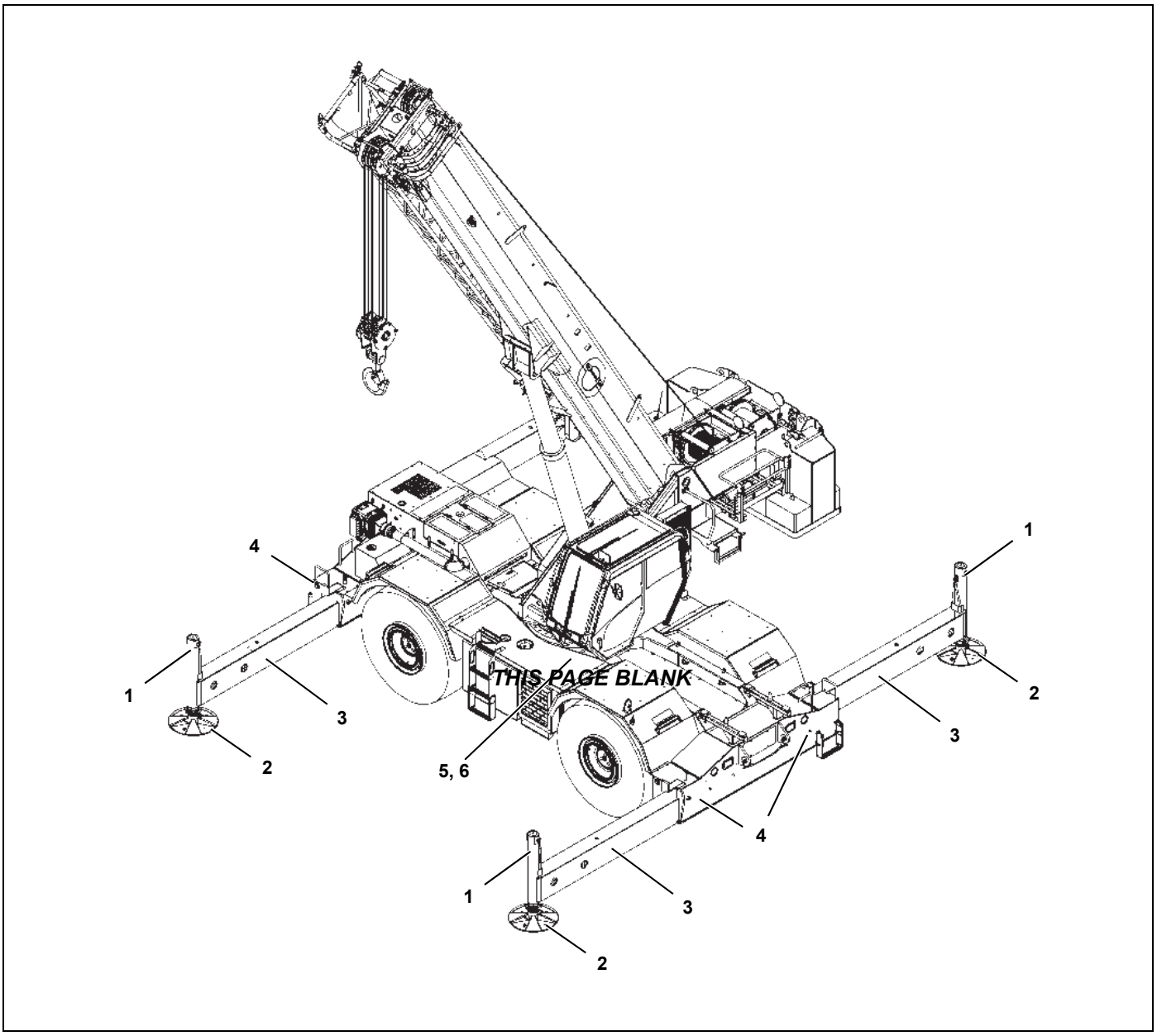
Overload less than 25%			
1	Sheaves	Inspect all for damage.	
2	Luffing Mechanism/ Cylinder	Inspect for damage/leaks.	
3	Collar-wear pads	Inspect all for damage.	
Overload from 25% to 49%			
1	Sheaves	Inspect all for damage.	
2	Luffing Mechanism/ Cylinder	Inspect for damage/leaks.	
3	Collar-wear pads	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.	

Superstructure Inspection



Overload less than 25%			
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.
Overload from 25% to 49%			
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.	

Carrier Inspection



Overload less than 25%			
1	Stabilizer Cylinders	Inspect for leaking.	
2	Outrigger Pads	Inspect for deformation and cracked welds.	
Overload from 25% to 49%			
1	Stabilizer 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.	

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SECTION 3
OPERATING CONTROLS AND PROCEDURES

SECTION CONTENTS

The following paragraphs describe the standard and optional controls and indicators located in the cab. Some machines may not be equipped with the optional controls shown.

NOTE: Many controls and indicators are integrated into the ECOS and RCL electronic controllers. Refer to either the *ECOS Control Unit,* page 3-17 or *RCL Control Unit,* page 3-68 for information on the controls and indicators in these electronic controllers.

The cab contains all the controls necessary for crane travel, parking and performing all craning operations.

OPERATIONAL AIDS

WARNING

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.

Rated Capacity Limiter System

The EKS 5 or Rated Capacity Limiter (RCL) is an electro-mechanical sensing system designed to alert the crane operator of impending capacity when the system has been properly preset by the operator. The control panel is mounted in the front console of the operator's cab. When an overload condition is sensed, the system provides the operator with a visual and audible warning, and locks out the control levers to prevent lowering the boom, extending the boom, or raising the main or auxiliary hoist cables.

Two additional features are included within the RCL system:

- Working Range Limitation
- Anti-two-block Device

Working Range Limitation

Refer to *Working Range Limitation submenu,* page 3-38.

This feature allows the crane operator to describe the crane's working area by setting up "virtual walls". They are referred to as virtual walls because they exist in the system and are not real walls. The virtual walls represent obstacles (i.e. buildings, towers, poles, etc.) in the crane's working range. They are set by defining points along the outer limits of the working area with the tip of the boom. Once the working area has been defined, the system will provide a visual and an audible warning if the boom approaches a virtual wall.

CAUTION

When defining virtual wall(s), always allow a safe working distance to any obstacles. Never work outside a safe working area as defined by common practice, standards, and manuals.

WARNING

There are no cutouts associated with the swing angle set limitation or the work area definition features.

Anti-Two-Block Device

This device is also incorporated into the system to prevent the hook block or overhaul ball from coming into contact with the boom nose or boom extension. This condition will also cause a lockout of hoist up, boom down, and telescope out, and also provide a visual and an audible alarm.

Refer to the *RCL Control Unit,* page 3-68 for more detailed information on the function of the RCL system.

RCL Boom Alarm (CE Units)

In addition to the audible warning in the cab, a visual RCL boom alarm is also mounted in the vicinity of the boom flood light to warn all personnel that a lockout has occurred.

Control Lever Lockout System

The control lever lockout system consists of hydraulic solenoid valves, located in the directional control valves. The valves are activated in such a manner as to prevent worsening the condition, i.e. boom down, telescope out, or hoist up. The control lever lockout system is used with the anti-two-block system and/or the RCL system.

STEERING COLUMN

Refer to Figure 3-1.

Transmission Shift Lever

The Transmission Shift Lever (1) is located on the right side of the steering column. It is used to select the transmission gears.

Before moving the lever up or down, pull back on the lever first. Position the lever up to actuate forward or down to actuate reverse. When the lever is in neutral, it rests in a detent.

To shift the transmission to forward first through sixth gear, rotate the knob on the transmission lever to the small 1 through 6. To shift the transmission to reverse first through third, rotate the knob to the large 1 through 3.

Turn Signal Lever

The Turn Signal Lever (2) (Figure 3-1 and 3-2) is located on the left side of the steering column. Pushing the lever down causes the left indicator light, left front and left rear turn signals to flash. Pushing the lever up causes the right turn signal indicator light, the right front and right rear turn signals to flash.

Windshield Wiper/Washer Control

The Windshield Wiper Switch (2) is incorporated in the turn signal lever. Rotate the center portion of the lever to energize the windshield washer pump to spray washer fluid on the windshield.

The Windshield Wiper Switch has three positions; **O**, **I**, and **II**. Position the wiper/washer portion of the lever to **I** to operate the wiper at low speed or to **II** to operate the wiper at high speed. Position the wiper/washer portion of the lever to **O** to turn the wiper motor off and to automatically return the wiper to the parked position.

Horn

The Horn Button(3) is a push-button type switch located on the end of the turn signal lever. Depressing the Horn Button will sound the horn on the cab exterior.

Ignition Switch

The Ignition Switch (4) is located on the right side of the steering column. The switch is key operated with four positions: accessory (left position), off (vertical position), run (position between vertical and right), and start (right position).

With the Ignition Switch in the off position, all electrical power is off except for the headlights, marker lights, gauge lights, turn and stop light, cab dome light, 12V accessory outlet, and work lights.

The accessory position energizes all electrical components except the engine ECM. The run position is the same as accessory except the engine ECM is energized. The start position energizes the starter relay which in turn energizes the starter motor solenoid and cranks the engine for starting. The switch will return to run when the switch is released after the engine is started. Turn the switch to off to shut down the engine. The key can be removed in the off position only.

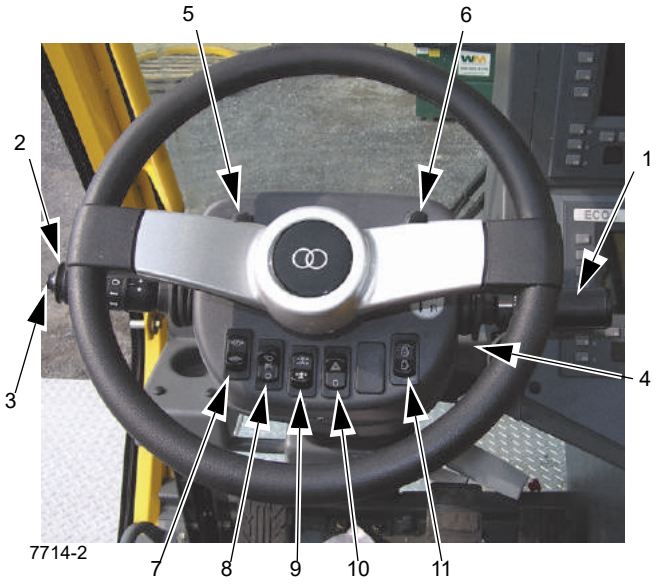


FIGURE 3-1

Item	Description
1	Transmission Shift Lever
2	Turn Signal Lever: Windshield Wiper Switch
3	Horn Button
4	Ignition Switch
5	Left Turn Signal Direction Indicator
6	Right Turn Signal Direction Indicator
7	Park Brake Switch
8	Headlights Switch
9	Drive Select Switch (2WD/4WD)
10	Hazard Lights Switch
11	Engine Idle Increase/Decrease Switch

Left Turn Signal Direction Indicator

The Left Turn Signal Direction Indicator (5) is located at the top left side of the steering column. It is a green arrow light that flashes when the turn signal lever is pushed down or the top of the hazard light switch (10) is pushed to on.

Right Turn Signal Direction Indicator

The Right Turn Signal Direction Indicator (6) is located at the top right side of the steering column. It is a green arrow light that flashes when the turn signal lever is pushed up or the top of the hazard light switch (10) is pushed to on.

Park Brake Switch

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

CAUTION

Avoid Crane Damage!

Do not engage the park brake while the vehicle is moving. Damage to the crane can occur.

Disengage the park brake before driving. Damage to the crane can occur.

The Park Brake Switch (7) is located on the left side of the steering column. The switch is used to apply and release the parking brake on the axle. The ECOS icon  is red when the brake is applied. The icon is gray when the brake is released.

Headlights Switch

The Headlights Switch (8) is located on the left side of the steering column. The bottom position is off. The center position will light the marker, clearance and gauge lights. The top position will turn on the headlights in addition to the marker, clearance and gauge lights. When switched to either ON position the switch is backlit green.

NOTE: When the front outrigger box is electrically connected, only the headlights in the outrigger box will illuminate. When the front outrigger box is electrically disconnected, only the headlights located on the carrier fender and decking will illuminate.

When the headlight switch is in the ON position and the transmission shifter is in the reverse position, only the two backup lamps on the rear fender and decking will illuminate if the rear outrigger box is electrically disconnected.

Drive Select Switch

NOTE: Four-wheel drive must be engaged to operate the outriggers.

The Drive Select Switch (9) is located on the bottom center of the steering column. Push the top of the switch to select 4 wheel drive (low) or the bottom of the switch to select 2 wheel drive (high). The ECOS icon  is yellow when in 4WD or gray when in 2WD.

Hazard Lights Switch

The Hazard Lights Switch (10) is located on the bottom center of the steering column. Push the top of the switch to cause the four turn signal lights and two turn signal indicator lights to flash at the same time.

Engine Idle Increase/Decrease Switch

The Engine Idle Increase/Decrease Switch (11), on the right side of the steering column, is used to set the engine operating speed. It is a two position (+/-) momentary switch.

Push and hold either the top or bottom of the switch to increase or decrease engine speed. Release the switch to hold the engine at the current speed. Pressing the foot pedal will increase engine speed above the “hold” speed. Releasing the foot pedal causes the engine to return to the “hold” speed.

STEERING COLUMN LEFT SIDE AND FLOOR

Refer to Figure 3-2.

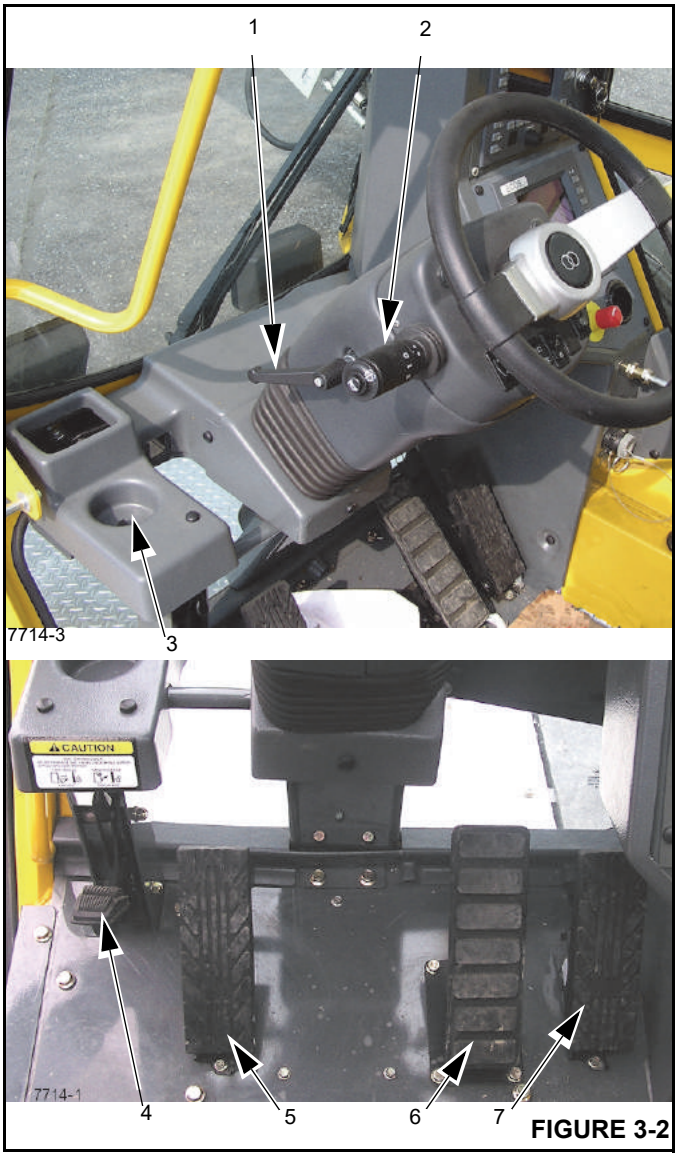


FIGURE 3-2

Item	Description
1	Steering column tilt/telescope lever
2	Turn Signal Lever: Windshield Wiper Switch
3	Cup Holder
4	360° Swing Lock Pedal
5	Swing Brake Pedal
6	Service Brake Foot Pedal
7	Foot Throttle Pedal

Steering Column Tilt/Telescope Lever

The Steering Column Tilt/Telescope Lever (1) is on the steering column below the turn signal lever. Rotate the lever counterclockwise to loosen the steering column for adjustment. The steering column can now be tilted or telescoped in and out. After adjustment tighten the lever by turning clockwise.

The lever can be re-positioned; push in and rotate to the desired position then pull the lever out.

WARNING

Loss of Control Hazard!

Never operate the crane with the steering column adjustment lever loose. Serious injury or property damage may result.

Cup Holder

Location to hold a beverage container (3) (Figure 3-2).

360° Swing Lock Pedal

The 360° Swing Lock Pedal (4) is located to the left of the swing brake pedal on the left side of the cab floor. The 360° swing lock secures the superstructure in any position.

When the pedal is up, the swing lock is disengaged and the superstructure can be rotated. Pushing down on the pedal engages the swing lock. To disengage the swing lock pull up on the release lever at the top of the pedal.

Swing Brake Pedal

The Swing Brake Pedal (5) is located on the left side of the cab floor. The Swing Brake Pedal is used to actuate the swing brake to slow or stop swing motion. Braking is proportional to pedal depression.

Service Brake Foot Pedal

The Service Brake Foot Pedal (6) is the second pedal from the right on the cab floor. Depressing the pedal controls the application of the service brakes to stop the vehicle. This pedal must be depressed to start the engine.

Throttle Pedal

The foot Throttle Pedal (7) is located on the right side of the cab floor. The pedal is used to control engine speed. The pedal controls engine speed proportionately to the applied foot pressure. The pedal is connected electrically to the engine ECM.

RIGHT SIDE CONSOLE

Refer to Figure 3-3.

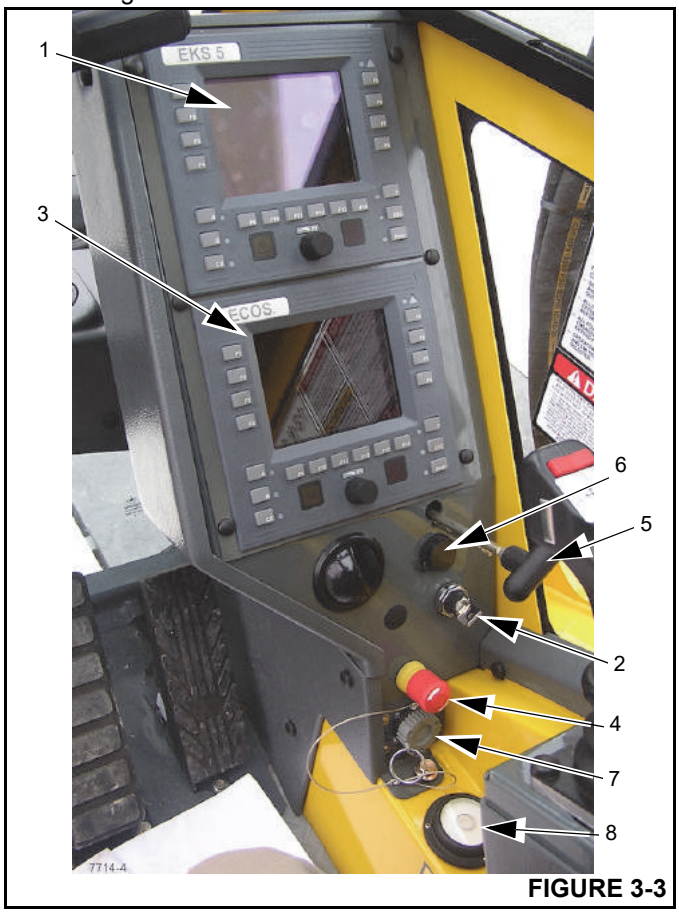


FIGURE 3-3

Item	Description
1	RCL Control Panel (EKS 5)
2	RCL Override Switch
3	ECOS Control Panel
4	Emergency Stop Switch
5	Turntable Lock Pin Control Handle
6	12v Accessory Outlet
7	Diagnostic Connector
8	Level Indicator

RCL Control Panel

The RCL Control Panel (1) is located at the top of the right side console. This panel is used to setup a lift and monitors all craning functions. Refer to *RCL Control Unit,* page 3-68 for detailed descriptions and instructions.

RCL Override Switch (Non-CE Certified Cranes)

The key operated RCL Override Switch (2) is located on the front of the console below the 12 volt accessory outlet. It is used to override the RCL in the event of an emergency that requires placing the crane in a safer position because of a malfunction or when rigging the crane to defeat the anti-two-block switch.

Refer to *RCL Override,* page 3-73 for more information.

WARNING

Tipping Hazard!

Do not operate crane with the RCL function OFF without being in communication with personnel on the ground observing the crane's operation. Serious injury or damage to the crane may result.

- Key in center position: the RCL is on and actively monitoring all craning functions.
- Turn key to the right and hold: RCL shutdown function is overridden; crane functions are no longer monitored
- Turn key to the left and hold: RCL shutdown and anti-two-block functions are no longer monitored.

Refer to *RCL Control Unit,* page 3-68 for detailed descriptions and instructions.

RCL Emergency Override Switch and Indicator (CE Certified Cranes)

WARNING

Loss of RCL Monitoring Hazard!

The RCL Emergency Override Switch is to be used in emergency situations only.

Do not operate the crane with the RCL overridden during normal operations.

The RCL system, when programmed accurately, will lockout the three craning functions—boom down, telescope extend, and hoist up—when a lift is attempted at or above the crane's capacity or when a two-block condition exists. Locking out these three functions prevents the overload or two-block condition from worsening.

The RCL emergency override switch is located inside a key-locked single-door enclosure (1, Figure 3-4) that is attached to the outside rear of the operator's cab. The switch is a two-position momentary rocker switch with integral indicator that, when actuated, will override and prevent the RCL, for a

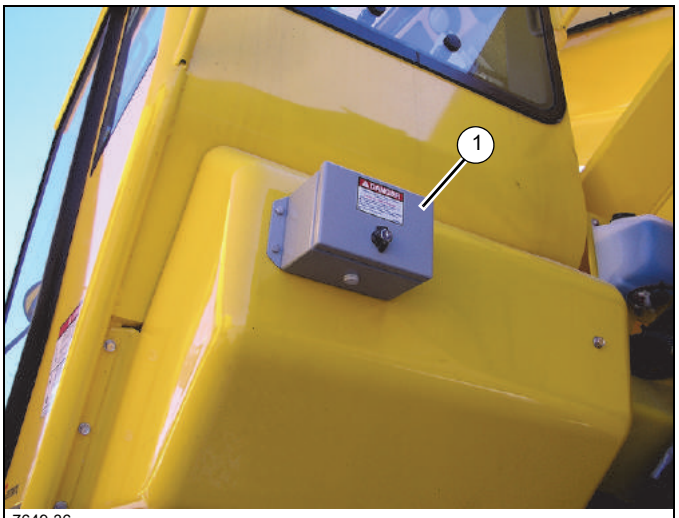
period of 30 minutes, from locking out the three craning functions (boom down, telescope extend, and hoist up) should an overload or two-block condition occur.

Overriding the RCL with this switch should only be done in the case of an emergency or when servicing the boom.

The indicator in the override switch will illuminate red and the RCL and A2B override indicators on the RCL display will flash to indicate the switch has been activated. Upon activation, all craning function movements are reduced to 15% of their normal maximum speeds.

The RCL override function is automatically cancelled after 30 minutes. The RCL override function can also be cancelled by the operator by either pressing the RCL emergency override switch a second time, by turning off the engine, or by turning the crane function power switch off.

Refer to the *RCL operator's manual* for more information.



7649-36

FIGURE 3-4

ECOS Control Panel

The ECOS Control Panel (3) is located on the right side console. Various menus are displayed on the ECOS display. The individual buttons have a different function in each menu. The display shows various indicators about the crane, the engine, outriggers, boom, etc. Many crane functions are also controlled by the ECOS system.

Refer to *ECOS Control Unit,* page 3-17 for detailed descriptions and instructions.

Emergency Stop Switch

The Emergency Stop Switch (4) is located on the right center console. Pressing this switch will shut down the engine.

Turntable Lock Pin Control Handle

The Turntable Lock Pin Control Handle (5) is located on the lower right side console. The purpose of the turntable lock pin is to lock the superstructure in position directly over the front (0°) or rear (180°). Pull the handle out to disengage the swing lock. Push it in to engage the lock, preventing the superstructure from turning.

Accessory Outlet

The Accessory Outlet (6) is located on the right side console. It provides an outlet for the operator to plug in a 12 vdc accessory. This outlet should be used only for components requiring 8 amps or less.

Diagnostic Connector

The electrical Diagnostic Connector (7) is located on the right side console. It can be used for troubleshooting engine faults and conditions.

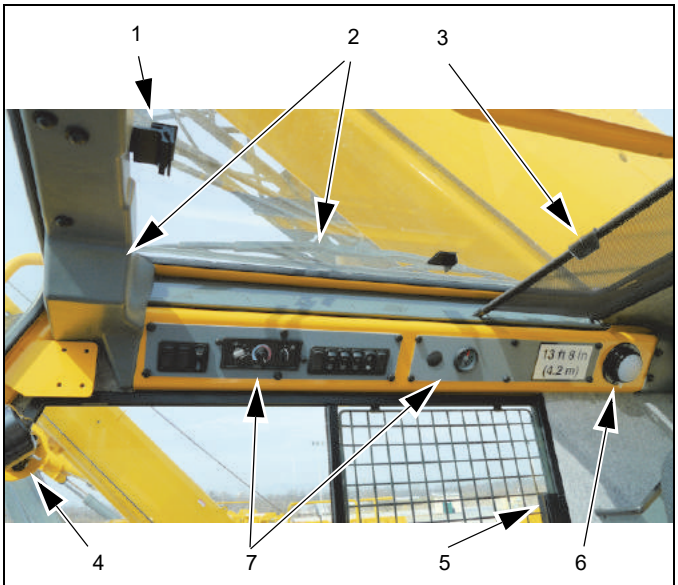
The connector is designed to connect a laptop computer, with appropriate cable and engine or electrical system software, to the crane for diagnostic work.

Level Indicator

The Level Indicator (8) is located on the right side of the cab below the right side console. The indicator provides the operator with a visual aid in determining the level of the crane. Refer to the Service Manual to determine the accuracy and how to adjust the level indicator.

OVERHEAD CONTROLS AND FEATURES

Refer to Figure 3-5.



8881-00 **FIGURE 3-5**

Item	Description
1	Skylight Window Latch
2	Skylight Wiper and Motor
3	Skylight Sunscreen
4	Cab Circulating Fan
5	Window Latch
6	Cab Overhead Light
7	Overhead Console

Skylight Window Latch

The Skylight Window Latch (1) is at the front of the window. Squeeze the latch and slide the window to the rear to open. to close slide the window forward until the latch engages.

Skylight Wiper and Wiper Motor

The Skylight Wiper (2) is controlled by the wiper switch, (5) (Figure 3-6), and operated by the indicated motor.

Skylight Sunscreen

The Skylight Sunscreen (3) is used to diminish direct sunlight. The sunscreen is self retracting and can be set to screen all the light or adjusted rearward by moving it into the notches provided.

Cab Circulating Fan

The Cab Circulating Fan (4) is located on the right front side of the cab, above the window frame. A swivel allows the fan to be rotated and a switch on the fan base controls the fan. The switch has a high, low and off position.

Right Side Window Latch

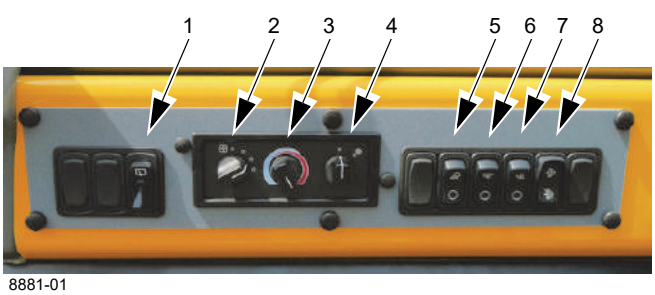
The window on the right side of the cab can be opened. Squeeze latch (5) to release the window and slide forward. To close slide the window rearward until the latch engages.

Overhead Light

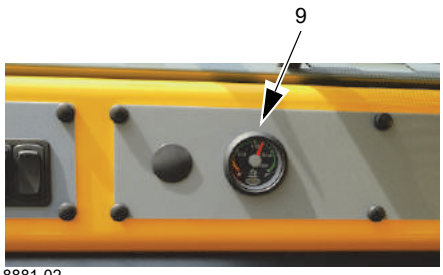
The cab Overhead Light (6) is on the right rear corner of the cab overhead console and provides illumination in the cab. The Overhead Light is controlled by a switch on the light.

Overhead Console (Right Side)

Refer to (7) Figure 3-5 and Figure 3-6.



8881-01



8881-02

FIGURE 3-6

Item	Description
1	Heater/Air Conditioner Fan Switch
2	Skylight Wiper Switch
3	Heater Control Switch
4	Air Conditioning Switch
5	Work Lights Switch
6	Boom Light Switch (Optional)
7	Aircraft Warning Light Switch (Optional)
8	Exhaust System Cleaning Switch
9	DEF Gauge

Heater/Air Conditioner Fan Switch

The Heater/Air Conditioner Fan Switch (1) controls the cab fan's speed. Fan speed controls the volume of heated air output (or cooled air output) of the fan. Settings are off, low speed, medium speed, and high speed.

Skylight Wiper Switch

The Skylight Wiper Switch (2) controls the skylight wiper motor (2) (Figure 3-5). Toggle the switch from; off, through six intermittent timed positions, to low and high. Pushing the switch up from the off position energizes the wiper motor. Push the switch down to off to stop the motor and return the wiper blade to the parked position.

Heater Control Switch

The Heater Control Switch (3) controls intensity of heating. Turn the switch to the right (clockwise) to open the valve for heat. (Heat comes from heated fluid going through the heater coil.) Turn the switch to the left (counterclockwise) to close the valve to stop fluid flow and minimize heat.

Air Conditioner Switch

The Air Conditioning Switch (4) controls the operation of the optional air conditioning system. Settings are off (O) and on (I).

Work Lights Switch

The Work Lights Switch (5) controls the crane's work lights mounted on the bottom front of the cab. Press the top of the switch to turn on the work lights. Press the bottom of the switch to turn off the work lights.

Boom Light Switch (Optional)

The Boom Light Switch (6) controls the boom light (the flood light on the boom base section). Press the top of the switch to turn on the flood light. Press the bottom of the switch to turn the flood light off.

Aircraft Warning Light Switch (Optional)

The Aircraft Warning Light Switch (7) controls the optional flashing light installed on the boom nose. Press the top of the switch to turn on the aircraft warning light. Press the bottom of the switch to turn off the light.

Exhaust System Cleaning Switch

WARNING

Fire or Burn Hazard!

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

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

The Engine Exhaust System Cleaning Switch (8) is located on the right side of the overhead control panel. This switch is a three position switch, Inhibit Cleaning/Permit Active Cleaning/Initiate Manual Cleaning. Center position enables clean to occur when required, or press this switch to force manual cleaning to begin immediately or to disable cleaning indefinitely:

- Manual Cleaning (7649-10)
- Inhibit Cleaning (7649-11)

To manually clean, set the crane parking brake, the crane transmission must be in neutral and have the brake and

throttle pedals released. Refer to *Exhaust System Cleaning,* page 3-111 for cleaning mode definitions and a description of when manual cleaning is needed.

CAUTION

Avoid Crane Damage!

Do not engage the park brake while the vehicle is moving. Damage to the crane can occur.

Disengage the park brake before driving. Damage to the crane can occur.

Set up a safe area around the crane's exhaust; remove tools, rags, grease or any debris from the engine exhaust area.

With the engine idling push the Cleaning Switch (9) to the Manual Clean position to initiate manual cleaning.

Within 5 seconds the engine should rev up to 1000 to 1400 rpm. The engine will continue to run at this speed for up to 45 minutes.

As a warning, the light (1, Figure 3-7) below the exhaust pipe (2, Figure 3-7) will blink during cleaning.

Pressing the brake or throttle pedal during cleaning or activating the Inhibit Cleaning Switch will interrupt the manual cleaning process.

Make sure the crane and surrounding area are monitored during manual cleaning. If any unsafe condition occurs, shut off the engine immediately.

During this period the sound of the engine may change. When manual cleaning is complete the engine will return to it's normal idle speed.

8881-03 **FIGURE 3-7**

DEF Gauge

The DEF Gauge (9) indicates the amount of diesel exhaust fluid (DEF) in the DEF tank (3, Figure 3-7) and has a scale calibrated from empty (E) to full (F) with markings in between of 1/4, 1/2, and 3/4 full.

SEAT-MOUNTED CONTROLS

Refer to Figure 3-8.

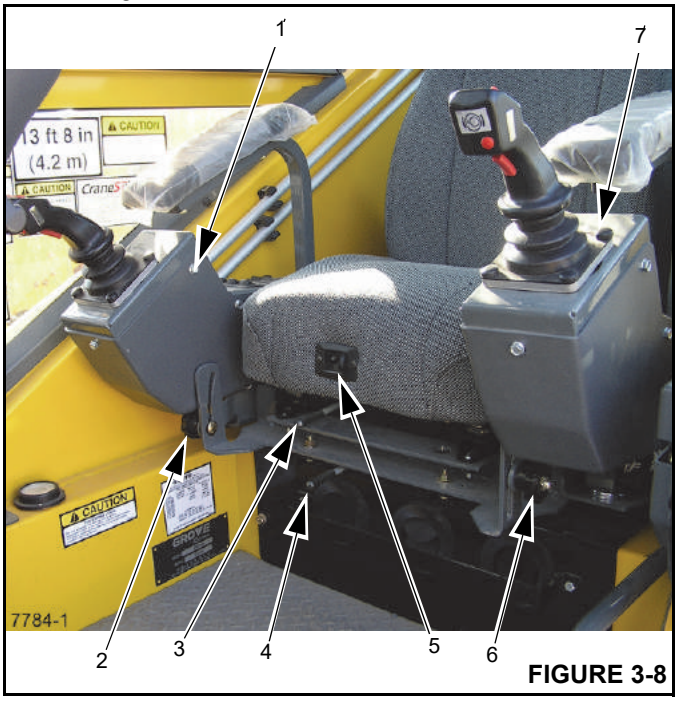


FIGURE 3-8

Item	Description
1	Right-hand Armrest Controls
2	Right-hand Armrest Adjustment Knob
3	Seat Adjustment Lever
4	Seat Assembly Adjustment Lever
5	Seat Back Adjustment Lever
6	Left-hand Armrest Adjustment Knob
7	Left-hand Armrest Controls

Right-Hand Armrest Assembly

The right-hand armrest (1) includes the dual axis joystick, control panel and armrest, refer to *Right-Hand Armrest Controls*, page 3-12. Use the adjustment knob (2) below the controller assembly to adjust its vertical position.

Seat Adjustment Lever

The Seat Adjustment Lever (3) is used to move just the seat forward or back. Push the lever to the left to release the latch and move the seat. Release the lever and slightly move the seat until the lever engages.

Seat Back Adjustment Lever

The Seat Back Adjustment Lever (5) is used to adjust the

angle of the seat back. Push the lever to the right and either lean forward so the seat moves up or lean back against the seat to lean it backwards. Release the lever and allow the seat back to engage a locking point.

Seat Assembly Adjustment Lever

The Seat Assembly Adjustment Lever (4) is used to move the seat and controllers forward or back. Push the lever to the left to release the latch and move the seat. Release the lever and slightly move the seat until the lever engages.

Armrest Adjustment Knob

The Armrest Adjustment Knobs (2, 6) are used to set the vertical angle of the controllers. Turn the knob to the left to release the adjustment and to the right to tighten.

Left-Hand Armrest Assembly

The left-hand armrest (7) includes the dual axis joystick, control panel and armrest, refer to *Left-Hand Armrest Controls,* page 3-13. Lift up on the controller assembly to move for seating, push down to use the controller for operation. Use the adjustment knob (6) below the controller assembly to adjust its vertical position. Crane functions are disabled when the armrest is raised.

RIGHT-HAND ARMREST CONTROLS

Refer to Figure 3-9.

NOTE: All switches on this controller are momentary rocker type. Press once to turn on the function, press again to turn the function off.

Main Hoist or Telescope/Boom Lift Controller

The Main Hoist or Telescope/Boom Lift Controller (1) is located on the right armrest. The controller is used to operate the main hoist and telescope the boom in and out or raise and lower the boom. The controller must be used in conjunction with the main hoist switch (5), lift switch (6) or telescope switch (7).

NOTE: A function is active when the icon on the ECOS display is green. Press the associated switch to toggle the function.

Main Hoist: Push the controller forward to let out the main hoist cable. Pull the controller back to reel the main hoist cable in. Refer to *Hoist Operation,* page 3-154.

Boom Raise/Lower: Push the controller to the right to lower the boom. Push the controller to the left to raise the boom. Refer to *Elevating/Lowering the Boom,* page 3-130.

Boom Telescope: Push the controller to the right to telescope out. Push the controller to the left to telescope in. Refer to *Telescoping the Boom,* page 3-132.

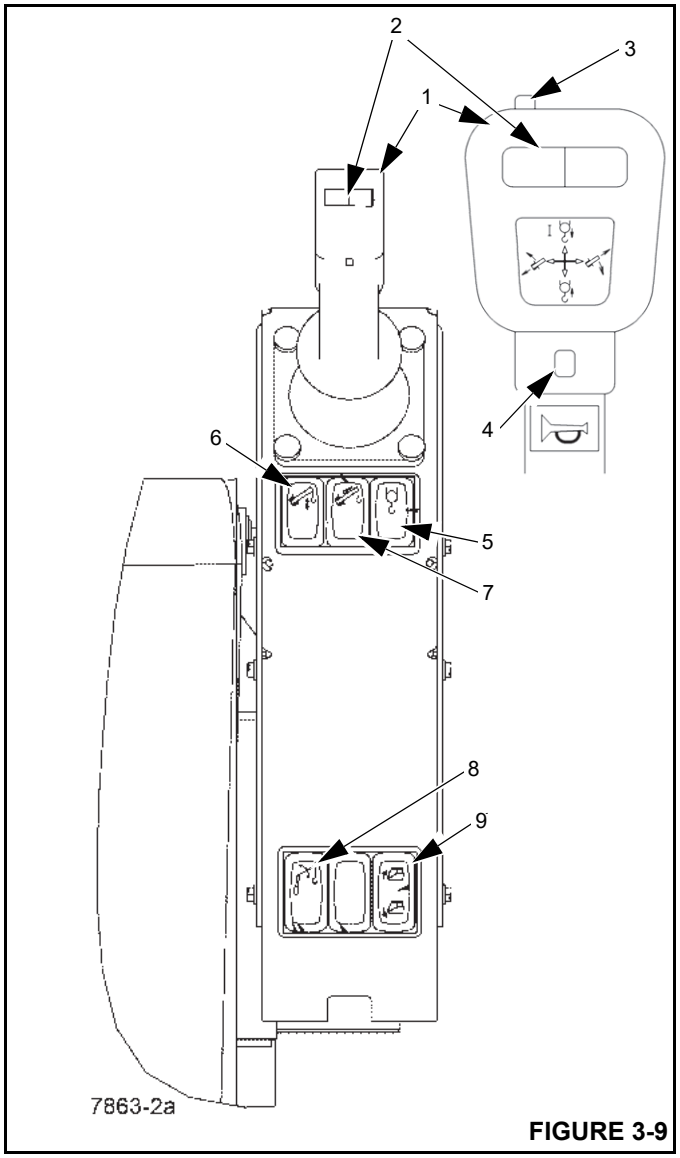


FIGURE 3-9

Item	Description
1	Boom Lift or Telescope/Main Hoist Controller
2	High Speed Boost Rocker Switch
3	Work Horn Button
4	Hoist Rotation Indicator
5	Main Hoist Switch
6	Boom Lift Switch
7	Boom Telescope Switch
8	Luffing Jib Switch (Optional)
9	Cab Tilt Switch

NOTE: All switches on this controller are momentary rocker type. Press once to turn on the function, press again to turn the function off.

High Speed Main and Auxiliary Hoist Boost Button

NOTE: Depending upon the crane configuration and conditions, the maximum speeds may be automatically limited by the ECOS system to prevent damage to the crane.

The High Speed Boost Rocker Switch (2) for both hoists is located on the top of the right-hand joystick controller.

For momentary high speed operation; push and hold the switch to the left, release for normal speed.

To toggle continuous high speed operation; push the switch to the right to turn high speed on or off.

When high speed boost is active either the ECOS icon  or  will turn yellow depending on which function is selected.

Work Horn Button

The Work Horn Button (3) is on the front of the right joystick. Press in on the button to sound the horn to warn or get the attention of others.

Hoist Rotation Indicators

The Hoist Rotation Indicators (4) are located on each hoist control lever. The indicators are electronically driven by a signal from an electronic transmitter and sensor attached to each hoist. A pulsating signal is sensed by the operator's thumb during hoist operation.

Main Hoist (I) Switch

The Main Hoist Switch (5) is located on the right armrest. The switch is used to turn on the main hoist function by pushing the top of the switch. Use the joystick controller (1) to activate the main hoist function after switch is turned on. Push the top of the switch again to turn the function off.

Boom Lift Switch

The Boom Lift Switch (6) is located on the right armrest. The switch is used to turn the lift function on by pushing the top of the switch. Use the telescope controller (1) to activate the lift function after the boom lift switch is turned on. Push the top of the switch again to turn the function off.

Boom Telescope Switch

The Boom Telescope Switch (7) is located on the right armrest. The switch is used to turn on the telescope function by pushing the top of the switch. Use the telescope controller (1) to activate the telescope function after switch is turned on. Push the top of the switch to turn the function off.

Luffing Jib Switch (Optional)

The hydraulic Luffing Jib Switch (8) is located on the right armrest. The switch is used to turn on the luffing jib function by pushing the top of the switch. Use the ECOS control unit to control the luffing jib function after switch is turned on.

Refer to *Raising and Lowering the Hydraulic Boom Extension,* page 3-156 and *Luffing jib, F7,* page 3-48 for more information on the hydraulic luffing jib.

Cab Tilt Switch

The Cab Tilt Switch (9) is located on the right arm rest. It allows the cab to be tilted either up or down. Push the top of the switch to raise the cab or the bottom of the switch to lower the cab.

NOTE: Park brake must be engaged to operate the cab tilt feature and cab must be completely down (at zero level) for the drive functions to be enabled.

LEFT-HAND ARMREST CONTROLS

Refer to Figure 3-10.

NOTE: All switches on this controller are momentary rocker type. Press once to turn on the function, press again to turn the function off.

Auxiliary Hoist/Swing Gear Controller

The Auxiliary Hoist/Swing Gear Controller (1) is located on the left armrest. The controller is used to operate the auxiliary hoist and swing the superstructure. The controller must be used in conjunction with the Auxiliary Hoist Switch (7) or Swing Brake Switch (5).

NOTE: A function is active when the icon on the ECOS display is green. Press the associated switch to toggle the function.

Auxiliary Hoist: Push the controller forward to let out the auxiliary hoist cable. Pull the controller back to reel the auxiliary hoist cable in.

Swing Gear: Push the controller to the right to rotate the superstructure to the right (clockwise). Push the controller to the left to rotate the superstructure to the left (counterclockwise).

High Speed Lift/Telescope Boost Button

NOTE: Depending upon the crane configuration and conditions the lift and or telescope speeds may be automatically limited by the ECOS system to prevent damage to the crane.

The high speed boost rocker switch (2) for the lift and telescope function is located on the top of the left-hand joystick controller.

Push and hold the switch to the left for high speed operation, release for normal speed.

Push the switch to the right to turn high speed on or off, for continuous high speed operation.

When high speed boost is active either the ECOS icon  or  will turn yellow depending on which function is selected.

Swing Gear Freewheel Button

Swing Gear Freewheel Button is used when the superstructure will be allowed to rotate to self-center over the load or to minimize side loading due to tandem crane operation.

WARNING

Tipping Hazard!

When Swing Gear is in freewheel, the upper structure is free to rotate. Ensure that the crane is only operated within the load chart capacity range to lift the load. Further, ensure that the crane is not allowed to rotate into external objects or hazardous areas. Death, serious injury or property damage may result.

The Swing Gear Freewheel Button (3) is used to switch off the swing gear brake.

Move the control lever to zero position, press and hold the button, the swing gear brake is released and the indicator  lamp on the ECOS control panel goes out.

Release the button to re-engage the swing gear brake, the indicator lamp illuminates.

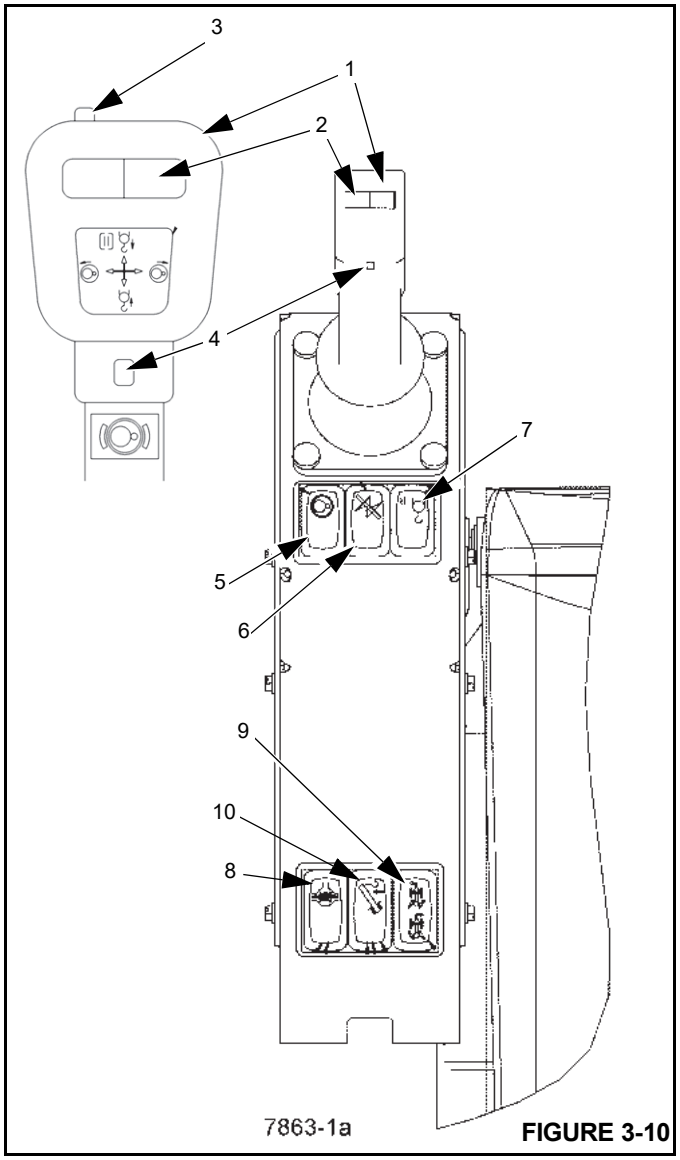


FIGURE 3-10

Item	Description
1	Auxiliary Hoist/Swing Gear Controller
2	High Speed Boost Rocker Switch
3	Swing Gear Freewheel
4	Hoist Rotation Indicator
5	Swing Gear Switch
6	Crane Function Switch
7	Auxiliary Hoist Switch
8	Differential Lock Switch
9	Rear Steer Control Switch
10	Lift Up Switch (CE Option)

Hoist Rotation Indicators

The Hoist Rotation Indicators (4) are located on each hoist control lever. The indicators are electronically driven by a signal from an electronic transmitter and sensor attached to each hoist. A pulsating signal is sensed by the operator's thumb during hoist operation.

Swing Gear Switch

The Swing Gear Switch (5) is located on the left armrest. The switch is used to activate the swing gear control circuit in order to rotate the superstructure. Push the top of the switch, the  icon on the ECOS display will turn green. Use the swing gear controller (1) to rotate the superstructure after the switch is turned on. Push the top of the switch again to turn the function off.

Crane Function Switch

Push the top of the switch: the icons on the ECOS display will turn red; swing, both hoists, lift, telescope and the luffing jib will become inoperative.

Auxiliary Hoist (II) Switch

The Auxiliary Hoist Switch (7) is located on the left armrest. The switch is used to turn on the auxiliary hoist function by pushing the top of the switch. Use the joystick controller (1) to activate the auxiliary hoist function after switch is turned on. Push the top of the switch again to turn the function off.

Differential Lock Switch (Optional)

The Differential Lock Switch (8) is located on the left armrest and is used to lock the right and left wheels in a tandem set. The differential lock increases traction on slippery roads. The differential lock switch is a momentary rocker switch.

NOTE: Release the throttle before using this switch.

Push and hold the top of the switch to engage the differential lock, the  icon on the ECOS display will turn red. Release the switch to dis-engage the differential lock.

CAUTION

Vehicle Control Hazard!

Do not operate the differential lock on dry roads, while the crane wheels are spinning or at speeds over approximately 10 mph (16 km/h). Damage to the vehicle may result.

Rear Steer Control Switch

The Rear Steer Control Switch (9) is located on the left armrest. Push the top of the switch to turn the rear wheels to the right, causing the crane to turn to the left. Push the bottom of the switch to turn the rear wheels to the left, causing the crane to turn to the right. Release the switch to return to the center off position. An indicator on the ECOS main menu indicates if the rear wheels are not centered.

Lift Switch (CE Option)

The Lift Switch (10) is located on the left armrest. When in an overload condition the RCL will lockout boom lift. Push the top of the switch to override the lockout condition to decrease the boom radius by raising the boom.

MISCELLANEOUS CAB CONTROLS AND FEATURES

Cab Door

FIGURE 3-11

Outside Handle/Latch

Refer to Figure 3-11.

Rotate the handle counterclockwise to release the door latch and slide the door to the rear.

After exiting the cab pull the handle towards the front of the cab, sliding the door completely until it latches.

Inside Door Latch

Refer to Figure 3-12.

The door will latch if slid fully open and will need to be unlatched to close the door.

When seated, and before lowering the left-hand armrest controls, move the inside door handle (1) to the front and use the grab handle (2) above the door latch to slide the door forward until it latches.

To open the door, pull the door handle to the rear; the latch releases and the door slides rearwards.

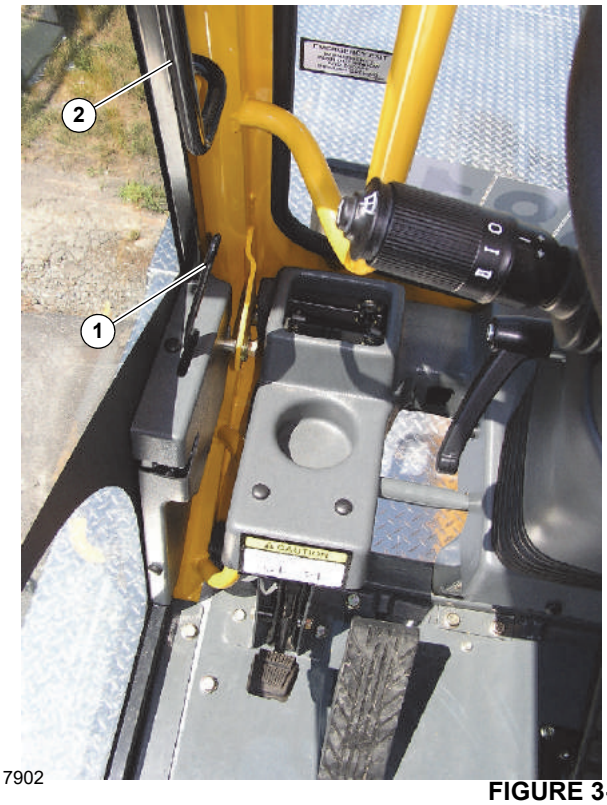


FIGURE 3-12

Fire Extinguisher

The Fire Extinguisher is located on the left rear side of the cab behind the operator's seat. The Fire Extinguisher is a BC rated dry type fire extinguisher for emergency use.

Emergency Exit

The front window is considered the Emergency Exit. In an emergency push out on the window and exit through the opening.

Dead Man's Switch and Seat Contact Switch

The dead man's switch is located on the front of each joystick controller handle.

The seat contact switch (not visible) is located inside the seat.

Together these switches protect all crane functions. You must sit on the crane cab seat or must be pressing at least one of the dead man's switches to operate a crane function.

If you stand up during crane movement or the dead man's switch is not pressed, all crane movements are brought to a complete stop within three seconds even if the control lever is moved.

Jib Release Pole

The Jib Release Pole is stored on the right side of the cab. It is used by the operator to release the jib locking mechanism from the ground.

RCL Lockout Alarm

The RCL Lockout Alarm sounds when the RCL senses an unsafe condition:

- Capacity overload
- Swing angle set limitation
- Work area definition
- Anti-two-block device

The RCL warning lights (red, yellow, green) are located on the front of the cab below the work lights.

Refer to *RCL Control Unit,* page 3-68 for more information.

ECOS CONTROL UNIT

The ECOS control panel is located on the right side console. Various menus are displayed on the ECOS display. the menus are operated using buttons F1 to F14. The individual buttons have a different function in each menu. The functions of the buttons in the display menu correspond to the symbols next to or above the buttons. After the button is pressed and released the function displayed is executed.

Common Elements

This section describes the operating elements that are the same for all menus.

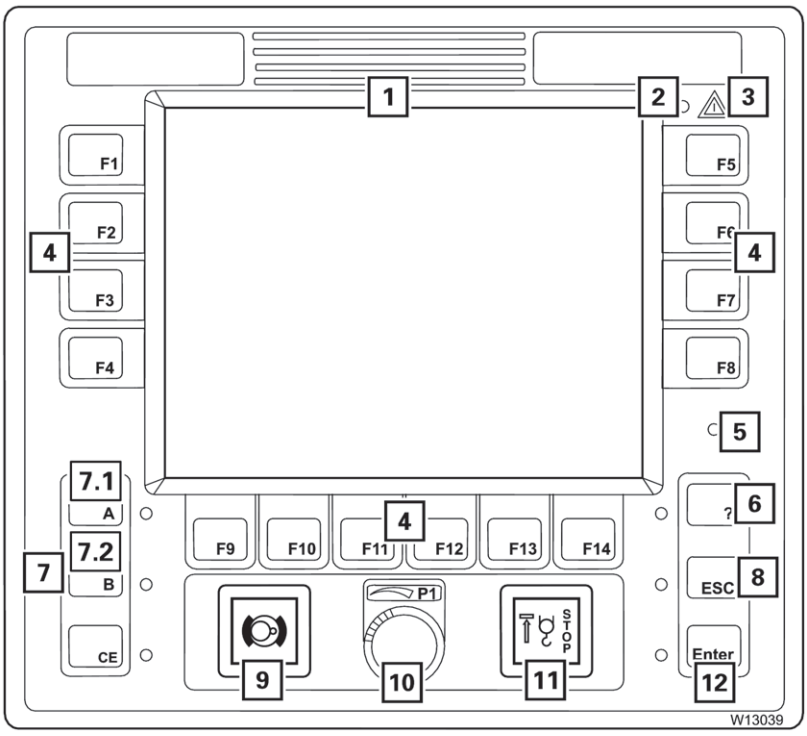
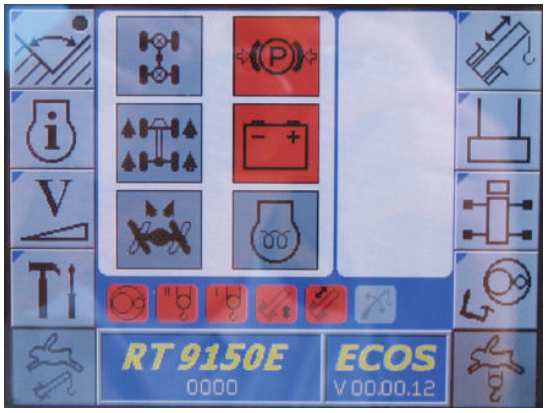
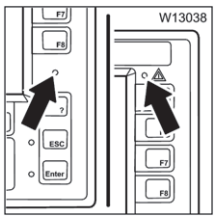
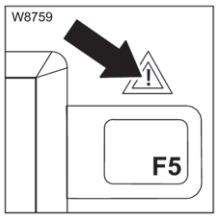
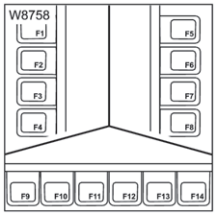
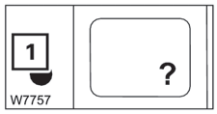
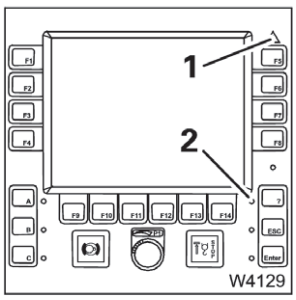


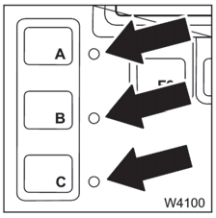
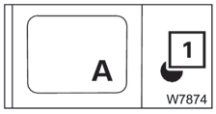
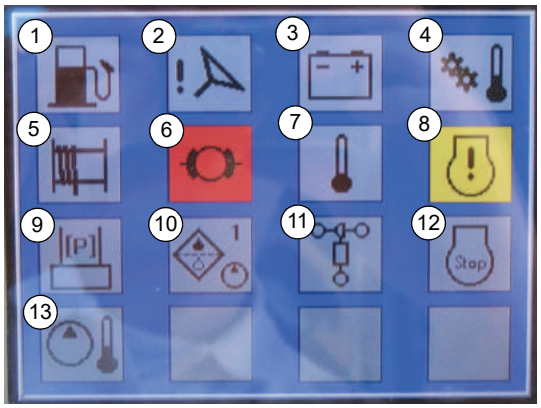
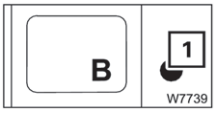
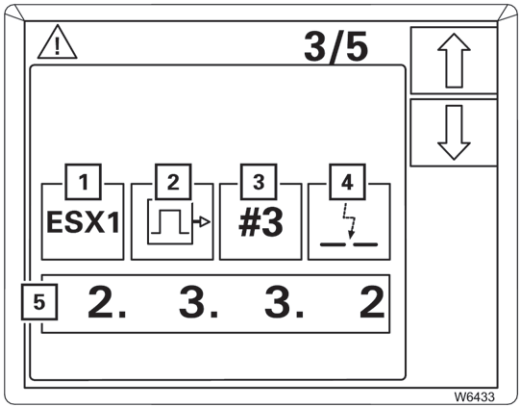
FIGURE 3-13

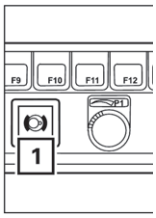
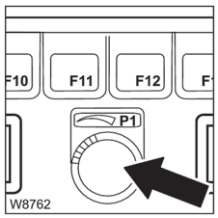
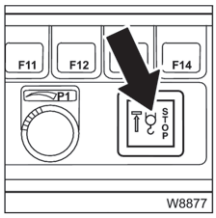
Item	Description
1	ECOS display: Main menu overview
2	Sensor for brightness
3	Error/warning message
4	Buttons F1 to F14
5	Sensor for brightness
6	Opening the Error submenu
	Submenu overview
7	Entering the keycode

Item	Description
7.1	Opening the warning submenu
	Submenu overview (superstructure)
7.2	Opening the warning submenu
	Submenu overview (carrier)
8	Exiting the submenu/input mode
9	Swing gear lock/brake engaged/released
10	Entering values
11	Warning for anti two-block switch shutdown
12	Input confirmation

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	**ECOS display: Main menu overview**		The main menu appears after switching on the ignition. The symbols, four per side, which represent submenus are indicated at the top left by a blue corner. Submenus are opened by pressing the button next to the respective symbol. Refer to *Main Menu,* page 3-21.
2 or 5	**Sensor for brightness**		Registers the brightness of the operating environment. The brightness of all displays are automatically adjusted. Refer to *Adjusting the Brightness of the Display,* page 3-57 to manually set the minimum brightness.
3	**Error/warning message**		• **Flashing**: new warning message or error has occurred • **On**: error acknowledged, but still present • **Off**: no warning message or error present Refer to *Error Messages,* page 3-66.
4	**Buttons F1 to F14**		The function of buttons F1 to F14 is shown on the symbol next to or above the button. Push the button once, the function displayed is executed.
6	**Opening the Error submenu**		The lamp (**1**) lights up or flashes. Press the button once to open the Error Submenu.
	Error submenu overview		ECOS differentiates between error messages and warning messages. In the event of an error message, the lamps (1) and (2) flash. More information on error messages, refer to *Error Messages,* page 3-66.

Item	Description	Graphic	Explanation
7	**Entering the keycode**		The lamps next to all three buttons will light when the keycode can be entered. Enter keycode: press buttons in the required order and confirm keycode.
7.1	**Opening the warning submenu**		The lamp (**1**) lights up or flashes. Press the button once to enter the Warning Submenu.
	Warning submenu overview		**(1)** Fuel level **(2)** Low steering pressure (CE option) **(3)** Voltage monitoring **(4)** Transmission oil temperature **(5)** Hoist 3rd wrap indicator **(6)** Low brake pressure **(7)** Ambient air temperature, -29° C (Russian Option) **(8)** Engine warning **(9)** Pre-tension the counterweight **(10)** Hydraulic oil filter restriction **(11)** Anemometer not connected **(12)** Engine stop **(13)** Hydraulic oil temperature Refer to *Warning Messages,* page 3-62 for more information.
7.2	**Opening the error submenu**		The lamp (**1**) lights up or flashes. Press the button once to enter the Error Submenu.
	Error submenu overview		Each error is defined by an error code (5) and the symbols (1) to (4). The symbols stand for: (1) The faulty device (2) The error group (3) The index within the group (4) The type of error The error code (5) consists of 4 digits, e.g. 2332. Always note down the error code before contacting Crane Care. Refer to *Error Messages,* page 3-66 for more information.

Item	Description	Graphic	Explanation
8	**Exiting the submenu/input mode**		The lamp (**1**) lights up. Press the button once to close the current submenu, the menu from the next level up opens. Input mode is deactivated.
9	**Swing gear brake engaged/released**		Swing gear brake indicator lamp (**1**) • **On**: swing gear brake engaged • **Off**: swing gear brake released
10	**Entering values**		When Input mode is activated: • **To the right**: increases the value • **To the left**: reduces the value Slow turning changes the value slowly. Fast turning changes the value fast.
12	**Warning for anti two-block switch shutdown**		Anti two-block switch warning lamp. • **On**: anti two-block switch triggered, hoist stops • **Flashing**: anti two-block switch triggered, shutdown overridden • **Off**: anti two-block switch not triggered
13	**Input confirmation**		When the lamp (**1**) lights up, press the button once to store the new value.

MAIN MENU

The main menu contains symbols for various functions and information about the current state of the crane and controls.

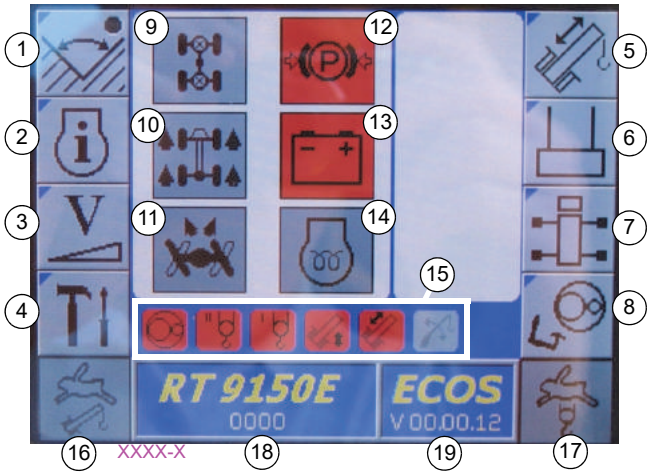
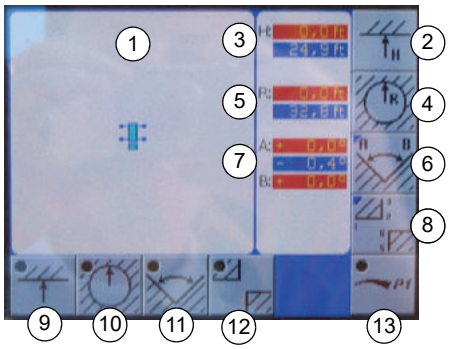


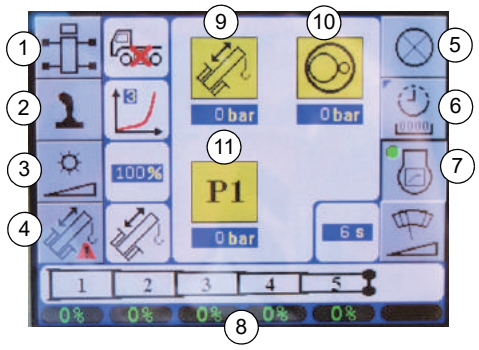
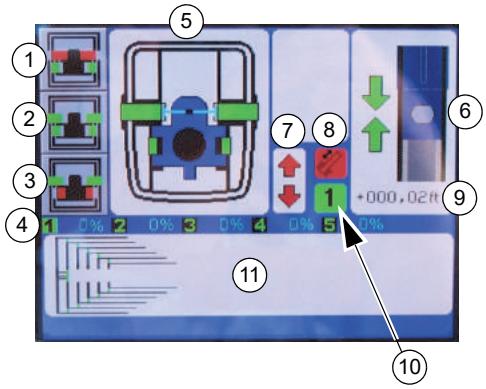
FIGURE 3-14

Item	Description	Ref.
1	Working Range Submenu	page 3-38
2	Monitoring Submenu	page 3-47
3	Power Unit Speeds Submenu	page 3-48
4	Settings Submenu	page 3-52
5	Telescoping Submenu	page 3-32
6	Counterweight Submenu	page 3-49
7	Outriggers Submenu	page 3-27
8	Swing Gear and Brake Submenu	page 3-30
9	Differential Lock Indicator (Optional)	page 3-14
10	Four-Wheel Drive Indicator	page 3-5
11	Rear Steer Indicator	page 3-15
12	Parking Brake Indicator	page 3-5
13	Charging Indicator	page 3-25
14	Engine Preheat	page 3-25

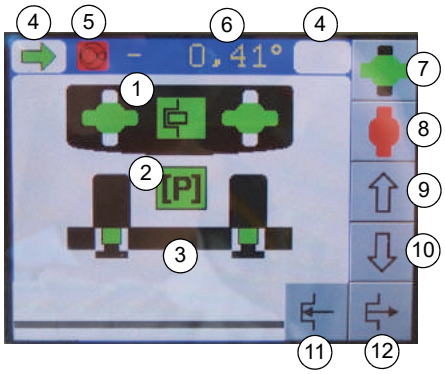
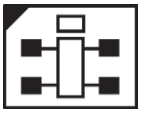
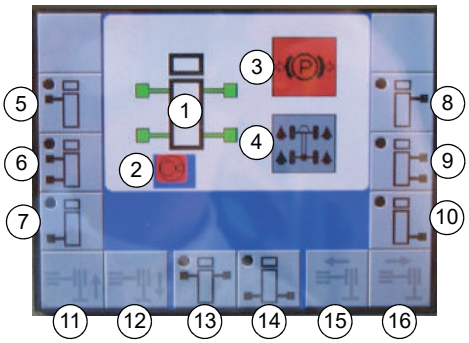
Item	Description	Ref.
15	Power Units Display	—
	• Swing Gear	—
	• Auxiliary Hoist II	—
	• Main Hoist I	—
	• Lift Cylinder	—
	• Telescope Cylinder	—
	• Raise/Lower Luffing Extension (Optional)	—
16	High Speed Lift, Telescope	page 3-12 or page 3-13
17	High Speed Hoist	
18	Serial Number Display	—
19	Program Version Display	—

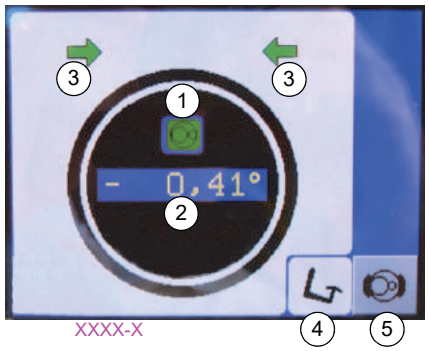
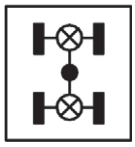
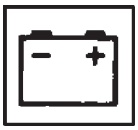
Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	***Working Range Submenu,* page 3-96**  Press the F1 button to open the submenu.		The Working Range Limiter Submenu is used to enter limit values by moving the boom to the shutdown points or entering known limit values manually. Refer to *Working Range Submenu,* page 3-96. **(1)** Working range limiter display **(2)** Enter maximum height, F5 **(3)** Maximum height values **(4)** Enter maximum working radius, F6 **(5)** Maximum/Current working radius values **(6)** Enter swing angle submenu, F7 **(7)** Maximum/Current swing angle values **(8)** Enter objects submenu, F8 **(9)** Overall height monitoring; on/off, F9 **(10)** Working radius monitoring; on/off, F10 **(11)** Swing angle monitoring; on/off, F11 **(12)** Object monitoring; on/off, F12 **(13)** Manual input; on/off, F14
2	***Monitoring submenu,* page 3-47**  Press the F2 button to open the submenu.		The Monitoring Submenu provides an overview of the following values: **(1)** Hydraulic oil temperature **(2)** Battery voltage **(3)** Coolant temperature **(4)** Fuel level **(5)** Engine speed **(6)** Transmission oil temperature. The color of the bar below the values indicate: **Green**: Value OK **Yellow**: Limit value almost reached **Red**: Limit value exceeded (or not reached) Refer to *RCL Monitoring Submenu,* page 3-86.

Item	Description	Graphic	Explanation
3	***Power Unit Speed Submenu,* page 3-48**  Press the F3 button to open the submenu.		Enter percent of maximum speed allowed for each power unit: **(1)** Swing gear, F1 **(2)** Main hoist, F2 **(3)** Auxiliary hoist, F3 **(4)** Telescope, F5 **(5)** Lift, F6 **(6)** Luffing jib, F7. Refer to *Power Unit Speed Submenu,* page 3-48.
4	***Settings Submenu,* page 3-52**  Press the F4 button to open the submenu.		**(1)** Outrigger control units **(2)** Setting control lever characteristics **(3)** Setting the display brightness **(4)** Telescoping emergency program access **(5)** Lamp test **(6)** Operating hours submenu **(7)** Critical load control, on/off **(8)** Current telescoping mechanism status display **(9)** Telescoping cylinder hydraulic pressure **(10)** Swing gear hydraulic pressure **(11)** Hydraulic circuit pressure Refer to *Settings Submenu,* page 3-52.
5	***Telescope Submenu,* page 3-32**  Press the F5 button to open the submenu.		**(1)** Unlock section **(2)** Lock section **(3)** Unlock telescoping cylinder **(4)** Boom length status **(5)** Lock status **(6)** Locking point alignment **(7)** Telescope cylinder status **(8)** Telescope function; on/off **(9)** Telescope cylinder length **(10)** Telescope cylinder location Teleautomation on/off display **(11)** Telescope diagram. Refer to *Telescope Submenu,* page 3-32.

3

Item	Description	Graphic	Explanation
6	***Counterweight Submenu,* page 3-49**  Press the F6 button to open the submenu.		**(1)** Lock status; lift and locking cylinders **(2)** Pre-tensioning pressure status **(3)** Lifting cylinders position **(4)** Swing gear direction indicators **(5)** Swing gear on/off indicator **(6)** Position of superstructure from 0° **(7)** Lock lift cylinders, F5 **(8)** Unlock lift cylinders, F6 **(9)** Retract lift cylinders, F7 **(10)** Extend lift cylinders, F8 **(11)** Extend lock cylinders, F13 **(12)** Retract lock cylinders, F14. Refer to *Counterweight Submenu,* page 3-49.
7	***Outriggers Submenu,* page 3-27**  Press the F7 button to open the submenu.		**(1)** Outriggers display **(2)** Swing gear indicator **(3)** Parking brake indicator **(4)** Four-wheel drive indicator **(5)** Left front outrigger; on/off, F2 **(6)** Left side outriggers; on/off, F3 **(7)** Left rear outrigger; on/off, F4 **(8)** Right front outrigger; on/off, F6 **(9)** Right side outriggers; on/off, F7 **(10)** Right rear outrigger; on/off, F8 **(11)** Retract jack cylinder(s), F9 **(12)** Extend jack cylinder(s), F10 **(13)** Front outrigger cylinders; on/off, F11 **(14)** Rear outrigger cylinders; on/off, F12 **(15)** Retract outrigger beam(s), F13 **(16)** Extend outrigger beam(s), F14 Refer to *Outriggers Submenu,* page 3-27.

Item	Description	Graphic	Explanation
8	***Swing Gear and Brake Submenu,* page 3-30**  OR  Press the F8 button to open the submenu.		**(1)** Swing gear indicator **(2)** Current swing angle display **(3)** Swing gear direction indicators **(4)** Swing gear brake function indicator **(5)** Swing gear brake control selector button, F14
9	**Differential Lock Indicator**		Switch located on left armrest control panel. **Gray**: Differential lock off. **Yellow**: Differential lock engaged.
10	**Four-Wheel Drive Indicator**		Switch located on steering column. **Gray**: Four-wheel drive off. **Yellow**: Four-wheel drive engaged.
11	**Rear Steer Indicator**		Switch located on left armrest control panel. **Gray**: Rear steer centered. **Yellow**: Rear steer off center.
12	**Parking Brake Indicator**		Indicates when the parking brake is either off or engaged. Switch located on steering column. **Gray**: Parking brake off. **Red**: Parking brake engaged.
13	**Charging Indicator**		Indicates when the charging system is operating. **Gray**: Charging. **Red**: Charging off.
14	**Engine Preheat**		Indicates the engine preheat system is operating. **Gray**: Preheat off. **Yellow**: Preheat system on.

Item	Description	Graphic	Explanation
15	**Power Units Display**	 7487-146	The Power Units Display consists of six icons that indicate when the associated function is active.
	Swing Gear		• **Green**: Swing gear on • **Red**: Swing gear off
	Auxiliary Hoist		• **Green**: Auxiliary hoist on • **Red**: Auxiliary hoist off
	Main Hoist		• **Green**: Main hoist on • **Red**: Main hoist off
	Lift Cylinder		• **Green**: Lift cylinder on • **Red**: Lift cylinder off
	Telescope Cylinder		• **Green**: Telescoping mechanism on • **Red**: Telescoping mechanism off
	Raise/Lower Luffing Jib (Optional)		• **Green**: Luffing cylinder on • **Red**: Luffing cylinder off
16	**High speed lift/ telescope**		Switch located on top of left-hand joystick controller. **Gray**: High speed off **Yellow**: High speed engaged.
17	**High speed hoist (Main or Auxiliary)**		Switch located on top of right-hand joystick controller. **Gray**: High speed off **Yellow**: High speed engaged.
18	**Serial Number Display**		**(1)** Shows the serial number which is on the name plate on the superstructure.
19	**Program Version Display**		**(2)** Shows the current ECOS program version.

OUTRIGGERS SUBMENU

The following information describes the Outrigger Submenu, for information on deploying the outriggers refer to *Deploying the Outriggers,* page 3-124.

DANGER

Crushing Hazard

Only activate the outriggers if you or a helper, with whom you are in visual contact, have an unobstructed view of their movements.

The outriggers must be properly extended and set and the crane level before any other operation of the crane on outriggers is attempted.

When operating the crane on outriggers, the outriggers should always be fully extended or locked in the mid-extend position, depending on the load chart being used.

Death or serious injury may result from improper crane setup on outriggers.

Outriggers Submenu

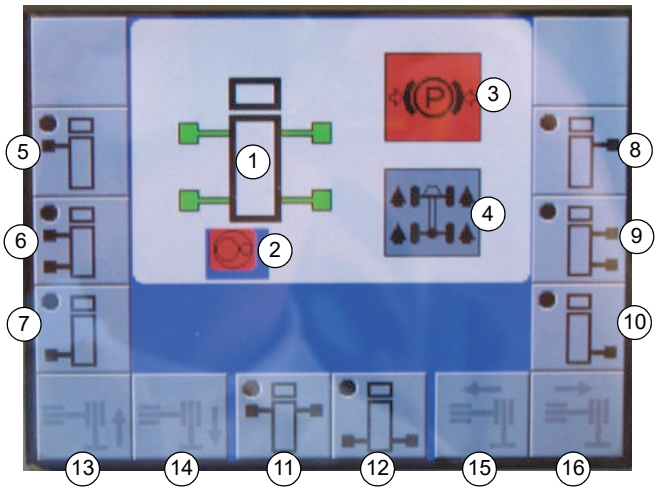


FIGURE 3-15

Press the outriggers submenu button (Figure 3-16) in the main menu to open the submenu.

NOTE: The machine must be in four-wheel drive with the parking brake ON in order to operate the outriggers.

CAUTION

Avoid Crane Damage!

Do not engage the park brake while the vehicle is moving. Damage to the crane can occur.

Disengage the park brake before driving. Damage to the crane can occur.

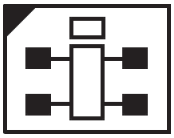
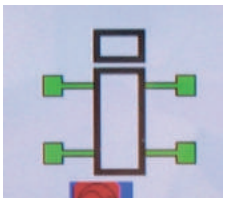
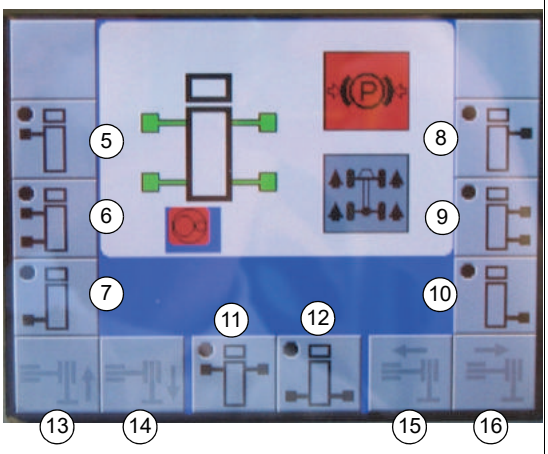


FIGURE 3-16

Item	Description
1	Outriggers graphic
2	Swing gear indicator
3	Parking brake indicator
4	Four-wheel drive indicator
5	Left front outrigger; on/off, F2
6	Left side jacks; on/off, F3
7	Left rear outrigger; on/off, F4
8	Right front outrigger; on/off, F6
9	Right side jacks; on/off, F7
10	Right rear outrigger; on/off, F8
11	Front jacks; on/off, F11
12	Rear jacks; on/off, F12
13	Retract jack cylinder(s), F9
14	Extend jack cylinder(s), F10
15	Retract outrigger beam(s), F13
16	Extend outrigger beam(s), F14

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	Outriggers graphic		The outriggers graphic helps to identify this menu only, there is no function.
2	Swing gear indicator		• **Red**: Swing gear switched off, outriggers can be deployed • **Grey**: Swing gear switched on, outrigger movement locked. Swing gear must be off to operate the outriggers.
3	Parking brake indicator		• **Red**: Parking brake applied, outriggers can be deployed • **Grey**: Parking brake released, outrigger movement locked. Parking brake must be on to operate the outriggers.
4	Four-wheel drive indicator		• **Yellow**: Four-wheel drive engaged • **Grey**: four-wheel drive off. Four-wheel drive must be engaged to operate the outriggers.

Item	Description	Graphic	Explanation
5	Left front outrigger; F2		To operate any outrigger function: • Swing gear must be OFF, red • The parking brake ON, red • Four-wheel drive engaged, yellow. **NOTE:** With the swing gear ON, an exclamation point is displayed when selecting a function and pre-selection does not take place. Press the associated button to pre-select the indicated outriggers/jacks; items (6), (9), (11) and (12) are for jacks only: **Green dot**: Outrigger(s) pre-selected and will remain selected for 10 seconds. **Black dot**: Not selected. After pre-selecting an individual outrigger, items (13) through (16) are active. Only items (13) and (14) are active when jacks are selected. • Press F14, extend outrigger button (16) or F13, the retract outrigger button (15) to move the outrigger(s) out or in. • Press F10, the extend jack button (14) or F9, the retract jack button (13) to move the jack(s) down or up.
6	Left side jacks; F3		
7	Left rear outrigger; F4		
8	Right front outrigger; F6		
9	Right side jacks; F7		
10	Right rear outrigger; F8		
11	Front jacks; F11		
12	Rear jacks; F12		
13	Retract jack cylinder(s), F9		
14	Extend jack cylinder(s), F10		
15	Retract outrigger beam(s), F13		
16	Extend outrigger beam(s), F14		

SWING GEAR AND BRAKE SUBMENU

The following information describes the Swing Gear and Brake Submenu, for information on rotating the superstructure refer to *Rotating the Superstructure,* page 3-128.

Press F8, the swing gear submenu button (Figure 3-17) in the main menu to open the submenu. The submenu button changes depending on which control is selected.

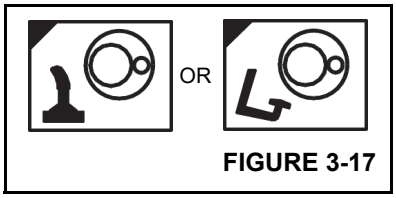


FIGURE 3-17

Swing Gear and Brake Submenu

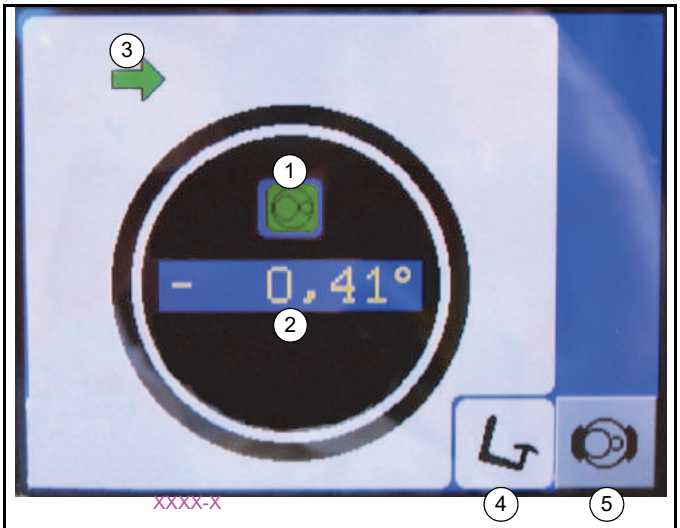
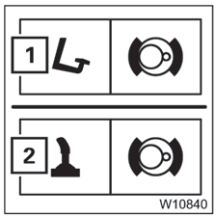
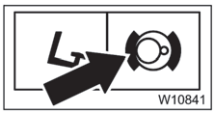


FIGURE 3-18

Item	Description
1	Swing gear on/off indicator
2	Current swing angle display
3	Swing gear direction indicators
4	Swing gear brake control indicator
5	Swing gear brake control selector button, F14

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	Swing gear indicator		Swing gear must be on to rotate the superstructure. **Red**: Swing gear switched off **Green**: Swing gear switched on, swing gear motor active.
2	Current swing angle display		Indicates, in degrees, the position of the superstructure: **0°**: Directly over-front **180°**: Directly over-rear **+0.1 to +180.0°**: Turned to the right from 0° **–0.1 to –179.9°**: Turned to the left from 0°.
3	Swing gear direction indicators		The swing gear direction indicators show which direction the superstructure needs to rotate when the auto stop function is active. Either the left (1) or right indicator (2) displays, both display when at 0°.

Item	Description	Graphic	Explanation
4	Swing gear brake control indicator		**(1) Brake pedal control**: use swing gear brake pedal to brake swing movement **(2) Control lever control**: control lever in zero position brakes swing movement. Swing gear brake pedal is without function. Swing gear must be off to switch controls.
5	Swing gear brake control selector button, F14		Swing gear must be switched off. To select between the brake pedal or control lever: Press F14 button once.

TELESCOPE SUBMENU

The following information describes the Telescope Submenu, for information on extending/retracting the boom refer to *Telescoping the Boom,* page 3-132.

Unlocking a telescopic section is required for the telescopic section to be telescoped. The telescoping cylinder and the telescopic section cannot be unlocked simultaneously.

Telescoping Submenu

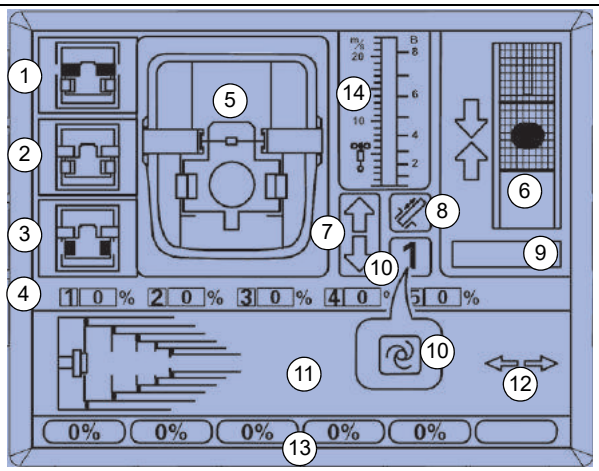


FIGURE 3-20

Press the Telescoping submenu button (Figure 3-19) in the main menu to open this submenu.

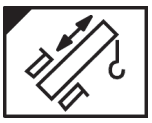
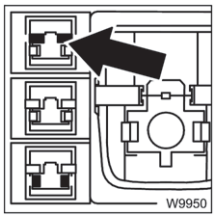
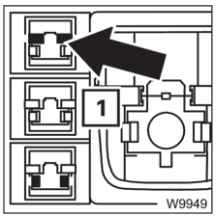
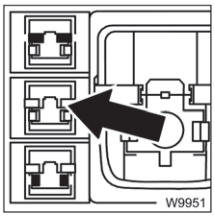
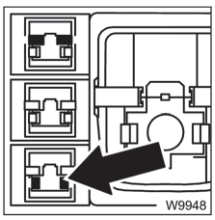
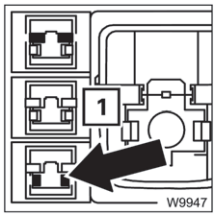


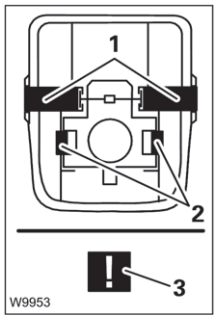
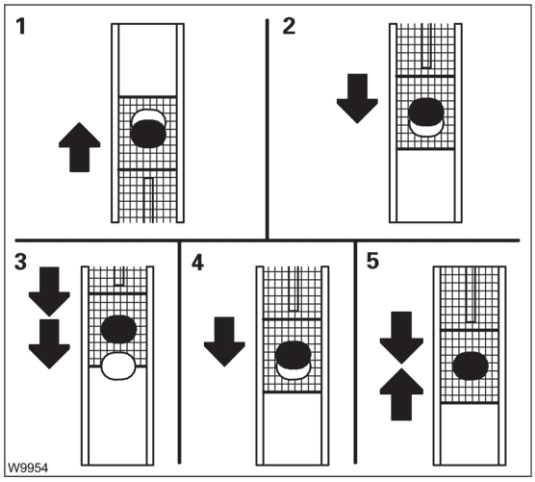
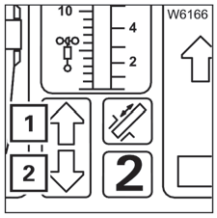
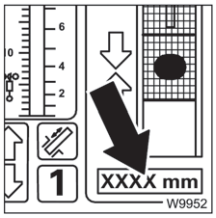
FIGURE 3-19

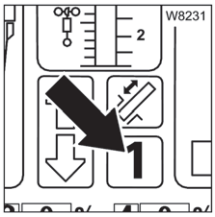
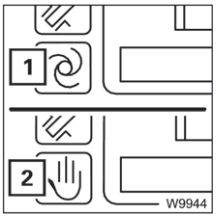
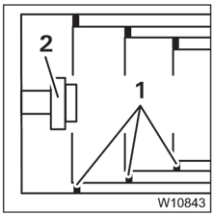
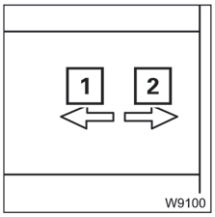
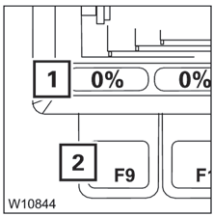
Item	Description
1	Unlock section button, F1
2	Lock button, F2
3	Unlock telescope cylinder button, F3
4	Boom length status
5	Lock status display
6	Locking point alignment
7	Telescope cylinder status
8	Telescope function; on/off
9	Telescope cylinder length
10	Telescope cylinder location
	Teleautomation on/off indicator
11	Telescope section display
12	Teleautomation direction indicator
13	Enter the value for teleautomation
14	Anemometer display

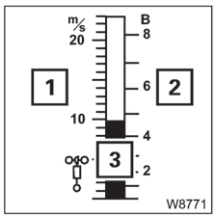
The telescope cylinder location (10) indicates which section the buttons (1-3), lock status (5) and locking point alignment (6) refer to.

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	Unlock section button, F1	 	**Red**: Telescopic section unlocked **Green**: Telescopic section locked **Flashing (yellow/grey)**: Unlock selected To select press the F1 button once. • With the telescopic cylinder locked: the selected section will unlock after moving the control lever • With the telescopic cylinder unlocked: the symbol (1) flashes (yellow/grey) as a prompt to lock the telescope cylinder.
2	Lock button, F2		**Red**: Telescope cylinder and telescopic section locked **Grey**: Telescope cylinder or telescopic section unlocked **Flashing (yellow/grey)**: Lock selected Press the F2 button once. The symbol flashes, lock telescopic cylinder/section is selected.
3	Unlock telescope cylinder button, F3	 	**Red**: Telescoping cylinder unlocked **Grey**: Telescoping cylinder locked **Flashing (yellow/grey)**: Unlock selected To select press the F3 button once: • With the telescope section locked: the section will unlock after moving the control lever • With the telescope section unlocked: unlock not selected, symbol (1) flashes (yellow/grey) as a prompt to lock the telescoping cylinder.
4	Boom length status		The boom length status display shows the extended length of the telescopic sections in percent (%). When the Telescopic section display is green: **On**: Telescoping cylinder is locked here **Flashing**: Indicates the next possibility for locking the telescope cylinder.

Item	Description	Graphic	Explanation
5	Lock status display		Depending on which is selected, the locking pins change position and color. **Locking pins** (1) On the telescopic section (2) On the telescope cylinder • **Green**: Locked • **Red**: Unlocked • **Yellow**: Intermediate position • **Violet**: Error, symbol (3) Refer to *Description of Telescope Section Views,* page 3-36.
6	Locking point alignment		The arrow indicates the direction of travel to the locking point: (1) Extend telescoping cylinder (2) Retract telescoping cylinder The color of the arrow(s) indicate the distance to the locking point: (3) **Yellow**: Approx. 1 m (3.3 ft) (4) **Yellow**: Less than 1 m (3.3 ft) (5) **Green**: At the locking point
7	Telescope cylinder status		(1) Extending **Red**: Blocked **Green**: Released (2) Retracting **Red**: Blocked **Green**: Released
8	Telescope function; on/off		• **Green**: Telescoping mechanism on • **Red**: Telescoping mechanism off Use the switch located on the right armrest controls to turn the telescope function on or off, refer to *Boom Telescope Switch,* page 3-12.
9	Telescope cylinder length		The current extended length of the telescoping cylinder is displayed in millimeters.

Item	Description	Graphic	Explanation
10	Telescope cylinder location		Displayed telescopic section, e.g. telescopic section 1: • **On**: Telescope cylinder is locked here • **Flashing**: Next possibility for locking telescope cylinder • **Off**: Telescope cylinder is in this telescopic section, the distance to the locking point is greater than 1 m (3.3 ft) **or** Teleautomation on, symbol  is displayed
	Teleautomation on/ off indicator		(1) Teleautomation on (2) Teleautomation off (The section number is displayed when teleautomation is off). Refer to *Telescoping with Teleautomation,* page 3-135 for more information.
11	Telescope section display		Current relation of the telescopic sections to each other (section of top view). • **Green**: Locked • **None**: Unlocked or intermediate position **Locking pins:** (1) On the telescopic section (2) On the telescoping cylinder. Refer to *Description of Telescope Section Views,* page 3-36.
12	Teleautomation direction indicator		(1) **On**: Start teleautomation with extending. (2) **On**: Start teleautomation with retracting **Flashing**: control lever movement not correct.
13	Enter the value for teleautomation		(1) **Red**: Teleautomation off **Yellow**: Enter set value **Green**: Teleautomation on (2) Press button first time to turn input on. Press button (F9-F14) to set value to next fixed length

Item	Description	Graphic	Explanation
14	Anemometer display		(1) Scale in meters per second (m/sec) (2) Beaufort scale (B) (3) Display of wind speed Refer to Section 2 for safety information and *Wind Forces,* page 3-105 for more information on this display.

Description of Telescope Section Views

Refer to Figure 3-21.

The Telescope submenu of the ECOS display shows two sectional views of the main boom:

- (A), the sectional view from the rear
- (B), the sectional view from above.

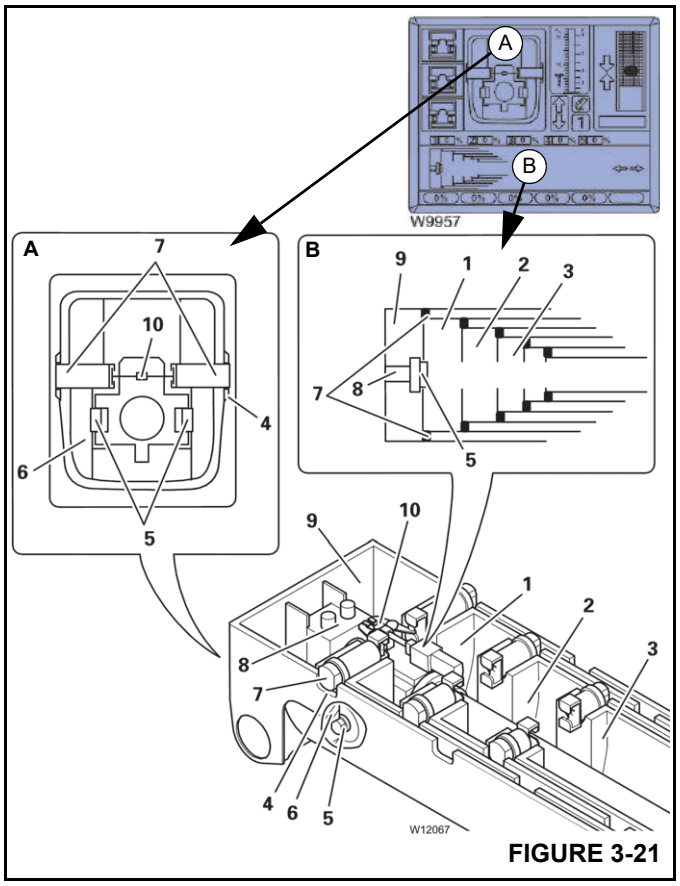


FIGURE 3-21

Item	Description
1	Telescopic section 1
2	Telescopic section 2
3	Telescopic section 3
4	Section cutouts
5	Cylinder locking pins
6	Cylinder locking pin cutouts
7	Telescopic section locking pins
8	Telescope cylinder (rod)
9	Boom base section
10	Butterfly mechanism

Telescope Mechanism Error Messages

If ECOS disables the telescoping mechanism, the following display (Figure 3-22) is shown in the Telescope submenu.

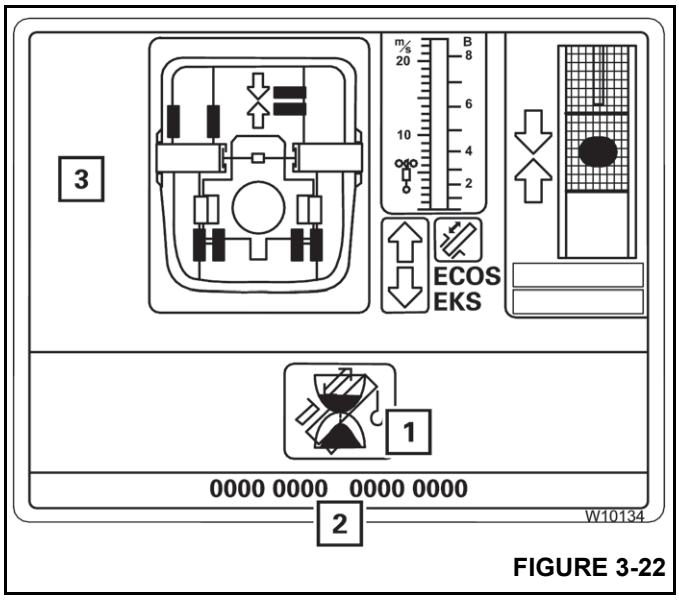


FIGURE 3-22

- All the symbols (3) for telescope operation disappear and the corresponding buttons are disabled.
- The display (1) appears.
- An error code (2) is displayed.

NOTE: Always note down this error code before contacting Crane Care.

The display (1) shows the following symbols for the current status:

Waiting

The symbol usually disappears shortly after switching on the ignition.

If the symbol does not go out or is displayed while operating the crane, this may be due to an RCL shutdown or blown F3-3 fuse. Contact Crane Care if these causes do not apply.

Telescope status divergence

ECOS has detected a difference between the displayed and the current telescope status. Enter the current telescope status, refer to *Entering the Current Telescope Status,* page 3-60

Emergency program access

The telescoping mechanism can only be operated with the emergency program, refer to *Telescope Emergency Program,* page 3-147.

Emergency program

The Telescoping emergency program is open, refer to *Telescope Emergency Program,* page 3-147.

Not active

Contact Crane Care if this status is still displayed after repeatedly switching on the ignition.

WORKING RANGE LIMITATION SUBMENU

Press the Working Range submenu button (Figure 3-23) in the Main menu to open the submenu.

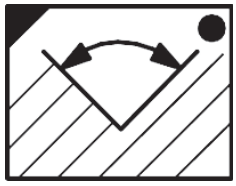


FIGURE 3-23

After turning on the ignition, all monitoring functions that were on before the ignition was switched off are switched on.

WARNING

Crushing and/or Property Damage Hazard!

After switching on the monitoring function, slowly approach all limit values and check that they switch off in time. If necessary, enter new values with larger safety distances.

When entering the limit values, bear in mind that, even after switching off the engine, movements can still occur that would bring the load into the shutdown range, e.g. due to the load swing or the boom bending. For this reason, always enter the limit values with sufficient safety distance to the object.

Death, serious injury or property damage may result from improper operation of the crane.

NOTE: With monitoring switched on, the speed of all power units is limited to 50%.

Limits below 50% continue to be active. We recommended limiting the swing gear speed to between 30% and 50%.

It is impossible to move behind a defined object whenever a monitoring function is switched on.

Entering Limit Values

This section describes how to enter unknown limit values by moving the boom nose to the shutdown points.

You can enter known limit values directly, see *Entering Limit Values/Objects Manually,* page 3-44.

Before entering values, monitoring must be switched off, dot black, see Items 9-12.

Manual input must be switched off to enter values using this method, see Item 13 in the following tables.

Working Range Limitation Submenu

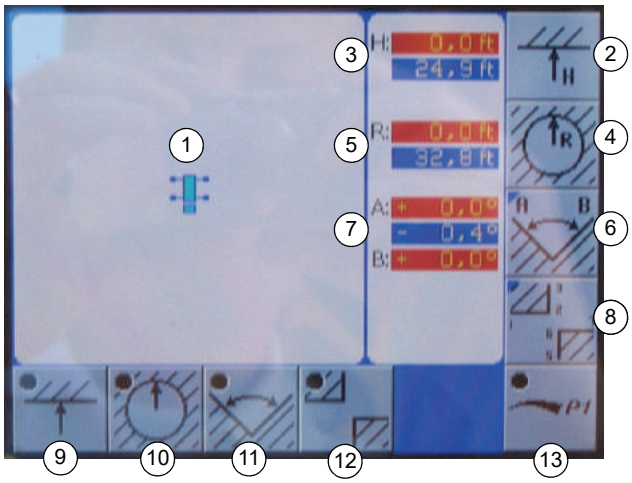
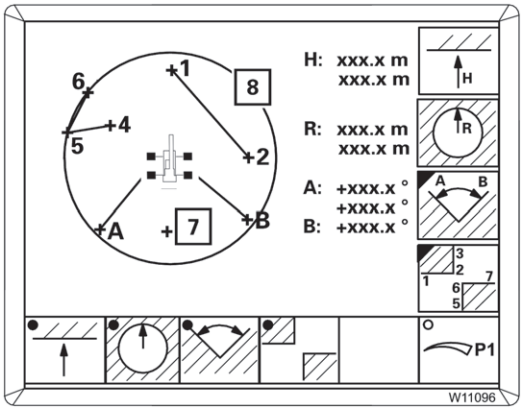
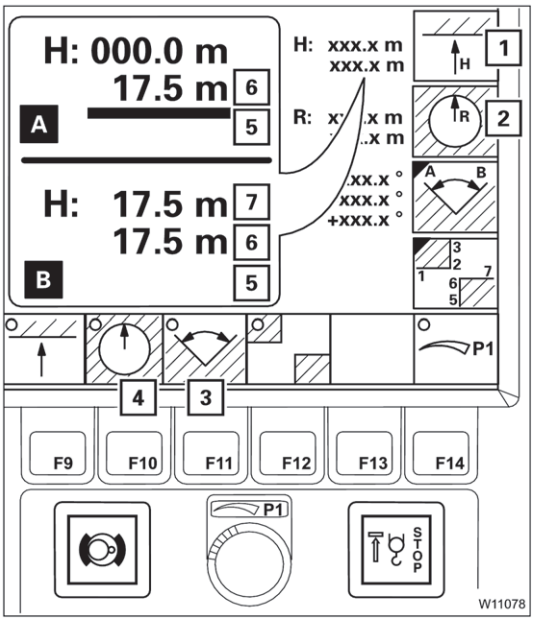
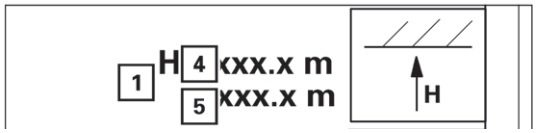


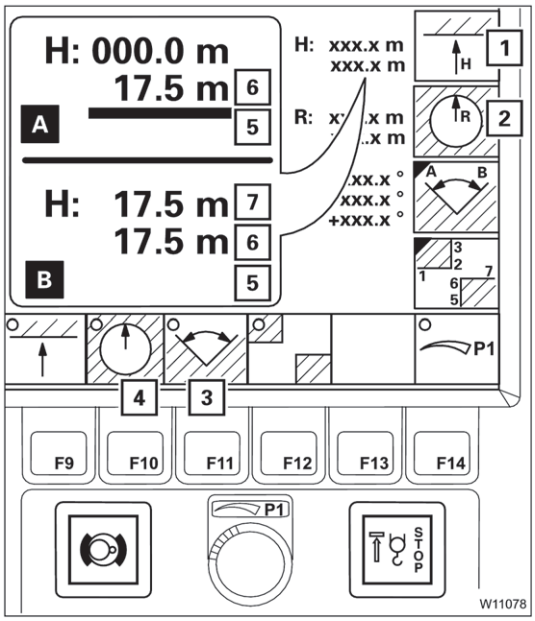
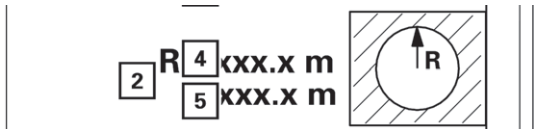
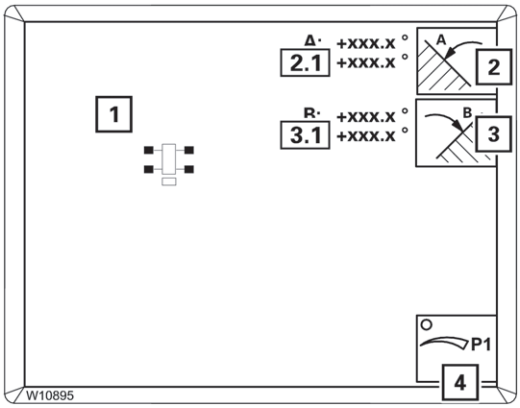
FIGURE 3-24

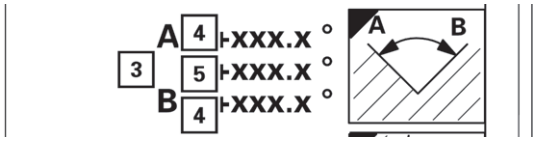
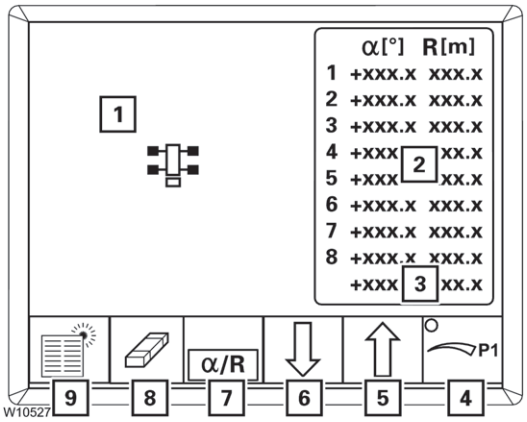
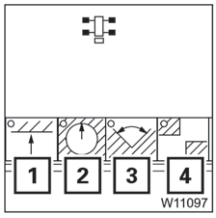
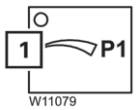
Item	Description
1	Working range limiter display
2	Enter maximum height, F5
3	Maximum height values
4	Enter maximum working radius, F6
5	Maximum/Current working radius values
6	Enter swing angle, F7
7	Maximum/Current swing angle values
8	Enter objects submenu, F8
9	Overall height monitoring; on/off, F9
10	Working radius monitoring; on/off, F10
11	Swing angle monitoring; on/off, F11
12	Object monitoring; on/off, F12
13	Manual input; on/off, F14

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	**Working range limiter display**		With monitoring functions turned on the monitored area is displayed: • **Working radius**: Circle (8), red. • **Permissible swing angle**: Circle sector, clockwise from A to B • **Objects**: Points and lines, e.g. 1 to 2 and 4 to 6. • **Overall height**: No display. The current main boom position (7) is always displayed.
2	**Enter maximum overall height**		The limit values for the overall height and the working radius are entered in the same way. The relevant monitoring function (3) or (4) must be switched off, dot black. • Press the (1) button, the bar (5) turns red, the input mode is turned on. To cancel input, press the Esc button. • (A): Move the main boom head to just before the shutdown point without a load, e.g. at 17.5 m, value (6). • (B): Press the button Enter. The current value (6) is accepted as the limit value (7). The bar (5) goes out. Switch on monitoring, see Items 9-12.
3	**Maximum overall height display**		The display indicates values for (1) overall height The display shows the following values: (4) Limit value, red (5) Current value, blue In case of manual input mode switched on, the display (5) changes.

3

Item	Description	Graphic	Explanation
4	**Enter maximum working radius**		The limit values for the overall height and the working radius are entered in the same way. The relevant monitoring function (3) or (4) must be switched off, dot black. • Press the (2) button, the bar (5) turns red, the input mode is turned on. To cancel input, press the Esc button. • (A): Move the main boom head to just before the shutdown point without a load, e.g. at 17.5 m, value (6). • (B): Press the Enter button. The current value (6) is accepted as the limit value (7). The bar (5) goes out. The limit value for the working radius affects the representation of defined objects. Only points that are within the limit value are displayed. Switch on monitoring, see Items 9-12.
5	**Maximum/Current working radius display**		The display (2) indicates values for the working radius. The display shows the following values: (4) Limit value, red (5) Current value, blue In case of manual input mode switched on, the display (5) changes.
6	**Enter swing angle**		(1) Limited swing angle display (2) Select Swing angle A (2.1) Maximum/Current swing angle A display (3) Select Swing angle B (3.1) Maximum/Current swing angle B display (4) Manual input on/off Refer to Display of the Swing Angles and *Entering the Permissible Swing Range,* page 3-42 for more information on entering swing angles.

Item	Description	Graphic	Explanation
7	**Maximum/Current swing angle display**		The display (3) indicates values for the swing angle. The display shows the following values: (4) Limit value, red (5) Current value, blue In case of manual input mode switched on, the display (5) changes.
8	**Enter objects submenu**		(1) Limitation by object display (2) Point data display (3) Current point data display (4) Manual input on/off (5) Select Previous point (6) Select Next point (7) Select angle/working radius (8) Delete selected point data (9) Delete all point data Refer to *Entering Points and Objects,* page 3-42.
9	Overall height monitoring; on/off, F9		Press the buttons for the required monitoring functions once. (1) Overall height **Dot is green**: Monitoring switched on. **Dot is black**: Monitoring switched off.
10	Working radius monitoring; on/off, F10		Press the buttons for the required monitoring functions once. (2) Working radius **Dot is green**: Monitoring switched on. **Dot is black**: Monitoring switched off.
11	Swing angle monitoring; on/off, F11		Press the buttons for the required monitoring functions once. (3) Swing angle **Dot is green**: Monitoring switched on. **Dot is black**: Monitoring switched off.
12	Object monitoring; on/off, F12		Press the buttons for the required monitoring functions once. (4) Objects **Dot is green**: Monitoring switched on. **Dot is black**: Monitoring switched off.
13	**Manual input on/ off**		Press the button (1), the dot changes color: • **Green**: on • **Black**: off.

Display of the Swing Angles

The cross (1) shows the current position of the main boom.

- The swing angle A limits swing to the left.
- The swing angle B limits swing to the right.

The permissible swing range is represented by the angle going clockwise from A to B. Approx. 270° in this illustration

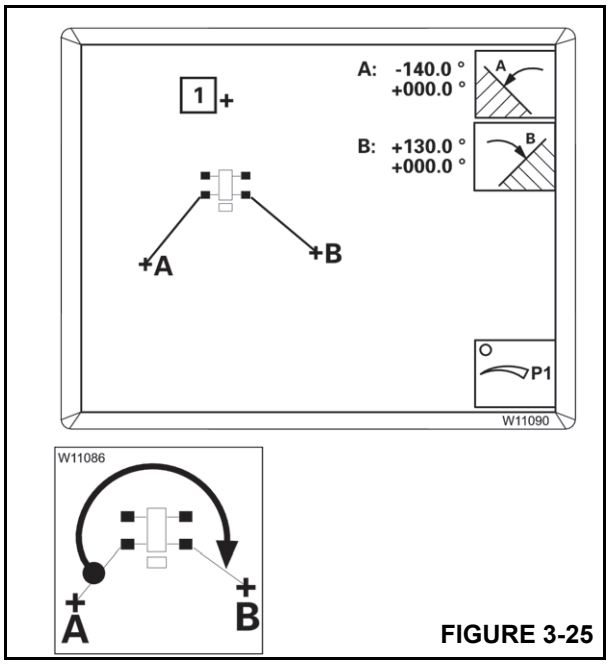


FIGURE 3-25

Entering the Permissible Swing Range

You must enter the swing angles A and B separately.

WARNING

Crushing and/or Property Damage Hazard!

Always swing the main boom to the shutdown point from the right for swing angle A and from the left for swing angle B. This prevents swing into the impermissible range from being enabled.

Serious injury or property damage may result from operating the crane in an impermissible range.

Swing Angle A

1. Press the button (3) (Figure 3-26) once.
2. The bar (1) turns red, input mode on. To cancel input press the Esc button.
3. Swing the main boom (4) to the shutdown point from the right, e.g. value (2) 45°.
4. Press the Enter button.
5. The swing angle A is displayed.
6. The value (2) is accepted as the limit value (5).
7. The bar (1) goes out.

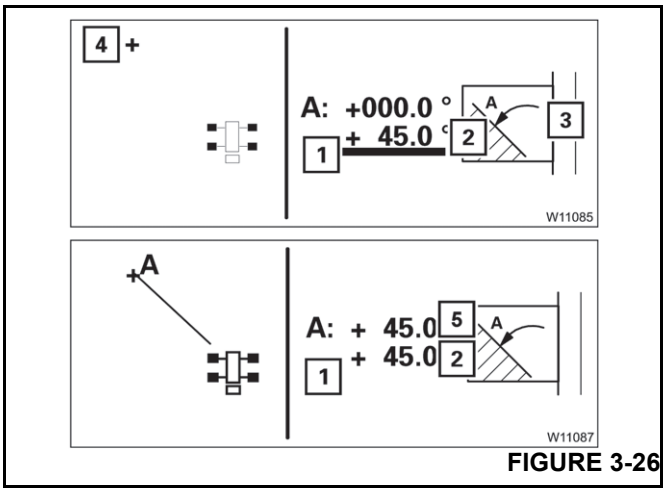


FIGURE 3-26

Swing Angle B

1. Press the button (3) (Figure 3-27).
2. The bar (1) turns red, input mode on. To cancel input press the Esc button.
3. Swing the main boom (4) to the shutdown point from the left, e.g. to value (2) 100°.
4. Press Enter button.
5. The swing angle B is displayed.
6. The value (2) is accepted as the limit value (5).
7. The bar (1) goes out.

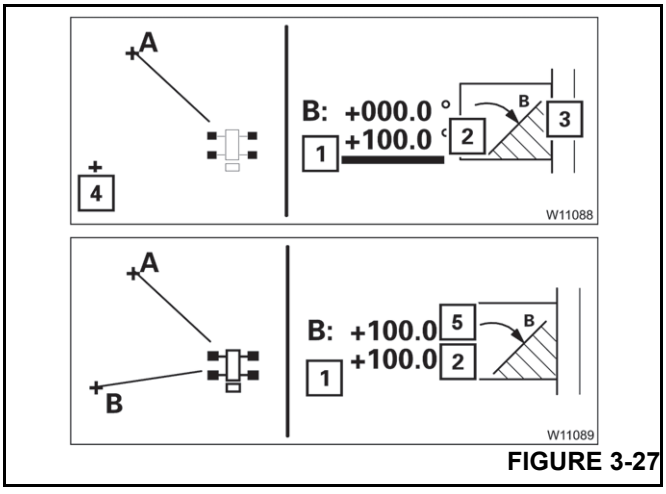


FIGURE 3-27

Entering Points and Objects

Objects are entered in a submenu.

Before entering values, the monitoring functions (1) to (3) must be switched off, dots black. Refer to the previous table, Items 7-10.

Press the button (1) (Figure 3-28) once.

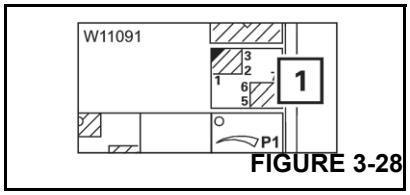


FIGURE 3-28

Representation of Points and Objects

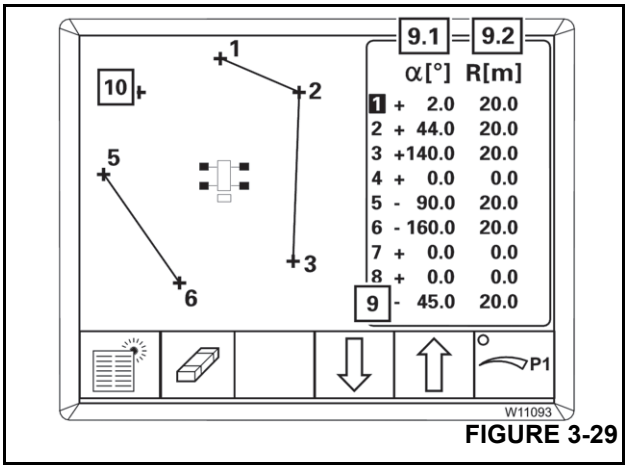


FIGURE 3-29

Each point shown (Figure 3-29) is numbered and defined by the point data Swing angle (9.1) and Working radius (9.2), red.

An object is made up of points that are connected by lines, e.g. the points 1 to 3 and the points 5 and 6.

The cross (10) and the point data (9) show the current position of the main boom, shown in blue.

NOTE: Only those points are displayed that are located within the entered, maximum working radius. You may need to enlarge the maximum working radius in order to display a point, refer to *Enter maximum working radius,* page 3-40.

Entering objects

(A):

1. With the buttons (10) (Figure 3-30), select the first point, e.g. point (1), it turns blue.
2. Move the main boom head (11) to just before the first point of the object.

(B):

1. Press the button Enter once.
2. The point (1) is displayed.
3. The current point data (9) is accepted for point (1), e.g. 2° and 20 m.

The first point has now been entered.

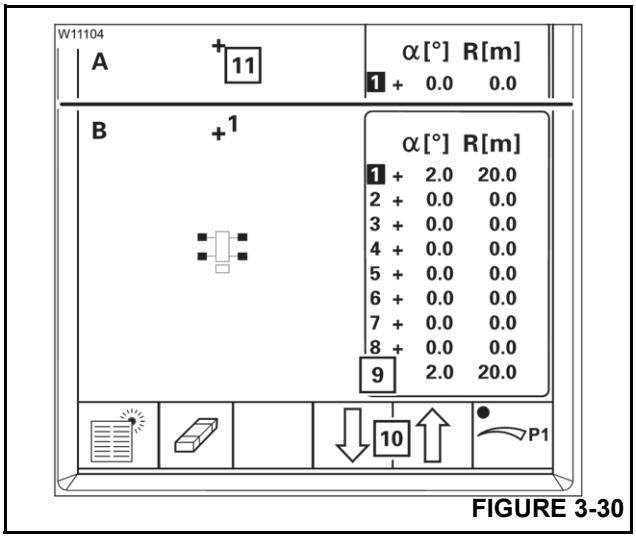


FIGURE 3-30

4. Enter the next point (2) (Figure 3-31) in the same manner, e.g. +90° and 20 m.
5. The point (2) is connected with point (1), an object has been entered.

To enlarge the object, you can enter subsequent points 3 to 8, e.g. point (3).

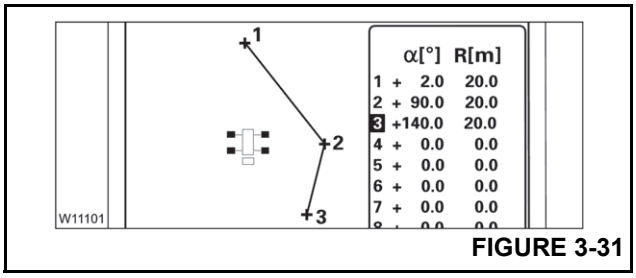


FIGURE 3-31

You can also add objects:

1. Delete the subsequent point, e.g. point (4) (Figure 3-32), point data 0.0, see Deleting Points.
2. Enter the next point, e.g. point (5) at -160° and 20 m.

This point (5) is the first point for the new object. The following point is added to this object, e.g. point (6).

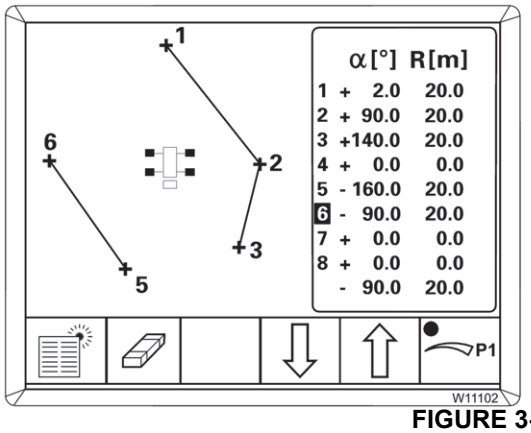


FIGURE 3-32

Deleting Points

You can delete selected, individual points or delete all points at once (Figure 3-33).

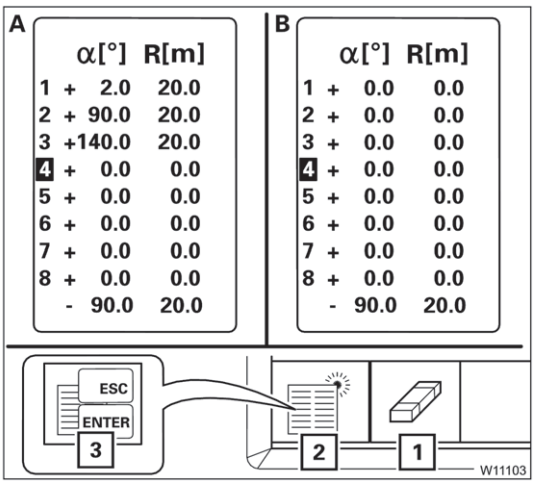


FIGURE 3-33

(A): Selected points

Press the button (1) once.

The selected point is deleted, e.g. point (4), point data 0.0.

(B): All points

Press the button (2) once, symbol (3) appears.

You can cancel the process with the Esc button.

Press the Enter button once, all points are deleted.

Entering Limit Values/Objects Manually

The limit values for the overall height, the working radius, and the swing range are entered in the same way.

Overall Height/Working Radius

Press the button (Figure 3-34) once:

- (1) for the overall height
- (2) for the working radius.

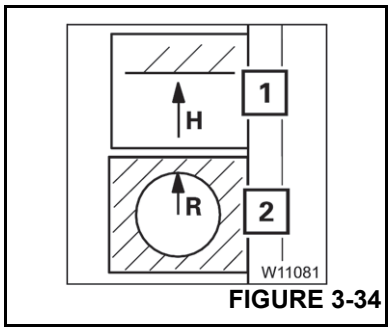


FIGURE 3-34

Swing Angles

Open the Enter swing angle submenu (Figure 3-35).

Press the button once:

- (1) for swing angle A
- (2) for swing angle B.

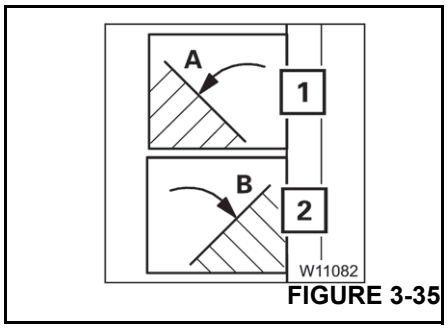


FIGURE 3-35

Entering a Limit Value

After pressing the appropriate button the bar (3) (Figure 3-36) is red, input mode on. To cancel the input press the Esc button once.

Press button (2) once, the dot turns green, manual input on.

(A) – Enter the new limit value, e.g. 17.5, with the switch (1) on display (4).

(B) – Press the Enter button once:

- Display (5) = new limit value
- Display (4) = current value, e.g. 3.0
- Bar (3) goes out
- Dot (2) black, manual input off.

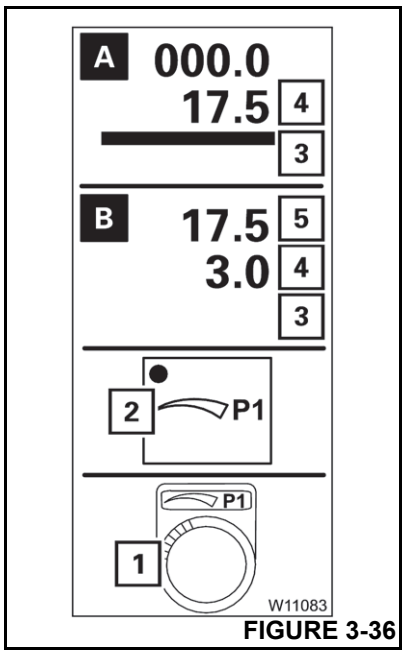


FIGURE 3-36

Objects

Objects are entered in a submenu.

Press the button (1) (Figure 3-37) once.

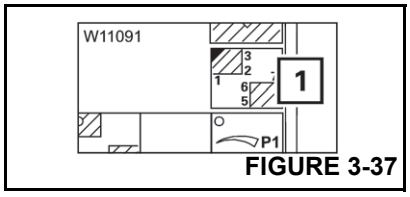


FIGURE 3-37

The Enter objects submenu (Figure 3-38) opens.

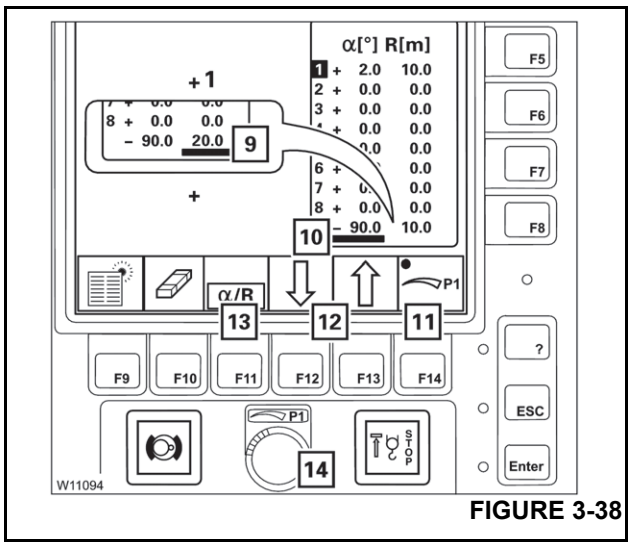


FIGURE 3-38

1. With the buttons (12), select the desired point, e.g. point 1, it turns blue.
2. Press the button (11) once, the dot turns green, manual input on.
3. With the button (13) select either the swing angle, bar (10) turns red or the working radius, bar (9) turns red, input on. To cancel input, press the Esc button once.
4. Enter the new values, e.g. –90.0° and 20.0 m with the switch (14).
5. Press the Enter button once. The new values for point 1 are accepted.

To end your input, press the Esc button once. The bar (9) or (10) goes out, display shows the current main boom position,

The dot (11) turns black, manual input off.

Shutdown by Working Range Limiter

If a limit value is reached, RCL shutdown occurs. All movements that would go closer to the limit value are disabled. Shutdown remains active even if you switch off the monitoring function.

WARNING

Tipping and/or Machine Damage Hazard!

Do not operate crane with the RCL overridden without being in communication with personnel on the ground observing the crane's operation, and then only to leave the shutdown range.

Serious injury or damage to the crane may result.

Shutdown point reached	Disabled movements
Overall height	Raising Extending Lowering the load Derricking the lattice extension
Working radius	Lowering Extending Lifting the load Derricking the lattice extension
Slewing angle A	Slewing to the left
Slewing angle B	Slewing to the right
Objects	Depending on the position of the object: • Slewing to the left or right • Lowering • Extending • Lifting the load • Derricking the lattice extension

The RCL also shows an error message. To enable the movements, you must leave the shutdown range and acknowledge the error message by pressing the *CE* button (Figure 3-39), refer to *Error Codes,* page 3-103.

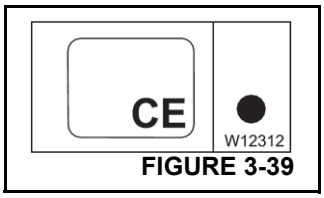


FIGURE 3-39

NOTE: If you override the RCL, the shutdown is overridden and all movements are enabled.

MONITORING SUBMENU

The Monitoring submenu shows the most important measured values.

Press the monitoring submenu button (Figure 3-40) in the main menu to open the submenu.

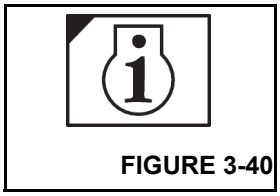


FIGURE 3-40

Monitoring Submenu

FIGURE 3-41

Item	Description
1	Hydraulic oil temperature, in °C (°F)
2	Battery voltage, in Volts
3	Coolant temperature, in °C (°F)
4	Fuel supply, as a percentage
5	Engine speed, in RPM
6	Transmission oil temperature, in °C (°F)

With the monitoring submenu open, the indicated values are displayed.

The color of the bar indicates the following:

- **Green**: Value OK
- **Yellow**: Limit value almost reached
- **Red**: Maximum limit value exceeded or minimum value not reached, refer to *Warning Messages,* page 3-62.

3

POWER UNIT SPEED SUBMENU

You can enter a percent of the maximum speed that should be enabled for each power unit. The values entered are the maximum speeds allowed, the power units can be operated from 0 up to the set speeds.

NOTE: Depending on the crane configuration and conditions the maximum speeds may be automatically limited by the ECOS system. The automatically limited values are not displayed.

Press the power unit speed submenu button (Figure 3-42) in the main menu to open this submenu.

FIGURE 3-42

Power Unit Speed Submenu

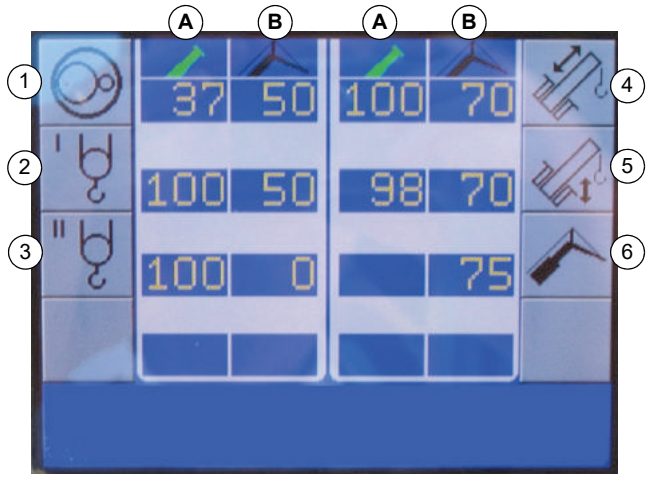


FIGURE 3-43

Item	Description
A	Main boom
B	Main boom with extension
1	Swing gear, F1
2	Main hoist, F2
3	Auxiliary hoist, F3
4	Telescope, F5
5	Lift, F6
6	Luffing jib, F7

The symbols for the main boom (A) or boom with extension (B) (Figure 3-43) for the current operation will be green, indicating which configuration is active. To use the boom extension, symbol (6) must be active, press the F7 button.

The values below the green symbols indicate the maximum speeds that can be used for that function.

The values for the swing gear, telescope cylinder and lift cylinder only apply if they are lower than the automatically limited values.

Changing values

Example: Referring to (Figure 3-44):

1. Press the F1 button (3) for the swing gear until the red bar is under the desired value (1), input mode is now on, indicated by the input icon (2).

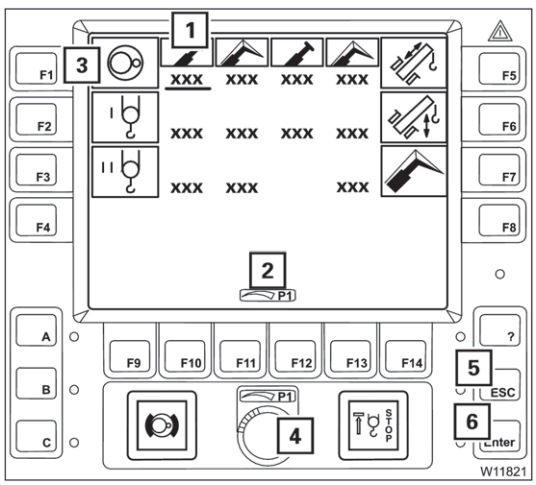


FIGURE 3-44

2. Change the value using the knob (4).

To cancel the input, press the *Esc* button (5) once.

If necessary, change the values for other power units in the same way.

Confirm the changed values by pressing the *Enter* button (6) once. All changed values are accepted.

COUNTERWEIGHT SUBMENU

Press the counterweight submenu button (Figure 3-45) in the main menu to open the this submenu.

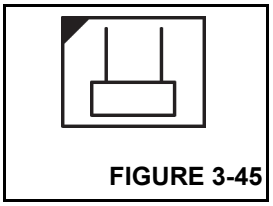


FIGURE 3-45

Counterweight Submenu

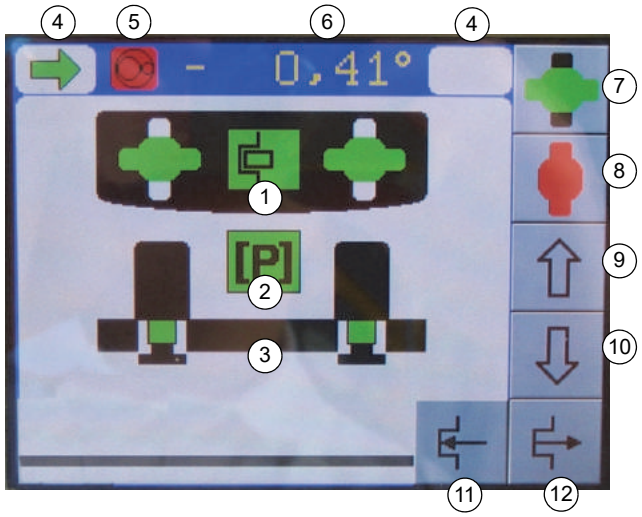
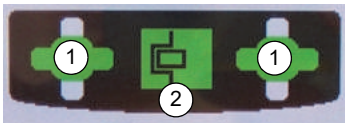
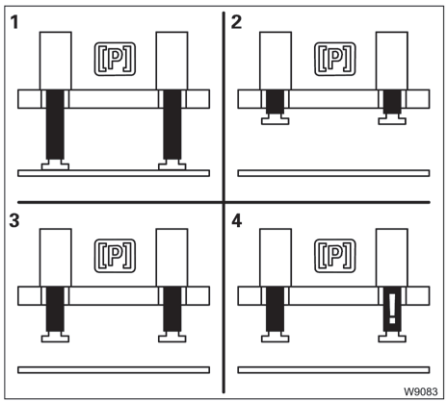


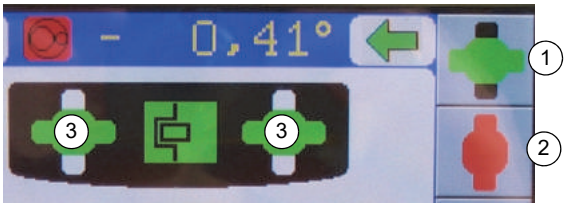
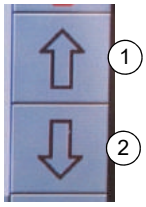
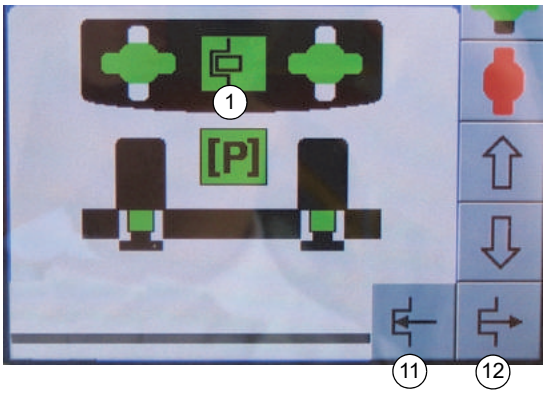
FIGURE 3-46

Item	Description
1	Lock status; lift and locking cylinders
2	Pre-tensioning pressure status
3	Lifting cylinders position
4	Swing gear direction indicators
5	Swing gear on/off indicator
6	Current swing angle display
7	Lock lift cylinders, F5
8	Unlock lift cylinders, F6
9	Retract lift cylinders, F7
10	Extend lift cylinders, F8
11	Engage lock cylinders, F13
12	Retract lock cylinders, F14.

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	Lock status; lift and locking cylinders		The current status of the counterweight lift (1) and lock (2) cylinders are shown by different symbols: **Green**: locked **Red**: unlocked **Yellow**: intermediate position **Violet**: error
2	Pre-tensioning pressure status		Pre-tensioning the counterweight is required to make sure the counterweight remains secure. To pre-tension the counter weight, continue to retract the counterweight lift cylinders until the symbol is green. **Green**: pre-tensioning pressure reached **Red**: pre-tensioning pressure too low, repeat the retract procedure. Refer to *Retracting the Lifting Cylinders,* page 3-119.

Item	Description	Graphic	Explanation
3	Lifting cylinders position		The current status of the counterweight lifting cylinders is shown by different symbols: (1) **Green**: extended (2) **Green**: retracted (3) **Yellow**: intermediate position (4) **Violet**: error
4	Swing gear direction indicators		The swing gear direction indicators show which direction the superstructure needs to rotate to get to 0° or 180°. Either the left indicator (1) or right indicator (2) will display, both display when at 0°.
5	Swing gear on/off indicator		Swing gear must be off to operate the counterweight cylinders. **Red**: Swing gear switched off, counterweight cylinders can be operated **Green**: Swing gear switched on, counterweight cylinders locked.
6	Current swing angle display		Indicates, in degrees, the position of the superstructure: **0°**: Directly over-front **180°**: Directly over-rear **+0.1 to +180.0°**: Turned to the right from 0° **–0.1 to –179.9°**: Turned to the left from 0° To install or remove the counterweight the boom must be at 180°, the turntable lock engaged and the counterweight stand installed.

Item	Description	Graphic	Explanation
7	Lock lift cylinders, F5		The counterweight lifting cylinders must be extended to rotate between locked or unlocked. Press the lock button (1). The cylinders will rotate and the lock icons (3) will change color: **Yellow**: intermediate position **Green**: locked.
8	Unlock lift cylinders, F6		The counterweight lifting cylinders must be extended to rotate between locked or unlocked. Press the unlock button (2). The cylinders will rotate and the lock icons (3) will change color: **Yellow**: intermediate position **Red**: unlocked.
9	Retract lift cylinders, F7		The turntable must be locked. To retract, press the button (1). After reaching the end position, the counterweight is pre-tensioned.
10	Extend lift cylinders, F8		The turntable must be locked. To extend, press the button (2).
11	Engage lock cylinders, F13		The counterweight must be fully retracted and pre-tensioned. To engage the counterweight lock cylinders, press engage button (11). When the lock cylinders are fully engaged the lock cylinders icon (1) turns green.
12	Retract lock cylinders, F14.		To retract the counterweight lock cylinders, press retract button (12). When the lock cylinders are fully retracted the lock cylinders icon (1) turns red.

SETTINGS SUBMENU

Press the settings submenu button (Figure 3-47) in the main menu to open this submenu.

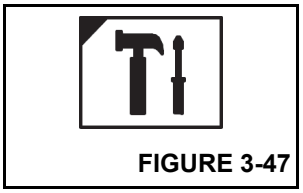


FIGURE 3-47

Settings Submenu

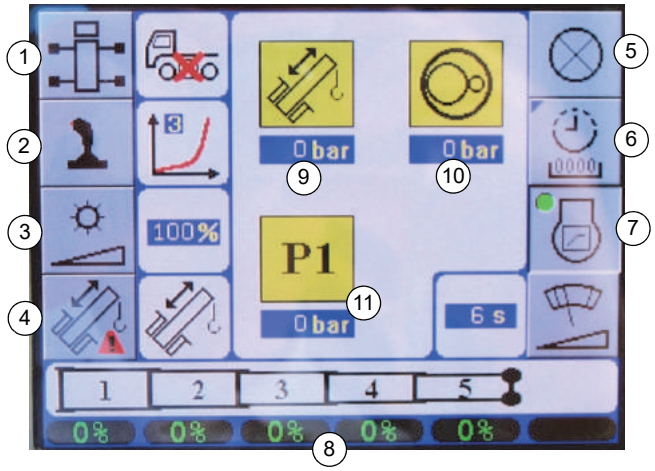
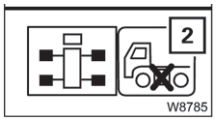
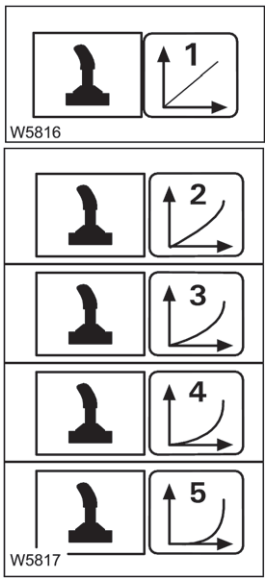
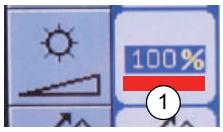


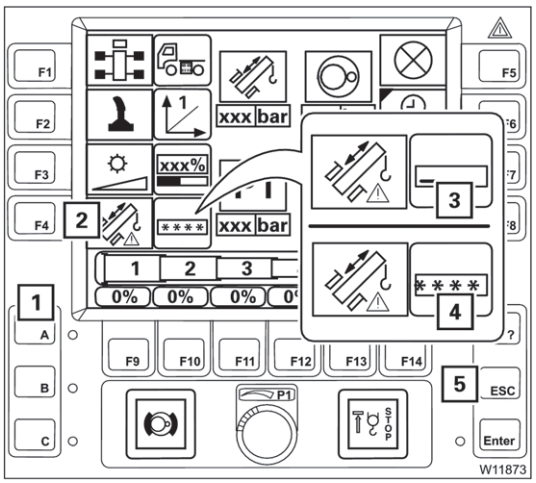
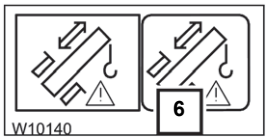
FIGURE 3-48

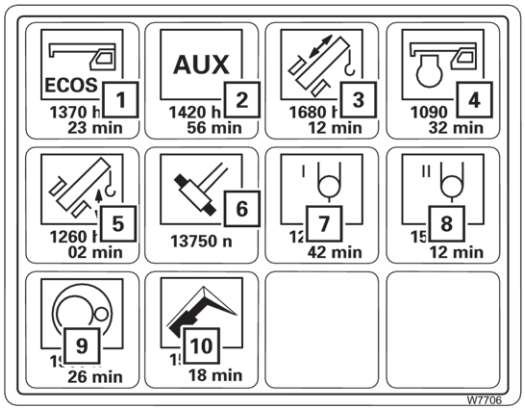
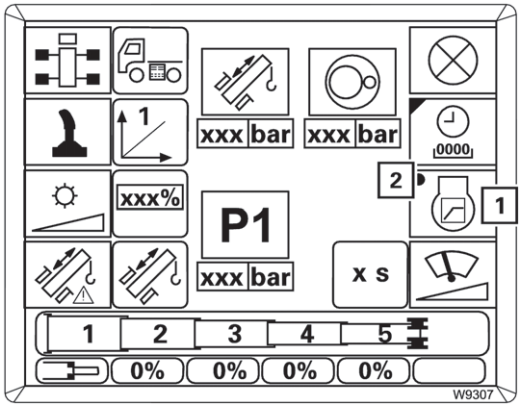
Item	Description
1	Outrigger control graphic
2	Setting control lever characteristics
3	Setting the display brightness
4	Telescoping emergency program access
5	Lamp test
6	Operating hours submenu
7	Critical load control, on/off
8	Current telescoping mechanism status display
9	Telescoping cylinder hydraulic pressure
10	Swing gear hydraulic pressure
11	Hydraulic circuit pressure

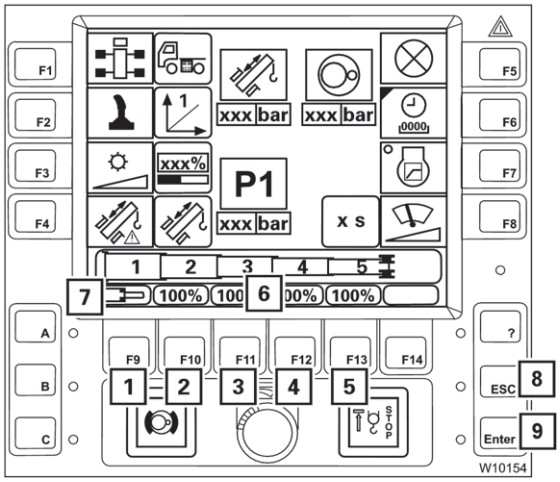
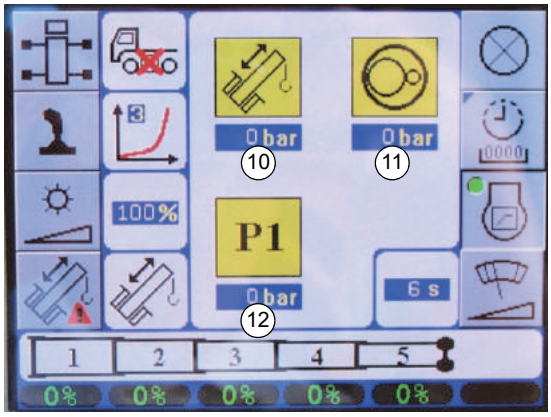
Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	Outrigger control graphic		No function.

Item	Description	Graphic	Explanation
2	Setting control lever characteristics, F2		The characteristic curve that is currently set is shown on the display. • Repeatedly press the F2 button until the desired characteristic curve is displayed. There are five characteristic curves: • Linear characteristic curve (1); the movement of the control levers effects a uniform speed increase. Even small movements of the control lever will produce a high speed. • Progressive characteristic curves (2) to (5); the speed is kept lower in the front range of the movement than with characteristic curve (1) and increases only with larger movements. The higher the number of the characteristic curve, the further the control lever must be moved to instigate a clear increase in speed.
3	Setting the display brightness, F3		Press the F3 button once. A red bar (1) appears below the display. Set the required minimum degree of brightness with the adjustment knob. The brightness of the display changes during the setting procedure and you can view the set value (0 to 100%) on the display (1). The degree of brightness which you set here is the minimum value for the automatic regulation. There is no automatic regulation if you set 100%, the displays will be set at maximum brightness. You can cancel the entry at any time using the *Esc* button. The settings are then reset. To accept your setting, press the *Enter* button once. The red bar below the display goes out. The brightness is automatically regulated between the newly set value and 100%.

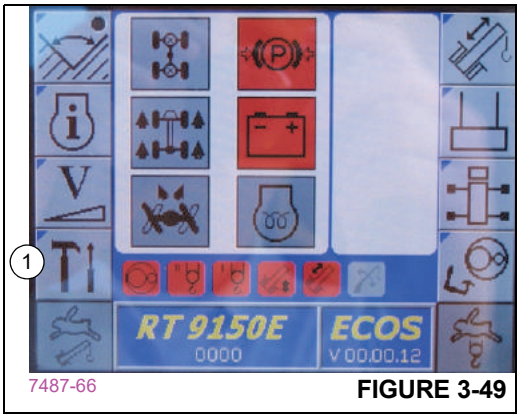
Item	Description	Graphic	Explanation
4	Telescope emergency program, F4	 	In the event of a malfunction in the telescoping mechanism, you can retract the main boom with the Telescope Emergency Program. **Refer to** *Telescope Emergency Program,* **page 3-147 for more information** **NOTE:** The emergency program is not intended for crane operation and is therefore restricted to about 360 seconds. To access the telescope emergency program: • Press and hold the right dead man's switch • Press the F4 button once: the display changes so you can enter the emergency keycode (3) • Press the buttons (1) in the order: BABC • The symbols shown (4) confirm the entry. If your input was incorrect, all the symbols (4) go out and you need to repeat the input. You can cancel the entry at any time using the *Esc* button (5). After correct input, the symbol (6) is displayed, the Telescope Emergency Program starts. • Press the Esc button (5) to open the Main Menu and press the Telescope button F5 once. The Telescoping submenu opens. Go to *Telescope Emergency Program,* page 3-147 for in-depth instructions.
5	Lamp test, F5		When the ignition is turned on certain lamps light up to verify they are working. To check those lamps while the ignition is already on: Press and hold the F5 button. The lamps light up until you let go of the button. For more information refer to, *Lamp Test,* page 3-58.

Item	Description	Graphic	Explanation
6	Operating hours submenu, F6		The operating hours are displayed below the symbols, e.g. 1,680 hours and 12 minutes for the telescoping mechanism (3). **Exception**: The value below symbol (6) indicates how often the Telescopic Section Lock has been operated, e.g. 13,750 times. **(1)** ECOS **(2)** Auxiliary systems: Counterweight cylinders Crane cab cylinder **(3)** Telescoping mechanism **(4)** Engine operation **(5)** Lift cylinder **(6)** Telescope locking system **(7)** Main hoist **(8)** Auxiliary hoist **(9)** Swing gear **(10)** Boom extension Refer to *Operating Hours,* page 3-59 for more information on this submenu.
7	Critical load control, on/off, F7		The critical load control prevents the engine from stalling at high power requirements. ECOS registers the currently available motor output and the hydraulic performance currently required by the power units. If the required hydraulic performance is above the current motor output (e.g. when conducting an additional crane movement), the critical load control automatically reduces the hydraulic performance of the power units. The swing gear is not influenced by the critical load control. The critical load control is switched on together with the ignition. You should only switch off the critical load control if it is faulty (engine stalls or individual power units can no longer be controlled). • **Switching off**: press button F7 until the dot turns black • **Switching on**: press F7 button (1) until the dot (2) turns green.

Item	Description	Graphic	Explanation
8	Current telescope status display		If the telescope status is no longer displayed you must enter the current telescope values from the RCL display. The display (6) shows the values for telescopic sections 1 to 5. To enter set values: Press one of the buttons (1) to (5), the values in the display (6) turn yellow. Each time you press a button, the corresponding value in the display (6) switches continuously between the fixed lengths and the symbol (7) for unlocked. Enter the desired set values for all telescopic sections from the RCL. You can cancel the entry at any time using the *Esc* button (8). To confirm the entered values, press the *Enter* button (9) once. You must now accept the values, refer to *Entering the Current Telescope Status,* page 3-60 for more information.
9	Telescope cylinder hydraulic pressure		Current pressure in bar for the telescope cylinder (10).
10	Swing gear hydraulic pressure		Current pressure in bar for the slewing gear (11).
11	Hydraulic circuit pressure		Current pressure in bar (12) for movements of the following: • Hoists • Lift cylinder • Counterweight cylinders • Incline cab • Locking units

Adjusting the Brightness of the Display

The brightness of the displays is regulated automatically by the ECOS, depending on the ambient brightness. You can set a minimum degree of brightness manually, which is always observed when the brightness is regulated.



7487-66 **FIGURE 3-49**

1. If necessary, open the main menu (*Esc*) and press the F4 button (1) (Figure 3-49) once. The Settings submenu opens (Figure 3-50).
2. Press the F3 button (1) once (Figure 3-50).

   A red bar will appear below the percent display.
3. Set the required minimum degree of brightness with the adjustment knob (2).

   The brightness of the display changes during the setting procedure and you can view the set value (0 to 100%) on the display. The degree of brightness which you set here is the minimum value for the automatic regulation.

7487-67 **FIGURE 3-50**

NOTE: There is no automatic regulation if you set 100%. The displays are always displayed with maximum brightness.

You can cancel the input at any time by pressing the *Esc* button. The settings are then reset.

4. To accept the entered minimum brightness, press the *Enter* button.

The red bar below the display goes out. The brightness is automatically regulated between the newly set value and 100%.

3

Lamp Test

WARNING

Loss of Control Hazard!

Always perform the following lamp tests and immediately replace faulty lamps or have them replaced!

Serious injury or property damage may result.

After the ignition has been switched on, a lamp test is conducted.

Check that the lamps indicated in Figure 3-51 and Figure 3-52 light up briefly.

If the specified time is insufficient, switch on the ignition again.

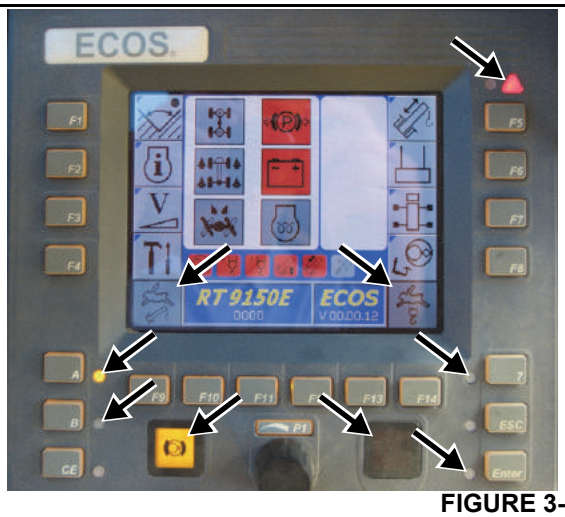


FIGURE 3-51

FIGURE 3-52

Contact Crane Care if one or more lamps do not light up.

If the specified time is insufficient, you can carry out the lamp test again as follows:

1. If necessary, in the ECOS display, open the main menu and press the F4 button (1) (Figure 3-53) once.

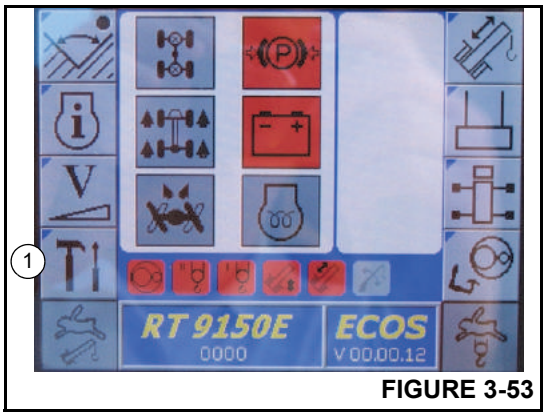


FIGURE 3-53

The Settings submenu opens.

2. Press the F5 button (1) (Figure 3-54).

The lamps indicated in Figure 3-51 and Figure 3-52 light up until you let go of the button.

If necessary, you can set the minimum brightness of the display, refer to *Adjusting the Brightness of the Display,* page 3-57.

FIGURE 3-54

Operating Hours

Press the Settings submenu button in the Main menu and then press the Operating hours button (1) (Figure 3-55) to open the Operating Hours submenu.

FIGURE 3-55

Operating Hours Submenu

The operating hours are displayed below the symbols, e.g. 1,680 hours and 12 minutes for the telescoping mechanism (3).

NOTE: The value below the Unlock telescopic section symbol (6) (Figure 3-56) indicates how often the cycle has been operated, e.g. 13,750 times.

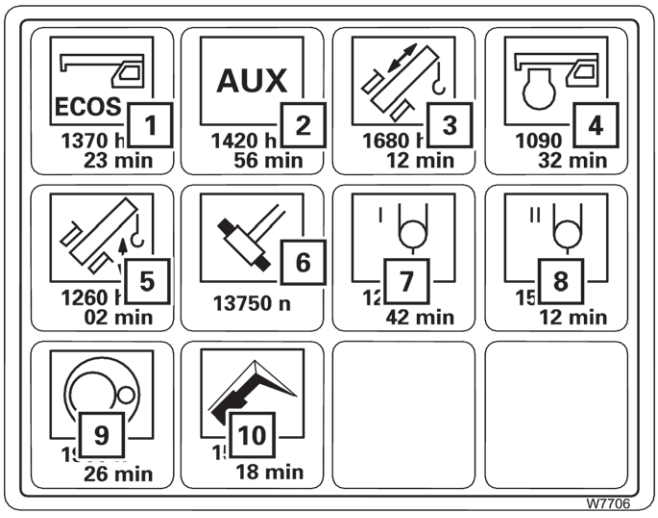


FIGURE 3-56

Item	Description
1	ECOS
2	Auxiliary systems: Counterweight cylinders Crane cab cylinder
3	Telescoping mechanism
4	Engine operation
5	Lift cylinder
6	Telescope locking system
7	Main hoist
8	Auxiliary hoist
9	Swing gear
10	Boom extension

3

Entering the Current Telescope Status

CAUTION

Equipment Damage Hazard!

Before working with the crane, check whether ECOS indicates the correct telescope values and correct any incorrect input.

Entering incorrect values may cause malfunctions and result in damage to the telescoping mechanism.

The ECOS will no longer display the current telescope configuration:

- if you telescoped in emergency mode or
- if the power supply was interrupted in the course of saving data.

If necessary, open the main menu by pressing the *Esc* button and then press the F4 button (Figure 3-57) once.

FIGURE 3-57

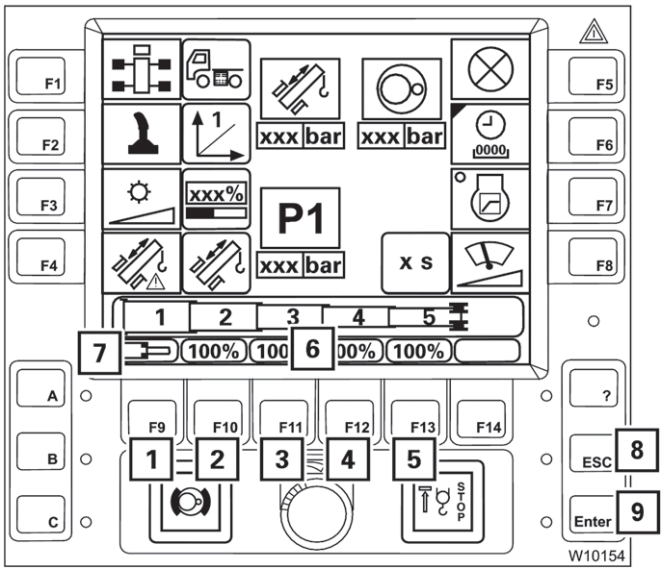


FIGURE 3-58

If the values entered are not permissible, the values on the telescope indicators (2) (Figure 3-60) turn red.

Entering RCL Telescope Values

The telescope display (6) (Figure 3-58) shows the values for telescopic sections 1 to 4.

1. Select a section; press one of the F9 to F13 buttons (1) to (5), the values in the display (6) turn yellow.

   Each time you press a button, the corresponding value in the display (6) switches continuously between the fixed lengths and the symbol (7) for unlocked.

2. Enter the values for all telescopic sections, e.g. unlocked, 100%, 100%, 100%, 100%.

NOTE: You can cancel the entry at any time using the *Esc* button (1).

3. Press and hold the left dead man's switch.
4. Confirm the entered values by pressing the *Enter* button (9) once.
5. The entered values must correlate to the actual boom position to link the ECOS system to the boom.

Approving Entered Telescope Values

1. Press the F4 button (2) (Figure 3-59) once, the symbol (3) appears.

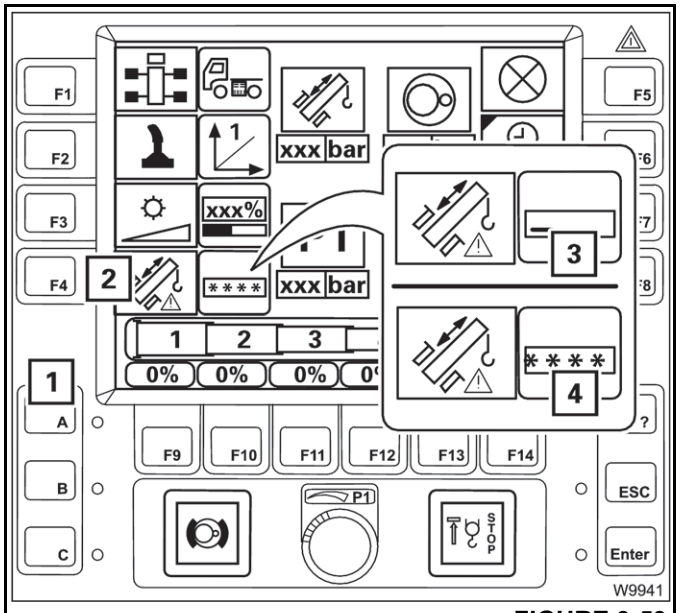


FIGURE 3-59

2. Press the *A*, *B*, *C* buttons (1) in the order:

ABAC

3. The symbols (4) appear to confirm the entry.

If your input was incorrect, all the symbols (4) go out and you need to repeat the input.

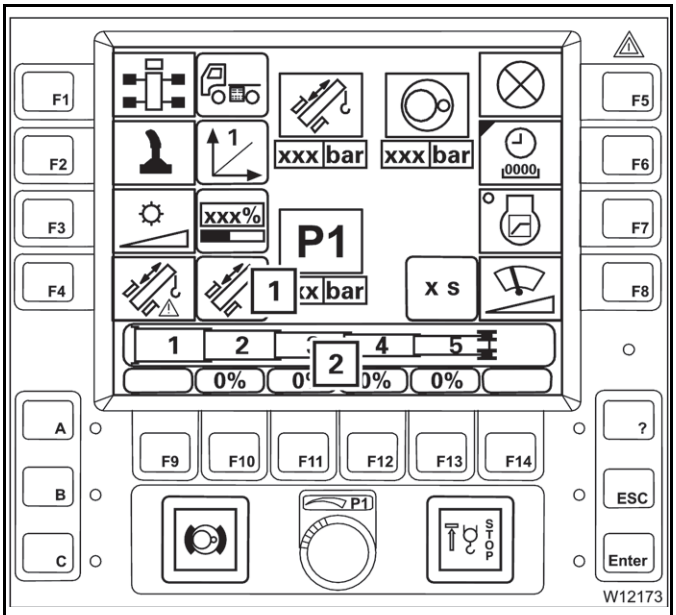


FIGURE 3-6

If the values entered are permissible, the values on the telescope indicators (2) turn green.

The display (1) shows the symbol for the current status.

3

WARNING MESSAGES

ECOS differentiates between warning messages and error messages, see *Error Messages,* page 3-66. A warning message indicates that certain values do not correspond to a set value.

In the event of a warning message, the following lamps flash:

- the Warning/Error indicator (1) (Figure 3-61)
- the **A** button lamp (2).

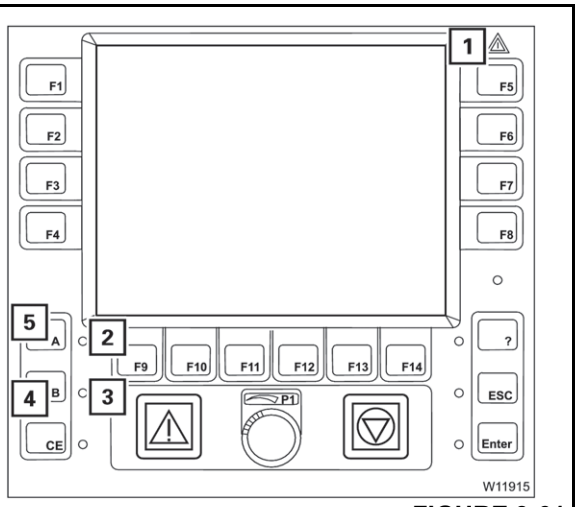


FIGURE 3-61

Press the A button (5) next to the flashing lamp to open the Warning submenu.

The warning message is acknowledged, lamp (2) lights up (does not flash any longer).

When all warning messages have been acknowledged, lamp (1) and lamp (2) lights up.

Both lamps start to flash again as soon as a new warning occurs.

Meaning of the Symbols

The color of the symbols indicate whether a warning message is active in the corresponding area:

- Symbol **grey**, no warning message.
- Symbol **red**, warning message.

Carry out the following procedures if a symbol is displayed in red.

Exiting the Submenu

You can exit the submenu at any time.

Press the *Esc* button (1) (Figure 3-62) once. The same menu opens that was open before the Warnings submenu opened.

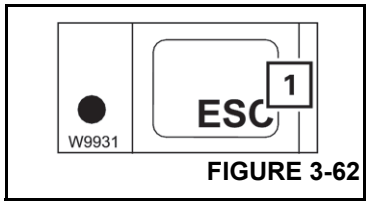


FIGURE 3-62

If the same warning messages are still present, the lamps (1) and (2) (Figure 3-61) light up.

If no warning message is present, both lamps will go out.

Both lamps start flashing again as soon as a new warning message occurs.

CAUTION

Equipment Damage Hazard!

Keep alert for warning messages. When warning messages appear take appropriate action to prevent malfunction and possible damage to the crane.

Warning Submenu

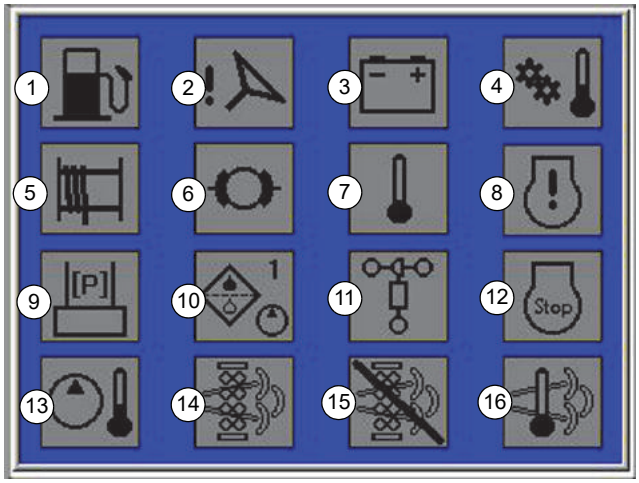
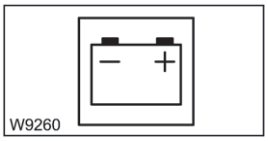
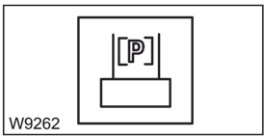
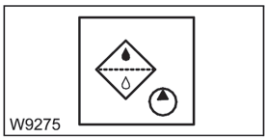
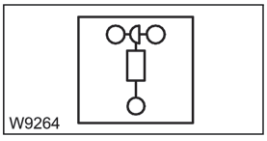


FIGURE 3-63

Item	Description
1	Fuel level
2	Low steering pressure (CE option)
3	Voltage monitoring
4	Transmission oil temperature
5	Hoist 3rd wrap indicator
6	Low brake pressure
7	Ambient air temperature, -29°C (Cold Weather Option)
8	Engine warning
9	Pre-tension the counterweight
10	Replace the hydraulic oil filter
11	Anemometer not connected
12	Engine stop
13	Hydraulic oil temperature
14	Exhaust System Cleaning Required (T4i Engine)
15	Inhibit Exhaust System Cleaning
16	High Exhaust System Temperature (HEST)

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	**Fuel level**		The fuel tank is only filled up to a level of approximately 5%. Refuel before the fuel is used up. When the fuel tank is almost empty, air is sucked in and you must bleed the fuel system, refer to the Service Manual.
2	**Low steering pressure (CE option)**		Inspect the steering system for leaks and check the accumulator charge. Refer to the Service Manual.
3	**Voltage monitoring**		The voltage in the electrical system is too high or too low. Display of the current voltage, refer to *Monitoring submenu,* page 3-47.
4	**Transmission oil temperature**		The temperature of the transmission oil is outside the operational range.

Item	Description	Graphic	Explanation
5	**Hoist 3rd wrap indicator**		Indicates when five wraps or less of cable remain on either hoist.
6	**Low brake pressure**		Inspect the brake system for leaks and check the accumulator charge. Refer to the Service manual.
7	**Ambient air temperature, -29°C (Cold Weather Option)**		The outside air temperature is below -29°C (-20°F).
8	**Engine warning**		Malfunction in the engine, switch off engine immediately, refer to the Service Manual.
9	**Pre-tension the counterweight**		The pre-tensioning pressure on the counterweight is lower than acceptable. Pre-tension the counterweight, refer to *Counterweight Submenu,* page 3-49.
10	**Hydraulic oil filter restriction**		Replace the corresponding hydraulic oil filter as soon as possible, refer to Service Manual.
11	**Anemometer not connected**		Connect the anemometer to the electrical power supply; refer to *Anemometer/Aircraft warning Light,* page 4-51.
12	**Engine stop**		The engine has stopped running.
13	**Hydraulic oil temperature**		The temperature of the hydraulic oil is outside the operational range.

Item	Description	Graphic	Explanation
14	**Exhaust System Cleaning Required**		The Exhaust System Cleaning Required indicator illuminates amber when the exhaust system is in need of a cleaning. The indicator will be lit continuously during the early stages of required cleaning. If this condition continues, the indicator will begin to flash and a slight engine derate will occur. If this condition continues further, the Engine Warning Light (8) will illuminate in addition to the Exhaust System Cleaning Required indicator and a severe engine derate will occur. If the Exhaust System Cleaning Required indicator illuminates or flashes, start the manual cleaning process (see *Exhaust System Cleaning Switch*, page 3-10)
15	**Inhibit Cleaning Activated**		When the Exhaust System Cleaning Switch (8) (Figure 3-6) is in the inhibit cleaning position, this indicator will illuminate and both manual and active cleaning will be inhibited.
16	**High Exhaust System Temperature (HEST)**		During the exhaust cleaning process, it is possible for the engine exhaust to reach temperatures exceeding 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 1157° F (625° C).

ERROR MESSAGES

If ECOS detects an error, an error message is indicated by two flashing lamps, (Figure 3-64):

- The Warning/Error indicator lamp (1)
- the ***?*** button lamp (2).

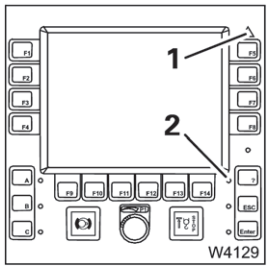


FIGURE 3-64

When all error messages have been acknowledged, lamp (1) and lamp (2) lights up.

Both displays start to flash again as soon as a new error occurs.

Opening the Submenu

To determine what the error is, you must open the Error submenu by pressing the***?*** button (2) (Figure 3-65) once. The button is only active when the lamp (1) flashes or lights up.

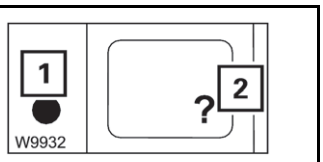


FIGURE 3-65

Exiting the Submenu

You can exit the Error submenu at any time.

Press the ***Esc*** button (1) (Figure 3-66) once. The same menu opens that was open before the Error submenu opened.

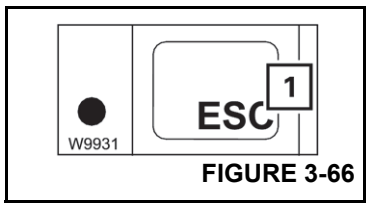


FIGURE 3-66

NOTE: All errors remain saved until you switch off the ignition, even those errors of which the cause has been eliminated in the meantime. All existing errors are treated as new errors and displayed again after turning on the ignition.

Error Submenu

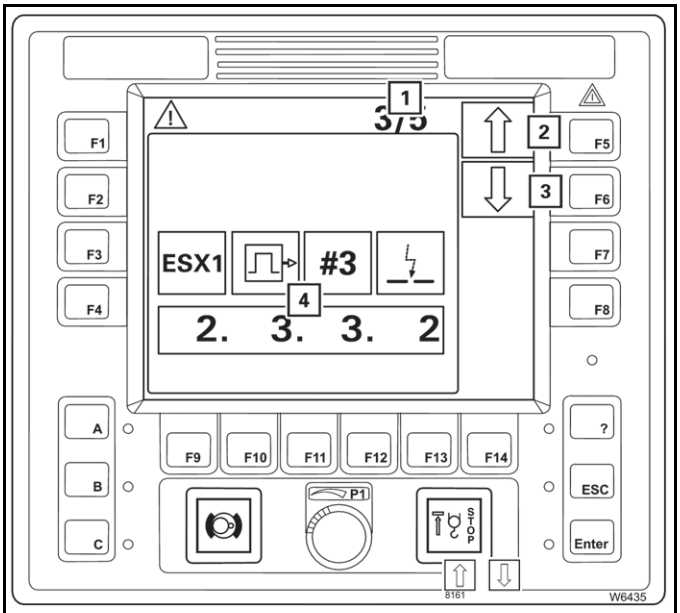
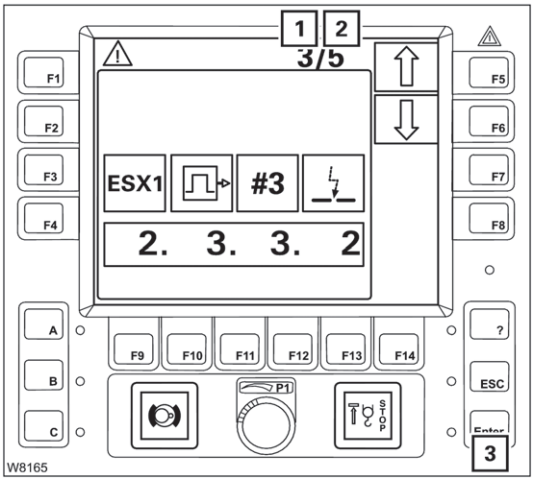
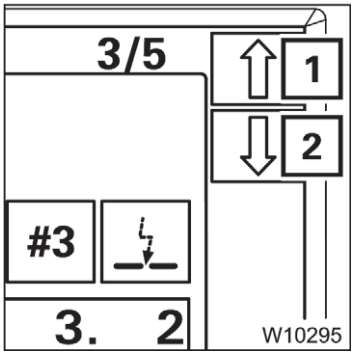
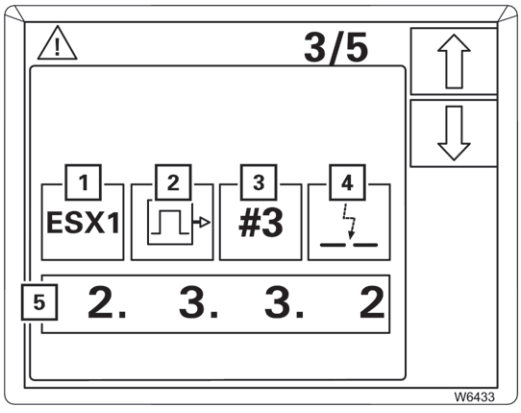


FIGURE 3-67

Item	Description
1	Display of current error/total errors
2	Press to go to next error
3	Press to see the previous error
4	Error display

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	**Display of current error/total errors**		Item (2) shows the error total, and item (1) shows which error is currently displayed. For example, 3/5, means: • that error 3 is shown • and there is a total of 5 errors. If the error shown is not acknowledged, the lamp next to the ***Enter*** button (3) lights up. To acknowledge the error, press the ***Enter*** button (3) once. If there are further errors, the next error is displayed and can be acknowledged.
2	**Next error**		When all errors have been acknowledged, you can retrieve any pending errors using the buttons next to the symbols (1) and (2). (1) Next error, F5 (2) Previous error, F6 Every time you press a button, the next error will be displayed. When you keep a button pressed, all errors are shown one after the other continuously. If all errors have not been acknowledged, the _____buttons have no function, the symbols are grey.
3	**Previous error**		
4	**Error display**		Each error is defined by an error code (5) and the symbols (1) to (4). The symbols stand for: (1) The faulty device (2) The error group (3) The index within the group (4) The type of error The error code (5) consists of 4 digits, e.g. 2332. Always note down the error code before contacting Crane Care.

RCL CONTROL UNIT

The RCL control panel (EKS 5) is located on the top right side console. Various menus are displayed on the RCL display. The menus are operated using buttons F1 to F14. The individual buttons have a different function in each menu. The functions of the buttons in the display menu correspond to the symbols next to or above the buttons. After the button is pressed and released, the function displayed is executed.

Common Elements

This section describes the operating elements that are the same for all menus.

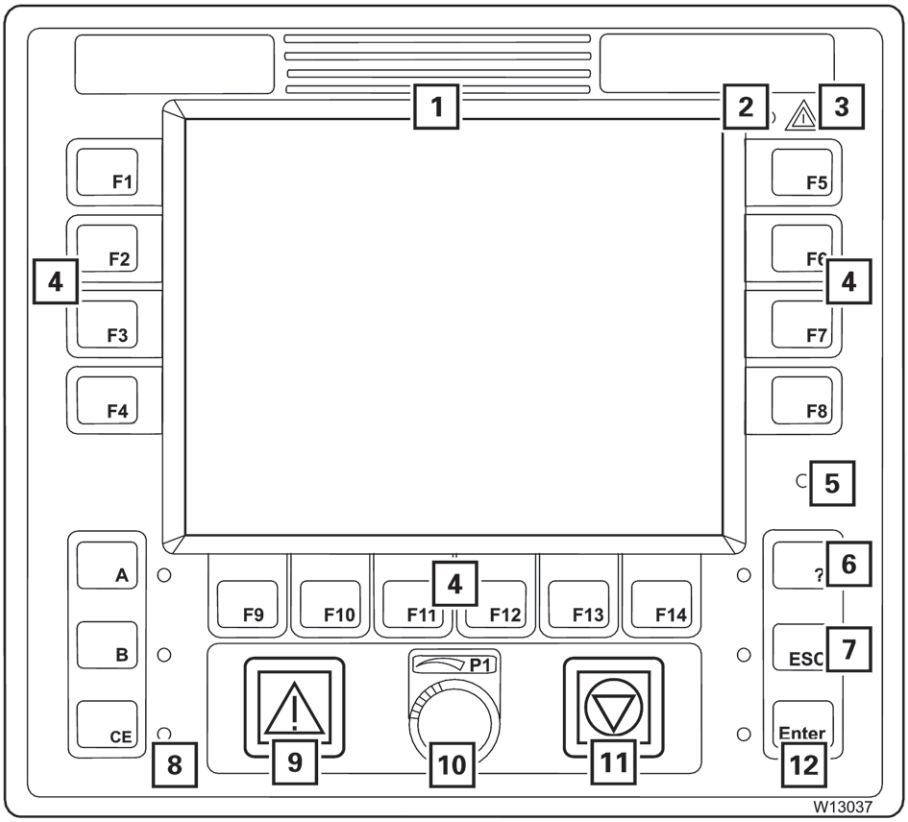
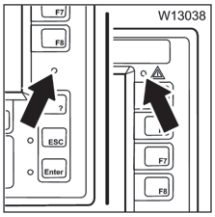
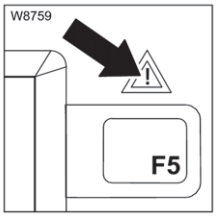


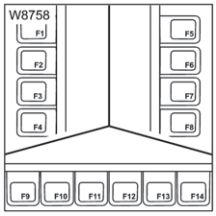
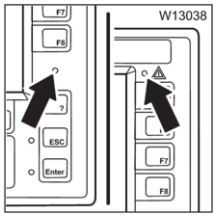
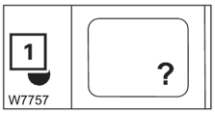
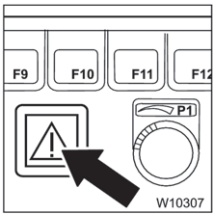
FIGURE 3-68

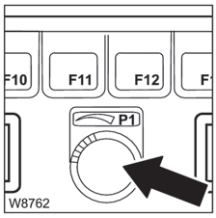
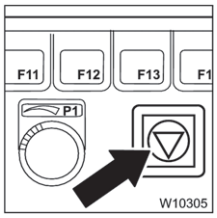
Item	Description
1	RCL display
	Main menu overview
2	Sensor for brightness
3	Error/warning message
4	Buttons F1 to F14
5	Sensor for brightness
6	Opening the Error submenu
	Error submenu overview

Item	Description
7	Exiting the submenu/input mode
8	Acknowledgement
9	RCL early warning
10	Entering values
11	RCL shutdown
12	Input confirmation

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	**RCL display**		**After a standstill of up to 48 hours** Ignition on: Monitoring submenu opens. Refer to *RCL Monitoring Submenu,* page 3-86.
			**After a standstill of more than 48 hours** Ignition on: Enter rigging mode submenu opens. Refer to *Rigging Mode Monitoring Submenu,* page 3-85.
	Main menu overview		The main menu shows symbols for further submenus and symbols for current displays. Refer to *RCL Main Menu,* page 3-75.
2	**Sensor for brightness**[1]		Registers the brightness of the operating environment. The brightness of all displays are automatically adjusted. Refer to *Adjusting the Brightness of the Display,* page 3-57 to manually set the minimum brightness.
3	**Error/warning message**		• **Flashing**: New warning message or error has occurred • **On**: Error acknowledged, but still present • **Off**: No warning message or error present

Item	Description	Graphic	Explanation
4	**Buttons F1 to F14**		The function of buttons F1 to F14 is shown on the symbol next to or above the button. After the button is pressed and released, the function displayed is executed.
5	**Sensor for brightness**[1]		Registers the brightness of the operating environment. The brightness of all displays are automatically adjusted. Refer to *Adjusting the Brightness of the Display,* page 3-57 to manually set the minimum brightness.
6	**Opening the Error submenu**		The lamp (**1**) lights up or flashes. Press the button once to open the Error Submenu.
	Error Submenu overview		The error submenu is where you access and acknowledge any errors that are present. Refer to *Error Submenu,* page 3-101.
7	**Exiting the submenu/input mode**		The lamp (**1**) lights up. Press the button once to close the current submenu, the menu from the next level up opens. Input mode is deactivated.
8	**Acknowledgement**		The lamp (**1**) lights up. Press the button once: buzzer tone off, error message acknowledged.
9	**RCL early warning**		• **Flashing**: Crane capacity at 90 to 100%: buzzer tone on • **On**: Crane capacity about 100%: buzzer tone on, machine shuts down. Refer to *RCL Shutdown,* page 3-72. • **Off**: Crane capacity 0 to 90% For more information refer to *RCL Early Warning,* page 3-72.

Item	Description	Graphic	Explanation
10	**Entering values**		When Input mode is activated: • **To the right**: increases the value • **To the left**: reduces the value Slow turning changes the value slowly. Fast turning changes the value fast.
11	**RCL shutdown**		• **On**: Machine Shutdown, buzzer sounds Degree of utilisation about 100% or an error exists. • **Off**: No shutdown Refer to *RCL Shutdown,* page 3-72.
12	**Input confirmation**		The lamp (1) lights up. **In the Rigging mode submenu:** Press button once, rigging mode monitoring submenu opens. **In the Rigging mode monitoring submenu:** Press button once, rigging mode is accepted, Monitoring submenu opens, lamp (1) goes out.

[1] Either Item 2 or 5

RCL Early Warning

Refer to Figure 3-69

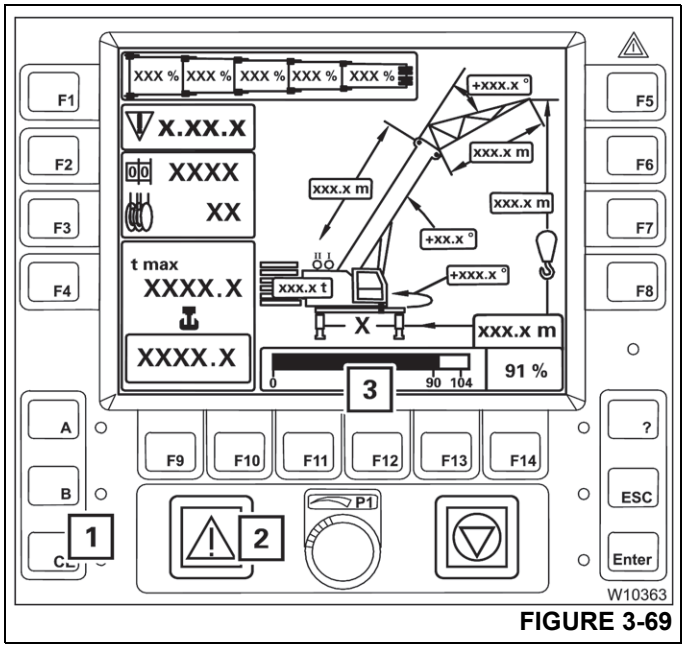


FIGURE 3-69

If about 90% of the maximum permissible load is exceeded, an RCL early warning is given:

- An intermittent buzzer tone sounds.

  After five seconds, you can switch off the buzzer tone using the *CE* button (1).
- The lamp (2) lights up.
- The display (3) shows the current percent of maximum load, e.g. 91%; the bar is yellow.

NOTE: If the current crane movements continue to be carried out in the same direction, there is an RCL shutdown.

RCL Shutdown

There are different types of RCL shutdowns:

- Shutdown due to overload,
- Shutdown due to an error message, refer to the *Error Submenu,* page 3-101.

When operating with a hydraulic luffing jib, an overload condition can develop when changing the angle of the jib. When this occurs the lowering of the hydraulic luffing jib is stopped by the RCL.

Shutdown Due to Overload

Refer to Figure 3-70

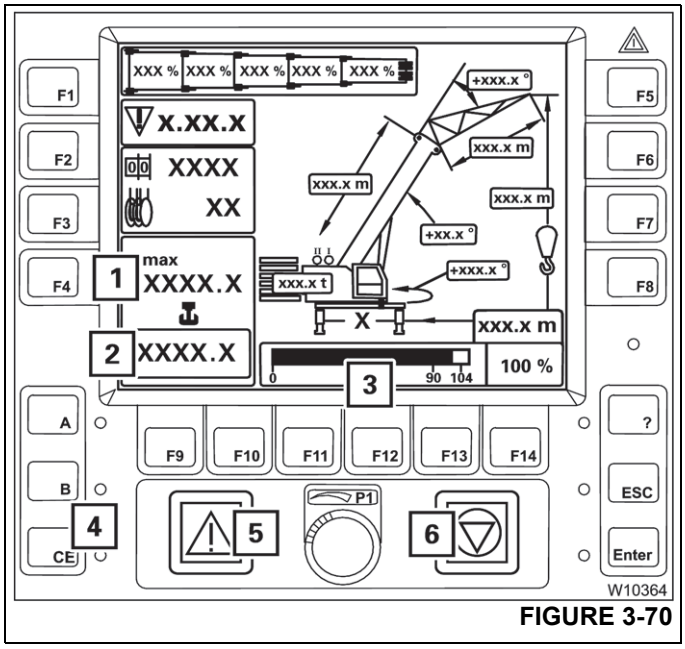


FIGURE 3-70

If about 100% of the maximum permissible load is exceeded, shutdown occurs due to overload:

- All crane movements which increase the load moment are switched off.
- The hydraulic luffing jib will not be allowed to lower—increase the angle.
- A continuous buzzer tone sounds.

  After five seconds, you can switch off the buzzer tone using the CE button (4).
- Lamps (5) and (6) light up.
- The display (3) shows the current percent of maximum load, e.g. 100%; the bar is red.
- The value on display (2) is equal to or greater than the value on display (1).

Canceling a Shutdown

1. Turn off the buzzer tone if necessary.
2. Leave the shutdown range by performing one of the operations listed in the following table—in most cases the permitted movement will be the opposite of the switched off movement:

Switched off crane movements	Permitted crane movements
Lifting loads	Lowering loads
Lowering the main boom	Raising the main boom[1]
Extending the main boom	Retracting the main boom[1]
Slewing to the left	Slewing to the right
Slewing to the right	Slewing to the left
Lowering the lattice extension	Raising the lattice extension

[1] In some cases, the RCL also switches off these movements. In this case, leave the shutdown range through other enabled movements. If this is not possible, set down the load.

If you have left the shutdown range, the lamp (6) goes out.

After pressing the button *CE* the crane movements are enabled.

RCL Override

If the RCL is overridden, the crane operation is not monitored and the switched off crane movements are enabled again.

WARNING

Tipping and/or Machine Damage Hazard!

You may only override the RCL if it becomes absolutely necessary in the event of an emergency. This is to put the crane into a safe condition in the event of a malfunction. In this case, do not perform any movements that would increase the load moment.

Overriding the RCL

Refer to Figure 3-71

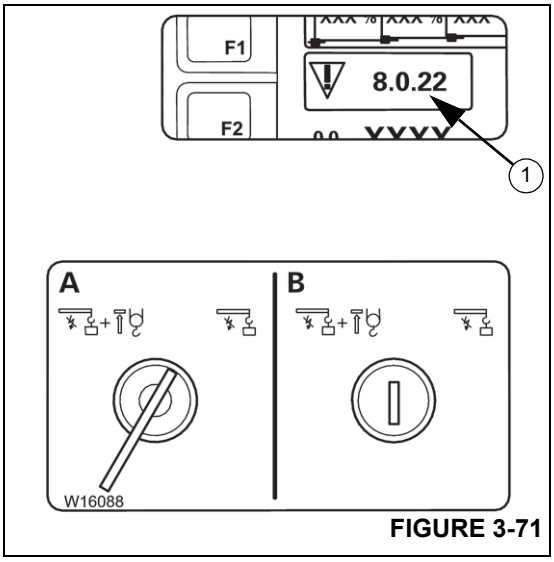


FIGURE 3-71

1. Insert the key into the key-operated switch below the ECOS console, *RCL Override Switch (Non-CE Certified Cranes),* page 3-7.
2. Turn the key clockwise and hold it in this position (A).
3. The display (1) shows the error message **8.0.22**.

Canceling the Override

1. Let go of the key (B).
2. Remove the key.
3. Press the *CE* button once, the error message is acknowledged.

Anti Two-Block Switch Override

Refer to Figure 3-72

When overridden, the shutdown of the anti two-block switch is cancelled and the crane operation is no longer completely monitored.

You can only override the anti two-block switch together with the RCL.

WARNING

Two-Blocking Hazard!

The anti-two-block override switch should be used with caution. The operator must ensure two-blocking doesn't occur when the override is activated.

If the anti-two-block switch is overridden, crane operation is no longer completely monitored; when hoisting the anti two-block switch weight, crane movement will be stopped once. After moving the control lever again, the crane movement is then enabled and the anti-two-block switch is overridden.

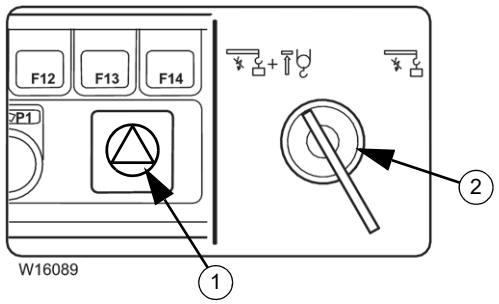


FIGURE 3-72

The lamp (1) lights up if the anti two-block switch has been triggered.

At the same time, all movement which increases the load moment are switched off; lifting, lowering, extending and adjusting the boom extension.

To cancel the shutdown, leave the shutdown range by performing a different crane movement or by setting down the load.

To override the lift limit switch:

1. Insert the key into the key-operated switch (2).
2. Turn the key counter-clockwise and hold.

   The anti two-block switch and the RCL are overridden until you let go of the key.

If the anti two-block switch is triggered now, crane movement is stopped once and the lamp (1) flashes.

Crane movement is enabled again if you bring the control lever to zero position and then move it again.

Crane movement will not be stopped again.

The lamp (1) goes out:

- if you let go of the key-operated switch (override cancelled) or
- if you leave the shutdown range.

RCL MAIN MENU

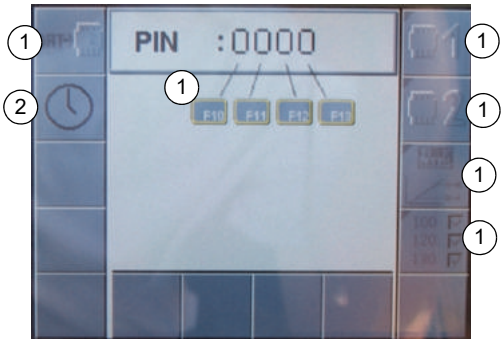
The Main menu shows symbols for further submenus and symbols for current displays.

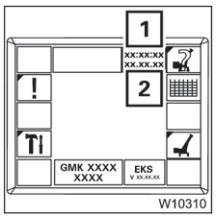
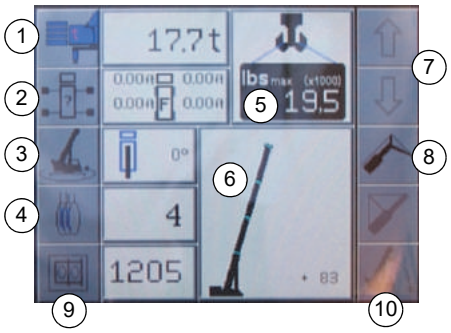
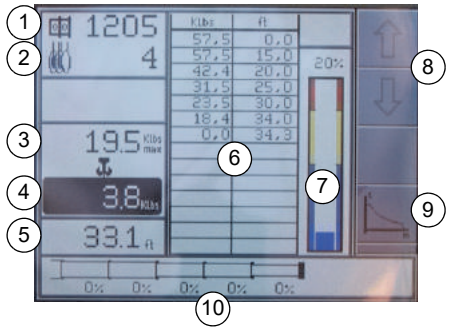
RCL Main Menu

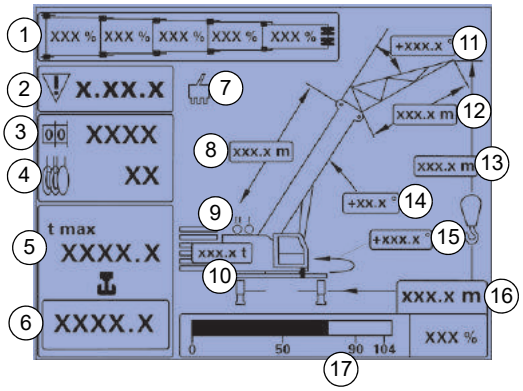
FIGURE 3-73

Item	Description
1	Error submenu, F2
2	Settings submenu, F4
3	Date/time display
4	Rigging mode submenu, F5
5	Lifting Capacity Tables submenu, F6
6	Monitoring submenu,F8
7	Serial number display
8	Program version display

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	***Error Submenu,*** **page 3-101, F2**		The error submenu is where you access and acknowledge any errors that are present. Refer to *Error Submenu,* page 3-101.
2	***Settings Submenu,*** **page 3-99, F4**		Buttons/displays (1) associated with buttons F1, F5, F6, F7 and F8 are only shown if a service device is connected, refer to *Settings Submenu,* page 3-99 for more information. Button F2 (2) is used to change the time and date. Press the Enter button, the entered values are accepted and displayed in the main menu. You can cancel the input at any time; press the Esc button, none of the values are changed.

Item	Description	Graphic	Explanation
3	**Date/time display**		**(1)** Time **(2)** Date To change the time/date refer to the *Settings Submenu,* page 3-99.
4	***Rigging Mode Submenu,* page 3-78, F5**		**(1)** Enter counterweight, F1 **(2)** Enter outrigger span, F2 **(3)** Enter swing range, F3 **(4)** Enter reeving, F4 **(5)** Maximum load display **(6)** Boom system display **(7)** Selection: Up, F5 Down, F6 **(8)** Boom system entry, F7 **(9)** Enter RCL code, F9 **(10)** Boom angle display, F14 For a complete rigging mode input, you must enter, confirm and accept the rigging mode and reeving, refer to *Rigging Mode Submenu,* page 3-78.
5	***Lifting Capacity Tables Submenu,* page 3-92, F6**		Press the F6 button in main menu to open this submenu. **(1)** RCL code display **(2)** Reeving display **(3)** Maximum load display **(4)** Current load display **(5)** Current working radius display **(6)** Load Chart display **(7)** Current percent of max. load display **(8)** Selection **(9)** Working range submenu **(10)** Telescope status display/input Refer to *Lifting Capacity Tables Submenu,* page 3-92.

Item	Description	Graphic	Explanation
6	***RCL Monitoring Submenu,* page 3-86, F8**		Press the F8 button in main menu to open this submenu. **(1)** Current telescope status display **(2)** Error display **(3)** RCL code display **(4)** Reeving display **(5)** Maximum load display **(6)** Current load display **(7)** Service symbol display **(8)** Current main boom length **(9)** Hoists display **(10)** Counterweight display **(11)** Boom extension angle display **(12)** Current length of boom extension **(13)** Current overall height **(14)** Current main boom angle display **(15)** Current swing angle display **(16)** Current working radius **(17)** Current percent of max. load; bar graph and number. Refer to *RCL Monitoring Submenu,* page 3-86.
7	**Serial number display**		Serial number listed under the model number of the crane.
8	**RCL program version display**		Current RCL program version number. **NOTE:** Always note down the number of the program version before notifying Crane Care in the event of a malfunction.

RIGGING MODE SUBMENU

For a complete rigging mode input, you must enter, confirm and accept the rigging and reeving conditions as they currently exist on the machine.

FIGURE 3-74

Opening the Submenu

In the main menu and press the F5 button (1) (Figure 3-74) once.

Rigging Mode Menu

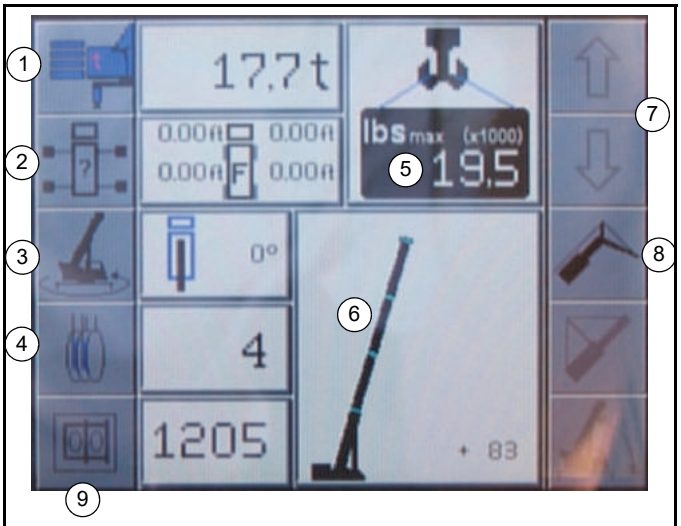
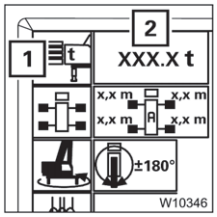


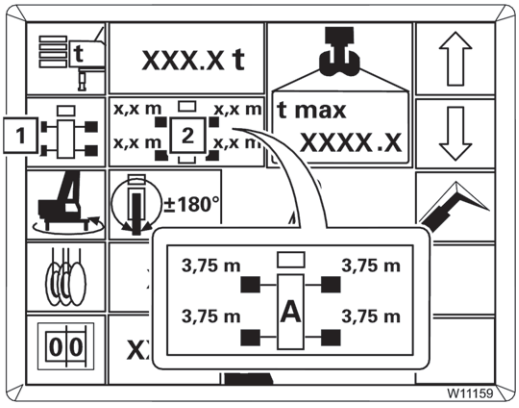
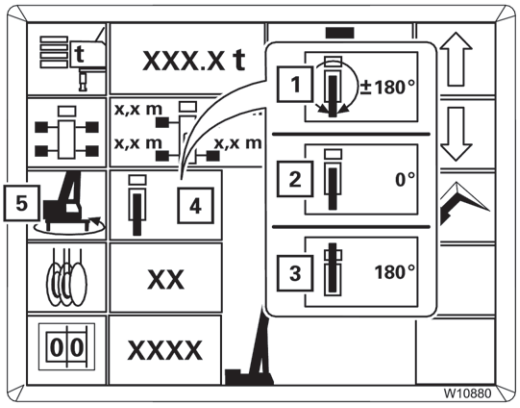
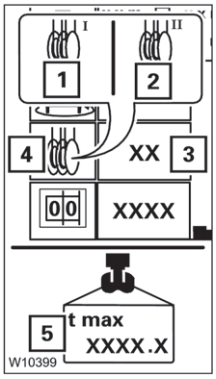
FIGURE 3-75

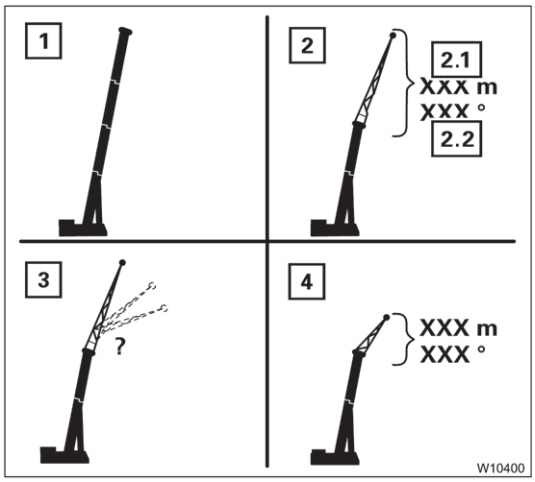
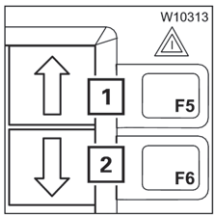
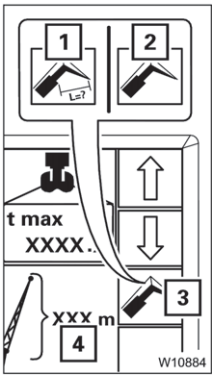
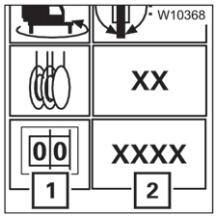
Item	Description
1	Enter counterweight, F1
2	Enter outrigger span, F2
3	Enter swing range, F3
4	Enter reeving, F4
5	Maximum load display
6	RCL code graphic display
7	Selection: Up, F5 Down, F6
8	Boom system entry, F7
9	Enter RCL code, F9

Refer to the following table for a description of each item listed above.

The procedures are given in detail after the table.

Item	Description	Graphic	Explanation
1	**Enter counterweight, F1**		• **Start Input mode**: press the F1 button (1) once, symbol turns green • **Input mode on**: press either the F5 button ⇧ or the F6 button ⇩ once, to bring up the next counterweight configuration (2). Refer to *Counterweight,* page 3-82.

Item	Description	Graphic	Explanation
2	**Enter outrigger span, F2**		• **Start Input mode**: press the F2 button (1) once, symbol turns green • **Input mode on**: press either the F5 button ⇧ or the F6 button ⇩ once, to bring up the next outrigger configuration(2): 100%, full extend 50%, mid-extend. Refer to *Outrigger Deployment,* page 3-82.
3	**Enter swing range, F3**		• **Start Input mode**: press the F3 button (1) once, symbol turns green • **Input mode on**: press either the F5 button ⇧ or the F6 button ⇩ once, to bring up the next permissible swing range (4): (1) 360° swing range (2) Working position 0° to the rear * (3) Working position 180° to the front * * Swing gear must be off. Refer to *Swing Range,* page 3-83.
4	**Enter reeving, F4**		• **Start Input mode**: **For main hoist**: press the F4 button (4) until symbol (1) is green **For auxiliary hoist**: press the F4 button (4) until symbol (2) is green • **Input mode on**: press either the F5 button ⇧ or the F6 button ⇩ once: To change reeving by one line (3) and display the relevant maximum load (5) for that reeving. Refer to *Entering the Reeving,* page 3-83.
5	**Maximum load display**		Maximum load in tons (t) or kilo pounds (klbs) for displayed RCL code. Refer to the *RCL Monitoring Submenu,* page 3-86 for more information.

Item	Description	Graphic	Explanation
6	**RCL code display**		Boom configuration for displayed RCL code: (1) Main boom/auxiliary single-sheave boom nose (2) Boom extension: (2.1) Length (2.1) Angle (3) RCL rigging code for the boom extension angle entered (4) Heavy load boom extension Refer to *Boom System,* page 3-82.
7	**Selection**		**When in input mode**: (1) Press the F5 button (1) once, next greater value is displayed (2) Press the F6 button (2) once, next smaller value is displayed.
8	**Boom system entry, F7**		**To turn input mode on**: **For boom system**: Press the F7 button (3) until symbol (2) is green. **For length and angle of boom extension**: Press the F7 button (3) until symbol (1) is green **When in input mode**: Press the F7 button (3) once, the next available length is displayed (4). Refer to *Boom System,* page 3-82.
9	**Enter RCL code, F9**		**To turn input mode on**: Press the F9 button (1) once, the symbol turns green. **With input mode on**: Press either the F5 button ⇧ or the F6 button ⇩ until the desired RCL code is displayed (2). Refer to *Entering the RCL Code,* page 3-83.

Entering the Rigging Mode

In the Rigging Mode submenu there are two ways of entering the current rigging mode.

- Either enter the individual components (1) to (5) (Figure 3-76) one after the other

or

- Enter the RCL code (6) and the current reeving (5).

Then you must confirm and accept the newly entered rigging mode.

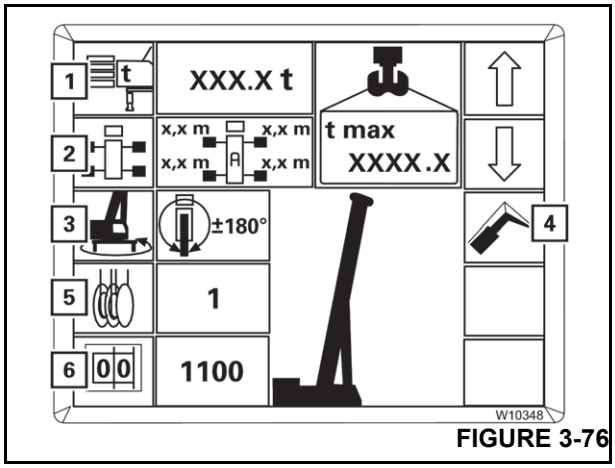


FIGURE 3-76

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 3-83.

Entering Individual Components

With this type of input, select all the components of the rigging mode one after the other.

WARNING

Tipping Hazard!

Values which have already been set may change when entering individual components. Always compare the displayed rigging mode with the current rigging mode of the crane after making an entry, this will prevent the RCL from calculating with incorrectly set components and the crane from becoming overloaded or overturning.

Serious injury or death may result from improper RCL data.

When re-entering the rigging mode completely, you can prevent already entered components from changing by making entries in the following order (Figure 3-77):

- counterweight (1)
- boom system (4)
- outrigger span (2)
- swing range (3)

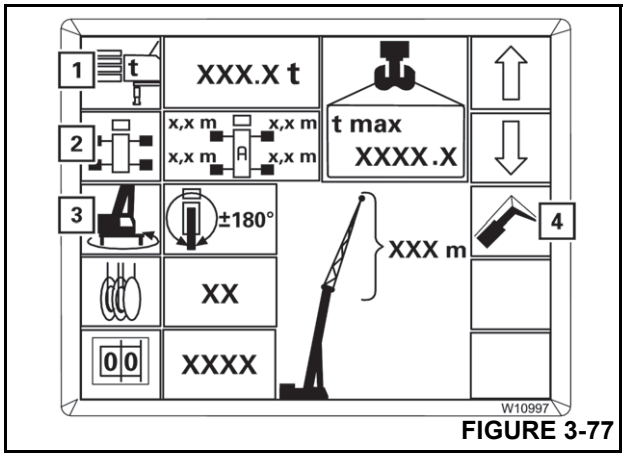


FIGURE 3-77

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.

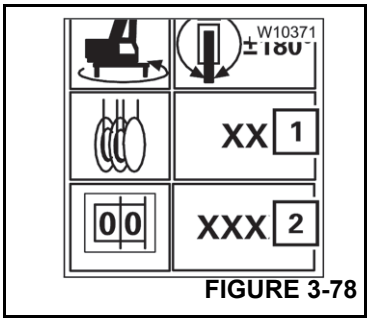


FIGURE 3-78

When entering the components, the corresponding RCL code (2) (Figure 3-78) is displayed at the same time.

Then you must enter the current reeving (1) and accept the indicated rigging mode

To Switch ON Input Mode

Press one of the buttons (1) to (4) (Figure 3-77) for the desired component.

The corresponding symbol turns green, input mode is switched on.

Selecting Values

With the input mode switched on, you can select values that are permissible according to the Load Chart.

The following example is for selecting the values for the counterweight, symbol (1) (Figure 3-79) green.

Counterweight

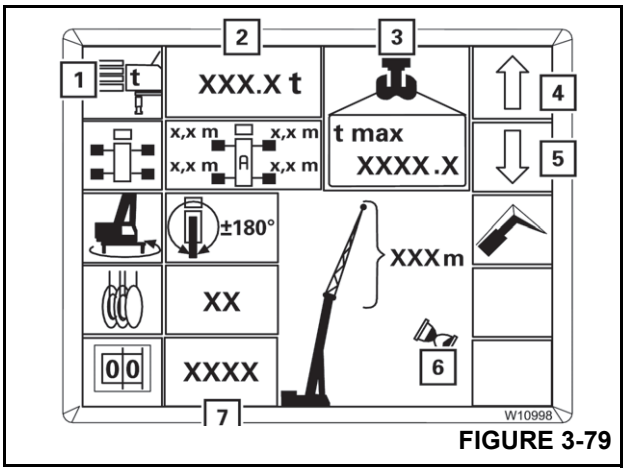


FIGURE 3-79

Press the F5 or F6 button (4) or (5) repeatedly until the display (2) shows the rigged counterweight version:

(4) Larger versions,

(5) Smaller versions.

The display (7) indicates the corresponding RCL code, the symbol (6) indicates the RCL code is being determined.

The display (3) indicates the maximum load for the displayed rigging mode and the displayed reeving.

You can cancel the input at any time. Press the Esc button. The main menu opens.

After the selection procedure, there are three options:

- Switching off the input mode:

  Press the F1 button (1) (Figure 3-80) once, symbol turns grey.
- Switching the input mode:

  Press the button for the next component once, for example, the F2 button (2), the symbol turns green.
- Accept the displayed rigging mode. Refer to *Approve the Rigging Mode,* page 3-84.

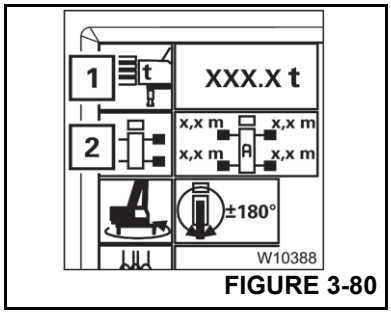


FIGURE 3-80

Enter the other components of the current rigging mode in the same way.

Boom System

For more information about using a boom extension refer to, *Boom Extensions,* page 3-155.

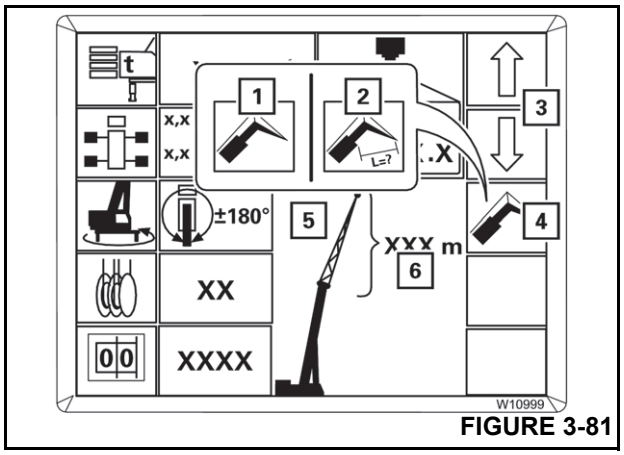


FIGURE 3-81

1. Press the button (4) (Figure 3-81) repeatedly until the symbol for the required input is green.

   (1) Boom system entry

   (2) Boom extension length/angle input
2. Press the button (3) repeatedly until:

   - the display (5) shows the rigged boom system, e.g. the boom extension

     or

   - until the display (6) shows the rigged boom extension length, and in the case of a luffing boom extension, the rigged boom extension angle.

Outrigger Deployment

Refer to Figure 3-82.

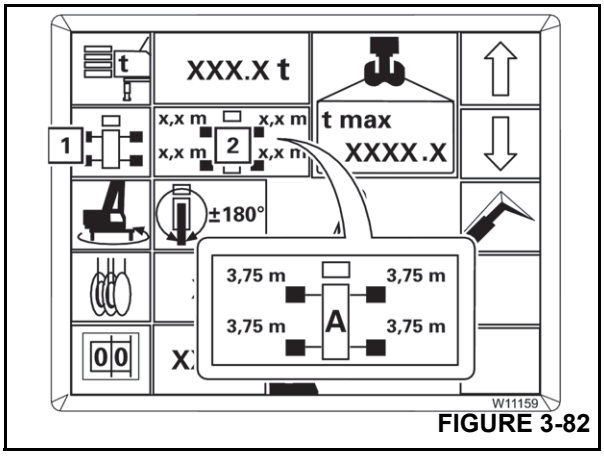


FIGURE 3-82

With symbol (1) green, function ON. Press the buttons ⇧ ⇩ to select:

- 100%, fully extended

- 50%, mid-extend position
- 0%, retracted.

Swing Range

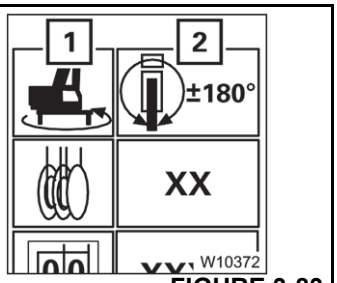


FIGURE 3-83

Symbol (1) (Figure 3-83) is green. Press the buttons ⇧ ⇩ repeatedly until the display (2) indicates the required swing range, e.g. 360°.

You can only confirm rigging modes for swing ranges other than 360°:

- if the swing gear is switched off in the 0°/180°/Free on wheels working position.
- if the superstructure is in the entered swing range. If necessary, first enter the 360° swing range and swing the superstructure into the required position.

Entering the RCL Code

You must enter the RCL code for the rigging mode according to the Lifting Capacity Table.

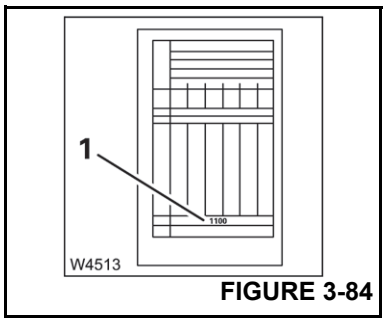


FIGURE 3-84

Refer to the Load Chart for the current rigging mode. The corresponding RCL code (1) (Figure 3-84) is specified at the bottom of the table (e.g. 1100).

1. Press the button (3) (Figure 3-85) once, symbol green.
2. Press the button (1) or (2) repeatedly until the display (4) shows the required RCL code.

or

1. Select the RCL code with the switch (5).

The other displays show the corresponding rigging mode.

Now you can enter the reeving and accept the rigging mode.

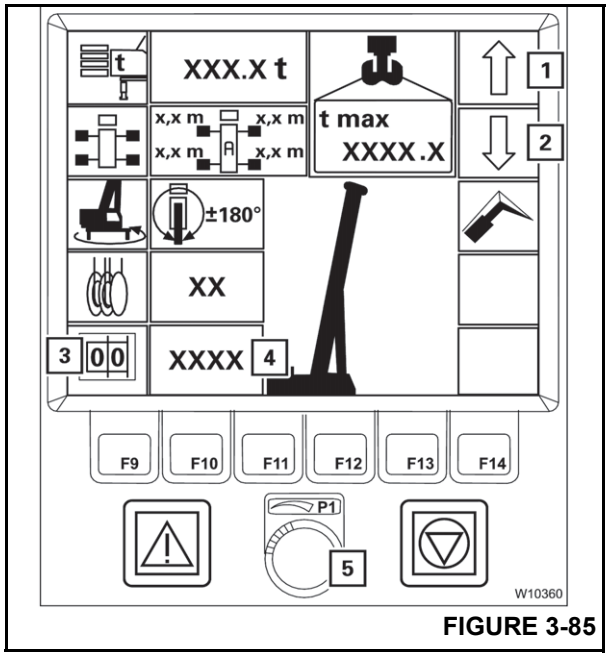


FIGURE 3-85

Entering the Reeving

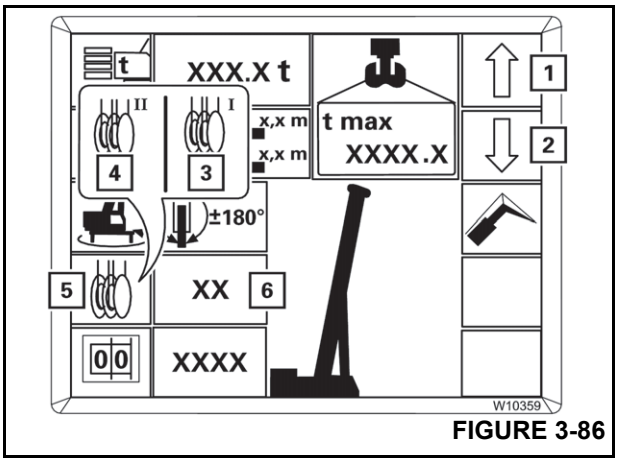


FIGURE 3-86

Entering the reeving does not have an effect on any other component that has already been entered.

1. Press the button (5) (Figure 3-86) repeatedly until the symbol for the hoist with which you want to lift the load has turned green:

   (3) Symbol for main hoist

   (4) Symbol for auxiliary hoist
2. Press the button (1) or (2) repeatedly until the display (6) shows the number of currently reeved rope lines.

3

Approve the Rigging Mode

Prior to crane operation, you must confirm and accept the newly entered rigging mode.

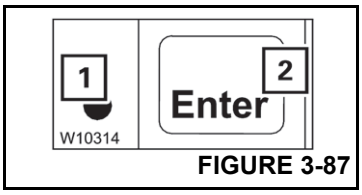


FIGURE 3-87

Confirming Rigging Mode

To confirm the rigging mode, press the button (2) (Figure 3-87) once:

- If the rigging mode is permissible, the lamp (1) goes out. The *Rigging Mode Monitoring Submenu,* page 3-85 opens and you can approve the rigging mode.

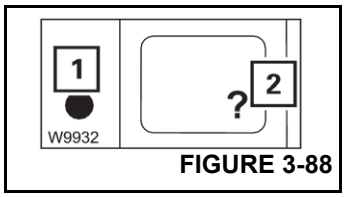


FIGURE 3-88

- If the rigging mode is not permissible, the lamp (1) (Figure 3-88) lights up. Press the button (2) once to display the error codes, refer to *Error Codes,* page 3-103.

Accepting Rigging Mode

You must check whether the current rigging mode of the crane corresponds to the displayed rigging mode.

WARNING

Tipping Hazard!

If the actual rigging mode varies from the displayed rigging mode, the maximum load displayed by the RCL will not correspond to the permissible lifting capacity allowed in the Load Chart. Inaccurate programming of the RCL allows the crane to be improperly operated.

Serious injury or death may occur if the crane is overloaded or overturns.

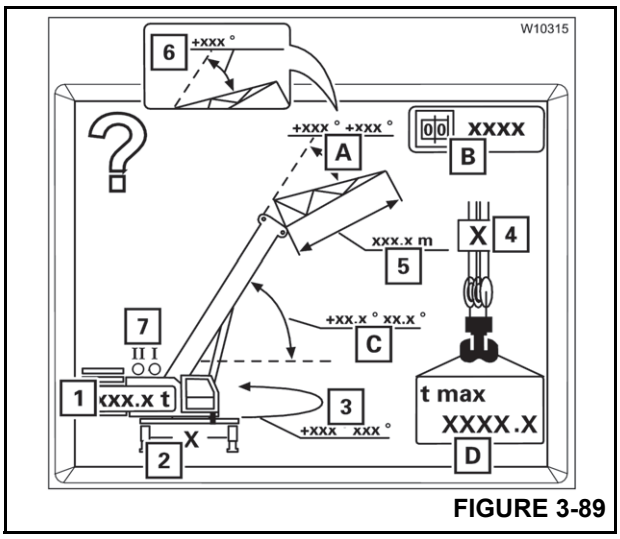


FIGURE 3-89

Check the following (Figure 3-89):

- (1) The rigged counterweight
- (2) The rigged outrigger span
- (3) The swing range for the planned job
- (4) The number of reeved rope lines
- (5) The length of the rigged boom extension
- (6) The angle of the rigged boom extension
- (7) The hoist that is switched on, to switch over hoists, refer to *Entering the Reeving,* page 3-83.

For the rigging mode, the following is displayed:

- (A) The permissible working range of the boom extension
- (B) The RCL code
- (C) The permissible working range of the main boom
- (D) The maximum load

If you need to correct some values, press the Esc button. The *Rigging Mode Submenu,* page 3-78 opens.

If the current rigging mode is displayed, press the Enter button. The *RCL Monitoring Submenu,* page 3-86 opens, and the crane movements are enabled provided no error is pending.

Rigging Mode Monitoring Submenu

For a complete rigging mode input, you must enter, confirm and accept the rigging mode and the reeving.

Rigging Mode Monitoring Menu

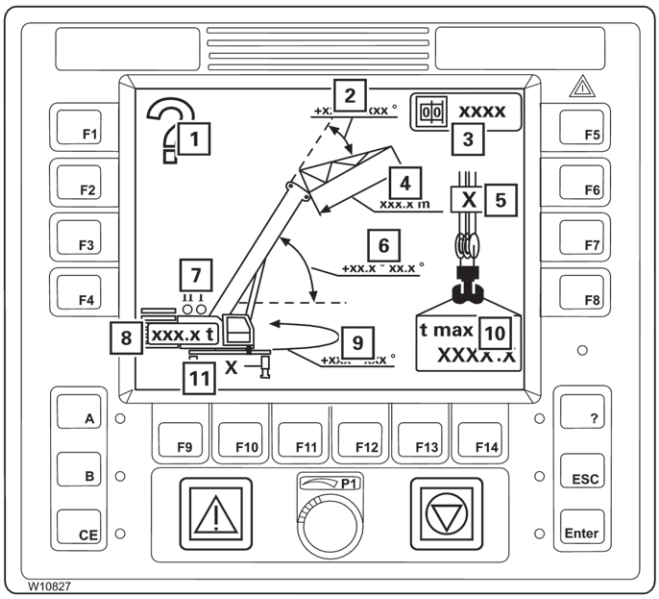


FIGURE 3-90

Item	Description
1	Review rigging mode
2	Permissible boom extension working range
3	RCL code
4	Length of boom extension
5	Reeving
6	Permissible main boom working range
7	Hoists display
8	Counterweight
9	Permissible swing range
10	Maximum load
11	Outrigger span

3

RCL MONITORING SUBMENU

Opening the Submenu

If necessary, open the main menu by pressing the Esc button. Press the F8 button (1) (Figure 3-91) once.

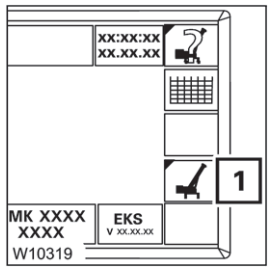


FIGURE 3-91

Monitoring Submenu

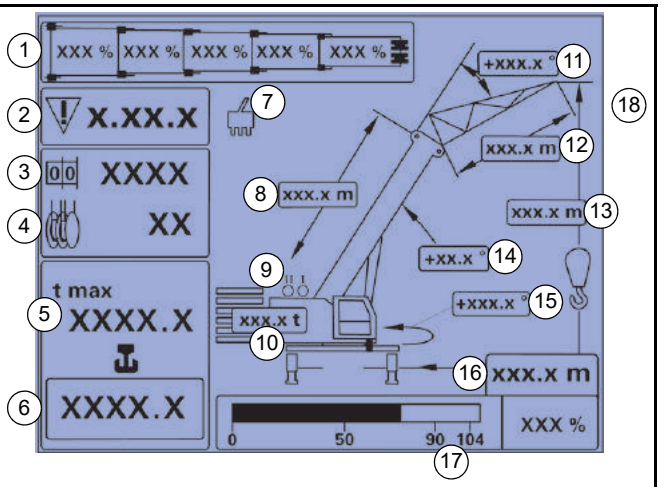
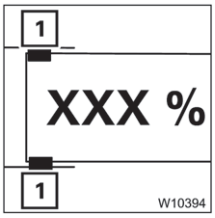
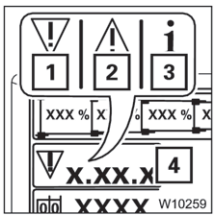
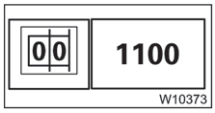
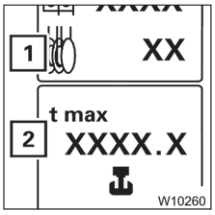
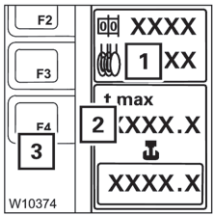
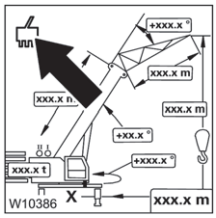
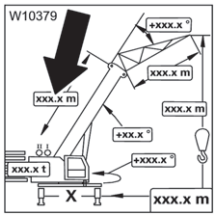
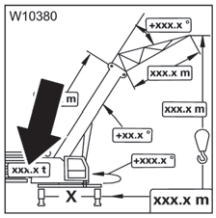


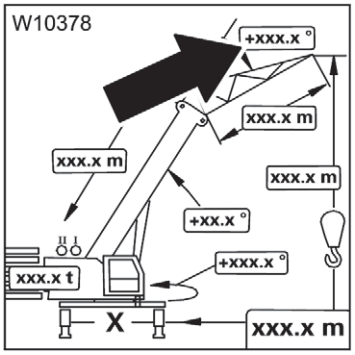
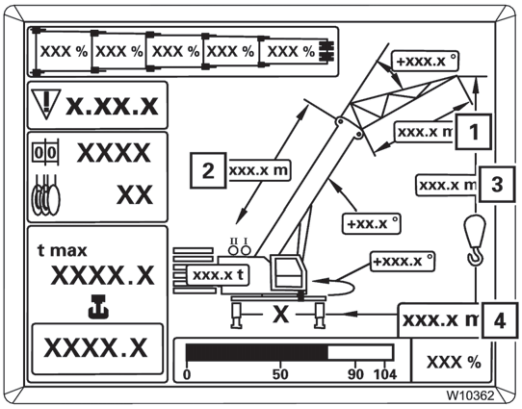
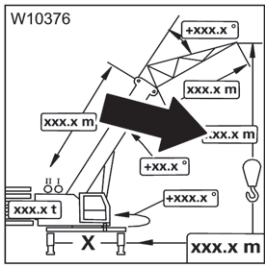
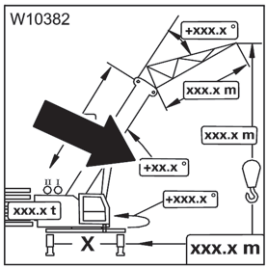
FIGURE 3-92

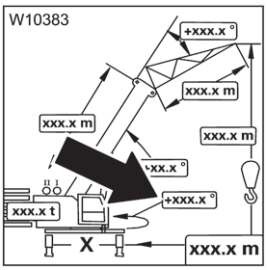
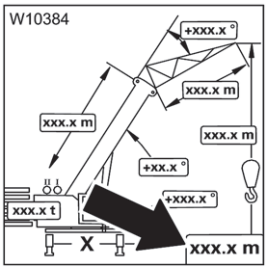
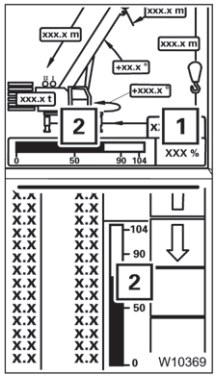
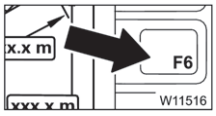
Item	Description
1	Current telescope status display
2	Error display
3	RCL code display
4	Reeving display
5	Maximum load display
6	Current load display
7	Service symbol display
8	Current main boom length
9	Hoists display
10	Counterweight display
11	Boom extension angle display
12	Current length of boom extension
13	Current overall height
14	Current main boom angle display
15	Current swing angle display
16	Current working radius
17	Current percent of max. load; bar graph and number.
18	Load Chart submenu, F6

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	**Current telescope status display**		Telescope status of all telescopic sections in percent, locking pins (1): • **Green**: Fixed length, locked with the locking pin notch engaged to the section • **Flashing**: Intermediate length, locked, locking pin notch not engaged to the section • **Black**: Intermediate length, not locked Refer to *Telescoping the Boom,* page 3-132.
2	**Error display**		(1) Error (2) Warning (3) Information (4) Corresponding number code, press the F2 button once, next available number code. Refer to *Error Submenu,* page 3-101.
3	**RCL code display**		RCL code, four digits.
4	**Reeving display**		(1) Required quantity of reeved ropes for displayed, maximum load (2).
5	**Maximum load display**		The display (2) shows the maximum load that can be lifted in the current rigging mode with the current working radius. If the maximum load is reduced due to the entered reeving, the symbol (1) is red. In this case, you can have the maximum possible load displayed briefly. Press the F4 button (3) once. The display (2) shows the maximum possible load that can be lifted with sufficient reeving according to the Load Chart.

Item	Description	Graphic	Explanation
6	**Current load display**		The display (1) shows the sum of the payload + lifting gear + hook block in metric tons (t) or kilo pounds (klbs), precision ± 5% of actual load. Example: 55.2 klbs is equal to 55,200 lbs.
7	**Service symbol display**		When the Symbol is displayed a service device is connected.
8	**Current main boom length**		Shows the current main boom length in metres (m) or feet (ft).
9	**Hoists display**		• **I on**: Main hoist switched on first, displayed reeving applies to main hoist • **II on**: Auxiliary hoist switched on first, displayed reeving applies to auxiliary hoist • **I** or **II flashing**: Corresponding hoist switched on as well, displayed reeving applies to the other hoist • **I** or **II out**: Corresponding hoist switched off
10	**Counterweight display**		Required counterweight combination in metric tons (t) for displayed RCL code.

Item	Description	Graphic	Explanation
11	Boom extension angle display		With a boom extension installed and the proper RCL code entered, the following is displayed: • Hydraulic boom extension; the current angle, in degrees (°), between the boom extension and main boom. • Offsettable boom extension; the angle, in degrees (°), between boom extension and main boom, for the displayed RCL code. If the displayed RCL code does not apply to a boom extension, there is no display of the extension.
12	**Current length of boom extension**		(1) Current length of boom extension in meters (m). If the displayed RCL code does not apply to a boom extension, there is no display of the extension.
13	**Current overall height**		Overall height is the vertical distance between the lower edge of the outrigger pad and the highest point of the main boom or boom extension. The displayed value applies to fully extended support cylinders on the largest outrigger span. The value is displayed either in meters (m) or in feet (ft), depending on the setting.
14	**Current main boom angle display**		Shows the current main boom angle in relation to the horizontal. Angles below the horizontal are displayed with a minus sign, e.g. –3°.

Item	Description	Graphic	Explanation
15	**Current swing angle display**		Shows the angle of the current superstructure position. 0° means that the superstructure is swung to the front. • **0°**: Position 0° to the front • **180°**: Position 180° to the rear • **+0.1 to +180.0°**: Turned to the right from 0° • **–0.1 to –179.9°**: Turned to the left from 0°
16	**Current working radius**		Shows the current working radius = horizontal distance between the turntable axis and the hook block axis. The displayed value is calculated on the basis of the telescoping and the main boom or boom extension angle. The value is displayed either in meters (m) or feet (ft), depending on the setting.
17	**Current percent of maximum load**		The percent of max. load shows the weight of the current load as a percentage of the maximum possible load. The display (1) indicates the percentage value. The display (2) shows the ranges in different colors: • **Blue**: 0 - 90% • **Yellow**: Approx. 90 -100%, early warning • **Red**: Greater than 100%, shutdown.
18	**Load Chart submenu, F6**		Press the F6 button to open the Load Chart submenu.

Error Messages in the Monitoring Submenu

For more information on RCL error messages, refer to *Error Submenu,* page 3-101

WARNING

Immediately stop operating the crane if an error message is displayed! Take the appropriate actions before resuming operation.

The RCL may only be repaired by trained and qualified personnel.

If the RCL detects an error, an error message is shown on the RCL control unit.

There are different types of error messages:

- Error messages without shutdown,
- Error messages with shutdown.

Error Message without Shutdown

Refer to Figure 3-93.

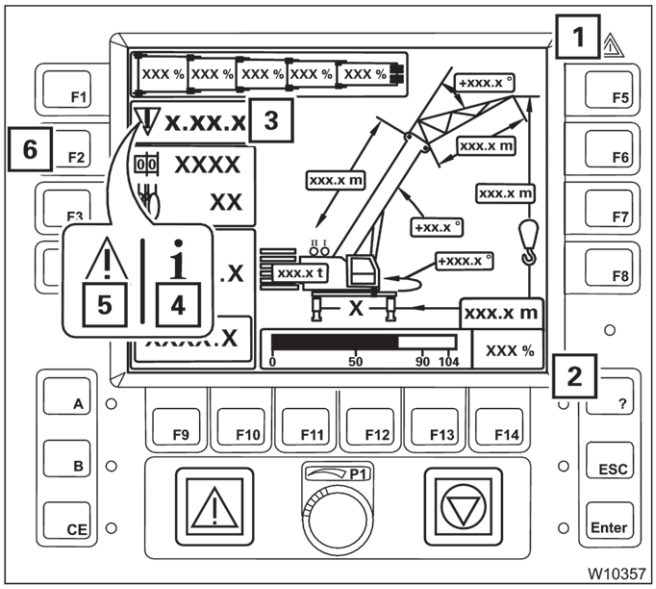


FIGURE 3-93

The error message is displayed either as a warning or information.

- The buzzer tone sounds once.
- Lamps (1) and (2) light up.
- Display (3) shows an error code and the respective symbol flashes:
  - (4) Information symbol
  - (5) Warning symbol

You can have all existing error messages displayed by repeatedly pressing the F2 button (6).

Try to remedy the error by turning off the ignition and turning it on again after about 15 seconds.

If the error is displayed again, check whether the error code is contained in the Error Codes table. This table contains information on how to remedy errors, refer to *Error Codes,* page 3-103.

Error Message with Shutdown

Refer to Figure 3-94.

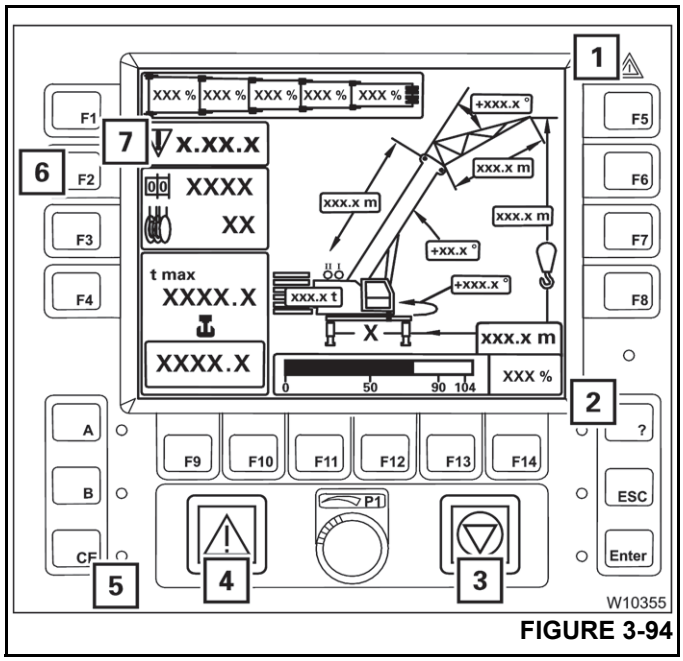


FIGURE 3-94

When this type of error occurs:

- All crane movements are turned off which are not required for the correction of the error.
- A continuous buzzer tone sounds.

  After five seconds, you can switch off the buzzer tone using the *CE* button (5).
- Lamps (1) and (2) light up.
- Lamps (3) and (4) light up.
- Display (7) shows an error code and the error symbol flashes.

You can have all existing error messages displayed by repeatedly pressing the F2 button (6).

Check whether the Error Codes table contains the error. These tables contain information on how to remedy errors, refer to *Error Codes,* page 3-103.

LIFTING CAPACITY TABLES SUBMENU

This submenu displays the status of the current lift based on the RCL code and current telescope status or you can have the lifting capacity tables displayed for all permissible telescoping statuses.

From this menu you can display the working range for all permissible telescope statuses by pressing the F9 button, refer to *Working Range Submenu,* page 3-96.

Opening the Submenu

In the Monitoring main menu or submenu, press the F6 button (1) (Figure 3-95) once.

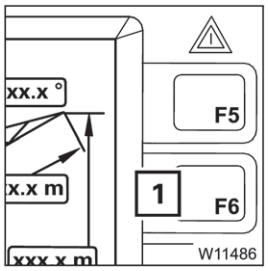


FIGURE 3-95

Lifting Capacity Tables Menu

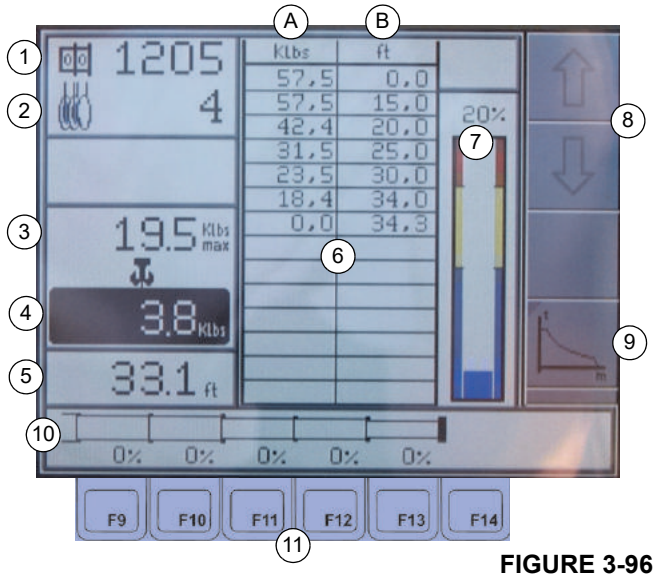
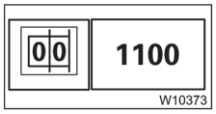
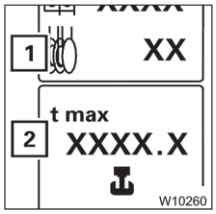
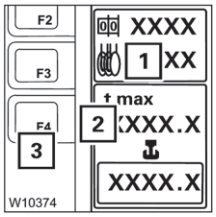
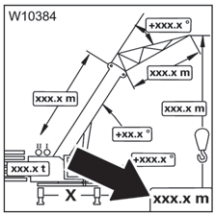
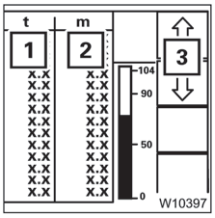


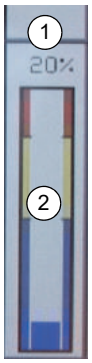
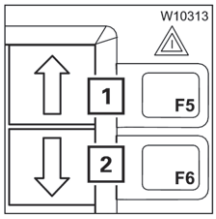
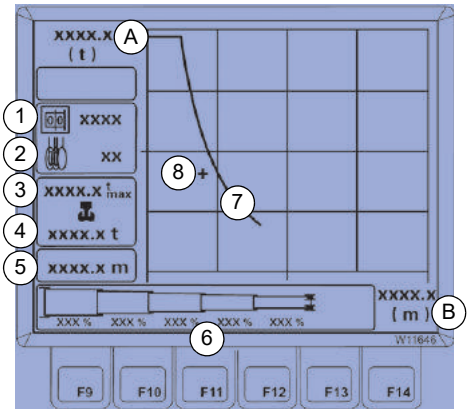
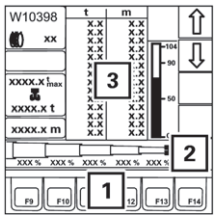
FIGURE 3-96

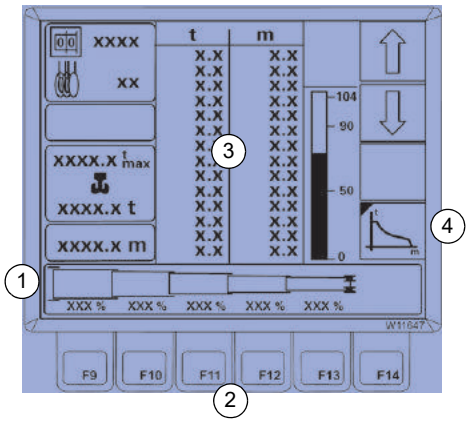
Item	Description
1	RCL code display
2	Reeving display
3	Maximum load display
4	Current load display
5	Current working radius display
6	Load Chart display: (A) Maximum load table (B) Working radius table
7	Current percent of maximum load display
8	Selection: Up, F5 Down, F6
9	Working range submenu
10	Telescope status display
11	Telescope status input buttons, F9-F13

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	**RCL code display**		RCL code, four digits.
2	**Reeving display**		(1) Required quantity of reeved ropes for displayed, maximum load (2).

Item	Description	Graphic	Explanation
3	**Maximum load display**		The display (2) shows the maximum load that can be lifted in the current rigging mode with the current working radius. If the maximum load is reduced due to the entered reeving, the symbol (1) is red. In this case, you can briefly display the possible maximum load: Press the F4 button (3) once. The display (2) shows the maximum possible load that can be lifted with sufficient reeving according to the Load Chart.
4	**Current load display**		The display (1) shows the sum of the payload + lifting gear + hook block in metric tons (t) or kilo pounds (klbs), precision ± 5% of actual load. Example: 55.2 klbs is equal to 55,200 lbs.
5	**Current working radius display**		Shows the current working radius; the horizontal distance between the turntable axis and the hook block axis. The displayed value is calculated on the basis of the telescoping and the main boom or boom extension angle. The value is displayed either in metres (m) or feet (ft), depending on the setting.
6	**Load Chart display**		Values for displayed RCL code and displayed telescope status: (1) Lifting capacity in metric tons (t) or in kilo pounds (klbs). (2) Working radius in metres (m) or feet (ft). (3) Press to show more values in the event of longer tables. The table (1) displays the maximum load as it relates to the working radius (2).

Item	Description	Graphic	Explanation
7	**Current percent of maximum load display**		The current percent of maximum load display shows the weight of the current load as a percentage of the maximum possible load. The display (1) indicates the percentage value. The bar graph (2) shows the ranges in different colors: • **Blue**: 0 - 90% • **Yellow**: Approx. 90 -100%, early warning • **Red**: Greater than 100%, shutdown
8	**Selection**		In input mode: (1) Press the F5 button once; the next greater value will be displayed (2) Press button once; the next smaller value will be displayed.
9	**Working range submenu**		(1) RCL code display (2) Reeving display (3) Maximum load display (4) Current load display (5) Current working radius display (6) Telescope status display/input (7) Permissible working range display (A) Permissible load (B) Permissible working radius (8) Current position display Refer to *Working Range Submenu,* page 3-96.
10	**Telescope status display**		Telescope status (2) in percent. Press an associated button, F9 to F13 (1): • The new telescope status will be displayed (2) • The corresponding value will display in the table (3) • If all values are 0, then no table is available.

Item	Description	Graphic	Explanation
11	**Telescope status input, F9-F13**		You can display the lifting capacity tables for all permissible telescoping statuses: Enter the desired telescoping status (1) with the F9 to F13 buttons (2). The corresponding Load Chart (2) is displayed. In the event of impermissible telescoping statuses, all values in the Load Chart will be 0. To display the permissible working range for the entered RCL code and telescope status or all permissible telescope statuses, press the F8 button (4) to open the working range submenu. Refer to *Working Range Submenu,* page 3-96.

WORKING RANGE SUBMENU

This submenu displays the permissible working range (the area under the curve) for the entered RCL code and the telescope status of the current lift or you can have the working range displayed for all permissible telescoping statuses.

The curve (8) (Figure 3-98) displays the permissible working range for the entered RCL code (1) and the telescope status (6).

The working range ends at the maximum possible working radius (B). Reduction of the working radius increases the enabled load along the curve (8) up to the maximum possible load (A). There has to be enough reeving for this load.

The maximum load (3) corresponds to the current reeving (2).

The cross (9) indicates the position in the working range for the current load (4) and the current working radius (5).

Opening the Submenu

In the lifting capacity submenu, press the F8 button (1) (Figure 3-97) once.

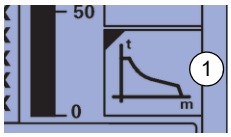


FIGURE 3-97

Working Range Menu

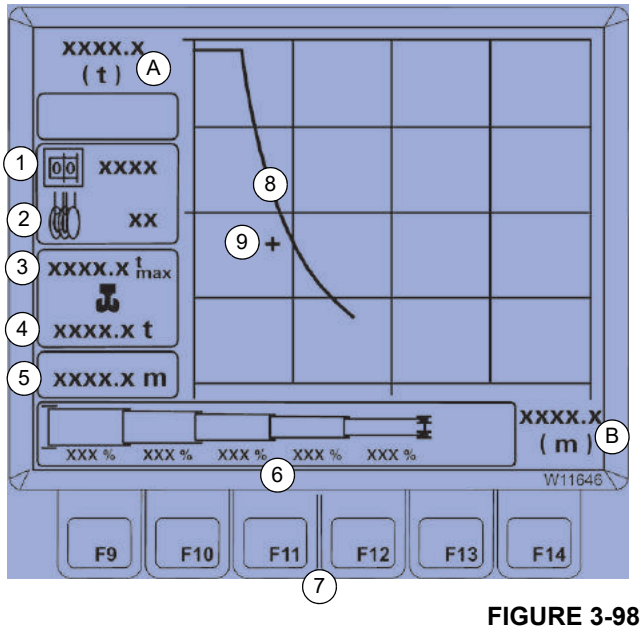
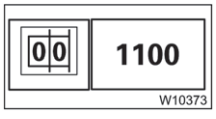
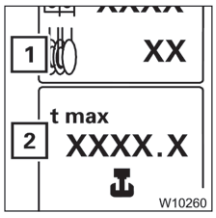
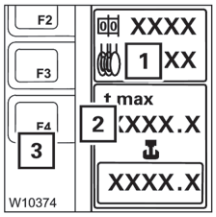
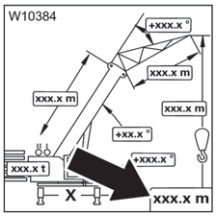
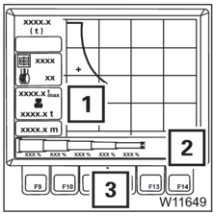


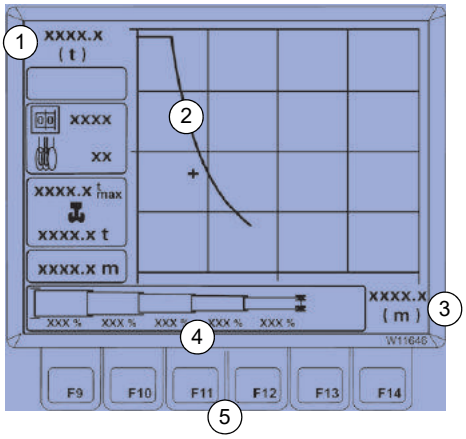
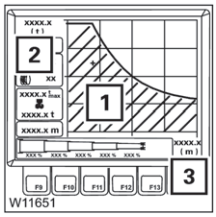
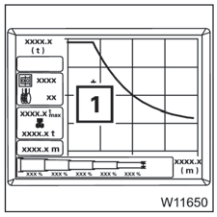
FIGURE 3-98

Item	Description
1	RCL code display
2	Reeving display
3	Maximum load display
4	Current load display
5	Current working radius display
6	Telescope status display
7	Telescope status input buttons, F9-F13
8	Permissible working range display: (A) Permissible load (B) Permissible working radius
9	Current position display

Refer to the following table for a description of each item listed above.

Item	Description	Graphic	Explanation
1	**RCL code display**		RCL code, four digits.
2	**Reeving display**		(1) Required quantity of reeved ropes for displayed, maximum load (2).

Item	Description	Graphic	Explanation
3	**Maximum load display**		The display (2) shows the maximum load that can be lifted in the current rigging mode with the current working radius. If the maximum load is reduced due to the entered reeving, the symbol (1) is red. In this case, you can briefly display the possible maximum load: Press the F4 button (3) once. The display (2) shows the maximum possible load that can be lifted with sufficient reeving according to the Load Chart.
4	**Current load display**		The display (1) shows the sum of the payload + lifting gear + hook block in metric tons (t) or kilo pounds (klbs), precision ± 5% of actual load. Example: 55.2 klbs is equal to 55,200 lbs.
5	**Current working radius display**		Shows the current working radius; the horizontal distance between the turntable axis and the hook block axis. The displayed value is calculated on the basis of the telescoping and the main boom or boom extension angle. The value is displayed either in metres (m) or feet (ft), depending on the setting.
6	**Telescope status display**		Telescope status (2) in percent. Press an associated button, F9 to F13 (3): • The new telescope status will be displayed (2) • The corresponding working range will display (1) • If all values are 0, then the telescope status is outside the working range.

Item	Description	Graphic	Explanation
7	**Telescope status input**		You can display the working range for all permissible telescoping statuses: Enter the desired telescoping status (4) with the F9 to F13 buttons (5). The displays (1), (2), and (3) show the respective permissible working range. If the telescoping status is not within the working range: • the displays (1) and (3) will show the value 0 • no curve (2) will be shown.
8	**Permissible working range display**		The display applies to the current RCL code and telescope status. (1) Permissible working range; area under the curve (2) Maximum possible load (3) Maximum possible working radius
9	**Current position display**		(1) Current position, defined by current load and current working radius.

SETTINGS SUBMENU

The settings submenu is where you set the time and date. It also displays the data when a service device is connected. The other settings should only be changed by a qualified technician.

Opening the Submenu

In the Main menu, press the F4 button (1) (Figure 3-99) once, the Settings submenu opens.

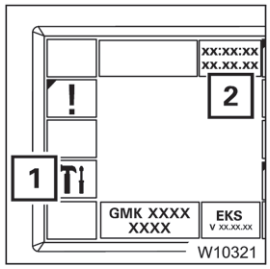


FIGURE 3-99

Settings Submenu

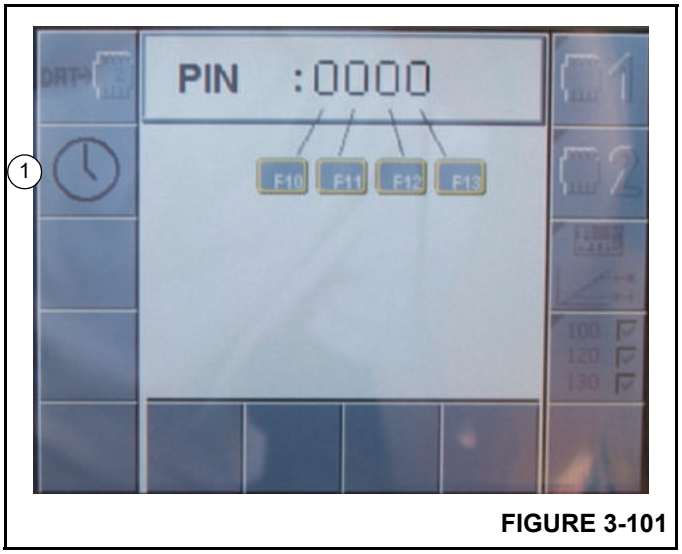


FIGURE 3-101

Cancel the Input

You can exit the Settings submenu at any time without saving your input.

Press the *Esc* button (1) (Figure 3-100) once.

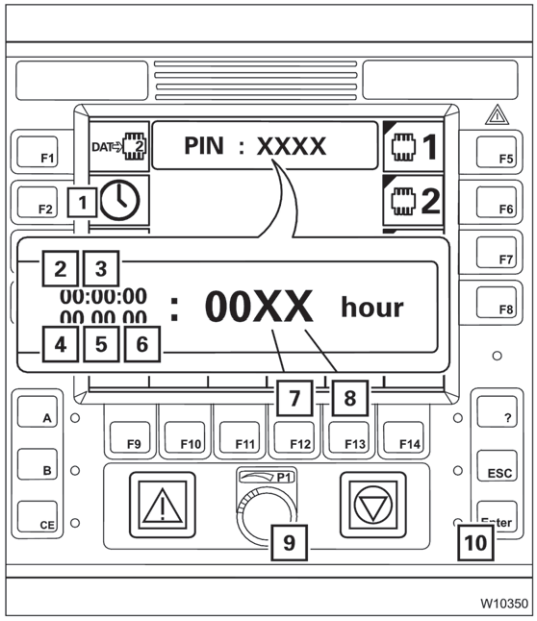
FIGURE 3-100

NOTE: Buttons/displays (3) (Figure 3-101) are only shown if a service device is connected.

Item	Description
1	Enter the time/date

Refer to the following table for a description of each item listed above.

3

Item	Description	Graphic	Explanation
199	Enter the time/date		Press the F2 button (1) repeatedly until the desired value flashes: (2) Hours (3) Minutes (4) Day (5) Month (6) Year • Enter the new value with the F12 button (7) and F13 button (8) or with the knob (9). • Enter all the required values. • Press the *Enter* button (10) once, the newly entered values are accepted and displayed in the main menu. Illogical values (e.g. 77 seconds) are not accepted and the display continues to flash. You can cancel the input at any time; press the Esc button. None of the values are changed.

ERROR SUBMENU

The RCL Error submenu is where you access and acknowledge any errors that are present.

Opening the Submenu

Stop all crane movements and bring both control levers into zero position.

Press the button (2) (Figure 3-102) once. The button is only active when the lamp (1) flashes or lights up.

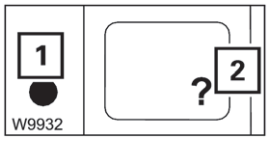


FIGURE 3-102

Exiting the Submenu

You can exit the Error submenu at any time.

Press the Esc button (1) (Figure 3-103) once.

FIGURE 3-103

The same menu opens that was open before the Error submenu opened.

NOTE: All errors remain saved until you switch off the ignition, even those errors of which the cause has been eliminated in the meantime. All existing errors are treated as new errors and displayed again after turning on the ignition.

Error Submenu

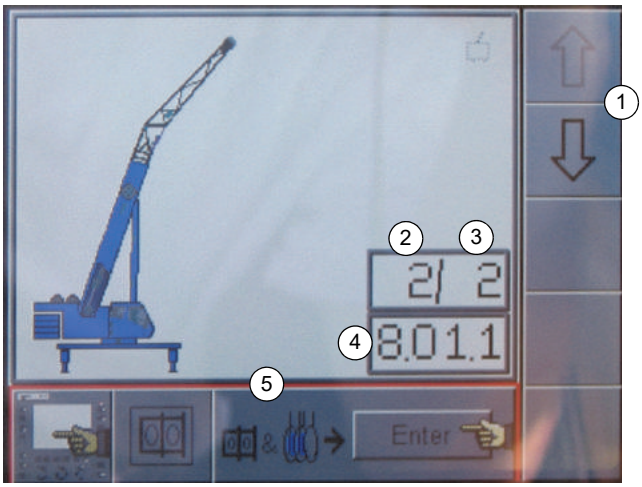
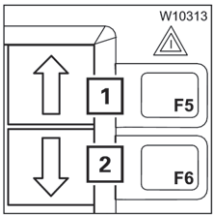
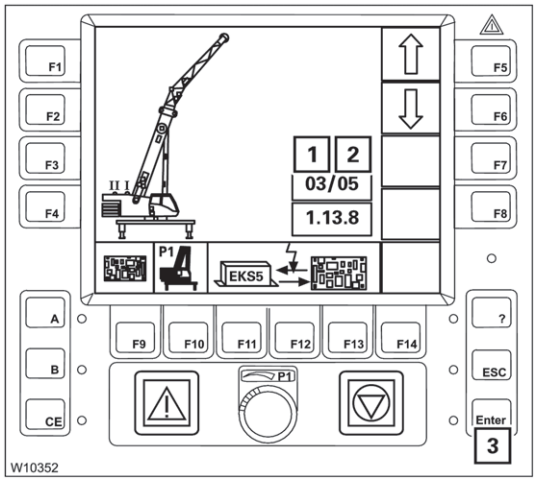
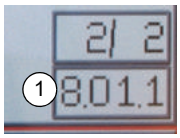
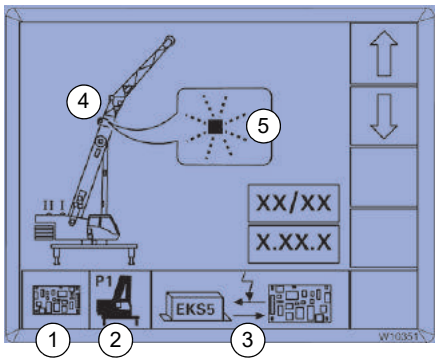


FIGURE 3-104

Item	Description
1	Selection
2	Display of current error
3	Display of total errors
4	Error code
5	Error display

Refer to the following section for a description of each item listed above.

Item	Description	Graphic	Explanation
1	**Selection**		You can call up all current errors with the buttons (1) and (2). (1) Display errors in ascending order. (2) Display errors in descending order. Every time you press, the next error will be displayed. When you keep a button pressed, all errors are shown one after the other continuously.

Item	Description	Graphic	Explanation
2	**Display of current error**		Item (1) shows which error is displayed. Item (2) shows the error total. For example, 3/5 means: • error 3 is shown • there is a total of 5 errors. If the error shown is not acknowledged, the lamp next to the *Enter* button (3) lights up. To acknowledge the error, press the *Enter* button (3) once. The next, pending error is displayed and can be acknowledged.
3	**Display of total errors**		
4	**Error code**		Check whether the *Error Codes,* page 3-103 contain the error and the appropriate action to be taken. If the error code is not in the error code table contact Manitowoc Crane Care.
5	**Error display**		The error display includes the following symbols: (1) the error group (2) the faulty component (3) the type of error In some cases the error location (4), will have a red flashing indicator (5).

Error Codes

The following table contains a number of error codes, their causes and possible remedies.

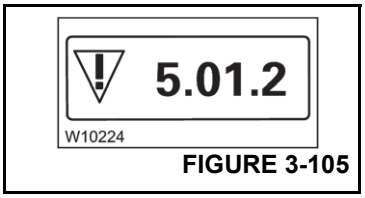


FIGURE 3-105

An error code (Figure 3-105) consists, from left to right, of a one-digit number (e.g. 5), a two-digit number (e.g. 01) and a one-digit number (e.g. 2).

Check whether the table contains the displayed error code. If the information in the table does not help to remedy an error, note the error code(s) down and contact Crane Care.

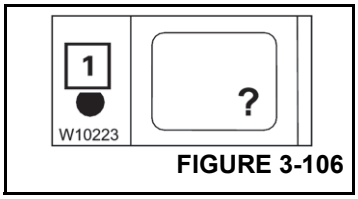


FIGURE 3-106

When all errors are remedied, the lamp (1) (Figure 3-106) goes out.

Table 3-1Error Code Table

Error code			Cause	Remedy
1	01	1...7	Error pressure sensor 1, Lower chamber	Switch off pressure sensor 1; Refer to Service Manual.
1	01	8	Pressure sensor 1 switched off	Have malfunction rectified.
1	02	1...7	Error pressure sensor 2, Lower chamber	Switch off pressure sensor 2; Refer to Service Manual.
1	02	8	Pressure sensor 2 switched off	Have malfunction rectified.
1	04	1...7	Error angle sensor 1, Main boom	Switch off angle sensor 1; Refer to Service Manual.
1	04	8	Angle sensor 1 switched off	Have malfunction rectified.
1	05	1...7	Error angle sensor 2, Main boom	Switch off angle sensor 2; Refer to Service Manual.
1	05	8	Angle sensor 2 switched off	Have malfunction rectified.
1	13 to 21	1	Boom extension not connected or sensor faulty	Electrically connect boom extension; if the error persists, notify Crane Care.
3	03	3	Comparison of telescoping diagram between ECOS control and RCL resulted in differences	Compare the actual telescope status with the values on the ECOS control display and, if necessary, re-enter the telescoping position. Accept the telescope status from the ECOS control if incorrect telescope status is displayed on the RCL: 1. Press the F3 + *Enter* buttons once, the RCL shows the new values. 2. Press *Enter* to acknowledge the error.
5	01	1	There is no capacity diagram available for the entered rigging mode	Re-enter the current rigging mode. If the error is displayed again, check whether the current rigging mode is permissible.
5	01	2	Main boom angle too small (not steep enough)	Raise the main boom.
5	01	3	Main boom angle too large (too steep)	Lower the main boom.
5	02	1	There is no RCL code available for the entered rigging mode	Re-enter the current rigging mode. If the error is displayed again, check whether the current rigging mode is permissible.
5	02	4	Boom extension angle is too small	Raise the boom extension.
5	02	5	Boom extension angle is too large	Lower the boom extension.

Table 3-1Error Code Table

Error code			Cause	Remedy
5	02	6	Current load is greater than the lift capacity, lower boom extension function is disabled	1. Raise the boom extension 2. Press *Enter* button once 3. If necessary, increase the working radius by lowering the main boom.
5	04	4	Maximum permissible swing angle exceeded	Swing into a permissible working range.
5	05	5	Minimum load value not reached	When the main boom is set down, raise main boom and acknowledge the error. Notify Crane Care if the error cannot be acknowledged.
6	02	1	Fuse F1 blown	Replace blown fuse; refer to the Service Manual.
6	02	2	Fuse F2 blown	
6	02	3	Fuse F3 blown	
6	02	4	Fuse F11 blown	
6	02	5	Fuse F12 blown	
8	01	1	Rigging state not yet confirmed	Confirming the rigging mode, Refer to *Entering the Rigging Mode,* page 3-81.
8	02	2	RCL is overridden	Cancel the override; Refer to *RCL Override,* page 3-73.
8	03	3	Swing gear switched ON with RCL code for working position 0°, 180° or Free-on-wheels.	Switch off the swing gear.
8	14	1	Maximum permissible overall height exceeded[1].	Retract or lower.
8	14	2	Maximum permissible overall working radius exceeded[1].	Raise or retract.
8	14	3	Maximum permissible overall swing range exceeded[1].	Swing into a permissible working range.
8	14	4	Shutdown area of a monitored object reached[1].	Move into a permissible working range.

[1] With working range limiter switched on.

OPERATING PROCEDURES

New Crane Conditioning

Your new Grove carrier has been thoroughly tested, adjusted, lubricated, and inspected prior to delivery. For detailed engine conditioning, refer to the applicable engine manual.

The guidelines below will aid in getting a long service life out of the crane.

1. Operate as much as possible in the half to three-quarters throttle or load range.
2. Avoid long periods of operation with the engine at idle or continuous maximum horsepower levels.
3. Observe instruments often and shut down at the first indication of an abnormal reading.
4. Operate to a power requirement that allows acceleration to governed speed when conditions require more power.
5. Check all components frequently for proper operation, unusual noises, and excessive heating.
6. Check the engine oil and coolant levels frequently.

These guidelines should not be considered limitations but rather as a guide for familiarization of the machine 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 checklist items are suggested specifically for the operator's benefit to make certain his crane is prepared for starting the day's work.

Fuel Supply

Check the fuel level and make sure the cap is on tight.

Engine Oil

Check the oil level in the crankcase and fill to the FULL mark on the dipstick. Do not overfill.

Engine Coolant

Check the coolant level in the radiator and fill to the proper level. Do not overfill and check to make sure the cap is secure.

Batteries

Check that the battery cables and clamps are tight and not corroded.

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.

Foot and Parking Brakes

Check the foot and parking brakes for proper operation.

Daily Lubrication

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

Hydraulic Reservoir and Filter

Check hydraulic fluid quantity level and filter condition indicator. Check breather for cleanliness and ensure it is secure.

Tires

Check for severe cuts, foreign objects embedded in treads, and for correct inflation pressures. A tire inflation chart, providing the correct air pressures, is located in the Load Chart Book in the crane cab.

Wire Rope

Inspect wire rope in accordance with applicable Federal Regulations.

Inspect sheaves, guards, guides, drums, flanges, and any other surfaces that may come in contact with the rope for any condition that could cause possible damage to the rope.

Hook Block

Visually inspect for nicks, gouges, cracks, and evidence of any other damage. Replace any hook that contains cracks or shows evidence of excessive deformation of the hook opening, including twist. Be sure the safety latch is free and aligned.

Boom

Ensure the large access cover on top of the boom base section is in place. The boom should not be operated unless it is installed.

Air Cleaner

Check the filter condition indicator. Check filter and tubing for security.

Access Hole Covers (CE Units)

Ensure the covers are installed in all access holes in the boom and the outrigger beams.

Wind Forces

Wind can have a significant affect on loads that may be lifted by a crane. Wind forces act differently on a crane depending

upon the direction from which the wind is blowing (e.g., wind on the rear of the boom can result in decreased forward stability, wind on the underside of the boom can result in decreased backward stability, wind on the side of the boom can result in structural damages, etc.). To assist you in determining prevailing wind conditions, refer to Table 3-2.

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

Table 3-2

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

Cold Weather Operation

Regions with ambient temperatures below -9°C (15°F) are considered arctic. The following recommendations are for operating Grove cranes in very low temperatures.

Use particular care to ensure that cranes being operated in very cold temperatures are operated and maintained in accordance with the procedures as provided by Grove. Cranes should have appropriate hydraulic oil, lubricants, and other auxiliary items required for operation in cold weather 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 -9°C (15°F) and -40°C (-40°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.

Use the correct grade of oil for the prevailing temperature in the crankcase to prevent hard cranking. Diesel fuel should have a pour point of 6°C (10°F) less than the lowest expected temperature. In case of emergency, white kerosene may be added to the fuel to bring the pour point down to the required temperature to prevent clogging of filters and small passages by wax crystals. The addition of kerosene is NOT recommended for general use.

Operation Below -40°F

For crane operation below -40°F, capacities shall be de-rated 2 percent of the rated load shown on the capacity charts for each degree below -40°F.

Operation Below -40°C

For crane operation below -40°C, capacities shall be de-rated 3.67 percent of the rated load shown on the capacity charts for each degree below -40°C.

Preheating the Hydraulic Oil

NOTE: If the oil is cold, it may take time for the solenoid valves or the power units to properly operate.

The current hydraulic oil temperature (1) is displayed in the Monitoring submenu (Figure 3-107).

FIGURE 3-107

To open the ECOS Monitoring submenu, press the monitoring submenu button (Figure 3-108) in the main menu.

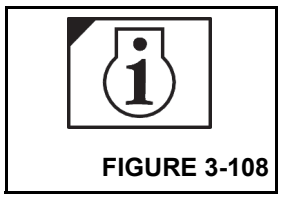


FIGURE 3-108

Temperature ranges and their effects:

- Above 50°F (10°C)

  Normal crane operation is permissible without speed restriction.

- From 50°F to 32°F (10°C to 0°C)

  To preheat, carry out crane movements with loads only in normal operation mode, at average engine speed and at average operating speed.

- From 5°F to 32°F (–15°C to 0°C)

  To preheat, only carry out crane movements without a load. Only operate at normal speed, at medium engine speed and medium working speed.

- Below 5°F (–15°C)

  Crane movements are not permitted. Preheat the hydraulic oil first.

Preheating

1. Set the swing gear to a maximum speed of 30%.
2. Lock the turntable.
3. Actuate the swing brake pedal.
4. While holding the swing brake on, attempt to swing the boom.
5. Observe the hydraulic oil temperature; the hydraulic oil is preheated when the display (1) (Figure 3-107) shows a temperature of at least 50°F (10°C).

From 5°F (–15°C), you can perform crane movements without a load in order to speed up the preheating process.

NOTE: Operate all crane functions at least twice after preheating the hydraulic oil temperature above 50°F (10°C) in order to remove the cold oil from all parts of the hydraulic system.

Cold Climate Engine Operation

For engine specific cold climate operation information for corresponding engines, Go to: http://www.cummins.com/-QuickServe Online *Service Bulletin no.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 Grove 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 Grove 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 Manual and supplement before operating the crane at full load.

Engine

Warm-up Procedures for All Temperature Ranges:

1. Upon startup, allow 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 engine speed to provide adequate lubrication to bearings and allow oil pressure to stabilize.

Transmission

CAUTION

For full load functionality, a minimum sump temperature of 20°C (68°F) is required. Before reaching 20°C (68°F) sump temperature only neutral gear or unloaded driving is allowed, not exceeding 1500 engine RPM and not exceeding half throttle.

Operating transmission with a sump temperature below normal operating temperature is limited to:

- operating in neutral gear or
- driving with an unloaded crane while not exceeding 1500 engine RPM and not exceeding half throttle.

Warm-up Procedure

1. Engage parking brake and apply service brake.

CAUTION

Avoid Crane Damage!

Do not engage the park brake while the vehicle is moving. Damage to the crane can occur.

Disengage the park brake before driving. Damage to the crane can occur.

2. Shift transmission into the highest gear and increase engine RPM to 1500 for 15 seconds, then allow engine RPM to return to idle.
3. Repeat Step 2 until temperature of transmission sump reaches normal operating temperature.

Alternate Warm-up Procedure

1. Setup crane on outriggers.
2. Engage transmission with 4-wheel drive selected (if equipped) and allow crane to run at idle until temperature of 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.

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 hoist function, warm hydraulic oil (see *Hydraulic Oil System*, page 3-108).
2. Once hydraulic system is warm, operate 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 crane on fully extended outriggers, with boom fully retracted and near maximum lift angle with no load applied.
2. Rotate superstructure at a speed of less than one RPM for at least one complete revolution in one direction, then rotate superstructure at a speed of less than one RPM for at least one complete revolution in opposite direction.

Warm-up Procedures for Temperatures Below -7°C (20°F):

1. Ensure boom is fully retracted and near maximum lift angle with no load applied.
2. Rotate superstructure at a speed of less than one-half RPM for at least two complete revolutions in one direction, then rotate superstructure at a speed of less than one-half RPM for at least two complete revolutions in opposite direction.

Axles

Warm-up Procedures for Temperatures Below -35°C (-30°F):

1. Setup crane on outriggers.
2. Engage transmission (see *Transmission*, page 2-1) with 4-wheel drive selected (if equipped) and allow crane to run at idle until temperature of 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.

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 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 operation and engine immediately and contact a Grove 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 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 crane's hydraulic oil cool by running engine at idle with no functions actuated.

Battery Disconnect

The battery disconnect switch is located near the battery box and the left rear wheel on the left side of the crane. To disconnect the batteries, place the battery disconnect switch to OFF. Place the switch to ON to connect the batteries.

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.)

Jump Starting Hazard

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.

This crane has 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. Refer to *Charging the Batteries,* page 3-109.

Charging the Batteries

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.

Starting Procedure

Make an under-the-hood inspection for fuel, oil, and coolant leaks, worn drive belts, and trash build-up.

If the crane was inactive for over 24 hours and the batteries were disconnected, make sure to connect the batteries before proceeding with start-up procedure.

WARNING

Diesel engine exhaust can be harmful to your health. Only operate the engine in a well ventilated area or vent exhaust outside.

Before starting the engine, apply the parking brake and engage the swing lock.

CAUTION

Never crank the engine for more than 30 seconds during an attempted start. If the engine fails to start after 30 seconds, stop and 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 further starts.

Damage to the starter or other components could result if these warnings are not followed.

Warm Engine

WARNING

Do not spray starting fluid into the air inlet. The spray will contact the heater elements and could explode causing personal injury.

NOTE: The engine ECM monitors the engine and, under certain conditions, cycles the air heater on and off at start-up and during operation.

The engine is equipped with an electric air heater grid at the air inlet elbow to aid in cold starting and reduce white smoke at start-up. In the preheat mode, the engine should not be cranked until the WAIT-TO-START lamp turns off.

1. Ensure the service brake pedal is depressed, parking brake is set and the transmission is in neutral.

CAUTION

Avoid Crane Damage!

Do not engage the park brake while the vehicle is moving. Damage to the crane can occur.

Disengage the park brake before driving. Damage to the crane can occur.

NOTE: Engine will not crank unless service brake pedal is depressed and transmission shift lever is in neutral.

2. Turn the IGNITION switch to START and release immediately when the engine starts. Do not push or hold the throttle down. The ECM will automatically provide the proper amount of fuel to start the engine.
3. Immediately check the engine instruments for proper indications after starting. Shut down the engine if the oil pressure gauge does not reach the proper reading within 15 seconds.

CAUTION

If temperature indicator(s) do not display proper readings, shut down the engine and correct the malfunction before resuming operation.

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

Cold Engine

WARNING

Do not spray starting fluid into the air inlet. The spray will contact the heater elements and could explode causing personal injury.

NOTE: The engine ECM monitors the engine and, under certain conditions, cycles the air heater on and off at start-up and during operation.

The engine is equipped with an electric air heater grid at the air inlet elbow to aid in cold starting and reduce white smoke at start-up. In the preheat mode, the engine should not be cranked until the WAIT-TO-START lamp turns off.

1. Ensure the service brake pedal is depressed, parking brake is set and the transmission is in neutral.

NOTE: The engine will not crank unless the service brake pedal is depressed and the transmission shift lever is in neutral.

CAUTION

Avoid Crane Damage!

Do not engage the park brake while the vehicle is moving. Damage to the crane can occur.

Disengage the park brake before driving. Damage to the crane can occur.

2. The WAIT-TO-START lamp is illuminated during the preheat time that takes place when the IGNITION switch is in the ON position during cold weather starting. To minimize cranking time during cold weather starting, the engine should not be cranked until the WAIT-TO-START lamp turns off.
3. Turn the IGNITION switch to START and release immediately when the engine starts. Do not push or hold the throttle down. The ECM will automatically provide the proper amount of fuel to start the engine.
4. Immediately check the engine instruments for proper indications after starting. Shut down the engine if the oil pressure warning light remains lit for 15 seconds.

CAUTION

If the temperature indicator does not display proper reading or the oil pressure light remains on, shut down the engine and correct the malfunction before resuming operation.

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

Detailed cold weather starting and operating procedures are covered in the engine manual.

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 idling is necessary, maintain at least 800 rpm.

Racing the Engine

NEVER race the engine during the warm-up period. NEVER operate the engine beyond governed speed (as might occur in 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 for about five minutes to avoid high internal heat rise and allow for heat dissipation.
2. Turn the ignition switch to OFF.

Exhaust System Cleaning

The Exhaust System Cleaning Required Indicator (see page 3-65) is displayed in the warning screen. This indicator will illuminate when the exhaust system is in need of cleaning.

When the Exhaust System Cleaning Indicator illuminates or flashes, start the regeneration process.

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 light will illuminate in addition to the Cleaning indicator and a severe engine derate will occur.

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.

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 Switch*, page 3-10 for more details 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. When the Cleaning Switch is in the active cleaning (center) position, active cleaning is enabled. This is recommended.

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 is momentarily placed in the manual cleaning position, manual cleaning is initiated. Often this is preceded by the Cleaning Switch being placed in the inhibit cleaning position, which can lead to the engine operational implications discussed above.

Transporting Crane

CAUTION

Machine Damage Hazard!

Dead end lug not to be used as tie down point for boom during transportation. Failure to comply may result in machine damage. When boom is secured for transport, boom shall not be constrained. All ties downs must allow reasonable freedom of movement.

Crane Travel Operation

Traveling — General

WARNING

Inadvertent Operation Hazard!

Before traveling, ensure the crane function switch is in the off position. This will prevent inadvertent operation of craning functions due to bumping of the controllers while traveling.

RT machines are subject to the same road regulations as any truck, regarding gross weight, width, and length limitations.

Although RT machines are specifically designed for rough terrain, the operator should be extremely cautious and aware of the terrain in which he is operating.

DANGER

Tipping Hazard!

Avoid holes, rocks, extremely soft surfaces, and any other obstacles which might subject the crane to undue stresses or possible overturn.

Do not drive the crane with the boom off center because automatic oscillation lockout will occur, making the crane subject to tipping on uneven surfaces. Center the boom over the front, turn the Swing Brake Switch to ON and engage the Turntable Lock Pin (if equipped).

Fully retract the boom and ensure the swingaway jib is properly stowed and secured.

CAUTION

Machine Damage Hazard!

Traveling at speeds greater than 16 km/h (10 mph) with the fixed counterweight installed and the boom extension stowed can result in axle failure if the boom angle is less than 10°.

When traveling at speeds greater than 16 km/h (10 mph) in the above configuration, ensure that the boom is elevated to an angle between 10° to 20° and the hook block is stowed in the storage tray.

CAUTION

Machine Damage Hazard!

Traveling at speeds greater than 16 km/h (10 mph) with the hydraulically removable counterweight installed and the boom extension stowed can result in axle failure if the boom angle is less than 15°.

When traveling at speeds greater than 16 km/h (10 mph) in the above configuration, ensure that the boom is elevated to an angle between 15° to 20° and the hook block is stowed in the storage tray.

CAUTION

Machine Damage Hazard!

Do not travel with an empty hook in a position where it can swing freely (except where noted). Either remove the hook block and/or overhaul ball from the hoist cable(s) and stow securely or make sure the hook block or overhaul ball is properly secured to the tie down provided for that purpose.

Do not drive the crane with the lift cylinder bottomed. At a minimum, position the boom slightly above horizontal.

Fully retract the outrigger jacks and properly store the floats.

Disengage Main Hydraulic Pump via pump disconnect for cold weather starting of the engine (Sub-Zero). Pump must be re-engaged for travel.

CAUTION

Machine Damage Hazard!

Grove recommends towing or pulling another vehicle with the optional pintle hook (if equipped) or by attaching at a point no higher than the pintle hook height, or severe damage may occur to the drivetrain.

Do not tow or pull by attaching to the tie-down lugs unless the attaching point is no higher than the pintle hook height.

Use four-wheel drive when greater traction is necessary to avoid severe damage to the drivetrain.

Should the crane become mired down, use a tow truck or tractor to free the vehicle. Severe damage to the drivetrain may occur if the operator attempts to free the crane unassisted.

- Use four-wheel drive only when greater traction is necessary. (Refer to *Four-Wheel Drive Operation*, page 3-114 for operating instructions.)
- Ensure the outrigger beams and jacks are fully retracted with the floats properly stowed.
- Conduct all travel with the assistance of a ground person to warn the operator of any changing conditions in the terrain being traversed.

The owner/lessee must take appropriate measures to ensure that all persons operating or working with the affected models are in compliance with Grove U.S. L.L.C. recommendations. The operator of the crane assumes responsibility for determining the suitability of traveling conditions. Traveling under the controlled conditions specified in these guidelines, must be conducted with the utmost diligence and care to ensure the safety of all

personnel performing the operation and/or working around the crane.

Traveling — Towing/Pulling

CAUTION

Machine Damage Hazard!

Grove recommends towing or pulling another vehicle with the optional pintle hook (if equipped) or by attaching at a point no higher than the pintle hook height, or severe damage may occur to the drivetrain.

Do not tow or pull by attaching to the tie-down lugs unless the attaching point is no higher than the pintle hook height.

Use four-wheel drive when greater traction is necessary to avoid severe damage to the drivetrain.

Should the crane become mired down, use a tow truck or tractor to free the vehicle. Severe damage to the drivetrain may occur if the operator attempts to free the crane unassisted.

To avoid severe damage to the drive train while using the crane to tow or pull another vehicle, follow these recommendations:

- Ensure the boom is in a horizontal position and not elevated above 0°.
- Ensure the outrigger beams and jacks are fully retracted with the floats properly stowed.
- Tow or pull on open ground when possible.
- Connect to the optional pintle hook (if equipped) or attach cables/straps to the crane at a point no higher than the pintle hook height.
- Use four-wheel drive when greater traction is necessary. (Refer to *Four-Wheel Drive Operation*, page 3-114 for operating instructions.)
- Should the crane become mired down, use a tow truck or tractor to free the vehicle. Severe damage to the drivetrain may occur if the operator attempts to free the crane unassisted.
- Conduct all travel with the assistance of a ground person to warn the operator of any changing conditions in the terrain being traversed.

Traveling — Being Towed/Pulled

Grove recommends connecting to a pintle hook (if equipped) or evenly attaching to the tie-down lugs when being towed by another vehicle.,

CAUTION

Machine Damage Hazard!

It is recommended to attach cables/straps to the optional pintle hook (if equipped) or evenly attach to the tie-down lugs if being towed by another vehicle.

Should the crane become mired down, use a tow truck or tractor to free the vehicle. Severe damage to the drivetrain may occur if the operator attempts to free the crane unassisted.

- Ensure the boom is in a horizontal position and not elevated above 0°.
- Ensure the outrigger beams and jacks are fully retracted with the floats properly stowed.

CAUTION

Machine Damage Hazard!

It is recommended to attach cables/straps to the pintle hook if one is available or evenly attach to the tie-down lugs if being towed by another vehicle.

Should the crane become mired down, use a tow truck or tractor to free the vehicle. Severe damage to the drivetrain may occur if the operator attempts to free the crane unassisted.

To avoid severe damage to the drive train while the crane engine is disabled:

- Disconnect drivelines.
- Disengage parking brake by manually turning parking brake adjustment until axle turns free.

DANGER

Run-away Crane Hazard!

Disabling the parking brake may result in the crane rolling away freely without the ability of the operator to stop the crane.

Ensure wheel chocks are properly placed when parking crane with the parking brake disabled.

Death or serious injury and damage to machinery could result from moving machinery.

- Secure steering to prevent turning while towing.

- Conduct all travel with the assistance of a ground person to warn the operator of any changing conditions in the terrain being traversed.

Traveling with Boom Extension and/or Insert Erected

CAUTION

Traveling is not permitted with a boom extension reeved with two parts of line.

Damage to the boom extension may occur.

36 ft (11 m)/59 ft (18 m) Extension

Travel is permissible under the following conditions:

- The boom extension shall be erected at minimum offset. If traveling with just the 36 ft (11 m) extension, the stinger extension must be stowed on the side of the main boom, not on the 36 ft folding extension.
- Jobsite travel only on firm, level surface.
- Main boom shall be fully retracted.
- Main boom angle: 0 degrees minimum, 30 degrees maximum.
- Maximum travel speed: 2.5 mph (4 km/h).
- Counterweight shall be installed.
- The boom shall be over the front.
- Swing lock and pin shall be engaged.
- Hookblock must be removed from main boom nose.
- Overhaul ball may be reeved over boom extension, hanging 3 ft (0.9 m) below sheave.

59 ft (18 m) Extension Plus 26 ft (8 m)/ 19 ft (6 m) Extension Inserts

Travel is permissible under the following conditions:

- The boom extension plus inserts shall be erected at minimum offset.
- Jobsite travel only on firm, level surface.
- Main boom shall be fully retracted.
- Main boom angle: 0 degrees minimum, 40 degrees maximum.
- Maximum travel speed: 2.5 mph (4 km/h).
- Counterweight shall be installed.
- The boom shall be over the front.
- Swing lock and pin shall be engaged.
- Hookblock must be removed from main boom nose.
- Overhaul ball may be reeved over boom extension, hanging 3 ft (0.9 m) below sheave.

12 ft (3.6 m) Extension

Travel is permissible under the following conditions:

- The boom extension shall be erected at minimum offset.
- Jobsite travel only on firm, level surface.
- Main boom shall be fully retracted.
- Main boom angle: 0 degrees minimum, 20 degrees maximum.
- Maximum travel speed: 2.5 mph (4 km/h).
- Counterweight shall be installed.
- The boom shall be over the front.
- Swing lock and pin shall be engaged.
- Hookblock or overhaul ball may be reeved over boom extension, hanging 3 ft (0.9 m) below sheave.

Extended Travel

CAUTION

Tire Damage!

For extended travel, check the cold tire pressure prior to start. (Refer to tire inflation chart in load chart book.) After every one hour of travel time, regardless of ambient temperature, stop and allow the tires to cool off for at least 30 minutes. At the destination, the tires must be allowed to cool to ambient temperature before lifting on rubber.

Depending upon the tire manufacturer, the higher inflation pressures normally specified for lifting on rubber are not recommended for site to site transfer over extended distances. The higher static/creep 5 mph (8 km/h) inflation pressures may remain in the tire while operating the crane on site within a distance of less than 4 miles (6.4 km).

Moving the Crane

The following superstructure conditions should be strictly adhered to before moving the crane. Procedures for accomplishing the following can be found in the various sections of this manual.

1. Fully retract the boom.
2. Ensure the swingaway jib is properly stowed and secured.
3. Swing the boom to over-the-front and lower it to slightly above horizontal.
4. Turn the Swing Brake switch on the front console to ON and engage the swing lock pin by turning the handle.
5. Actuate the Crane Function switch to prevent unintended operation of crane functions.
6. Remove the hook block and/or overhaul ball from the hoist cable(s) and stow securely before traveling or make sure the hook block or overhaul ball is properly secured to the tie down provided for that purpose.
7. Fully retract the outrigger jacks and remove the floats.

8. Properly store the floats.

Steering

Steering is accomplished by the steering wheel and the rear steer control. These controls, used singly or together, provide front wheel steering, rear wheel steering, four-wheel steering, and crabbing capabilities (Figure 3-109).

Front Wheel Steering

Conventional front wheel steering is accomplished with the steering wheel. This method of steering should always be used when traveling at higher speeds.

WARNING

Operate the rear steer only for added job site maneuverability.

Rear Wheel Steering

Rear wheel steering is controlled by the REAR STEER control switch. Moving this switch to the desired position activates the rear steer cylinders, thereby steering the crane in the selected direction.

Four Wheel Steering

Four wheel steering is accomplished with the steering wheel and the REAR STEER control. Depending upon which direction the operator wishes to travel, the steering wheel is turned opposite direction of the REAR STEER control position. This allows the crane to turn or maneuver in close, restricted areas.

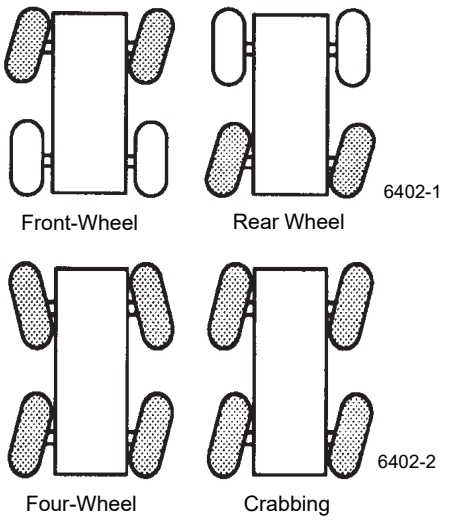


FIGURE 3-109

Crabbing

Crabbing is accomplished with the steering wheel and the REAR STEER control switch. Depending upon which direction the operator wishes to travel (crab), the steering wheel is turned in the same direction as the REAR STEER control switch. This permits driving the crane forward or backward in a crabbing manner.

Secondary Steering (CE Units)

A secondary steering system is provided to back up the normal front steering system if loss of hydraulic flow occurs. This happens automatically when normal steering load sense flow is lost. The pilot operated, two position, 3-way valve will shift and supply flow from the accumulator to the steer control valve to allow the operator to safely steer the crane to a safe stop.

The LOW STEER PRESSURE (PRESS) indicator comes on during pressure drops. This indicates the secondary steering system should also be working.

Traveling - Forward

CAUTION

Engage the swing lock pin for extended travel.

1. Actuate the Crane Function switch to prevent unintended operation of the crane functions.

2. After the engine has warmed up, apply the service brake and place the transmission shift lever from neutral (N) to forward (F) position.

3. Place the DRIVE AXLE switch to either 2WD or 4WD.

CAUTION

Use four wheel drive only when more traction is required.

With the standard counterweight (39,000 lb (17690 kg)) installed, the maximum travel speed is 10 mph (16 kph).

If the heavy counterweight (63,000 lb (28576 kg)) is installed, the maximum travel speed is 2.5 mph (4 kph), in first gear only.

NOTE: If hydraulic pressure is low, the parking brake cannot be released.

4. Put the transmission shift lever knob to the first (1) gear position and release the parking brake. Depress the foot throttle until maximum first gear speed is attained and shift into the second (2) gear position by rotating the handle.

5. Repeat the above procedure for the third (3) gear position and so forth until the desired travel speed is attained.

CAUTION

Do not downshift to a lower gear if the road speed is greater than the maximum speed of the lower gear.

Traveling - Reverse

Traveling in reverse is accomplished the same way as traveling forward, except for shifting the transmission shift lever to reverse (R) position and rotating the knob to the 1, 2, and 3 positions. (Refer to *Traveling - Forward,* page 3-113.)

CAUTION

Apply service brakes and bring crane to a complete stop before shifting transmission into reverse.

Four-Wheel Drive Operation

CAUTION

Machine Damage Hazard!

Do not tow or pull in 1st gear with Drive Axle Selector Switch in two-wheel drive position. Severe damage to the drive train will result. Always engage four-wheel drive.

If more traction is required due to slipping or spinning wheels, engage front axle drive as follows:

CAUTION

Possible Machine Damage!

Before shifting from two-wheel drive to four-wheel drive (or from four back to two), crane travel must be stopped.

1. Stop crane by depressing the Service Brake Foot Pedal.
2. Position Transmission Shift Lever to neutral (N) position.
3. Position Drive Axle Selector Switch to four-wheel low.

NOTE: If Drive Axle Selector Switch is positioned to four-wheel low and the Service Brake Foot Pedal is not depressed or Transmission Shift Lever is not in neutral (N) position, the Four-Wheel Drive Indicator will flash and four-wheel drive function will not engage.

4. Select gear speed and direction of travel using the Transmission Shift Lever and Knob.
5. Drive crane as described under *Traveling - Forward*, page 3-113.
6. Return Drive Axle Selector Switch to the two-wheel high position as soon as two-wheel traction will suffice and crane motion has stopped. The Service Brake Foot Pedal must be depressed and Transmission Shift Lever must be in the neutral (N) position to shift from four-wheel low to two-wheel high.

Traveling on Slopes

Crane operators must exercise caution whenever operating the crane on uneven surfaces. Travel on slopes is permitted if the following conditions are met.

General Conditions

- Travel must be on an improved surface or hard-packed dry earth. Crane operators are required to inspect the surface for good tire adhesion.
- All boom sections must be fully retracted.
- Boom extension must be in stowed position or removed from the crane (if traveling with an erected boom extension, follow the requirements under the section *Traveling with Boom Extension and/or Insert Erected*, page 3-114.
- Boom must be positioned over the front of the crane. Boom angle must be as follows:
  - For fore/aft travel on grades less than 15%, the maximum allowable boom angle is 20°.
  - For fore/aft travel on grades greater than 15%, the boom angle must be limited to horizontal (0°).
  - For side slope travel on grades less than 10%, the maximum allowable boom angle is 20°.
  - For side slope travel on grades greater than 10%, the boom angle must be limited to horizontal (0°).
- Swing brake must be applied and turntable lock pin engaged.
- 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 hook block or overhaul ball remains reeved on the boom, it must be secured at the tie down on the carrier to prevent swinging.
- Tires must be inflated to the recommended pressure for pick and carry operations.
- Hydraulic tank must be filled to specified level. Fuel tank must be over half full.
- Engine and transmission fluids must be filled to the specified levels.
- Axle differentials and planetary hub fluids must be filled to the specified levels.
- No loads may be supported by the boom (i.e., no pick and carry loads) while traversing a slope.
- All cribbing or other non-standard accessories must be removed from the crane.

- Avoid holes, rocks, extremely soft surfaces, and any other obstacles that might subject crane to undue stresses and possible overturn.
- Operator is to check for changing road conditions and utilize a ground person if deemed necessary.

Slope Limitations - Fore/Aft Travel

- When traversing a fore/aft slope that is less than or equal to 15% (8.5°), follow the normal crane travel procedures outlined in this manual.
- When traversing a fore/aft slope that is greater than 15% (8.5°) and less than 25% (14°), transmission shall be in four-wheel drive. If crane must be parked, make sure the transmission is in 4-wheel drive and the wheels are chocked.
- When traversing a fore/aft slope that is equal to or greater than 25% (14°), use an assist vehicle and shift the crane's transmission to four-wheel drive. Do not park crane on a slope equal to or greater than 25% (14°).
- Travel on a fore/aft slope greater than 30% (16°), such as ramps, is permitted for short distances at low speed. Consideration must be given for the terrain at the end of the slope (for example, does the terrain level out so that the crane can stop).
- For mine applications and similar, where the slopes and the travel distance can be significant, brake fade must be taken into consideration. For extended travel, check cold tire pressure before start. (Refer to tire inflation chart in Load Chart Book.) After every one hour of travel time, regardless of ambient temperature, stop and allow tires to cool for at least 30 minutes. At destination, tires must be allowed to cool to ambient temperature before crane lifting on rubber.
- For slope limitations when traveling with an elevated boom or an erected boom extension and inserts, refer to the specific traveling instructions in this section.

Slope Limitations - Side Slope Travel:

- Side slope shall not exceed 15% (8.5°).

Operator should carefully consider the conditions and travel at the appropriate speed given the condition and should not exceed the maximum speeds in the following tables taking into consideration both fore/aft slopes and side slope.

Table 3-1 Fore and Aft Travel - No Load

Crane Condition	0 - 15% (0 - 8.5°)	15 - 25% (8.5 - 14°)	25 - 29% (14 - 16.7°)	30% + (16.7° +)
Two-Wheel Drive	Yes, no restrictions up to 37 kph (23 mph)	No	No	No
Four-Wheel Drive/Low Range	Yes, up to 10 kph (6 mph)	Yes, up to 10 kph (6 mph)	Yes, up to 5 kph (3 mph)	Yes, up to 1.6 kph (1 mph)
Park using Park Brake only	Yes	No	No	No
Park using Park Brake, Chock Wheels, and Four-Wheel Drive		Yes	No, do not park on slopes greater than 25%	No, do not park on slopes greater than 25%
Assist Vehicle Required for Braking and Propulsion	No	No	Yes	Yes
Short Distance Travel allowed (on ramps)				Yes, but do not park on slopes greater than 25%
Consider Brake Fade possibility if traveling long distance	Yes	Yes	Yes	Yes

Table 3-2 Side Slope Travel - No Load

Crane Condition	0 - 5% (0 - 2.9°)	5 - 10% (2.9 - 5.7°)	10 - 15% (5.7 - 8.5°)	15% + (8.5° +)
Two-Wheel Drive	Yes, up to 37 kph (23 mph)	Yes, up to 15 kph (9 mph)	No	No
Four-Wheel Drive/Low Range	Yes, up to 10 kph (6 mph)	Yes, up to 10 kph (6 mph)	Yes, up to 1.6 kph (1 mph)	No

Owner/lessee must take appropriate measures ensure that all persons operating or working with affected models are complying with these Grove Crane recommendations. Crane operator assumes responsibility for determining suitability of traveling on a slope.

Traveling on a slope should only be attempted under controlled conditions specified in these guidelines, and must be conducted with the utmost diligence and care to make sure safety of all personnel performing the operation and/or working around the crane.

Should operator need to traverse slopes outside the criteria defined in the above guidelines, contact Grove Crane for further guidance.

Proper Operation of Differential Lock

WARNING

Vehicle Control Hazard!

When using the differential lock, steering characteristics may be affected.

Try to use four wheel drive to gain adequate traction before using the differential lock.

Do not operate the differential lock while the crane is moving; when traveling downhill, at speeds above 10 mph, on hard, dry surfaces or during axle spin.

Failure to follow these warnings may result in loss of vehicle control causing serious injury or death.

NOTE: The differential lock will not operate unless the DRIVE selector switch is in the 4WD-LO position.

General

The purpose of the differential lock is to provide maximum traction and control on poor road or highway surfaces. When the differential locks are actuated, the clutch collar completely locks the differential case, gearing, and axle shafts together, thus maximizing traction to both wheels of each axle. The lock position will also protect against spinout. When normal driving conditions exist (during periods of good traction), the differential locks should not be actuated. The axles should be allowed to operate with differential action between both wheels.

When using the differential locks, the operator must remember the following:

1. The AXLE DIFF control switch is a momentary rocker switch and must be held in the LOCK position.
2. The differentials can be locked or unlocked when the vehicle is standing still or at a constant low speed when the wheels are not slipping.
3. Lock differentials and operate vehicle only at low speeds.
4. When the differentials are locked, the crane's turning radius will increase, creating an understeer condition. The operator must use caution, good judgement and drive at low speeds when operating the vehicle with locked differentials.

NOTE: Turning on hard surfaces with locked differentials should be avoided.

5. Lock the differentials only when maximum traction is needed on poor road or highway surfaces.
6. Always unlock the differentials when the need for maximum traction has passed or when traveling on good road or highway surfaces.
7. Do not lock the differentials when the wheels are slipping. Damage to the differentials can result.
8. Do not lock the differentials when the vehicle is traveling down steep grades and traction is minimal. Potential loss of vehicle stability can result.

Operation

The differential lock (AXLE DIFF) 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 engaged do not deviate from a straight path more than is absolutely necessary.

1. When operating the differential lock, place switch to the locked position with crane stationary or at slow speed.
2. If moving at slow speed, let up momentarily on the accelerator to relieve torque on the differential gearing. This will fully engage the differential locks. When activated the square amber LED on the switch should be illuminated.
3. Proceed over the poor road condition cautiously.

When adverse condition has passed, do the following:

1. Place the differential lock (AXLE DIFF) switch to the UNLOCK position while maintaining slow speed.
2. Let up momentarily on accelerator to relieve torque on differential gearing, allowing differential to fully unlock. The square amber LED on the switch should go out.
3. Resume driving at a normal speed using good driving judgement.

Proper Operation of Axle Oscillation Lockouts

NOTE: The following procedure should be used to periodically check the axle oscillation system and ensure that it is in proper working condition.

1. Ensure the tires are inflated to the recommended pressure. Refer to the Load Chart Book in the crane cab for proper inflation pressures.
2. With the hook unloaded, the boom fully retracted and centered over the front at no more than a 10 to 15 degree boom angle, place the crane on a block or curb so that one rear tire is approximately 15 to 30 cm (6 to 12 inches) above the level of the opposite tire.
3. Slowly swing the superstructure to the right or left until the axle oscillation lockout valve is activated. This will lock the rear axle out of level. Do not swing beyond the tire track.
4. After engaging the swing brake, slowly drive off of the block or curb and stop. The rear tires should both be touching the road surface and the opposite front tire should be light or slightly off the road surface.
5. Release the swing brake and swing the superstructure until it is centered over the front.

CAUTION

Do not operate the crane if the axle oscillation lockout system is not functioning properly.

6. If the axle oscillation lockout valve is not functioning properly, the crane will not re-level itself. If the rear axle does not lock or unlock properly, evaluate the lockout system and repair as necessary.

General Crane Operation

Pump Drive

The main hydraulic pumps are mounted on the torque converter drive pad. The hydraulic oil cooler pump is mounted on the engine. The pumps operate any time the engine is running.

Operating the Crane On Outriggers

In order to operate the crane on outriggers:

- the transmission must be shifted into 4WD (four-wheel-drive) for the outriggers to be deployed and
- the parking brake set.

When this procedure is correctly followed, the wheels will not rotate with the crane on outriggers during any crane function.

Control Lever Operation

The control lever operation for all crane functions is standard, i.e. the closer the lever is to neutral (center), the slower the system responds. The control lever should be returned to neutral to hold the load. Never feather the hoist control lever to hold the load.

NOTE: Always operate the control levers with slow, even pressure.

Preload Check

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

CAUTION

Operate engine at or near governed rpm during preload check of crane functions.

NOTE: Carefully read and become familiar with all crane operating instructions before attempting a preload check or operating the crane under load.

1. Extend and set outriggers.
2. Raise, lower, and swing the boom a minimum of 45° right and left.
3. Telescope the boom in and out.
4. Raise and lower the cable a few times at various boom lengths. Ensure there is no kinking.

Using Your Load Chart

NOTE: One of the most important tools of every Grove crane is the load chart found in the crane operator's cab. Terms to know are shown in (Figure 3-110).

The load chart contains a large amount of information, which must be thoroughly understood by the operator.

The load chart contains outrigger capacity charts for fully extended, mid extended, outriggers for the main boom and boom extension, and fully retracted outrigger beams for main boom only. In addition, the load chart contains two on-rubber capacity charts: 360° stationary, and pick and carry over front.

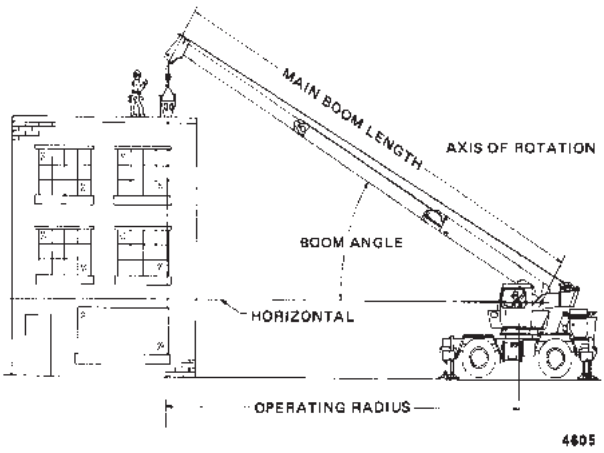


FIGURE 3-110

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

The left column is the load radius, which is the distance from the center of crane rotation to the load center of gravity. The top row lists various boom lengths ranging from fully retracted to fully extended or boom extension lengths and offsets. The number at the intersection of the left column and top row is the total load capacity for that load radius and boom length or boom extension lengths offset. The number in parentheses below the total load capacity is the required boom angle (in degrees) for that load. Any boom length between increments should always be treated as if it was the next longer length. For example, if the actual boom length is 50 ft and the chart shows boom lengths of 48 and 54 ft, use the load capacity shown in the 54 ft column.

Another important section is the range diagram. The range diagram shows the operating radius and tip height that can be achieved at a given boom length and angle. If the operator knows the radius and tip height required for a specific lift, the angle and boom length can be quickly determined from the range diagram. Or, if the boom length and angle are known, the tip height and operating radius can be quickly determined.

A lifting diagram is included to describe over side, over rear, and over front lifting areas. The lifting area diagram shows that the locations of the outrigger jack cylinders in the fully extended position are used to mark the boundaries of the lifting areas.

A boom extension capacity chart and notes are included to list the capacities for the extension length, load radius, and boom angle.

Another section contains the notes for lifting capacities. Be sure to read and understand all the notes concerning lifting capacities.

The load chart also gives weight reductions for Grove load handling devices such as hook blocks, overhaul balls, boom extensions, etc., which must be taken into consideration as part of the load. Remember, the weight of any other load handling devices such as chains, slings, or spreader bars must be added to the weight of the load.

Counterweight Installation/Removal

Refer to Figure 3-111.

DANGER

Crushing Hazard!

Ensure no one is on the counterweight platform while the counterweight is being lifted or lowered.

Before lifting or lowering the counterweight, ensure there are no objects on top of or below it.

Serious injury or death may result if these warnings are not followed.

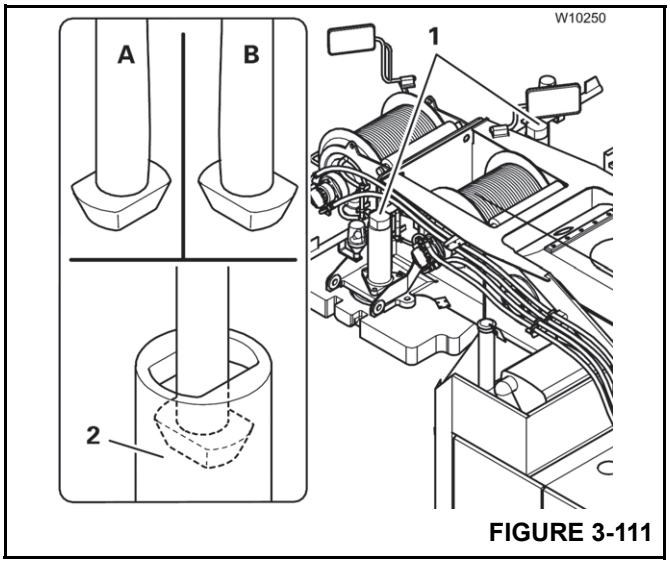


FIGURE 3-111

The lifting cylinders (1) can be:

- extended and retracted and
- turned to the positions Unlocked (A) or Locked (B).

To lift and lower the counterweight, the lifting cylinders have to be locked in the counterweight tubes (2).

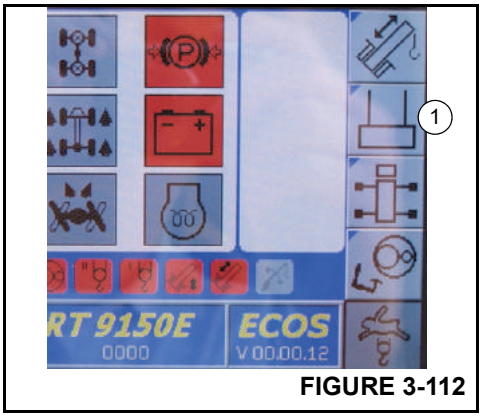


FIGURE 3-112

To operate the counterweight hoist unit, you must open the Counterweight submenu:

1. If necessary, open the main menu, press *Esc* button.
2. In the Main menu, press the F6 button (1) (Figure 3-112) once.

   The Counterweight submenu opens.

NOTE: If an error symbol (1) (Figure 3-113) is displayed during subsequent operation, please contact Crane Care.

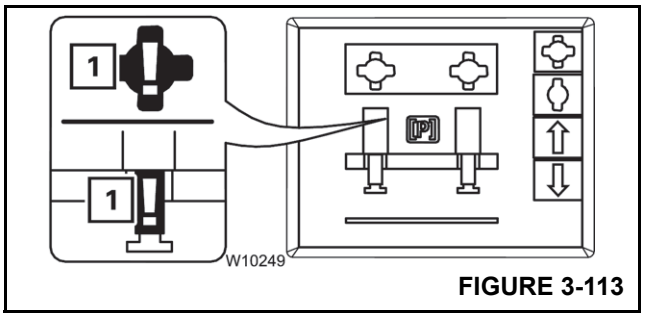


FIGURE 3-113

The extension or retraction of the lifting cylinders will only take place when both lifting cylinders are fully in the locked or unlocked positions.

Extending the Lifting Cylinders

Extension is only enabled when the superstructure is in the 180°, boom over-the-rear position.

CAUTION

Equipment Damage Hazard!

The hoist unit can become damaged by moving the lifting cylinders against the counterweight in the locked position.

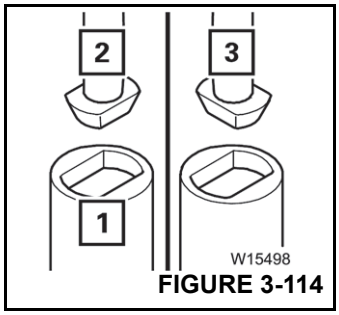


FIGURE 3-114

If the lifting cylinders (1) (Figure 3-114) are to move into the cutouts, then the lifting cylinders have to be in the unlocked (2) position.

If the lifting cylinders are in the locked (3) position, then you may have to lift the counterweight off the counterweight platform and:

- extend the lifting cylinders,
- turn the lifting cylinders into the unlocked (2) position, refer to *Locking/Unlocking Counterweight Lift Cylinders,* page 3-119,
- retract the lifting cylinders.

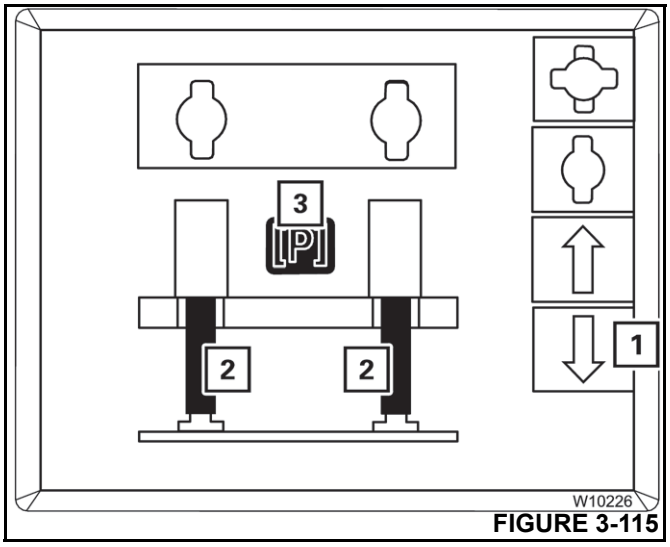


FIGURE 3-115

To extend the lifting cylinders:

1. Press the F8 button (1, Figure 3-115).
2. The lifting cylinders (2) extend:
   Yellow: Intermediate position
   Green: Extended.
   The counterweight is now lowered, provided it has been rigged.
3. The display (3) turns red.

Retracting the Lifting Cylinders

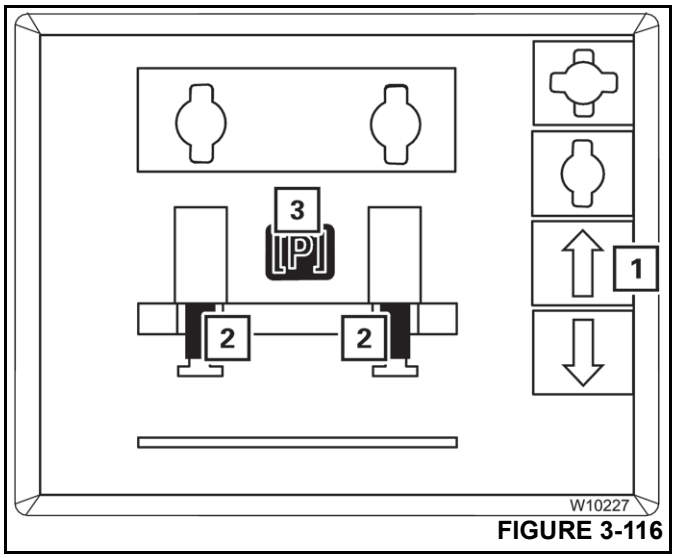


FIGURE 3-116

To retract the lifting cylinders:

1. Press the F7 button (1) (Figure 3-116).
2. The lifting cylinders (2) retract.
   Yellow: Intermediate position
   Green: Retracted
3. Press and hold the F7 button (1) until the Pre-tension Counterweight display (3) turns **green**.

The counterweight which is needed for crane operation will now be pulled under the turntable with pressure.

Locking/Unlocking Counterweight Lift Cylinders

The movement between the positions locked and unlocked will only be active when the lifting cylinders have been extended.

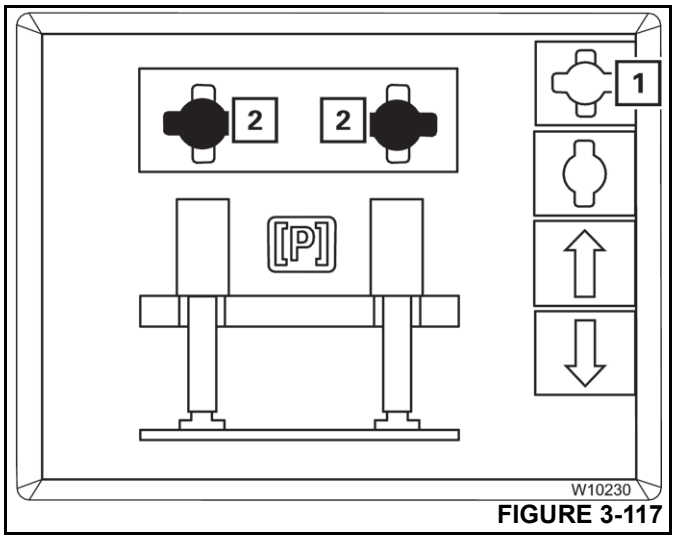


FIGURE 3-117

To rotate lifting cylinders to locked (Figure 3-117):

1. Press the button (1).
2. The lifting cylinders (2) turn:

   Yellow: Intermediate position

   Green: Locked

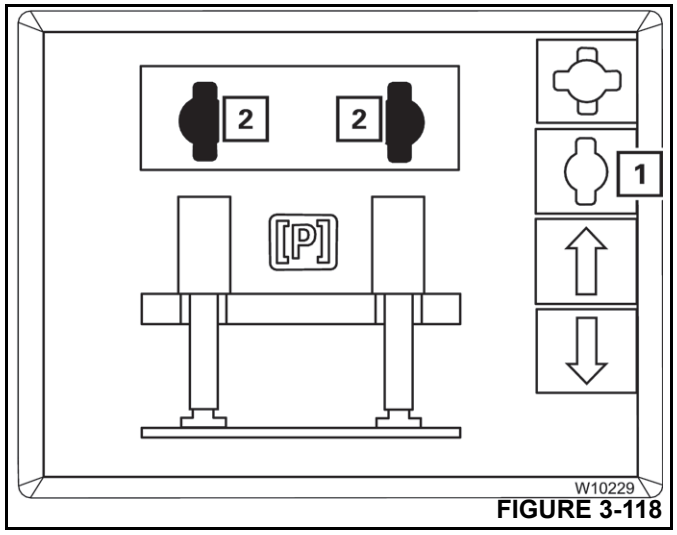


FIGURE 3-118

To rotate lifting cylinders to unlocked (Figure 3-118):

1. Press the button (1).
2. The lifting cylinders (2) turn:

   Yellow: Intermediate position

   Red: Unlocked.

Locking/Unlocking the Counterweight

The counterweight is secured to the crane with a pair of horizontal locking cylinders. After the counterweight has been pretensioned the locking cylinders need to engage the counterweight to secure it to the crane.

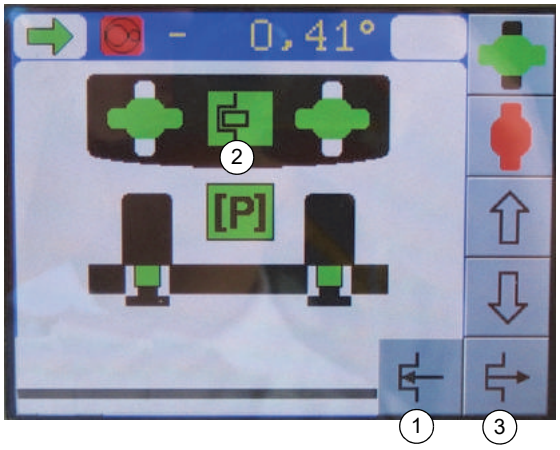


FIGURE 3-119

Locking the Counterweight

After pretensioning the counterweight:

1. Press the engage button (1) (Figure 3-119). When the lock cylinders are fully engaged the lock cylinders icon (2) turns green.

Unlocking the Counterweight

In order to remove the counterweight the locking cylinders must be retracted:

1. Press the retract button (3) (Figure 3-119). When the lock cylinders are fully retracted the lock cylinders icon (2) turns red.

CRANE FUNCTIONS

Operation of the Rated Capacity Limiter (RCL)

If the current rigging mode of the crane is registered properly, the RCL prevents the permissible lifting capacity from being exceeded and the crane from being overloaded.

DANGER

Tipping Hazard!

If the actual rigging mode varies from the displayed rigging mode, the maximum load displayed by the RCL will not correspond to the permissible lifting capacity allowed in the Load Chart. Inaccurate programming of the RCL allows the crane to be improperly operated.

You may only override the RCL if it becomes absolutely necessary in the event of an emergency. This is to put the crane into a safe condition in the event of a malfunction. In this case, do not perform any movements that would increase the load moment.

Serious injury or death may occur if the crane is overloaded or overturns.

The current rigging mode is based on measured values and manually entered values:

Registered Based on Measured Values	Registered Based on Manually Entered Values
Main boom length	Counterweight
Main boom angle	Length of boom extension
Current load	Angle of the boom extension
Luffing jib angle	Reeving

During the operation of the crane, a visual and acoustic early warning is issued before the load limit is reached and the functions are shut down that would lead into the overload range.

Switching on the RCL

NOTE: The RCL is not switched off if you turn the ignition key to position R instead of position 0 to restart the engine. The test program will not run and you will not have to acknowledge the settings again.

The RCL is switched on together with the ignition.

A test program runs after switching on the ignition. A continuous buzzer tone sounds for about 2 seconds and a lamp test is performed:

- Check whether you can hear a buzzer tone.
- Check that the lamps indicated in Figure 3-120 light up briefly after turning on the ignition.

FIGURE 3-120

If the specified time is insufficient, switch on the ignition again or conduct a lamp test, refer to *Lamp Test,* page 3-58.

Contact Crane Care if one or more lamps do not light up.

WARNING

If the lamps or the buzzer fail, notify Crane Care and have the error rectified.

In the meantime, pay particular attention to the lamps in the event of a failure of the buzzer and vice versa.

After the test program the two lamps (1) light up and all power units are disabled.

What is displayed depends on whether the RCL had been switched off for up to 48 hours or had been switched off for more than 48 hours, refer to the following sections.

After Crane Shutdown of up to 48 Hours

Refer to RCL Monitoring submenu, Figure 3-121.

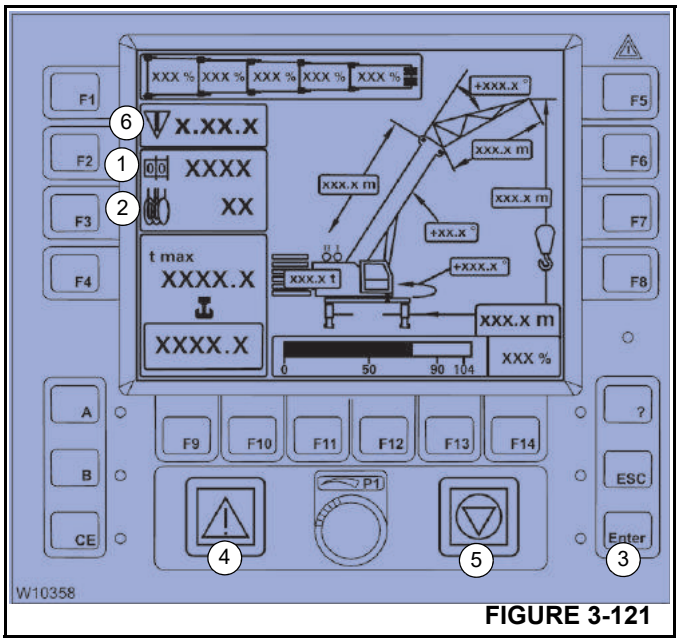


FIGURE 3-121

The RCL Monitoring submenu opens if the crane was shutdown for less than 48 hours.

The last set rigging mode is displayed, and the symbols (1) and (2) are green and flash.

You can accept the displayed values if they correspond to the actual rigging of the crane:

- Press the *Enter* button (3) once, the symbols (1) and (2) stop flashing.
- The lamps (4) and (5) go out. The RCL code is accepted.

If no error message is displayed, the RCL is set for crane operation and the crane functions are enabled.

Any pending errors are indicated on the display (6), refer to *Error Messages in the Monitoring Submenu,* page 3-91.

You must re-enter the current rigging if the displayed values do not correspond to the actual rigging mode of the crane, refer to *Entering the Rigging Mode,* page 3-81.

After Crane Shutdown of more than 48 Hours

Refer to Figure 3-122.

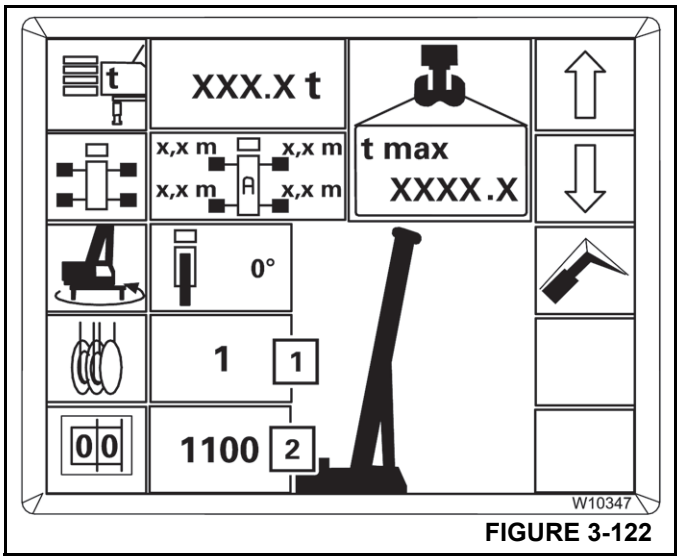


FIGURE 3-122

If the crane was shutdown for more than 48 hours the Enter Rigging Mode submenu opens:

- The SLI code 1100 (2) is displayed along with the corresponding rigging mode,
- The last reeving entered (1) is displayed.

You must now enter the actual rigging, refer to *Entering the Rigging Mode,* page 3-81.

Prior to Crane Operation

NOTE: Crane functions are only enabled when the RCL Monitoring submenu is open, refer to *RCL Monitoring Submenu,* page 3-86.

After Crane Shutdown of less than 48 hours the Monitoring submenu opens automatically.

After Crane Shutdown of more than 48 hours and after accepting a rigging mode—refer to *Approve the Rigging Mode,* page 3-84—the Monitoring submenu opens automatically.

Opening the Submenu Manually

Refer to Figure 3-123.

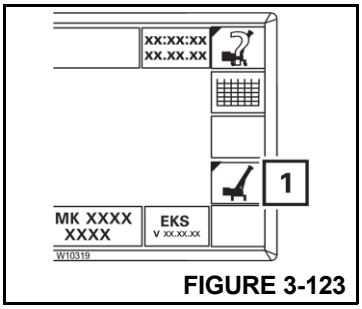


FIGURE 3-123

You can also open the submenu manually:

1. If necessary, open the Main menu by pressing the *Esc* button until the Main menu opens.
2. Press the F8 button (1) once.

The Monitoring submenu opens.

NOTE: You can only quit the RCL Monitoring submenu when all crane movements have stopped; the control lever must be in the zero position.

Verify Rigging

Check whether the actual rigging of the crane corresponds to the displayed rigging mode.

DANGER

Tipping Hazard!

Serious injury or death may occur if the crane is overloaded or overturns.

If the actual rigging mode varies from the displayed rigging mode, the maximum load displayed by the RCL will not correspond to the permissible lifting capacity allowed in the Load Chart. Inaccurate programming of the RCL allows the crane to be improperly operated.

In the RCL Monitoring submenu (Figure 3-124) verify the following items correspond to the actual rigging of the crane:

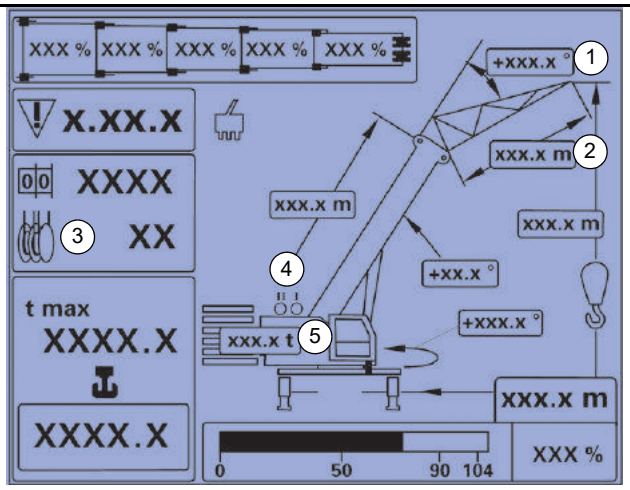


FIGURE 3-124

(1) The angle of the rigged luffing boom extension.

(2) The length of the rigged boom extension.

(3) The number of reeved rope lines.

(4) The hoist that is switched on, refer to *Verify Hoists Display,* page 3-123.

(5) The rigged counterweight.

If you need to correct the values, press the *Esc* button to open the Rigging Mode submenu, refer to *Entering the Rigging Mode,* page 3-81.

You can start working with the crane when the current rigging mode of the crane is displayed correctly.

Verify Hoists Display

Refer to Figure 3-123.

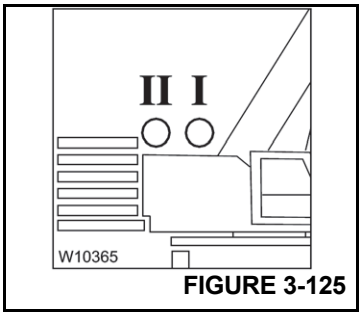


FIGURE 3-125

The lamp that lights up must always be for the actual hoist with which the load is to be lifted:

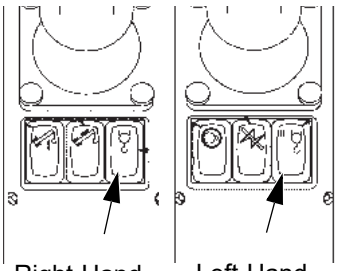
- Lamp **I**: Must light up if the load is to be raised with the main hoist.
- Lamp **II**: Must light up if the load is to be raised with the auxiliary hoist.

To switch the display to the hoist that will be used, refer to the following section.

How to Switch the Hoist Display

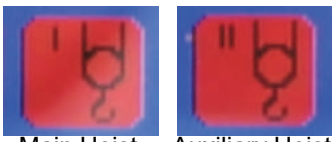
In the following example the main hoist will be selected:

1. Switch off both hoists by pressing each hoist switch once.



Right-Hand Controls | Left-Hand Controls

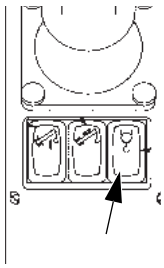
2. The ECOS indicators must turn red.



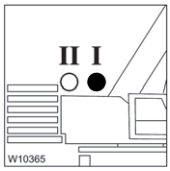
Main Hoist | Auxiliary Hoist

3. The lamps **I** and **II** go out.

4. Switch on the main hoist by pressing the switch once.



Now lamp **I** for the main hoist is ON and the ECOS indicator is green.



DANGER

Tipping Hazard!

After switching over the hoists, always check whether the displayed reeving value corresponds to the current reeving value of the displayed hoist and, if necessary, enter the current reeving value.

This will prevent the RCL from making calculations based on an incorrect reeving value and the crane from becoming overloaded or from overturning.

Verify Reeving

After selecting the hoist and making sure the associated lamp is on verify that the reeving for that hoist is correct.

The indicator (3) (Figure 3-124) will show the last entered reeving value for the main hoist.

If no reeving has been entered yet, the RCL selects 1 for the reeving.

If necessary, enter the current reeving, refer to *Entering the Reeving,* page 3-83.

Deploying the Outriggers

DANGER

Tipping Hazard!

All four outrigger beams must be equally extended to the mid-position vertical stripe with the lock pins engaged or fully extended or retracted before beginning operation.

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

Serious injury or death may occur if the proper load chart and RCL program are not used and the crane tips over.

1. Engage the parking brake using switch on the steering column, see *Park Brake Switch,* page 3-5.

CAUTION

Avoid Crane Damage!

Do not engage the park brake while the vehicle is moving. Damage to the crane can occur.

Disengage the park brake before driving. Damage to the crane can occur.

2. Enable the four-wheel drive system using switch on the steering column, see *Drive Select Switch,* page 3-5.
3. Position the outrigger floats directly out from each outrigger to where the outriggers will be properly extended.
4. Press the appropriate button on the outrigger menu and hold to extend. The chosen outrigger beam(s) should begin to extend. (Refer to *Engaging the Mid-Extend Lock Pin,* page 3-125 if the crane is to be operated with the outriggers at the mid-extend position.) Extend each outrigger in turn. Refer to *Outrigger Monitoring System (OMS) RCL Display (Optional—Standard in North America),* page 3-125

NOTE: More than one outrigger at a time may be extended. However, to ensure that each outrigger is fully extended, repeat step 4 for each outrigger after a multi-outrigger extension.

5. After all four outrigger beams have been fully extended, press the appropriate button on the outrigger menu for extending the desired jack and hold the button to extend.

   Extend each jack, positioning the float as necessary, until the locking levers of the float engage the jack cylinder rod. Verify each float is secure on its related jack cylinder rod.

NOTE: More than one jack may be extended at one time.

6. With each jack float firmly touching the ground, extend the front jacks approximately 3 to 4 in (8 to 10 cm).
7. Extend the rear jacks approximately 3 to 4 in (8 to 10 cm).
8. Repeat steps 6 and 7 until all wheels are clear of the ground and the crane is level as indicated by the bubble level indicator on the right side control panel, see *Level Indicator,* page 3-8.

NOTE: If it is suspected that the bubble level indicator is out of adjustment, refer to the Service Manual for the proper procedure to check and adjust the indicator.

Engaging the Mid-Extend Lock Pin

1. Turn the locking pin 90° from its stowed position and allow the pin to rest on top of the outrigger beam.

NOTE: It may be necessary to use the appropriate outrigger extension button and jog the outriggers slightly to ensure proper pin engagement.

2. Slowly extend or retract the outrigger beam, allowing the locking pin to drop into the hole in the top of the outrigger beam, engaging the outrigger beam at the desired length.

Stowing the Mid-Extend Lock Pin

1. Retract the outrigger jack cylinder.

NOTE: If the lock pin is wedged in the hole in the outrigger beam, it may be necessary to jog the button while pulling upward on the pin.

2. Lift the lock pin and turn it 90° to its stowed position.

Outrigger Monitoring System (OMS) RCL Display (Optional—Standard in North America)

DANGER

Tipping Hazard!

The crane can overturn, causing death or serious injury or sustain serious damage from operating the crane from outrigger positions other than fully retracted, mid-extended or fully extended.

The OMS is an operator's aid only, it does not program the RCL. 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 eight sensors, two per outrigger beam, to identify when an outrigger beam is positioned to one of three pre-defined locations, including retracted, mid-extend, and full extend.

Set up of the outriggers is the same for cranes equipped with OMS; refer to *Outriggers Submenu,* page 3-27. The RCL only indicates the horizontal position of the outrigger beam and should not be used to deploy the beam.

When an outrigger is not properly deployed the outrigger symbol will flash 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.

Fully Retracted or 0% Deployed

With all outriggers fully retracted and corresponding rigging code selected, the outrigger symbol (1, Figure 3-126) should stay lit when all outriggers are at the correct position.

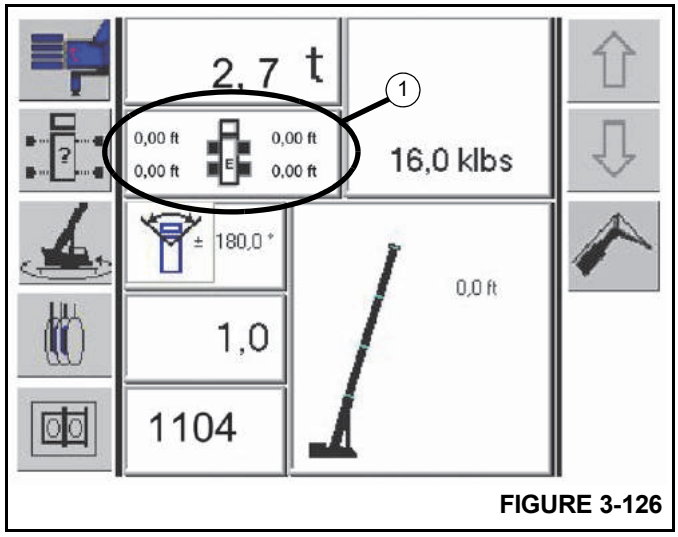


FIGURE 3-126

When an outrigger beam is not within the ±3% tolerance from the selected rigging setup the outrigger symbol will flash and display the actual outrigger length (1, Figure 3-127).

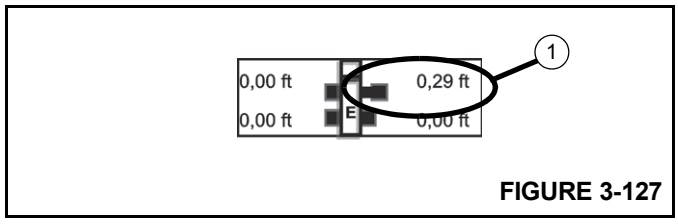


FIGURE 3-127

By pressing the "ENTER" key twice the operator will confirm the rigging code. Should an outrigger be outside the ±3% tolerance an error code will display, refer to *Error Code Display,* page 3-126 and (1) Figure 3-132.

Mid-Extended or 50% Deployed

With all outriggers 50% deployed and corresponding rigging code selected, the outrigger symbol (1, Figure 3-128) should stay lit if all outriggers are at the correct position.

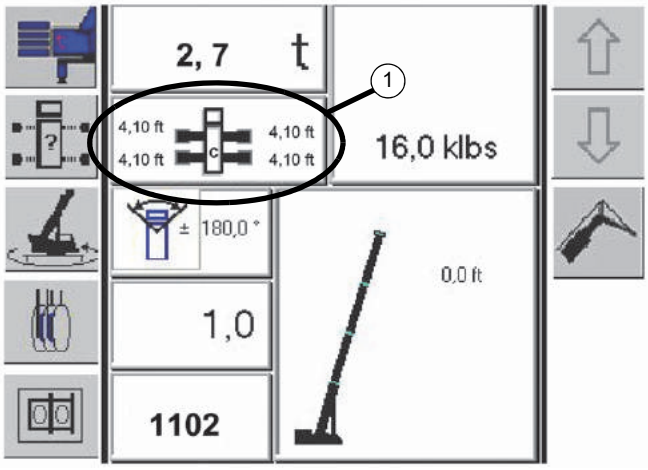


FIGURE 3-128

When an outrigger beam is not within the ±3% tolerance from the selected rigging setup the outrigger symbol will flash and display the actual outrigger length (1, Figure 3-129).

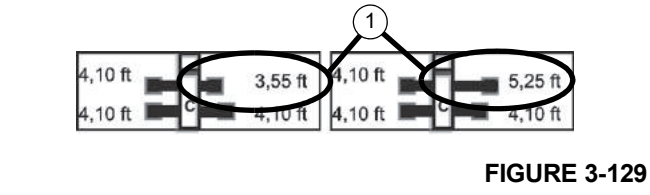


FIGURE 3-129

By pressing the “ENTER” key twice the operator will confirm the rigging code. Should an outrigger be outside the ±3% tolerance an error code will display, refer to *Error Code Display,* page 3-126 and (1) Figure 3-132.

Fully Extended or 100% Deployed

With all outriggers 100% deployed and corresponding rigging code selected, the outrigger symbol (1, Figure 3-130) should stay lit when all outriggers are at the correct position.

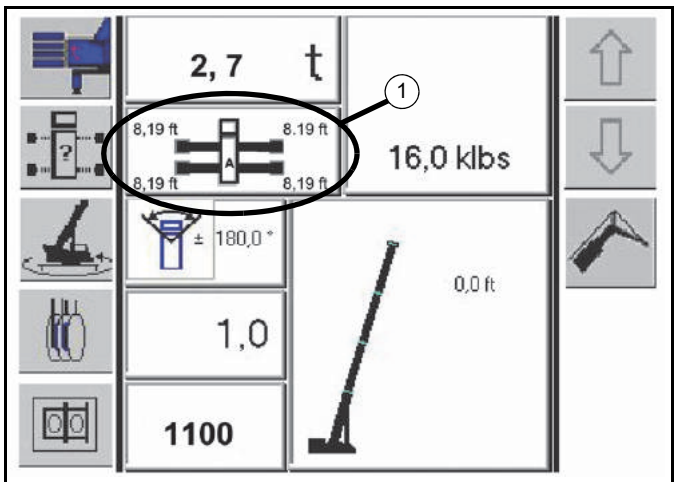


FIGURE 3-130

When an outrigger beam is not within the ±3% tolerance from the selected rigging setup the outrigger symbol will flash and display the actual outrigger length (1, Figure 3-131).

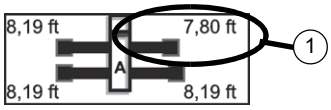


FIGURE 3-131

By pressing the “ENTER” key twice the operator will confirm the rigging code. Should an outrigger be outside the ±3% tolerance an error code will display, refer to *Error Code Display,* page 3-126 and (1) Figure 3-132.

Error Code Display

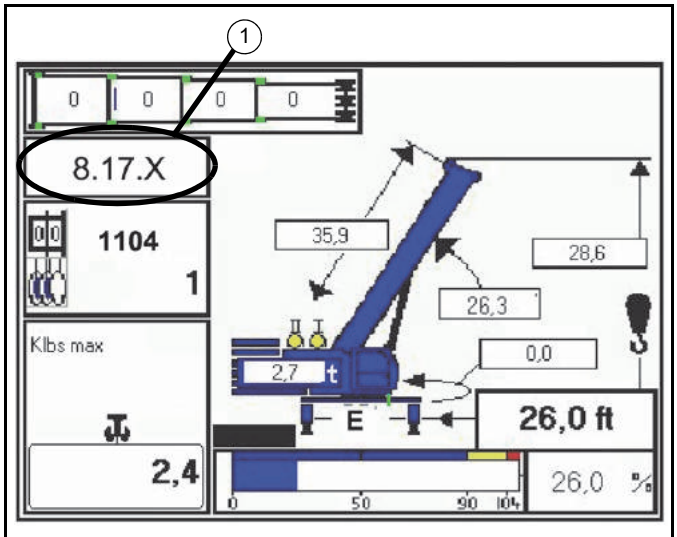


FIGURE 3-132

When any outrigger is not at the correct position matching the selected rigging code, the confirmation of the rigging

code will still be available; however, the corresponding error code will be displayed on the operating screen (1, Figure 3-132).

An error code of 8.17.2 is when an outrigger is at a lesser predefined location, 0% or 50%, when it should be at 50% or 100%, respectively. For example, error 8.17.2 will be displayed if one or more outriggers are at 0% or 50% when selecting 100%.

An error code of 8.17.3 is when an outrigger is more than ±3% of 0%, 50% or 100%, or if a sensor is disconnected or has failed.

The audible alarm can be silenced by pressing the “CE” key, but the out of tolerance condition still exists.

ECOS Error Reporting

There are two errors that can be reported in the ECOS display associated with the OMS:

- 9.2.1.7; length sensor disconnected or broken cable.
- 9.2.1.14; sensor not calibrated, or sensor output below minimum or above maximum.

Stowing the Outriggers

1. Pre-select the rear outriggers with the appropriate switches. Press and hold the jack retract switch until the rear jacks have retracted several inches.
2. Pre-select the front outriggers with the appropriate switches. Press and hold the jack retract switch until the front jacks have retracted several inches.
3. Repeat steps 1 and 2 until the crane is resting on all four wheels and the jack floats are several inches off the ground.

CAUTION

Falling Equipment Hazard!

Keep feet and hands clear of floats when unlocking the floats from the jacks.

Hands and/or feet could be injured by a falling float.

4. Release the locking levers and allow the floats to drop to the ground.
5. Continue to retract the jacks until they are fully retracted.
6. Pre-select the desired outrigger(s) with the appropriate switches. Press and hold the outrigger retract switch. The chosen outrigger beam should begin to retract. (Refer to *Stowing the Mid-Extend Lock Pin,* page 3-125 if the crane has been operated with the outriggers at the mid-extend position.) Retract each outrigger in turn.

NOTE: More than one outrigger may be retracted at one time.

CAUTION

Heavy Equipment Hazard!

Outrigger floats weigh 92 lb (41.7 kg), use care when lifting to prevent injury.

Hands and/or feet could be injured by a falling float.

7. After all outriggers have been fully retracted, stow the outrigger floats.
8. Pin the floats to their front and rear stowing points with retainer pins.

Rotating the Superstructure

Refer to *Main Menu,* page 3-21 and *Swing Gear and Brake Submenu,* page 3-30 for information on using the ECOS system.

DANGER

Tipping Hazard!

Always check before rotating the superstructure whether it is permitted in the crane's current rigging mode (counterweight, outrigger span, working radius).

Before activating swing, sound the horn and verify that all personnel are clear of rotating and moving parts.

Death or serious injury could result from being hit by the load or moving machinery.

CAUTION

Machine Damage Hazard!

Disengage the swing brake and the swing lock pin and/or 360° swing lock before attempting to swing.

Never push or pull the swing control lever through neutral to the opposite direction to stop swing motion. Use the swing brake foot pedal to stop swing rotation.

Do not accelerate the slewing speed to such a degree that the load starts swinging.

Damage to the crane may result from improper swing operation.

NOTE: Automatic rear axle oscillation lockout will activate when the superstructure swings right or left of the 0° forward position.

Swing Operation Prerequisites

The following prerequisites must be fulfilled before rotating the superstructure:

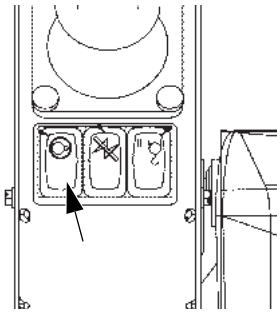
- The Swing Lock is released.
- The counterweight lifting cylinders are fully retracted.
- Slewing is permissible with the current rigging mode, refer to *Rotating Superstructure with Counterweight,* page 3-129.
- The current rigging mode is entered on the RCL.

If slewing is not permissible with the current rigging mode, the slewing gear is disabled.

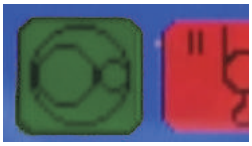
Rotating the Superstructure

To rotate the superstructure, use the controls on the left-hand armrest:

1. Push the top of the Swing Gear switch once.



2. ECOS indicator must be green.



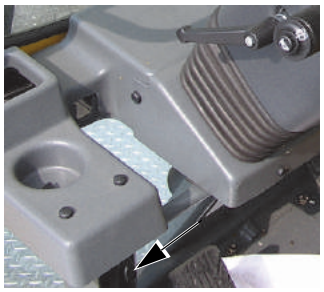
NOTE: If an RCL code has been entered for the working position 180° to the rear or Free-on-wheels, an RCL shutdown will occur after switching on the swing gear, and rotation will be disabled. To acknowledge the shutdown, you must either switch off the swing gear or set down the load and enter an RCL code for the 360° working range.

3. Apply the swing foot brake or leave the control lever at the neutral position, depending on which control is selected in the Main menu.

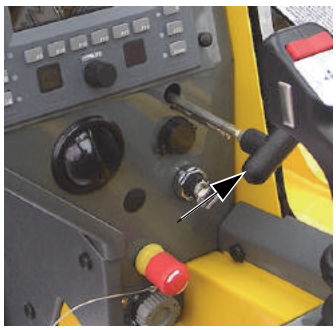

Foot Brake


Control Lever

4. Release the Swing Lock by pulling up on the lever.



5. Pull the Swing Lock Pin handle out to release the pin lock.



6. Engage the swing gear:

   a. **Brake pedal**: Release the brake pedal as you move the control lever in the direction you want the superstructure to rotate.

   b. **Control lever**: Move the control lever in the direction you want the superstructure to rotate.

NOTE: With the Brake pedal function, swing movements are not braked automatically. If you let go of the control lever or move it to the neutral position, the swing movement will continue; use the brake pedal to stop the rotation.

Always operate the control lever with a slow, even pressure. Depending on your configuration; use the swing brake pedal or control lever to stop rotation, then push the Swing Brake switch once, the icon will turn red, to engage the swing brake preventing further rotation.

Rotating Superstructure with Counterweight

WARNING

Tipping Hazard!

The RCL only disables the swing operation if the RCL code was entered correctly and the RCL is not overridden.

Therefore always check before rotating whether the RCL code is valid for the current rigging mode displayed. This prevents swing operations from being allowed within impermissible ranges and the crane from overturning.

You may only rotate the superstructure with a rigged counterweight if the crane is supported by a sufficient outrigger span and the permissible working radii are observed. Otherwise the crane will overturn during rotation.

The current rigging mode is registered by the RCL code entered, and the RCL disables the swing operation if it is not permitted.

The following table specifies (depending on the counterweight and outrigger span) whether rotating the superstructure is:

- Permitted; limited to working radii on Load Chart
- Disabled.

Rigged Counterweight	Rigged Outrigger Span			
	Free on Wheels	Retracted	Mid-Extended	Full-Extended
No Counterweight	Rotation Permitted[1]	Rotation Disabled		Rotation Permitted[2]
Standard 39,000 lb (17,690 Kg)	Rotation Disabled	Rotation Permitted		
Heavy 63,000 lb (28,577 Kg)				

1 Used to install outrigger boxes onto crane.

2 Used to install counterweight onto crane.

Elevating/Lowering the Boom

DANGER

Crushing and/or Tipping Hazard!

Keep the area above and below the boom clear of all obstructions and personnel when elevating the boom.

Long cantilever booms can create a tipping condition, even when unloaded and in an extended, lowered position.

Death or serious injury could result from the crane tipping over and/or being crushed by moving machinery.

Refer to *Main Menu,* page 3-21 for information on using the ECOS system.

Depending on the size of the load and the rigging mode, the RCL switches off the lowering process of the boom as soon as the working area specified in the Load Chart is left.

To lower the boom out of the working range, refer to *Lowering the Boom to a Horizontal Position,* page 3-131.

NOTE: The lift cylinder is not intended for lifting loads. If an overly heavy load is lifted by raising, the SLI switches this process off.

Boom Elevating/Lowering Operation

WARNING

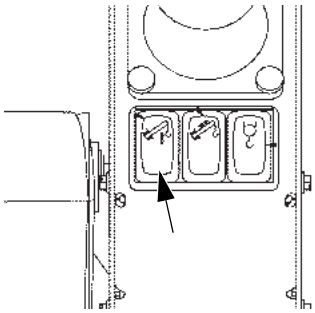
Unexpected Operation Hazard!

When using a multi-function control lever, always verify that the proper function is selected before you move the control lever.

This way, you avoid accidents due to unexpected crane movements.

To elevate/lower the boom, use the controls on the right-hand armrest:

1. Push the top of the Boom Lift switch once.



2. The ECOS lift cylinder indicator turns green.

   If the telescope function was selected; that indicator turns red.

3. Use the right-hand joystick controller:

   To raise the boom: Push the control lever to the left.

   To lower the boom: Push the control lever to the right.

CAUTION

Machine Damage Hazard!

When lowering the boom, simultaneously let out the hoist cable to prevent two-blocking the boom nose and hook block.

4. You can regulate the elevate/lower speed by:
   - moving the control lever
   - changing the engine speed with the accelerator
   - limiting the speed by setting the maximum speed in the Power Unit Speed submenu, see *Power Unit Speed Submenu,* page 3-48.
   - using the High Speed function, refer to *High Speed Main and Auxiliary Hoist Boost Button,* page 3-12.

NOTE: The maximum lift cylinder speed is automatically reduced as the boom length is increased. If you now reduce the working radius (e.g. by retracting the boom), the lift cylinder speed is automatically increased again.

You can adjust the sensitivity of the control levers to suit the operating conditions, refer to *Settings Submenu,* page 3-52.

5. After the elevate/lower operation is complete be sure to press the Boom Lift switch again or select the Crane Function switch to turn the function off to avoid unintentional use.

Lowering the Boom to a Horizontal Position

WARNING

Tipping Hazard!

Do not under any circumstances override the RCL. If the RCL shuts down the lowering procedure, the crane is in a condition in which the main boom may not be lowered beyond the working range (e.g. the load or working radius is too large).

The crane will overturn if you continue to lower the boom with the RCL overridden.

Serious injury or death may result if the crane overturns.

Lowering the boom out of the working range is enabled only without a load and if there is a rigging table for the current rigging mode.

Enabling is automatic, the rigging tables cannot be entered manually. The same tables apply to raising outside of the working range.

The RCL switches off the lowering procedure at about 10 to 15° if there are no rigging tables for the current rigging mode. In this case, you must bring the crane into a rigging mode for which a rigging table exists (e.g. retracting, setting down the load, other superstructure position).

All rigging modes for which rigging tables exist can be found in the Load Chart.

Lowering Boom to Horizontal with Boom Extension Installed

If the following requirements are met, lowering into the horizontal position with boom extension with a swing range of 360° is permitted and is monitored by the RCL.

The following requirements must be satisfied when raising and lowering the main boom with rigged boom extension:

- The current rigging mode with the rigged boom extension is entered on the RCL, and the corresponding RCL code is displayed as per the Load Chart.
- The current reeving on the boom extension is entered for the hoist whose rope is reeved on the boom extension.
- Apart from the overhaul ball, there is no load on the boom extension.
- The main boom is fully retracted.

The RCL will only allow the main boom to raising and lowering when the main boom is completely retracted.

When all of the above requirements have been satisfied, the RCL will automatically switch to the rigging tables and lowering the boom can then be done in the angle range below the working range of approximately 15°.

Tilting the Crane Cab

CAUTION

Falling Objects Hazard!

Close the cab door before tilting and remove all loose objects (e.g. bottles) from the cab.

In this way, you prevent objects from tipping over, the cab door opening by itself, and unintended operational accidents caused by falling objects.

NOTE: Park brake must be engaged to operate the cab tilt feature and cab must be completely down (at zero level) for the drive functions to be enabled.

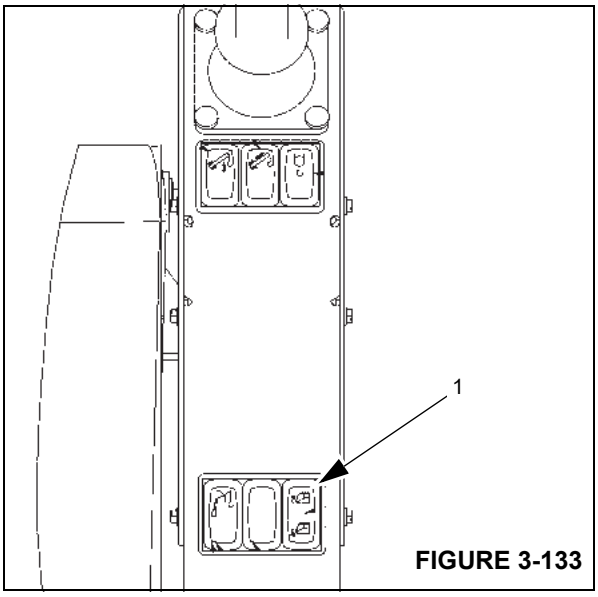


FIGURE 3-133

The crane cab can be tilted to the rear in order to attain a better operating position when working at great heights, refer to *Cab Tilt Switch,* page 3-13.

To Raise the Cab

1. Close the crane cab door.
2. Press the top of the switch (1) (Figure 3-133).

To Lower the Cab

1. Close the crane cab door.
2. Press the bottom of the switch (1).

The crane cab continues to tilt as long as you hold the button down or the end position is reached.

Telescoping the Boom

For a review of the mechanics involved in extending and retracting the boom, refer to *Telescope System Overview,* page 3-133. Refer to *Main Menu,* page 3-21 and *Telescope Submenu,* page 3-32 for information on using the ECOS system.

Telescope Mechanism

The telescoping process requires locking and unlocking of the telescope cylinder assembly with the sections of the main boom. You can telescope the main boom in two ways:

- **Manual Telescoping, refer to *Manual Telescoping,* page 3-138**

  For manual telescoping, you must initiate all locking and unlocking processes at the right time.

- **Telescoping with Teleautomation, refer to *Telescoping with Teleautomation,* page 3-135**

  When telescoping with teleautomation, you enter the telescoping requirements and the ECOS system controls all the locking and unlocking processes automatically. You may additionally need to telescope to an intermediate length manually.

Fixed Length, Intermediate Length, Telescoping Length

There are Load Chart 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 *Load Chart* tables 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 and,
  - All telescopic sections are engaged with the locking pin notch.

- **Main Boom Intermediate Length**

  A main boom intermediate length is reached if all telescopic sections are not locked to fixed lengths.

  - Extend the main boom to the required length before hoisting the load!
  - You cannot telescope the boom with the specified lifting capacities for main boom intermediate lengths.

- **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.

Current Telescope Display, (Figure 3-134)

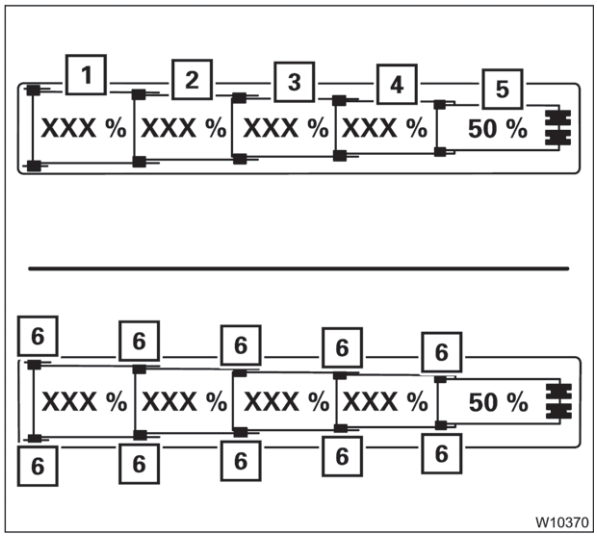


FIGURE 3-134

The displays (1) to (5) show the current telescoping of the telescopic sections 1 to 5 in percent, e.g. 50%.

Fixed and intermediate lengths differ in the locking pins (6):

- **Green**: Fixed length
- **Black**: Intermediate length
- **Flashing**: Telescopic section at fixed length with the locking pin not engaged to the section or unlocked

Telescope System Overview

Refer to Figure 3-135.

The illustration shows the main boom assembly with the telescope cylinder completely retracted into the main boom base section (9) and the first three telescopic sections 1 to 3 (1) to (3).

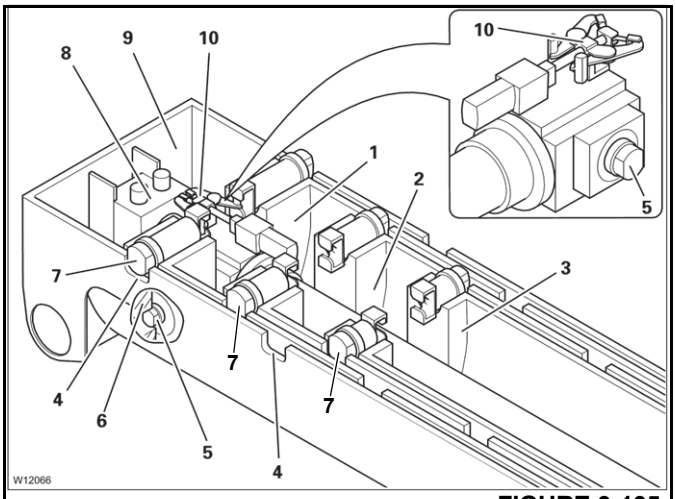


FIGURE 3-135

Each telescopic section is equipped with two section locking pins (7) which are extended by spring force and retracted by the butterfly levers (10).

A telescopic section is locked when the locking pins (7) in that section engage the cutouts (4) in the previous section.

The telescope cylinder piston rod (8) is attached to the boom base (9). When hydraulic pressure is applied to the cylinder the rod remains stationary and the cylinder extends.

The telescope cylinder has two locking pins (5) at the bottom, which engage the section to be moved and the butterfly mechanism at the top (10) to retract the section locking pins.

After the telescope cylinder is positioned at a locking point:

- The cylinder locking pins (5) extend into the cutouts (6) in the section to be moved, the telescope cylinder is now locked.
- The butterfly mechanism (10) engages the section locking pins (7) and retracts them, the telescopic section is now unlocked.
- The cylinder can now be extended/retracted, moving the section it is locked to.

For a more in-depth description of the telescoping process refer to the next section.

Telescoping Process

The following section describes the normal operation of the telescoping process from its initial starting point.

The telescoping processes consist of 4 steps:

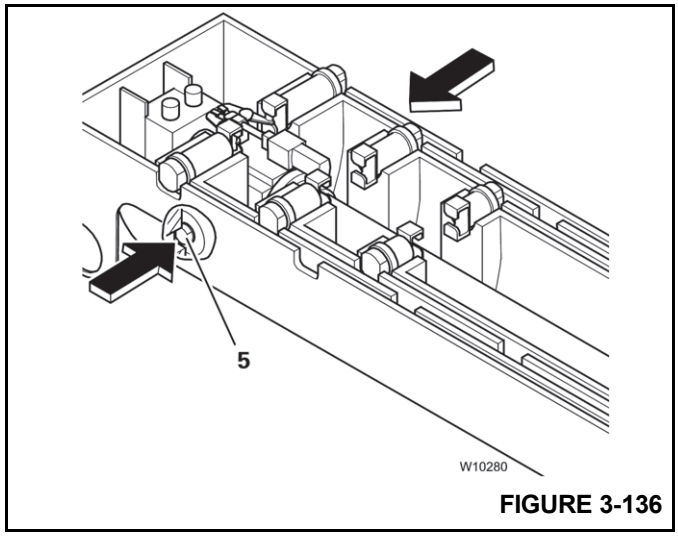


FIGURE 3-136

1. Unlocking the telescoping cylinder (Figure 3-136);

a. The cylinder locking pins (5) retract, unlocking the telescope cylinder.

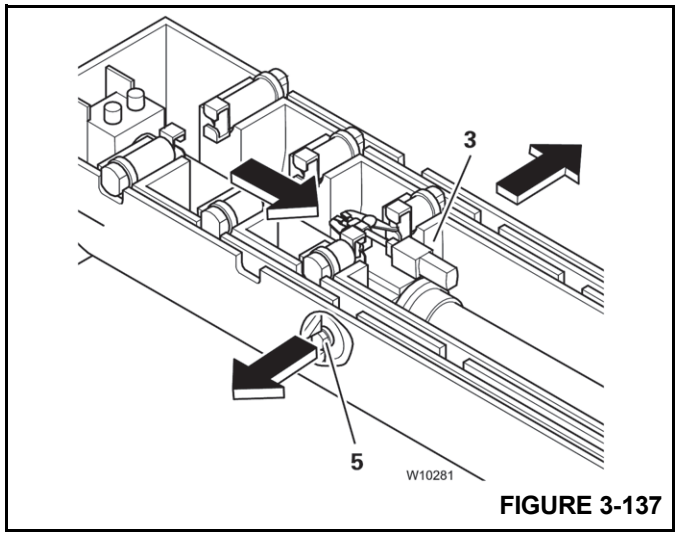


FIGURE 3-137

2. Moving and locking the telescope cylinder (Figure 3-137);

a. The telescope cylinder moves into the telescopic section to be telescoped, e.g. section 3 (3).

b. The cylinder locking pins (5) extend, the telescope cylinder is locked into section 3.

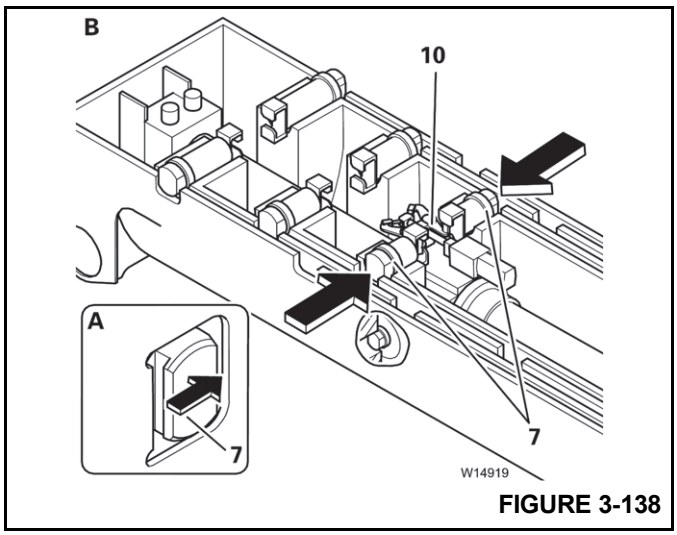


FIGURE 3-138

3. Unlocking the telescopic section (Figure 3-138);
   a. The telescope cylinder extends until the notch in the section locking pins (7) are no longer engaged with the section (A).
   b. The butterfly mechanism (10) retracts the section locking pins (7) unlocking the telescopic section.

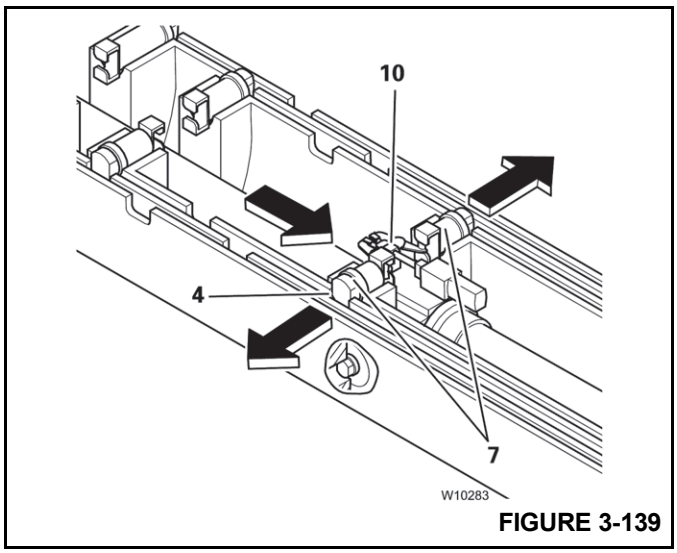


FIGURE 3-139

4. Moving, locking and engaging the telescopic section (Figure 3-139);
   a. The telescope cylinder pushes the telescopic section to a new locking point.
   b. The section locking pins (7) extend into the cutouts (4).

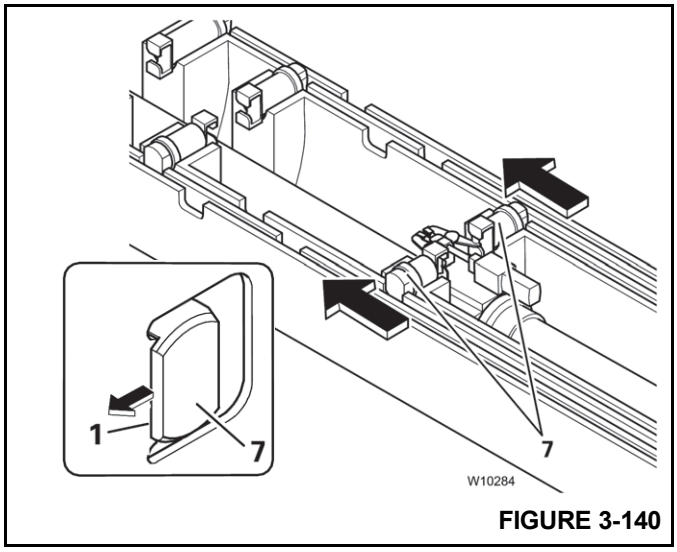


FIGURE 3-140

   c. The telescopic cylinder retracts until the section locking pins' notch (7) is engaged with the telescopic section (1).

The weight of the load is now on the telescopic sections and not on the telescoping cylinder.

Telescoping with Teleautomation

When telescoping with teleautomation, you enter the desired fixed lengths and then move the control lever in the required direction. Switching between the telescopic sections is carried out automatically by ECOS.

NOTE: If the desired telescoping is not a fixed length, you can first telescope to the next closest fixed length with the teleautomation and then telescope further to the desired length manually.

Switch the telescoping mechanism on and open the Telescope submenu, refer to *Telescope Submenu,* page 3-32.

To Switch on Input Mode

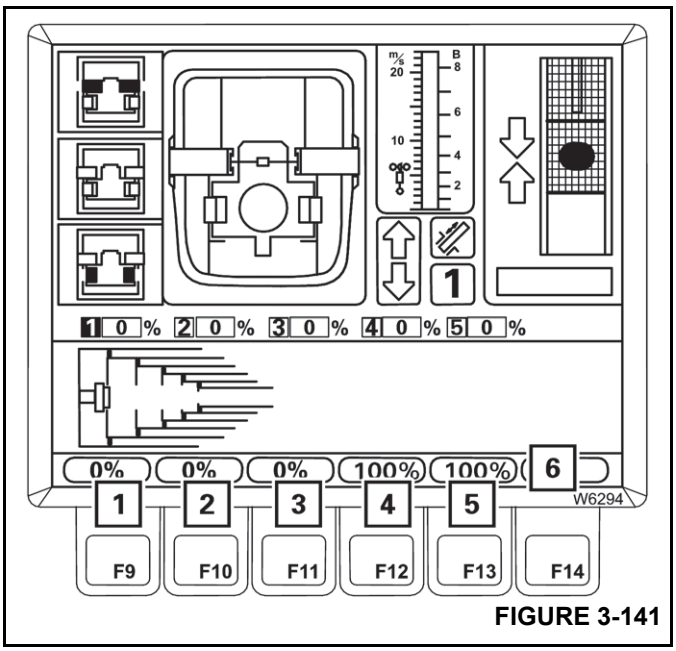


FIGURE 3-141

The display (6) (Figure 3-141) shows the set values for all telescopic sections.

The values are displayed in red if teleautomation is switched off.

No values are shown if teleautomation is disabled.

1. To turn on input mode, press one of the F9 to F13 buttons (1) to (5).

   The values in the display (6) turn yellow.

   Input mode is now switched on.

You can exit the input mode with the *Esc* button. The values in the display (6) turn red.

To Enter Values

Refer to Figure 3-142.

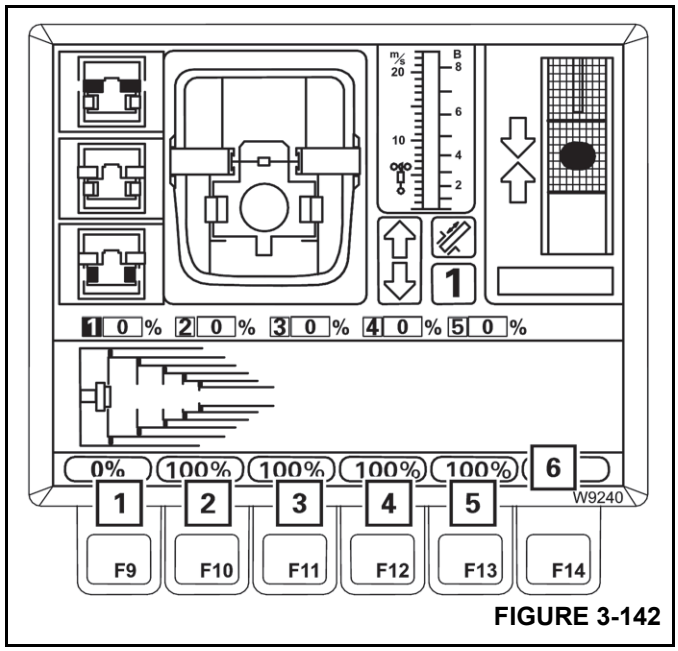


FIGURE 3-142

1. Press one of the F9 to F13 buttons (1) to (5).

   Each time you press a button, the corresponding value in the display (7) switches continuously between the fixed lengths.

2. Enter the desired set values for all telescopic sections, e.g. 0%, 100%, 100%, 100%, 100%.

3. Press the button *Enter* once.

   The entered set values are confirmed.

If the entered set values are not permissible, the values on the display (3) (Figure 3-143) turn red. Teleautomation remains switched off.

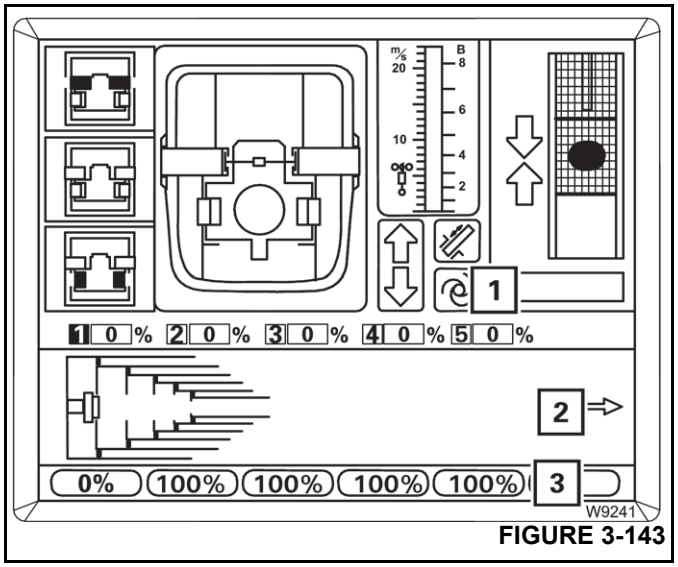


FIGURE 3-143

If the entered set values are permissible, the values on the display (3) turn green.

- The symbol (1) is displayed and the teleautomation is switched on.
- The display (2) shows the telescoping direction for the teleautomation start, e.g. the arrow pointing to the right, for Extending.

Telescope Operation

Move the control lever for the displayed telescoping direction.

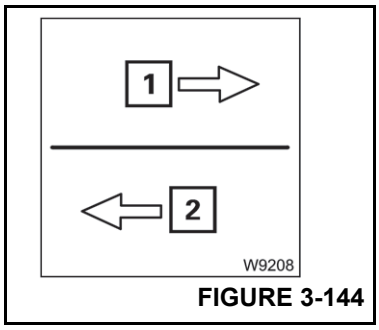


FIGURE 3-144

- The arrow (1) (Figure 3-144) for the indicated telescoping direction flashes if you move the control lever in the wrong direction.
- If you move the control lever in the correct direction, ECOS telescopes the boom automatically until the direction has to be changed. Then the arrow (2) for the new telescoping direction is indicated, e.g. for Retracting.

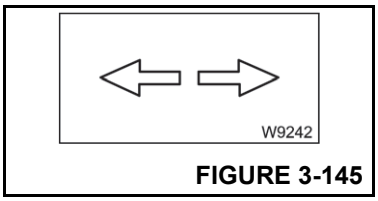


FIGURE 3-145

- In the case of the telescope cylinder only moving (without telescopic section), both arrows are displayed. Cylinder only movements are automatically performed in both directions, irrespective of the control lever movement.

You can regulate the speed for telescoping in the same way as for manual telescoping.

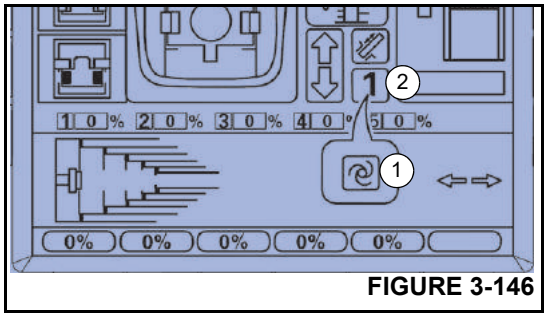


FIGURE 3-146

The telescoping process stops when the entered set values are reached.

- Move the control lever to the zero position.

  The display (Figure 3-146) changes from the teleautomation icon (1) to the section number icon (2). Teleautomation is switched off.

Canceling Teleautomation

Refer to Figure 3-147.

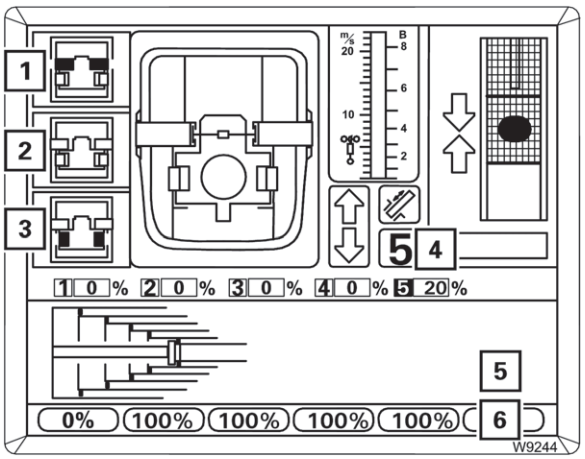


FIGURE 3-147

To cancel teleautomation, press one of the F1 to F3 buttons (1), (2) or (3) once.

The telescoping process is stopped:

- The display (5) goes out,
- the icon (4) appears,
- the values in the display (6) are red.

Teleautomation is now switched off.

Example of Telescoping with Teleautomation

Refer to Figure 3-148.

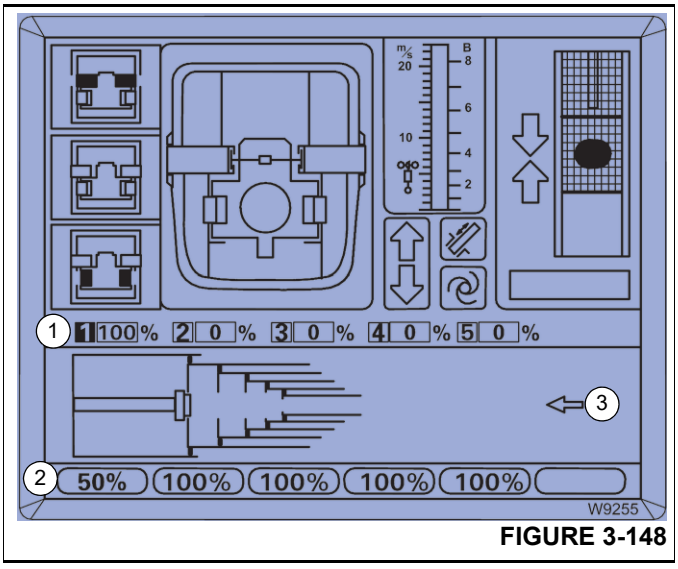


FIGURE 3-148

Assuming the current telescoping is 100/0/0/0/0 and the telescoping cylinder is locked in telescopic section 1(1).

The desired telescope status is 50/100/100/100/100 (2).

The display should correspond to Figure 3-148 once you have entered the desired telescope status and confirmed it.

ECOS calculates the following telescoping sequence:

Telescopic section 1	retract	to 0%
Telescopic section 5	extend	to 100%
Telescopic section 4	extend	to 100%
Telescopic section 3	extend	to 100%
Telescopic section 2	extend	to 100%
Telescopic section 1	extend	to 50%

Since the first step is retracting, the arrow (3) points to the left.

1. Move the control lever for retracting and hold it there, refer to (Figure 3-149).

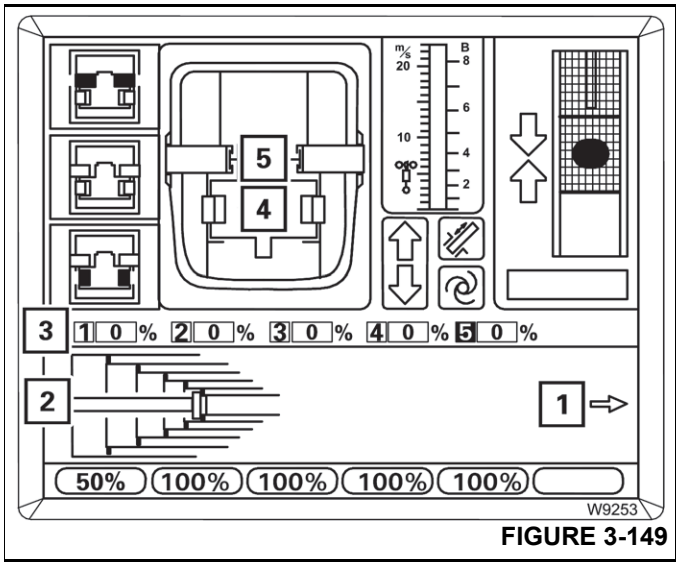


FIGURE 3-149

Telescopic section 1 is fully retracted. The following processes are carried out automatically, in order:

- Telescopic section 1 retracts; display (3) 0%
- Telescopic section 1 locks; pins (5) green
- Telescope cylinder unlocks; pins (4) red
- The telescope cylinder moves into telescopic section 5; display (2)
- Telescope cylinder locks; pins (4) green

The arrow (1) shows the new telescoping direction, extending.

NOTE: The arrow (1) flashes as long as you are moving the control lever for retracting.

2. Move the control lever for extending and hold it there.

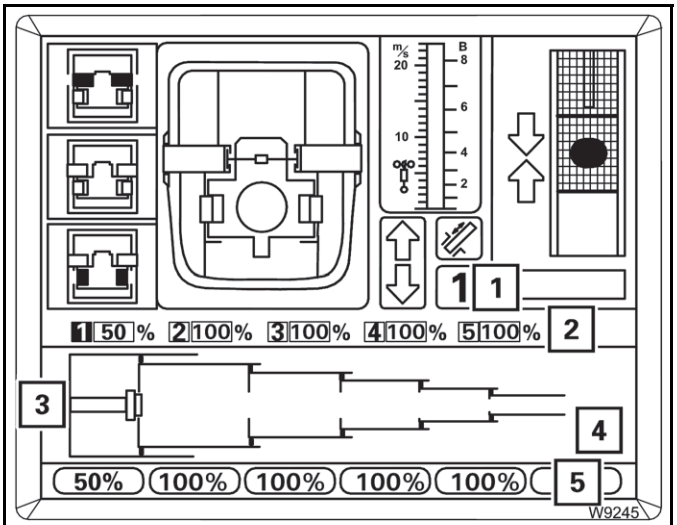


FIGURE 3-150

ECOS now automatically moves telescopic sections 5, 4, 3 and 2 to the full extent and stops when telescopic section 1 reaches the set value of 50%.

3. Move the control lever to the zero position.
   - The display (4) goes out.
   - The display (1) is active again.
   - The values in the display (5) are red.
   - The display (2) shows the current telescoping, e.g. 50/100/100/100/100.
   - The display (3) shows the current telescoping graphically.

   Teleautomation is switched off.

NOTE: To extend telescopic section 1 to 60%, for example, you can now further extend this telescopic section manually.

Manual Telescoping

To telescope manually, you must initiate all locking and unlocking processes, which are then carried out automatically.

The following sections describe the operating procedures necessary to extend/retract the boom manually.

NOTE: The operating order depends on the current initial position. For an overview of the telescope process, refer to *Telescope System Overview,* page 3-133.

- *Checking the Initial Position,* page 3-138
- unlocking the telescoping cylinder,
- moving the telescoping cylinder (without telescopic section),
- locking the telescoping cylinder,
- unlocking the telescopic section,
- telescoping the telescopic section,
- locking the telescopic section.

NOTE: The lengths given in the following illustrations are purely sample values, and may therefore deviate from the actual values displayed.

Checking the Initial Position

Before telescoping, you must check the following statuses:

- The *Current Telescope Status,* page 3-139,
- the *Position of the Telescope Cylinder,* page 3-139,
- the *Position of the Locking Pins,* page 3-139.

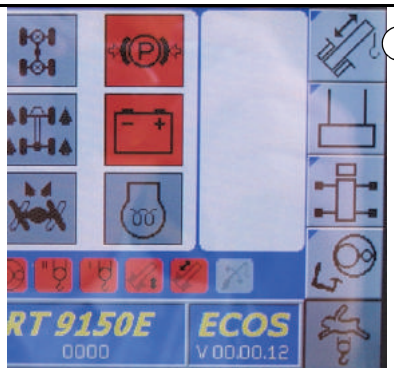


FIGURE 3-151

If necessary, open the main menu by pressing the *Esc* button, then press the F5 button (1) once (Figure 3-151).

The Telescoping submenu opens.

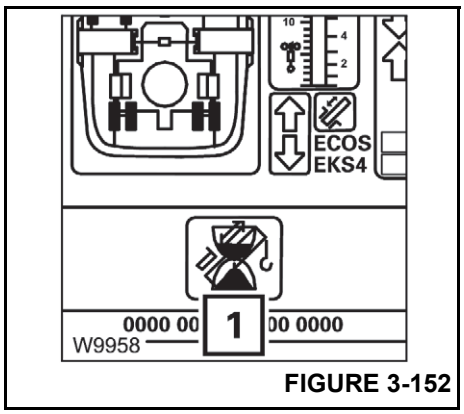


FIGURE 3-152

If an “error” display (1) (Figure 3-152) is pending, all operating elements are disabled, refer to *Telescope Mechanism Error Messages,* page 3-37

Current Telescope Status

Refer to Figure 3-153.

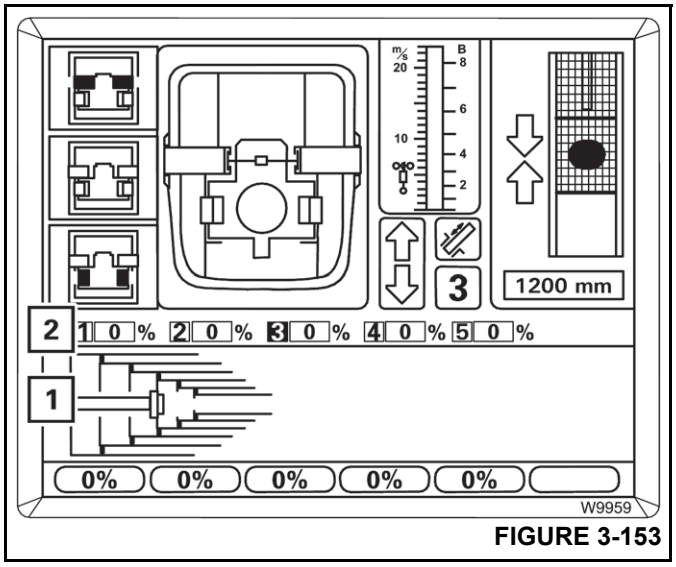


FIGURE 3-153

The display (2) shows the current telescoping in percent for each telescopic section.

The display (1) shows the current telescope diagram.

Position of the Telescope Cylinder

Refer to Figure 3-154.

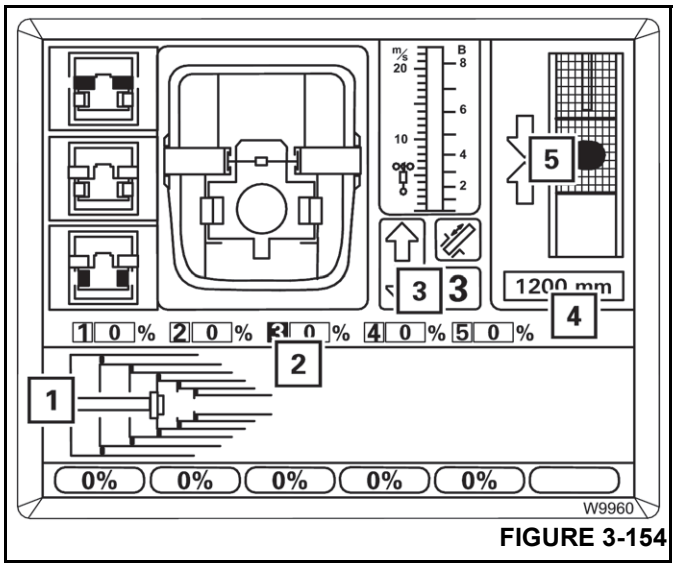


FIGURE 3-154

The display (4) shows how far the telescope cylinder is extended, e.g. 1,200 mm (3.93 ft).

If the telescope cylinder is near a locking point:

- The display (3) shows the corresponding telescopic section, e.g. telescopic section 3,
- the display (2) shows the corresponding telescopic section number in green,
- the display (5) shows one or two arrows, depending on the distance to the locking point.

The display (1) shows a top view of the current position.

Position of the Locking Pins

Refer to Figure 3-155.

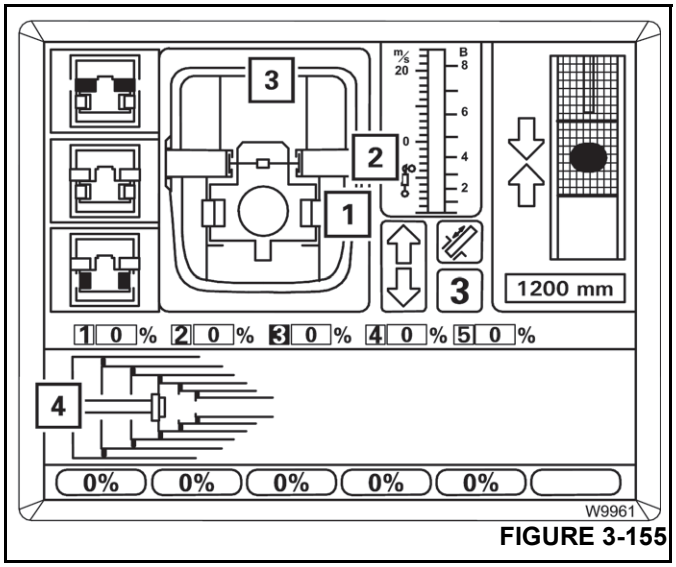


FIGURE 3-155

The display (3) shows the current positions of the locking pins:

(1) the telescope cylinder pins,

(2) the telescopic section pins.

The current status of the pins are indicated by color:

Red: Unlocked

Green: Locked

Yellow: Intermediate position.

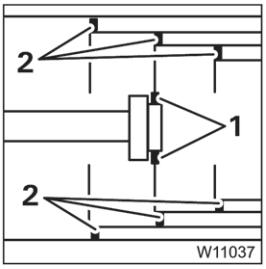


FIGURE 3-156

The display (4) shows the same positions as detailed in Figure 3-156:

- (1) Locking pins on the telescope cylinder
- (2) Locking pins on the telescopic sections

Green: Locked

No display: Unlocked or intermediate position.

Unlocking the Telescope Cylinder

Unlocking the telescope cylinder is required for the cylinder to be moved separately without telescopic section.

NOTE: The telescope cylinder and the telescopic section cannot be unlocked simultaneously.

Prerequisites

Refer to Figure 3-157.

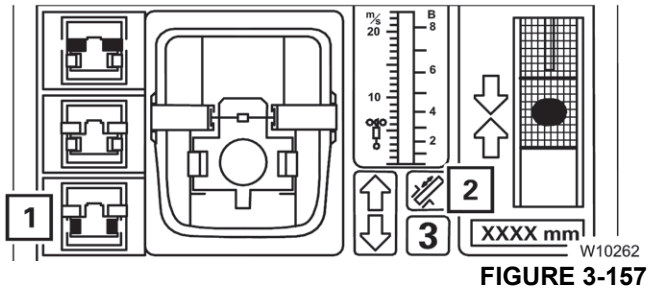


FIGURE 3-157

The following conditions must be met to unlock the telescope cylinder:

- The telescoping mechanism must be on, symbol (2) green,
- the telescope cylinder must be locked, symbol (1) grey.

To Select Unlock

Refer to Figure 3-158.

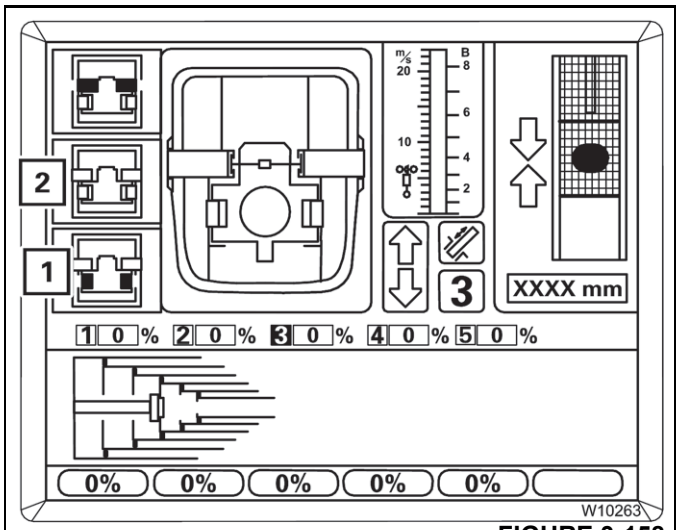


FIGURE 3-158

Press the F3 button (1) once.

- If the telescopic section is *locked*, symbol (1) flashes indicating the telescope cylinder can be unlocked with the control lever.
- If the telescopic section is *unlocked*, symbol (2) flashes indicating that when the control lever is actuated the telescopic section will lock and the telescope cylinder will unlock.

NOTE: In the next step, both selections are carried out one directly after the other.

Unlocking the Telescoping Cylinder

Refer to Figure 3-159.

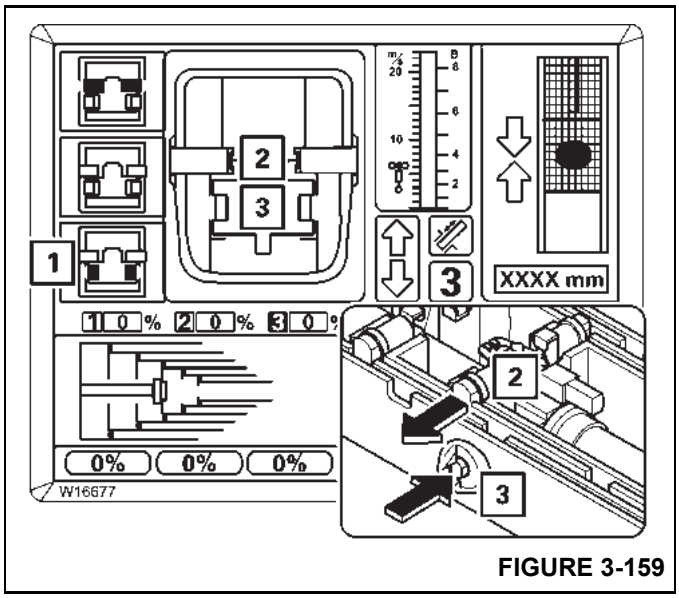


FIGURE 3-159

Move the right control lever for telescoping.

If required, the section locking pins (2) will extend first.

The cylinder locking pins (3) will retract:

Yellow: Intermediate position,

Red: Unlocked.

In the unlocked position, the symbol (1) is yellow.

If the control lever is moved, the telescope cylinder moves immediately.

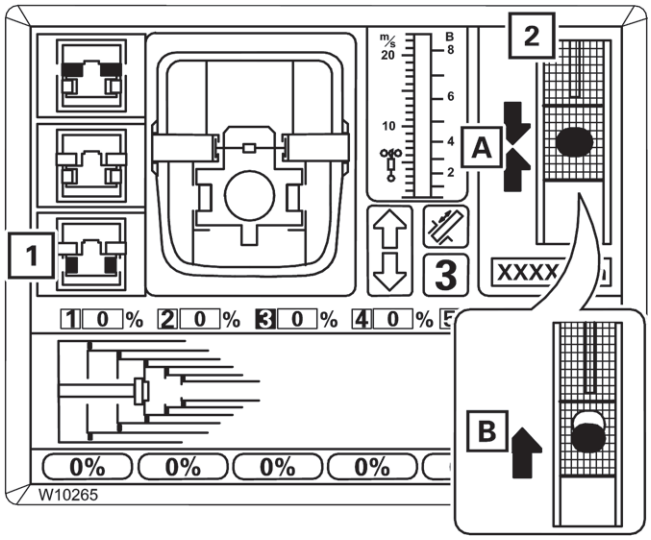


FIGURE 3-160

If the symbol (1) (Figure 3-160) is still flashing after approximately 10 seconds, this means that the locking pins are under load.

Let go of the control lever.

The display (2) shows which direction you need to move the cylinder to take the load off:

(A) Retract

(B) Extend.

CAUTION

Boom Damage Hazard!

Repeated attempts to extend and retract may cause damage to the boom system.

NOTE: If removing the load does not cause unlocking, you must lock the telescope cylinder and restart the unlocking process, refer to *Lock Telescope Cylinder,* page 3-142.

Extending/ Retracting the Telescope Cylinder

Operating the telescope cylinder (without telescopic section) is required when the telescope cylinder needs to be moved into a different telescopic section.

Prerequisites

Refer to Figure 3-161.

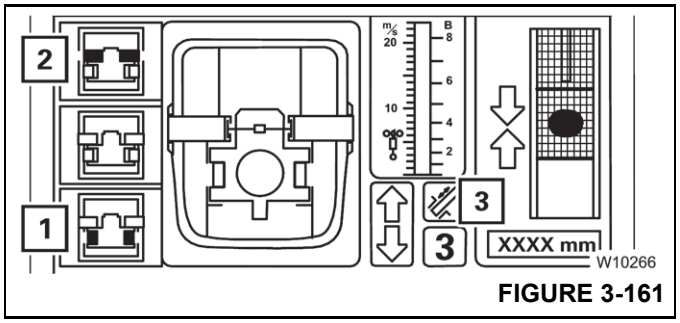


FIGURE 3-161

In order to extend/retract the telescope cylinder the following conditions must be met:

- The telescoping mechanism must be on, symbol (3) green
- The telescopic section must be locked, symbol (2) grey
- The telescope cylinder must be unlocked, symbol (1) yellow.

Extend/Retract

Refer to Figure 3-162.

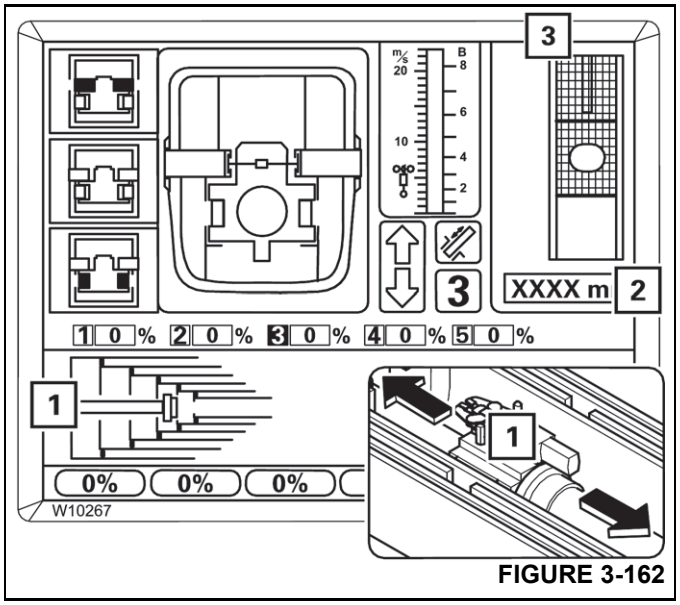


FIGURE 3-162

Move the control lever in the desired direction to extend or retract the telescope cylinder (1).

The display (2) shows the currently extended length, e.g. 1,500 mm (4.92 ft).

Near a locking point, the display (3) indicates the following, refer to (Figure 3-163):

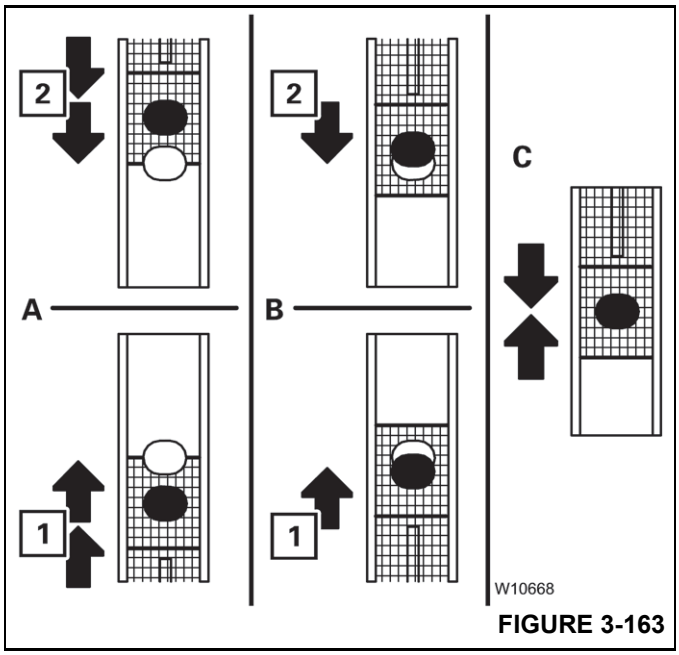


FIGURE 3-163

- The distance to the locking point;
  (A) Yellow: Approx. 1 m (3.3 ft)
  (B) Yellow: Less than 1 m (3.3 ft)
  (C) Green: At the locking point

and

- The direction of travel to the locking point;
  (1) Extending
  (2) Retracting

Lock Telescope Cylinder

The telescope cylinder must be locked to a telescopic section so that the telescopic section can be moved.

Prerequisites

Refer to Figure 3-164.

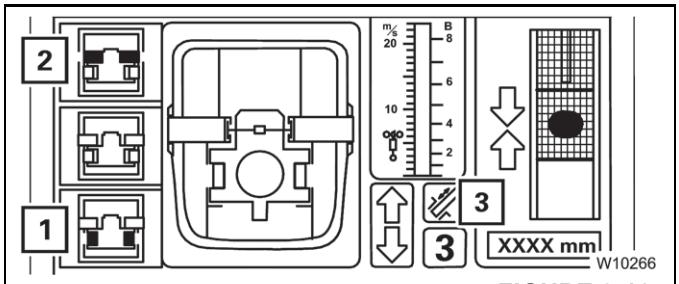


FIGURE 3-164

In order to lock the telescope cylinder the following conditions must be met:

- The telescoping mechanism must be on, symbol (3) green
- The telescopic section must be locked, symbol (2) grey
- The telescope cylinder must be unlocked, symbol (1) yellow.

To Select Lock

Refer to Figure 3-165.

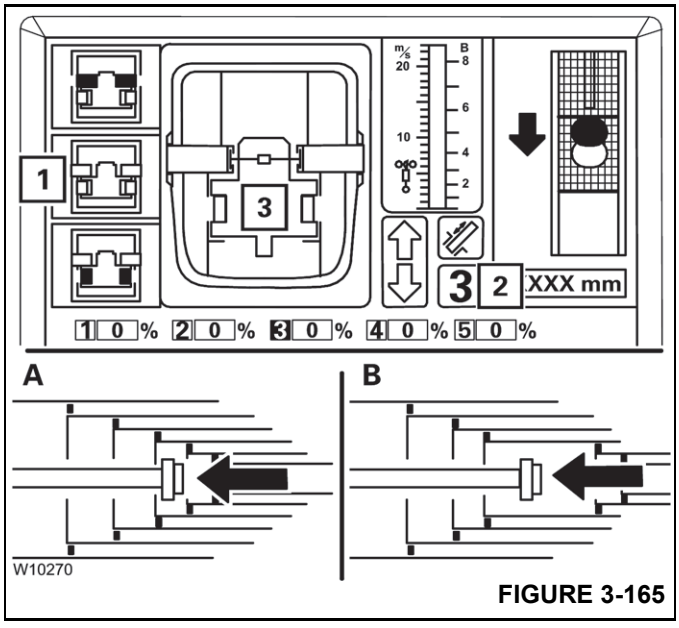


FIGURE 3-165

1. Move the telescope cylinder to the desired locking point, e.g. to telescopic section 3.

   Wait until the display (2):

   (A): shows the desired telescopic section or,

   (B): shows no telescopic section and the desired

locking point is reached next.

2. Press the F2 button (1) once, The symbol (1) flashes indicating that locking the telescope cylinder is selected.

Locking the Telescope Cylinder

Refer to Figure 3-166.

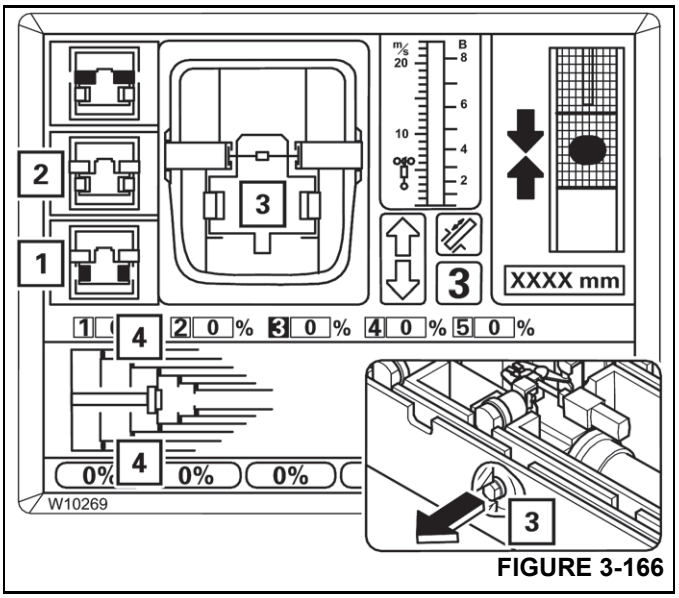


FIGURE 3-166

Move the control lever until locking is complete:

- The cylinder locking pins (3) extend into the locking point;
  - Yellow: Intermediate position
  - Green: Locked.
- When the cylinder is locked:
  - the symbol (1) is yellow,
  - the symbol (2) is grey,
  - the cylinder locking pins (4) are green.

Unlocking the Telescopic Section

Unlocking a telescopic section is required for that section to be moved.

NOTE: The telescope cylinder and a telescopic section cannot be unlocked simultaneously.

Prerequisites

Refer to Figure 3-167.

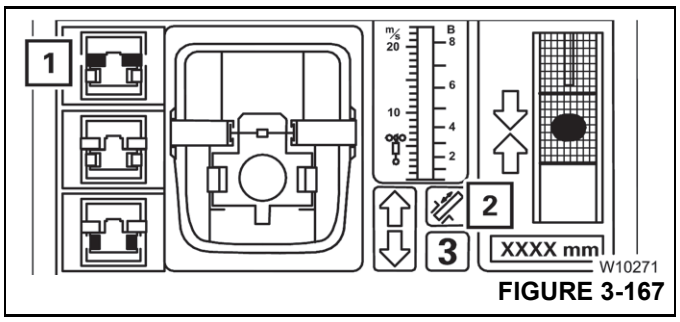


FIGURE 3-167

In order to unlock a telescopic section the following conditions must be met:

- The telescoping mechanism must be on, symbol (2) green
- The telescopic section must be locked, symbol (1) grey.

To Select Unlock

Refer to Figure 3-168.

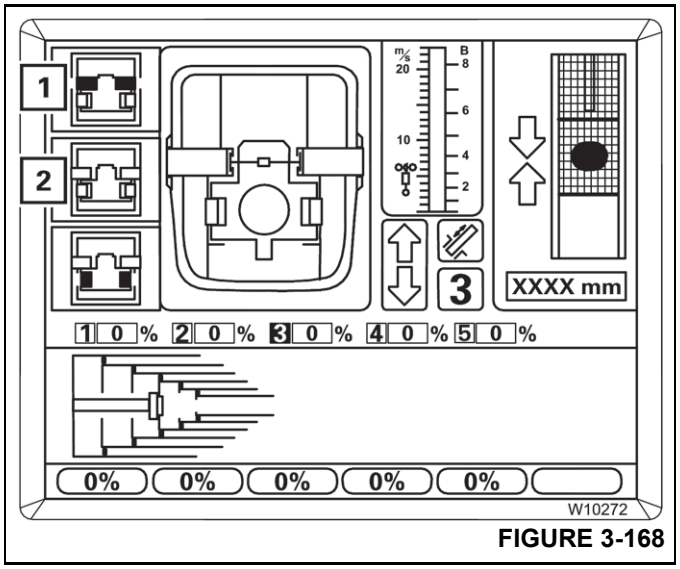


FIGURE 3-168

Press the F1 button (1) once:

- If the telescope cylinder is locked, symbol (1) flashes indicating that the unlock telescopic section process has been selected.
- If the telescope cylinder is unlocked, symbol (2) flashes and the following is selected:
  - Lock the telescope cylinder,
  - Unlock the telescopic section.

In the next step, both of the previous selections are carried out one directly after the other.

Unlocking the Telescopic Section

Refer to Figure 3-169.

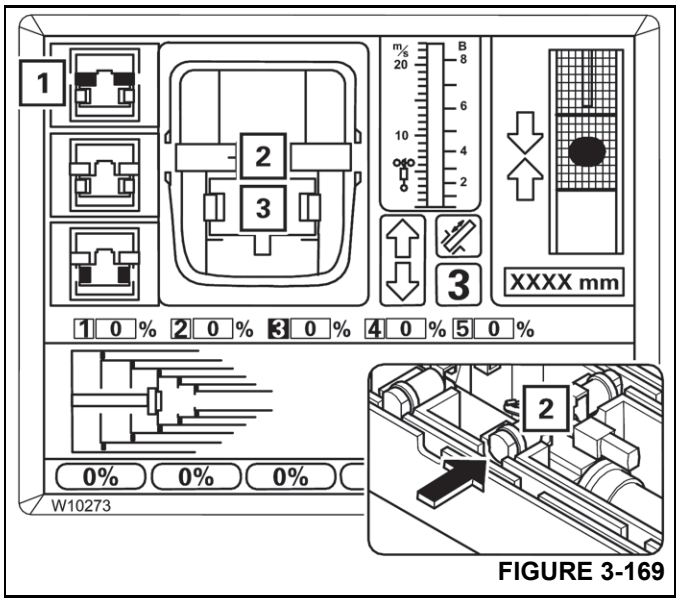


FIGURE 3-169

Move the right control lever for telescoping.

- If necessary, the telescope cylinder locking pins (3) will extend first.
- The section locking pins will (2) retract:

  Yellow: Intermediate position,

  Red: Unlocked.

In the unlocked position, the symbol (1) is yellow.

If the control lever is moved, the telescopic section is telescoped immediately.

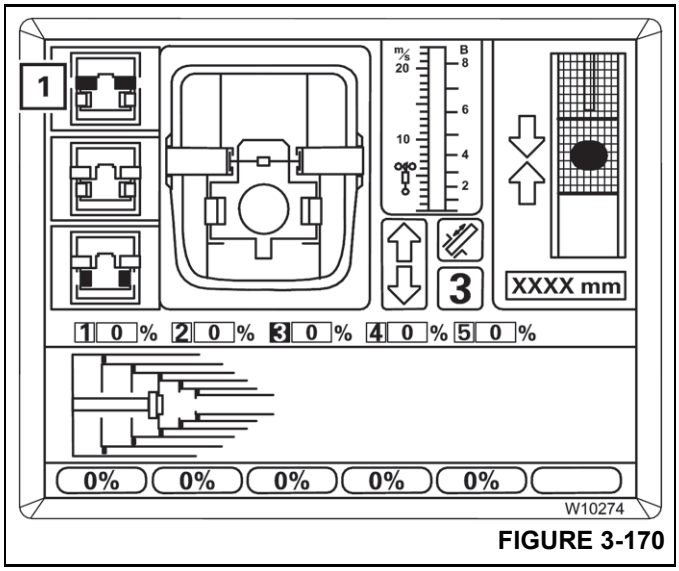


FIGURE 3-170

If the symbol (1) (Figure 3-170) is still flashing after approximately 10 seconds, this means that the section locking pins are under load.

Let go of the control lever.

To relieve the load, carefully retract and extend the boom a little.

CAUTION

Boom Damage Hazard!

Repeated attempts to extend and retract may cause damage to the boom system.

NOTE: If removing the load does not cause unlocking, you must lock the telescopic section again and restart the unlocking process, refer to *Lock Telescope Cylinder,* page 3-142.

3

Telescoping the Telescopic Section

You can telescope the telescopic section once it is unlocked.

Prerequisites

Refer to Figure 3-171.

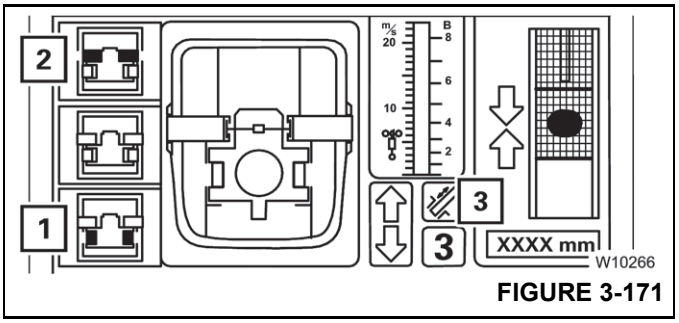


FIGURE 3-171

In order to telescope a section it must be unlocked, the following conditions must be met:

- The telescoping mechanism must be on, symbol (3) green
- The telescope cylinder must be locked, symbol (1) grey
- The telescopic section must be unlocked, symbol (2) yellow.

Telescoping

Refer to Figure 3-172.

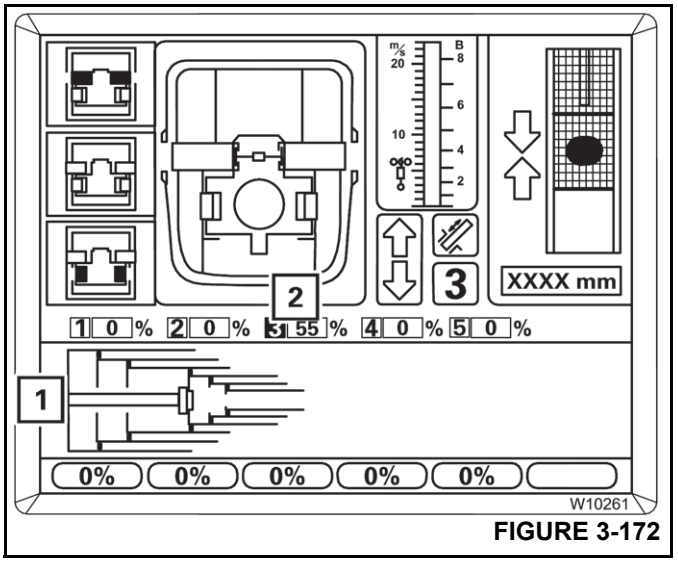


FIGURE 3-172

Move the right control lever in the desired telescoping direction.

The display (2) shows the currently extended length in percent, e.g. 55% for telescopic section 3.

The current telescope diagram on the display (1) changes continually.

Locking the Telescopic Section

Every telescopic section can be locked at the fixed lengths, refer to *Fixed Length, Intermediate Length, Telescoping Length,* page 3-132.

Prerequisites

Refer to Figure 3-173.

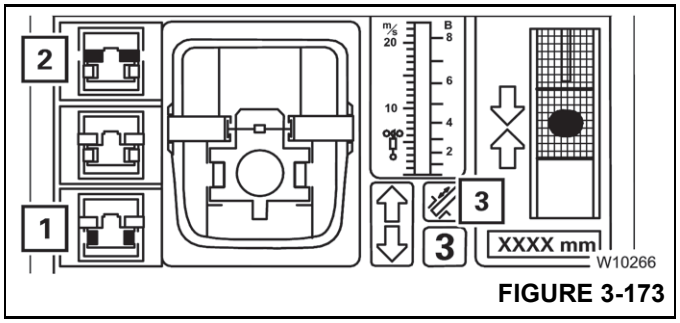


FIGURE 3-173

In order to lock a telescopic section the following conditions must be met:

- The telescoping mechanism must be on, symbol (3) green
- The telescopic section must be unlocked, symbol (2) yellow
- The telescope cylinder must be locked, symbol (1) grey.

To Select Lock

Refer to Figure 3-174.

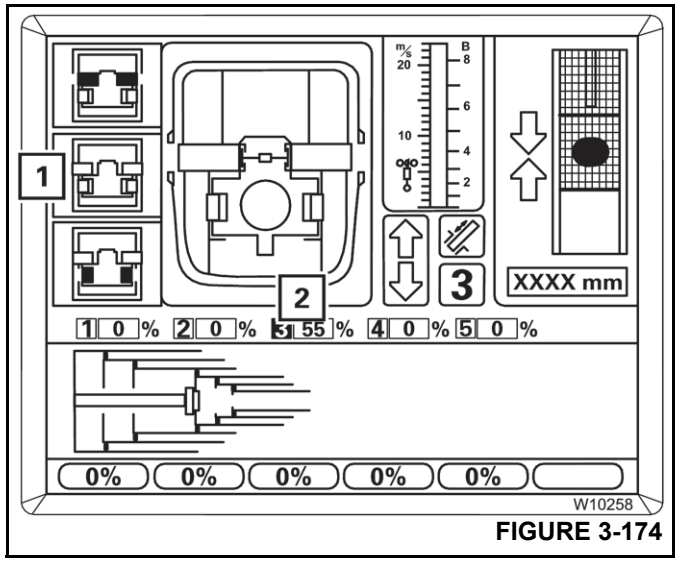


FIGURE 3-174

1. Telescope to the desired fixed length, e.g. telescopic section 3 to 100%.

   If necessary, wait until the telescopic section moves past a non-desired fixed length by approximately 5%, e.g. at 50%, display (2).

2. Press the button (1) once, the symbol (1) flashes indicating that lock telescopic section is selected.

Locking the Telescopic Section

Refer to Figure 3-175.

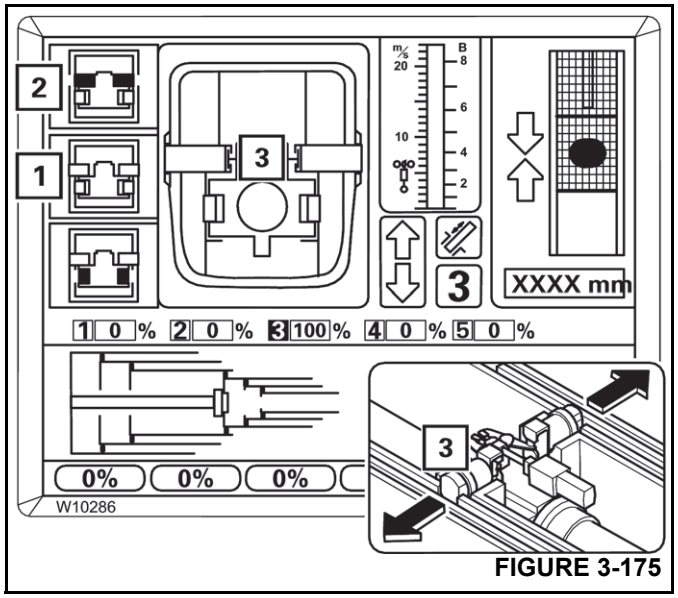


FIGURE 3-175

Move the right control lever until locking is complete:

- The section locking pins (3) extend at the locking point:

  Yellow: Intermediate position

  Green: Locked
- The notch in the section locking pins engage the telescopic section is set down.

In the locked position:

- The symbol (1) is yellow,
- The symbol (2) is grey.

NOTE: Ensure the telescopic section is locked and the locking pins engaged with the section, the symbol * must be yellow.

This prevents the load from exerting pressure on the telescope cylinder and allows the load to be enabled for fixed lengths.

Telescoping Main Boom in Horizontal Position

Position the main boom to the horizontal position as described in *Lowering the Boom to a Horizontal Position,* page 3-131.

The RCL automatically switches to the corresponding rigging table. It specifies the maximum permissible telescoping where extending is switched off, refer to the shutdown values in the Load Chart.

1. Set down the load.

2. Extend the main boom only until the RCL switches off the extension procedure.

NOTE: If you continue to extend the main boom after a RCL shutdown, you may enter ranges in which you can neither perform retraction operations nor raise the boom.

Telescoping with Rigged Boom Extension

CAUTION

Boom Damage Hazard!

Do not rotate the superstructure while telescoping the main boom with a rigged boom extension.

Damage to the boom may occur.

The telescoping of the main boom with a rigged boom extension is monitored by the RCL. Telescoping will only be enabled if the main boom is raised to a certain angle and a maximum permissible load is not exceeded.

The required angle (between 70° and 78°) depends on the rigging mode of the crane.

You will find the required main boom angle and the maximum permissible load (weight of the hook block) in the Load Chart.

If the main boom angle is too small for telescoping with the rigged boom extension, the RCL shows the corresponding error message.

Extending/Retracting the Boom

DANGER

Crushing and Hazard!

Check the load chart for the maximum load at a given radius, boom angle, and length before extending the boom with a load.

Death or serious injury could result from the crane tipping over or being crushed by moving machinery.

CAUTION

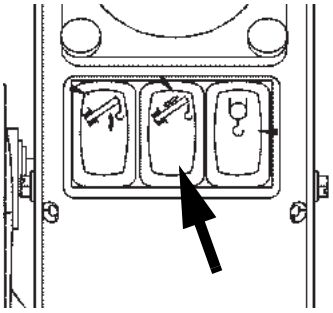
Machine Damage Hazard!

When extending the boom, simultaneously let out the hoist cable to prevent two-blocking the boom nose and hook block.

When retracting the boom, the load will lower unless the hoist cable is taken in at the same time.

To extend or retract the boom, use the controls on the right-hand armrest:

1. Push the top of the Telescope switch once.



2. ECOS indicator must be green.

3. Using the right-hand joystick controller:
   - **Extend**; push the controller to the right, and hold until the boom is at the desired position.
   - **Retract**; push the controller to the left, and hold until the boom at the desired position.
4. Push the top of the Telescope switch again to turn off the function.

Telescope Emergency Program

Refer to Figure 3-176.

In the event of a malfunction in the telescoping mechanism, you can retract the main boom with the Telescoping emergency program.

NOTE: The emergency program is not intended for crane operation and is therefore restricted to a certain amount of time.

Starting the Emergency Program

Only start the emergency program when the Z symbol is displayed, refer to *Telescope Mechanism Error Messages,* page 3-37.

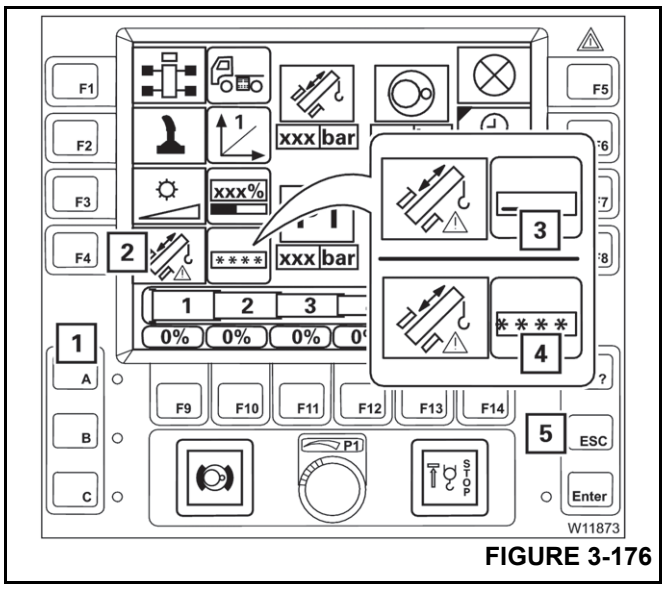


FIGURE 3-176

1. Press and hold the right dead man's switch.
2. Additionally press the button (2) (Figure 3-176) once – symbol (3) appears.

To access the telescope emergency program:

1. Press and hold the right dead man's switch
2. Press the F4 button once: the display changes so you can enter the emergency keycode (3)
3. Press the buttons (1) in the order:
4. The symbols shown (4) confirm the entry.

   If your input was incorrect, all the symbols (4) go out and you need to repeat the input.

   You can cancel the entry at any time using the *Esc* button (5).

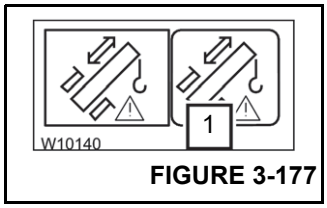


FIGURE 3-177

After correct input, the symbol (1) (Figure 3-177) is displayed, the Telescope Emergency Program starts.

5. Press the *Esc* button to open the Main Menu and press the Telescope button, F5 once.
6. The Telescoping submenu opens, refer to (Figure 3-178).

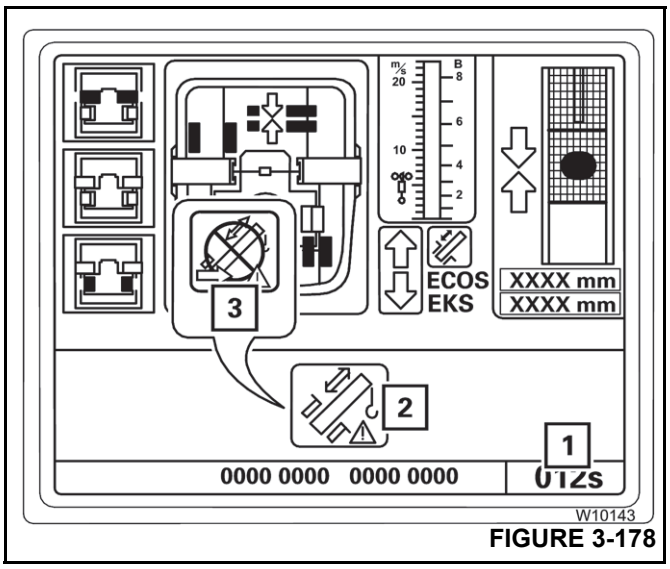


FIGURE 3-178

The emergency program is active if:

- The symbol (2) is displayed and
- the display (1) is shown; a time span of about 360 seconds elapses.

The telescoping mechanism can be operated with the emergency program within this time.

After this time has elapsed, the symbol (3) appears, and you need to restart the emergency program.

Determining the Type of Error

Refer to Figure 3-179.

CAUTION

Equipment Damage Hazard!

In emergency mode, there is no monitoring of prerequisites; functions are performed **immediately** after pressing a button.

Ensure you constantly monitor the status of the telescoping mechanism before you initiate locking or unlocking.

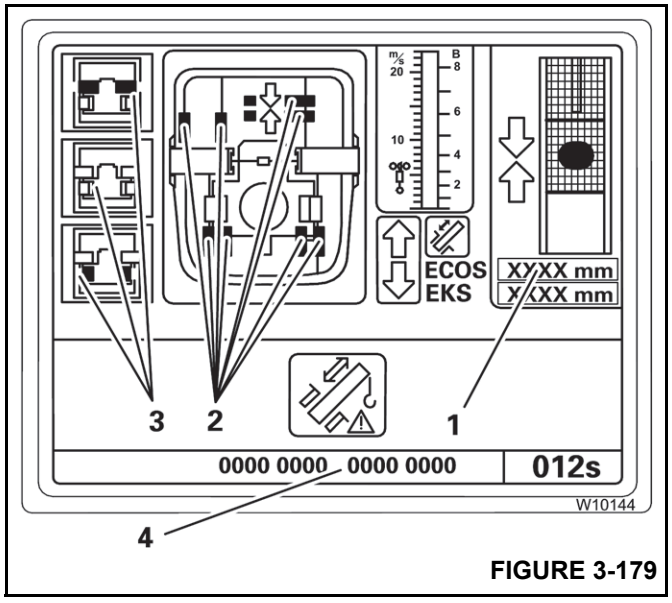


FIGURE 3-179

Check which emergency program procedure is suitable for the current error:

- If the display (1) shows no value, there is an error on the length indicator.
- If a symbol (2) is violet, there is an error on the proximity switch.
- The buttons next to the symbols (3) are active.

  After pressing the button, locking or unlocking is performed immediately.

NOTE: Note down the error code (4) first if you intend to contact Crane Care before carrying out the emergency program.

CAUTION

Equipment Damage Hazard!

Never telescope the main boom if there is an error on the length indicator and on the proximity switch at the same time.

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.

NOTE: In the Telescope Emergency Program, all functions for retracting the main boom remain enabled as long as there are no other errors (hydraulic or mechanical).

The speed is restricted to approximately 30% of the maximum speed.

Refer to *If There is an Error at a Proximity Switch,* page 3-151 or the following section if there is an error on the length indicator.

If There is an Error on the Length Indicator

Refer to Figure 3-180.

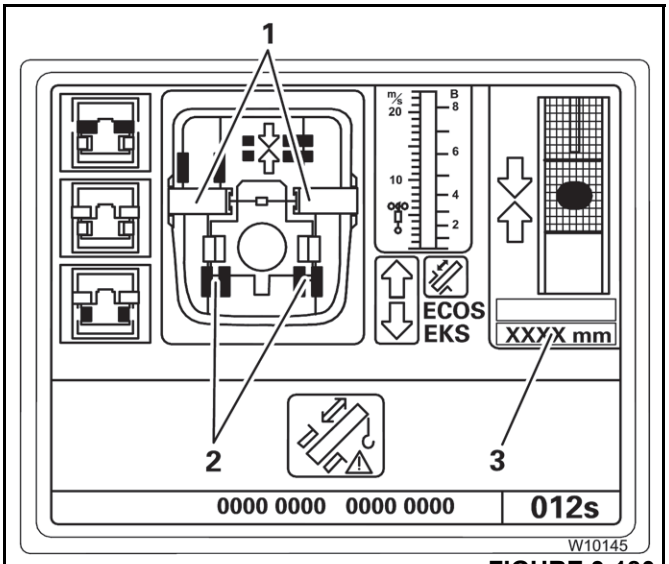


FIGURE 3-180

First note down the current status of the telescoping mechanism:

- Check the positions of the locking pins as usual, i.e. on the displays (1) and (2).
- Check whether the display (3) shows the RCL measured value for the extended length of the telescope cylinder.
- Check the telescoping on the RCL.

Inspections Prior to Telescoping

Refer to Figure 3-181.

WARNING

Unintended Operation Hazard!

Press the *, F1 button (1) for unlocking the telescopic section **no more than twice**.

If this does not start the unlocking procedure, contact Crane Care.

Serious injury or death may occur from sudden retraction of the telescopic section.

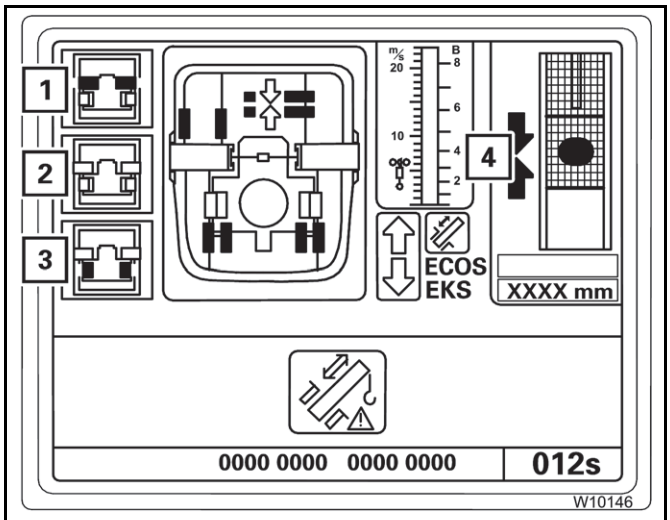


FIGURE 3-181

Before telescoping, check that the following conditions are met:

- The telescoping cylinder is locked, symbol (3) is grey.
- The telescopic section is unlocked (**press no more than twice**), symbol (1) is yellow.
- Locking is not selected, symbol (2) is grey.
- The telescope cylinder is at the locking point, the arrows (4) are green.

Retracting and Locking A Telescopic Section

Refer to Figure 3-182.

CAUTION

Equipment Hazard!

Selecting Lock during telescoping will cause the locking pins on the telescopic section to slide out immediately and damage or tear the electrical or hydraulic components in the main boom.

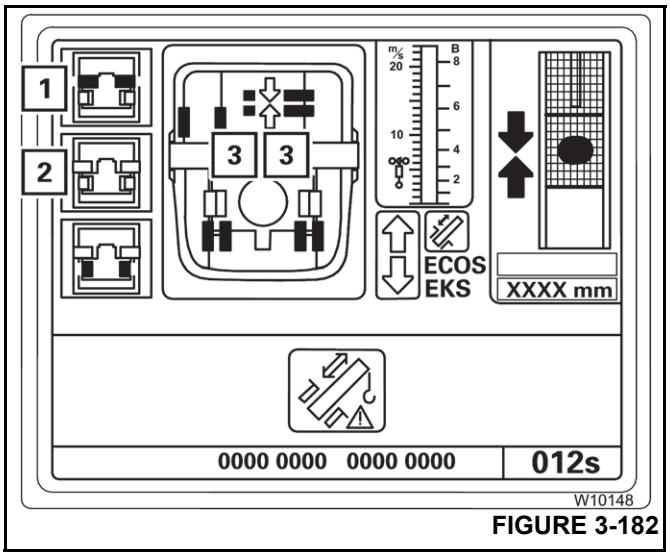


FIGURE 3-182

During telescoping you must not select Lock. **Under no circumstances** should you press the F2 button (2).

1. Retract the telescopic section slowly and as far as possible.
2. Press the F1 button (1) once.
3. Extend the section approximately 1.38 in (35 mm).

The telescopic section should be locked. In locked position:

- The locking pins (3) are green,
- the symbol (1) is grey,
- the symbol (2) is yellow.

4. Engage the locking pin notch with the section and retract the telescopic section as far as it will go.

Unlocking the Telescope Cylinder

Refer to Figure 3-183.

WARNING

Unintended Operation Hazard!

Press the *, F1 button (1) for unlocking the telescopic section **no more than twice**.

If this does not start the unlocking procedure, contact Crane Care.

Serious injury or death may occur from sudden retraction of the telescopic section.

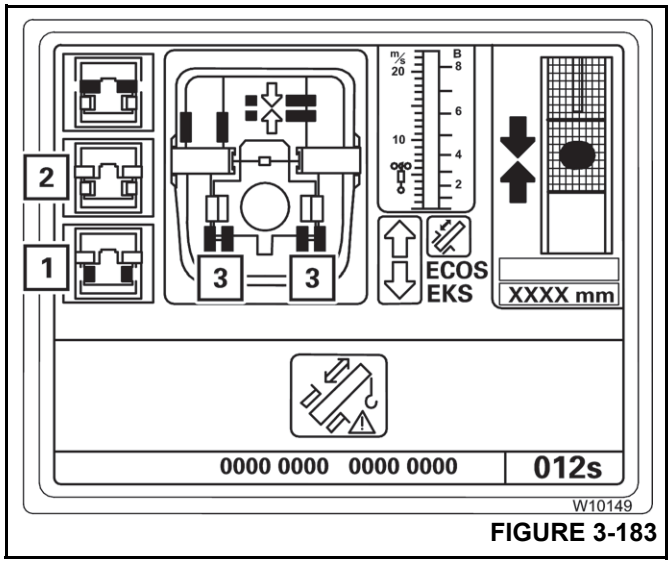


FIGURE 3-183

If the telescopic section is locked, you can now unlock the telescoping cylinder by pressing the F3 button (1) once (**at the most twice**).

The telescoping cylinder should be unlocked. In the unlocked position:

- The locking pins (3) are red,
- the symbol (1) is yellow,
- the symbol (2) is grey.

You can now move the telescoping cylinder into the next telescopic section.

Extending and Locking the Telescope Cylinder

Refer to Figure 3-184.

CAUTION

Equipment Hazard!

Selecting Lock during telescoping will cause the locking pins on the telescopic section to slide out immediately and damage or tear the electrical or hydraulic components in the main boom.

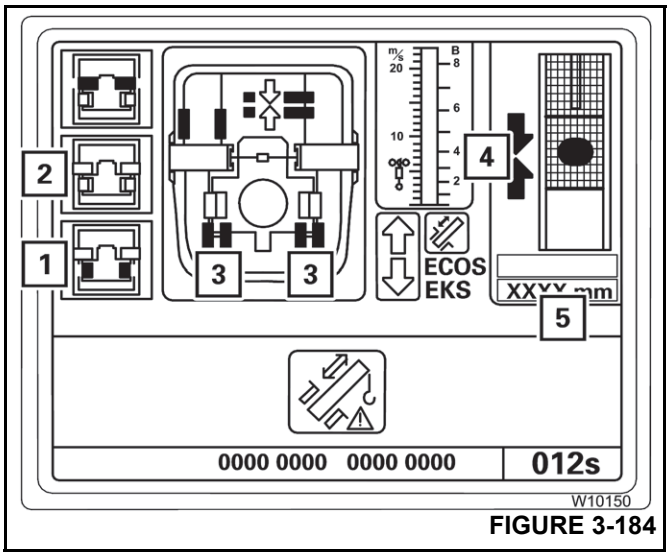


FIGURE 3-184

You may **not** select Lock while the telescope cylinder is retracting or extending. **Under no circumstances** should you press the F3 button (1).

1. Slowly move the telescope cylinder into the next extended telescopic section.

   At the locking point:

   - the arrows (4) are green,
   - the display (5) shows the length for the current locking point, refer to *Tables for Approaching the Locking Points,* page 3-153.

2. Press the F3 button (1) once.

   The telescope cylinder is locked. In Locked position:

   - The locking pins (3) are green,
   - the symbol (1) is grey,
   - the symbol (2) is yellow.

3. You can now retract this telescopic section, refer to *Retracting and Locking A Telescopic Section,* page 3-150.

If There is an Error at a Proximity Switch

Refer to Figure 3-185.

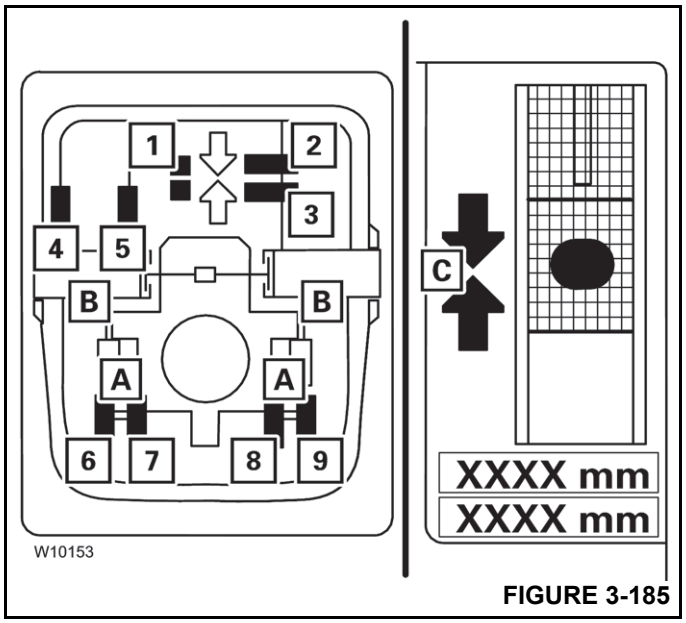


FIGURE 3-185

Faulty proximity switches are shown in violet.

The displays (A), (B) and (C) only show the current positions when all the corresponding proximity switches are free of error.

Several proximity switches are related to the displays (A), (B) and (C).

A: Proximity switches (6) to (9)

B: Proximity switches (4) and (5)

C: Proximity switches (1) to (3)

When a proximity switch is faulty (violet), then:

- The corresponding locking pins on the displays (A) and (B) are always yellow.
- The corresponding arrows are not shown on the display (C).

When an error occurs, you can determine the current position more precisely based on the other, fault-free proximity switches. The proximity switches show the following positions:

- Display (C): Telescoping cylinder at the locking point
  (1) At the locking point
  (2) Behind the locking point
  (3) In front of the locking point
- Display (B): Telescopic section locked
  (4) Locked
  (5) Unlocked
- Display (A): Telescoping cylinder locked

(6) Locked left

(7) Unlocked left

(8) Unlocked right

(9) Locked right

For fault-free proximity switches, the following applies:

Green: Position reached

Red: Position not reached

Required Inspection

Refer to Figure 3-186.

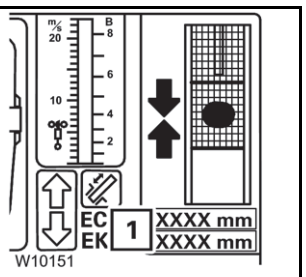


FIGURE 3-186

When the locked position can no longer be displayed, always conduct the following check before unlocking:

1. Carefully retract and extend the telescoping cylinder or telescopic section.
2. In the locked position, the length shown on the displays (1) should vary only slightly, i.e. by the play of the locking pins.

Retracting

Refer to Figure 3-187.

CAUTION

Equipment Damage Hazard!

Extend the telescope cylinder (without telescopic section) only to the specified length.

This prevents the piston rod from becoming damaged if the telescope cylinder slides out of the telescopic section.

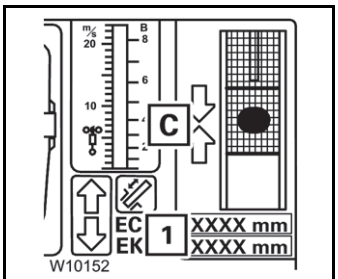


FIGURE 3-187

The steps for retracting are the same when an error occurs on the proximity switch as for an error on the length indicator.

When the display (C) fails:

1. Calculate the telescope cylinder length for the locking point;
   - Refer to *Locking Points for the Telescoping Cylinder,* page 3-153,
   - Refer to *Locking Points for the Telescopic Sections,* page 3-153.
2. Move the telescoping cylinder to the required length shown in display (1).

Terminating the Emergency Program

The emergency program is terminated:

- If the displayed time has expired or
- when the ignition is turned off.

NOTE: The current telescoping status does not correspond to the telescoping status last saved by ECOS if the Telescope Emergency Program was open. You must enter the current telescope status after terminating the emergency program, refer to *Entering the Current Telescope Status,* page 3-60.

Tables for Approaching the Locking Points

The extent to which the telescope cylinder has to be extended in order to reach a locking point depends on whether you:

- Want to lock the telescope cylinder or
- lock a telescopic section.

Locking Points for the Telescoping Cylinder

The following table shows the extended length for locking the telescoping cylinder.

Table for locking the telescoping cylinder			
Telescopic Section	**Locking point at fixed length**	**Extended length of the telescoping cylinder**	
	%	**mm**	**ft**
Telescopic Section 1	0 50 100	5 4,792 9,578	0.02 15.72 31.42
Telescopic Section 2	0 50 100	331 5,079 9,828	1.09 16.67 32.24
Telescopic Section 3	0 50 100	627 5,348 10,071	2.06 17.55 33.04
Telescopic Section 4	0 50 100	918 5,587 10,257	3.01 18.33 33.65
Telescopic Section 5	0 50 100	1,200 5,810 10,424	3.94 19.06 34.20

Locking Points for the Telescopic Sections

Refer to Figure 3-188.

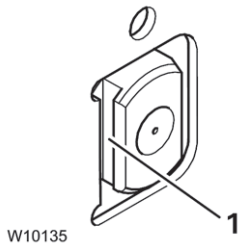


FIGURE 3-188

The locking pin must not engage the telescopic section for locking or unlocking it.

The notch (1) must be clear. That is why you have to extend the telescoping cylinder 0.38 in (35 mm) further than with a return run.

The following table shows the extended length for locking and unlocking the telescopic sections.

Table for locking/unlocking the telescopic sections			
Telescopic Section	**Locking point at fixed length**	**Extended length of the telescoping cylinder**	
	%	**mm**	**ft**
Telescopic Section 1	0 50 100	40 4,827 9,613	0.13 15.84 31.54
Telescopic Section 2	0 50 100	366 5,114 9,863	1.20 16.78 32.36
Telescopic Section 3	0 50 100	662 5,383 10,106	2.17 17.66 33.15
Telescopic Section 4	0 50 100	953 5,622 10,292	3.12 18.44 33.76
Telescopic Section 5	0 50 100	1,235 5,845 10,459	4.05 19.18 34.31

Hoist Operation

Refer to *Main Menu,* page 3-21 for information on using the ECOS system.

Lowering and Raising the Hoist Cable

DANGER

Crushing Hazard!

Keep the area beneath the load clear of all obstructions and personnel when lowering or raising the cable (load).

Death or serious injury could result if the load should fall.

CAUTION

Machine Damage Hazard!

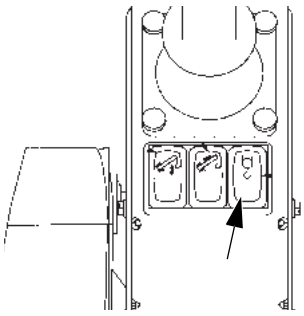
Do not jerk the control lever when starting or stopping the hoist. Jerking the lever causes the load to bounce, which could result in possible damage to the crane.

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

Main Hoist

To lower or raise the main hoist cable, use the controls on the right-hand armrest:

1. Push the top of the Main Hoist switch once.

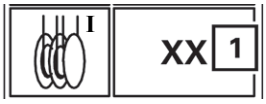


2. ECOS indicator must be green.

3. On the RCL Monitoring submenu, check whether lamp **I** is on.

If lamp **I** is flashing, turn off both hoists and turn on hoist **I** again to switch the display to lamp **I**, refer to *Verify Hoists Display,* page 3-123.

4. Check that the actual reeving of the main hoist (1) is displayed correctly. Correct the reeving if necessary, refer to *Verify Reeving,* page 3-124.

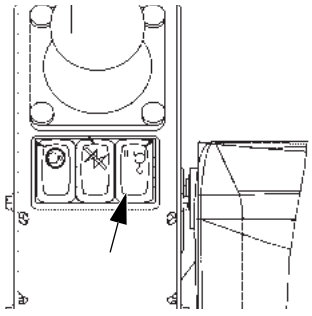


5. Using the right-hand joystick controller:
   - Push forward and hold until the hook or load is lowered to the desired height,
   - Pull backward and hold until the hook or load is raised to the desired height.
6. Push the top of the Main Hoist switch again to turn off the function.

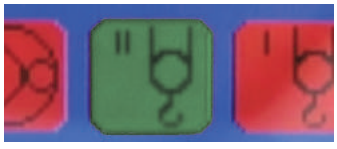
Auxiliary Hoist

To lower or raise the auxiliary hoist cable, use the controls on the left-hand armrest:

1. Push the top of the Auxiliary Hoist switch once.



2. ECOS indicator must be green.

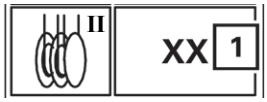


3

3. On the RCL Monitoring submenu, check whether lamp **II** is on.

   If lamp **II** is flashing, switch the display to lamp **II**, refer to *Verify Hoists Display,* page 3-123.

4. Check that the actual reeving of the auxiliary hoist (1) is displayed correctly. Correct the reeving if necessary, refer to *Verify Reeving,* page 3-124.



5. Using the left-hand joystick controller:
   - Push forward and hold until the hook or load is lowered to the desired height,
   - Pull backward and hold until the hook or load is raised to the desired height.
6. Push the top of the Auxiliary Hoist switch again to turn off the function.

Hoist Speed Range Selection

CAUTION

Do not change the hoist speed range with the hoist rotating.

To change the speed range of the hoist, use the switch on top of the appropriate joystick controller.

Push and hold the switch to the left for momentary high speed operation, release for normal speed.

Push the switch to the right to turn high speed on or off, for continuous high speed operation.

Boom Extensions

When operating the crane with a boom extension installed, the maximum speed for the different power units is limited to 70%.

WARNING!

Equipment Damage Hazard!

During operation with the 36ft (11m) boom extension set at 0° angle at the steepest boom position, the head sheaves of the main boom can be damaged when a hook block is raised or lowered.

Reduce the hoist speed so that the hook block is raised slowly passed the head sheaves.

Setting the RCL

When a boom extension is installed the associated displays change to include its graphical representation.

NOTE: If a hook block is reeved on the main boom during operation with a boom extension, the loads given in the Load Chart decrease and the RCL subsequently switches off earlier.

The values which must be deducted from the load capacities depend on the length of the boom extension and the weight of the hook block. You will find a table with the values in the Load Chart in the section; *Information on working with the swing-away boom extension*.

Enter the following into the RCL when a luffing boom extension is installed, refer to *Entering the Rigging Mode,* page 3-81:

- hydraulic jib's length
- mechanical jib's length and the angle the jib is set at
- the actual rigging configuration;
  - using the corresponding RCL code according to the Load Chart

    or
  - using the individual components
- the current reeving.

After entering the above information into the RCL, check that the following displayed values correspond with the actual rigging configuration of the crane (Figure 3-189) in the Monitoring submenu, *RCL Monitoring Submenu,* page 3-86:

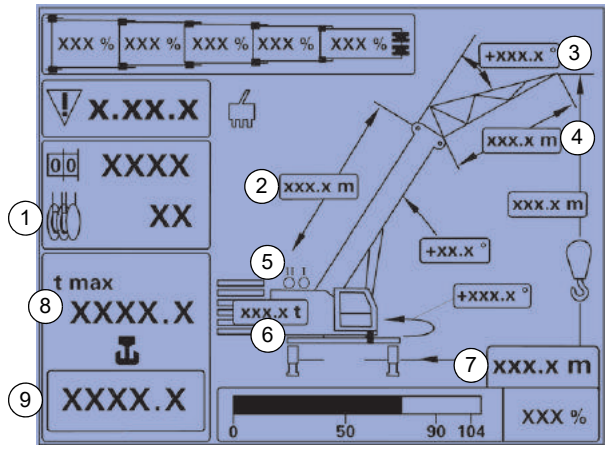


FIGURE 3-189

- (1) the number of reeved rope lines
- (2) the length of the rigged boom extension
- (3) with a mechanical luffing jib, the rigged angle
- (4) the length of the jib
- (5) the hoist that is switched on.
- (6) the rigged counterweight
- (7) the rigged outrigger span
- (8) the maximum load weight
- (9) the actual load weight

Load Bearing Capacities

When the telescopic sections are telescoped to a fixed length during operation with a luffing jib, the RCL changes the current value as determined by the Load Chart and displays the maximum load value (8) (Figure 3-189).

Depending on the current angle, the RCL automatically switches to the Load Chart for fixed angles (0° inclination) and intermediate angles (0 - 20° or 20 - 40° inclination) when this is permitted for the load currently being raised.

Raising and Lowering the Hydraulic Boom Extension

The normal operating range for the hydraulic luffing boom extension (hydraulic luffing jib) is an offset of 0 - 40 degrees. The extension must be retracted to 0 degree offset for stowage on the side of the boom.

The hydraulic luffing boom extension is controlled by an ON/OFF switch and joystick controller on the right-hand armrest.

Refer to *Right-Hand Armrest Controls,* page 3-11 for location and description of these switches.

The boom extension may also be controlled by the remote station on the extension. The station is located on the boom extension to the front of the luffing hydraulic cylinder, see (Figure 3-190).

CAUTION!

Equipment Damage!

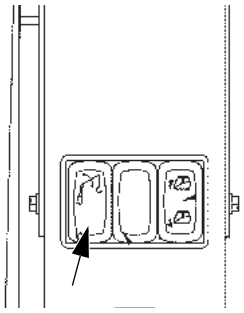
When lowering the boom extension, simultaneously let out the hoist cable to prevent two-blocking the extension sheave and the hookblock or overhaul ball.

Hydraulic Boom Extension Operation — Cab

In order to enable the operation of the hydraulic luffing jib the RCL code must be set for the current rigging mode, refer to *Rigging Mode Submenu,* page 3-78.

To lower or raise the hydraulic luffing jib, use the controls on the right-hand armrest:

1. Push the top of the Luffing Jib switch once.



2. ECOS indicator must be green.

3. Using the right-hand joystick controller:
   - **To lower the jib**: push the controller to the right,
   - **To raise the jib**: push the controller to the left.
4. Push the top of the Luffing Jib switch again to turn off the function.

To limit the speed to lower or raise the luffing jib refer to *Power Unit Speed Submenu,* page 3-48.

3

FIGURE 3-190

Hydraulic Boom Extension Operation — Remote Station

When using the remote station (Figure 3-190) to operate the hydraulic luffing jib, press the button until the desired angle is reached or until the end position or a switch-off point is reached.

To lower or raise the hydraulic luffing jib, using the remote station:

- **To lower the jib**: push the right button,
- **To raise the jib**: push the left button.

Two Hook-Operation

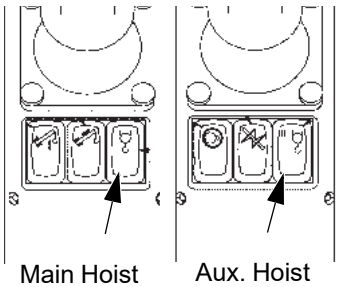
Two-hook operation is permissible only when one of the following is installed:

- Swingaway boom extension
- Auxiliary single-sheave boom nose
- Heavy load boom extension.

For two-hook operation, both hoists must be activated on the RCL.

NOTE: Enter the reeving for both hoists before reeving the boom. The values are stored and opened directly when switching hoists. This eliminates the need for input later during operation.

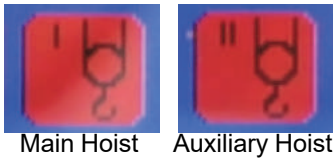
1. Switch off both hoists by pressing each hoist switch once.



Main Hoist Right-hand Controls

Aux. Hoist Left-hand Controls

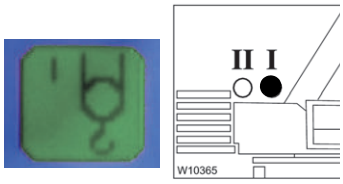
2. The ECOS indicators must turn red.



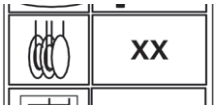
Main Hoist Auxiliary Hoist

3. Switch on the main hoist by pressing its switch on the right-hand controls.

The ECOS indicator turns green and the main hoist lamp **I** lights.

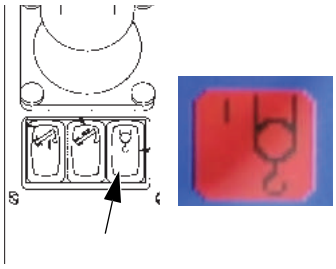


4. In the reeving display, enter the quantity of reeved ropes of the main hoist on the main boom.



5. Switch off the main hoist by pressing the switch once.

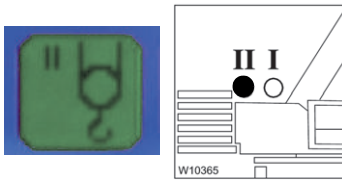
The ECOS indicator will turn red.



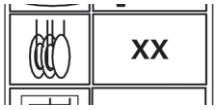
Now the reeving for the main hoist has been stored and you can switch to the auxiliary hoist.

6. Switch on the auxiliary hoist by pressing its switch on the left-hand controls.

The ECOS indicator turns green and the auxiliary hoist lamp **II** lights.

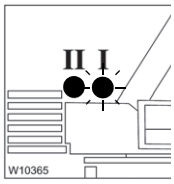


7. In the reeving display, enter the quantity of reeved ropes of the auxiliary hoist on the boom extension.



8. Switch on the main hoist by pressing its switch on the right-hand controls.

   The ECOS indicator turns green. The auxiliary hoist indicator **II** remains on and the main hoist indicator **I** flashes.



9. Enter RCL code according to the Load Chart for the actual rigging mode of the crane with the rigged boom extension.

The RCL is now set for two-hook operation. It now takes into account:

- The reeving for the auxiliary hoist
- The *Load Chart* for the boom extension.

Stowing and Parking

WARNING

Tipping Hazard!

Never park the crane near holes, or on rocky or extremely soft surfaces. This may cause the crane to overturn.

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

When parking, the crane should be left in the smallest, most stable, valid operational configuration that the job site practically allows, do the following:

1. Park the crane on a stable surface.
2. Remove the load from the hook.
3. Stow the swingaway boom extension, if erected.
4. Fully retract the boom and position it in the normal travel position or at least as far as is practical to make the crane as stable as possible, including, boom angle, superstructure orientation, jib angle, etc. In high winds the boom and jibs should be lowered or secured.
5. Engage the swing brake and/or swing lock pin.
6. Retract all jack cylinders and outrigger beams.
7. Apply the parking brake.

CAUTION

Avoid Crane Damage!

Do not engage the park brake while the vehicle is moving. Damage to the crane can occur.

Disengage the park brake before driving. Damage to the crane can occur.

8. Put all operating controls in the neutral position.
9. Actuate the Crane Function switch.
10. Shut down the engine following the proper procedures specified in this manual and the applicable engine manual.
11. Remove the keys.

CAUTION

To avoid possible engine fault codes and undesirable operation, ensure the keyswitch has been off 2 minutes before disconnecting batteries.

12. Disconnect batteries, if machine will be inactive for over 24 hours.
13. Close and lock all windows, covers, and doors.

Unattended Crane

DANGER

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.

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SECTION 4
SET-UP AND INSTALLATION

SECTION CONTENTS

GENERAL

This section provides procedures for installing the hoist cable (wire rope) on the hoist drum, cable reeving, dead-end rigging, counterweight removal and installation, outrigger removal and installation, swingaway boom removal and installation, and hydraulic boom extension connecting and disconnecting.

ACCESSING THE HOIST AREA

Change the hoist access area from the Travel Configuration (Figure 4-1) to the Working Configuration (Figure 4-2).

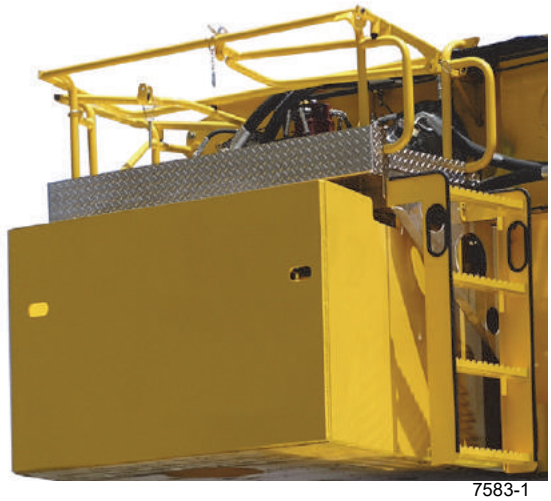
WARNING

Platform must not be used for hauling passengers as death or serious injury could occur.

No storage of components are allowed on the platform.

Only one person at a time is allowed on the platform.

Travel Configuration



7583-1

FIGURE 4-1

1. Front and rear railings are in the pinned and down position (1 pin installed, 1 pin stowed).
2. Rear post is in the down position (1 pin stowed).
3. Gate is in the open and down position (1 pin stowed).

Working Configuration

7583-2

FIGURE 4-2

1. Front and rear railings are in the up position and pinned (2 pins installed).
2. Rear post is in the up position and pinned (1 pin installed).
3. Gate is closed and pinned in the up position (1 pin installed.

HOIST CABLE (WIRE ROPE)

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

Removing the Old Cable

WARNING

Entanglement Hazard!

Keep all body parts and loose clothing clear while hoist is running.

Death or serious injury may result if entanglement occurs during hoist operations.

NOTE: Make sure the crane is level and the main boom is fully lowered.

1. Unreel the hoist cable until the hoist switches off.
2. Adjust the lowering limit switch so that the cable can unreel completely.
3. Unreel remaining layers from the hoist drum.
4. Lock the cab to prevent unauthorized use.

5. Remove the clamp (1) (Figure 4-3).

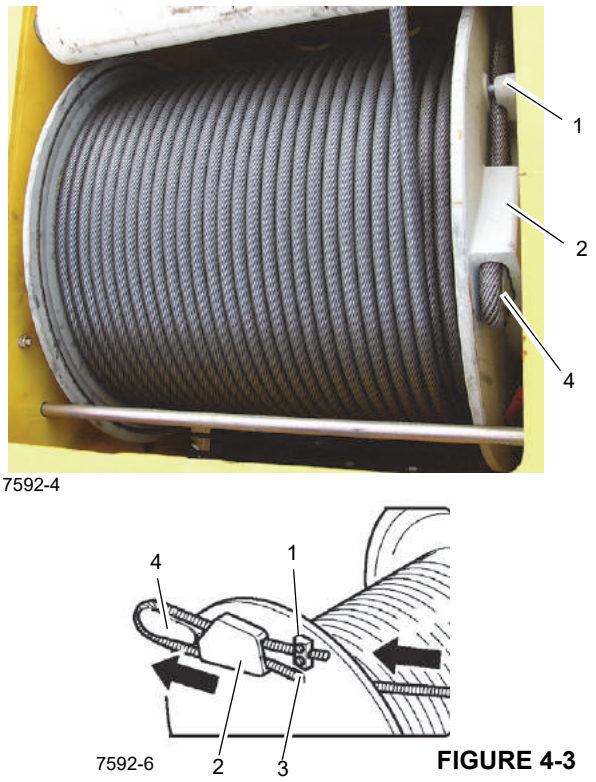


FIGURE 4-3

Item	Description
1	Clamp
2	Pouch
3	Cable Hole
4	Cable Wedge

6. Push the cable through the hole (3) (Figure 4-3) until the cable wedge (4) slides out of the pouch (2).

7. Remove the cable wedge and place the cable away from the crane.

Installing a New Cable

WARNING

Entanglement Hazard!

Keep all body parts and loose clothing clear while hoist is running.

Death or serious injury may result if entanglement occurs during hoist operations.

CAUTION

If cable is wound from the storage drum, the reel should be rotated in the same direction as the hoist.

Damage to the wire rope may occur.

1. Tension the cable slightly while winding it onto the drum.

2. Place the reel stand (1) (Figure 4-4) with the new cable in front of the main boom head.

3. Guide cable over the head sheave (2) (Figure 4-4) up to the hoist drum.

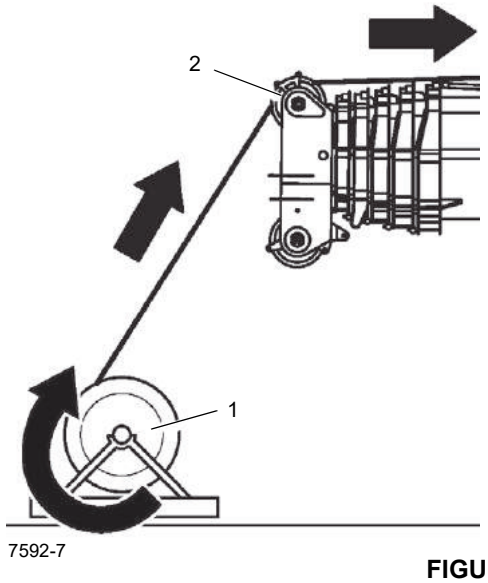


FIGURE 4-4

4. Guide the cable through the hole (3) (Figure 4-5) until it extends about 5.0 ft (1.5 m) beyond the pouch (2) (Figure 4-5).

5. Feed the free end of the cable back through the pouch (2) (Figure 4-5).

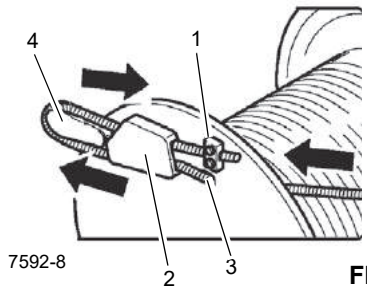


FIGURE 4-5

6. Secure the clamp (1) (Figure 4-5) and tighten it. Torque to 58 lb-ft (79 Nm).

7. Place the cable wedge (4) (Figure 4-5) in the loop.

8. Push the cable back until cable wedge (4) (Figure 4-6) is fully in the pouch (2) (Figure 4-6).

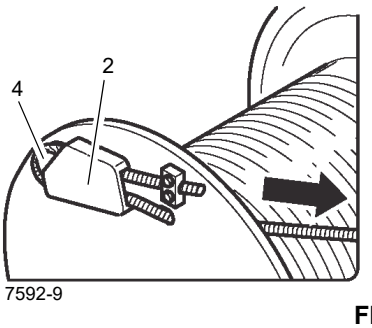


FIGURE 4-6

9. Ensure that the cable wedge (4) (Figure 4-6) loop and cable end do not protrude beyond the flanged wheel. This will prevent damage.
10. Start the engine.
11. Hold the cable taut and wind up the cable slowly.
12. Reeve the hookblock at least 4 times.
13. Raise the main boom to a steep position and extend it fully.
14. Unwind the cable out until only five turns remain on the cable drum.

NOTE: Watch the hookblock when unwinding. The hookblock must not rotate.

DANGER

Crushing Hazard!

After installing new cable, the lowering limit switch must always be reset. This will avoid the lowering limit switch from switching off too late or not at all, the cable being damaged and the load falling.

Death or serious injury may result from an improperly set limit switch.

15. Run in the new cable with small loads so that the hoist cable can settle on the drum.

CABLE REEVING

NOTE: There are two types of cable (wire rope) available on this crane; 6 x 36 WS and 35 x 7 (non-rotating).

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 4-12). This reeving should be accomplished by a qualified rigger using standard rigging procedures.

CAUTION

Do not reeve Auxiliary Hoist cable through the cable grab. Reeve the Main Hoist cable through the cable grab. If both Main & Auxiliary Hoists are being reeved, neither one may be reeved through the cable grab. Keep it in the down position (Figure 4-7).

NOTE: Use the cable grab (Figure 4-7) when using the main hoist with lattice extensions.

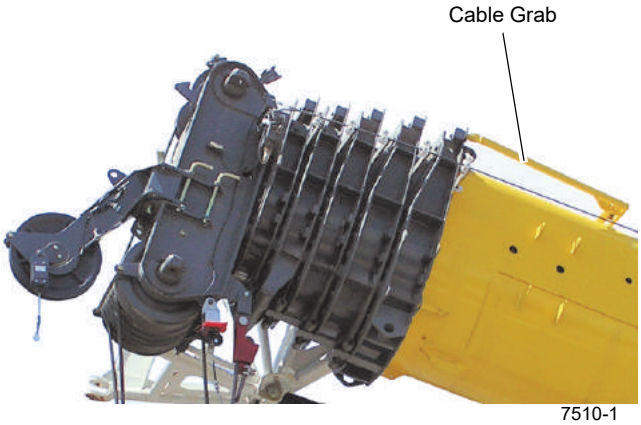


FIGURE 4-7

In order to quick reeve the hook block without removing the wedge socket on the end of the cable refer to (Figure 4-8).

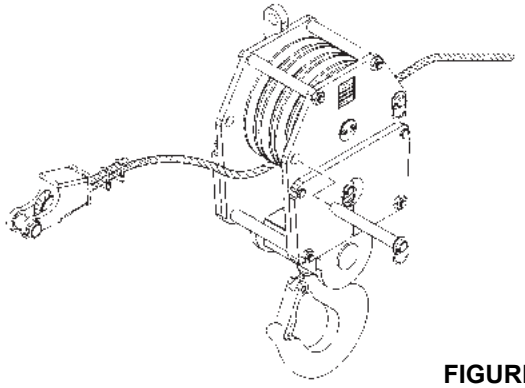


FIGURE 4-8

DEAD-END RIGGING/WEDGE SOCKETS

Wedge socket assemblies are popular rigging accessories and have been successfully used for decades to terminate cables 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 cable fitted. Failure to do so may result in the cable 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 cable manufacturer upon whose cable the wedge socket assembly will be used.

Grove specifies the size, type, class and line pulls for cable, predominately rotation resistant cable, and rigging accessories such as overhaul balls and hook blocks for use with each new crane that it manufactures. Other cables 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 cables they produce. Their advice should be sought for each specific type of cable 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 cable 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, ensure the flat face of the socket is in position, as shown, away from the boom sections (Figure 4-9).

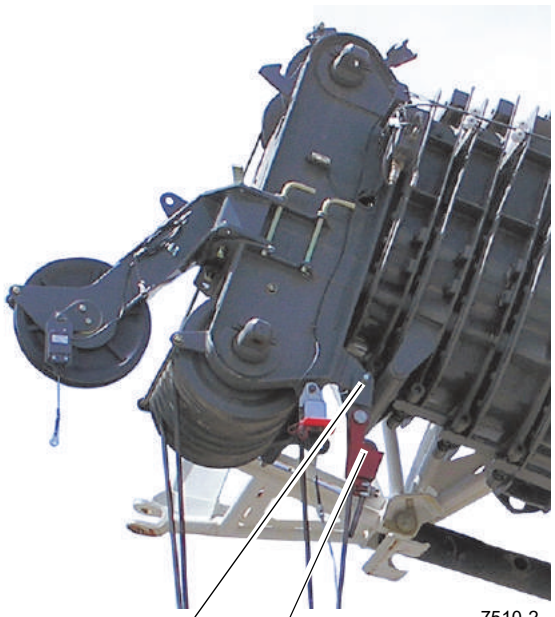


FIGURE 4-9

Installing Wedge and Socket

1. Inspect the wedge and socket. Remove any rough edges and burrs.
2. The end of the cable should be seized using soft, or annealed wire or strand. If the end of the cable is welded, the welded end should be cut off. Refer to *Section 1, Wire Rope (Hoist Cable)* for wire rope (cable) procedures. This will allow the distortion of the wire rope strands, caused by the bend around the wedge, to adjust themselves at the end of the line.

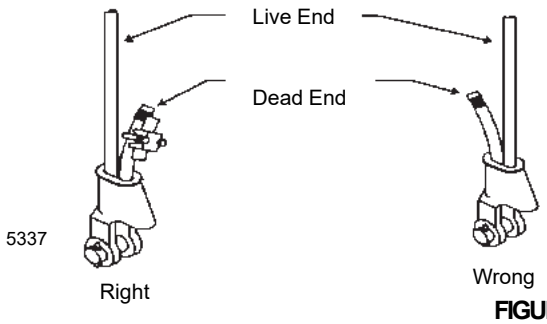


FIGURE 4-10

4

3. Make sure the live-loaded side (Figure 4-10) of the wire rope is directly in line with the ears of the socket and the direction of pull to which the wire rope will be subjected. If the wire rope is loaded into the socket incorrectly, under a load the wire rope will bend as it leaves the socket, and the edge of the socket will wear into the wire rope causing damage to the wire rope and eventual failure.

4. Insert the end of a wire rope into the socket, form a loop in the wire rope, and route the wire rope back through the socket allowing the “dead” end (Figure 4-10) to protrude from the socket. Ensure the dead end of the wire 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 wire rope until the wedge and wire 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 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 wire rope suddenly become unloaded from the overhaul ball or hook block striking the ground, etc.

Sketches A through F (Figure 4-11) 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, 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 wire rope diameters but not less that 6 in (15.2 cm) for standard 6 to 8 strand wire ropes and 20 wire 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 wire rope to the wire 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.

NOTE: Use of swivels is not allowed in conjunction with non-rotation resistant wire ropes

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) Swaged, compressed, or wedge socket fittings shall be applied as recommended by the wire 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 wire ropes shall be of a construction recommended by the wire 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.

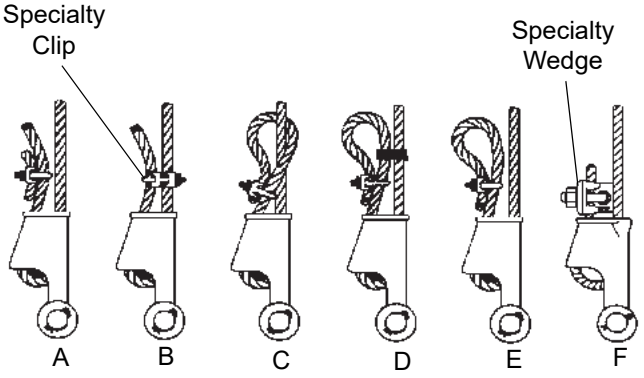
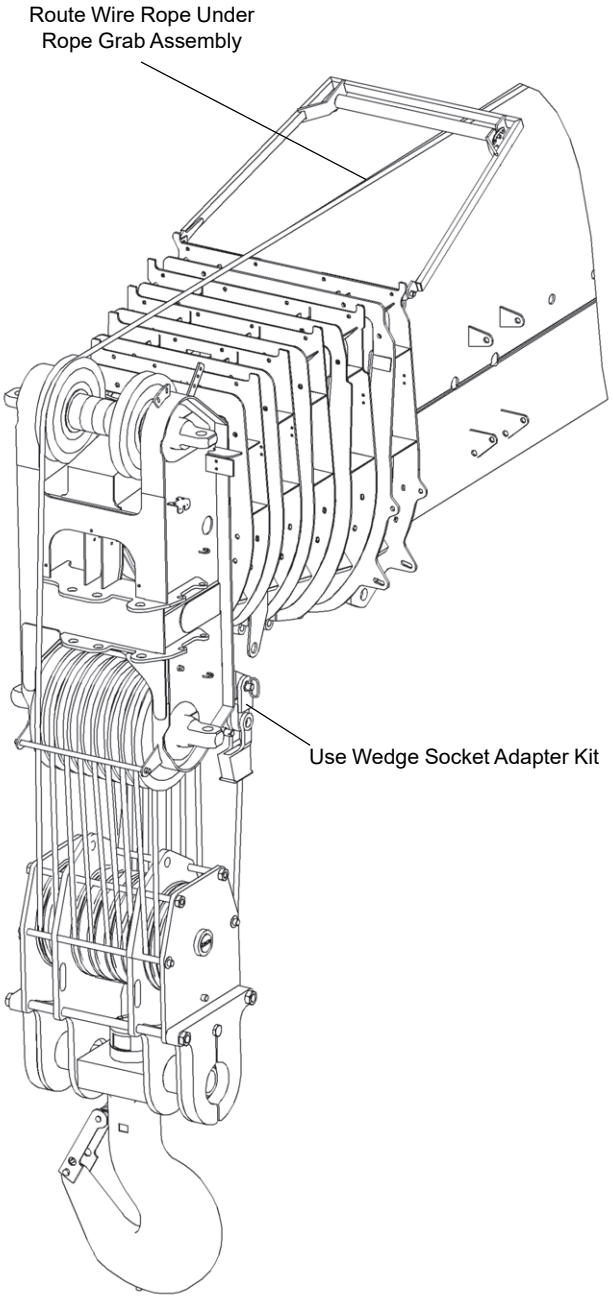


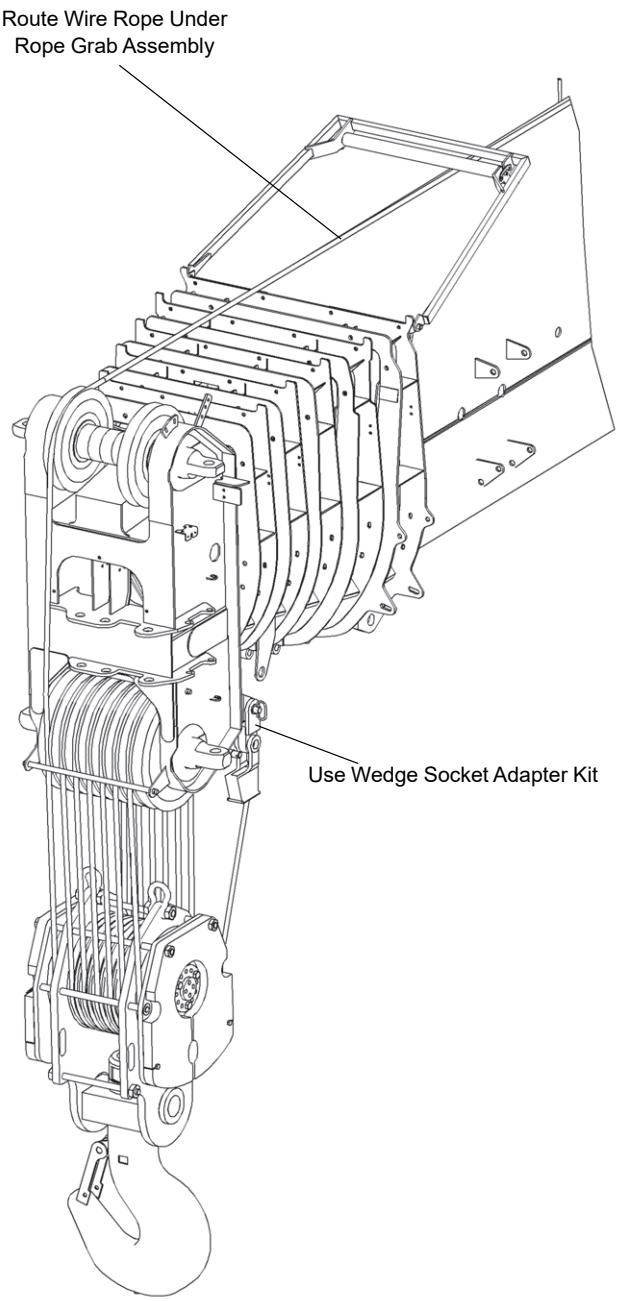
FIGURE 4-11

0

WIRE ROPE CLIP TORQUE VALUES			
Clip Sizes		***Torque**	
mm	**Inches**	**Nm**	**Lb-Ft**
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



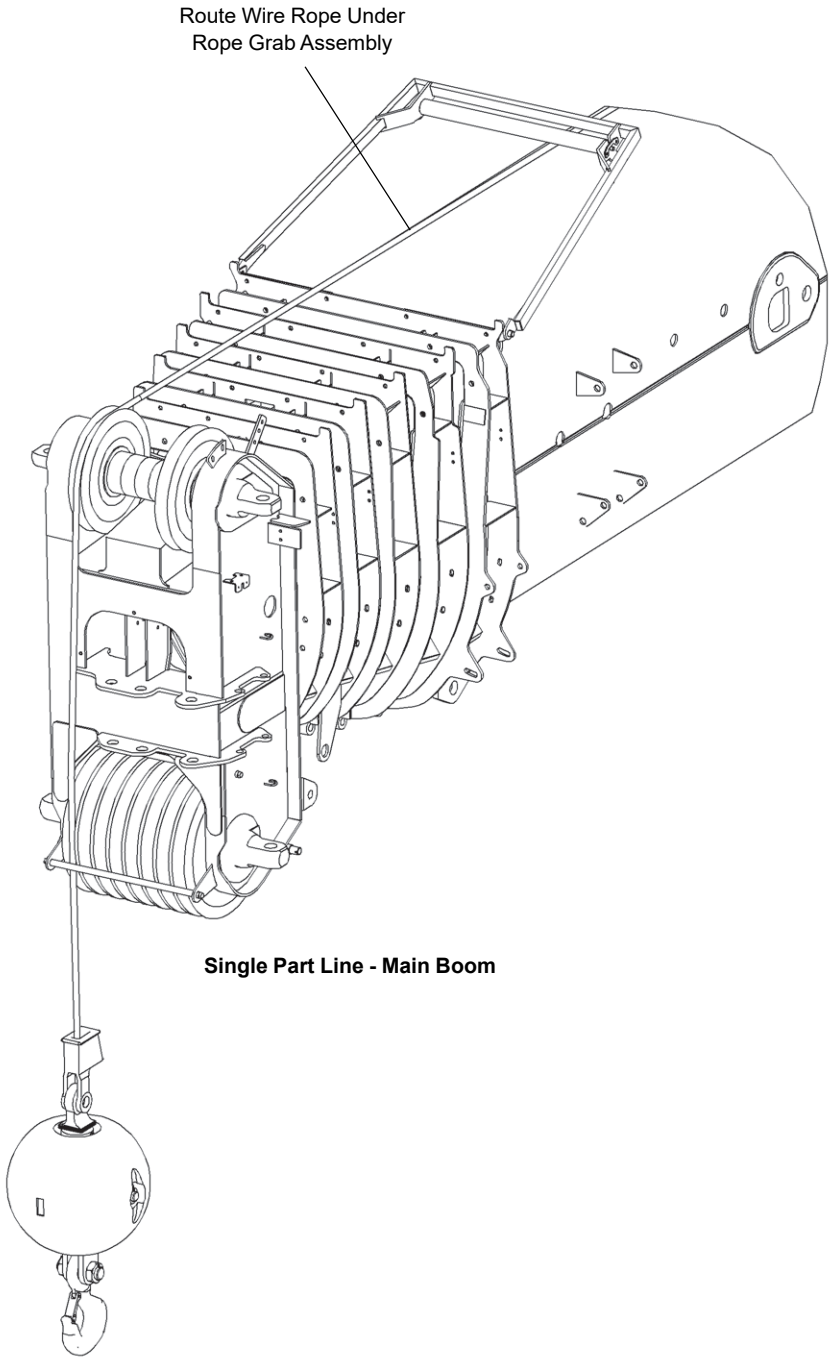
16 Parts of Line
With 8 Sheave Hookblock



14 Parts of Line

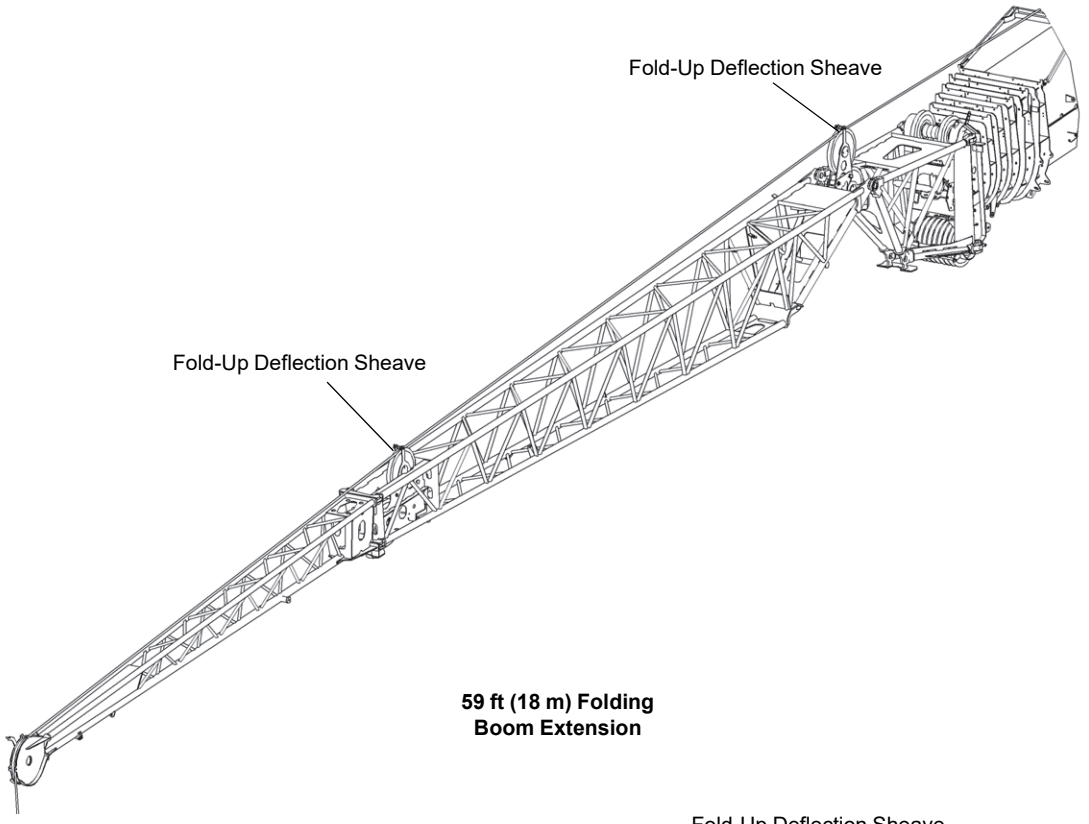
FIGURE 4-12

4

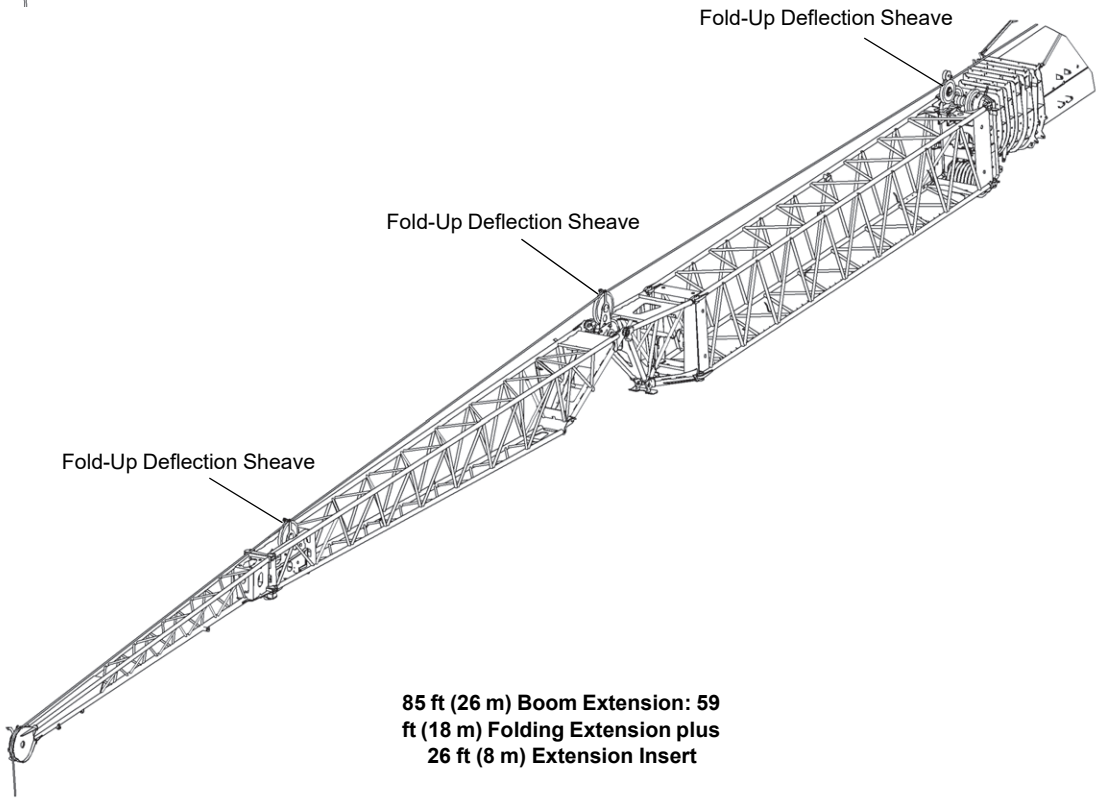


Single Part Line - Main Boom

FIGURE 4-12 continued

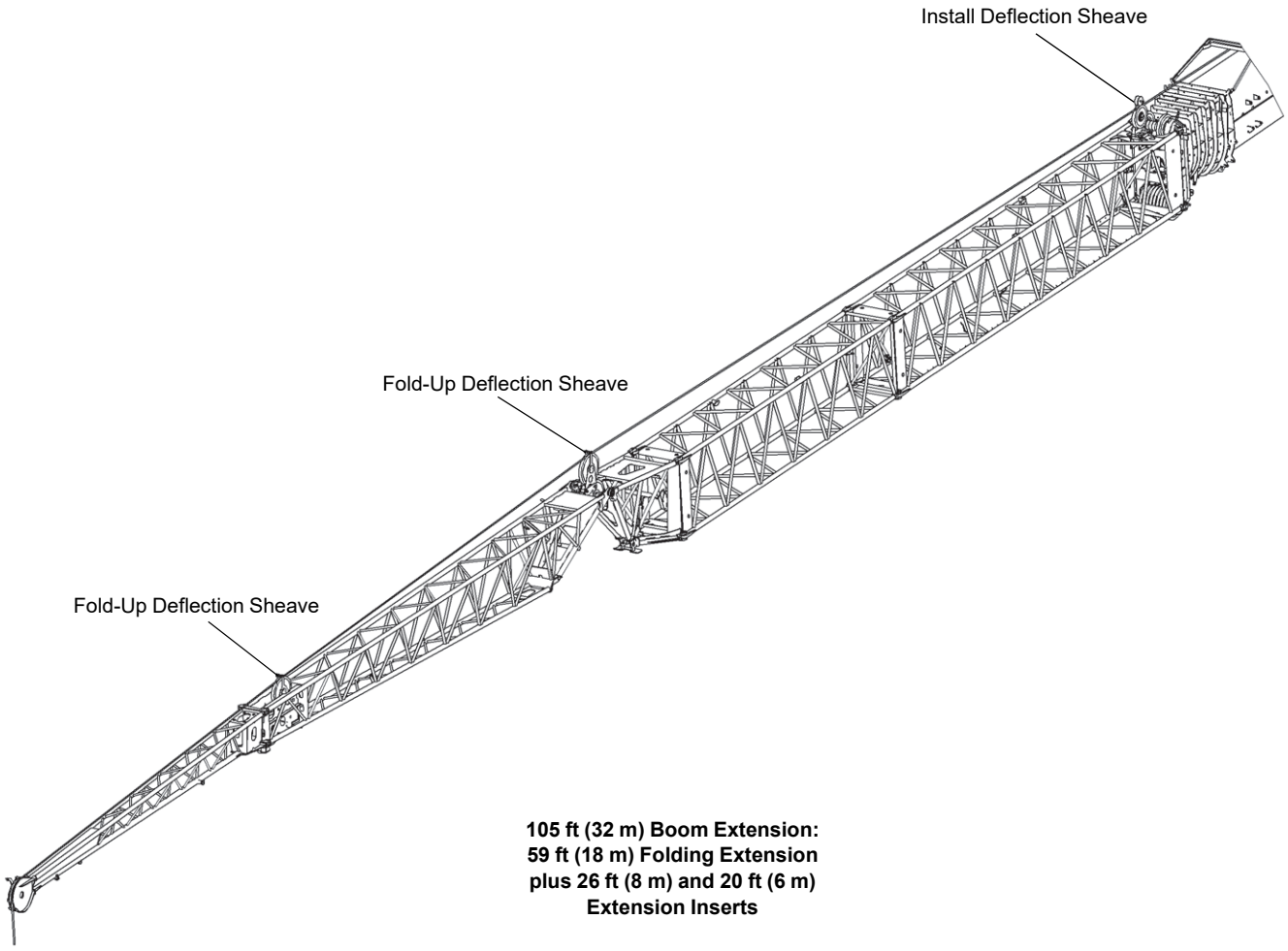


59 ft (18 m) Folding Boom Extension



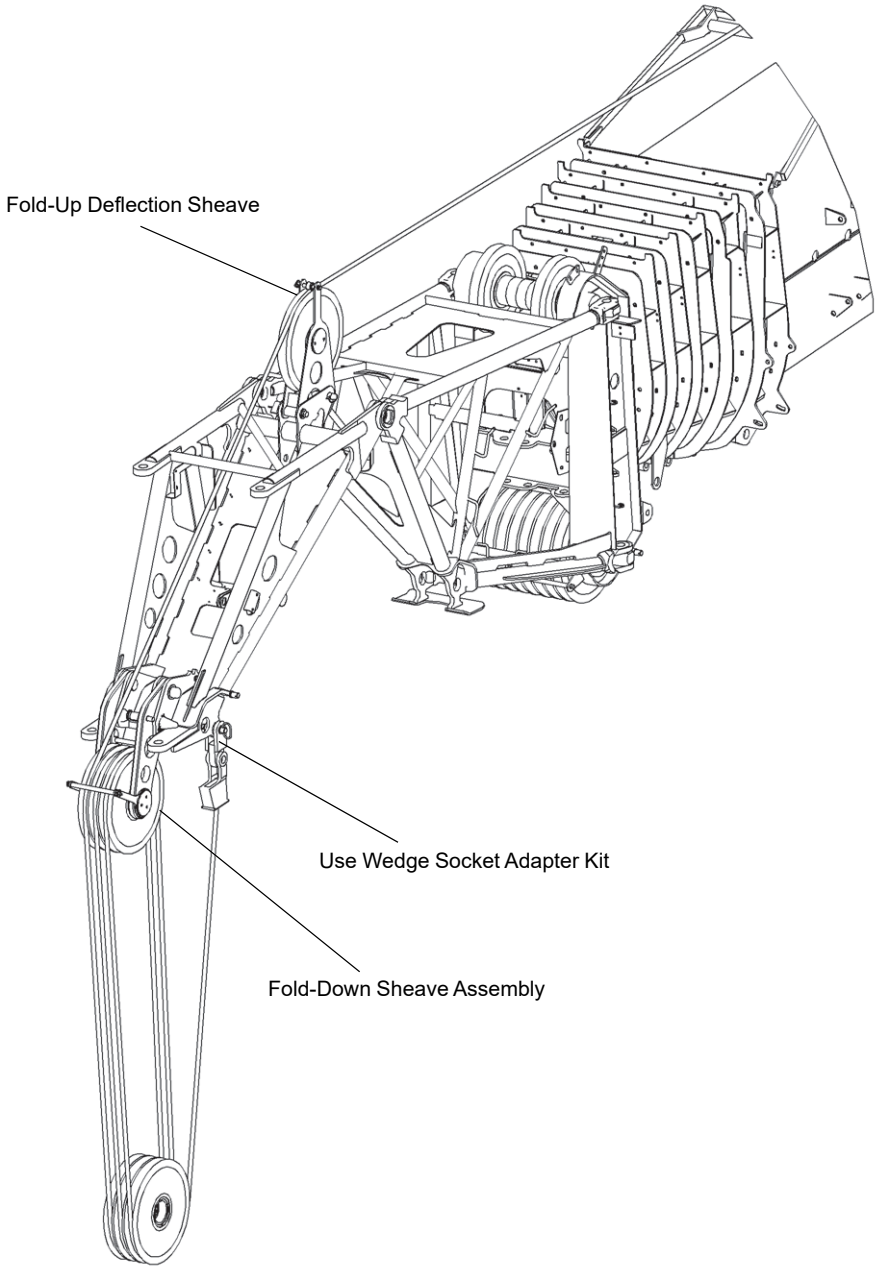
85 ft (26 m) Boom Extension: 59 ft (18 m) Folding Extension plus 26 ft (8 m) Extension Insert

FIGURE 4-12 continued



**105 ft (32 m) Boom Extension:
59 ft (18 m) Folding Extension
plus 26 ft (8 m) and 20 ft (6 m)
Extension Inserts**

FIGURE 4-12 continued



Six Parts Line - 3.6 Meter Extension

FIGURE 4-12 continued

COUNTERWEIGHT REMOVAL AND INSTALLATION

Counterweight Stand Installation

NOTE: The counterweight stands must be installed on the front of the carrier before installing or removing the counterweight.

1. Using an adequate lifting device, install the counterweight stands (1) (Figure 4-13) to the front of the carrier frame (2) and secure with the hitch pins (3).

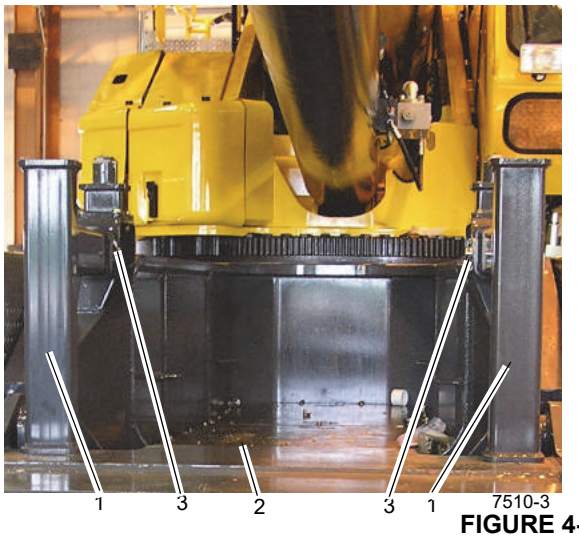


FIGURE 4-13

DANGER

Crushing Hazard!

Adjustment of the counterweight stand supports is prohibited when the counterweight is resting on them.

The main boom must not be lowered below horizontal when swinging over the front while the counterweight supports are installed.

Death or serious injury may occur.

Standard Fabricated Counterweight Installation

DANGER

Read and understand the following when removing and installing the counterweight or counterweight stand, to avoid serious injury or death.

- Outriggers must be fully extended and set and crane level before installation or removal of counterweight.
- Lifting operations are not permitted with any counterweight on the carrier deck except for the removal or installation of the counterweight.
- Boom is not permitted over carrier deck when the boom angle is less than 30° and any counterweight is positioned on deck.
- Hookblock is not permitted to come in contact with counterweight during removal or installation.
- Travel is not permitted with any counterweight on carrier deck.

1. Rig the crane with three parts of line.
2. The standard 39,000 lb (17,690 kg) fabricated counterweight may be lifted in one of the following boom configurations.

Boom Configuration		
0-0-0-0-0 (30 ft radius)	0-0-0-0-50	0-0-0-50-0

3. Enter RCL code 1100. Refer to *RCL Main Menu, page 3-75*.
4. Connect sling assembly to the standard counterweight using the installation lifting holes (Figure 4-14).
5. Lift and place the counterweight onto the carrier stands.
6. Swing turntable to place the boom over the rear of the crane.
7. Set the turntable lock pin in the down position.
8. Using the ECOS display lower the counterweight cylinders into the tubes in the counterweight, refer to *RCL Main Menu, page 3-75*.
9. Rotate the cylinders to lock into the counterweight.
10. Raise the counterweight until the display indicates the counterweight is pre-tensioned.
11. Using the ECOS display, extend the locking cylinders until the display indicates the counterweight is locked in place.

Standard Fabricated Counterweight Removal

1. Rig the crane with three parts of line.
2. The standard fabricated counterweight may be lifted in one of the following boom configurations.

Boom Configuration		
0-0-0-0-0 (30 ft radius)	0-0-0-0-50	0-0-0-50-0

3. Enter RCL code 1100. Refer to *RCL Main Menu, page 3-75*.
4. Swing turntable to place the boom over the rear of the crane.
5. Set the turntable lock pin in the down position.
6. Using the ECOS display, retract the locking cylinders until the display indicates the cylinders are fully retracted.
7. Lower the counterweight onto the carrier stands until the display indicates the counterweight is fully lowered.
8. Rotate the cylinders to unlock from the counterweight.
9. Using the ECOS display raise the counterweight cylinders from the tubes in the counterweight.
10. Swing the turntable to place the boom over-the-front.
11. Connect sling assembly to the standard counterweight using the installation lifting holes (Figure 4-14).
12. Lift and place the counterweight onto the ground.

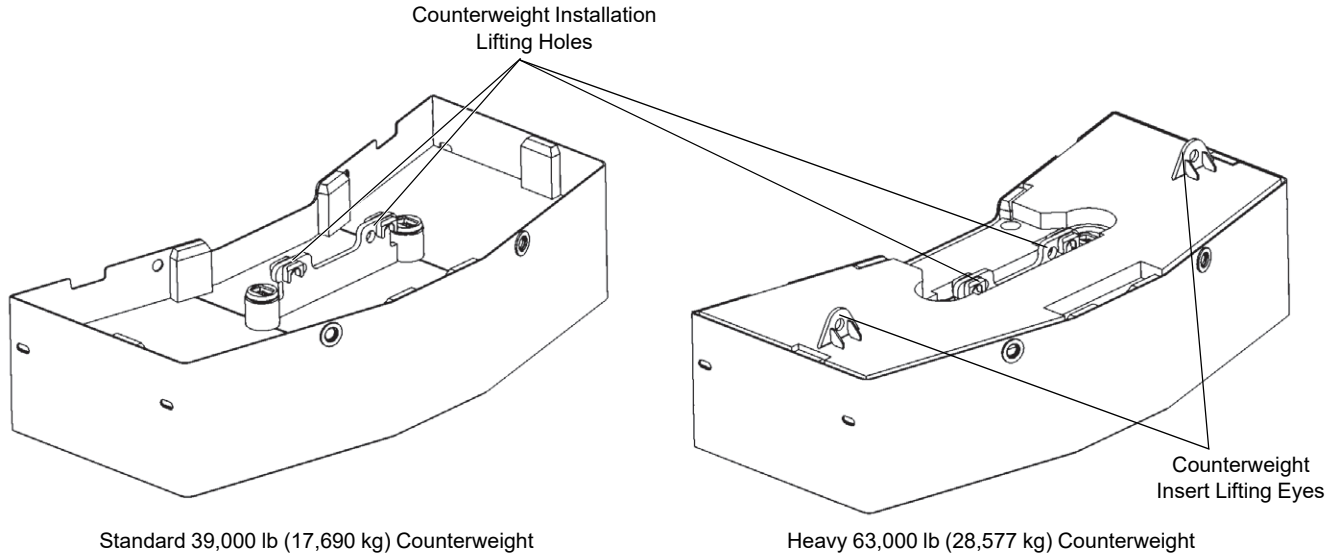


FIGURE 4-14

Heavy Fabricated Counterweight Installation

DANGER

Read and understand the following when removing and installing the counterweight or counterweight stand, to avoid serious injury or death.

- Outriggers must be fully extended and set and crane level before installation or removal of counterweight.
- Lifting operations are not permitted with any counterweight on the carrier deck except for the removal or installation of the counterweight.
- Boom is not permitted over carrier deck when the boom angle is less than 30° and any counterweight is positioned on deck.
- Hookblock is not permitted to come in contact with counterweight during removal or installation.
- Travel is not permitted with any counterweight on carrier deck.

CAUTION

Counterweight assembly must be completed on the ground; not on the carrier counterweight stand.

Outrigger boxes must be installed and outrigger beams must be fully extended.

1. Rig the crane with five parts of line.
2. The heavy 63,000 lb (28,576 kg) fabricated counterweight may be lifted in one of the following boom configurations.

Boom Configuration		
0-0-0-0-0	0-0-0-0-50 (20 ft radius)	0-0-0-50-0

3. Enter RCL code 1100. Refer to *RCL Main Menu, page 3-75*.
4. Connect sling assembly to the 24,000 lb (10,886 kg) counterweight insert using the lifting eyes on the insert.
5. Lift and place the counterweight insert into the standard fabricated counterweight.
6. Connect sling assembly to the heavy fabricated counterweight assembly using the installation lifting holes (Figure 4-14).
7. Lift and place the counterweight assembly onto the carrier stands.
8. Swing turntable to place the boom over the rear of the crane.
9. Set the turntable lock pin in the down position.
10. Using the ECOS display lower the counterweight cylinders into the tubes in the counterweight, refer to *RCL Main Menu, page 3-75*.
11. Rotate the cylinders to lock into the counterweight.
12. Raise the counterweight until the display indicates the counterweight is pre-tensioned.
13. Using the ECOS display, extend the locking cylinders until the display indicates the counterweight is locked in place.

Heavy Fabricated Counterweight Removal

1. Rig the crane with five parts of line.
2. The 63,000 lb (28,576 kg) heavy fabricated counterweight may be lifted in one of the following boom configurations.

Boom Configuration		
0-0-0-0-0	0-0-0-0-50 (20 ft radius)	0-0-0-50-0

3. Enter RCL code 1100. Refer to *RCL Main Menu, page 3-75*.
4. Swing turntable to place the counterweight over the front of the crane.
5. Set the turntable lock pin in the down position.
6. Using the ECOS display, retract the locking cylinders until the display indicates the cylinders are fully retracted.
7. Lower the counterweight until the display indicates the counterweight is fully lowered onto the stands.
8. Rotate the cylinders to unlock from the counterweight.
9. Raise the counterweight cylinders from the tubes in the counterweight.
10. Connect sling assembly to the heavy counterweight assembly using the installation lifting holes.
11. Lift and remove the counterweight from the carrier stands.
12. Place the counterweight on the ground.
13. Disassemble the counterweight, if necessary.

17,690 kg (39,000 lb) Cast Counterweight Installation

DANGER

Read and understand the following when removing and installing the counterweight or counterweight stand, to avoid serious injury or death.

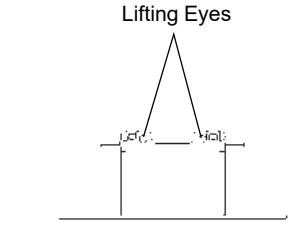
- Outriggers must be fully extended and set and crane level before installation or removal of counterweight.
- Lifting operations are not permitted with any counterweight on the carrier deck except for the removal or installation of the counterweight.
- Boom is not permitted over carrier deck when the boom angle is less than 30° and any counterweight is positioned on deck.
- Hookblock is not permitted to come in contact with counterweight during removal or installation.
- Travel is not permitted with any counterweight on carrier deck.
- Counterweight assembly must be completed on the ground not on the carrier counterweight stands.

1. Rig the crane with three parts of line.
2. The 17,690 kg (39,000 lb) cast counterweight assembly may be lifted in one of the following boom configurations.

Boom Configuration		
0-0-0-0-0 (30 ft radius)	0-0-0-0-50	0-0-0-50-0

3. Enter RCL code 1100. Refer to *RCL Main Menu, page 3-75*.
4. Connect sling assemblies to the cast counterweight using the installation lifting holes (Figure 4-15).
5. Lift and place the counterweight onto the support bracket (Figure 4-15) on the ground.
6. Lift and place the counterweight/support bracket assembly onto carrier counterweight stands using the support bracket lifting eyes (Figure 4-16).

17,690 kg (39,000 lb) Cast Counterweight



Support Bracket

FIGURE 4-15

4

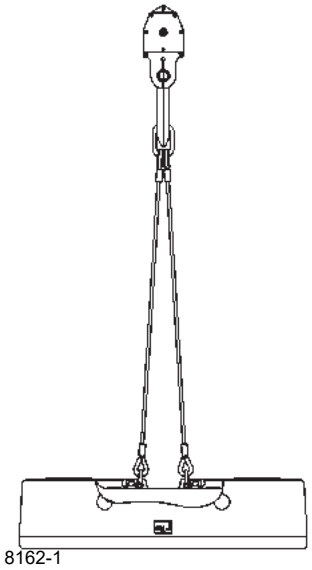


FIGURE 4-16

7. Swing turntable to place the boom over the rear of the crane.
8. Set the turntable lock pin in the down position.
9. Using the ECOS display lower the counterweight cylinders into the tubes in the counterweight/support bracket assembly, refer to *RCL Main Menu, page 3-75*.
10. Rotate the cylinders to lock into the counterweight assembly.
11. Raise the counterweight until the display indicates the counterweight is pre-tensioned.
12. Using the ECOS display, extend the locking cylinders until the display indicates the counterweight is locked in place.

17,690 kg (39,000 lb) Cast Counterweight Removal

1. Rig the crane with three parts of line.
2. The 17,690 kg (39,000 lb) cast counterweight assembly may be lifted in one of the following boom configurations.

Boom Configuration		
0-0-0-0-0 (30 ft radius)	0-0-0-0-50	0-0-0-50-0

3. Enter RCL code 1100. Refer to *RCL Main Menu, page 3-75*.
4. Swing turntable to place the boom over the rear of the crane.
5. Set the turntable lock pin in the down position.
6. Using the ECOS display, retract the locking cylinders until the display indicates the cylinders are fully retracted.
7. Lower the counterweight assembly onto the carrier stands until the display indicates the counterweight is fully lowered.
8. Rotate the cylinders to unlock from the counterweight.
9. Using the ECOS display raise the counterweight cylinders from the tubes in the counterweight.
10. Swing the turntable to place the boom over-the-front.
11. Connect sling assembly to the counterweight assembly using the support bracket lifting eyes (Figure 4-16).
12. Lift and place the counterweight assembly onto the ground.

Heavy Cast Counterweight Installation

DANGER

Read and understand the following when removing and installing the counterweight or counterweight stand, to avoid serious injury or death.

- Outriggers must be fully extended and set and crane level before installation or removal of counterweight.
- Lifting operations are not permitted with any counterweight on the carrier deck except for the removal or installation of the counterweight.
- Boom is not permitted over carrier deck when the boom angle is less than 30° and any counterweight is positioned on deck.
- Hookblock is not permitted to come in contact with counterweight during removal or installation.
- Travel is not permitted with any counterweight on carrier deck.
- Counterweight assembly must be completed on the ground; not on the carrier counterweight stands.

1. Rig the crane with five parts of line.
2. The heavy 63,000 lb (28,576 kg) cast counterweight assembly may be lifted in one of the following boom configurations.

Boom Configuration		
0-0-0-0-0	0-0-0-0-50 (20 ft radius)	0-0-0-50-0

3. Enter RCL code 1100. Refer to *RCL Main Menu, page 3-75*.

4. Connect sling assemblies to the 16,705 kg (36,825 lb) cast counterweight using the installation lifting holes (Figure 4-15).
5. Lift and place the counterweight onto the support bracket on the ground.
6. Connect sling assembly to the 10,902 kg (24,035 lb) cast counterweight insert using the lifting lugs on the insert (Figure 4-17).

10,902 kg (24,035 lb) Cast Counterweight Insert

FIGURE 4-17

7. Lift and place the counterweight insert into the 16,705 kg (36,825 lb) cast counterweight.
8. Connect sling assembly to the heavy cast counterweight assembly using the support bracket lifting eyes (Figure 4-16).
9. Lift and place the counterweight assembly onto the carrier stands.
10. Swing turntable to place the boom over the rear of the crane.
11. Set the turntable lock pin in the down position.
12. Using the ECOS display lower the counterweight cylinders into the tubes in the counterweight, refer to *RCL Main Menu, page 3-75*.
13. Rotate the cylinders to lock into the counterweight.
14. Raise the counterweight until the display indicates the counterweight is pre-tensioned.
15. Using the ECOS display, extend the locking cylinders until the display indicates the counterweight is locked in place.

Heavy Cast Counterweight Removal

1. Rig the crane with five parts of line.
2. The heavy 63,000 lb (28,576 kg) cast counterweight assembly may be lifted in one of the following boom configurations.

Boom Configuration		
0-0-0-0-0	0-0-0-0-50 (20 ft radius)	0-0-0-50-0

3. Enter RCL code 1100. Refer to *RCL Main Menu, page 3-75*.
4. Swing turntable to place the counterweight over the front of the crane.
5. Set the turntable lock pin in the down position.
6. Using the ECOS display, retract the locking cylinders until the display indicates the cylinders are fully retracted.
7. Lower the counterweight until the display indicates the counterweight is fully lowered onto the stands.
8. Rotate the cylinders to unlock from the counterweight.
9. Raise the counterweight cylinders from the tubes in the counterweight.
10. Connect sling assembly to the heavy cast counterweight assembly using the lifting eyes.
11. Lift and remove the counterweight from the carrier stands.
12. Place the counterweight on the ground.
13. Disassemble the counterweight, if necessary.

Counterweight Stand Removal

WARNING

Tipping Hazard!

The main boom must not be lowered below horizontal when swinging over the front while the counterweight supports are installed.

Serious injury, death or machine damage may occur.

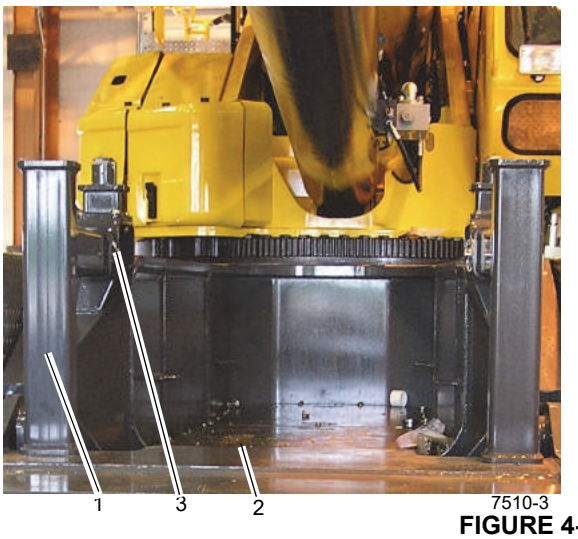


FIGURE 4-18

1. Attach an adequate lifting device with slings to a counterweight stand (1) (Figure 4-18).
2. Remove the hitch pins (3).
3. Using the lifting device, remove a counterweight stand (1) (Figure 4-18).

OUTRIGGER REMOVAL AND INSTALLATION

DANGER!

Tipping Hazard

When lifting the outrigger box on rubber the machine may tip over. The boom must be fully retracted and limited to a 6 m (20 ft) maximum radius.

With one outrigger box installed the machine may become unstable. Do not swing over the end with the outrigger box already installed while installing the other outrigger box.

The boom angle must not be less than 35° when over sides of the machine; loss of stability will occur causing a tipping condition. To lower boom below 35° boom angle, boom must be swung over front or rear and RCL bypass activated.

Bleed Valve Operation

The manual pressure bleed-off valve (1) (Figure 4-19) is located on the back of the right rear fender. The purpose of the valve is to reduce the effort required to separate and connect the hydraulic quick disconnect couplers when removing or installing the front and rear outrigger boxes.

FIGURE 4-19

1. Shut off the engine.
2. Turn the handle counterclockwise to open the bleed valve.
3. Wait approximately 20 to 30 seconds.
4. As necessary, separate or connect the quick disconnects.
5. Immediately close the bleed valve.
6. Restart the engine if necessary.

Outrigger Box Removal

FIGURE 4-20

1. Remove the quick release pins (1) Figure 4-20 from the ends of each of the pinning cylinder rod ends.
2. Using the crane boom for the lifting operation, fasten lifting slings to the lifting lugs provided on each end of the outrigger box.
3. Lift the outrigger box enough to remove the pressure off of the ends of the pinning cylinder rod ends.

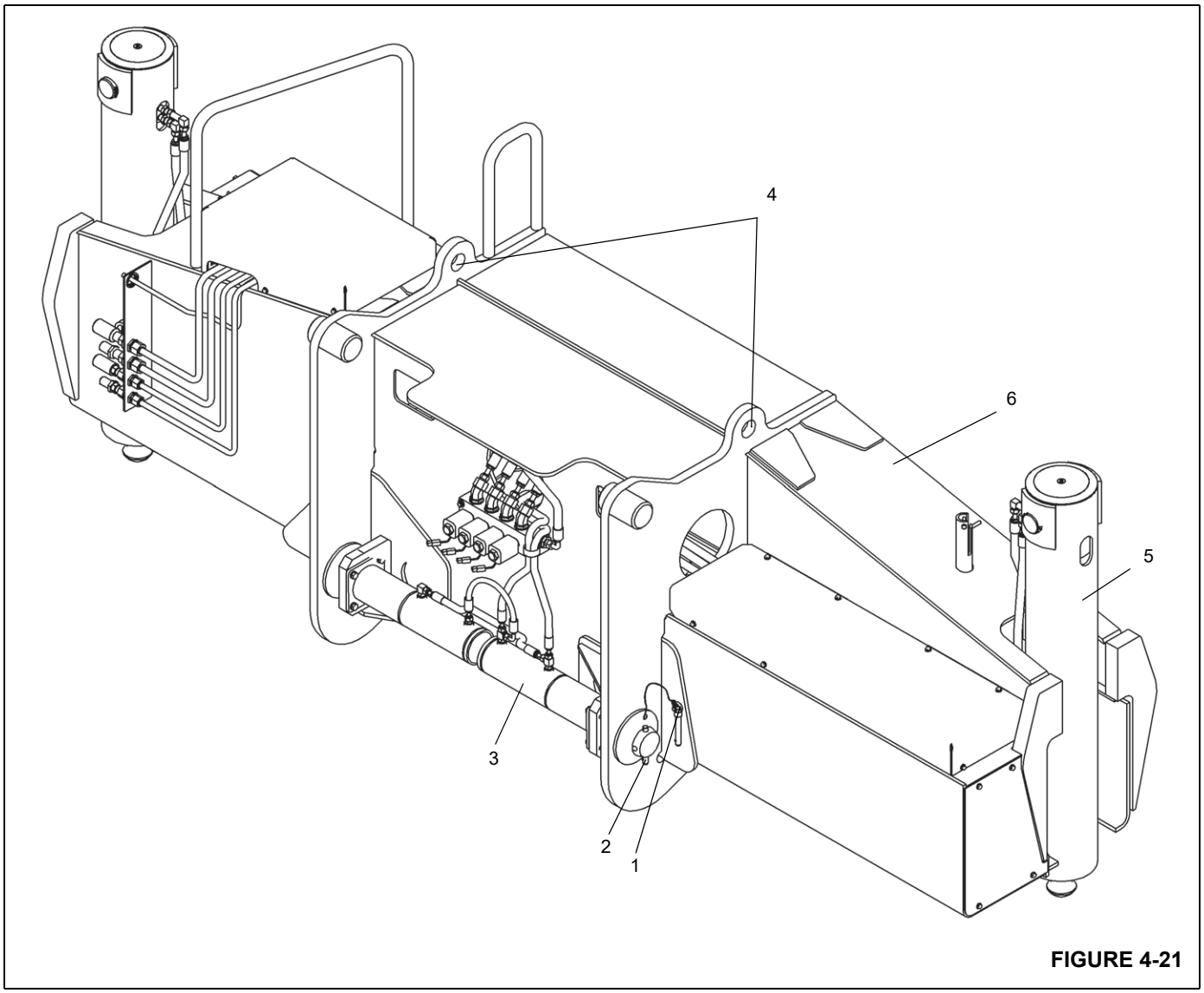


FIGURE 4-21

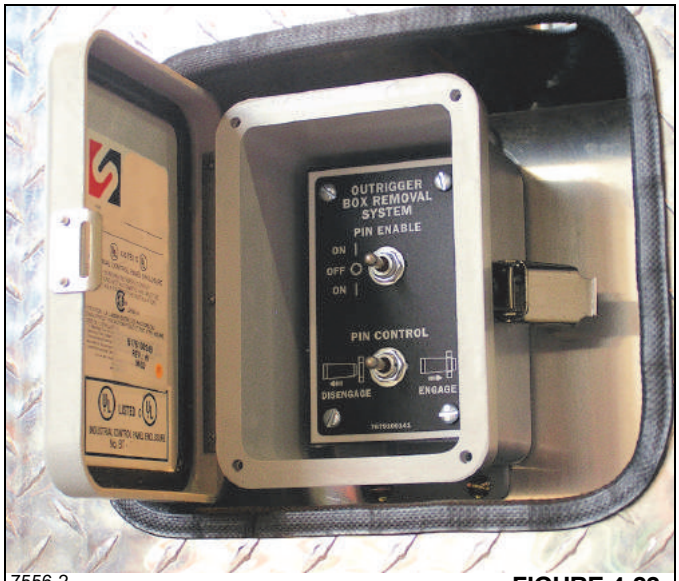
Item	Description
1	Clamp
2	Quick Release Pin
3	Pin Cylinder

Item	Description
4	Lifting Lug
5	Outrigger Beam Assembly
6	Outrigger Box

CAUTION!

Do not activate any switches on the control in (Figure 4-22) until you are thoroughly familiar with the outrigger box installation and removal procedure.

4. Using the appropriate outrigger box removal control: either in the left front fender for the front outrigger box or in the right rear fender for the rear outrigger box, hold the Pin Enable switch to the ON position (Figure 4-22) and push the Pin Control switch to DISENGAGE until the pinning cylinder rods are fully retracted.



7556-2 **FIGURE 4-22**

5. Disconnect the carrier external electrical connector from the outrigger external connection.
6. Disconnect the carrier hydraulic quick disconnects from the external connections of the outrigger. Stow the carrier lines inside the fender.
7. Lift the outrigger box from the carrier.
8. Stow the retainer pins in the stowage clamps on the outrigger box.
9. Stow the electrical connector in the plug provided on the fender.

Outrigger Box Installation

NOTE: Outrigger boxes are not interchangeable front to rear or with outrigger boxes from another crane.

The outrigger box assembly weighs approximately 9427 lb (4276 kg).

1. Make sure the outrigger pressure bleed valve is closed.
2. Connect sling assembly to the lifting lugs provided on each end of the outrigger box (Figure 4-21).
3. Lift and align the outrigger box close to the installed position at the rear or front of the carrier, as applicable.
4. Connect the carrier external electrical connector to the outrigger external connection.
5. Install the carrier hydraulic quick disconnects to the external connections of the outrigger box.
6. Lower the outrigger box aligning the pinning cylinder pins with the attach points on the carrier frame.

CAUTION!

Do not activate any switches on the control (Figure 4-22) until you are thoroughly familiar with the outrigger box installation and removal procedure.

7. Using the appropriate remote mounted pin control box, hold the Pin Enable switch at the ON position and hold the Pin Control switch to the ENGAGE position (Figure 4-22).
8. After the pinning cylinders have fully engaged the outrigger box, install a quick release pin in the end of each of the cylinder rod ends (1) (Figure 4-20).

ANTI TWO BLOCK (A2B) SWITCH

If a hoist rope has been reeved and two A2B switches are installed, the unused A2B switch must be locked (disabled) to allow all crane operations.

Lock

CAUTION

If the A2B switch is locked (disabled), the hook block could hit the main boom head or extension, resulting in damage to the hook block, main boom head or extension, and hoist rope. Never lock an A2B switch with a switch weight attached.

1. Remove A2B weight.
2. (A) Remove cap (1) from switch.
3. Pull lanyard (2) down.
4. (B) Secure lanyard (2) in this position using cap (1). A2B switch is locked (disabled).

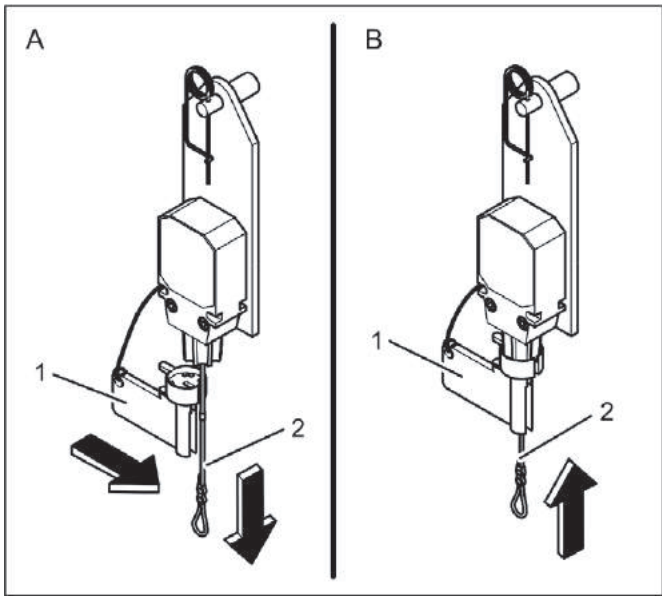


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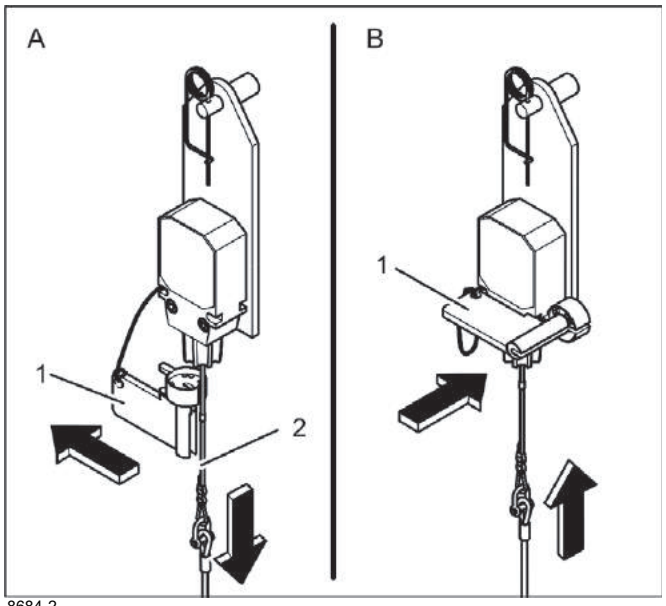
FIGURE 4-23

Unlock

NOTE: Always remove the switch lock (enable) before installing an A2B weight around the hoist rope.

1. (A) Pull down lanyard (2) and remove cap (1). Switch is unlocked (enabled).
2. (B) Install cap (1) on A2B switch.



8684-2

FIGURE 4-24

Before Operation

Check the following electrical connections before operating the crane to ensure the LMI system is properly connected for the crane configuration.

Cranes With Main Hoist Only

If the crane is operated only with the boom and without boom extension or lattice extension, no additional connections are necessary. It must however be ensured that the A2B switch weight is correctly mounted on the main boom hoist rope. With even numbers of rope lines, the lifting limit switch weight shall be attached to the "dead end" of the hoist rope. With odd numbers of rope lines, the lifting limit switch weight shall be attached to the rope line with the lowest operating speed.

If the crane is operated with a main boom extension or top section, the connecting cable must be mounted between the distributor socket on the lattice extension and the distributor socket on the main boom. The main boom A2B switch weight must be disconnected and mounted on the extension or fly boom A2B switch.

WARNING

Failure to reposition the A2B weight will prevent the A2B system from functioning properly. No weight shall be mounted on the A2B switch of the main boom when working with the extension/top section.

Machines with Main and Auxiliary Hoists

If the main boom extension or fly section is not used, then the bridging plug must be plugged into the distributor socket on the main boom and the lifting limit switch weight must be mounted on the main boom.

If the crane is operated with a main boom extension and/or with a lattice extension, then the connecting cable must be mounted between the distributor socket on the extension or on the top section and the distributor socket on the main boom. In addition, weights must be fitted to both the A2B switch of the main boom and the extension or fly section.

If the boom extension or lattice extension are in working position and if the main boom is not equipped with a hoist rope, then the weight of the A2B switch on the main boom must be removed to prevent endangering personnel or damaging equipment.

After electrical connections have been checked to ensure the system is properly connected for the respective crane configuration, the following checks must be made:

1. Check electrical wiring connecting various parts of the system for physical damage.
2. Check A2B switches and weights for free movement.
3. Inspect spring cable drum for smooth running, initial drum tension, and correct cable winding.
4. Inspect mechanical and electrical installation of power measurement sockets on the lattice extension (if present).

WARNING

The following tests must be performed with care to prevent personnel injury or crane damage. Proper functioning of the CCS requires successful completion of these tests before starting work.

If the operator cannot see the hook block approaching the pulley head, this task must be assigned to an assistant (slinger).

The crane operator must be prepared to stop the crane immediately if the CCS is not working correctly, i.e. when warning indicators do not display, the acoustic alarm does not sound, and crane movements such as raising, extending and luffing are not disabled.

Check *Hoist limit switch warning light* and acoustic alarm as follows:

1. Manually raise weight fitted on the A2B switch. As soon as weight is raised, the acoustic alarm should sound and *A2B* switch warning should display.
2. Using the main hoist, pull hook block slowly against the A2B switch weight. As soon as the hook block raises the weight, the acoustic alarm should be triggered, the *A2B* switch warning should display, and the main hoist should switch off. Lower the hook block slightly to eliminate this condition.
3. Slowly lower the boom to bring about a potential hoist limit situation. As soon as the hook block raises the weight, the acoustic alarm should sound, the *A2B* switch warning should display, and the luffing gear should switch off. Lower the hook block slightly to eliminate this condition.
4. Slowly extend (telescope out) the boom to bring about a potential hoist limit situation. As soon as the hook block raises the weight, the acoustic alarm should sound, the *A2B* switch warning should display, and the telescoping function should switch off. Lower the hook block slightly to eliminate this condition.

WARNING

If warning indicators and audible alarm do not function as described and crane movements are not switched off, the system is not working properly. The malfunction must be corrected before starting work.

5. If crane is equipped with a main boom or lattice extension, the inspection procedure must be repeated for the A2B switch of the extension/top section.
6. Check display of main boom length agrees with actual boom length.
7. Check display of main boom angle agrees with actual boom angles.
8. Check display of the crane operating radius agrees with the actual radius.
9. Check load display by lifting a load of known weight. Load display accuracy must be within the tolerance range.

BOOM EXTENSIONS

Refer to Figure 4-25 for a diagram of the boom extensions available for this crane.

The RT9150E can be used with the following boom extensions:

- 36 ft to 59 ft (11 m to 18 m) manual offsettable bi-fold swingaway boom extension (folding manual luffing extension), with mechanical offset mechanism for offsets of 0, 20, & 40 degrees, as standard—unless it was explicitly not ordered.
- 36 ft to 59 ft (11 m to 18 m) hydraulic offsettable bi-fold swingaway boom extension (folding hydraulic luffing extension), with hydraulic offset mechanism for offsets of 0 to 40 degrees.
- 11.8 ft (3.6 m) heavy duty six-sheave hydraulic offsettable boom extension (heavy duty extension), with hydraulic offset mechanism for offsets of 0 to 40 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.
- 19.6 ft. (6 m) extension insert (20 ft insert) to be used with the 26 ft insert and any of the 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 extensions on several Grove cranes, the extensions and cranes must be adjusted. Label all extensions with the respective crane serial numbers.

CAUTION

Have the adjustment of the boom extension carried out only by Manitowoc Crane Care.

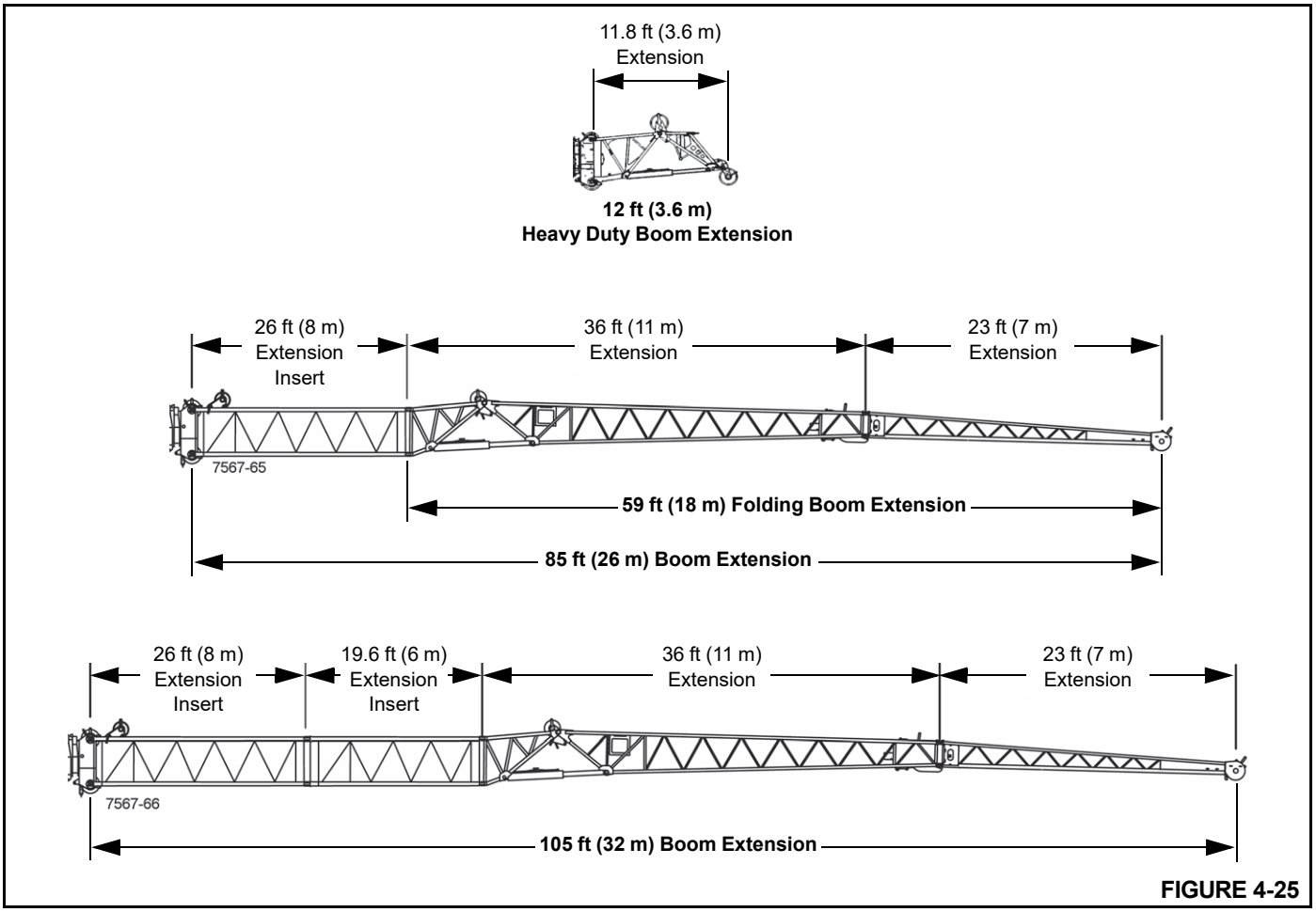


FIGURE 4-25

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 *Deploying the Outriggers, page 3-127*.

NOTE: An auxiliary crane with sling is required to install the boom extension.

2. Rotate the superstructure so the boom is over the front.
3. Retract and lower the boom to horizontal.
4. Attach a tag line to the junction of the 36 ft and 23 ft extensions.
5. Using a sling attached to an auxiliary crane, lift the extension in front of the main boom (Figure 4-26).

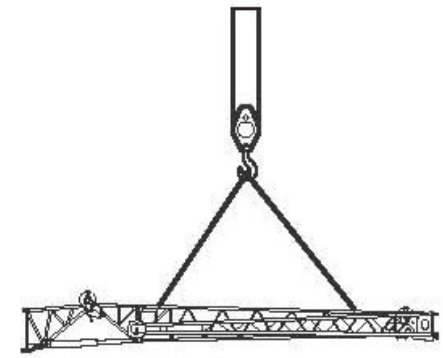


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FIGURE 4-26

6. Align the extension left side mounting lugs (1) to the boom nose right side mounting lugs (2) (Figure 4-27).
7. Install the pins (3) through the mounting lugs and secure with the retaining clips.

To stow the entire 59 ft folding extension on the main boom, refer to the *Stowing Procedure: 59 ft (18 m) Extension, page 4-41*.

To erect just the 36 ft extension, refer to *Stowing Procedure: 23 ft (7 m) Boom Extension, page 4-40*.

To erect the 59 ft extension, continue with the follow steps.

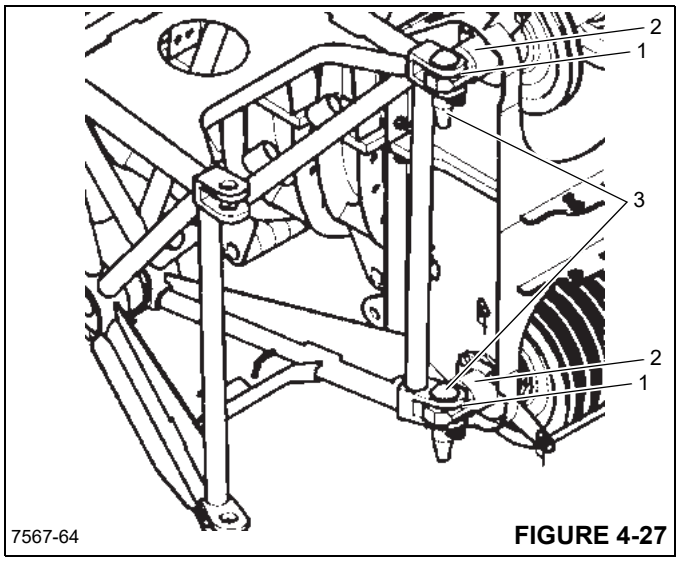

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FIGURE 4-27

8. While maintaining control with the tag line, swing extension into position on boom nose.
9. Remove the pins out of the holders (1) (Figure 4-28). Install the pins (2) into the mounting lugs (3) and secure with the retaining clips.

NOTE: If the pins cannot be inserted, the strain can be taken off the connecting points. Refer to *Relieving the Load on Connecting Lugs, page 4-26*.

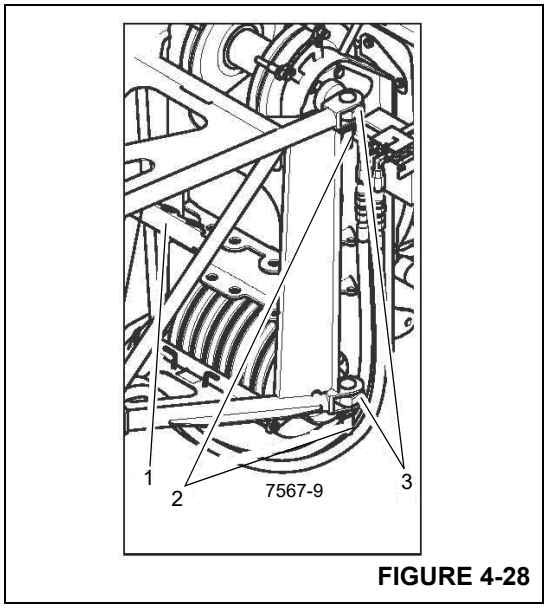


FIGURE 4-28

10. Establish electrical connections between the extension and the main boom, refer to *59 ft (18 m) Extension Electrical Connections, page 4-32*.
11. Install the limit switch, refer to *59 ft (18 m) Extension A2B Installation, page 4-33*

12. For units equipped with a hydraulic luffing extension, establish hydraulic connections between the extension and the main boom, refer to *Establishing the Hydraulic Connection, page 4-35*.

NOTE: You can also install the folding boom extension in front of the inserts when changing from a 59 ft extension to a longer boom extension.

Securing Extension with Tag Line (Rope)

DANGER

Crushing Hazard!

Always secure the boom extension with a tag line (rope) on the main boom before removing any connections. This will prevent the extension from slipping off the run-up ramp, swinging around and knocking you off the carrier or injuring other persons in the swing range.

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

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

The extension may swing out on its own when the last connection is removed that held the extension at the side of the main boom.

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). Leave enough play in the tag line that it is tight only when you swing the lattice extension towards the main boom head later on.

Relieving the Load on Connecting Lugs

NOTE: The weight of the extension can cause the connecting lugs on the left side to be misaligned or the pins to become wedged which makes it difficult to install or remove the pins.

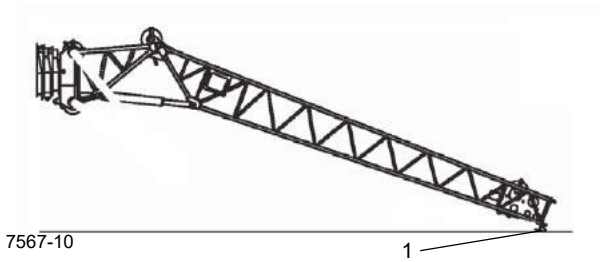


FIGURE 4-29

When installing or removing the pins and the connecting lugs do not align:

1. Lower the boom until the nose of the extension is on the ground or suitable support (1) (Figure 4-29). If necessary, override the lifting limit switch.

2. Continue to lower carefully until the connecting points align or until the load has been removed from the pins.

Extension Erecting Warnings and Requirements

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!

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 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: 36 ft (11 m) Extension

This procedure is for erecting just the 36 ft extension, leaving the 23 ft 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 ensure all pins securing the extension are installed.

NOTE: The crane should be setup on outriggers using normal setup procedures. Refer to *Deploying the Outriggers, page 3-127*.

2. Retract and lower boom to horizontal for erecting over the front of the crane.
3. Attach a tag line (3) (Figure 4-32) at the front of the extension.
   a. Guide the tag line around the end of the extension and through the bracket (4) (Figure 4-32) on the main boom and back again.
   b. If possible, have a helper hold the tag line tight while releasing the connections.
4. Release the spring latch (1) (Figure 4-30). Fold out the run-up ramp (2) until the locking pin (3) engages the tab (4).

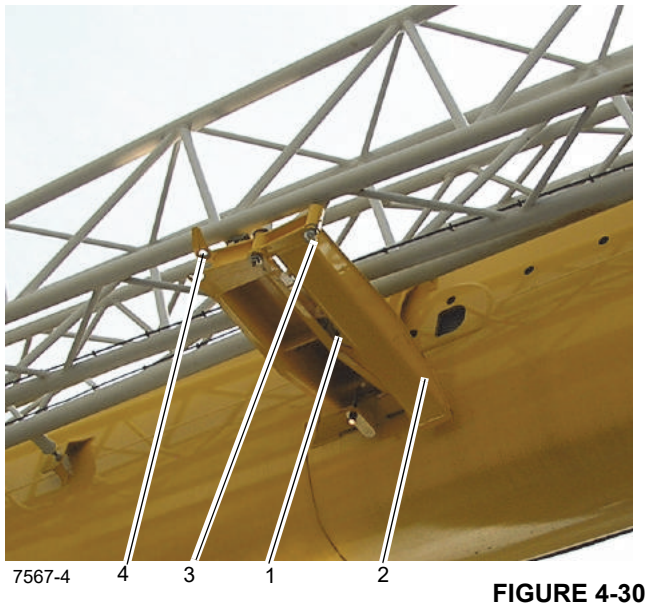


FIGURE 4-30

5. Remove the pin (1) (Figure 4-31) from the locking bar (2). Move the locking bar (2) to the base section attachment bar (3) and install pin. Secure with retaining clip.

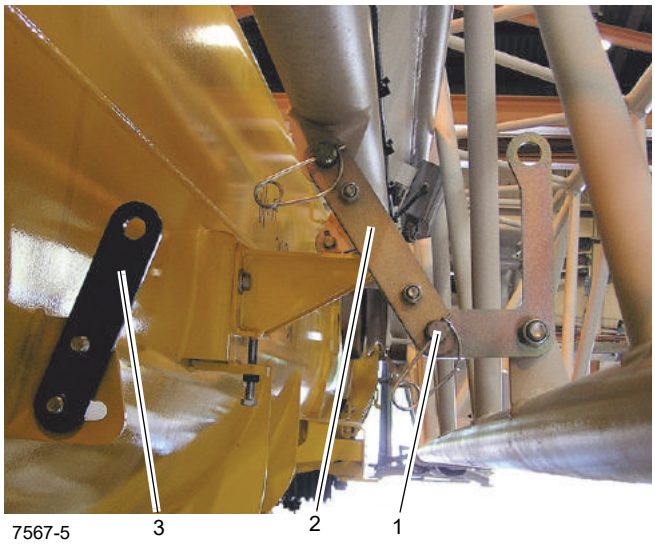


FIGURE 4-31

DANGER

Crushing Hazard!

Before disconnecting the locking bar and rear pins, ensure the extension is secured with the tag line, is on the run-up ramp and attached at the front latch.

This will prevent extensions from falling when disconnected, causing death or serious injury.

6. Remove the retainer clips (1) (Figure 4-32) and pull pins (2) out of connecting points. Insert pins into holder and secure with retainer clips.

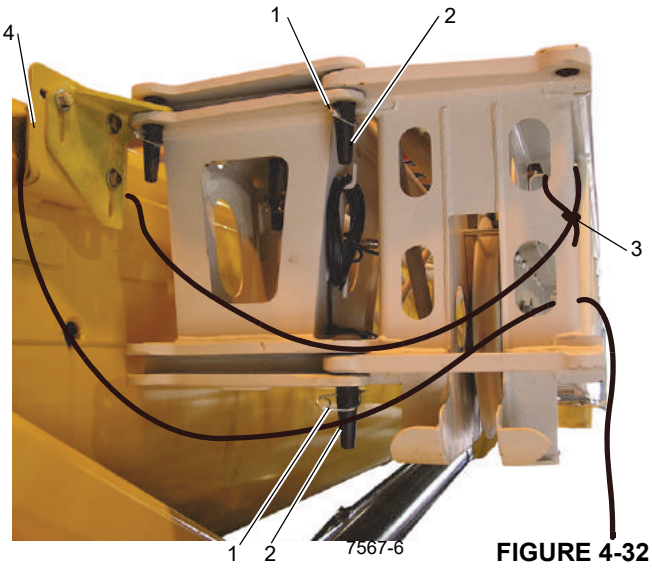


FIGURE 4-32

4

CAUTION

Falling Objects Hazard!

Ensure the extension connecting pins are always secured with retaining clips. This prevents unsecured pins from becoming loose and falling out causing injuries.

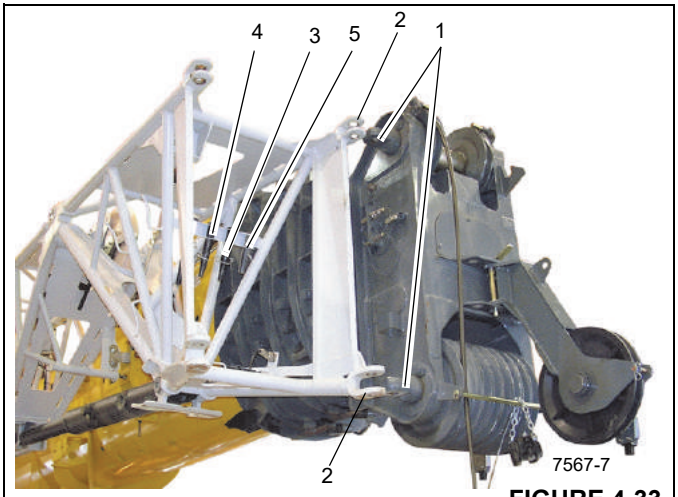


FIGURE 4-33

7. Using the tag line, pull the front of the extension until the extension mounting lugs (2) (Figure 4-33) align with the boom head lugs (1).
8. Using a ladder or suitable lifting device, remove the retainer clips (3) and pull the pins (4) out of the holders (5). Install the pins through the connecting lugs and secure with the retainer clips.
9. Have a helper hold, or make secure, the front of the extension against the main boom.
10. Using a ladder or aerial work platform, use the jib extension pole, located in the cab, to pull the retaining clip out of the horizontal locking pin (1) (Figure 4-34).
11. Use the jib extension pole to pull the horizontal locking pin out of the front latch assembly and place in the storage lugs (2). Secure with the retaining clip.

DANGER

Crushing Hazard!

To prevent serious injury or death, do not release the front latch without the extension being secured with a tag line at the other end.

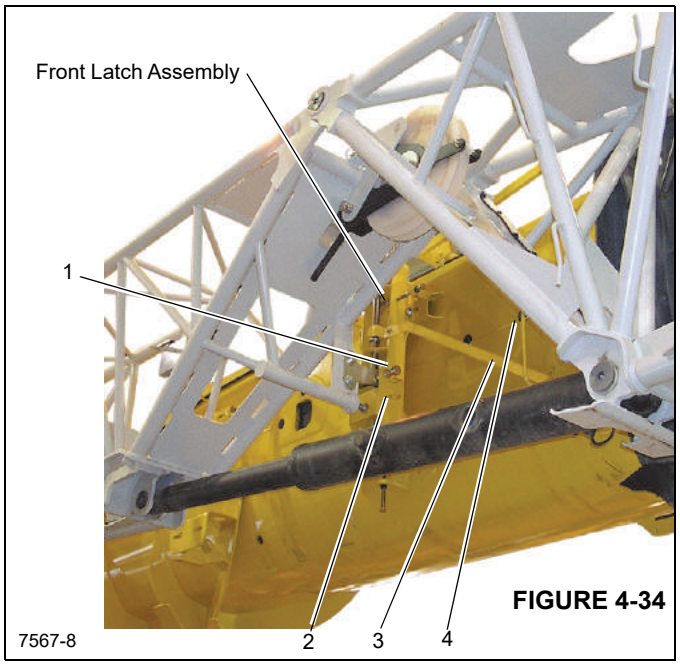


FIGURE 4-34

12. Using the jib extension pole, disengage the front latch assembly by pushing handle (3) (Figure 4-34) up and onto the handle rest (4).
13. While maintaining control of the extension with the tag line, disconnect the tag line from the main boom.

WARNING

Crushing Hazard!

To prevent serious injury or death, do not stand in the swing arch of the extension.

14. Use the tag line to pull the extension off the ramp.
15. While maintaining control with the tag line, swing extension into position on boom nose. The 23 ft (7 m) section will remain on the boom.

NOTE: If the extension doesn't easily swing around to the front, slightly lower the boom from horizontal.

16. Using a ladder or suitable lifting device, remove the retainer clips and pull the pins out of the holders (1) (Figure 4-35). Install the pins (2) into the connecting lugs (3). Secure with the retainer clips.

NOTE: If the pins cannot be inserted, the strain can be taken off the connecting lugs, refer to, *Relieving the Load on Connecting Lugs, page 4-26*.

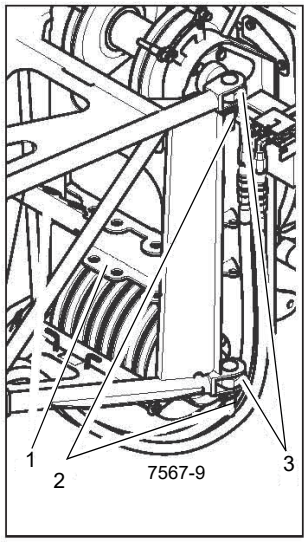


FIGURE 4-35

Erecting Procedure: 59 ft (18m) Extension

The 59 ft extension includes the 36 ft extension with the 23 ft extension unfolded and attached to the nose of the 36 ft extension.

WARNING

Falling Hazard!

To prevent serious injury or death, do not stand on decking until extensions are secure.

1. Visually check to ensure all pins securing the extension are installed.

NOTE: The crane should be setup on outriggers using normal setup procedures. Refer to *Deploying the Outriggers, page 3-127*.

2. Retract and lower boom to horizontal for erecting over the front of the crane.
3. Attach a tag line (3) (Figure 4-37) at the front of the extension.
   a. Guide the tag line around the end of the extension and through the bracket (4) on the main boom and back again.
   b. If possible, have a helper hold the tag line tight while releasing the connections.
4. Release the spring latch (1) (Figure 4-36). Fold out the run-up rail (2) until the locking pin (3) engages the tab (4).

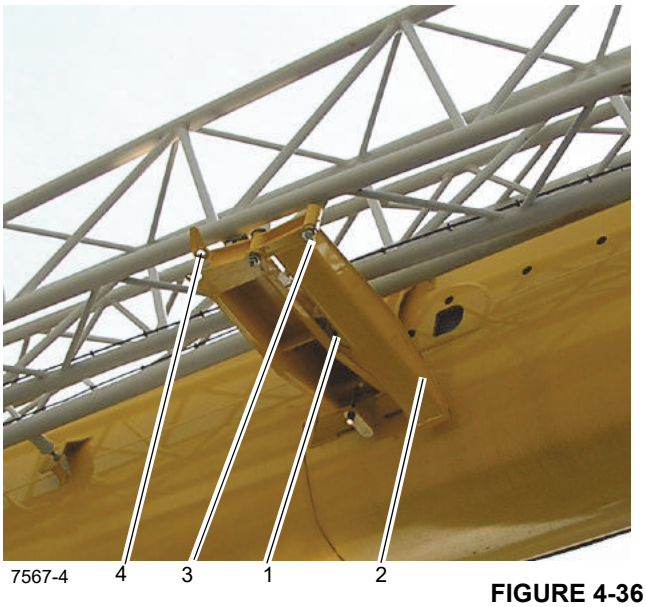


FIGURE 4-36

DANGER

Crushing Hazard!

Before disconnecting the rear pins, ensure the extension is secured with the tag line, is on the run-up ramp and attached at the front latch.

This will prevent extensions from falling when disconnected, causing death or serious injury.

5. Remove the retainer clip (1) (Figure 4-37) and pull the pin (2) out of connecting lug. Insert pin into holder and secure with retainer clip.

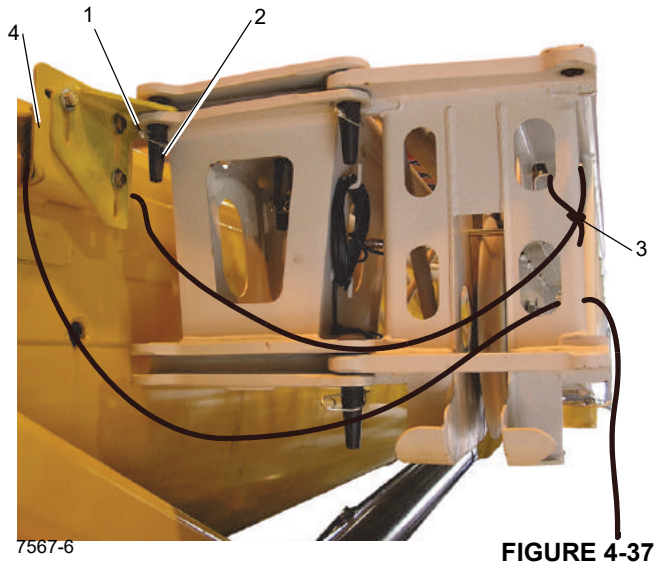


FIGURE 4-37

CAUTION

Falling Objects Hazard!

Ensure the extension connecting pins are always secured with retaining clips. This prevents unsecured pins from becoming loose and falling out causing injuries.

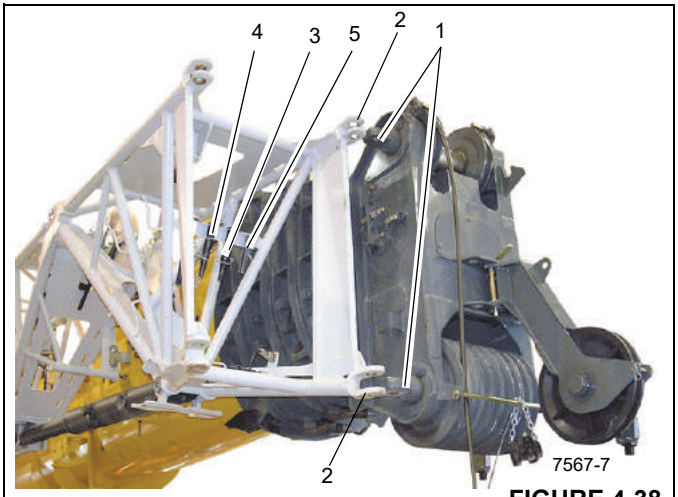


FIGURE 4-38

6. Using the tag line, pull the front of the extension until the extension mounting lugs (2) (Figure 4-38) align with the boom head lugs (1).
7. Using a ladder or suitable lifting device, remove the retainer clips (3) and pull the pins (4) out of the holders (5). Install the pins through the connecting lugs and secure with the retainer clips.
8. Have a helper hold, or make secure, the front of the extension against the main boom.
9. Using a ladder or aerial work platform, use the jib extension pole, located in the cab, to pull the retaining clip out of the horizontal locking pin (1) (Figure 4-39).
10. Use the jib extension pole to pull the horizontal locking pin out of the front latch assembly and place in the storage lug (2). Secure with the retaining clip.

DANGER

Crushing Hazard!

To prevent serious injury or death, do not release the front latch without the extension being secured with a tag line at the other end.

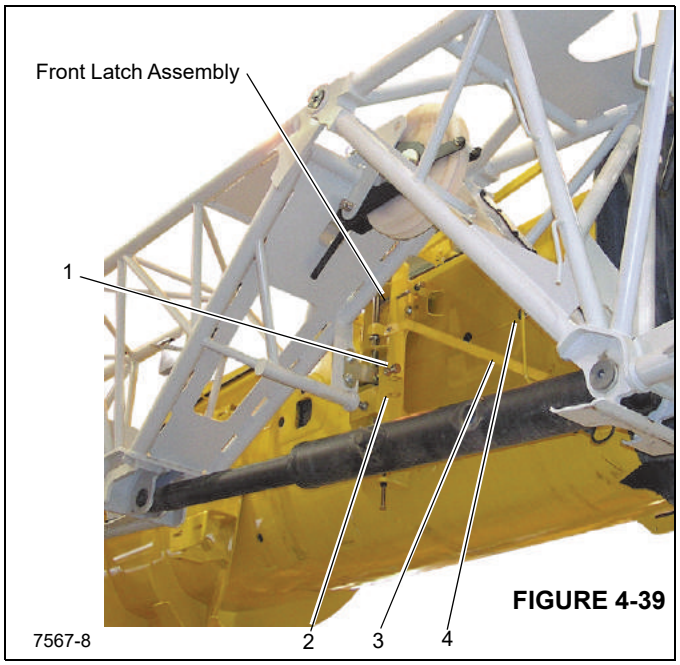


FIGURE 4-39

11. Using the jib extension pole, disengage the front latch assembly by pushing handle (3) (Figure 4-39) up and onto the handle rest (4).
12. While maintaining control of the extension with the tag line, remove the tag line from the bracket (4) (Figure 4-37) on the main boom.

WARNING

Crushing Hazard!

To prevent serious injury or death, do not stand in the swing arch of the extension. Be aware that if the boom is lowered the extension will swing out on its own if not secured with the tag line.

13. Use the tag line to pull the extension off the ramp.
14. While maintaining control with the tag line, swing extension into position on boom nose.

NOTE: If the extension doesn't easily swing around to the front, slightly lower the boom from horizontal.

15. Using a ladder or suitable lifting device, remove the retainer clips and pull the pins out of the holders (1) (Figure 4-35). Install the pins (2) into the connecting lugs (3). Secure with the retainer clips.

NOTE: If the pins cannot be inserted, the strain can be taken off the connecting lugs, refer to, *Relieving the Load on Connecting Lugs, page 4-26*.

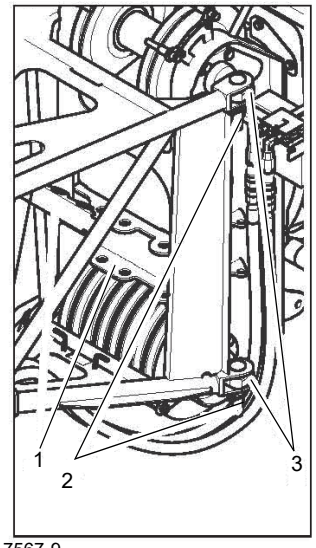


FIGURE 4-40

16. Remove tag line from the 36 ft (11 m) extension and secure to the front of the 23 ft (7 m) extension, routing the line through the 36 ft (11 m) extension.

WARNING

Crushing Hazard!

Always secure the 23 ft extension with a tag line before releasing the connection between the two extensions.

This will prevent the 23 ft extension from swinging uncontrolled, causing serious injury or death.

17. Have a helper hold the tag line taut or fasten it to the rear of the 36 ft extension.

18. Ensure the boom is horizontal.

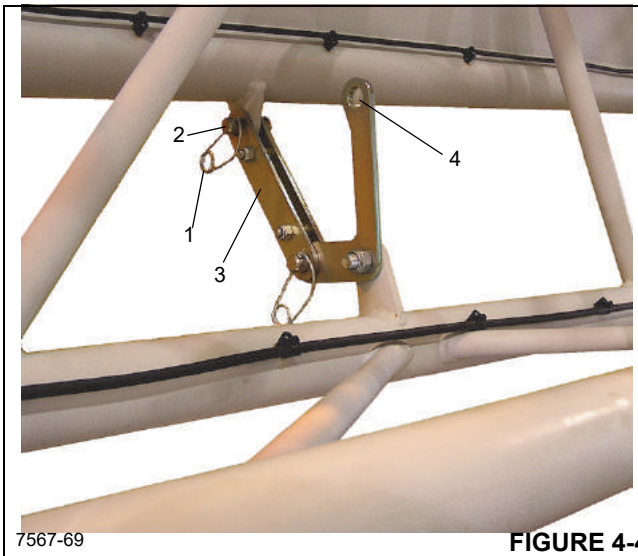


FIGURE 4-41

19. Remove the retaining clip (1) (Figure 4-41) from the pin (2) and remove the pin. Secure the locking bar (3) to the stowage lug (4) on the 36 ft (11 m) extension with the pin and retainer clip.

WARNING

Crushing Hazard!

To prevent serious injury or death, do not stand in the swing arch of the extension.

20. Using the tag line (Figure 4-42) to maintain control, swing the 23 ft (7 m) extension into the erected position.

NOTE: Do not lower boom until the 23 ft extension has been completely swung in front of the 36 ft extension.

21. Slightly lower the boom.

22. Remove retainer clips and pins (Figure 4-42) from holder. Install pins (1) in connecting lugs and secure with retainer clips (2).

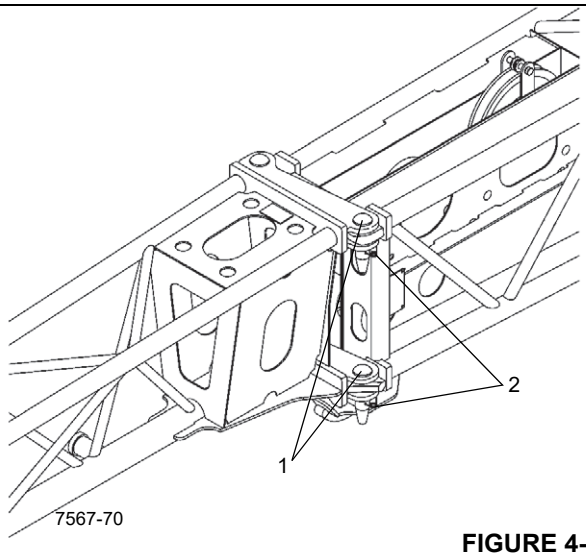


FIGURE 4-42

Extension Electrical Connections

To connect the anti-two block (A2B) switch, aircraft warning light or anemometer to boom extensions the following procedures must be performed.

36 ft (11m) Extension Electrical Connections

The following procedure connects the 36 ft 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 bridging plug (1) from socket (3) and plug it into the storage socket (2) (Figure 4-43).

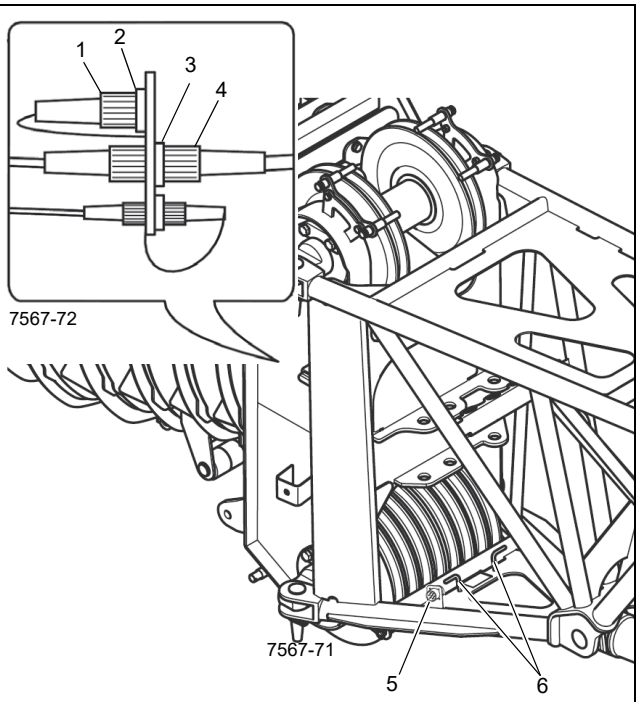


FIGURE 4-43

2. Remove the plug (4) from the storage socket (5) and unwind the cable from the storage location (6). Connect the plug (4) to the socket (3).

   This connects the extension to the main boom circuit.

3. Wind the cable around the storage location (6) such that it will not be damaged during crane operation.

59 ft (18 m) Extension Electrical Connections

The following procedure connects the 23 ft (7 m) extension wiring to the 36 ft (11 m) extension wiring for operation of the 59 ft (18 m) extension. This connection must be made in order to connect any electrical devices and an anti-two block switch.

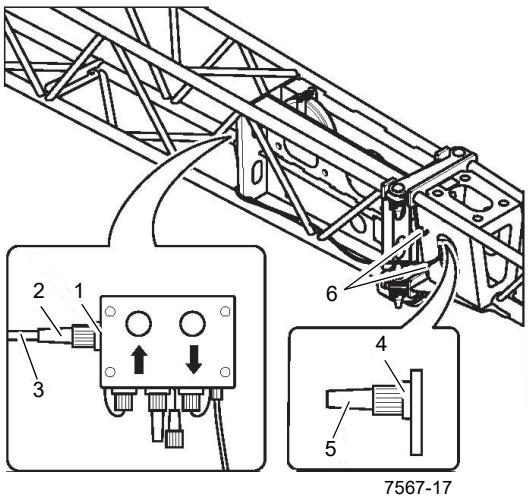


FIGURE 4-44

1. Remove the bridging plug (5) (Figure 4-44) from the socket (1).
2. Unwind the cable (3) from the storage location (6).
3. Remove the plug (2) from the storage socket (4) and unwind the cable (3) from the storage location (6). Connect plug (2) into the socket (1).

   This makes the connection from the 23 ft (7 m) extension to the 36 ft (11 m) extension for use of the 59 ft (18 m) extension.

4. Plug the bridging plug (5) into the storage socket (4).
5. Wind the cable (3) on the storage location (6) so that it will not become damaged.

Disconnect Electrical Connections to the 59 ft (18 m) Section

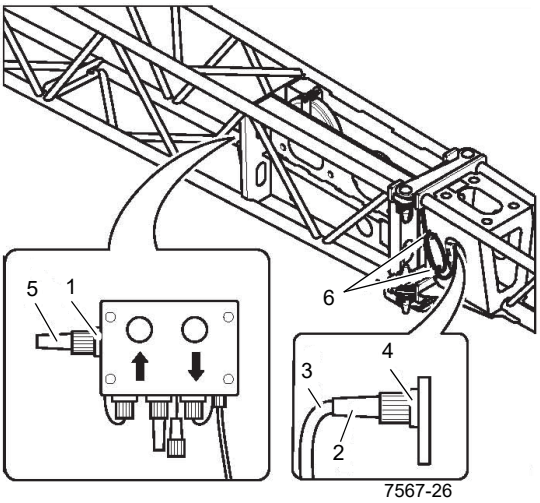


FIGURE 4-45

1. Remove the plug (2) from the socket (1) and plug it into the dummy socket (4) (Figure 4-45).
2. Wind the cable (3) onto the storage lugs (6).
3. Remove the bridging plug (5) from the dummy socket (4) and plug it into the socket (1).

Connecting the Anti-Two Block Switch

36 ft (11 m) Extension A2B Installation

To electrically connect the A2B switch the electrical connections to this extension must be completed, refer to *36 ft (11m) Extension Electrical Connections, page 4-32*.

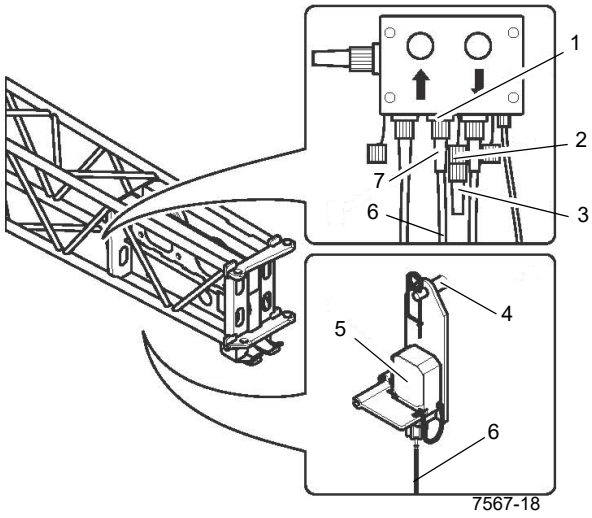


FIGURE 4-46

1. Install the A2B switch assembly (5) (Figure 4-46) on to the pin (4) and secure it with a retaining clip.
2. Remove the bridging plug (3) from the socket (1) and plug it into the storage socket (2), as shown.
3. Route the cable (6) so that it will not be damaged during crane operation, and connect the A2B connector (7) to the socket (1).

36 ft (11 m) Extension A2B Removal

When the extension is no longer needed or if installing the 23 ft extension for 59 ft extension operation, the A2B switch must be removed.

1. Remove the A2B connector (7) from the socket (1).
2. Connect the bridging plug (3) into the socket (1).
3. Install the cap on the storage socket (2).
4. Remove the retaining clip from the mounting pin and remove the A2B assembly.

The A2B switch can now be moved to another location and connected.

59 ft (18 m) Extension A2B Installation

To electrically connect the A2B switch the electrical connections to this extension must be completed, refer to *59 ft (18 m) Extension Electrical Connections, page 4-32*.

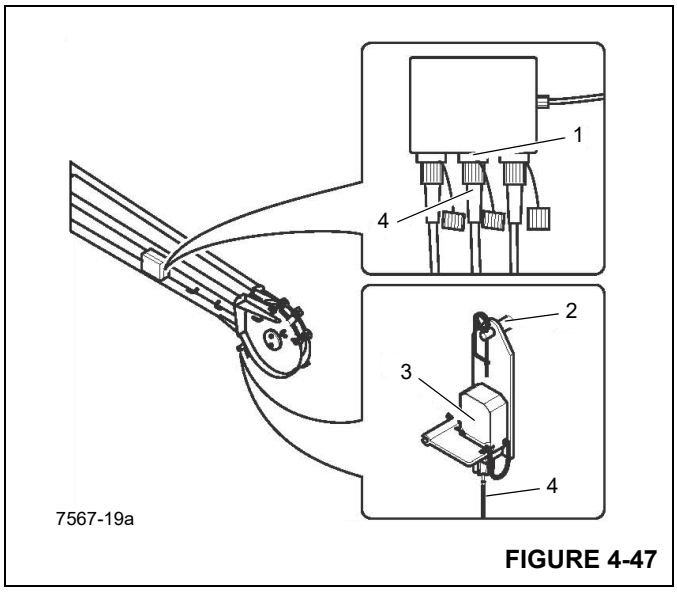


FIGURE 4-47

1. Install the A2B switch (3) on to the pin (2) and secure it with a retaining clip (Figure 4-47).
2. Route the A2B cable (4) such that it will not be damaged during crane operation, and connect the A2B switch to socket (1).

59 ft (18 m) Extension A2B Removal

1. Remove the plug from the socket (1) (Figure 4-48).
2. Remove the A2B switch assembly (3) from the pin (2).
3. Fasten the retaining pin to the lifting limit switch.

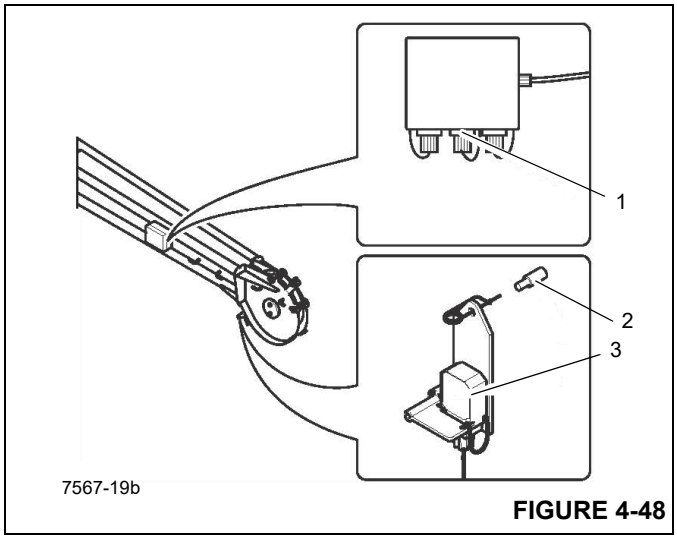


FIGURE 4-48

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 jib. 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 4-49) are distributed on the inner wheel of the hose drum. Rotating the latch (2) engages one of the holes to lock the drum, preventing it from turning.

Unlocking the Drum

Rotate the latch (2) 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).
2. Rotate the latch (2) counterclockwise to position (B), until the latch fully engages the hole.

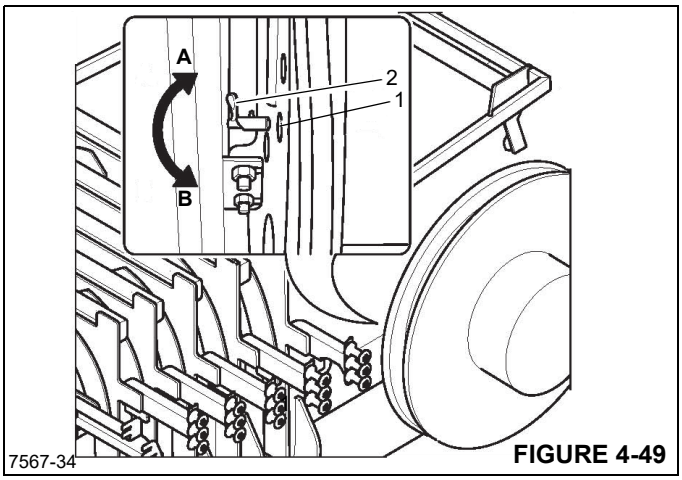


FIGURE 4-49

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 4-50) and fold up the guide sheaves (2).
3. Remove the strain relief (3) from its main boom mounting bracket (4) and pull the hydraulic hoses (5) towards the boom nose.
4. Hook the strain relief onto the boom nose mounting bracket (6).
5. Fold down the guide sheaves (2) and secure them with the hinged pins (1).

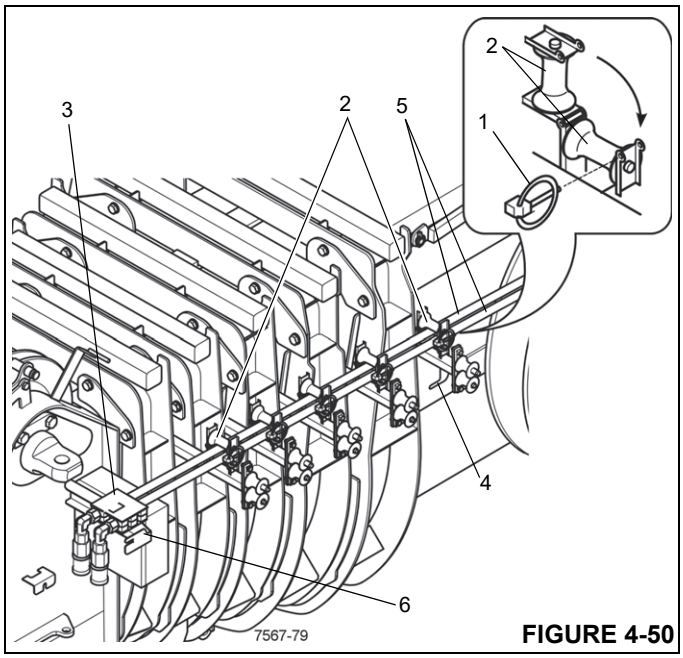


FIGURE 4-50

Position for Main Boom Operation

The locking device on the hose drum must be undone:

1. Loosen the hinged pins (5) (Figure 4-51) and fold up the guide sheaves (4).
2. Detach the strain relief from the holder (3) and attach it to the holder (2).
3. Fold down the guide sheaves (4) and secure them with the hinged pins (5).

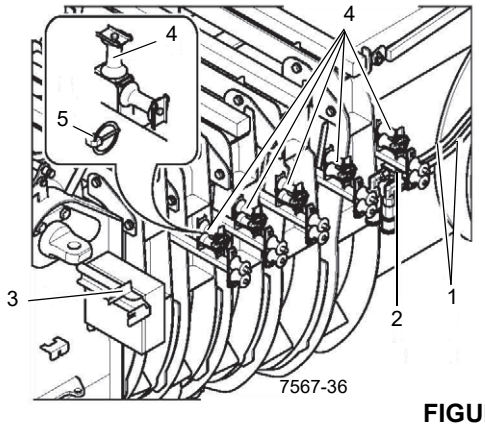


FIGURE 4-51

Establishing the Hydraulic Connection

1. If necessary, bring the connections (1) (Figure 4-52) into the position for lattice extension operations on page 4 - 34.
2. Remove the hose line (2) from the clamp (4).
3. Feed the hose lines towards the left hand side through the lower opening (3) in the 36 ft (11 m) section under the boom head.
4. Remove the protective caps to the connections (1) and attach the hose lines (observe color code).

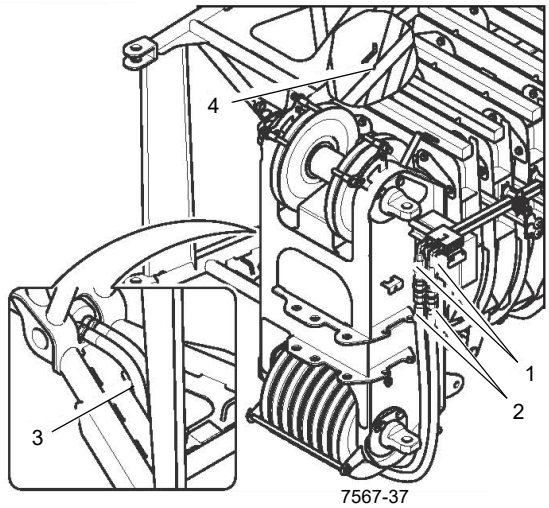


FIGURE 4-52

Disconnecting the Hydraulic Connection

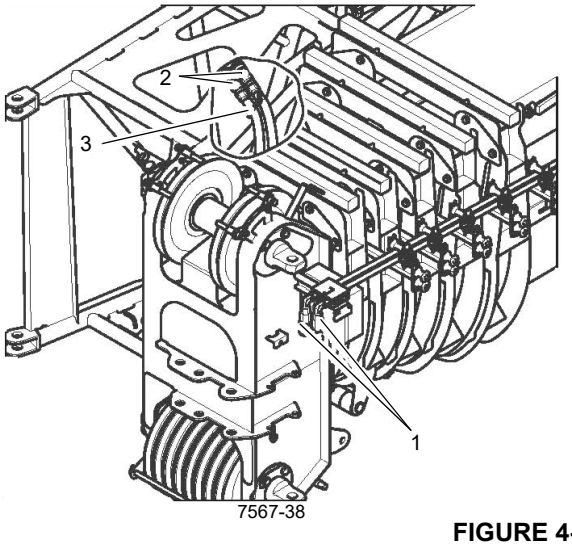


FIGURE 4-53

1. Remove the hose lines (2) from the connections (1) (Figure 4-53).
2. Close off the hose lines and the connections (1) with the protective caps.
3. Secure hoses in holder (1) on the 11 m (36 ft) extension.

Folding Deflection Sheaves

Deploying the Rear Deflection Sheave

CAUTION

Pinch Hazard!

Always hold the deflection sheave by the handle when removing the pin. You might get your fingers crushed if you hold the sheave by the side plates.

1. Remove the retaining clip from the pin (2) (Figure 4-54).

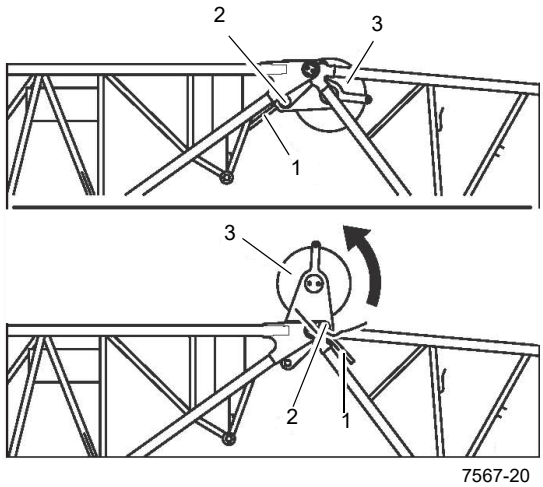


FIGURE 4-54

2. Hold the deflection sheave by the handle (1) and pull out the pin (2).
3. Fold the deflection sheave (3) up and fasten it in this position with the pin (2).
4. Secure the pin (2) using the retaining clip.

Stowing Rear Deflection Sheave

1. Remove the retaining clip from the pin (2) (Figure 4-54).
2. Hold the deflection sheave by the handle(1) and pull out the pin (2).
3. Fold the deflection sheave (3) down and fasten it in position with the pin (2).
4. Secure the pin (2) using the retaining clip.

Deploying the Front Deflection Sheave

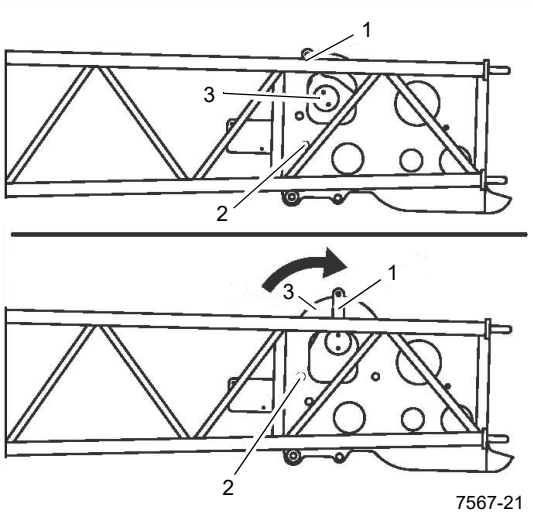


FIGURE 4-55

1. Remove the retaining clip from the pin (2) (Figure 4-55).
2. Hold the deflection sheave by the strut (1) and pull out the pin (2).
3. Fold the deflection sheave (3) up and fasten it in this position with the pin.
4. Secure the pin (2) using the retaining clip.

Folding In Front Deflection Sheave

1. Remove the retaining clip from the pin (2) (Figure 4-55).
2. Hold the deflection sheave by the strut (1) and pull out the pin (2).
3. Fold the deflection sheave (3) down and fasten it in position with the pin (2).
4. Secure the pin (2) 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 4-56).
2. Guide the wire rope over the deflection sheaves (4), (3) and over the nose sheave (2) of the extension.
3. Reinstall all the retaining sheaves (1) and secure with retaining clips.
4. Install the hook tackle or the hookblock. The wire rope may now be reeved once or twice, depending on the length of the section.

Removing Hoist Cable

1. Unreeve the hookblock.
2. Remove the retaining sheaves (1) (Figure 4-56).
3. Take the wire rope off the head sheave (2) and deflection sheaves (4), (3) and place it on the ground on the left side.
4. Replace all retaining sheaves and secure them with retaining clips.

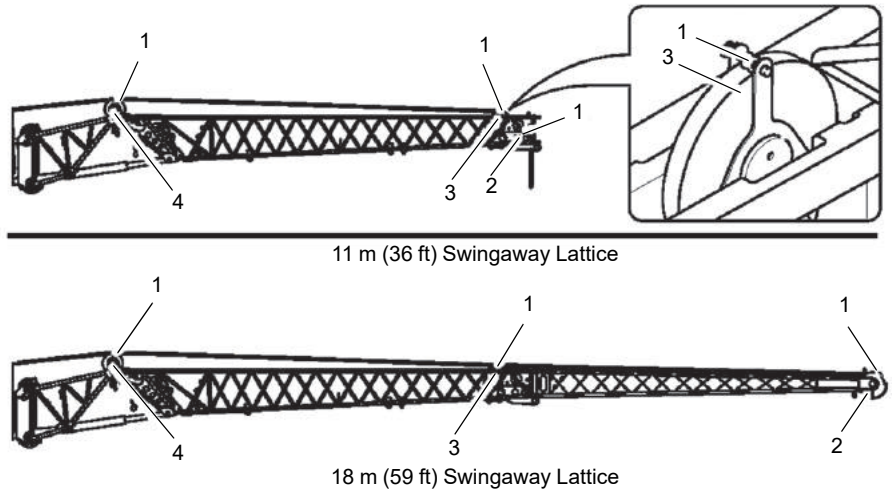


FIGURE 4-56

Mechanical Luffing Jib (Adjustable Boom Extension)

Extension Angle Adjusting Mechanism

WARNING

Crushing Hazard!

Always secure the adjustable boom extension with an auxiliary crane or set the nose of the extension on the ground before you remove the adjusting pins when adjusting the angle of the jib.

This prevents the extension from suddenly unfolding and causing serious injury or death.

CAUTION

Risk of Equipment Damage!

Always fold up the deflection sheave before adjusting the luffing jib angle.

This will prevent any interference between the deflection sheave and extension.

Refer to Figure 4-57.

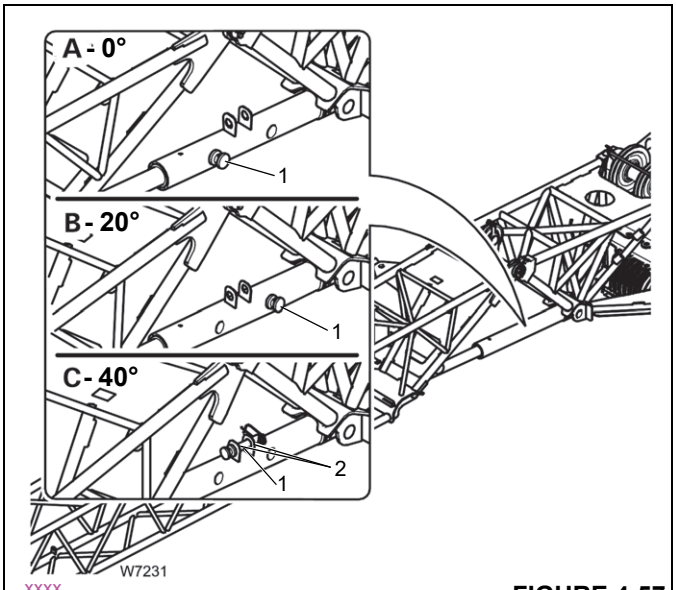


FIGURE 4-57

The jib 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.
- **40° angle**: (**C**) – For a 40° angle, the pin (1) is removed and stored in the holder (2) and secured with the retaining clip.

Setting the Angle with an Auxiliary Crane

NOTE: The information in this section only applies to the mechanical luffing jib. For operation of the hydraulic luffing jib, refer to *Raising and Lowering the Hydraulic Boom Extension, page 3-159*.

If an auxiliary crane is available, the boom extension can be slung to set the angle.

If no auxiliary crane is available, refer to *Setting the Angle without an Auxiliary Crane, page 4-38*.

1. Lift the extension with the auxiliary crane until the pin (1) (Figure 4-57) 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 4-38*.
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 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.

WARNING

Tipping Hazard!

Always enter the RCL rigging code for the current rigging mode of the crane. Only rotate the superstructure into the working position permitted by the RCL rigging code set according to the *Load Chart*.

This prevents the crane from overturning when the main boom is extended.

The telescoping range which is enabled for the rigging code is only permissible for telescoping without a load and without hookblock/hook tackle.

When the main boom is fully extended, load measurement is not possible and the RCL monitoring depends on the working radius. For this reason, you must unreeve the hookblock. This prevents the crane from overturning when the main boom is extended. Serious injury or death may occur should the crane tip or overturn.

CAUTION

Risk of Damage to the Wire Rope!

Unreeve the hook block and lay the hoist cable beside the boom extension before you set the angle of the extension.

This prevents the cable from being damaged when the head of the extension is set on the ground.

Entering the RCL Code

Enter the RCL rigging code for the boom extension angle in accordance with the current rigging mode of the crane, refer to the *Load Chart, Chapter Remarks*.

When adjusting the angle without an auxiliary crane, you must enter an RCL rigging code, refer to *Entering the Rigging Mode, page 3-81*. 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 Chart* for the RCL rigging code that was entered.

Setting an Angle of 20° or 40°

This section assumes that the extension has been pinned in front of the main boom and the unreeved cable has been laid beside the extension.

1. Enter the RCL rigging code for the extension angle, refer to *Entering the Rigging Mode, page 3-81*.
2. Extend the main boom as far as is permitted for the RCL rigging code set, or as far as possible given the space available.
3. Lower the main boom until the lattice extension head touches the ground.
4. If the ground cannot be reached, you can incline the crane further, refer to *Inclining the Crane, page 4-39*.

NOTE: In the steps which follow, the extension head is pulled or pushed over the ground. Lay boards or similar under the skids on the extension head so that it is not damaged.

WARNING

Crushing Hazard!

If the extension is lowered onto timbers or some other structure to set the angle, keep in mind that as the extension is raised the extension head will slide towards the crane until the set angle is reached.

The extension could slip off an unsuitable structure, fold down and cause serous injury or death.

5. If necessary, relieve the load on the adjusting pin (1) (Figure 4-57) by lowering the boom slightly.
6. Raise or lower the main boom so the pin (1) can be inserted into the position for the angle required, refer to *Extension Angle Adjusting Mechanism, page 4-38*.
7. Raise the main boom slowly until the extension head is no longer touching the ground. The head of the extension will be pulled across the ground.
8. The extension will then be inclined by the angle set.
9. If you inclined the crane using the outriggers in order to set the angle, align it to the horizontal again.
10. Fully retract the main boom. While doing so, the lattice extension must not touch the ground; raise the boom as necessary.
11. Set down the head of the lattice extension on the ground.
12. If you inclined the crane using the outriggers, align it to the horizontal now so that the lattice extension sections can be folded more easily.

Inclining the Crane

In order to set the angle of the adjustable extension, you must set it down on the ground by extending and lowering the main boom.

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 rear outriggers and jack cylinders.
2. Fully extend the front outriggers.
3. Extend the front jack cylinders to raise the front wheels 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, 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 Chart* 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 Chart*.
- The main boom is fully retracted.

DANGER

Crushing and/or Tipping Hazard!

To prevent serious injury or death, do not stand on decking until extensions are secure.

Do not override the RCL when lowering the boom into a horizontal position.

If the RCL is overridden, the crane operations will not be monitored 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 A2B switch weight and A2B switch, refer to *Connecting the Anti-Two Block Switch, page 4-33*.
- Unreeve the cable and remove it from the extension. Refer to *Positioning/Removing the Hoist Cable, page 4-37*.
- Fold in the deflection sheaves at the front and rear. Refer to *Folding Deflection Sheaves, page 4-36*.

Stowing Procedure: 23 ft (7 m) Boom Extension

The 23 ft extension can be folded to the side of the 36 ft extension or stowed on the main boom.

1. Attach tag line to the nose of the 23 ft (7 m) section.

   If working alone, route the tag line through the left side of the 36 ft section and secure it to the lattice framework. This will prevent the 23 ft (7 m) extension from swinging around uncontrolled.

WARNING

Crushing Hazard!

To prevent injury or death, ensure there are no people or objects in the swing area of the extension.

If working alone, secure the rear of the 23 ft (7 m) extension to the front of the 36 ft (11 m) section using the tag line or a second rope.

2. Remove the retaining clips from the pins (1) and remove the pins from the connecting lugs (Figure 4-58).

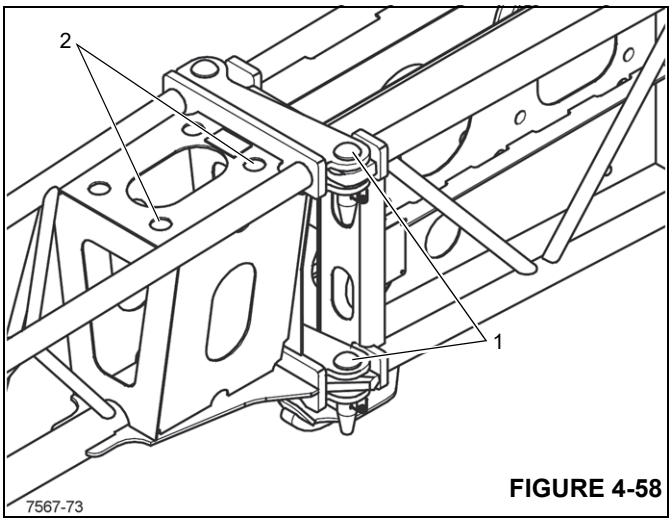


FIGURE 4-58

3. Install the pins (1) into the holder (2) and secure with retaining clips.
4. Using the tag line to control movement of the extension, swing it into the stowed position on the side of the 36 ft (11 m) extension.

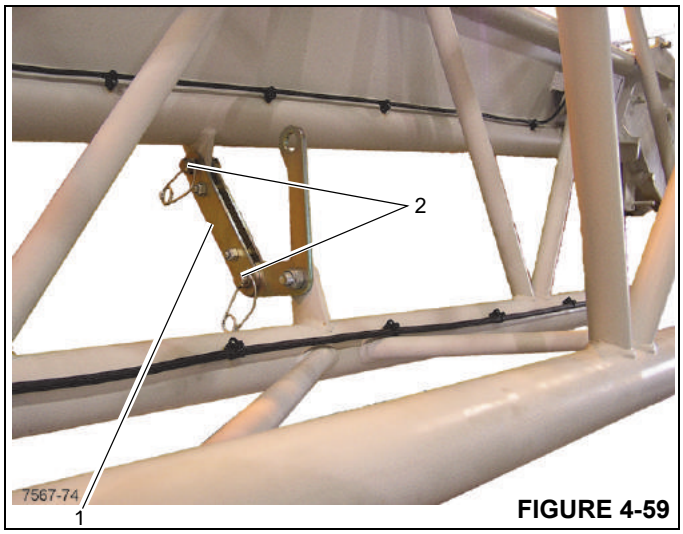


FIGURE 4-59

5. Secure the 23 ft (7 m) extension to the 36 ft (11 m) extension with the locking bar (1) (Figure 4-59) and pins (2).

6. Secure the pins with the retaining clips.

NOTE: If the 23 ft (7 m) extension is being stowed on the main boom and the 36 ft (11 m) extension will continue to be used, follow the next procedure for stowing the 59 ft (18 m) extension in order to attach the 23 ft (7 m) extension onto the main boom. Then refer to *The main boom is completely retracted and has been lowered into a horizontal position., page 4-26* to deploy the 36 ft extension.

Stowing Procedure: 59 ft (18 m) Extension

In order to stow the 59 ft extension first perform the previous procedure to stow the 23 ft (7 m) extension onto the 36 ft (11 m) extension.

DANGER

Crushing Hazard!

Ensure 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 ensure all electrical and hydraulic lines are disconnected.

1. Lower the boom and attach a tag line to the front of the 36 ft (11 m) section and route the tag line back to the nose of the main boom and secure it there to prevent the extension from swinging around.

2. Release the retaining pin (1) and fold out the run-up ramp (2) until the locking pin (3) engages in the lug (4) (Figure 4-60).

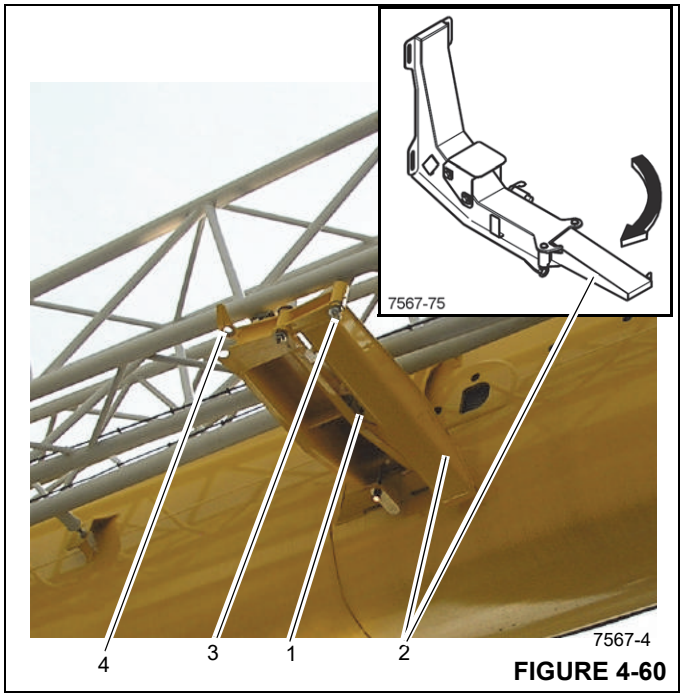


FIGURE 4-60

4

3. Using the jib pole, pull the front latch handle (1) (Figure 4-61) down to put the latch pin in position to lock the extension against the main boom.

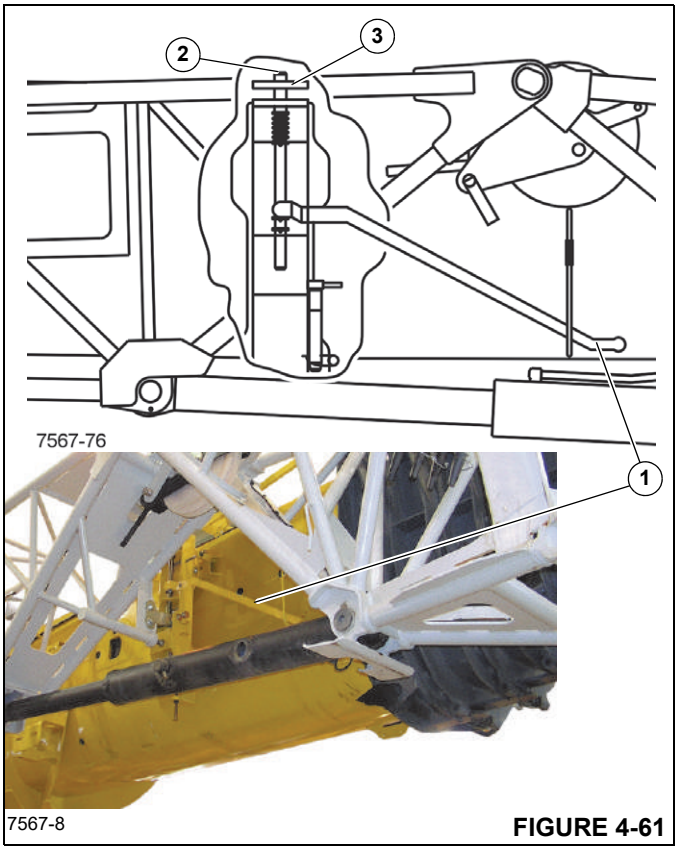


FIGURE 4-61

DANGER

Crushing Hazard!

Ensure 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.

4. Remove the retaining clips from the pins (1) (Figure 4-62) securing the extension to the left side of the boom nose and remove the pins from the connecting lugs (2). Insert the pins in the storage locations (3) and secure with the retaining clips.

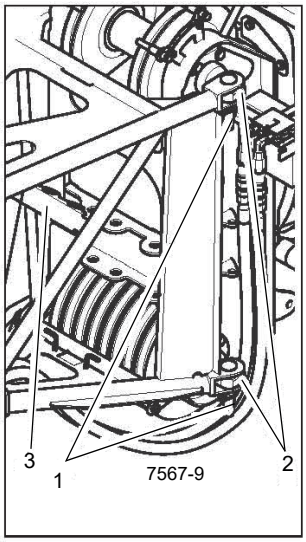


FIGURE 4-62

5. Disconnect the tag line from the boom nose and pull the front of the extension around so it rides up onto the run-up ramp (2) (Figure 4-60) and the locking lug (3) (Figure 4-61) is fully engaged by front latch pin (2).

DANGER

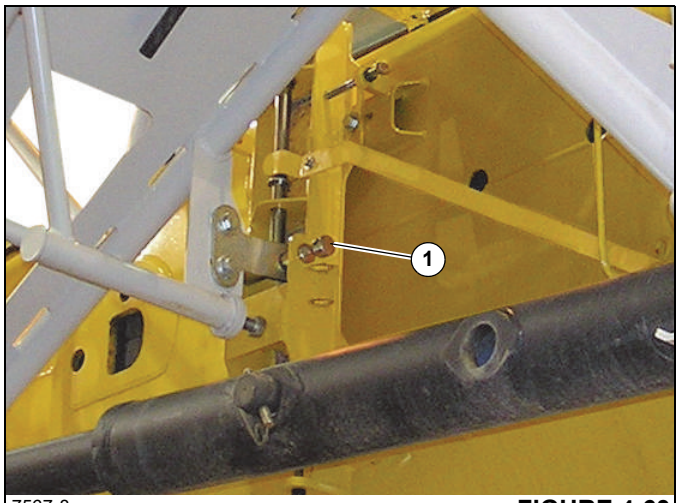
If the front latch pin (2) (Figure 4-61) does not engage the 36 ft (11 m) extension, **STOP**. DO NOT continue to stow the boom extensions until the front latch pin has properly engaged the extension and the horizontal locking pin (1) (Figure 4-63) has been installed correctly.

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.

Contact Manitowoc Crane Care for correct adjustments if unable to align the extension with the spring pin or the locking pin.

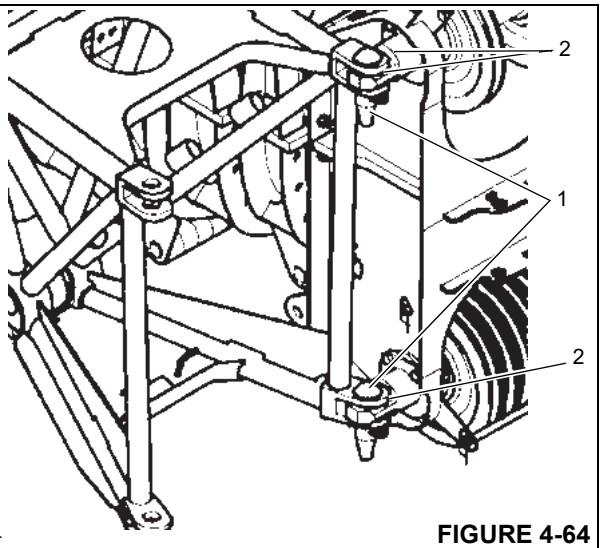
6. Remove the horizontal locking pin (1) (Figure 4-63) from the storage lugs and insert into the latch assembly, as shown, to lock the extension to the main boom. Secure the horizontal locking pin with the retaining clip.



7567-8 **FIGURE 4-63**

7. Remove the retaining clips from the pins (1) (Figure 4-64) on the right side of the boom nose.

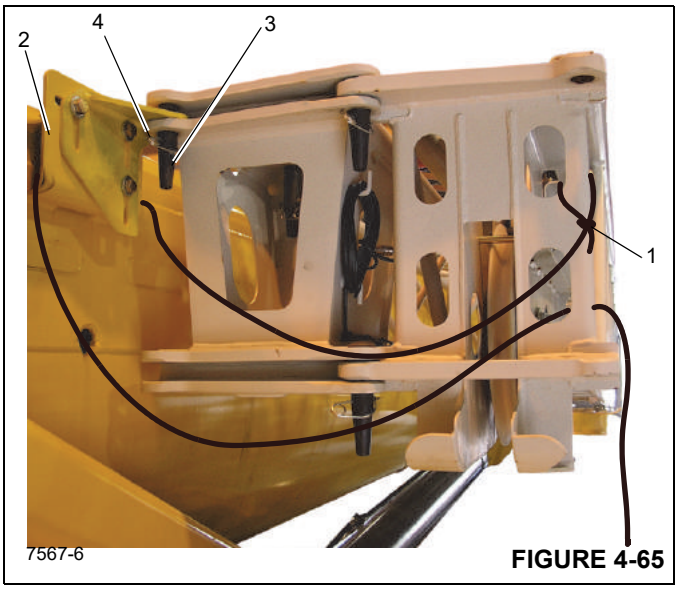
8. Remove the pins (1) from the attachment lugs (2) and insert them into the storage locations, secure the pins with the retaining clips.



7567-64 **FIGURE 4-64**

9. Guide the tag line (1) around the end of the extension and through the bracket (2) (Figure 4-65) on the main boom and back again. If possible, have a helper hold the tag line tight.

10. Insert the pin (3) through the lugs on the main boom and the 23 ft (7 m) extension and secure with the retaining clip (4).



7567-6 **FIGURE 4-65**

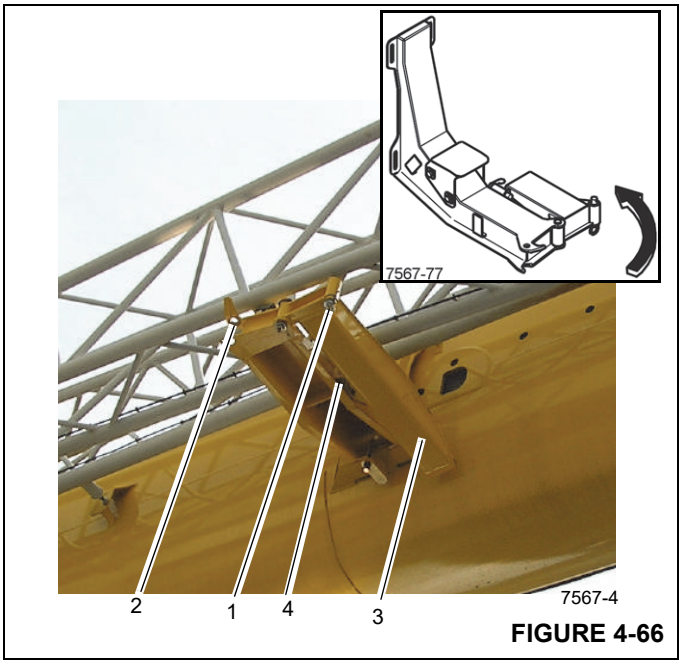


FIGURE 4-66

11. Pull the locking pin (1) (Figure 4-66) down against spring force, and out of the attachment lug (2). Fold in the run-up ramp (3) around until it can be secured with the spring latch (4).

12. Remove all tag lines.

13. Reeve the hoist cable, refer to *Cable Reeving, page 4-4*.

Boom Extension Transport Condition

The crane can be transported with the swingaway boom extension installed and secured at the side of the main boom or with the boom extensions completely removed.

4

For transportation, with the boom extension installed, certain connections between both parts of the extensions must be established.

WARNING

Crushing Hazard!

Always put the extension into transport condition when folded at the side or working with the main boom; only then is the extension safely secured.

An unsecured boom extension can fall resulting in death, serious injury or damaged equipment.

Check transport condition:

- After stowing the extension, before driving the crane with the extension folded at the side or when working with the main boom.
- Before erecting the swingaway boom extension.

Transport Condition with Extensions Installed

The transport condition with the extension folded at the side is created when all of the connections described in *Stowing Procedure: 59 ft (18 m) Extension, page 4-41* are established. Check the following connections and establish them, if necessary:

With the 59 ft (18 m) Extensions Folded at the Side

- The 36 ft (11 m) extension is locked at the front support on the main boom and secured with the horizontal pin (Figure 4-63).
- The two extensions are connected and secured with retaining pins (Figure 4-59).
- The connection between 23 ft (7 m) extension and main boom at the rear, is secure (Figure 4-65).

With the 23 ft (7 m) Extension Only Folded at the Side

- The connection between the extension and main boom is secured with retaining pins (Figure 4-59).
- The connection between 23 ft (7 m) extension and main boom at the rear, is established (Figure 4-67).

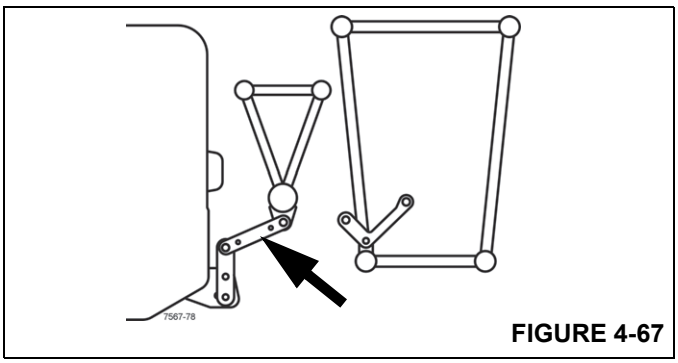


FIGURE 4-67

Installing and Removing the 26 ft (8 m) and 19 ft (6 m) Extension Inserts

Installation

1. Use another crane or suitable lifting device to install the extension.
2. Connect a sling to the two lifting lugs (1) (Figure 4-68).

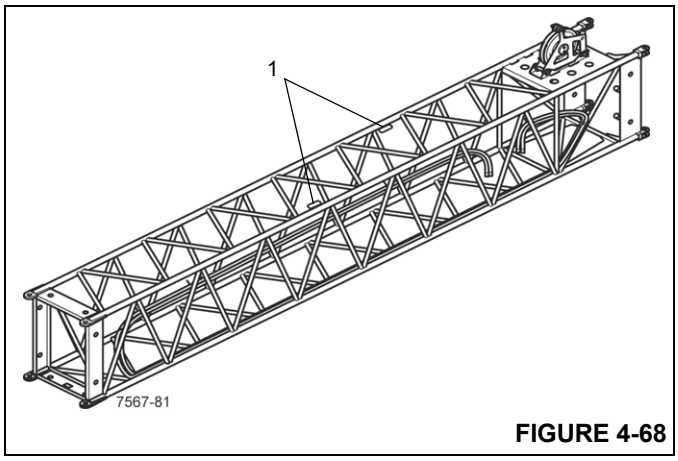


FIGURE 4-68

3. Lift the extension in front of the main boom head so the four connecting points (1) (Figure 4-69) align on both sides.
4. Remove the pins from the holders.
5. Insert the pins into the connecting points (1) and secure them with retaining clips.

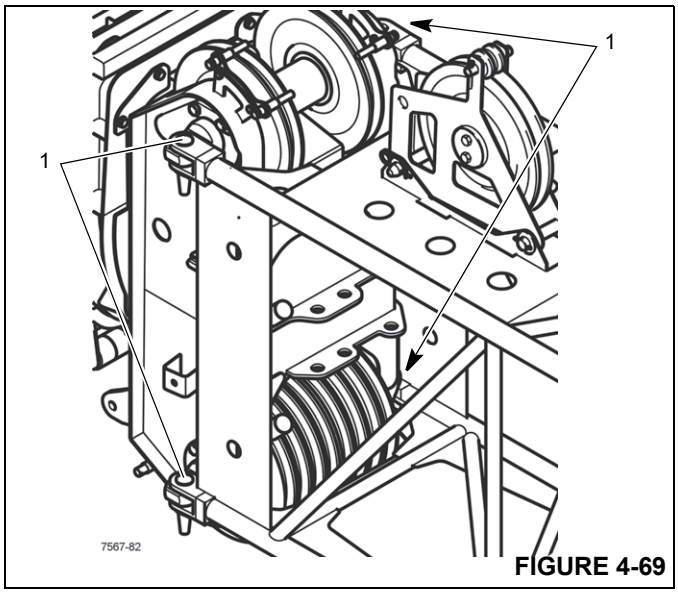


FIGURE 4-69

Removal

CAUTION

Equipment Damage Hazard!

Before removing an extension, ensure that the electrical and hydraulic connections have been disconnected and properly stowed to prevent damaging the cable and hydraulic hoses.

1. Use another crane or suitable lifting device to remove the extension.
2. Connect a sling to the two lifting lugs (1) (Figure 4-68) and lift the extension enough to take the load off the connecting pins.
3. Verify the electrical and hydraulic connections have been disconnected. Refer to *Extension Hydraulic Connection, page 4-47* and *Extension Electrical Connection, page 4-46*.
4. Remove the pins from the connecting points (1) (Figure 4-69).
5. Insert the pins into the holders and secure them with retaining clips.
6. Remove the extension.

Extension Electrical Connection

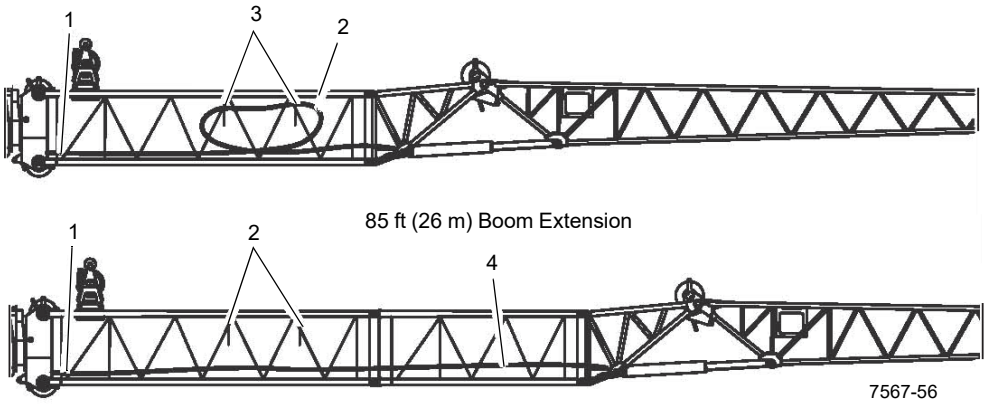


FIGURE 4-70

The electric cable (1) (Figure 4-70) is installed in the 26 ft (8 m) extension (2), with the long end of the cable wound on the stowage lugs (3).

When the 105 ft (32 m) boom extension is rigged, the cable is routed through the 20 ft (6 m) extension (4).

Connecting Main Boom to the 26 ft (8 m) Extension

Establishing a Connection

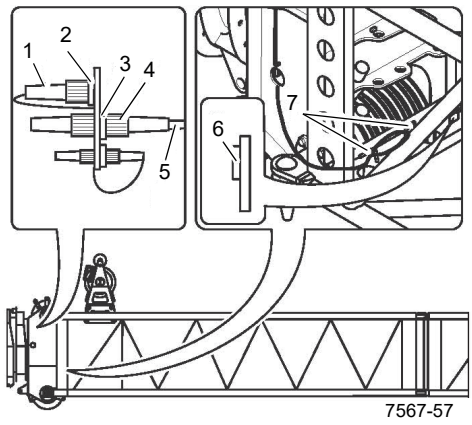


FIGURE 4-71

1. Remove the bridging plug (1) (Figure 4-71) from the socket (3) and plug it into the dummy socket (2).
2. Unwind the cable (5) from the holder (7).
3. Remove plug (4) from the dummy socket (6) and plug into the socket (3).
4. Wind up the cable (5) far enough on the holder (7) so that it will not be damaged during operation.

Disconnecting Main Boom Electrical Connection

1. Remove the plug (4) (Figure 4-72) from the socket (3) and plug into the dummy socket (6).
2. Wind the cable (5) onto the holder (7).
3. Remove the plug (2) from the dummy socket (1) and plug it into the socket (3).

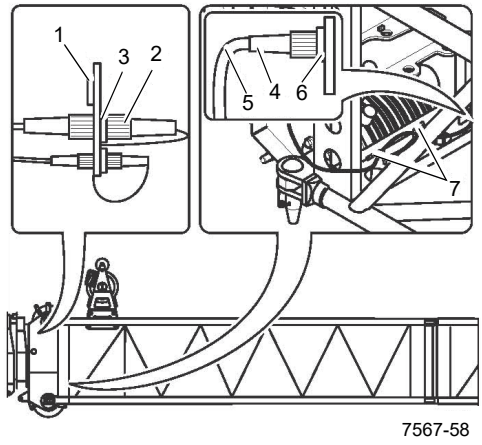


FIGURE 4-72

Connecting the Folding Extension Electrical Circuit

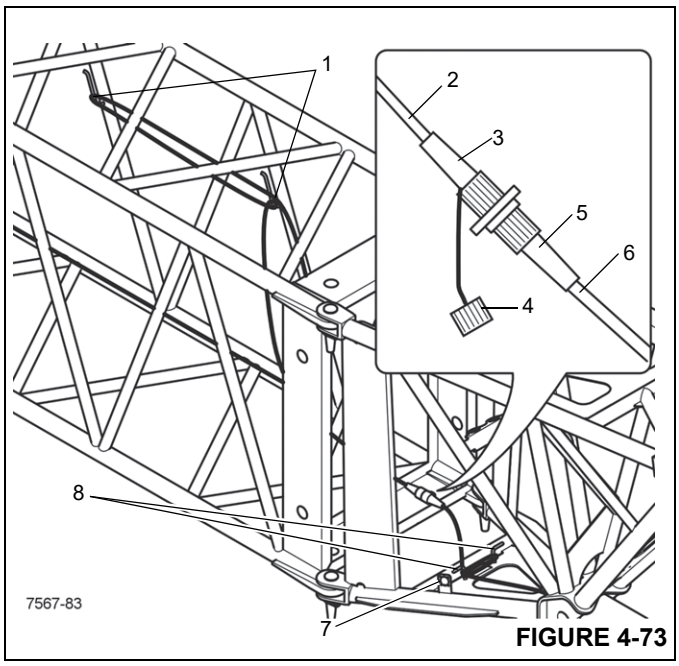


FIGURE 4-73

1. Unwind the cable (2) (Figure 4-73) from the holder (1).
2. Remove the cap (4) off the socket (3).
3. Unwind the cable (6) from the holder (8).
4. Remove the bridging plug (5) from the dummy socket (7) and plug it into the socket (3).
5. Wind up the cable (8) far enough on the holder (7) so it will not be damaged during operation.
6. Wind up the cable (2) far enough on the holder (1) so it will not be damaged during operation.

Disconnecting the Folding Extension Electrical Circuit

1. Remove the bridging plug (5) (Figure 4-74) from the socket (3) and plug it into the dummy socket (7).
2. WInd the cable (6) on to the holder (8).
3. Install the protective cap on the socket (3).
4. Wind the cable (2) onto the holder (1).

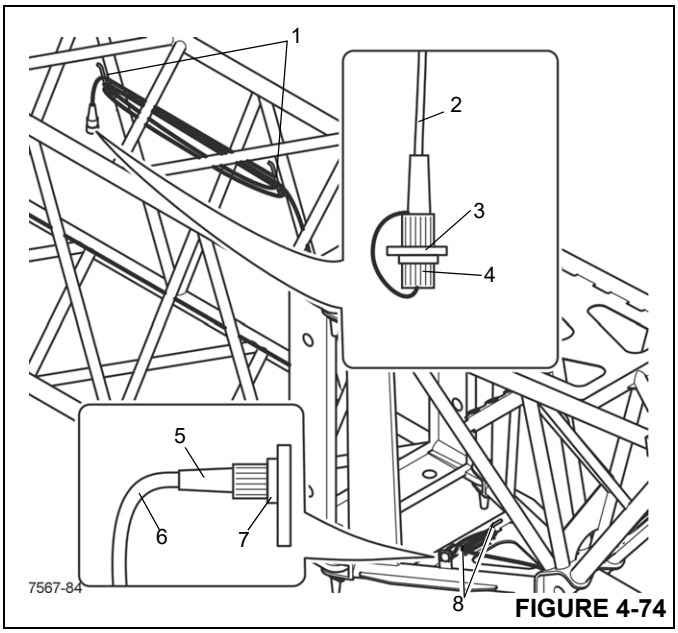


FIGURE 4-74

Extension Hydraulic Connection

All hydraulic lines are located in the 26 ft (8 m) extension (Figure 4-75). 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) of the hoses are suspended from clamps.

The short ends (2) 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 jib through the 26 ft (8 m) and 20 ft (6 m) extensions are the same as connecting to the 26 ft (8 m) extension only.

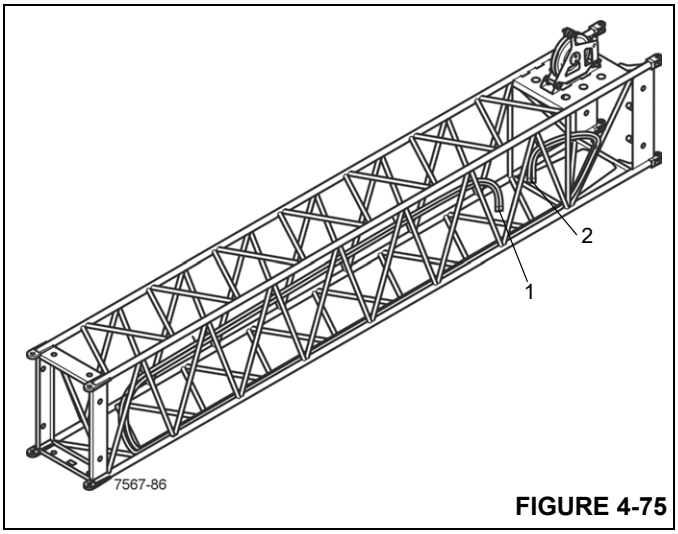


FIGURE 4-75

Connecting Main Boom Hydraulics

1. If necessary, install the hydraulic hoses (1) (Figure 4-76) on the boom nose, refer to *Extension Hydraulic Connections (Optional Hydraulic Extension), page 4-34*.
2. Route the short ends (2) to the main boom head.
3. Remove the protective caps and connect the short ends (2) to the boom nose connectors (1).

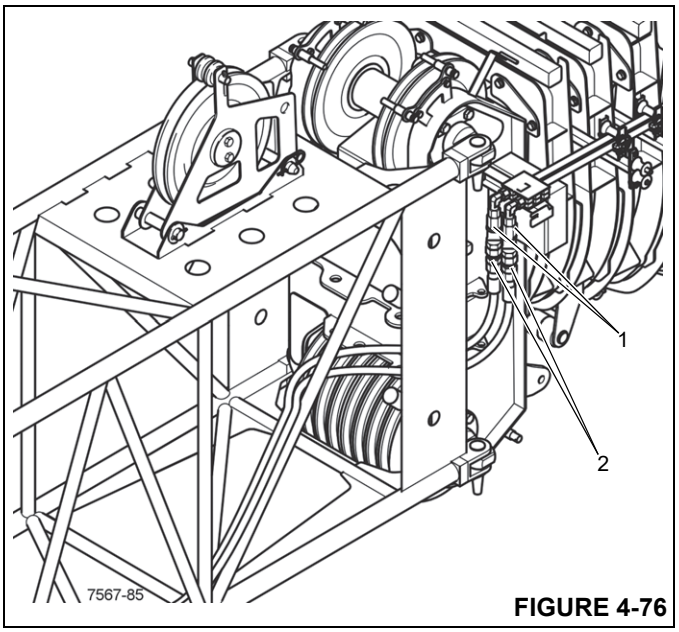


FIGURE 4-76

Disconnecting Main Boom Hydraulics

1. Disconnect the short hose ends (2) from the boom nose connectors (1) (Figure 4-76).
2. Cover the short end and boom nose connectors with the protective caps.
3. Route the short ends (2) 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 4-77) from the holders (2) on the extension.
2. Route the hoses to the front of the extension.
3. Remove the protective caps and connect the folding extensions hoses (3) to the long hose ends (4).

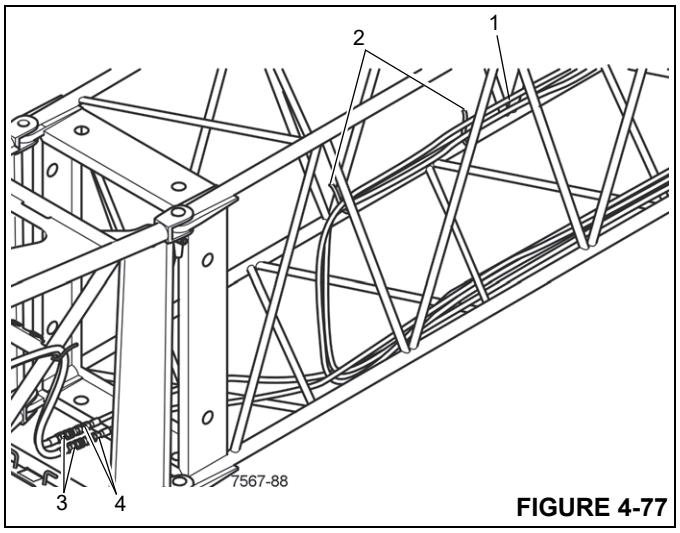


FIGURE 4-77

4. Secure the hoses (1) (Figure 4-77) to the holders (2) to ensure the hoses are not damaged during operation.

Disconnecting the Folding Extension Hydraulics

1. Disconnect the hoses (3) from the long hose ends (4) (Figure 4-79).
2. Install protective caps (1) (Figure 4-78) on the hose ends.

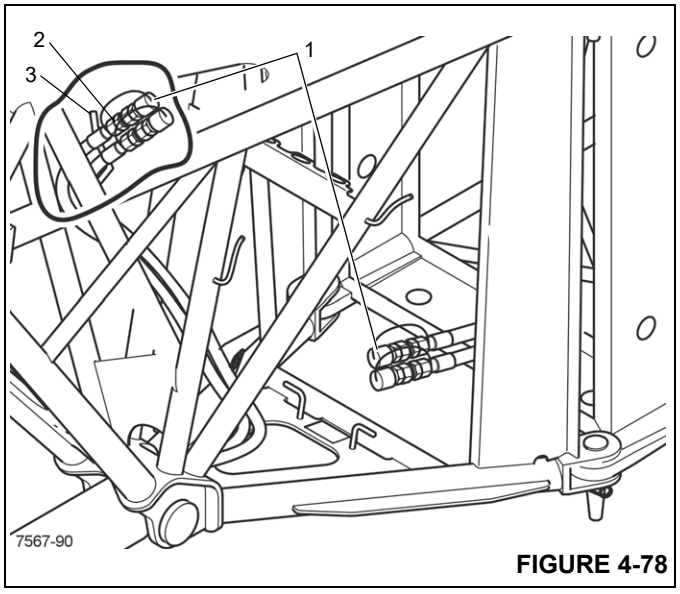


FIGURE 4-78

3. Secure the hoses (2) to the holder (3) in the 36 ft (11 m) section.
4. Stow the long hoses (1) (Figure 4-77) on the holders (2) provided.

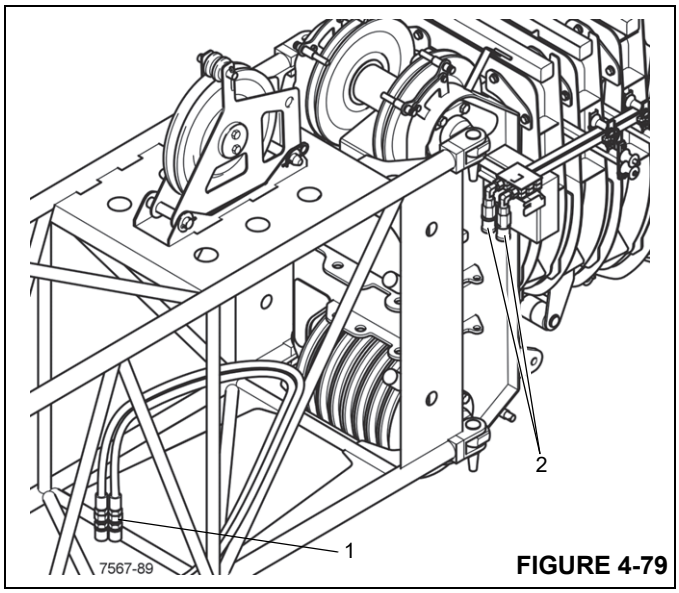


FIGURE 4-79

5. Disconnect the short end hoses (1) (Figure 4-79) from the 26 ft (8 m) extension from the boom nose connectors (2).
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 4-36*.

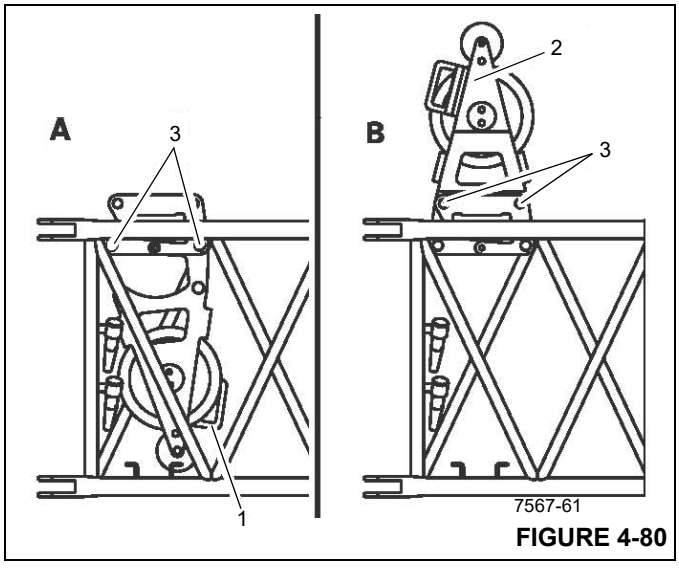


FIGURE 4-80

Folding Out the Deflection Sheave

1. Remove the retaining clips from the pins (3) (Figure 4-80).
2. Hold the deflection sheave by the handle (1) and pull out the pins (3).
3. Fold the deflection sheave up by the handle (1) and insert the pins (3).
4. Secure the pins using the retaining clips.

Folding In the Deflection Sheave

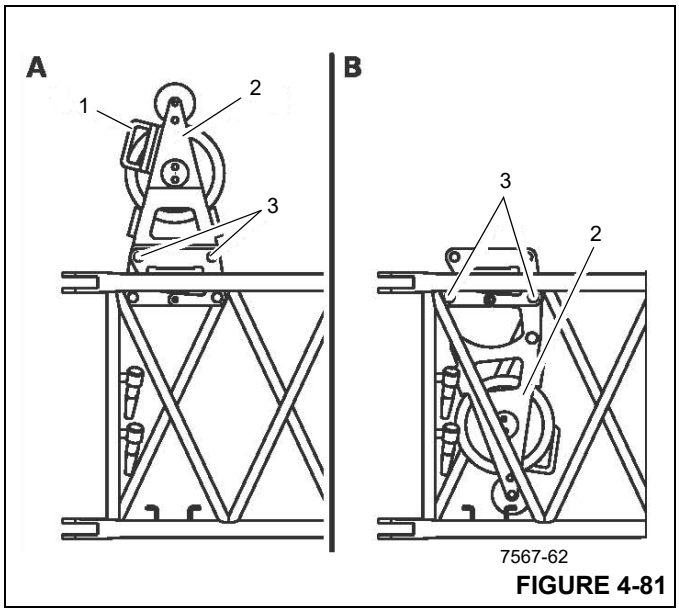


FIGURE 4-81

1. Remove the retaining clips from the pins (3) (Figure 4-81).
2. Hold the deflection sheave by the handle (1) and pull out the pins (3).
3. Fold the deflection sheave (2) downwards and fasten it in this position with the pins (3).
4. Secure the pins (3) using retaining clips.

4

Positioning/Removing the Hoist Cable

CAUTION

Falling Objects Hazard!

Always secure the cable holding sheaves and pins with retaining clips. This prevents them from coming loose, falling down and causing injury.

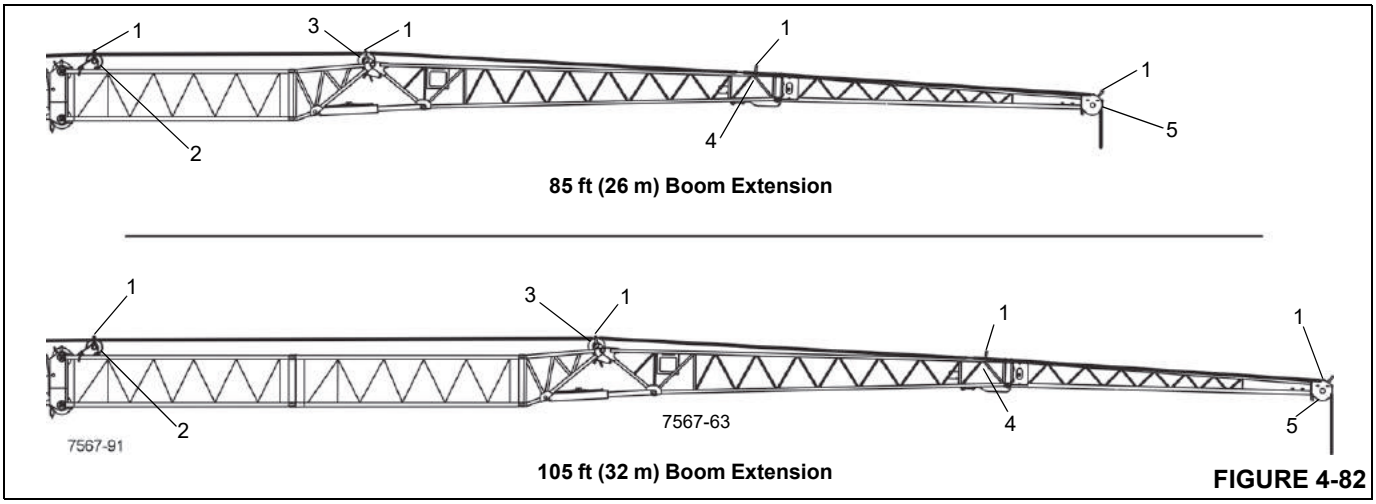


FIGURE 4-82

Positioning the Cable

1. Remove the guide sheaves (1) (Figure 4-82). Guide the cable over the deflection sheaves (2), (3), (4) and over the head sheave (5) on the 36 ft extension.
2. Replace all guide sheaves (1) and secure them with retaining clips.
3. Install the hook tackle or the hookblock. The cable can only be reeved once on the boom extension.

Removing the Cable

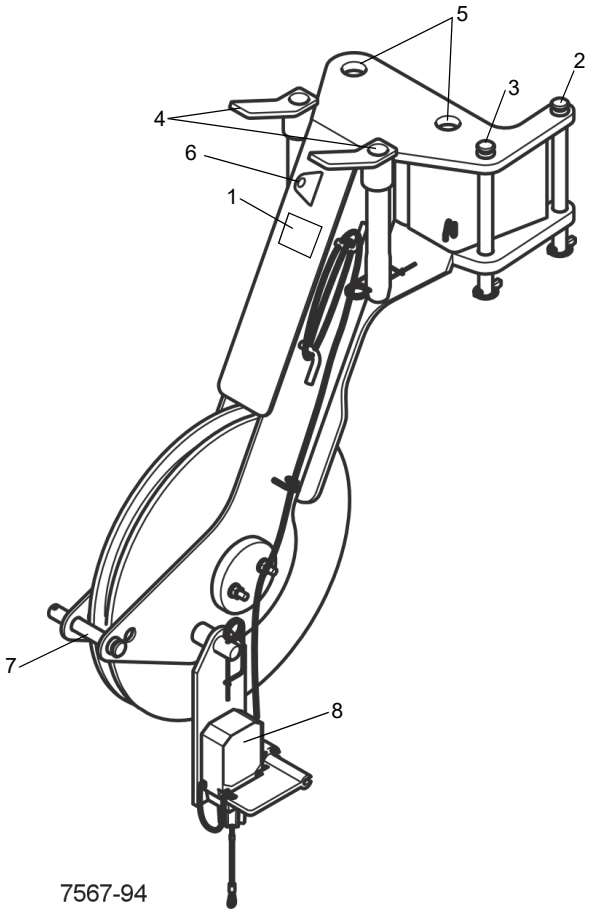
1. Unreeve the hookblock.
2. Remove the guide sheaves (1) (Figure 4-82).
3. Take the cable off the head sheave (5) and the deflection sheaves (4), (3), (2) and place it onto the ground on the left side.
4. Replace all guide sheaves (1) and secure them with retaining clips.

AUXILIARY SINGLE-SHEAVE BOOM NOSE

The auxiliary boom nose (rooster sheave) is designed for the crane it was delivered with. It has the same serial number as the crane.

To use the auxiliary boom nose on several Grove cranes, it needs to be adapted to the corresponding crane and marked with all the serial numbers.

The serial number (1) (Figure 4-83) is on the front of the auxiliary boom nose.



Item	Description	Item	Description
1	Serial Number Plate	5	Mounting Pin Holes
2	Pivot Pin	6	Lifting Lug
3	Transport Position Pin	7	Cable Guide Pin
4	Mounting Pins (Stowed)	8	A2B Switch

FIGURE 4-83

CAUTION

Incompatible Equipment Hazard!

Operate the crane only with the auxiliary boom nose that has the identical serial number as the crane.

The RCL is set only for the corresponding auxiliary boom nose.

The auxiliary boom nose should only be adjusted by an authorized Grove dealer or Manitowoc Crane Care.

Injury or equipment damage may result if an incompatible boom nose is used.

Installation

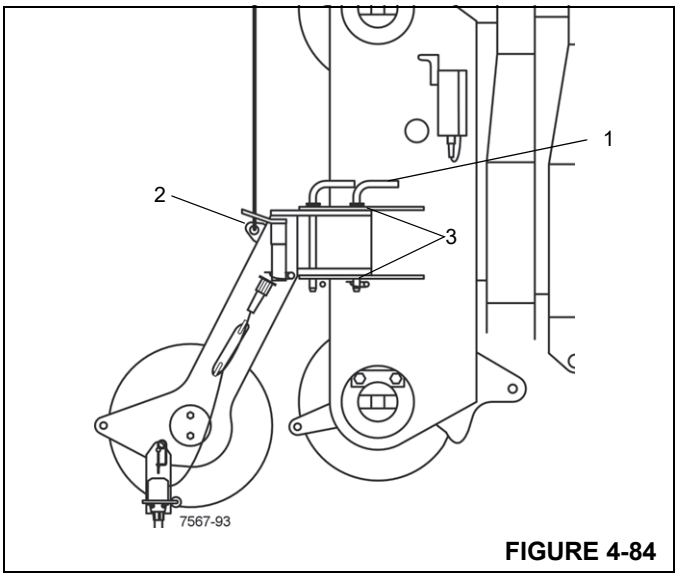


FIGURE 4-84

1. Remove the pivot pin (1) (Figure 4-84) from the boom nose.
2. Attach a sling to the lifting lug (2) on the boom nose.
3. Use another crane or suitable lifting device to lift the auxiliary boom nose in front of the boom head.
4. Align the boom nose with the mounting lugs (3) on the boom head and install the swivel pin (1), secure the pin with a retaining clip.
5. Place the auxiliary boom nose into either the *Transport Position, page 4-52* or *Working Position, page 4-52*.

Removal

1. Attach a sling to the lifting lug (2) (Figure 4-84) on the boom nose.
2. Use another crane or suitable lifting device to support the auxiliary boom nose while removing the mounting pins.

3. Remove all the pins securing the boom nose to the boom head (Figure 4-83).
4. Lift the auxiliary boom nose from the head of the main boom.
5. Insert the pins into the lugs on the boom nose and secure with retaining clips.

Working Position

1. Verify the swivel pin (1) (Figure 4-85) is installed.
2. If necessary, remove the pin (2) from the transport lug.

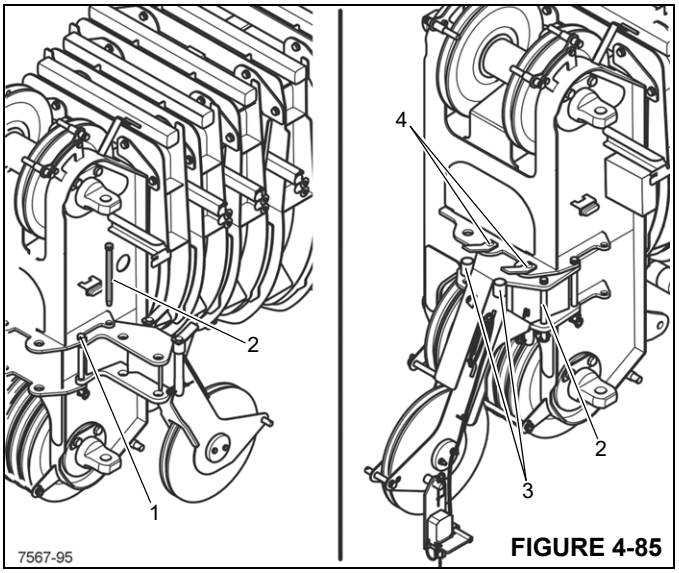


FIGURE 4-85

3. Swing the auxiliary boom nose in front of the main boom head.
4. Remove the pins from the storage lugs (3).
5. Insert the pins into the mounting lugs (4) and secure with retaining clips.
6. Insert the pin (2) into the transport position lug and secure with retaining clip.

Rigging the auxiliary boom nose

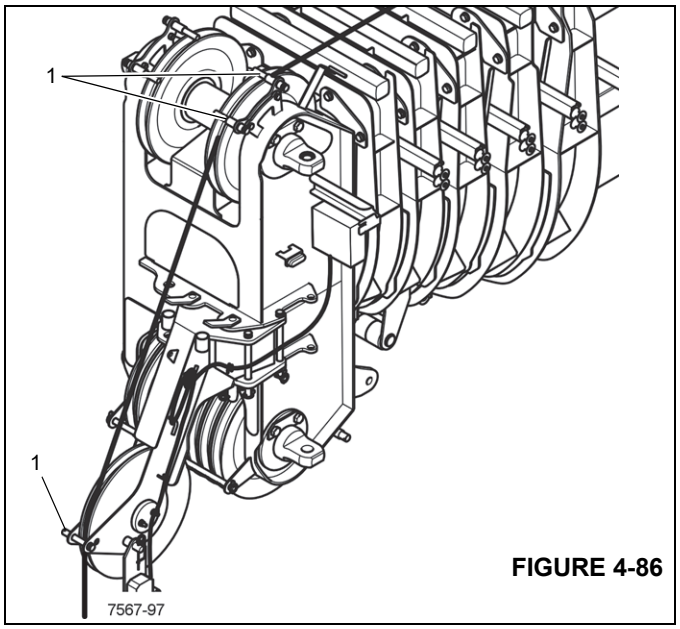


FIGURE 4-86

1. Remove the cable retaining pins (1) (Figure 4-85) from the head of the main boom and from the auxiliary single-sheave boom nose.
2. When reeving, guide the hoist rope over the left head sheave of the main boom, as shown.
3. Insert the cable retaining pins into the mounting lugs and secure them with the retaining clips.
4. Fasten the cable end clamp on the hook tackle or the hookblock.

Transport Position

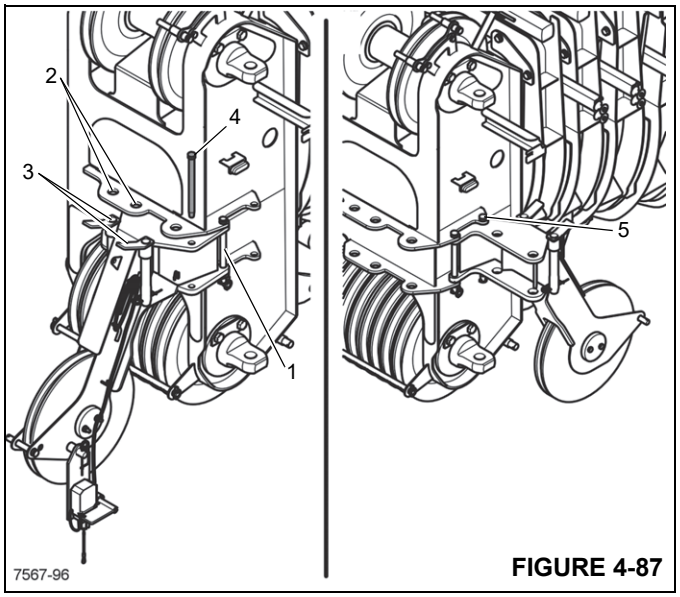


FIGURE 4-87

1. Verify the swivel pin (1) (Figure 4-87) is installed and secured with a retaining clip.
2. Remove the mounting pins from the mounting lugs (2).
3. Insert the mounting pins into the storage holes (3) and secure them with retaining clips.
4. Remove the transport pin (4).
5. Swing the auxiliary boom nose onto the side of the main boom.
6. Insert the transport pin in the transport lug (5) and secure it with a clip.

HEAVY DUTY LUFFING BOOM EXTENSION

The heavy duty boom extension (Figure 4-88) consists of three sections:

- a 12 ft (3.6 m) heavy duty section with luffing cylinder and fold down sheave
- a removable 24 ft (7.3 m) lattice section
- a fold-out 23 ft (7 m) stinger or fly section.

The heavy duty boom extension is designed for the crane it was delivered with. Each section has the same serial number as the crane.

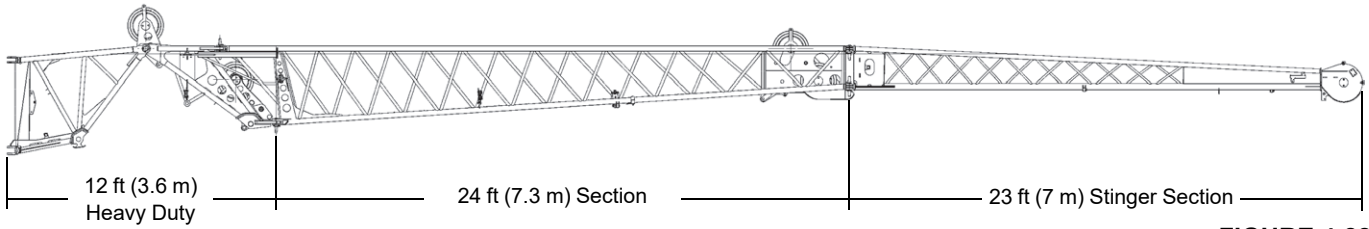


FIGURE 4-88

Installation and Removal

Installation and removal of this extension is the same for the standard luffing extension, refer to *Installing the Folding Boom Extension, page 4-25*.

The two lattice extensions are removed from the 12 ft section using a suitable lifting device to remove the load from the four attachment lugs and removing the attachment pins.

Heavy Duty Nose Sheave

Work Position

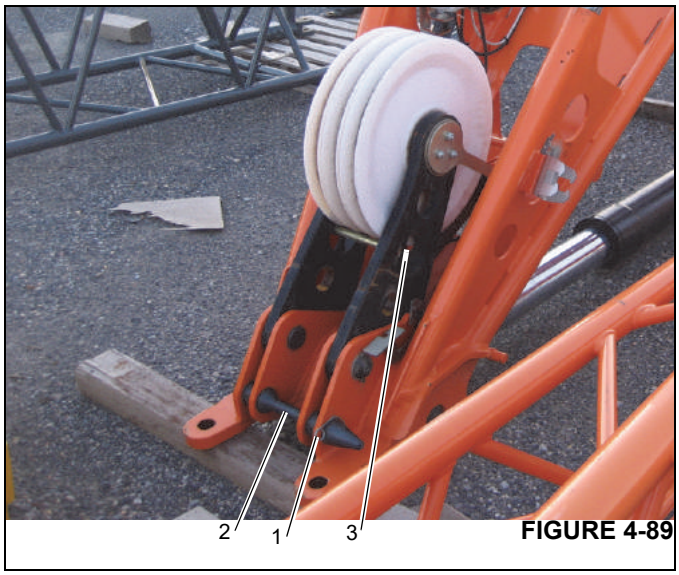


FIGURE 4-89

1. Remove the retaining clip (1) (Figure 4-89) and then the pin (2).
2. Rotate the sheave into the work position.
3. Secure the sheave assembly with the pin and retaining clip.

Stowed Position

1. Remove the retaining clip and then the pin.
2. Rotate the sheave up into the stowed position, as shown (Figure 4-89).
3. Stow the pin (1) and secure with the retaining clip (2).

ANEMOMETER/AIRCRAFT WARNING LIGHT

CAUTION

Equipment Damage Hazard!

Always remove the anemometer/aircraft warning light before transporting the crane.

This prevents damage by overhead obstructions and the anemometer from being damaged due to excessive air speeds.

Mounting Anemometer/Aircraft Warning Light

1. Insert the mounting arm (1) (Figure 4-90) into the holder (3) and secure it with the retaining clips.
2. Remove the cable from the clamps (2); connect the anemometer cable to the socket (4), connect the aircraft warning light cable to the socket (5).
3. Arrange the cable so that it will not be damaged during crane operation.
4. Check that the anemometer is able to swing free so that it hangs vertically at different boom angles.

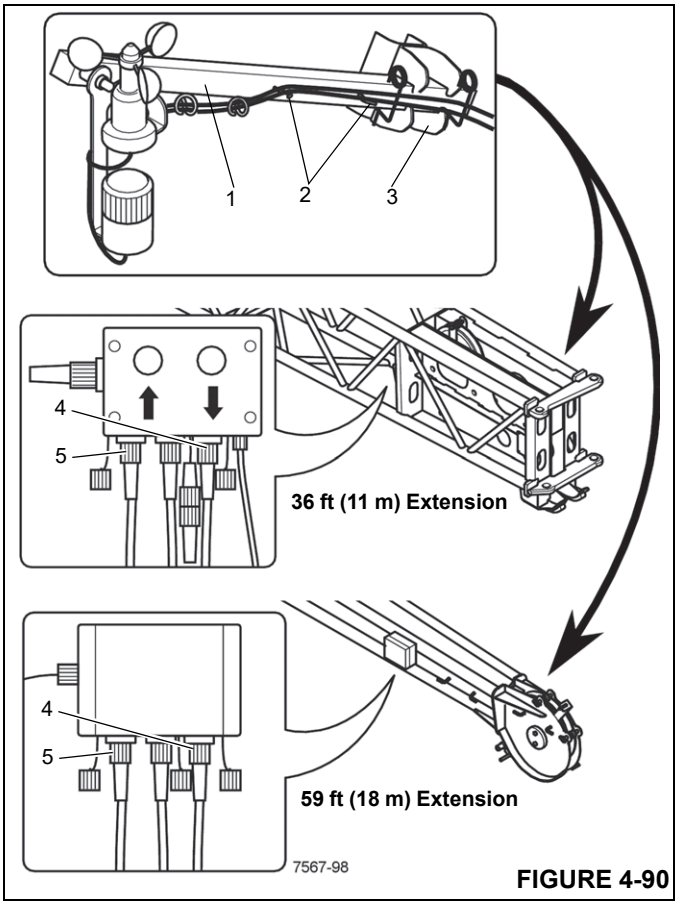


FIGURE 4-90

Removing Anemometer/Aircraft Warning Light

1. Take the plugs out of the sockets (4 and 5) (Figure 4-90) and install the protective caps.
2. Wind the cable onto the clamps (2).
3. Remove the mounting arm (1) from the holder (3).
4. For transportation, fasten the retaining clips to the mounting arm (1).

SECTION 5
MAINTENANCE AND LUBRICATION

SECTION CONTENTS

5

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.

Refer to your *Inspection and Lubrication Service Log* for routine checks which will help maintain the safety, dependability, and productivity designed into your crane. One copy of the *Inspection and Lubrication Service Log* is provided in the original package of manuals shipped with the crane. Additional copies are available through the Grove distributor network.

Refer to your Service Manual for specific maintenance and adjustment procedures.

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.

LUBRICATION INTERVALS

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 Distributor or Manitowoc Crane Care.

Lube intervals are to be used as a guideline only. Actual lube intervals should be formulated by the operator to correspond accordingly to conditions such as continuous duty cycles and/or hazardous environments.

CAUTION

Possible Equipment Damage Hazard!

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 incompatible grease could result in damage to equipment.

STANDARD LUBRICANTS PACKAGE

The following table lists all the lubricants and coolant recommended for this Grove crane. These standard lubricants are effective in 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 [Down to -9°C (15°F)]

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Axle Gear Oil	6829012964	Century Unigear Semi-synthetic Texaco Multigear SS Chevron DELO	80W-90	
Tier 3 Engine Oil	6829003483	Exxon XD-3 Conoco Fleet Supreme	15W-40	CI-4
Tier 4 Engine Oil	6829104182	Conoco Fleet Supreme EC Mobil Delvac 1300 Super	15W-40	Cj-4
Hydraulic/Transmission Oil	6829006444	Kendall Hyken 052 Exxon Torque Fluid 56 Esso Torque Fluid 56 BP-Eldoran UTH & Trak-Tran 9 BP- Blend- 7367	10W-20	Must Meet John Deere Std. JDM J20C
		Exxon Mobil 424 Phillip 66 PowerTran XP	ISO 46/68	
Hoist Gear Oil	02313611	ARAL Synthetik API	75W-90	GL 4

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Grease, Multipurpose	6829003477	Citgo Lithoplex MP# 2 Texaco Starplex Moly # 2 Phillips 66 Philube M Mobil Mobilgrease XHP 222 Special Chemtool Inc, Lube-A-Boom	NLGI 2	
Open Gear Lube	6829102971	LPS Dry Force 842 Moly Lube	NLGI 1-2	
Swing Box Gear Oil	02313611	ARAL Synthetik API	75W-90	GL 4
Boom Telescopic Sections, Upper and Lower Faces	02310394	Sliding-paste		
Antifreeze Coolant	6829101130	Old World Industries, Inc. Fleet Charge SCA Caterpillar DEAC Fleetguard Complete EG	Mix 50/50	
Supplemental Coolant Additive (SCA)	6829012858	Fleetguard DCA4 Fleetguard DCA2 Penray Pencool 3000		

ARCTIC CONDITIONS

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. 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 distributor or Manitowoc Crane Care.

NOTE: All fluids and lubricants may be purchased by contacting the Manitowoc Crane Care Parts Department.

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.

Down to –29C° (–20°F)

ALL Weather Package & Lubricants

Engineering recommends the following lubricants for components for ambient temperatures to -40°F. Special lubricants alone are not sufficient to operate at extreme low temperatures. We also recommend the use of appropriately sized heaters for the hydraulic tank, engine oil pan, engine water jacket and batteries. The operator needs to follow the guide lines as stated in the operator's manual. We assume that the customer has taken steps for use of an appropriate engine antifreeze coolant, have taken care of the fuel, fuel system and starting system. And has done whatever they feel necessary to add insulation for under hood temperatures to meet the engine manufacturer's intake air temperature. Other lubricants may be used if they meet the specification of the lubricant that is requested. Please consult factory.

Table 5-2: [Down to -29°C (-20°F)]

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Axle/Swing Box Gear Oil	6829014058	Petro-Canada Traxon E Synthetic CITGO, Synthetic Gear Lube Eaton, Roadranger EP Mobil, Mobilube SCH Shell, Spirax S Sunoco Duragear EP	75W-90	GL-5
Tier 3 Engine Oil	6829101560	Petro-Canada Duron Synthetic Mobil Delvac 1	5W-40	CI-4
Tier 4 Engine Oil	6829104412	Citgo Citgard® Syndurance® Synthetic Mobil Delvac 1 ESP SW-40	5W-40	CJ-4
Hydraulic/Transmission Oil	6829101559	Petro-Canada Duratran Synthetic THF Chevron All Weather THF Texaco TDH Oil SS		Must Meet John Deere Std. JDM J20C
Grease, Multipurpose	6829104275	Petro-Canada Precision Synthetic EP1 Mobil, Mobilith SHC 220	NLGI 2	
Open Gear Lube	—	Vultrex OGL Synthetic All Season	NLGI 1-2	
Antifreeze Coolant	6829104212	Petro-Canada AFC Old World Industries, Inc Fleet Charge SCA Fleetguard Compleat EG Antifreeze/Coolant	Premix 60/40	
Supplemental Coolant Additive (SCA)	6829012858	Fleetguard DCA4 Fleetguard DCA2 Penray Pencool 3000		

SURFACE PROTECTION FOR CYLINDER RODS

Steel cylinder rods include a thin layer of chrome plating on their surfaces to protect them from corroding. However, chrome plating inherently has cracks in its structure which can allow moisture to corrode the underlying steel. At typical ambient temperatures, hydraulic oil is too thick to penetrate these cracks. Normal machine operating temperatures will allow hydraulic oil to warm sufficiently to penetrate these cracks and if machines are operated daily, protect the rods. Cranes that are stored, transported, or used in a corrosive environment (high moisture, rain, snow, or coastline conditions) need to have the exposed rods protected more frequently by applying a protectant. Unless the crane is operated daily, exposed rod surfaces will corrode. Some cylinders will have rods exposed even when completely retracted. Assume all cylinders have exposed rods, as corrosion on the end of the rod can ruin the cylinder.

It is recommended that all exposed cylinder rods be protected using Boeshield® T-9 Premium Metal Protectant. Manitowoc Crane Care has Boeshield® T-9 Premium Metal Protectant available in 12 oz. cans that can be ordered through the Parts Department.

Cylinder operation and inclement weather will remove the Boeshield® protectant; therefore, inspect machines once a week and reapply Boeshield® to unprotected rods.

WIRE ROPE LUBRICATION

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

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, tires on the ground, and the suspension set at the proper ride height.

Lubrication checks must be performed while the oil is cool and has not been operated within the past 30 minutes, unless otherwise specified.

On plug type check points, the oil levels are to be at the bottom edge of the fill plug hole. The hoists have an oil level indicator.

All grease fittings are SAE STANDARD unless otherwise indicated. Grease non-sealed fittings until grease is seen extruding from the fitting. 28 grams (one ounce) of EP-MPG equals one pump on a standard one pound (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.

CraneLUBE

Grove highly recommends the use of CraneLUBE lubricants to increase your crane's reliability and performance. Contact your Grove distributor for information about the Grove's CraneLUBE lubrication program.

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. Select the one that applies to your engine to view the registered oils.

Safety

To lubricate many of the locations the engine will need to be started. After positioning areas of the crane for lubrication the engine must be turned off and the areas to be lubricated made stable before proceeding.

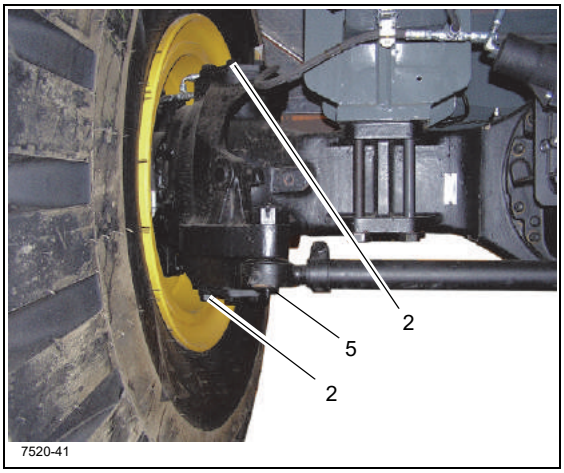
DANGER

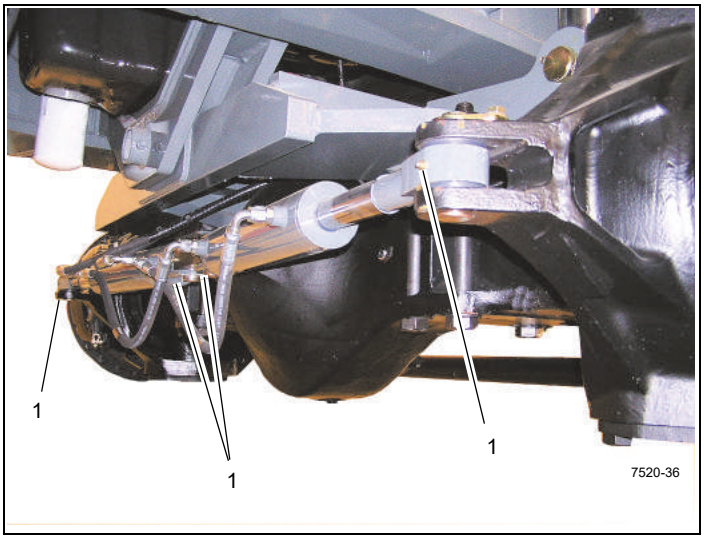
Crushing Hazard!

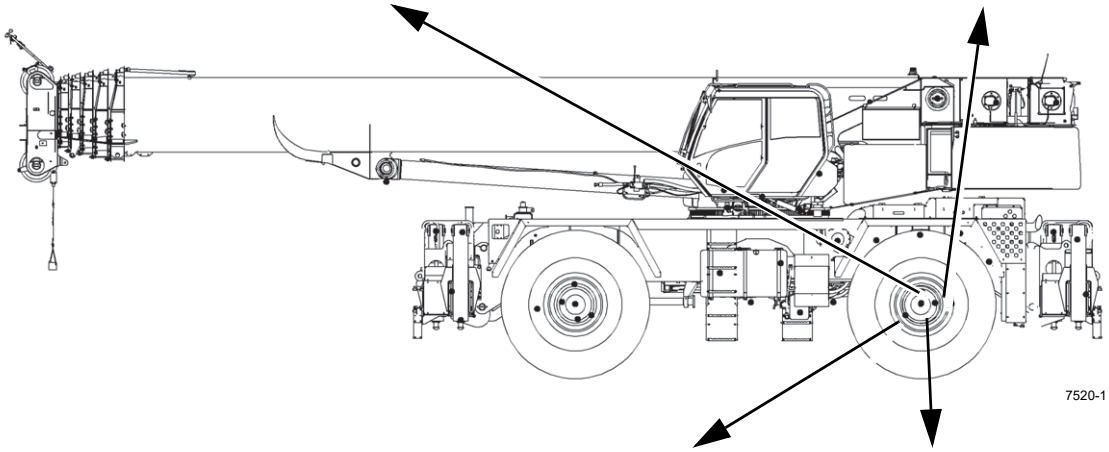
Movement of the superstructure and the boom may create a crushing and/or pinching hazard. Failure to observe this warning could result in death or serious injury.

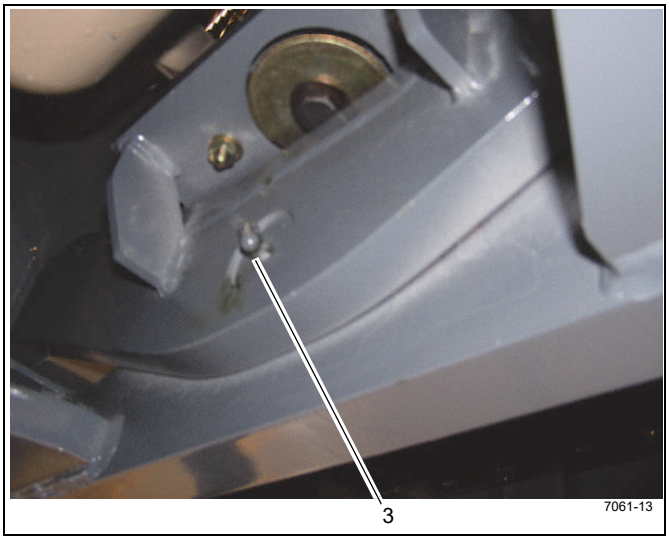
Steering and Suspension

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
NOTE:	Standard fluids good to -15°C (5°F) - Cold weather fluids good to -29°C (-20°F) The standard fluid part number in Approved Lubricant column in this chart appears first and cold weather part number is listed second. If only one part number is listed, it is the standard fluid.					
1	Steer Cylinder Pivot Pins	Figure 5-1	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	500 hours or 3 months	8 grease fittings
2	Upper and Lower King Pins	Figure 5-1	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	500 hours or 3 months	8 grease fittings
3	Fifth Wheel Pivots	Figure 5-1	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	500 hours or 3 months	2 grease fittings
4	Lockout Cylinder Pivot Pins	Figure 5-1	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	500 hours or 3 months	4 grease fittings









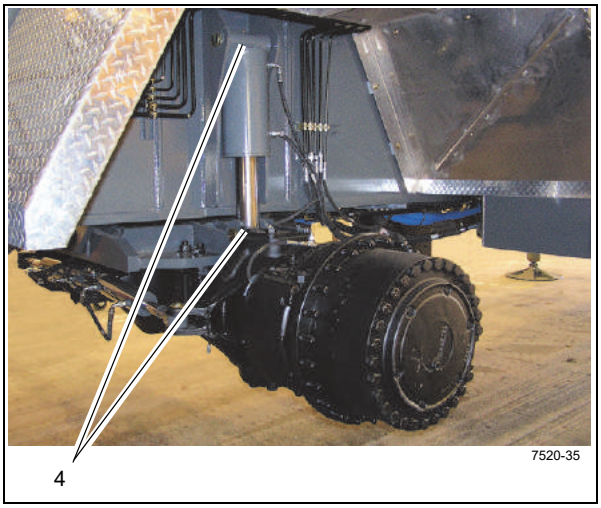
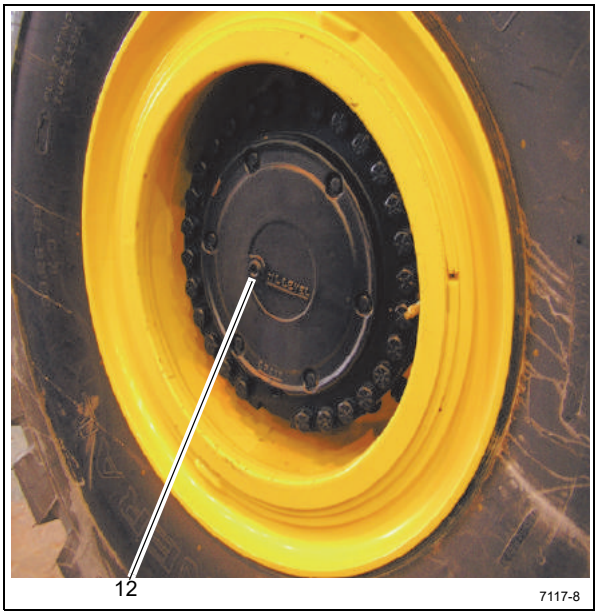
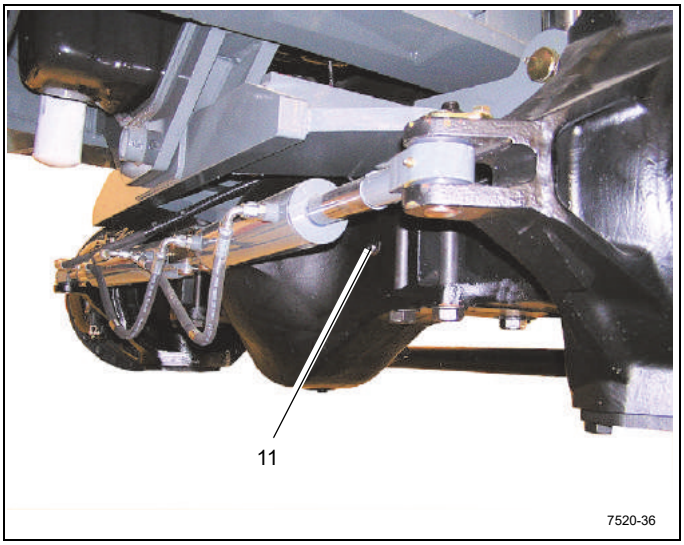


FIGURE 5-1

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Axles						
11	Differentials	Figure 5-2	GL-5 Extended Service Interval Gear Lubricant 6829012964 6829014058	130.2 pints (61.6 liters)	• Check level every 500 hours or 3 months • Drain and fill every 4000 hours or 2 years	Fill to bottom of hole in housing on the steer cylinder side (2 places)
NOTE: Lube level close enough to the hole to be seen or touched is not sufficient. It must be level with the hole. When checking lube level, also check and clean housing breathers. **CAUTION:** Use of non semi-synthetic lubricant may damage components and/or invalidate published lubricant intervals. **CAUTION:** If the makeup amount is substantially more than 0.23 liter (0.5 pint), check for leaks.						
12	Planetary Hubs and Wheel Bearings	Figure 5-2	GL-5 Extended Service Interval Gear Lubricant 6829012964 6829014058	14.4 pints (6.8 liters)	• Check level every 500 hours or 3 months • Drain and fill every 4000 hours or 2 years	Fill to the bottom of the level hole in the housing with the fill plug and the oil level mark horizontal (4 places)
CAUTION: Use of non synthetic lubricant may damage components and/or invalidate published lubricant intervals.						





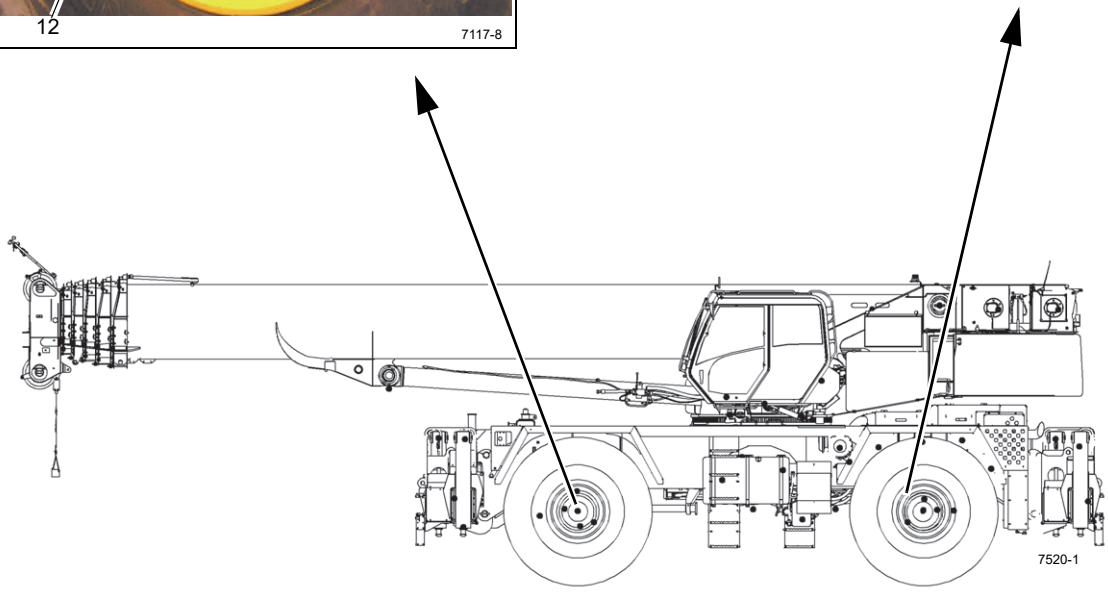
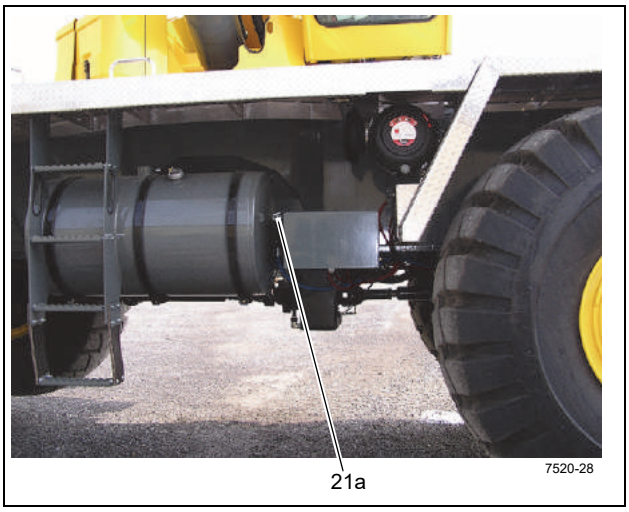
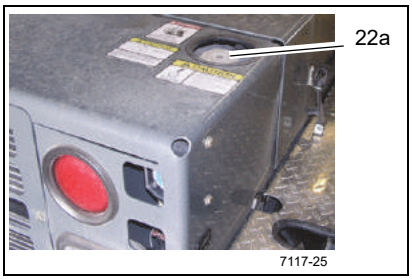
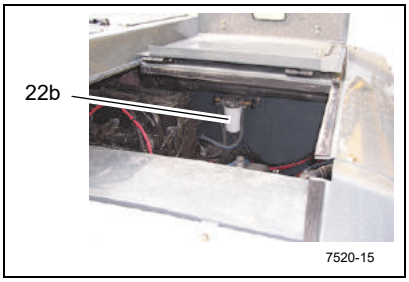


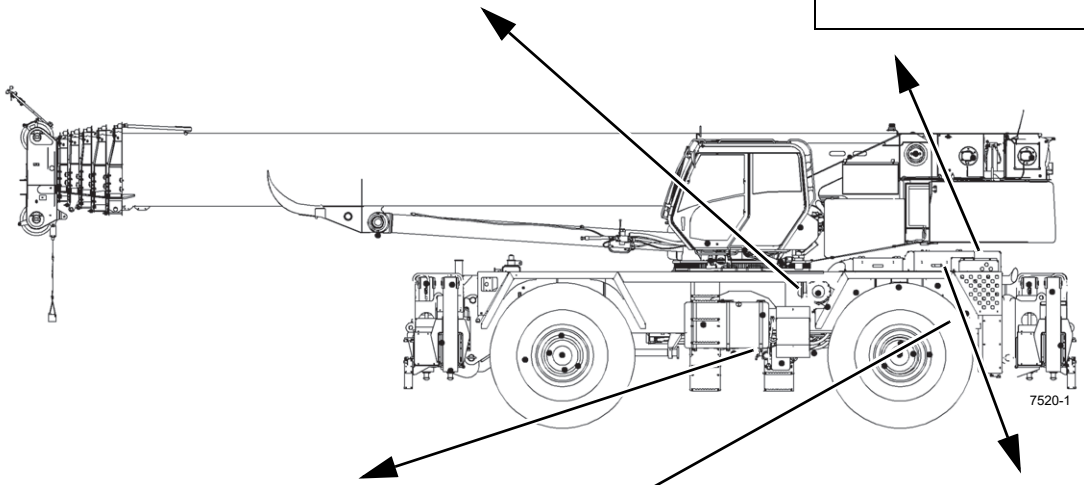
FIGURE 5-2

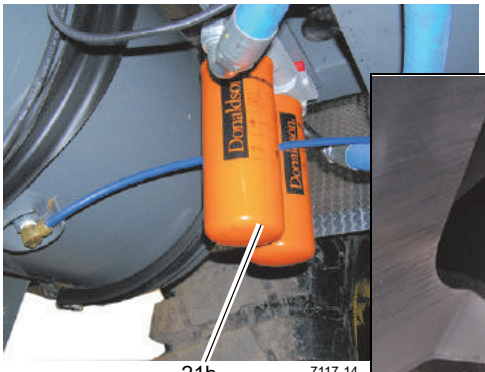
Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Drive Train						
20a **20b**	a. Engine Crankcase b. Filter	Figure 5-3	EO-15W/40 Engine Oil SAE 15W-40 T3 Engine: 6829003483 T4 Engine: 6829104182	Tier 3: 20 quarts (19 liters) Tier 4: 23 quarts (22 liters)	• Check level every 10 hours or daily • Drain, fill and replace filter every 500 hours	• Through fill cap to FULL mark on dipstick • Filter located under radiator
21a **21b**	a. Transmission and Torque Converter b. Filter	Figure 5-3	HYDO Hydraulic Oil 6829006444	68 quarts (64 liters)	• Check level every 10 hours or daily • Drain and refill every 1000 hours or 6 months • Change transmission filter after first 50 and 100 hours of service, then every 500 hours thereafter	Through fill pipe to FULL mark on dipstick
NOTE: • Check fluid level with engine running at 800 rpm idle and the oil at 150° to 200°F (65° to 90°C). Do not attempt an oil level check with cold oil. To bring the oil temperature to this range, it is necessary to either work the crane or stall the converter. Converter stall should be accomplished by engaging shift lever in forward high range with the brakes applied and then accelerating the engine to half or three-quarter throttle. Hold the stall until the required converter temperature is reached and stabilized. Do not operate the converter at stall condition for longer than 30 seconds at one time. Shift to neutral for 15 seconds and repeat the procedure until the desired temperature is reached. Excessive temperature, i.e, 250°F (120°C) maximum will cause damage to transmission clutches, fluid, converter and seals. • Drain and fill with the oil at 150° to 200°F (65° to 90°C). • Transmission filters are located on the outside left hand frame in the area of the hydraulic oil cooler. • Do not operate the machine in two wheel drive while the machine is up on outriggers. Serious transmission damage could result. • To add fluid: **a.** Fill to FULL mark on dipstick **b.** Run engine at 800 rpm to prime torque converter and lines **c.** Check oil level with engine running at 800 rpm and oil at 150° to 200°F (65° to 90°C). Add oil to bring oil level to FULL mark on dipstick						
22a **22b**	a. Engine Cooling System and SCA Levels b. Coolant Filter	Figure 5-3	AFC 50/50 50/50 Blended Fully Formulated Antifreeze Coolant A6-829-101130 SCA 6829012858	42 quarts (40 liters)	• Check coolant level every 10 hours or daily • Change filter and check SCA levels every 500 hours • Check coolant for contamination every 1000 hours	See *Service Manual*


21a
7520-28


22a
7117-25


22b
7520-15


7520-1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21b
7117-14


20b
7117-19

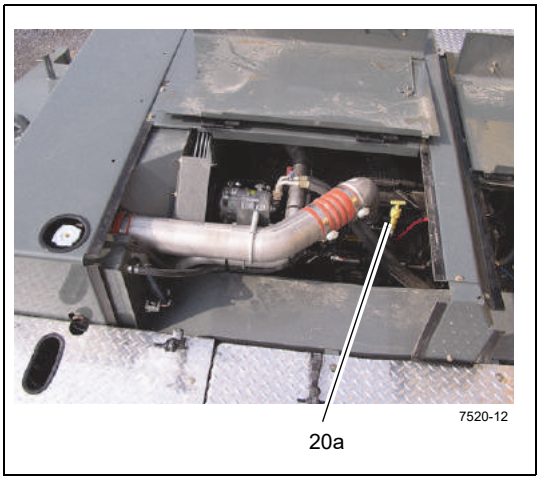

7520-12
20a

FIGURE 5-3

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Drive Train (continued)						
23	Coolant Strainer (Cab Heater)	Figure 5-4	---	---	Clean strainer screen after first 100 hours and every 2000 hours or 12 months thereafter.	Close shutoff valves. Unscrew hex plug to clean filter.
24a **24b**	Air Cleaner Filters Pre-cleaner	Figure 5-4	---	---	• Replace primary filter element when indicator shows red (25 in of H_20). Replace secondary filter every third time primary filter is replaced. • In severe dust conditions the pre-cleaner may need to be serviced.	Right hand side of engine hood.
25a **25b**	Water Separator Fuel Filter - Primary and Secondary	Figure 5-4	---	---	• Drain water trap every 10 hours or daily. • Change filter every 500 hours or 6 months.	Primary fuel/water separator is located beside the fuel tank. Secondary fuel filter is located on the right side of the engine
26a **26b**	Driveline - Slip Joints	Figure 5-4	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	500 hours or 3 months	3 grease fittings
27	DEF Supply Module Filter (Tier 4)	---	---	---	Check filter every 4500	
28	DEF Tank (Tier 4)	---	DEF (AUS 32)	20 quarts (18.9 liters)	Check and fill every 10 hours or daily	
CAUTION: Use caution when adding Diesel Exhaust Fluid (DEF) to avoid spills during vehicle fill-up. **CAUTION:** DEF is corrosive to certain metals and paint and should be washed off with mild soap and water if spilled.						
29	DEF Tank Filter (Tier 4)	---	---	---	Check filter every 1 year	

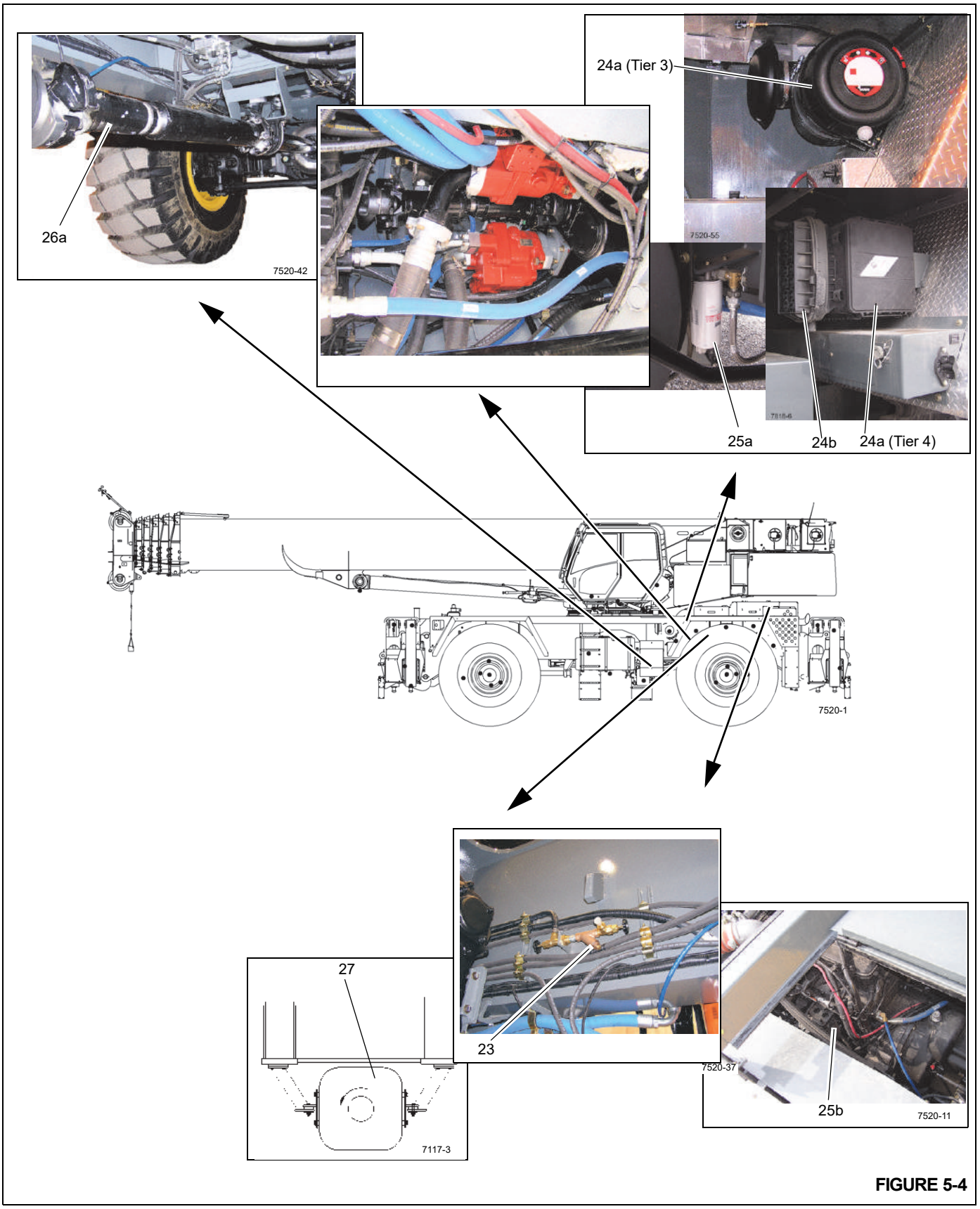
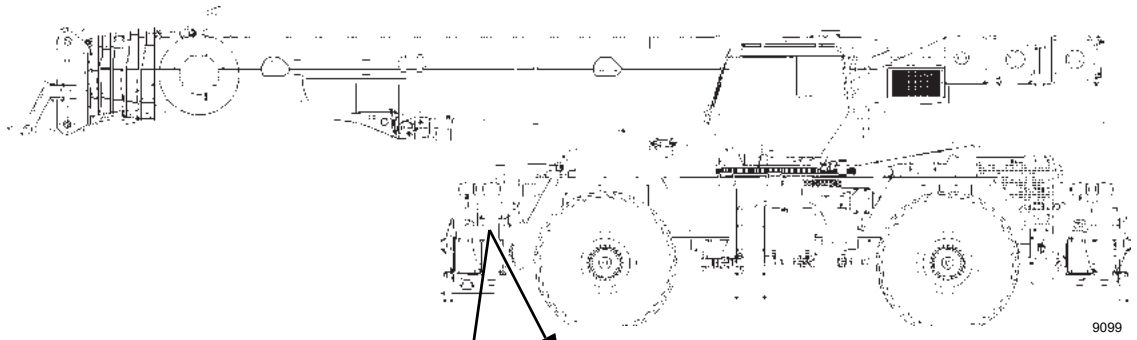
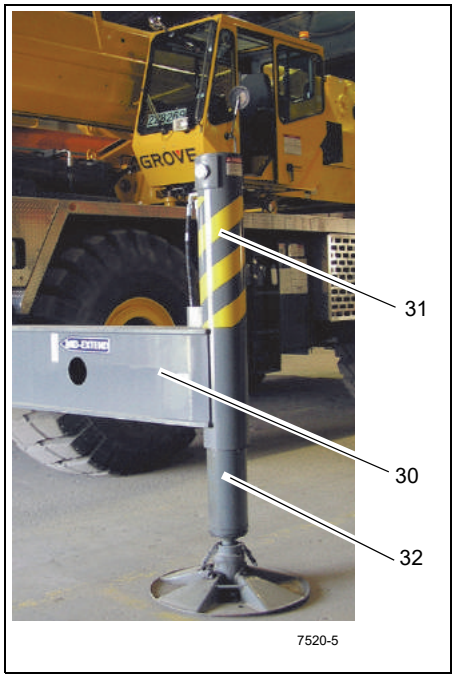
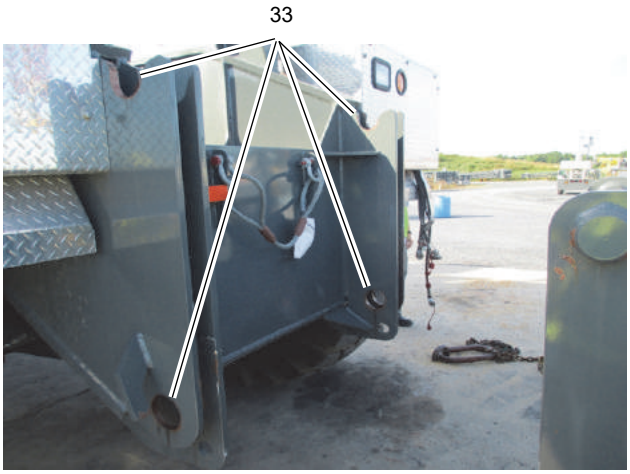

26a
7520-42
24a (Tier 3)
7520-55
25a
24b
24a (Tier 4)
7520-1
27
7117-3
23
25b
7520-37
7520-11

FIGURE 5-4

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Outriggers						
30	Outrigger Beams	Figure 5-5	EP-MPG Extreme Pressure Multipurpose Grease 6829015304 6829104275	---	50 hours or 1 week	Brush lubricant on bottom of outrigger beams
31	Jack Cylinder Support Tubes	Figure 5-5	EP-MPG Extreme Pressure Multipurpose Grease 6829015304 6829104275	---	50 hours or 1 week	Brush lubricant on ID of jack cylinder support tubes and wear bands four (4) places before installing jack cylinders
32	Jack Cylinder Barrels	Figure 5-5	EP-MPG Extreme Pressure Multipurpose Grease 6829015304 6829104275	---	50 hours or 1 week	Brush lubricant on ID of jack cylinder support tubes and wear bands four (4) places before installing jack cylinders and on outside of support tubes at regular intervals
33	Removable Outrigger Box	Figure 5-5	Anti-Seize Compound (ASC) 6829003689	---	100 hours or 1 month	Brush anti-seize compound on all removable outrigger to frame attachment areas







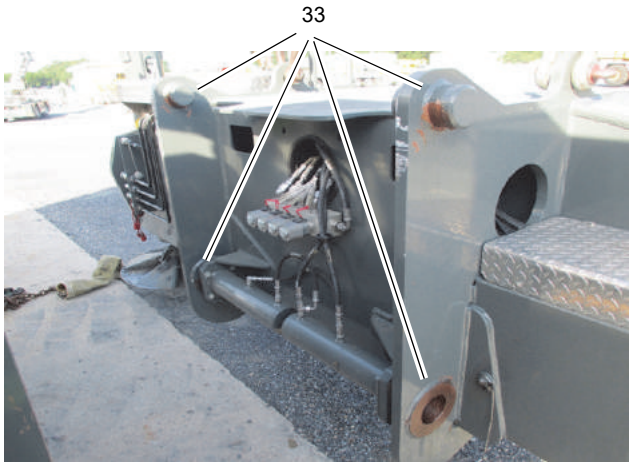


FIGURE 5-5

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Hydraulic						
40	Hydraulic Tank	Figure 5-6	HYDO Hydraulic Oil 6829006444 6829101559	655 liters (173 gallons)	Check fluid level every 10 hours or daily.	• Use sight gauge on side of tank, with boom down and all outrigger cylinders retracted. • Drain and refill as necessary

NOTE:

- Environmental and other conditions can dramatically affect the condition of hydraulic oil and filters. Therefore, specific intervals for servicing/changing hydraulic oil, filters and hydraulic tank breathers cannot be set. However, it is imperative for the continued satisfactory performance of Grove cranes that inspections be performed on the basis of how and where each crane is used. Air borne and ingested contaminants can significantly reduce the life of oil and the condition of hydraulic oil filters and tank breathers.
- Under normal operating conditions, it is recommended that hydraulic oil, filters and breathers be inspected and oils sampled at least every 3 to 6 months and more frequently for severe operating conditions. The inspections should be for air borne and/or ingested particles and water that deteriorate and contaminate the oil (e.g., oil appears “milky” or no longer has a transparent clear to amber color). The return filter by-pass indicator should be observed daily to determine if the contaminants content may be high. If the indicator reaches the red zone or indicates a by-pass condition, the hydraulic oil must be sampled. The hydraulic tank breather should also be inspected to assure that it is not restricting air flow into and out of the reservoir.
- To inspect hydraulic oil, fill a small glass container with a sample of reservoir oil and another glass container with fresh oil. Let the samples stand, undisturbed, for one to two hours and then compare the samples. If the reservoir oil is heavily contaminated with water the sample will appear “milky” with only a small layer of transparent oil on top. If the “milky” appearance was due to air foaming, it will dissipate and the oil should closely match the fresh oil. Should you have any questions, please contact your local authorized Grove distributor.
- The hydraulic oil shall meet or exceed ISO #4406 class 19/17/14 cleanliness level.

Fill Procedure for Hydraulic Tank (Operation below +5°F (-15 °C)

- Drain existing oil.
- Fill tank with hydraulic/transmission oil (6829101559) and cycle all cylinders
- Drain oil
- Fill tank with oil (6829101559)

41	Hydraulic Filter	Figure 5-6	---	---	Change filter when the indicator is red	---

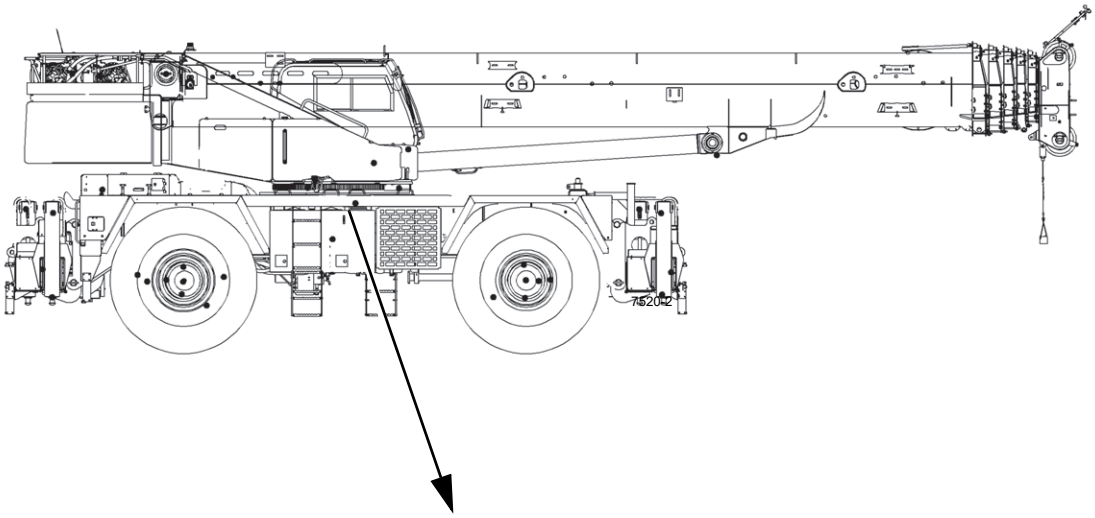


FIGURE 5-6

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Turntable						
100	Swing Drives	Figure 5-7	SGL-5 Synthetic Gear Lube - API GL4+ SAE75W-90 02313611	1.0 quarts (0.9 liters)	• Check and fill every 50 hours • Drain and fill every 1000 hours or 12 months thereafter.	Fill to level on sight gauge
CAUTION: Do not mix synthetic oil with mineral based oil.						
101 A	Turntable Gear and Drive Pinion	Figure 5-7	EP-OGL Open Gear Lubricant 6829102971	Coat all teeth	500 hours or 6 months	Spray on
101 B	Turntable Swivel Lock Pin	Figure 5-7	EP-OGL Open Gear Lubricant 6829102971	Coat entire pin	500 hours or 6 months	Spray on
102	Turntable Bearing	Figure 5-7	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes the whole circumfer-ence of the bearing	500 hours or 6 months	4 grease fittings at the front of the turntable.
NOTE: Rotate the turntable 90° and apply grease to fittings. Continue rotating 90° and grease the fittings until the whole bearing is greased.						
103	Slew Angle Sensor	Figure 5-7	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	5000 hours or 60 months	1 grease fittings
NOTE: Remove plug from housing. Apply grease to fitting on bottom of sensor. Reinstall plug and tighten to 25 Nm (18 ft-lb).						
104	Boom Pivot Pin	Figure 5-7	EP-MPG Extreme Pressure Multipurpose Grease 6829015304 6829104275	Until grease extrudes	300 hours or 3 months	4 grease fittings

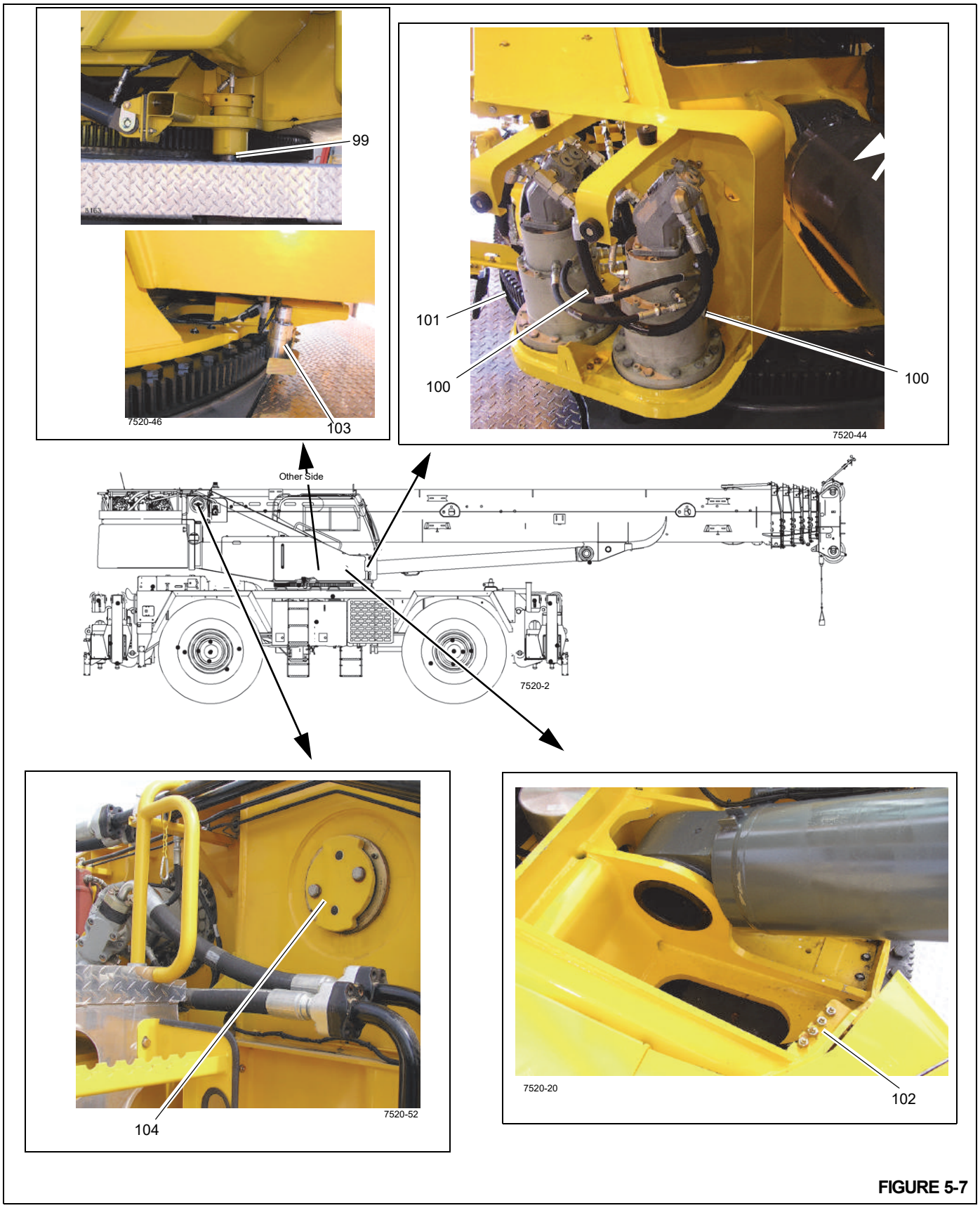
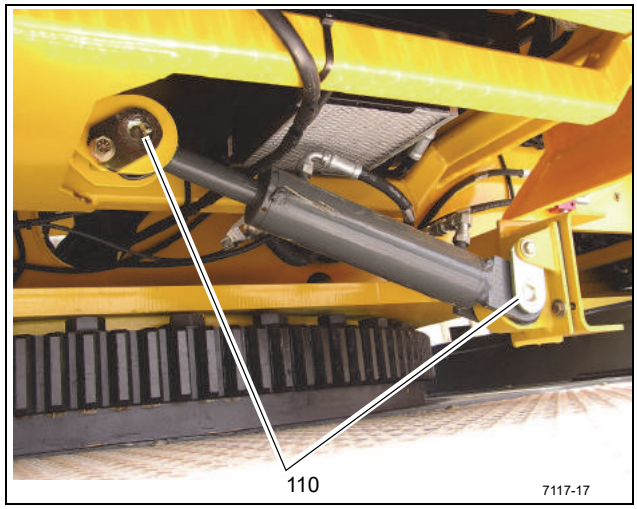
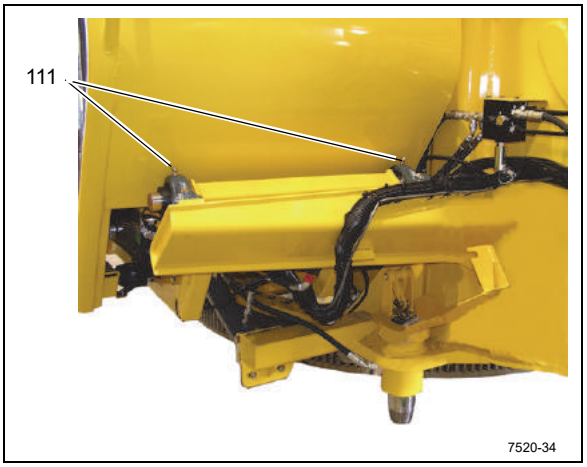

99
7520-46
103
101
100
100
7520-44
Other Side
7520-2
104
7520-52
7520-20
102

FIGURE 5-7

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Cab Tilt						
110	Cab Tilt Cylinder Pivot Pins	Figure 5-8	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	500 hours or 3 months	2 grease fittings
111	Cab Tilt Pivot Bearings	Figure 5-8	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	500 hours or 3 months	2 grease fittings
112	Cab Door Track and Rollers	---	Light Oil	---	6 months	2 places





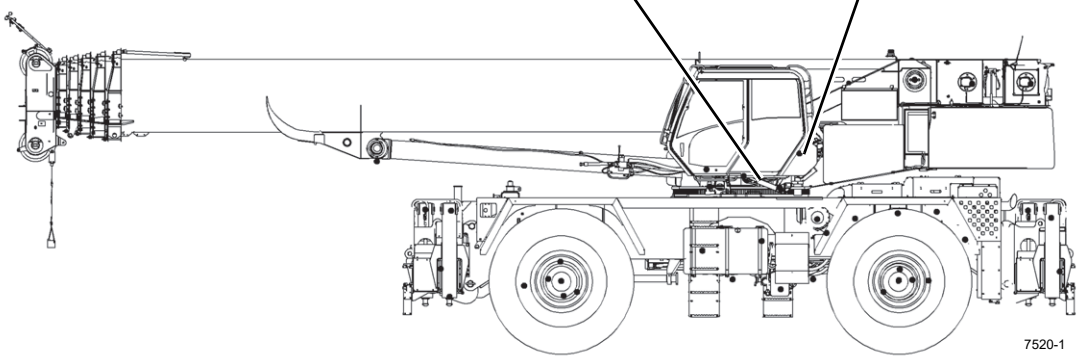


FIGURE 5-8

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Lift Cylinder						
115	Upper Lift Cylinder Pivot Pin	Figure 5-9	EP-MPG Extreme Pressure Multipurpose Grease 6829015304 6829104275	Until grease extrudes	100 hours or 1 months	1 grease fittings
116	Lower Lift Cylinder Pivot Pin	Figure 5-9	EP-MPG Extreme Pressure Multipurpose Grease 6829015304 6829104275	Until grease extrudes	100 hours or 1 months	1 grease fittings

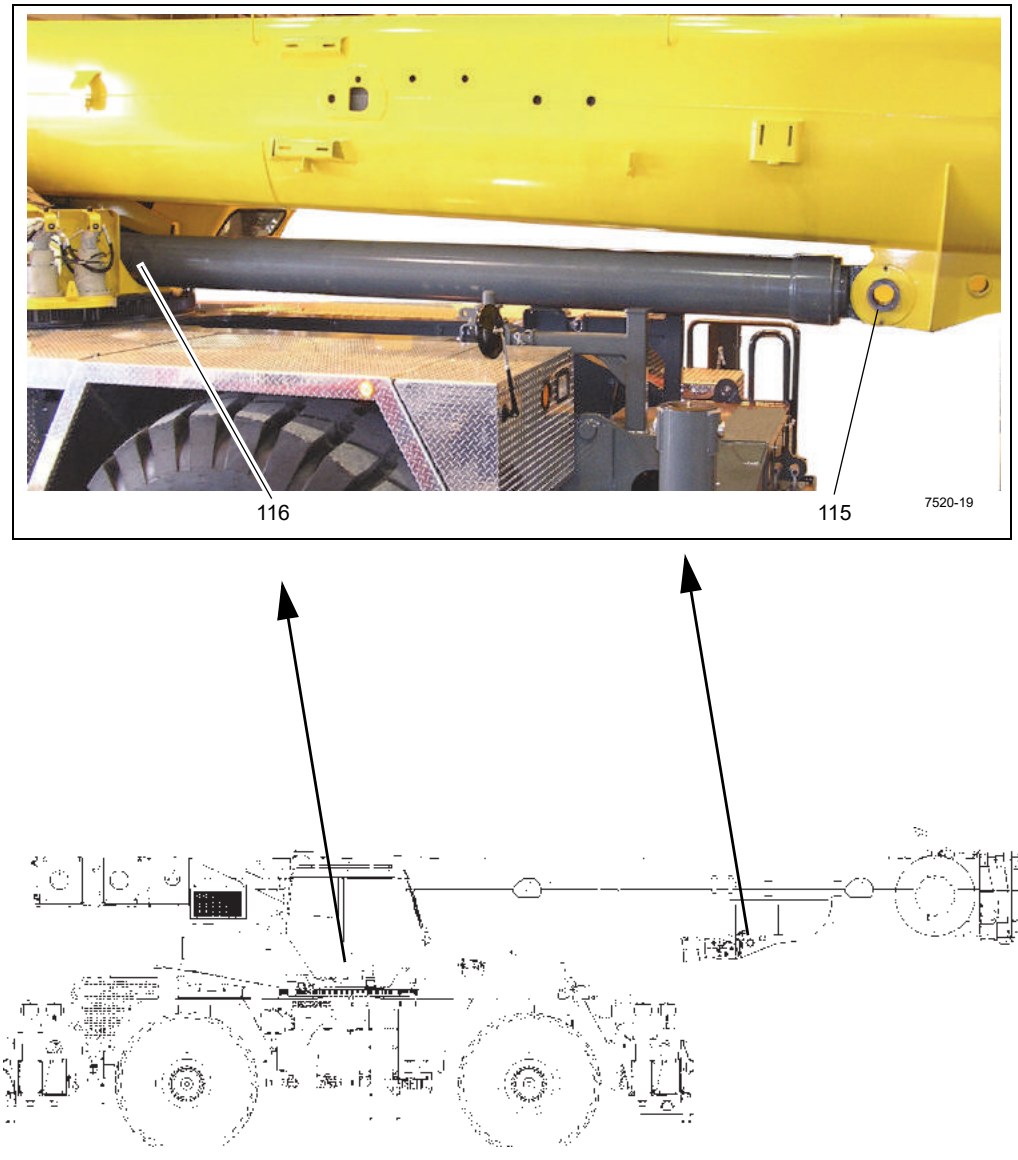
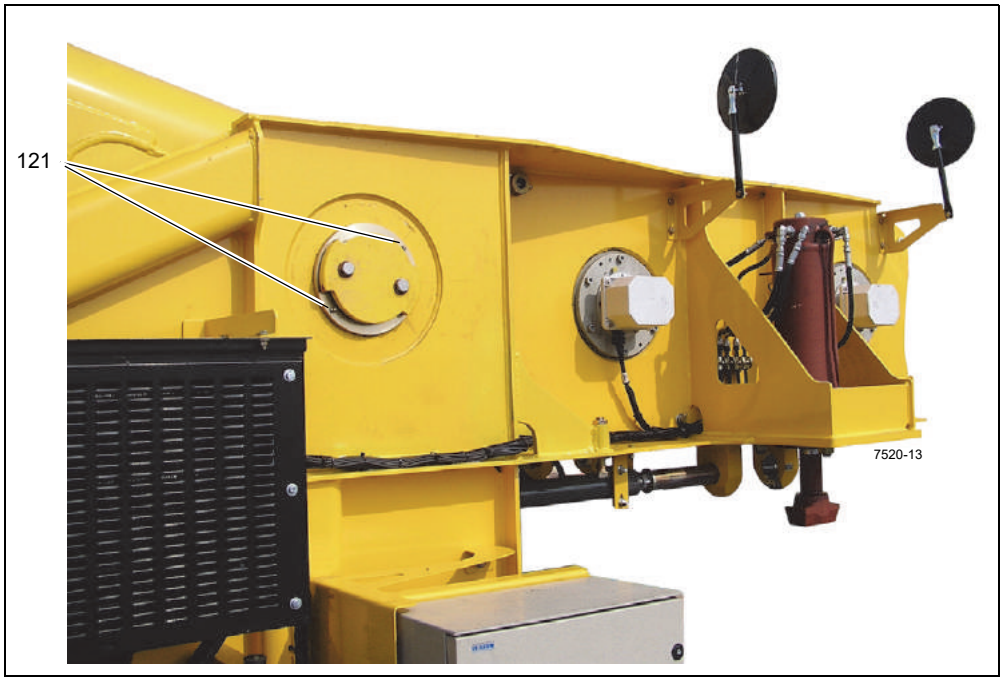
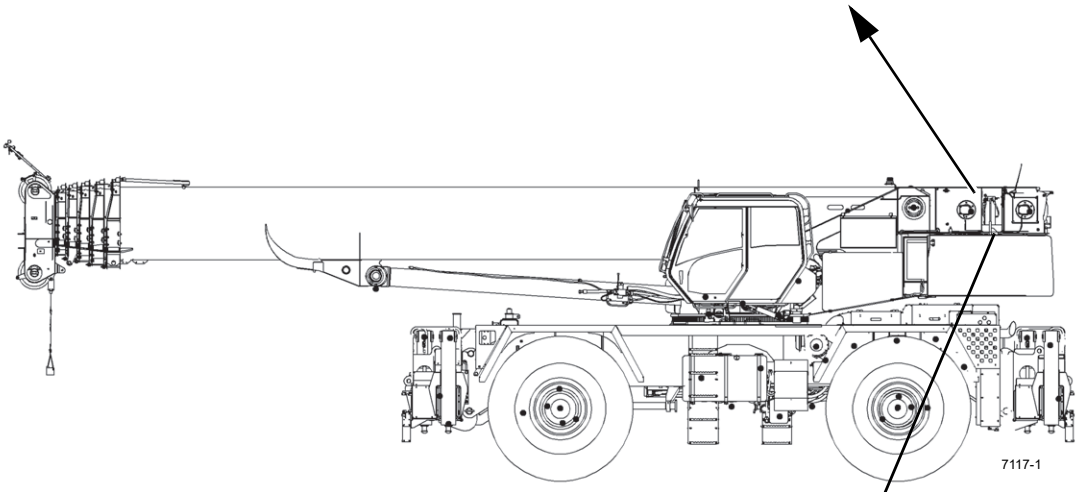


FIGURE 5-9

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Hoist						
120	Drum	Figure 5-10	SGL Synthetic Gear Lube - API GL4 + SAE 75W-90 02313611	4 quarts (4 liters)	• Check and fill every 50 hours or weekly • Drain and fill every 1000 hours or 12 months	Ensure hoist is level. The oil must have settled for 20 minutes with the temperature in the 21°C ± 7°C (70°F ± 20°F) range. The oil level must be between the 'MIN' and 'MAX' marks on the sight gauge. Variations in oil temperature will cause oil level to fluctuate. To add or refill the oil, remove hose at top of sight gauge. Fill hoist through hose until the oil level is visible between the 'MIN' and 'MAX' marks on the sight gauge.
CAUTION: Do not mix synthetic oil with mineral based oil.						
121	Boom Pivot Bearing	Figure 5-10	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	500 hours or 6 months	4 grease fittings, 2 on each side





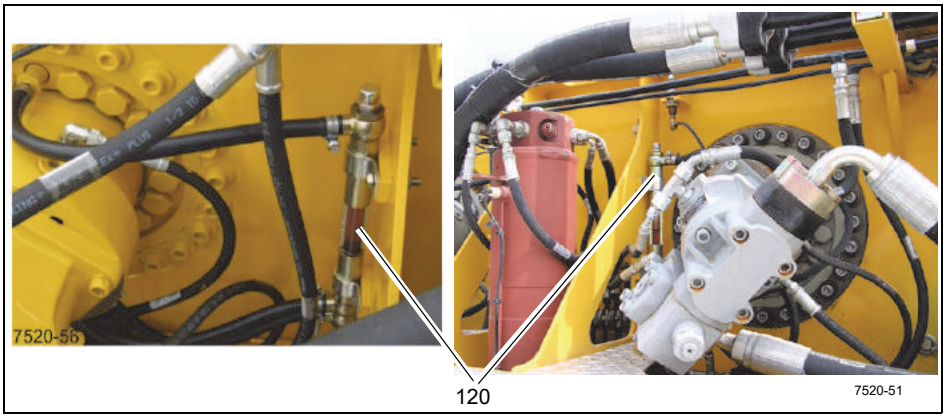


FIGURE 5-10

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Boom						
130	Telescope Sections - Lower Faces	Figure 5-11	Lubricant Grease 02310394	Thoroughly coat	300 hours or 3 months	5 places by brush. Refer to Boom Lubrication Procedure.
131	Telescope Sections - Upper Faces	Figure 5-11	Lubricant Grease 02310394	Thoroughly coat	300 hours or 3 months	10 places by brush. Refer to Boom Lubrication Procedure.

Boom Lubrication Procedure

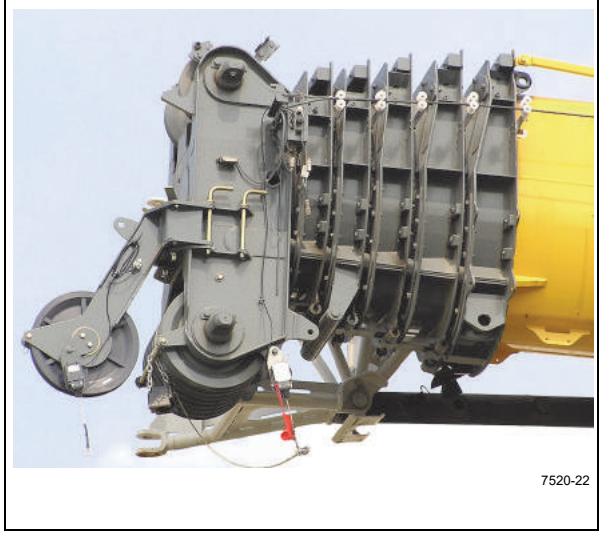
Telescope Section 1

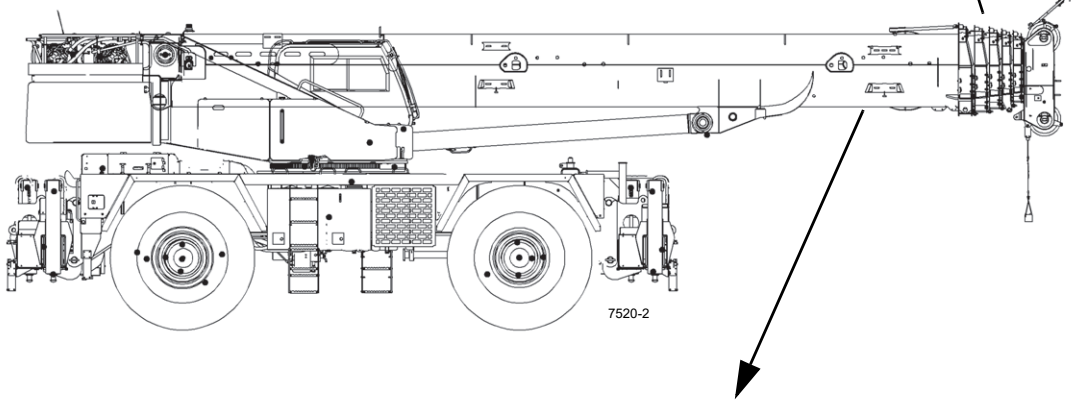
- Extend telescope section 1 to 100%.
- Using a brush or roller, apply grease to lower slide faces.
- Apply grease to the upper wear pads at fitting (item 131).
- Lubricate locking pins at fitting (item 132).
- Lock and unlock the section to distribute the grease.
- Extend section 1 to 50%
- Apply grease to the upper wear pads at fitting (item 131).

  Fully retract section.

Telescope Section 2 - 5

- Extend telescope section 5 to 100% and telescope section 4 to approximately 25%.
- Using a brush or roller, apply grease to the lower slide faces.
- Apply grease to the upper wear pads at fitting (item 131).
- Lubricate locking pins at fitting (item 132).
- Raise the main boom to 15 degrees.
- Retract telescope section 4 to 0% and telescope section 5 to approximately 50%.
- Lock and unlock telescope section 5 several times to distribute the grease.
- Lower the main boom to 0 degrees. Do not lower less than 0 degrees.
- Extend telescope section 4 to approximately 75%.
- Apply grease to the upper wear pads at fitting (item 131)
- Raise the main boom to 15 degrees.
- Retract telescope sections 4 and 5 to 0%,
- Fully extend and retract telescope section 5 to distribute the grease.
- Lower the main boom to 0 degrees.
- Lubricate telescope sections 2, 3 and 4 in the same method.





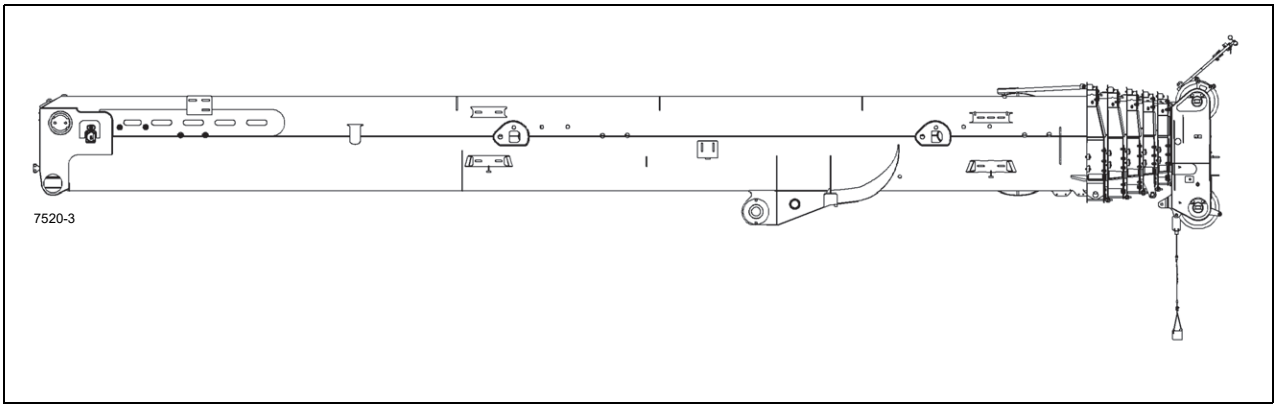


FIGURE 5-11

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Boom (continued)						
132	Locking Pins	Figure 5-12	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	300 hours or 3 months	Refer to Boom Lubrication Procedure on page 27.
133	Boom Nose Sheaves	Figure 5-12	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	---	Apply grease at assembly and/or teardown	10 service points
134	Auxiliary Boom Nose Sheave	Figure 5-12	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	250 hours or 3 months	1 grease fittings

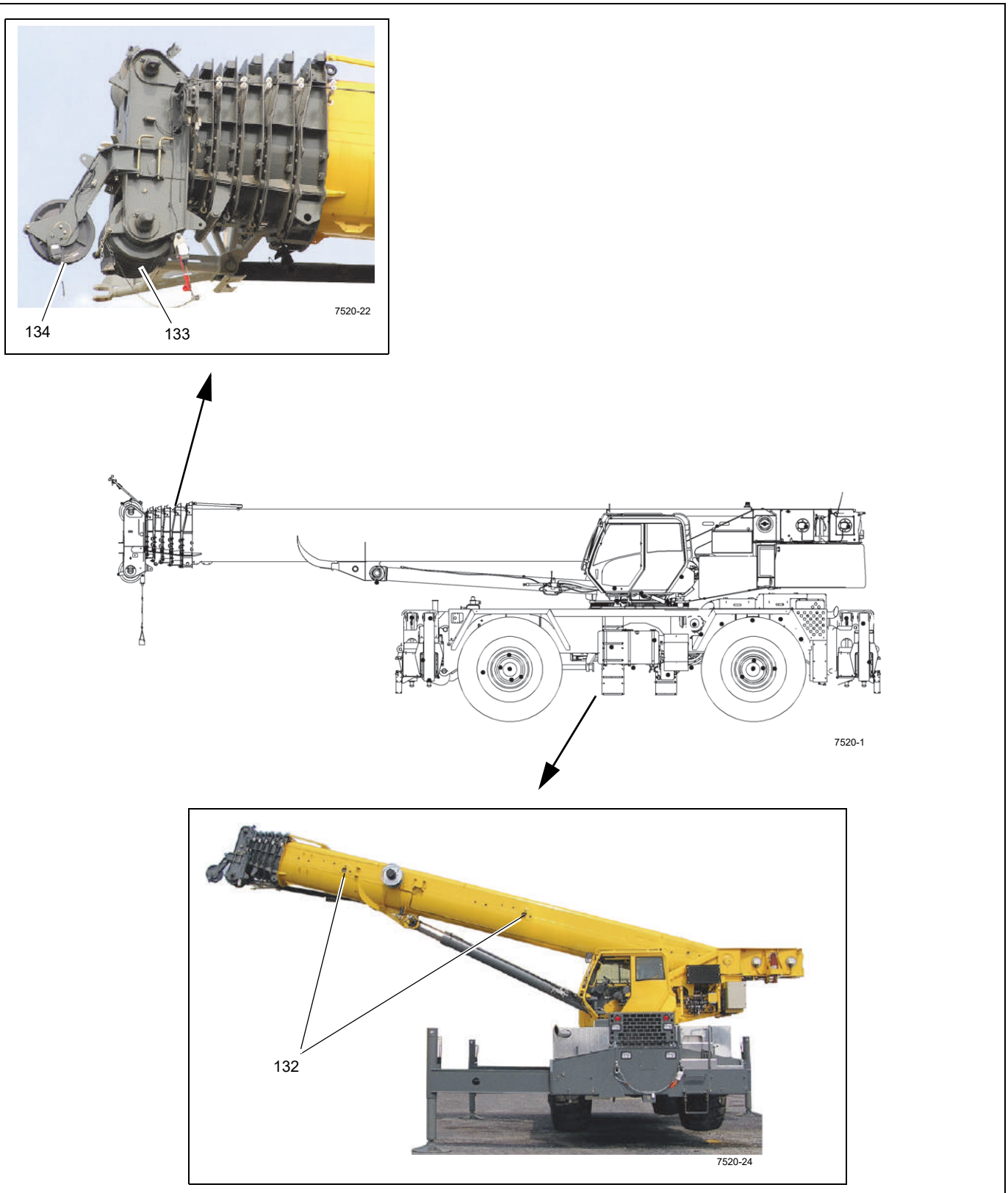


FIGURE 5-12

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Boom Extension						
140	Luffing Cylinder/ Adjustment Pivot Pins	Figure 5-13	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	250 hours or 3 months	2 grease fittings
141	Luffing Extension Pivot Pins	Figure 5-13	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	250 hours or 3 months	2 grease fittings
142	Mast Sheave	Figure 5-13	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	---	Apply grease at assembly and/or teardown	1 place
143	11 Meter Extension Head Sheave	---	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	---	Apply grease at assembly and/or teardown	2 places
144	18 Meter Extension Head Sheave	---		---		1 place
145	8 Meter Insert Sheave	---		---		1 place
146	3.6 Meter Extension Sheave	---		---		3 places

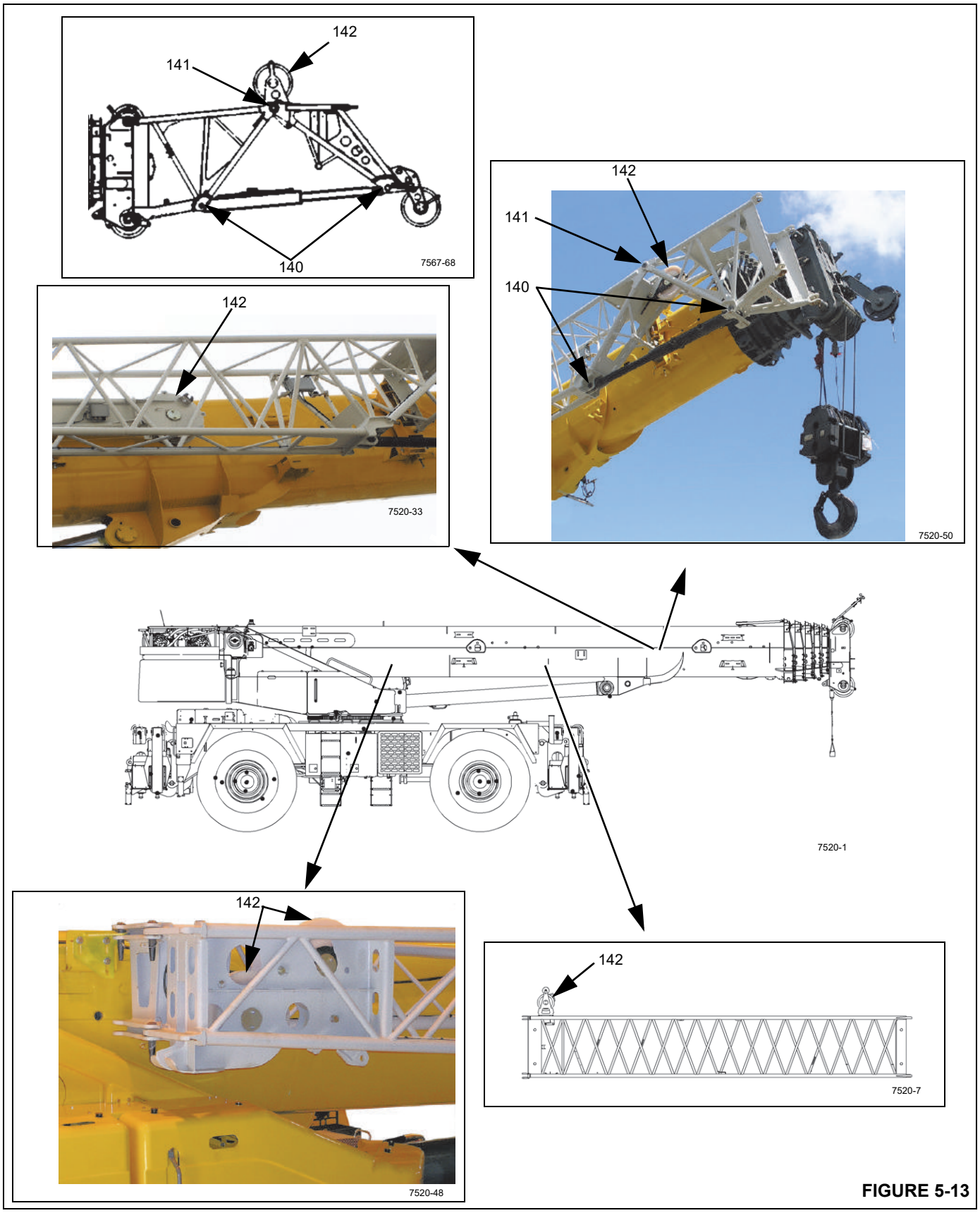

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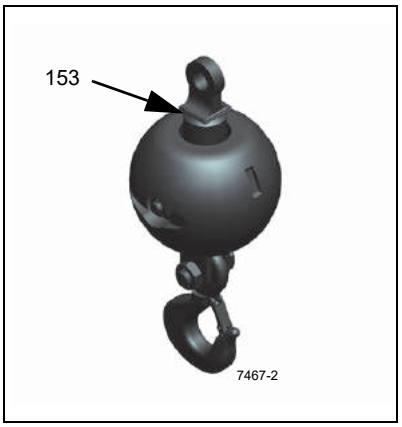
FIGURE 5-13

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Boom						
150	Hook Block Swivel Bearing	Figure 5-14	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	250 hours or 3 months	1 grease fitting
151	Hook Block Sheaves	Figure 5-14	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	250 hours or 3 months	1 grease fitting per sheave
153	Overhaul Ball	Figure 5-14	EP-MPG Extreme Pressure Multipurpose Grease 6829003477 6829104275	Until grease extrudes	250 hours or 3 months	1 grease fitting



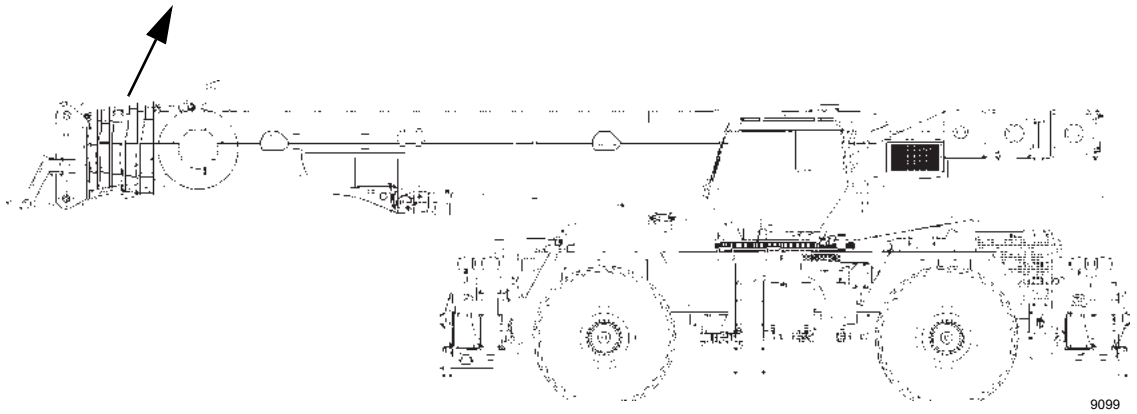


FIGURE 5-14

CARWELL® RUST INHIBITOR

Protecting Cranes From Rusting

Manitowoc Crane Group's 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 are 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, Chlorofluorocarbons (CFCs) or anything that would be classified as hazardous under OSHA Regulation 29CFR 19 10.1200. 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

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.

NOTE: 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:

NOTE: Manitowoc Crane Care recommends that a qualified body repairman prepare, prime and paint any major scratch(es) or minor damage.

CAUTION

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:

1. 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.
2. Cover all bare metal with a primer that is compatible with the original paint finish and allow to dry thoroughly.
3. Prepare the surface prior to applying the finish coat of paint.
4. Apply a finish coat 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 primered 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.

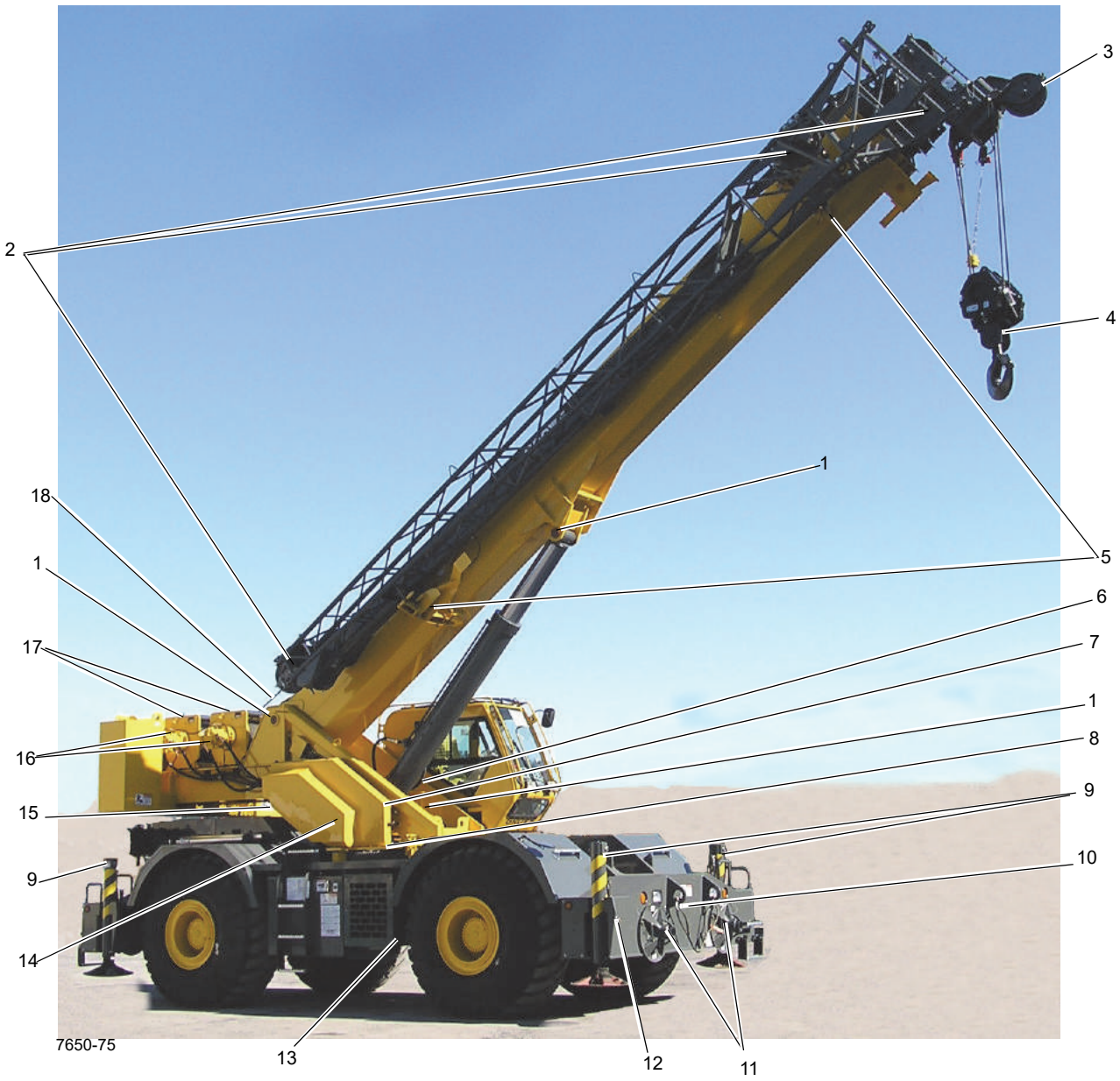
Areas of Application

Refer to Figure 5-15 and Figure 5-16.

- 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 end and fittings, Swivel, pumps, axles, drive lines, 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 end and fittings, wire rope on hoist 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 end and fittings, jib pins and shafts, all bare metal surfaces, headache ball pins/ hook block pins and fasteners.
- All hardware, clips, pins, hose connections not painted will have treatment applied.



Picture may not be same model as your machine, it is for reference only.

Figure 5-15

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Picture may not be same model as your machine, it is for reference only.

Figure 5-16

Item	Description
1	Pivot Shaft
2	Boom Extension Pins, Clips
3	Boom Nose Pins, Clips
4	Hook Block/Headache Ball
5	Boom Extension Hanger Hardware
6	Hose Connections inside turntable
7	All Hardware, Clips, Pins, Hose Connections not painted O/R Pins, Clips
8	Turntable Bearing Fasteners
9	O/R Hose Connections
10	Hookblock Tiedown Cable

Item	Description
11	O/R Pins, Clips
12	O/R Beam Wear Pad Adjustment Hardware
13	Entire underside of unit
14	Powertrain Hardware Inside Compartment
15	Valve Bank
16	Hoist Hose Connections
17	Tension Spring
18	Wire Rope
19	Counterweight Mounting Hardware
20	Counterweight Pins
21	Hose Connections
22	Mirror Mounting Hardware

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ALPHABETICAL INDEX