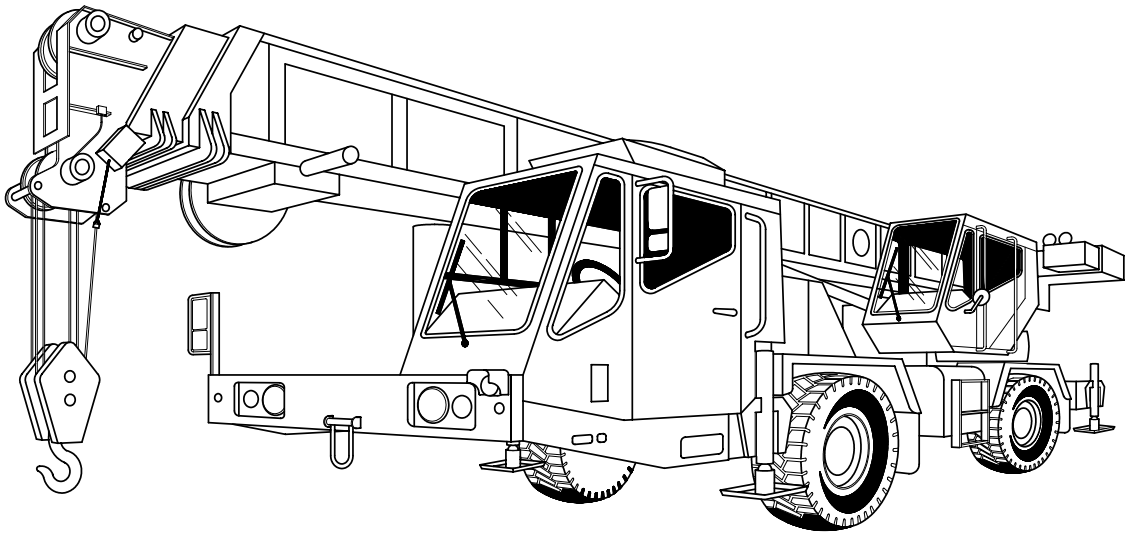
TM 5-3810-307-10

TECHNICAL MANUAL

OPERATOR'S MANUAL FOR ALL-TERRAIN CRANE (ATEC) AT422T DIESEL ENGINE DRIVEN, 22 TON CAPACITY TRUCK MOUNTED WITH CAB

NSN 3810-01-448-2619



HEADQUARTERS, DEPARTMENT OF THE ARMY

1 November 1999

WARNING

OPERATIONS ADJACENT TO OVERHEAD LINES ARE PROHIBITED UNLESS ONE OF THE FOLLOWING CONDITIONS ARE SATISFIED.

1	POWER HAS BEEN SHUT OFF AND POSITIVE MEANS TAKEN TO PREVENT LINES FROM BEING ENERGIZED.	
2	POSITION AND BLOCK EQUIPMENT INSURING NO PARTS, INCLUDING CABLE, CAN COME WITHIN THE FOLLOWING CLEARANCES:	VOLTAGE REQD CLEARANCE UNDER 50 KV - 10 FEET 69 KV - 12 FEET 115-161 KV - 15 FEET 230-285 KV - 20 FEET 345 KV - 25 FEET 500 KV - 35 FEET

CHECK WITH YOUR LOCAL POWER SUPPLIER FOR CORRECT LINE VOLTAGE

NOTE

READ AND UNDERSTAND ALL OF THE SAFETY WARNINGS AND CAUTIONS CONTAINED IN SECTION 2 - SAFETY PRECAUTIONS BEFORE OPERATING THE CRANE, DIRECT ANY QUESTIONS THAT YOU MAY HAVE TO YOUR SUPERVISOR FOR CLARIFICATION.

TM 5-3810-307-10

CHANGE NO. 1

HEADQUARTERS, DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 2 JUNE 2006

TECHNICAL MANUAL

OPERATOR'S MANUAL FOR All-Terrain Crane (ATEC) AT422T Diesel Engine Driven, 22 Ton Capacity Truck Mounted With Cab NSN 3810-01-448-2619

DISTRIBUTION STATEMENT A – Approved for public release; distribution is unlimited.

TM 5-3810-307-10, 1 November 1999, is updated as follows:

1. File this sheet in front of the manual for reference.
2. This change is a result of changes documented against the configuration of the crane. Extreme weather equipment including engine coolant and hydraulic reservoir heaters have been added as an option.
3. New or updated test is indicated by a vertical bar in the outer margin of the page.
4. Added illustrations are indicated by a vertical bar adjacent to the figure number. Changed illustrations are indicated by change bars in the outside margin adjacent to the updated area and a change bar adjacent to the figure number.
5. Remove old pages and insert new pages as indicated below:

Remove Pages	Insert Pages
List of Effective Pages	List of Effective Pages
i and ii	i and ii
iii and iv	iii and iv
v and vi	v and vi
1-1 and 1-2	1-1 and 1-2
1-5 and 1-6	1-5 and 1-6
2-33/(2-34 blank)	2-33/(2-34 blank)
4-7/(4-8 blank)	4-7/(4-8 blank)
5-27 and 5-28	5-27 and 5-28
5-29 and 5-30	5-29 and 5-30
5-35 thru 5-38	5-35 thru 5-38
5-49 and 5-50	5-49 and 5-50
5-73 and 5-74	5-73 and 5-74
5-89 thru 5-92	5-89 thru 5-92
5-95 and 5-96	5-95 and 5-96
5-101 and 5-102	5-101 and 5-102
6-23 thru 6-30	6-23 thru 6-30
Appendix A A-1(A-2 blank)	Appendix A A-1(A-2 blank)
Appendix B B-3 thru B-6	Appendix B B-3 thru B-6
Appendix C C-3 and C-4	Appendix C C-3 and C-4

Remove Pages	Insert Pages
Appendix D D-1 and D-2	Appendix D D-1 and D-2
Appendix E E-1 thru E-10	Appendix E E-1 thru E-9/ (E-10 blank)
Appendix F F-1 thru F-6	Appendix F F-1 thru F-6
Appendix F F-29/(F-30 blank)	Appendix F F-29 and F-30
Appendix G (G-1 thru G-39)	Appendix G (G-1 thru G-41/ G-42 blank)
Appendix H (H-1 thru H-18)	Appendix H (H-1 thru H-97/ H-98 blank)
Index-1 thru Index-6	Index-1 thru Index-6

6. Add the following new pages:

5-42a/(5-42b blank)
B-7/(B-8 blank)
Appendix K (K-1 thru K-4)
Appendix L (L-1 thru L-18)
Appendix M (M-1 thru M-12)

By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:

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Administrative Assistant to the
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TM 5-3810-307-10

INSERT LATEST CHANGED PAGES. DESTROY SUPERCEDED DATA.

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NOTE: The portion of text affected by the changes is indicated by a vertical line in the outer margins of the pages. Added illustrations are indicated by a vertical bar adjacent to the figure number. Changed illustrations are indicated by change bars in the outside margin adjacent to the updated area and a change bar adjacent to the figure number.

Dates of issue for original and changed pages are:

Original ..0 1 November 1999

Change ..1 2 June 2006

TOTAL NUMBER OF PAGES FOR THIS MANUAL IS 454 CONSISTING OF THE FOLLOWING:

Page No.	*Change No.	Page No.	*Change No.	Page No.	*Change No.
Cover	0	5-74 – 5-88	0	H-1 – H-97/ (H-98 blank)	1
Blank	0	5-89	1		
Warning	0	5-90	0	I-1 – I-3/ (I-4 blank)	0
Blank	0	5-91	1		
i – iii	1	5-92 – 5-94	0	J-1 – J-3/ (J-4 blank)	0
iv	0	5-95	1		
v – vi	1	5-96 – 5-100	0	K-1 – K-4	1
1-1	0	5-101	1	L-1 – L-18/	1
1-2	1	5-102- 5-110	0	M-1 – M-12	1
1-3 – 1-5	0	6-1 – 6-22	0	Index-1 – Index -6	1
1-6	1	6-23	1		
1-7 – 1-9/ (1-10 blank)	0	6-24	0		
		6-25	1		
2-1 – 2-32	0	6-26 – 6-27	0		
2-33/(2-34 blank)	1	6-28 – 6-30	1		
3-1 – 3-4	0	A-1/(A-2 blank)	1		
4-1 – 4-6	0	B-1 – B-2	0		
4-7/(4-8 blank)	1	B-3 – B-7/ (B-8 blank)	1		
5-1 – 5-26	0				
5-27 – 5-29	1	C-1 – C-3	0		
5-30 – 5-34	0	C-4	1		
5-35 – 5-36	1	D-1 – D-2	1		
5-37	0	D-3 – D-4	0		
5-38	1	E-1 – E-9/ (E-10 blank)	1		
5-39 – 5-42	0				
5-42a/(5-42b blank)	1	F-1 – F-6	1		
		F-7 – F-28	0		
5-43 – 5-48	0	F-29 – F-30	1		
5-49	1	G-1 – G-41/ G-42 blank)	1		
5-50 – 5-72	0				
5-73	1				

* Zero in this column indicates an original page.

OPERATOR'S MANUAL FOR
ALL-TERRAIN CRANE (ATEC)
DIESEL ENGINE DRIVEN, 22 TON CAPACITY
TRUCK MOUNTED WITH CAB
NSN 3810-01-448-2619

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (Recommended Changes to Equipment Technical Publications), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is http://aeps.ria.army.mil. The DA Form 2028 is located under the Public Applications section in the AEPS Public Home Page. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or E-mail your letter or DA Form 2028 direct to: AMSTA-LC-LPIT / TECH PUBS, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The email address is TACOM-TECH-PUBS@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

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TABLE OF CONTENTS – Continued

HOW TO USE THIS MANUAL

This manual contains operation and operator maintenance instructions for the Army's AT422T, 22-ton All-Terrain Crane (ATEC). The manual contains operator instructions, operator troubleshooting, and operator maintenance. Other manuals in the set contain unit and Direct Support/General Support (DS/GS) troubleshooting and maintenance instructions for crane.

Although these manuals do not conform with the format specified for other Army vehicles, the technical data presented herein is essential for properly operating and maintaining the vehicle.

These manuals were developed to help you operate and maintain the equipment. All task descriptions will take you step-by-step through the procedure. Don't take shortcuts. Before you begin any task, you should read through the complete procedure, make sure you know what needs to be done, then go back and follow the steps as written.

Pay particular attention to **WARNINGS**, **CAUTIONS**, and **NOTES**. This will prevent injury to personnel, damage to equipment, and provide clear instructions.

Use the alphabetical index at the back of the manual to find a topic not listed in the table of contents.

The definitions of **WARNING**, **CAUTION**, and **NOTE** as used in this manual apply as follows:

WARNING

A warning or danger is used to emphasize that if an operation, procedure, or practice is not followed exactly, death or injury to personnel may result.

CAUTION

A caution is used to emphasize that if an operation, procedure, or practice is not followed exactly, equipment damage may result.

NOTE

A note is used to emphasize an important procedure or condition.

The following paragraphs provide a general description of each ATEC technical manual.

TM 5-3810-307-10 - Operator's Manual. Contains general theory of operations, operator safety, instructions for driving and operating the crane, operator troubleshooting, and operator maintenance. The manual also contains appendices for:

(1) APPENDIX A. References - Forms and Publications,

(2) APPENDIX B. Components of End Item and Basic Issue Items List (COEI/BII),

(3) APPENDIX C. Additional Authorization List (AAL),

(4) APPENDIX D. Expendable/Durable Supplies and Materials List (EDSML),

(5) APPENDIX E. Load Chart,

(6) APPENDIX F. Location/Description of Signs/Decals/Data Plates,

(7) APPENDIX G. Load Moment Indicator (LMI) Operator's Handbook,

(8) APPENDIX H. Instructions for Installation/Operation of Pile Driver System (Berminghammer),

(9) APPENDIX I. Determination of ATEC Weight Distribution,

(10) APPENDIX J. Transportability Guidance,

(11) APPENDIX K. Winterizing the ATEC Crane,

(12) APPENDIX L. Instructions for Installation/Operation of Pile Driver (Linkbelt),

(13) APPENDIX M. Lubrication,

(14) Alphabetical Index.

TM 5-3810-307-24-1 - Maintenance Manual with Supplemental Data. This manual consists of two volumes: Volume one is the basic service manual and Volume two is the Service Maintenance (SM) packages.

Volume one, the service manual, is divided into chapters and sections. Chapter One contains general maintenance information, preventive maintenance, lubrication, and troubleshooting. Chapter Two covers specific vehicle component removal/replacement procedures. Where vehicle components are repairable, the replacement procedure may refer to an SM package for repair. The Maintenance Allocation Chart is also included as an appendix to volume one.

Volume Two covers the SM packages that contain repair procedures for selected components of the vehicle. Each SM package is complete with its own Table of Contents. Any requirement for tools and materials to perform each repair task is also listed.

TM 5-3810-307-24-2 - Diesel Engine Operation and Maintenance Manual. This manual also consists of two volumes: Volume one is the Cummins operation and maintenance handbook while volume two contains engine repair information. Each manual has been edited specifically for the ATEC. Included are preventive maintenance, troubleshooting, adjustment/repair/ replacement specifications/torques values, and warranty data.

TM 5-3810-307-24P – Repair Parts and Special Tools List (RPSTL). Contains a complete illustrated parts breakdown for the ATEC. Also included are:

(1) Introduction Work Package,

(2) Repair Parts List Work Package,

(3) Special Tools Work Package,

(4) Cross-Reference Index Work Packages.

WARRANTY INFORMATION

All warranty information and directions for taking warranty actions are addressed in TB 5-3810-307-14.

WARNING

Structural repairs and/or modifications must be approved by the manufacturer. Repair requests should be submitted to Manitowoc® Crane CARE, P.O. Box 21, Shady Grove, PA 17256-0021, USA. Any unauthorized repairs and/or mod-ification could void any remaining crane warranty.

SECTION 1

GENERAL

1-1. INTRODUCTION.

This handbook provides information for the operator of the AT422T Grove All-Terrain Crane (ATEC).

The lift capacities are listed on the Load Chart in Appendix E.

The all-terrain crane incorporates an all welded steel frame using planetary drive axles to provide selectable four-wheel drive. Axle steering is accomplished utilizing hydraulic steer cylinders. The engine is mounted at the front of the crane and provides motive power through a six speed transmission. Hydraulic, double box, sliding beam outriggers are integral with the carrier frame. Figure 1-1 will be useful in locating components of the crane.

The carrier frame incorporates oscillation lockout cylinders to which the axles are mounted. Axle oscillation is provided through the front and rear axle suspension cylinders.

The superstructure is capable of continuous 360 degree rotation in either direction. All crane functions are controlled from the fully-enclosed cab mounted on the superstructure. On site travel can also be accomplished from driving controls located in the superstructure cab. The basic crane is equipped with a three-section, trapezoidal, cable synchronized boom. Lifting is provided by a main hoist and an auxiliary hoist.

The crane is also capable of supporting and operating a clamshell bucket, a pile driver, a concrete bucket, and a grapple. Special hardware adapters and hydraulic quick disconnects have been provided for attaching these components. The crane is equipped with the following additional equipment requirements: NATO socket; 24-volt electrical system; air conditioning; AOAP valves for engine oil, transmission, and hydraulic system; pintle hooks; specific tiedown brackets; black out lights; decontamination canister bracket; additional safety and other decals; weight classification sign kit; emergency recovery system (electric over hydraulic); rifle rack; catwalk bracket; and CARC paint.

NOTE

Throughout this manual, reference is made to left, right, front, and rear when describing locations. When operating the crane from the carrier, these reference locations are to be considered as those viewed from the operator's seat with the super-structure facing forward over the front of the carrier frame.

1-2. LIST OF SPECIFICATIONS.

GENERAL.

Model	AT422T
Rated Capacity	See Load Chart, Appendix E
Drive	4 x 4 x 4
Gross Weight	See Lifting and Transportation decal located on the side of the right-front deck

DIMENSIONS.

NOTE

Dimensions listed are with all components fully retracted.

Overall Crane Length	396.00 in. (1005.84 cm)
Overall Crane Width	96.00 in. (243.8 cm)
Overall Crane Height	126.00 in. (320.04 cm)
Track Width	78.38 in. (199.1 cm)
Turning Radius (2 Wheel Steering)	331 in. (840.7 cm)
Turning Radius (4 Wheel Steering)	198 in. (509.9 cm)
Wheel Base	121.0 in. (307.3 cm)
Centerline of Rotation	40.0 in. (101.6 cm)

CAPACITIES.

Fuel Tank	
(Reservoir Capacity)	44.0 gal. (166.6 L)
(Draw Capacity)	42 gal. (160.0 L)
Coolant System	Liquid - 10.5 gal. (39.7 L)
Radiator only	35 qts (33.1 L)
Engine Lubrication System	17.3 qts (16.4 L)
Hydraulic Tank	
(Total Reservoir Capacity)	72.8 gal. (275.6 L)
(Full Level)	64.4 gal. (243.0 L)
(Low Level)	59.9 gal. (226.7 L)
Hoist	
Grove Model HO-15C-16	9.0 qt (8.5 L)
Swing Gearbox	2 qts (1.9 L)
Swing Brake	1/2 pt (.24 L)
Axle Planetary Ends	1.5 qts (1.5 L)
Differential	14 qts (13 L)
Transmission and Torque Converter	28 qts (26.5 L)

ENGINE.

Make and Model	Cummins B5.9-190
Type	6 Cylinder Diesel
Bore	4.02 in. (102.1 mm)
Stroke	4.72 in. (120.0 mm)
Displacement	359 $in.^3$ (5.9 L)

ENGINE - Continued.

Max Power	190 hp @ 2300 rpm
Governed RPM	
No Load	2875
Full Load	2500
Idle	840 (± 25)
Power at Governed RPM	185 hp @ 2500
Torque (Net)	475 lb ft (644 Nm) @ 1500 RPM
Combustion System	4 Cycle, Turbocharged and Charge Air Cooled
Fuel Injection Pump	Bosch In-Line Injection Pump, Model P7100
Fuel Transfer Pump	Plunger Piston Type, 25 psi (172 kPa) output

TRANSMISSION.

Manufacturer	Clark
Model	13.9 LFHR24658 w/APC 100 Auto Shift
Speeds	6
Gear Ratios	
Fwd 1st	9.07:1
2nd	6.32:1
3rd	3.57:1
4th	2.49:1
5th	1.19:1
6th	0.83:1
Rev 1st	9.07:1
2nd	3.57:1
3rd	1.19:1
Filter	Remote mounted
Transmission Oil Cooler	Remote mounted
Torque Converter	Clark 13.9 w/Lockup and Freewheel

AXLES.

Manufacturer	Kessler
Model (Front and Rear)	LT 51 PL 375
Capacity	22,475 lbs @ 55 mph (10,194 kg @ 88 km/h)
Ratio	9.06:1
Track (Front and Rear)	78.38 in. (199.1 cm)

BRAKES.

Front	Perrot Air Twin Wedge 410 x 180 DE
Rear	Perrot Air Single Wedge 410 x 180 ZE

Service Brake Actuators.

Manufacturer	WABCO
Size	
Front	Type 16 (2 per wheel)
Rear	Type 20 (1 per wheel)

BRAKES - Continued.

Parking Brake Actuator.

Manufacturer . . . . . WABCO
Size
Front . . . . . Type 16 (1 per wheel)
Rear. . . . . Type 24 (1 per wheel)

WHEELS AND TIRES.

Type . . . . . Disc
Rim Width. . . . . 10.0 in. (25.4 cm)
Bead Seat Diameter . . . . . 21.0 in. (53.3 cm)
Capacity. . . . . 11,050 lbs-55 mph (5,012 kg-88 km/h)
Lugs
Front Axle 10
Rear Axle 10
Torque . . . . . 480 Ft-Lbs (651 Nm)
Tires:
Size 16.00 R21
Rating. . . . . 22 Ply
Capacity . . . . . 14,540 lbs-55 mph (6,595 kg-88 km/h)
Load Range . . . . . M
Pressure (Cold) . . . . . 110 psi (758 kPa)
to ensure full mission capability
(i.e., lifting on rubber)

SUSPENSION.

Front and Rear. . . . . Leaf Spring w/Hollow
rubber helper spring
Capacity. . . . . 22,046 lb (10,000 kg) each at ground

CARRIER STEERING.

System . . . . . ZF semi-integral, dual circuit steering gear
Manufacturer . . . . . Z.F.
Model 7421 965 112
Type . . . . . Recirculating Ball w/Worm Gear
Steering Ratio 18:1:1

STEERING PUMP PRIMARY.

Manufacturer . . . . . Dana Corporation
Part Number PVP16-115C-JU
Type . . . . . Gear, Clockwise Rotation
Output . . . . . 8 gpm (30.2 lpm)
controlled flow

STEERING PUMP EMERGENCY.

Manufacturer	Dana Corporation
Part Number	SSP2-85-DRW
Displacement per rev	1.68 in^3

SUPERSTRUCTURE STEERING CONTROL VALVE

Manufacturer	Eaton
Model	211-1012-002
Displacement	14.8 cu in. (242.5 cu cm) per rev.
Capacity	8 gpm (30 lpm)

MAIN HYDRAULIC PUMP.

Manufacturer	Commercial
Type	Gear
Sections	3
GPM @ 2500 rpm	39 gpm (147 lpm) 39 gpm (147 lpm) 16 gpm (61 lpm)

SWING MOTOR.

Manufacturer	Eaton
Model	H Series
Type	Orbit
Displacement per rev	6.2 in^3 (15.7 cm^3)

SWING GEARBOX.

Manufacturer	Grove
Type	Planetary Gear Reduction
Reduction Ratio	27.98:1

BOOM.

Elevation	-3º to 78º
Sections	Three, fully synchronized
Length	27-70 ft (8.2-21.3 m)
Power	Single stage telescoping cylinder w/ cable synchronization

HOISTS - MAIN AND AUXILIARY.

Manufacturer	Grove
Model	HO-15C-16
Type	Planetary gear reduction
Drum Dimension	
Diameter	12 in. (30.5 cm)
Length	16 in. (40.6 cm)

HOISTS - MAIN AND AUXILIARY - Continued.

Wire Rope
- Size . . . . . 0.625 in. (16 mm)
- Length . . . . . 365 ft (111.0 m)

Permissible Line Pull . . . . . Refer to Load Chart

OUTRIGGERS.

Type . . . . . Double box beam and inverted jack

Spread
- Extended . . . . . 18.5 ft (5.6 m)
- Retracted . . . . . 7.5 ft (2.3 m)

AIR COMPRESSOR.

NOTE

Check the identification plate on the air compressor to determine which model (Holset or Wabco) is installed on your crane.

Manufacturer . . . . . Holset
Model QE296B
Number of Cylinders 1
Piston Displacement @ 1250 RPM . . . . . 13.2 ft³/min (62,297 cm³/sec)

Manufacturer . . . . . Cummins/Wabco
Model 250CC
Number of Cylinders 1
Piston Displacement @ 1250 RPM . . . . . 15.2 ft³/min (71,736 cm³/sec)

AIR/HYDRAULIC SWIVEL.

Manufacturer . . . . . Grove

Ports
- Air 6
- Hydraulic 8

ELECTRICAL SYSTEM.

System Voltage . . . . . 24 VDC negative - ground (chassis ground)

Starter
- Manufacturer . . . . . Delco-Remy
- Model 37MT

Batteries
- Number 4
- Model 6TL (MS52149-2)

Alternator
- Manufacturer . . . . . Delco-Remy
- Type . . . . . 21-SI Series, Negative-Ground
- Part Number 1117900
- Rating . . . . . 70 amperes

Slip Ring Assembly
- Manufacturer . . . . . United Equipment Accessories
- Type . . . . . 49 Conductor, RC850 A Series
- Part Number S15AP49GR1

CAB HEATING AND AIR CONDITIONING.

Carrier Heater.

Manufacturer . . . . . Hunter
Model HW30-5
Type . . . . . Hot Water

Carrier Air Conditioner.

Manufacturer . . . . . Red Dot Corporation
Model . . . . . Grove PN 7576001682
Type . . . . . Roof Mounted
Refrigerant R134A
Lubricant . . . . . Red Dot PN 79R4590, 5 oz (0.15 l)

Superstructure Heater.

Manufacturer . . . . . Hunter
Model DH22-17A
Type . . . . . Internal Combustion
Voltage . . . . . 24 volts
Fuel . . . . . Diesel
Ignition. . . . . Solid State (6000 V)
Rating . . . . . 20,000 BTU/hr

Superstructure Air Conditioner.

Refrigerant Compressor
- Manufacturer . . . . . Red Dot Corporation
- Max Speed. . . . . 7000 rpm
- Refrigerant. R134A
- Lubricant . . . . . Red Dot PN 79R4590, 5 oz (0.15 l)

FIRE EXTINGUISHER.

Manufacturer . . . . . Mellits Fire Equipment
Type . . . . . Dry Chemical
Rating 1-A:10-B:C
Weight. . . . . 2.50 lb (1.13 kg)

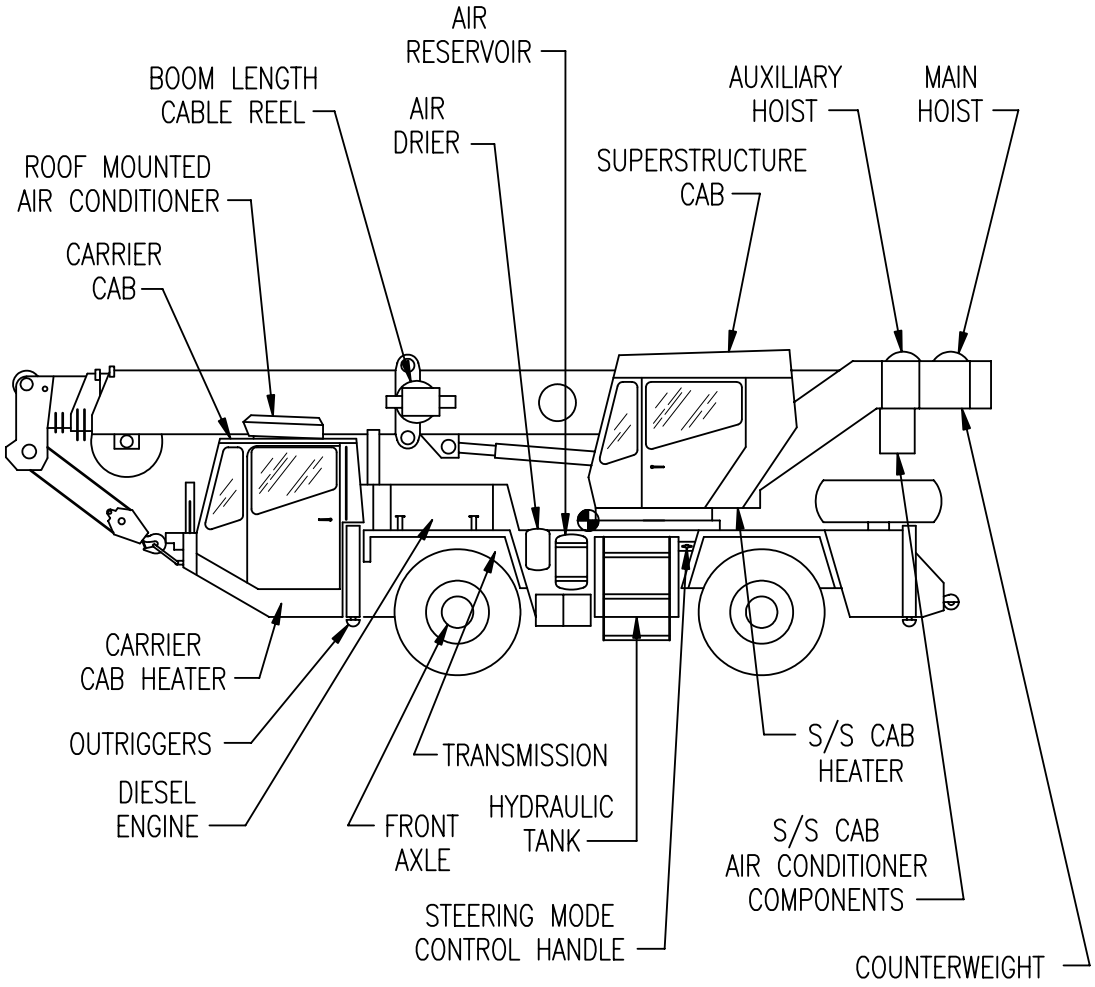


Figure 1-1. Basic Nomenclature (Sheet 1 of 2)

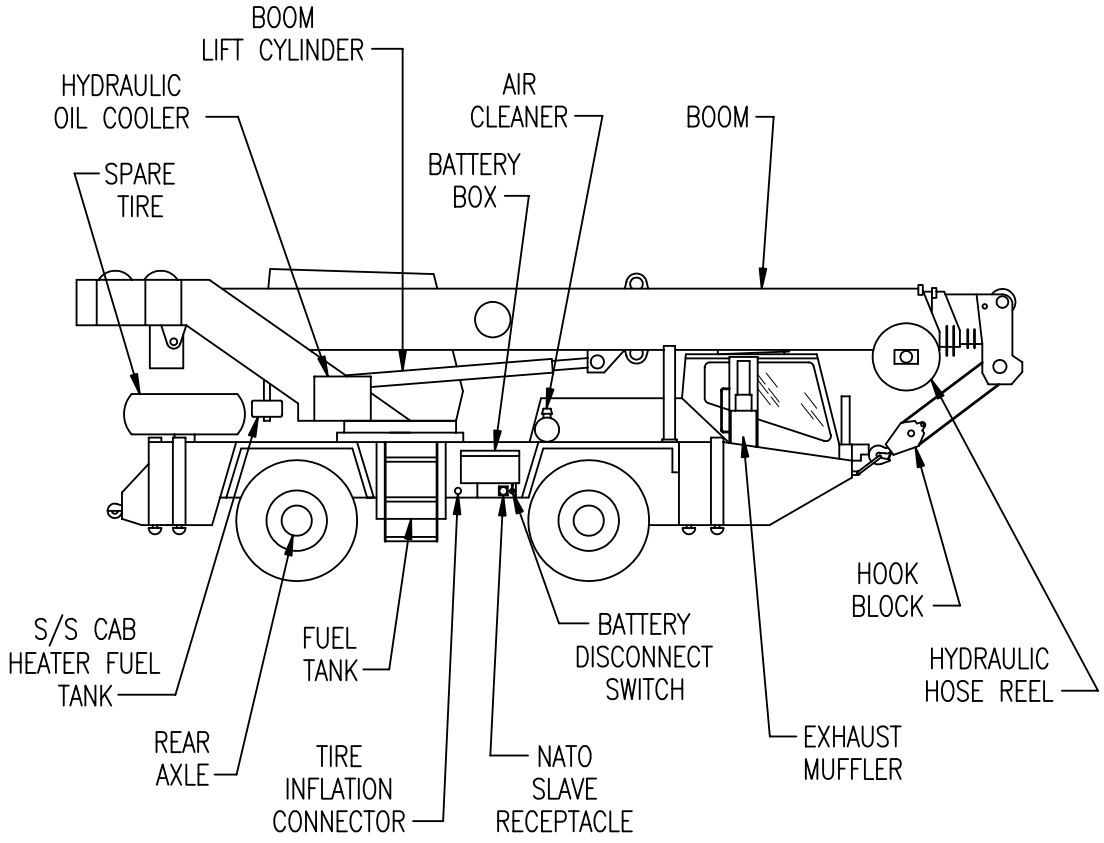


Figure 1-1. Basic Nomenclature (Sheet 2 of 2)

SECTION 2

SAFETY PRECAUTIONS

2-1. GENERAL.

NOTE

Illustrations have been included in this section to emphasize certain proper and improper points; READ AND FOLLOW PRINTED INSTRUCTIONS.

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.

With this thought in mind, this information has been provided to assist you, the operator, 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, the operator, 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, the operator, 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.

IMMEDIATELY report all accidents, malfunctions, and equipment damages to your local Grove distributor. Following any accident or damage to equipment, the local 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 Worldwide Product Support. 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 local Grove Worldwide distributor and/or Grove Worldwide.

2-2. OPERATOR'S INFORMATION.

You must READ and UNDERSTAND the Operator's and Safety Handbook and the Load Chart before operating the crane. This handbook and the Load Chart must be readily available to the operator at all times and they must remain in the cab while the crane is in use.

Ensure 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 placards and decals on the crane. Decals provide important instructions and warnings and must be read prior to any operational or maintenance function.

You must be familiar with the regulations and standards governing cranes and their 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.

DO NOT REMOVE the load chart, this Operator's and Safety Handbook or any decal from this crane.

Inspect the crane every day (before the start of each shift). Ensure that routine maintenance and lubrication are being dutifully performed. Do not operate a damaged or poorly maintained crane. You risk lives when operating faulty machinery, including your own.

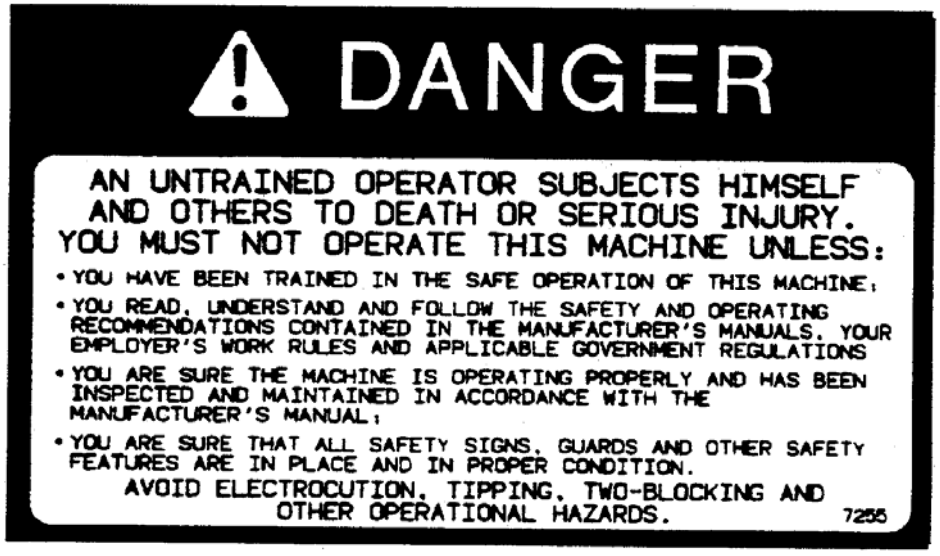
Only the crane operator shall occupy the crane when traveling or in operation.

2-3. OPERATOR'S QUALIFICATIONS.

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

YOU MUST NOT OPERATE THIS MACHINE UNLESS:

- You have been trained in the safe operation of this machine;
- You 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 machine is operating properly and has been inspected and maintained in accordance with the manufacturer's manuals;
- You are sure that all safety signs, 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.

2-4. CRANE STABILITY/STRUCTURAL STRENGTH.

To avoid death or serious injury, ensure that the crane is on a firm surface with load and crane's configuration within capacity as shown on the crane's load rating chart and notes.

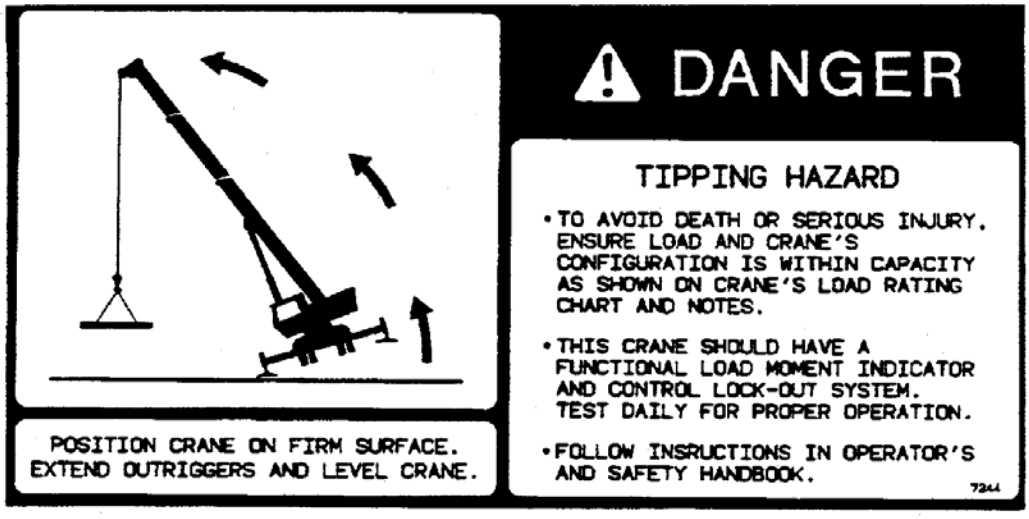
Do not lift loads unless the outriggers are properly extended and the crane leveled. On models equipped with outriggers that can be pinned at the mid-extend position, the outriggers must also be pinned when operating from the mid-extend position.

This crane should have a functional load moment indicator and control lock-out system. Test daily for proper operation. Never interfere with the proper functioning of operational aids or warning devices.

Before swinging the superstructure over the side when the outriggers are retracted, check the load chart for backwards stability.

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. Ensure the outriggers (or tires if lifting on rubber) are firmly positioned on solid surfaces. Ensure 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.



Ensure all pins and floats are properly installed and outrigger beams are properly extended before lifting on outriggers.

Unless lifting within "on rubber" capacities, outrigger beams must be properly extended and jack cylinders extended and set to provide maximum leveling of the crane. 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. Tires must be clear of the ground before lifting on outriggers. Remove all weight from tires before lifting on outriggers.

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

Carefully follow the procedures in this handbook when extending or retracting the outriggers. Death or serious injury could result from improper crane set-up on outriggers.

Be sure the outriggers are properly extended and set and the crane is level for operation on outriggers.

All four outrigger beams must be equally extended to the appropriate vertical stripe before beginning operation.

All four outrigger beam lock pins must be engaged before operating from the mid-extend position.

The operator must select the proper load chart and LMI program for the outrigger position selected.

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

2-4.1 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.

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.

2-4.2 Work Site.

Prior to any operation, you must inspect the ENTIRE work-site, including ground conditions, where the crane will travel and operate. Be sure that the surfaces will support a load greater than the crane's weight and maximum capacity. Barricade the area where the crane is working and keep all unnecessary personnel out of that area.

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

Use caution when operating in the vicinity of overhanging banks and edges.

Wind and other factors such as boom length, boom angle, size and weight of load, etc., can affect crane stability and crane structures. If wind velocity exceeds 20 mph (32 km/h), rated loads and boom lengths shall be appropriately reduced. Practical working loads for each particular job and lift shall be established by the user depending upon conditions that exist at the time a lift is being made. Appropriate capacity reductions shall be made whenever conditions indicate the possibility that a loss of crane stability or structural damage could occur. The crane should not be operated at winds above 30 mph (48 km/h).

2-4.3 Lifting Operations.

If the boom extension, jib, or auxiliary boom nose is to be used, ensure the electrical cable and the weight for the anti-two block switch are properly installed and the LMI is programmed for the crane configuration. Refer to the LMI handbook supplied with the crane.

Before lifting, position the crane on a firm surface, properly extend and set the outriggers, and level the crane.

If the boom extension or auxiliary boom nose is to be used, you must ensure that the cable for the LMI system is properly connected at the junction box located on the boom nose.

Depending on the nature of the supporting surface, adequate cribbing may be required to obtain a larger bearing surface.

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.

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

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.

Be sure 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, jib, 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.

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.

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

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 rating 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.

Wind and other factors such as boom length, boom angle, size and weight of load being lifted, etc., can affect crane stability and crane structures. Practical working loads for each particular job and lift shall be established by the user depending upon conditions that exist at the time a lift is being made. Appropriate capacity reductions shall be made whenever conditions indicate the possibility that a loss of crane stability or structural damage could occur. Be extremely cautious if wind velocity approaches 20 mph (32 km/h). The crane should not be operated at winds above 30 mph (48 km/h).

The crane cab is equipped with a sight level bubble 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 be sure it is in-line with the center of the boom at all points on the swing circle.

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. Ensure the load capacity chart is not exceeded when this occurs.

Be sure 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.

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.

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

Use only one hoist at a time when lifting loads.

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 wire rope.

Never operate the crane with less than two wraps of wire rope on the hoist drum.

2-4.4 Counterweight.

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

Death or serious injury could result from being crushed by moving machinery. Clear all personnel from the counterweight and superstructure area before raising or lowering the counterweight or when rotating the superstructure.

To reduce the crushing hazard and to prevent death or serious injury, always clear all personnel from the counterweight area before moving the counterweight.

Federal law prohibits modification or additions which affect the capacity or safe operation of the equipment without the manufacturer's written approval. [29CFR 1926.550]

Do not add material to the counterweight to increase capacity.

2-4.5 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 engineer. You, the operator, shall be responsible for assuring that one qualified signal person is used, communication between all parties is maintained, and load lines are kept directly over the attach points to avoid side loading and transfer of loading from one crane to another.

Use cranes and rigging of equal capacities and use the same boom lengths.

Be certain of adequate lifting capacity. Calculate the amount of weight to be lifted by each crane and attach slings at the correct points for proper weight distribution.

DO NOT TRAVEL - Lift only from a stationary position.

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:

1. Secure the services of a qualified engineer to direct the operation.

2. Use one signal person and be sure he is qualified.

3. Coordinate lifting plans with the operator, engineer, and signal person prior to beginning the lift.

4. Use cranes and rigging of equal capabilities and use the same boom length. Be certain cranes are of adequate lifting capacity.

5. Use outriggers on cranes so equipped.

6. Calculate the amount of weight to be lifted by each crane and attach slings at the correct points for proper weight distribution.

7. Lift only from a stationary position - DO NOT TRAVEL.

8. If possible, provide approved radio equipment for voice communication between all parties engaged in the lift.

9. Ensure the load lines are directly over the attach points to avoid side loading the cranes.

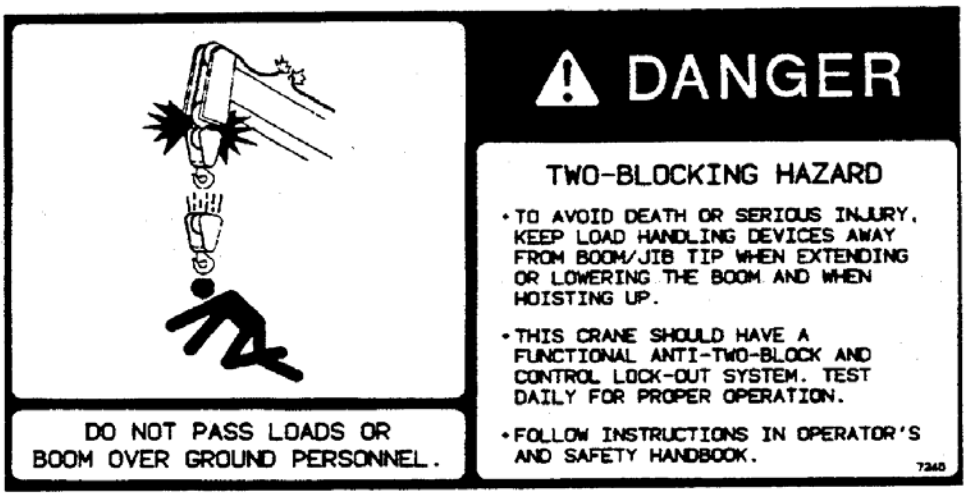
2-5. TWO BLOCKING.

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

This crane should have a functional ANTI-TWO BLOCK and CONTROL LOCK-OUT system. Test daily for proper operation.

Do not pass loads or boom over ground personnel.

Two blocking occurs whenever the load block (hook block, headache ball, rigging, etc.) comes into physical contact with the boom (boom nose, sheaves, jib, etc.). Two blocking can cause hoist lines (wire rope) rigging, reeving, and other components to become highly stressed and overloaded, in which case the wire rope may fail allowing the load, block, etc., to free 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/jib 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/jib nose, thus causing damage to the sheaves, or causing the wire rope to fail, dropping the lifting device to the ground and possible injuring personnel working below.

Caution must be used when lowering or extending the boom. 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 wire rope as the boom is lowered. Keep load handling devices a minimum of 18 in. (45.7 cm) 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.

Barricade the area where the crane is working and keep all unnecessary personnel out of that area. DO NOT allow personnel to be under the load or boom.

Never pass loads, load handling devices, or the crane boom over people on the ground.

Never operate the crane with less than two wraps of wire rope on the hoist drum.

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

2-6. LOAD MOMENT INDICATING SYSTEMS.

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.

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 ensure the load to be lifted at the desired radius is within the rated capacity of the crane.

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

For detailed information concerning the operation and maintenance of the load moment indicating system installed on the crane, see the manufacturer's manual supplied with the crane.

2-7. ELECTROCUTION HAZARD.

To avoid death or serious injury, keep all parts of this machine, the rigging, and materials being lifted at least twenty (20) feet away from all electrical power lines and equipment.

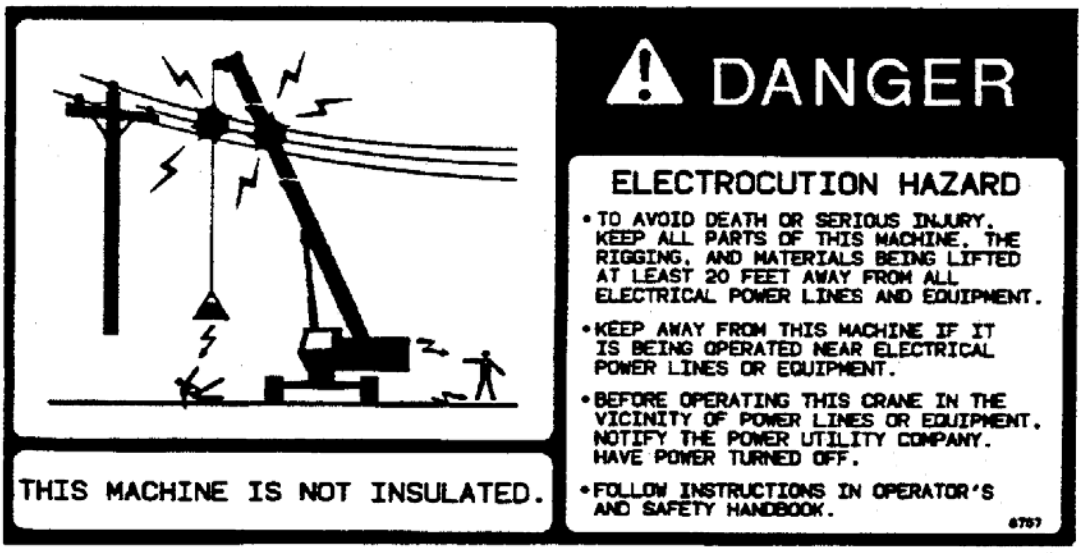
Keep all personnel away from this machine if it is being operated near electrical power lines or equipment.

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 machine is NOT INSULATED. Always consider all parts of the load and the crane, including the wire rope, hoist cable, pendant cables, and tag lines as conductors.

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 handbook must be followed at all times, even if the electrical power lines or equipment have been de-energized.



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.

If the load, wire rope, crane 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.

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

You, the operator, are responsible for alerting all personnel of dangers associated with electrical power lines and equipment. The crane is not insulated. 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.

Even if the crane operator is not affected by an electrical contact, others in the area may become seriously injured or killed.

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.

Thoroughly read, understand, and abide by all applicable federal, state, and local regulations.

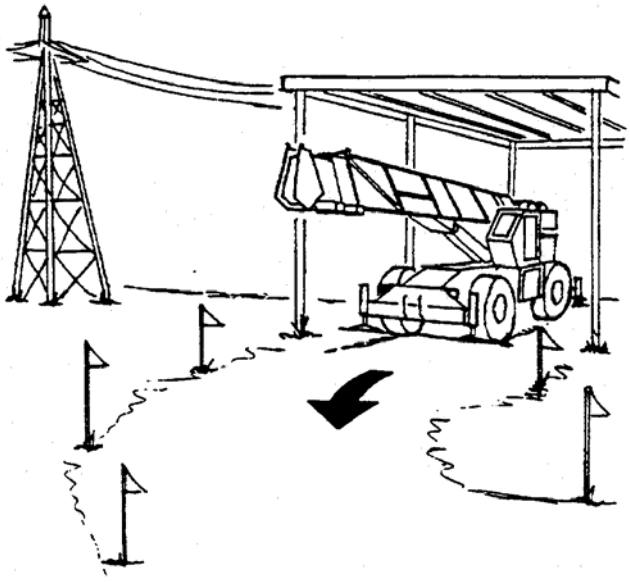
Federal law prohibits the use of cranes closer than 10 ft (3.05 m) to power sources up to 50,000 volts and greater distances for higher voltages. [29CFR1910.180 and 29CFR1926.550] Grove recommends keeping cranes twice the minimum distance (e.g., 20 ft (6.10 m) as specified by U.S. Department of Labor - Occupational Safety and Heath Administration (OSHA) standards.

2-7.1 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 20 ft (6.10 m) of electrical power lines or equipment. This includes the crane boom (fully extended to maximum height, radius and length) and all attachments (jibs, 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.

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 should 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.

2-7.2 Electrocution Hazard Devices.

The use of insulated links, insulated boom cages/guards, proximity warning devices, or mechanical limit stops 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 handbook 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 supposed to detect the existence of electricity and not its quantity or magnitude.
- Some proximity devices will 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 and 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 (wire) conductor used, the condition of the ground, the magnitude of the voltage and current present, and numerous other factors.

2-7.3 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 are likely to remain 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 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 local, authorized Grove Worldwide distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Thoroughly inspect the wire rope and all points of contact on the crane. Should the distributor not be immediately available, contact Grove Worldwide Product support. 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 Grove Worldwide or your local Grove Worldwide distributor.

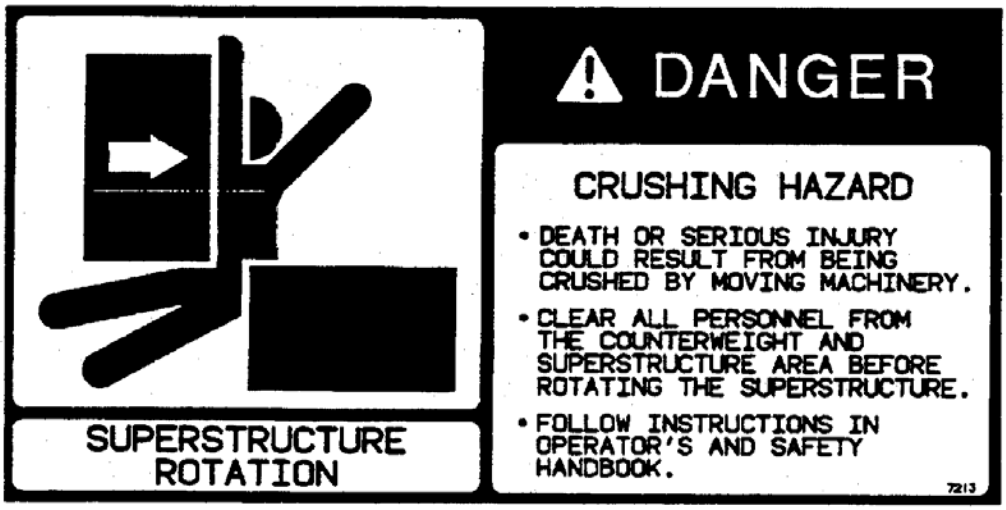
2-7.4 Special Operating Conditions and Equipment.

Never operate the crane during an electrical thunderstorm.

Working in the vicinity of radio frequency transmission towers and other transmission sources may cause a crane to become "electrically charged".

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.

2-8. CRUSHING HAZARDS.



Death or serious injury could result from being crushed by moving machinery.

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

Barricade the entire area where the crane is working and keep all unnecessary personnel out of the work area.

Never allow anyone to stand or work on or near the superstructure while the crane is in operation. Always barricade the tail-swing of the rotating superstructure.

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

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.

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

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.

Death or serious injury could result from being crushed by moving machinery.

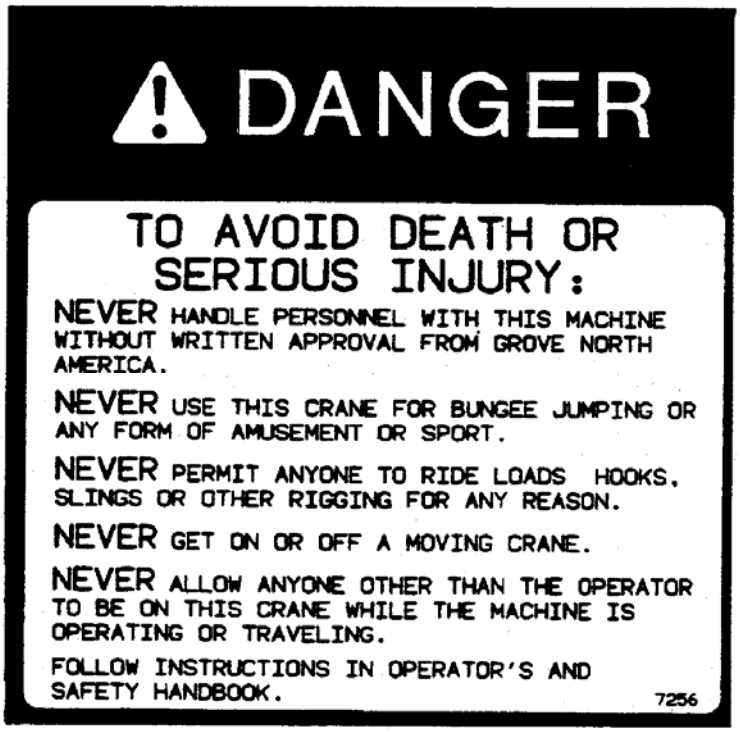
Clear all personnel from the outrigger area before extending or retracting the outriggers.

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

2-9. PERSONNEL HANDLING.

To avoid death or serious injury:

- NEVER handle personnel with this machine without written approval from Grove Worldwide.
- NEVER use this crane for bungee jumping or any form of amusement or sport.
- NEVER permit anyone to ride loads, hooks, slings, or other rigging for any reason.



- NEVER get on or off a moving crane.
- NEVER allow anyone other than the operator to be on this crane while the machine is operating or traveling.

It is against federal law [OSHA - 29CFR1926.550(g)] to use a crane to handle personnel unless there is no less hazardous means to perform the work that needs to be done.

If you wish to use a Grove crane to handle personnel, you must contact your local, authorized Grove Worldwide distributor for further information on how to obtain Grove Worldwide's approval for your particular crane and application.

2-10. TRAVEL OPERATION.

Strictly adhere to the guidelines and restrictions in the load chart for pick and carry operations.

Check load limits of bridges. Before traveling across bridges, ensure they will carry a load greater than the crane's weight.

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

When moving in tight quarters, post a look-out to help guard against collisions or bumping structures.

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

When traveling, the boom should be completely retracted and lowered to the travel position.

If equipped with HI-SPEED GLIDE, follow instructions and conditions in Section 4 of this handbook. Never engage the HI-SPEED GLIDE system with a load on the hook.

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

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

When traveling, keep the lights on, use traffic warning flags and signs, and use front and rear flag vehicles. Check state and local restrictions and regulations.

Drive carefully and avoid speeding.

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

Secure the turntable before moving crane, use the swing lock.

Stay alert at the wheel.

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

When shutting down the crane, adhere to the following;

- engage the parking brake,
- lower the boom and the load,
- place the controls in neutral,
- chock the wheels,
- ensure the swing lock is engaged,
- remove the ignition key,
- lock the machine and install vandal guards, if used.

2-11. MAINTENANCE.

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

Keep the crane properly maintained and adjusted at all times. 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 handbook when performing crane maintenance as well as crane operations.

Before crane use:

- Conduct a visual inspection for cracked welds, damaged components, loose pin/bolt, 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.

- Check for proper functioning of all controls and operator aids (e.g. LMI).

- Check all braking (e.g. wheel, hoist, and swing brakes) and holding devices before operation.

Keep brakes properly adjusted. Keep brake linings free of oil and grease. Do not over lubricate the bearings or brake anchor pins. Refer to the Preventive Maintenance Checks and Services (PMCS), Section 5.

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

ROUTINE MAINTENANCE and INSPECTION of this crane must be performed by a qualified person(s) according to the recommendations in the Grove Worldwide Crane Maintenance and Inspection Manual. Any questions regarding procedures and specifications should be directed to your local, authorized Grove Worldwide Distributor.

2-11.1 Service and Repairs.

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 handbook and the Service Manual for this machine. 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 Worldwide is STRICTLY PROHIBITED. Such action invalidates all warranties and makes the owner/user liable for any resultant accidents.

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.
- 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.

Recognize and avoid pinch-points while performing maintenance. Stay clear of sheave wheels, holes, and lattice work in crane booms.

After maintenance or repairs:

- Replace all guards and covers that had been removed.
- Remove all tags, connect the battery, and perform a function check of all operating controls.
- Load tests must be performed when a structural or lifting member is involved in a repair.

2-11.2 Lubrication.

The crane must be lubricated according to the factory 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:

1. Follow the manufacturer's recommendations when adding oil to the system. Mixing the wrong fluids could destroy seals, causing machine failure.

2. Be certain all lines, components, and fittings are tight before resuming operation.

3. When checking for suspected leaks, use a piece of wood or cardboard and wear appropriate personal protective equipment.

4. Never exceed the manufacturer's recommended relief valve settings.

2-11.3 Tires.

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

Ensure all lug nuts are properly torqued.

Ensure pneumatic tires are inflated to the proper pressure (refer to the Tire Inflation Decal on the crane). When inflating tires, use a tire gauge, clip-on inflator, and extension hose which will permit standing clear of the tire while inflating.

2-11.4 Wire Rope.

Use ONLY the wire rope specified by Grove as indicated on the crane's load capacity chart. Substitution of an alternate wire rope may require the use of a different permissible line pull and, therefore, require different reeving.

Always make daily inspections of the wire rope, keeping in mind that 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:

1. 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.

2. For running ropes other than rotation resistant - six (6) broken wires in one rope lay or three (3) broken wires in one strand.

3. One valley break where the wire fractures between strands in a running rope is cause for removal.

4. Abrasion of the rope resulting in wear of the individual outside wires of 1/3 of the original wire diameter.

5. Any kinking, bird caging, crushing, corrosion, or other damage resulting in distortion of the rope structure.

6. Rope that has been in contact with a live power line or 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.

7. 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.

8. Core deterioration is usually observed as a rapid reduction in rope diameter and is cause for immediate removal of the rope.

Refuse to work with worn or damaged wire rope.

When installing and inspecting wire ropes and attachments, 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.

Periodic rope inspection records are required by law. Make sure these records have been reviewed and are up to date.

When installing new rope:

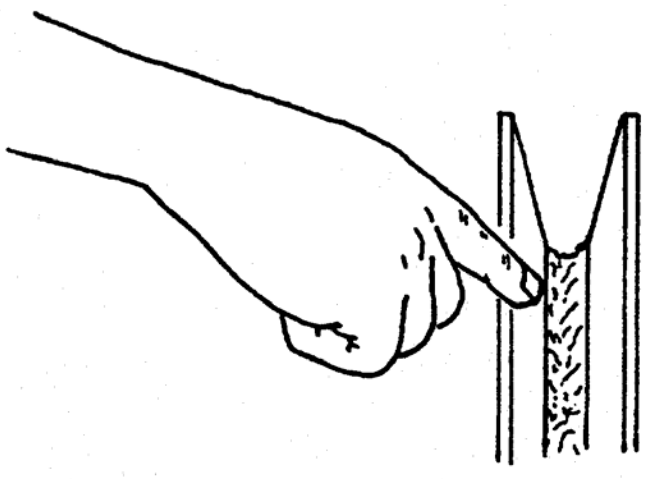
- Follow proper instructions for removing rope from a reel.
- Apply back tension to the storage/payoff reel of the new rope to ensure tight, even spooling onto the hoist drum.
- Operate the new rope, first through several cycles at light load and then through several cycles at intermediate load to allow 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.

Never overload or shock load a wire rope.

Lubricate the wire rope periodically as the lubricant becomes depleted.



Inspect the boom nose and hook block sheaves for wear. Damaged sheaves cause rapid deterioration of wire rope.

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

The use of cast nylon (nylatron) sheaves, as compared with steel sheaves, will substantially increase the service life of wire 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.

2-12. 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:

- Disconnect the batteries.
- Wear safety glasses when servicing batteries.
- Do not short across the battery posts to check charge. Short circuit, spark, or flame could cause battery explosion.
- Maintain battery electrolyte at the proper level. Check the electrolyte with a flashlight.
- Check battery test indicator on maintenance-free batteries.
- 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.
- Check battery condition only with proper test equipment. Batteries shall not be charged except in an open, well ventilated area free of flame, smoking, sparks, and fire.

2-13. ENGINE.

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.

2-14. WORK PRACTICES.

2-14.1 Crane Access.

You must take every precaution to ensure 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).

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

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.

Wear shoes with a highly slip-resistant sole material. Clean any mud or debris from shoes before entering the crane cab or climbing onto the crane superstructure. Excessive dirt and debris on the hand-holds, 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 make modifications or additions to the crane's access system that have not been evaluated and approved by Grove Worldwide.

2-14.2 Job Preparation.

You must inspect the crane prior to your work shift; checking for cracked welds, damaged components, and evidence of improper maintenance (consult Maintenance/Inspection and Service Manuals).

You must ensure that the crane is properly equipped including access steps, covers, doors, guards, and controls.

You must ensure that the outriggers 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.

Wear appropriate clothing and personal protective equipment whether or not required by local or job regulations. Be prepared for the work day.

Before entering the cab, you must be THOROUGHLY familiar with the planned route of travel and area of operation, including surface conditions and the presence of overhead obstructions and power lines.

Always keep the crane clean and free of dirt, debris, and grease.

Fuel the crane ONLY with the engine turned off. Do not smoke while fueling the crane. Do not store flammable materials on the crane or in the operator's cab.

Follow standard safety precautions when refueling. FUEL IT SAFELY.

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

Cold weather requires special starting procedures, use of built-in starting aids, if provided, and ample time for hydraulic oil to warm up. Keep the crane free of ice and snow.

2-14.3 Working.

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

Keep unauthorized personnel clear of the working area during operation.

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.

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

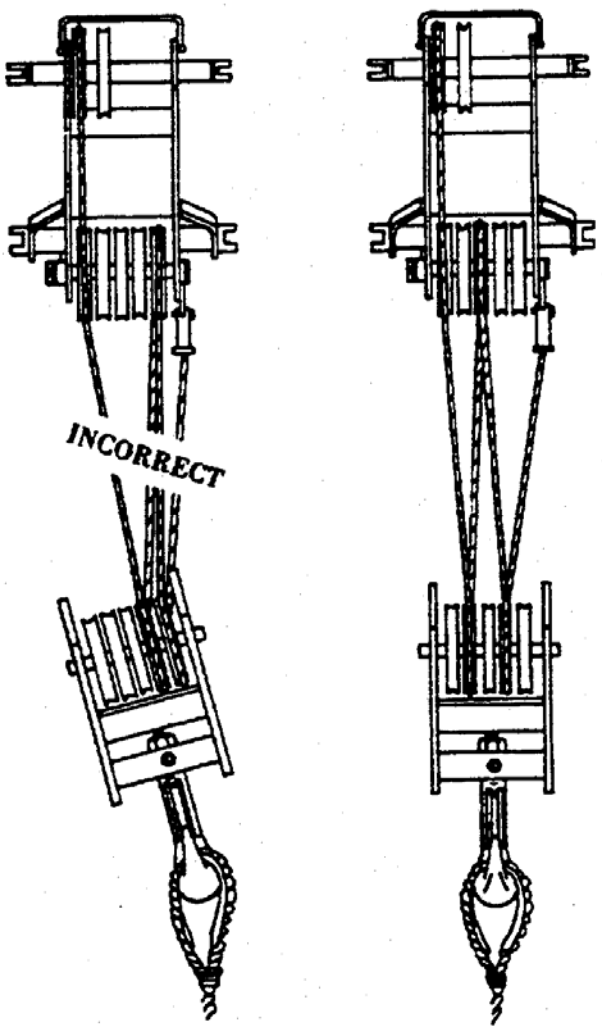
A good practice is to make a "dry run" without a load before making the first lift. Become familiar with all factors peculiar to the job site.

Ensure the wire rope is properly routed on the hook block and boom nose and that all rope guards are in place.

USE ENOUGH PARTS OF LINE FOR HEAVY 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. NO LESS THAN TWO WRAPS of wire rope should remain on the hoist drum. When slings, ties, hooks, etc., are used, make certain they are correctly positioned and secured before raising or lowering the loads.

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

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



2-14.4 Lifting.

Operate the crane at or near governed RPM during all lifting operations.

Check the hoist brake by raising the load a few inches, stopping the hoist, and holding the load. Be sure 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.

LIFT ONE LOAD AT A TIME. Do not lift two or more separately rigged loads at one time, even if the loads are within the crane's rated capacity.

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 cab.

Remember, all rigging equipment must be considered as part of the load. Lifting capacities vary with working areas. Permissible working areas are posted in the crane cab. When swinging from one working area to another, ensure load chart capacities are not exceeded. Know your crane!

Never swing or lower the boom into the carrier cab.

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 set-up may be been checked, situations do change.

Keep everyone away from suspended loads. Allow no one to walk under a load. Ensure that all slings, ties, and hooks are correctly placed and secured before raising or lowering the load.

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

Be sure 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.

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

Use only slings or other rigging devices rated for the job and use them properly. Never wrap the hoist cable around a load.

Check all tackle, hardware, and slings before use. Refuse to use faulty equipment.

Never work the crane when darkness, fog, or other visibility restrictions make such operations unsafe.

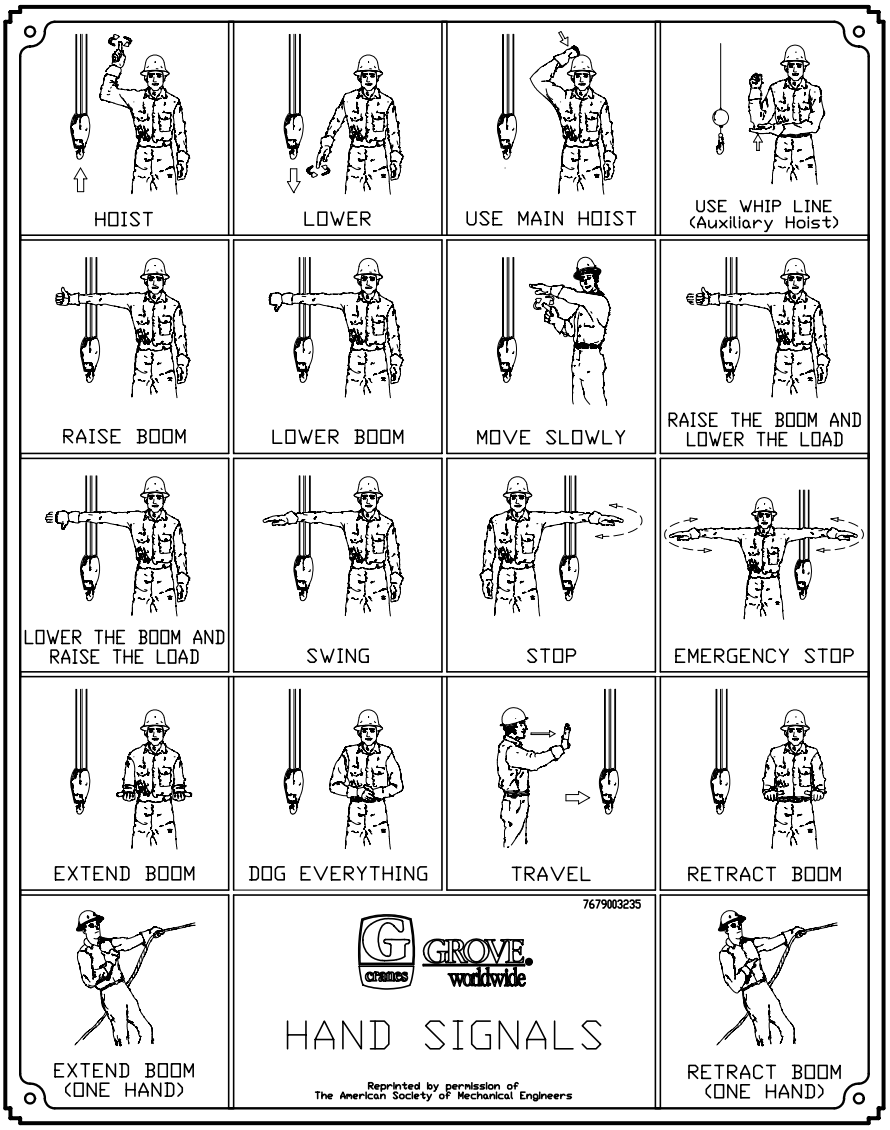
2-14.5 Hand Signals.

A 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 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.

When vision is obscured, use and follow the directions of a single qualified signal person.

Obey a signal to stop from anyone.

2-14.6 Traveling.

Before travel, fully retract and lower the boom into the boom rest and engage the turntable swing lock.

Secure hook block and other items before moving the crane.

Follow the instructions in this handbook when preparing the crane for highway travel.

If using boom dolly/trailer, thoroughly read and understand all steps and safety precautions in the handbook for set-up and travel.

Watch overhead and side clearances and avoid running into obstructions along the travel route.

When moving in congested area, post a signal person to help guard against collisions.

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

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

Before taking the crane on the highway, check state and local restrictions and regulations.

Check load limits on bridges and make sure they are greater than the combined weight of the crane and transport vehicle.

Always drive carefully, obey speed limits and highway regulations. Keep the lights ON, use traffic warning flags and signs, and use front and rear flag vehicles when necessary.

2-15. SHUTDOWN.

Never leave the crane with a load suspended. Lower the load to the ground before shutting down the crane.

Use the following steps when shutting down the crane:

- Fully retract and lower the boom.
- Engage the swing lock.
- Place controls in neutral position.
- Shut down the engine and remove the ignition key.
- In cold weather, never park the crane where the tires can become frozen to the ground.

2-16. COLD WEATHER OPERATION.

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

Check operating procedures for cold weather starting.

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

Clean the crane of all ice and snow.

Allow ample time for hydraulic oil to warm up.

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.

In freezing weather, frequently check all air tanks for water.

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.

2-17. SUPPLEMENTAL WARNINGS AND CAUTIONS.

BURN HAZARD

Allow engine to cool before performing maintenance on the muffler, exhaust pipe, exhaust manifold, or turbocharger. If necessary, use insulated pads and gloves.

Do not touch hot exhaust system with bare hands; injury to personnel will result.

EXHAUST GASES CAN KILL

Brain damage or death can result from heavy exposure. Precautions must be followed to ensure crew safety when personnel heater, main, or auxiliary engine of any vehicle is operated for any purpose.

- Do not operate vehicle engine in enclosed areas. If vehicle must be operated in an enclosed area (e.g., maintenance troubleshooting or inside lifting requirements) ensure exhaust is ducted to the outside. Also install a 1/4" NPT plug in the muffler moisture ejection port to prevent normal exhaust expulsion from the port. MAKE SURE plug is removed when inside operation is completed.

- Do not idle vehicle engine with vehicle windows closed.

- Be alert at all times for exhaust odors.

- Be alert for exhaust poisoning symptoms. They are:

  - Headache
  - Dizziness
  - Sleepiness
  - Loss of muscular control

- If you see another person with exhaust poisoning symptoms:

- Remove person from area
- Expose to open air
- Keep person warm
- Do not permit physical exercise
- Administer artificial respiration, if necessary*
- Seek immediate medical attention

* For artificial respiration, refer to FM 21-11.

• BE AWARE, the field protective mask for nuclear-biological-chemical (NBC) protection will not protect you from carbon monoxide poisoning.

THE BEST DEFENSE AGAINST EXHAUST POISONING IS ADEQUATE VENTILATION

High pressure hydraulics operate this equipment at 3500 psi. Never disconnect any hydraulic line or fitting without first dropping pressure to zero. A high pressure oil stream can pierce body and cause severe injury to personnel.

Diesel or hydraulic fluid under pressure can penetrate skin or damage eyes. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks, but do not use a bare hand. Wear safety goggles for protection. If fluid enters skin or eye, get immediate medical attention.

Do not move under any hydraulically-controlled implement when making adjustments or repairs to hydraulic system. Lower implement and work from above. If implement must be raised for access, always block to support. If implement drops, injury to personnel can result.

Dry cleaning solvent (P-D-680) is TOXIC and flammable. Wear protective goggles and gloves; use only in well-ventilated area; avoid contact with skin, eyes, and clothes, and do not breathe vapors. Keep away from heat or flame. Never smoke when using solvent; the flash point for type I dry cleaning solvent is 100º F (38º C) and for type II is 138º F (50º C). Failure to do so may result in injury or death to personnel.

If personnel become dizzy while using cleaning solvent, immediately get fresh air and medical help. If solvent contacts skin or clothes, flush with cold water. If solvent contacts eyes, immediately flush eyes with water and get immediate medical attention.

When operating the air conditioner, open side window slightly to allow fresh air to enter the cab.

TOXIC AND FLAMMABLE

Starting fluid is toxic and highly flammable. Container is pressurized. NEVER heat container and NEVER discharge starting fluid in confined areas or near open flame. Severe injury to personnel may result.

Use only the cold weather starting aids provided on your crane. The use of aerosol spray or other types of starting fluids containing ether/volatiles can cause explosions or fire.

HEAT AND COLD STRESS

Operating the crane under extremely hot or cold ambient temperatures require special precautions to avoid operator fatigue, heat stress, frostbite, and other health problems.

Refer to the following Technical Bulletins and Field Manuals:

- TB MED 507 Occupational and Environmental Health, Prevent, Treatment, and Control of Heat Energy. (Jul-80)
- TB MED 81 Occupational and Environmental Health, Prevent, Treatment, and Control of Cold Energy. (Sept-76)
- FM-11 First Aid for Soldiers. Chapter 5, (10-88), Change 1, (9-89), and Change 2. (12-91).
- FM 21-10 Field Hygiene and Sanitation. Sections 1 - Heat Injuries and Section 2 - Cold Injuries (11-88).

[**Note:** Section 1 and Section 2 from this Field Manual are reprinted here.]

HEAT INJURIES

DRINK PLENTY OF WATER. Depending on the heat, you may need to drink from ½ qt (0.5 l) [78º F to 82º F (26º C to 28º C)], to 2 qt (1.9 l) [90º F (32º C) and above] of water per hour; or 4 gal. (15.1 l) or more per day in hot dry climates. Drink extra water before starting any mission or hard work. Cool water [50º F to 55º F (10º C to 13º C)] is absorbed faster than cold water. Drink small quantities frequently. Drink water even if you are not thirsty. Refill your canteens at every opportunity. Remember - If your urine is dark yellow, you are not drinking enough water. Thirst is not a good indicator of dehydration.

USE WORK/REST CYCLES. Work and rest as your leader directs. General guidelines are:

- When the temperature is between 78º F to 82º F (26º C to 28º C), work 50 minutes and rest 10 minutes.
- When the temperature is 90º F (32º C) or above, work 20 minutes and rest 40 minutes.
- Work and rest in the shade, if possible.

EAT ALL MEALS TO REPLACE SALT. Take a salt solution *only* when directed by the medical personnel.

MODIFY YOUR UNIFORM. If directed/authorized by your commander: Unblouse pants from boots. Keep skin covered in the sun, loosen, or remove shirt when working in the shade. Keep clothing loose at the neck, wrists, and lower legs. If the threat from biting insects is high, leave shirt sleeves down and pants bloused inside boots. See FM-21-11, First Aid for Soldiers for information on heat injury prevention and first aid.

COLD INJURIES

WEAR UNIFORM PROPERLY. Wear the clothing your commander directs. Wear clothing in loose layers (top and bottom). Avoid tight clothing including tight underwear. Keep clothing clean and dry. Remove or loosen excess clothing when working or in heated areas to prevent overheating that causes sweating.

KEEP YOUR BODY WARM. Keep moving if possible. Exercise your big muscles (arms, shoulders, trunk, and legs) frequently to keep warm. If you must remain in a small area, exercise your toes, feet, fingers, and hands. Avoid the use of alcohol. Avoid standing directly on cold wet ground, when possible. Avoid tobacco products. The use of tobacco products decreases blood flow to your skin. Eat all meals to maintain energy. Drink plenty of water and/or drink warm nonalcoholic fluids. Dark yellow urine means you are not drinking enough fluids. You can dehydrate in cold climates too.

PROTECT YOUR FEET. Bring at least five pairs of issue boot socks with you. Keep socks clean and dry. Change wet or damp socks as soon as possible. Beware of wet socks from sweating. Wash your feet daily if possible. Avoid tight socks and boots (lace boots as loosely as possible). Wear overshoes to keep boots dry.

PROTECT YOUR HANDS. Wear gloves (with inserts) or mittens (with inserts). Warm hands under clothing if they become numb. Avoid skin contact with snow, fuel, and bare metal.

PROTECT YOUR FACE AND EARS. Cover your face and ears with a scarf or other material, if available. Wear your insulated cap with flaps down and around your chin. Warm your face and ears by covering them with your hands. Exercise facial muscles.

PROTECT YOUR BUDDY. Watch for signs of frostbite on his/her exposed skin (pale/gray/waxy areas). Ask him/her if feet, hands, ears, or face are numb and need warming. Do not let him/her sleep in or near the exhaust of a vehicle with engine running or in an enclosed area where an open fire if burning (carbon monoxide poisoning). Do not let him/her sleep directly on the ground. See FM-21-11, First Aid for Soldiers - for information on cold injury prevention and first aid.

NOISE

Hearing protection is required by the operator and all personnel within 50 ft (15.2 m) of the vehicle while the engine is running or the crane is in operation. If you must raise your voice to be understood, the continuous noise level is high enough to damage your hearing.

Hearing protection is required:

1. During crane operation.
2. When operating the pile driver, grapple hook, concrete bucket, or clamshell.
3. During traveling operations with cab door or window open.
4. When traveling on unpaved country road.
5. When operating air conditioner with cab window slightly open for fresh air.

FIRE EXTINGUISHER

When using fire extinguisher, conduct all extinguishing operations from outside the cab and ventilate the cab thoroughly prior to reentry. Fire extinguishers are located in both the carrier and superstructure cabs.

STEERING WHEEL RESTRAINING DEVICES

WARNING

To avoid the possibility of bodily injury and/or catastrophic failure, remove restraining devices from the carrier cab steering wheel before operating from the superstructure cab.

SECTION 3

PREPARATION FOR USE

3-1. SUMMARY.

The crane is shipped in an "operation-ready" condition requiring no maintenance or operator actions. However, it is recommended that a visual inspection of each system be made to ensure hydraulic, fuel, and coolant lines or fittings have not loosened or been damaged during transit from the manufacturer.

3-2. UNPACKING.

The following should be used as a check list while unpacking the crane.

a. Prepare the superstructure cab for use as follows:

1. Remove the restraining straps on cab door.

2. Remove cushion and tape around the LMI console, defroster fan, and load chart.

3. Remove tape securing seat arm rest in down position.

4. Remove tape securing the fire extinguisher in its bracket.

5. Remove tape on both sliding windows.

6. Check and adjust the outside mirror.

b. Prepare the carrier cab for use as follows:

1 Remove the restraining strap on cab door.

2. Remove tape and cushion from the defroster fan.

3. Remove tape securing fire extinguisher in its bracket.

4. Remove tape on both sliding windows.

5. Check and adjust the outside mirror.

c. Unpack the technical manuals and store the operator's manual in the bracket provided in the cab.

d. Unpack and install the hook block. Refer to Section 6 of this manual for proper cable reeving instructions.

e. Straighten and adjust the hoist rotation mirrors.

f. Remove the two sets of cab door lock keys. One set is tie wrapped under the

diesel engine hood and one set is located in the LMI CPU box.

g. If required for immediate use, unpack the grapple hook and/or clamshell bucket.

3-3. CHECKING UNPACKED EQUIPMENT.

a. Inspect the crane thoroughly for damage incurred during shipment. If the equipment has been damaged, report the damage on Form DD Form 6, Packaging Improvement Report.

b. Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA PAM 738-750.

c. Check to see whether the equipment has been modified.

3-4. DEPROCESSING UNPACKED EQUIPMENT.

The crane should be clean and free of excess grease. However, if during inspection, any excess grease or lubricant is found on the frame or superstructure it should be cleaned immediately.

3-5. PRELIMINARY SERVICING AND ADJUSTMENT.

The crane is shipped completely serviced except for diesel fuel. Perform all B (Before) Preventive Maintenance Checks and Services (PMCS) prior to operating the crane for the first time. Refer to PMCS in Section 5. Report all faults to next higher level of maintenance.

A complete walk-around visual inspection of the crane should always be made before operation. Special attention should be given to structural damage, loose equipment, leaks, or other conditions that would require immediate correction for safe operation. The following checklist items are suggested specifically for the operator's benefit to make certain the crane is prepared for starting the days work.

a. Place battery disconnect switch in the off position before performing inspection and servicing instructions.

b. Batteries. Check each cell for the correct electrolyte level. Add only clean, distilled water. Do not overfill. Ensure the cables and clamps are tight and not corroded. Examine battery case for cracks or leaking electrolyte.

c. Fuel Supply/Fuel-Water Separator. Fill the fuel tank with approved diesel fuel and ensure that the cap is on tight. Then drain water from the fuel water separator. Refer to PMCS in Section 5, Table 5-1 for information on the Fuel Water Separator, and Section 5-3.7 for List of Recommended Diesel Fuels.

d. Daily Lubrication. Make certain that all components requiring daily lubrication have been serviced. Refer to PMCS in Section 5.

e. Tires. Check for severe cuts, foreign objects imbedded in treads, and for correct inflation pressure. The correct cold tire air pressure is 110 psi (758 kPa) for all operations, including lifting on rubber.

f. Hydraulic Reservoir and Filter. Check hydraulic fluid quantity level gauge and check filter condition indicator. Check breather for cleanliness and security. If necessary, add hydraulic oil until oil appears half-way up in the sight gauge. Refer to PMCS in Section 5.

g. Hook Block. Visually inspect for nicks, gouges, cracks, and evidence of any other damage. Replace a hook containing cracks or showing evidence of excessive deformation of the hook opening (including twist). Be sure the safety latch is free and aligned.

h. Fire Extinguisher. Check the charge indicator dials on both fire extinguishers to ensure the pointer is in the green zone.

i. Windshield Washer Fluid. Check that the windshield washer fluid bottle is full. The bottle is located behind the seat in the carrier cab and under the seat in the superstructure cab. Refer to PMCS in Section 5.

j. Engine Oil. Check oil level in the crankcase; fill the FULL mark on the dipstick. Do not overfill. Refer to PMCS in Section 5.

k. Engine Coolant. Check coolant level in the radiator by inspecting the coolant recovery bottle level located in the engine compartment; fill to proper level. Do not overfill. Check cap for security. Refer to PMCS in Section 5.

l. Fan Belt and Fan. Inspect fan belt for cracks or fraying. Inspect fan for cracks. Refer to PMCS in Section 5.

m. Transmission. Check transmission oil level; fill if required. Refer to PMCS in Section 5.

n. Air Cleaner. Check the air restriction indicator for an extended red flag evident when there is a dirty air cleaner. Check filter and tubing for security. Refer to PMCS in Section 5.

o. Muffler and Pipes. Inspect the exhaust system for corrosion, damage, and loose parts.

p. Wire Rope. Inspect wire rope in accordance with PMCS in Section 5. Sheaves, guards, guides, drums, flanges, and any other surfaces that come in contact with the rope should be inspected for any condition that could cause possible damage to the rope.

q. Place battery disconnect switch in on position.

r. Horns, Signals, and Lights. Check all signal and running lights for proper operation. Replace burned out lamps with those of the same number, or equivalent. Ensure both backups alarms and steering wheel horns are operable. Also ensure that boom swing button on superstructure cab seat arm rest sounds the horn when button is depressed.

s. External mirrors. Ensure all outside mirrors including the hoist rotation mirrors, superstructure cab mirror, carrier cab mirror, and right-side carrier frame mirror are adjusted in the correct position and that all mounting hardware is tightened securely.

SECTION 4

PRINCIPLES OF OPERATION

4-1. GENERAL.

The All-Terrain Crane (ATEC) incorporates an all welded steel frame and is fully self-contained. All crane functions are either electrically or hydraulically controlled, and hydraulically operated. The crane is equipped with two cabs, a carrier cab and a superstructure cab. The carrier cab contains all controls and indicators necessary for crane travel. The superstructure cab contains all controls and indicators necessary to perform craning operations. Both cabs utilize international symbols to label the various crane controls. A symbol identification decal is located in each cab.

Both front and rear axles are drive/steer axles. Only the front axle is used for steering during normal travel operation which is accomplished by the carrier cab steering wheel. When additional maneuverability is needed for parking or other special conditions, the rear axle can also be steered from the carrier cab by a rear steer control switch.

Steering can also be performed from the superstructure cab during craning operations. Job site travel is normally with the boom over-the-rear. Hence, the steering wheel in the superstructure cab steers the rear axle and a switch steers the front axle. The engine is mounted in front of the carrier and provides power through a six-speed forward and reverse, electrically shifted transmission.

The main operating functions of the superstructure are raising and lowering the boom, swinging the boom, extending or retracting the boom, raising and lowering loads with the hoists, and extending and retracting the outriggers. Hydraulic cylinders activate the elevation, telescope, and outrigger systems. The hoist and swing systems are driven by hydraulic motors.

A diesel engine provides drive power for the main hydraulic pump and the primary steering pump. The diesel engine also drives an alternator which supplies electrical power for control, accessory, and lighting systems and an air compressor which supplies pressure for operating the service/parking brakes, the trailer supply lines, and the tire inflation system. The engine also provides power through a transmission, to drive the crane.

Hydraulic flow, air, and electrical power are transferred from the carrier to the superstructure by an air/hydraulic swivel and electrical collector ring located at the center of rotation.

4-2. MAJOR COMPONENTS AND SYSTEMS.

a. **Carrier Cab Assembly**. The carrier cab contains all the controls and indicators necessary for traveling and parking functions. The cab is all-steel, acoustically treated, fully enclosed with tinted safety glass windows throughout. Access to the cab is via a hinged left side door which features a latch handle and keyed lock. A grab handrail is provided to aid the operator in getting in and out of the cab. A suspension seat installed in the cab is adjustable both vertically and horizontally. The seat is also equipped with a seat belt.

A 1-A:10-B:C rated 2.50 lb (1.13 kg) dry-type fire extinguisher is mounted inside the cab, between the door and the operator's seat.

A single-blade windshield wiper is installed to remove moisture from the windshield. The wiper is driven by an electric motor that is controlled by a lever on the steering column. A windshield washer system is installed to spray a cleaning solution onto the windshield. It consists of two nozzles (one on each side of the wiper arm), a canister, and pump. The electric pump draws the solution from the canister and forces it through a hose to the two nozzles that spray it onto the windshield.

The carrier cab also features a hot-water heater and a roof-mounted air conditioning unit. The cab heater circulates hot engine coolant through a heat exchanger. Hot air is blown out of the heater into the cab by a variable speed blower motor. The air conditioning unit is comprised of a self-contained evaporator and condenser coil unit, a remote engine-mounted compressor, and a control panel which allows the operator to control temperature and fan speed.

b. **Superstructure Cab Assembly**. The superstructure cab contains all controls and indicators for craning operations and traveling on the job site. The cab is all-steel, acoustically-treated, and fully enclosed with tinted safety glass windows throughout. Access to the cab is via a sliding door which features a latch handle and keyed lock. Grab handrails are provided beside the door opening to aid the operator in getting in and out of the cab.

The superstructure cab has a skylight with a tinted safety glass window. A manually-operated skylight wiper is provided to remove moisture from the skylight.

The cab seat is mounted on a track assembly, allowing it to be adjusted to a comfortable distance from the steering wheel and front console. The seat has a lever at the front of the bottom cushion to adjust the tilt of the seat back. An armrest on each side of the seat houses the hydraulic remote controls used to control the crane functions. The armrests swing up beside the seat and latch in place to make it easier for traveling and entering and exiting the cab. A safety device in the armrests disables the controllers when the armrests are in the latched position. In addition to the safety device in the armrests, a tape switch incorporated in the cab seat, deactivates the controllers when the operator leaves the seat.

A 1-A:10-B:C rated, 2.5 lb (1.13 kg) dry-type fire extinguisher is mounted in the cab, under the operator's seat.

A single-blade windshield wiper is installed to remove moisture from the windshield. The wiper arm is driven by an electric motor which is controlled by a two-speed switch located on the front console panel. A windshield washer system is installed to spray a cleaning solution on to the windshield. It consists of two nozzles (one on each side of the wiper arm), a canister which is located beneath the cab, and a pump assembly.

Located beneath the cab, is a diesel fuel burning heater which provides heat to the cab. The heater fuel tank is located on the right side of the turntable. All heater controls are located within the cab. Windshield defroster controls and tubing are provided with the heater.

The superstructure cab also features an air conditioning unit. The air compressor and condenser unit is housed behind a cover on the left side of the boom on the forward side of the counterweight. The air conditioner controls including the air handler and blower fan are located in the cab.

c. **Engine**. The diesel engine is housed in the engine compartment behind the carrier cab and is used to provide crane mobility. The engine is also used to charge the air system, drive the steering pumps, and supply electrical power for carrier control circuits, accessories, and lighting. In addition, the engine drives the hydraulic pumps though the pump drive. All controls for the engine are located in both cabs.

d. **Fuel Tank**. A single 44-gal. (166.6 L) capacity fuel tank is mounted on the right side of the carrier frame. The filler cap is located on the top of the tank.

e. **Drive Train**. The drive train consists of the transmission, drive shafts, and the associated linkages. The transmission is electrically shifted and has six forward and three reverse speeds from the carrier cab and three forward and three reverse speeds from the superstructure cab.

f. **Axles**. The axles are drive steer axles and have inter-axle differential locks to lock the differentials together for traveling in adverse road conditions.

g. **Steering Systems**. The crane is equipped with a front axle steering system and a rear axle steering system. The two separate systems can be activated from either cab.

h. **Brakes**. The brakes, which are drum and shoe-type, are air operated. The rear axle is equipped with spring applied brakes to hold the carrier stationary when parking and to provide auxiliary braking in case of emergency.

i. **Air System**. The air system provides the air supply to operate the service brakes, the parking brakes, trailer service connections, air inflation system, and the engine air throttle. The engine driven air compressor supplies the air to charge the air reservoirs. An air dryer removes moisture from the air before it reaches the reservoirs.

j. **Hydraulic System and Components**. The hydraulic system is designed to provide adequate pressure and flow for simultaneous operation of various crane functions.

(1) Reservoir. The hydraulic reservoir is a 64 gal. (242 L) steel tank located on the left side of the carrier. A full flow return-type 10 micron filter is installed in the reservoir.

(2) Hydraulic Oil Cooler. An air cooled hydraulic oil cooler is mounted on the right side of the superstructure. The oil cooler consists of a hydraulic radiator, a by-pass valve, a fan, and an electric fan motor. The fan draws cool air through the cooling fins of the oil cooler. All return oil from the superstructure is routed through the oil cooler.

(3) Pump and Disconnect. The hydraulic pump and disconnect are mounted on a drive pad of the torque converter. With the disconnect engaged and the engine and torque converter operating, the pump provides oil to the hydraulic components.

The hydraulic pump is a gear-type pump and consists of three sections. The first section of the pump, the one on the mounting flange end, provides an output of 39 gpm (147 lpm). The second section provides 39 gpm (147 lpm) and the third section supplies 16 gpm (61 lpm).

The disconnect assembly is provided for cold weather starting and consists of a housing, lever, movable collar, and a sliding splined sleeve. The disconnect housing is connected to the torque converter drive pad and the pump is bolted to the disconnect housing.

(4) Directional Control Valves. The directional control valves are four way, three position valves with either an open or closed spool. The valves are grouped into valve banks permitting simultaneous independent control of crane functions. The closed spool-type valves are equipped with integral check valves to ensure components will remain stationary when the valves are closed. Each valve bank contains a main relief valve. In addition, certain crane functions are further protected by a circuit relief valve.

(5) Emergency Steer Pump. The emergency steer pump will provide oil flow for the steering system in the event of an oil flow loss in the main steering system caused by an engine or steering pump failure. The pump is ground-driven off of the transmission. This function is automatic, being activated by a flow switch.

k. **Turntable Assembly and Swing Mechanism**. An anti-friction roller bearing supports the superstructure and attaches it to the carrier allowing 360º of continuous rotation (swing) in either direction. The swing function is accomplished through use of a hydraulically driven motor driving a gearbox which in turn drives the roller bearing via an external gear. A spring and hydraulically actuated and hydraulically released brake is provided to stop swing and hold the superstructure in a desired position, two mechanical swing locks are also provided.

(1) Swing Motor. The hydraulic swing motor is a low speed, high torque motor. The motor provides indirect drive power for turntable swing through the swing gearbox.

(2) Swing Gearbox. The swing gearbox is a sun and planetary gear-type, driven mechanically by the swing motor. The swing gearbox rotates the turntable at a reduced operational speed.

(3) Swing Brake. The swing brake assembly consists of a brake assembly mounted on the swing gearbox. The swing brake is hydraulically controlled by the operator from the superstructure cab through use of the SWING BRAKE ON/OFF selector switch which electrically positions the swing brake control valve, and by the swing brake foot pedal when the SWING BRAKE ON/OFF selector switch is in the OFF position.

(4) Mechanical Swing Locks.

(a) Swing Lock Pin. A pin-type swing lock that consists of a rounded pin which engages a welded retainer to lock the turntable with the boom straight over the front or rear of the carrier. The swing lock pin is operated using the SWING LOCK Pin Control Lever (49, Figure 5-2).

(b) Positive Swing Lock. A gear-type swing lock that consists of a lock assembly with teeth that meshes with the swing gear teeth to lock the turntable with the boom at any point along the 360º of rotation of the swing gear. The positive swing lock is operated using the Positive Swing Lock Handle (6, Figure 5-2).

l. **Boom Assembly**. The boom is a three section, 27 to 70 ft (8.2 to 21.3 m) cable extended boom.

The boom is trapezoidal in design and utilizes one 5.5 in. (13.9 cm) telescope cylinder. The telescoping sections are supported on graphite impregnated nylatron wear pads. Adjustable side wear pads prevent metal to metal contact between the sections. The boom nose consists of three sheaves mounted on heavy duty, tapered roller bearings and utilizes pin-type guards to allow easy reeving. The boom features a mechanical boom angle indicator mounted on the left-rear side of the boom.

m. **Main Hoist, Superstructure**. The main hoist provides power and speed for load raising and lowering operations utilizing the main hook block. A vane-type hydraulic motor drives the hoist drum by means of a planetary gear reduction system. A metallic disc brake is also an integral part of the hoist assembly. An indication of hoist drum rotation is provided by an electronic pulse generator attached to the hoist with a pulsating indicator in the boom LIFT/MAIN hoist control lever (8, Figure 5-2) in the cab. The pulsation rate felt by the operator is proportional to the hoist speed.

n. **Auxiliary Hoist, Superstructure**. The auxiliary hoist provides power and speed for all operations requiring an auxiliary hook such as when the pile driver is attached to the crane. Since the hoist is identical to the main hoist, it can perform all main hoist operations. A vane-type hydraulic motor drives the hoist drum by means of a planetary gear reduction system. A metallic disc brake is also an integral part of the hoist assembly. The auxiliary hoist indicator also provides hoist drum rotation information to the operator via a pulsating indicator in the boom SWING/AUXiliary hoist control lever (20, Figure 5-2) in the cab.

o. **Outrigger System**. The outriggers are integral with the carrier frame but are controlled and operated from the superstructure. The outriggers are full hydraulic, double box-type. They are positioned to provide a rigid four point platform (outriggers fully extended and set) capable of supporting the machine and its maximum load capacity. Integral holding valves and floats are standard equipment. A sight level bubble indicator is located in the superstructure cab to ensure crane leveling.

p. **Swivels**. Electrical and air/hydraulic swivels are used to route the air, electrical, and hydraulic circuits to the superstructure from the carrier frame. These swivels are mounted as a single assembly, and are installed at the center of rotation.

q. **Electrical System**. The electrical system operates on 24 VDC and consists of an alternator and four 12-volt, lead acid batteries which are series-parallel connected. The system is single wire ground return-type, utilizing the crane's chassis as ground. The system also features a battery disconnect switch designed to protect operators and maintenance personnel while performing inspections and maintenance.

There is a standard NATO slave receptacle mounted below the battery box located on the right side of the crane. The receptacle can be used to start the crane or power the auxiliary power unit in the event the vehicle's onboard batteries cannot provide the power for either function.

A backup alarm is an audio system used to warn personnel outside the crane when the vehicle is backing up. The alarm system is electrical and consists of the backup alarm and associated wiring. The alarm is tied into the backup light electrical wiring, and is activated when the backup light is activated. Two backup alarms are installed. One is installed on the rear of the turntable and one is installed on the rear of the chassis.

A boom swing alarm can also be sounded by the crane operator in the superstructure cab. The alarm is activated by a pushbutton on the right side arm rest.

r. **Related Crane Functions**. The crane is equipped with interface components and attachment points for connecting and operating the following attachments:

(1) Clamshell. When attached to the main hoist cable, a hydraulically-operated general purpose bucket with teeth can be operated from the superstructure cab. Hydraulic control and actuation power is supplied by the crane via a hose reel/tagline mounted on the boom.

(2) Grapple. When attached to the main hoist cable, a hydraulically-operated, four-tine grapple with heavy-duty cylinders can be operated from the superstructure cab. A hydraulic tagline mounted on the boom provides power for operating the grapple.

(3) Concrete Bucket. A concrete bucket can be attached to the main hoist cable. The material release lever is operated by personnel on the ground. This is a Government-furnished attachment.

(4) Pile Driver. The Linkbelt drop hammer, diesel engine-driven, and Berminghammer pile driver systems can be attached to the shafts on the boom nose using parallel adapter plates mounted on the lead tower. Mounting lugs, located on brackets on the front of the crane superstructure, allow attachment of the catwalk for the Linkbelt pile driver system and the spotter for the Berminghammer pile driver system. The pile drivers, which are Government-furnished attachments, are operated by controls that are part of the respective pile driver systems.

The spotter for the Berminghammer pile driver system is controlled by controls in the superstructure cab and hydraulic power is provided by the boom hose reel on the crane.

A catwalk bracket, for the Linkbelt pile driver system, may be fabricated to raise the catwalk platform above the spare tire when swinging the boom from the 12 o'clock through the 10 o'clock positions. See Appendix L, Installation/Operation of Pile Driver (Linkbelt), for fabrication information.

s. **Auxiliary Power Unit for Emergency Crane Stowage**. An auxiliary power unit (APU) has been provided on the left side of the crane, just forward of the main hydraulic tank. The unit provides hydraulic power for returning the crane to the travel mode after a catastrophic failure of the crane's hydraulic system. It uses the onboard 24 VDC power supply to operate a small hydraulic pump. The hydraulic pump supplies the power for swinging/retracting/lowering the boom, lowering the hook block, lifting and retracting the outriggers, and steering/straightening the wheels. The APU can also be powered from an external 24 VDC power source via the NATO slave receptacle coupled to an intervehicular cable.

The auxiliary power unit consists of an electrically-driven hydraulic motor and starter relay, a two-way diverter ball valve, an on/off switch, and associated hydraulic piping and check valves.

There are two user interface controls for the APU. First, an on/off toggle switch turns on and shuts off the electric motor driving the APU hydraulic pump. Second, a two-way diverter valve determines which crane hydraulic circuit is powered by the APU hydraulic pump. Refer to Section 5 of this manual for detailed procedures covering the use of the APU for vehicle recovery operations.

SECTION 5

OPERATING INSTRUCTIONS

5-1. CARRIER CAB CONTROLS AND INDICATORS.

NOTE

The following paragraphs describe the controls and indicators located in the carrier cab. The numbers in parentheses ( ) represent the index number from Figure 5-1.

NOTE

Any reference made to left, right, front, and rear when describing locations from the carrier cab is to be considered as viewed from the carrier cab operator's seat.

Cab Circulating Fan (1). The fan is located on the left on a mounting bracket above the window frame. A swivel allows the fan to be rotated. The fan is controlled by a switch on the base.

PUSH FOR TELE/PULL FOR TILT Steering Column Tilt/Telescope Lever (2). The lever is located on the left side of the steering column below the Turn Signal Lever (15). When pulled, the operator can tilt the steering column to one of six different positions. When pushed, the operator can move the steering wheel in or out for ease of operation and comfort.

Brake Foot Pedal (3). The pedal is located on the carrier cab floor and is the first pedal to the right of the steering column. Depressing the pedal activates an air valve to proportionally control application of the service air brakes.

Foot Throttle Pedal (4). The pedal is located on the carrier floor and is the second pedal to the right of the steering column. The pedal is connected via cable to the diesel engine throttle control.

CAUTION

The engine must be shut down to engage or disengage the Hydraulic Pump Disconnect Control (5). Attempting to engage control with engine running will result in damage to pump and transmission.

Hydraulic Pump Disconnect Control (5). The control is located on the right side of the carrier cab. The control is a push-pull cable that is used to engage and disengage the main hydraulic pump. Pulling control disengages main hydraulic pump, pushing control engages main hydraulic pump. During cold weather starting and extended periods of travel, control should be pulled to disengage pump.

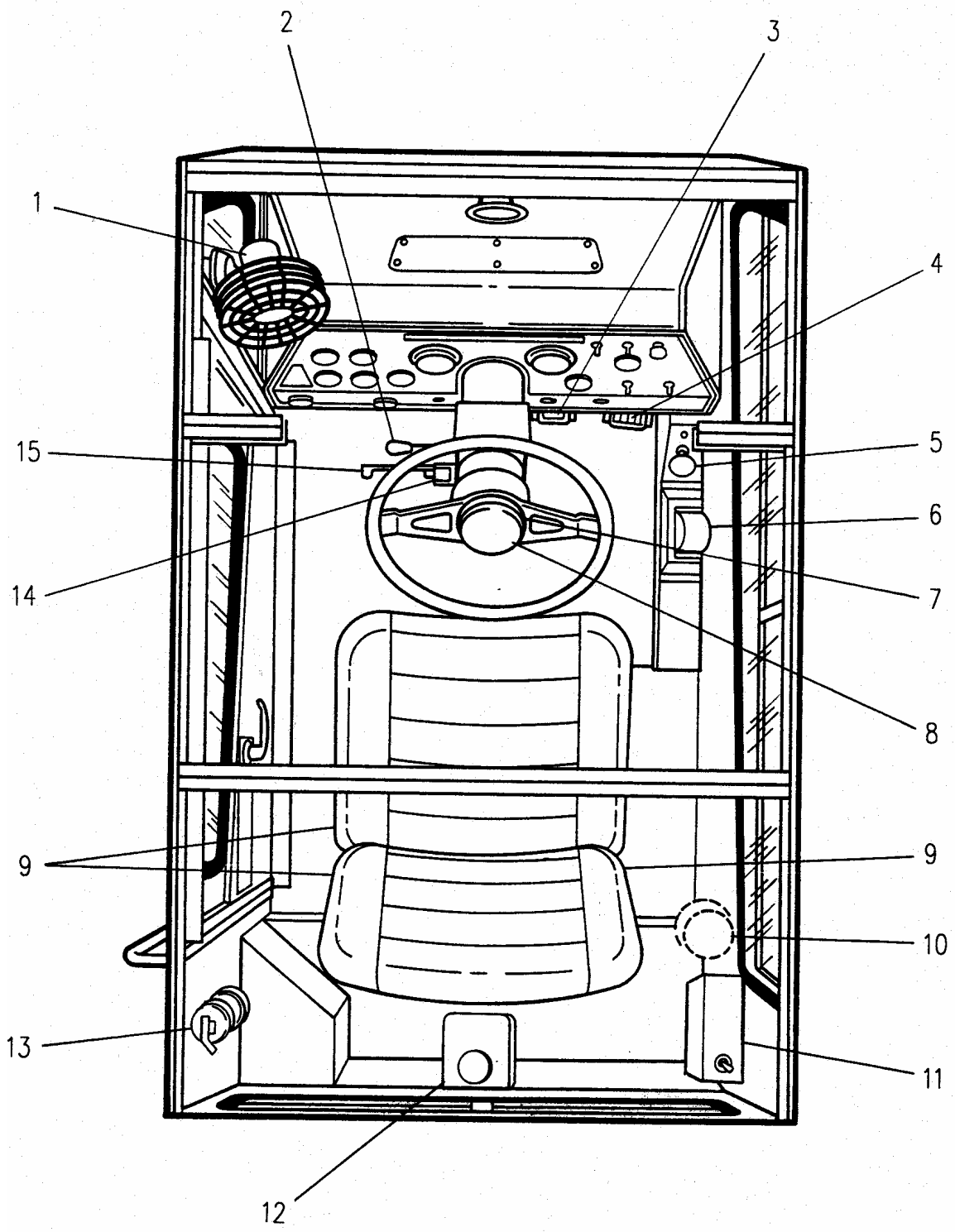


Figure 5-1. Carrier Cab Controls and Indicators (Sheet 1 of 4)

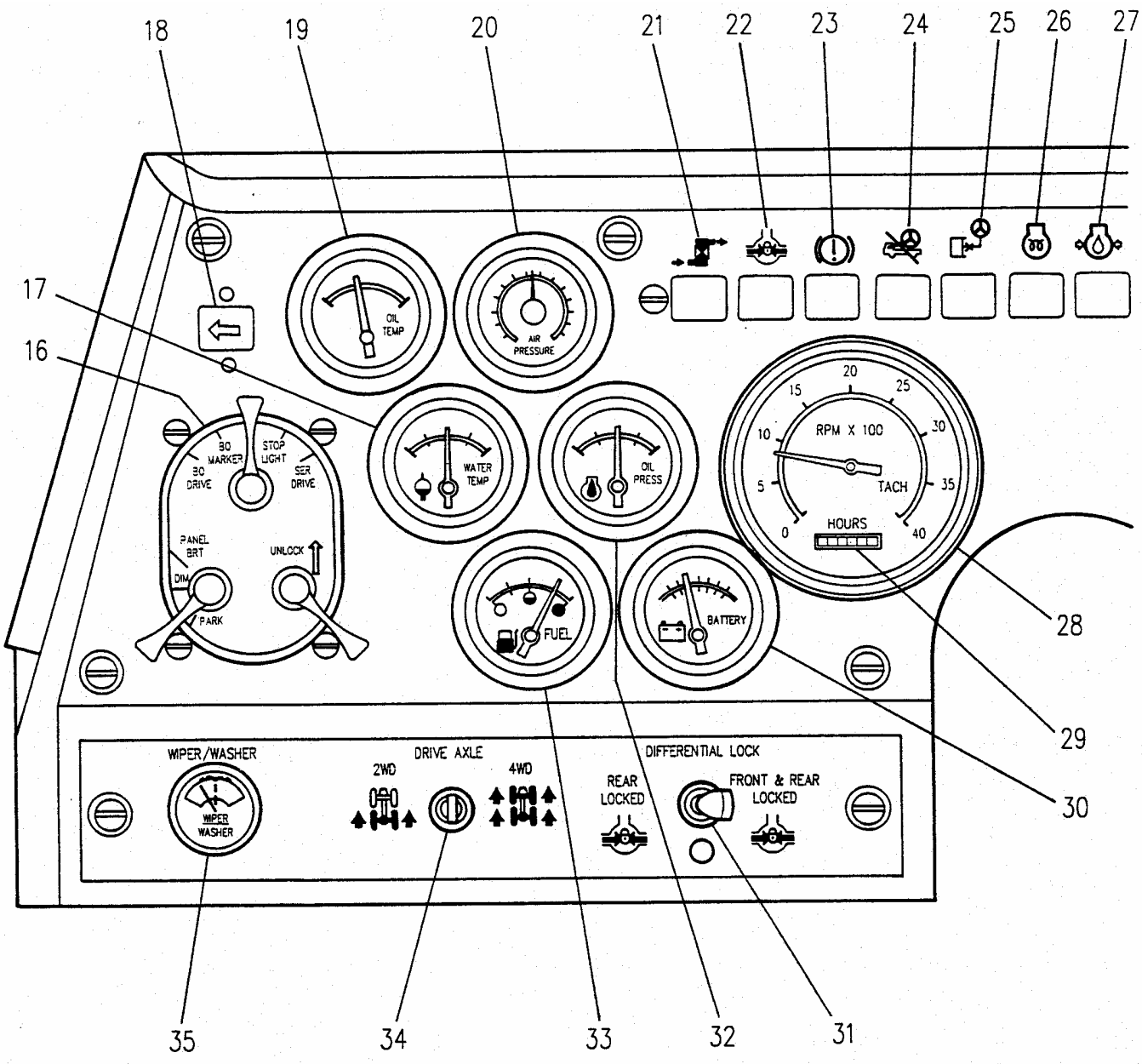


Figure 5-1. Carrier Cab Controls and Indicators (Sheet 2 of 4)

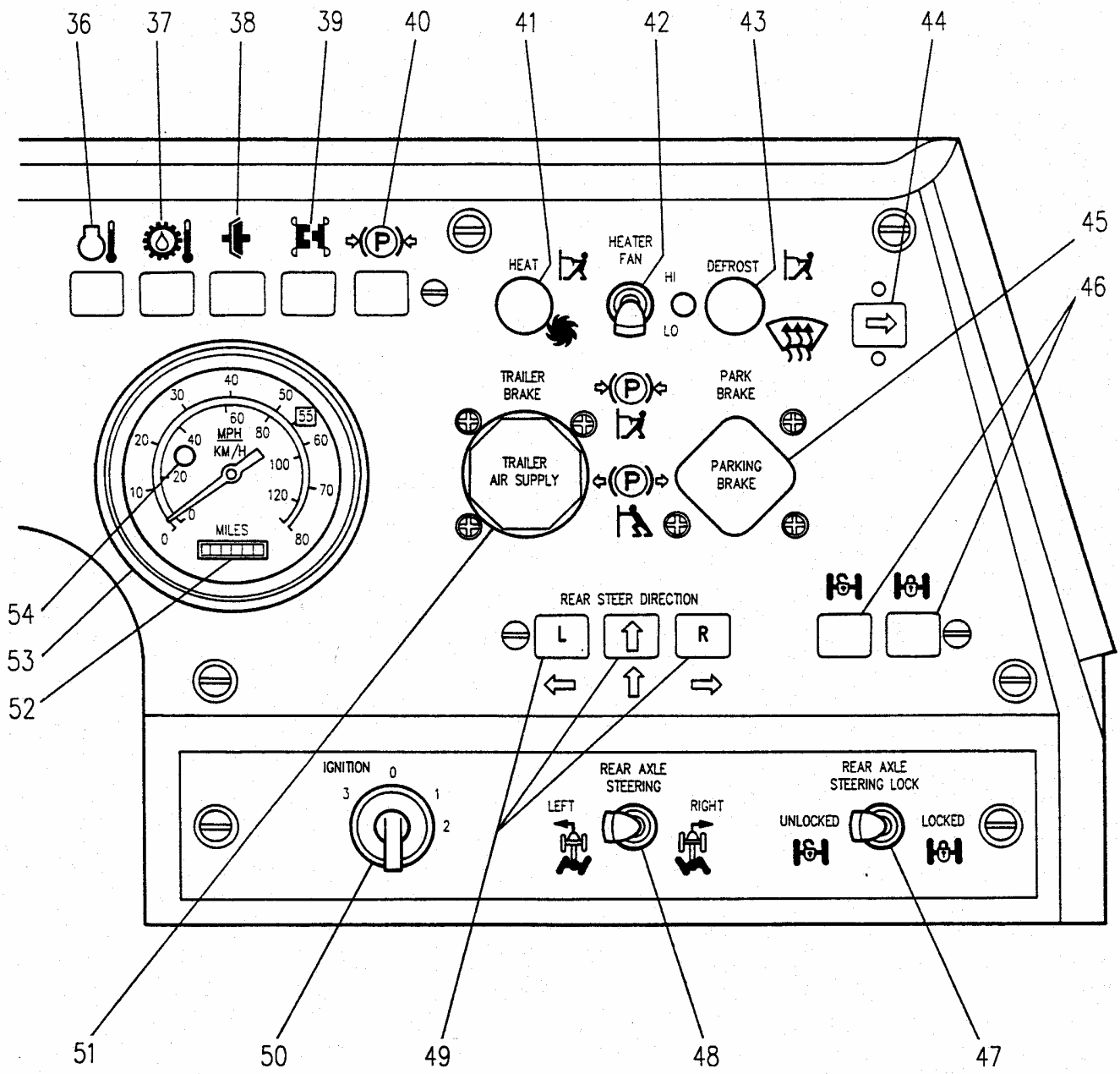


Figure 5-1. Carrier Cab Controls and Indicators (Sheet 3 of 4)

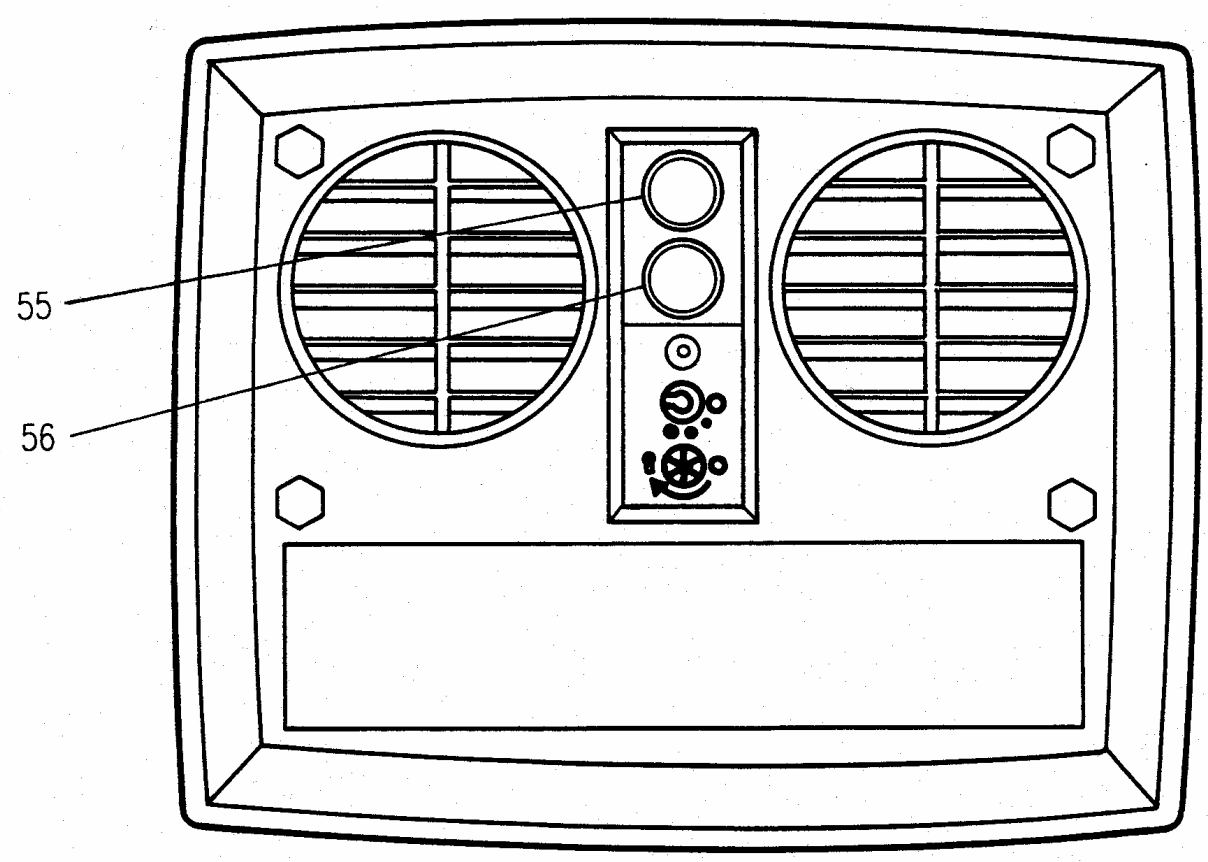


Figure 5-1. Carrier Cab Controls and Indicators (Sheet 4 of 4)

Legend for Figure 5-1.

1. Cab Circulating Fan
2. PUSH FOR TELE/PULL FOR TILT Steering Column Tilt/Telescope Lever
3. Brake Foot Pedal
4. Foot Throttle Pedal
5. Hydraulic Pump Disconnect Control
6. Transmission Shift Lever
7. Steering Wheel
8. Horn Button
9. Seat Position Adjustment
10. Cab Dome Light
11. APC 100 Override Switch
12. Windshield Washer Fluid Container
13. Fire Extinguisher
14. Four-Way Flasher Switch
15. Turn Signal Lever
16. Blackout Lighting Control
17. WATER TEMPerature Gauge
18. Left Turn Signal Indicator
19. Transmission OIL TEMPerature Gauge
20. AIR PRESSURE Gauge
21. Hydraulic PUMP ENGAGED Indicator
22. DIFFerential LOCKED Indicator
23. LOw AIR PRESSure Indicator
24. CARRIER STEERing DISENGAGED Indicator
25. STEER PUMP FAILED Indicator
26. FUEL PREHEAT Indicator
27. Low ENGINE OIL PRESSure Indicator
28. TACHometer Gauge
29. Hourmeter (HOURS)
30. BATTERY Voltmeter
31. Axle DIFFERENTIAL LOCK Switch
32. Engine OIL PRESSure Gauge
33. FUEL Gauge
34. DRIVE AXLE Selector Switch
35. Windshield WIPER/WASHER Switch
36. ENGINE WATER TEMPerature Indicator
37. TRANSmission OIL TEMPerature Indicator
38. TRANSmission RPM/PRESSure Indicator
39. TORQUE CONVERter UNLOCKED Indicator
40. PARK BRAKE Indicator
41. HEATer Control
42. HEATER FAN Switch
43. DEFROST Control Knob
44. Right Turn Signal Indicator
45. PARK BRAKE Control
46. REAR STEER LOCK ENGAGED/ DISENGAGED Indicators
47. REAR AXLE STEERING LOCK Switch
48. REAR AXLE STEERING Control Switch
49. REAR STEER DIRECTION Indicator
50. IGNITION Switch
51. Trailer Air Supply Control (TRAILER BRAKE)
52. Odometer (MILES)
53. Speedometer (MPH/KM/H)
54. Headlight High Beam Indicator
55. Air Conditioner Temperature Control
56. Air Conditioner Fan Control

Transmission Shift Lever (6). The lever is located on the right side of the cab on the side console and is electrically connected to the transmission selector valve. The lever has ten different shift positions allowing the operator to select from three reverse speeds (R1, R2, and R3), neutral (N), and six forward speeds (F1 thru F6).

Steering Wheel (7). It is a conventional automotive-type steering wheel used to control front wheels. Clockwise steers crane to right, counterclockwise steers crane to left.

Horn Button (8). The button is located in the center of the steering wheel. Depressing the horn energizes a relay that in turn sounds the horn on the cab exterior.

Seat Position Adjustment (9). These controls adjust seat back position and seat suspension stiffness. Also moves seat cushion forward and back.

Cab Dome Light (10). The light is located on the right rear corner of the cab roof to illuminate the cab interior. The light is controlled by a door switch and a switch on the light.

APC 100 Override Switch (11). The Automatic Powershift Control (APC) 100 Override Switch is located on top of the APC control panel in the right rear corner of the cab. The switch is used to permit manual shifting of the transmission. There are two lights on the unit which indicate which position the switch is in: Green for automatic and Red for manual. The switch must be reactivated for manual operation each time the ignition switch is turned OFF.

Windshield Washer Fluid Container (12). The container is located on the cab floor behind the operator's seat. It contains the windshield washer fluid.

WARNING

When using fire extinguisher, conduct all extinguishing operations from outside the cab and ventilate the cab thoroughly prior to reentry. Fire extinguishers are located in both the carrier and superstructure cabs.

Fire Extinguisher (13). The extinguisher, which is located at the rear of the cab on the left side, is a 1-A:10-B:C-rated, dry-type fire extinguisher.

Four-Way Flasher Switch (14). The switch is located on the steering column just behind the Turn Signal Lever (15). Pulling the switch causes all four turn signals to flash. The lights will continue to flash until the switch is depressed.

Turn Signal Lever (15). The lever is located on the steering column. Moving the switch handle down causes the left turn signals to flash. Moving the handle up causes the right turn signals to flash. Pulling lever activates dimmer switch for headlights high and low beams.

Blackout Lighting Control (16). The control is the large three-lever control located on the left side of the front console panel. This control contains the service lighting controls, the auxiliary lighting switch, and the mechanical lock. The service lighting control switch is located on the top of the plate. It has five positions; BlackOut DRIVE, BlackOut MARKER, OFF, STOP LIGHT, and SERvice DRIVE. The mechanical lock switch is located on the

lower right of the control plate. It is used to prevent accidental movement of the main light control switch. The switch must be turned 45º (maximum) to UNLOCK. The following lists each switch position and the lighting/electrical circuit affected.

Switch Position	**Circuits Enabled**
OFF	ALL carrier-controlled lighting, horn and alarm circuits disabled (see Note 2)
Normal Modes	
STOP LIGHT	Backup/Superstructure Driving Lights (see Note 2) Carrier Backup Alarm Carrier Horn Carrier Cab Dome Light Service Stop Lights Service Turn Signals, front & rear Service Hazard Signals (4-way flash) Service Headlights: flash Carrier Panel Lights, according to the Auxiliary switch position: panel lights are available in all positions except OFF, i.e., bright in BRIGHT position, dim in DIM and PARK positions; instrument lights are constantly on in this position.
SERvice DRIVE	All as in STOP LIGHT mode above, plus: Service Park Lights, front Service Tail Lights Service Marker Lights, both sides Service Identification Lights, front & rear Service Clearance Lights, front & rear Service Head Lights: High/Low beam, according to the Auxiliary Switch Position (head lights enabled in all positions except PARK).
Blackout Modes	
BlackOut MARKER	Blackout Park Lights, Front Blackout Tail Lights Blackout Stop Lights Carrier Panel Lights and instrument illumination, according to the Auxiliary switch position (See STOP LIGHT mode above)
BlackOut DRIVE	All as in BlackOut MARKER mode above, plus: Blackout Driving Light

NOTES
(for Blackout Lighting Control Switch)

1. Carrier warning/indicator lights are all blackout-safe, and are therefore not controlled by the Blackout Lighting Control Switch (16, Figure 5-1). The circuits identified above are the only other circuits that are enabled in the specified conditions: All other circuits are disabled.

2. With Blackout Lighting Control Switch (16) in the OFF position (i.e., all carrier lighting circuits disabled), the backup alarm and the carrier backup/ superstructure driving light circuits are enabled from the superstructure cab only. The carrier backup/ superstructure driving lights can be turned on by placing the DRIVE/PANEL Light Switch (52, Figure 5-2) in the on position. The backup alarm will sound only when the superstructure Transmission Shift Lever (48) is placed in one of the R (reverse) positions.

   With the blackout lighting control switch in either Normal mode position, the carrier backup/ superstructure driving lights will be controlled by the position of the carrier Transmission Shift Lever (6, Figure 5-1) regardless of what position (on or off) the superstructure cab DRIVE/PANEL Light Switch (52, Figure 5-2) is in. For example, these lights will turn on if the carrier transmission lever is placed in one of the R (reverse) positions and off when in N (neutral) or in one of the F (forward) positions.

3. When the blackout lighting control switch is in either blackout mode position, all power to the superstructure functions is disabled including the control panel illumination and warning/indicator lights.

WATER TEMPerature Gauge (17). The gauge is located on the middle left side of the front console panel. The gauge receives a signal from a sending unit in the engine coolant system and indicates the engine temperature on a dual scale calibrated from 100º to 280º F and 38º to 138º C.

Left Turn Signal Indicator (18). The indicator is located on the upper left of the front console panel. The indicator lights when the Turn Signal Lever (15, Figure 5-1) is positioned for a left turn.

Transmission OIL TEMPerature Gauge (19). The gauge is located on the upper left side of the front console panel. The gauge indicates transmission oil temperature as sensed by a transducer in the transmission oil lines. Indication is on a dual scale which is graduated from 160º to 320º F and 60º to 160º C.

AIR PRESSURE Gauge (20). The gauge located on the upper left side of the front console panel. The gauge is a direct reading, dual pressure gauge. A red needle indicates primary air pressure in supply reservoir, and a green needle indicates secondary air pressure in secondary reservoir and auxiliary reservoir. The gauge has a dual scale calibrated from 10 to 150 psi and 100 to 1,000 kPa. Tubing connects the gauge to the air system.

Hydraulic PUMP ENGAGED Indicator (21). The indicator is located at the upper left of the front console panel. The red indicator is lit when the hydraulic pump is engaged.

DIFFerential LOCKED Indicator (22). The indicator is located on the upper left side of the front console panel. The red indicator is lit when the differential lock control switch is in the FRONT & REAR LOCKED position and the front and rear differentials are locked and when the switch is in the REAR LOCKED position indicating the rear differential is locked.

Low AIR PRESSure Indicator (23). The indicator is located at the upper left side of the front console panel. The red light is lit when the pressure in the air system(s) is below 75 psi (517 kPa). The indicator is controlled by two pressure switches electrically connected in parallel. The pressure switches also energize an alarm buzzer.

CARRIER STEERing DISENGAGED Indicator (24). The indicator is located at the middle of the upper left side of the front console panel. The indicator is lit when the steering mode selector handle (mounted by the hydraulic reservoir) is pulled out allowing steering from superstructure.

STEER PUMP FAILED Indicator (25). The indicator is located at the upper middle of the front console panel. The indicator lights when the pressure drops in the steering circuit indicating a failure in the steering system.

FUEL PREHEAT Indicator (26). The indicator is located at the upper middle of the front console panel. The indicator is lit when a thermostat turns on the diesel fuel heater.

Low ENGINE OIL PRESSure Indicator (27). The indicator is located on the upper middle of the front console panel. The indicator is illuminated by a red light when engine oil pressure is too low. In addition to the indicator, the switches also energize an alarm buzzer.

TACHometer Gauge (28). It is the large gauge located on the left center of the front console panel. The tachometer registers engine RPM and is calibrated in RPM x 100 with a range of 0 to 40. It receives a signal from a sending unit on the engine.

Hourmeter (HOURS) (29). The meter shares the lower portion of the TACHometer Gauge (28) and registers total hours of engine operation.

BATTERY Voltmeter (30). The gauge is located on the lower left side of the front console panel, above the Engine DIFFERENTIAL LOCK Switch (31) and left of the steering column. With the IGNITION Switch (50) in the ON position and before starting the engine, the voltmeter indicates the condition of the batteries. With the engine running, the voltmeter indicates output voltage of the alternator. The voltmeter indicates voltage on a scale from 20 to 32 volts.

NOTE

The differential lock can only be engaged when 4WD is active.

Axle DIFFERENTIAL LOCK Switch (31). The switch is a three-position toggle switch located on the lower left side of the front console panel. Placing the switch to the FRONT & REAR LOCKED position activates two solenoid valves to route air pressure to lock the front and rear differentials. With the differentials locked, the right and left wheels on each axle rotate at the same rate. When used with the range selector in 4WD (low range) position, torque is equally split to the front and rear axles, and drive all wheels at the same rate. Placing the switch to the REAR LOCKED position activates a single solenoid valve to route air pressure to lock the rear differential. Placing the switch to the UNLOCKED position returns the axles to normal.

Engine OIL PRESSure Gauge (32). The gauge is located on the left center of the front console panel. The gauge indicates engine oil pressure on a dual scale calibrated from 0 to 100 psi (0 to 690 kPa). Normal indication at idle is 35 psi (241 kPa), and at maximum governed speed is 85 psi (586 kPa). It receives a signal from an oil pressure sending unit on the engine.

FUEL Gauge (33). The gauge is located on the lower left side of the front console panel. The gauge indicates the quantity of fuel in the tank and has a scale calibrated from 0 to 4/4. The gauge receives a signal from a sending unit in the fuel tank.

DRIVE AXLE Selector Switch (34). The switch is located on the lower left side of the front console panel. The switch is a two-position switch; 2WD (high range) and 4WD (low range). The switch controls a solenoid-operated valve that operates the high/low speed range and axle disconnect cylinders on the transmission.

Windshield WIPER/WASHER Switch (35). The switch is located on the lower left side of the front console panel. The switch has four positions; Off, Intermittent, Low, and High. Depress the switch to energize windshield washer pump assembly. Placing switch to Intermittent energizes the wiper motor to operate at an intermittent interval (the farther the switch is moved clockwise in the Intermittent position range, the faster the interval). Low energizes the wiper motor in low speed, while HIGH energizes the motor for high speed. The OFF position stops the motor which automatically parks the wiper blade.

ENGINE WATER TEMPerature Indicator (36). The indicator is located on the upper right of the front console panel. The indicator will light when the engine water temperature reaches 205º F (96º C) as detected by a switch mounted in the diesel engine block.

TRANSmission OIL TEMPerature Indicator (37). The indicator is located on the upper right middle of the front console panel. The indicator lights when the transmission oil temperature exceeds 250º F (121º C).

TRANSmission RPM/PRESSure Indicator (38). The indicator is located on the upper right of the front console panel. The amber indicator lights when the transmission is in an overspeed condition or when clutch pressure becomes critically low. The indicator will also light when the ignition switch is in the ON position and the engine is not running because no clutch pressure is generated.

TORQUE CONVERter UNLOCKED Indicator (39). The indicator is located on the upper right side of the front console panel. The amber indicator lights when the torque converter is in an unlocked condition.

PARK BRAKE Indicator (40). The indicator is located at the upper right of the front console panel. The red indicator lights when the PARK BRAKE Control (45) is in the ON position.

HEATer Control (41). The control is located on the upper right side of the front console panel. The control must be pulled out for high heat temperature.

HEATER FAN Switch (42). The switch is located on the right upper side of the front console between the HEATer Control (41) and the DEFROST Control Knob (43). It is a three-position toggle switch. Positioning the fan to HI activates the heater fan for high speed. Positioning the switch to LO activates the heater fan for low speed and the center position is the OFF position.

DEFROST Control Knob (43). The control knob is located on the upper right side of the front console panel. The control must be pulled out for the heater air flow to be routed to defrost the windshield.

Right Turn Signal Indicator (44). The indicator is located on the right upper of the front console panel. The indicator lights when the Turn Signal Lever (15) is positioned for right turn.

PARK BRAKE Control (45). The control is the yellow handle located on the right side of the front console panel. The control is a push-pull-type air valve used to set and release the parking brakes on the front and rear axles. Pull to apply parking brake, push to release parking brake.

REAR STEER LOCK ENGAGED/DISENGAGED Indicators (46). The indicator is located on the right lower side of the front console panel. There are two indicators. The red REAR STEER LOCK ENGAGED indicator is on the right side and is lit when the rear wheels are locked in a straight ahead position. The red REAR STEER LOCK DISENGAGED indicator is lit when the rear wheels are not locked in a straight ahead position.

REAR AXLE STEERING LOCK Switch (47). The switch is a two-position toggle switch, located on the lower right side of the front console panel. Placing the switch to UNLOCKED, unlocks the rear axle and allows it to be steered by the REAR AXLE STEERING Control Switch (48). The rear wheels MUST be straight ahead with the control switch in the LOCKED position before the crane can be driven on the highway from the carrier cab.

REAR AXLE STEERING Control Switch (48). The control switch is a three-position, spring-centered-to-OFF toggle switch, located on the lower right of the front console panel. This function provides conventional rear wheel steering of the rear axle and can only be used safely when moving slowly. Positioning the switch to RIGHT with front wheels straight ahead turns the rear wheels to steer the crane right. Positioning the switch to LEFT with front wheels straight ahead turns the rear wheels to steer the crane left. The switch will return to the center (OFF) position when released.

REAR STEER DIRECTION Indicator (49). The indicator arrows are located on the lower right of the front console panel above the REAR AXLE STEERING Control Switch (48). The indicator receives a signal from a sending unit on the axle to show that the rear wheels are positioned to steer the crane left or right as selected by the REAR AXLE STEERING Control Switch (48).

IGNITION Switch (50). The switch is located at the lower right side of the front console panel, right of the steering column. It is a non-keyed switch with four positions; ACC (3), OFF (0), RUN (1), and START (2). The switch is spring-returned from start to run. With the switch in the OFF position, all electrical power in the carrier is off. Placing the switch in the ACC position energizes all electrical components except the engine fuel solenoid valve. The RUN position energizes the same components except the engine fuel solenoid valve also becomes energized. Placing the switch in the START position energizes the starter relay which in turn energizes the solenoid and cranks the diesel engine for starting. Releasing the switch allows it to spring-return to the RUN position. Placing the switch to OFF shuts down the diesel engine.

Trailer Air Supply Control (TRAILER BRAKE) (51). The control is located on the right side middle of the front console panel. It controls the application of air to the trailer brake couplings located on the rear of the vehicle. Push to apply air to brake couplings, pull to evacuate air pressure.

Odometer (MILES) (52). The odometer is located on the Speedometer (MPH/KM/H) (53) at the bottom and shows the total distance the crane has traveled in miles.

Speedometer (MPH/KM/H) (53). The speedometer is the large gauge located on the right middle of the front console panel. It has a dual scale calibrated from 0 to 80 mph and 0 to 120 kph.

Headlight High Beam Indicator (54). The indicator is located in the Speedometer (MPH/KM/H) (53) on the upper left side. The blue indicator light is lit when the headlights are on high beam.

Air Conditioner Temperature Control (55). It controls air temperature and turns roof-mounted air conditioner on and off (full counterclockwise position is off).

Air Conditioner Fan Control (56). It controls fan speed of roof-mounted air conditioner. Control knob has four positions; OFF, LO, MED, and HI.

STEERING MODE CONTROL Handle (Not Shown). Located to rear of hydraulic tank, this handle selects which cab (carrier or superstructure) has control of vehicle steering. When pushed in and locked, enables steering from the carrier cab. When pulled out and locked, enables steering from the superstructure cab.

CAUTION

Do not use the BATTERY DISCONNECT switch as an emergency stop switch. Moving the BATTERY DISCONNECT switch to off will not shut down the engine and could result in damage to the alternator.

BATTERY DISCONNECT Switch (Not Shown). Located below the battery box, this switch energizes and deenergizes the crane's 24 VDC electrical system. When handle is turned clockwise and locked, the electrical system is energized.

5-2. SUPERSTRUCTURE CAB CONTROLS AND INDICATORS.

NOTE

The crane is equipped with a Load Moment Indicating (LMI) system as an aid the operator, refer to Appendix G for LMI operation.

The following paragraphs describe the controls and indicators located in the superstructure cab. The numbers in parentheses ( ) represent the index number from Figure 5-2.

Any reference made to left, right, front, and rear when describing locations from the superstructure cab is to be considered as viewed from the superstructure operator's seat with the boom directly over the rear of the carrier.

Cab Circulating Fan (1). The fan is located on the left on a mounting bracket above the window frame. A swivel allows the fan to be rotated. The fan is controlled by a switch on the base.

Turn Signal Lever (2). The lever is located on the steering column. Moving the switch handle down causes the left turn signals to flash. Moving the switch handle up causes the right turn signals to flash.

Four-Way Flasher (3). The flasher is located on the steering column just below the turn signal lever. Pulling the switch causes all four turn signal lights to flash. The lights will continue to flash until the switch is depressed.

PUSH FOR TELE/PULL FOR TILT Steering Column Tilt/Telescope Lever (4). The lever is located on the left side of the steering column below the turn signal lever. When pulled, the lever allows the operator to tilt the steering column to one of six different positions. When pushed, the operator can move the steering wheel in or out for ease of operation and comfort.

Foot Throttle Pedal (5). The pedal is the right most pedal on the cab floor. The pedal is connected to a valve which pneumatically actuates the throttle cylinder on the engine to control engine speed.

Positive Swing Lock Handle (6). The handle is located on the right side of the operator's seat beneath the control armrest. The purpose of the positive swing lock is to secure the superstructure, so that it cannot swing during craning. When the handle is pulled up, the positive swing lock is disengaged and swing can be accomplished. Pushing down on the handle engages the positive swing lock assembly in the gear teeth of the swing gear. The handle is adjusted to require approximately 45 lbs (20.4 kg) of force to move the lever into the engaged position.

Hoist Rotation Indicators (7). The indicators are located in the top of the LIFT/MAIN and SWING/AUXiliary hoist control levers. Each indicator consists of a solenoid which produces a mechanical thump in response to a signal transmitted by an electronic pulse generator attached to each hoist frame. A thumping signal is felt by the operator's thumb when the drum rotates.

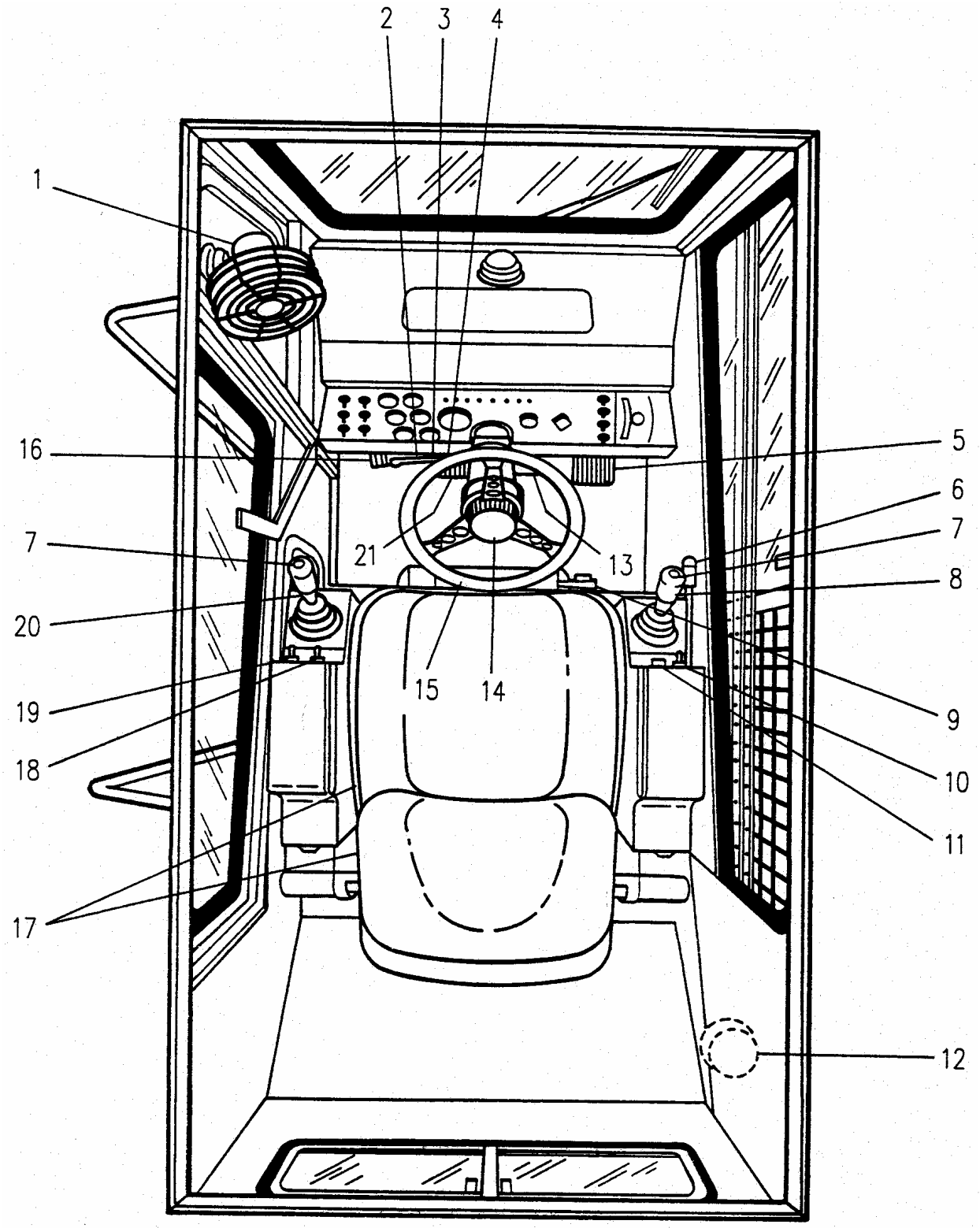


Figure 5-2. Superstructure Cab Controls and Indicators (Sheet 1 of 4)

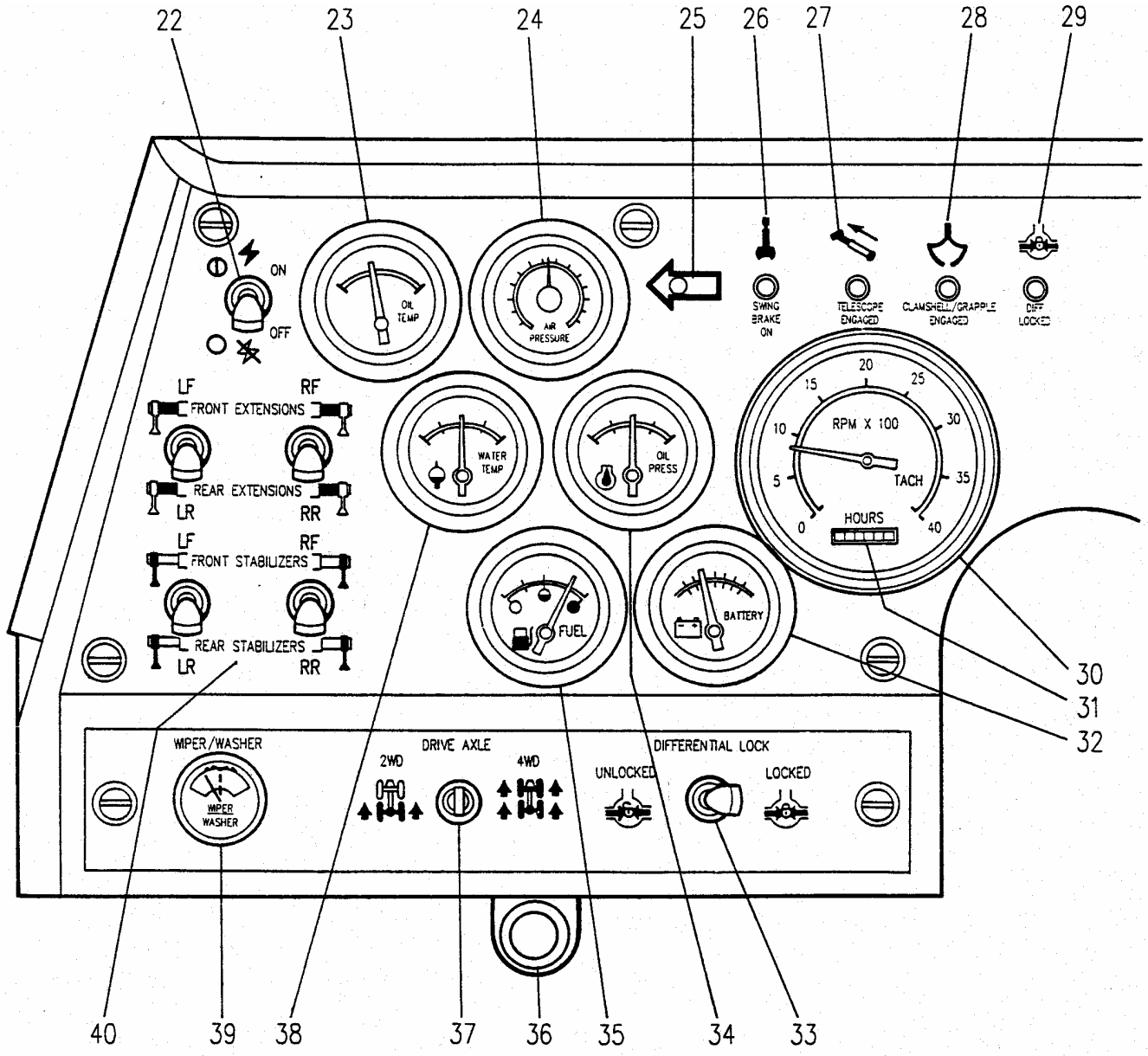


Figure 5-2. Superstructure Cab Controls and Indicators (Sheet 2 of 4)

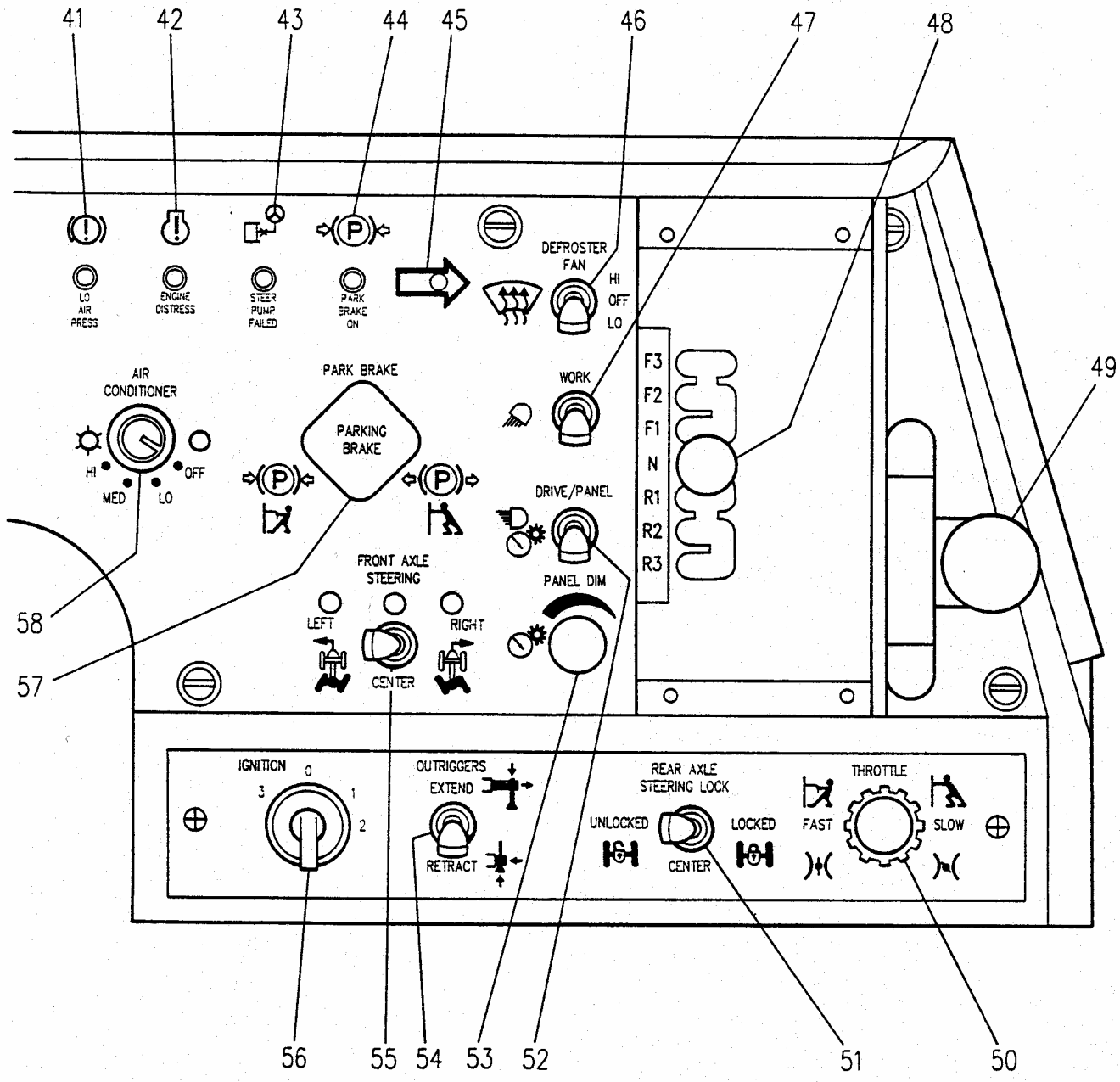


Figure 5-2. Superstructure Cab Controls and Indicators (Sheet 3 of 4)

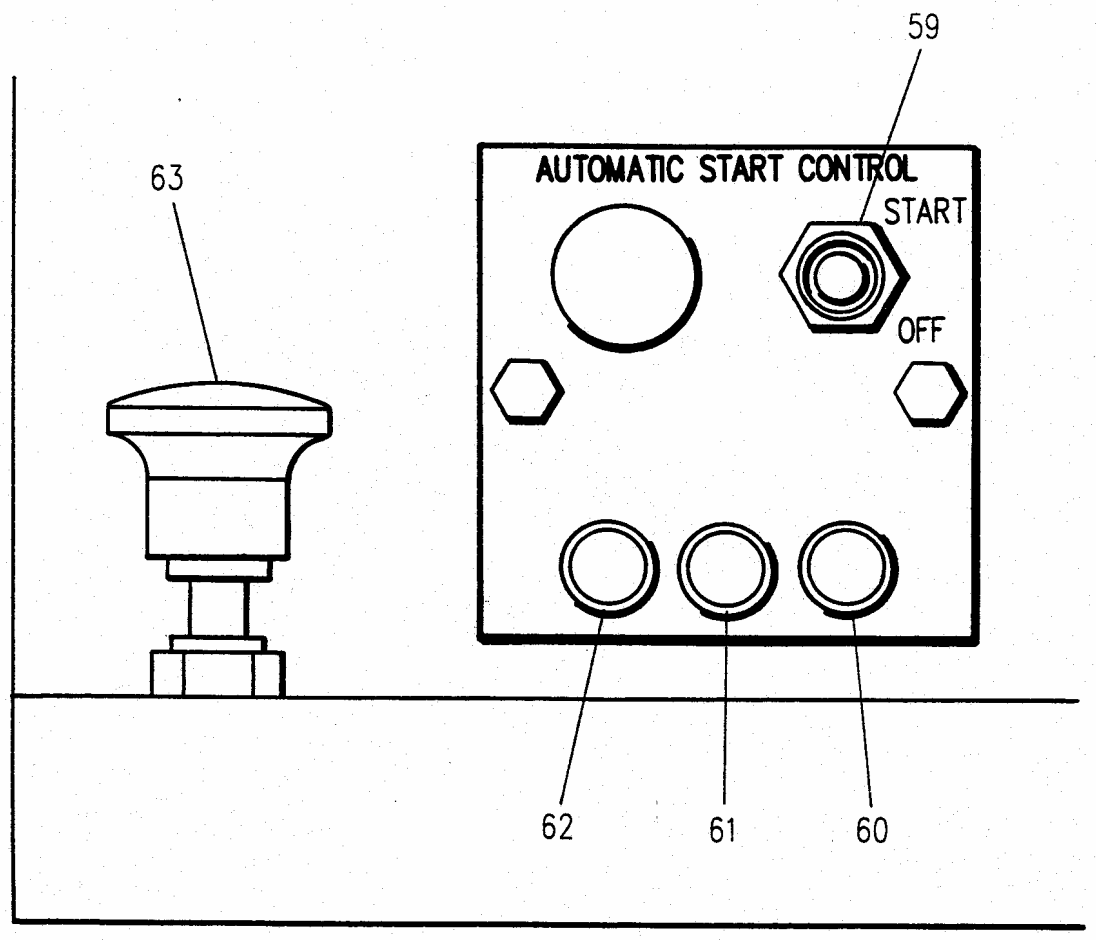


Figure 5-2. Superstructure Cab Controls and Indicators (Sheet 4 of 4)

Legend for Figure 5-2.

1. Cab Circulating Fan
2. Turn Signal Lever
3. Four-Way Flasher
4. PUSH FOR TELE/PULL FOR TILT Steering Column Tilt/Telescope Lever
5. Foot Throttle Pedal
6. Positive Swing Lock Handle
7. Hoist Rotation Indicators
8. Boom LIFT/MAIN HOIST Control Lever
9. Fire Extinguisher
10. TELE/CLAMSHELL Selector Switch
11. Horn Button - Swing
12. Cab Dome Light
13. Brake Foot Pedal
14. Horn Button
15. Steering Wheel
16. Swing Brake Pedal
17. Seat Position Adjustment
18. SWING BRAKE ON/OFF Selector Switch
19. AUX HOIST ON/OFF Selector Switch
20. SWING/AUXiliary Hoist Control Lever
21. Telescope/Clamshell Control Pedal
22. CRANE FUNCTION POWER Switch
23. Transmission OIL TEMPerature Gauge
24. AIR PRESSURE Gauge
25. Left Turn Signal Indicator
26. SWING BRAKE ON Indicator
27. TELESCOPE ENGAGED Indicator
28. CLAMSHELL/GRAPPLE ENGAGED Indicator
29. DIFFerential LOCKED Indicator
30. TACHometer Gauge
31. Hourmeter (HOURS)
32. BATTERY Voltmeter
33. DIFFERENTIAL LOCK Switch
34. Engine OIL PRESSure Gauge
35. FUEL Gauge
36. Bubble Level
37. DRIVE AXLE Selector Switch
38. WATER TEMPerature Gauge
39. Windshield WIPER/WASHER Switch
40. OUTRIGGER SELECTOR Switches
41. LOw AIR PRESSure Indicator
42. ENGINE DISTRESS Indicator
43. STEER PUMP FAILED Indicator
44. PARK BRAKE ON Indicator
45. Right Turn Signal Indicator
46. DEFROSTER FAN Control Switch
47. WORK Light Switch
48. Transmission Shift Lever
49. SWING LOCK Pin Control Lever
50. THROTTLE FAST/SLOW Control Knob
51. REAR AXLE STEERING LOCK Switch
52. DRIVE/PANEL Light Switch
53. PANEL Light DIMmer Control
54. OUTRIGGERS EXTEND/RETRACT Switch
55. FRONT AXLE STEERING Control
56. IGNITION Switch
57. PARK BRAKE Control
58. AIR CONDITIONER Control
59. START/OFF Switch (Heater)
60. PUSH TO RESET Button (Heater)
61. FAULT Red Indicator (Heater)
62. POWER Green Indicator (Heater)
63. PULL FOR AIR FLOW Knob

Boom LIFT/MAIN Hoist Control Lever (8). The lever is located on the right armrest. The lever, when positioned to the left, actuates the control valve through hydraulic pilot pressure to raise the boom. Positioning the lever to the right lowers the boom. Pushing the lever forward will let out the main hoist rope and pulling the lever back reels the rope in. Moving the lever in a diagonal direction actuates both functions.

WARNING

When using fire extinguisher, conduct all extinguishing operations from outside the cab and ventilate the cab thoroughly prior to reentry. Fire extinguishers are located in both the carrier and superstructure cabs.

Fire Extinguisher (9). The extinguisher is mounted under the front of the operator's seat. The extinguisher is a BC rated dry-type fire extinguisher for emergency use.

TELE/CLAMSHELL Selector Switch (10). The switch is located on the right arm rest behind the Boom LIFT/MAIN HOIST Control Lever (8). In TELE position, the Telescope/Clamshell Control Pedal (21) controls telescope function of boom. The TELESCOPE ENGAGED Indicator (27) is lit. In CLAMSHELL position, the Telescope/ Clamshell Control Pedal (21) controls the clamshell and grapple hydraulic cylinder. The CLAMSHELL/GRAPPLE ENGAGED Indicator (28) is lit.

HORN Button - Swing (11). Located on right side arm rest, behind the Boom LIFT/MAIN HOIST Control Lever (8), press and hold pushbutton to sound a horn. Used by operator to alert personnel in the area prior to swinging the boom.

Cab Dome Light (12). The light is located on the right rear corner of the cab roof to illuminate the cab interior. The light is controlled by a switch on the light.

Brake Foot Pedal (13). The pedal is the second pedal from the right on the cab floor. Depressing the pedal actuates an air valve to control application of the brakes.

Horn Button (14). It is a push-button-type switch located in the center of the steering wheel. Depressing the horn button energizes a relay that in turn sounds the horn on the cab exterior.

Steering Wheel (15). It is a conventional automotive-type steering wheel used to control rear wheels. Clockwise steers crane to right, counterclockwise steers crane to left when the STEERING MODE CONTROL handle is in the superstructure position.

Swing Brake Pedal (16). The pedal is located on the left side of the cab under the front console. The pedal is used to actuate the swing brake to slow or stop motion. Braking is proportional to pedal depression. With the pedal not depressed and the swing brake release valve engaged (SWING BRAKE ON/OFF Selector Switch in OFF position), hydraulic pressure is applied to the brake release circuit, thereby, overcoming spring pressure and releasing the brake. Depressing the pedal actuates the swing power brake valve to apply hydraulic pressure to the brake actuation (service) circuit. This pressure (proportional to pedal depression) aids the brake spring in overcoming the hydraulic pressure being applied to the brake release circuit and applies the swing brake.

Seat Position Adjustment (17). One adjustment controls seat back position. The other moves seat cushion forward and back.

SWING BRAKE ON/OFF Selector Switch (18). The switch is located on the left arm rest behind the SWING/AUXiliary Hoist Control Lever (20). The switch sets the swing brake when in ON position (prevents all swing functions). In OFF position, swing brake is controlled by the Swing Brake Pedal (16).

AUX HOIST ON/OFF Selector Switch (19). The switch is located on left arm rest behind SWING/AUXiliary Hoist Control Lever (20). This switch enables and disables the auxiliary hoist function only in the SWING/AUX Hoist Control Lever (20). In the ON position, the auxiliary hoist function is enabled. The function is disabled in the OFF position. The switch must be pulled while moving it from the OFF to the ON position.

SWING/AUXiliary Hoist Control Lever (20). The lever is located on the end of the left armrest. The lever controls swing and auxiliary hoist functions. The lever, when positioned to the left or right actuates a control valve through hydraulic pilot pressure to provide 360º continuous swing rotation in the desired direction. When AUX HOIST ON/OFF Selector Switch (19) is in the ON position, pushing the lever forward actuates the control valve to let out auxiliary hoist rope and pulling the lever back reels the wire rope in. Moving the lever in a diagonal direction actuates the both swing and auxiliary hoist functions.

Telescope/Clamshell Control Pedal (21). The pedal is located on the left side of the cab floor. When the TELE/CLAMSHELL Selector Switch (10) is in the TELE position, pushing forward on the top of the pedal actuates a control valve through hydraulic pilot pressure to telescope the boom out. Pushing on the bottom of the pedal will telescope the boom in. When the TELE/CLAMSHELL Selector Switch (10) is in the CLAMSHELL position, pushing forward on the top of the pedal actuates the clamshell (or grapple) cylinder to open the clamshell (grapple). Pushing on the bottom of the pedal closes the clamshell (grapple).

CRANE FUNCTION POWER Switch (22). The switch is located on the upper left side of the front console panel. The switch is a two-position toggle switch marked ON/OFF. Placing the switch to OFF removes all power from the crane functions controlled by the armrest joysticks. This prevents accidental operation of the controlled crane functions caused by bumping the joysticks.

Transmission OIL TEMPerature Gauge (23). The gauge is located on the upper left side of the front console panel. The gauge indicates the transmission oil temperature as sensed by a transducer in the transmission oil lines. Indication is on a dual scale which is graduated from 160º to 320º F and 60º to 160º C.

AIR PRESSURE Gauge (24). The gauge located on the upper left side of the front console panel. The gauge is a direct reading, dual pressure gauge. A red needle indicates primary air pressure in supply reservoir, and a green needle indicates secondary air pressure in secondary reservoir and auxiliary reservoir. The gauge has a dual scale calibrated from 10 to 150 psi and 100 to 1,000 kPa. Tubing connects the gauge to the air system.

Left Turn Signal Indicator (25). The indicator is located on the upper left of the front console panel. The indicator lights when the turn signal lever is positioned down to make a left turn.

SWING BRAKE ON Indicator (26). The indicator is located on the upper left side of the front console panel. The red indicator is lit when the SWING BRAKE ON/OFF Selector Switch (18) is in ON position. The indicator is controlled by the position of the SWING BRAKE ON/OFF Selector Switch (18).

TELESCOPE ENGAGED Indicator (27). The indicator is located on the upper left side of the front console panel. The green indicator is lit when the telescope function is controllable via the Telescope/Clamshell Control Pedal (21) as selected by the TELE/CLAMSHELL Selector Switch (10) on the left arm rest.

CLAMSHELL/GRAPPLE ENGAGED Indicator (28). The indicator is located on the upper middle of the front console panel. The green indicator is lit when the clamshell/grapple function is controllable via the Telescope/Clamshell Control Pedal (21) as selected by the TELE/CLAMSHELL Selector Switch (10) on the left arm rest.

DIFFerential LOCKED Indicator (29). The indicator is located on the upper middle portion of the front console panel. The red indicator lights when the DIFFERENTIAL LOCK Switch (33) is in the LOCKED position and the front and rear differentials are locked.

TACHometer Gauge (30). This large gauge is located on the left side of the front console panel. The tachometer registers engine RPM and is calibrated in RPM x 100 with a range of 0 to 40. It receives a signal from a sending unit on the engine.

Hourmeter (HOURS) (31). The meter shares the lower portion of the TACHometer Gauge (30) and registers total hours of engine operation.

BATTERY Voltmeter (32). This gauge is located on the left side of the front console panel. With the IGNITION Switch (56) in the ON position and before starting the engine, the voltmeter indicates the condition of the batteries. With the engine running, it indicates output voltage of the alternator. The voltmeter indicates voltage on a scale from 20 to 32 volts.

DIFFERENTIAL LOCK Switch (33). The switch is a two-position toggle switch located on the lower left side of the front console panel. Placing the switch to the LOCKED position activates two solenoid valves to route air pressure to lock the front and rear differentials. The differentials will lock only in the four-wheel drive mode. With the differentials locked, the right and left wheels on each axle rotate at the same rate. When used with the DRIVE AXLE Selector Switch in 4WD position, torque is equally distributed to the front and rear axles driving all wheels at the same rate. Placing the switch to the UNLOCKED position, returns the axles to the normal mode.

Engine OIL PRESSure Gauge (34). The gauge is located on the left side of the front console panel. The gauge indicates the engine oil pressure on the dual scale graduated from 0 to 100 psi and 0 to 690 kPa. Normal indication at idle is 10 psi (70 kPa), at high idle is 35 psi (241 kPa), and at maximum governed speed is 85 psi (686 kPa). It receives a signal from an oil pressure sending unit on the engine.

FUEL Gauge (35). The gauge is located on the left side of the front console panel. The gauge indicates the quantity of fuel in the fuel tank and has a scale calibrated from 0 to 4/4. The fuel quantity gauge receives a signal from a sending unit in the fuel tank.

Bubble Level (36). The bubble level indicator is located on the bottom left of the front console. The indicator provides the operator with a visual indication for determining the levelness of the crane.

DRIVE AXLE Selector Switch (37). The switch located on the bottom left of the front console panel is a two-position switch; 2WD (high range) and 4WD (low range). The switch operates a solenoid valve that controls the speed range and axle disconnect cylinders on the transmission.

WATER TEMPerature Gauge (38). The gauge is located on the left side of the front console panel. The gauge receives a signal from a sending unit in the engine coolant system and indicates the engine temperature on a dual scale calibrated from 100º to 280º F and from 38º to 138º C.

Windshield WIPER/WASHER Switch (39). The switch is located on the lower left side of the front console panel. The switch has four positions; Off, Intermittent, Low, and High. Depress the switch to energize windshield washer pump assembly. Placing switch to Intermittent energizes the wiper motor to operate at an intermittent interval (the farther the switch is moved clockwise in the Intermittent position range, the faster the interval). Low energizes the wiper motor in low speed, while HIGH energizes the motor for high speed. The OFF position stops the motor which automatically parks the wiper blade.

OUTRIGGER SELECTOR Switches (40). The switches (FRONT/REAR EXTENSIONS and FRONT/REAR STABILIZER) are located on the left side of the front console panel. There are four two-position, spring-centered-to-off toggle switches. These switches are used in conjunction with the OUTRIGGERS EXTEND/RETRACT Switch (54) to control the four outrigger extension and stabilizer cylinders. Activating any one of the toggle switches energizes a solenoid valve for the appropriate component to be operated. Activating the OUTRIGGERS EXTEND/RETRACT Switch (54) energizes the control solenoid to allow hydraulic fluid to flow through the control solenoid valve and move the selected component in the desired direction.

LOw AIR PRESSure Indicator (41). The indicator is located on the upper middle portion of the front console panel. The indicator is illuminated by a red light when the pressure in the air system(s) is below 75 psi (517 kPa). The indicator is controlled by two pressure switches electrically connected in parallel. The pressure switches also energize an alarm buzzer.

ENGINE DISTRESS Indicator (42). The indicator is located on the upper right portion of the front console panel. The red indicator lights when engine temperature or transmission oil temperature is too high or engine oil pressure is too low. The indicator is energized by a high temperature switch or a low oil pressure switch connected in parallel. Check the appropriate gauge to determine which system is abnormal. An alarm buzzer will also be sound.

STEER PUMP FAILED Indicator (43). The indicator is located on the upper right portion of the front console panel. The red indicator lights when vehicle is not moving indicating that ground driven steering pump is not pumping.

PARK BRAKE ON Indicator (44). The indicator is located on the upper right portion of the front console panel. The red indicator is lit when the PARK BRAKE Control (57) is in the ON position.

Right Turn Signal Indicator (45). The indicator is located on the upper right of the front console panel. The indicator lights when the turn signal lever is positioned to make a right turn.

DEFROSTER FAN Control Switch (46). The switch is located on the upper right of the front console panel. The switch controls the windshield defroster fan located under the front console panel. The switch has three positions: LO, OFF, and HI.

WORK Light Switch (47). The switch is a two-position (ON/OFF) toggle switch, located on the right side of the front console panel. It controls the crane's work light.

Transmission Shift Lever (48). The lever is located on the right side of the front console panel and is electrically connected to the transmission selector valve. The lever has seven different shift positions allowing the operator to select from three forward (F3, F2, F1) speeds, neutral (N), and three reverse (R1, R2, R3) speeds.

CAUTION

Ensure SWING LOCK Pin control lever is locked in the disengaged position prior to swinging the superstructure.

SWING LOCK Pin Control Lever (49). The lever is located in the lower right side of the front console panel. When actuated, the lever engages a socket in the carrier to prevent the superstructure from swinging. The boom must be directly over the boom rest cradle or centered over the rear of the crane to engage the pin. The lever must be disengaged to rotate the crane superstructure.

THROTTLE FAST/SLOW Control Knob (50). The knob is located at the lower right side of the front console panel. The hand throttle is mechanically connected to the foot throttle and provides the operator with a means of maintaining specified engine RPM for crane operation. To use the hand throttle, depress the foot throttle to the desired engine RPM, push the button on the hand throttle control knob, and pull out on the knob. When pressure is felt, release the button and turn the locknut in a clockwise direction to lock and throttle at the desired RPM. To release the throttle, rotate the locknut counterclockwise, depress the button, and push in on the cable. Fine adjustment of engine speed is accomplished by turning the control knob.

REAR AXLE STEERING LOCK Switch (51). The switch is a two-position toggle switch located on the lower right side of the front console panel. The switch must be in the UNLOCKED position to enable rear wheel steering with the steering wheel in the superstructure cab. An indicator to the right of the switch lights when the switch is in the LOCKED position.

DRIVE/PANEL Light Switch (52). The light switch is a two-position, ON/OFF toggle switch located on the right side of the front console panel. The ON position turns on the driving lights on the rear of the crane and the panel lights.

PANEL Light DIMmer Control (53). The control is located below the DRIVE/PANEL Light Switch (52) on the right side of the front console panel. PANEL Light DIMmer Control knob controls the brightness of the panel lights.

OUTRIGGERS EXTEND/RETRACT Switch (54). The switch is located on the lower right panel of the front console. It is a two-position, spring-centered-to-off toggle switch. This switch is used in conjunction with the OUTRIGGER SELECTOR Switches (40) to extend and retract the outrigger extensions and stabilizers. The OUTRIGGER EXTEND/RETRACT Switch energizes a solenoid, which allows hydraulic fluid to flow through the control valve and selected solenoid valve(s) to move the selected component in the desired direction.

FRONT AXLE STEERING Control (55). The control is a three-position (LEFT/center/ RIGHT), spring-centered-to-off, toggle switch located on the right side of the front console. With boom over rear of crane, this function provides conventional "rear wheel" steering of the front axle and can only be used safely when moving slowly. Positioning the switch to RIGHT with rear wheels straight ahead turns the front wheels to steer the crane right. Positioning the switch to LEFT with rear wheels straight ahead turns the front wheels to steer the crane left. The switch will return to the center (OFF) position when released. Indicators above the switch light to indicate which direction the crane will turn and when wheels are centered.

IGNITION Switch (56). The switch is located on the lower right side of the front console panel next to the steering column. It is non-keyed switch with four positions; 3 (ACC), 0 (OFF), 1 (RUN), and 2 (START). The switch is spring-returned from START to RUN. The OFF position deenergizes the superstructure electrical system except for the beacon lights, heater, and oil cooler fan.

The ACC position energizes all electrical components except the engine fuel solenoid valve. The RUN position energizes the same components except that the engine fuel solenoid valve is also energized. Placing the switch in the START position energizes the starter relay which in turn energizes the cranking motor solenoid and cranks the engine for starting. Releasing the switch will allow it to spring-return to the RUN position. Placing the switch to OFF shuts down the diesel engine.

PARK BRAKE Control (57). The control is the yellow handle located on the right side of the front console panel. The control is a push-pull-type air valve used to set and release the parking brakes on the front and rear axles. Pull to apply parking brake, push to release parking brake.

AIR CONDITIONER Control (58). The control is located on the right side of the front console panel. It is a four-position control (HI/MED/LO/OFF).

START/OFF Switch (Heater) (59). The switch is located on the diesel heater control panel to the right of the operator's seat. Placing the switch in the START position turns on the heater fuel pump, ignites fuel in the heat exchanger, and turns on the heater fan after a short delay. The OFF position shuts down the heater. After shutdown, the heater fan will continue to run until the heat exchanger has cooled down.

PUSH TO RESET Button (Heater) (60). The button is located on the diesel heater control panel to the right of the operator's seat. When depressed, it resets heater relay after fault in preparation for restart.

FAULT Red Indicator (Heater) (61). The indicator is located on the diesel heater control panel to the right of the operator's seat. When lit, diesel heater has experienced a malfunction.

POWER Green Indicator (Heater) (62). The indicator is located on the diesel heater control panel to the right of the operator's seat. When lit, diesel heater is running and functioning normally.

PULL FOR AIR FLOW Knob (63). The knob is located to the right of the operator's seat. When pulled, knob opens flapper valve to allow air flow from cab heater. Amount of flow is controlled by how far knob is pulled out.

Skylight Wiper (Not Shown). A skylight wiper removes moisture and debris from the skylight. The wiper is manually operated.

Mechanical Boom Angle Indicator (Not Shown). Mounted on left-side of boom, provides visual indication of boom angle in degrees. Indicator is visible from superstructure operator's cab.

5-3. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

5-3.1 General.

a. Before you operate. Always keep in mind the CAUTIONS and WARNINGS. Perform your "before" PMCS.

b. While you operate. Always keep in mind the CAUTIONS and WARNINGS. Perform your "during" PMCS.

c. After you operate. Be sure to perform your "after" PMCS.

d. If your equipment fails to operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 750-8.

5-3.2 Procedure.

PMCS procedures in the table are intended to insure that the crane is ready to be operated safely with minimum crane wear and tear.

The PMCS table lists the checks and services that need to be performed at various intervals. The intervals were determined by crane design and expected use.

a. "Before" PMCS shall be performed by the operator prior to starting the engine and attempting to operate the crane.

b. "During" PMCS shall be performed while operating the crane both while sitting in the cab manipulating the controls and when outside the cab doing other tasks associated with operations.

c. "After" PMCS shall be performed after crane operation and when it is being shut down for a period of time.

d. "Weekly" PMCS need not be performed every day or every time the crane is operated, but must be done relatively frequently, and not delayed or forgotten. A weekly routine must be established to check and service these items.

e. "Monthly" PMCS provides checks and services that need not be done weekly but cannot be ignored more than a month. A monthly service routine must be established.

f. There are checks and services that must be done on the basis of the number of hours of engine operation, or based on special environmental conditions. These more frequent checks are marked with an asterisk. An appropriate footnote explains the special service interval.

5-3.3 Additional Special Checks and Services.

Perform "weekly" as well as "before" operations PMCS if:

a. You are the assigned operator and have not operated the crane since the last weekly.

b. You are operating the crane for the first time.

5-3.4 Leakage Definitions.

Leakage definitions for operator/crew PMCS shall be classified as follows:

Class I Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.

Class II Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.

Class III Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

Equipment operation is allowable with minor leaks (Class I or II). Of course, you must consider the fluid capacity in the item/system being checked/ inspected. When in doubt, notify your supervisor.

When operating with Class I or II leaks, continue to check fluid levels as required in your PMCS.

Class III leaks should be reported to your supervisor or organizational maintenance.

5-3.5 Not Fully Mission Capable If:

This column provides a brief statement of the condition (e.g., malfunction, shortage) that would cause the crane to be less than fully ready to perform its assigned mission.

Deficiencies in the crane and its performance shall be reported to your supervisor, and/or to your organizational maintenance group on Form 2404 in accordance with DA Pam 750-8.

PMCS can be performed by the operator without removing any assemblies.

5-3.6 General Safety Precautions.

It is impossible to compile a list of safety precautions covering all situations. However, there are basic safety precautions that MUST be followed during your daily routine. Safety is YOUR PRIME RESPONSIBILITY, since any piece of equipment is only as safe AS THE PERSON AT THE CONTROLS.

With this thought in mind, Section 2 of the operator's manual will assist you, the operator, in promoting 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, the operator, 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.

You, the operator, 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 can cause an accident to people and equipment.

You are responsible for the safety of yourself and of those around you.

Ensure you and those working with you are aware of any special dangers where you are operating the crane. Be especially careful of dangerous ground and objects, including buildings, near the crane.

Be aware at all times that you are responsible for the safety of yourself, your co-workers, the crane, and everything around it. Make certain the crane is properly maintained, and then pay attention to winds, boom deflections, rope sway, and any unusual things, which you, as a crane operator, may notice which would not be important to others.

Know and abide by the basic safety rules.

Read and understand the Operator's Manual before entering the cab.

WARNING

To avoid personal injury and/or catastrophic steering gear failure, remove restraining devices from the carrier cab steering wheel before operating from the superstructure cab.

Follow directions on all placards. Know what they mean and follow their instructions.

Operators must be thoroughly familiar with safe crane operating practices and have a complete understanding of all operation and maintenance instructions provided. Operators should be physically fit and thoroughly trained, with related experience, not be easily excitable, not be subject to epileptic seizures, and not be using any drug that could impair physical, visual, or mental reactions or capabilities.

Wear the proper clothing for the job. Wear personnel protective equipment as required by local or job regulations.

Inspect the crane every day (before the start of each shift). Ensure that routine maintenance and lubrication are being dutifully performed. Do not operate a damaged or poorly maintained crane. You risk lives when operating faulty machinery, including your own.

5-3.7 Diesel Fuel Recommendations/Specifications.

WARNING

Do not mix gasoline or alcohol with diesel fuel. This mixture can cause an explosion.

CAUTION

Any adjustment to compensate for reduced performance with a fuel system alternate fuel is not warrantable. Cummins, the diesel engine manufacturer, advises that certain fuels, listed below, can not provide adequate lubrication to the Bosch fuel injection pump internal parts and must not be used. If these fuels are used, it will result in internal parts failure in the Bosch fuel injection pump, due to lack of lubrication, and any warranty repair will be voided.

Use ASTM No. 2-D fuel with a minimum Cetane number of 40. No. 2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to prevent misfires and excessive smoke. At operating temperatures below 32º F (0º C), use a blend of No. 1-D and No. 2-D fuels, also known as "winterized" No. 2-D.

Use low sulfur content fuel having a cloud point that is at least 10 degrees below the lowest expected fuel temperature. Cloud point is the temperature at which crystals begin to form in diesel fuel. The viscosity of the fuel must be kept above 1.3 centistokes to provide adequate fuel system lubrication at 104º F (40º C).

Acceptable Alternate Fuel Types: *No. 1-D Diesel and No. 2 Fuel Oil, No. 1-K Kerosene, No. 2-K Kerosene, Jet-A, Jet A-1, JP-5, and JP-8**

Unacceptable Fuel Types: *Jet-B, JP-4, and Cite*

**JP-8 (MIL-T-83133) is acceptable if its lubricity is 3100 grams or greater as measured with the US Army scuffing BOCLE test or Wear Scuff Diameter less than 0.45 mm at 60º C (less than 0.38 mm at 25º C) as measured with the HFRR method.*

5-3.8 Lubrication Instructions.

Refer to Appendix M – Lubrication for ATEC lubrication instructions and specifications.

Table 5-1. Operator Preventive Maintenance Checks and Services

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
1	BEFORE	Superstructure and Carrier	While performing PMCS on crane, check for flaking/cracking paint or rust which may indicate dangerous cracks in the carrier frame or superstructure. Check all placards and decals for security and legibility.	Any cracks in carrier frame, boom, or turntable.
2	BEFORE	Hardware	While performing PMCS on crane, perform a general inspection for loose or missing attaching hardware.	Any loose or missing attaching hardware.
3	BEFORE	Hydraulic Cylinders and Valves	Inspect all hydraulic cylinders and valves for damage, security, and leaks as you proceed around the crane. Check for cracked or broken mounting structures including worn, loose, or missing pivot pins and attaching hardware.	Cracked or broken components, loose, or missing hardware, or Class III leak.
4	BEFORE	Air System Components	Inspect all air system components for damage, security, and leaks. Check for broken mounting structures including worn, loose, or missing attaching hardware.	Cracked or broken components, loose, or missing hardware, or detected leak.
5	BEFORE	Fuel and Oil Lines and Components	While performing PMCS on crane, perform a general inspection for fuel and oil leaks.	Any fuel leak or Class III oil leak exists.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
6	BEFORE	Headlights and Horn	a. Check for cracked or broken lenses. b. Inspect connectors/ wiring for security and damaged insulation.	a. Any lens cracked or broken for night operation. b. Loose connectors/wiring or damaged insulation for night operation.
7	BEFORE	Right Side Clearance and Marker Lights	a. Check for cracked or broken lenses. b. Inspect connectors/ wiring for security and damaged insulation.	a. Any lens cracked or broken for night operation. b. Loose connectors/ wiring or damaged insulation for night operations.
8	BEFORE	Muffler and Exhaust Pipe	**WARNING** Ensure exhaust system components are cool to touch. Inspect exhaust system piping for evidence of leaks and corrosion. Check muffler and piping for security.	Any loose or damaged exhaust system components. Any evidence of exhaust leak.
9	BEFORE	Right Side Tires	**WARNING** To inflate a tire that is removed from vehicle, always use tire inflation cage and clip-on inflator as tire rim parts can fly apart with lethal force.	

Continued on next page.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
9	BEFORE	Right Side Tires (Continued)	Inspect tires for missing valve caps, excessive wear/cuts, low air pressure/flat tires, or loose/missing lug nuts. Refer to the tire inflation chart for proper inflation.	Tire air pressure less than 110 psi 758 kPa), flat/ damaged tire, excessive wear, or lug nut(s) loose/ missing.
10	BEFORE	Air Cleaner Evacuator	Pinch air cleaner evacuator several times to eliminate accumulated dirt.	
11	BEFORE	Right Side Outrigger Float Pads (if installed on jack cylinders)	Check for cracked or broken welds and cracks in pad structure.	Pads are required for craning operations.
12	BEFORE	Engine and Transmission Oil Filter Elements	Inspect engine and transmission filter elements for leaks and tightness.	Class III oil leak(s) exist.
13	BEFORE	Fuel Tank and Lines	Inspect fuel tank and lines for damage, security and evidence of leaks. Check fuel tank filler screen for damage and debris.	Any fuel system component damaged, loose, or leaking; Any fuel leak exists.
14	BEFORE	Tail Lights	a. Check for cracked or broken lenses. b. Inspect connectors/ wiring for security and damaged insulation.	a. Any lens cracked or broken for night operations. b. Loose connectors/ wiring or damaged insulation.
15	BEFORE	Outrigger Pads (if installed on frame)	If roading the crane, ensure outrigger pads are secure in their mounts.	

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
16	BEFORE	Pintle Hook	Inspect pintle hook safety chain and pin for damage.	Pintle hook safety chain and pin damaged or missing for towing operations.
17	BEFORE	Carrier Backup Alarm	Check connectors and wiring for security and damaged insulation.	Damaged insulation.
18	BEFORE	Left Side Clearance and Marker Lights	a. Check for cracked or broken lenses. b. Inspect connectors/ wiring for security and damaged insulation.	a. Any lens cracked or broken for night operations. b. Loose connect-ors/wiring or damaged insula-tion for night operations.
19	BEFORE	Left Side Tires	**WARNING** Always use tire infla-tion cage and clip-on inflator as tire rim parts can fly apart with lethal force. Inspect tires for missing valve caps, excessive wear/cuts, low air pressure/flat tires, or loose/missing lug nuts. Refer to the tire inflation chart for proper inflation.	Tire air pressure less than 110 psi 758 kPa), flat/ damaged tire, excessive wear, or lug nut(s) loose/ missing.
20	BEFORE	Left Side Outrigger Float Pads (if installed on jack cylinders)	Check for cracked or broken welds and cracks in the pad structure.	Pads are required for craning operations.
21	BEFORE	STEERING MODE SELECTOR	Check STEERING MODE CONTROL handle for proper operation.	STEERING MODE CONTROL handle does not operate to select the correct steering mode.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
22	BEFORE	Hydraulic Reservoir & Filter	**CAUTION** Ensure all hydraulic cylinders are fully retracted when checking hydraulic fluid level.	
			a. Check sight gauge (on front of hydraulic tank) for proper oil level. Ensure that oil is visible between HIGH and LOW marks on sight gauge. Reservoir capacity is 65 gallons.	a. Hydraulic oil level low; Class III leak exists.
			b. Inspect hydraulic tank breather intake for cleanliness.	b. Hydraulic tank breather is plugged with debris or breather is missing.
23	BEFORE	Emergency Stowage System	Ensure diverter valve is in either the HOIST or LIFT/TELESCOPE positions.	Diverter valve is between one of the two extreme settings.
24	BEFORE	Alcohol Evaporator	Momentarily open and close petcock on alcohol evaporator and ensure small amount of alcohol escapes.	No alcohol in the evaporator.
25	BEFORE (Temp. below 30º F)	Cold Start Ether Bottle	Open cover and check that cold start ether bottle is installed.	Cold start ether bottle missing when temperature below 30º F.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
26	BEFORE	Carrier	Inspect underside of carrier and components (e.g., frame, axles, steering linkage, engine, transmission case, fuel and oil lines, etc.) for damage and evidence of leaks. Check axle differentials for cracks and leaks. Check brake lines for security, chafing, and leaks. (Text Deleted)	Damaged frame or components, any fuel leak exists, or Class III oil leak exists.
27	BEFORE	Boom Sheaves & Hook Block	a. Inspect boom sheaves and hook block to ensure all components are properly installed and secure.	a. Any component loose, damaged, or not installed properly.
			b. Inspect hook block for cracks, damage, and deformed hook. Check for damaged/ missing safety latch.	b. Hook block cracked, damaged, or deformed. Safety latch damaged/ missing.
			c. Inspect boom and boom nose sheaves for excessive dirt, grease, and debris.	c. Excessive dirt, grease, or foreign matter.
28	BEFORE	Clamshell/ grapple/pile driver or con-crete bucket if installed)	Inspect attachment for damage and evidence of hydraulic leaks. Ensure attachment is properly rigged to main hoist rope.	For attachment operation, if any physical damage to attachment, attachment is not properly rigged, or Class III oil leak.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
29	BEFORE	Wire Rope	a. Inspect wire rope, rope sockets, and fittings for damage, wear, corrosion, heat damage, and lack of lubrication on rope. Check for kinks and exposed/ broken wire strands. Ensure that all components are properly reeved and secure.	a. Refer to paragraph 2-4 for wire rope safety criteria. If in doubt, contact maintenance.
			b. Inspect sheave guards, guides, drums, flanges, and other surfaces that come in contact with wire rope for sharp edges, burrs, and corrosion that could damage wire rope.	b. Any component damaged and/or corroded to the extent of inflicting damage to the wire rope.
30	BEFORE	Engine Crankcase	Check engine crankcase oil level. Maintain oil level within cross-hatched area on dipstick (between arrows).	Engine oil level at or below cross-hatched area on dipstick. Class III leak exists.
31	(Text Deleted)			

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
32	BEFORE	Hydraulic Pump Disconnect	Inspect for loose mounts, cracks, and leaks.	Hydraulic pump disconnect loose and/or leaking. Class III leak exists.
33	BEFORE	Fuel Water Separator	Open drain hose valve on bottom of fuel water separator bowl which is located on the left-rear side of the diesel engine. Get set to catch fuel/water in suitable drip pan. Drain water and sediment from fuel water separator by pushing pump button on top of filter head until clean fuel flows out of drain tube into drip pan. Close drain hose valve.	Any fuel leak exists.
34	BEFORE	Fan	Inspect fan for loose mounts, cracks, or broken blades.	Fan loose, cracked, or broken blades.
35	BEFORE	Drive Belts	a. Inspect drive belts for wear, cracks, and fraying. b. Check belt tension. Each belt should deflect approx. 1/2 in. at midspan between pulleys.	a. Belts worn, cracked, or frayed. b. Belt tension loose.
36	BEFORE	Charge Air Cooler (CAC)	Inspect CAC for cracks and holes. Check fins and welds for damage.	Damage that could affect CAC efficiency.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
37	BEFORE	Antifreeze & Coolant	**WARNING** The cooling system is pressurized. Personal injury may result when removing the radiator cap after operating temperature is reached. Do not remove radiator cap when radiator is hot to touch.	
			a. Check for proper coolant level in coolant recovery tank.	a. Coolant level below ADD; Class III leak exists.
			b. Inspect radiator hoses and clamps for damage, for missing clamps, and for evidence of leaks.	b. Hoses/clamps damaged, loose, or missing; Class III leak exists.
37(a)	BEFORE	Engine Coolant Heater (If Installed)	a. Inspect engine coolant heater hoses for damage and loose/missing clamps.	a. Hose/clamps damaged, loose or missing. Class III leak exists.
			b. Inspect fuel line for leaks.	b. Any fuel leak exists.
38	BEFORE	Swing Gear Box	Inspect gearbox case for cracks and leaks.	Gearbox case cracked or Class III leak exists.
39	BEFORE	Mechanical Boom Angle Indicator	Check indicator for loose mounting and/or damage.	Indicator missing or unreadable or when Load Moment Indicating System is not operating.
40	BEFORE	Load Moment Indicator System	a. Inspect electrical connectors/wiring for security and damaged insulation.	a. Loose connectors/ wiring or damaged insulation.
			Continued on next page.	

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
40	BEFORE	Load Moment Indicator System (Continued)	b. Inspect for worn insulation on boom length sensor cable and damaged cable guides.	
			c. Check that boom length cable is properly spooled on the reel and that reel is under tension.	c. Boom length cable not spooled properly or cable reel lacks tension for maritime operation only or boom angle indicator is not inoperable.
			d. Inspect pressure transducers and connecting hoses for security and oil leakage. Refer to Figure 1, Appendix G for locations.	d. Pressure transducers or hoses loose or leaking for maritime operations or boom angle indicator inoperable.
41	BEFORE	Boom	a. Inspect boom for cracked or broken welds and bends/distortion of boom sections.	a. Cracked or broken welds or distortion exists.
			b. Inspect boom wear pads for damage, wear, security, and lack of lubrication.	b. Worn, damaged, loose, or unlubricated wear pads.
42	BEFORE	Roof-Mounted Air Conditioner (Carrier Cab)	Inspect for loose mounting, damage, or evidence of leaks. Check for damage/obstructions to condenser and outlet vents in cab.	
43	BEFORE	Air Intake Piping	Inspect air filter housing, air intake piping, and all clamps for damage and security.	

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
44	BEFORE	Hydraulic Oil Cooler	Inspect hydraulic oil cooler for evidence of leaks and dirt restricting air flow through cooler.	Hydraulic oil cooler contaminated or Class III leak exists.
45	BEFORE	Superstructure Backup Alarm	Check connectors and wiring for security and damaged insulation.	Damaged insulation.
46	BEFORE	Counterweight	Inspect counterweight for cracked or broken welds.	Excessive cracks (more than two) detected.
47	BEFORE	Main and Auxiliary Hoist Drums and Motors	a. Inspect hoist hydraulic lines for damage, security, and evidence of leaks.	a. Any damage, loose, or leaking component: Class III leak exists if required for hoist operation.
			b. Check that wire rope is spooled evenly on both hoist drums. Ensure cable followers are not damaged.	b. Wire rope not spooled correctly or cable follow-er(s) damaged for hoist operation.
			c. Inspect hoist mirrors for damage. Ensure each mirror can be seen from cab.	c. Hoist mirror(s) damaged or misaligned.
48	BEFORE	Superstructure Cab Air Conditioner	Inspect for loose parts and damage to the condenser and evidence of hydraulic oil leakage.	Class III hydraulic oil leak exists.
49	BEFORE	BATTERY DISCONNECT switch	Place BATTERY DISCONNECT switch in the on position.	
50			CARRIER CAB	
50a	BEFORE	Dash Panel Gauges	a. Inspect for loose, broken, or cracked lenses.	
			Continued on next page.	

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
50a	BEFORE	Dash Panel Gauges (Continued)	b. Inspect for loose connectors, wiring, and damaged insulation.	b. Loose connector or wiring. Damaged insulation.
50b	BEFORE	Lights and Horn	a. With IGNITION switch in RUN position, check all lights for proper working order.	a. Any light inoperable for night operation or crane brake lights inoperable.
			b. Depress horn button, horn should sound.	b. Horn inoperable.
50c	BEFORE	Windshield Wipers & Washer Fluid Container	a. Check for proper operation.	a. Wiper motor inoperable.
			b. Check fluid level in windshield washer fluid container.	
			c. Check cab safety glass for cracks, damage, etc.	c. Safety glass damage that impairs visibility.
50d	BEFORE	Fire Extinguisher	Check charge indicator. Inspect fire extinguisher for broken or missing seal/lock wire.	Indicator in red zone. Seal/lock wire missing on fire extinguisher handle.
50e	BEFORE	Seat Belt	Check seat belt for wear, tears, and condition of locking device.	Seat belt worn, damaged, or inoperable.
50f	BEFORE	Transmission Shift Lever	Check that transmission shift lever operates smoothly through all positions.	Shift lever binds preventing shifting.
50g	BEFORE	Hydraulic Pump Disconnect Control Cable	Check lever for proper operation, chafing, and wear.	Lever binds or inoperable.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
51	BEFORE		CARRIER CAB	
51a	BEFORE	Dash Panel Gauges	Ensure transmission shift lever is in N (neutral) and PARK BRAKE control is set. Start diesel engine and check the following carrier dash panel gauges for operation and proper readings after warm up:	
			a. OIL PRESS gauge. Normal reading is 10 psi at idle. (35 psi at high idle and 85 psi at maximum governed speed)	a. Oil pressure lower than 10 psi.
			b. WATER TEMP gauge. Normally pointer is in green area.	b. Gauge reads in red area.
			c. BATTERY Voltmeter gauge. Normal reading is 24 to 28 volts.	c. Gauge reads outside of acceptable limits.
			d. AIR PRESSURE gauge. Normal reading is 105 to 120 psi.	d. Gauge reads outside of acceptable limits.
51b	BEFORE	Throttle Linkage	Check that throttle operates smoothly through full range and is indicated properly on tachometer.	Operation is rough or binding linkage.
52	BEFORE	Diesel Engine	With diesel engine running at normal operating temperature, check for fuel and oil leaks.	Any fuel leak or Class III oil leak exists.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
52a	BEFORE	Transmission Oil Level	**CAUTION** Maintaining the torque converter at full throttle stall speed for an extended period of time will overheat the torque converter. **NOTE** Do not attempt to check transmission oil level when oil is cold. In cold weather, it may be necessary to stall the torque converter in order to reach the required oil temperature as follows: a. With diesel engine running, level the crane by raising the outriggers. b. Apply parking brake. c. Place transmission shift lever to forward (F) and high range. d. Accelerate engine to between 1500 and 1800 rpm. e. Hold converter stalled until transmission oil temperature is between 180 and 200° F. With the diesel engine running, check for correct transmission oil level on dipstick. Maintain between “add” and “full” marks on dipstick. Add transmission oil through fill pipe if necessary.	Class III leak exists.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
53	BEFORE	Hydraulic Reservoir & Filter	With engine running at normal operating temperature, check condition of hydraulic oil filter indicator located on filter head. Indicator reading in the red area indicates fouled element.	Hydraulic oil filter indicator in red area.
54	BEFORE	Air Filter Restriction Indicator	Check air filter restriction indicator for red flag indicating fouled filter element.	Red flag appears.
55	BEFORE	Steering System Filter Indicator	a. Chock wheels. b. Inspect steering system filter indicator for fouled filter.	Hydraulic oil filter indicator in red area.
56			CARRIER CAB	
56a	BEFORE	Air Conditioner (hot weather)	Check for proper operation and cooling.	
56b	BEFORE	Backup Alarm	With PARK BRAKE applied and engine at idle, place transmission shift lever in R1 and listen for backup alarm.	Backup alarm inoperable/no ground guide available for backing operation.
56c	BEFORE	Brakes, Service & Parking	**NOTE** Ensure outriggers are retracted.	
			a. Check park brake operation with PARK BRAKE control pulled, diesel engine at idle, and transmission in gear, check for forward and reverse motion of vehicle.	a. Any vehicle movement with park brake applied.
			Continued on next page.	

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
56c	BEFORE	Brakes, Service & Parking (Continued)	b. Service brakes. Check/listen for noise and stopping ability with crane moving slowly (in either direction) when depressing brake foot pedal.	b. Chattering, grinding, or inability to stop.
56d	BEFORE	Front Axle Steering	a. Ensure STEERING MODE CONTROL handle is pushed in and locked. b. Check front axle steering for smooth and proper operation.	Steering wheel binds or turns rough.
56e	BEFORE	Rear Axle Steering	a. Shut down engine and engage main hydraulic pump. b. Start engine. c. Place REAR AXLE STEERING LOCK switch to UNLOCKED. d. Check rear axle steering mode with REAR AXLE STEERING CONTROL switches. e. Return rear axle to center position and place REAR AXLE STEERING LOCK switch to LOCKED.	Rear axle does not steer or lock as indicated.

Continued on next page.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
56e	BEFORE	Rear Axle Steering (Continued)	f. Verify the REAR AXLE STEERING CONTROL switches do not steer the rear axle.	
			g. Shut down engine.	
57			SUPERSTRUCTURE CAB	
57a	BEFORE	Dash Panel Gauges	a. Inspect for loose, broken, or cracked lenses.	.
			b. Inspect for loose connectors, wiring and damaged insulation.	b. Loose connector or wiring. Damaged insulation.
57b	BEFORE	Lights and Horn	a. With IGNITION switch in RUN position, check all lights for proper working order.	a. Any light inoperable for night operation or crane brake lights inoperable.
			b. Depress horn button, horn should sound.	b. Horn inoperable.
57c	BEFORE	Windshield Wipers & Washer Bottle	a. Check windshield and skylight wipers for proper operation.	a. Wiper motor inoperable.
			b. Check fluid level in windshield washer bottle.	
			c. Check cab safety glass for cracks, damage, etc.	c. Safety glass damage that impairs visibility.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
57d	BEFORE	Fire Extinguisher	Check charge indicator. Inspect fire extinguisher for broken or missing seal/lock wire.	Indicator in red zone. Seal/lock wire missing on fire extinguisher handle.
57e	BEFORE	Seat Belt	Check seat belt for wear, tears, and condition of locking device.	Seat belt worn, damaged, or inoperable.
57f	BEFORE	Air Conditioner (hot weather)	Inspect outlet vents in cab for damage and obstructions.	Damage or obstructions.
58			SUPERSTRUCTURE CAB Start diesel engine from superstructure cab.	
58a	BEFORE	Load Moment Indicator System	a. Ensure LMI system self checks properly without error codes. b. Program Load Moment Indicator System. Refer to Appendix G.	LMI System does not pass self test for maritime operation only or if the boom angle indicator is inoperable.
58b	BEFORE	Dash Panel Gauges	Check the following superstructure dash panel gauges for operation and proper readings after warm up:	
			a. OIL PRESS gauge. Normal reading is 10 psi at idle. (35 psi at high idle and 85 psi at maximum governed speed.)	a. Oil pressure lower than 10 psi.
			b. WATER TEMP gauge. Normally pointer is in green area.	b. Gauge reads in red area.
			Continued on next page.	

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
58b	BEFORE	Dash Panel Gauges (Continued)	c. BATTERY Voltmeter gauge. Normal reading is 24 to 28 volts.	c. Gauge reads outside of acceptable limits.
58c	BEFORE	Air Conditioner (hot weather)	Check for proper operation and cooling.	
58d	BEFORE	Swing Brake	**CAUTION** Ensure hook block is removed from tie-down point and positive swing lock is disengaged. a. Disengage Swing Lock Pin. b. Place SWING LOCK switch in OFF position. c. Check for proper operation of joystick and swing brake pedal. d. Place SWING LOCK switch in ON position. e. Verify that swing joystick does not rotate superstructure. f. Place SWING LOCK switch in OFF position.	c. Superstructure continues to move with swing brake pedal depressed. Chattering, grinding, or inability to stop. e. Superstructure swings in either direction.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
58e	BEFORE	Anti-two Block Switch	a. Without extending boom, swing boom over the rear and lower boom to allow access to boom nose from ground. b. Place SWING LOCK switch in ON position. c. Have assistant on the ground slide anti-two block weight up hoist cable to verify that switch trips anti-two block lockout. d. Place SWING LOCK switch in OFF position.	Anti-two block switch does not operate.
58f	BEFORE	Backup Alarm	With PARK BRAKE applied and engine at idle, place transmission shift lever in R1 and listen for backup alarm.	Backup alarm inoperable/no ground guide available for backing operation.
58g	BEFORE	Brakes, Service & Parking	**NOTE** Ensure outriggers are retracted. a. Check park brake with PARK BRAKE control pulled, diesel engine at idle, and trans-mission in gear, check for forward and reverse motion of vehicle.	a. Any vehicle movement with park brake applied.

Continued on next page.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
58g	BEFORE	Brakes, Service & Parking (Continued)	b. Service brakes. Check/listen for noise and stopping ability with crane moving slowly (in either direction) when depressing service brake pedal.	b. Chattering, grinding, or inability to stop.
58h	BEFORE	Rear Axle Steering	a. Ensure STEERING MODE CONTROL handle is pulled out and locked. b. Ensure REAR AXLE STEERING LOCK switch is in the UNLOCKED position. c. Check steering wheel for smooth and proper operation. d. Place REAR AXLE STEERING LOCK switch to LOCKED.	Steering wheel binds or turns rough.
58i	BEFORE	Front Axle Steering	**WARNING** The steering wheel in the carrier cab will turn and could injure someone in the carrier cab. To avoid injury and/or damage, ensure any restraining device on the carrier steering wheel is removed. a. Steer front axle with FRONT AXLE STEERING switch. Observe LEFT/ CENTER/RIGHT indicators. b. Return front axle to center position.	Front axle steering does not operate properly.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
58j	BEFORE	Outriggers	a. Extend front and rear outrigger beams. b. Inspect outrigger beams for cracks and damage. c. Install outrigger pads. d. Lower outrigger jack cylinders and level crane.	Outriggers damaged or inoperative.
58k	BEFORE	Mechanical Boom Angle Indicator and LMI lockout	a. Check for proper operation. Raise boom to verify that light and error code occurs on LMI console. Refer to Appendix G.	
			b. While raising boom, verify that mechanical angle indicator moves from 0 to 70º without sticking or binding.	b. Mechanical boom angle indicator is inoperative, missing, or binds/ sticks if LMI inoperable.
			c. After lockout occurs, override lockout and lower boom.	c. LMI fails to lockout boom lift control lever if mechanical boom angle indicator inoperable.
58l	BEFORE	Main and Auxiliary Hoists	Check for proper operation by raising and lowering the hook block several times. Ensure hoist motor and brake operate smoothly.	Chattering or roughness detected.
58m	BEFORE	Suspension Lockout System	Test crane suspension lockout system in accordance with paragraph 5-12.13.	Suspension lockout system fails test.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
59	DURING	Dash Panel Gauges, Indicators, and LMI Console	Continually monitor dash panel gauges, indicators, and LMI console for operation and normal readings.	Dash panel gauges or LMI fail to operate or readings not normal. Boom angle indicator is not operating for LMI backup.
60	DURING	Air System Reservoirs	Check for air leaks, corroded fittings, and proper air pressure gauge reading (105 to 120 psi (724 to 827 kPa).	Air pressure less than stated. Air leak detected.
61	DURING Every 4 Hrs	Pile Driver (If Used)	Inspect and tighten all pile driver adapter attaching hardware. Inspect and tighten all pile driver hardware.	Any pile driver hardware loose or missing during pile driver operation.
62	AFTER	Suspended Loads	Ensure that all suspended loads have been lowered to the ground before shutting down the crane.	Any suspended load.
63	AFTER	BATTERY DISCONNECT switch	Ensure BATTERY DISCONNECT switch in off position.	
64	AFTER	Crane	Perform general inspection for leaks and physical damage.	Crane has leaks or physical damage impairing operation. Any fuel or other Class III leak exists.
65	WEEKLY	Air System and Park Brake Relays	Check for proper operation and leaks. a. Chock the wheels and fully charge the air system. Adjust the brakes. b. Apply and release the brakes several times and check for prompt response of the brakes at all wheels.	Brakes not operating properly.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
65	WEEKLY	Air System and Park Brake Relays (Continued)	Perform leakage test. a. With dual brake valve in brake released position, coat exhaust port with soap solution to check for inlet valve and O-ring leakage. A 1 in. (2.54 cm) bubble in five seconds is permitted. b. Place dual brake valve in brake applied position and check at exhaust port for leakage of exhaust valve. Apply soap solution around valve where cover joins body to check for seal ring leakage. A 1 in. (2.54 cm) bubble in three seconds is permitted. c. With dual brake valve still in brake applied position, apply soap solution to quick release exhaust port on R-12 valve to check diaphragm exhaust seat, and to valve body in area where the cover joins body on R-12 valve, to check for O-ring leakage. No leakage is permitted.	Relay defective or leaking.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
66	WEEKLY	Air System Low Pressure Indicating Switches	Perform operating and leakage checks. a. With the engine shut down and the ignition switch ON, slowly reduce pressure in the system. b. Low pressure switch should actuate at approximately 75 psi (517 kPa) as indicated by sounding of the buzzer and illumination of the LOW AIR indicator. c. With air pressure present at the port, coat the indicator switch with a soap solution. No leakage is permitted.	Any switch defective or leaking.
67	WEEKLY	Dual Brake Valve	a. Clean dirt and foreign material away from heel of treadle, plunger boot, and mounting plate. b. Check plunger boot for cracks, holes, and deterioration. c. Check mounting plate treadle for security.	Plunger boot damaged and/or missing/loose hardware.

Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	NOT FULLY MISSION CAPABLE IF
68	WEEKLY	Air System Park Brake/ Trailer Control Valve	Perform operation and leakage checks.	Valve defective or leaking.
69	WEEKLY	Batteries	**WARNING** Do not smoke or allow flame or spark in the vicinity while checking the batteries. The batteries generate hydrogen, a highly explosive gas. Battery electrolyte is toxic to skin, eyes, and respiratory tract. Avoid all contact. Skin and eye protection and vapor control are re-quired.	
			a. Inspect battery terminals, cables, and clamps for security, damage, and corrosion.	Battery terminals, cables, or clamps loose, damaged, or corroded.
			b. Remove battery caps and check electrolyte level. Level should be even with bottom of cap opening.	Electrolyte level is low.

5-4. ENGINE STARTUP AND SHUTDOWN.

5-4.1 Normal Engine Starting. The following procedure covers starting the diesel engine from the carrier cab. Starting the diesel engine from the superstructure follows a similar procedure except that there must be at least 85 psi (586.1 kPa) in the air system to operate the diesel engine throttle pedal in the superstructure cab.

WARNING

Before starting the engine, ensure the PARK BRAKE is applied and the SWING BRAKE switch in the superstructure cab is ON (brake engaged).

CAUTION

Never crank the engine for more than 30 seconds at a time. If the engine fails to start after 30 seconds, allow the starter motor to cool for approximately two minutes between attempts.

NOTE

The engine will not crank unless the Transmission Shift Lever (6, Figure 5-1) is in the neutral (N).

Since the superstructure engine throttle is air operated, the diesel engine should be started from the carrier cab when the crane air pressure is below 85 psi (586.1 kPa). Otherwise, the engine must idle until air pressure builds up.

a. If diesel engine is cold, disengage the main hydraulic pump via the Hydraulic Pump Disconnect Control (5).

b. Turn the IGNITION Switch (50) to START and release immediately when the engine starts. If the diesel engine does not start (less than 30 second cranking time) and must be re-cranked, wait at least 3 seconds to allow the starter pinion and ring gear to stop turning.

c. Check engine instruments for proper indications.

CAUTION

Both air system pressures must be in normal operating range prior to disengaging parking brake. Otherwise, service air brakes may not operate properly when applied.

If oil pressure and/or temperature indicator(s) do not display proper readings, shut down the engine and correct the malfunction.

NOTE

The diesel engine should be started only from the carrier cab in cold weather.

CAUTION

Do not race the diesel engine during the warm-up period. Failure to follow this caution could result in premature failure of the engine bearings, pistons, and valves.

d. Allow the engine and hydraulic oil to warm up at least five minutes before applying a load.

CAUTION

Idling the diesel engine for long periods of time not only wastes fuel but fouls the injector nozzles. Unburned diesel fuel can cause carbon formation, diluted oil, lacquer formation, or gummy deposits on the intake and exhaust valves, pistons and rings. Unburned diesel fuel also contributes to a rapid accumulation of sludge in the engine.

If it is necessary to idle the diesel engine, maintain the engine speed at no less than 800 RPM.

NOTE

Gauge readings are given as a guide only. Readings may be slightly higher or lower depending on the individual engine condition. If in doubt, refer to the applicable engine service or operation manual.

5-4.2 Cold Weather Starting.

WARNING

Before starting the engine, ensure the PARK BRAKE is applied and the SWING BRAKE switch in the superstructure cab is ON (brake engaged).

CAUTION

Never crank the engine for more than 30 seconds at a time. If the engine fails to start after 30 seconds, allow the starter motor to cool for approximately two minutes between attempts.

CAUTION

Avoid overloading the air intake manifold with highly volatile starting fluid while attempting to start the diesel engine during cold weather. Do not attempt more that three consecutive cold weather starts without first allowing the starting fluid in the air intake manifold to dissipate. Failure to follow this caution could result in overloading the air intake manifold with starting fluid which could result in a minor explosion and damage to the engine.

NOTE

The engine will not crank unless the Transmission Shift Lever (6, Figure 5-1) is in the neutral (N) position.

NOTE

There are two diesel fuel warmers and a cold start ether system. One diesel fuel warmer is an in-line unit located between the fuel tank and the fuel water separator. The second diesel fuel warmer is integral to the fuel water separator. Both diesel fuel warmers and the cold start ether system are controlled by thermostats designed to close at 30º F (-1º C).

NOTE

The correct grade of oil for the prevailing temperature should be used in the crankcase to prevent hard cranking.

NOTE

Diesel fuel should have a pour point of 10º F (-12º C) 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. If low temperatures are ONLY expected at startup, it is advisable to use only the in-line fuel warmers and the cold weather starting aid.

a. Disengage the main hydraulic pump via the Hydraulic Pump Disconnect (5).

b. To preheat the fuel, place the IGNITION Switch (50) to the RUN position. Verify that the FUEL PREHEAT Indicator (26) is lit. Allow the fuel heaters to warm the fuel for two minutes or until the indicator light goes out.

c. If the temperature is below 30º F (-1º C), fully depress and hold foot throttle pedal (4) until the engine starts and runs on its own. As engine comes up to speed, gradually ease off of the throttle pedal.

d. Place the IGNITION Switch (50) to START and hold until the diesel engine starts. Release the switch as soon as the diesel engine starts. If the diesel engine does not start (less than 30 seconds cranking time) and must be re-cranked, wait at least 3 seconds to allow the starter pinion and ring gear to stop turning.

e. If the engine does not start within 30 seconds, allow the starter to cool for approximately two minutes and repeat the procedure.

NOTE

Gauge readings are given in Table 5-1 as a guide only. Readings may be slightly higher or lower depending on the individual engine condition. If in doubt, refer to the applicable engine service or operation manual.

f. Check engine instruments for proper indications.

CAUTION

Both air system pressures must be in normal operating range prior to disengaging parking brake. Otherwise, service air brakes may not operate properly when applied.

CAUTION

If oil pressure and/or temperature indicator(s) do not display proper readings, shut down the engine and correct the malfunction before resuming operation.

CAUTION

Do not race the diesel engine during the warm-up period. Failure to follow this caution could result in premature failure of the engine bearings, pistons, and valves.

g. Allow the engine and hydraulic oil to warm up at least five minutes before applying a load.

CAUTION

Idling the diesel engine for long periods of time not only wastes fuel but fouls the injector nozzles. Unburned diesel fuel can cause carbon formation, diluted oil, lacquer formation, or gummy deposits on the intake and exhaust valves, pistons and rings. Unburned diesel fuel also contributes to a rapid accumulation of sludge in the engine. If it is necessary to idle the diesel engine, maintain the engine speed at no less than 800 RPM.

5-4.3 Shutdown Procedure.

a. Allow the engine to operate at fast idle speed for approximately five minutes to avoid high internal heat rise and allow for heat dissipation.

b. Position the IGNITION Switch (50) to the OFF position.

CAUTION

Leaving the crane with the BATTERY DISCONNECT switch in the on position may result in the batteries becoming discharged within a relatively short time period. It is therefore recommended that the BATTERY DISCONNECT switch be placed in the off position at the end of each work day.

c. Position the BATTERY DISCONNECT switch in the off position.

5-5. DRIVING THE CRANE - CARRIER CAB.

5-5.1 General. The crane is designed for travel on primary and secondary roads and for off-road travel. Consult local vehicular codes and regulations in your area before traveling on public roadways.

Although the crane is designed for rough terrain travel, the operator must be extremely cautious and aware of the terrain over which the crane is operating.

WARNING

Do not drive the crane with the boom off center. Automatic oscillation lockout will occur making the crane subject to tipping on uneven ground.

WARNING

Do not travel with an empty hook in a position where it can swing freely. Always secure an empty hook to the tiedown provided on the front of the crane.

WARNING

Avoid holes, rocks, extremely soft surfaces, and any other obstacles which might subject the crane to undue stresses or possible overturn.

WARNING

On open ground, tow or pull only on the pintle hook or lift/tow lugs.

CAUTION

For extended travel, check the cold tire pressure prior to start. Regardless of ambient temperature, after every two hours of travel time, stop and allow the tires to cool off for at least a 30-minute period. At destination, the tires must be allowed to cool to ambient temperature before performing any lifts with the crane on rubber (i.e., without extending the outriggers). The tire pressure should be 110 psi (758 kPa) when performing on rubber lifts. However, lower tire pressures are allowed for non-craning operations such as driving on highways and over rough-terrain. The minimum tire pressure while traveling at 55 mph (93 kph) is 75 psi (517.1 kPa) while the minimum tire pressure for traveling at 10 mph (16 kph) is 50 psi (344.8 kPa).

CAUTION

Do not drive the crane with the lift cylinder bottomed. Position the boom to just above horizontal with boom resting on boom cradle.

CAUTION

Should the crane become mired down, use a tow truck or tractor to free the vehicle. Use the tow lugs located on the rear of the crane to pull or tow it. When using these lugs, always tow or pull using both lugs. Severe damage to the transmission or axles may occur if the operator attempts to free the crane unassisted.

CAUTION

Disengage the hydraulic pump for extended periods of travel, when starting the diesel engine in cold weather, or when performing engine trouble-shooting.

NOTE

Use four-wheel drive only when greater traction is necessary. (Refer to paragraph 5-5.13 - Four-Wheel (4WD) Drive Operation, for operating instructions.)

5-5.2 **Preparation for Travel**. The following operating 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.

a. Remove any attachments such as a clamshell bucket (paragraph 5-9.3), grapple (paragraph 5-10.3), concrete bucket (paragraph 5-11.2), or pile driver (refer to Appendix H).

b. Ensure the boom is fully retracted. Refer to paragraph 5-7.10.

c. Swing the boom over-the-front and engage the SWING LOCK Pin Control Lever (49, Figure 5-2). Then lower the boom until it rests in the boom rest cradle, if necessary, refer to paragraph 5-7.6 and 5-7.8.

d. Remove the hook block and stow securely before traveling or ensure the hook block is properly secured to the tie down provided for that purpose. Refer to illustration of crane on front cover.

e. Ensure the outriggers are fully retracted. Refer to paragraph 5-7.5. Then remove and stow the outrigger floats in the racks provided.

f. Close and/or install all superstructure cab windows and door.

g. Be sure to place the Blackout Lighting Control switch (16, Figure 5-1) in either one of the normal modes (non-blackout conditions) to activate the carrier-controlled lighting, horn, and alarm circuits.

h. When traveling for extended distances, disengage the main hydraulic pump via the Hydraulic Pump Disconnect Control (5, Figure 5-1).

5-5.3 **Steering The Crane - General**. Steering is accomplished by the steering wheel and the rear axle steer control. These controls, used singly or together, provide front wheel steering, rear wheel steering, four-wheel steering, and crabbing capabilities.

5-5.4 **Steering Mode Selection**.

WARNING

Position the steering mode control handle for the proper cab. Failure to do so will result in a lack of steering which could cause serious damage and injury.

NOTE

In order to steer the crane from the carrier cab after driving the crane from the superstructure cab, the diesel engine must be shut down, the STEERING MODE CONTROL handle (Figure 5-3) must be pushed in and locked, and the diesel engine must be restarted in the carrier cab.

The steering mode control handle is mounted to the hydraulic tank on the left side of the carrier. Position the STEERING MODE CONTROL handle for the proper cab.

a. Shut down the diesel engine.

b. Lift lock lever and push in the handle for carrier cab steering.

c. Lower the lock lever to lock the steering mode control handle in place.

WARNING

If the CARRIER STEERing DISENGAGED Indicator (24, Figure 5-1) is on when the control handle is pushed in and locked, do NOT attempt to drive the crane as a malfunction in the steering system may have occurred. The malfunction must be corrected to assure safe reliable steering control.

WARNING

Lock rear axle steering before traveling. Front axle steering will not provide normal control unless rear wheels are locked in the straight ahead position.

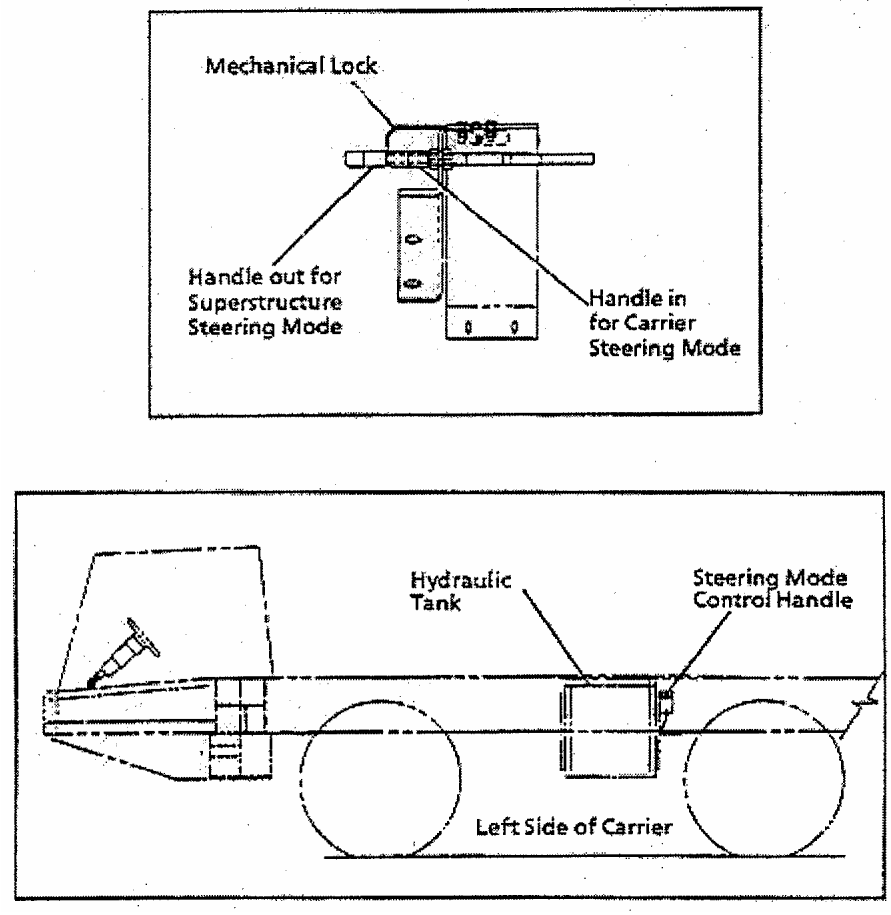


Figure 5-3. STEERING MODE CONTROL Handle Location

5-5.5 **Front Axle Steering**. The steering wheel in the carrier cab provides conventional steering control of the front axle so that the crane is steered in the direction the steering wheel is turned. This method of steering must always be used on the road or when traveling at higher speeds. However, the rear wheels must be centered and locked in the straight ahead position for normal steering response.

Before moving the crane:

a. Verify that REAR AXLE STEERING LOCK Switch (47, Figure 5-1) is in the LOCKED position.

b. Verify that REAR STEER LOCK ENGAGED Indicator (46) on the front console panel is lit.

If the DISENGAGED indicator light is on:

a. Check the REAR STEER DIRECTION Indicator (49) arrows and use the REAR AXLE STEERING Control Switch (48) to center the wheels.

b. Move the REAR AXLE STEERING LOCK Switch (47) to the LOCKED position. Verify that REAR STEER LOCK DISENGAGED Indicator (46) goes out, and the REAR STEER LOCK ENGAGED Indicator (46) lights. If the DISENGAGED indicator light stays on, travel must be restricted to low speed until the malfunction is corrected.

CAUTION

Operate rear axle steering only for added job site maneuverability when traveling at low speeds. Rear steering can only be operated with the gear selector switch in F1 and F2 (forward gears 1st and 2nd), N (neutral), and R1 (reverse low).

NOTE

It maybe necessary to move the REAR AXLE STEERING Control Switch (48) slightly in one direction or the other to engage the rear axle steer lock and light the REAR STEER LOCK ENGAGED indicator.

5-5.6 Rear Axle Steering. Rear axle steering is controlled by the REAR AXLE STEERING CONTROL Switch (48, Figure 5-1).

CAUTION

The engine must be shut down to engage or disengage the Hydraulic Pump Disconnect Control (5). Attempting to engage control with engine running will result in damage to pump and transmission.

a. If disengaged, engage the main Hydraulic Pump Disconnect Control (5). The Hydraulic PUMP ENGAGED Indicator (21) should come on. To engage the hydraulic pump, it may be necessary to "bump" the diesel engine with IGNITION Switch (50) to align the pump drive gear with the transmission.

b. Place the REAR AXLE STEERING LOCK Switch (47) in the UNLOCKED position.

c. Move REAR AXLE STEERING CONTROL Switch (48) to the desired position activates the rear axle steer cylinders, thereby positioning the rear wheels in the direction necessary to steer the crane in the selected direction. The REAR STEER DIRECTION Indicator (49) on the front console panel indicates the direction the crane will turn, except when crabbing.

5-5.7 **Four-Wheel Steering**. Four-wheel steering is accomplished by using both the steering wheel and the REAR AXLE STEERING Control Switch (48, Figure 5-1). Depending upon which direction the operator wishes to travel, the steering wheel is turned in the same direction of the REAR AXLE STEERING Control Switch (48) position. This method of steering allows the crane to turn or maneuver in close, restricted areas.

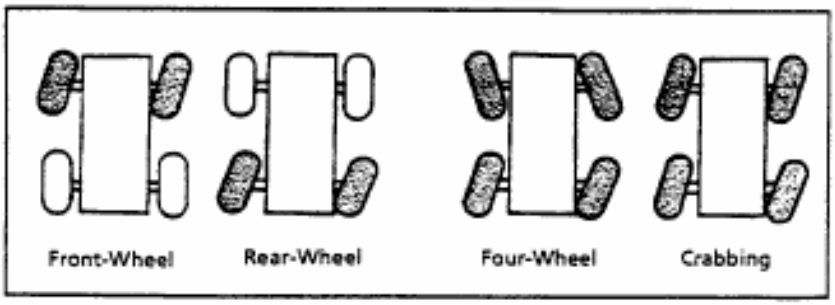


Figure 5-4. Steering Modes

5-5.8 **Crabbing**.

Crabbing is also accomplished by using both the steering wheel and the REAR AXLE STEERING Control Switch (48, Figure 5-1). Depending upon which direction the operator wishes to travel (crab), the steering wheel is turned in the opposite direction in which REAR AXLE STEERING Control Switch (48) is positioned. This method permits driving the crane forward or in reverse at an angle from straight ahead in the crabbing manner.

5-5.9. **Transmission Operation**.

Automatic Mode. The Automatic Powershift Control (APC) will automatically shift up to the gear selected on the gear selector at the proper shift point as determined by its sensors. The APC will also downshift and, engage and disengage torque converter lockup at the proper time. Although the APC determines the shifting pattern, having a good knowledge of proper shifting procedures is required for manual override operation APC 100 Override Switch (11, Figure 5-1). Note that the APC100 is active when driving from the carrier cab only. When driving from the superstructure cab, the transmission must be manually shifted.

CAUTION

None of the protective devices designed to protect the drive train are in effect when operating in the manual mode. Do not downshift to a lower gear if the crane is traveling at a speed greater than the maximum speed of the lower gear. Also, do not shift from forward to reverse without completely coming to a stop and do not speed up beyond second gear with the vehicle in four-wheel drive (or with differential locks engaged).

Manual Mode.

a. In the early stages of shifting, keep the engine rpm down to the actual power requirement, but anticipate the next shift demand so that the engine does not labor with the next upshift.

b. As you upshift, increase the crane speed with a progressive increase in engine rpm. It should seldom be necessary to reach governed speed in the lower gears except in peak load situations such as starting up a grade.

c. Maintain a reasonable rate of speed when climbing a grade and preplan the climb whenever possible. Gradually depress the throttle to maintain governed rpm and remain at full throttle as the crane starts up the grade. If there is sufficient power to maintain satisfactory speed without the engine laboring, remain in that gear for the entire grade.

d. If the engine starts to labor, ease the throttle off a bit to allow the transmission to shift into the next lower gear. Make the shift quickly because the speed will usually drop quickly when shifting.

NOTE

Going downhill, the engine provides the most efficient braking when at or near top rpm in operating range, however, the governor has no control over the engine speed when it is being pushed by a heavy crane.

e. If the engine exceeds governed rpm when descending a grade, engine overspeed can result in serious damage. Use both the vehicle brakes and gears in combination to keep the crane speed under control.

f. Continue to monitor the Transmission OIL TEMPerature Gauge (19) when the ambient temperature is high and in particular, when traveling up an extended or steep grade. If the transmission oil temperature continues to rise, manually downshift to the next lower gear.

The following information outlines proper shift points when in a manual (emergency) mode.

To avoid hard shifting, the road speeds at which the shift should be made are shown on the following chart.

Shift Points at MPH/KPH			
Gear Upshift	Speed MPH	KPH	Gear Downshift
1st to 2nd	5	8	2nd to 1st
2nd to 3rd	7	11	3rd to 2nd
3rd to 4th	12	19	4th to 3rd
4th to 5th	17	28	5th to 4th
5th to 6th	36	57	6th to 5th

Stepping of changes should be progressive. No attempt should be made to upshift 2 gears or more at a time. It is not always necessary to start a crane in 1st gear. Up to 3rd gear may be used when starting on reasonably level terrain.

5-5.10 **Seat Belt**. Before fastening the seat belt, always adjust the driver's seat to the position in which you will drive.

For greater restraint and comfort:

a. Only one person should be strapped in each seat belt.

b. Pull belt across your lap and push the latch plate into the buckle until it clicks.

c. Position the belt across your lap as low on your hips as possible and pull it toward the door to a snug fit so the inertia reel can take up the slack.

d. If the shoulder belt is too tight, pull the shoulder belt out at least 5 in. (13 cm) and let it return to your chest. Then pull down on the shoulder belt, no more than needed to ease pressure [1 in. (2.5 cm)], then release belt.

e. To unfasten the belt, press the button on the buckle. Lightly hold the belt and allow the inertia reel to rewind the belt.

5-5.11 **Traveling - Forward.**

WARNING

Engage swing lock pin before starting extended traveling.

a. After the engine has warmed up, position the transmission shift lever to the highest forward gear desired.

CAUTION

Use 4WD only when more traction is required.

b. Position the DRIVE AXLE Selector Switch (34, Figure 5-1) to either high speed (2WD) or low speed (4WD).

c. Release the parking brake and depress the throttle.

5-5.12 **Traveling - Reverse**.

CAUTION

Apply the service brakes and bring the crane to a complete stop before shifting the transmission into reverse.

Traveling in reverse is accomplished the same way as traveling forward, except for shifting the Transmission Shift Lever (6, Figure 5-1) to the highest reverse (R) gear desired. (Refer to Traveling - Forward.)

5-5.13 **Four-Wheel (4WD) Drive Operation**. If more traction is required due to slipping or spinning wheels, engage the rear axle drive. Engage 4WD as follows:

a. Position the DRIVE AXLE Selector Switch (37, Figure 5-2) to the 4WD position.

NOTE

Crane must be traveling at a speed below 11 mph (18 kph) for 4WD to engage and remain engaged.

b. Return the DRIVE AXLE Selector Switch (37) to the 2WD position as soon as 2WD traction will suffice.

5-5.14 **Inter-axle Differential**. To lock out the inter-axle differential (front and rear, or just rear differentials) and achieve maximum pulling power when approaching slippery or poor road conditions, proceed as follows:

CAUTION

The differential lock can only be engaged when 4WD is active. Do not actuate the DIFFERENTIAL LOCK Switch (31, Figure 5-1) while the wheels are actually slipping or spinning.

a. Position DIFFERENTIAL LOCK Switch (31) to FRONT & REAR LOCKED position to lock the front and rear differentials or the REAR LOCKED position to lock the rear differential, while maintaining crane speed [below 11 mph (18 kph)].

b. Let up momentarily on accelerator. This will engage the differential lock.

c. Use extreme caution when driving over poor roads.

As soon as driving conditions improve, perform the following:

a. Position DIFFERENTIAL LOCK Switch (31) to the UNLOCKED (center) position while maintaining crane speed.

b. Let up momentarily on accelerator to allow the shift.

c. Resume driving at a safe speed.

5-5.15 **Brakes**. For most effective braking and for maximum life from brake system components, the following suggestions are made.

NOTE

Air brakes have light pedal operation and the driver is cautioned to use extreme care in application until a good feel is achieved.

a. Use the engine as a brake when approaching a stop or when going down a long grade. On a downgrade, use the same transmission gear as would be needed to go up the same grade.

b. When necessary to use brake to reduce crane speed on a downgrade, pump the brake pedal to minimize heat and wear. Do not hold a continuous brake application or slide the wheels.

c. When driving on slippery pavement or under icy conditions, pump brake pedal smoothly to prevent skidding.

d. Keep tires properly inflated. Improperly inflated tires can reduce the efficiency of brakes.

e. After driving through water, dry brakes by applying them lightly while maintaining a slow forward speed with an assured clear distance ahead until brake performance returns to normal.

WARNING

Stop immediately and determine cause of air pressure loss. Downshift, using the engine as a brake, and make final stop using a single brake pedal movement to avoid excessive loss of air and consequent sudden engagement of automatic spring brakes.

Crane should not be operated once the low air pressure buzzer sounds and the LOw AIR PRESSure indicator (23, Figure 5-1) or (41, Figure 5-2) is lit indicating a pressure drop below 75 psi (517 kPa).

f. Regularly check AIR PRESSURE Gauge (20, Figure 5-1) or (24, Figure 5-2). System air pressure should never be allowed to fall below 45 psi (310 kPa). If both systems drop below 45 psi (310 kPa), the automatic spring brakes will actuate. Normal operating pressure range is 105 to 120 psi (724 to 827 kPa).

WARNING

Release brakes before any attempt to drive, or drive train damage will result. Use parking brake for parking only. Do not use parking brake for stopping crane except in case of an emergency, as a severe sudden stop will occur.

CAUTION

If pressure drops more than 2 psi (14 kPa) per minute with the engine stopped, have air system checked for leaks.

g. Parking brakes are controlled by PARK BRAKE Control (57) on the front console panel. To apply parking brake, pull control out. To release parking brake, push control in.

5-5.16 Parking and Stowing Crane.

WARNING

Never park crane near holes, or on rocky or extremely soft surfaces. This may cause crane to overturn, resulting in injury to personnel.

The proper stowing and parking of crane after the working day is one of the simplest and easiest ways of extending the serviceable life of the crane and preventing theft, vandalism, and accidents.

a. Perform procedures found under Recommended Crane Shutdown Procedures.

b. Park crane on a proper surface with outrigger stabilizers and beams fully retracted. Do not park in a location where it may become frozen to ground or may settle unevenly and overturn.

c. Apply parking brakes and if necessary, chock the wheels.

d. Shut down engine using proper procedures as specified by this manual and engine manual.

e. Ensure all controls are in neutral and/or positioned to off.

f. Place BATTERY DISCONNECT switch in the off position.

g. Perform any other specified procedures required at the end of the work day.

h. Close all windows.

i. Lock up crane. Install vandal guards, if used.

j. Perform all AFTER PMCS procedures. Refer to Table 5-1.

5-6. DRIVING THE CRANE - SUPERSTRUCTURE CAB. (LIMITED TO ON-SITE ROADS ONLY)

5-6.1 General. The crane is designed for on-site travel only from the superstructure cab. Refer to paragraph 5-5.1 for general warnings and cautions to be followed when driving.

5-6.2 Preparation for Travel. The following operating conditions shall be strictly adhered to before moving the crane. Procedures for accomplishing the following can be found in the various Sections of this manual.

WARNING

Driving the crane from the superstructure cab with the boom rotated over the front of the vehicle shall be reserved for emergencies only. Driving the vehicle in this configuration increases the risk of collisions and loss of vehicle control as visibility is obstructed, exterior lighting is inoperable, and transmission functions are reversed. When driving from the superstructure cab under non-emergency conditions, always rotate the boom over the rear of the vehicle.

a. Ensure the boom is fully retracted. Refer to paragraph 5-7.10.

b. Swing the boom over-the-rear of the crane and engage the SWING LOCK Pin Control Lever (49, Figure 5-2). Then lower the boom to slightly below horizontal.

c. Remove the hook block and stow securely before traveling or ensure the hook block is properly secured to the tie down provided for that purpose.

CAUTION

Keep hands and feet clear when removing and stowing outrigger floats.

d. Ensure the outriggers are fully retracted. Refer to paragraph 5-7.5. Remove and stow the outrigger floats in racks provided.

e. Close and/or install all carrier cab windows and door.

5-6.3 Steering The Crane from the Superstructure - General. Steering is accomplished by the steering wheel and the front axle steer control. These controls, used singly or together, provide rear wheel steering, front wheel steering, four-wheel steering, and crabbing capabilities.

5-6.4 Steering Mode Selection.

WARNING

Position the steering mode control handle for the proper cab. Failure to do so will result in a lack of steering which could cause serious damage and injury.

NOTE

In order to steer the crane from the superstructure cab after driving the crane from the carrier cab, the diesel engine must be shut down, the Hydraulic Pump disconnect control in the carrier cab must be engaged, the STEERING MODE CONTROL Handle (Figure 5-3) must be pulled out and locked, and the diesel engine must be restarted in the superstructure cab.

The STEERING MODE CONTROL Handle (Figure 5-3) is mounted to the hydraulic tank on the left side of the carrier. Position the handle for the proper cab.

a. Raise the lock lever and pull out the handle for superstructure cab steering. When the control handle is pulled out, the CARRIER STEERing DISENGAGED Indicator (24, Figure 5-1) on the carrier cab front console panel is on to alert the operator that superstructure cab has steering control.

b. Lower the lock lever to lock the steering mode control handle in place.

5-6.5 Rear Axle Steering. Since most craning operations are performed with the boom positioned over the rear of the crane, conventional "front wheel" steering can be accomplished by unlocking the rear axle. Then using the superstructure steering wheel, the crane can be steered in the direction the steering wheel is turned (e.g., steer left, turn left). This method of steering should always be used when controlling the crane travel from the superstructure cab.

WARNING

Unlock rear axle steering before traveling. Lack of steering control could cause damage to the crane and/or serious injury to personnel.

a. Place the REAR AXLE STEERING LOCK Switch (51, Figure 5-2) in the UNLOCKED position. Ensure that indicator to right of the REAR AXLE STEERING LOCK Switch (51) on console is out. If light is still lit, place REAR AXLE STEERING LOCK Switch (51) to UNLOCKED. If light remains lit, there is a steering system malfunction. Contact maintenance for repair.

b. Steer crane using Steering Wheel (15) in superstructure cab.

5-6.6 **Front Axle Steering**. Since most craning operations are performed with the front axle to the rear of the superstructure, the FRONT AXLE STEERING Control (55, Figure 5-2) provides conventional "rear wheel" steering of the front axle. Moving the switch to the desired position actuates the front axle steering cylinders, turning the front wheels to steer the crane in the desired direction as indicated by the light to the left or the right of the FRONT AXLE STEERING Control (55) on the superstructure cab console.

WARNING

The Steering Wheel (7, Figure 5-1) in the carrier cab will turn when performing front axle steering from the superstructure cab. Use care to avoid injury to personnel occupying the carrier cab.

WARNING

To avoid personal injury and/or catastrophic steering gear failure, remove any restraining devices from the carrier cab steering wheel before operating from the superstructure cab.

CAUTION

Operate front axle steering only for added job site maneuverability when traveling at low speeds.

a. Place FRONT AXLE STEERING Control (55, Figure 5-2) to right to steer right or to the left to steer left.

b. Observe front axle direction lights, to the left or right of the FRONT AXLE STEERING Control (55), for an indication of which direction crane will turn, except when crabbing.

c. Return FRONT AXLE STEERING Control (55) to center (off) position.

5-6.7 **Four-Wheel Steering**. Four-wheel steering is accomplished by using both the Steering Wheel (15, Figure 5-2) and the FRONT AXLE STEERING Control (55). Depending upon which direction the operator wishes to travel, the steering wheel is turned in the same direction of the FRONT AXLE STEERING Control (55) position. This method of steering allows the crane to turn or maneuver in close, restricted areas.

5-6.8 **Crabbing**. Crabbing (Figure 5-4) is also accomplished by using both the Steering Wheel (15, Figure 5-2) and the FRONT AXLE STEERING Control (55). Depending upon which direction the operator wishes to travel (crab), the steering wheel is turned in the opposite direction in which FRONT AXLE STEERING Control (55) is positioned. This method permits driving the crane forward or in reverse at an angle from straight ahead in the crabbing manner.

5-6.9. Transmission Operation.

NOTE

The APC 100 is not active when driving from the superstructure cab. Thus transmission operation is entirely manual.

The following information outlines proper shift points for manual operation.

CAUTION

Do not downshift to a lower gear if the crane is traveling at a greater speed than the maximum speed of the lower gear.

To avoid hard shifting, the road speeds at which the shift should be made are shown on the following chart.

Shift Points at MPH/KPH			
Gear Upshift	Speed MPH	KPH	Gear Downshift
1st to 2nd 2nd to 3rd	5 7	8 11	2nd to 1st 3rd to 2nd

Stepping of changes should be progressive. It is not always necessary to start a crane in 1st gear. Up to 3rd gear may be used when starting on reasonably level terrain.

5-6.10 Seat Belt. Before fastening the seat belt, always adjust the driver's seat to the position in which you will drive.

For greater restraint and comfort:

a. Be sure the belt is snugly fitted around the hips - not the waist - and not twisted. Failure to properly fit belt may result in unnecessary injury in the event of a collision.

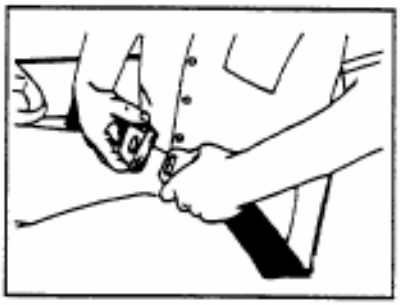


Figure 5-5. Seat Belt Coupling

b. Only one person should be strapped in each seat belt.

c. To lengthen the belt, tip the buckle end downward, as shown, and pull the buckle until the belt ends can be joined. Insert the belt into the open end of the buckle until a snap is heard and check for latch engagement. This belt can be shortened, after connection, by pulling on the loose end until the belt is snug. Press the buckle release to remove the belt.

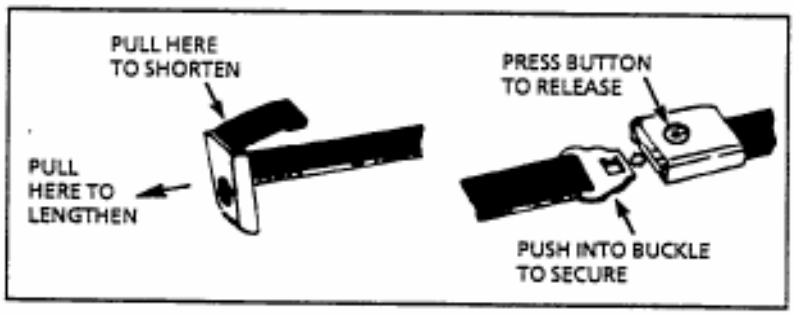


Figure 5-6. Seat Belt Adjustment

5-6.11 Traveling - Forward.

CAUTION

Engage the SWING LOCK Pin Control Lever (49, Figure 5-2) before traveling.

CAUTION

Use four wheel drive only when required for more traction.

a. Position the DRIVE AXLE Selector Switch (37) to either high speed (2WD) or low speed (4WD).

b. After the engine has warmed up, shift Transmission Shift Lever (48) from N (neutral) to the forward (F) gear desired. The carrier backup/ superstructure driving lights will come on and the backup alarm mounted on the rear of the carrier will sound when driving the crane forward from the superstructure cab.

c. Release the PARK BRAKE Control (57) and depress the Foot Throttle Pedal (5).

5-6.12 Traveling - Reverse.

CAUTION

Apply the Brake Foot Pedal (13, Figure 5-2) and bring the crane to a complete stop before shifting the transmission into reverse.

Traveling in reverse is accomplished the same way as traveling forward (see above), except for shifting the Transmission Shift Lever (48) to the reverse (R) gear desired.

5-6.13 Four-Wheel (4WD) Drive Operation. If more traction is required due to slipping or spinning wheels, engage the rear axle drive. Engage 4WD as follows:

a. Position the DRIVE AXLE Selector Switch (37, Figure 5-2) to the 4WD position.

NOTE

Crane must be traveling at a speed below 11 mph (18 kph) for 4WD to engage and remain engaged.

b. Return the DRIVE AXLE Selector Switch (37) to the 2WD position as soon as 2WD traction will suffice.

5-6.14 Inter-axle Differential. To lock the inter-axle differential and achieve maximum pulling power when approaching slippery or poor road conditions, proceed as follows:

CAUTION

The differential lock can only be engaged when 4WD is active. Do not actuate the DIFFERENTIAL LOCK Switch (33, Figure 5-2) while the wheels are actually slipping or spinning.

a. Position DIFFERENTIAL LOCK Switch (33) to LOCKED position to lock the front and rear differentials, while maintaining crane speed [below 11 mph (18 kph)].

b. Let up momentarily on accelerator. This will engage the differential lock.

c. Use extreme caution when driving over rough terrain.

As soon as driving conditions improve, perform the following:

a. Position DIFFERENTIAL LOCK Switch (33) to the UNLOCKED position while maintaining crane speed.

b. Let up momentarily on accelerator to allow the shift.

c. Resume driving at a safe speed.

5-7. CRANE OPERATION.

5-7.1 General Crane Operation. The control lever operation for crane functions is standard, i.e., the closer the lever is to neutral (center), the slower the system responds. This applies to both forward and rear movement of the applicable lever, the Boom LIFT/MAIN HOIST Control Lever (8, Figure 5-2) or the SWING/AUXiliary Hoist Control Lever (20). The control lever should be returned to neutral to hold the load.

WARNING

Always calculate the total weight of the load, then operate within the load chart parameters.

CAUTION

Never feather the control lever to hold the load.

NOTE

Always operate the control lever with slow, even pressure.

5-7.2 Functional Check. After the crane has been readied for service, a functional check of all craning functions (with no load applied) should be performed.

WARNING

Carefully read and become familiar with all crane operating instructions before attempting to operate the crane.

a. Ensure IGNITION Switch (50, Figure 5-1) in the carrier cab is in the O (off) position.

CAUTION

The engine must be shut down to engage or disengage the Hydraulic Pump Disconnect Control (5). Attempting to engage control with engine running will result in damage to pump and transmission.

b. Ensure that the Hydraulic Pump Disconnect Control (5, Figure 5-1) in the carrier cab is engaged. To engage the main hydraulic pump, it may be necessary to "bump" the diesel engine with the IGNITION Switch (50) to align the pump drive gears.

c. Start and operate the diesel engine (from the superstructure cab) at or near the governed RPM during performance of all crane functions.

d. Set the LMI panel for the proper operating mode. If necessary, refer to Appendix G - LMI Operator's Handbook.

e. Extend and set the outriggers. Refer to paragraph 5-7.4.

f. Raise, lower, and swing the boom right and left a minimum of 45 degrees. Refer to paragraphs 5-7.7, 5-7.8, and 5-7.6.

g. Telescope the boom in and out. Refer to paragraphs 5-7.9 and 5-7.10.

h. Raise and lower the hoist rope a few times at various boom lengths. Check for kinks in the wire rope. Refer to paragraphs 5-7.11 and 5-7.12.

5-7.3 Using Load Chart.

NOTE

In addition to the load chart, the crane is equipped with a Load Moment Indicating (LMI) system to aid the operator in craning operations, refer to Appendix G for LMI operation.

NOTE

One of the most important tools of every crane is the load chart found in the operator's cab. Refer to Figure 5-7 as required.

The load chart contains a large amount of information, which must be thoroughly understood by the operator.

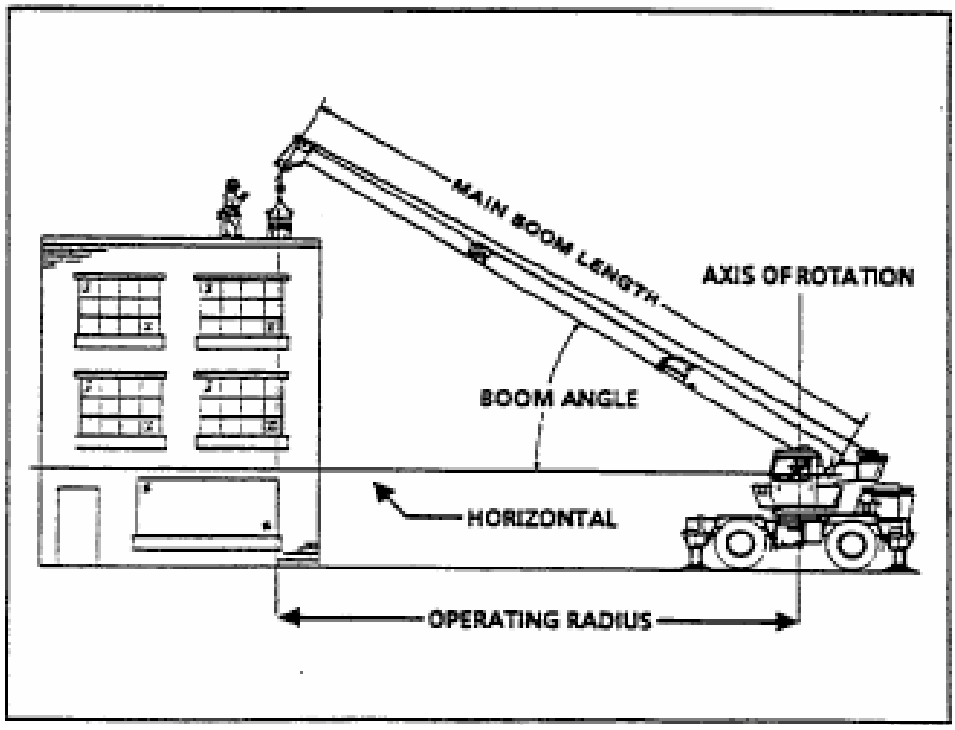


Figure 5-7. Terms to Know When Using Load Chart

The load chart contains a Range Diagram, Lifting Area Diagrams, an On Outriggers Capacity Chart, and On Rubber (Stationary and Pick & Carry) Capacity Charts.

The capacity charts are divided into two areas, separated by a bold line. Capacities appearing below the bold line are limited by the crane's stability (overloading of the crane in any of the listed configurations would result in the crane tipping before any structural damage occurred). Capacities above the bold line are limited by the structural strength of the crane (overloading the crane in any of these configurations would likely result in structural damage before tipping of the crane occurred). It is never permissible to exceed any capacity figure appearing in the charts, and it is important to never rely on tipping as a means of determining the crane's lifting capacity, particularly with regard to capacities appearing above the bold line.

The capacities appearing in the capacity charts are the "rated" capacities of the crane, and represent the maximum loads that may be placed on the crane hook in each of the configurations identified in the tables. A table is included in the load chart which gives weight reductions for the Grove furnished clamshell and grapple. When using these attachments, their weight must be deducted from the capacities listed in the charts. Any other load handling devices such as chains, slings, or spreader bars must also be considered, and the weight of these devices must be added to the weight of the load or deducted from the listed capacities. The weight of the hook block supplied with the crane was considered when the rated capacities were established in the charts, so no deduction is required for hook block weight. Another thing to remember is that the capacities listed in the charts do not take into account the number of parts of line required to lift a particular load. The operator must therefore calculate the number of parts of line required to lift a load using the "Line Pulls and Reeving Information" table included in the load chart, configure the crane appropriately, and enter the information into the LMI prior to attempting the lift. To determine the parts of line required, the weight of the load to be lifted is divided by the permissible line pulls figure appearing in the table, and rounding UP the result to the next whole number. This number is the "parts of line" to be reeved and entered into the LMI.

Another important section of the load chart is the range diagram. The range diagram illustrates the tip height which can be achieved at each boom length, angle, and radius. If the operator knows the radius required for a specific lift and the tip height necessary, he can calculate the required boom length and angle needed for the lift. He then checks the capacity chart for the specific boom length and radius to find out if the crane is capable of performing the lift safely. Or, on the other hand, if the boom length and angle are known, the radius can be determined from the range diagram.

A lifting area diagram is included as part of the load chart to describe over side, over rear, and over front lifting areas. An examination of the lifting area diagram shows that the locations of the outriggers in the fully extended position are used to mark the boundaries of the lifting areas.

The last major portion of the load chart is the section concerning notes to lifting capacities. Be sure to read all notes carefully so you understand what each one means.

It is most important that each lift be planned in advance, and the correct sequence of steps accomplished as follows:

- Determine weight of load to be lifted.
- Review where load must be moved relative to its current resting place.
- Determine from the load charts the most suitable crane configuration to use, and the best place to locate the crane, so that the entire task of lifting and moving the load can be accomplished without exceeding any load capacity limits.

NOTE

Remember that the load radius diagrams appearing in the load chart correspond to the suspended load, not the radius of the load relative to the crane before the load is lifted. Therefore the crane must be located somewhat closer to the load than the listed radius, or the boom angle and/or length adjusted appropriately before making the lift, so that structural deflections that occur as the load is lifted do not result in the allowable load radius being exceeded when the load clears the ground.

- Determine the number of parts of line required to make the lift (weight of the load divided by the permissible line pull).
- Situate the crane appropriately for the lift.
- Program the LMI.

Only when all the above have been accomplished, in sequence, make the lift.

5-7.4 Setting the Outriggers.

WARNING

Death or serious injury could result from not properly setting the crane up on outriggers.

The outriggers must be set and the crane must be level before any other crane operation is attempted, unless lifting on rubber. Failure to comply could result in injury or death.

All four outrigger beams must be fully extended (and the crane level) before beginning craning operations on outriggers.

The crane operator must select that portion of the load chart applicable to the crane when "on outriggers" and "on rubber".

a. Place the outrigger floats approximately 5 feet (1.5 m) directly out from each outrigger.

CAUTION

Always select an outrigger beam or stabilizer cylinder using the OUTRIGGER SELECTOR Switches (40, Figure 5-2) before placing the OUTRIGGERS EXTEND/RETRACT Switch (54) to either EXTEND or RETRACT. Failure to follow this caution could cause a hydraulic lock against the individual solenoid valves, thus preventing them from moving.

NOTE

More than one outrigger beam can be extended at one time. However, each OUTRIGGER SELECTOR Switch (40) should be depressed individually while momentarily holding the OUTRIGGERS EXTEND/ RETRACT Switch (54) at EXTEND to ensure that each outrigger beam is fully extended.

b. Select and hold the appropriate OUTRIGGER SELECTOR Switch (40) to extend the front outrigger beam(s). Then place and hold the OUTRIGGERS EXTEND/RETRACT Switch (54) in the EXTEND position until front outrigger beam(s) is fully extended.

c. Select and hold the appropriate OUTRIGGER SELECTOR Switch (40) to extend the rear outrigger beam(s). Then place and hold the OUTRIGGERS EXTEND/RETRACT Switch (54) in the EXTEND position until rear outrigger beam(s) is fully extended.

d. Extend the front stabilizer cylinders in order to lock the floats onto the ball end of the stabilizer. To do this, first select and hold the OUTRIGGER SELECTOR Switch (40). Then select and hold the OUTRIGGERS EXTEND/RETRACT Switch (54) in the EXTEND position while repositioning the float(s) as necessary to line up the float socket with the ball end of the cylinder. Ensure float locking levers are properly locked and floats are firmly touching the ground.

e. Repeat step d. for the rear stabilizers and floats by selecting and holding the OUTRIGGER SELECTOR Switch (40).

f. With each stabilizer float firmly touching the ground, select and hold the OUTRIGGER SELECTOR Switch (40). Then select and hold the OUTRIGGERS EXTEND/RETRACT Switch (54) in the EXTEND position to extend the front stabilizers approximately 3 to 4 inches (7.6 to 10.2 cm).

g. Repeat step f. for the rear stabilizers and floats by selecting and holding the OUTRIGGER SELECTOR Switch (40).

h. Repeat steps f. and g. until all wheels are clear of the ground and the crane is level as indicated on the Bubble Level (36). If it is suspected that the Bubble Level is not accurate, adjust as follows:

(1) Locate the crane on a level, firm surface.

(2) Extend and set the outriggers. Using the outriggers, level the crane as indicated on the Bubble Level (36).

(3) Place another bubble level, or similar device which will check level of crane on all axis, on the turntable bearing surface near the positive swing lock.

(4) Using the outriggers, level the crane using the bubble level positioned in step (3).

(5) Loosen the screws securing the Bubble Level (36) and reposition it until the bubble is centered indicating the crane is level, see Figure 5-8. Tighten the Bubble Level (36, Figure 5-2) screws.

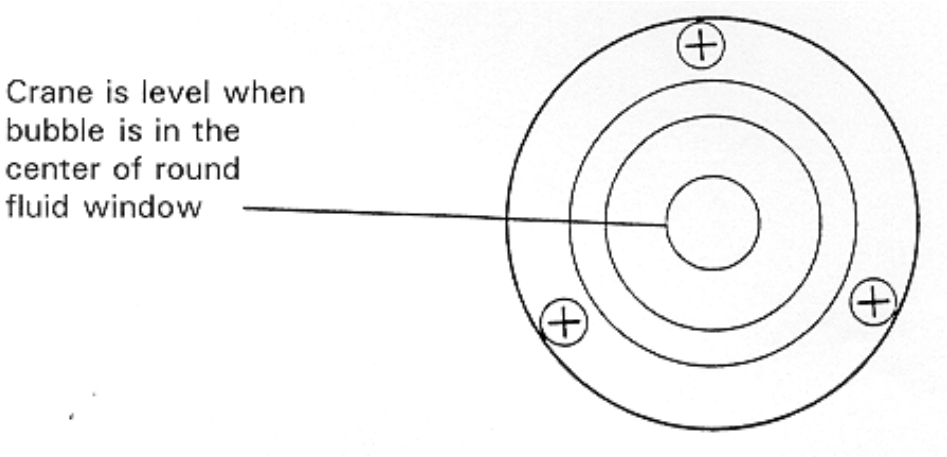


Figure 5-8. Bubble Level Indicator

5-7.5 Retracting the Outriggers.

a. Select and hold the OUTRIGGER SELECTOR Switch (40, Figure 5-2). Then select and hold the OUTRIGGERS EXTEND/RETRACT Switch (54) in the RETRACT position until rear stabilizers have retracted several inches.

b. Repeat step a. for the front stabilizers and floats by selecting OUTRIGGER SELECTOR Switch (40).

c. Repeat steps a. and b. until the crane is resting on all four wheels and stabilizer floats are 1-2 inches (2.5 - 5.0 cm) off the ground.

WARNING

Keep feet and hands clear when unlocking and dropping stabilizer floats as they are heavy and could cause serious injury.

d. Release locking levers and allow each float to drop to the ground.

e. Continue to retract each stabilizer until all four are fully retracted.

f. Select appropriate OUTRIGGER SELECTOR switch (40) and retract front and rear extensions (outrigger beams) until all four are fully retracted.

g. Stow outrigger floats on the posts provided at the rear of the crane. Ensure each is pinned and secure.

5-7.6 Swinging the Boom.

WARNING

Before initiating any swing operations, make certain the area in the swing path of the hook block and/or load as well as the tail swing area, is clear of all obstructions. Failure to comply could result in injury or death.

When swinging the load from over-the-rear to over-the-side of the crane, refer to the 360º load chart to make certain the applicable capacity is not exceeded. Traveling with any load over-the-side is prohibited.

CAUTION

Never push or pull the SWING/AUXiliary Hoist Control Lever (20, Figure 5-2) through neutral to the opposite direction to stop swing motion. Use the Swing Brake Pedal (16) to stop swing motion.

Disengage the SWING LOCK PIN Control Lever (49), the Positive Swing Lock Handle (6), and the SWING BRAKE ON/OFF Selector Switch (18) before attempting swing.

NOTE

Always operate the SWING/AUXiliary Hoist Control Lever (20) with a slow, even pressure.

Automatic front axle oscillation lockout will occur when the boom swings to the right six degrees or to the left six degrees of the crane centerline.

a. If ON, place AUX HOIST ON/OFF Selector Switch (19) to OFF. If locked, disengage SWING LOCK PIN Control Lever (49). If ON, place SWING BRAKE ON/OFF Selector Switch (18) to OFF. If set, release Positive Swing Lock Handle (6).

b. Depress Horn Button - Swing (11) on right arm rest as a warning that boom swing is going to take place.

c. To swing boom RIGHT, push SWING/AUXiliary Hoist Control Lever (20) to the right. To swing LEFT, push the SWING/AUXiliary Hoist Control Lever (20) to the left.

d. To stop boom swing, depress Swing Brake Pedal (16).

5-7.7 Elevating the Boom.

WARNING

Before elevating the boom, ensure the area above and beneath the boom is clear of all obstructions and personnel.

a. To elevate boom, push Boom LIFT/MAIN HOIST Control Lever (8, Figure 5-2) to the left and hold until the boom reaches the desired elevation angle.

b. To stop boom elevation, return Boom LIFT/MAIN HOIST Control Lever (8) to its neutral position.

5-7.8 Lowering the Boom.

WARNING

Before lowering the boom, make certain the area beneath the boom is clear of all obstructions and personnel.

Long cantilever booms can create a tipping condition even when unloaded and in an extended and lowered position.

When lowering the boom, lower the hoist rope at the same time to prevent two-blocking the boom nose and the hook block.

CAUTION

The closer the load is carried to the boom nose, the more important it becomes to let out hoist rope as the boom is lowered.

a. To lower boom, push Boom LIFT/MAIN HOIST Control Lever (8, Figure 5-2) to the right and hold until boom is lowered to desired position.

b. To stop boom, return Boom LIFT/MAIN HOIST Control Lever (8) to its neutral position.

5-7.9 Extending the Boom.

WARNING

When extending the boom, let out wire rope simultaneously to prevent two-blocking the boom nose and hook block.

WARNING

Check the load chart for maximum load at given radius, boom angle, and length before extending boom with a load.

a. Place TELE/CLAMSHELL Selector Switch (10, Figure 5-2) to TELE.

b. To extend boom, push top pad of Telescope/Clamshell Control Pedal (21) forward (away from the operator) and hold until the boom extends to desired length.

c. To stop boom extension, depress bottom pad on telescope control pedal to return Telescope/Clamshell Control Pedal (21) to its neutral position.

5-7.10 Retracting the Boom.

WARNING

When retracting the boom, the load will lower unless the hoist rope is taken in simultaneously.

a. Place TELE/CLAMSHELL Selector Switch (10, Figure 5-2) to TELE.

b. To retract boom, depress bottom pad on Telescope/Clamshell Control Pedal (21) and hold until boom retracts to desired length.

c. To stop boom, push top pad of Telescope/Clamshell Control Pedal (21) to its neutral position.

5-7.11 Lowering Hoist Rope.

WARNING

Before lowering or raising the load, ensure the area beneath the load is clear of all obstructions and personnel.

CAUTION

When starting or stopping the hoist, do not jerk the Boom LIFT/MAIN HOIST Control Lever (8, Figure 5-2). 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.

a. If operating the auxiliary hoist, place AUX HOIST ON/OFF Selector Switch (19) to ON.

b. To lower hoist rope, push Boom LIFT/MAIN HOIST Control Lever (8) or SWING/AUXiliary Hoist Control Lever (20) forward (away from the operator) and hold until the hook or load is lowered to the desired height.

c. To stop hoist rope, return Boom LIFT/MAIN HOIST Control Lever (8) or SWING/AUXiliary Hoist Control Lever (20) to its neutral position. This automatically sets the hoist brake.

5-7.12 Raising the Hoist Rope.

a. If operating the auxiliary hoist, place AUX HOIST ON/OFF Selector Switch (19, Figure 5-2) to ON.

b. To raise hoist rope, pull the Boom LIFT/MAIN HOIST Control Lever (8) or SWING/AUXiliary Hoist Control Lever (20) back (toward the operator) and hold until hook or load is raised to desired height.

c. To stop hoist rope, return Boom LIFT/MAIN HOIST Control Lever (8) or SWING/AUXiliary Hoist Control Lever (20) to its neutral position.

5-7.13 Crane Shutdown Procedures. The following procedure will extend the service life of various crane components, reduce vandalism and accidents during crane shutdown periods or anytime the crane is left unattended.

WARNING

Never park the crane near holes, or on rocky or extremely soft surfaces. This may cause the crane to overturn, resulting in injury to personnel.

a. Remove load from hook block.

b. Fully retract the boom.

c. Lower boom to normal travel position.

d. Retract all outriggers.

e. Engage SWING LOCK and/or positive swing lock handle.

f. Park crane on a flat stable surface.

g. Apply parking brake and chock wheels.

h. Ensure all operating controls are in their neutral positions.

CAUTION

Allow the engine to idle from 3 to 5 minutes after a full-load operation before shutting it down. This will allow the engine to cool down gradually and uniformly.

i. After cool down period, shut down engine by turning IGNITION Switch (50, Figure 5-1) to OFF.

j. Close and latch sliding cab door windows. Close and lock cab door.

k Close and secure all frame access covers.

l. Place BATTERY DISCONNECT switch in off position.

5-8. HEATING AND AIR CONDITIONING OPERATION.

5-8.1 Carrier Cab Heater.

NOTE

The cab heater has air ducts that release air both under the operator's seat and above the main control panel (to defrost the windshield). The air flow through both ducts is controlled by the HEATER FAN Switch (42, Figure 5-1).

a. Turn HEATER FAN Switch (42) to control the speed of the fan.

b. Pull HEATer Control (41) for warm air and push the knob in for cool air.

c. Pull DEFROST Control Knob (43) to direct heater air flow to the windshield.

5-8.2 Carrier Cab Air Conditioner.

NOTE

There are two controls on the ceiling mounted air conditioner control panel. One control turns the air conditioner on and controls temperature. The Air Conditioner Fan Control (56, Figure 5-1) controls fan speed.

a. Turn the Air Conditioner Temperature Control (55) clockwise to turn on the air conditioner unit. Adjust the temperature by turning the control clockwise. The coldest setting is the extreme clockwise position.

b. Turn the Air Conditioner Fan Control (56) clockwise to increase fan speed. There are low, medium, and high settings.

5-8.3 Superstructure Cab Heater.

a. Pull the PULL FOR AIR FLOW Knob (63, Figure 5-2) out for maximum air flow.

NOTE

The cab heater igniter requires full system voltage to start. In order to ensure full system voltage, the crane's diesel engine must be running. After the cab heater starts, the engine can be shutdown since the voltage supplied by the crane's batteries should be enough to run the heater fan and fuel pump.

b. Start the diesel engine.

c. Place START/OFF Switch (59) to START. Ensure POWER Green Indicator (62) is lit. Heater fan will start after a short time delay.

d. If FAULT Red Indicator (61) comes on, heater failed to start.

e. If heater failed to start, wait two minutes and depress PUSH TO RESET Button (60). Verify that FAULT Red Indicator (61) goes out.

f. Repeat step c. to start heater.

g. Shut down the diesel engine if applicable.

NOTE

The superstructure cab heater is factory set to operate on diesel fuel (DF-2) with the carburetor fuel adjustment knob installed so the pointed side of knob is pointing to 6 o'clock position. To switch from DF-2 to JP-8, turn carburetor fuel adjustment knob 1/8 turn clockwise. When switching back to DF-2, return fuel adjustment knob to its original position.

5-8.4 Superstructure Cab Air Conditioner. Turn AIR CONDITIONER Control (58, Figure 5-2) to one of the detent positions to control air conditioner blower speed.

5-9. INSTALLING AND OPERATING CLAMSHELL BUCKET.

WARNING

Always calculate the total weight of the load, then operate within the load chart parameters.

NOTES

When computing Load Chart Limits, the weight of accessories must be added. Weights for the clamshell and grapple accessories are found in Appendix E (Load Chart). Weights of other accessories may be found in the manufacturer's equipment manuals.

The Eurotech clamshell has a working pressure limitation of 3,500 psi (24,133 kPa). The Pro-line/Anvil Model HG-760 has a maximum working pressure limitation of 3,600 psi (24,822 kPa).

5-9.1 Installation.

a. Preposition clamshell on firm level surface.

b. Set outriggers, refer to paragraph 5-7.4.

c. Position boom tip over center of clamshell.

d. Change the 3-sheave hook block to a two part line. Then use the chain sling (Grove P/N 7286000745) to connect the clamshell attachment point to the hook block.

WARNING

Use care when unreeling the hydraulic hoses from the boom hose reel as the hose reel is under tension. Do not release the hydraulic hoses and allow them to rewind onto the reel as this will allow hoses to swing freely until the tension on the reel is relieved.

CAUTION

When attaching tag lines to clamshell, ensure they are even, secure, and taut so that there will be no tension on hydraulic hoses when connected.

e. Unclasp the hose reel tag lines from stowage link, and while maintaining the preload on the hose reel, pull the hoses from hose reel on end of boom. Then hook tag lines onto rings of clamshell, remove caps on hose fittings and cylinder fittings, and connect quick disconnect fittings to clamshell cylinder fittings.

5-9.2 Operation.

a. Position clamshell by lifting, swinging, and telescoping the boom and by hoisting the clamshell.

b. Place TELE/CLAMSHELL Selector Switch (10, Figure 5-2) to CLAMSHELL.

CAUTION

To prevent bird caging of hoist cable, permit as little slack in the cable as possible when operating the clamshell. Correct any bird caging as soon as detected to prevent having to rewind entire length of cable.

c. Raise and lower the clamshell using the Boom LIFT/MAIN HOIST Control Lever (8), refer to paragraph 5-7.11 and 5-7.12.

d. To open the clamshell, push top pad of Telescope/Clamshell Control Pedal (21) forward (away from the operator) and hold until the clamshell opens.

e. To close clamshell, depress bottom pad on Telescope/Clamshell Control Pedal (21) and hold until clamshell closes.

5-9.3 Removal.

a. Open clamshell and set bucket down on firm level surface.

WARNING

Use care when stowing the hydraulic hoses onto the boom hose reel as the hose reel is under tension. Do not release the hydraulic hoses and allow them to rewind onto the reel as this will allow hoses to swing freely until the tension on the reel is relieved.

b. Disconnect hydraulic quick disconnect fittings at clamshell. Then install caps on quick-disconnect fittings. Unhook hose reel tag lines from clamshell. Then while maintaining the tension on the hose reel and rewind hydraulic hoses onto hose reel. Hook the tag lines on their stowing ring. Cap open fittings on cylinder of clamshell.

c. Disconnect clamshell at its attachment point. Restore hook block to its original configuration. Stow chain sling.

5-10. INSTALLING AND OPERATING GRAPPLE.

WARNING

Always calculate the total weight of the load, then operate within the load chart parameters.

NOTES

When computing Load Chart Limits, the weight of accessories must be added. Weights for the clamshell and grapple accessories are found in Appendix E (Load Chart). Weights of other accessories may be found in the manufacturer's equipment manuals.

The Eurotech grapple has a working pressure limitation of 3,500 psi (24,133 kPa). Pro-Line/Anvil Model HMG-760 has a maximum working pressure limitation of 3,600 psi (24,822 kPa).

5-10.1 Installation.

a. Preposition grapple on firm level surface.

b. Set outriggers, refer to paragraph 5-7.4.

c. Position boom tip over center of grapple.

d. Change the 3-sheave hook block to a two part line. Then use the chain sling (Grove P/N 7286000745) to connect the grapple attachment point to the hook block.

WARNING

Use care when unreeling the hydraulic hoses from the boom hose reel as the hose reel is under tension. Do not release the hydraulic hoses and allow them to rewind onto the reel as this will allow hoses to swing freely until the tension on the reel is relieved.

CAUTION

When attaching tag lines to grapple, ensure they are even, secure, and taut so that there will be no tension on hydraulic hoses when connected.

e. Unclasp the hose reel tag lines from stowage link, and while maintaining the preload on the hose reel, pull the hoses from hose reel on end of boom. Then hook tag lines onto rings of grapple, remove caps on hose fittings and cylinder fittings, and connect quick disconnect fittings to grapple cylinder fittings.

5-10.2 Operation.

a. Position grapple by lifting, swinging, and telescoping the boom and by hoisting the grapple.

b. Place TELE/CLAMSHELL Selector Switch (10, Figure 5-2) to CLAMSHELL.

CAUTION

To prevent bird caging of hoist cable, permit as little slack in cable as possible when operating the grapple. Correct any bird caging as soon as detected to prevent having to rewind entire length of cable.

c. Raise and lower the grapple using the Boom LIFT/MAIN HOIST Control Lever (8), refer to paragraph 5-7.11 and 5-7.12.

d. To open the grapple, push top pad of Telescope/Clamshell Control Pedal (21) forward (away from the operator) and hold until the grapple opens.

e. To close grapple, depress bottom pad on Telescope/Clamshell Control Pedal (21) and hold until grapple closes.

5-10.3 Removal.

a. Open grapple and set it down on firm level surface.

WARNING

Use care when stowing the hydraulic hoses onto the boom hose reel as the hose reel is under tension. Do not release the hydraulic hoses and allow them to rewind onto the reel as this will allow the hoses to swing freely until the tension on the reel is relieved.

b. Disconnect hydraulic quick disconnect fittings at grapple. Then install caps on quick-disconnect fittings. Unhook hose reel tag lines from grapple. Then while maintaining the tension on the hose reel and rewind hydraulic hoses onto hose reel. Hook the tag lines on their stowing ring. Cap open fittings on cylinder of grapple.

c. Disconnect grapple at its attachment point. Restore hook block to its original configuration. Stow chain sling.

5-11. INSTALLING CONCRETE BUCKET.

WARNING

Always calculate the total weight of the load, then operate within the load chart parameters.

NOTE

When computing Load Chart Limits, the weight of accessories must be added. Weights for the clamshell and grapple accessories are found in Appendix E (Load Chart). Weights of other accessories may be found in the manufacturer's equipment manuals.

5-11.1 Installation.

a. Place the concrete bucket on a firm, level surface.

b. Set outriggers, refer to paragraph 5-7.4.

c. Hook concrete bucket attachment point onto hook block.

5-11.2 Removal.

a. Lower concrete bucket onto firm, level surface.

b. Unhook concrete bucket attachment point from hook block.

5-12. OPERATION UNDER UNUSUAL CONDITIONS. This section provides special procedures, safety precautions, etc., for weather conditions and modes of operation that are not ordinary.

5-12.1 Cold Weather Operation.

CAUTION

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

While performing your PMCS in cold weather, there may be instances where you notice minor leakage at the spin-on filter elements. If leaking is noted, hand-tighten the filter to stop the leak. If necessary, contact maintenance.

a. Check operation procedures for cold weather starting.

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

c. Keep the crane clean and free of ice and snow, especially the boom.

d. Allow ample time for the hydraulic oil to warm up before beginning crane operations.

e. Frequently check and drain all air tanks of water.

f. Check that your load is not frozen to the ground before attempting a lift.

WARNING

Use only the cold weather starting aids provided with your crane. Do not use aerosol-type sprays or other starting fluids since they are volatile and can cause a fire or explosion.

g. If needed, use the cold weather starting aid provided for the diesel engine.

CAUTION

The crane's drive line can be damaged when attempting to move or free a crane that is frozen in place.

h. In freezing weather, be sure to park the crane in an area where it can not become frozen to the ground.

5-12.2 **Extremely Low Temperature Operation [0º to -40º F (-18º to -40º C)]**. The ATEC is capable of being operated in ambient temperatures as low as -40º F (-40º C). Before the ATEC is placed in service in low temperature environments (i.e. when temperatures below 0º F are expected), the following preparations must be observed.

CAUTION

It is important that the preparations be performed in the exact order specified below. Failure to follow this order may result in degradation of the low-temperature fluids if the preparations are being conducted at moderate temperatures. See the Appendix M - Lubrication and/or the lubrication data plate for a listing of fluid and lubricant usage applicable to particular temperature ranges.

NOTE

Contact maintenance to perform the following procedures for operation in extremely low temperatures.

5-12.2.1 Engine Cooling System.

a. Remove the radiator cap, and measure the specific gravity of the engine coolant. Verify that the coolant is suitable for temperatures as low as -40º F (-40º C). Add anti-freeze coolant as necessary to achieve this capability.

b. Repeat the procedure in step a. for the coolant in the coolant recovery bottle.

5-12.2.2 Hydraulic System. Perform the following procedure to install low temperature fluid in the ATEC's hydraulic system:

a. With the crane in travel configuration, drain all oil from the hydraulic oil reservoir.

b. Add a sufficient quantity of OEA per MIL-L-46167 to the reservoir, that will allow all the ATECs hydraulic cylinders to be extended completely, without drawing down the fluid level in the reservoir to the extent that a vortex may appear at the fluid surface when the engine is run at high speed. Appearance of a vortex indicates that air is being drawn into the pumps along with the fluid, which will result in serious damage to the pumps.

c. Engage the main hydraulic pump drive and start the engine.

d. Fully extend the outrigger beams and stabilizer jacks.

e. Raise the boom to maximum elevation.

f. Swing the crane 360 degrees in both directions, and bring it to rest with the boom over one side.

NOTE

During this step, and until steps h. and i. have been completed, visually monitor the oil in the reservoir to ensure that no air is drawn into the pump suction connections.

g. Lower the boom to minimum angle, then raise it again to maximum angle, a total of three times.

h. With the boom at maximum angle, extend it to maximum length.

i. Retract the boom to minimum length, then extend it again to maximum length, a total of three times.

j. Steer both front and rear wheels fully from right to left and back again a total of six times each.

k. Return the crane to travel configuration.

l. Plug together the two hydraulic quick-disconnect fittings at the end of the hose reel hoses.

m. With the TELE/CLAMSHELL Selector Switch (10, Figure 5-2) in the CLAMSHELL position, operate the foot control pedal in one direction only until all regular oil in both hoses has been forced back into the reservoir.

n. Drain all oil from the hydraulic oil reservoir, and remove the hydraulic oil filter.

o. Install a new hydraulic system filter.

p. Remove the steering system filter.

q. Install a new steering system filter.

r. Remove the crane pilot control (joystick) system filter.

s. Install a new pilot control system filter.

t. Fill the hydraulic oil reservoir to the "FULL" level.

u. Repeat steps c. through m. above.

v. Open the swing brake "service" side bleeder valve on the swing drive. Start the diesel engine, and depress the swing brake pedal to bleed out all regular oil, until OEA fills the service brake cavity. Re-tighten the bleeder valve.

w. Open the swing brake "release" side bleeder valve on the swing drive, and operate the brake release switch to bleed out all regular oil, until OEA fills the brake release cavity. Re-tighten the bleeder valve.

x. Loosen the hose connection at the pressure switch which actuates the SWING BRAKE ON Indicator (26) on the superstructure console. Allow the regular oil to drain out of the switch, then operate the SWING BRAKE ON/OFF Selector Switch (18) to bleed out all regular oil in the hose, until OEA fills the hose and the switch. Re-tighten the hose connection.

y. With the boom in the rest cradle, loosen the hose connection at the LMI piston-side pressure transducer. Allow all regular oil to drain out of the transducer, then barely operate the boom lift control in the “raise” direction, until all regular oil in the hose to the transducer and in the transducer itself has been replaced with OEA. Re-tighten the hose connection.

z. With the boom in the rest cradle, loosen the hose connection at the LMI rod-side pressure transducer. Allow all regular oil to drain out of the transducer, then barely operate the boom lift control in the “lower” direction, until all regular oil in the hose to the transducer and in the transducer itself has been replaced with OEA. Re-tighten the hose connection.

aa. Examine the ATEC for any visible leakage from the hydraulic system, and correct as necessary. Add OEA as necessary to bring the hydraulic reservoir oil level to “full”.

bb. Disconnect the main hydraulic pump drive.

5-12.2.3 Axles.

a. Extend and lower the outriggers until the wheels are clear of the ground. Otherwise, the crane must be moved back and forth as necessary to accomplish step a. below.

b. Start the engine and place the transmission in gear, or otherwise rotate the wheels as necessary to bring the drain plugs of the planetary wheels ends to their lowest position.

NOTE

Depending on the relative positions of the drain plugs, it may be necessary to perform steps b., c., and d. in succession for each wheel end.

c. Drain all oil from each wheel end, and replace the plug.

d. Without rotating the wheels, remove the fill plugs, and refill the wheel ends to the correct level using GO-75 per MIL-L-2105.

e. Drain all oil from both differential housings, and refill to the correct level using GO-75 per MIL-L-2105.

5-12.2.4 Engine and Drive System Lubrication. Perform the following procedure to install low temperature fluids in the ATEC Engine and Drive system:

a. If the fuel tank contains regular diesel fuel (e.g. DF-2 per VV-F-800), drain all diesel fuel from the tank and from the engine primary fuel filter.

b. Fill the fuel tank with JP-8 fuel per MIL-T-83133.

c. Start the engine, and extend the outrigger jacks to raise the tires clear of the ground.

d. Run the engine with the transmission in gear, until both the engine oil and transmission oil are warm, and all regular diesel fuel in the fuel lines has been consumed (after approximately ten [10] minutes). Turn off the engine.

e. Remove the engine primary fuel filter, and install a new filter element.

f. Drain all oil from the engine oil pan.

g. Drain all oil from the transmission/torque converter sump.

h. Fill the engine to the correct level with OEA per MIL-L-46167.

i. Fill the transmission to the correct level with OEA per MIL-L-46167.

NOTE

If all of the fuel was burned out of the diesel engine and the fuel lines during step d. above, it may be necessary to prime the fuel system.

j. Start the engine. If it will not start, prime the fuel system as follows:

(1) Open the vent fitting on the fuel-water separator and crack the fitting at the inlet to the fuel injection pump.

(2) With fuel tank cap on and secure, connect a regulated air pressure supply to the fuel tank vent line and apply no more than 15 psi air pressure.

(3) When fuel begins to bleed at the fuel-water separator vent, close the vent fitting.

(4) When fuel begins to bleed at the fuel injection pump inlet, tighten the inlet fitting.

CAUTION

To avoid overheating the diesel engine starting motor, do not crank the starting motor for more than ten (10) seconds without allowing it to cool down.

(5) Operate the manual primer on the fuel injection pump and crank the diesel engine until it starts.

(6) If the diesel engine does not run smoothly, stop the engine and contact maintenance to bleed the diesel engine fuel system.

k. Select 2WD and 6th gear forward, and drive the wheels through all gears. Select 4WD drive and 3rd gear reverse, and again drive the wheels, so that fresh oil is circulated through all passages of the transmission and its remote cooling circuit.

l. Stop the engine, drain all oil from the engine oil pan, and remove the engine oil filter.

m. Drain all oil from the transmission/torque converter, and remove the transmission oil filter.

n. Install a new engine oil filter, and fill the engine to the correct level with OEA.

o. Install a new transmission oil filter, and fill the transmission to the correct level with OEA.

p. Start the engine, select 6th gear forward, and drive the wheels until all areas of the transmission are filled.

q. Examine the ATEC for any visible leakage from the engine and drive systems, and correct as necessary. Check the engine and transmission fluid levels, and add OEA as necessary to bring them to the correct level (check the transmission with the engine running at idle and the transmission in gear).

CAUTION

The starting fluid used in the cold start system contains ethyl ether and is extremely flammable and toxic. Do not smoke and make sure you are in a well-ventilated area away from heat, open flames, or sparks when installing, maintaining, testing, or troubleshooting the cold start system.

CAUTION

Wear goggles and make sure openings are pointed away from you when activating cold start system with lines or fittings disconnected to avoid eye injury. If fluid enters the eyes or fumes irritate the eyes, they should be flushed with large quantities of clean water for 15 minutes. A physician should be contacted.

Starting fluid can be harmful or fatal if swallowed. If swallowed, DO NOT INDUCE VOMITING. Call a physician immediately.

Contents of cylinder are under pressure. Store in a cool dry place. Do not incinerate, puncture, or attempt to remove cores from cylinder.

r. Verify that the ether canister of the ether injection cold start system contains ether, or replace as necessary, together with the associated filters. Use a scale to check the amount of ether left (a full canister weighs 37 oz [1049 gr] while an empty one weighs 16 oz [454 gr]).

5-12.2.5 Crane Superstructure Heater. If the crane superstructure cab heater fuel tank contains regular diesel fuel (e.g. DF-2 per VV-F-800), perform the following procedure to install low temperature fuel in the cab heater system:

a. Drain all fuel from the superstructure cab heater fuel tank and sediment bowl.

b. Start the cab heater and run it until all fuel in the heater and in the fuel lines has been consumed.

c. Fill the heater fuel tank with JP-8 fuel per MIL-T-83133.

d. Turn heater fuel adjustment knob 1/8 turn clockwise from the 6 o'clock position.

e. Operate the heater control until fuel has been pumped through to the heater and the heater runs normally. As the heater is running, adjust fuel adjustment needle to achieve optimum fuel air mixture.

f. Verify that the heater and defroster controls are operating correctly.

5-12.2.6 Miscellaneous Preparations.

a. Drain all fluid from the windshield washer systems of both cabs.

b. Exhaust all air from the air system, using the drain valves on each reservoir to expel all condensate from the reservoirs.

c. Verify that the desiccant cartridge in the air dryer is in good condition, and that the air dryer discharge valve heater is operating correctly.

d. Verify that the engine cold start ether injection system is operating correctly. To check the ether injection system at engine temperatures above 30º F (-1º C), it will be necessary to by-pass the engine temperature sensor using a jumper wire.

e. Without heating the engine excessively (see Section 6), verify that the carrier cab heater and defroster controls are operating correctly, and that the engine cooling thermostat is operating correctly (i.e. is not stuck open or closed).

f. Verify that the engine belts and hoses are all in good condition.

g. Verify that all cab door and window seals are in good condition, and that the windows and doors close and latch securely.

h. Verify that the hoist cable(s) are in good condition, and are well lubricated with the applicable wire rope dressing.

i. Conduct a thorough examination of all structural components of the crane (boom sections, turntable, carrier frame, outriggers, all load-holding cylinders, etc.) and verify that no cracks or other evidence of failures exist.

5-12.2.7 Check-Out at Prevailing Ambient Temperatures.

CAUTION

Excessive heating of the low temperature fluids and lubricants can cause degradation of those fluids, and resulting in potential equipment damage.

At prevailing ambient temperature, conduct a full functional check-out of the ATEC and its pertinent sub-systems, including all warning and status indicator lights, and the Load Moment Indicator system, to verify that all systems are performing correctly following the preparations. Note that care must be taken if the prevailing ambient temperature is above 70º F (21° C), to avoid unnecessary and excessive heating of the engine, transmission and the hydraulic systems.

5-12.3 Operation in Extreme Heat.

a. When operating in extreme heat, keep all engine air passages and hood openings clean and free of obstructions.

b. Do not completely fill the fuel tank. Leave room for expansion.

c. Ensure diesel engine is serviced with proper lube oil for high temperatures. Refer to Appendix M - Lubrication.

d. Constantly monitor all temperature gauges and indicators for possible overheating.

5-12.4 Operation in Dusty/Sandy Areas.

a. When operating in sandy/dusty areas, keep all engine air passages and hood openings clean and free of obstructions.

b. Inspect air cleaner restriction indicator frequently. Pinch the dust evacuator to remove accumulated debris.

c. Keep all cab doors and windows closed particularly when the crane is not in use.

d. Keep area around fuel tank and hydraulic tank clean and free of dust and sand.

e. Keep all hydraulic cylinder rods clean and free of dust and sand.

5-12.5 Operation in Rainy or Humid Conditions.

a. When not in use, cover the diesel engine compartment with canvas or other waterproof material.

b. Keep the fuel tank full to prevent condensation in the fuel tank.

5-12.6 Operation in Salt Water Areas.

CAUTION

Salt water is harmful to paint and is particularly corrosive when allowed to remain on exposed metal surfaces.

a. Wash crane exterior surfaces frequently with fresh water and allow it to dry thoroughly.

b. When not in use, cover as much of the crane as possible with canvas or other waterproof material.

5-12.7 Fording. When fording water, do not allow the water to rise above half-way up the axle.

5-12.8 Emergency Starting. A NATO slave receptacle is located at the battery box for starting the diesel engine from an external 24 VDC power source.

NOTE

The crane can not be started by pushing it or by towing it.

a. Place BATTERY DISCONNECT switch of disabled vehicle in the off position.

b. Connect another vehicle having a compatible NATO slave intervehicular cable and a 24 VDC electrical system to disabled vehicle's NATO slave receptacle located on battery box.

c. Place BATTERY DISCONNECT switch of disabled vehicle in the on position

d. Start engine of source vehicle and then disabled vehicle's engine. When engine is running smoothly, disconnect the NATO slave intervehicular cable.

5-12.9 **Emergency Shutdown.** Should moving the IGNITION Switch to the 0 (off) position fail to shut off the engine, perform the following steps:

CAUTION

Do not use the BATTERY DISCONNECT switch as an emergency stop switch. Moving the BATTERY DISCONNECT switch to off will not shut down the engine and could result in damage to the alternator.

a. Ensure IGNITION Switch is positioned to 0 (off) and PARK BRAKE Control is pulled out (parking brake applied).

b. Open and secure left side engine access door.

c. Rotate fuel shutoff lever (Figure 5-9) clockwise to the stop and hold until engine stops running.

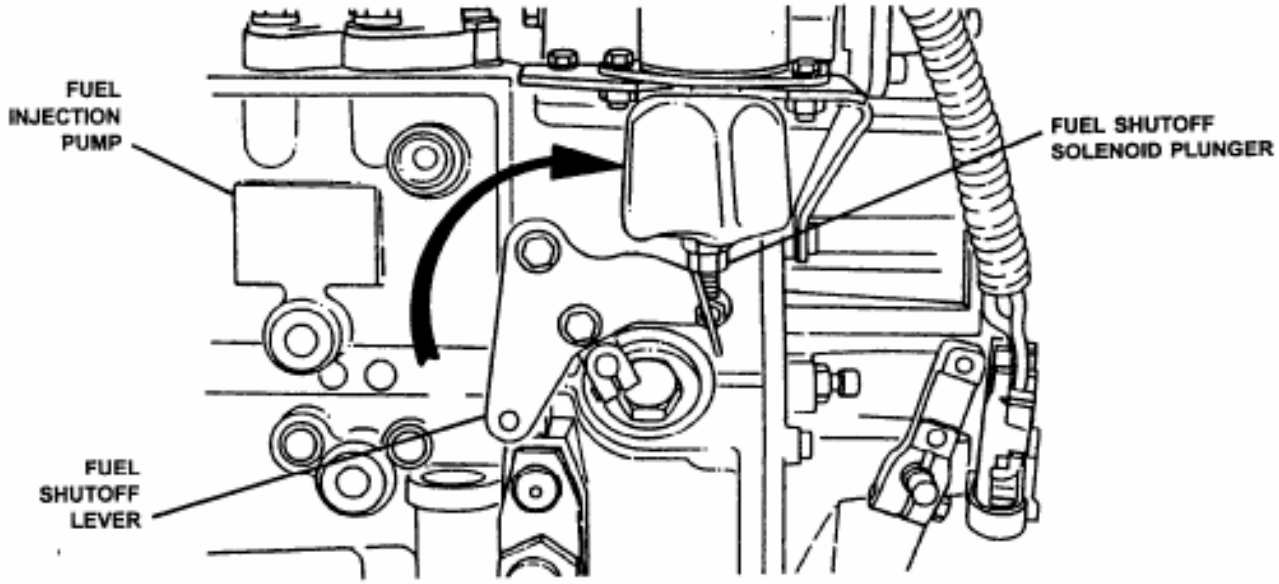


Figure 5-9. Fuel Shutoff Lever

5-12.10 **Programming LMI for Lifting on Rubber.** Refer to Appendix G for LMI operation.

5-12.11 **Lifting on Rubber.**

CAUTION

Ensure that all four tires are inflated to 110 psi (758 kPa) before attempting any lift on rubber.

a. When lifting a load on rubber (i.e. without extending outriggers), review all safety precautions for operating on rubber.

b. Study job site and determine best location for crane.

c. Get weight of load, measure load radius and check On-Rubber Capacity Chart (refer to Appendix E) to determine boom length and angle.

d. Position crane on level surface.

e. Perform suspension lockout system functional check, refer to paragraph 5-12.13.

f. Perform a dry run with no load, following Preload Check procedure.

g. Rig load and attach to hook.

h. Be sure everyone is clear of the crane and the work area.

i. Raise load a few inches and hold it there. Check that hoist brake is working correctly. Check for settling of tires. Watch bubble level and alignment of the load line with boom. If there is any sign of instability, put the load down and move crane to a flatter surface.

5-12.12 **Pick and Carry Operations.**

WARNING

Exercise extreme caution when picking and carrying a load. Ensure that all four tires are inflated to 110 psi (758 kPa).

a. Perform suspension lockout system functional check prior to any pick and carry operation, refer to paragraph 5-12.13.

b. When performing pick and carry operations or operating on sloping ground, carry loads much less than capacity. Keep load low and uphill from crane. Swing load only to keep the load uphill, and always place loads on high side.

c. When traveling with a load, boom should be carried in line with direction of motion.

5-12.13 Suspension Lockout System Functional Check

a. With crane standing on its wheels and the boom in the boom rest, start engine from superstructure cab.

NOTE

The testing to be conducted according to this procedure does not involve lifting any loads, but it does involve moving the boom, and although the boom can be raised without programming the LMI, it cannot be lowered again without activating the by-pass control if the programming action has not been performed.

b. Program LMI for any legitimate configuration.

c. Raise boom out of boom rest approximately six inches (i.e., ensure that the underside of the boom is clear from contact with the roller of the switch that is located in the top of the boom rest).

d. Extend the outrigger stabilizers to raise the crane, lifting the tires clear of ground. **As the crane is lifted, all wheels should remain in the same position relative to fenders.**

e. Lower boom onto boom rest.

f. Turn superstructure IGNITION switch to 0 (off) position to shut down engine.

WARNING

Suspended axles and wheels/tires can fall when carrier IGNITION switch is actuated or crane is rotated. Death or serious injury can result from being crushed by a falling suspension. When on outriggers, ensure areas beneath crane and adjacent to wheels are clear of all personnel before swinging superstructure to the rear or actuating carrier IGNITION switch.

g. Turn carrier IGNITION switch to 1 (on) position (there is no need to start the engine). **When IGNITION switch is actuated, all four wheels should fall to the full extension of the suspension lockout cylinders.**

h. Turn carrier IGNITION switch to 0 (off) position to shut off power.

i. Start engine from superstructure cab.

j. Retract outrigger stabilizers and set crane on its wheels.

k. Raise boom out of boom rest approximately six inches (i.e., ensure that the underside of the boom is clear from contact with the roller of the switch that is located in the top of the boom rest).

l. Extend the outrigger stabilizers to raise the crane, lifting tires clear of ground.

As the crane is lifted, all wheels should remain in the same position relative to fenders.

WARNING

Suspended axles and wheels/tires can fall when carrier IGNITION switch is actuated or crane is rotated. Death or serious injury can result from being crushed by falling suspension. When on outriggers, ensure areas beneath crane and adjacent to wheels are clear of all personnel before swinging superstructure to the rear or actuating carrier IGNITION switch.

m. Slowly rotate superstructure to the rear. **As boom approaches within 6° of directly over-rear position, both front wheels (only) should fall to full extension of front suspension lockout cylinders. The rear tires should remain in the same position relative to fenders.**

n. Rotate superstructure to front, return boom to its boom rest, and retract outrigger stabilizers, placing crane back on its wheels.

o. Shut down engine: test is complete.

5-12.14 **Emergency Boom Operating Procedures.** Although improbable the boom lift cylinders hydraulic equalizer line could fail. If this occurs, there are devices that allow continued crane operation. All crane functions remain operable until the hydraulic oil in the reservoir is depleted. The most important thing is to get the boom in a safe position so that repairs can be made. The following procedures are recommended for getting the boom to a safe position should the equalizer line fail.

a. Don't panic. Remain in cab. All functions can be accomplished from the cab.

b. Maintain engine at normal operating speed.

c. Maintain desired boom angle by pulling back on boom control joystick as necessary. With oil leaking from the hydraulic system, boom angle will drop if you do not react.

d. While maintaining boom at this angle: activate swing; retract boom; and operate hoist(s) as necessary until load is safely lowered to ground.

e. If over-the-side, retract as much boom as possible and then lower boom. If over-the-front, it will not be necessary to retract boom. Remember, boom cannot be lowered to minimum elevation over-the-rear, as boom would hit engine hood.

5-12.15 **Emergency Crane Stowage Procedure.** In the event of a hydraulic system failure (pumps, diesel engines, etc.), it will be necessary to lower a suspended load, retract the boom, swing the boom over the front and retract the outriggers in order to tow the crane to a maintenance area.

To return the crane to the travel mode from; elevated and extended boom; over-the-side; with suspended load and outriggers extended and set; proceed as follows:

a. Stop the crane's engine, apply the parking brakes, place the transmission in N (neutral), and engage the main hydraulic pump drive.

b. Verify that the carrier cab IGNITION Switch (50, Figure 5-1) is in the 0 (off) position, and that the hydraulic pump drive is disengaged.

c. Place the superstructure cab IGNITION Switch (56, Figure 5-2) is in the 0 (off) position.

d. Open the cover of the Auxiliary Power Unit (APU) control box, and verify that the APU power switch is in the "Off" position.

e. Verify that the battery disconnect switch is in the on position, and turn the superstructure cab IGNITION Switch (56) to the 3 (accessory) position.

NOTES

(1) To conserve battery electrical power, turn off the APU when not operating a crane function. If the crane's battery power fails while performing the following procedures, turn off the APU and connect another vehicle having a compatible NATO slave intervehicular cable and a 24 VDC electrical system to the NATO slave receptacle located on the left side of the APU. Turn on the APU and with the engine running, continue the emergency load lowering procedure.

(2) The LMI system may not be operational, depending on the failure experienced.

(3) It may be necessary to by-pass the LMI system when performing certain functions.

(4) Operate only one crane function at a time.

(5) It will be necessary to shift the diverter valve control lever to the function(s) to be operated, i.e., "hoists", or boom "lift/telescope". Swing, outrigger, and steering functions are available with the control lever in either position.

f. If a load is suspended in the air, turn on the APU power switch, and using swing, telescope, and/or hoist functions as appropriate, lower any hook load to the ground and detach.

g. Alternately place the APU diverter valve handle to the "lift/telescope" and "hoist" positions, and use the Telescope/Clamshell Control Pedal (21) and Boom LIFT/MAIN HOIST Control Lever (8) to retract the boom while, at the same time, raising the hook block to keep it clear of the ground or adjacent crane structure.

h. If set, disengage the positive swing lock and place SWING BRAKE ON/OFF Selector Switch (18) to OFF. Then use the SWING/AUXiliary Hoist Control Lever (20) to rotate the crane until the boom is over the front of the carrier, and oriented directly over the boom rest. Engage the swing locks.

i. Alternately place the diverter valve handle to the "lift/telescope" and "hoist" positions, use the Boom LIFT/MAIN HOIST Control Lever (8) to position the hook block directly over the tiedown loop on the front bumper. Attach the hook block to the tiedown loop.

j. Alternately place the diverter valve handle to the "lift/telescope" and "hoist" positions, use the Boom LIFT/MAIN HOIST Control Lever (8) to lower the boom onto the boom rest, at the same time keeping the hook block drawn snug against the tie down loop.

k. Fully retract the outrigger stabilizers using the OUTRIGGER SELECTOR Switches (40). Then retract the outrigger extension cylinders.

l. Place superstructure cab IGNITION Switch (56) to 0 (off) position and turn off the APU.

m. Remove and stow the outrigger pads.

n. Verify that the steering mode control (mounted to the hydraulic tank) is pushed in and locked in the "carrier" position.

o. Place carrier cab IGNITION Switch (50, Figure 5-1) to 3 (accessory) and turn on the APU. Then operate the carrier cab REAR AXLE STEERING Control Switch (48) to straighten the rear wheels as indicated by REAR STEER DIRECTION Indicator (49).

p. Engage the rear axle steering lock by placing REAR AXLE STEERING LOCK Switch (47) at LOCKED. Visually verify that the lock is engaged.

q. Place carrier cab IGNITION Switch (50) to 0 (off). Turn off the APU.

r. Release the locking lever and pull the steering mode control handle out and lock it in the "superstructure" position.

s. Place superstructure cab IGNITION Switch (56, Figure 5-2) to 3 (accessory) and turn on the APU. Then operate the FRONT AXLE STEERING Control (55) to straighten the front wheels.

t. Place superstructure cab IGNITION Switch (56) to 0 (off) and turn off the APU. Close the APU control box.

u. Verify that both superstructure and carrier cab IGNITION Switches (56, Figure 5-2) and (50, Figure 5-1) are in the 0 (off) position. Also verify that the battery disconnect switch is off.

5-12.16 Blackout Conditions. When driving the crane under blackout conditions, all normal carrier-controlled lighting, horn, and alarm circuits are disabled by placing the Blackout Lighting Control (16, Figure 5-1) in either blackout mode. When in the blackout mode, only the blackout park lights, blackout tail lights, blackout stop lights, blackout driving light, and carrier cab panel/instrument lights are lit. It is not possible to perform any craning operations in blackout conditions since all power to the superstructure cab is shut off.

5-13. NUCLEAR, BIOLOGICAL, AND CHEMICAL DECONTAMINATION PROCEDURES.

NOTE

The crane is equipped with a bracket for storing decontamination materials. The bracket is located on the left side of the vehicle just forward of the hydraulic tank.

a. The crane is capable of being operated by personnel wearing nuclear, biological, or chemical (NBC) protective clothing without special tools or support equipment. Refer to FM 3-5, NBC Decontamination for information on decontamination procedures. Specific procedures for the crane consist of the following:

b. All sealing gaskets, rubber sleeves, sound attenuation materials in the cabs, door and window gaskets, rubber tubing, coverings for electrical conduits, etc., will absorb and retain chemical agents. Replacement of these items is the recommended method of decontamination.

c. Lubricants and fuel may be present on the external surfaces of the crane or components due to leaks or normal operation. These fluids will absorb NBC agents. The preferred method of decontamination is removal of these fluids using conventional decontamination methods in accordance with FM 3-5.

d. Continued decontamination of external crane surfaces with supertropical bleach (STB) and decontaminating solution number 2 (DS2) will degrade clear plastic indicator coverings to a point where reading indicators will become impossible. This problem will become more evident for soldiers wearing protective masks. The use of STB and DS2 decontaminants in these areas should be minimized. Indicators should be decontaminated with warm, soapy water.

e. External surfaces of the crane that are marked with painted or stamped lettering will not withstand repeated decontamination with STB or DS2 without degradation of this lettering. The recommended method of decontamination for these areas is warm, soapy water.

f. Areas that will entrap contaminants, making efficient decontamination extremely difficult, include the following: space behind knobs and switches on the control panel, exposed heads of screws, areas adjacent to and behind exposed wiring conduits, hinged areas of access doors, spaces behind externally-mounted equipment data plates, retaining cords for external receptacle covers, door and access panel locking mechanisms, fuel cap, NATO slave receptacle, areas around tie-down/lifting points, crevices around access doors, and external screens covering ventilation areas. Replacement of these items, if possible, is the preferred method of decontamination. Conventional decontamination methods should be used on these areas, while stressing the importance of thoroughness and the probability of some degree of continuing contact and vapor hazard.

g. The use of overhead shelters or chemical protective covers is recommended as an additional means of protection against contamination in accordance with FM 3-5. If using covers, care should be taken to provide adequate space for air flow and exhaust.

h. For additional NBC information, refer to FM 3-3 and 3-4.

SECTION 6

MAINTENANCE INSTRUCTIONS

6-1. TROUBLESHOOTING.

SYMPTOM INDEX

TRANSMISSION

HYDRAULIC SYSTEM

DIESEL HEATER

Table 6-1 lists the common malfunctions which you may find during the operation or maintenance of the crane or its components. You should perform the tests/inspections and corrective actions in the order listed.

This manual cannot list all malfunctions that may occur, nor all test or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 6-1. Operator Troubleshooting

MALFUNCTION TEST OR INSPECTION	CORRECTIVE ACTION
1. ENGINE WILL NOT CRANK OR CRANKS SLOWLY.	
Step 1 .	Starting circuit connections loose or corroded.
	a. Inspect connections at starting motor. If tight and corrosion free, do step 2.
	b. Contact Organizational Maintenance to clean and tighten connections.
Step 2 .	Battery charge low.
	a. Contact Organizational Maintenance to charge/service batteries.
2. ENGINE HARD TO START OR WILL NOT START - EXHAUST SMOKE PRESENT.	
Step 1	Starting aid needed for cold weather.
	a. Use cold weather starting aid. Refer to paragraph 5-4.2. If engine does not start do step 2.
Step 2.	Intake air system restricted.
	a. Inspect air cleaner inlet hood. If OK, do step 3.
	b. Contact Organizational Maintenance to remove intake hood and air filter element. Replace air filter element and clean intake hood.
Step 3.	Fuel contaminated.
	a. Check fuel filter/water separator for contamination. Refer to PMCS in Section 5. If fuel OK, do step 4.
Step 4.	Contact Organizational Maintenance.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
3. ENGINE CRANKS, BUT WILL NOT START - NO SMOKE FROM EXHAUST.	
Step 1.	No fuel in tank.
	a. Check fuel level in tank. If OK, do step 2.
	b. Service fuel tank.
Step 2.	Fuel filter/water separator plugged with water.
	a. Drain fuel filter/water separator. Refer to PMCS in Section 5.
4. ENGINE STARTS BUT WILL NOT KEEP RUNNING.	
Step 1.	Fuel waxing due to cold weather.
	a. Drain fuel filter/water separator. Refer to PMCS in Section 5. If OK, do step 2.
	b. Contact Organizational Maintenance to drain fuel tank and service with cold weather fuel grade.
Step 2.	Fuel contaminated.
	a. Check fuel/filter water separator for contamination. Refer to PMCS in Section 5. If fuel OK, do step 3.
Step 3.	Contact Organizational Maintenance.
5. ENGINE WILL NOT SHUT OFF.	
	CAUTION Do not use the BATTERY DISCONNECT switch as an emergency stop switch. Moving the BATTERY DISCONNECT switch to off will not shut down the engine and could result in damage to the alternator.
Step 1 .	Fuel system malfunction.
	a. Set outriggers and shut down diesel engine. Disconnect fuel shutoff solenoid valve from fuel shutoff valve lever and manually move fuel shutoff valve lever clockwise to off position. Refer to emergency shutdown procedures, paragraph 5-12.9.
	b. Contact Organizational Maintenance.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
6. ROUGH IDLE, WARM ENGINE.	
Step 1.	Intake air system restricted.
	a. Inspect air cleaner inlet hood. If OK, do step 2.
	b. Contact Organizational Maintenance to remove intake hood and air filter element. Replace air filter element and clean intake hood.
Step 2.	Fuel contaminated.
	a. Check fuel filter/water separator for contamination. Refer to PMCS in Section 5. If fuel OK, do step 3.
Step 3.	Contact Organizational Maintenance.
7. ENGINE SURGES AT IDLE.	
Step 1.	Low fuel level in the fuel tank.
	a. Check fuel level in tank.
	b. Service fuel tank.
8. LOW LUBRICATING OIL PRESSURE.	
Step 1.	Incorrect oil level.
	a. Check engine oil level. If OK, do step 2.
	b. Add engine oil to correct level.
Step 2.	Oil diluted with water.
	a. Inspect for missing oil fill cap, dipstick, etc. If OK, do step 3.
	b. Contact Organizational Maintenance to drain and refill engine oil.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 3.	Oil leak due to loose or missing pipe plug.
	a. Check for external leak at rear of cylinder head, along fuel pump side of block, oil cooler cover and gear housing.
	b. Contact Organizational Maintenance.
9. LUBRICATING OIL PRESSURE TOO HIGH.	
Step 1.	Engine lubrication system malfunction.
	a. Contact Organizational Maintenance.
10. LUBE OIL LOSS.	
Step 1.	External leaks.
	a. Visually inspect for oil leaks. If no leaks, do step 2.
	b. Contact Organizational Maintenance.
Step 2.	Crankcase overfilled.
	a. Remove dipstick and check oil level. If OK, do step 3.
	b. Contact Organizational Maintenance to drain engine oil to proper level.
Step 3.	Engine lubrication system malfunction.
	a. Contact Organizational Maintenance.
11. CONTAMINATED ENGINE OIL.	
Step 1.	Engine lubrication system malfunction.
	a. Contact Organizational Maintenance.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
12. EXHAUST SMOKE EXCESSIVE UNDER LOAD.	
Step 1.	Engine overloaded.
	a. Downshift to lower gear.
Step 2.	Fuel system malfunction.
	a. Contact Organizational Maintenance.
13. ENGINE WILL NOT REACH RATED SPEED WHEN LOADED.	
Step 1.	Vehicle overloaded.
	a. Reduce load or downshift to lower gear.
Step 2.	Fuel system malfunction.
	a. Contact Organizational Maintenance.
14. LOW POWER.	
Step 1.	Vehicle overloaded.
	a. Reduce load or downshift to lower gear.
Step 2.	Engine oil level too high.
	a. Remove dipstick and check engine oil level. If OK, do step 3.
	b. Contact Organizational Maintenance to drain engine oil to proper level.
Step 3.	Transmission oil level low.
	a. Remove dipstick and check transmission oil level. If OK, do step 4. Refer to PMCS in Section 5.
	b. Fill to proper level.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 4.	Fuel system malfunction.
	a. Contact Organizational Maintenance.
15. ENGINE MISFIRING.	
Step 1.	Fuel system malfunction.
	a. Contact Organizational Maintenance.
16. FUEL KNOCK.	
Step 1.	Engine overloaded.
	a. Downshift to lower gear.
Step 2.	Fuel system malfunction.
	a. Contact Organizational Maintenance.
17. EXCESSIVE FUEL CONSUMPTION.	
Step 1.	Operator Technique.
	a. Review Section 5 - Operating Instructions. If OK, do step 2.
Step 2.	Fuel leak.
	a. Inspect for fuel leaks. If OK, so step 3.
	b. Contact Organizational Maintenance to repair leaks.
Step 3.	Fuel system malfunction.
	a. Contact Organizational Maintenance.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
18. EXCESSIVE VIBRATION.	
Step 1.	Engine drive component failure.
	a. Contact Organizational Maintenance.
19. EXCESSIVE ENGINE NOISES.	
Step 1.	Drive belt squeal, insufficient tension or abnormally high loading.
	a. Check belt tension and condition of drive belt. Refer to PMCS in Section 5.
	b. Contact Organizational Maintenance to replace drive belt or tensioner.
Step 2.	Defective engine.
	a. Contact Organizational Maintenance.
20. FUEL OR OIL LEAKING FROM EXHAUST MANIFOLD.	
Step 1.	Defective engine.
	a. Contact Organizational Maintenance.
21. COOLANT TEMPERATURE ABOVE NORMAL.	
Step 1.	Low coolant level.
	a. Check coolant level. If OK, do step 2.
	b. Service coolant system.
Step 2.	Radiator fins damaged or obstructed with debris.
	a. Inspect radiator fins for damage and debris. If OK, do step 3.
	b. Clean debris from radiator.
	c. Contact Organizational Maintenance.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 3.	Collapsed radiator hose.
	a. Inspect upper and lower radiator hoses. If OK, do step 4.
	b. Contact Organizational Maintenance to replace radiator hose(s).
Step 4.	Engine oil level too high or too low.
	a. Remove dipstick and check engine oil level. If OK, do step 5.
	b. Add engine oil to proper level.
	c. Contact Organizational Maintenance to drain engine oil to proper level.
Step 5.	Loose fan drive belt.
	a. Inspect fan drive belt and belt tensioner. Refer to PMCS in Section 5. If OK, do step 6.
	b. Contact Organizational Maintenance to replace fan drive belt and/or tensioner.
Step 6.	Engine overloaded.
	a. Reduce load or downshift to lower gear.
Step 7.	Defective engine.
	a. Contact Organizational Maintenance.
22. COOLANT LOSS.	
Step 1.	Radiator leaking coolant.
	a. Visually inspect radiator hoses and connections to locate leak. If OK, do step 2.
	b. Contact Organizational Maintenance to replace radiator components.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 2.	External engine leaks.
	a. Visually inspect engine and components for seal or gasket leaks.
	b. Contact Organizational Maintenance to repair leaks.
23. COOLANT TEMPERATURE BELOW NORMAL.	
Step 1.	Short runs and intermittent driving.
	a. Allow engine to warm up properly.
Step 2.	Temperature sensor or gauge malfunction.
	a. Contact Organizational Maintenance.
24. CONTAMINATED COOLANT.	
Step 1.	Coolant system malfunction.
	a. Contact Organizational Maintenance to repair coolant system.
25. ALTERNATOR NOT CHARGING OR INSUFFICIENT CHARGING.	
Step 1.	Loose or corroded battery connections.
	a. Inspect battery connection. If OK, do step 2.
	b. Contact Organizational Maintenance to clean or tighten battery connections.
Step 2.	Fan drive belt slipping.
	a. Inspect fan drive belt tensioner by hand. Refer to PMCS in Section 5. If OK, do step 3.
	b. Contact Organizational Maintenance to replace fan drive belt and/or tensioner.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 3.	Alternator pulley loose on shaft.
	a. Inspect alternator pulley. If OK, do step 4.
	b. Contact Organizational Maintenance to tighten alternator pulley.
Step 4.	Charging system malfunction.
	a. Contact Organizational Maintenance.
26. CRANE WILL NOT MOVE OR MOVES ERRATICALLY (TRANSMISSION FAILURE).	
Step 1.	Low transmission oil level.
	a. Remove dipstick and check transmission oil level. If OK, do step 2. Refer to PMCS in Section 5.
	b. Fill to proper level.
Step 2.	Transmission shift lever at N-Neutral.
	a. Check position of transmission shift lever.
Step 3.	Defective transmission.
	a. Contact Organizational Maintenance.
27. TRANSMISSION OIL TEMPERATURE ABOVE NORMAL.	
Step 1.	Low transmission oil level.
	a. Remove dipstick and check oil level. Refer to PMCS in Section 5. If OK, do step 2.
	b. Fill to proper level.
Step 2.	Transmission not down shifting properly.
	a. Manually shift to lower gear.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 3.	Defective transmission.
	a. Contact Organizational Maintenance.

28. NO CRANE FUNCTIONS (LIFT, HOIST, SWING, TELESCOPE).

Step 1.	Hydraulic pump disconnect control not properly engaged.
	a. Engage hydraulic pump disconnect control.
Step 2.	Hydraulic oil low.
	a. Check hydraulic oil level in reservoir. Refer to PMCS in Section 5.
	b. Service hydraulic reservoir.

29. HARD TO STEER OR STEERING ERRATIC.

Step 1.	Hydraulic oil low.
	a. Check hydraulic oil level in reservoir. Refer to PMCS in Section 5. If OK, do step 2.
	b. Service hydraulic reservoir.
Step 2.	Steering system failure.
	a. Contact Organizational Maintenance.

30. SLOW OR ERRATIC OPERATION OF OUTRIGGER CYLINDERS.

Step 1.	Low hydraulic oil.
	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 2.
	b. Service hydraulic reservoir.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 2.	Cylinder rods or outrigger beams dirty.
	a. Clean cylinder rods or outrigger beams.
Step 3.	Outrigger system malfunction.
	a. Contact Organizational Maintenance.

31. OUTRIGGER SYSTEM WILL NOT ACTIVATE.

Step 1.	Hydraulic oil low.
	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 2.
	b. Service hydraulic reservoir.
Step 2.	Outrigger system malfunction.
	a. Contact Organizational Maintenance.

32. OUTRIGGER SYSTEM ACTIVATES, BUT SELECTED OUTRIGGER WILL NOT RETRACT OR EXTEND AND LOWER AS DESIRED.

Step 1.	Outrigger system malfunction.
	a. Contact Organizational Maintenance.

33. BOOM RAISES OR LOWERS ERRATICALLY.

Step 1.	Hydraulic oil low.
	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 2.
	b. Service hydraulic reservoir.
Step 2.	Low engine rpm.
	a. Increase engine rpm.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 3.	Hydraulic system failure.
	a. Contact Organizational Maintenance.
34. BOOM RAISES OR LOWERS SLOWLY.	
Step 1.	Low hydraulic oil.
	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 2.
	b. Service hydraulic reservoir.
Step 2.	Low engine rpm.
	a. Increase engine rpm.
Step 3.	Cold hydraulic oil.
	a. Operate crane to bring oil to operating temperature.
Step 4.	Hydraulic system failure.
	a. Contact Organizational Maintenance.
35. BOOM WILL NOT RAISE OR LOWER.	
Step 1.	Low hydraulic oil.
	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 2.
	b. Service hydraulic reservoir.
Step 2.	Excessive load.
	a. Reduce load as required.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 3.	Hydraulic system failure.
	a. Contact Organizational Maintenance.

36. ERRATIC OPERATION OF TELESCOPE CYLINDER.

Step 1.	Low hydraulic oil.
	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 2.
	b. Service hydraulic reservoir.
Step 2.	Low engine rpm.
	a. Increase engine rpm.
Step 3.	Air in telescope cylinder.
	a. Lower boom so telescope cylinder is below horizontal and cycle cylinder.
Step 4.	Lack of lubrication on boom section.
	a. Lubricate boom sections. Contact Organizational Maintenance.
Step 5.	Side loading causing improper boom alignment.
	a. Reduce load. Use proper hoisting procedures.
Step 6.	Hydraulic system failure.
	a. Contact Organizational Maintenance.

37. TELESCOPE CYLINDER WILL NOT EXTEND OR RETRACT.

Step 1.	TELE/CLAMSHELL selector switch in CLAMSHELL position.
	a. Ensure TELE/CLAMSHELL selector switch (10, Figure 5-2) is in TELE position.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 2.	Low hydraulic oil level.
	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 3.
	b. Service hydraulic reservoir.
Step 3.	Excessive load.
	a. Reduce load.
Step 4.	Hydraulic system failure.
	a. Contact Organizational Maintenance.

38. HOIST WILL NOT RAISE LOAD.

Step 1.	If auxiliary hoist, AUX HOIST ON/OFF selector switch in OFF position.
	a. Ensure AUX HOIST ON/OFF selector switch (19, Figure 5-2) in ON position.
Step 2.	Load capacity exceeded.
	a. Reduce load.
Step 3.	Low hydraulic oil.
	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 4.
	b. Service hydraulic reservoir.
Step 4.	Too much cable on hoist drum.
	a. Reduce amount of cable on drum (line pull increases).
Step 5.	Hydraulic system failure.
	a. Contact Organizational Maintenance.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION	CORRECTIVE ACTION
39. HOIST WILL NOT LOWER LOAD.	
Step 1. If auxiliary hoist, AUX HOIST ON/OFF selector switch in OFF position.	a. Ensure AUX HOIST ON/OFF selector switch (19, Figure 5-2) in ON position.
Step 2. Malfunctioning hoist brake.	a. Contact Organizational Maintenance.
40. SLOW OR ERRATIC HOIST OPERATION.	
Step 1. Low engine rpm.	a. Increase rpm.
Step 2. Low hydraulic oil.	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 3. b. Service hydraulic reservoir.
Step 3. Hydraulic system failure.	a. Contact Organizational Maintenance.
41. BOOM SWING OPERATIONS ERRATIC IN EITHER DIRECTION.	
Step 1. Low engine rpm.	a. Increase rpm.
Step 2. Low hydraulic oil.	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 3. b. Service hydraulic reservoir.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 3.	Insufficient lubricant on swing bearing.
	a. Inspect swing bearing. Lubricate bearing. Contact Organizational Maintenance.
Step 4.	Crane not level.
	a. Level crane using outriggers.
Step 5.	Crane overloaded.
	a. Reduce load.
Step 6.	Swing system failure.
	a. Contact Organizational Maintenance.
42. SWING BRAKE SYSTEM WILL NOT OPERATE.	
Step 1.	Low hydraulic oil.
	a. Check hydraulic oil level. Refer to PMCS in Section 5. If OK, do step 2.
	b. Service hydraulic reservoir.
Step 2.	Swing system failure.
	a. Contact Organizational Maintenance.
43. DIESEL HEATER FAILS TO START - MOTOR DOES NOT RUN.	
Step 1.	Blown fuse.
	a. Check fuse in heater control panel. If OK do Step 2.
	b. Replace fuse with spare.
Step 2.	Diesel heater failure.
	a. Contact Organizational Maintenance.

Table 6-1. Operator Troubleshooting (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
44. DIESEL HEATER FAILS TO START - MOTOR RUNS.	
Step 1.	Improper starting procedure.
	a. Review starting procedures, refer to Section 5.
Step 2.	Heater fuel tank empty.
	a. Check fuel tank. If OK, do Step 3.
	b. Service tank with diesel fuel.
Step 3.	Diesel heater failure.
	a. Contact Organizational Maintenance.

6-2. INSTALLING CABLE ON THE HOIST.

WARNING

Wear heavy gloves and safety glasses when working with the hoist cable. Failure to follow this warning could result in personal injury.

CAUTION

If cable is wound from the storage reel onto the drum, the reel should be rotated in the same direction as the hoist.

NOTE

The cable should preferably be straightened before installation on the hoist drum.

Install cable on the hoist drum using Figure 6-3 and the following procedures.

a. Position the cable over the boom nose sheave and route to the hoist drum.

b. Position the hoist drum with the cable anchor slot on top, (Figure 6-3).

c. Insert the cable through the slot and position around the anchor wedge.

NOTE

The end of the cable should be even with the bottom of the anchor wedge.

d. Position the anchor wedge in the drum slot; pull firmly on the free end of the cable to secure the wedge.

NOTE

If the wedge does not seat securely in the slot, carefully tap the top of the wedge with a mallet.

e. Slowly rotate the drum, ensuring the first layer of cable is evenly wound onto the drum.

f. Install the remainder of the cable, as applicable.

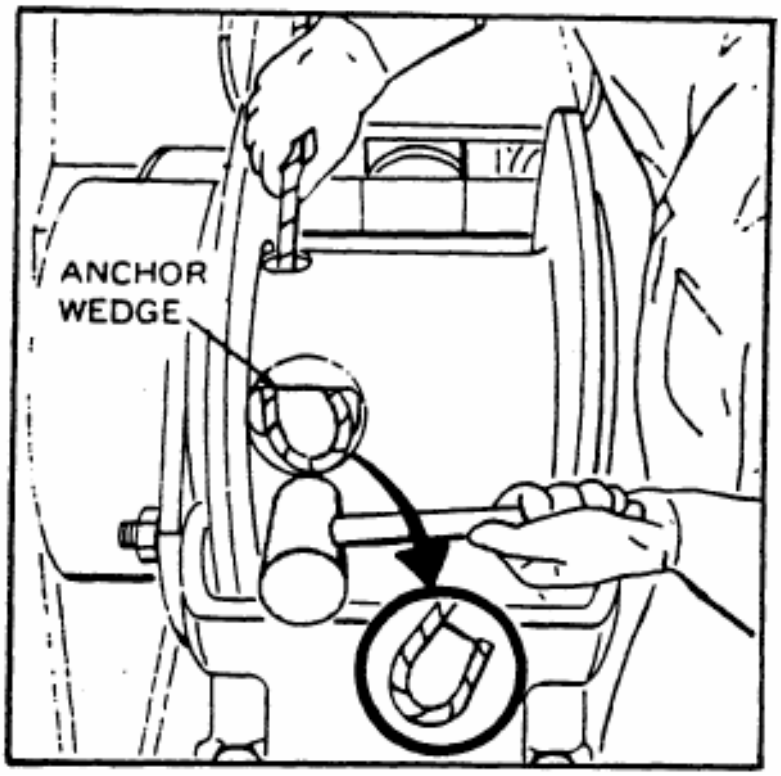


Figure 6-3. Installing Cable Anchor Wedge

6-3. CABLE REEVING.

Within the limits of the load and range charts and permissible line pull, multi-part lines allow the operator to raise a greater load then can be raised with a single part line. This reeving should be accomplished by a qualified rigger using standard rigging procedures.

Figure 6-4 illustrates cable reeving for the AT422T which includes routing the cable over the upper boom nose sheave (1), lower boom nose sheave (2), hook block sheave (3), and lower boom nose sheave (4) with the cable terminating at the wedge socket (5). Figure 6-5 shows 3-sheave boom nose reeving.

6-4. INSTALLING WEDGE AND SOCKET.

WARNING

Use only a wedge and socket of the correct size for the wire rope (cable) fitted. Failure to do so may result in the rope pulling through the fitting.

Make sure the live-loaded side of the cable is in line with the ears of the socket as shown in Figure 6-6. If the wire rope is loaded incorrectly, it will bend under a load as it leaves the socket. The edge of the socket will eventually wear into the rope causing damage and failure.

a. Inspect the wedge and socket. Remove rough edges and burrs.

LEGEND

1. Upper Boom Nose Sheave
2. Lower Boom Nose Sheave No. 1
3. Hook Block Sheave
4. Lower Boom Nose Sheave No. 2
5. Hook Block Sheave
6. Wedge Socket Anchored on Boom Nose

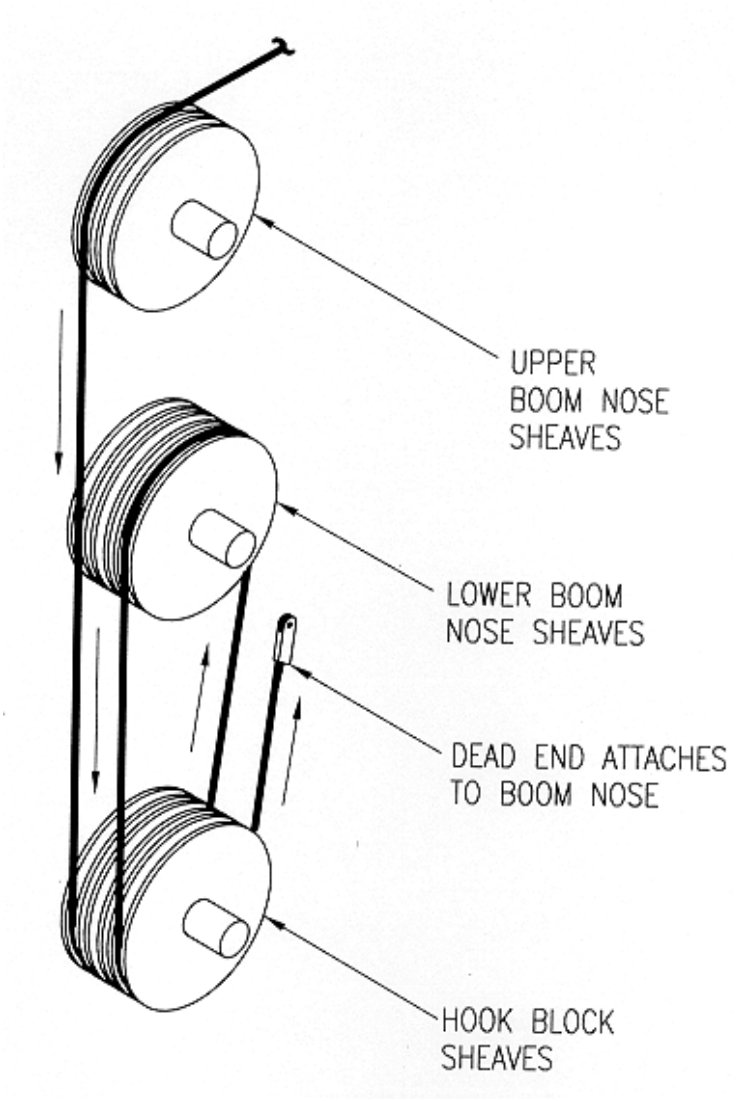


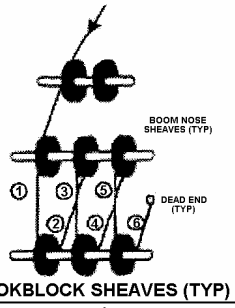
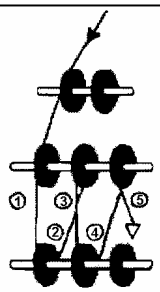
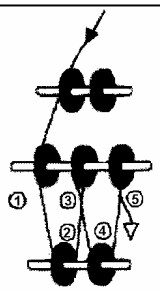
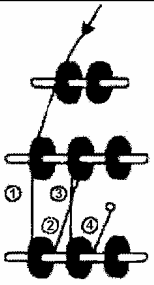
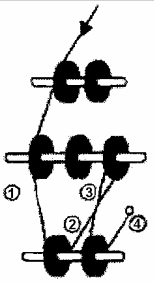
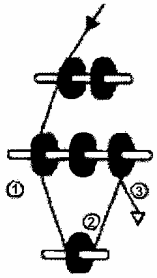
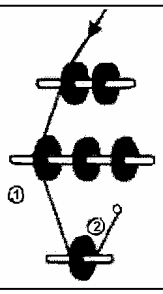
Figure 6-4. Boom Nose and Hook Block Cable Reeving

b. If the wire rope is welded, cut the welded end off. This will allow distortion in the rope strands to adjust themselves at the end of the line.

c. Insert wire rope into socket as shown in Figure 6-6 until the end of the rope extends approximately six to nine inches (15 to 23 cm) from the socket.

d. Place wedge in socket.

e. Seize the wire rope at the dead end by wrapping it with wire as shown. Place a wire rope u-bolt clip around the dead end and clamp it to the wedge as shown. DO NOT CLAMP THE LIVE END. The u-bolt should bear against the dead end with the saddle of the clip resting against dead end as shown. Ensure clamp is not resting on the seizing. Torque the u-bolts in accordance with Table 6-2.

OPT. EQUIP	PARTS OF LINE	BOOM NOSE SHEAVES		HOOKBLOCK		
		UPPER	LOWER	3 SHEAVES	2 SHEAVES	1 SHEAVES
	6	2	3			
	5	2	3			
	4	2	3			
	3	2	3			
	2	2	2			

NOTE:

This reeving diagram is to be used only as a guide for reeving hook block with multiple parts of line. Correct hook block reeving is vitally important for safe crane operation and is the responsibility of the crane operator to ensure safe reeving practices are followed.

Refer to Load Chart for line pull and reeving.

M Denotes cable dead end on boom nose.

▼ Denotes cable dead end on hook block

Ψ Denotes cable dead end on swingaway.

Figure 6-5. 3-Sheave Boom Nose Reeving

Table 6-2 Wire Rope Clip Torque Chart

Clip Size (Inches)	Torque (lb-ft, dry)	Clip Size (Inches)	Torque (lb-ft, dry)
1/8	3	5/8	75
3/16	4.5	3/4	75
1/4	15	7/8	130
5/16	15	1	130
3/8	30	1-1/8	200
7/16	40	1-1/4	200
1/2	45	1-3/8	360
9/16	50	1-1/2	360

f. Secure ears of socket to a sturdy support. Pull wedge and rope into position with tension on the live side of the wire rope sufficiently tight enough to hold them in place.

g. After final pin connections are made, increase loads gradually until wedge is properly seated.

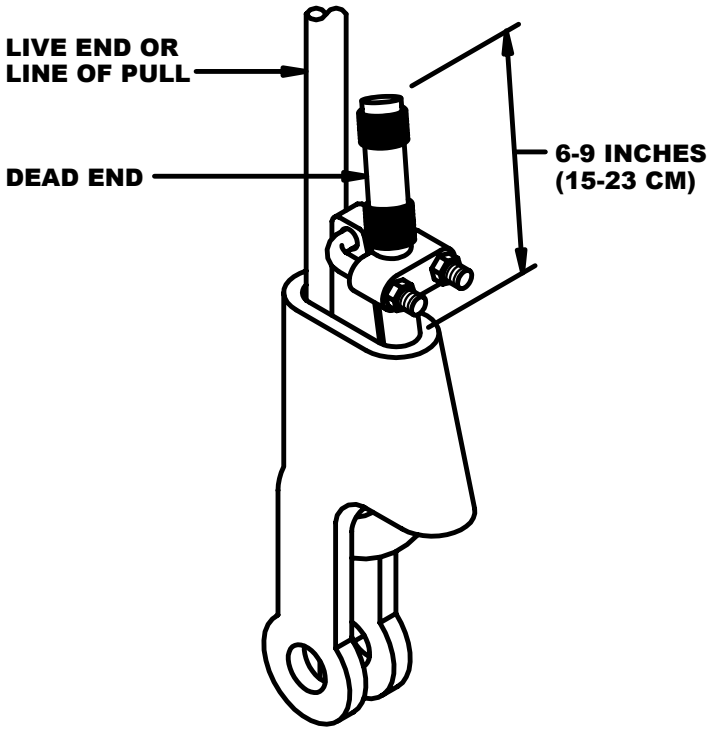


Figure 6-6. Dead-End Rigging/Wedge Socket

6-5 TRAINING THE CABLE ("BREAK-IN")

WARNING

Wear heavy gloves and safety glasses when working with the hoist cable. Failure to follow this warning could result in personal injury.

To avoid injury to personnel, always stand clear of cable when operating the boom.

CAUTION

For proper operation of the cable, ensure the following steps have been taken.

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 (never use a steel hammer) to tap rope in place.

Spool multiple layers with sufficient tension. It is 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.)

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.

Attach rope's end to drum. Pull the rope over the point sheave and attach the end to the drum. Before making any end attachment, be sure the rope strands are free to adjust. (In other words, make sure the rope is not welded together.)

Wind rope onto drum slowly and carefully; keeping each layer tight.

When paying out the rope, always leave a minimum of three wraps on the drum for safety to help prevent pulling the rope through the wedge.

a. With boom raised, attach light load (up to 10% of capacity) at hook and raise it a few inches off the ground. Allow to stand for several minutes.

b. Cycle load between full UP and DOWN positions several times. Watch the drum as the rope winds onto it to ensure uniformity and tightness. Do not allow gaps between windings.

c. Increase load to 50% capacity and repeat steps a and b.

d. Increase load to full capacity and repeat steps a and b.

6-5. PREPARATION FOR TOWING.

NOTE

Maximum towing speed with the drive shaft(s) installed is 2 mph (3 kmh) for a maximum of 6 miles (10 K). Maximum towing speed with both drive shafts removed is 20 mph (32 kph).

a. Engage swing lock pin with SWING LOCK lever (49, Figure 5-2) with boom over the front. Then lower boom onto its cradle. Engage positive swing lock handle (6). Place SWING BRAKE ON/OFF switch (18) in ON position.

b. Connect tow bar of tow vehicle to crane towing lugs on rear of vehicle.

c. Connect safety chains from towing vehicle to crane rear tiedown lugs.

d. From carrier cab, pull PARK BRAKE control knob (45, Figure 5-1) to set crane parking brakes. Ensure towing vehicle parking brake is also set.

e. Ensure transmission shift lever (6) is in N (neutral). Ensure DIFFERENTIAL LOCK switch (31) is in the center (unlocked) position.

f. If engaged, disengage main hydraulic pump with pump disconnect control (5).

g. Straighten both front and rear wheels. Ensure REAR STEER DIRECTION (49) in carrier cab indicates that rear wheels are centered. If necessary, ensure FRONT AXLE STEERING indicator (55, Figure 5-2) in superstructure cab indicates that front wheels are centered.

h. Ensure REAR AXLE STEERING LOCK switch (47, Figure 5-1) is in the LOCKED position.

NOTE

Skip the next step if the crane is to be towed for less than 6 miles (10 k), and towing speed will not exceed 2 mph (3 kph).

i. Remove front axle drive shaft. Refer to the -24-1-1 Service Manual.

j. Disconnect the rear axle drive shaft at the rear axle differential end and secure on stowage bracket. Refer to -24 Service Manual.

k. If towing vehicle has a 120 psi (827 kPa) maximum auxiliary air supply, connect air hose to AUX AIR IN connection at rear of crane. Charge crane air system using the auxiliary air supply.

l. Release crane parking brake by depressing PARK BRAKE control knob (45, Figure 5-1) or if no auxiliary air supply is available, cage the rear axle air brake chamber springs to release the parking brake.

m. If set for carrier steering, raise the lock lever and pull out the handle for superstructure cab steering. Lower the lock lever to lock the control cable handle in place.

6-6. INSTALLING THE HEADACHE BALL.

WARNING

Wear heavy gloves, safety glasses, and steel-toed protection while working with the hoist cable. Failure to follow this warning could result in personal injury.

WARNING

The headache ball is used for single part line, light load operation only. Be sure to subtract the weight of the headache ball (150 pounds) from the lift weight shown on the Load Chart. Failure to adhere to this warning could cause damage to equipment and/or injury to personnel. Refer to the Load Chart, Appendix E, for proper weight limitation.

Use only a wedge socket of the correct size for the wire rope fitted. Failure to do so may result in the rope pulling through the fitting.

Ensure that the live (loaded) side of the wire rope is in line with the ears of the socket as shown. If the rope is loaded incorrectly, it will bend under a load as it leaves the socket. The edge of the socket will eventually wear into the rope causing damage and failure.

a. Rig crane for single part line. Refer to paragraph 6-3. Install wedge and socket on dead end of wire rope. Refer to paragraph 6-4.

WARNING

Use caution when lifting the headache ball. It weighs approximately 150 pounds (68.1 kg). Failure to follow this warning could result in personal injury.

b. Align hole in headache ball (1, Figure 6-7) with holes in wedge and socket (2) and secure with pin (3). Install new cotter pin (4).

WARNING

The anti-two block weight must be installed on the hoist cable and the anti-two block switch must be operational before using the headache ball. Failure to ensure that the anti-two block system is operational could result in damage to equipment and/or injury to personnel.

NOTE

The anti-two block system consists of a weight suspended on a chain attached to a limit switch mounted on the boom nose weldment. The system also features a relay, buzzer, and warning light. The buzzer and light are mounted on the cab console.

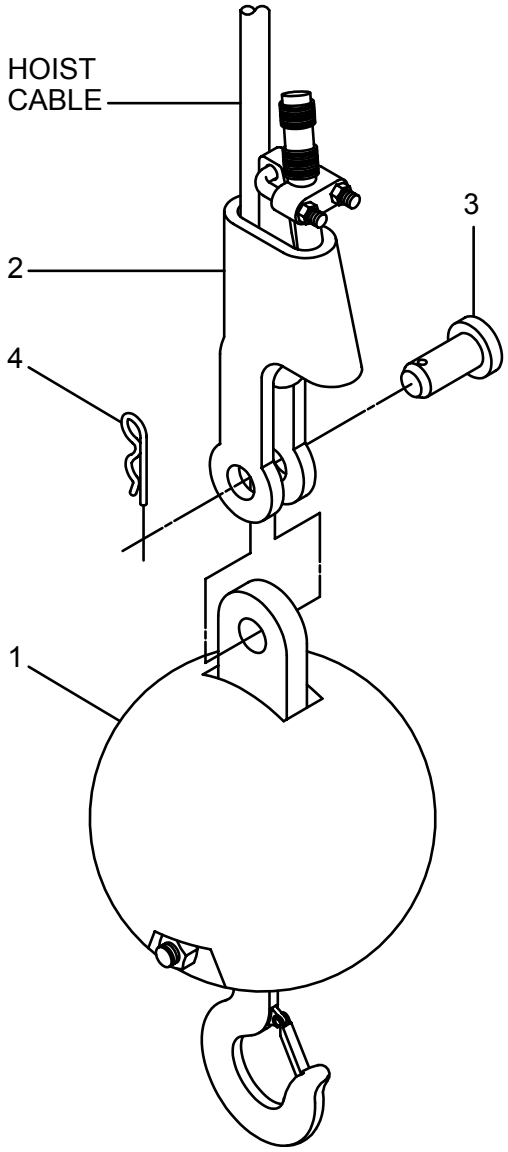


Figure 6-7. Headache Ball Installation

NOTE

When the headache ball moves close to the bottom boom nose sheave, it makes contact with and lifts the anti-two block weight (Figure 6-8). When the weight is lifted, it releases a spring-held limit switch that locks out further upward movement of the headache ball, thus preventing physical contact between the headache ball and the lower boom nose sheave. The headache ball can be lowered away from the boom nose sheave.

c. Install anti-two block weight by placing two weight halves around the hoist cable. Insert cotter pins to join the two halves.

d. Attach a light load to headache ball.

e. Raise load to seat the wedge in its socket. Refer to paragraph 6-3.

f. Remove the load.

6-7. REMOVING THE HEADACHE BALL.

a. Lower headache ball until it rests on the ground. Allow enough slack in the hoist cable to permit headache ball removal.

b. Remove the anti-two block weight by removing the cotter pins that secure the two halves.

c. Remove cotter pin (4, Figure 6-7), pin (3), and wedge and socket (2) from headache ball (1).

d. Remove the wedge and socket (2) from the hoist cable.

WARNING

Use caution when lifting the headache ball. It weighs approximately 150 pounds (68.1 kg). Failure to follow this warning could result in personal injury.

e. Stow headache ball in the ATEC toolbox.

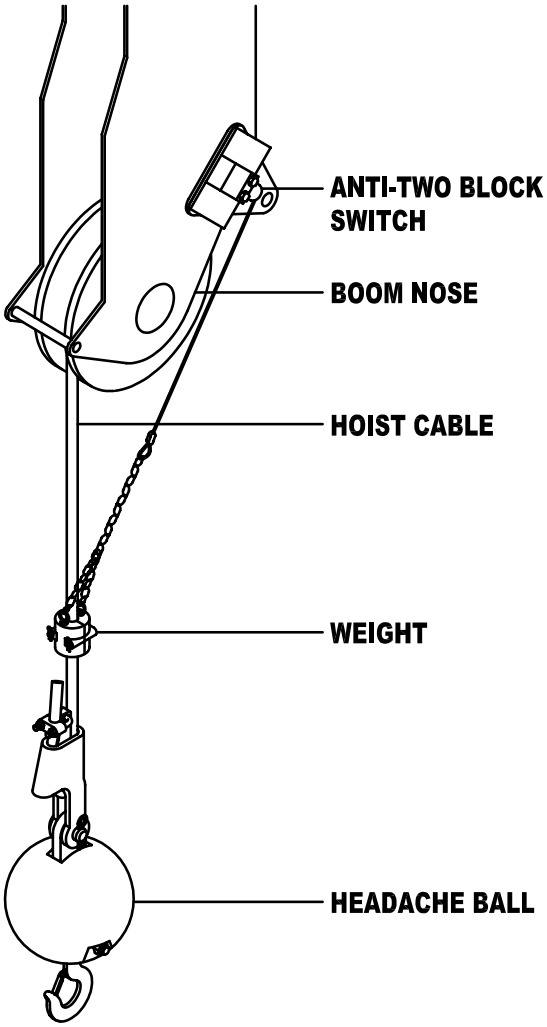


Figure 6-8. Anti-two Block Switch

APPENDIX A

REFERENCES

A-1. SCOPE

This appendix lists all forms and publications that are referenced in this manual.

A-2. PAMPHLETS

DA Pam 25-30	Consolidated Index of Army Publications and Blank Forms
DA Pam 750-8	The Army Maintenance Management System (TAMMS)

A-3. FORMS

DA Form 2404	Equipment Inspection and Maintenance Worksheet
DA Form 2028	Recommended Changes to Publications and Blank Forms
SF 361	Transportation Discrepancy Report
SF 364	Report of Discrepancy (ROD)
SF 368	Product Quality Deficiency Report

A-4. TECHNICAL MANUALS/BULLETINS

TM 43-0139	Painting Instructions for Field Use
TB 5-3810-307-14	Warranty Technical Bulletin, All-Terrain Crane (ATEC) DED, 22-Ton Capacity, Truck Mounted With Cab

A-5. FIELD MANUALS

FM 3-3	NBC Contamination Avoidance
FM 3-4	NBC Protection
FM 3-5	NBC Decontamination
FM 4-25.11	First Aid

A-6. MISCELLANEOUS PUBLICATIONS

CTA 50-970	Expendable Items (Except: Medical, Class V, Repair Parts and Heraldic Items)
MWO 5-3810-307-20-1	Maintenance Work Order All-Terrain Crane, AT422T

APPENDIX B

COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

Section I. INTRODUCTION

B-1. SCOPE

This appendix lists components of end item and basic issue items for the All-Terrain Crane (ATEC) to help you inventory items required for safe and efficient operation.

B-2. GENERAL

The components of end item and basic issue items lists are divided into the following sections.

a. Section II. Components of End Item

This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation and shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

b. Section III. Basic Issue Items

These are the minimum essential items required to place the ATEC in operation, to operate it, and perform emergency repairs. Although shipped separately, packaged BII must be with the crane during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard to identify items. This manual is your authority to request/requisition replacement BII, based on TOE/MTOE authorization of the end item.

B-3. EXPLANATION OF COLUMNS

The following provides an explanation of columns found in the tabular listings.

a. Column (1) - Illustration Number (Illus No.)

This column indicates the number of the illustration in which the item is shown.

b. Column (2) - National Stock Number

Indicates the national stock number assigned to the item and will be used for requisitioning purposes.

B-3. EXPLANATION OF COLUMNS - Continued

c. Column (3) - Description (Description (CAGE) and Part Number)

Indicates the national item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the Commercial and Government Entity (CAGE) Code (in parentheses) followed by the part number.

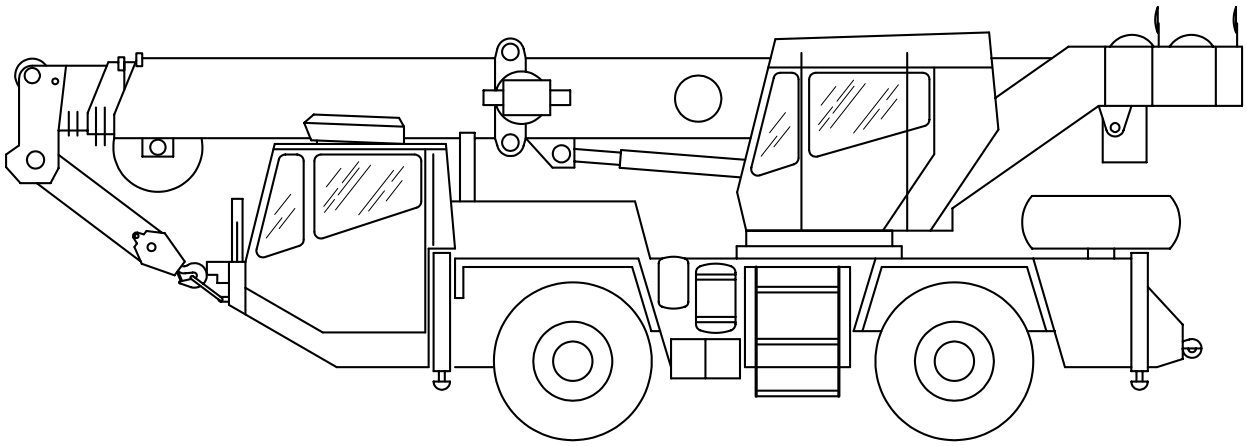
d. Column (4) - Unit of Measure (U/M)

Indicates the measure used in performing the actual operational/maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., EA, IN, PR).

e. Column (5) - Quantity Required (Qty Reqd)

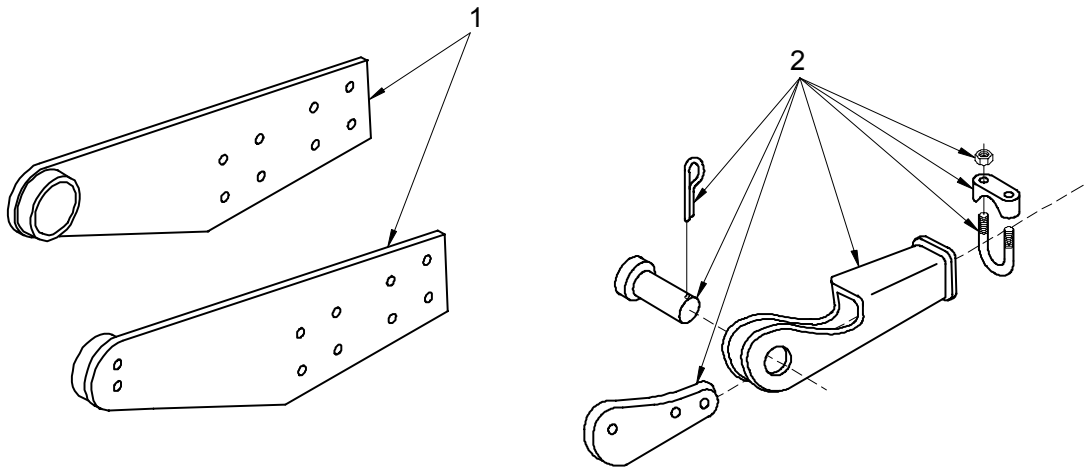
Indicates the quantity of the item authorized to be used with/on the equipment.

Section II. COMPONENTS OF END ITEM - All-Terrain Crane (ATEC) AT422T



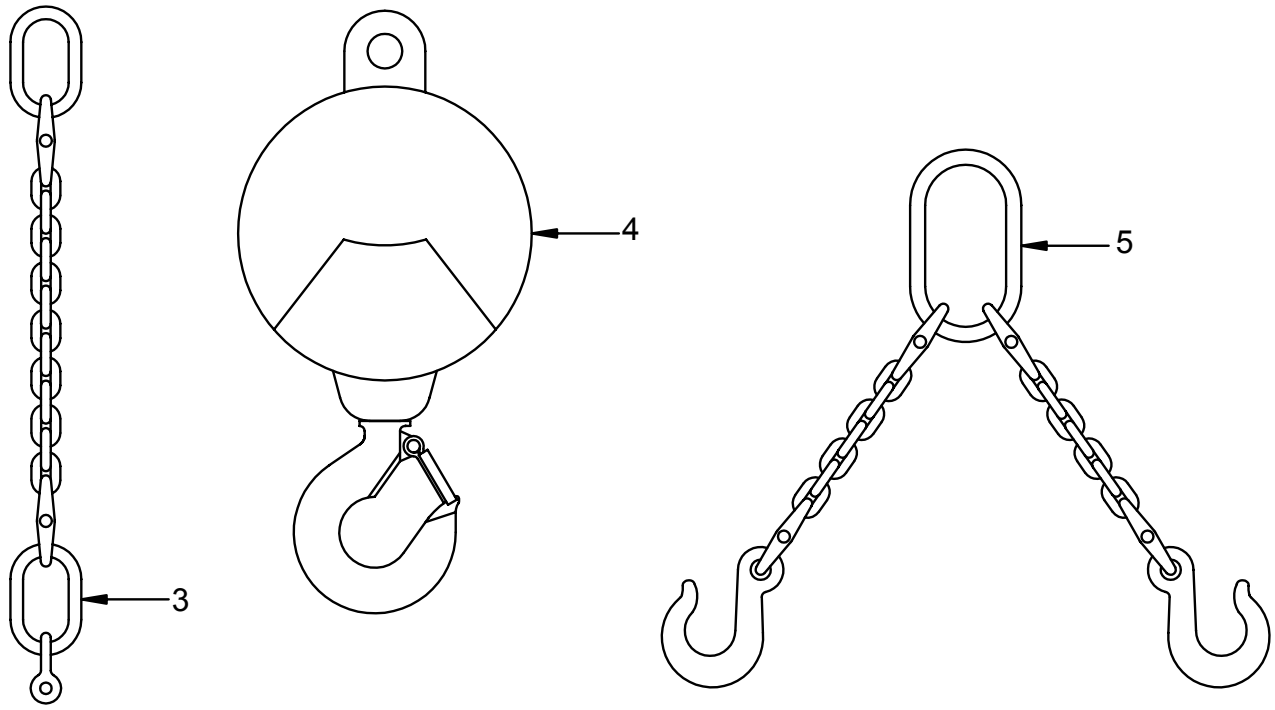
(1) Illus. No.	(2) National Stock Number	(3) Description (CAGE) and Part Number	Usable On Code	(4) U/M	(5) Qty Reqd
	3810-01-448-2619	All-Terrain Crane (ATEC), (12361) 1-1-40-0-00513		EA	1

Section II. COMPONENTS OF END ITEM - All-Terrain Crane (ATEC) AT422T - Continued



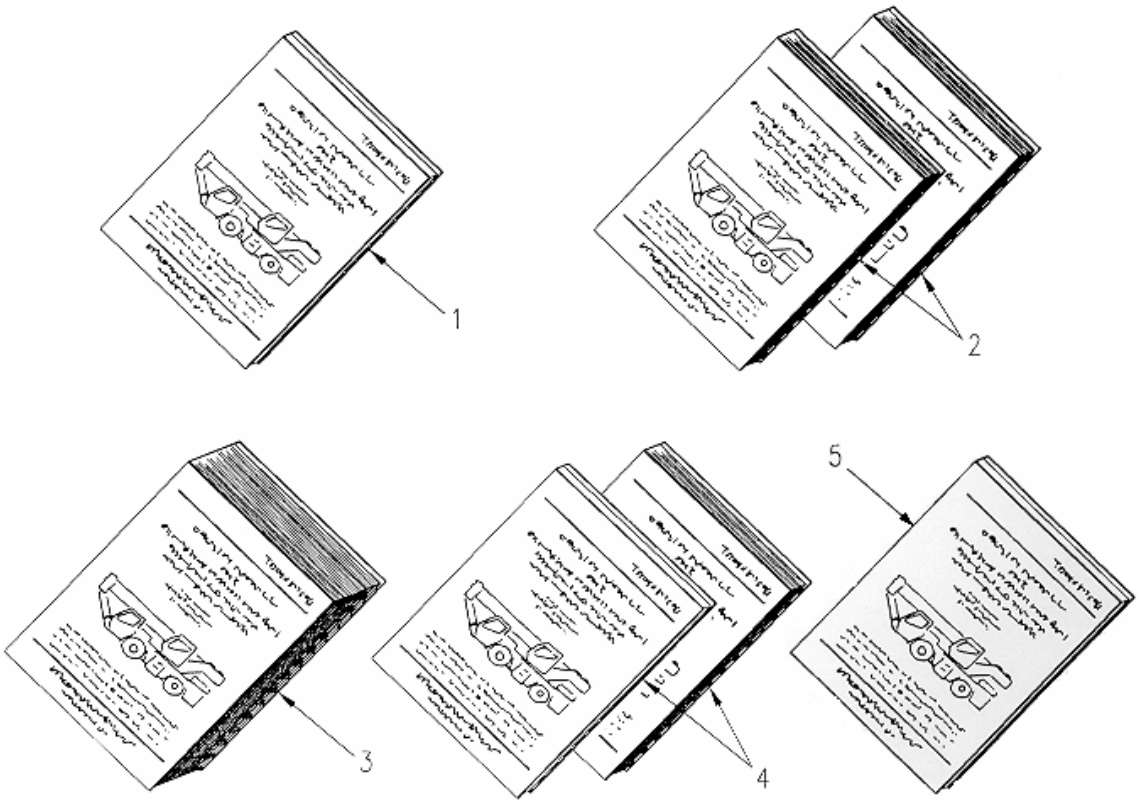
(1) Illus. No.	(2) National Stock Number	(3) Description (CAGE) and Part Number	Usable On Code	(4) U/M	(5) Qty Reqd
1		Pile Driver Attachments			1
	3815-01-534-4276	(12361) 2140900808 (Right)		EA	1
	3815-01-534-4274	(12361) 2140900809 (Left)		EA	
2	4030-01-450-8807	5/8” Wedge and Socket Assy (75535) 1035027 ((12361) 7826000640)		EA	2

Section II. COMPONENTS OF END ITEM - All-Terrain Crane (ATEC) AT422T - Continued



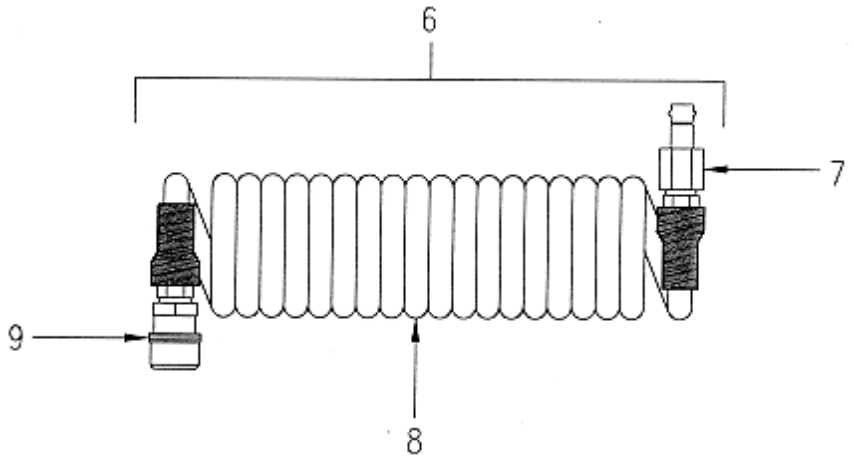
(1) Illus. No.	(2) National Stock Number	(3) Description (CAGE) and Part Number	Usable On Code	(4) U/M	(5) Qty Reqd
3	4010-01-534-4020	Sling Assembly (12361) 7286000745		EA	1
4	3940-01-534-4060	Headache Ball (12361) 6052000547		EA	1
5	3940-01-534-4040	Sling Assembly (Spare Tire) (12361) 7286000735		EA	1

Section III. BASIC ISSUE ITEMS



(1) Illus. No.	(2) National Stock Number	(3) Description (CAGE) and Part Number	Usable On Code	(4) U/M	(5) Qty Reqd
1		Operators Manual, TM 5-3810-307-10		EA	2
2		Organizational, Direct and General Support Maintenance Manual, TM 5-3810-307-24-1-1		EA	2
		Organizational, Direct and General Support Maintenance Manual, TM 5-3810-307-24-1-2		EA	2
3		Commercial Parts Manual TM 5-3810-307-24P		EA	2
4		Diesel Engine Operator's Manual TM 5-3810-307-24-2-1		EA	2
		Organizational, Direct and General Support for Engine Maintenance Manual TM 5-3810-307-24-2-2		EA	2
5		Warranty Technical Bulletin, TB 5-3810-307-14		EA	2

Section III. BASIC ISSUE ITEMS - Continued



(1) Illus. No.	(2) National Stock Number	(3) Description (CAGE) and Part Number	Usable On Code	(4) U/M	(5) Qty Reqd
6		Tire Inflation Kit (Not available as an assembly, order each part):		EA	1
7	4730-00-068-5679	Nipple (01276) FD40-1013-04-04		EA	1
8	4720-01-477-6720	Hose Assembly, Coiled Air (12361) 7543003444		EA	1
9	4730-01-185-9660	Chuck, Air (12361) 7926001001		EA	1

APPENDIX C

ADDITIONAL AUTHORIZATION LIST

Section I. INTRODUCTION

C-1. SCOPE

This appendix lists additional items you are authorized for the support of the ATEC.

C-2. GENERAL

The list identifies items that do not have to accompany the crane and that do not have to be turned in with it. These items are all authorized to you by CTA, MTOE, TDA, or JTA.

C-3. EXPLANATION OF LISTING

The following provides an explanation of columns found in the tabular listings.

a. Column (1) - National Stock Number

Indicates the national stock number assigned to the item and will be used for requisitioning purposes.

b. Column (2) - Description (Description (CAGE) and Part Number)

Indicates the national item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the Commercial and Government Entity (CAGE) Code (in parentheses) followed by the part number.

c. Column (3) - Unit of Measure (U/M)

Indicates the measure used in performing the actual operational/maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., EA, IN, PR).

d. Column (4) - Quantity Required (Qty Reqd)

Indicates the quantity of the item authorized to be used with/on the equipment.

Section II. ADDITIONAL AUTHORIZATION LIST - All-Terrain Crane (ATEC) AT422T

(1) National Stock Number	(2) Description (CAGEC) and Part Number	(3) U/M	(4) Qty Reqd
	OPERATOR		
7520-00-559-9618	Bag, Pamphlet	EA	1
4240-00-052-3776	Goggles, Eye Protection	PR	2
5120-00-061-8546	Hammer, Hand (58536) A-A-3105	EA	1
8415-00-889-3767	Helmet, Construction	EA	2
6545-00-912-1200	Kit, First Aid	EA	1
5120-01-335-1457	Punch, Tapered (55719) 1816A	EA	1
	MAINTENANCE		
	Air Compressor Seat Socket (12361) 9414101386	EA	1
	Assembly Sleeve for Thrust Ring (12361) 9049111057	EA	1
	Camshaft Gear Installation Kit (12361) 9414101416	EA	1
	Connecting Rod Checking Mandrel Kit (C) (12361) 9414101451	EA	1
	Connecting Rod Pin Bushing/Remover Tool (12361) 9414101433	EA	1
	Cup Plug Driver (12361) 9414101390	EA	1
	Cup Plug Driver (12361) 9414101414	EA	1
	Drive Sleeve, 42 x 55 (12361) 9049111058	EA	1
	Drive Sleeve, 90 x 120 (12361) 9049111139	EA	1
	Drive Sleeve, 52 x 68 (12361) 9049111140	EA	1
	Exhaust Valve Guide Installer (12361) 9414101448	EA	1

Section II. ADDITIONAL AUTHORIZATION LIST - All-Terrain Crane (ATEC) AT422T - Continued

(1) National Stock Number	(2) Description (CAGEC) and Part Number	(3) U/M	(4) Qty Reqd
	MAINTENANCE - Continued		
	Fillet Ball Gages (12361) 9414101432	EA	1
	Flow Meter (12361) 9999100845	EA	1
	Hydraulic Puller, Steering Swivel Pin Kit (12361) 9049111056	EA	1
	Intake/Exhaust Valve Guide Remover (12361) 9414101449	EA	1
	Intake Valve Guide Installer (12361) 9414101447	EA	1
	Main Bore Salvage Kit (12361) 9414101434	EA	1
	Oil Seal Installation Tool (12361) 9414101422	EA	1
	Press in Tool, Axle Swivel Pin (12361) 9049111059	EA	1
	Protective Sleeve (12361) 9414101407	EA	1
	Protective Sleeve (12361) 9414101409	EA	1
	Protective Sleeve (12361) 9414101410	EA	1
	Seal Puller (12361) 9414101406	EA	1
	Spanner, Axle Adjusting Nut (12361) 9049111054	EA	1
	Tapper Removal Tool Kit (12361) 9414101430	EA	1
	Turbocharger Wastegate, Press Set Kit (12361) 9414101389	EA	1
	Valve Seat Insert Bore Cutter Kit (12361) 9414101450	EA	1

Section II. ADDITIONAL AUTHORIZATION LIST - All-Terrain Crane (ATEC) AT422T - Continued

(1) National Stock Number	(2) Description (CAGEC) and Part Number	(3) U/M	(4) Qty Reqd
	MAINTENANCE - Continued		
	Wear Sleeve Installation Tool (12361) 9414101421	EA	1
	CRANE ATTACHMENTS/EQUIPMENT		
3815-01-146-7183	Bucket, Concrete, 2 cu yd	EA	1
3895-01-523-0365	Pile Driver System (Berminghammer)	EA	1
3815-01-315-1479	Catwalk, Pile Driver (Linkbelt)	EA	1
3815-01-463-9925	Clamshell- (12361) 7041000505	EA	1
3895-01-227-1439	Extractor, Pile	EA	1
2040-01-463-9192	Grapple (12361) 7041000506	EA	1
3895-00-014-0583	Hammer, Pile Driver (Linkbelt)	EA	1
3895-00-641-7982	Jetting Set, Portable	EA	1
3815-00-221-2215	Lead Section, Lower, Pile Driver (Linkbelt)	EA	1
3815-00-983-8029	Lead Section, Top, Pile Driver, 15 ft (Linkbelt)	EA	1
	EXTREME WEATHER OPERATON AIDES		
	Espar Engine Coolant Heater – Kit (12361) 50101701015	EA	1
	Arctic Fox Hydra Liner Hydraulic Reservoir Heaters (12361) 9710770101	EA	2

APPENDIX D

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

D-1. SCOPE

This appendix lists the expendable supplies and materials you will need to operate and maintain the All-Terrain Crane (ATEC). These items are authorized to you by CTA 50-970, Expendable Items (except Medical, Class V, Repair Parts, and Heraldic Items).

D-2. FORMS

a. Column (1) - Component Application

Identifies application of EDSML.

b. Column (2) - Manufacturer's Part Number or National Stock Number/Unit of Issue

Identifies the manufacturer's part number or the national stock number assigned to the item and its unit of issue. Use it to request or requisition the item.

c. Column (3) - Description

Indicates Military Standard Number with SAE weight (if applicable) and the symbol used to identify the lubricant in the Lube Chart (Appendix M).

d. Column (4) - Quantity Required For Initial Operation

Identifies the amount of each item required to operate the vehicle upon initial startup or at the beginning of each work shift.

e. Column (5) - Quantity Required For Eight (8) Hours of Operation

Indicates the amount of each item consumed during a normal 8-hour shift.

f. Column (6) - Notes

Provides additional information regarding the use of EDSML items.

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

NOMENCLATURE: All-Terrain Crane Truck Mounted		MAKE: Grove	MODEL: AT422T
MFR PART NO.: 1140000513	NSN: 3810-01-448-2619	SERIAL # RANGE N/A to N/A	DATE:

(1) Component Application	(2) Mfr P/N or NSN (Unit of Issue)	(3) Description	(4) Qty Req'd F/Initial Opn	(5) Qty Req'd F/8 Hrs Opn	(6) Notes
Hook Block Swivel Bearing	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Hook Block Sheave	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Wire Rope	9150-00-191-2772 (55 gal.)	Oil, Hyd OE/HDO 10W MIL-L-2104	Variable	Variable	Lube IAW Lube Chart
Boom Nose Sheaves	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Telescope Cyl Wear Pads	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Adjustable Wear Pads	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Boom Section Wear Pads	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Boom Pivot Shaft	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Tele Cylinder Pivot Pin	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Alcohol Evaporator	6810-01-027-4771 (4 gal.)	Alcohol, Methyl	Variable	Variable	As Required by PMCS

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST - Continued

NOMENCLATURE: All-Terrain Crane Truck Mounted		MAKE: Grove	MODEL: AT422T
MFR PART NO.: 1140000513	NSN: 3930-01-412-5345	SERIAL # RANGE N/A to N/A	DATE:

(1) Component Application	(2) Mfr P/N or NSN (Unit of Issue)	(3) Description	(4) Qty Req'd F/Initial Opn	(5) Qty Req'd F/8 Hrs Opn	(6) Notes
Retract/Extend Pulleys	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Pile Driver Attach Shafts	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Lift Cylinder	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Hoists (2)	9150-01-035-5395 (5 gal.)	GO-MIL-L-2105 85W140	9.0 qts (8.5 L)	Variable	Lube IAW Lube Chart
Cable Follower Arms	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Engine	9150-01-178-4725 Case, 24 qts	Oil, Eng 15W40 MIL-L-2104	17.3 qts (16.4 L) Tot Sys Pan, Filter, Lines	Variable	Use MIL-L-46167 below -10̃F (23̃C)
Turntable Bearing	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Swing Gearbox	9150-01-035-5395 (5 gal.)	GO-MIL-L-2105 85W140	0.8 qts (0.75 L)	Variable	Lube IAW Lube Chart
Swing Brake	9150-00-191-2772 (55 gal.)	Oil, Hyd OE/HDO 10W MIL-L-2104	16 oz (.24 L)	Variable	Lube IAW Lube Chart

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST - Continued

NOMENCLATURE: All-Terrain Crane Truck Mounted		MAKE: Grove	MODEL: AT422T
MFR PART NO.: 1140000513	NSN: 3930-01-412-5345	SERIAL # RANGE N/A to N/A	DATE:

(1) Component Application	(2) Mfr P/N or NSN (Unit of Issue)	(3) Description	(4) Qty Req'd F/Initial Opn	(5) Qty Req'd F/8 Hrs Opn	(6) Notes
Turntable Gear/Pinion	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Torque Rod Bushing	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
King Pins Upper/Lower	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Lockout Cyl. Pivot Pins	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Planetary Ends (Axle)	9150-01-035-5395 (5 gal.)	MIL-L-2105 85W140	1.5 qts (1.5 L)	Variable	Lube IAW Lube Chart
Differential	9150-01-035-5395 (5 gal.)	MIL-L-2105 85W140	14 qts (13 L)	Variable	Lube IAW Lube Chart
Drive Line Joints	9150-01-197-7692 (35 lb)	GAA MIL-G-10924	Variable	Variable	Lube IAW Lube Chart
Hydraulic Reservoir (Complete System)	9150-00-191-2772 (55 gal.)	Oil, Hyd OE/HDO 10W MIL-L-2104	75 gal. (283.9 L)	Variable	Lube IAW Lube Chart
Transmission	9150-00-191-2772 (55 gal.)	Oil, Hyd OE/HDO 10W MIL-L-2104	28.0 qt (26.5 L) After complete drain	Variable	Lube IAW Lube Chart

APPENDIX E

LOAD CHART

This appendix contains the ATEC load chart which is also located in the superstructure cab.

Figure E-1. Load Chart, All-Terrain Crane (Sheet 1 of 9)

NOTES FOR LIFTING CAPACITIES

GENERAL:

1. Rated loads as shown on lift chart pertain to this machine as originally manufactured and equipped. Modifications to optional equipment other than that specified can result in a reduction of capacity.
2. Construction equipment can be hazardous if improperly operated or maintained. Operation and maintenance of th compliance with the information in the Operator's and Safety Handbook, Service Manual and Parts Manual supplied wit manuals are missing, order replacements from the manufacturer through the distributor.
3. The operator and other personnel associated with machine shall fully acquaint themselves with the latest American Natic (ANSI) Safety Standards for cranes.

SETUP:

1. The machine shall be leveled on a firm supporting surface. Depending on the nature of the supporting surface, it may structural supports under the outrigger floats or tires to spread the load to a larger bearing surface.
2. For outrigger operation, outriggers shall be properly extended with tires raised free of crane weight before operating th
3. If machine is equipped with front jack cylinder, the front jack cylinder shall be set in accordance with written procedu
4. When equipped with extendable counterweight, the counterweight shall be fully extended before operation.
5. Tires shall be inflated to the recommended pressure before lifting on rubber.
6. With certain boom and hoist tackle combinations, maximum capacities may not be obtainable with standard cable l
7. Do not travel with crane boom extension or jib erected.

OPERATION:

1. Rated loads at rated radius shall not be exceeded. Do not tip the machine to determine allowable loads. For clamsh operation, weight of bucket and load must not exceed 80% of rated lifting capacities.
2. All rated loads have been tested to and meet minimum requirements of SAE J1063 OCT80 - Cantilevered Boom Cran of Test, and do not exceed 85% of the tipping load on outriggers as determined by SAE J765 OCT80 Crane Stability
3. **Rated loads shown are the net loads which can be freely suspended from the hook when machine is equipped v 22 ton, 3 sheave hookblock (498 lbs.). When more than the minimum required hoist reeving is used, the ad shall be considered part of the load to be handled.**
4. Load ratings are based on freely suspended loads. No attempt shall be made to move a load horizontally on the grou
5. Rated loads do not account for wind on lifted load or boom. It is recommended when wind velocity is above 20 m.p.h. and boom lengths shall be appropriately reduced.
6. Rated loads are for lift crane service only.
7. Do not operate at a radius or boom length where capacities are not listed. At these positions, the machine may overtu the hook.
8. The maximum load which can be telescoped is not definable because of variations in loadings and crane maintenance, retraction and extension within the limits of the capacity chart.
9. When either boom length or radius or both are between values listed, the smallest load shown at either the next large or shorter boom length shall be used.
10. For safe operation, the user shall make due allowances for his particular job conditions, such as: soft or uneven ground, high winds, side loads, pendulum action, jerking or sudden stopping of loads, hazardous conditions, experience of pe lifts, traveling with loads, electric wires, etc. Side pull on boom or jib is extremely dangerous.
11. If machine is equipped with individually controlled powered boom sections, the boom sections must be extended e
12. Never handle personnel with this machine without written approval from Grove North America.
13. Keep load handling devices a minimum of 18 inches (45.7 cm) below boom head at all times.
14. The boom angle before loading should be greater than the loaded boom angle to account for deflection.
15. Capacities appearing above the bold line are based on structural strength and tipping should not be relied upon as a
16. Capacities for the 27 ft. (8.3 m) boom length shall be lifted with boom fully retracted. If boom is not fully retracted, capa those shown for the 40 ft. (12.2 m) boom length.
17. The maximum outrigger pad load is 37,229 pounds (16,887 kg).

DEFINITIONS:

1. Operating Radius: Horizontal distance from a projection of the axis of rotation to the supporting surface before loadi vertical hoist line or tackle with load applied.
2. Loaded Boom Angle (Shown in Parenthesis on Main Boom Capacity Chart): is the angle between the boom base secti after lifting the rated load at the rated radius with the rated boom length.
3. Working Area: Areas measured in a circular arc about the center line of rotation as shown on the working area diagr
4. Freely Suspended Load: Load hanging free with no direct external force applied except by the lift cable.
5. Side Load: Horizontal force applied to the lifted load either on the ground or in the air.

Figure E-1. Load Chart, All-Terrain Crane (Sheet 2 of 9)

NET RATED LIFTING CAPACITIES IN POUNDS
27 FT. - 70 FT. BOOM
ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	#0001				
	Main Boom Length in Feet				
	27	40	50	60	70
8	44,000 (64)	43,150 (73)	41,950 (76.5)		
9	41,000 (61.5)	40,500 (71.5)	39,350 (75.5)		
10	40,000 (59)	37,500 (70)	37,050 (74)		
12	30,950 (54)	30,950 (66.5)	30,950 (71.5)	30,950 (75.5)	
15	23,800 (45)	23,800 (61.5)	23,800 (68)	23,800 (72)	21,500 (76.5)
20	17,500 (23)	17,150 (52.5)	17,150 (61.5)	17,150 (67)	17,150 (72)
25		12,800 (42)	12,800 (54.5)	12,800 (61.5)	12,800 (67)
30	See Note 16	9,900 (28.5)	9,900 (46.5)	9,900 (55.5)	9,900 (62.5)
35			8,080 (37.5)	8,080 (49.5)	8,080 (57.5)
40			6,500 (25)	6,500 (42.5)	6,500 (52)
45				5,340 (34)	5,340 (46)
50				4,300 (23.5)	4,300 (39.5)
55					3,400 (31.5)
60					2,700 (21.5)
Minimum boom angle (deg.) for indicated length (no load)					0
Maximum boom length (ft.) at 0 deg. boom angle (no load)					70

Note: ( ) Boom angles are in degrees. A6-829-015204

#LMI operating code. Refer to LMI manual for instructions.

Figure E-1. Load Chart, All-Terrain Crane (Sheet 3 of 9)

NET ON RUBBER CAPACITIES WITH 16.00R21 TIRES

STATIONARY CAPACITIES - 360°

Radius in Feet	#9005 Main Boom Length in Feet				
	27	40	50	60	70
8	22,050 (64)	22,050 (73)			
9	19,000 (61.5)	19,000 (71.5)	17,500 (75.5)		
10	16,600 (59)	16,600 (70)	15,800 (74)		
12	12,900 (54)	12,900 (66.5)	12,900 (71.5)	12,050 (75.5)	
15	8,430 (45)	8,430 (61.5)	8,430 (68)	8,430 (72)	7,120 (76.5)
20	4,530 (23)	4,530 (52.5)	4,530 (61.5)	4,530 (67)	4,530 (72)
25		2,730 (42)	2,730 (54.5)	2,730 (61.5)	2,730 (67)
30		1,680 (28.5)	1,680 (46.5)	1,680 (55.5)	1,680 (62.5)
35			960 (37.5)	960 (49.5)	960 (57.5)
40			440 (25)	440 (42.5)	440 (52)

A6-829-015205

STATIONARY CAPACITIES - DEFINED ARC OVER REAR (SEE NOTE 3)

Radius in Feet	#9005 Main Boom Length in Feet				
	27	40	50	60	70
8	27,000 (64)	23,600 (73)			
9	23,900 (61.5)	20,800 (71.5)	18,900 (75.5)		
10	21,600 (59)	18,500 (70)	16,950 (74)		
12	18,300 (54)	15,000 (66.5)	13,900 (71.5)	12,900 (75.5)	
15	12,350 (45)	11,350 (61.5)	10,650 (68)	10,000 (72)	9,420 (76.5)
20	7,180 (23)	7,180 (52.5)	7,180 (61.5)	6,910 (67)	6,560 (72)
25		4,730 (42)	4,730 (54.5)	4,730 (61.5)	4,700 (67)
30		3,280 (28.5)	3,280 (46.5)	3,280 (55.5)	3,280 (62.5)
35			2,290 (37.5)	2,290 (49.5)	2,290 (57.5)
40			1,570 (25)	1,570 (42.5)	1,570 (52)
45				1,020 (34)	1,020 (46)
50				590 (23.5)	590 (39.5)

Figure E-1. Load Chart, All-Terrain Crane (Sheet 4 of 9)

NET ON RUBBER CAPACITIES WITH 16.00R21 TIRES (cont'd.)

PICK & CARRY CAPACITIES - UP TO 2.5 MPH
BOOM CENTERED OVER REAR (SEE NOTE 6)

Radius in Feet	#9006				
	Main Boom Length in Feet				
	27	40	50	60	70
8	23,600 (64)	23,600 (73)			
9	21,700 (61.5)	21,700 (71.5)	21,300 (75.5)		
10	20,050 (59)	20,050 (70)	19,750 (74)		
12	17,200 (54)	17,200 (66.5)	17,200 (71.5)	12,050 (75.5)	
15	12,350 (45)	12,350 (61.5)	12,350 (68)	9,800 (72)	9,030 (76.5)
20	7,180 (23)	7,180 (52.5)	7,180 (61.5)	7,170 (67)	6,550 (72)
25		4,730 (42)	4,730 (54.5)	4,730 (61.5)	4,730 (67)
30		3,280 (28.5)	3,280 (46.5)	3,280 (55.5)	3,280 (62.5)
35			2,290 (37.5)	2,290 (49.5)	2,290 (57.5)
40			1,570 (25)	1,570 (42.5)	1,570 (52)
45				1,020 (34)	1,020 (46)
50				590 (23.5)	590 (39.5)

Note: ( ) Boom angles are in degrees.

A6-829-015207

#LMI operating code. Refer to LMI manual for instructions.

1. Capacities are in pounds and do not exceed 75% of tipping loads as determined by test in accordance with SAE J765
2. Capacities are applicable to machines equipped with 16.00R21 (22 ply) radial tires, at 110 psi cold inflation press
3. Defined Arc - Over rear includes 6° on either side of longitudinal centerline of machine.
4. Capacities appearing above the bold line are based on structural strength and tipping should not be relied upon as a limitation.
5. Capacities are applicable only with machine on firm level surface.
6. For pick and carry operation, boom must be centered over rear of machine, mechanical swing lock engaged and load re from swinging. When handling loads in the structural range with capacities close to maximum ratings, travel should be to creep speeds.
7. Axle lockouts must be functioning when lifting on rubber. Refer to Operators and Safety Handbook.
8. All lifting depends on proper tire inflation, capacity and condition. Capacities must be reduced for lower tire inflation pr See lifting capacity chart for tire used. Damaged tires are hazardous to safe operation of crane.
9. Creep - not over 200 ft. of movement in any 30 minute period and not exceeding 1 mph.

	No Load Stability Data	Main Boom 70 ft.
Rear (No Load)	Min. boom angle (deg.) for indicated length	26
	Max. boom length (ft.) at 0 deg. boom angle	60
360 Deg. (No Load)	Min. boom angle (deg.) for indicated length	44
	Max. boom length (ft.) at 0 deg. boom angle	50

Figure E-1. Load Chart, All-Terrain Crane (Sheet 5 of 9)

WEIGHT REDUCTIONS FOR LOAD HANDLING DEVICES

WITH HOOKBLOCK REMOVED

CLAMSHELL	2,900 lbs.
GRAPPLE	3,200 lbs.

NOTE: All load handling devices and boom attachments are considered part of the load and suitable allowances MUST BE MADE for their combined weights. Weights are for Grove furnished equipment.

LINE PULLS AND REEVING INFORMATION

HOISTS	CABLE SPECS.	PERMISSIBLE LINE PULLS	NOMINAL CABLE LENGTH
Main & Aux. Model 15	5/8" (16 mm) 18x19 Class or 35x7 Rotation Resistant Min. Breaking Str. 45,400 lbs.	8,074 lbs.	364 ft.

Figure E-1. Load Chart, All-Terrain Crane (Sheet 6 of 9)

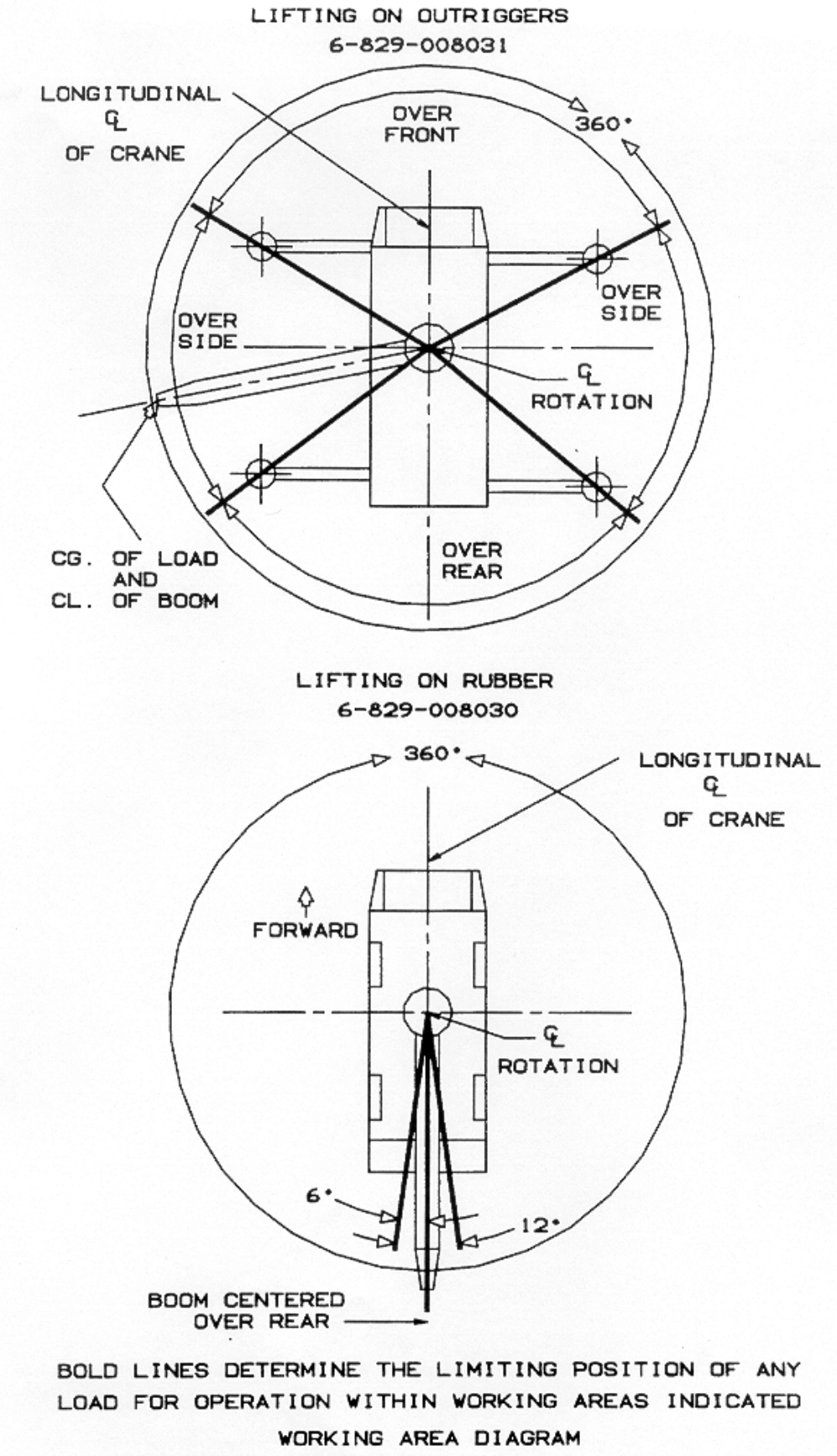


Figure E-1. Load Chart, All-Terrain Crane (Sheet 7 of 9)

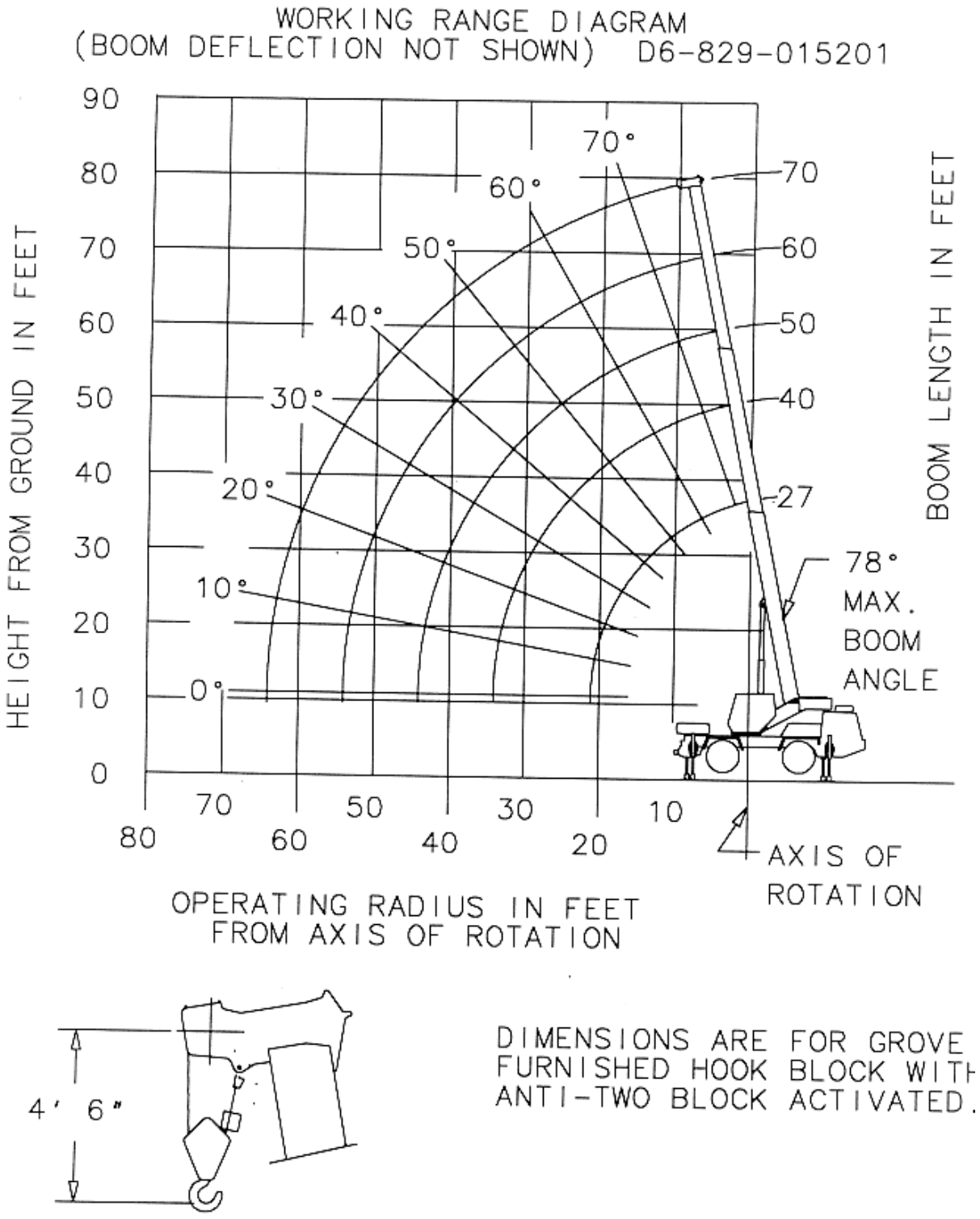


Figure E-1. Load Chart, All-Terrain Crane (Sheet 8 of 9)

ZERO DEGREE BOOM ANGLE CHARTS

ON OUTRIGGERS FULLY EXTENDED - 360°

Boom Angle	Main Boom Length in Feet				
	27	40	50	60	70
0°	12,550 (21.1)	7,420 (33.7)	5,200 (43.7)	3,690 (53.7)	2,430 (63.8)

ON RUBBER 16.00R21 TIRES

Stationary Capacities Defined Arc Over Rear and
Pick & Carry Capacities Up to 2.5 MPH Boom Centered Over Rear

Boom Angle	Main Boom Length in Feet				
	27	40	50	60	
0°	6,420 (21.1)	2,510 (33.7)	1,150 (43.7)	320 (53.7)	

Stationary Capacity 360° Arc

Boom Angle	Main Boom Length in Feet		
	27	40	50
0°	3,960 (21.1)	1,120 (33.7)	130 (43.7)

A6-829-015208

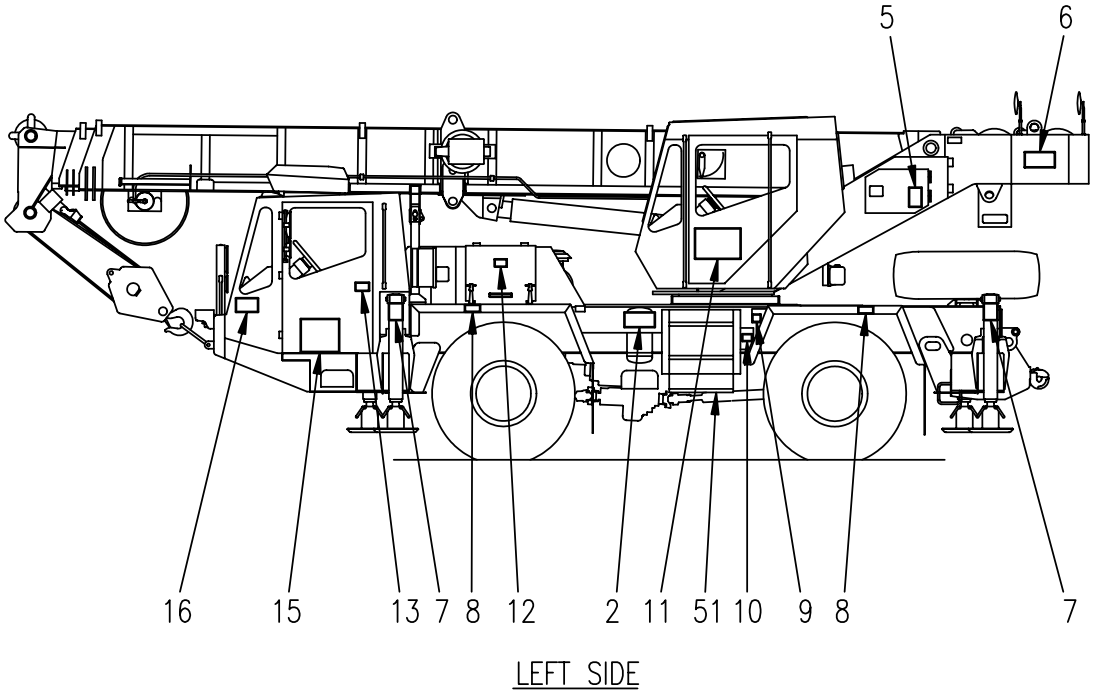
Note: ( ) Reference radii in feet.

Figure E-1. Load Chart, All-Terrain Crane (Sheet 9 of 9)

APPENDIX F

LOCATION/DESCRIPTION OF SIGNS/DECALS/DATA PLATES

This appendix lists, identifies, and locates the signs, decals, and data plates of the All-Terrain Crane (ATEC).



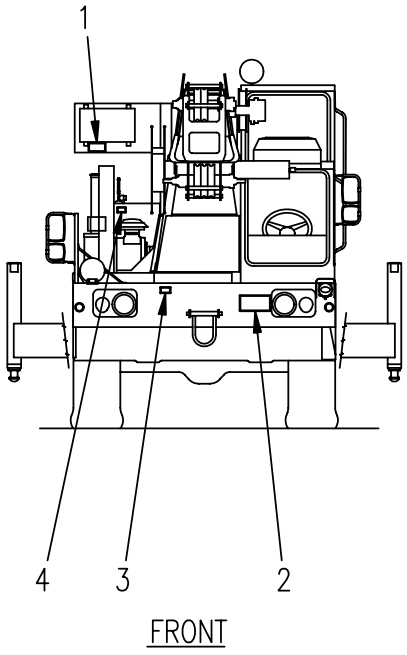
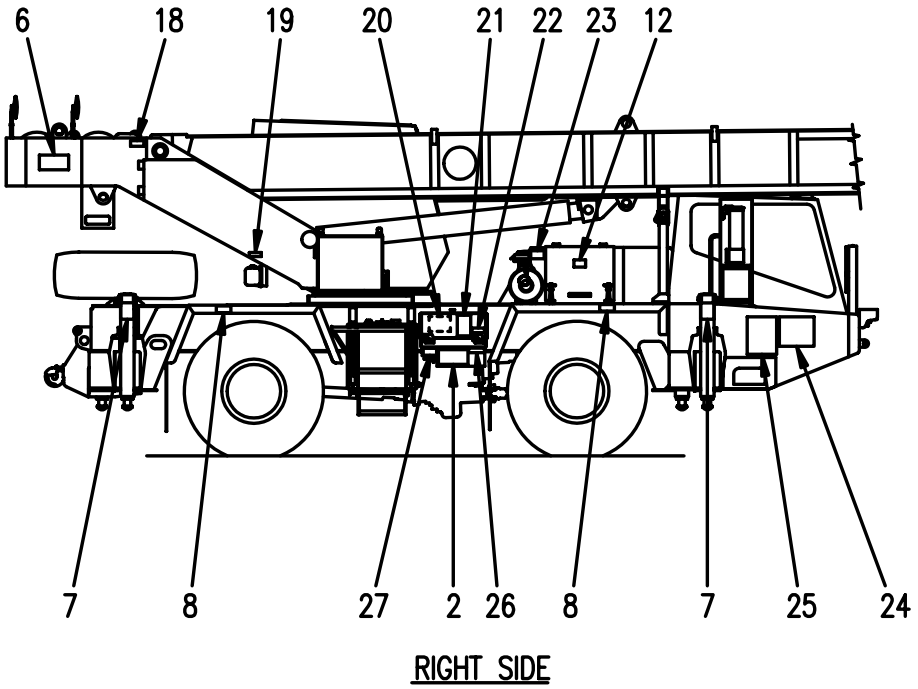


Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 1 of 30)



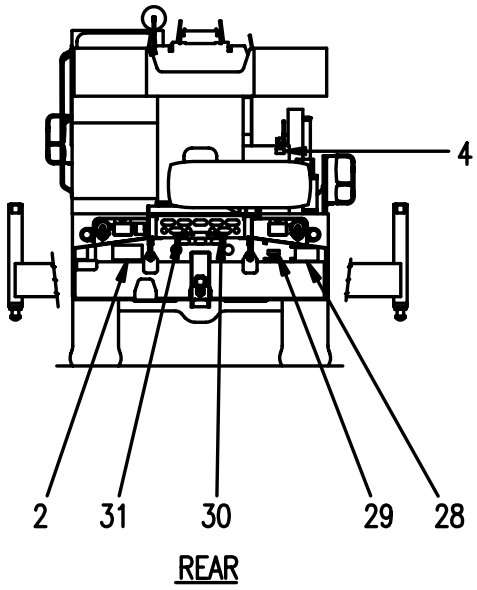


Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 2 of 30)

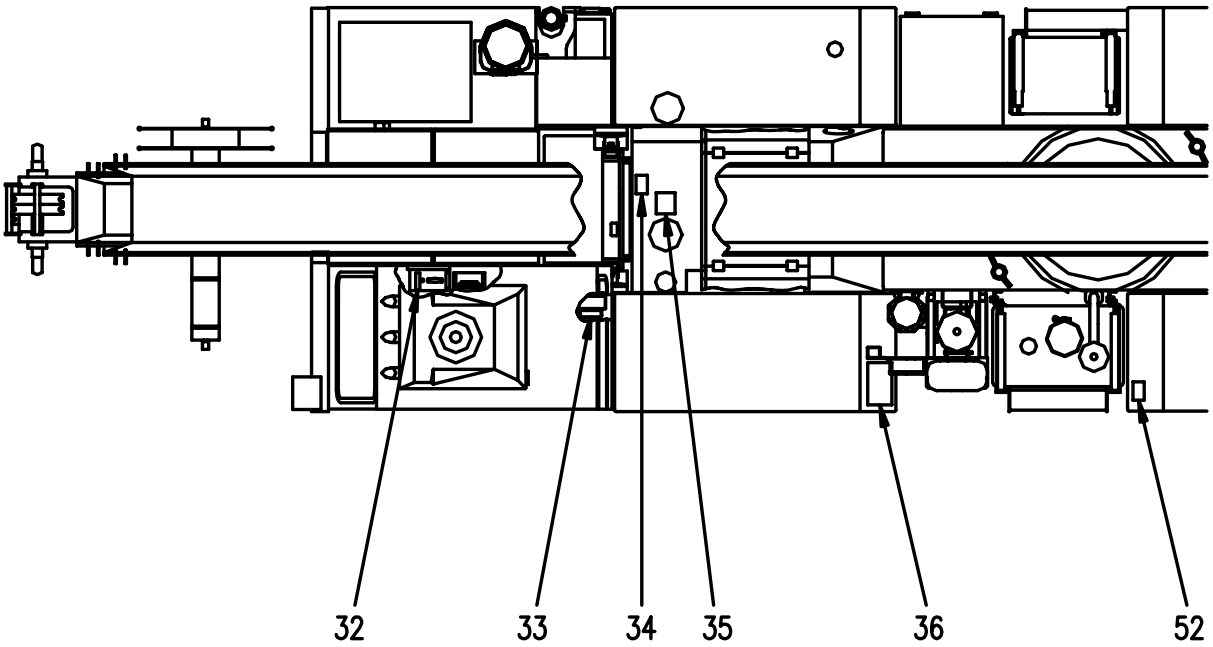
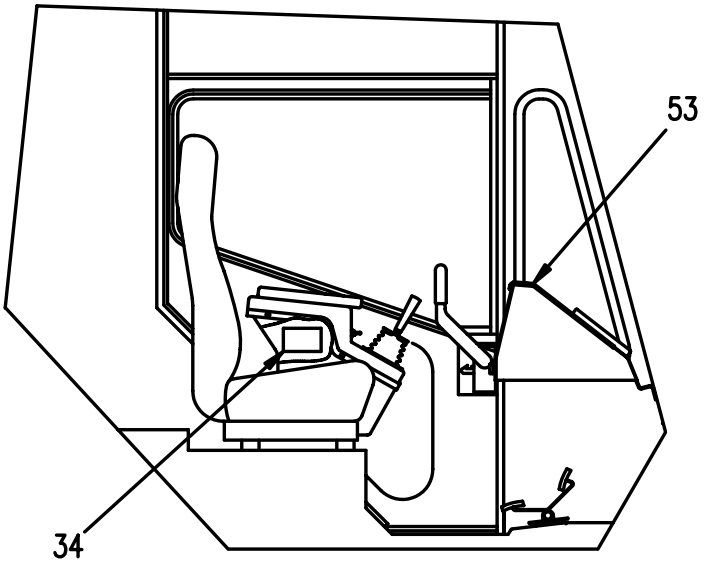
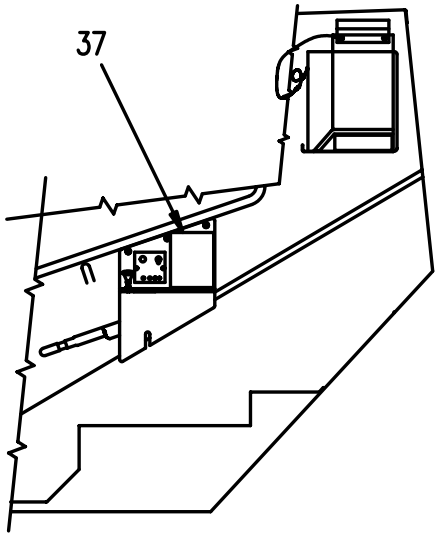


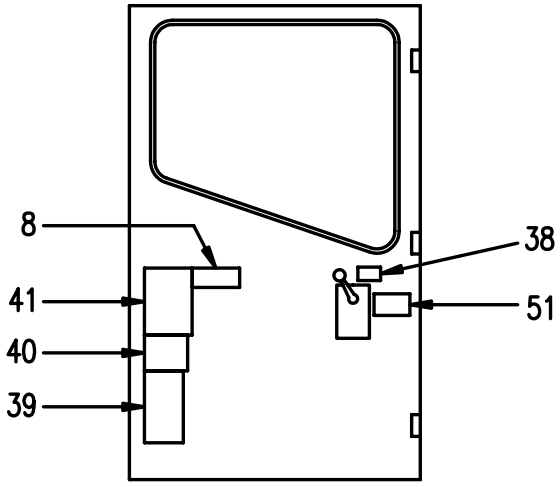
Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 3 of 30)



LEFT HAND SIDE
SUPERSTRUCTURE CAB – INSIDE

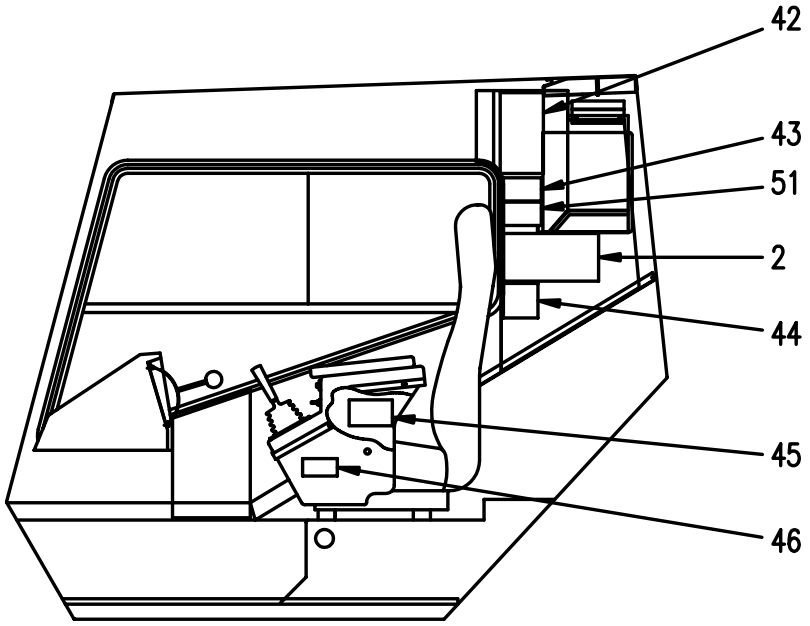


LEFT HAND SIDE
SUPERSTRUCTURE CAB – INSIDE

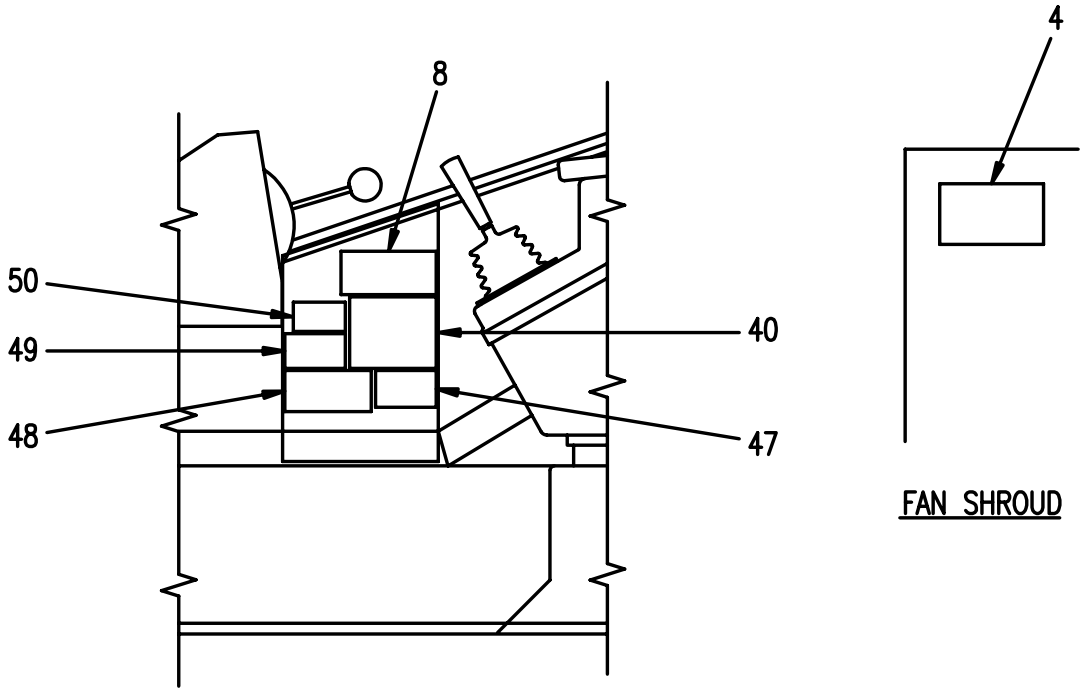


CARRIER CAB DOOR – INSIDE

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 4 of 30)



RIGHT HAND SIDE
SUPERSTRUCTURE CAB – INSIDE



FAN SHROUD

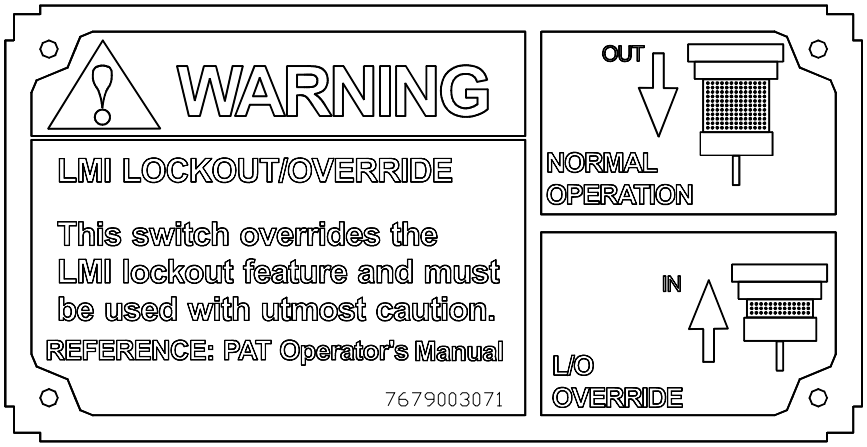
RIGHT HAND SIDE
SUPERSTRUCTURE CAB – BELOW WINDOW

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 5 of 30)

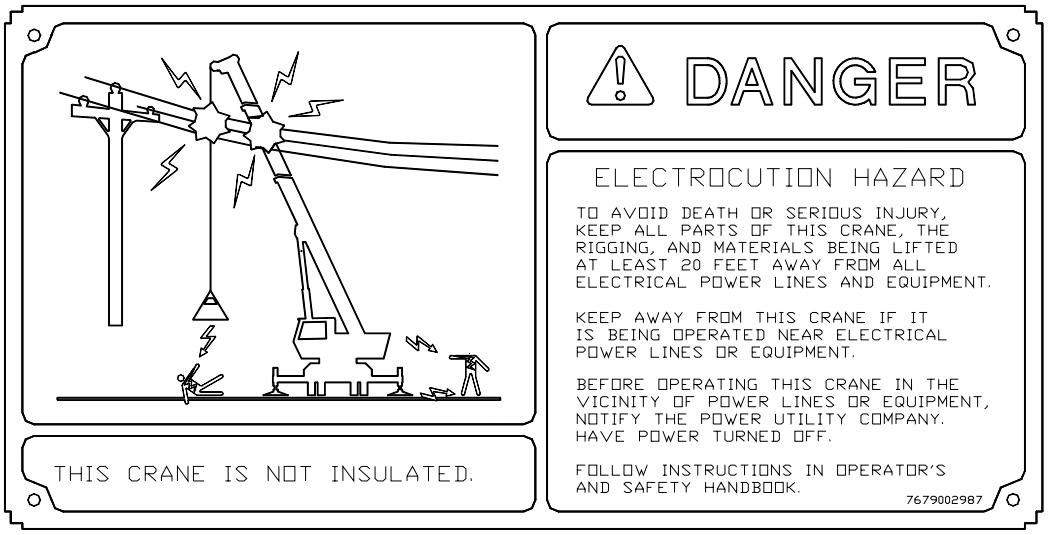
Legend for Figure F-1.

1. WARNING - LMI Lockout/Override
2. Panel - Electrocution Hazard
3. CAUTION - Loose Material
4. DANGER - Rotating Fan
5. Panel - Hydraulic Test
6. DANGER - CWT Crushing Hazard
7. Panel - Crushing Hazard - Outriggers
8. DANGER - Falling Suspension
9. Panel - Hydraulic Oil Sample
10. Panel - Steering Control
11. DANGER - 2-Block, Tipping, etc.
12. Panel - Hearing Protection
13. DANGER - Untrained Operator
14. DANGER - LMI Override Key (located in front of LMI CPU)
15. Panel - Shipping Data
16. Panel - Identification Plate
17. DANGER - Use Proper Cable Wedge
18. Panel - Do Not Use Boom as a Walkway
19. Panel - Heater Fuel Tank
20. Panel - Battery Connection
21. CAUTION - Loose Material, Electrical Components
22. CAUTION - Battery Disconnect
23. CAUTION - Check Oil
24. Panel - Lube Chart
25. Panel - Hand Signals
26. Panel - Slave Receptacle/Battery Disconnect
27. 27. Panel - Oil Sampling Valves
28. CAUTION - Towing Preparations
29. Panel - Auxiliary Air In
30. Panel - Control
31. Panel - Supply
32. Panel - Pump Control
33. Panel - Blackout - Safe Lighting Cover
34. CAUTION - Folded Boomrest
35. Panel - Check Coolant Level, Fluid Under Pressure
36. DANGER - Emergency Stowage System
37. DANGER - Multicaution
38. CAUTION - Cab Heater
39. Panel - Certification and Tire Information
40. CAUTION - Differential Locks
41. CAUTION - Disengage Pump, etc.
42. DANGER - Untrained Operator, etc.
43. CAUTION - Hearing Protection
44. Panel - Patent Information
45. DANGER - Crushing Hazard - Swing
46. CAUTION - Armrest
47. Panel - Swing Lock
48. CAUTION - Swing Lock
49. CAUTION - Do Not Operate 4WD on Dry Surface
50. CAUTION - Shift 2WD/4WD
51. Danger – Oxygen Depletion
52. Panel – Stop
53. Panel – Stop

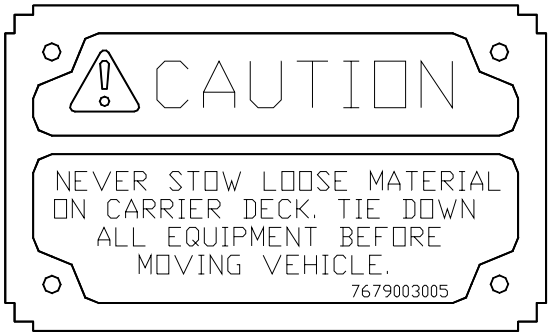
Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 6 of 30)



F/N 1

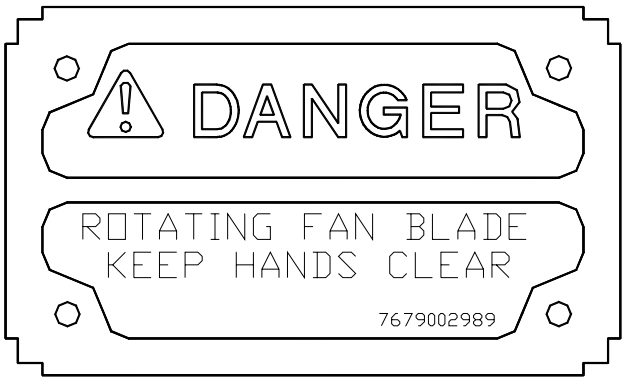


F/N 2

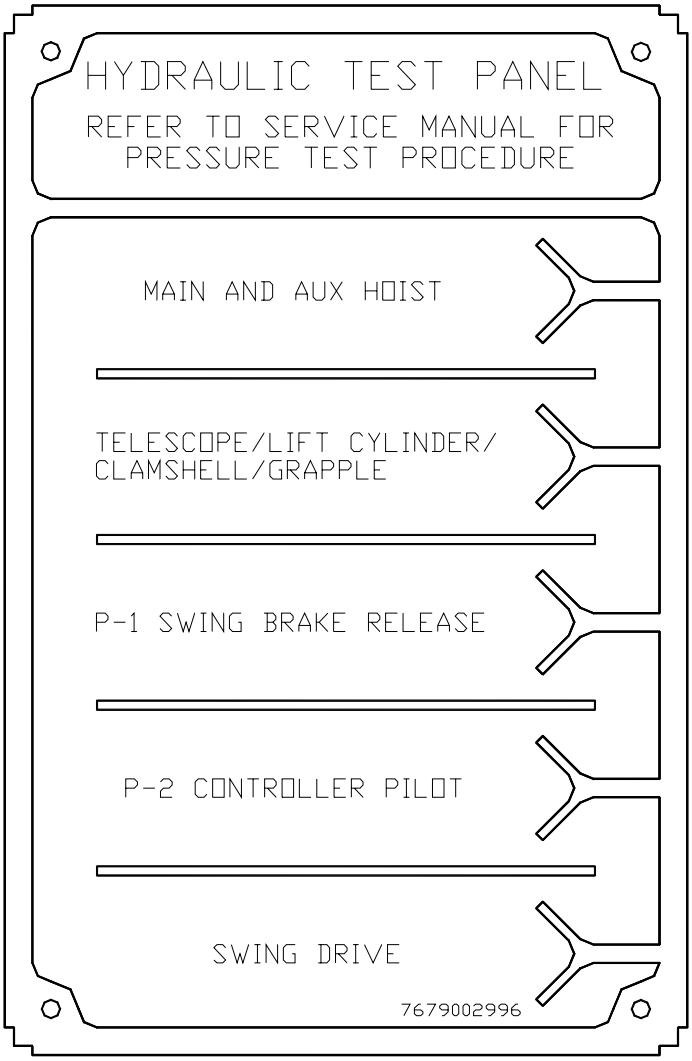


F/N 3

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 7 of 30)

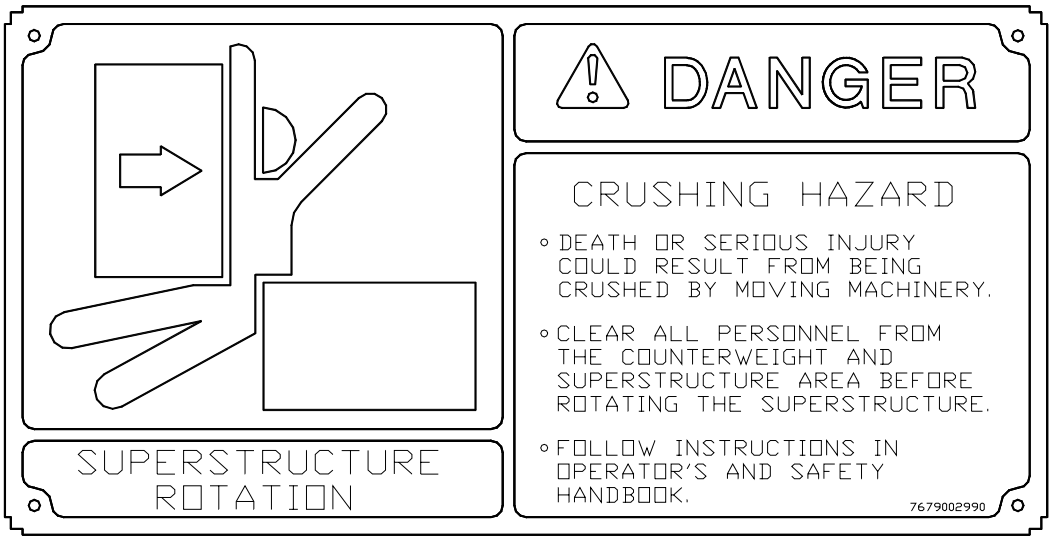


F/N 4

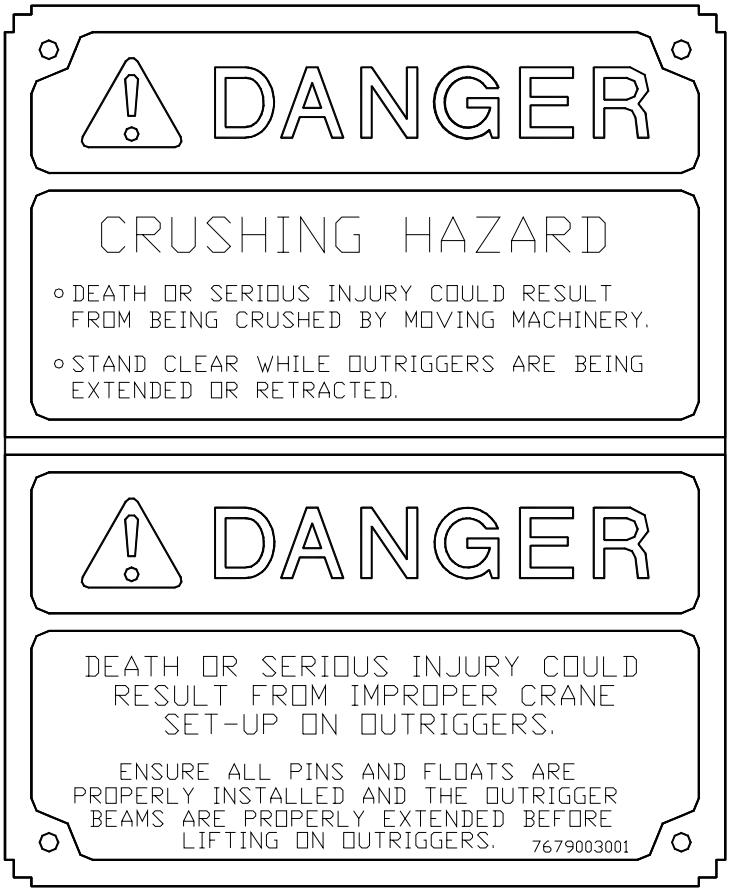


F/N 5

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 8 of 30)

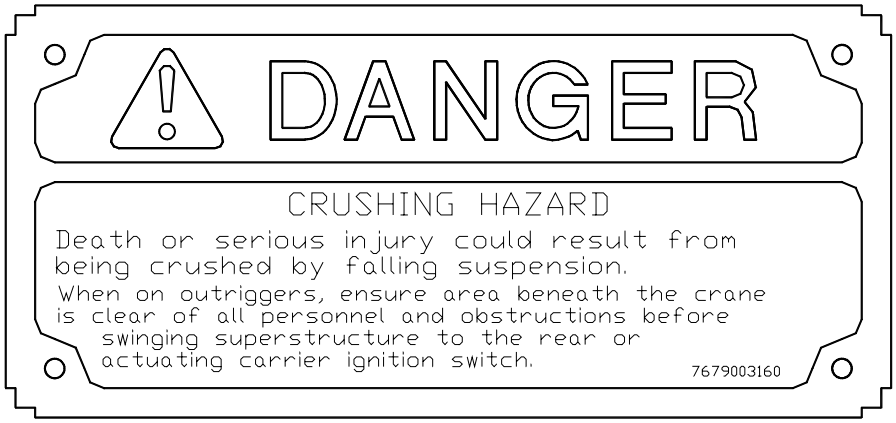


F/N 6

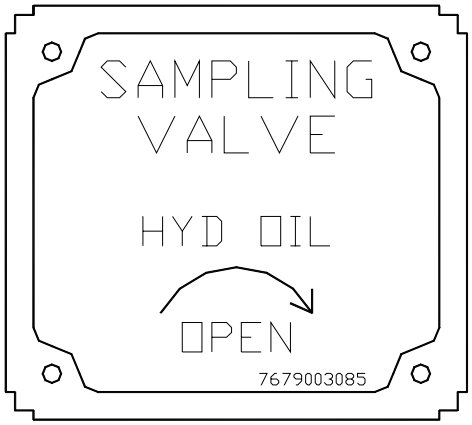


F/N 7

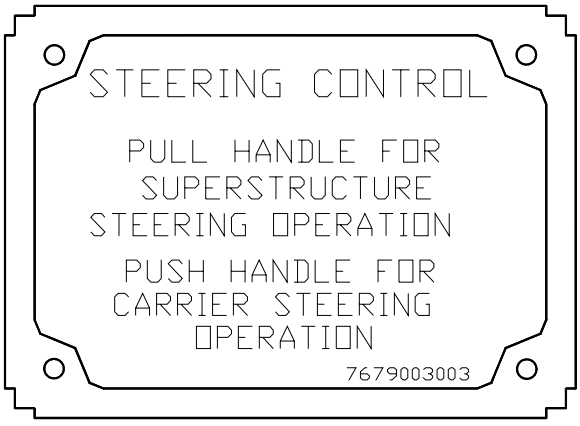
Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 9 of 30)



F/N 8

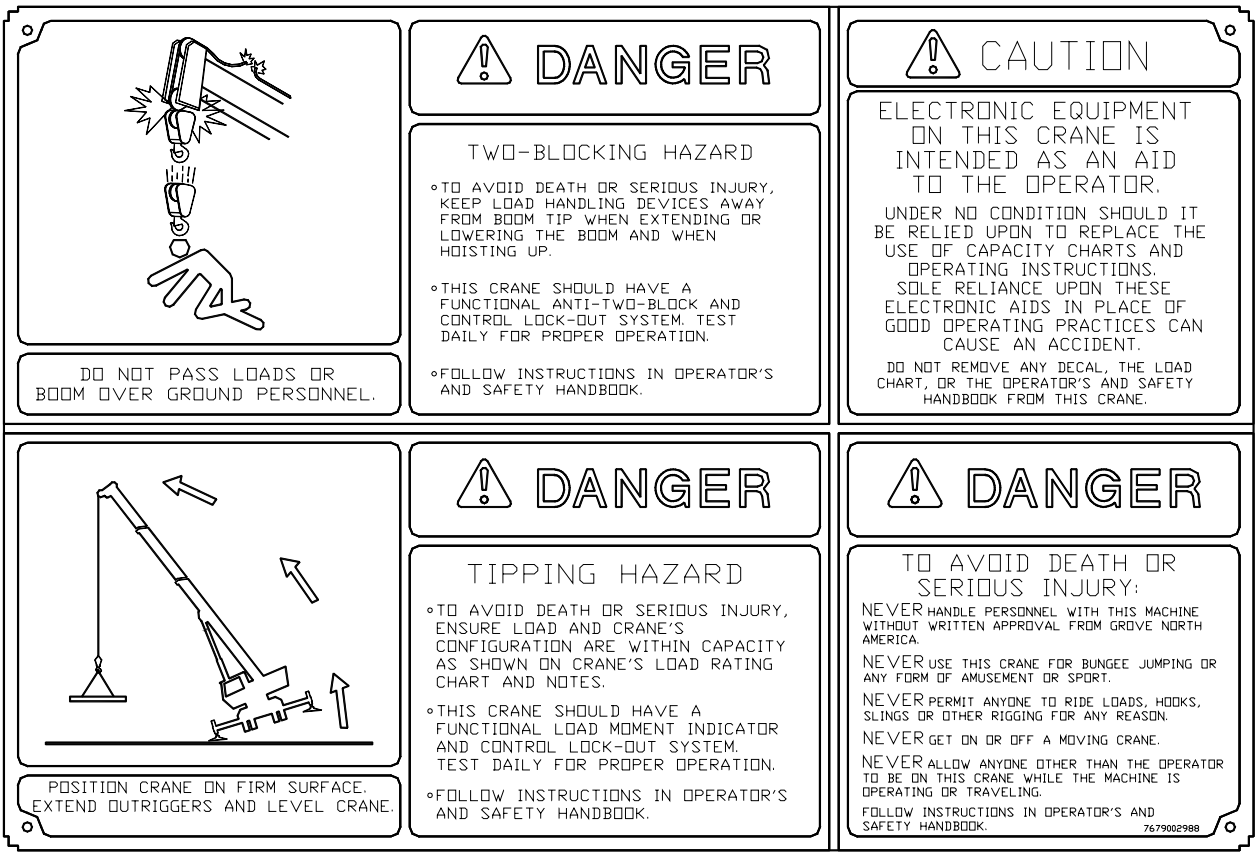


F/N 9



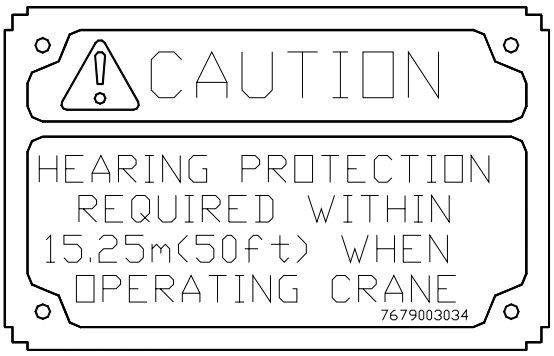
F/N 10

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 10 of 30)

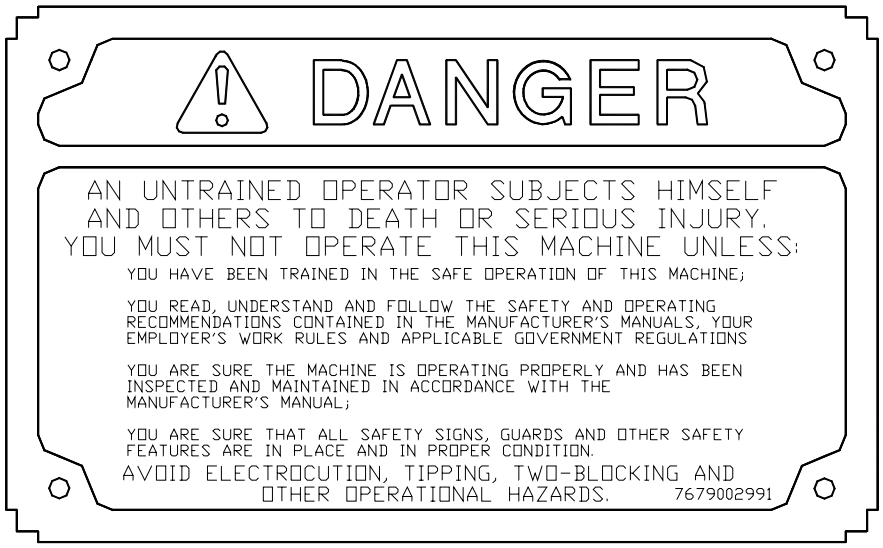


F/N 11

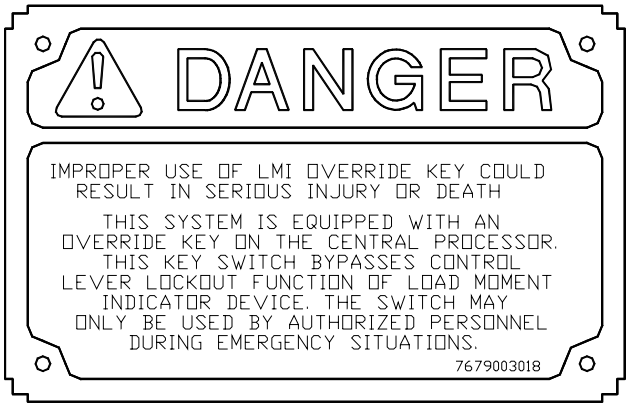
Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 11 of 30)



F/N 12

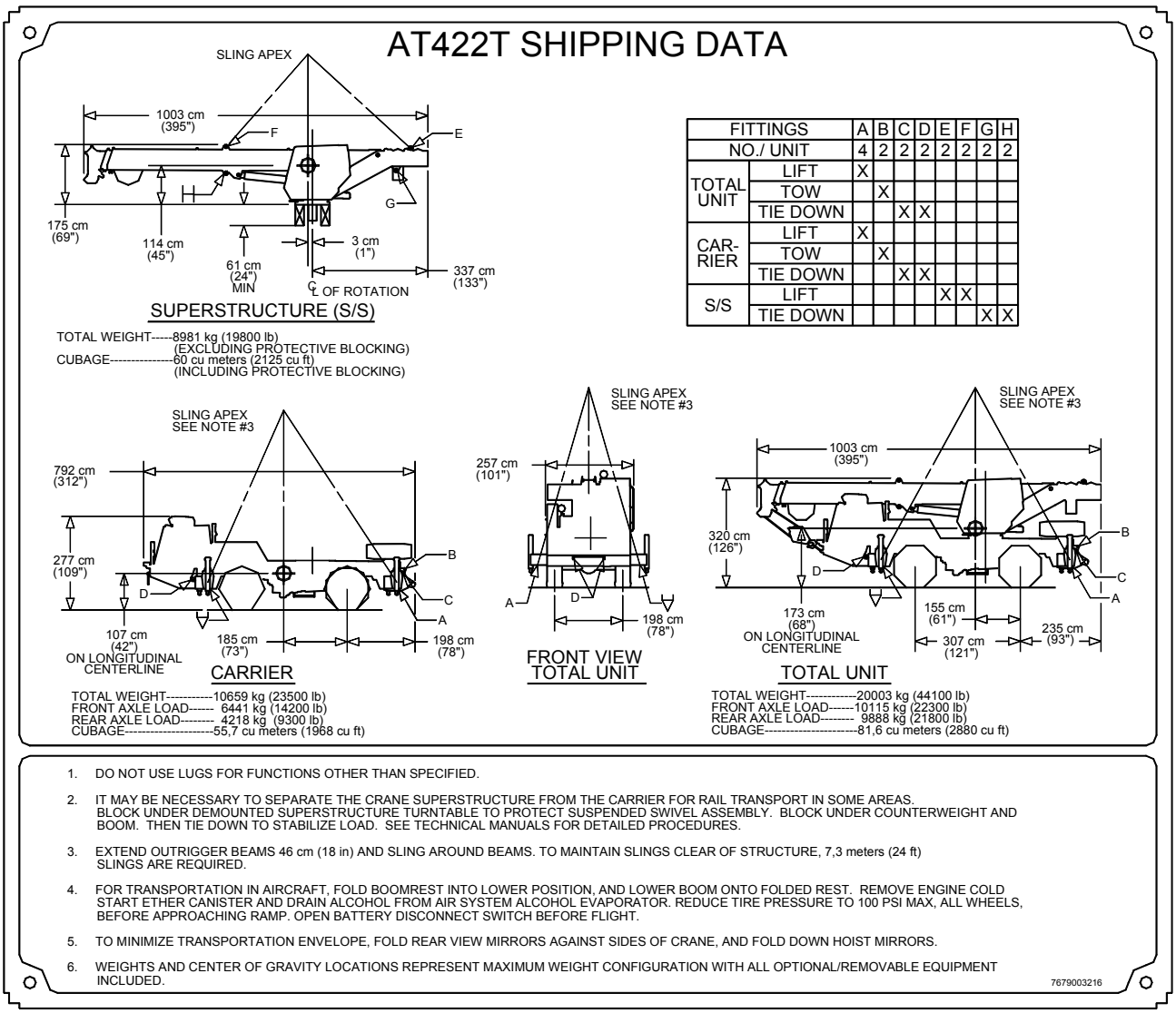


F/N 13



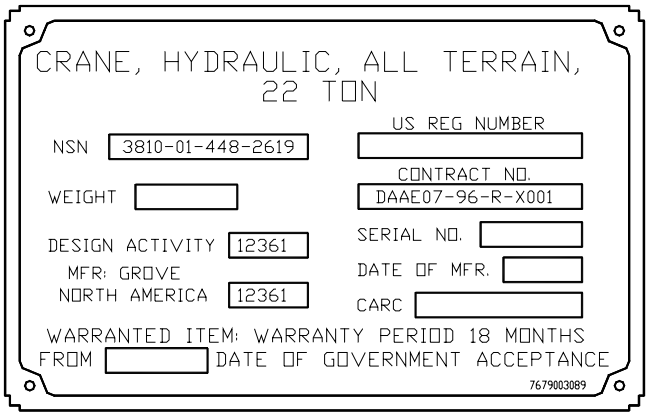
F/N 14

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 12 of 30)

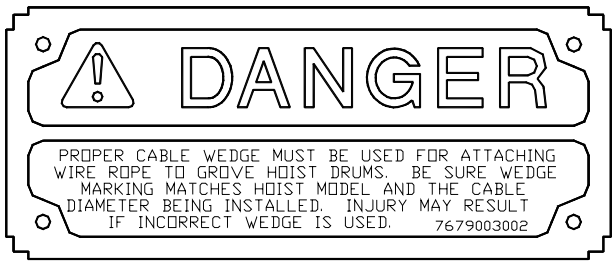


F/N 15

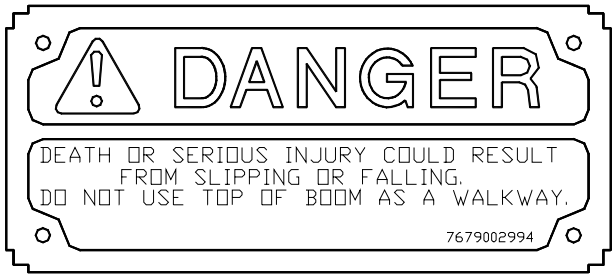
Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 13 of 30)



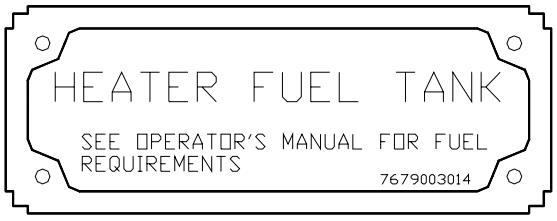
F/N 16



F/N 17

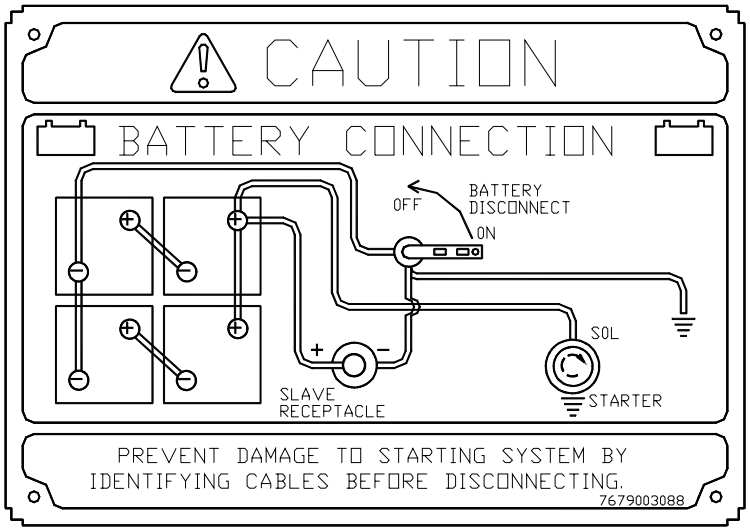


F/N 18

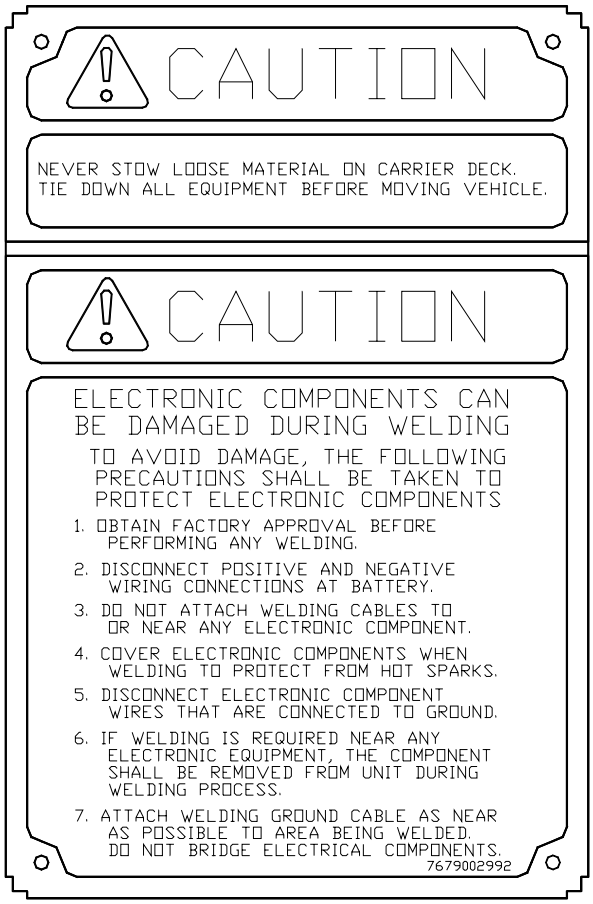


F/N 19

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 14 of 30)

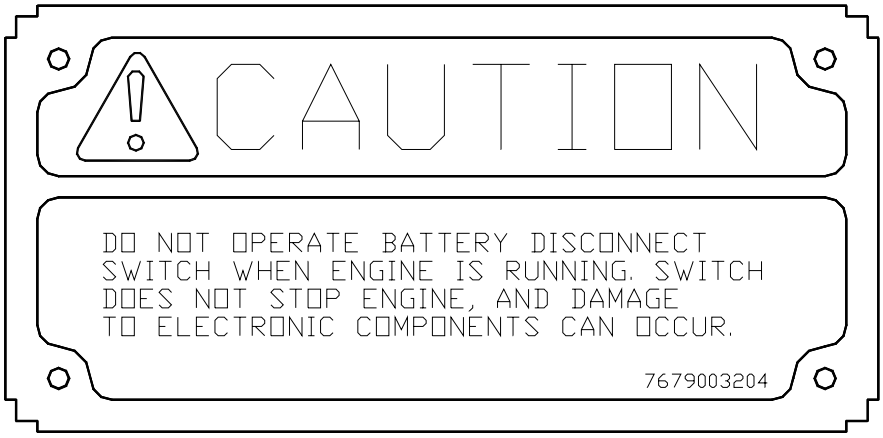


F/N 20

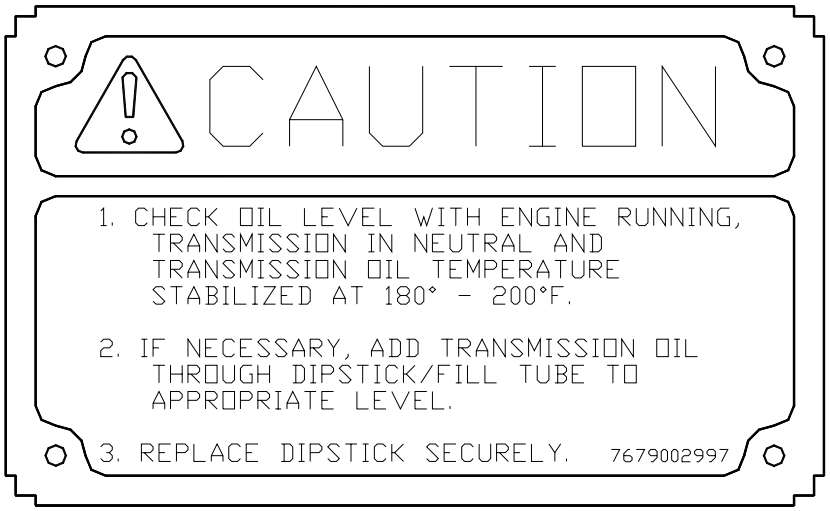


F/N 21

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 15 of 30)



F/N 22



F/N 23

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 16 of 30)

LUBRICATION CHART

SERVICE INTERVAL	ITEM NO.	COMPONENT	MIL - SYMBOL	SERVICE	SERV PTS
DAILY	10	ENGINE CRANKCASE-CUMMINS 6BTA 5.9	OE/HDO-15/40	CHECK/FILL	1
	11	TRANS. & TORQUE CONVERTER	OE/HDO-10	CHECK/FILL	1
	13	ENGINE COOLING SYS-CUMMINS	ANTI-FREEZE COOLANT	CHECK/FILL	1
	18	TURNTABLE GEAR & DRIVE PINION	GAA	BRUSH ON	1
	25	HYDRAULIC TANK	OE/HDO-10	CHECK/FILL	1
100 HOURS	32	HOOK BLOCK TRUNNION BEARING	GAA	LUBE	2
	33	HOOK BLOCK THRUST BEARING	GAA	LUBE	1
	34	HOOK BLOCK SHEAVES	GAA	LUBE	3
	35	BOOM NOSE SHEAVES	GAA	LUBE	5
200 HOURS	3	DIFFERENTIALS	GO-85/140	CHECK/FILL	2
	4	PLANETARY HUBS & WHEEL BRGS.	GO-85/140	CHECK/FILL	4
	17	TURNTABLE SWING BOX	GO-85/140	CHECK/FILL	1
250 HOURS	7	LOCKOUT CYL. PIVOT PINS	GAA	LUBE	8
	10	ENGINE CRANKCASE-CUMMINS 6BTA 5.9	OE/HDO-15/40	DRAIN/FILL	1
	15	OUTRIGGER BEAMS	GAA	BRUSH ON	4
	16	JACK CYL. SUPPORT TUBES	GAA	BRUSH ON	4
	19	TURNTABLE BEARING	GAA	LUBE	2
	27	PINTLE HOOK	GAA	LUBE	3
	30	DOOR HINGE	GAA	LUBE	3
	36	TELE. CYL. WEAR PADS	GAA	BRUSH ON	3
	37	ADJUSTABLE WEAR PADS	GAA	BRUSH ON	8
	38	BOOM SECTION WEAR PADS	GAA	BRUSH ON	12
	39	TELE. CYL. PIVOT PIN	GAA	LUBE	1
	40	RETRACT & EXTEND PULLEYS	GAA	LUBE	2
	41	BOOM PIVOT SHAFT	GAA	LUBE	2
	42	PILE DRIVER ATTACHMENT SHAFTS	MIL-A-907	BRUSH ON	2
	43	CABLE FOLLOWER ARMS	GAA	LUBE	2

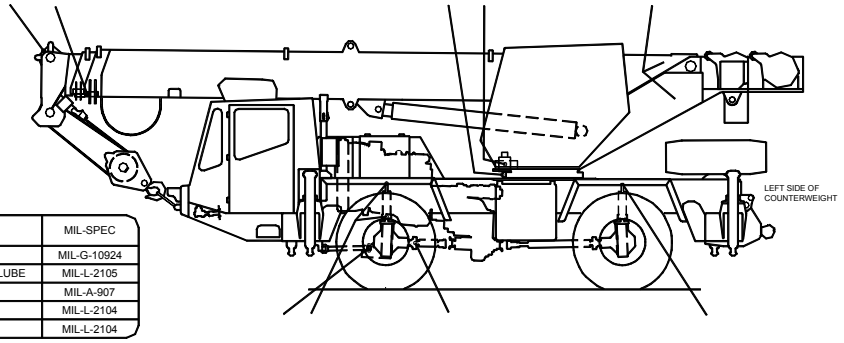
SERVICE INTERVAL	ITEM NO.	COMPONENT	MIL - SYMBOL	SERVICE	SERV PTS
500 HOURS	5	UPPER KINGPIN BEARINGS	GAA	LUBE	4
	6	LOWER KINGPIN BEARINGS	GAA	LUBE	4
	22	UPPER LIFT CYL. PIVOT	GAA	LUBE	1
	23	LOWER LIFT CYL. PIVOT	GAA	LUBE	1
	46	HOIST CABLE	WIRE ROPE LUBRICANT	BRUSH ON	ALL
1000 HOURS	3	DIFFERENTIALS	GO-85/140	DRAIN/FILL	2
	4	PLANETARY HUBS & WHEEL BRGS.	GO-85/140	DRAIN/FILL	4
	11	TRANS. & TORQUE CONVERTER	OE/HDO-10	DRAIN/FILL	1
	17	TURNTABLE SWING BOX	GO-85/140	DRAIN/FILL	1
	20	SWING BRAKE	OE/HDO-10	CHECK/FILL	1
	31	BOOM REST	GAA	BRUSH ON	2
	44	HO15-16 (MAIN)	GO-85/140	DRAIN/FILL	1
	45	HO15-16 (AUX)	GO-85/140	DRAIN/FILL	1
2000 HOURS	20	SWING BRAKE	OE/HDO-10	DRAIN/FILL	1
	25	HYDRAULIC TANK	OE/HDO-10	DRAIN/FILL	1
6000 HOURS	13	ENGINE COOLING SYS-CUMMINS	ANTI-FREEZE COOLANT	DRAIN/FILL	1
3 MONTHS	10	ENGINE CRANKCASE-CUMMINS 6BTA 5.9	OE/HDO-15/40	DRAIN/FILL	1
YEARLY	3	DIFFERENTIALS	GO-85/140	DRAIN/FILL	2
	4	PLANETARY HUBS & WHEEL BRGS.	GO-85/140	DRAIN/FILL	4
	28	AIR CONDITIONING	HFC R-134a REFRIGERANT	DRAIN/FILL	1
	29	AIR CONDITIONING	PAG REFRIGERATION OIL	DRAIN/FILL	1
1000 MILES	1	ANGLE GEAR BOX	GAA	LUBE	1
	8	TORQUE ROD BUSHING	GAA	LUBE	2
	12	DRIVE LINE SLIP JOINTS & U "JOINTS"	GAA	LUBE	6
3000 MILES	5	UPPER KINGPIN BEARINGS	GAA	LUBE	4
	6	LOWER KINGPIN BEARINGS	GAA	LUBE	4
6000 MILES	3	DIFFERENTIALS	GO-85/140	DRAIN/FILL	2
	4	PLANETARY HUBS & WHEEL BRGS.	GO-85/140	DRAIN/FILL	4
	10	ENGINE CRANKCASE-CUMMINS 6BTA 5.9	OE/HDO-15/40	DRAIN/FILL	1

LUBRICANTS NOTED ARE FOR OPERATION WHEN AMBIENT TEMPERATURE BETWEEN 0°F AND 100°F IS EXPECTED. FOR OPERATION OUTSIDE THIS RANGE SEE SERVICE AND OPERATOR'S MANUALS.

FOR ITEMS THAT HAVE NO MIL SYMBOL LISTED, REFER TO SERVICE MANUAL FOR SPECIFICATIONS.

THESE LUBE INTERVALS ARE TO BE USED AS A GUIDELINE ONLY. ACTUAL LUBE INTERVALS SHALL BE FORMULATED BY MAINTENANCE PROTOCOLS ACCORDING TO PARTICULAR CONDITIONS SUCH AS CONTINUOUS DUTY CYCLES AND/OR AGGRESSIVE ENVIRONMENTS. CONSULT SERVICE AND OPERATOR'S MANUALS FOR DETAILED INSTRUCTIONS.

MIL-SYMBOL	DESCRIPTION	MIL-SPEC
GAA (NATO G-403)	MULTIPURPOSE GREASE	MIL-G-10924
GO-85/140 (NATO 0-228)	EXTREME PRESSURE GEAR LUBE	MIL-L-2105
MIL-A-907	ANTI-SEIZE COMPOUND	MIL-A-907
OE/HDO-10 (NATO 0-237)	ENGINE OIL / HYDRAULIC OIL	MIL-L-2104
OE/HDO-15/40 (NATO 0-1236)	ENGINE OIL / HYDRAULIC OIL	MIL-L-2104



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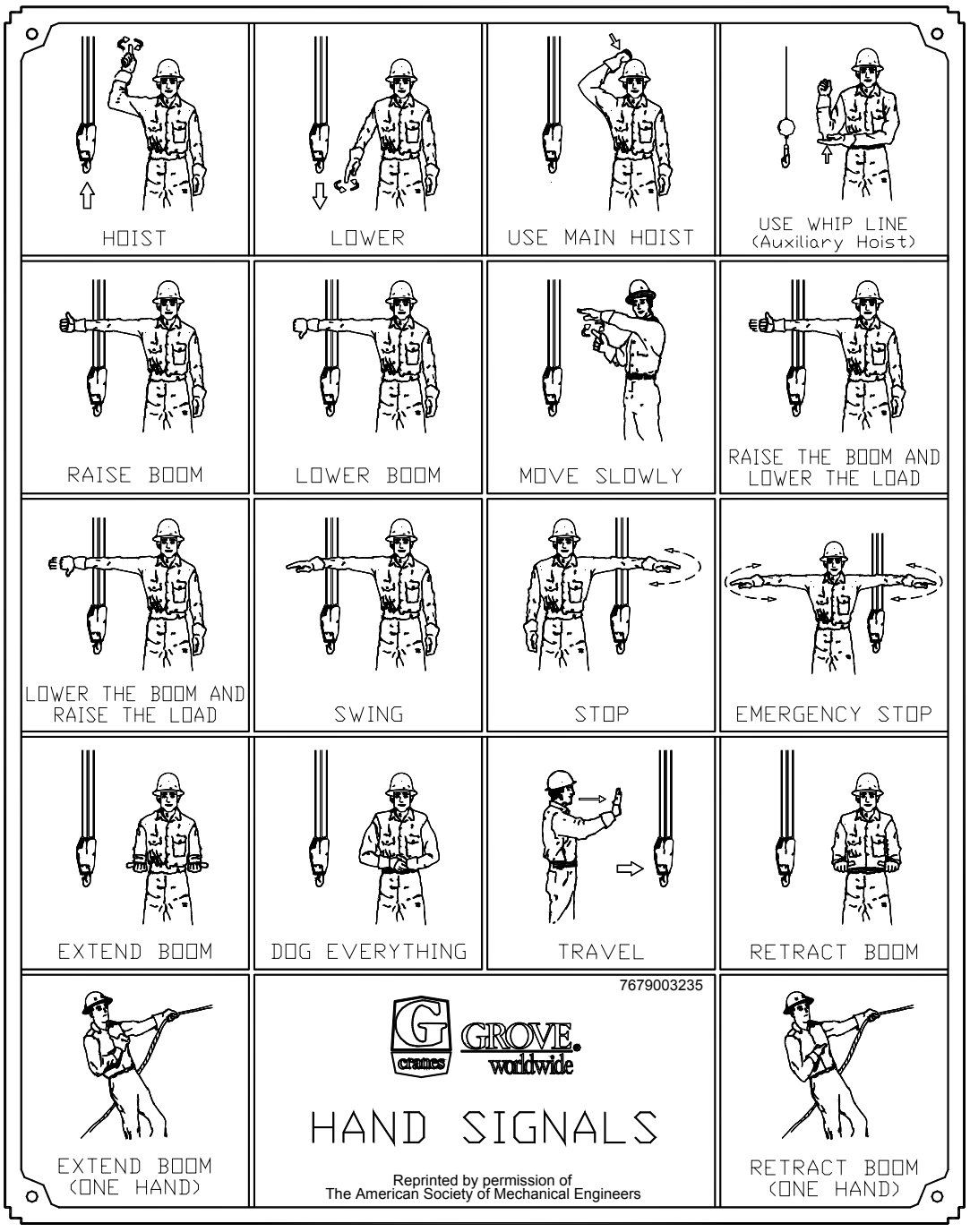
F/N 24

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 17 of 30)



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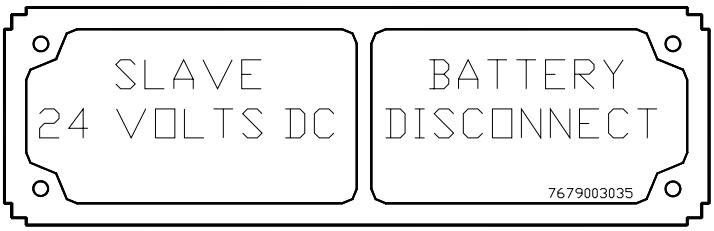

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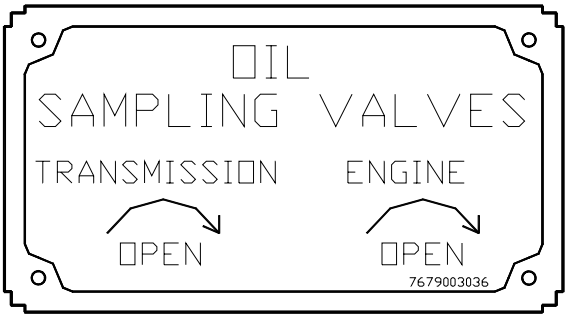

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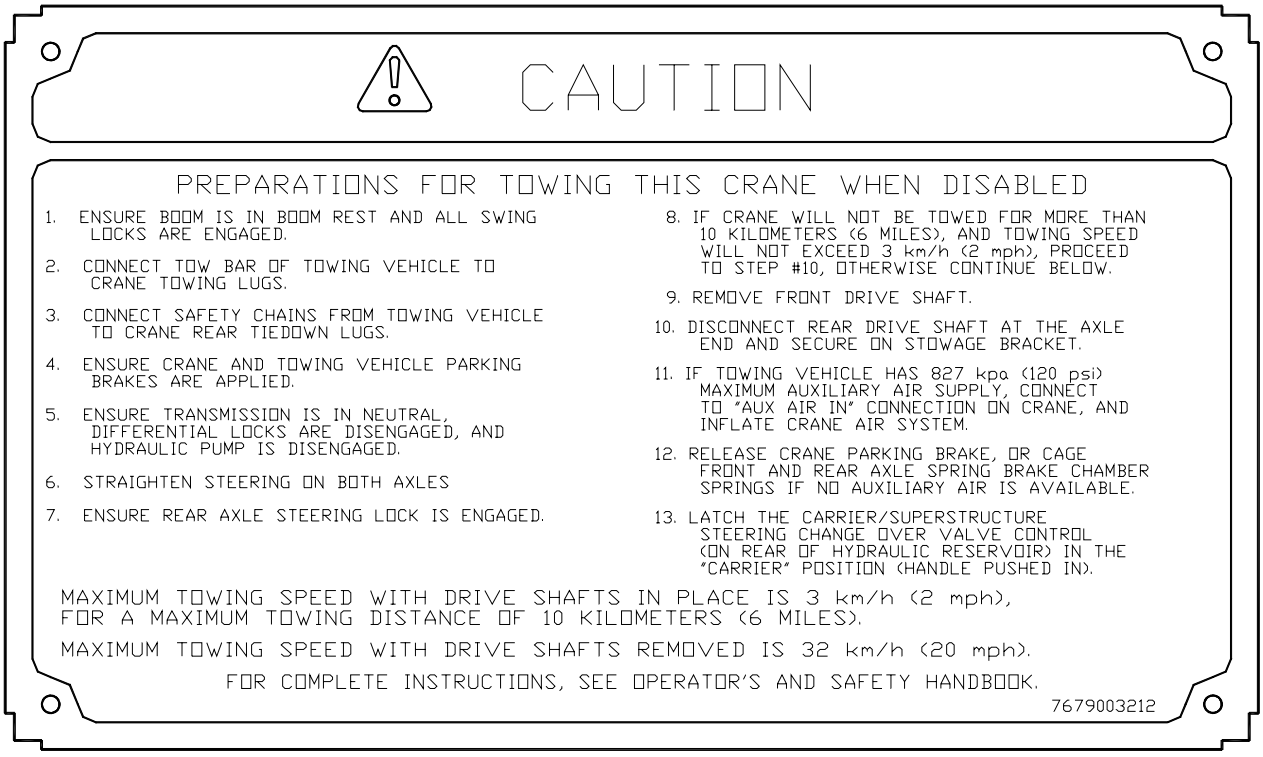

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Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 19 of 30)

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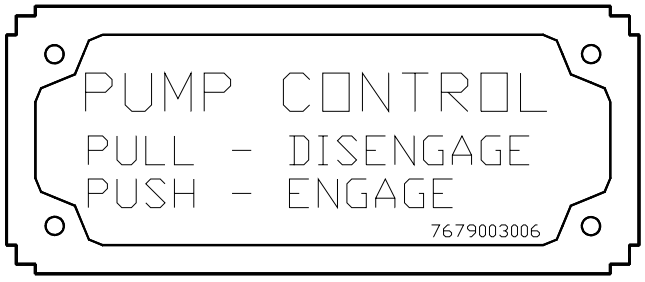
F/N 31



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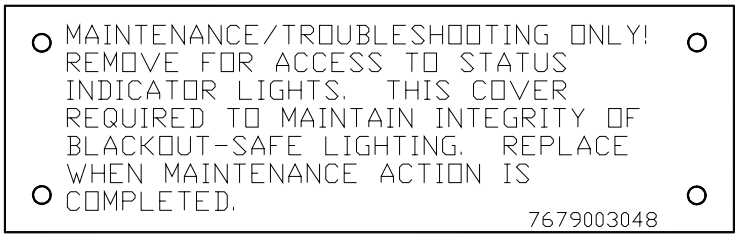

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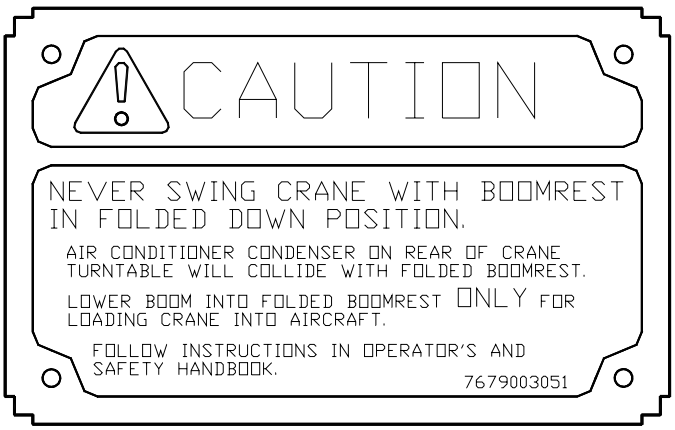

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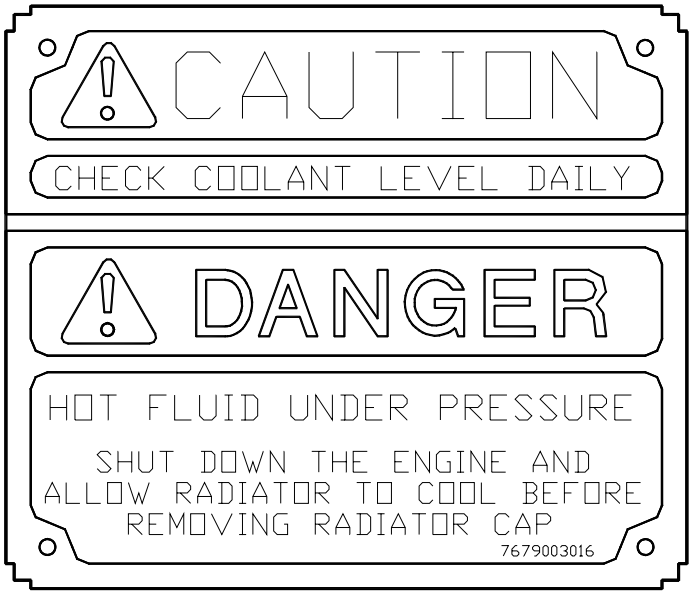


F/N 35

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 21 of 30)

⚠ DANGER

EMERGENCY CRANE STOWAGE SYSTEM

FAILURE TO FOLLOW PROCEDURES COULD RESULT IN DEATH OR SERIOUS INJURY.

PREPARATIONS:

1. Open APU control box and verify that APU power switch is turned off.
2. If crane's own electrical power is compromised, connect a NATO slave electrical cable between slave receptacle (under battery enclosure) and another vehicle having 24 VDC electrical system with a compatible receptacle.
3. Verify that battery disconnect switch is in engaged position.

OPERATION (select steps according to need):

TAKE HEED: Depending on failure mode, LMI may not be operational: do not extend or lower boom when lowering load. Operate only one function at a time.

NOTE: To conserve electrical power, turn off APU when not operating a function.

1. Ensure carrier ignition switch is turned to position O, and turn superstructure ignition switch CCW to position 3.

NOTE: It will be necessary to shift the diverter valve control to the function(s) to be operated, i.e. hoist(s), or boom lift/telescope. Swing, outrigger and steering functions are available with diverter valve in either position.

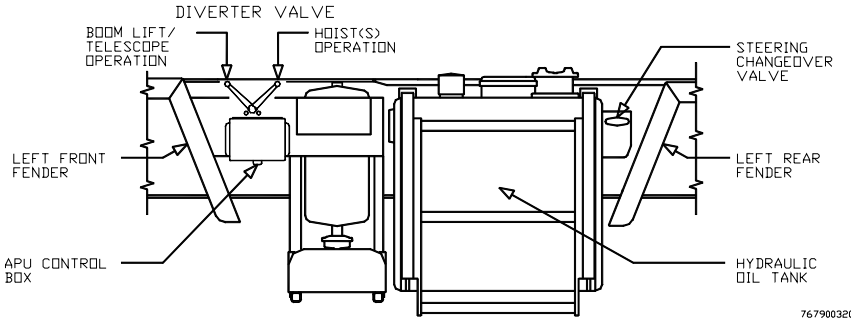
2. Turn on APU, and using swing, telescope and/or hoist functions as appropriate, lower any hook load to ground, and detach.

NOTE: Depending on failure mode, it may be necessary to actuate LMI by-pass to perform certain functions.

3. Retract boom, using hoist to keep hook block off ground.
4. Swing boom over boom rest, and use boom lift and hoist functions as appropriate to secure hook block to front storage loop.
5. Lower boom onto boom rest, keeping hoist cable snug, and engage swing locks.
6. Retract outrigger stabilizers, and then the beams.
7. Remove and stow outrigger pads.

NOTE: If crane is to be towed, proceed with steps 8 through 10. If crane can be driven, proceed to step 12.

8. Turn superstructure ignition switch to position O, and place steering changeover valve in "Carrier" position (control pushed in).
9. Turn carrier ignition switch CCW to position 3, and use carrier rear axle steering switch to straighten rear wheels.CCW
10. Engage rear axle steer lock and visually verify engagement.
11. Turn carrier ignition switch to position 0, and place steering changeover valve in "Superstructure" position (control pulled out).
12. Turn superstructure ignition switch CCW to position 3, and use superstructure front axle steer switch to straighten front wheels.
13. Turn off APU power switch and close APU control box.
14. Ensure both ignition switches are turned to position 0, and commence separate towing procedures according to need.



F/N 36

Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 22 of 30)

F/N 37

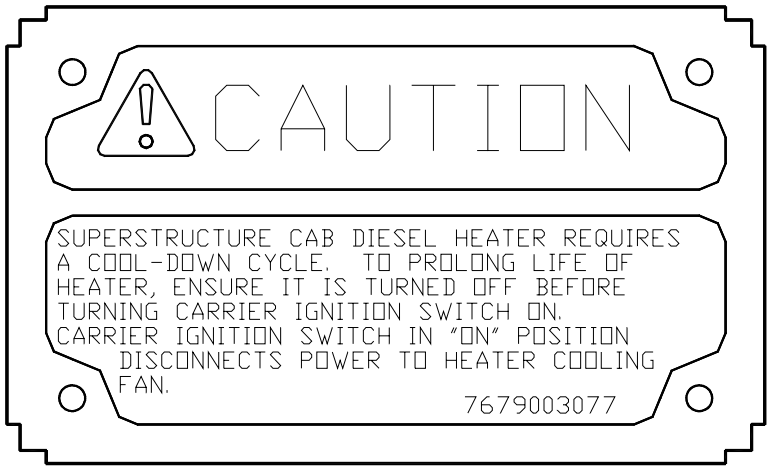


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Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 23 of 30)

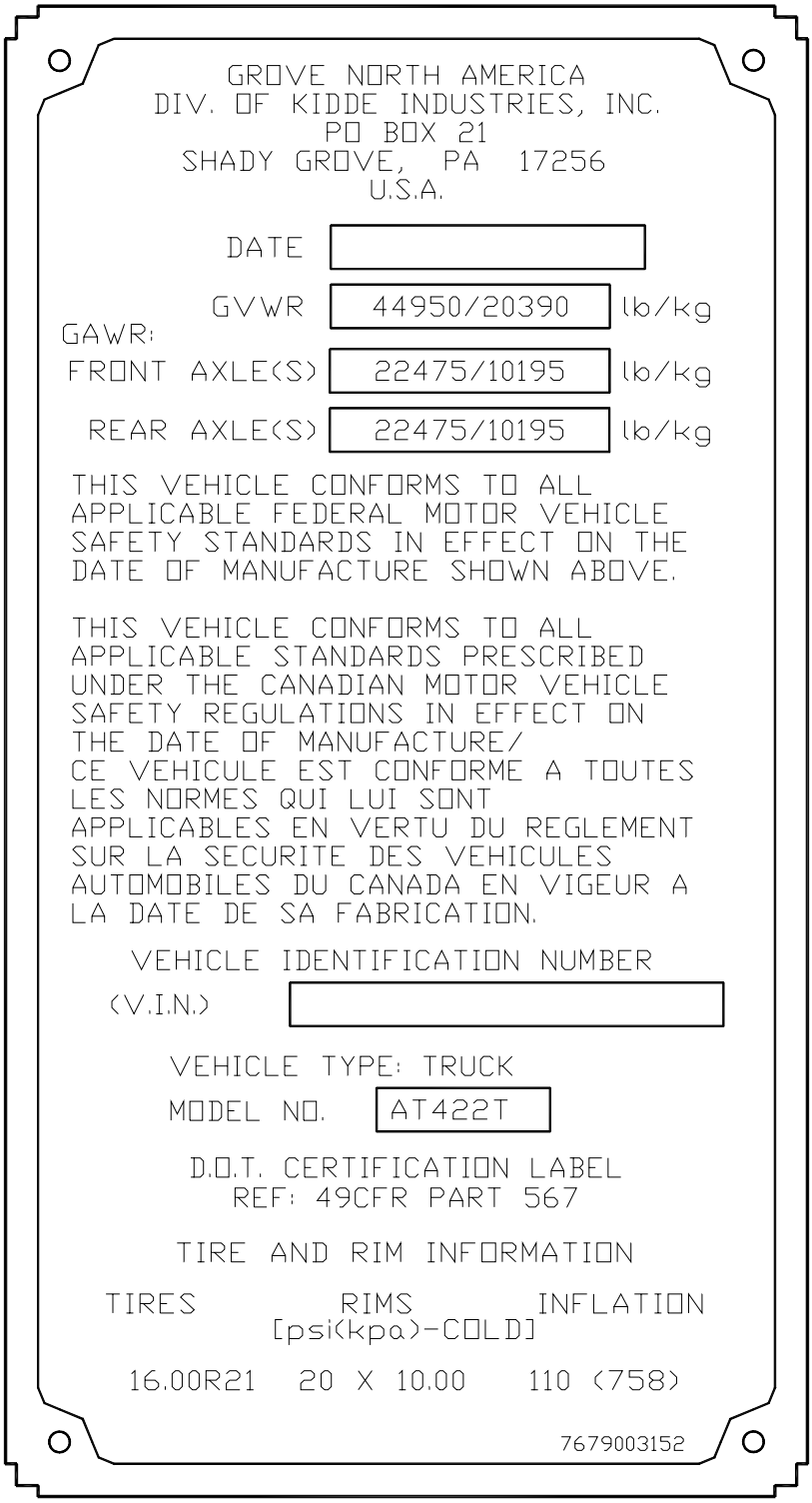

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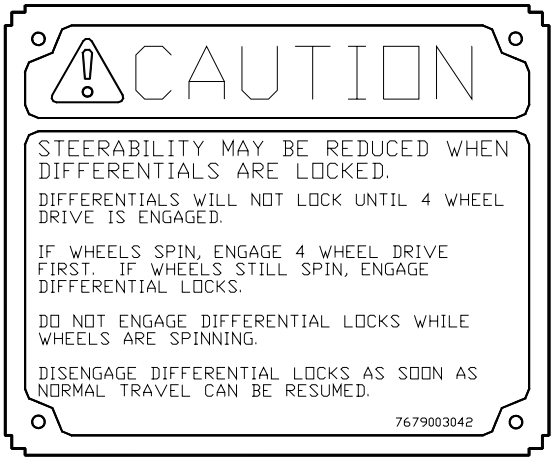
Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 24 of 30)



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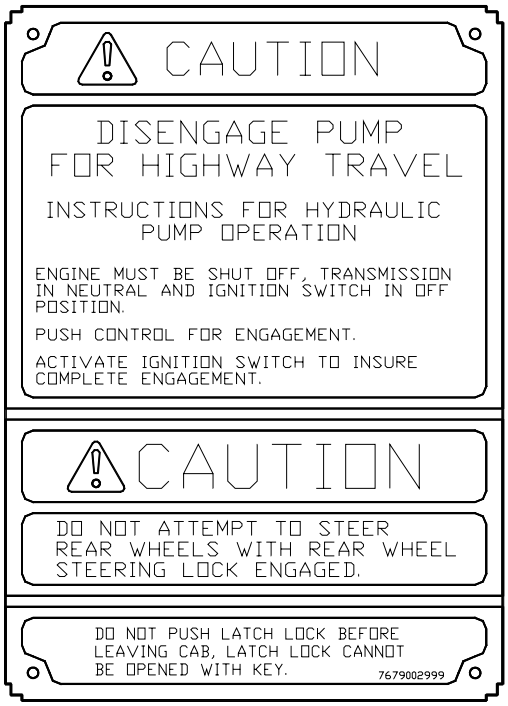

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Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 25 of 30)

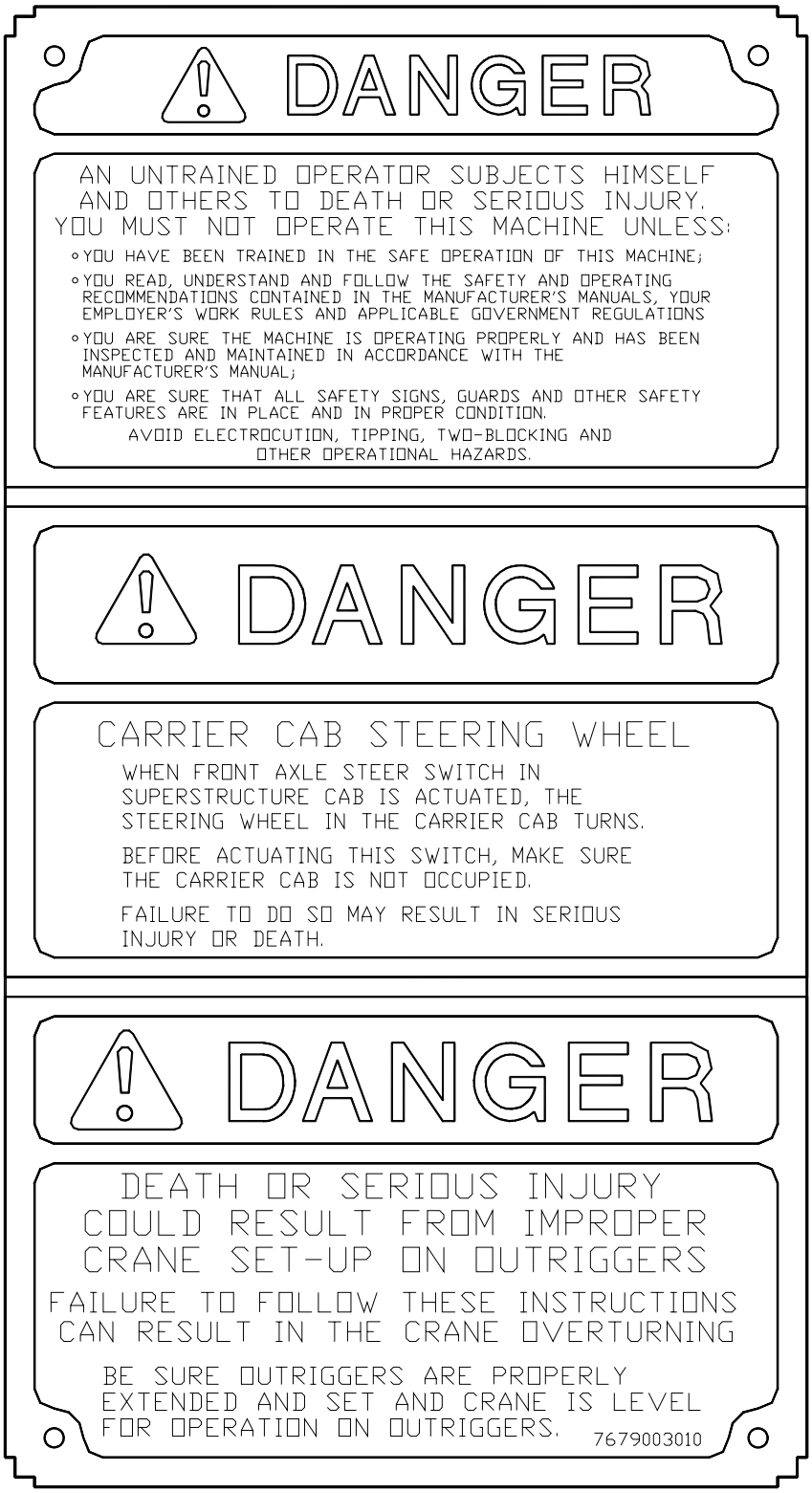

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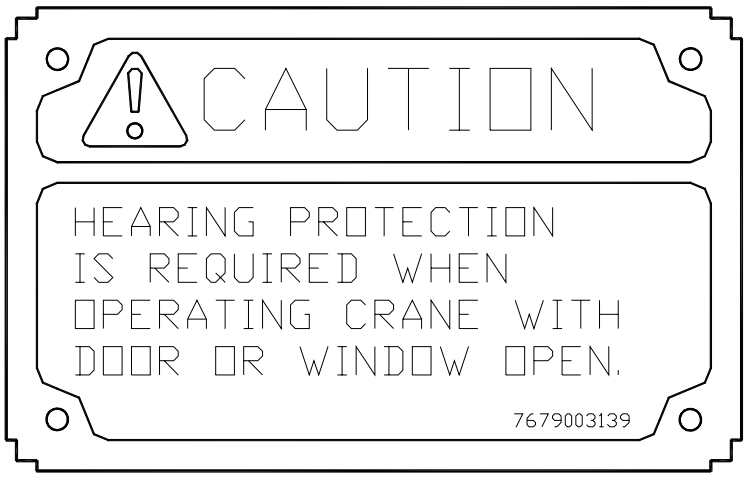
Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 26 of 30)



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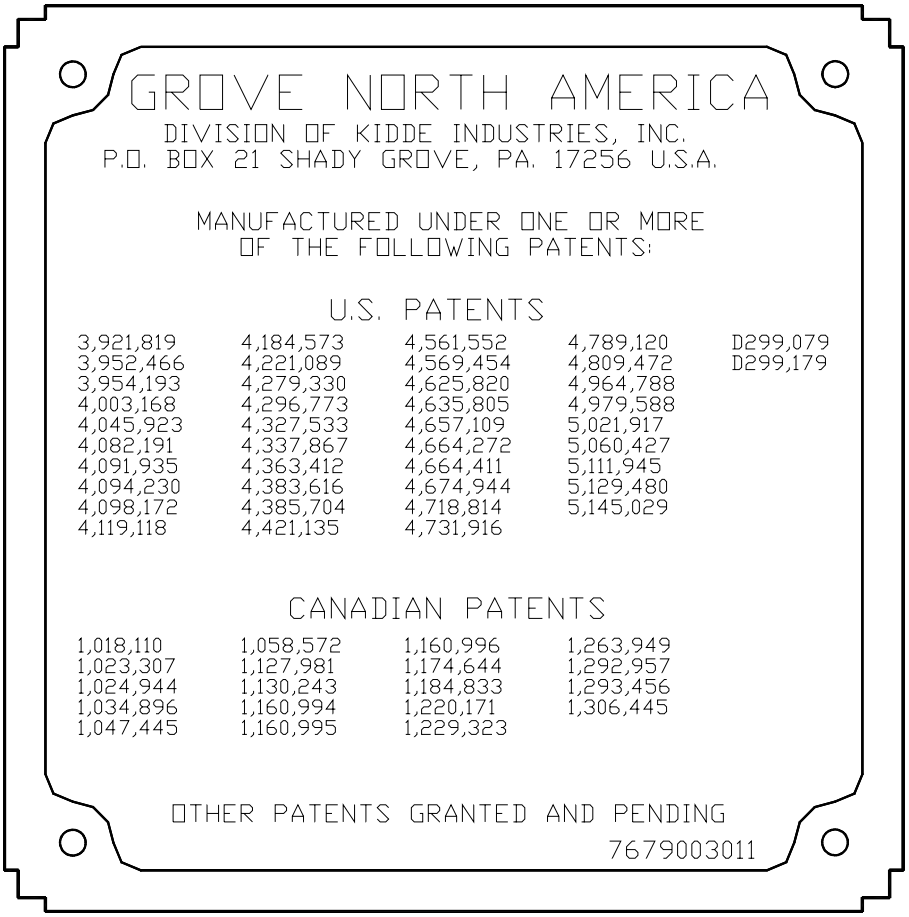

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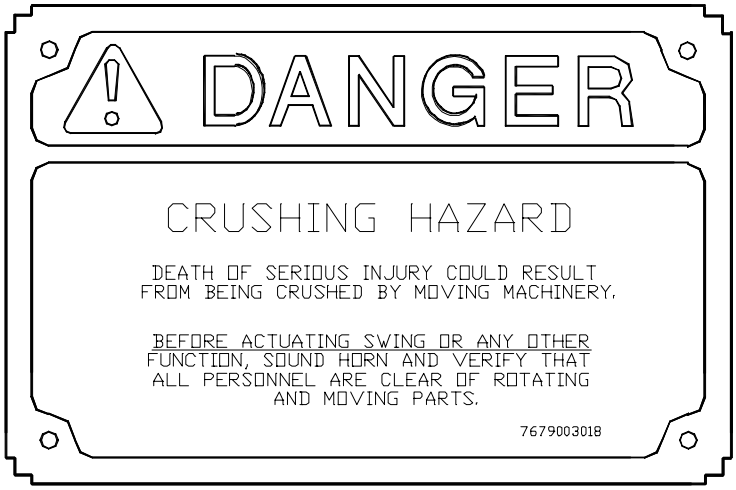
Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 27 of 30)



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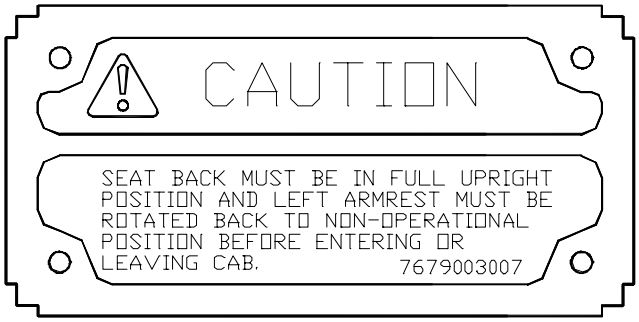

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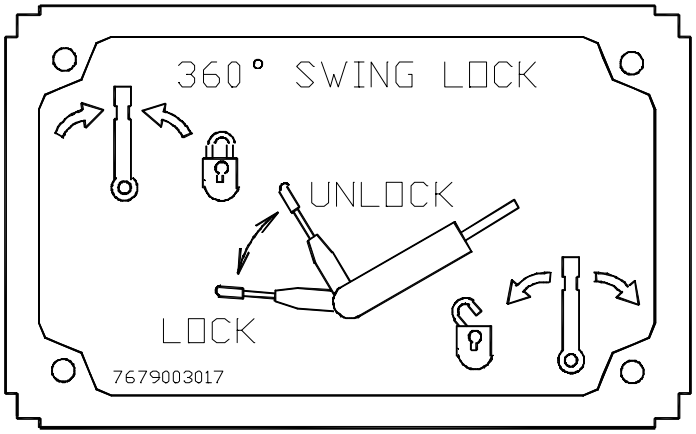

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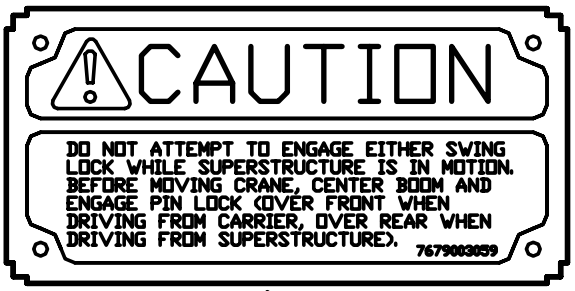
Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 28 of 30)



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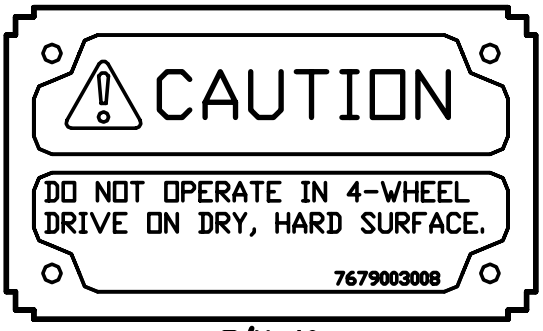

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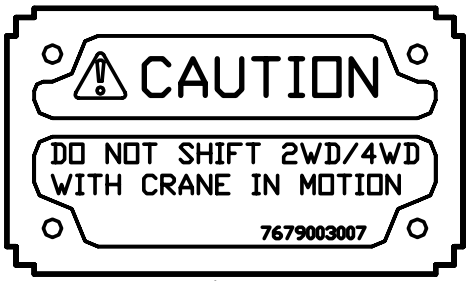

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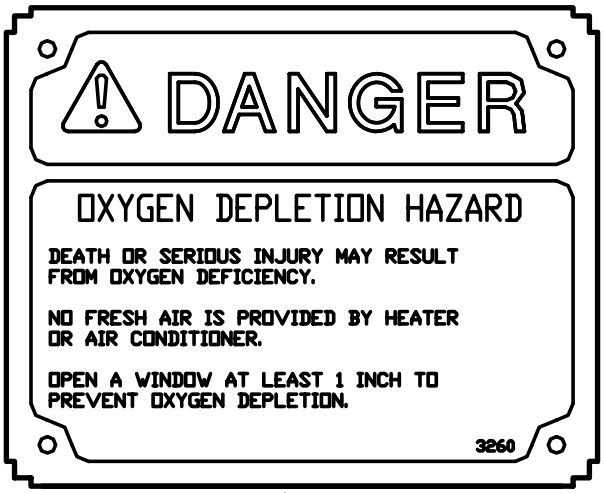

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Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 29 of 30)

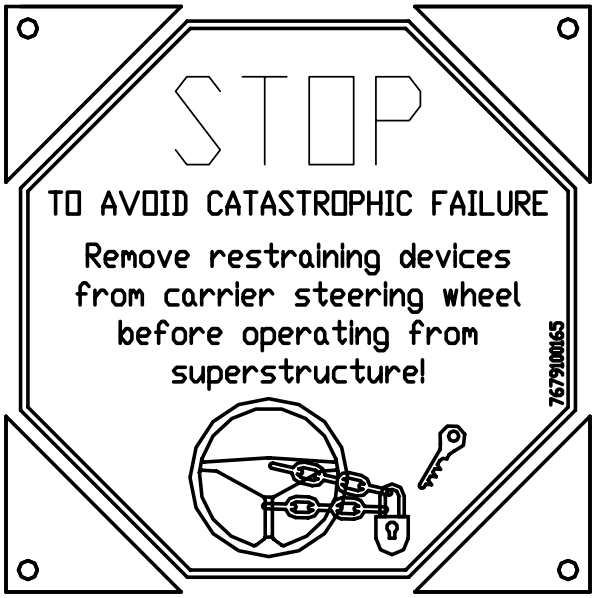

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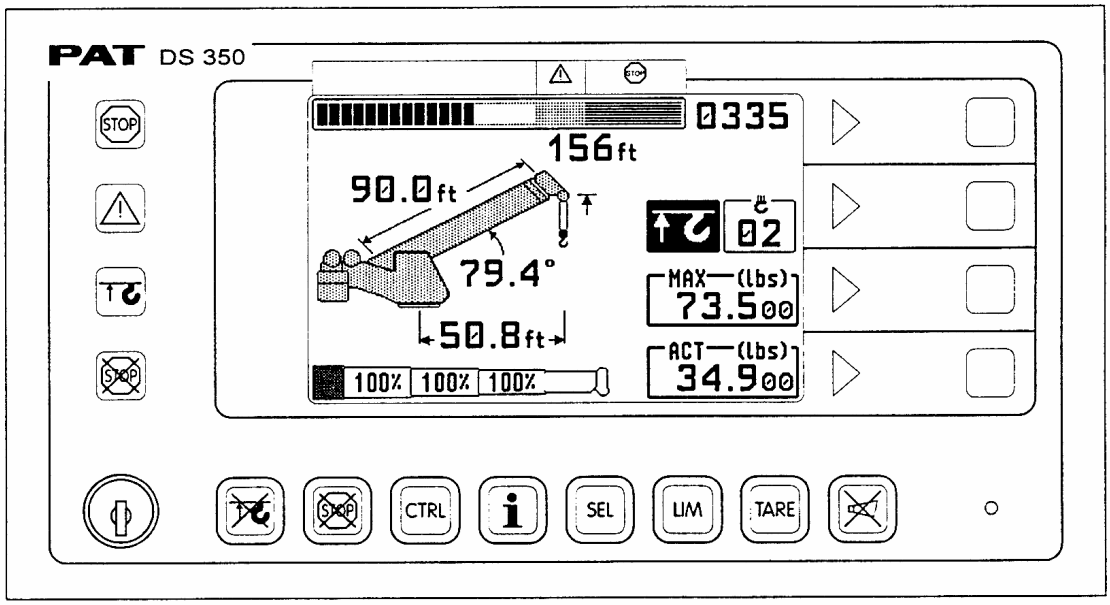
Figure F-1. Location/Description of Signs/Decals/Data Plates (Sheet 30 of 30)

APPENDIX G

LOAD MOMENT INDICATOR



DS 350 / 1328 GRAPHIC

for ATEC AT422T

OPERATOR'S HANDBOOK

TABLE OF CONTENTS

1 GENERAL INFORMATION

The PAT Load Moment Indicator[1] (LMI) DS 350 has been designed to provide the crane operator with the essential information required to operate the machine within its design parameters.

This low temperature system uses heaters for stable system operation in a subzero climate. The main electronics are automatically warmed before the system boards and components are energized. Therefore, all system components must be installed and sealed from the environment when operating and/or troubleshooting in low temperature conditions.

Using a variety of sensing devices, the Load Moment Indicator (LMI) system monitors various crane functions and provides the operator with a continuous reading of the crane's capacity. The readings continuously change as the crane moves through the motions necessary to make the lift.

The LMI provides the operator with information regarding the length and angle of the boom, working radius, rated load and the calculated total weight being lifted by the crane.

If prohibited conditions are approached, the DS 350 Load Moment Indicator will warn the operator by sounding an audible alarm, lighting a warning light, and rendering inoperative those functions that may aggravate the crane's condition.

[1] LOAD MOMENT: generally the product of a force and its moment arm; specifically, the product of the load and the load-radius. Used in the determination of the lifting capacity of a crane.

2 WARNINGS

The LMI is an operational aid that warns a crane operator of approaching overload conditions and of overhoist conditions that could cause damage to equipment and personnel.

The device is not, and shall not, be a substitute for good operator judgment, experience and use of accepted safe crane operating procedures.

The responsibility for the safe crane operation shall remain with the crane operator who shall ensure that all warnings and instructions in this manual supplied by the crane manufacturer are fully understood and observed.

Prior to operating the crane, the operator must carefully and thoroughly read and understand the information in this manual to ensure that he knows the operation and limitations of indicator and crane.

WARNING

The PRIMARY (i.e. cab-side) anti-two block switch must be used in ALL Operations except operation of the Berminghammer pile driver system. Simultaneous two-hoist working is prohibited in all circumstances other than operation of the Linkbelt Pile Driver System.

Proper functioning depends upon proper daily inspection and observance of the operating instructions set forth in this manual. Refer to Section 6. *Pre-Operation Inspection and Calibration Verification* of this handbook.

WARNING

The LMI can only work correctly, if all adjustments have been properly set. For correct adjustment, the operator has to answer thoroughly and correctly all questions asked during the setup procedure in accordance with the real rigging state of the crane. To prevent material damage and serious or even fatal accidents, the correct adjustment of the LMI has to be ensured before starting the crane operation.

3 SYSTEM DESCRIPTION

The PAT Load Moment Indicator DS 350 consists of a central (micro) processing unit (CPU), operating display console, length/angle sensor, pressure transducers, and anti-two block switches. This low temperature system uses heaters for stable system operation in a subzero climate. The main electronics are automatically warmed before the system boards and components are energized. Therefore, a warming period will be required in low temperature conditions.

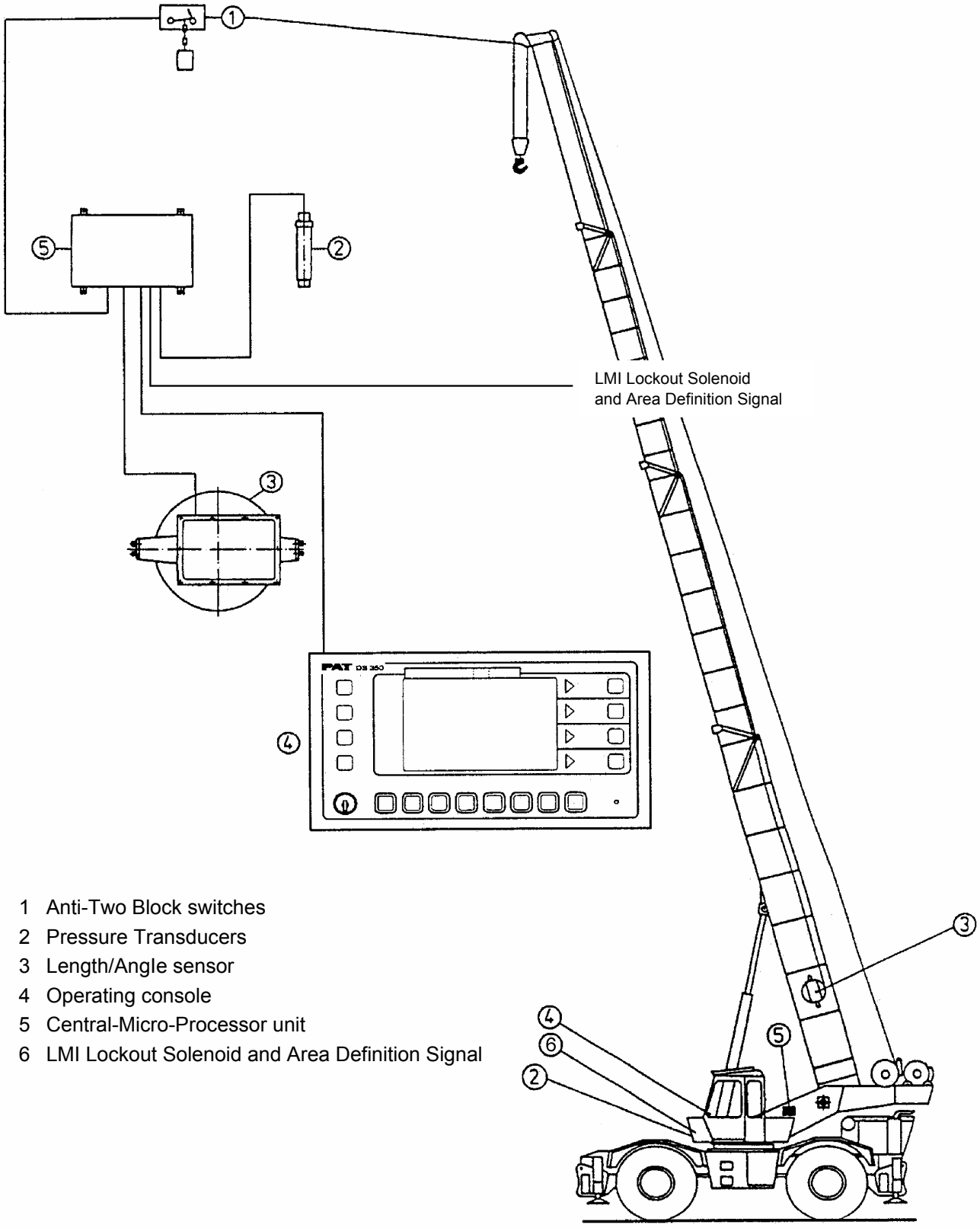
The system operates on the principle of reference/real comparison. The real value, resulting from the pressure measurement is compared with the reference data, stored in the central processor memory and evaluated in the micro processor. When limits are reached, an overload warning signal is generated at the operator's console. At the same time, the aggravating crane movements, such as hoist up, telescope out and boom down, will be stopped by activating an LMI lockout solenoid.

The fixed data regarding the crane, such as capacity charts, boom weights, centers of gravity and dimensions are stored in memory chips in the central processor unit. This data is the reference information used to calculate the operating conditions.

Boom length and boom angle are registered by the length/angle sensor, mounted inside the cable reel which is mounted on the boom. The boom length is measured by the cable reel cable which also serves as an electrical conductor for the anti-two block switches.

The crane load is measured by pressure transducers attached to the piston and rod side of the hoist cylinders.

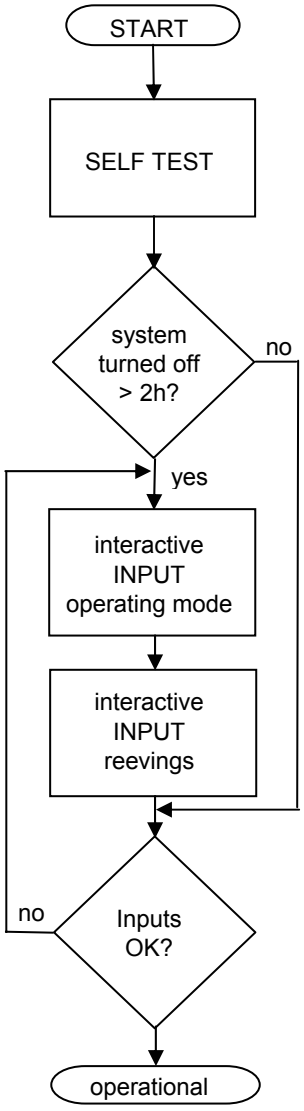
The interactive user guidance considerably simplifies the input of operating modes as well as the setting of geometry limit values.



1 Anti-Two Block switches
2 Pressure Transducers
3 Length/Angle sensor
4 Operating console
5 Central-Micro-Processor unit
6 LMI Lockout Solenoid and Area Definition Signal

Fig. 1: Components of the LMI system PAT DS 350

3.1 System Function



Upon switching on, the system starts with an automatic test of the LMI system, of lamps and audible alarm. During the test, the LC display shows the initial logo.

If the system was turned off for more than two hours, the setup configuration has to be entered after the system test. (⇨ chapter 4)

First, the operating mode is determined by an interactive step-by-step interrogation of the rigging states.

Next is the interactive input of the reeving.

Now the LC display shows in symbols all inputs and awaits acknowledgment or canceling.

Upon acknowledgment of the inputs the system is ready for operation.

3.2 Operating Console

The console has 3 functions:

- inputs by the crane operator (operating mode, reeving)
- input of geometry limit values and signalization of exceeded limit values
- display of important data and information

The operator's console is mounted in the crane's cab in the operator's field of vision. For a better identification of displays and operating elements, they are continuously backlit during operation.

3.3 Control Identification

This unit contains a display and different controls which are described as follows:

Legend to **Fig 2:**

1 LC Display Area
2 Load Moment Limit Light
3 Load Moment Prewarning Light
4 Alarm Light “Anti-Two Block”
5 Override Key Warning Light
6 Button “Alarm Stop”
7 Button and Control Light “TARE”
8 Button and Control Light “LIMITS”
9 Button and Control Light “SELECT OPERATION MODE”
10 Button and Control Light “INFO”
11 Button and Control Light “CONTROL”; backlight control button
12 Audible Alarm
13 By-Pass Key Switch
14 Button and Control Light “By-Pass Anti-Two Block”
15 Button and Control Light “By-Pass LMI shut-off function”
F1 Button “Function 1”; used in configuration setup
F2 Button “Function 2”; used in configuration setup
F3 Button “Function 3”; used in configuration setup
F4 Button “Function 4”; used in configuration setup

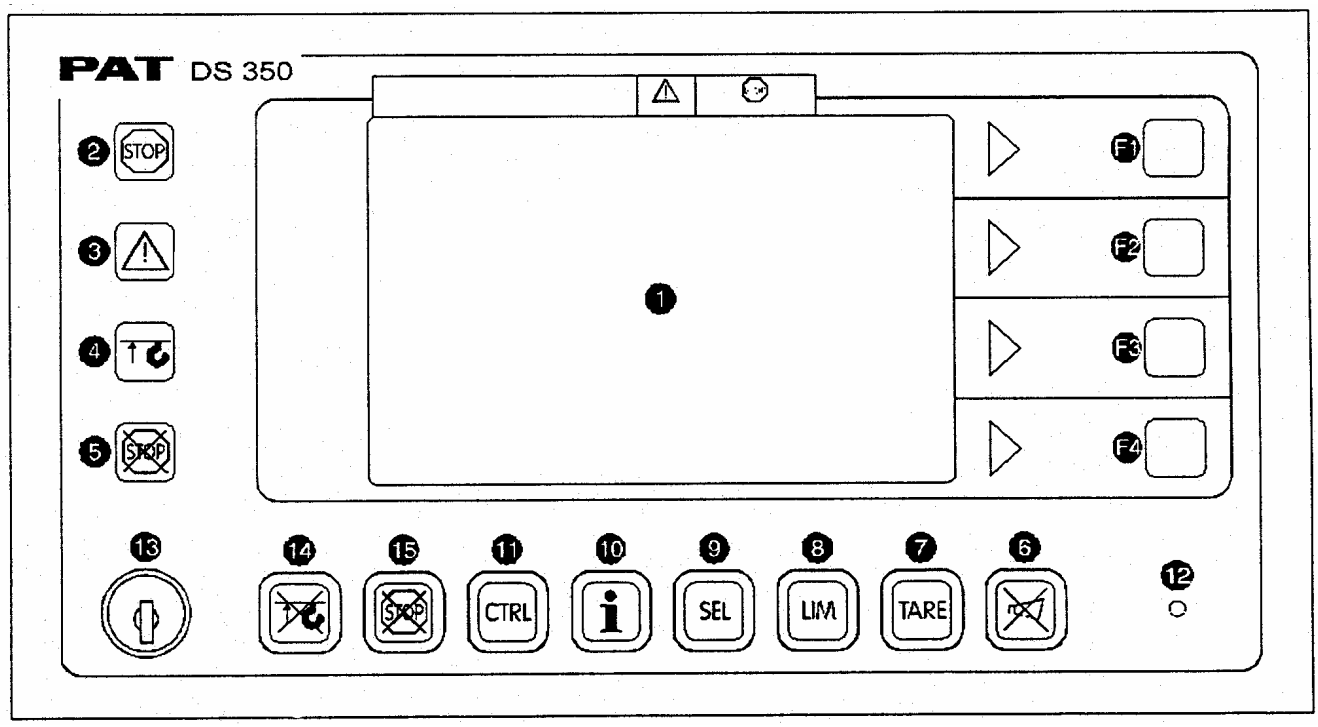


Fig. 2: Operating Console

❶ LC-Display

The LC Display visualizes graphical symbols, texts and numerical values. Depending on the selected operating mode (setup, limit mode or LMI representation), the corresponding information is indicated on the display.

Please refer to specific information for selected operating mode.

The display shows a utilization bar graph below the green, yellow, and red area over the upper left portion of the display. The utilization bar graph indicates the percent load of the maximum load. The green portion indicates 0 to 90%, the yellow prewarning indicates 10% to overload cutout, and the red indicates overload over 100% of maximum load.

❷ Load Moment Limit Light

The red LOAD MOMENT LIMIT LIGHT (2) warns the operator that a rated load condition has been reached. When the load on the crane reaches the crane load capacity this light comes on and the audible alarm sounds. During this condition, the following crane movements will be stopped concurrently: hoist up, telescope out, and boom down

❸ Load Moment Prewarning Light

The yellow LOAD MOMENT PRE-WARNING LIGHT (3) will light up when the load on the crane reaches the defined prewarning area, thus indicating that an overload condition is approaching.
The operator should continue crane operation only with extreme caution.

❹ Alarm Light “Anti-Two Block”

The red “Anti-Two Block Alarm Light” (4) lights up when the anti-two block limit switch contacts open, indicating that a two-blocking condition is approaching. At the same time the audible alarm will sound and the following crane movements will be stopped: hoist up, telescope out, boom down.

❺ Override Key Warning Light

The red OVERRIDE KEY WARNING LIGHT (5) flashes to indicate that the cut-off function of the A2B / LMI system is deactivated.

❻ Button and Control Light “Alarm Stop”

This ALARM STOP BUTTON (6) allows the audible alarm to be silenced for approximately 15 seconds by pressing this button. Reference □ “Audible Alarm” (12).

❼ Button and Control Light “Tare”

The button “TARE” (7) is used to indicate the “Net load” on the LC Display (1). Net load is the present load, less lifting tackle and hook block. The Tare Button (7) must be activated before lifting.

After pushing the “Tare Button” (7) the load display is set to zero (taring) and the control light lights up. After lifting a load the display shows the net load (pay load).

The net load display will change to the actual load display when the boom radius is changed (either by angle or length).

❽ Button “LIMITS”

Button to start the function “program limit values”.
Please refer to Section 5.1 for the setup procedure.

⑨ Button Select

Button to start the function “set operating mode”.
For the proceeding please refer to Section 4.1.

WARNING

The correct setting is of utmost importance for the proper function of the system and the crane. Therefore only operators who are thoroughly familiar with use and operation of the system shall set this button.

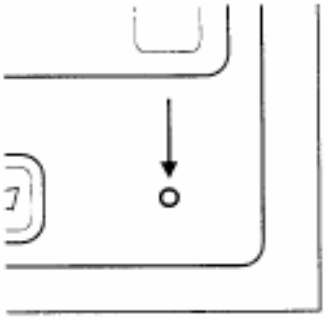
⑩ Button “INFO”

Button to start the function “information crane configuration”
Please refer to Section 5.2.

⑪ Button “CONTROL”

Button to start additional functions.
Please refer to Section 5.3.

⑫ Audible Alarm

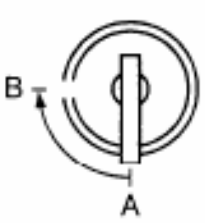


The AUDIBLE ALARM (12), sounds during the following conditions:

- overload condition
- approaching two-block condition
- preset limits reached
- malfunction of the LMI system
- operating error

The alarm can be temporarily silenced by pushing the button “Alarm Stop” (6).

⓭ Key Switch



The anti-two block switch cut-off function is deactivated when the KEY SWITCH (13) is turned to position “B” and the “By-pass A2B” button (14) is pushed.
OR
The LMI cut-off function is deactivated when the KEY SWITCH (13) is turned to position “B” and the “By-pass LMI” button (15) is pushed

WARNING

Since button (14) and (15) deactivate the cut-off function of the LMI system/ anti-two block system, the following instructions must be obeyed:

- The by-pass function shall be used with discretion, as unwarranted use of it to override the control lever lockout system can result in harm to the crane and danger to property and persons.
- Never use the by-pass function to either overload or operate the crane in a non permissible range.

⓮ Button “By-pass A2B”

This button can be operated only if key switch (13) is turned to position B.
After pushing this button, the cut-off function of the anti-two block switch is deactivated.
The Override Key Warning Light (5) flashes to indicate that the cut-off function is deactivated.

⓯ Button “By-pass LMI”

This button can be operated only if key switch (13) is turned to position B.
After pushing this button, the control lever lockout function of the LMI is deactivated.
The Override Key Warning Light (5) flashes to indicate that the cut-off function is deactivated.

4 CONFIGURATION SETUP

The LMI setup procedure allows the operator to input the crane configuration using interactive displays. The operator must complete the setup procedure for the Load Moment Indicator system if the system has been turned off for more than two hours or the crane operation configuration has been changed.

4.1 LMI Setup Procedure

...starts:

- *automatically,* if the system was turned off for more than two hours.
- *manually* at each modification of the crane configuration by pressing key (9) “SEL”

...is operated:

- by answering the different questions using functional keys F1...F4 in accordance with the actual configuration of the crane.

...is cancelled:

- any time by pressing again key (9) “SEL”. The system, however, is only ready for operation, if the procedure has been completed and the inputs have been confirmed.

If the system is turned off less than two hours (during short breaks), all adjustments remain stored. When turning the system on again these adjustments can be acknowledged by merely pressing the “OK” function if the crane configuration has not been modified.

NOTE

During low temperatures the LC Display will not show the graphics, or become operational, until the display console heater has warmed the electronics.

During the programming procedure the Load Moment Prewarning Light (3) and the Load Moment Limit Light (2) will light up and the aggravating crane movements will be interrupted.

NOTE

If a configuration is selected which is not available, the display will indicate error code E04. In this case, the procedure has to be repeated with valid values.

WARNING

The correct setting is of utmost importance for the proper functioning of the system and the crane. Therefore, only operators who are thoroughly familiar with the crane and the operation of the system should execute the setting of the system according to the operating configuration of the crane.

The LMI programming procedure consists of the following steps:

NOTE

The main boom and counter weight configuration are automatically setup. This system is not set up for use with an extension or additional counter weight.

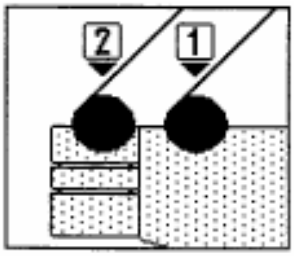
- setting the hoist configuration
- setting the outrigger configuration
- setting the reevings
- confirmation of the programming procedure

For easy operation, the computer guides the operator through the procedure step by step (interactive operation).

Definition of the Displayed Symbols:

The following illustrations define the symbols appearing on the display during the setup procedure. Not all symbols will be shown, depending on the crane type and the answers to the questions.

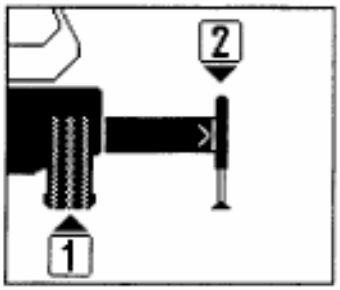
- **Setting the hoist configuration**



1 Front Hoist

2 Rear Hoist

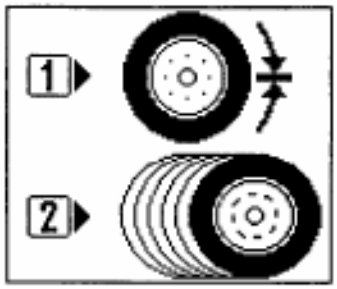
- **Setting the outrigger configuration**



1 on rubber

2 outrigger fully extended (100% position)

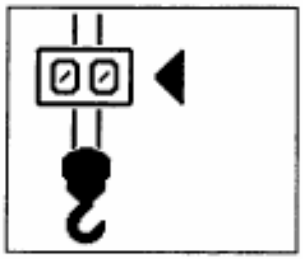
If 1 (on rubber) is selected you have the following choices.



1 static

2 pick and carry

- **Setting the reeving (parts of line)**

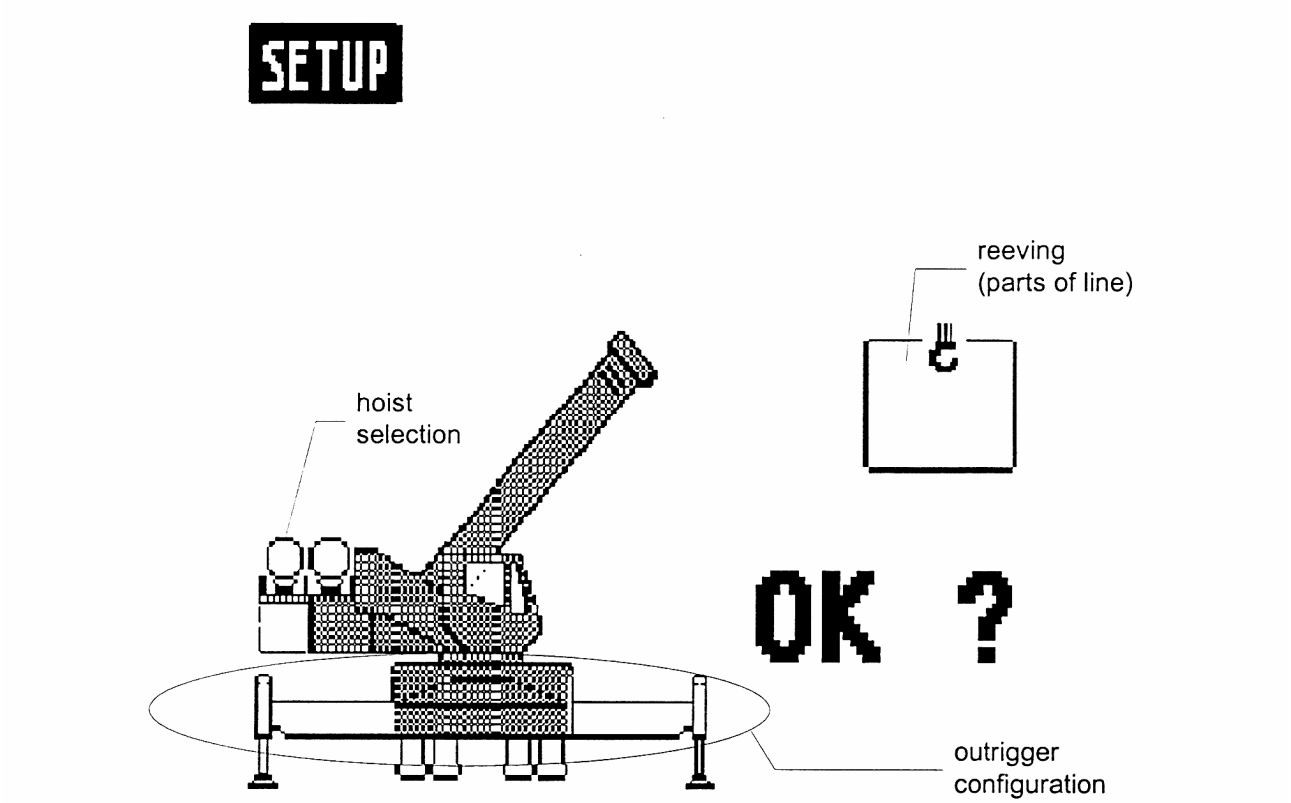


+ increase reeving

− decrease reeving

OK confirm reeving

- **Confirmation of the programming procedure**



At the end of the procedure all inputs are represented once again in symbolic forms. If inputs have been made, the corresponding symbols are filled black.


Quick setting the reeving
(⇨ Section 4.3)


quick hoist line selection
(⇨ Section 4.2)

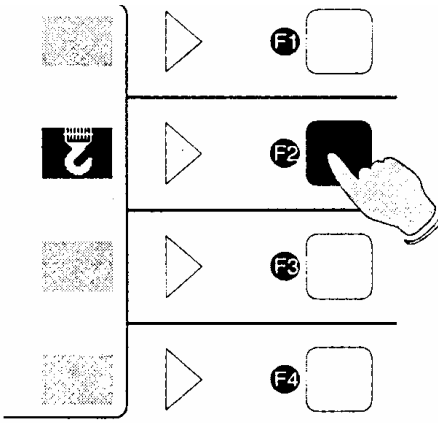
DEL cancel procedure

OK confirm inputs

4.2 Quick Setting of the Reeving

If, during the crane operation, the reeving is modified, the LMI system has to be adjusted to this modification. The input of the reeving can be carried out directly without having to go through the whole LMI programming procedure again:

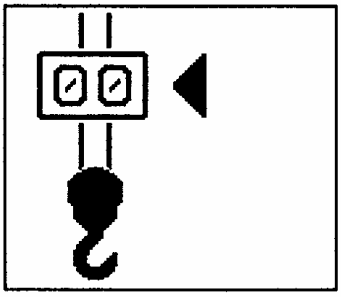
Call LMI Programming Procedure.



Directly call function “Quick Setting of the Reevings”.

NOTE

The direct call is impossible, if the system has been turned off for more than two hours.

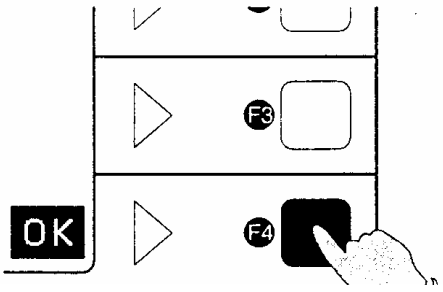


input of reeving:

increase reeving

decrease reeving

confirm reeving



Confirm modification.

(select again the function upon faulty input)

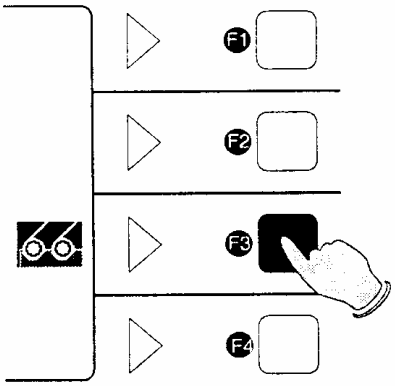
NOTE

If a configuration is selected which is not available on the present crane, the system will not accept the selection and the display will indicate the error code E04.

4.3 Quick Hoist Line Selection

If, during the crane operation, the crane is switched over from front to rear hoist, the LMI system has to be adjusted to this modification. This modification can be entered without having to go through the whole LMI setup procedure again:

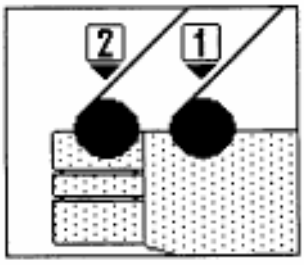
Call LMI setup procedure.



Directly call function “Hoist Line Selection”.

NOTE

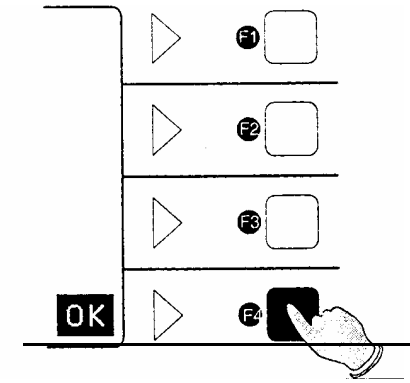
The direct call is not possible, if the system has been turned off for more than two hours.



Select hoist:

1 Front Hoist

2 Rear Hoist



Confirm modification.

(call up the function again if you have selected the wrong hoist by mistake)

NOTE

If a configuration is selected which is not available on the crane, the system will not accept the selection and the display will indicate the error code E04.

4.4 Anti-Two Block (A2B) Switch(es)

AT422T cranes are provided with two different configurations of anti-two block switches, i.e. some having only one switch, and some having two switches. Correct use of the anti-two block switches must be followed to prevent material damage and serious or even fatal accidents. The applications under which these switches are used are described below:

a. Primary Anti-Two Block Switch (Mandatory For All Operations)

The **Primary** (i.e. cab-side) anti-two block switch is used in **ALL** applications (expect operation of the Berminghammer pile driver system). For single-hoist working (i.e. normal lifting operations), always use this switch, with the weight and chain installed correctly around the main hoist cable (if the crane also has a Secondary (i.e. right-side) anti-two block switch installed, the secondary switch is used **only** in operation of the Linkbelt pile driver system).

For single-hoist working with cranes on which a secondary switch is also installed, the weight and chain is to be removed from the secondary switch and the by-pass flag installed. Failure to do this will result in the primary switch being non-functional. However, if the crane is being used for pile-driving operations, see Paragraph b. below.

b. Secondary Anti-Two Block Switch (Pile Driving Applications Only)

Operation of the Linkbelt pile driver system requires the use of a **Secondary** (i.e. right-side) anti-two block switch, as well as the Primary Switch described in Paragraph a. above. The **Secondary** Switch must be used with the by-pass flag removed and the weight and chain attached around the auxiliary hoist cable.

ONLY during operation of the Linkbelt pile driver system is the Secondary Switch used, because Pile-Driving is the **only** application in which it is permissible to deploy and operate both hoists simultaneously.

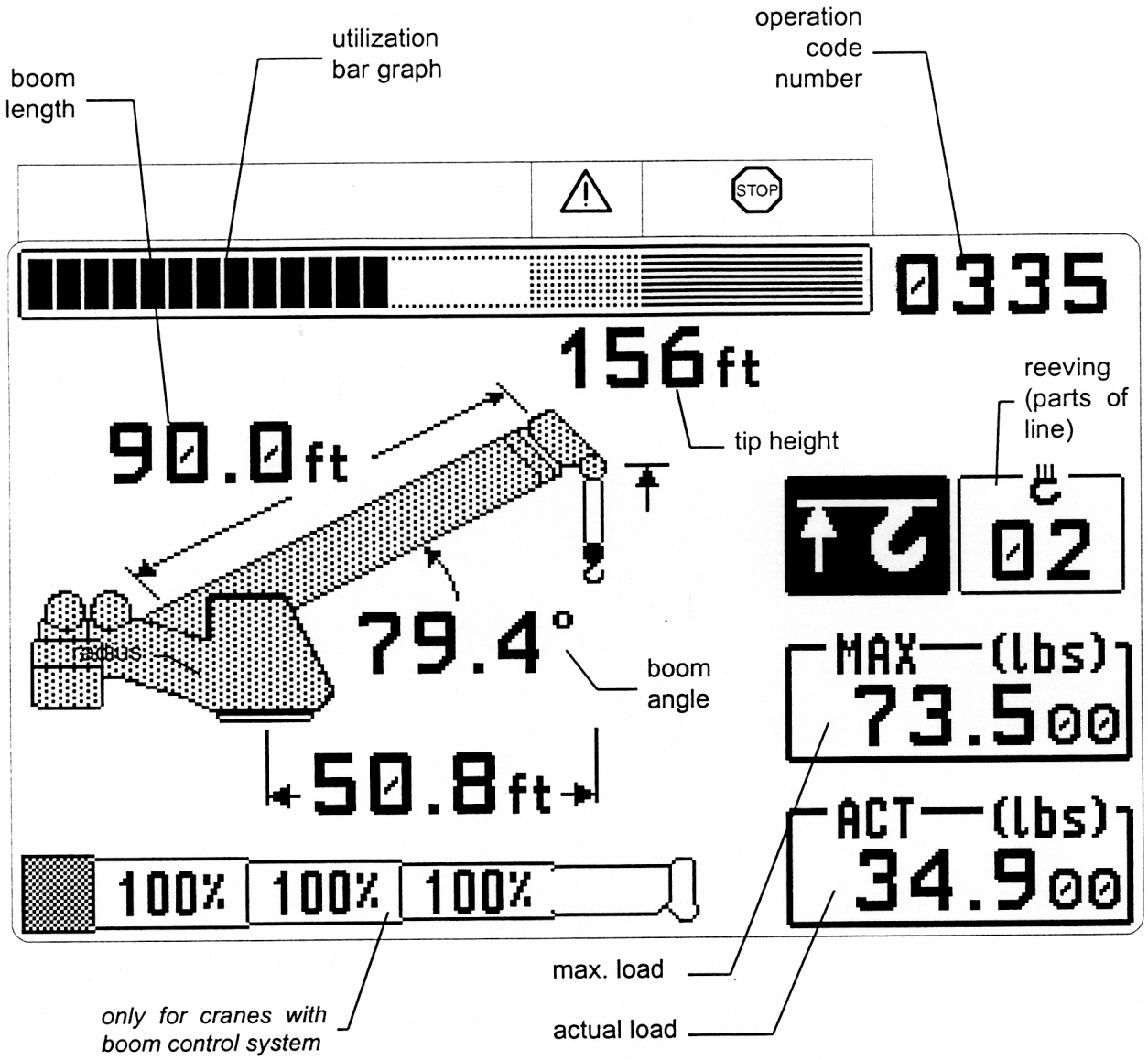
Operation of the Berminghammer pile driver system uses an impact hammer stop, installed near the top of the lead tower, to physically prevent the impact hammer from colliding with the boom nose by limiting its vertical travel. This replaces the anti-two block function of the Load Moment Indicator (LMI) system.

WARNING

The PRIMARY (i.e. cab-side) anti-two block switch must be used in ALL Operations except operation of the Berminghammer pile driver system. Simultaneous two-hoist working is prohibited in all circumstances other than operation of the Linkbelt Pile Driver System.

5 OPERATION

After having set the LMI to the actual crane configuration, the system is ready for operation. The display shows the LMI screen (example for value representation).



When the system condition is activated, the following symbols will be displayed:

Symbol **Anti-Two Block Alarm**
- visible when the anti-two block limit switch contacts open, indicating that a two-blocking condition is approaching

Symbol **height limitation:**
- continuously visible:
  height limitation active
- blinking:
  height limit exceeded
  (⇨ see Section 5.1.2)

Symbol **boom angle limitation:**
- continuously visible:
  boom angle limitation active
- blinking:
  angle limits exceeded
  (⇨ see Section 5.1.3)

Symbol **radius limitation**
- continuously visible:
  radius limitation active
- blinking:
  range limits exceeded
  (⇨ see Section 5.1.4)

E####

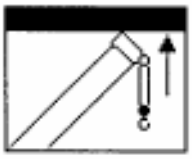
Error code No. ####
(⇨ see Section 8 “Troubleshooting”)

5.1 LIMIT Setting

The LMI system has been equipped with programmable limits for the crane's operation range.

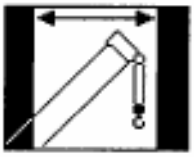
- Easy programming due to interactive, step-by-step user guidance.
- Functions can be used individually or in combinations.
- Exceeding a programmed limit triggers an audible and visual alarm.

Overview limits:



Tip Height Limitation
(⇨ *Section 5.1.1)*

Boom Angle Limitation
(⇨ *Section 5.1.2)*



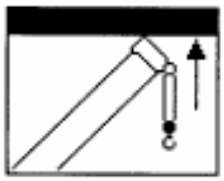
Radius Limitation
(⇨ *Section 5.1.3)*

5.1.1 Set Tip Height Limitation

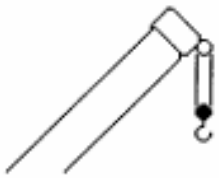
Programmable function for the limitation of the tip height

- **Set tip height / delete height limitation:**

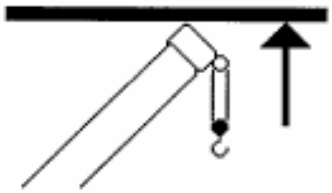
Call LIMIT Setting.

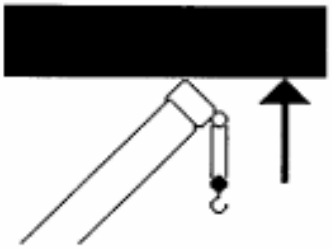


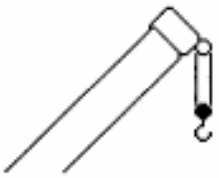
Press the corresponding figure to select function “tip height limitation”.



Press key.







set:	delete:
Move the tip to the required upper limit. SET set present tip height as upper limit. Display shows symbol and value of the programmed height limit.	DEL delete tip height limitation. Display shows symbol without values.

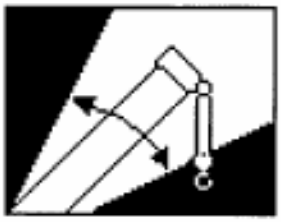
OK quit function.

5.1.2 Set Boom Angle Limitation

Programmable function for the limitation of the upper and/or lower boom angle.

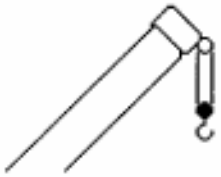
- **Call function:**

Call LIMIT Setting.



Enter the corresponding figure to call function “boom angle limitation”.

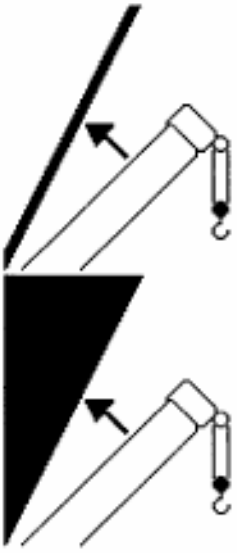
- **set / delete upper limit value:**



Select limit:

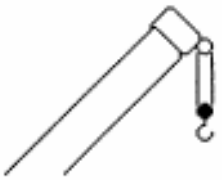
selection upper boom angle limit.

set:	**delete:**
Raise the boom the requested limit value.	DEL delete upper angle limit.
SET set present boom angle as upper limit.	
Display shows symbol with value of the upper angle limit.	Display shows symbol without value of the upper angle limit.



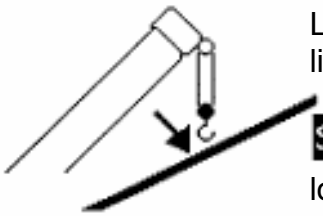
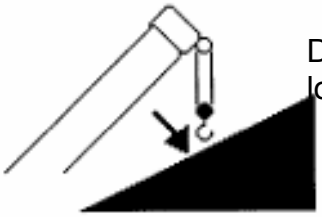
OK quit function.

- **set / delete lower limit angle:**



Select limit:

selection lower boom angle limit.

set:	delete:
 Lower the boom to the required limit value.  set present boom angle as lower limit.	 delete lower angle limit.
 Display shows symbol with lower angle limit.	Display shows symbol without value of the lower limit angle.

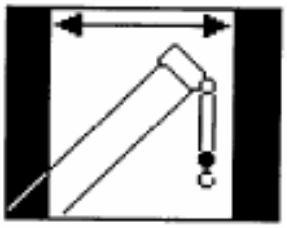
 quit function.

5.1.3 Set Radius Limitation

Programmable function for the limitation of the minimum and/or maximum working radius.

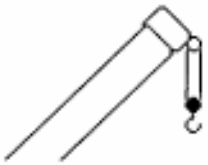
- **Call function:**

Call LIMIT Setting.



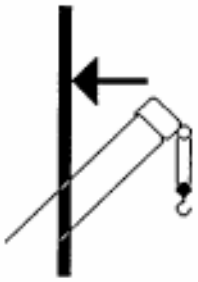
Select the corresponding figure to call the function “radius limitation”.

- **set / delete minimum radius:**

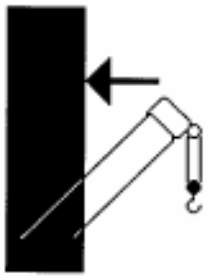


Select limits:

select minimum radius limit.



set:	**delete:**
position boom at the required minimum radius value.	DEL delete minimum radius limit.
SET set present boom radius as minimum radius.	

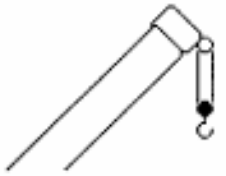


Display shows symbol with radius value of minimum limit.

Display shows symbol without value of minimum radius.

OK quit function.

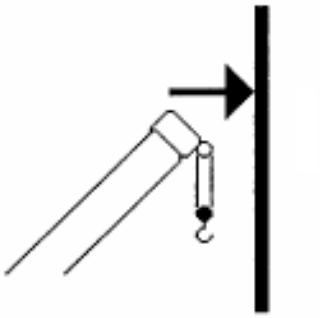
- **set / delete maximum radius:**

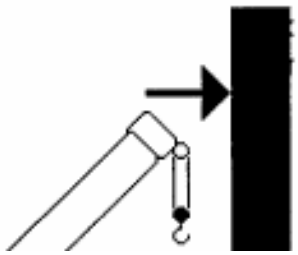


Select limit:

selection maximum radius limit.

set:	**delete:**
Position boom to the required maximum radius value. SET set present boom radius as maximum radius.	DEL delete maximum radius limit.
Display shows symbol with radius value of max. limit.	Display shows symbol without value of max. radius.





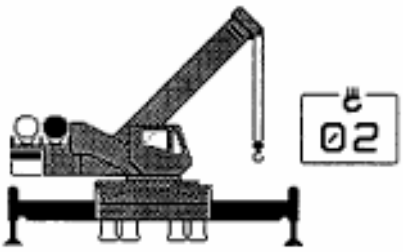
quit function.

5.2 INFO Crane Configuration

With the system being ready for operation, this function serves to display the system configuration

- **Call function**

Press key “INFO”.



The display shows the crane symbol representing the adjusted configuration (marked black), the extended operating code number and the reeving number (parts of line).

- **End function**

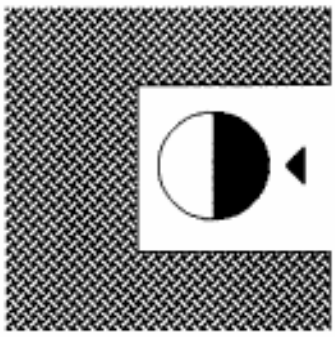
Press again key “INFO”.

5.3 Display Contrast Control

This function serves for the contrast adjustment of the LC display. The last adjustment is stored and does not have to be repeated at every system start.

- **Contrast adjustment**

Press “CTRL”.



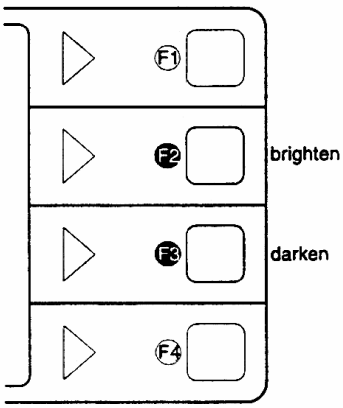
A pattern is shown by means of which the display can be adjusted to the optimum contrast. Use the functional keys to modify the contrast upon request:

+ darken display.

– brighten display.

OK confirm setting

Press key “OK” to store the adjusted contrast value and to quit the function.



During normal LMI operation the display contrast can be adjusted too by pressing button:

F2 (brighten display) or
F3 (darken display).

6 Pre-Operation Inspection and Calibration Verification

Before operating the crane, the following electrical connections must be checked to ensure that the system is properly connected for the crane configuration.

Check that the weight of the anti-two block switch is properly installed on the main hoist load line. The hoist line runs through the anti-two block weight. With even parts of hoisting line, the weight must be attached to the dead-end line. With odd parts of hoisting line, the weight shall be attached to the line of lowest speed.

After the electrical connections have been checked to insure that the system is properly connected for the crane configuration, the following checks shall be made:

1. Check the electrical wiring connecting the various parts of the system for physical damage.
2. Check the anti-two block switch and weight for free movement.
3. Check the spring-loaded cable reel to be sure it is free to rotate, has tension and the cable is reeled properly.

WARNING

The following tests shall be performed with care to prevent damage to the machine or injury to personnel. Proper functioning of the system requires successful completion of these tests before operating the machine.

If the operator cannot see the load handling device approaching the boom nose, he shall have an assistant (signal person) watch the load handling device. The operator shall be prepared to stop the machine immediately should the LMI system not function properly as indicated by lighting the red warning light (4), sounding the audible alarm (12) and locking the crane movements, hoist up, telescope out and boom down (see Page G-10 for location of these components on the LC Display).

4. Check the anti-two block alarm light (4) and the audible alarm (12) by performing one of the following tests:

   A) By manually lifting the weight attached to the anti-two block switches. When the weight is lifted, the audible alarm (12) should sound, the anti-two block alarm light (4) should light.
   B) Slowly raise the main boom load handling device to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (12) should sound, the anti-two block alarm light (4) should light and the motion of the load handling device should be stopped. Lower the load handling device slightly to eliminate this condition.
   C) Slowly lower the boom to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (17) should sound, the anti-two block alarm light (24) should light and the boom lowering function should be stopped. Lower the load handling device slightly to eliminate this condition.
   D) Slowly extend (telescope) the boom to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (17) should sound, the anti-two block alarm light (24) should light and the boom telescope out function should be stopped. Lower the load handling device slightly to eliminate this condition.

WARNING

If the light and audible alarms do not function as described and the crane movements are not stopped, the system is not working properly. The malfunction shall be corrected before operating the crane.

5. Check that the display of the main boom length agrees with the actual boom length.
6. Check that the display of the main boom angle agrees with the actual boom angles.
7. Check that the display of the operating radius of the crane agrees with the actual radius.
8. Check the load display by lifting a load of known weight.

Operation

Upon correct inspection, the LMI is operational. The operator shall be thoroughly familiar with all controls of the LMI before operating the crane. The proper function of the system shall be checked by lifting a load of known weight and comparing the load to the information displayed on the LMI.

Rated loads include the weight of the hook block, slings, and auxiliary load handling devices. Their combined weights shall be subtracted from the listed load capacities as stated on the load capacity chart to obtain the net load to be lifted.

WARNING

If any of the displays reflects a deviation between displayed and actual values, an authorized and qualified technician shall be called for repair of the system or verification of the crane's LMI calibration.

WARNING

Any structural modifications or changes to the crane shall require verification of the crane's LMI calibration.

7 SERVICE AND MAINTENANCE

Daily maintenance of the load moment indicator consists of inspecting:

1. The electrical wiring connecting the various parts of the system.
   If electrical wiring is damaged, it shall be replaced immediately.

2. If the insulation is worn on the length sensor cable or cable guides are damaged, these parts shall be replaced.

3. Check the anti-two block limit switch(es) for freedom of movement.

4. The cable reel shall be under tension to operate properly.

5. Check the pressure transducers at the hoist cylinder(s) and the connecting hoses for oil leakage.

Other than correcting the problems identified in the Error Codes Table and replacing faulty mechanical parts and cables, no other repairs shall be performed by non-expert personnel.

8 ERROR CODES

PROBLEM: Error code displayed. Lever lockout activated. Warning lights on.

ERROR CODE	ERROR	CAUSE	ACTION
E01	Minimum radius or maximum angle range exceeded	Fallen below the minimum radius or above the angle given in the load chart due to raising the boom too far.	Lower boom back to a radius or angle given in the load chart.
E02	Maximum radius or minimum angle range exceeded	The maximum radius or minimum angle given in the load chart was exceeded due to lowering the boom too far.	Raise boom back to a radius or angle given in the load chart.
E04	Operating mode not available	Operating mode switch in the console set incorrectly. Operating mode is not permissible with actual crane configuration.	Set operating mode switch correctly to the code assigned to the operating mode of the crane.
E05	Length range not permitted	Boom has been extended too far or not far enough. Length sensor adjustment changed; i.e. length sensor cable slid off the cable drum.	Retract or extend boom to correct length given in the load chart. See Section 6.
E07	No acknowledgment signal from overload relay (K1)	Overload relay is stuck, defective or not being selected.	Replace relay.
E08	No acknowledgment signal from Anti-Two Block switch relay (K2)	Anti-Two Block switch relay is defective or not being selected.	Replace relay.
E11	Fallen below limit for the measuring channel “length”	a.) Cable between length sensor and central unit is defective, not connected or water in the connectors. b.) Length sensor potentiometer is defective. c.) Electronic board in the measuring channel is defective.	a.) Check cable and connector as well and replace, if necessary. See Section 6. b.) Replace and reset length sensor potentiometer. See Section 6 & Procedure 5. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.

8 ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E12	Fallen below lower limit value for the measuring channel “pressure transducer piston side”	a.) Cable leading from the central unit to the pressure transducer is defective, loose or water in the connector. b.) Pressure transducer on piston side is defective. c.) Electronic component in the measuring channel is defective.	a.) Check cable and connector as well and replace, if necessary. See Section 7. b.) Replace pressure transducer and reset pressure channel. See Section 7 & Procedure 4. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E13	Fallen below lower limit value for the measuring channel “pressure transducer rod side”	a.) Cable leading from the central unit to the pressure transducer is defective, loose or water in the connector. b.) Pressure transducer on rod side is defective, c.) Electronic component in the measuring channel is defective.	a.) Check cable and connectors as well and replace, if necessary. See Section No. 7. b.) Replace pressure transducer and reset pressure channel. See Section 7 & Procedure 4. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E15	Fallen below lower limit value for the measuring channel “angle main boom”	a.) Cable from central unit to the length/angle sensor is defective or loose. b.) Angle sensor is defective. c.) Electronic component in the measuring channel is defective.	a.) Check cable. Replace if necessary. See Section 6 b.) Replace angle sensor and reset adjustment. See Procedure 5 c.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E19	Error in the reference voltage	Electronic component on the main board is defective.	Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E20	No analog voltages	a.) The crane supply voltage is too low. b.) The voltage converter is defective or short circuit in the wiring.	a.) Check crane voltage. b.) Check supply voltages.

8 ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E21	Upper limiting value for the measuring channel “length” exceeded	a.) Cable from central unit to the length/angle sensor is defective or loose. b.) Length potentiometer is defective. c.) Electronic component in the measuring channel is defective on main board.	a.) Check cable. Replace if necessary. See section 6. b.) Replace and reset length potentiometer. See Procedure 5. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E22	Upper limiting value for the measuring channel “pressure piston side” exceeded	a.) Cable from central unit to the pressure transducer is defective, loose or water in the plug. b.) Pressure transducer on piston side is defective, c.) Electronic component in the measuring channel is defective on main board.	a.) Check cable as well as plug. Replace if necessary. See Section 7. b.) Replace pressure transducer and reset pressure channels. See Section 7. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E23	Upper limit value for the measuring channel “pressure transducer rod side” exceeded	a.) Cable lead in from the central unit to pressure transducer is defective, not connected or water in the connectors. b.) Pressure transducer on road side is defective, c.) Electronic component in the measuring channel is defective.	a.) Check cable and connectors as well and replace, if necessary. See Section 7. b.) Replace pressure transducer. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E25	Upper limit value for the measuring channel “angle main boom” exceeded	a.) Cable leading from the central unit to the length/angle sensor is defective, loose or water in the connectors. b.) Angle sensor is defective c.) Electronic component in the measuring channel is defective.	a.) Check cable as well as connectors and replace, if necessary. See Section 6. b.) Replace angle sensor and reset adjustment. See Section No. 6 & Procedure 5. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.

8 ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E27	Upper limit value for the measuring channel 7 exceeded	a.) Cable leading from the central unit to the sensor of channel 7 is defective, loose or water in the connectors. b.) Sensor of channel 7 is defective. c.) Electronic component in the measuring channel 7 is defective.	a.) Check cable as well as connectors and replace, if necessary. b.) Replace sensor of channel 7 and reset adjustment. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E29	Reference voltage defective	a.) The total of the supply and the reference voltages on MP10 is more than 3.3V b.) A/D converter is defective.	a.) Check supply voltages. b.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E31	Error in the system program	a.) EPROM with system program is defective. b.) Electronic component on the main board is defective.	a.) Replace system program EPROM. b.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E37	Error in the program run	a.) EPROM with system program is defective. b.) Electronic component on the main board is defective.	a.) Replace system program EPROM. b.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E38	Wrong system program in the LMI	The system program in the LMI does not correspond to the programming in the data EPROM	Replace system program EPROM.
E41	Error in the external RAM	Defective electronic component.	Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E42	Error in the external write/read memory (RAM)	Internal defect in digital part of CPU.	Exchange write/read memory (CMOS-RAM). Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E45	Error in internal communications	Defective electronic component.	Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.

8 ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E48	Malfunction in the monitored write/read memory	Internal defect in digital part of CPU.	Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E51	Error in data memory	Data EPROM on the main board is defective.	Replace Data EPROM. Make sure BR3 on the main board is installed. See Theory 1.
E71	Incorrect acknowledgment of the “1” Relay on the terminal board A101	a.) Anti-Two Block relay is stuck or defective. b.) Anti-Two Block relay is not being selected due to a break on the terminal board A101, main board or ribbon cables.	a.) Replace 1. relay. b.) Check terminal board A101, main board and ribbon cables as well as replace defective part, if necessary.
E72-E77	Similar to E71 for the relays 2 thru 7	Similar to E71 for the relays 2 thru 7.	Similar to E71 for the relays 2..7.
E89	Change of the operating code during lifting a load	The operating mode switch in the console was used while lifting a load.	Lower the load and set the operating mode switch correctly to the code assigned to the actual operating mode of the crane.
E91	No data transmission from console to central unit (See Section 8)	a.) 24V supply of console is interrupted. b.) Interruption or accidental ground in the line from console electronics to central unit. c.) Transmitter/receiver module is defective.	a.) Check 24V at terminal X1 of console electronics. b.) Check the connection between console electronics and central unit. c.) If you find an accidental ground, the transmitter module in the console electronics can be damaged. You should, therefore, replace the console electronics. Replace console electronics or main board respectively. See Procedure 3
E92	Error in the data transmission from console to central unit (See also Section 8)	a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module is defective.	a.) Check the connection between console electronics and central unit.

8 ERROR CODES - continued

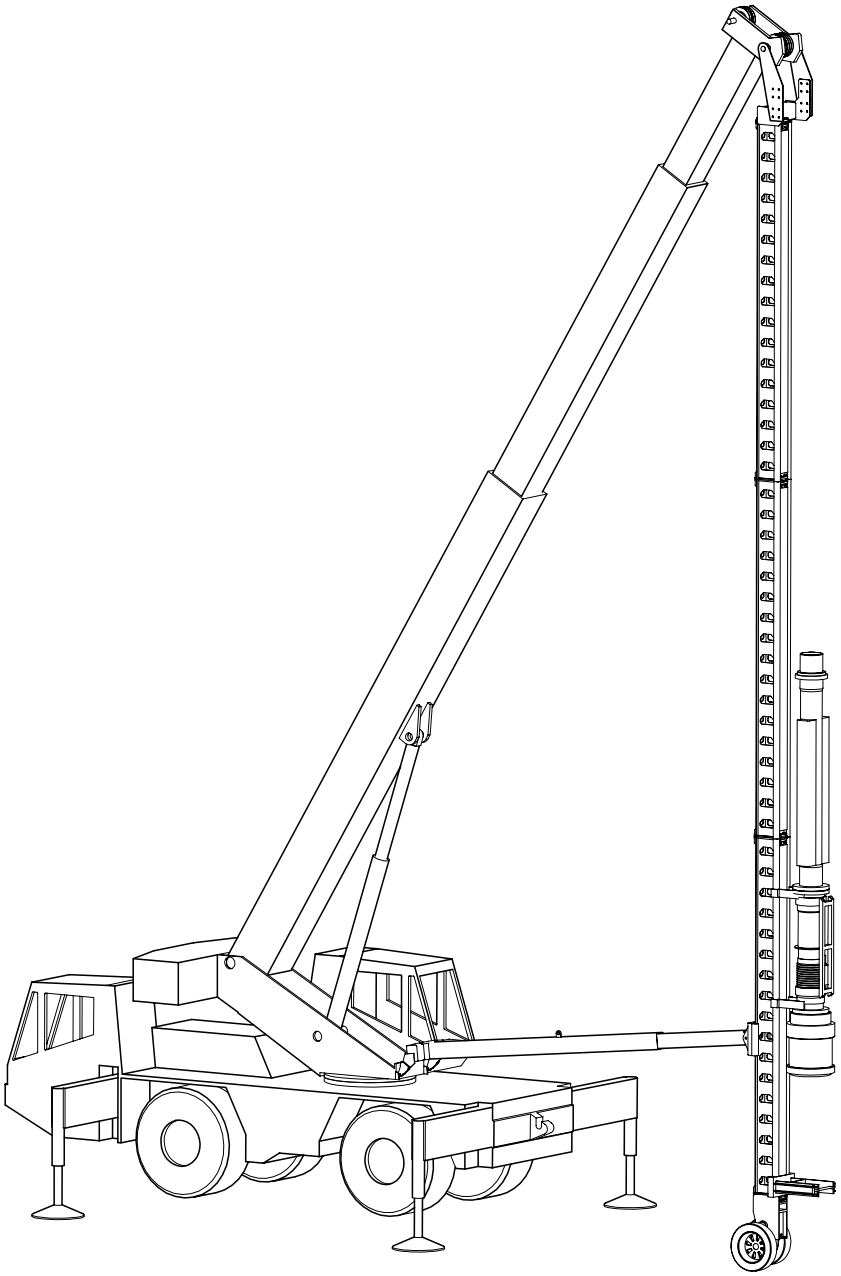
ERROR CODE	ERROR	CAUSE	ACTION
E93	Error in the data transmission from central unit to console (See also Section 8)	a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module is defective.	a.) Check the connection between console electronics and central unit. b.) Replace console electronics or main board respectively. See Procedure 3
E94	No data transmission from central unit to console (See also Section 8)	a.) Interruption or accidental ground in the line from console electronics to central unit. b.) Transmitter/receiver module is defective. c.) Data-EPROM is defective. d.) CPU is defective. e.) Electromagnetic interference (when switching contractors or valves).	a.) Check the connection between console electronics and central unit. If you find an accidental ground, the transmitter module in the console electronics can be damaged. Replace the console electronics. b.) Replace console electronics or main board, respectively. c.) Check data EPROM. d.) Replace main board. e.) Eliminate interference source by inverse diodes or resistors.
E95	Error in the crane data EPROM	a.) Data EPROM is defective. b.) Position of jumper for the selection of the type of EPROM is wrong. c.) Electronics component on the main board is defective.	a.) Replace data EPROM. b.) Check the jumper position. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedures 3 and 4.
E96	Error in the internal RAM of the CPU of the console	CPU or main board of the console is defective.	Replace console main board.
E97	Error in the external RAM of the CPU of the console	a.) External RAM of the console is defective b.) Electronic component on the main board is defective.	a.) Replace console main board. b.) Replace console main board.

8 ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E98	Wrong jumper position in the console	a.) The jumper position BR 9/BR 10 in the console does not correspond to the actual type of central unit. b.) Electronic component on the main board is defective.	a.) Check the jumper position. b.) Replace console main board.

APPENDIX H

INSTALLATION/OPERATION OF PILE DRIVER SYSTEM (BERMINGHAMMER)



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SAFETY SUMMARY

WARNING

Always wear personal protective equipment including ear and eye protection, work gloves, hard hat, and steel-toed boots/shoes.

WARNING

Use caution when removing equipment tie-down straps in the shipping/storage container to prevent sudden movement of equipment caused by equipment shifting during transport.

WARNING

Installing the lead head adapter on the boom nose adapter plates, installing the spotter, and relocating the crane while rigged with the pile driver system procedures present several opportunities for pinching body parts. Use care when lining up the boom nose adapter plates with the lead head adapter, when lining up the spotter base with the mounting lugs on the spotter mounting brackets of the crane superstructure, and when configuring the Pile Driver System for transportation.

WARNING

Never stand directly under the impact hammer or a suspended lead tower.

WARNING

Be sure that the crane operator can see all ground personnel including those on the crane. Ground personnel on the carrier deck must always position themselves to prevent obstructing the crane operator's view.

WARNING

If, during relocation of the crane while rigged with the Pile Driver System, traversing rough or unstable terrain cannot be avoided, use extreme caution and constantly monitor crane stability.

WARNING

Ensure that the crane operator is aware that attaching (and removing) the hammer line (main hoist) to the impact hammer will be performed while under a suspended load (impact hammer).

Have the crane operator turn the CRANE FUNCTION POWER switch to the OFF position to remove power from the crane functions controlled by the armrest joysticks. This prevents accidental operation of the controlled crane functions caused by bumping the joysticks.

WARNING

Ensure the pressure has been relieved on the remote throttle prior to disconnecting the remote throttle hydraulic line.

WARNING

Never allow personnel between the pile and the lead tower when hoisting or setting any pile.

WARNING

If the wooden pile is bowed, set the pile with the bow facing the lead tower.

WARNING

Check the pressure at the two spotter support pins securing the spotter base in the mounting lugs on the spotter mounting brackets when removing the spotter from the crane. The pins must move easily before trying to remove them.

CAUTION

The following general safety precautions should be observed during setup and operation:

- Safe pile driving piles is a three-person operation. Always use two ground assistants and one crane operator for set-up and operation. Accept direction from only one person. However, obey a stop signal from anyone in the vicinity. All other non-essential personnel should be cleared from the area.

- Failure to position wood blocking directly under bolt hole locations before removing the shipping/storage container cover will cause unnecessary pressure on bolts and damage threads.

- Ensure all mounting hardware is in place and tight. Ensure no loose articles such as tools, clothing, and shipping/lifting equipment are resting on the impact hammer.

CAUTION

The following general safety precautions should be observed during setup and operation (continued):

- Check the working pile to be sure it is strong enough to withstand the force of the impact hammer.
- Verify that driving a pile will not cause damage from vibration to adjacent structures.
- Do not lift the impact hammer with the hammer line (main hoist) alone. This could seriously damage the hammer trip system. Use a combination of the pile (aux. hoist) and hammer (main hoist) lines until the impact hammer is mounted on the lead tower.
- When unloading or loading the shipping/storage container, visually inspect each component for damage.
- The spotter slide pin should not be allowed to engage a hole in the lead tower lower than the seventh hole up from the foot roller. This will ensure that the spotter will not make contact with and damage the spare tire mounting bracket.
- Prior to hoisting the impact hammer during installation, inspect the cable on both crane hoist drums to ensure it is straight and undamaged
- If a new hole is drilled in the superstructure cab to route the remote throttle hydraulic hose into the cab, be sure to file edges to prevent damage to the hydraulic hose.
- Use care when lowering the impact hammer on the lead tower to avoid damage to the pile gate.

CAUTION

Observe the following precautions before starting the impact hammer:

- Do not use starting fluids as a cold weather starting aid as they can cause excessive piston stroke and damage to the impact hammer.
- Do not start the impact hammer until it is squarely positioned over the pile.
- Before starting the impact hammer for pile driver operation, ensure the impact hammer has been properly serviced and all Preventive Maintenance Checks and Services (PMCS) identified as “Before Operation (B)” have been performed.
- The full weight of the impact hammer must be on a pile or on a pile adapter (square or sheet) to distribute the grease properly when servicing the lower cylinder (impact block) lubrication fittings.

CAUTION

Observe the following precautions during pile driving operation:

- Never leave the impact hammer unattended while in operation.
- When driving a pile, do not exceed the recommended pile driving criteria of 20 blows per inch (2.5 cm). If the pile does not drive into the ground more than one inch (2.5 cm) per 20 blows, it is obstructed and further driving may cause damage to the pile.
- When driving wood and sheet piles, start with a low pressure gauge setting (low stroke rate). Gradually increase the stroke rate if practical.
- Never adjust the height of the spotter below the horizontal position particularly when working near the spare tire mount. Damage to the spare tire mount could occur.
- When hoisting piles into position underneath the impact hammer, ground personnel must stand at least the 1-1/2 times the length of the pile from the bottom of the lead tower. The bottom of the pile can suddenly swing upwards after contacting the direct drive assembly of the impact hammer.
- The crane operator must always monitor the load moment indicator (LMI) system during operation of the Pile Driving System. The capacity of the crane, as indicated by the LMI system, should never be exceeded during any operation.
- If the pile line (aux. hoist) remains connected to components during pile driving operations (i.e. ground-release shackles are not used), simultaneously pay out the pile line (aux. hoist) cable as load lowers. Do not allow tension to develop on pile line (aux. hoist) during pile driving operations.
- While the impact hammer is driving a pile and traveling down the lead tower, simultaneously pay out hammer line (main hoist) cable to maintain the hammer trip assembly in the middle portion of the hammer trip track rails. Do not allow tension to develop on the hammer line (main hoist) during pile driving operations.
- Pile driving should be performed over the rear of the crane within a 120 degree arc on either side of the crane.

SYSTEM DESCRIPTION.

General Description (Refer To Figure H-1.)

The Pile Driver System is a sectional tower framework that contains a single-cylinder, diesel engine-driven impact hammer that pounds pilings (wood, steel H-beam, pre-cast concrete, or sheet pilings), into the soil to create foundations for buildings, bridges, docks, seawalls, and other structures required to maintain or support heavy loads. Standard pile lengths may be up to 25-feet (7.6 m) long but the system is capable of driving up to 40-foot (12.2 m) long piles without splicing.

The impact hammer drives the pilings by projecting a large steel mass (a “piston” or “ram”) upward through a cylinder until it free-falls back down, striking the top of the piling through a drive system, there-by driving the piling into the ground. The AT422T All-Terrain Crane (ATEC) is used to assemble, lift, position, stabilize, and operate the Pile Driver System.

The main Pile Driver System components include the lead tower, spotter, impact hammer, remote throttle, and accessory components. The Pile Driver System, including the lead tower, spotter, impact hammer, and all accessories, is housed in a reusable, weather-proof shipping/storage container. The general weight of the lead tower, spotter, and impact hammer is approximately 9,500 lbs (4,318 kg) (not including pile adapters). The weight of the shipping/storage container with all components stored inside is approximately 19,500 lbs (8,864 kg).

Specifications for the Pile Driver System are provided in Tables H-1 through H-4 at the end of this section.

Shipping/Storage Container

The shipping/storage container is a steel container used to house and transport the Pile Driver System. It consists of a steel base, with forklift pockets, that is used to secure all the components and a steel cover that is placed over the components and bolted to the base. A wrench, stored in a bracket on the outside of the steel cover, can be used to remove the bolts securing the steel cover to the base. Four lifting lugs are located on top of the steel cover and 1-1/4-inch (3.2 cm) shackles are permanently attached. Equipment tie-down straps prevent shifting of the components. A spotter storage support rests on the lead tower sections and provides a base for support of the spotter within the shipping/storage container.

Weight data is stenciled on the sides of the shipping/storage container.

Lead Tower (Refer To Figure H-1.)

The lead tower holds and allows vertical travel of the impact hammer, connected via four gibs (or brackets), along rails on the front of the lead tower. The lead tower is a single column, vertical travel (spud-type) style consisting of three identical 15-foot (4.6 m) sections joined together by removable nuts and bolts. The total length of the fully assembled lead is 45 feet (13.8 m) but expansion (60 feet (18.4 m)) is possible by adding one additional lead section.

The lead tower is attached to the top of the crane boom by two parallel boom adapter plates and the lead head adapter that enable vertical suspension of the lead tower. The lead head adapter is connected to the top of the lead tower by removable nuts and bolts and the boom adapter plates are connected to the lower boom nose shaft by locking collars. The lead head adapter and boom adapter plates are then bolted together. Weight, bolt storage location, and impact hammer orientation data is stenciled on the sides of the lead head adapter.

A foot roller is attached to the bottom lead section to assist in raising and lowering the assembled lead tower. A pile gate stop, installed in the foot roller, holds the pile gate in position on the lead tower. Two wheels can be attached to shafts on the foot roller to create a rough-terrain dolly.

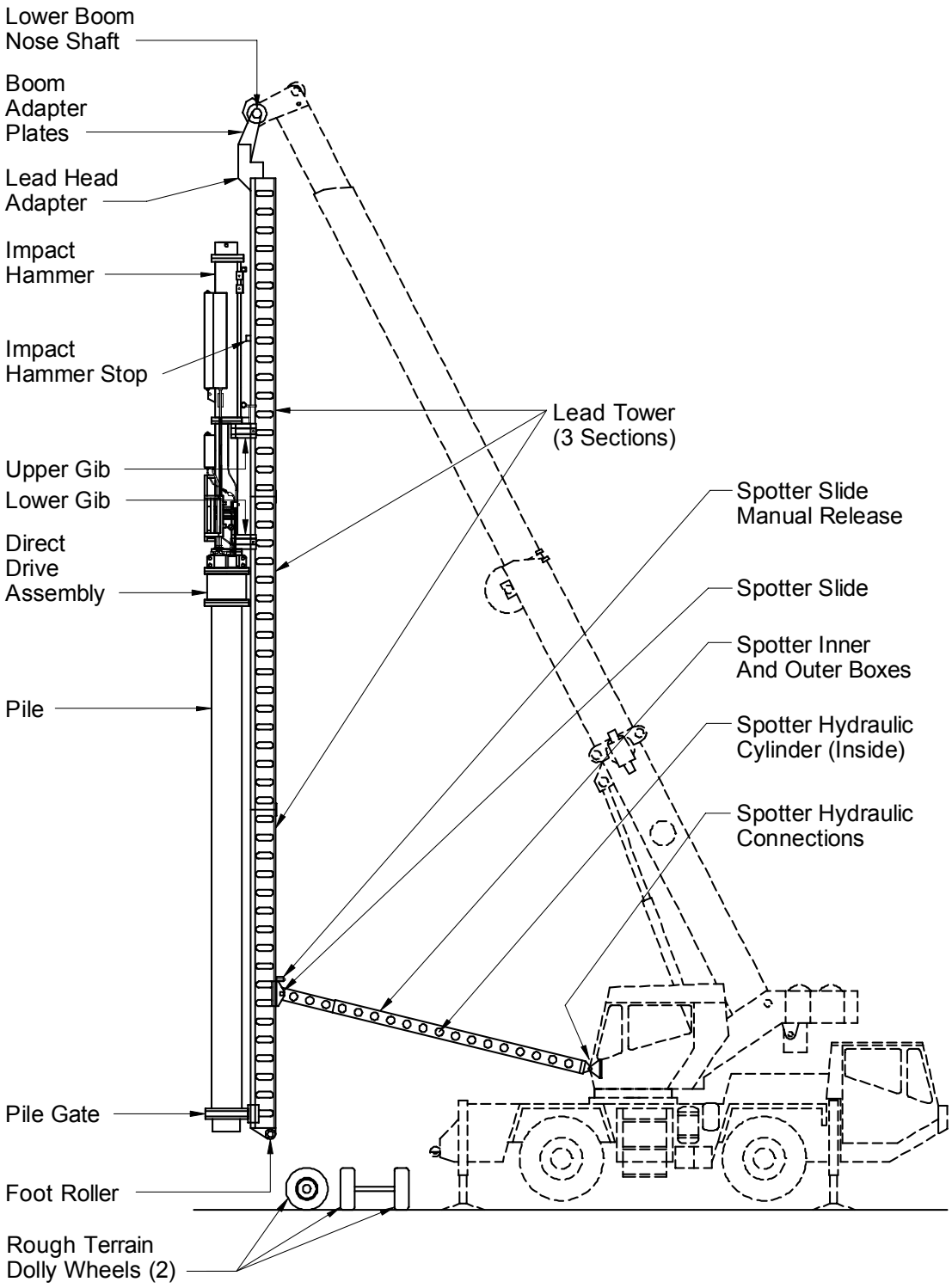


Figure H-1. Crane, Lead Tower, Spotter, and Impact Hammer

A pile gate, able to accommodate up to 18-inch (45.7 cm) diameter piles, is attached to the bottom lead section to assist in properly aligning the piles during operation. The pile gate consists of a pile gate frame, swing arm, and latch. Weight data is stenciled on the sides of the pile gate and warning and lift point location decals are also located on the pile gate.

An impact hammer stop, installed near the top of the lead tower by removable bolts, replaces the anti-two block function of the Load Moment Indicator (LMI) system for pile driving operations. The impact hammer stop physically prevents the impact hammer from colliding with the boom nose by limiting its vertical travel.

NOTE

The anti-two block function of the Load Moment Indicator (LMI) system is disabled and not used during pile driving operations.

Weight, impact hammer orientation (UP), and center-of-gravity location are stenciled on the individual lead tower sections.

Spotter (Refer To Figure H-1.)

The spotter is a hydraulically-operated, adjustable, mechanical link attached to the bottom lead section and the crane superstructure to provide stability to and control the location and pitch of the lead tower. The spotter is attached to the bottom lead section via the spotter slide and to mounting lugs on the front of the crane superstructure via brackets and two support pins. The hydraulic connections are provided by the boom hose reel on the crane and connected to two hydraulic connections (spotter manifold) located on the right-hand side of the spotter base (at crane superstructure mounting bracket). A hydraulic hose retention chain, attached to the base of the spotter, is used to secure the hydraulic hose reel lines. The spotter is extended and retracted by the telescope/clamshell control pedal in the superstructure cab (when the TELE/CLAMSHELL selector switch is in the CLAMSHELL position).

The spotter consists of two telescoping inner and outer boxes with short and long wear pads on each, a hydraulic cylinder (3-inch (7.6 cm) diameter x 96-inch (2.4 m) stroke), and spotter slide.

The spotter slide, connected to rails on the rear of the lead tower, allows vertical adjustment of the spotter connection to the lead tower. A pin on the spotter slide engages holes on the rear of the lead tower to hold the spotter slide in place along the rails. A manual release on the spotter slide can be operated by a tag line and enables the pin to be disengaged to allow vertical movement of the spotter slide along the rails. A retainer pin can be used to hold the manual release (and spotter slide pin) in the disengaged position during height adjustment. Two lubrication fittings, located on each side of the spotter slide, enable lubrication of the spotter slide.

Warning and weight data is stenciled on top of the spotter. Warning, lubrication location, and lift point location decals are located on the spotter. In addition, a decal illustrating crane signals and additional pile driving hand signals is attached to the left-hand side of the spotter.

Impact Hammer (Refer To Figures H-2, H-3, H-4.)

The impact hammer is a self-contained, diesel engine-driven, direct drive-type pile driving hammer operating on compression/ignition, two-cycle operation. The impact hammer utilizes an air-activated, high pressure fuel injection system with a fuel tank and air-activated, pressurized lubrication system with attached oil tank. Startup of the impact hammer is controlled by an integrated hammer trip system with trip safety lock.

The main components of the impact hammer are the piston and impact block, upper and lower cylinders, hammer trip assembly (mechanical starting device), fuel injection system, lubrication system, and direct drive system that houses a recoil dampening system and striker plate (driving head).

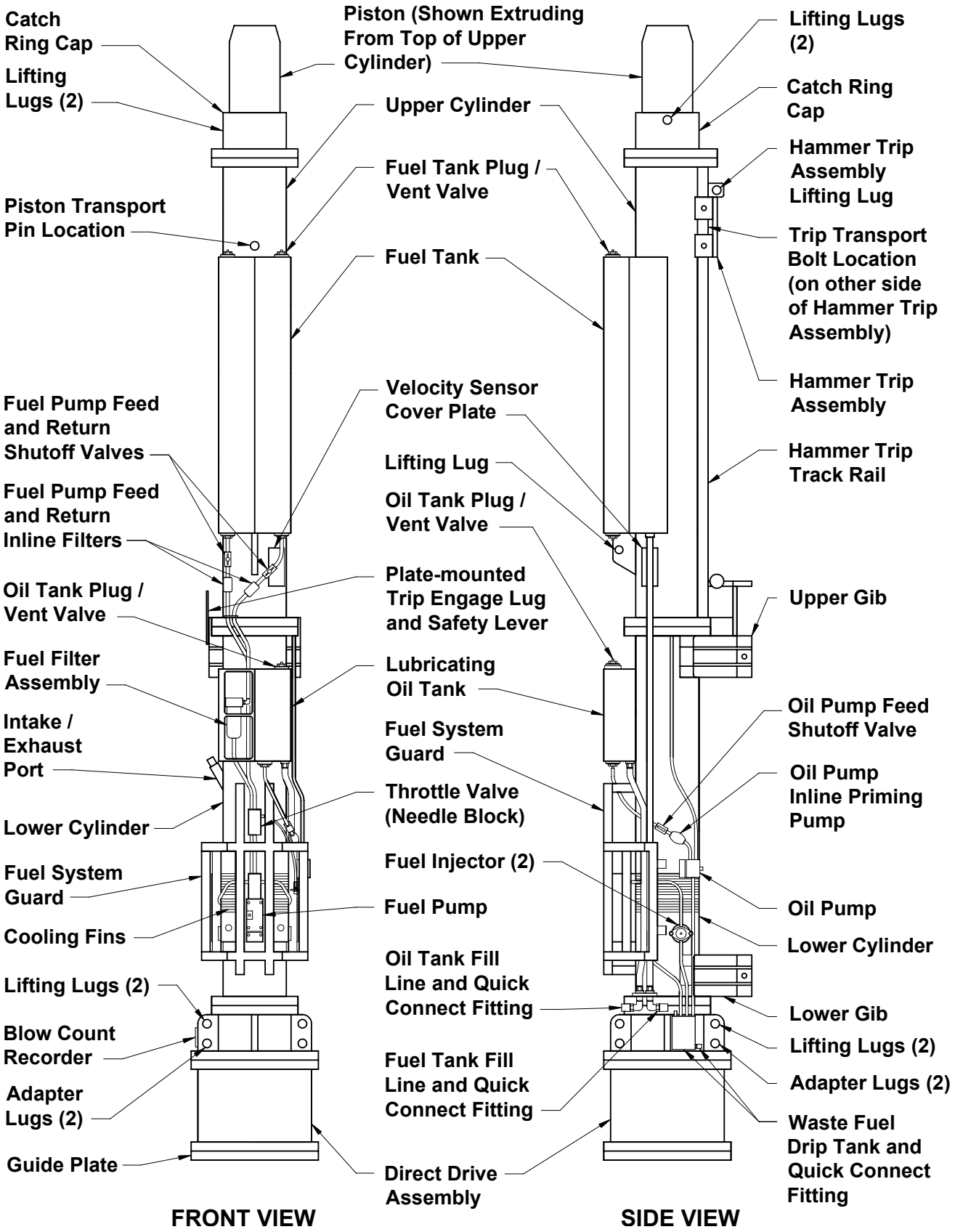
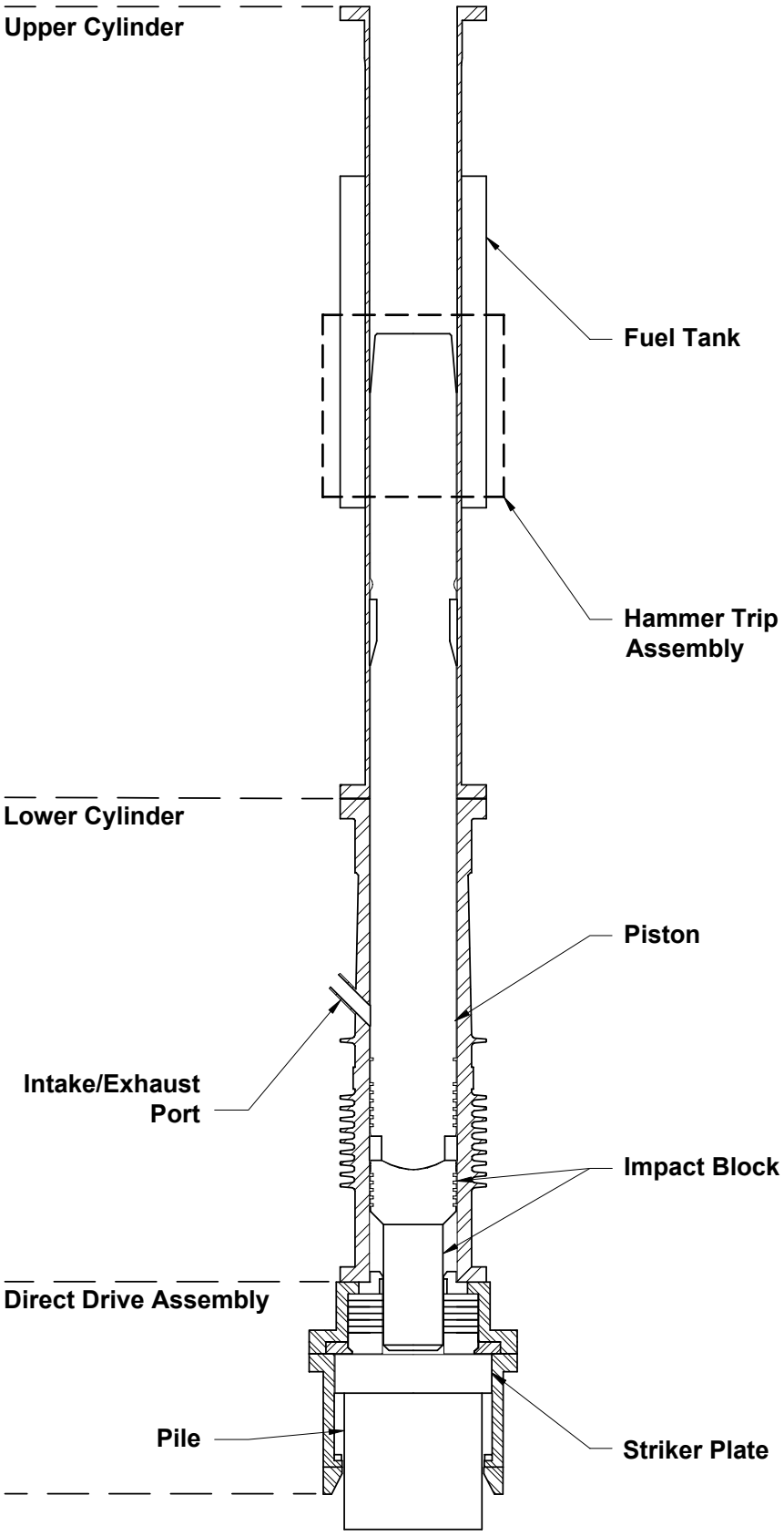


Figure H-2. Impact Hammer – Exterior View



WOOD PILE SHOWN

Figure H-3. Impact Hammer – Interior View

The piston is a free piston that provides the impact energy delivered to the pile. The impact block is located at the bottom of the lower cylinder and relays the energy from the piston to the pile via the direct drive assembly. Piston compression rings and impact block compression rings are installed to assist in compression and to prevent exhaust gases from entering the upper cylinder and escaping from the bottom of the lower cylinder.

The upper and lower cylinders are porous-chrome-lined and bolted together to form cylinder that enclose the piston and impact block. An o-ring, installed between the upper and lower cylinders, provides an air-tight seal.

The upper cylinder contains the catch ring cap, fuel tank, and hammer trip system. Lifting lugs are located on the front of the upper cylinder. A red-colored piston transportation pin, normally housed in the tool box, can be installed in the top part of the upper cylinder to secure the piston for shipping/transportation purposes. A red-colored weather cap with securing strap, normally housed in the tool box, can be installed on the catch ring cap of the upper cylinder to keep out moisture and foreign objects.

The lower cylinder contains the four upper and lower gibs, intake/exhaust port, cooling fins, fuel injection system, fuel system guard, oil lubrication system, and lubricating oil tank. The lower cylinder also contains the internal combustion chamber that is created by the ring-shaped area on the nose of the piston and the cylinder walls. A cushion housing guide ring and cushion housing guide ring support are located in the bottom of the lower cylinder. A red-colored weather cap, normally housed in the tool box, can be installed on the intake/exhaust port to keep out moisture and foreign objects.

The hammer trip system consists of the hammer trip assembly, hammer trip track rails, trip disengage lug, trip safety lever and trip engage lug, trip safety lever cord, and trip transport bolt. The hammer trip assembly, sliding along the hammer trip track rails and hoisted up and down by the hammer line (main hoist) of the crane, contains a trip mechanism that is used to start the impact hammer by raising and automatically releasing the piston at a predetermined height. The trip mechanism of the hammer trip assembly consists of a lifting pawl, lever and shaft, connecting links, stop pin, and cam mounted in a housing and backplate. The trip engage lug, located on the trip safety lever in the lower portion of the upper cylinder, engages the trip mechanism in the hammer trip assembly when it is lowered to allow lifting of the piston. The trip disengage lug, located at the top of a slot in the upper cylinder and part of the upper cylinder, activates the trip mechanism and causes the piston to be released when the hammer trip assembly is raised to the predetermined height. The red-colored trip transport bolt, normally housed in the tool box, can be installed in the hammer trip assembly to secure the hammer trip assembly to the hammer trip track rails for shipping/transportation purposes.

The trip safety lever is used by ground personnel to engage the trip engage lug to allow the hammer line (main hoist) to raise the hammer trip assembly (and piston) in order to start the impact hammer. The trip safety lever cord, attached to the trip safety lever, is used to control the position of the trip safety lever. When in the normal position (trip safety lever cord not pulled), the trip safety lever locks out the hammer trip assembly allowing the hammer line (main hoist) to raise and lower the entire impact hammer.

The direct drive system transfers the driving energy developed by the piston and impact block in the lower cylinder to the pile being driven. This is provided by the direct drive assembly connected to the bottom of the lower cylinder that houses a recoil dampening system and striker plate (driving head). The direct drive assembly consists of the upper and lower drive housings and is capable of driving up to 18-inch (45.7 cm) piles. Lifting lugs and adapter holes (used to secure the square (concrete) and sheet pile adapters) are provided at the top of the direct drive assembly. A blow count recorder and waste fuel drip tank are also installed at the top of the direct drive assembly.

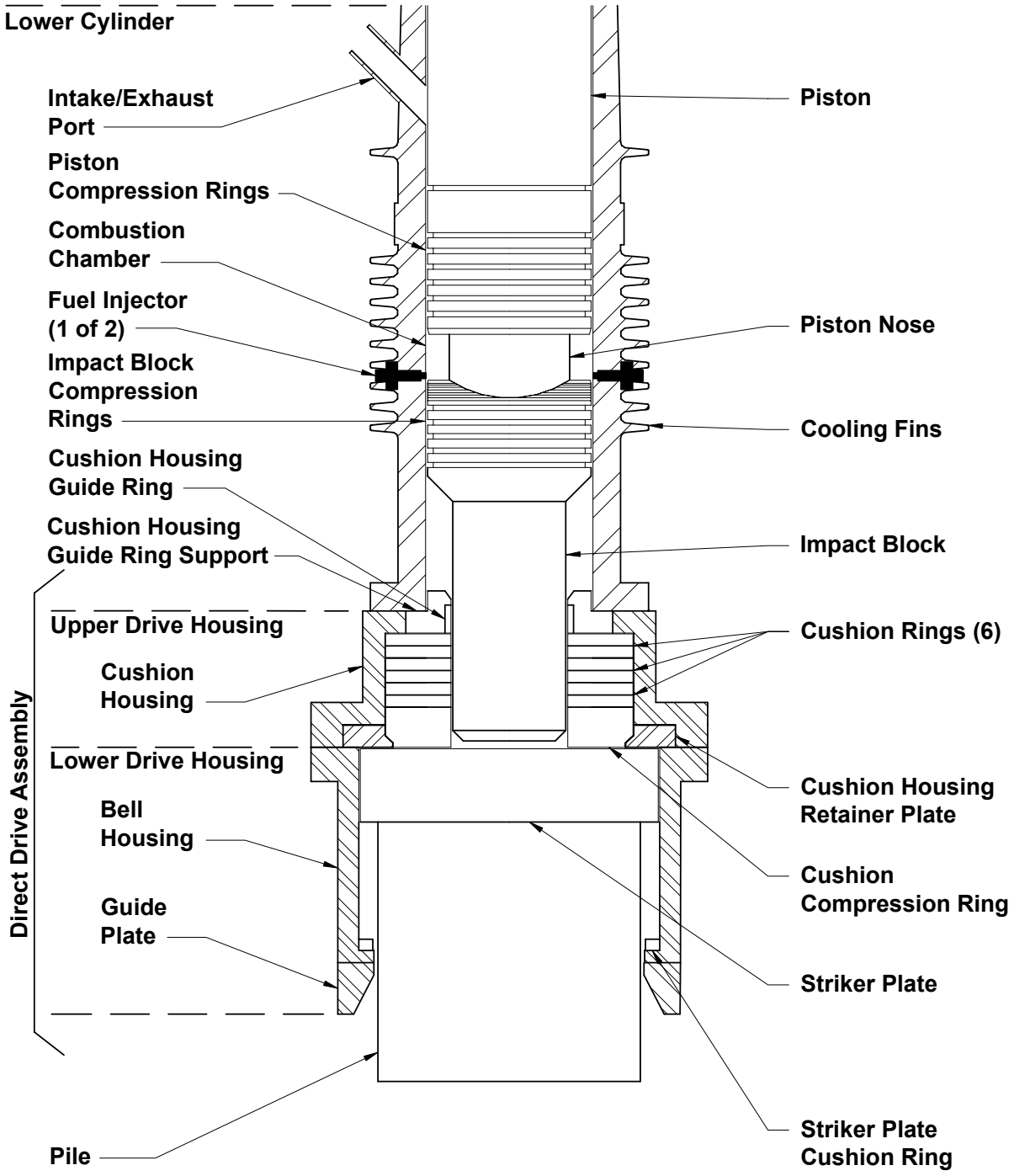


Figure H-4. Impact Hammer – Lower Cylinder and Direct Drive Assembly

The upper drive housing, bolted to the bottom of the lower cylinder, contains the recoil dampening system. The recoil dampening system consists of six cushion rings and the cushion compression ring secured in the cushion housing by the cushion housing retainer plate. A cushion shim ring can be installed in between the lower cushion ring and the cushion compression ring in order to give a 1/8-inch (3.175 mm) cushion ring stack preload.

The lower drive housing, bolted to the bottom of the upper drive housing, is used to hold the piles in place under the impact hammer during operation. It consists of a bell housing that contains the striker plate and an 18-inch (45.7 cm) guide plate is bolted onto the bottom of the bell housing. A striker plate cushion ring protects the bottom of the bell housing from damage caused by the striker plate.

The fuel injection system consists of a fuel tank, fuel tank fill line and quick connect fitting, two fuel tank suction strainers, fuel pump, two fuel injectors, throttle valve (needle block), fuel filter assembly, fuel pump feed inline filter, fuel return inline filter, fuel pump feed shutoff valve, fuel return shutoff valve, and associated lines and fittings.

The fuel tank, located on the side of the upper cylinder, provides fuel via gravity feed to the fuel pump located on the front of the lower cylinder. The in-tank suction strainers, located inside the fuel tank, filter the fuel prior to being delivered to and returned from the system. Two fuel tank plug/vent valves, located on top of the fuel tank, are used to vent the system during impact hammer operation.

The fuel tank is filled from the ground by connecting the quick connect fitting on the ground fueling hand pump to the fuel tank fill line and quick connect fitting located at the bottom of the lower cylinder and using the hand pump to pump fuel from an external JP-8 or No. 2 diesel fuel source to the fuel tank on the impact hammer. If the external fuel source has its own pump, it can be connected directly to the fuel tank fill line and quick connect fitting located at the bottom of the lower cylinder and the ground fueling hand pump need not be used. The fuel tank fill line and quick connect fitting on the impact hammer is identified by a red-colored “FUEL” label. In the absence of the ground fueling hand pump, the fuel tank can be filled manually by removing the fuel tank plug/vent valves.

The fuel pump, located on the front of the lower cylinder behind the fuel system guard, is an air-activated, single plunger-type pump that pressurizes and pumps the fuel to the fuel injectors. Inlet and outlet check valves on the fuel pump prevent fuel from flowing in a reverse direction.

The fuel injectors, located on each side of the lower cylinder, inject atomized fuel into the combustion chamber to initiate combustion.

The throttle valve (needle block), located on the front of the lower cylinder behind the fuel system guard, controls the stroke rate (blows per minute) by regulating the amount of fuel returned to the fuel tank. The throttle valve (needle block) is hydraulically-controlled by the remote throttle.

The fuel pump feed inline filter and fuel return inline filters, located behind the fuel system guard, filter the fuel delivered to the fuel pump and returned to the fuel tank respectively. The fuel pump feed shutoff and fuel return shutoff valves, also located behind the fuel system guard, are used to turn off the fuel supply in their respective lines.

The fuel filter assembly, mounted on the side of the lubricating oil tank on the lower cylinder, is a housing that contains a fuel filter element. The fuel filter assembly is downstream from the fuel pump feed inline filter and further filters the fuel being delivered to the fuel pump.

A waste fuel drip tank receives waste fuel and oil from the fuel injectors and oil pump. A quick connect fitting allows periodic draining of the waste fuel drip tank. The waste fuel drip tank vent valve, located on top of the tank, is used to vent the system during impact hammer operation.

The lubrication system provides lubricating oil to the lower cylinder and piston during operation. The system consists of the lubricating oil tank, oil tank fill line and quick connect fitting, oil pump, oil pump feed shutoff valve, oil pump inline priming pump, and associated lines and fittings.

The lubricating oil tank, located on the front of the upper cylinder, provides lubricating oil via gravity feed to the oil pump located on the rear of the lower cylinder. The in-tank suction strainer, located inside the lubricating oil tank, filters the oil prior to being delivered to the system. An oil tank plug/vent valve, located on top of the lubricating oil tank, is used to vent the system during impact hammer operation.

The lubricating oil tank is filled from the ground by connecting the hose and quick connect fitting to the ground oiling hand pump, placing the oiling hand pump container cover on an oil container filled with MIL-L-2104 15W40 oil, and installing the ground oiling hand pump in the container cover. Then connect the quick connect fitting on the ground oiling hand pump to the oil tank fill line and quick connect fitting located at the bottom of the lower cylinder and manually pump oil to the lubricating oil tank on the impact hammer. The oil tank fill line and quick connect fitting are identified by a yellow-colored “OIL” label. In the absence of the ground oiling hand pump, the lubricating oil tank can also be filled manually by removing the oil tank plug/vent valve. For temperatures below -20.0º F (-29º C), arctic-grade MIL-L-46167 0W40 oil should be used.

The oil pump is an air-activated, single plunger-type pump that pumps the lubricating oil to the lower cylinder via an oil line and fitting. Inlet and outlet check valves on the oil pump prevent oil from flowing in a reverse direction.

The oil pump feed shutoff valve is used to turn off the oil feed to the oil pump from the lubricating oil tank. The oil pump inline priming pump is used to prime the system for initial startup.

The impact hammer is equipped with a battery-powered blow count recorder located at the top of the direct drive assembly. The blow count recorder is an indicator that provides the operator with a running count of blows delivered. The blow count recorder and battery pack are protected by a foam cushion insert and housed in a weather-proof housing with a viewing window. The internal battery pack is designed to last for two years.

The impact hammer is equipped with a fitting for an optional velocity sensor located on the lower part of the upper cylinder, directly below the fuel tank. A velocity sensor cover plate is installed over the fitting.

The impact hammer has several major data and safety plates and decals. The Identification Plate, located on the top side of the direct drive assembly, specifies the name of the manufacturer, model number, National Stock Number, USA Registration Number, manufacture date, contract number, weight, and serial number. The Identification Bar Code Plate, located on the side of the fuel tank and readable by a hand-held scanner, provides comprehensive information about the impact hammer. “HOT AREA” warning and “LIFT POINT” location plates are located at the cooling fins and upper/lower cylinder lifting lugs respectively. Safety and hard hat warning decals are located on the side of the direct drive assembly. “PINCH POINT” warning decals are located at the upper and lower gibs.

Remote Throttle (Refer To Figure H-5.)

The remote throttle provides remote speed control and shutdown of the impact hammer diesel engine. The remote throttle can be installed in the superstructure cab if desired.

The remote throttle is a hydraulically-operated, bypass device that controls the stroke rate of the impact hammer by controlling the amount of fuel delivered to the fuel injectors by the fuel pump. It consists of a hydraulic reservoir and pump, a movable handle, pressure relief valve, pressure gauge, 70-foot (18 m) hydraulic hose, and associated fittings. The remote throttle is filled via a fill plug and utilizes automatic transmission fluid Dexron II/III or equivalent. A pressure relief

valve is used to reduce remote throttle pressure in order to adjust the stroke rate or to remove remote throttle pressure (0 psi) in order to shut-down impact hammer operation.

The hydraulic hose is connected to the remote throttle via a quick connect fitting and is routed to the lower cylinder section of the impact hammer. The hydraulic hose is connected to the throttle valve whip line of the throttle valve (needle block) that is identified by a “THROTTLE CONNECTION” label. The pulley with 15-inch (38 cm) anchor bungee, normally stored in the toolboxes, can be attached to the hydraulic hose reel on the crane boom to ensure the hydraulic hose is kept out of the way during pile driving operations.

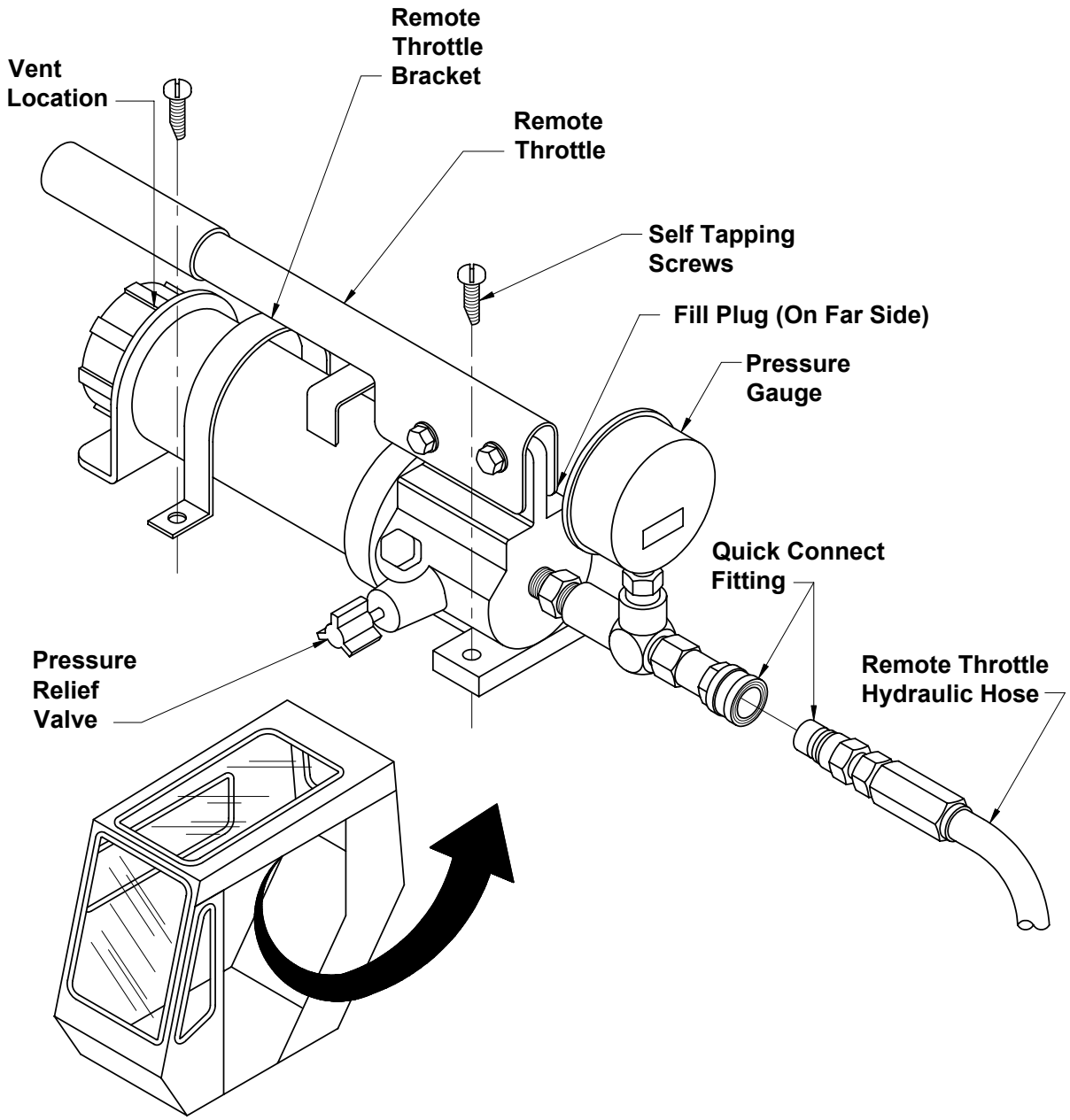


Figure H-5. Remote Throttle

Accessory Tools and Components

The accessory tools and components are initially provided with the Pile Driver System and located in two tool boxes that are housed in the shipping/storage container. Identification and weight data is stenciled on the sides of the tool boxes. The accessory tools and components include rigging and safety equipment, shipping/storage equipment, accessories and adapters, ground servicing tools, special tools, consumable materials such as lubricants, seal kits and spare filters, and miscellaneous spare parts.

The rigging and safety equipment include the following:

- One trip safety lever cord (3/8" x 100 ft (10 mm x 30.5 m))
- One piston lifting eyebolt
- Two 96-inch (2.44 m) wire rope lifting slings
- Two 89-inch (2.26 m) wire rope lifting slings
- Two 72-inch (1.8 m) wire rope lifting slings
- Two nylon lifting slings
- One H-type pile lifting sling (30-inch (76 cm))
- Two H-type pile chain lifting slings with hooks
- Two one-inch (2.5 cm) shackles
- Two 7/8-inch (2.2 cm) shackle
- Eight 3/4-inch (1.9 cm) shackles
- Two ground-release shackles
- One temporary hydraulic hose retainer chain (5/16 x 90-inch (0.8 x 229 cm))
- Four 4x4-inch (10 x 10 cm) wood blocks
- 1/2 x 48-inch (1.3 cm x 1.22 m) long wire cable
- 5/8 x 96-inch (1.6 cm x 2.44 m) long wire cable and 5/8-inch (1.6 cm) clamps for rigging the square (concrete) and sheet pile adapters

The shipping/storage equipment is red in color and used to protect and secure the impact hammer for storage and/or transportation. The equipment includes the catch ring weather cap and securing strap, intake/exhaust port weather cap, piston transportation pin and clip, and trip transport bolt.

The accessories and adapters are used to drive different size piles (wood other than 18-inch (45.7 cm and steel H-beam), pre-cast concrete, or sheet piles. The adapters include the following:

- 10-inch (25.4cm), 12-inch (30.5 cm), and 16-inch (40.6 cm) guide plates
- 18-inch (45.7 cm) square (concrete) pile adapter
- Sheet pile adapter
- Plywood template for the 18-inch (45.7 cm) square (concrete) pile adapter

The guide plates are bolted onto the lower drive housing of the direct drive assembly and replace the standard 18-inch (45.7 cm) guide plate. The size of the guide plate indicates the inside diameter. The square (concrete) pile adapter and sheet pile adapter are installed in the direct drive assembly and secured via cables and clamps to the adapter holes located at the bottom of the lower cylinder. The adapter holes are the lower holes directly below the impact hammer lifting lugs. Weight data is stenciled on the sides of the pile adapters. The plywood template for the 18-inch (45.7 cm) square (concrete) pile adapter can be used by operating personnel to fabricate a cushion to prevent damage to the square concrete piles during operation.

The ground servicing tools are used to add fuel and oil to the fuel and lubrication systems and to drain the waste fuel drip tank on the impact hammer. The ground fueling tools include a ground fueling hand pump and ground fueling hose and quick connect fitting. The ground oiling tools

include a ground oiling hand pump and ground oiling hose and quick connect fitting. A waste fuel drip tank drain hose and quick connect fitting is also provided.

The special tools include the following:

- Various hex keys
- Grease gun with flex hose and fitting
- Oil gun
- Check valve extractor tool
- Ring compressor
- Piston ring pliers
- Wood pile tongs
- Crowbar
- Steel bar with hickey (5-foot (1.5 m))
- Cheater bar (36 x 2-inch (91 x 5 cm))
- Ten-pound (4.5 kg) sledge hammer
- Two-pound (0.9 kg) hammer
- Axe
- Vice grip
- 12-inch (30.5 cm) and 18-inch (46 cm) adjustable wrenches
- 1-5/16-inch combination wrench
- 1-1/8-inch combination wrench
- 1-5/16-inch box end wrench
- 1-1/8-inch box end wrench
- Two-inch (5 cm) wood level
- 100-foot (30.5 m) fiberglass measuring tape
- Pulley with 15-inch (38 cm) anchor bungee
- 36-inch (91 cm) peavey

The consumable materials include ten 14-oz. (400g) tubes of MIL-G-10924 grease, 1-quart (1 l) of MIL-L-2105 oil, 1/3-oz. (10 ml) of Loctite® 272, and Teflon® tape.

The seal kits include a fuel pump seal kit, throttle valve (needle block) seal kit, and oil pump seal kit. The spare filters include spare inline fuel filters, fuel filter element for the fuel filter assembly, and fuel/oil tank suction strainer assemblies.

Various spare parts are also included in the tool boxes. Refer to Component End Item Section at the end of this Appendix for a complete listing of the spare parts.

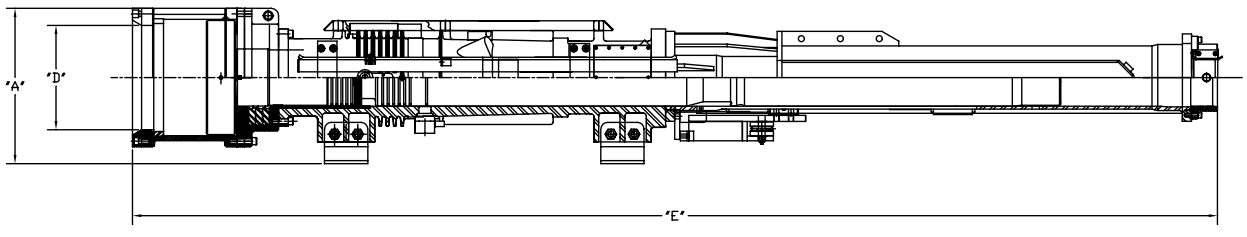
Table H-1. General Specifications – Loaded Shipping/Storage Container

Manufacturer	Berminghammer Foundation Equipment
Shipping/Storage Container	
Dimensions	247 in. (L) x 65 in. (W) x 68 in. (H) 627.4 cm (L) x 165 cm (W) x 172.7 cm (H)
Weight (Fully Loaded Shipping/Storage Container)	19,500 lbs (8,864 kg)

Table H-2. General Specifications – Impact Hammer and Lead Tower

Model Number (Impact Hammer)	B-9M
Serial Number (Impact Hammer)	04-01-B9M
Performance	
Ram Weight x Maximum Stroke	20,000 ft•lb (27.1 kN•m)
Impact Energy	13,000 ft•lb (17.6 kN•m)
Maximum Ram Stroke	10.0 ft (3.05 m)
Ram Weight	2,000 lbs (900 kg)
Impact Block Weight/Mass	286 lb (130 kg)
Blows Per Minute (BPM)	38-54 BPM
Operating Weight	
Bare Impact Hammer Weight/Mass	4,480 lbs (2,032 kg)
Total Operating Weight/Mass of Impact Hammer	5,800 lbs (2,630 kg)
Weight of Tool Box – Spare Parts	115 lbs (52 kg)
Weight of Tool Box – Accessories	315 lbs (143 kg)
Weight of 18-inch Square (Concrete) Pile Adapter	1,240 lbs (564 kg)
Weight of Sheet Pile Adapter	890 lbs (405 kg)
Weight of Spotter Storage Support	340 lbs (154 kg)
Weight of Lead Section	740 lbs (336 kg)
Weight of Foot Roller	400 lbs (182 kg)
Weight of Spotter	815 lbs (370 kg)
Capacity	
Fuel Tank Capacity	15.0 US gallons (57.0 liters)
Fuel Consumption	0.6 gal./hr. (2.3 l/hr.)
Oil Tank Capacity	1.5 US gallons (6.0 liters)
Oil Consumption	0.16 gal./hr. (0.6 l/hr.)

Table H-3. Dimensional Specifications – Impact Hammer



Dimensions			
A	C - Minimum Box Lead	D	E
24.0 in (61 cm)	21.0 in (52.5 cm)	15.0 in (38.0 cm)	~ 220 in (5.34 m)

Table H-4. Lubricants Required

Fuel System	
Fuel Tank	No. 2 Diesel, JP-8
Lubrication System	
Lubricating Oil Tank	MIL-L-2104 (15W40)
Lubricating Oil Tank (Temperatures below -20.0º F (-29º C))	MIL-L-46167 (0W40)
Grease	
Lower Cylinder (Impact Block) Lubrication Fittings (four (4) locations)	MIL-G-10924
Impact Hammer Gibs (four (4) locations)	MIL-G-10924
Hammer Trip Assembly Gibs (four (4) locations)	MIL-G-10924
Spotter Slide (two (2) locations)	MIL-G-10924
Oiling	
Fuel Pump Lubrication Fitting	MIL-L-2105
Oil Pump Lubrication Fitting	MIL-L-2105
Fuel Tank Preservative/Fog Oil Spray	Kleen-Flo Tumbler Industries (Stock #789)
Hydraulic Oil	
Remote Throttle	Automatic Transmission Fluid Dexron II/III or equivalent

THEORY OF OPERATION

Impact Hammer - General Operation (Refer To Figure H-6.)

There are five stages of operation for the impact hammer. To start the impact hammer, the hammer line (main hoist) of the crane is used to lift the hammer trip assembly, which raises the piston to a predetermined height. The hammer trip assembly then releases the piston, allowing it to free-fall in the cylinder. After initial start-up, the following sequence occurs:

1. Purge. The piston falls under the force of gravity and accelerates downward. As the piston falls, the air and/or gases in the cylinder are expelled through the intake/exhaust ports.

2. Compression. When the piston reaches the intake/exhaust port, the port is closed, compressing the air in the lower cylinder.

3. Combustion. As the piston nears the end of its downstroke a combustion chamber is created by the ring-shaped nose of the piston and the lower cylinder. The fuel pump, connected to the combustion chamber, amplifies the gas pressure compressed beneath the piston and delivers high pressure fuel to the fuel injectors. Just before the piston strikes the impact block, the fuel pressure overcomes the opening pressure of the fuel injectors, injecting atomized fuel into the combustion chamber. The fuel ignites (due to high compression temperatures) and the piston strikes the impact block, transferring its kinetic energy to the direct drive assembly. The combustion force drives the piston upward and the impact block further downward.

4. Exhaust. As the piston rises in the cylinder and passes the intake/exhaust port, the port is opened, allowing the exhaust gases to escape.

5. Intake. As the piston continues rising, fresh air is drawn into the lower cylinder via the intake/exhaust port. Under the force of gravity, the piston decelerates on the upward stroke until completely stopping at the top of the stroke. The piston then begins to fall, starting the five-stage cycle again. The fuel pump recharges and the cycle is repeated until the fuel supply is interrupted.

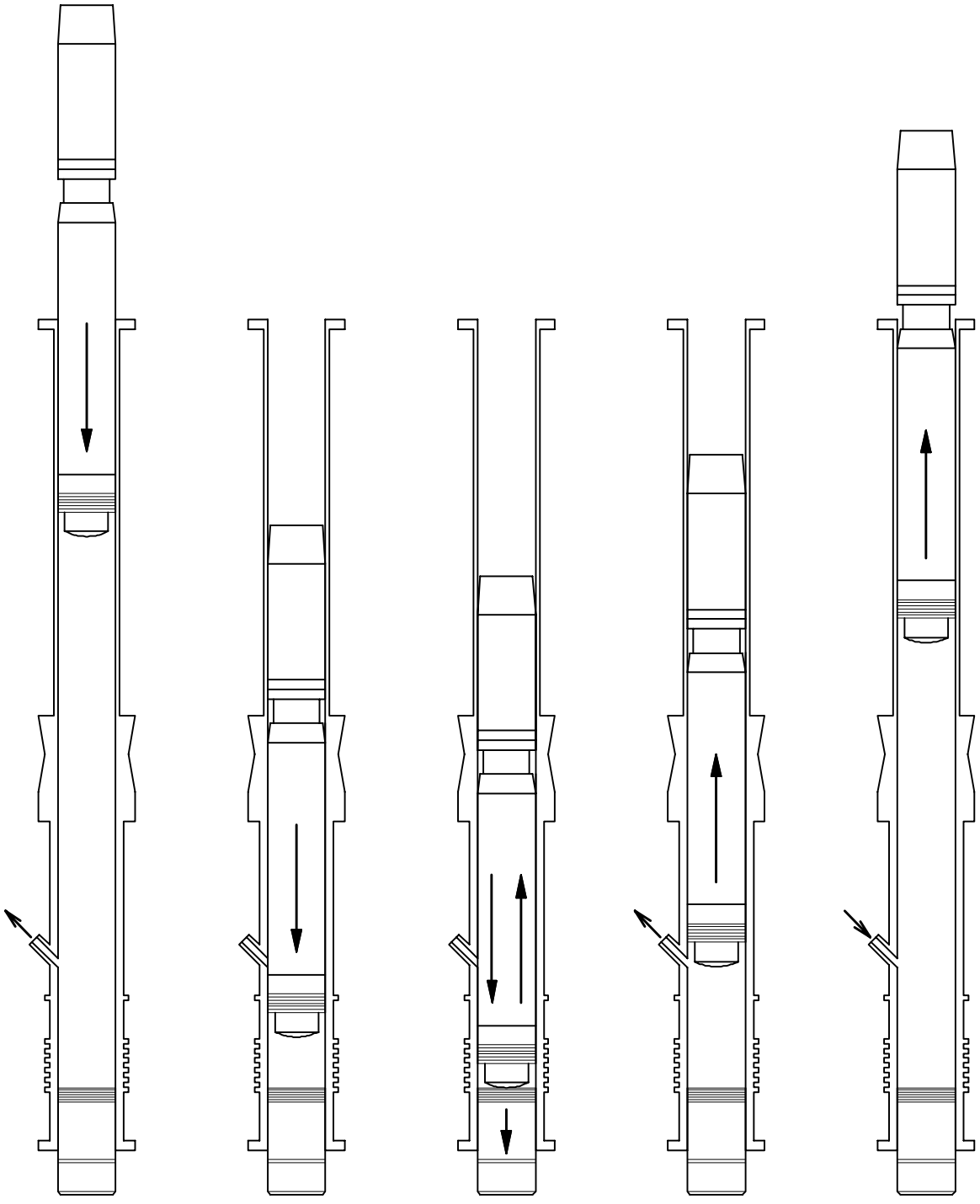


Figure H-6. Impact Hammer Stages of Operation

Impact Hammer - Hammer Trip System Operation (Refer To Figure H-7.)

There are four stages of operation for the hammer trip system. The hammer trip assembly, moving along the hammer trip track rails and controlled by the hammer line (main hoist) of the crane, is used to start the impact hammer by raising and automatically releasing the piston at a predetermined height. The predetermined height is determined by the position of the trip disengage lug on the impact hammer. To start the impact hammer with the hammer trip assembly, the weight of the impact hammer must be fully on a pile, allowing the following sequence to occur:

1. With the trip safety lever cord (attached to the trip safety lever) pulled and held in place by ground personnel, the trip engage lug is engaged. The hammer trip assembly is then lowered by the crane operator, via the hammer line (main hoist) of the crane, along the hammer trip track rails. The lifting pawl is in the vertical disengaged position.

2. As the hammer trip assembly is lowered, the cam attached to the lever and shaft encounters the trip engage lug mounted at the bottom of the upper cylinder. The trip engage lug pushes the cam (and lever and shaft) upward, rotating the lifting pawl towards the horizontal, engaged position via the connecting links.

3. The hammer trip assembly is raised by the hammer line (main hoist). The lifting pawl is in the horizontal engaged position. The connecting links have passed "over-center" and rest against the stop pin. The leaf spring assists in rotating the connecting links over-center and retaining them in position. As the lifting pawl engages the lifting collar on the piston, the piston is lifted and the connecting links bear against the stop pin.

4. The crane operator continues raising the hammer trip assembly, via the hammer line (main hoist), until the lever and shaft encounters the trip disengage lug. The connecting links will rotate away from the over-center position and the stop pin, causing the lifting pawl to rotate to the vertical disengaged position. The piston falls freely.

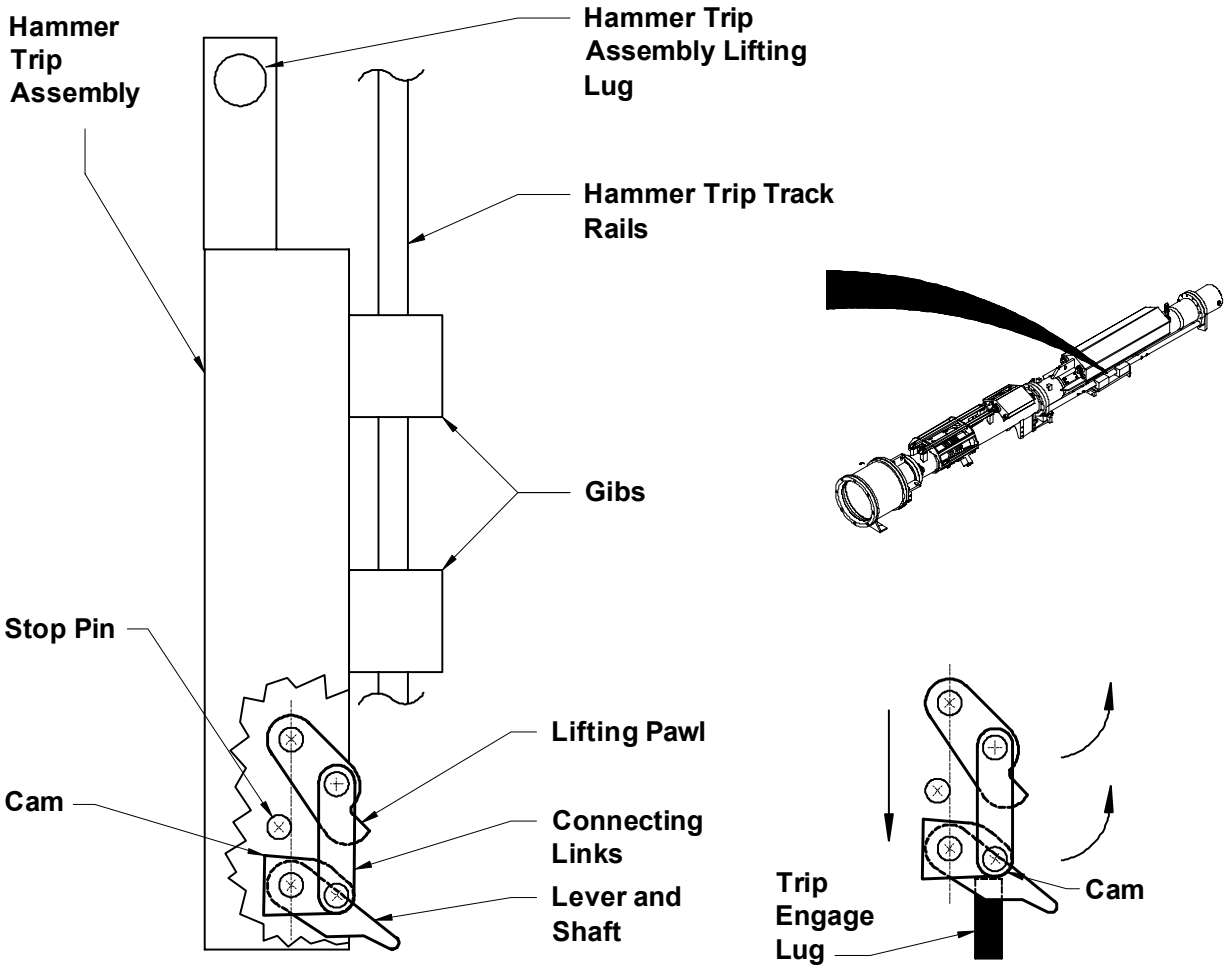
NOTE

The crane operator must cease hoisting the hammer trip assembly as soon as the piston falls.

The normal position of the trip safety lever is used to lock out the hammer trip assembly in order to use the hammer line (main hoist) to raise and lower the entire impact hammer. The trip safety lever is held in its normal position by a spring (when the trip safety lever cord is not pulled) and maintains the trip engage lug in the disengaged position. The trip disengage lug is out of alignment with the hammer trip assembly and will not engage with the cam attached to the lever and shaft.

The trip safety lever is used to engage the trip engage lug to allow the hammer line (main hoist) to raise the hammer trip assembly (and piston) in order to start the impact hammer. This is accomplished by pulling and holding the trip safety lever cord attached to the trip safety lever. This will rotate the trip engage lug into position in order to engage with the cam attached to the lever and shaft of the hammer trip assembly when lowered.

Rotating the lever and shaft with a wrench can manually disengage the hammer trip assembly.



1. Lifting Pawl in Vertical Disengaged Position

2. Cam Encounters Trip Engage Lug

3. Lifting Pawl in Horizontal Engaged Position

4. Lever and Shaft Encounters Trip Disengage Lug

Figure H-7. Hammer Trip Assembly Operation

Impact Hammer - Fuel Injection System Operation (Refer To Figure H-8.)

The fuel injection system consistently delivers a precise amount of highly atomized fuel to the combustion chamber of the lower cylinder. The fuel injection system is both driven and timed by the pre-combustion pressure in the lower cylinder.

As the intake/exhaust port on the lower cylinder closes during the downward stroke, air in the lower cylinder combustion chamber begins to compress. As the air pressure increases, the increased force on the air piston in the fuel pump pushes the fuel plunger up into the fuel pump head. The fuel plunger, whose diameter is smaller than the air piston, produces a greater pressure in the fuel above the fuel plunger. As the fuel pressure increases, the inlet check valve closes and the outlet check valve opens, transferring high pressure fuel through the fuel injector lines to the two fuel injectors.

The fuel injectors contain an injector nozzle, needle, adjustable spring, and a small ring-shaped piston around the injector needle. Fuel is injected into the combustion chamber via two holes in the injector nozzle. The needle, held against its seat by the adjustable spring, blocks the flow of fuel when fuel is not required. As fuel enters the chamber behind the needle tip, it acts upon the needle in the opposite direction of the spring. When the fuel pressure is high enough, the pressure overcomes the spring and the needle is lifted off its seat, allowing fuel to pass through the nozzle.

NOTE

The fuel is injected into the ring-shaped area around the piston nose that forms the combustion chamber with the lower cylinder. It is not injected beneath the piston nose.

Fuel injection occurs one millisecond before the piston strikes the impact block. The instant one of the fuel injectors opens, the combustion process begins. The combustion of diesel fuel and air produces a rapid increase in the cylinder pressure, which is transmitted to the fuel pump where the fuel pressure will increase to approximately twice the opening pressure of the fuel injectors. The rapid increase in fuel pressure ensures that both fuel injectors deactivate within the same initial millisecond.

Fuel injection lasts for some five milliseconds and produces peak combustion pressure for ten milliseconds. Fuel injection continues until the air piston in the fuel pump reaches the end of its stroke. During the upward impact hammer piston stroke, the lower cylinder intake/exhaust ports open, relieving the cylinder pressure acting upon the fuel pump. The fuel plunger spring returns the fuel plunger and air piston to their original positions. As the fuel plunger retracts, the outlet check valve closes and the inlet check valve opens, refilling the fuel pump for the next cycle.

The remote throttle controls how much fuel pump output is transferred to the fuel injectors by controlling how much fuel is returned to the fuel tank via the return line. This controls the stroke rate (blows per minute) of the impact hammer operation. During fuel injection the throttle valve (needle block) allows a very small amount of fuel to return to the fuel tank. The throttle valve (needle block) is hydraulically-controlled by the remote throttle to vary the amount of fuel returned to the fuel tank. When the remote throttle is placed in the off position (no pressure), the throttle valve (needle block) is completely open and all of the fuel can return to the fuel tank before high pressures develop.

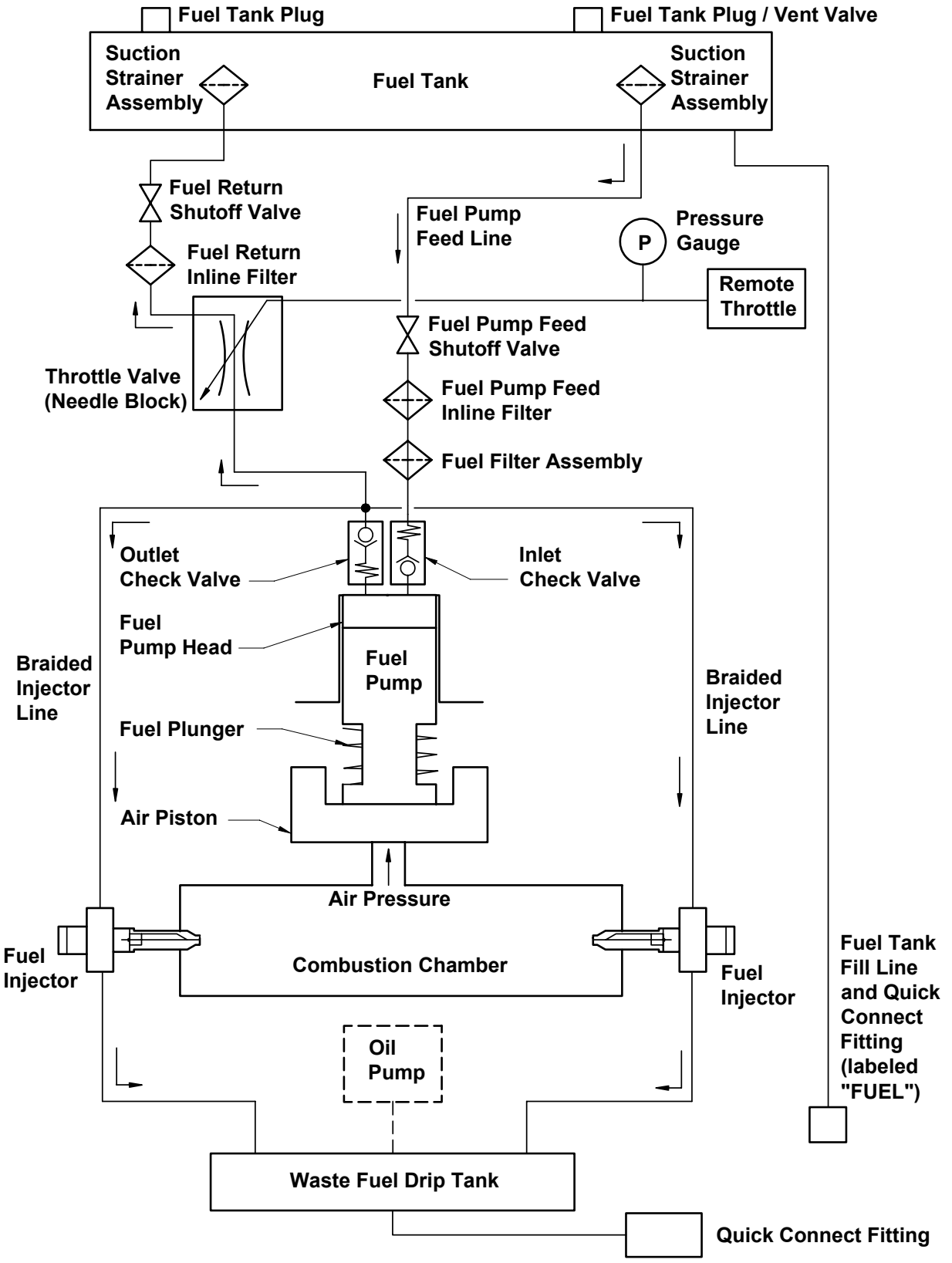


Figure H-8. Fuel Injection System Schematic

Impact Hammer - Lubrication System Operation (Refer To Figure H-9.)

The lubricating system delivers lubricating oil to the lower cylinder and is controlled by the air pressure in the lower cylinder.

Lubricating oil is supplied to the oil pump by gravity flow from the lubricating oil tank. It is then pumped by the oil pump to a fitting on the lower cylinder.

Operation of the oil pump is similar to the fuel pump operation. The plunger in the oil pump is operated by the change in air pressure in the lower cylinder during operation, forcing lubricating oil through the outlet check valve and into the lower cylinder via the lubrication fitting.

An indicator on the oil pump will pop in and out as the piston falls to indicate proper operation of the oil pump.

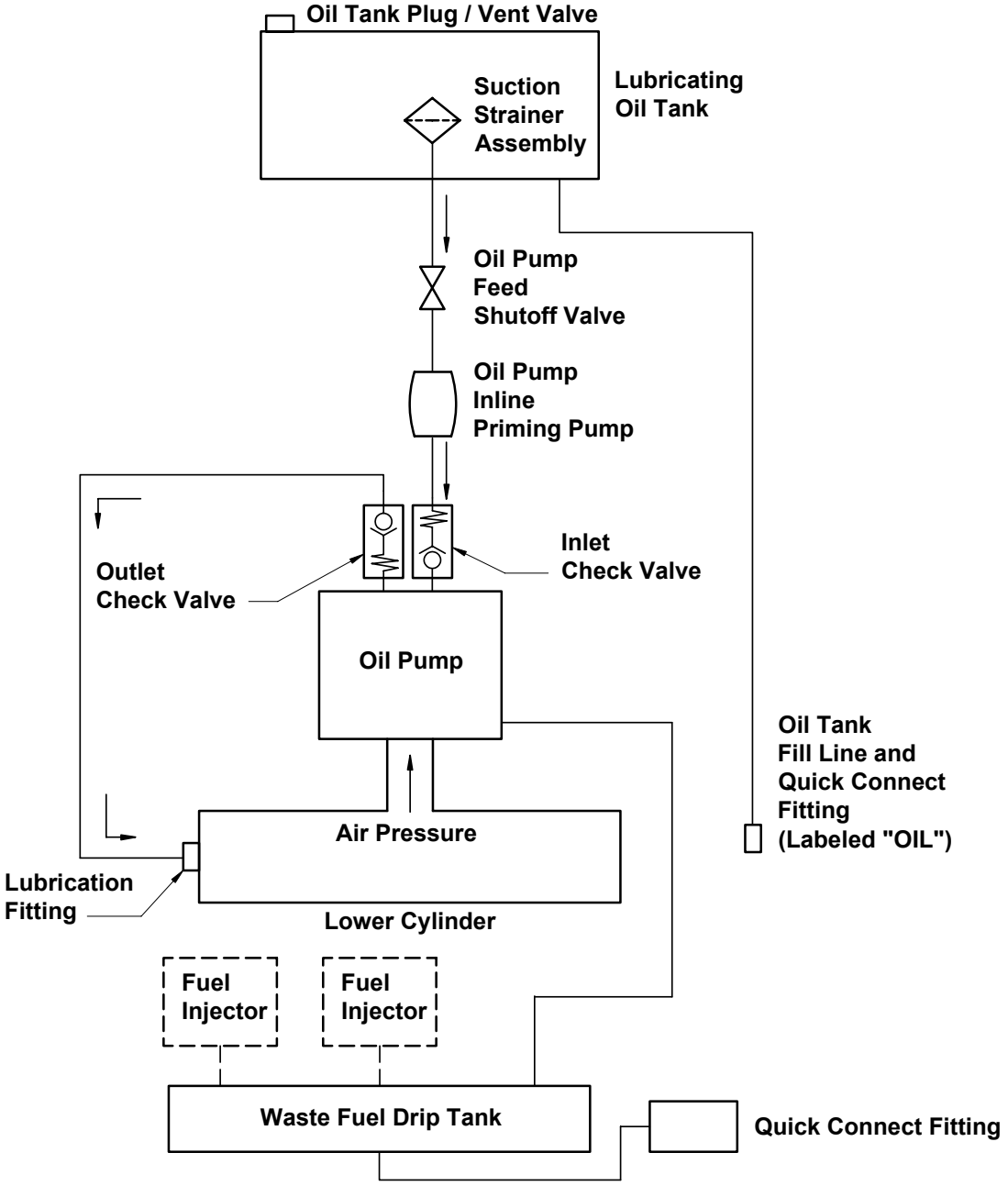


Figure H-9. Lubrication System Schematic

Impact Hammer - Direct Drive System Operation (Refer To Figure H-10.)

The direct drive system transfers the impact energy developed by the piston and impact block in the lower cylinder to the pile being driven. This is provided by the direct drive assembly connected to the bottom of the lower cylinder that houses the recoil dampening system and striker plate (driving head). During operation of the impact hammer the following sequence takes place.

1. At the bottom of the piston downstroke, the nose of the piston strikes the top of the impact block in the lower cylinder.
2. The impact block moves unimpeded and strikes the top of the striker plate in the direct drive assembly, transferring the impact energy from the impact block to the striker plate.
3. The impact energy from the striker plate is then delivered to the pile being driven by the striker plate. The striker plate evenly distributes and transfers the impact energy to the pile head to minimize mushrooming/splitting of the piling.
4. The pile is driven into the soil.
5. The recoil dampening system, consisting of the six cushion rings and cushion compression ring in the direct drive assembly, dissipates the rebound energy to allow up to 95% of the impact energy to be transmitted to the pile and only 5% of the rebound energy back to the impact hammer.

SAFETY PRECAUTIONS

The following general safety precautions should be observed during installation and operation:

1. Safe pile driving piles is a three-person operation. Always use two ground assistants and one crane operator for set-up and operation. Accept direction from only one person. However, obey a stop signal from anyone in the vicinity. All other non-essential personnel should be cleared from the area.
2. Ensure all mounting hardware is in place and tight. Ensure no loose articles such as tools, clothing, and shipping/lifting equipment are resting on the impact hammer.
3. Check the working pile to be sure it is strong enough to withstand the force of the impact hammer.
4. Verify that driving a pile will not cause damage from vibration to adjacent structures.
5. When unloading or loading the shipping/storage container, visually inspect each component for damage.

Observe the following precautions before starting the impact hammer:

1. Always wear personal protective equipment including ear and eye protection, work gloves, and a hard hat.
2. Do not use starting fluids as a cold weather starting aid as they can cause excessive piston stroke and damage to the impact hammer.
3. Never stand directly under the pile driving head.
4. Do not start the impact hammer until it is squarely positioned over the pile.

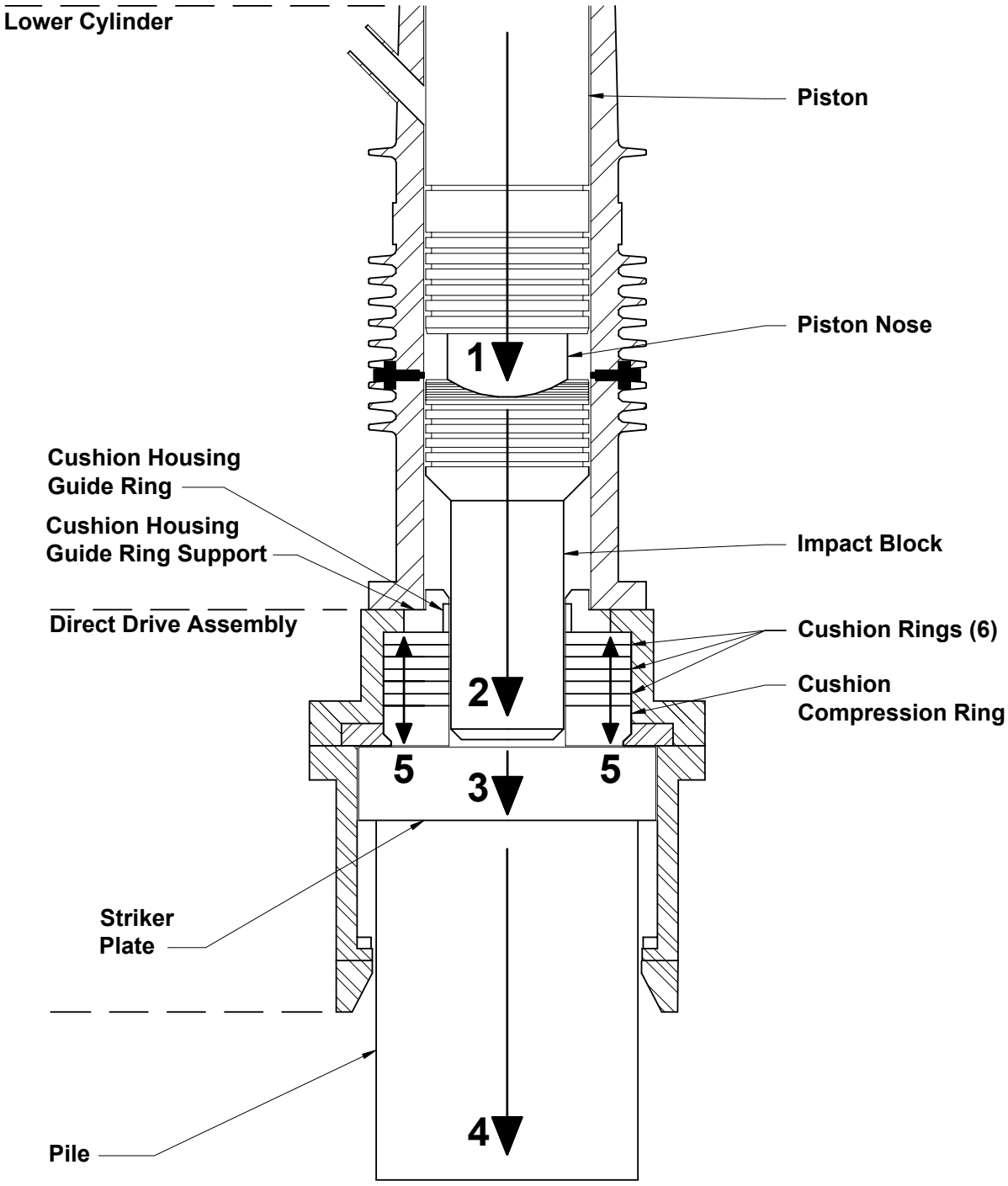


Figure H-10. Direct Drive System Operation

Observe the following precautions during pile driving operation:

1. Never leave the impact hammer unattended while in operation.

2. Do not exceed the recommended pile driving criteria of 20 blows per inch (2.5 cm).

3. Never adjust the height of the spotter below the horizontal position particularly when working near the spare tire mount. Damage to the spare tire mount could occur.

4. When hoisting piles into position underneath the impact hammer, ground personnel must stand at least the 1-1/2 times the length of the pile from the bottom of the lead tower. The bottom of the pile can suddenly swing upwards after contacting the direct drive assembly of the impact hammer.

5. The crane operator must always monitor the load moment indicator (LMI) system during operation of the Pile Driving System. The capacity of the crane, as indicated by the LMI system, should never be exceeded during any operation.

6. If the pile line (aux. hoist) remains connected to components during pile driving operations (i.e. ground-release shackles are not used), simultaneously pay out the pile line (aux. hoist) cable as load lowers. Do not allow tension to develop on pile line (aux. hoist) during pile driving operations.

7. While the impact hammer is driving a pile and traveling down the lead tower, simultaneously pay out hammer line (main hoist) cable to maintain the hammer trip assembly in the middle portion of the hammer trip track rails. Do not allow tension to develop on hammer line (main hoist) during pile driving operations.

8. Pile driving should be performed over the rear of the crane within a 120 degree arc on either side of the crane.

HAND SIGNALS FOR PILE DRIVING OPERATIONS (REFER TO FIGURE H-11.)

All the conventional hand signals used for hydraulic crane operations are utilized during operation of the Pile Driver System. Additional hand signals include for the raising and lowering of the hammer line (main hoist), the raising and lowering of the pile line (aux. hoist), and extension or retraction of the hydraulic spotter.

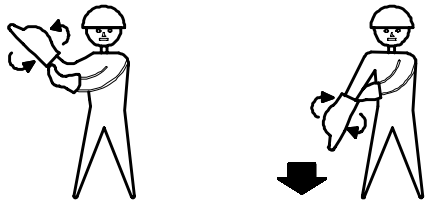
A decal illustrating crane signals and additional pile driving hand signals is attached to the outside box of the spotter on the crane operator's left-hand side.

To raise or lower the pile line (aux. hoist), the signaler will touch their right elbow and indicate either raising a load signal (index finger pointing up and twirling) or lowering the load (index finger pointing down and twirling). To raise or lower the hammer line (main hoist), the signaler will touch their hard hat and indicate either to raise or lower the load using the same index finger motions.

To raise the hammer line (main hoist), pile line (aux. hoist), and lead tower together, the signaler will extend both arms with the palms upward and motion in an upwards direction. To lower the hammer line (main hoist), pile line (aux. hoist), and lead tower together, the signaler will extend both arms with the palms downward and motion in a downwards direction.

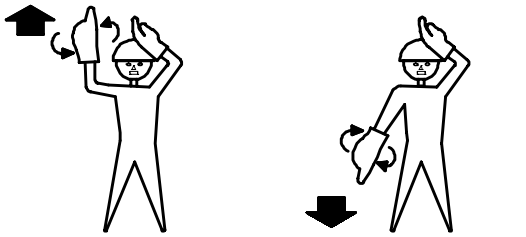
To extend the hydraulic spotter, the signaler will put his right arm in front of them in view of the operator and motion towards the crane operator with their palm facing the crane operator. To retract the hydraulic spotter the signaler will put his right arm in front of them and motion towards their body with the palm of their hand facing their body.

All other OSHA approved signals for use with hydraulic crane operations apply during Pile Driver System operation. It is important to note that all signals be given in plain and clear view of the crane operator. Only one person per crew should be designated as the signaler or front-end personnel for the crane. If any confusion occurs during signaling than the crane operator should not commence an operation until the signaler and operator have clarified the work procedure.



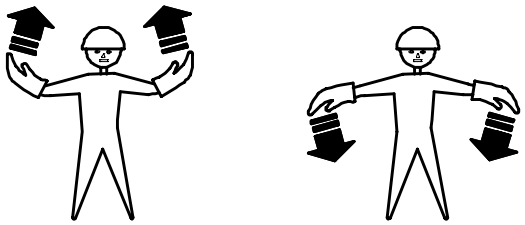
Raise Pile Line (Aux. Hoist) **Lower Pile Line (Aux. Hoist)**

1. Pile Line (Aux. Hoist)



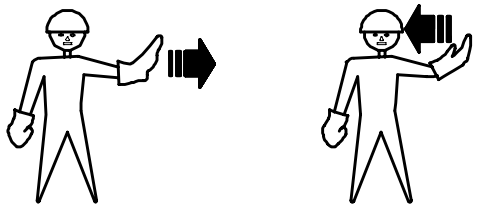
Raise Hammer Line (Main Hoist) **Lower Hammer Line (Main Hoist)**

2. Hammer Line (Main Hoist)



Raise Hammer Line, Pile Line, and Lead Tower Together **Lower Hammer Line, Pile Line, and Lead Tower Together**

3. Hammer Line (Main Hoist), Pile Line (Aux. Hoist), and Lead Tower Together



Extend Spotter (Away From Crane) **Retract Spotter (Towards Crane)**

4. Spotter

Figure H-11. Hand Signals for Pile Driving Operations

INSTALLATION OF THE PILE DRIVER SYSTEM

General

Unload, assemble, and install, the Pile Driver System in an area of stable and flat ground. The work area should also be clear of any obstructions.

WARNING

Always wear personal protective equipment including ear and eye protections, work gloves, hard hat, and steel-toed boots/shoes.

Removal From Storage (Refer To Figure H-12.)

The Pile Driver System, including the lead tower, spotter, impact hammer, lifting slings, and other tools required to install and operate the pile driver system are stowed in the weather-proof shipping/storage container. The shipping/storage container is to be unloaded in the immediate vicinity of the crane.

The weight of the shipping/storage container with all components stored inside is approximately 19,500 lbs (8,864 kg). Prior to hoisting the shipping/storage container for unloading and loading check to ensure all the shipping/storage container cover bolts are installed and secured. If the crane is being used to lift a fully loaded shipping/storage container, it is necessary to have the crane rigged with a four-part hook block.

NOTE

Warnings, dimensions, weight, and center-of-gravity location decals are located on the sides of the shipping/storage container.

Perform the following procedure to unload the shipping/storage container:

a. Park the crane into position shown in Figure H-12, rotate superstructure so that boom faces the rear, and set up crane properly for lifting operations on outriggers. Configure the Load Moment Indicator (LMI) system on the crane for Front Hoist, Outrigger Position 100%, and Four (4) Parts of Line.

NOTE

All crane lifting shall be done with the outriggers fully extended, tires relieved of the crane weight, and the crane set on a firm and level supporting surface. It may be necessary to place cribbing under the outrigger floats.

CAUTION

Failure to position wood blocking directly under bolt hole locations before removing the shipping/storage container cover will cause unnecessary pressure on bolts and damage threads.

b. Ensure the main hoist of the crane is rigged with the four-part hook block. Attach four-point lifting sling to the four lifting lugs on top of the pile driving system shipping/storage container with shackles. Using the main hoist and hook block, hoist and place the shipping/storage container onto level wood blocking placed at the bolt hole locations, adjacent and perpendicular to the crane stabilizers on the right side of the crane (facing front). The loaded container weighs 19,500 pounds (8,864 kg). Be sure to lift the shipping/storage container within the load radius of the crane.

c. Remove the hardware securing the shipping/storage container cover to the base. Then, using the four-point lifting sling and hook block (main hoist), hoist and remove the shipping/storage container cover and place it beside the base, farthest from the crane.

NOTE

The shipping/storage container is to be unloaded at a 15 foot (4.6 m) crane radius and less than 60 feet (18.3 m) of boom length.

d. If not installed, install the headache ball, stored in the crane tool box, on the auxiliary hoist wire rope. This line is called the pile line. Then remove the four-part hook block from the main hoist wire rope. This line is called the hammer line. Temporarily attach a weight (ground-release shackle) to the hammer line (main hoist) wedge and socket to prevent slack in the line.

e. Using the quick-set feature, change the Load Moment Indicator (LMI) configuration to Rear Hoist and Two (2) Parts of Line.

WARNING

Use caution when removing equipment tie-down straps in the shipping/storage container to prevent sudden movement of equipment caused by equipment shifting during transport.

f. Release the equipment tie-down straps in the shipping/storage container.

g. Remove the ten-pound sledge hammer, steel bar with hickey, 36-inch peavey, and cheater bar (bundled together). Also remove the ground fueling hand pump and four 4x4-inch wood blocks.

h. Remove the two rough-terrain wheels.

i. Remove two tool boxes.

j. Attach a nylon lifting sling to the spotter slide. Then, using the pile line (aux. hoist), hoist and remove the spotter slide from the sheet pile adapter and install it on the spotter.

k. Attach a wire rope lifting sling with a 3/4-inch shackle to the center lifting lug on the spotter. Then, using the pile line (aux. hoist), hoist and remove the spotter and place it along the left side of the crane.

l. Attach two nylon lifting slings to the spotter storage support. Then, using the pile line (aux. hoist), hoist and remove the spotter storage support and place it along the right side of the crane in front of the shipping/storage container.

m. Attach two nylon lifting slings to the center of each lead section (looped through the holes in the sides). Using the pile line (aux. hoist), hoist and remove each lead section. Lay each lead section in line with the crane on two wood blocks spaced three feet (0.9 m) from each end with the dowel ends of the lead sections facing the crane. The top lead section should be placed a few feet from the rear of the crane. Turn each lead section over onto its side to aid in assembly. Ensure the hammer side with the larger tubular rails on each lead section face in the same direction.

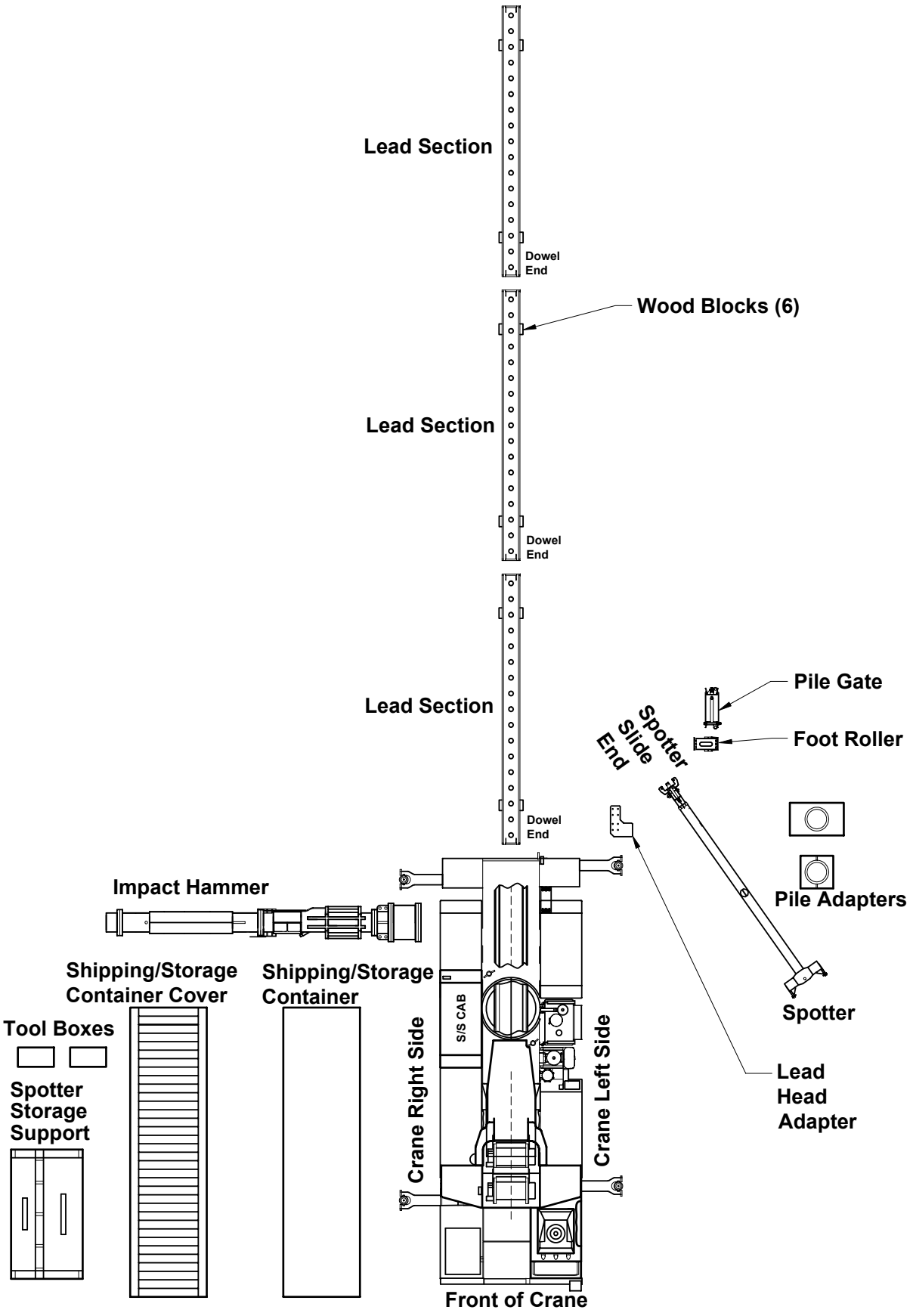


Figure H-12. General Pile Driver System Components Arrangement (Pre-setup)

n. Attach a nylon lifting sling to the lead head adapter and using the pile line (aux. hoist), hoist and remove the lead head adapter.

o. Attach two lifting slings with 3/4-inch shackles to the pile gate and using the pile line (aux. hoist), hoist and remove the pile gate.

p. Remove the pile gate stop and the lead transportation chain from the square (concrete) pile adapter.

q. Attach the nylon lifting sling to the foot roller assembly and using the pile line (aux. hoist), hoist and remove the foot roller assembly.

r. Attach two lifting slings with 3/4-inch shackles to the sheet pile adapter and using the pile line (aux. hoist), hoist and remove the sheet pile adapter.

s. Attach two lifting slings with 3/4-inch shackles to the square (concrete) pile adapter and using the pile line (aux. hoist), hoist and remove the square (concrete) pile adapter.

t. If not already attached, attach the 89-inch lifting sling with a 7/8-inch shackle to the upper cylinder lifting lug on the impact hammer (center of upper cylinder) and attach the 96-inch lifting sling with a 7/8-inch shackle to the lower cylinder lifting lug (at top of direct drive assembly). This will help to ensure that the impact hammer remains level throughout the lift. Using the pile line (aux. hoist), hoist and remove the impact hammer. After removal, disconnect the 96-inch lifting sling but leave the 89-inch lifting sling attached to the impact hammer.

u. If needed, remove the appropriate size guide plate (10, 12, or 16-inch) from the bottom of the shipping/storage container.

v. The final arrangement of pile driving system components, ready for assembly should appear as shown in Figure H-12.

Pile Driver System Component Inventory (Refer To Table H-5 and Figure H-13.)

A quick inventory of the equipment needed for a typical pile driving operation should be performed before getting underway. Inspect each component to be sure it is serviceable. Procure any missing or damaged mission-critical components before proceeding.

NOTE

Table H-5 is a list of the necessary components needed to assemble, perform PMCS, and operate the Pile Driver System and **not** a comprehensive list of all components delivered with the system to be used when performing an inventory. Refer to Components of End Item Section at the end of this Appendix for a complete list.

Table H-5. Pile Driver System Pre-Assembly Inventory Checklist

No.	Qty.	Component Description	√
		Crane Components	
1.	1	Five-ton headache ball (The headache ball is provided with the crane and is normally stowed in the crane's toolbox.)	
2.	2	Boom nose adapter plates, right and left side (The plates are provided with the crane and are normally stowed in the crane's toolbox.)	
3.	1	Four-point lifting sling (Used to lift shipping/storage container and/or cover.)	
4.	-	Assorted rope tag lines (Used to connect to spotter slide manual release and ground-release shackles.)	
		Shipping/Storage Container	
5.	1	Shipping/storage container cover (Includes mounting bolts.)	
6.	1	Shipping/storage container base	
7.	1	Wrench for shipping/storage container cover bolts	
8.	2	Equipment tie-down straps – 1,400 lbs (636 kg)	
9.	3	Equipment tie-down straps – 1,000 lbs (455 kg)	
10.	2	Tool boxes	
		Lead Tower Assembly	
11.	3	Lead tower sections (with attaching hardware – bolts, nuts, washers, and retaining blocks)	
12.	1	Lead head adapter (Includes attaching hardware – bolts, nuts, and lockwashers.)	
13.	1	Foot roller	
14.	1	Pile gate stop	
15.	2	Rough-terrain wheels	
16.	1	Impact hammer stop (With attaching hardware – two bolts.)	
17.	1	Pile gate	
		Spotter Assembly	
18.	1	Spotter	
19.	1	Spotter slide	
		Impact Hammer	
20.	1	Impact hammer with 18-inch guide plate installed.	
21.	1	Remote throttle	
22.	1	70-foot (18 m) hydraulic hose for remote throttle.	
23.	1	Automatic transmission fluid Dexron II/III or equivalent for remote throttle.	
		Rigging and Safety Equipment	
24.	1	Trip safety lever cord – 100-feet (30.5 m)	
25.	1	Hydraulic hose retaining cord – 100-feet (30.5 m)	
26.	2	96-inch wire rope lifting sling	
27.	2	89-inch wire rope lifting sling (One may be attached to impact hammer.)	
28.	2	72-inch wire rope lifting sling	
29.	2	Nylon lifting slings	
30.	1	H-type pile lifting sling (Double bridle – 30" x 5/8" (76 cm x 1.6 cm))	
31.	2	H-type pile chain lifting sling with hooks	
32.	2	1-inch shackles	
33.	2	7/8-inch shackle (May be attached to impact hammer.)	
34.	8	3/4-inch shackles	
35.	2	Ground-release shackles	
36.	1	Temporary hydraulic hose retainer chain (5/16 x 84-inch (0.8 x 213 cm))	
37.	1	Lead transportation chain	
38.	1	Hydraulic hose clamp (With attaching hardware – two bolts.)	
39.	1	Pulley with 15-inch (38 cm) anchor bungee	
40.	4	4x4-inch (10 x 10 cm) wood blocks	
41.	2	1/2 x 48-inch wire rope	

Table H-5. Pile Driver System Pre-Assembly Inventory Checklist (Continued)

No.	Qty.	Component Description	√
		Ground Servicing Equipment – Supplied with Pile Driver System (Cont'd)	
42.	4	5/8 x 96-inch wire rope to attach the pile adapters to the impact hammer.	
43.	8	5/8-inch cable clamps to attach the pile adapters to the impact hammer.	
44.	1	Ground fueling hand pump with hose and quick connect fitting	
45.	1	Ground oiling hand pump	
46.	1	Ground oiling hose and quick connect fitting	
47.	1	Ground oiling hand pump container cover	
48.	1	Waste fuel drip tank drain hose and quick connect fitting	
49.	1	Grease gun with flex hose	
50.	1	Coupler for grease gun	
51.	1	MIL-G-10924 grease	
52.	1	Oil gun	
53.	1	MIL-L-2105 oil	
		Ground Servicing Equipment – Not Supplied with Pile Driver System	
54.	1	External JP-8 or No. 2 diesel fuel source	
55.	1	External MIL-L-2104, 15W40 oil source	
56.	1	Kleen-Flo Tumbler Industries (Stock #789) Engine Storage/Fog Oil Spray or equivalent	
57.	1	Suitable container for catching fuel to bleed air from fuel lines and to drain waste fuel drip tank.	
		Tools	
58.	1	Hex key – 3/4-inch (12-inch long)	
59.	1	Hex key – 5/8-inch (10-inch long)	
60.	1	Hex key – 1/2-inch (8-inch long)	
61.	1	Hex key – 3/8-inch (7-inch long)	
62.	1	Hex key – 5/16-inch (6-inch long)	
63.	1	Wood pile tongs	
64.	1	Crowbar (2-foot (61 cm))	
65.	1	Two-pound (0.9 kg) hammer	
66.	1	Vice grips	
67.	1	12-inch (30.5 cm) adjustable wrench	
68.	1	18-inch (46 cm) adjustable wrench	
69.	1	1-5/16-inch combination wrench	
70.	1	1-1/8-inch combination wrench	
71.	1	1-5/16-inch box end wrench	
72.	1	1-1/8-inch box end wrench	
73.	1	Two-inch (5 cm) wood level	
74.	1	100-foot (30.5 m) fiberglass measuring tape	
		Tools - Bundled Together	
75.	1	Axe	
76.	1	Ten-pound (4.5 kg) sledge hammer	
77.	1	36-inch (91 cm) peavey	
78.	1	Cheater bar (36 x 2-inch (91 x 5 cm))	
79.	1	Steel bar w/ hickey (5-foot (1.5 m))	
		Accessories and Adapters (to Drive Concrete, Sheet, or 10, 12, or 14-inch Steel H-beam and Wood Piles)	
80.	1	18-inch square (concrete) pile adapter	
81.	1	Sheet pile adapter	
82.	1	10-inch (25.4 cm) guide plate	
83.	1	12-inch (30.5 cm) guide plate	
84.	1	16-inch (40.6 cm) guide plate	
85	1	Plywood template for 18-inch square (concrete) pile adapter	

SHIPPING/STORAGE CONTAINER AND ACCESSORIES AND ADAPTERS

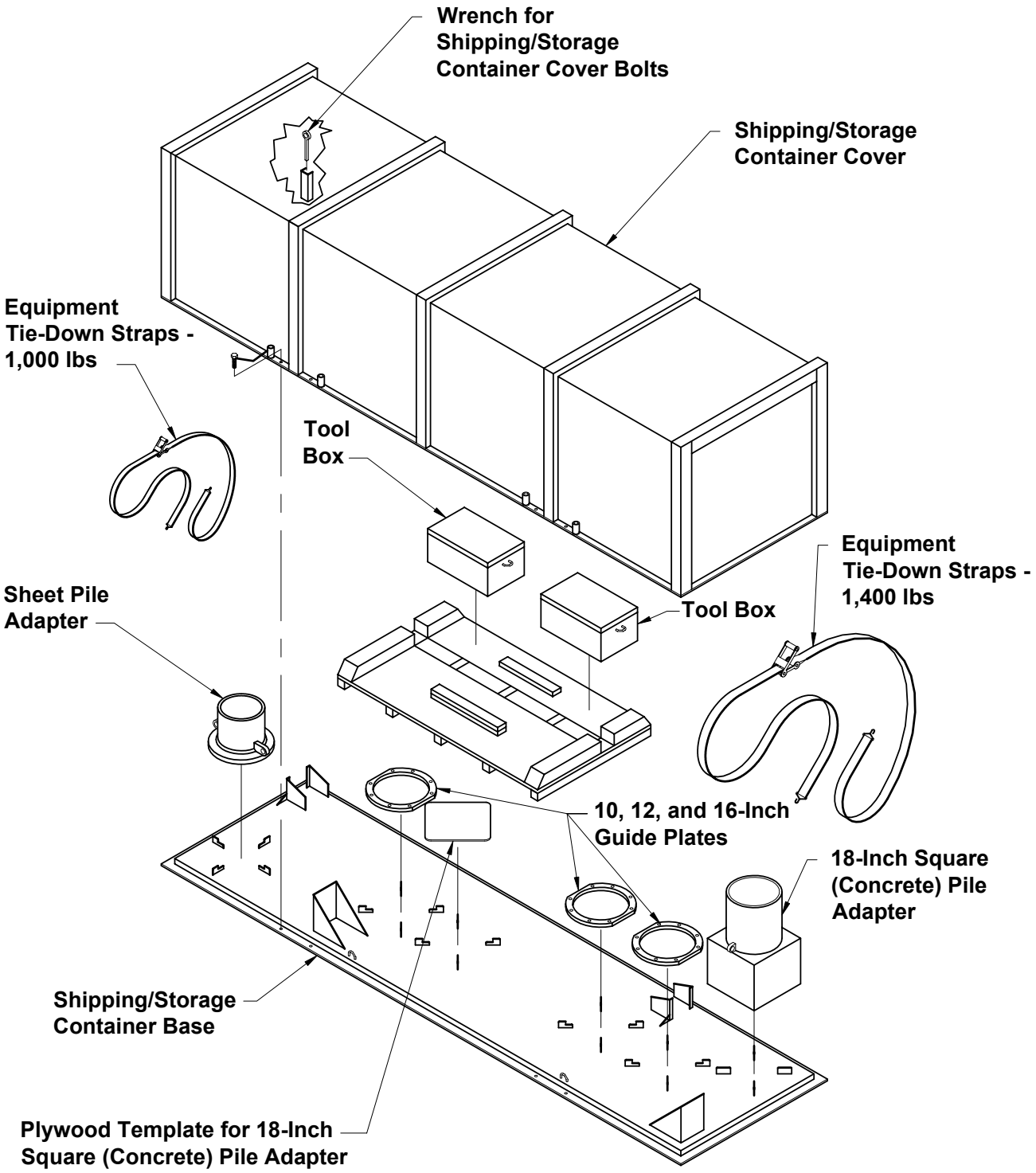
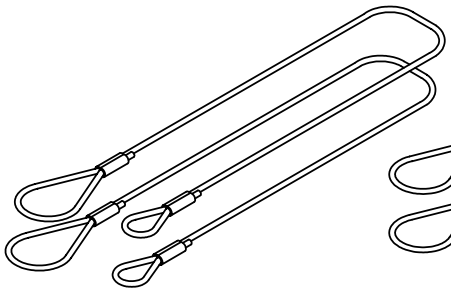


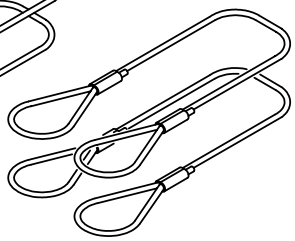
Figure H-13. Pile Driver System Pre-Assembly Inventory Components (Sheet 1 of 4)

RIGGING AND SAFETY EQUIPMENT

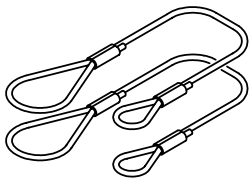
Trip Safety Lever Cord and Hydraulic Hose Retaining Cord



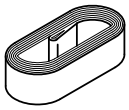
96-Inch Wire Rope Lifting Slings



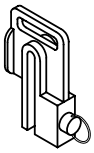
89-Inch Wire Rope Lifting Slings



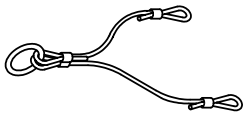
72-Inch Wire Rope Lifting Slings



Nylon Lifting Slings



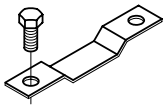
Ground-Release Shackles



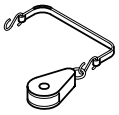
H-Type Pile Lifting Sling

H-Type Pile Chain Lifting Slings (with Hooks)

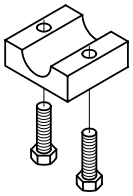
Shackles



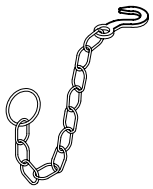
Impact Hammer Stop and Bolts



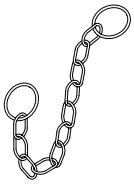
Pulley with 15-Inch Anchor Bungee



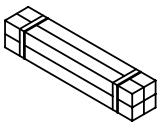
Hydraulic Hose Clamp and Bolts



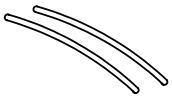
Temporary Hydraulic Hose Retainer Chain



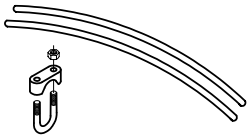
Lead Transportation Chain



4x4-Inch Wood Blocks



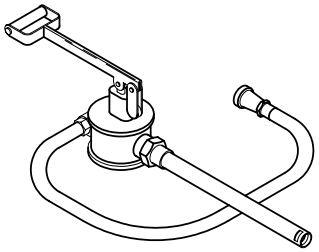
1/2 x 48-Inch Wire Rope



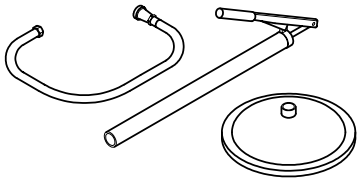
5/8 x 96-Inch Wire Rope and 5/8-Inch Cable Clamps

Figure H-13. Pile Driver System Pre-Assembly Inventory Components (Sheet 2 of 4)

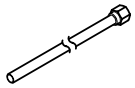
GROUND SERVICING EQUIPMENT - SUPPLIED WITH PILE DRIVER SYSTEM



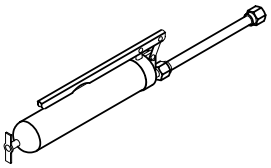
Ground Fueling Hand Pump



Ground Oiling Hand Pump, Hose and Quick Connect Fitting, and Hand Pump Container Cover

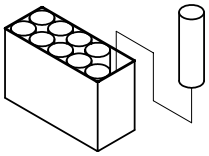


Waste Fuel Drip Tank Drain Hose and Quick Connect Fitting

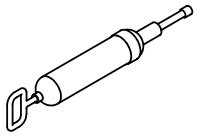


Grease Gun with Flex Hose

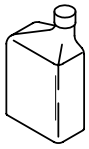
Coupler for Grease Gun



MIL-G-10924 Grease



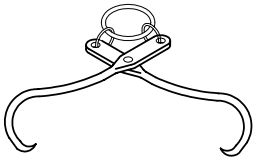
Oil Gun



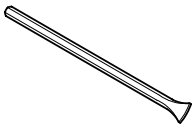
MIL-L-2105 Oil

TOOLS - LOCATED IN TOOL BOXES

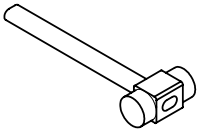
3/4, 5/8, 1/2, 3/8,and 5/16-Inch Hex Keys



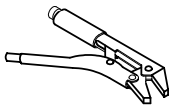
Wood Pile Tongs



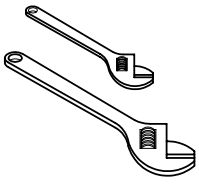
Two-Foot Crowbar



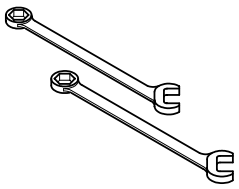
Two-Pound Hammer



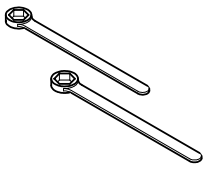
Vice Grips



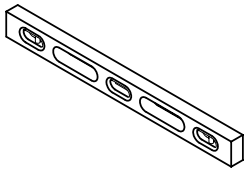
12 and 18-Inch Adjustable Wrenches



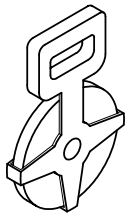
1-5/16 and 1-1/8 Combination Wrenches



1-5/16 and 1-1/8 Box End Wrenches



Two-Inch Wood Level



100-Foot Fiberglass Measuring Tape

Figure H-13. Pile Driver System Pre-Assembly Inventory Components (Sheet 3 of 4)

TOOLS - BUNDLED TOGETHER

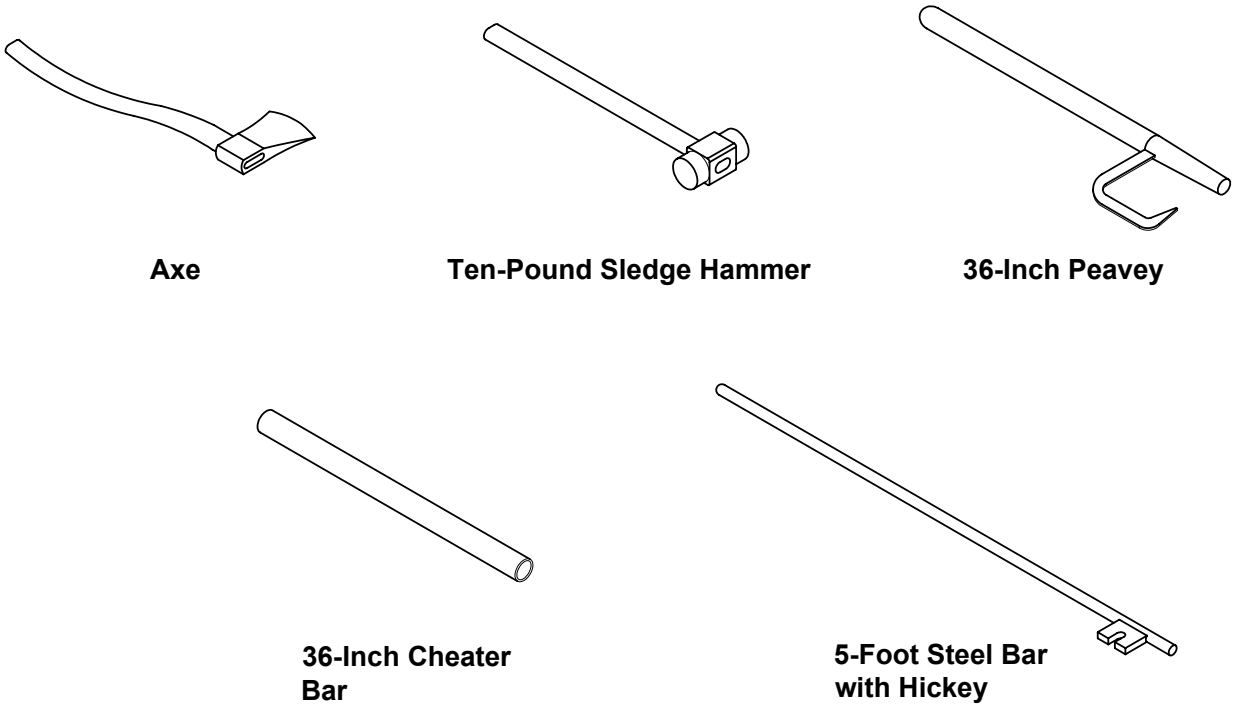


Figure H-13. Pile Driver System Pre-Assembly Inventory Components (Sheet 4 of 4)

Spare Tire Removal

It is necessary to remove the spare tire before installing the Pile Driver System on the crane. Otherwise the spotter cannot be installed and operated properly. Retain all spare tire attaching hardware for installation later. Use the five-ton headache ball on the pile line (aux. hoist) and the spare tire handling (lifting) sling, located in the crane tool box, to remove the spare tire. Set the spare tire down well away from the immediate work area.

Lead Tower Assembly

The lead tower consists of three identical, 15-foot (4.6 m) sections that must be assembled and attached to the crane boom nose. The lead tower will be assembled immediately in behind the center rear of the crane carrier.

Perform the following procedure to assemble the lead tower:

a. Clear a 25 by 100-foot (7.6 x 30.5 m) area immediately to the rear of the crane's carrier for assembling the lead tower.

NOTE

The three lead sections are identical and interchangeable. One end of each section features tapered dowels, the other end has no dowels.

b. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

c. Ensure the top lead section is on its side, within a few feet of the rear of the crane, on wood blocking spaced three feet (0.9 m) from each lead section end, and with the dowel end facing the crane.

d. Loosen the assembled bolts, washers, and nuts securing the retaining blocks to the top lead section.

NOTE

The pile line (aux. hoist) of the crane along with the wire rope lifting sling and nylon lifting sling can be used to position and align the lead sections during assembly. The five-foot bar with hickey can also be used to aid in lead section alignment.

e. Attach the two nylon lifting slings to the middle lead section. Use the pile line (aux. hoist) of the crane to position and align the middle lead section with the top lead section and push the ends together. Ensure the dowels on the middle section mate with the holes in the top section and the hammer side with the larger tubular rails on each lead section faces in the same direction.

f. Install the joint retaining blocks with assembled bolts, washers, and nuts. Be sure the tapered end of the joint retainer block is on the inside against the weld and that the nuts are facing downward (i.e. towards the ground with lead tower attached to boom). Tighten the bolts and nuts simultaneously or alternately on each side in order to draw the two sections together. Torque the joint bolts and nuts to 680 ft•lb (920.6 N•m).

g. Ensure the middle lead section is also resting on wood blocks spaced three feet (0.9 m) from each lead section end.

h. Attach two nylon lifting slings to the bottom lead section. Use the pile line (aux. hoist) of the crane to position and assemble the bottom lead section to the middle lead section.

i. Use the pile line (aux. hoist) of the crane and the nylon lifting slings to lift the assembled lead tower in order to place additional wood blocks under the tower, raising it 12 to 16 inches (30-40 cm) above the ground.

j. Attach a nylon lifting sling to the foot roller and use the pile line (aux. hoist) of the crane to position and assemble the foot roller onto the base of the lead tower. Align the dowels on the foot roller with the holes in the lead tower and ensure the gib rails are properly aligned. Install the joint retaining blocks with assembled bolts, washers, and nuts. Torque the joint bolts and nuts to 680 ft•lb (920.6 N•m).

NOTE

If the gib rails are not lined up properly it will be difficult to install the impact hammer and pile gate.

k. Attach the nylon lifting sling to the lead head adapter and use the pile line (aux. hoist) of the crane to position and assemble the lead head adapter onto top of the lead tower. Ensure the impact hammer (front) side of the lead head adapter faces the hammer side of the lead tower. Align the dowels on the top lead section with the holes in lead head adapter. Install the joint retaining blocks with assembled bolts, washers, and nuts. Torque the joint bolts and nuts to 680 ft•lb (920.6 N•m).

l. Use the pile line (aux. hoist) of the crane and the nylon lifting slings to turn the assembled lead tower over on the wood blocks with the impact hammer side surface with the larger tubular rails on each lead section facing up.

m. Install the rough-terrain wheels on the shafts of the foot roller assembly and secure with the shaft pins.

Lead Tower Installation

The lead head adapter, attached to the top of the lead tower, attaches to the crane boom nose via two boom nose adapter plates, one on each side. The boom nose adapter plates are then connected to the lower boom nose shafts on the boom nose by locking collars.

NOTE

The left and right side boom nose adapter plates are different and are stenciled with the words LEFT and RIGHT. Each must be installed on the correct side of the boom nose.

NOTE

If at any time during the installation of the lead tower the weight of the anti-two block switch, which is hanging freely, comes in contact with the ground (i.e. the weight is lifted, relieving the tension on the chain), the hydraulic functions of the crane will be locked out by the Load Moment Indicator (LMI) system. Take measures to ensure tension remains on the chain(s) during lead tower installation. Be sure to return the chain(s) to the normal position prior to raising the lead tower to the vertical position. If the crane is equipped with only one anti-two block switch, the red by-pass flag can be installed on the anti-two block switch to maintain tension on the chain.

Perform the following procedure to install the lead tower on the crane boom nose:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Reposition the wire rope lifting sling and nylon lifting sling to the top of the lead tower. Use the pile line (aux. hoist) of the crane to lift the top of the lead tower and allow the base to roll out until the lead head adapter is approximately 37-38 feet (11.3-11.6 m) from the rear of the crane and inline with the boom assembly.

c. Lower the lead tower onto wooden blocks placed near the lead head adapter at the top of the lead tower. The blocks should be sufficient to raise the top of the lead tower approximately 30-inches (76 cm) high.

d. With the crane's boom aligned with the lead tower, lower the boom to its lower limit. The boom should be at a negative angle.

e. Raise the rear outriggers until the rear wheels are touching the ground. Then lower the front outriggers to tilt the crane towards the rear.

f. Remove the bolts and washer securing the locking collars to the two lower boom nose shafts and remove the locking collars from the shafts.

NOTE

The lead head adapter attaches to the crane boom nose via two boom nose adapters plates, one on each side. These plates are located in the crane's tool box. The left and right side adapter plates are different and are stenciled with the words LEFT and RIGHT. Each must be installed on the correct side of the boom nose with the bushing installed inward toward the boom nose.

g. Install the boom nose adapter plates, locking collars, nuts, and lockwashers with the boss portion of the boom nose adapter plates facing inwards. Ensure that all hardware is secure and that the boom nose adapter plates swing freely.

h. Remove and retain the nuts, bolts, and lockwashers installed in the lead head adapter brackets.

i. Telescope the boom out approximately 50 feet (15 m). Be sure to pay out the hammer line (main hoist) and pile line (aux. hoist) cables while extending the boom. Telescope slowly as the boom tip approaches the lead head adapter brackets. Align the hammer line (main hoist) and pile line (aux. hoist) cables along one side of the lead tower.

WARNING

This procedure presents several opportunities for pinching body parts. Use care when lining up the boom nose adapter plates with the lead head adapter.

j. Rotate the boom nose adapter plates to horizontal and telescope and raise or lower the boom until the bolt hole patterns on the adapter plates line up with holes in the lead head adapter bracket. Use the tapered end of a pry bar to line up the bolt hole patterns.

k. Insert the lead head adapter bracket attaching bolts, washer, and nuts with the nuts on the outside. Torque the hardware to 260 ft•lb (352 N•m).

l. Release the retainer chain securing the tag line on the hydraulic hoses wound on the boom-mounted hose reel. Allow the tag line to unwind at least seven revolutions to relieve tension on the lines. Then pull out the hydraulic hose reel lines and temporarily attach the hoses, with a temporary hydraulic hose retainer chain (i.e. small length of chain), to the spotter mounting bracket welded to the crane superstructure near the base of the lift cylinder.

m. Mount, with the 15-inch anchor bungee, the pulley to the operator's side of the hydraulic hose reel on the crane boom. Lay a 40-foot (12.2 m) length of rope over the pulley allowing the loose ends to hang free. The rope will be used to secure the remote throttle hydraulic hose and keep it out of the way during pile driving operations.

n. Install the impact hammer stop on the top of the lead tower using the two bolt holes close to the lead head adapter.

o. Lower the rear outriggers and level the crane.

p. Pay out the hammer line (main hoist) and pile line (aux. hoist) cables the length of lead tower and lay alongside the lead tower.

q. Through a combination of telescoping and booming up, slowly raise the lead tower to the vertical position. Stop when the rough-terrain wheels are from 18 to 24 inches (46-61 cm) off the ground.

NOTE

Be sure to pay out the hammer line (main hoist) and pile line (aux. hoist) cables while extending the boom.

r. Remove the rough-terrain wheels.

Spotter Installation

The spotter is attached to the bottom lead section and the crane superstructure to provide stability to and control the location and pitch of the lead tower. The spotter is connected to rails on the rear of the bottom lead section via the spotter slide and to mounting lugs on the front of the crane superstructure via brackets and two support pins. The mounting lugs are located on spotter mounting brackets welded to the crane superstructure near the base of the lift cylinder. The spotter slide, allows vertical adjustment of the spotter connection to the lead tower. A pin on the spotter slide engages holes on the rear of the lead tower to hold the spotter slide in place along the lead tower rails and a retainer pin can be used to hold the manual release (and spotter slide pin) in the disengaged position during height adjustment.

WARNING

This procedure presents several opportunities for pinching body parts between moving parts. Use care when lining up the spotter base with the mounting lugs on the spotter mounting brackets of the crane superstructure.

Never stand directly under the suspended lead tower.

WARNING

Be sure that the crane operator can see all ground personnel including those on the crane. Ground personnel on the carrier deck must always position themselves to prevent obstructing the crane operator's view.

NOTE

The installation of the spotter is different for a 60-foot (18.3 m) four-section lead tower.

Perform the following procedure to install the spotter on the crane with a 45-foot (13.7 m) three-section lead tower:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Using the crane boom, raise the lead tower off of the ground high enough to allow the spotter to pass under the foot roller.

c. If not installed, attach a rope tag line to the manual release on the spotter slide.

d. Attach a wire rope lifting sling with a shackle to the center lifting lug on the spotter and attach the headache ball on the pile line (aux hoist) to the wire rope lifting sling.

e. With ground personnel at each end of the spotter, use the pile line (aux. hoist) to hoist and raise the spotter into position over the center-rear of the carrier frame. One of the ground personnel should climb onto the carrier frame in order to guide the spotter base into the spotter mounting brackets on the crane superstructure.

f. Secure the spotter base in the mounting lugs on the spotter mounting brackets with two spotter support pins. Insert the spotter support pins all the way and retain each with a cotter pin.

g. Shackle the hydraulic hose retention chain attached to the base of the spotter to the chain attached to the hydraulic hose reel lines. Then disconnect the temporary hydraulic hose retainer chain.

h. Remove the protective caps on the hydraulic hose connections (spotter manifold) and connect the hydraulic hose reel lines to the appropriate connections.

CAUTION

The spotter slide pin should not be allowed to engage a hole in the lead tower lower than the seventh hole up from the foot roller. This will ensure that the spotter will not make contact with and damage the spare tire mounting bracket.

i. For spotter installation use a boom length of 46-feet (14 m) for a 45-foot (13.7 m) lead tower (three sections).

j. Using the crane boom, lower the lead tower and rotate the spotter slide to the near vertical position. Engage the spotter slide and lead tower by adjusting the lead tower, raising the spotter with the pile line (aux. hoist), and turning the spotter slide.

k. When the pin on the spotter slide is aligned with the seventh hole up from the foot roller (or higher if required), pull the spotter slide pin back and hold. Remove the retainer pin, release the spotter slide pin, and it will engage the hole in the back of the lead tower.

l. Using the crane boom, lower the lead tower and spotter. Disconnect the pile line (aux. hoist), wire rope lifting sling, and headache ball from the center lifting lug on the spotter.

Perform the following procedure to install the spotter on the crane with a 60-foot (18.3 m) four-section lead tower:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. If not installed, attach a rope tag line to the manual release on the spotter slide.

c. Attach a wire rope lifting sling with a shackle to the center lifting lug on the spotter and attach the headache ball on the pile line (aux hoist) to the wire rope lifting sling.

d. Using the pile line (aux. hoist), hoist the spotter and place on wood blocks directly in front of the rear of the crane with the slide pointing away from the crane with approximately eight feet (2.4 m) between the crane and the spotter. Wood blocking under the spotter slide must be high enough for the slide to pivot without contacting the ground.

e. Disconnect the pile line (aux. hoist), wire rope lifting sling, and headache ball from the center lifting lug on the spotter.

f. For spotter installation use a boom length of 59-feet (18 m) for a 60-foot (18.3 m) lead tower (four sections).

g. Using the crane boom, move the lead tower and place above the spotter slide. Then, holding the spotter slide vertical, align the lead tower with the spotter slide and lower the lead tower to engage the spotter slide.

h. Attach the wire rope lifting sling with a shackle to the front lifting lug on the spotter closest to the lead tower and attach the headache ball on the pile line (aux hoist) to the wire rope lifting sling.

i. Using the pile line (aux. hoist), raise the spotter slide along the lead tower to a height of approximately four feet (1.2 m) from the ground.

j. Remove the retainer pin in the spotter slide, and pull the rope tag line attached to the manual release on the spotter slide to disengage the pin from the hole in the lead tower. Hold the spotter slide pin in the retracted (disengaged) position.

CAUTION

The spotter slide pin should not be allowed to engage a hole in the lead tower lower than the seventh hole up from the foot roller. This will ensure that the spotter will not make contact with and damage the spare tire mounting bracket.

k. Using the pile line (aux. hoist), raise the spotter slide until the pin on the spotter slide is aligned with the seventh hole up from the foot roller. Release the manual release on the spotter slide and the spotter slide pin will engage the hole in the lead tower.

l. Disconnect the pile line (aux. hoist), wire rope lifting sling, and headache ball from the front lifting lug on the spotter and reconnect to the middle lifting lug.

m. Using the pile line (aux. hoist), raise the spotter until it is level.

n. With ground personnel on the carrier frame at the end of the spotter, use a combination of the boom and pile line (aux. hoist) to hoist and raise the spotter into position over the center-rear of the carrier frame. The ground personnel should guide the spotter base into the spotter mounting brackets on the crane superstructure.

o. Secure the spotter base in the mounting lugs on the spotter mounting brackets with two spotter support pins. Insert the spotter support pins all the way and retain each with a cotter pin.

p. Shackle the hydraulic hose retention chain attached to the base of the spotter to the chain attached to the hydraulic hose reel lines. Then disconnect the temporary hydraulic hose retainer chain.

q. Using the crane boom, lower the lead tower and spotter. Disconnect the pile line (aux. hoist), wire rope lifting sling, and headache ball from the center lifting lug on the spotter.

Spotter Length and Height Adjustment

The length of the spotter, adjusted by the crane operator, controls the pitch of the lead tower. This will need to be adjusted to perform the impact hammer installation and is also used during pile driving operations. The spotter is extended and retracted by placing the TELE/CLAMSHELL selector switch, in the superstructure cab, in the CLAMSHELL position and moving the telescope/clamshell control pedal to operate the hydraulic cylinder of the spotter.

NOTE

The boom telescope hydraulic functions are disabled while operating the spotter. To telescope the boom, return the TELE/CLAMSHELL selector switch in the superstructure cab, to the TELE position.

The height of the spotter slide connection to the lead tower can be adjusted if necessary. The spotter slide can be moved to a hole in the lead tower above the seventh up from the foot roller (raised only).

CAUTION

The spotter slide pin should not be allowed to engage a hole in the lead tower lower than the seventh hole up from the foot roller. This will ensure that the spotter will not make contact with and damage the spare tire mounting bracket.

Perform the following procedure to raise the height of the spotter slide connection to the lead tower:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Attach a wire rope lifting sling with a shackle to the front lifting lug on the spotter and attach the headache ball on the pile line (aux hoist) to the wire rope lifting sling.

c. Remove the slack in the pile line (aux. hoist) to slightly support the spotter.

d. Pull the rope tag line attached to the manual release on the spotter slide to disengage the pin from the hole in the lead tower. Hold the spotter slide pin in the retracted (disengaged) position.

e. Raise the spotter to the desired hole location using the pile line (aux. hoist). Release the manual release on the spotter slide and the spotter slide pin will engage the desired hole in the lead tower.

Impact Hammer Installation

The impact hammer, connected via four gibs (two on each side), travels vertically along rails on the front of the lead tower.

CAUTION

Prior to hoisting the impact hammer, inspect the cable on both crane hoist drums to ensure it is straight and undamaged.

Perform the following procedure to install the impact hammer on the lead tower:

a. Verify that the guide plate installed on the direct drive assembly of the impact hammer is the correct size for the diameter of the piles to be driven. Install the correct size guide plate if necessary. Refer to the “Guide Plate Installation” Paragraph on Page H-52.

b. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

c. If necessary, attach the 89-inch lifting sling with a 7/8-inch shackle to the upper cylinder lifting lug on the impact hammer (center of upper cylinder) and attach the 96-inch lifting sling with a 7/8-inch shackle to the lower cylinder lifting lug (at top of direct drive assembly). Using the pile line (aux. hoist), hoist and place the impact hammer in front of the lead tower, parallel to the front outriggers. Disconnect the 96-inch lifting sling but leave the 89-inch lifting sling attached to the impact hammer.

d. Attach the headache ball of the pile line (aux. hoist) to the free end of the 89-inch lifting sling. Using the pile line (aux. hoist), hoist and lift the top of the impact hammer approximately four to five feet (1.2-1.5 m) off of the ground.

e. Remove the catch ring weather cap, the piston transport pin, the trip transport bolt, and the intake/exhaust port weather cap and store them in the tool box. Refer to Figure H-16.

NOTE

The storage and transportation parts are red in color.

f. Open the two fuel tank plug/vent valves located on the top of the fuel tank and the two fuel pump feed and return shutoff valves (handle parallel to the lines) located directly below the fuel tank. Refer to Figure H-16.

g. Open the oil tank plug/vent valve located on the top of the lubricating oil tank and the oil pump feed shutoff valve (handle parallel to the lines) located directly below the lubricating oil tank. Also open the waste fuel drip tank vent valve located on top of the waste fuel drip tank. Refer to Figure H-16.

h. Attach the trip safety lever cord to the hole on the trip safety lever. Refer to Figure H-16.

i.Using the pile line (aux. hoist), raise the impact hammer another foot (30 cm) so that the impact hammer is at approximately a 60-degree angle relative to the ground.

WARNING

Ensure that the crane operator is aware that attaching the hammer line (main hoist) will be performed while under a suspended load (impact hammer).

j. Have the crane operator turn the CRANE FUNCTION POWER switch to the OFF position to remove power from the crane functions controlled by the armrest joysticks. This prevents accidental operation of the controlled crane functions caused by bumping the joysticks.

k. Attach the wedge and socket of the hammer line (main hoist) to the lifting lug on the hammer trip assembly and secure with the pin. Refer to Figure H-16.

NOTE

Ensure that the crane operator is aware that the hammer line (main hoist) connection was made to the hammer trip assembly.

l. When all personnel are clear of the suspended impact hammer, have the crane operator turn the CRANE FUNCTION POWER switch to the ON position to return power to the crane functions controlled by the armrest joysticks.

CAUTION

Do not lift the impact hammer with the hammer line (main hoist) alone. This could seriously damage the hammer trip system. Use a combination of the pile (aux. hoist) and hammer (main hoist) lines until the impact hammer is mounted on the lead tower.

m. Using the quick-set feature, change the Load Moment Indicator (LMI) system configuration to Front Hoist. Slowly hoist the impact hammer to the vertical position using a combination of the pile (aux. hoist) and hammer (main hoist) lines. Then lift the impact hammer off of the ground and rotate it so that its attachment gibs are facing the lead tower.

n. Using the crane boom and the hydraulic length adjustment of the spotter, raise the lead tower above the upper set of impact hammer attachment gibs. Then align the attachment gibs with the lead tower and raise the impact hammer to engage the lead tower. Using the hammer (main hoist) and pile (aux. hoist) lines, continue to raise the impact hammer until the lower set of attachment gibs engage the lead tower.

o. With the upper and lower impact hammer attachment gibs fully engaged and impact hammer in a vertical position, lower the impact hammer and the lead tower to within six inches (15 cm) of the ground. Lower the lead tower using the crane boom and the impact hammer using the hammer line (main hoist). Also, pay out the pile line (aux. hoist) while lowering the impact hammer.

p. Disconnect the headache ball of the pile line (aux. hoist) from the 89-inch lifting sling. Then attach the free end of the 89-inch lifting sling to the lower cylinder lifting lug with a shackle.

q. Perform the Preventive Maintenance Checks and Services (PMCS) identified as "Before Operation (B)."

NOTE

Prior to operation of the impact hammer, the fuel and lubricating oil systems must be filled and primed, all lubricating points on the impact hammer must be serviced, and the waste fuel drip tank must be drained. The spotter slide is also equipped with lubrication fittings for servicing. All servicing can be performed by personnel on the ground.

Pile Gate Installation

The pile gate is connected to the bottom of the lead tower via gibs sliding over the rails on the front of the foot roller and held in place by a sliding gate stop.

NOTE

If the 18-inch square (concrete) pile adapter is to be used for pile driving operations, the adapter must be installed prior to installing the pile gate. Refer to the "18-Inch Square (Concrete) and Sheet Pile Adapter Installation" Paragraph on Page H-53. If driving sheet piles the pile gate is not used at all and need not be installed.

Perform the following procedure to install the pile gate:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Use the hammer line (main hoist) to lift the impact hammer up the lead tower and away from the foot roller and use the crane boom to lift the lead tower approximately two-feet (60 cm) from the ground.

c. Attach two lifting slings to the five-ton headache ball on the pile line (aux. hoist). Raise the pile line (aux. hoist) and attach the lifting slings to the pile gate lifting lugs with 3/4-inch shackles.

d. Using the pile line (aux. hoist), raise the pile gate and install it on the lead tower by sliding it beyond the foot roller, aligning the gibs with the rails, and raising. Ensure that the gibs on the pile gate are fully engaged.

e. Install the pile gate stop in the foot roller with the stop extended beyond the front of the lead tower and insert the quick-release pin.

f. Using the pile line (aux. hoist), lower the pile gate onto the pile gate stop and remove the lifting slings and 3/4-inch shackles from the pile gate.

g. Using the hammer line (main hoist), lower the impact hammer down onto the pile gate.

Remote Throttle Installation

The remote throttle can be installed in the superstructure cab or operated by ground personnel. If installed in the cab, the hydraulic hose is routed out of the cab via a hole drilled in the lower left hand front of the superstructure cab. The hydraulic hose of the remote throttle is then connected to the throttle valve whip line quick connect fitting on the impact hammer. The hydraulic hose connection is located near the fuel pump and is labeled “THROTTLE CONNECTION.”

If superstructure cab mounting is desired, perform the following procedure to install the remote throttle in the superstructure cab:

a. Ensure the remote throttle is filled with automatic transmission fluid Dexron II/III or equivalent. If necessary fill via the fill plug.

b. Remove the hydraulic hose from the remote throttle by disconnecting it at the quick connect fitting near the pressure gauge.

c. Using the remote throttle mounting holes and remote throttle bracket (with the bracket over the cylinder portion of the remote throttle) as a template, drill four appropriately sized holes for self-tapping screws in the crane superstructure cab, above the door.

d. Align the two holes on the remote throttle with the holes at the mounting location and secure with two self-tapping screws.

e. Place the remote throttle bracket over the cylinder portion of the remote throttle and secure with two self-tapping screws.

f. Locate an appropriately sized hole (or drill) at the lower left hand front of the superstructure cab for routing the hydraulic hose into the cab.

CAUTION

If a new hole is drilled, be sure to file edges to prevent damage to the hydraulic hose.

g. Being careful not to pinch or cut the hydraulic hose in the hole, route the proper end of the hydraulic hose into the superstructure cab, over the dash, and to the remote throttle. Connect the hydraulic hose to the quick connect fitting near the pressure gauge of the remote throttle.

Perform the following procedure to connect the remote throttle to the impact hammer for impact hammer operation:

a. If the remote throttle was not installed in the superstructure cab, ensure the remote throttle is filled with automatic transmission fluid Dexron II/III or equivalent. If necessary fill via the fill plug.

b. Route the remote throttle hydraulic hose to the impact hammer and connect to the throttle valve whip line quick connect fitting labeled “THROTTLE CONNECTION.”

c. Tie one end of the 40-foot (12.2 m) rope suspended from the pulley (connected with the 15-inch anchor bungee to the hydraulic hose reel on the crane boom) to the remote throttle hydraulic hose. Pull the other end of the rope to raise the remote throttle hydraulic hose until it will not interfere with pile driving operations. Secure the loose end of the rope to the spotter base attached to the crane superstructure.

INSTALLATION OF ADAPTERS

The adapters are used to drive different size piles (wood other than 18-inch (45.7 cm and steel H-beam), concrete, or sheet piles. The adapters include 10-inch (25.4cm), 12-inch (30.5 cm), and 16-inch (40.6 cm) guide plates, an 18-inch (45.7 cm) square (concrete) pile adapter, and sheet pile adapter.

Guide Plate Installation (Refer To Figure H-14.)

The three different size guide plates are bolted onto the bottom of the direct drive assembly and replace the standard 18-inch (45.7 cm) guide plate.

Perform the following procedure to install a different size guide plate on the direct drive assembly of the impact hammer:

a. Remove the ten guide plate bolts securing the guide plate to the bell housing of the direct drive assembly.

b. Remove the guide plate.

c. Install the desired guide plate on the bell housing of the direct drive assembly and align the bolt holes.

d. Place Loctite® 272 on the ten guide plate bolts, secure the guide plate on the bell housing with the bolts, and torque the hardware to 500 ft•lb (677 N•m).

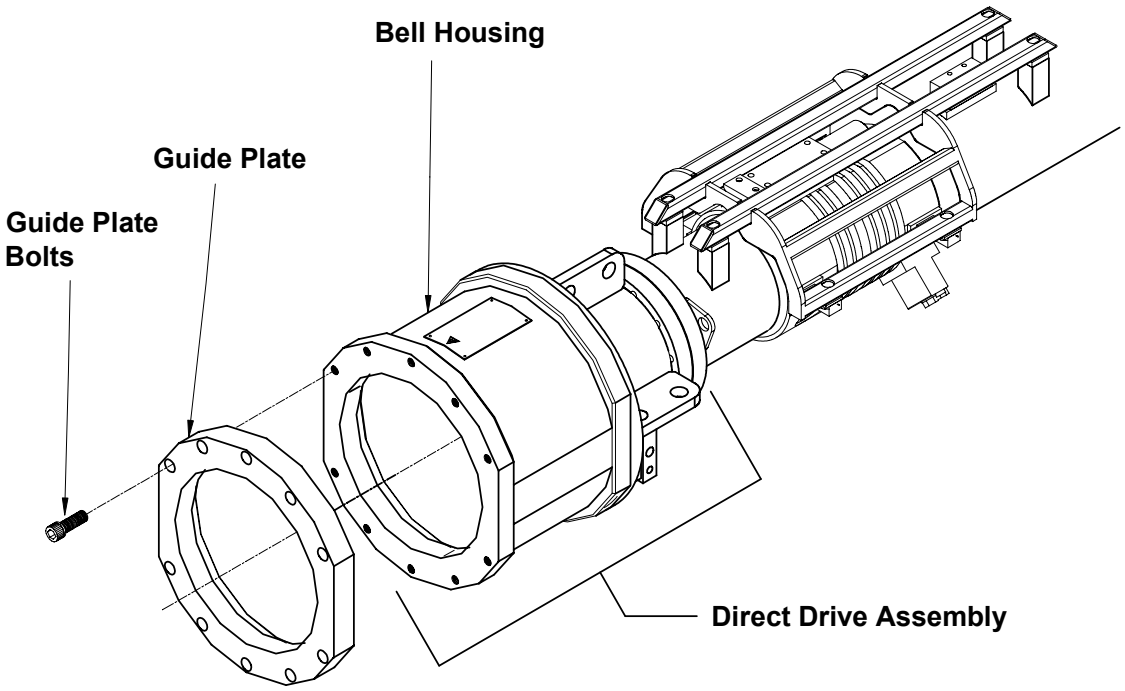


Figure H-14 Guide Plate Installation

18-Inch Square (Concrete) and Sheet Pile Adapter Installation (Refer To Figure H-15)

The 18-inch square (concrete) and sheet pile adapters are installed in the direct drive assembly and secured via cables and clamps to the adapter holes located at the top of the direct drive assembly. The adapter holes are the lower holes directly below the impact hammer lifting lugs.

Perform the following procedure to install the 18-inch Square (Concrete) or Sheet Pile Adapter on the impact hammer:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Ensure the 18-inch guide plate is installed on the direct drive assembly of the impact hammer for the use of the 18-inch square (concrete) or sheet pile adapter. If not, install the 18-inch guide plate as described in the "Guide Plate Installation" Paragraph on Page H-52.

c. If installed, remove the pile gate by performing the following procedure:

   1) Use the hammer line (main hoist) to lift the impact hammer up the lead tower and away from the pile gate and use the crane boom to lift the lead tower approximately two-feet (60 cm) from the ground.

   2) Attach two lifting slings to the five-ton headache ball on the pile line (aux. hoist). Raise the pile line (aux. hoist) and attach the lifting slings to the pile gate lifting lugs with shackles.

   3) Using the pile line (aux. hoist), raise the pile gate away from the gate stop.

   4) Remove the quick-release pin securing the pile gate stop on the foot roller. Retract the stop into the foot roller and reinsert the quick-release pin.

   5) Using the pile line (aux. hoist), lower the pile gate and remove it from the lead tower by lowering, disengaging the gibs from the rails, and sliding it beyond the foot roller.

d. Set the desired pile adapter upright and place on wood blocking so that it is aligned directly underneath the direct drive assembly of the impact hammer.

e. Using the hammer line (main hoist), slowly lower the impact hammer onto the pile adapter with the adapter sliding fully into the direct drive assembly.

f. Cut two pieces of 5/8-inch (1.6 cm) wire rope, five to six feet (1.5-1.8 m) in length. One wire rope secures the left side of the adapter and the other secures the right side.

g. Loop a wire rope through the lifting lugs on the left side of the adapter and the lower adapter holes on the left side of the impact hammer. Use two 5/8-inch (1.6 cm) cable clamps to secure the wire rope. Repeat for the right side.

h. Use the hammer line (main hoist) to lift the impact hammer and adapter up the lead tower and away from the ground.

i. Ensure that the loops in the wire rope are approximately the same on both sides and that the adapter is level relative to the impact hammer. Lower the impact hammer and adjust the cable clamps if necessary.

j. Tighten the four cable clamps and cut off any excess wire rope.

k. If using the 18-inch square (concrete) pile adapter, reinstall the pile gate as described in the “Pile Gate Installation” Paragraph on Page H-50. If using the sheet pile adapter the pile gate need not be installed.

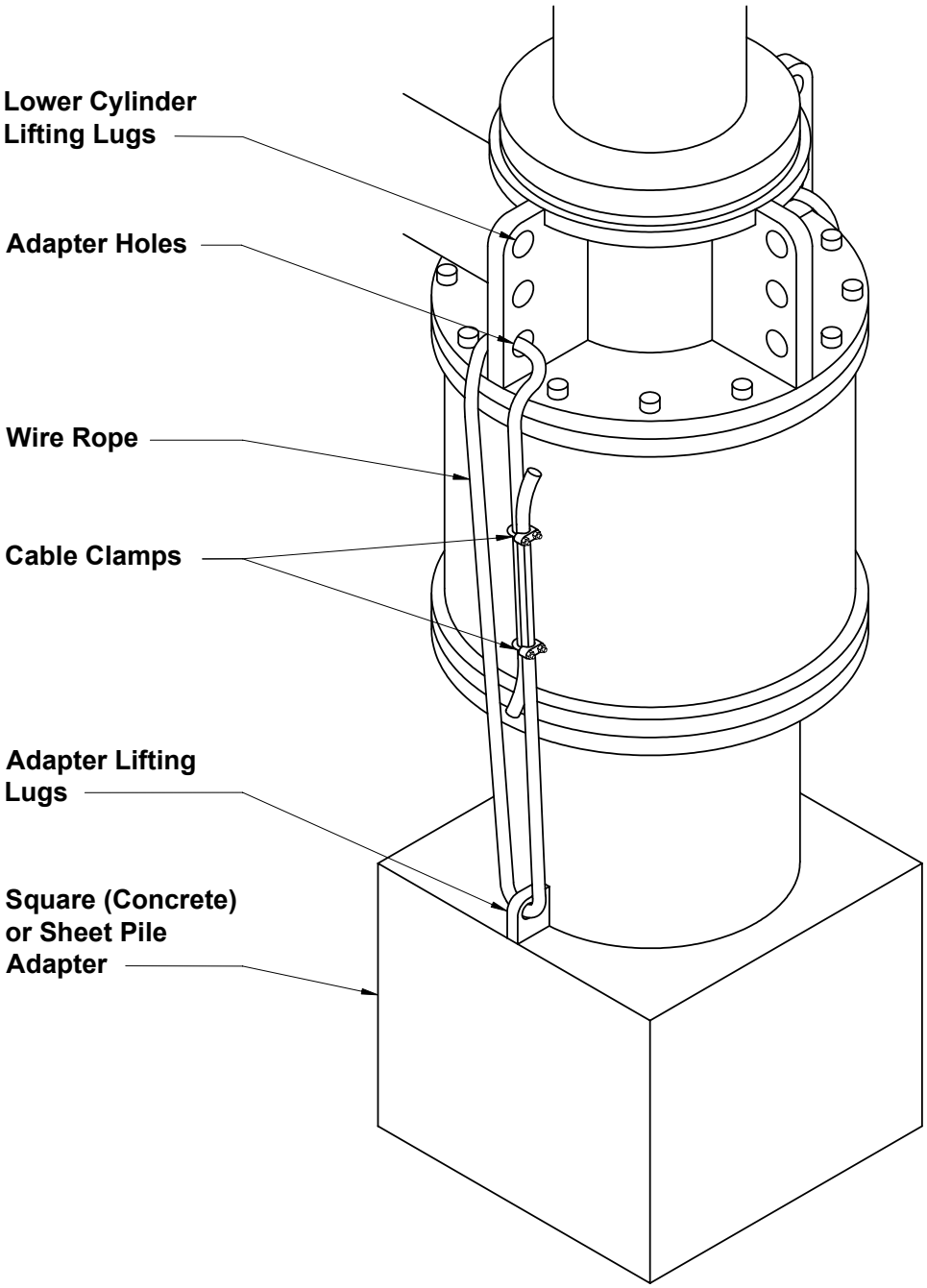


Figure H-15 18-Inch Square (Concrete) and Sheet Pile Adapter Installation

OPERATOR'S PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) (REFER TO FIGURE H-16)

Table H-6 contains Preventive Maintenance Checks and Services (PMCS) which must be performed by the Operator.

CAUTION

Before starting the impact hammer for pile driver operation, you must perform the Preventive Maintenance Checks and Services (PMCS) identified as "Before Operation (B)."

Table H-6. Operator's Preventive Maintenance Checks and Services (PMCS)

No.	Interval				B – Before Operation D – During Operation A – After Operation W – Weekly	
	B	D	A	W	Item to be Inspected	Procedure
1.	X				Service the Impact Hammer	Service the impact hammer by performing the following procedure: **NOTE** There are a total of twelve lubrication fittings on the impact hammer that require grease and two lubrication fittings that require oiling. Refer to Figure H-16 for Locations. The pile gate must be removed before performing the following procedure. a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line. b. Set the square (concrete) pile adapter upright and place on wood blocking so that it is aligned directly underneath the direct drive assembly of the impact hammer. c. Using the hammer line (main hoist), slowly lower the impact hammer onto the square pile adapter with the adapter sliding fully into the direct drive assembly. This will move the piston up into the lower cylinder and ensure that grease is distributed evenly. d. Have the crane operator turn the CRANE FUNCTION POWER switch to the OFF position to remove power from the crane functions controlled by the armrest joysticks. This prevents accidental operation of the controlled crane functions caused by bumping the joysticks. e. Ensure the two fuel tank plug/vent valves, located on the top of the fuel tank, are fully open. f. Ensure the oil tank plug/vent valve, located on the top of the lubricating oil tank, is fully open.

Table H-6. Operator's Preventive Maintenance Checks and Services (PMCS) (Continued)

No.	Interval				B – Before Operation D – During Operation A – After Operation W – Weekly	
	B	D	A	W	Item to be Inspected	Procedure
1.	X				Service the Impact Hammer (Continued)	g. Remove the protective cap from the fuel tank fill line and quick connect fitting labeled "FUEL" that is located at the bottom of the lower cylinder. Attach the hose of the ground fueling hand pump to the fuel tank fill line and quick connect fitting (FUEL) on the impact hammer. Place the ground fueling hand pump in an external JP-8 or No. 2 diesel fuel source. Manually pump fuel into the impact hammer fuel tank. Observe the fuel tank plug/vent valves for evidence that the fuel tank is full. Disconnect the hose of the ground fueling hand pump and reinstall the protective cap. h. Remove the protective cap from the oil tank fill line and quick connect fitting labeled "OIL" that is located at the bottom of the lower cylinder. Connect the ground oiling hose and quick connect fitting to the ground oiling hand pump and place the ground oiling hand pump container cover on an oil container filled with MIL-L-2104 15W40 oil. Install the ground oiling hand pump in the container cover. Connect the hose on the ground oiling hand pump to the oil tank fill line and quick connect fitting (OIL) on the impact hammer. Manually pump oil to the lubricating oil tank on the impact hammer. Observe the oil tank plug/vent valve for evidence that the lubricating oil tank is full. Disconnect the oil supply line and reinstall the protective cap. **NOTE** For temperatures below -20.0º F (-29º C), arctic-grade MIL-L-46167 0W40 oil should be used. i. Bleed air from the fuel inlet line at each of the two fuel injectors. Loosen and remove the fuel injector fuel line and allow fuel to flow into a suitable container until no bubbles are noted. Reconnect the fuel injector fuel line and tighten. Repeat for the other fuel injector. j. Prime the oil feed line from the lubricating oil tank by squeezing the oil pump inline priming pump several times. **CAUTION** The full weight of the impact hammer must be on a pile or on a pile adapter (square or sheet) to distribute the grease properly.

Table H-6. Operator's Preventive Maintenance Checks and Services (PMCS) (Continued)

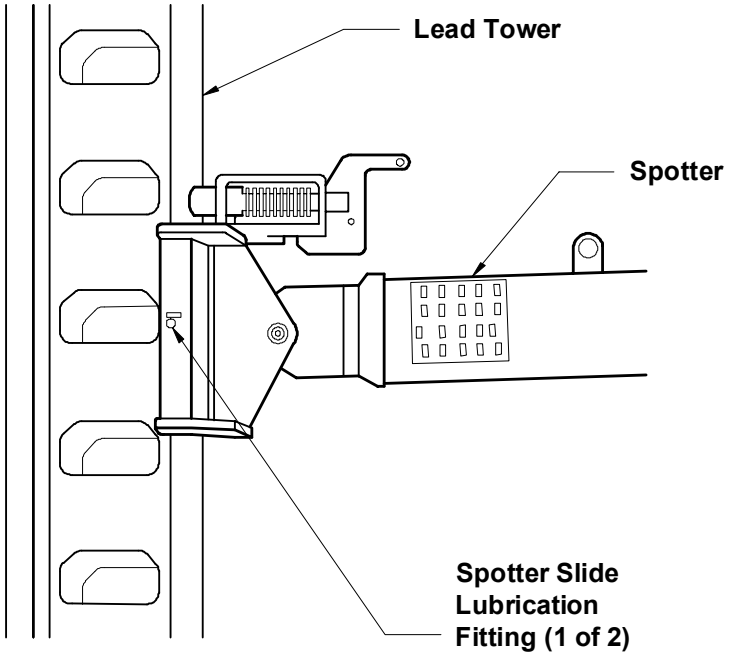
No.	Interval				B – Before Operation D – During Operation A – After Operation W – Weekly	
	B	D	A	W	Item to be Inspected	Procedure
1.	X				Service the Impact Hammer (Continued)	k. Using the grease gun charged with MIL-G-10924 grease, grease the four lower cylinder (impact block) lubrication fittings (ten shots per fitting). m. Using the oil gun charged with MIL-L-2105 oil, apply three shots of oil to the fuel pump lubrication fitting and oil pump lubrication fitting. n. Remove the protective cap from the waste fuel drip tank quick connect fitting located at the bottom of the lower cylinder. With one end in a suitable container, attach the quick connect fitting of the waste fuel drip tank drain hose to the waste fuel drip tank quick connect fitting on the impact hammer. Drain all liquid from the waste fuel drip tank. o. Have the crane operator turn the CRANE FUNCTION POWER switch to the ON position to return power to the crane functions controlled by the armrest joysticks. p Using the hammer line (main hoist), raise the impact hammer away from the square pile adapter. Move the square pile adapter away from the work area.
2.	X				Service the Spotter Slide	**NOTE** There are a total of two lubrication fittings on spotter slide that require grease. Refer to Figure H-16 for Locations. Using the grease gun charged with MIL-G-10924 grease, grease the two spotter slide lubrication fittings.
3.	X				Catch ring cap weather cap	Ensure the red catch ring cap with securing strap is removed.
4.	X				Piston transport pin	Ensure the red piston transport pin is removed.
5.	X				Trip transport bolt	Ensure the red trip transport bolt is removed.
6.	X				Intake/exhaust port weather cap	Ensure the red intake/exhaust port weather cap is removed.
7.	X				Fuel tank	Ensure the fuel tank is full, two fuel plug/vent valves are fully open, and fuel pump feed and return shutoff valves are fully open.
8.	X				Lubricating oil tank	Ensure the lubricating oil tank is full and oil tank plug/vent valve and oil pump feed shutoff valve are both fully open.
9.	X				Waste Fuel Drip Tank	Ensure the waste fuel drip tank vent valve is open.
10.	X				Attaching hardware	Inspect all attaching hardware, including the impact hammer gib bolts, guide plate bolts, and boom nose attaching hardware, for security.
11.	X				Remote throttle	Ensure the remote throttle reservoir is full of automatic transmission fluid Dexron II/III or equivalent and that the pressure relief valve is fully open (no pressure on pressure gauge).

Table H-6. Operator's Preventive Maintenance Checks and Services (PMCS) (Continued)

No.	Interval				B – Before Operation D – During Operation A – After Operation W – Weekly	
	B	D	A	W	Item to be Inspected	Procedure
12.	X				Impact Hammer Exercise	Exercise the impact hammer once by performing the following procedure with the weight of the impact hammer fully resting on a pile or a pile adapter: **NOTE** The lifting pawl of the hammer trip assembly will not be able to engage with the lifting collar of the piston unless the weight of impact hammer is fully resting on a pile or pile adapter. a. With no pressure indicated on the pressure gauge of the remote throttle, pull and hold the trip safety lever cord to engage the trip engage lug (allows the impact hammer piston to be raised by the hammer line (main hoist)). b. Using the hammer line (main hoist), raise the piston and let it free fall. c. Ensure all mechanisms operate properly and without binding. d. Ensure all excessive lubricant and moisture has been blown from inside the cylinder. If excessive lubricant or moisture was present, repeat the Impact Hammer Exercise until the cylinder chamber is clear.
13.		X			Piston	Periodically inspect the piston as it rises out of the top of the upper cylinder. If it appears shiny, the impact hammer is lubricated properly. If the piston appears dull, stop the impact hammer, fill the lubricating oil tank, and prime the system. Also ensure that the oil tank plug/vent valve and oil pump feed shutoff valve are fully open.
14.		X			Impact hammer and spotter slide greasing and oiling	Stop the impact hammer operation every twenty minutes or after 1,000 blows and perform the following: **CAUTION** The full weight of the impact hammer must be on a pile or on a pile adapter (square or sheet) to distribute the grease properly. a. Using the grease gun charged with MIL-G-10924 grease, grease the four lower cylinder (impact block) lubrication fittings (ten shots per fitting). b. Using the oil gun charged with MIL-L-2105 oil, apply three shots of oil to the fuel pump lubrication fitting and oil pump lubrication fitting. c. Inspect the impact hammer gibs, hammer trip track rails, and spotter slide for adequate lubrication. If necessary, using the grease gun charged with MIL-G-10924 grease, grease the fittings.

Table H-6. Operator's Preventive Maintenance Checks and Services (PMCS) (Continued)

No.	Interval				B – Before Operation D – During Operation A – After Operation W – Weekly	
	B	D	A	W	Item to be Inspected	Procedure
14.		X			Impact hammer and spotter slide greasing and oiling (Continued)	d. Inspect all attaching hardware, including the impact hammer gib bolts, guide plate bolts, and boom nose attaching hardware, for security. e. Lubricate the ground-release shackles as necessary to keep them working smoothly.
15.			X		Waste Fuel Drip Tank	Drain the waste fuel drip tank by performing the following procedure: a. Remove the protective cap from the waste fuel drip tank quick connect fitting located at the bottom of the lower cylinder. b. With one end in a suitable container, attach the quick connect fitting of the waste fuel drip tank drain hose to the waste fuel drip tank quick connect fitting on the impact hammer. c. Drain all liquid from the waste fuel drip tank.



SPOTTER SLIDE SIDE VIEW

Figure H-16. Spotter Slide and Impact Hammer Service Points (Sheet 1 of 2)

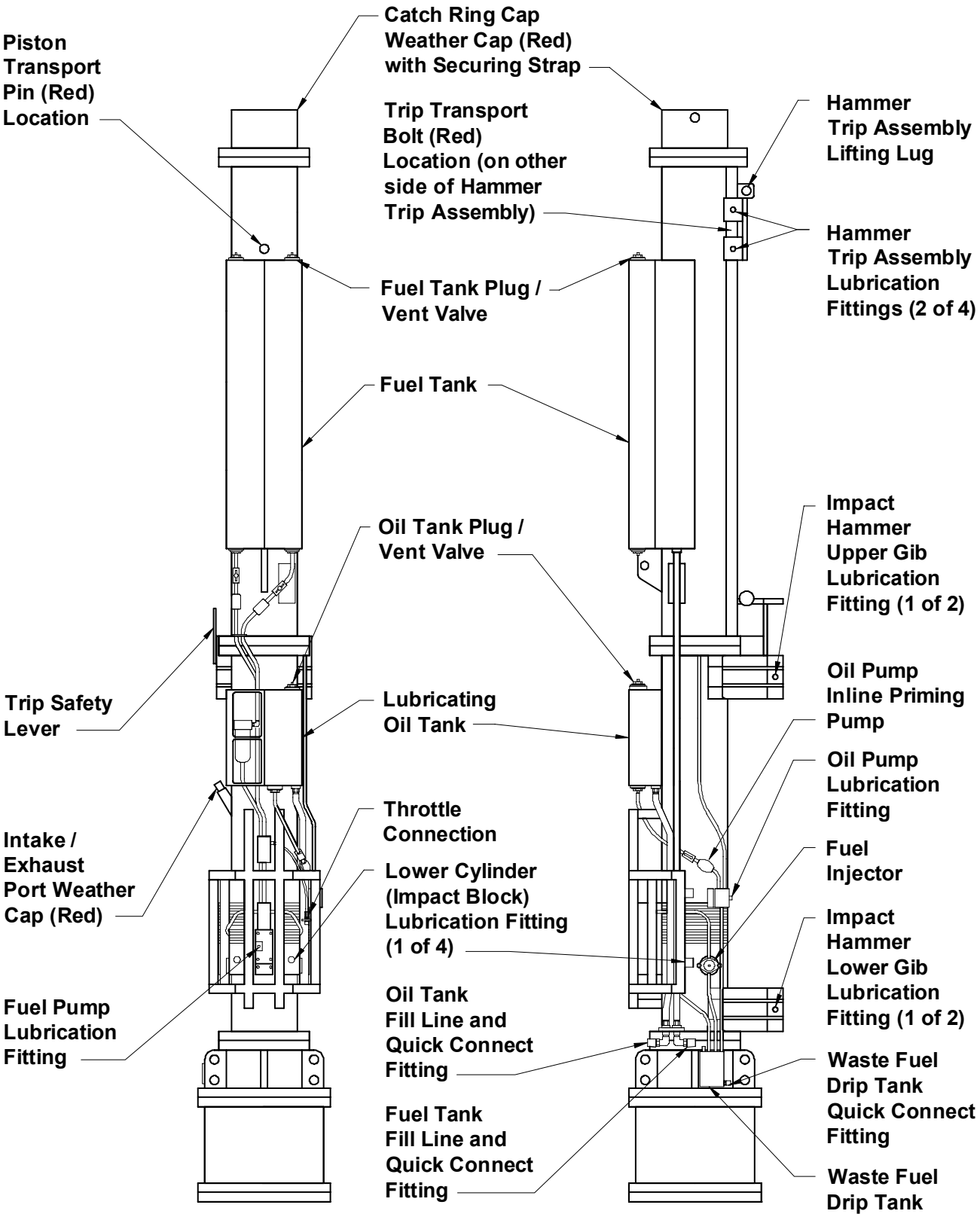


Figure H-16. Spotter Slide and Impact Hammer Service Points (Sheet 2 of 2)

OPERATION OF THE PILE DRIVER SYSTEM

Setup Pile - Wood (Refer To Figure H-17.)

WARNING

Never allow personnel between the pile and the lead tower when hoisting or setting any pile.

WARNING

If the wooden pile is bowed, set the pile with the bow facing the lead tower.

WARNING

When hoisting piles into position underneath the impact hammer, ground personnel must stand at least the 1-1/2 times the length of the pile from the bottom of the lead tower. The bottom of the pile can suddenly swing upwards after contacting the direct drive assembly of the impact hammer.

Perform the following procedure to set-up a wood pile for driving:

a. Ensure the correct size guide plate is installed on the direct drive assembly of the impact hammer. If not, install the proper guide plate as described in the “Guide Plate Installation” Paragraph on Page H-52.

b. If not removed, remove and stow the five-ton headache ball and install a ground release shackle on the pile line (aux. hoist). Attach a rope tag line to the ground release shackle cut to a length at least equal to that of the pile being driven.

c. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

d. Install a shackle on one end of the 96-inch lifting sling. Use the 96-inch lifting sling as a choker by wrapping it around the wood pile five feet (1.5 m) from the butt or largest diameter end and routing the free end through the shackle. Tighten choker around pile. Attach the free end of the 96-inch lifting sling to the ground-release shackle attached to the pile line (aux. hoist).

e. Using the hammer line (main hoist), raise the impact hammer along the lead tower to a height equal to approximately two-thirds the length of the pile to be driven.

f. Open the swing arm on the pile gate.

g. Using the pile line (aux. hoist), raise the pile to a point where it meets the front side of the direct drive assembly. It may be necessary to raise or lower the impact hammer using the hammer line (main hoist).

h. Using the pile (aux. hoist) and hammer (main hoist) lines, raise the pile and the impact hammer simultaneously allowing the pile to enter the direct drive assembly. Allow the pile to come to a vertical position then close the swing arm on the pile gate. Ensure the latch on the pile gate springs shut.

i. Ensure there are no obstructions along the proposed swing path. Then, using the crane boom, position the pile over the center of the driving location. Adjust the length of the spotter for any final adjustments.

j. Using the pile (aux. hoist) and hammer (main hoist) lines, lower the pile and impact hammer simultaneously. The pile may penetrate the ground under the weight of the pile and impact hammer. The weight of the impact hammer should be fully resting on the pile.

k. Using a carpenter's level, ensure the pile is plumb. Raise, lower, telescope the boom, and/or adjust the length of the spotter to plumb the pile.

l. Proceed to the "Startup and Shutdown" Procedure on Page H-62 to start the impact hammer and drive the pile.

m. Pull the rope tag line to free the ground-release shackle from the 96-inch wire rope lifting sling when the pile has penetrated at least three feet (91 cm).

Startup and Shutdown of the Impact Hammer

Once a pile is hoisted and setup then the impact hammer is ready to be started.

CAUTION

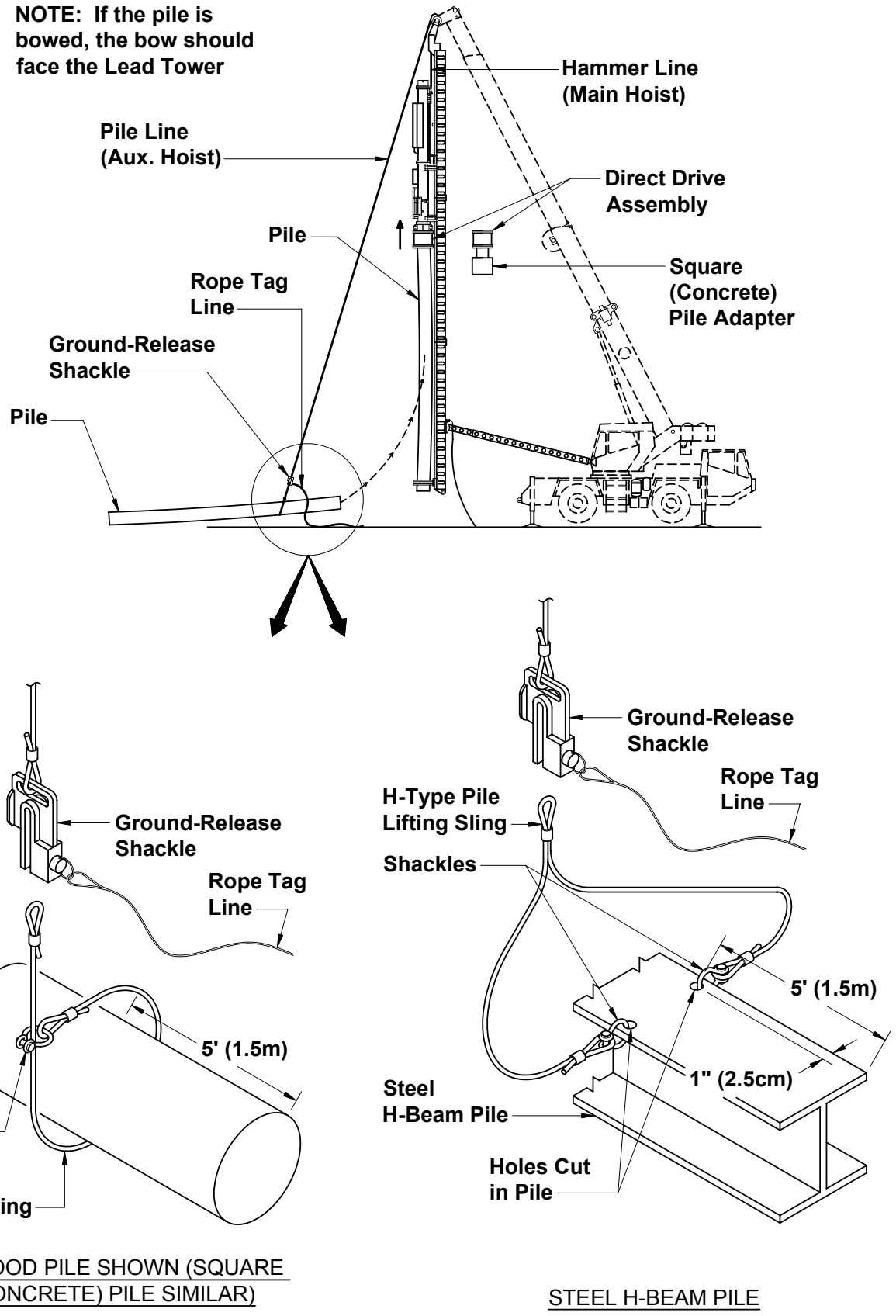
- Before starting the impact hammer for pile driver operation, ensure the impact hammer has been properly serviced and all Preventive Maintenance Checks and Services (PMCS) identified as "Before Operation (B)" have been performed.
- Do not use starting fluids as a cold weather starting aid as they can cause excessive piston stroke and damage to the impact hammer.
- Do not start the impact hammer unless it is squarely positioned over the pile.
- Do not leave the impact hammer unattended while operating.
- Do not exceed the recommended pile driving criteria of 20 blows per inch (2.5 cm).
- When driving wood and sheet piles, start with a low pressure gauge setting (low stroke rate). Gradually increase the stroke rate if practical.

Perform the following procedure to the start the impact hammer:

a. Ensure the pressure release valve on the remote throttle is closed. Then pump the handle on the remote throttle until the pressure gauge reads 300 psi (20.6 bar).

b. Pull the trip safety lever cord to engage the trip engage lug and allow the impact hammer piston to be raised by the hammer line (main hoist).

c. With the weight of the impact hammer fully resting on the pile, pay out the hammer line (main hoist) to allow the hammer trip assembly to bottom out on the hammer trip track rails. This will cause the lever and shaft of the hammer trip assembly to contact the trip engage lug, there-by placing the lifting pawl in the horizontal engaged position.



WOOD PILE SHOWN (SQUARE (CONCRETE) PILE SIMILAR)

STEEL H-BEAM PILE

Figure H-17. Set-up Pile (Wood Shown, Steel H-Beam, and Concrete Similar)

d. Using the hammer line (main hoist), raise the hammer trip assembly (with piston) upwards along the hammer trip track rails until the piston falls (the lever and shaft of the hammer trip assembly has encountered the trip disengage lug and the lifting pawl disengages with the piston). Stop raising and then lower the hammer line (main hoist) to lower the hammer trip assembly.

e. The impact hammer should start operating to drive the pile into the ground.

NOTE

If the impact hammer does not start after five attempts, troubleshoot the impact hammer by ensuring all Preventive Maintenance Checks and Services (PMCS) identified as “Before Operation (B)” have been performed.

f. If necessary, adjust the remote throttle pressure to increase or decrease the stroke rate. Pressure can be reduced (reduce blow rate) by turning the pressure relief valve counter clockwise until the desired pressure is indicated on the pressure gauge (or stroke rate is achieved), then turn clockwise to close the valve. Pressure is increased (increase stroke rate) by increasing the pressure with the handle.

CAUTION

If the pile line (aux. hoist) remains connected to components during pile driving operations (i.e. ground-release shackles are not used), simultaneously pay out the pile line (aux. hoist) cable as load lowers. Do not allow tension to develop on pile line (aux. hoist) during pile driving operations.

g. While driving the pile, the impact hammer will travel down the lead tower. Use the hammer line (main hoist) to lower the hammer trip assembly as the impact hammer descends. The hammer trip assembly should be maintained near the middle portion of the hammer trip track rails during operation. Perform all Preventive Maintenance Checks and Services (PMCS) identified as “During Operation (D)”.

NOTE

Ground-release shackles should be released when the pile has penetrated at least three feet (91 cm).

h. When the pile has been driven to the proper length, the impact hammer should be shutdown.

i. Shutdown the impact hammer by opening the pressure release valve on the remote throttle (0 psi). The drop in pressure opens the throttle valve (needle block) to allow the fuel being delivered by the fuel pump to be returned to the fuel tank. This starves the fuel injectors and stops combustion, there-by stopping the piston.

j. When pile driving operation is suspended/completed, perform all Preventive Maintenance Checks and Services (PMCS) identified as “After Operation (A)”.

k. If pile driving operation will be suspended for a short period of time, for example, overnight, the catch ring weather cap, intake/exhaust port weather cap, and piston transportation pin should be reinstalled. If pile driving operation is complete and the system will be removed, disassembled, and stowed, it is not necessary to install the weather caps, and piston transportation pin at this time.

Emergency Shutdown of the Impact Hammer

The crane operator can perform the following procedure to shutdown the impact hammer in an emergency:

a. Use the hammer line (main hoist) to raise the impact hammer at least two inches (5 cm) from the pile being driven. This will disrupt the pre-combustion pressure in the lower cylinder of the impact hammer and cause the fuel injection to stop, thereby shutting down the impact hammer.

In the event the above shutdown procedure does not work and the impact hammer is accessible by ground personnel, the following procedure can performed to the shutdown the impact hammer in an emergency:

a. Turn the two fuel pump feed and return shutoff valves, located directly below the fuel tank, to the off position (handles perpendicular to the lines).

Setup Pile – Steel H-Beam (Refer To Figure H-17.)

Perform the following procedure to set-up a steel H-beam pile for driving:

a. Ensure the correct size guide plate is installed on the direct drive assembly of the impact hammer. If not, install the proper guide plate as described in the “Guide Plate Installation” Paragraph on Page H-52.

b. If not removed, remove and stow the five-ton headache ball and install a ground-release shackle on the pile line (aux. hoist). Attach a rope tag line to the ground release shackle cut to a length at least equal to that of the pile being driven.

c. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

d. Cut two holes on the outside flanges of the pile to be driven. Cut the holes approximately 60 inches (1.5 m) from the top of the pile, one on either side. The holes should be slightly larger than the shackle pin and there should be no less than 1 inch (2.5 cm) of steel remaining to the outside edge of the pile.

e. Connect the H-type pile lifting sling shackles to the holes cut in the pile. Due to excessive vibration caused by driving steel H-beam piles, lock wire the pins to keep them tight. Then attach the H-type pile lifting sling to the ground-release shackle attached to the pile line (aux. hoist).

f. Using the hammer line (main hoist), raise the impact hammer along the lead tower to a height equal to approximately two-thirds the length of the pile to be driven.

g. Open the swing arm on the pile gate.

h. Using the pile line (aux. hoist), raise the pile to a point where it meets the front side of the direct drive assembly. It may be necessary to raise or lower the impact hammer using the hammer line (main hoist).

i. Using the pile (aux. hoist) and hammer (main hoist) lines, raise the pile and the impact hammer simultaneously allowing the pile to enter the direct drive assembly. Allow the pile to come to a vertical position then close the swing arm on the pile gate. Ensure the latch on the pile gate springs shut.

j. Ensure there are no obstructions along the proposed swing path. Then, using the crane boom, position the pile over the center of the driving location. Adjust the length of the spotter for any final adjustments.

k. Using the pile (aux. hoist) and hammer (main hoist) lines, lower the pile and impact hammer simultaneously. The pile may penetrate the ground under the weight of the pile and impact hammer. The weight of the impact hammer should be fully resting on the pile.

l. Using a carpenter's level, ensure the pile is plumb. Raise, lower, telescope the boom, and/or adjust the length of the spotter to plumb the pile.

m. Proceed to the "Startup and Shutdown" Procedure on Page H-62 to start the impact hammer to drive the pile, start the impact hammer, and stop it after five strokes.

n. Recheck the pile to be sure it is still plumb and correct if necessary. Pull the rope tag line to free the ground-release shackle from the 96-inch wire rope lifting sling.

o. Restart the impact hammer and continue driving.

p. When the H-type pile lifting sling shackles are accessible from the ground, shutdown the impact hammer and remove the H-type pile lifting sling from the pile. Then restart the impact hammer and continue driving to the desired depth.

Setup Pile – Pre-cast Concrete (Refer To Figure H-17.)

Perform the following procedure to set-up a pre-cast concrete pile for driving:

a. Ensure the 18-inch square (concrete) pile adapter is installed in the direct drive assembly of the impact hammer. If not, install the 18-inch square (concrete) pile adapter as described in the "18-inch Square (Concrete) and Sheet Pile Adapter Installation" Paragraph on Page H-53.

b. Inspect the cushion inside the 18-inch square (concrete) pile adapter. If necessary, replace in accordance with the following procedure:

   1) Remove all damaged cushioning material from inside of square (concrete) pile adapter.

   2) Using the plywood template for the square (concrete) pile adapter, fabricate a new cushion.

   3) If installed, remove the pile gate as described in the "Pile Gate Removal" Paragraph on Page H-78.

   4) Place the new cushion on blocking that is almost the same size as the inside of the square (concrete) pile adapter (The sheet pile adapter can also be used) and place under the square (concrete) pile adapter.

   5) Lay a piece of 1/2-inch (1.25 cm) cable over the cushion and let it rest in the small grooves.

   6) Using the hammer line (main hoist), lower the impact hammer and suspend the square (concrete) pile adapter over the cushion. Slowly lower the impact hammer and work the pile adapter down over the cushion. If done correctly the cables will wedge the cushion in place.

7) Using the hammer line (main hoist), raise the impact hammer and remove the blocking (or sheet pile adapter)

8) Reinstall the pile gate as described in the “Pile Gate Installation” Paragraph on Page H-50.

c. If installed, remove and stow the five-ton headache ball and install a ground release shackle on the pile line (aux. hoist). Attach a rope tag line to the ground release shackle cut to a length at least equal to that of the pile being driven.

d. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Three (3) Parts of Line.

NOTE

The Load Moment Indicator (LMI) system is configured for Three (3) Parts of Line to compensate for the additional weight of a pre-cast concrete pile.

e. Install a shackle on one end of the 96-inch lifting sling. Use the 96-inch lifting sling as a choker by wrapping it around the wood pile five feet (1.5 m) from the top of the pile and routing the free end through the shackle. Tighten choker around pile. Attach the free end of the 96-inch lifting sling to the ground-release shackle attached to the pile line (aux. hoist).

f. Using the hammer line (main hoist), raise the impact hammer along the lead tower to a height equal to approximately two-thirds the length of the pile to be driven.

g. Open the swing arm on the pile gate.

h. Using the pile line (aux. hoist), raise the pile to a point where it meets the front side of the square (concrete) pile adapter. It may be necessary to raise or lower the impact hammer using the hammer line (main hoist).

i. Using the pile (aux. hoist) and hammer (main hoist) lines, raise the pile and the impact hammer simultaneously allowing the pile to enter the square (concrete) pile adapter. Allow the pile to come to a vertical position then close the swing arm on the pile gate. Ensure the latch on the pile gate springs shut.

j. Ensure there are no obstructions along the proposed swing path. Then, using the crane boom, position the pile over the center of the driving location. Adjust the length of the spotter for any final adjustments.

k. Using the pile (aux. hoist) and hammer (main hoist) lines, lower the pile and impact hammer simultaneously. The pile may penetrate the ground under the weight of the pile and impact hammer. The weight of the impact hammer should be fully resting on the pile.

l. Using a carpenter’s level, ensure the pile is plumb. Raise, lower, telescope the boom, and/or adjust the length of the spotter to plumb the pile.

m. Proceed to the “Startup and Shutdown” Procedure on Page H-62 to start the impact hammer, start the impact hammer, and then stop the impact hammer after five strokes.

n. Recheck the pile to be sure it is still plumb and correct if necessary. Pull the rope tag line to free the ground-release shackle from the 96-inch wire rope lifting sling.

o. Restart the impact hammer and continue driving. Repeat stopping the impact hammer, checking the alignment of the pile, and restarting several times as necessary.

Setup Pile – Sheet (Refer To Figures H-18 and H-19.)

The initial pair of sheet piles must be modified with a driving tube prior to driving. The initial pair of sheet piles is driven without the use of the sheet pile adapter. After driving the initial pair of sheet piles, the driving tube is then cut off and removed for re-use.

To drive the remaining, adjacent sheet piles, the sheet pile adapter is installed on the impact hammer and the adjacent sheet piles are driven.

CAUTION

Always drive sheet piles as a slow blow rate to avoid damage to the sheet piles. Ground personnel should observe each sheet as it is being driven.

NOTE

To minimize any sheet pile alignment difficulties, it is recommended that the initial pair of sheet piles be driven at the center of the proposed structure. Follow-on sheet piles should be driven equally on alternating sides of the center location.

Perform the following procedure to modify the initial pair of sheet piles for driving:

a. Fit two sheet piles together. Ensure the sheet piles are properly interlocked together.

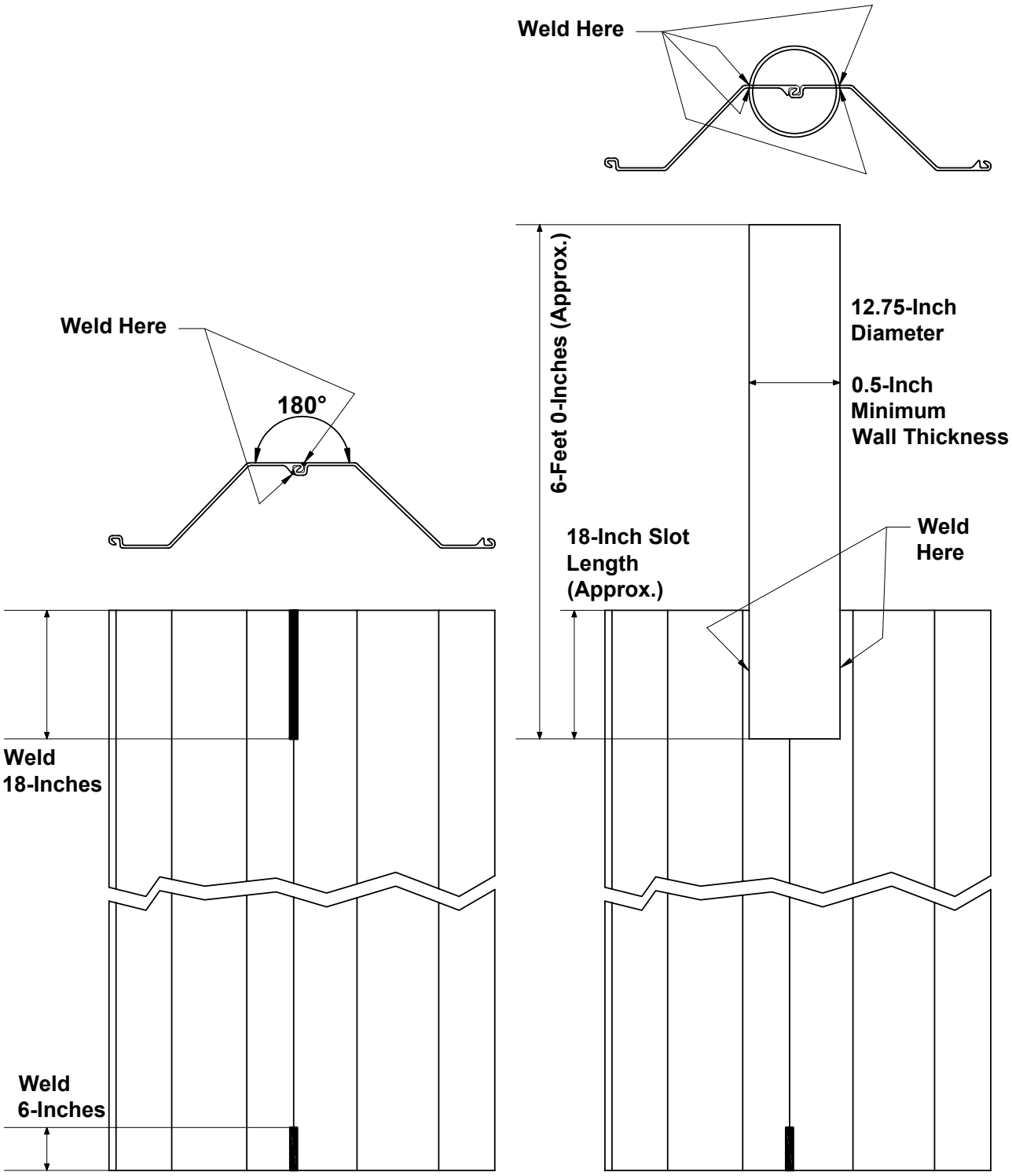
b. Weld the top 18-inches (45 cm) of the center interlock together.

c. Obtain a 72-inch (183 cm) long piece of pipe having a minimum outside diameter of 12.75 inches (32.5 cm) by a wall thickness of 0.500 inches (1.3 cm). This pipe will be used to create the driving tube.

d. Cut an 18-inch (45 cm) long slot in one end of the driving tube in order to be able to slide the driving tube over the center interlock of the pair of sheet piles. The width of the slot should be marginally larger than the thickness of the sheet piling.

e. Slide the driving tube over the center interlock of the pair of sheet piles and weld all intersection points of the driving tube with the sheet piles. There are two intersection points on the top of the sheet piles and two on the bottom (i.e. the sheet piles will have to be turned over to weld the bottom intersection points).

f. It is recommended that the bottom 6-inches (15 cm) of the center interlock be welded together to prevent sheet spreading during driving.



1. Weld Two Sheet Piles Together at Center Interlock

2. Slide Driving Tube Over Pair of Sheet Piles and Weld

Figure H-18. Sheet Pile Modification Diagram

Perform the following procedure to set-up the initial pair of sheet piles for driving:

a. Ensure the initial pair of sheet piles has been properly modified with a driving tube as outlined above.

b. Ensure the correct size guide plate is installed on the direct drive assembly of the impact hammer for the size of drive tube installed on the initial pair of sheet piles. If not, install the proper guide plate as described in the “Guide Plate Installation” Paragraph on Page H-52.

c. If removed, connect the five-ton headache ball to the pile line (aux. hoist).

d. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

e. If not removed, remove the pile gate by performing the following procedure:

   1) Use the hammer line (main hoist) to lift the impact hammer up the lead tower and away from the pile gate and use the crane boom to lift the lead tower approximately two-feet (60 cm) from the ground.

   2) Attach two lifting slings to the five-ton headache ball on the pile line (aux. hoist). Raise the pile line (aux. hoist) and attach the lifting slings to the pile gate lifting lugs with shackles.

   3) Using the pile line (aux. hoist), raise the pile gate away from the gate stop.

   4) Remove the quick-release pin securing the pile gate stop on the foot roller. Retract the stop into the foot roller and reinsert the quick-release pin.

   5) Using the pile line (aux. hoist), lower the pile gate and remove it from the lead tower by lowering, disengaging the gibs from the rails, and sliding it beyond the foot roller.

f. Cut lifting holes, at the same elevation, in the return pans of the initial pair of sheet piles. The holes should be slightly larger than the ground-release shackle pins. Also cut lifting holes, at the same elevation, in the return pans of each of the remaining, adjacent sheet piles to be driven. All lifting holes should be cut in the same manner.

g. Connect, with shackles, each leg of the H-type pile lifting sling to a 72-inch lifting sling and connect, with shackles, the other end of each 72-inch lifting sling to a ground-release shackle.

h. Connect the ground-release shackles to the lifting holes cut in the initial pair of sheet piles. Attach a rope tag line to each ground release shackle cut to a length at least equal to that of the pile being driven. Ensure the H-type pile lifting sling is in front of the driving tube welded to the top of the sheet piles.

i. Due to excessive vibration caused by driving sheet piles, lock wire the ground-release shackle pins (connected to the H-type pile lifting sling) to ensure they remain tight.

j. Remove the headache ball from the pile line (aux. hoist) and stow in the crane tool box.

k. Connect the H-type pile lifting sling to the wedge and socket on the pile line (aux. hoist).

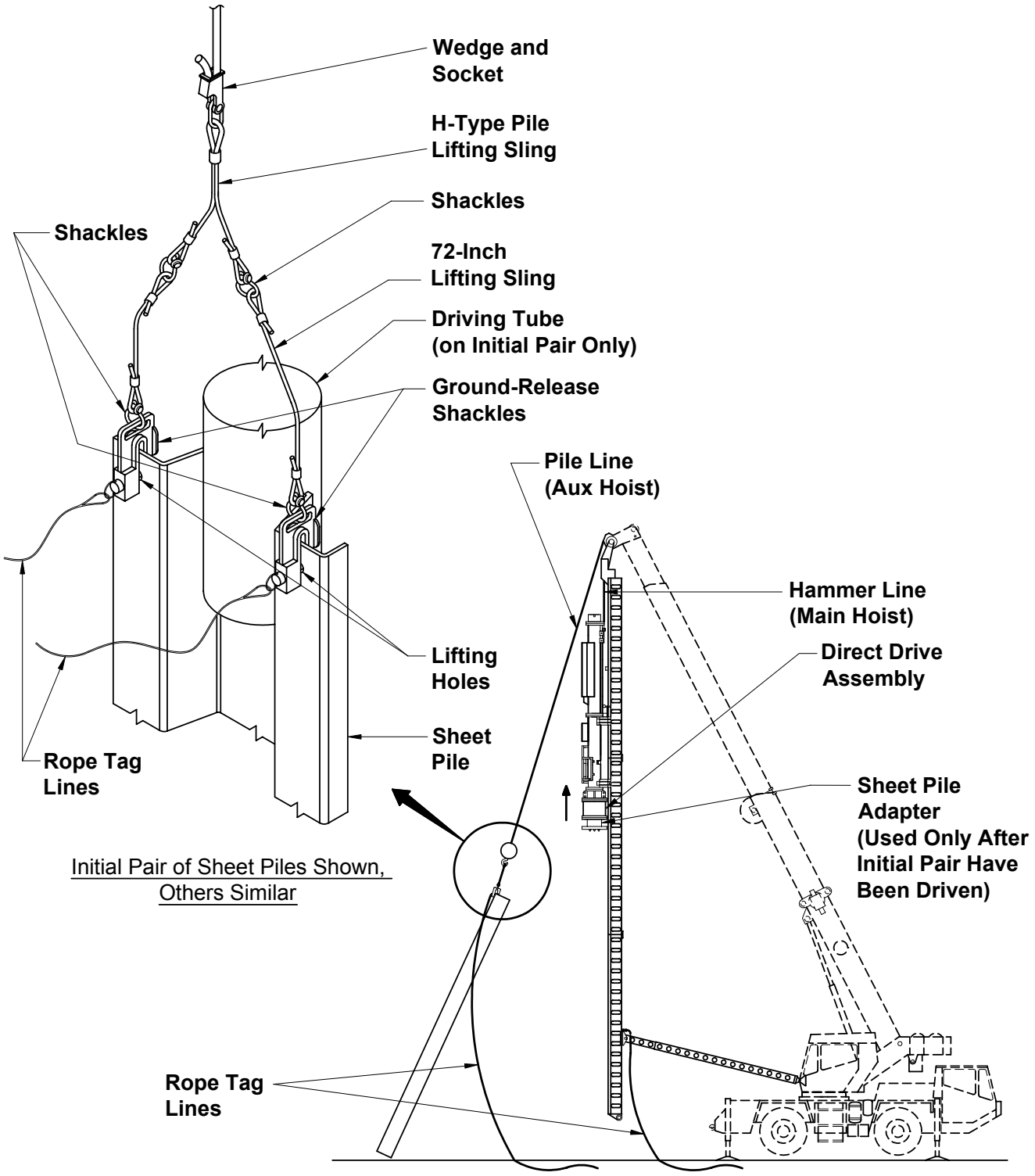


Figure H-19. Set-up Sheet Pile

l. Using the hammer line (main hoist), raise the impact hammer along the lead tower to a height equal to approximately two-thirds the length of the pile to be driven.

m. Using the pile line (aux. hoist), raise the sheet piles to a point where the driving tube meets the front side of the direct drive assembly. It may be necessary to raise or lower the impact hammer using the hammer line (main hoist).

n. Using the pile (aux. hoist) and hammer (main hoist) lines, raise the sheet piles and the impact hammer simultaneously allowing the driving tube to enter the direct drive assembly.

o. Then, using the crane boom, position the sheet piles over the center of the driving location. Rotate the sheet piles while under the impact hammer until they line up with the driving location on the ground. Adjust the length of the spotter for any final adjustments.

p. Using the pile (aux. hoist) and hammer (main hoist) lines, lower the sheet piles and impact hammer simultaneously. The pile may penetrate the ground under the weight of the piles and impact hammer. The weight of the impact hammer should be fully resting on the piles.

q. Using a carpenter's level, ensure the pile is plumb. Raise, lower, telescope the boom, and/or adjust the length of the spotter to plumb the sheet piles.

r. Proceed to the "Startup and Shutdown" Procedure on Page H-62 to start the impact hammer to drive the sheet piles, start the impact hammer, and then stop the impact hammer after five strokes.

s. Recheck the pile to be sure it is still plumb and correct if necessary. Pull the rope tag lines to free the ground-release shackles from the lifting holes in the sheet piles.

t. Restart the impact hammer and continue driving. Repeat stopping the impact hammer, checking the alignment of the pile, and restarting several times as necessary.

u. Stop the impact hammer after driving the sheet piles between five and ten feet (1.5-3.0 m) or until the sheet piles are stable in the upright position.

NOTE

This is a temporary elevation. All piles will be driven to the final elevation after all pairs of sheet piles are driven to the temporary elevation.

Perform the following procedure to set-up the remaining adjacent sheet piles for driving:

a. Install the sheet pile adapter as described in the "18-inch Square (Concrete) and Sheet Pile Adapter Installation" Paragraph on Page H-53.

b. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

c. Ensure lifting holes have been cut, at the same elevation, in the return pans of each pair of the remaining, adjacent sheet piles to be driven. If not, cut the lifting holes. The holes should be slightly larger than the ground-release shackle pins and should be cut in the same manner.

d. Connect the ground-release shackles connected to the 72-inch lifting slings on the pile line (aux. hoist) to the lifting holes cut in the pair of sheet piles.

e. Using the pile line (aux. hoist), raise the pair of sheet piles into position next to the initial set of sheet piles (already driven).

f. Interlock the hoisted pair of sheet piles with the pair already in the ground and using the pile line (aux. hoist), lower the pair of sheet piles to the ground. The pile may penetrate the ground under the weight of the piles.

g. With the pairs of sheet piles locked and secured (and resting on the ground), pull the rope tag lines to free the ground-release shackles from the lifting holes in the sheet piles.

h. Visually inspect the sheet piles to be driven and the bottom of the sheet pile adapter to ensure that they will mate (with the cleats on the bottom).

i. Using the hammer (main hoist) line, lower the impact hammer and sheet pile adapter onto top-center of the sheet piles to be driven. Ensure the top edge of the sheets fit in between the cleats. The weight of the impact hammer should be fully resting on the pile.

j. Using a carpenter's level, ensure the pile is plumb. Raise, lower, telescope the boom, and/or adjust the length of the spotter to plumb the sheet piles.

k. Proceed to the "Startup and Shutdown" Procedure on Page H-62 to start the impact hammer to drive the sheet piles, start the impact hammer, drive the sheet piles until they are stable in the upright position (not fully driven), and then stop the impact hammer.

NOTE

This is a temporary elevation. All piles will be driven to the final elevation after all pairs of sheet piles are driven to the temporary elevation.

l. Repeat this procedure to position and drive the remaining sets of sheet piles alternating, if possible to the left and to the right of the first set of sheet piles until the desired number of sheet piles have been driven.

m. Place the impact hammer over installed sheets and drive them in turn, back and forth, to the final elevation.

Relocating the Crane – While Rigged with Pile Driver System (Refer To Figure H-20.)

The crane can be relocated while rigged with the Pile Driver System by transferring some of the weight of the lead tower and impact hammer to the rear pintle hook and operating the crane "On Rubber" and in the "Pick and Carry" mode.

WARNING

This procedure presents several opportunities for pinching body parts. Use care when configuring the Pile Driver System for transportation.

Perform the following procedure to relocate the crane while rigged with the Pile Driver System equipment:

a. Remove any unnecessary weight from the Pile Driver System and crane.

b. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

c. Attach a wire rope lifting sling with a shackle to the front lifting lug on the spotter and attach the headache ball on the pile line (aux hoist) to the wire rope lifting sling. Remove the slack in the pile line (aux. hoist) to slightly support the spotter.

d. Pull the rope tag line attached to the manual release on the spotter slide to disengage the spotter slide pin from the hole in the lead tower. Hold the spotter slide pin in the retracted (disengaged) position.

e. Lower the spotter using the pile line (aux. hoist). Reinstall the retainer pin in the spotter slide to keep the spotter slide pin disengaged from the lead tower and allow unrestricted movement of the spotter slide along the lead tower.

f. Using the pile line (aux. hoist), raise the spotter slide along the lead tower to allow the base of the lead tower to be moved close to the rear pintle hook.

CAUTION

Use care when lowering the impact hammer on the lead tower to avoid damage to the pile gate.

g. Using the hammer line (main hoist), lower the impact hammer down and rest it gently on top of the pile gate. If the pile gate has been removed for sheet pile driving operations, remove the quick-release pin securing the pile gate stop on the foot roller, extend the stop beyond the front of the lead tower, reinsert the quick-release pin, and rest the impact hammer gently on the pile gate stop.

h. Rotate the boom to center it over the rear of the crane carrier and engage the SWING LOCK pin by pulling the SWING LOCK pin control lever in the superstructure cab.

i. Loop the lead transportation chain onto the shaft on the foot roller.

j. Using the crane boom, raise the lead tower off of the ground and position it at a point where the large ring on the lead transportation chain can be placed over the rear pintle hitch. Simultaneously, the spotter slide may have to be moved upward along the lead tower using the pile line (aux. hoist).

k. Place the large ring on the lead transportation chain over the rear pintle hitch and close and secure the hitch.

l. Once the chain is connected, retract the boom and lower the boom to a point where the weight of the Pile Driving System rests on the rear pintle hitch. Check the Load Moment Indicator (LMI) display console in the superstructure cab to ensure the majority of the load is on the rear pintle hitch. The LMI display console should indicate no more than 1,000 lbs (454 kg).

m. Raise the rear and front outrigger floats but do not retract the outrigger beams into the crane carrier if the travel path allows.

n. Configure the Load Moment Indicator (LMI) system on the crane for Front Hoist, On Rubber, Pick and Carry, and Two (2) Parts of Line.

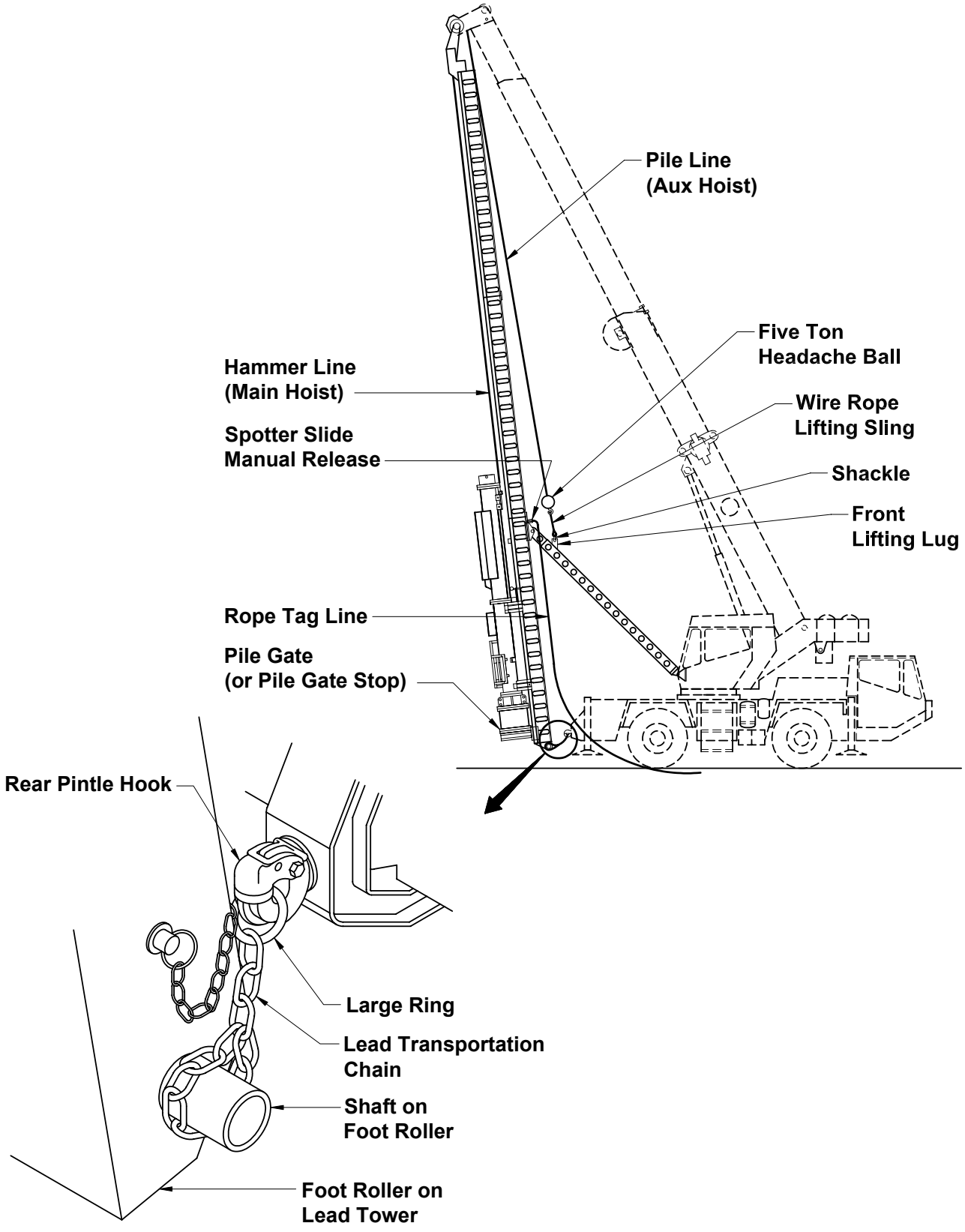


Figure H-20. Relocating the Crane While Rigged with Pile Driver System

WARNING

If traversing rough or unstable terrain can not be avoided, use extreme caution and constantly monitor crane stability.

o. Having ground personnel direct all crane movements, relocate the crane in accordance with crane “On Rubber” and in the “Pick and Carry” mode operation.

p. Upon arrival at the new crane location, lower the outrigger floats, level the crane, and re-configure the Load Moment Indicator (LMI) system for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

q. Open the rear pintle hook. Extend the boom and raise the boom to a point where the weight of the Pile Driving System no longer rests on the rear pintle hook. Remove the lead transportation chain, still connected to the shaft on the foot roller, from the rear pintle hook.

r. Remove the lead transportation chain from the shaft on the foot roller.

s. Disengage the SWING LOCK pin by releasing the SWING LOCK pin control lever in the superstructure cab.

t. Using the crane boom, lower the lead tower to the ground.

CAUTION

The spotter slide pin should not be allowed to engage a hole in the lead tower lower than the seventh hole up from the foot roller. This will ensure that the spotter will not make contact with and damage the spare tire mounting bracket.

u. Lower the spotter using the pile line (aux. hoist) to the seventh hole up from the foot roller (or higher if required). Pull the spotter slide pin back and hold. Remove the retainer pin, release the spotter slide pin, and it will engage the hole in the back of the lead tower.

v. Disconnect the pile line (aux. hoist), wire rope lifting sling, and headache ball from the center lifting lug on the spotter.

w. Using the hammer line (main hoist), raise the impact hammer off of the pile gate or pile gate stop. If the pile gate has been removed for sheet pile driving operations, retract the pile gate stop into the front of the lead tower and reinsert the quick-release pin.

DISASSEMBLY OF THE PILE DRIVER SYSTEM

General

The work area should be clear of any obstructions prior to disassembly of the Pile Driver System equipment.

Disassembly of the Pile Driver System is accomplished in reverse order of the assembly. To disassemble the Pile Driver System perform the following procedures in the order they appear. Components, as they are disassembled and removed, should be placed in the same locations in the work area as they were placed when unloading the shipping/storage container.

NOTE

The final arrangement of pile driving system components, disassembled and ready for loading into the shipping/storage container, should appear as shown in Figure H-12.

Square (Concrete) and Sheet Pile Adapter Removal

If necessary, perform the following procedure to remove the square (concrete) or sheet pile adapter from the impact hammer:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Using the hammer line (main hoist), lower the impact hammer and adapter and place the adapter onto wood blocking.

c. Remove the four cable clamps and two pieces of wire rope securing the adapter to the adapter holes on the direct drive assembly.

d. Using the hammer line (main hoist), raise the impact hammer away from the adapter. Move the adapter away from the immediate work area.

Remote Throttle Hydraulic Hose Removal

Perform the following procedure to remove the remote throttle hydraulic hose from the impact hammer:

WARNING

Ensure the pressure has been relieved on the remote throttle prior to disconnecting the remote throttle hydraulic line.

Perform the following procedure to disconnect the remote throttle from the impact hammer:

a. Open the pressure relief valve on the remote throttle and ensure the pressure gauge indicates no pressure (0 psi).

b. Untie the 40-foot (12.2 m) length of rope securing the remote throttle hydraulic hose, remove from the pulley, and store in the toolbox.

c. Disconnect the remote throttle hydraulic hose from the throttle valve whip line quick connect fitting labeled “THROTTLE CONNECTION” on the impact hammer.

If the remote throttle was installed in the superstructure cab, perform the following procedure to remove the remote throttle from the superstructure cab:

a. Disconnect the hydraulic hose from the remote throttle by disconnecting it at the quick connect fitting near the pressure gauge.

b. Being careful not to pinch or cut the hydraulic hose in the hole, remove the remote throttle hydraulic hose from the superstructure cab.

c. Remove the four self-tapping screws securing the remote throttle to the superstructure cab and remove the remote throttle and remote throttle bracket.

Pile Gate Removal

If necessary, perform the following procedure to remove the pile gate from the bottom of the lead tower:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Use the hammer line (main hoist) to lift the impact hammer up the lead tower and away from the pile gate and use the crane boom to lift the lead tower approximately two-feet (60 cm) from the ground.

c. Attach two lifting slings to the five-ton headache ball on the pile line (aux. hoist). Raise the pile line (aux. hoist) and attach the lifting slings to the pile gate lifting lugs with shackles.

d. Using the pile line (aux. hoist), raise the pile gate away from the gate stop.

e. Remove the quick-release pin securing the pile gate stop on the foot roller. Retract the stop into the foot roller and reinsert the quick-release pin.

f. Using the pile line (aux. hoist), lower the pile gate and remove it from the lead tower by lowering, disengaging the gibs from the rails, and sliding it beyond the foot roller. Move the pile gate away from the immediate work area.

Impact Hammer Removal

Perform the following procedure to remove the impact hammer from the lead tower:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Front Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Set the square (concrete) pile adapter upright and place on wood blocking so that it is aligned directly underneath the direct drive assembly of the impact hammer.

c. Using the hammer line (main hoist), slowly lower the impact hammer onto the square (concrete) pile adapter with the adapter sliding fully into the direct drive assembly. This will move the piston up into the lower cylinder and ensure that grease is distributed evenly.

d. Using the grease gun charged with MIL-G-10924 grease, grease the four lower cylinder (impact block) lubrication fittings (ten shots per fitting).

e. Using the hammer line (main hoist), raise the impact hammer away from the square (concrete) pile adapter. Move the square pile adapter away from the work area.

f. When removing the impact hammer from the lead tower to place into storage, the fuel tank must be drained into a suitable container by performing the following procedure:

1) Loosen the hose clamp securing the fuel inlet hose to the fitting on the fuel pump and remove the fuel hose.

2) Drain the fuel into a suitable container.

3) Reinstall the fuel inlet hose to the fitting on the fuel pump and secure with the hose clamp.

g. When removing the impact hammer from the lead tower to place into storage, the lubricating oil tank must be completely filled by performing the following procedure:

1) Remove the protective cap from the oil tank fill line and quick connect fitting labeled “OIL” that is located at the bottom of the lower cylinder.

2) Connect the ground oiling hose and quick connect fitting to the ground oiling hand pump and place the ground oiling hand pump container cover on an oil container filled with MIL-L-2104 15W40 oil.

3) Install the ground oiling hand pump in the container cover.

4) Connect the hose on the ground oiling hand pump to the oil tank fill line and quick connect fitting (OIL) on the impact hammer.

5) Manually pump oil to the lubricating oil tank on the impact hammer.

6) Observe the oil tank plug/vent valve for evidence that the lubricating oil tank is full.

7) Disconnect the oil supply line and reinstall the protective cap.

h. Close the oil tank plug/vent valve on the lubricating oil tank.

i. Ensure the waste fuel drip tank has been drained in accordance with the Preventive Maintenance Checks and Services (PMCS) identified as “After Operation (A).” Close the waste fuel drip tank vent valve.

j. If attached, disconnect the 89-inch lifting sling from the lower cylinder lifting lug and connect the free end to the headache ball of the pile line (aux. hoist). If not attached to the impact hammer, connect one end of the 89-inch lifting sling to the upper cylinder lifting lug with a shackle and the free end to the headache ball of the pile line (aux. hoist).

k. Place wood blocking underneath the impact hammer and using the hammer line (main hoist), lower the impact hammer along the lead tower to the wood blocking.

l. Raise the pile line (aux. hoist) and apply nominal tension to it. Maintain holding the impact hammer vertical with the hammer line (main hoist).

m. Using the crane boom (combination of telescoping and booming up), raise the lead tower above the lower and upper gibs on the impact hammer. Be sure to pay out the hammer line (main hoist) and pile line (aux. hoist) cables while extending the boom. Ensure the impact hammer gibs are fully disengaged from the lead tower.

n. When the lead tower is clear of the impact hammer gibs, retract the spotter and using the crane boom, lower the lead tower to within six inches (15 cm) of the ground.

CAUTION

Do not lift the impact hammer with the hammer line (main hoist) alone. This could seriously damage the hammer trip system. Use a combination of the pile (aux. hoist) and hammer (main hoist) lines when the impact hammer is not mounted on the lead tower.

o. Slowly hoist the impact hammer using a combination of the hammer (main hoist) and pile (aux. hoist) lines. Then lift the impact hammer off of the ground and rotate it so that its attachment gibs are facing towards the position or direction it is to be laid down.

p. Using a combination of the hammer (main hoist) and pile (aux. hoist) lines, slowly lower the impact hammer and allow it to lean back towards the gibs. Continue lowering until the impact hammer reaches approximately a 60-degree angle relative to the ground. Maintain the hammer trip assembly in position at the middle of the hammer trip track rails.

q. Remove the fuel tank plug/vent valve from the fuel tank, apply Kleen-Flo Tumbler Industries (Stock #789) engine storage/fog oil spray or equivalent to the inside of the fuel tank, and reinstall the fuel tank plug/vent valve. Close both fuel tank plug/vent valves on the fuel tank.

r. Close the fuel pump feed and return shutoff valves (handle perpendicular to the lines) located directly below the fuel tank.

s. Close the oil pump feed shutoff valve (handle perpendicular to the lines) located directly below the lubricating oil tank.

t. Apply Kleen-Flo Tumbler Industries (Stock #789) engine storage/fog oil spray or equivalent to the following: inside surfaces of the catch ring cap, exposed surfaces of the hammer trip track rails, through the trip slot in the rear of the upper cylinder and onto the exposed surface of the piston, hammer trip assembly, exposed face of the striker plate, and any other exposed, unpainted metal surfaces (other than dataplates).

u. Remove the tension on the hammer line (main hoist) by lowering and support the impact hammer at the 60-degree angle with the pile line (aux. hoist).

WARNING

Ensure that the crane operator is aware that removing the hammer line (main hoist) will be performed while under a suspended load (impact hammer).

v. Have the crane operator turn the CRANE FUNCTION POWER switch to the OFF position to remove power from the crane functions controlled by the armrest joysticks. This prevents accidental operation of the controlled crane functions caused by bumping the joysticks.

w. Remove the pin from the wedge and socket of the hammer line (main hoist) and remove it from the lifting lug on the hammer trip assembly. Temporarily attach a weight to the hammer line (main hoist) wedge and socket to prevent slack in the line.

NOTE

Ensure that the crane operator is aware that the hammer line (main hoist) connection was removed from the hammer trip assembly.

x. When all personnel are clear of the suspended impact hammer, have the crane operator turn the CRANE FUNCTION POWER switch to the ON position to return power to the crane functions controlled by the armrest joysticks.

y. Continue lowering the impact hammer with the pile line (aux. hoist) only. Prior to placing the impact hammer completely on the ground, lower the hammer trip assembly to the bottom of the hammer trip track rails. Install the red trip transport bolt in the hammer trip assembly to secure it in place.

z. Using the pile line (aux. hoist), completely lower the impact hammer to the ground until it is resting fully on the gibs. Remove the 89-inch lifting sling from the headache ball of the pile line (aux. hoist).

aa. Remove the trip safety lever cord from the hole on the trip safety lever and place in the tool box.

ab. Install the red intake/exhaust port weather cap, piston transport pin, and the catch ring weather cap with the securing strap.

ac. Connect the 96-inch lifting sling to the lower cylinder lifting lug with a shackle. Leave the 89-inch lifting sling connected to the upper cylinder lifting lug with a shackle. Using the pile line (aux. hoist), hoist and place the impact hammer in front of the lead tower, parallel to the front outriggers as shown on Figure H-12. Leave both lifting slings in place until the impact hammer is loaded into the shipping/storage container.

Spotter Removal

WARNING

This procedure presents several opportunities for pinching body parts between moving parts.

WARNING

Never stand directly under the suspended lead tower.

WARNING

Be sure that the crane operator can see all ground personnel including those on the crane. Ground personnel on the carrier deck must always position themselves to prevent obstructing the crane operator's view.

Perform the following procedure to remove the spotter from the crane with a 45-foot (13.7 m) three-section lead tower:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Attach a wire rope lifting sling with a shackle to the center lifting lug on the spotter and attach the headache ball on the pile line (aux hoist) to the wire rope lifting sling.

c. Remove the slack in the pile line (aux. hoist) to slightly support the spotter.

d. Pull the rope tag line attached to the manual release on the spotter slide to disengage the pin from the hole in the lead tower and hold in place. Using the pile line (aux. hoist), lower the spotter and replace the retainer pin to keep the spotter slide pin retracted.

e. Using the pile line (aux. hoist), lower the spotter and using the crane boom, raise the lead tower to disengage the spotter slide from the lead tower. During this procedure, the position of the spotter and lead tower will need to be adjusted to prevent the spotter slide from binding. When fully disengaged from the lead tower, raise the spotter to a horizontal position using the pile line (aux. hoist).

f. Instruct the crane operator to fully retract the spotter and then extend it approximately two inches (5 cm) to the white line painted on the spotter.

NOTE

Fully retracting the spotter and then extending it approximately two inches (5 cm) to the white line painted on the spotter will relieve any pressure built up in the hydraulic lines and make the spotter the exact size required to fit properly in the storage/transportation container. The spotter will not fit properly in the storage/transportation container and the hydraulic lines will be not be able to be reconnected to the spotter (without relieving the pressure manually) unless this is performed.

g. Remove the hydraulic hose reel lines from the hydraulic hose connections (spotter manifold) on the spotter and replace the protective caps.

h. Temporarily attach the hydraulic hose reel lines to the spotter mounting bracket and secure the hoses with a temporary hydraulic hose retainer chain (i.e. small length of chain). Remove the hydraulic hose retention chain attached to the base of the spotter from the chain attached to the hydraulic hose reel lines.

WARNING

Check the pressure at the two spotter support pins securing the spotter base in the mounting lugs on the spotter mounting brackets when removing the spotter from the crane. The pins must move easily before trying to remove them.

i. Remove the cotter pins from the two spotter support pins.

j. With ground personnel at each end of the spotter, carefully remove the two spotter support pins securing the spotter base in the mounting lugs on the spotter mounting brackets.

k. Using the pile line (aux. hoist), hoist and remove the spotter from the spotter mounting brackets on the crane superstructure. Place the spotter on the ground in the position shown on Figure H-11.

l. Remove the rope tag line from the hole on the manual release on the spotter slide and place in the tool box.

Perform the following procedure to remove the spotter from the crane with a 60-foot (18.3 m) four-section lead tower:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Instruct the crane operator to fully retract the spotter and then extend it approximately two inches (5 cm) to the white line painted on the spotter.

NOTE

Fully retracting the spotter and then extending it approximately two inches (5 cm) to the white line painted on the spotter will relieve any pressure built up in the hydraulic lines and make the spotter the exact size required to fit properly in the storage/transportation container. The spotter will not fit properly in the storage/transportation container and the hydraulic lines will be not be able to be reconnected to the spotter (without relieving the pressure manually) unless this is performed.

c. Temporarily attach the hydraulic hose reel lines to the spotter mounting bracket and secure the hoses with a temporary hydraulic hose retainer chain (i.e. small length of chain). Remove the hydraulic hose retention chain attached to the base of the spotter from the chain attached to the hydraulic hose reel lines.

d. Remove the hydraulic hose reel lines from the hydraulic hose connections (spotter manifold) on the spotter and replace the protective caps.

e. Attach a wire rope lifting sling with a shackle to the center lifting lug on the spotter and attach the headache ball on the pile line (aux hoist) to the wire rope lifting sling.

f. Remove the slack in the pile line (aux. hoist) to slightly support the spotter.

WARNING

Check the pressure at the two spotter support pins securing the spotter base in the mounting lugs on the spotter mounting brackets when removing the spotter from the crane. The pins must move easily before trying to remove them.

g. Remove the cotter pins from the two spotter support pins.

h. With ground personnel at each end of the spotter, carefully remove the two spotter support pins securing the spotter base in the mounting lugs on the spotter mounting brackets.

i. Using the pile line (aux. hoist), hoist and remove the spotter from the spotter mounting brackets on the crane superstructure.

j. Using the crane boom and the pile line (aux. hoist), lower the rear of the spotter down onto wood blocks.

k. Disconnect the pile line (aux. hoist), wire rope lifting sling, and headache ball from the center lifting lug on the spotter.

l. Attach the wire rope lifting sling with a shackle to the front lifting lug on the spotter

closest to the lead tower and attach the headache ball on the pile line (aux hoist) to the wire rope lifting sling.

m. Pull the rope tag line attached to the manual release on the spotter slide to disengage the pin from the hole in the lead tower and hold in place. Using the pile line (aux. hoist), lower the spotter and replace the retainer pin to keep the spotter slide pin retracted.

n. Using the pile line (aux. hoist), lower the spotter and using the crane boom, raise the lead tower to disengage the spotter slide from the lead tower. During this procedure, the position of the spotter and lead tower will need to be adjusted to prevent the spotter slide from binding.

o. Remove the rope tag line from the hole on the manual release on the spotter slide and place in the tool box.

p. Disconnect the pile line (aux. hoist), wire rope lifting sling, and headache ball from the front lifting lug on the spotter.

q. Attach the wire rope lifting sling with a shackle to the center lifting lug on the spotter and attach the headache ball on the pile line (aux hoist) to the wire rope lifting sling.

r. Using the pile line (aux. hoist), hoist and place the spotter on the ground in the position shown on Figure H-11.

Lead Tower Removal

NOTE

If at any time during the removal of the lead tower the weight of the anti-two block switch, which is hanging freely, comes in contact with the ground (i.e. the weight is lifted, relieving the tension on the chain), the hydraulic functions of the crane will be locked out by the Load Moment Indicator (LMI) system. Take measures to ensure tension remains on the chain(s) during lead tower removal. Be sure to return the chain(s) to the normal position after removal. If the crane is equipped with only one anti-two block switch, the red by-pass flag can be installed on the anti-two block switch to maintain tension on the chain.

Perform the following procedure to remove the lead tower from the crane:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Using the crane's boom, move the lead tower to a position directly in-line with the rear of the crane and aligned with the crane's boom.

c. Through a combination of telescoping and booming down, slowly lower the lead tower into position to install the rough-terrain wheels. Install the rough-terrain wheels on the shafts of the foot roller assembly and lower the lead tower down until the wheels are on the ground.

d. Place a rope tag line on the pile (aux. hoist) and hammer (main hoist) lines and raise the lines.

e. Disengage the swing brake of the crane to prevent any undo stress developing on the boom nose connection if the rough-terrain wheels at the base of the lead tower wander slightly during lowering.

f. Through a combination of telescoping and booming down, slowly lower the lead tower, allowing the base of the lead tower to move outwards away from the crane. While lowering, ensure that the pile (aux. hoist) and hammer (main hoist) lines are kept to the side of the lead tower.

g. Lower the top of the lead tower onto wood blocks placed near the lead head adapter at the top of the lead tower. The blocks should be sufficient to raise the top of the lead tower approximately 30-inches (76 cm) high. The boom should be lowered to its lower limit and the boom should be at a negative angle.

h. Raise the rear outriggers until the rear wheels are touching the ground. Then lower the front outriggers to tilt the crane towards the rear.

WARNING

This procedure presents several opportunities for pinching body parts between moving parts. Use care when removing the boom nose adapter plates from the lead head adapter.

i. When the top of the lead tower is fully resting on the wood blocking, remove the bolts, washer, and nuts attaching the lead head adapter bracket to the boom nose adapter plates.

j. Swing each boom nose adapter plate away from the lead head adapter and reinstall the attaching bolts, washer, and nuts in the holes on the flange plates of the lead head adapter.

k. Remove the bolts and washer securing the locking collars to the two lower boom nose shafts. Remove the locking collars and the two boom nose adapter plates. Store the boom nose adapter plates in the crane tool box.

l. Reinstall the locking collars on the two lower boom nose shafts and secure with the bolts and washers.

m. Remove the temporary hydraulic hose retainer chain securing the hydraulic hose reel lines to the spotter mounting bracket, recoil the hydraulic lines onto the hose reel, and reconnect the retainer chain securing the tag line on the hydraulic hoses wound on the boom-mounted hose reel.

n. Remove the pulley, mounted with the 15-inch anchor bungee, from the operator's side of the hydraulic hose reel on the crane boom and store in the toolbox.

o. Lower the rear outriggers and level the crane.

p. Attach the wire rope lifting sling and nylon lifting sling to the top of the lead tower and use the pile line (aux. hoist) of the crane to raise the top of the lead tower and allow it to roll in towards the crane. When the top of the lead tower is within five feet (1.5 m) of the crane carrier, lower the lead tower down onto six wood blocks spaced three feet (0.9 m) from each lead section end.

q. Remove the rough-terrain wheels.

r. Lower the pile (aux. hoist) and hammer (main hoist) lines and remove the rope tag lines.

Lead Tower Disassembly

Perform the following procedure to disassemble the lead tower:

NOTE

Use the pile line (aux. hoist) of the crane along with the wire rope lifting sling and nylon lifting sling to move the lead sections during disassembly.

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Remove the bolts securing the impact hammer stop to the top of the lead tower and remove the impact hammer stop. Store the impact hammer stop and bolts in the tool box.

c. Attach a wire rope lifting sling and nylon lifting sling to the lead tower (looped through the holes in the sides). Using the pile line (aux. hoist), hoist and turn the assembled lead tower over onto its side.

d. Loosen the bolts, washers, nuts, and joint retaining blocks securing the lead head adapter to the top of the lead tower and remove the lead head adapter. Reattach the joint retaining blocks to the lead tower with bolts, washers, and nuts.

e. Remove the quick-release pin securing the pile gate stop in the foot roller and remove the pile gate stop from the foot roller.

f. Attach a nylon lifting sling to the foot roller and support the weight of the foot roller with the pile line (aux. hoist). Loosen the assembled bolts, washers, and nuts securing the retaining blocks to the joints of the lead section and the foot roller. Using the pile line (aux. hoist), remove the foot roller assembly from the base of the lead tower. Reattach the joint retaining blocks to the lead section with bolts, washers, and nuts.

g. Loosen the assembled bolts, washers, and nuts securing the retaining blocks to the joints of each lead section. Disassemble each lead section joint. Reattach the joint retaining blocks with bolts, washers, and nuts to the tethered half of the joint.

STORAGE OF THE PILE DRIVER SYSTEM

General

The Pile Driver System, including the lead tower, spotter, impact hammer, lifting slings, and other tools required to operate the pile driver system are stowed in the weather-proof shipping/storage container when placed in long-term storage. The shipping/storage container is to be loaded in the immediate vicinity of the crane and the work area should be clear of any obstructions prior to loading the Pile Driver System equipment. It is also very important that components be loaded in a specific order and in exactly the same locations from which they were removed.

NOTE

The final arrangement of pile driving system components, ready for loading into the shipping/storage container, should appear as shown in Figure H-12. The final arrangement of pile driving system components, loaded into the shipping/storage container, should appear as shown in Figure H-21.

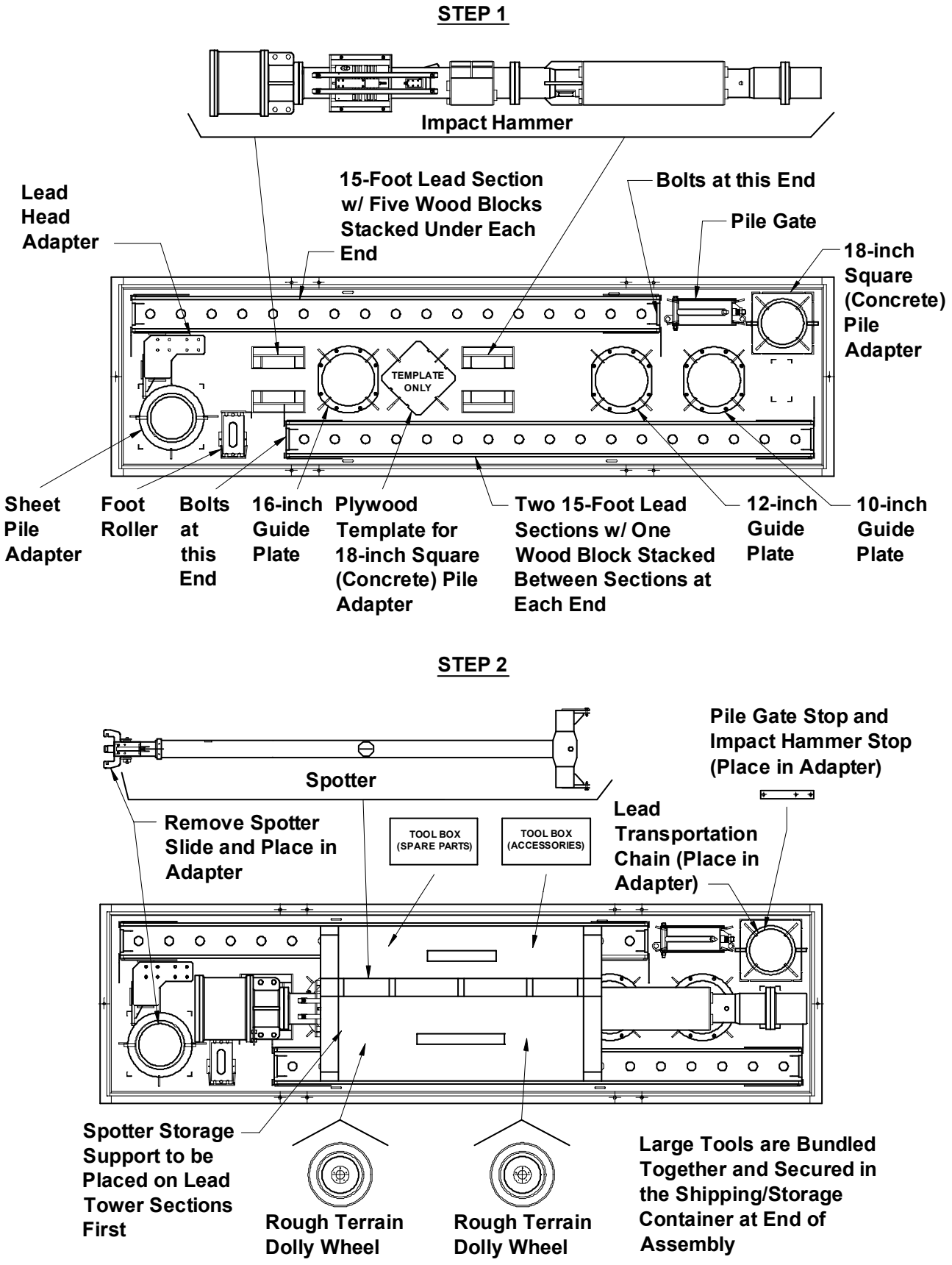


Figure H-21. Shipping/Storage Container Arrangement

Load the Shipping/Storage Container (Refer To Figures H-12 and H-21.)

NOTE

The shipping/storage container is to be loaded at a 15 foot (4.6 m) crane radius and less than 60 feet (18.3 m) of boom length.

Perform the following procedure to load the Pile Driver System equipment in the shipping/storage container:

a. Ensure the Load Moment Indicator (LMI) system on the crane is configured for Rear Hoist, Outrigger Position 100%, and Two (2) Parts of Line.

b. Ensure the empty shipping/storage container is in the immediate work area in the position as shown in Figure H-12. The empty container weighs 6,500 pounds (2,955 kg).

c. Place the three guide plates (10, 12, and 16-inch) and the plywood template for the 18-inch square (concrete) pile adapter in the bottom of the shipping/storage container as shown in Figure H-21.

d. Attach the pile line (aux. hoist) to the 89-inch lifting sling and 96-inch lifting sling attached to the impact hammer. Using the pile line (aux. hoist), hoist and load the impact hammer into the shipping/storage container. After loading, disconnect the 96-inch lifting sling but leave the 89-inch lifting sling attached to the impact hammer.

e. Attach two nylon lifting slings to the center of each lead section (looped through the holes in the sides). Using the pile line (aux. hoist), hoist and load each lead section into the shipping/storage container. The two lead sections that are placed together are placed in the shipping/storage container with one wood block between the sections at each end. The third lead section is placed in the shipping/storage container with five wood blocks stacked under each end.

f. Using the pile line (aux. hoist) and wire rope lifting slings, hoist and place the square (concrete) and sheet pile adapters in the shipping/storage container.

g. Using the pile line (aux. hoist) and nylon lifting sling, hoist and place the foot roller assembly in the shipping/storage container.

h. Using the pile line (aux. hoist) and wire rope lifting slings, hoist and place the pile gate in the shipping/storage container.

i. Using the pile line (aux. hoist) and nylon lifting sling, hoist and place the lead head adapter in the shipping/storage container.

j. Attach two nylon lifting slings to the spotter storage support. Using the pile line (aux. hoist), hoist and load the spotter storage support into the shipping/storage container and place on top of the lead sections. Ensure the spotter storage support rests squarely.

k. Attach a wire rope lifting sling with a shackle to the center lifting lug on the spotter. Then, using the pile line (aux. hoist), hoist and load the spotter into the shipping/storage container.

l. Remove the spotter slide from the spotter and place it inside the sheet pile adapter in the shipping/storage container.

m. Place the pile gate stop and lead transportation chain inside the square (concrete) pile adapter in the shipping/storage container.

n. Place the two rough-terrain dolly wheels on top of the spotter storage support in the shipping/storage container.

o. Bundle the following large tools together and secure in the shipping/storage container at the end of the assembly: the ground fueling hand pump, ten-pound sledge hammer, steel bar with hickey, 36-inch peavey, and cheater bar.

p. Ensure all accessory tools and components are placed in the appropriate locations in the tool boxes. Place the two tool boxes on the spotter storage support in the shipping/storage container.

q. Install all equipment tie-down straps in the appropriate locations. Two 15-foot (4.6 m) 1,400 lb (636 kg) equipment tie-down straps are placed over the spotter and the outer edges of the spotter storage support and are secured to brackets on the shipping/storage container base. Two 8-foot (2.4 m) 1,000 lb (455 kg) equipment tie-down straps are placed over the two tool boxes and rough-terrain wheels and secured to the lead tower sections. The 6-foot (1.8 m) 1,000 lb (455 kg) equipment tie-down strap is used to secure the lead head adapter.

r. Ensure all components, including the desiccant bags, have been placed in the shipping/storage container before reinstalling the cover.

s. Using the four-point lifting sling and pile line (aux hoist), hoist and reinstall the shipping/storage container cover. Apply a coat of anti-seize compound (NSN 8030-00-664-6146) to the bolts and secure the cover to the base with the bolts.

t. Install the four-part hook block on the main hoist wire rope. Ensure the anti-two block switch weight has been installed properly on the main hoist cable.

Spare Tire Installation

Use the five-ton headache ball on the pile line (aux. hoist) and the spare tire handling (lifting) sling, located in the crane tool box, to install the spare tire and secure with the attaching hardware.

Moving the Loaded Shipping/Storage Container

The weight of the shipping/storage container with all components stored inside is approximately 19,500 lbs (8,864 kg). Prior to hoisting the shipping/storage container for loading check to ensure all the shipping/storage container cover bolts are installed and secured.

NOTE

Weight data is stenciled on the sides of the shipping/storage container.

NOTE

All crane lifting shall be done with the outriggers fully extended, tires relieved of the crane weight, and the crane set on a firm and level supporting surface. It may be necessary to place cribbing under the outrigger floats.

If using the crane to move a full shipping/storage container, it is necessary to have the crane rigged with a four-part hook block and set up properly for lifting operations on outriggers and the Load Moment Indicator (LMI) system configured for Front Hoist, Outrigger Position 100%, and Four (4) Parts of Line. The shipping/storage container must always be lifted within the load radius of the crane.

COMPONENTS OF END ITEM.

General (Refer To Table H-7 and Figure H-22.)

Table H-7 lists components of end item for the Berminghammer Pile Driver System to help you inventory items required for safe and efficient operation.

This listing is for informational purposes only, and is not authority to requisition replacements. These items are part of the end item and are packaged together for transportation and shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations in Figure H-22 are furnished to assist you in identifying the items.

Table H-7. Components of End Item - Berminghammer Pile Driver System

Item No.	Qty.	Component Description
		Shipping/Storage Container
14	1	Shipping/storage container cover (includes tethered mounting bolts)
25	1	Shipping/storage container base
15	1	Wrench for shipping/storage container cover bolts
18	2	15-foot (4.6 m) equipment tie-down strap – 1,400 lbs (636 kg)
29	2	8-foot (2.4 m) equipment tie-down strap – 1,000 lbs (455 kg)
28	1	6-foot (1.8 m) equipment tie-down strap – 1,000 lbs (455 kg)
16	1	Tool box – spare parts
17	1	Tool box - accessories
19	1	Spotter storage support
		Lead Tower Assembly
5	3	Lead tower section (with attaching hardware – bolts, nuts, washers, and retaining blocks)
4	1	Lead head adapter (with attaching hardware – bolts, nuts, and lockwashers)
9	1	Foot roller
8	1	Pile gate stop
10	2	Rough-terrain wheels
31	1	Impact hammer stop
30	2	Impact hammer stop bolts (7/8 x 2-inch HHCS)
7	1	Pile gate
		Spotter Assembly
12	1	Spotter
13	1	Spotter slide
		Impact Hammer
6	1	Impact hammer with 18-inch guide plate installed.
1	1	Remote throttle
2	1	70-foot (18 m) hydraulic hose for remote throttle.
3	1	Remote throttle mounting bracket
		Rigging and Safety Equipment
32	1	Trip safety lever cord – 100-feet (30.5 m)
33	1	Hydraulic hose retaining cord – 100-feet (30.5 m)
34	2	96-inch wire rope lifting sling
35	2	89-inch wire rope lifting sling NOTE: one may be attached to impact hammer
36	2	72-inch wire rope lifting sling
37	2	Nylon lifting sling
42	1	H-type pile lifting sling (double bridle – 30” x 5/8” (76 cm x 1.6 cm))
43	2	H-type pile chain lifting sling with hooks

Table H-7. Components of End Item - Berminghammer Pile Driver System (Continued)

Item No.	Qty.	Component Description
		Rigging and Safety Equipment (Continued)
41	2	1-inch shackle
40	2	7/8-inch shackle NOTE: may be attached to impact hammer
39	8	3/4-inch shackle
38	2	Ground-release shackle
44	1	Temporary hydraulic hose retainer chain (5/16 x 84-inch (0.8 x 213 cm))
11	1	Lead transportation chain
46	1	Hydraulic hose clamp (with attaching hardware – two bolts)
45	1	Pulley with 15-inch (38 cm) anchor bungee
26	4	4x4-inch (10 x 10 cm) wood block
47	2	1/2 x 48-inch wire rope
48	4	5/8 x 96-inch wire rope to attach the pile adapters to the impact hammer.
49	8	5/8-inch cable clamps to attach the pile adapters to the impact hammer.
50	1	Piston lifting eyebolt
		Shipping/Storage Equipment (NOTE: May be on Impact Hammer)
51	2	Intake/exhaust port weather cap
52	1	Catch ring weather cap
53	2	Catch ring weather cap securing strap
54	1	Piston transportation pin and clip
55	1	Piston transportation pin clip
56	1	Trip transport bolt
		Ground Servicing Equipment
57	1	Ground fueling hand pump with hose and quick connect fitting
59	1	Ground oiling hand pump
58	1	Ground oiling hose and quick connect fitting
60	1	Ground oiling hand pump container cover
61	1	Waste fuel drip tank drain hose and quick connect fitting
62	1	Grease gun with flex hose
63	1	Coupler for grease gun
64	1	Oil gun
		Tools
65	1	Hex key – 3/4-inch (12-inch long)
66	1	Hex key – 5/8-inch (10-inch long)
67	1	Hex key – 1/2-inch (8-inch long)
68	1	Hex key – 3/8-inch (7-inch long)
69	1	Hex key – 5/16-inch (6-inch long)
70	1	Wood pile tongs
71	1	Crowbar (2-foot (61 cm))
72	1	Two-pound (0.9 kg) hammer
73	1	Vice grips
74	1	12-inch (30.5 cm) adjustable wrench
75	1	18-inch (46 cm) adjustable wrench
77	1	1-5/16-inch combination wrench
76	1	1-1/8-inch combination wrench
78	1	1-5/16-inch box end wrench
79	1	1-1/8-inch box end wrench
80	1	Two-inch (5 cm) wood level
81	1	100-foot (30.5 m) fiberglass measuring tape
82	1	Check valve extractor tool
83	1	Ring compressor
84	1	Piston ring pliers

Table H-7. Components of End Item - Berminghammer Pile Driver System (Continued)

Item No.	Qty.	Component Description
		Tools - Bundled Together
85	1	Axe
86	1	Ten-pound (4.5 kg) sledge hammer
89	1	36-inch (91 cm) peavey
87	1	Cheater bar (36 x 2-inch (91 x 5 cm)).
88	1	Steel bar w/ hickey (5-foot (1.5 m))
		Accessories and Adapters
24	1	18-inch square (concrete) pile adapter
27	1	Sheet pile adapter
20	1	10-inch (25.4 cm) guide plate
22	1	12-inch (30.5 cm) guide plate
23	1	16-inch (40.6 cm) guide plate
21	1	Plywood template for 18-inch square (concrete) pile adapter
		Seal Kits and Filters
98	1	Fuel pump seal kit
95	1	Throttle valve (needle block) seal kit
94	1	Oil pump seal kit
90	2	Fuel filter element for the Fuel Filter Assembly
91	6	In-line fuel filter
92	2	Fuel or oil tank suction strainer element
		Spare Parts
107	4	Lubrication fitting
96	1	24-inch (61 cm) braided fuel injector line
97	1	16-inch (41 cm) braided fuel injector line
93	2	Fuel injector
98	1	8-1/2-inch 22 cm) braided fuel line
100	1	Fuel plunger assembly
110	2	Roll pin (cam to shaft) – 3/8 x 2-inch
111	4	Roll pin – 1/4 x 1-1/2-inch
108	1	Lifting pawl
109	2	Stop pin
102	2	Hose end fitting (fuel line repair fittings)
101	1	1/4-inch JIC – 1/4-inch JIC hydraulic fitting (fuel line repair fitting)
103	6	Hose clamp
106	1	Throttle valve (needle block) mounting bolt
105	1	Fuel pump mounting bolt (1/2 x 3-3/4-inch)
104	1	Fuel pump mounting bolt (1/2 x 4-inch)

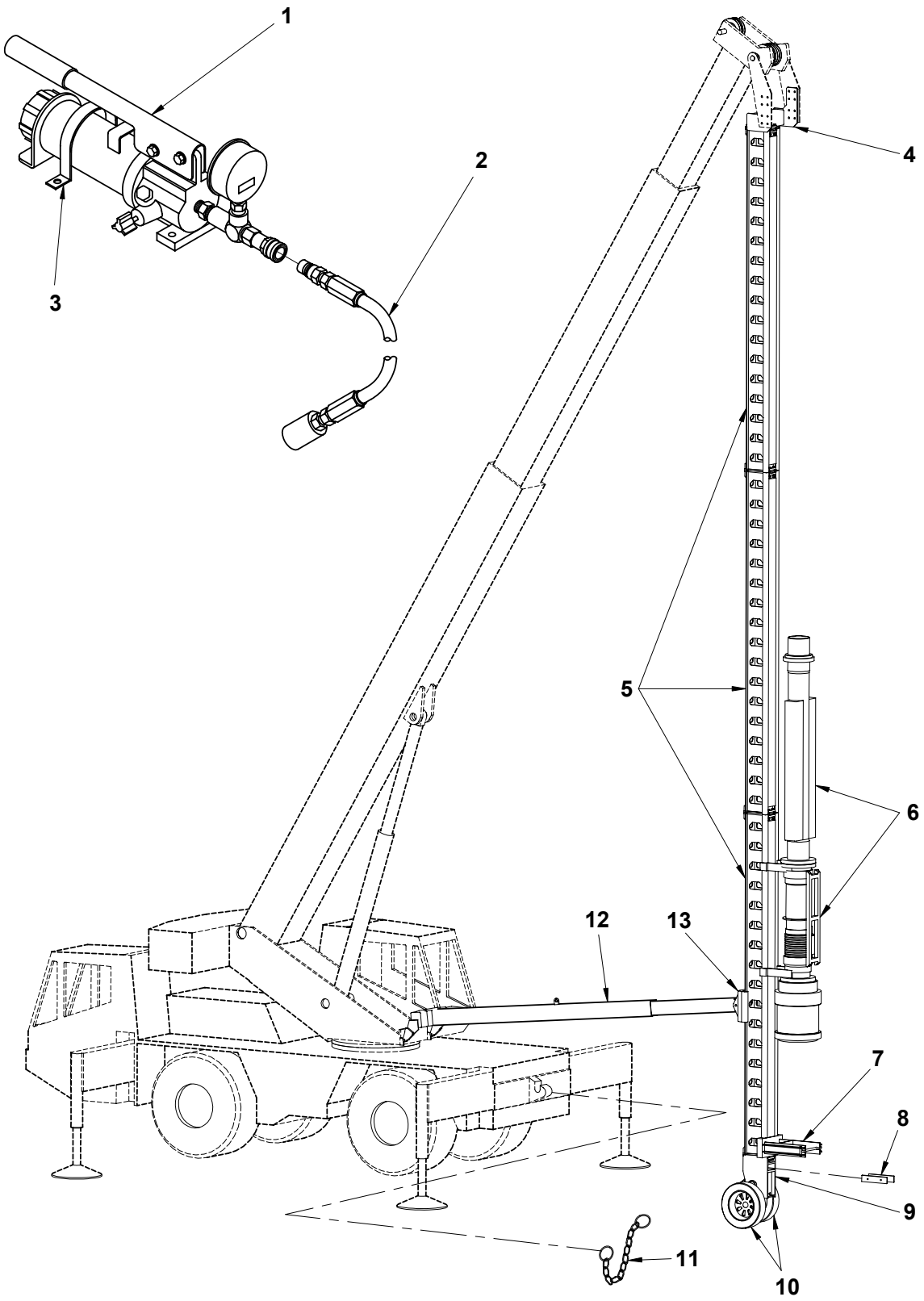


Figure H-22. Components of End Item - Berminghammer Pile Driver System (Sheet 1 of 5)

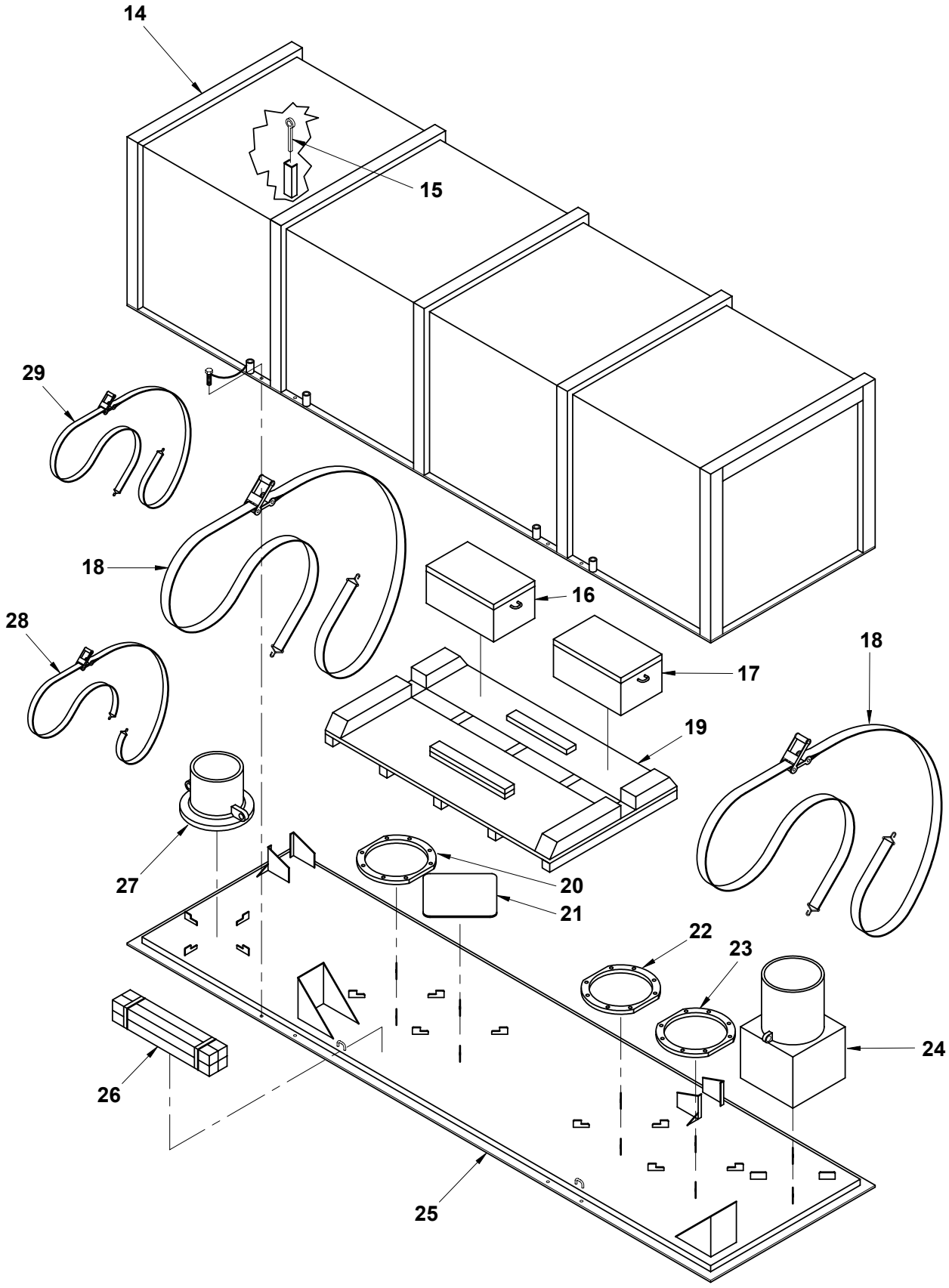


Figure H-22. Components of End Item - Berminghammer Pile Driver System (Sheet 2 of 5)

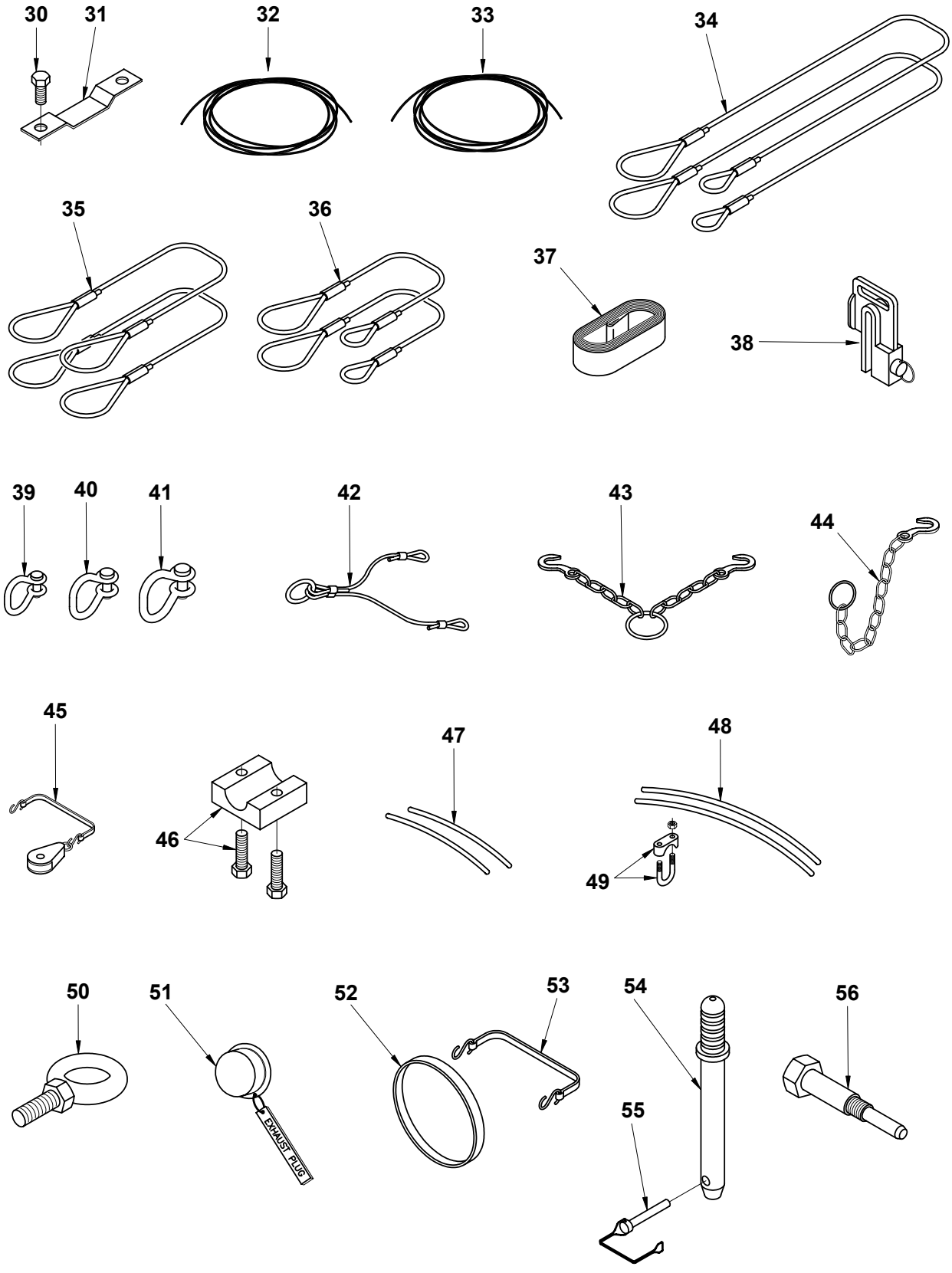


Figure H-22. Components of End Item - Berminghammer Pile Driver System (Sheet 3 of 5)

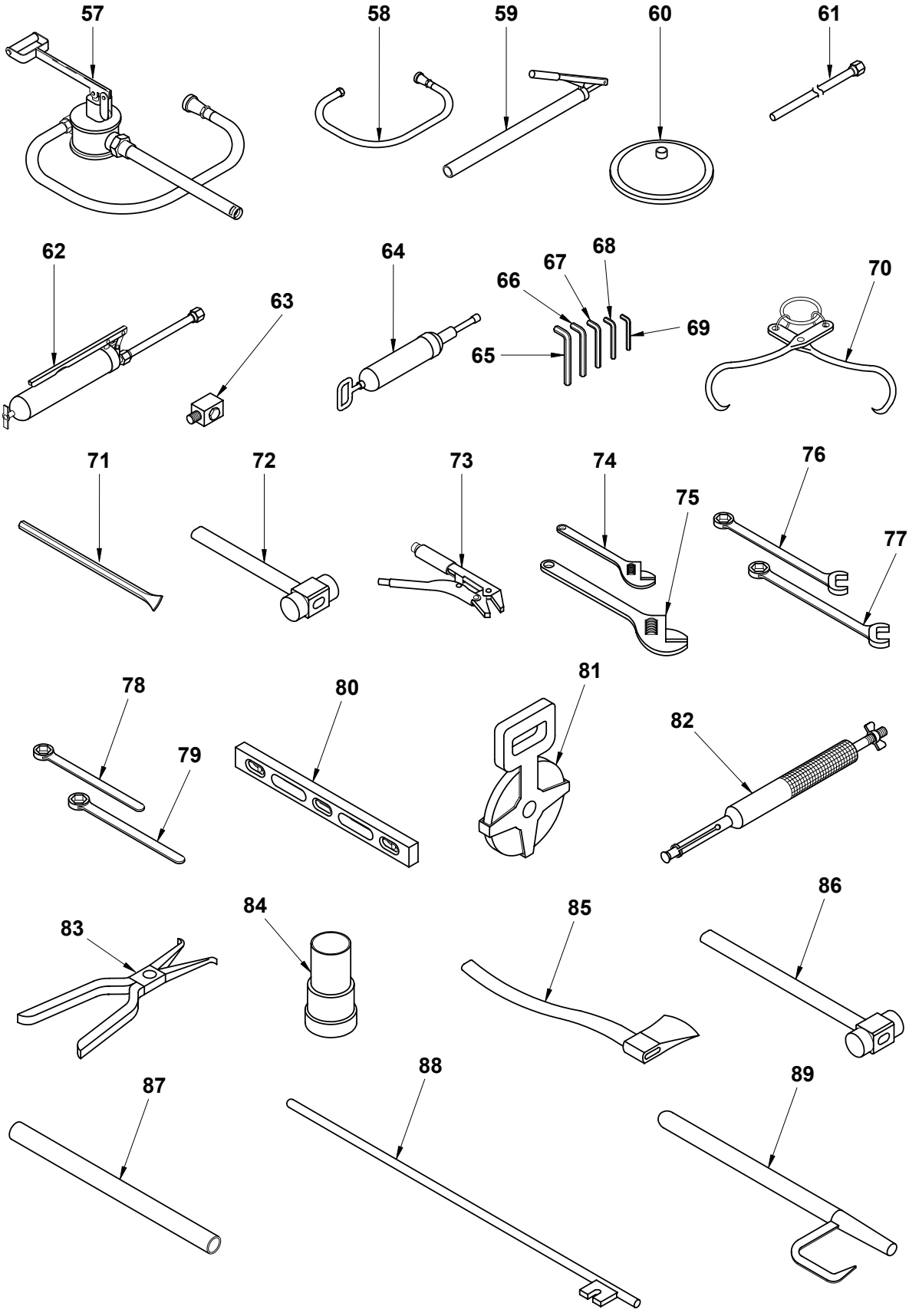


Figure H-22. Components of End Item - Berminghammer Pile Driver System (Sheet 4 of 5)

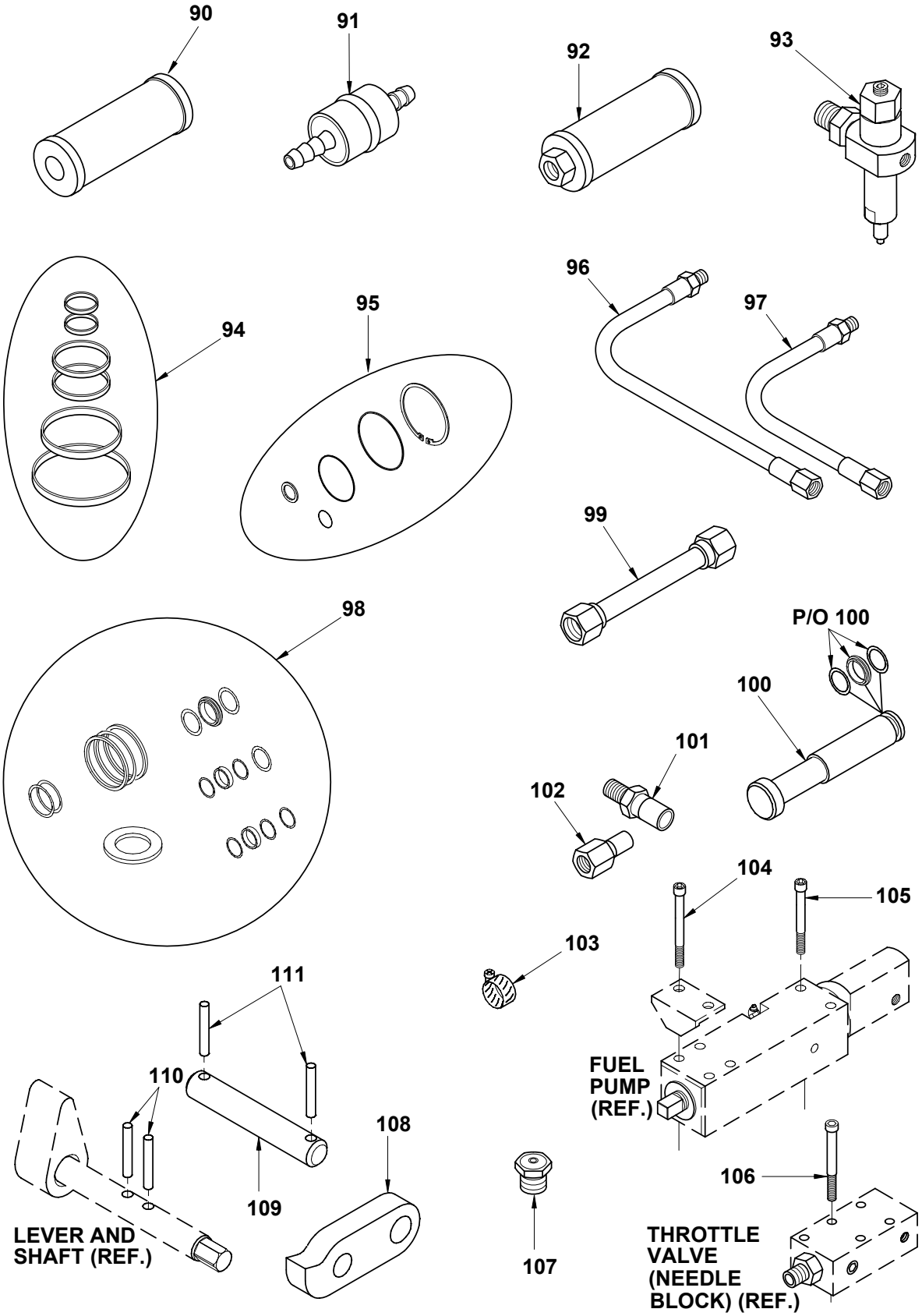


Figure H-22. Components of End Item - Berminghammer Pile Driver System (Sheet 5 of 5)

APPENDIX I

ATEC WEIGHT DISTRIBUTION

The ATEC with all of its components and options presents a number of variations in axle weight distribution and gross vehicle weight. In many cases, highway travel and vehicle loading requirements restrict the ways in which the vehicle can be configured. In such cases, it may be necessary to reconfigure the ATEC. The following are examples of different ways that the ATEC can be configured. The front and rear axle loads and the gross vehicle weights have been calculated for each configuration. Calculations have also been included to show how certain components affect the axle loads and gross vehicle weight.

NOTE

All weights are in pounds.

The maximum allowable front and real axle loads for 55 mph travel are 22475 pounds (each).

1. ATEC in the As Shipped Configuration. The ATEC as shipped (e.g., with the hose reel, outrigger pads, and spare tire installed; tie-down shackles, spare tire handling sling, and tire inflation kit in front storage box; and fuel and hydraulic tanks full), weighs:

	FRONT AXLE	REAR AXLE	GROSS WEIGHT
Total	20886	21592	42478

2. ATEC Rigged for Heavy Lifting. To configure the ATEC for heavy lifting, the hoist cable and the 22-ton hook block must be installed. Installing these components results in the following weight configuration:

	FRONT AXLE	REAR AXLE	GROSS WEIGHT
Install main hoist cable	-205	+511	+306
Install 22 ton hook block (reeved at front bumper)	+1047	-548	+499
Total	21728	21555	43283

3. ATEC Rigged for Light Lifting. To configure the ATEC for light lifting, the 22-ton hook block will be removed and a 5-ton headache ball will be installed. This results in the following weight configuration:

	FRONT AXLE	REAR AXLE	GROSS WEIGHT
Substitute Headache Ball for 22-Ton Hook Block	-699	+372	-327
Total	21029	21927	42956

4. ATEC Rigged for Heavy Lifting with All Accessories. Configuring the ATEC with the 22-ton hook block installed and all accessories (excluding headache ball) would result in the following weight configuration:

	FRONT AXLE	REAR AXLE	GROSS WEIGHT
Install aux. hoist cable	-147	+453	+306
Pile driver plates (in front storage box)	+269	-93	+176
DAP kit	+34	+20	+54
Tech manuals/personal gear (in front storage box)	+153	-53	+100
Driver (in carrier cab)	+265	-85	+180
Total	22302	21797	44099

5. Rigged for Heavy Lifting with Accessories and Headache Ball. Configuring the ATEC with the 22-ton hook block installed and all accessories including the headache ball option would result in the following weight configuration:

CAUTION

Configuring the ATEC for heavy lifting with all accessories including the headache ball will exceed the 55 mph front axle limit of 22475 pounds. The crane weight distribution must be adjusted appropriately to reduce the front axle load to the safe maximum. Similarly, adjustments may be necessary to achieve acceptable weight distributions for prevailing local highway regulations.

	FRONT AXLE	REAR AXLE	GROSS WEIGHT
5-ton headache ball	+348	-176	+172
Total	22650*	21621	44271

* Exceeds 55 mph front axle limit.

6. Removing Selected Components. It may be necessary from time to time, to remove ATEC components in order to achieve a required axle load/gross weight limitation. As examples, removing the spare tire and/or the boom-mounted hose reel would result in the following weight changes:

	FRONT AXLE	REAR AXLE	NET GROSS LOSS
Remove spare tire	+199	-699	-500
Remove hose reel	-717	+372	-345

APPENDIX J

TRANSPORTABILITY REPORT

RAIL and MARINE GUIDANCE

Prepare the ATEC AT422T for Rail or Marine transport by following these instructions, in addition to the information in the reference material at the end of this appendix.

NOTE

For Highway transport see Reference Material at the end of this appendix.

Inside Carrier Cab

1. Tape securely the sliding door glass, rear window sliding glass, and remaining glass.
2. Tape Carrier door keys to ignition switch actuator arm.
3. Tape Fire Extinguisher to its bracket and defroster fan to adjacent structure.
4. Move Transmission Control lever to Neutral position and tape securely.
5. Install a block under Parking Control Knob to hold in “pulled out” position and tape securely.
6. Secure Technical Manuals in bracket.
7. Close and secure cab door with tape, leaving cab doors unlocked.

Inside Superstructure Cab

1. Start engine, swing the boom over the crane front end and lower to just above the rest cradle.
2. Push down the Swing Lock Pin Control Handle to engage locking pin, (located at right side of console).
3. Push down on the Positive Swing Lock Handle (located right side of operator’s seat armrest) and engage locking pin.
4. Lower boom until it rests on the boom cradle, and shut engine down.
5. Tape securely the seat armrest in the down position.
6. Move control levers to forward position and tape securely to the steering wheel.
7. Tape fire extinguisher to its bracket and defroster fan to adjacent structure.
8. Cushion and tape LMI console to instrument panel console and steering column.
9. Tape securely the door glass, rear window sliding glass, skylight window, and remaining glass.
10. Move Transmission Control lever to Neutral position and tape securely.
11. Install a block under Parking Control Knob to hold in “pulled out” position and tape securely.
12. Secure Load Chart Binder in its bracket located behind seat at upper left corner of cab.
13. Tape Superstructure door keys to ignition switch actuator arm.
14. Close and secure cab door with tape, leaving cab doors unlocked.

On Carrier (Outside of Cab):

1. At boom, tape Tagline Hose Reel hoses to the Tagline Hose Reel chain.
2. Install safety tie down wire rope to boom as follows. Place wire rope around boom and reeve through hook block clevis. Form one continuous loop and overlap ends a minimum of 24 inches. Secure overlapped cable ends together with four U-bolt type clips. Install two clips in the same direction maintaining a distance of 3” between them. Install the remaining two clips facing in the opposite direction. Have assistant hand tighten wire rope ends and torque U-bolt nut to 65 lbs. ft.
3. Tape hose reel quick-disconnect plugs to hydraulic tubes for the Tagline Hose Reel.
4. Pivot cab mirrors flush with cab doors. Pivot inward other mirrors on crane. Tape mirrors securely.
5. Latch hinged engine hood covers and tape securely.
6. Latch and tape tool compartment cover.
7. Latch and tape down battery box hinged cover.
8. Place Battery Disconnect Switch Handle in OFF position and tape handle to adjacent structure.
9. Tape the Cold Start injection bottle and cover to its bracket.
10. Stow outrigger pads at rear of carrier and secure in provided storage bracket.

WHEEL CHOCKS

NOTE

Wheel Chocks are required only with standard draft (non-cushioned) rail cars.

1. Nail wheel chocks to rail car deck using 40d nails.
2. Nail side bracing together to railway using 20d nails.
3. Tie Down - Two Types (Wire Rope or Chains).

WIRE ROPES with Clips: Minimum of 5/8" Diameter.

1. At each tie down lug place first wire rope at 45 degrees, other two at greater angles.
2. Thread each wire rope through a rail car stake pocket and a crane tiedown lug and form one continuous loop. Overlap ends a minimum of 34 inches.
3. Clamp wire rope over lapped ends together and install six U-bolt type dips. Install the first two clips in the same direction maintaining a distance of 3-3/4" between them. Install the next two clips facing in the opposite direction. Continue until all the clips are in place.
4. Apply tension to each wire rope (ends) using Chain Hoist and Cable Grip tool. Follow the tie down guidance in Pamphlet No. 55-19. "Tie down Handbook for Rail Movement" with chain hoist tension applied, torque nuts on U-bolts to 130 lbs. ft. If U-bolt breaks when this amount torque is applied, loosen U-bolt nuts, increase cable overlap, replace broken U-bolts.
5. Install additional U-bolt type clips, and torque below breaking point. Remove Chain Hoist
6. and Cable grip tool.

CHAIN with load binders: (NSN 4010-00-449-6573) required.

Reeve three (3) chains through each of the two tie downs at crane front and through looped rail car stake pocket. At each tie down place first chain at 45 degrees, other two at greater angles. Repeat tie down layout at rear of crane. (12 Chains total). Apply tension by installing a load binder at each chain

JACK CYLINDERS:

Secure front jack cylinders with steel tape band (0.035" x 1.25").
Do the same with the two rear jack cylinders. Cushion surfaces to protect paint.

REFERENCE PRINTED MATTER:
All unspecified characteristics are to be in accordance with Association of American Railroads open top loading rules. Ref: AAR Loading Rules, TM 55-2200-001-12.

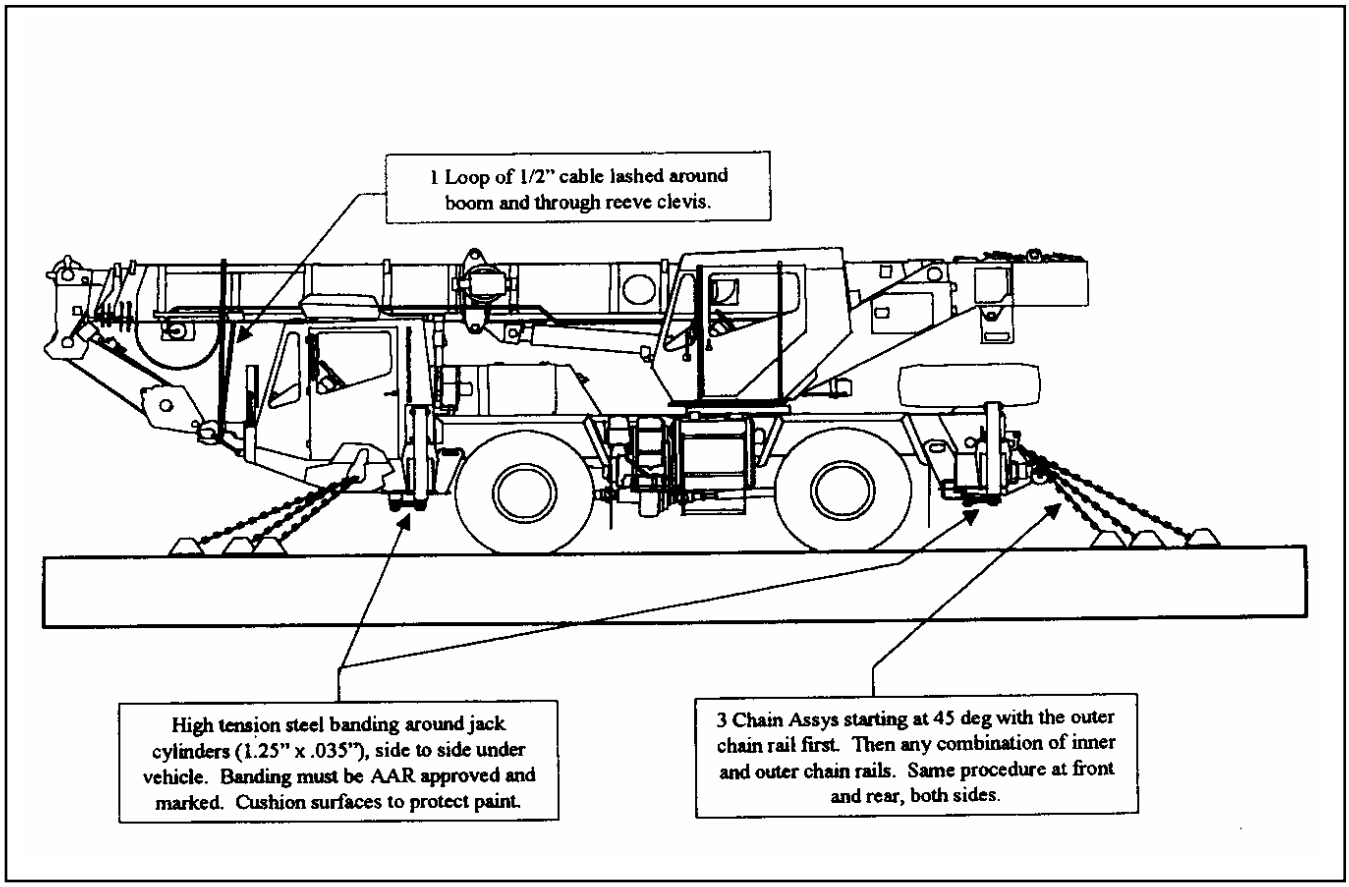
REFERENCE PAMPHLETS ARE AVAILABLE AT NO CHARGE THROUGH:

MTMCTEA (Military Traffic Management Command, Transportation Engineering Agency).

Telephone (DSN 927-4646, (757) 878-4646, or (800) -722-0727)

Pamphlet No. 55-19. Tie Down Handbook for Rail Movement,
Pamphlet No. 96-55-22. Marine Lifting and Lashing Handbook
Pamphlet No.55-1g. Transportability for Highway

All Terrain Crane (ATEC)
Grove Model AT422T
Tiedown Procedure for Rail Transport
TOFC and Chain Equipped Flatcars



Twelve (12) - each 1/2" Alloy Steel Chain Assys; three (3) each on four (4) end provisions.

Vehicle Weight Range (lb)	Alloy Steel Chain		
	Dia (in)	Minimum Working Load Limit (lb)	Number of Chains Required per Vehicle
42,000 - 45,000	1/2	13,750	12

APPENDIX K
WINTERIZING THE ATEC AT422T
OPERATION AND TROUBLESHOOTING

K-1 INTRODUCTION

The Espar seven day timer is located above the carrier cab operator's console, right side. The seven day timer controls the operation of the Espar engine coolant heater (when installed). The seven day timer also has the capability to display fault codes generated by the coolant heater control unit.

The seven day timer allows the crane operator to pre-select engine coolant heater on/off cycles up to seven days in advance. The timer enables manual coolant heater operation.

K-2 CONTROLS & INDICATORS

NOTE

The following paragraphs describe the seven day timer controls and indicators. The numbers in parentheses ( ) represent the index number from Figure K-1.

Time Set Pushbutton (1). This pushbutton initiates the clock setting sequence.

Preheat Time Set Pushbutton (2). Selects the desired memory location for one of three possible stored engine coolant heater on/off sequences.

Heater "On" Pushbutton (3). Turns the engine coolant heater on and off manually.

Backward Scan Pushbutton (4). When pressed, the timer information on the timer display screen scrolls backward.

Forward Scan Pushbutton (5). When pressed, the timer information on the timer display screen scrolls forward.

Memory Location Display (6). Indicates the current memory location (1-2-3).

Time and Day Display (7). Indicates the day of the week MO (Monday), TU (Tuesday), etc., and the current time (24-hour clock).

Heater On Symbol (8). Symbol appears when the engine coolant heater is operating (preheat or heat mode).

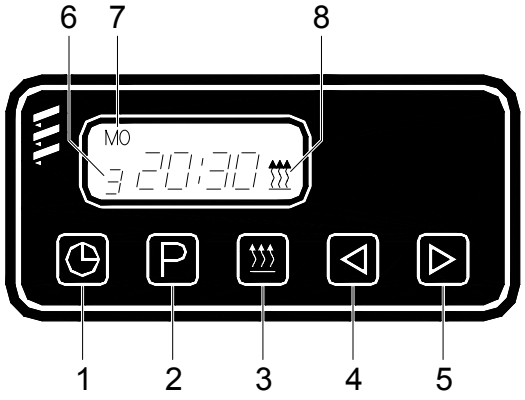


Figure K-1. Espar Coolant Heater Seven Day Timer Controls and Indicators

K-3 ENGINE COOLANT HEATER OPERATION

K-3.1 Setting the Time and day

Set the current time and date as follows:

NOTE

The display will appear when the crane ignition switch is in the run position. The display will remain on for fifteen seconds after the crane is shutdown.

a. Push the time set pushbutton (1, Figure K-1) once. "12:00" will appear on the time and date display (7). It will flash on and off.

b. Press the backward scan pushbutton (4) or the forward scan pushbutton (5) to set the time of day (24-hour clock). When the time display stops flashing, the time of day has been stored.

c. The weekday display (7) will now flash on and off. Use the backward scan pushbutton (4) or the forward scan pushbutton (5) to set the day of the week. When the weekday display stops flashing, the day has been stored.

K-3.2 Changing The Time Or Day

a. Press and hold the time set pushbutton (1, Figure K-1) until the time and date displays flash on and off.

b. Press the backward scan pushbutton (4) or the forward scan pushbutton (5) to set the time of day (24-hour clock). When the time display stops flashing, the time of day has been stored.

c. The weekday display (7) will now flash on and off. Depress the backward scan pushbutton (4) or the forward scan pushbutton (5) to set the day of the week. When the weekday display stops flashing, the day has been stored.

K-3.3 Starting The Engine Coolant Heater With The Ignition Switch Off

a. Press heater "On" pushbutton (3, Figure K-1). The heater on symbol (8) will appear on the display.

b. The engine coolant heater will start (after the preheat cycle times out) for two hours (or until the temperature set limits have been met). The two-hour limit (120 min) is a factory set limit which can be changed. Refer to paragraph K-3.4.

K-3.4 Adjusting Current Engine Coolant Heater Run-Time

a. Press heater "On" pushbutton (3, Figure K-1). The heater on symbol (8) will appear on the display. The current programmed coolant heater run time will be displayed.

b. Press the backward scan pushbutton (4) or the forward scan pushbutton (5) to set the run time, up to 120 minutes.

K-3.5 Adjusting Engine Coolant Heater Run Time Permanently

a. Press and hold the backward scan ◀ pushbutton (4, Figure K-1) for three seconds.

b. Press the backward scan ◀ pushbutton (4) or the forward scan ▶ pushbutton (5) to set the new run time, up to 120 minutes. When the display goes off, the new run time is set.

NOTE

The seven day timer will turn the engine coolant heater off after the preheat cycle is complete. The engine coolant heater will automatically shut down after completing its cool down cycle.

K-3.6 Starting The Engine Coolant Heater With The Ignition Switch In On Position

a. Press heater "On" pushbutton (3, Figure K-1). The heater on symbol (8) will appear on the display. The time of day will remain displayed when the crane's ignition switch is on.

b. The engine coolant heater will continue to function while the crane's ignition switch is in the on position. The coolant heater will continue to operate for fifteen minutes after the crane is shutdown.

c. Press the backward scan ◀ pushbutton (4) or the forward scan ▶ pushbutton (5) to control the run time while the crane is operating.

d. Turn off the engine coolant heater by depressing the heater "On" pushbutton (3). The coolant heater will also shutdown automatically when the ignition switch is in the off position.

K-3.7 Storing Engine Coolant Heater Run Times In Memory

NOTE

The seven day timer will store up to three engine coolant heater run times which can be programmed to start on a specific day of the week.

a. Press preheat time set P pushbutton (2, Figure K-1) until the desired memory location (1, 2, or 3) appears in the memory location display (6).

b. Press the backward scan ◀ pushbutton (4) or the forward scan ▶ pushbutton (5) to set the time of day (24-hour clock) for starting the coolant heater. When the time display stops flashing on and off, the start time has been stored.

c. Press the backward scan ◀ pushbutton (4) or the forward scan ▶ pushbutton (5) to set the day of the week that the engine coolant heater will be required to operate. When the weekday display stops flashing, the day has been stored.

K-3.8 Activating A Stored Engine Coolant Heater Run Time

a. Press preheat time set P pushbutton (2, Figure K-1) until the desired memory location (1, 2, or 3) appears in the memory location display (6). The engine coolant heater will start at the day and time indicated on the display. The display will go dark after fifteen seconds. The memory location (1, 2, or 3) will be stay on in the memory location display (6) indicating that the engine coolant heater is set to start on the day and time stored at that memory location.

K-3.9 TURNING THE ENGINE COOLANT HEATER OFF – ALL MODES

a. Press heater "On"  pushbutton (3, Figure K-1). The engine coolant heater will shutdown after its normal cool down cycle is complete. The time of day will remain displayed when the crane's ignition switch is on.

K-4 TROUBLESHOOTING

NOTE

The seven day timer will display fault code numbers if the engine coolant heater shuts down due to an operating fault. A fault code will appear in place of the time and day display (7, Figure K-1). The fault codes can be used by maintenance to troubleshoot the system

If the engine coolant heater fails, check the following before contacting maintenance to troubleshoot the heater.

- Check electrical connections and the in-line fuses (in the battery box and engine coolant heater box). Ensure that the crane's batteries are charged.
- Check for interference between the combustion air and exhaust pipes.
- Check the fuel source.
- Check for coolant flow from the crane's engine coolant system.

a. Contact maintenance to troubleshoot and repair the engine coolant heater. Refer to TM 5-3810-307-24-1-2, Appendix J.

APPENDIX L

INSTALLATION/OPERATION OF PILE DRIVER (LINK BELT)

CONTENTS

NOTE

Refer to TM 5-3895-265-14 "Hammer, Pile Driver Self Powered; Diesel Driven, w/fuel oil, Tank and Lubricating Oil Tank (Link Belt Speeder, Model 180-M)"

L-1. SCOPE:

This appendix covers procedures for the installation, operation, and disassembling of a Pile Driver and Catwalk used with the ATEC Crane. Only general guidance is provided. Refer to Technical Manual of Pile Driver Hammer and Catwalk used for complete instructions.

L-2. GENERAL.

A Pile Driver is a sectional tower framework that contains a diesel engine driven battering ram device that pounds Piling (Poles, I-Beams, Sheets, etc.). into the soil to create foundations for buildings, bridges, docks, seawalls, and other structures required to maintain or support heavy loads.

Pile Driver components include Lead Sections (tower) a Hammer (a two cycle diesel engine with a reciprocating cylinder, and a fuel tank), an Adapter (to absorb the ram impact forces to minimize mushrooming/splitting of the piling and to protect the hammer) and a Driving Head (battering ram in contact with the pole or pile being driven into the soil).

The Top Lead Section is connected to the crane boom by two parallel Adapter Plates. The Lower Lead Section(s) bolt to the Top Lead Section. The combined (bolted together) sections form a metal frame up to an allowable 45 ft. height.

A crane is used to lift, position, and stabilize the pile driver lead sections over each desired pole placement site.

The pole or pile may be driven partially or all the way into the ground. If bedrock is encountered the pole will not be able to be driven further into the soil. It may be cut off to suit the "above ground length" requirement.

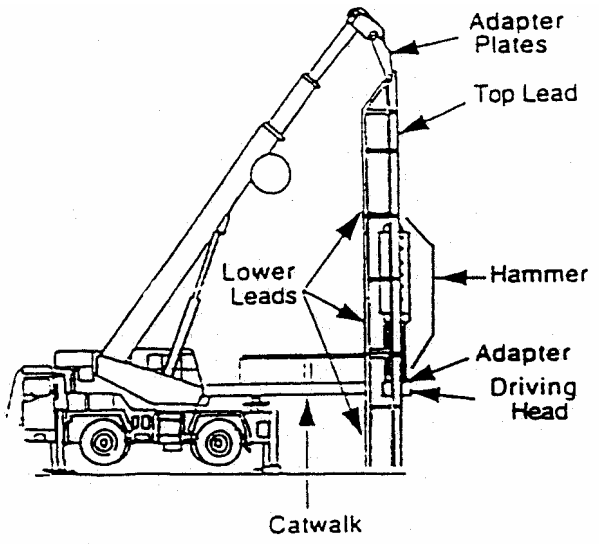


Figure 1. Crane, Catwalk, and Pile Driver.

The crane operator lifts and repositions the Pile Driver for each new pole to be driven into the ground. The operator moves the Crane and/or changes Boom lengths for each desired pole location. Poles may be up to 25 ft long.

The crane is also used to pull each pole upright into the lead section tower so that it is in a position to be driven into the ground by the ramming action of the Hammer.

General weights for the Hammer Engine, Driving Head, Adapter, and Guide Angles are about 6500 lbs.

Other Pile Driver components are cables, tie ropes, adapter plates, a Transmitter (pile driver speed control) device and a cable.

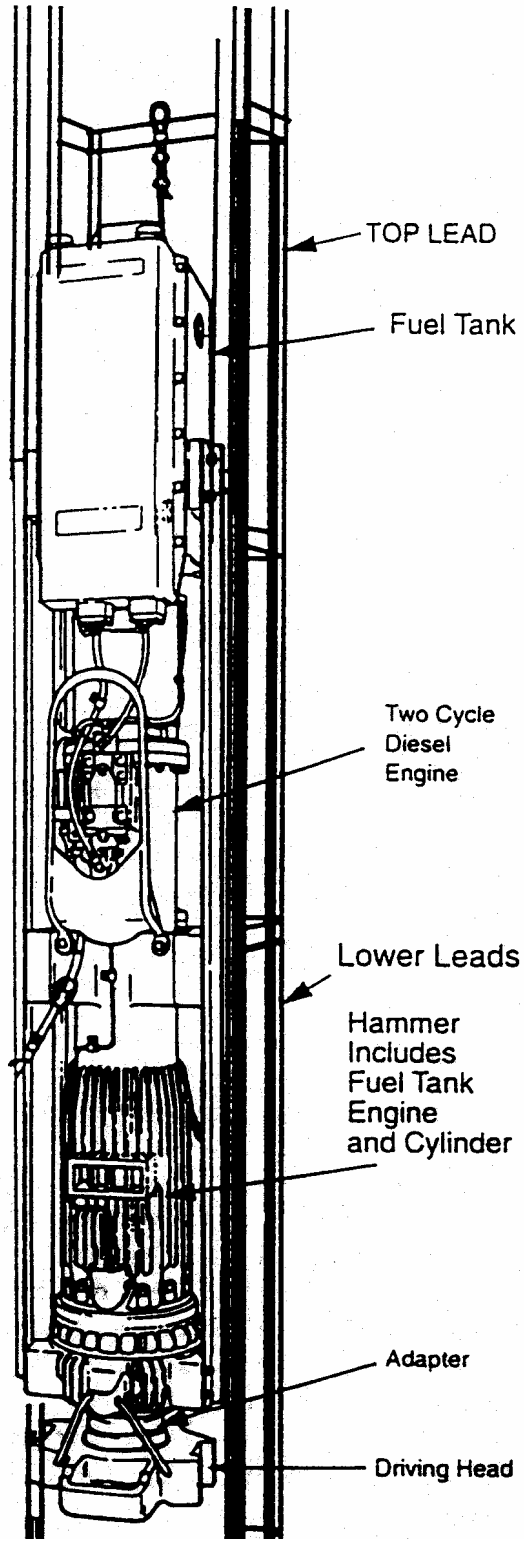


Figure 2. Components of Pile Driver

TRANSMITTER

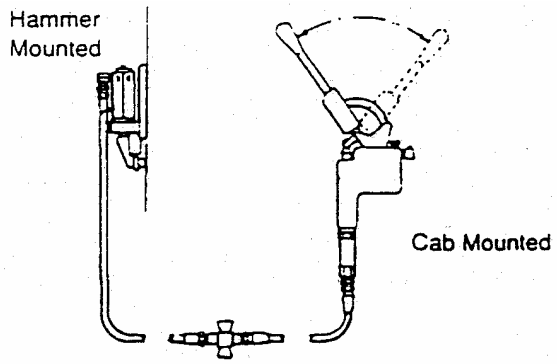


Figure 3. Transmitter. (Pile Driver Speed Control)

The speed of the Pile Driver diesel engine is controlled by a hydraulic operated remote device called a Transmitter. The Transmitter controls the amount of fuel to the engine via the fuel pump and injector.

It consists of a hydraulic reservoir mounted on the hammer, a movable handle, valves, and a hydraulic hose. It also acts as a engine device to turn the engine "off". (See Figure 3).

CATWALK

An adjustable bridge that provides stability to the lead section. This allows personnel a staging area for tools and supplies. It also allows personnel to service the Pile Driver and it helps to stabilize the lead sections.

A Catwalk is positioned between the Crane and the Pile Driver (see figure 4).

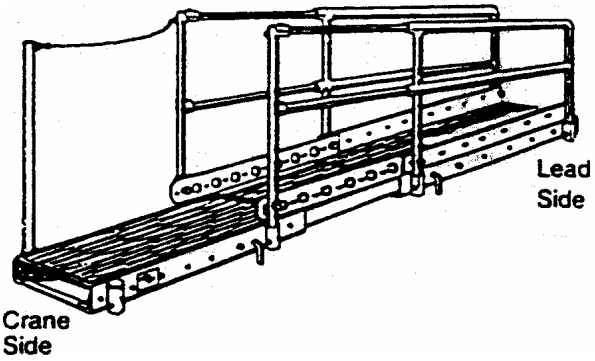


Figure 4. Catwalk

A Catwalk comes in three or more 10 ft sections that slide inside each other to adjust to the desired length needed. When a catwalk is installed

in place. hardware fasteners and slide-in locking pins are used to secure the sections into one rigid structure.

When a catwalk is used with the ATEC Crane, interference exists with the spare tire mounting bracket when swinging the boom to the left. To eliminate this interference, brackets need to be locally fabricated, and installed on the cab catwalk mount brackets. These brackets raise the catwalk over the top of the spare tire mount bracket.(See Fabrication Drawing at the end of this Appendix and Figure 5).

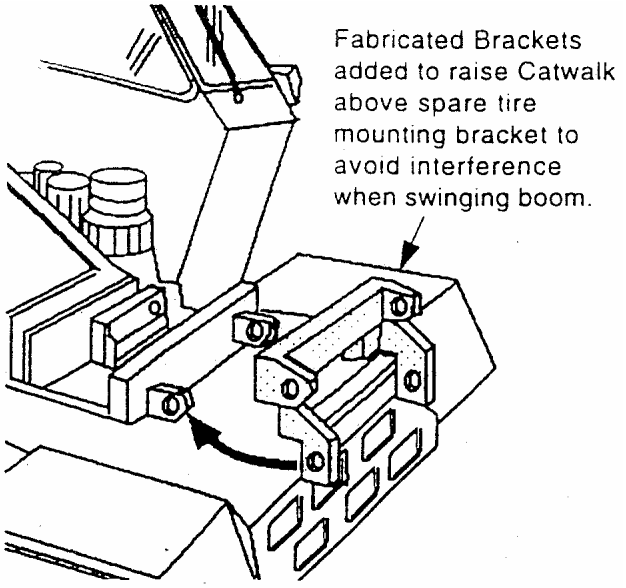


Figure 5. Extension Brackets Added to Crane.

ANTI-TWO BLOCK ASSEMBLY

A PAT LMI (Load Moment Indicator) System is used on the ATEC crane to guide the operator to stay within the crane design parameters. Part of the LMI system is a safety device that prevents the Hook Block from running into the Boom Nose Block.

The ATEC uses an anti-two block assembly as the safety device. It automatically stops any impending collision of the Hook Block with the Boom Nose Block when the operator is paying-in cable to lift a load or otherwise raise the hook block.

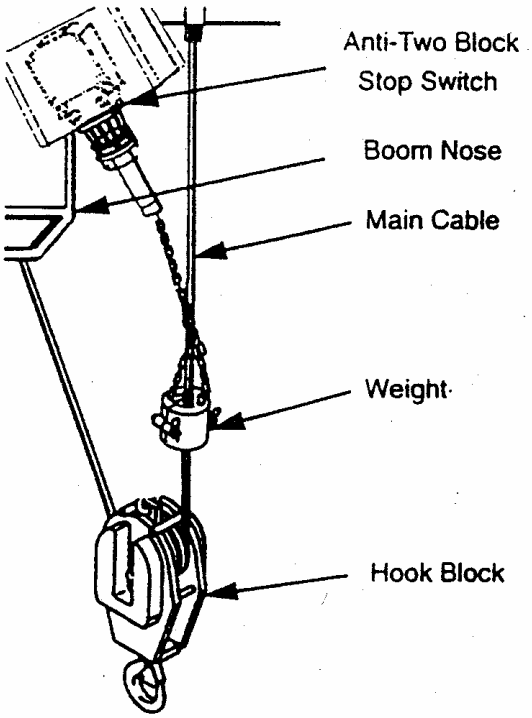
An anti-two block assembly has a chain, weight, switch, relay, buzzer, warning light, and wiring. The chain, relay, and switch are located at the end of the boom. The light and buzzer are located inside the cab and on top of the dash panel in a small enclosure.

The anti-two block weight is placed around the main cable on the side where the main cable return is fastened at the boom.

When the hook block moves close to the block in the boom end it encounters and lifts the weight. As the weight is lifted it releases a spring held switch that stops the cable movement thus preventing further movement of the hook block. (See Figure 6).

The hook block is used to lift and place the pile driving components in the staging area. After that it is not needed. The operator swings it out of the way and lowers it to the ground on cribbing. Personnel unhook the main cable and remove the hook block from the boom nose.

In crane operations, as well as in pile driving operations, the anti-two block assembly is used.



When the hook block moves close to the block in the boom end it encounters and lifts the weight. As the weight is lifted it releases a spring held switch that stops the cable movement thus preventing further movement of the hook block.

Figure 6. Anti-Two Block System.

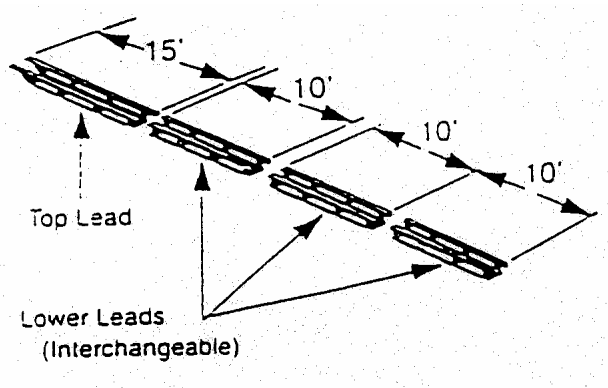
L-3. INSTALLATION OF PILE DRIVER.

NOTE

An area with a radius of 25 ft will be needed to position the crane so that the Pile Driver, Pile Driver components, and site where piles are to be driven are within limitations and capacities of the crane being used.

(1) NUMBER OF LOWER LEADS NEEDED.

a. Measure pole length and see Note to determine total number of Lower Leads needed.



NOTE

Total Number of Lower Leads needed is determined by length of pile or post to be driven into ground. See text.

Figure 7. Pile Driver Top and Lower Lead Sections. (Lower Lead Sections are Interchangeable)

NOTE

Prior to assembling Top and Lower Leads determine number of Lower Lead Sections Required.
Add 20 ft to length of Pole (Pile) to be driven into ground.
That number will be the required total length of Assembled Top and Lower Sections that will need to be assembled together.
Add sufficient number of Lower Lead Sections to be added To Top Lead to meet or exceed that required length.

(i.e.,) Poles to be driven into ground are 25 ft long. Add an additional 20 ft. = 45 ft total.
Answer Top Lead Section Length is 15 ft. plus three Lower Lengths are 10 ft each = 45 ft total length of assembled Top and Lower lead sections. The total Is equal or more that the combined numbers. (See Figure 7).

(2). SPARE TIRE REMOVAL.

a. Remove ATEC crane spare tire from superstructure and set aside. See index under Tire Spare for page number of section on using hoist to lift and move spare tire.

(3). PLACING PILE DRIVER COMPONENTS.

a. Park crane into position shown in Figure 8 and rotate superstructure so that boom faces rear or carrier.

b. Position crane so that rear is aligned with 1st pole to be driven. Place Pile Driver Top and Lower Leads, Adapter, Driving Head, catwalk sections, and other components on planks positioned on the ground at the rear of the Crane. (See Figure 8).

Note: When placing hammer assy., Hammer has to be placed with fuel tank in up position using cribbing to prevent fuel leakage.

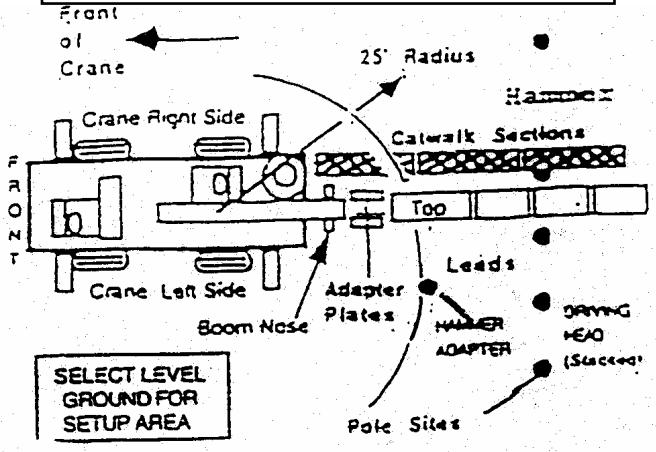


Figure 8. Assembly Components On Level Ground Within A 25 Ft Radius.

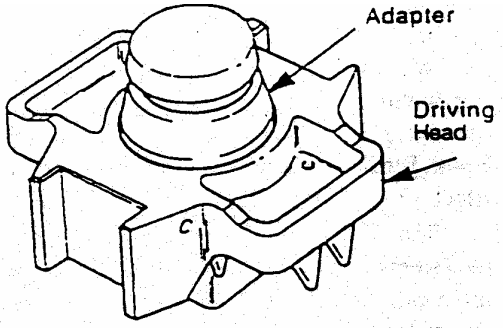


Figure 9. Adapter On Top Of Driving Head

c. Place Top Lead Section, required number of Lower Lead Sections, and Adapter plates on ground in an approximate assembly position as follows:

d. Place Left and Right Adapter Plates on ground at crane Boom Nose. (See Figure 8).

e. Position Top Lead Section on ground facing the crane boom and next to Adapter Plates. Position required number of Lower Lead Sections on ground and in line with the Top Lead Section.

(4). ASSEMBLING COMPONENTS.

a. With crane located in line with leads as shown in Figure 8. ensure rear superstructure is rotated so that boom is facing the rear of the crane.

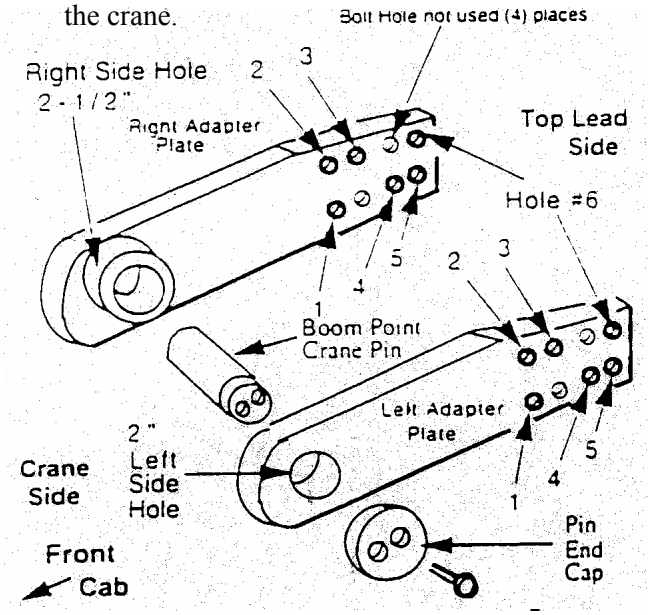


Figure 10. Right and Left Crane Adapter Plates

b. Tilt crane front-to-rear and level left-to-right by extending outriggers. Raise front of crane and lower rear of crane. When correct, crane will be left to right level and front to rear tilted and fully supported on its outriggers.

c. Raise and/or lower boom so that adapter plates attachment shafts. on the end of the boom. are at working level.

NOTE

Adapter Plates are not interchangeable. there is a left Adapter Plate and a Right Adapter Plate. The RIGHT side Adapter Plate has a step-down hole size to interface the pivot pin shaft, that has a step down shaft size. The LEFT side Adapter Plate has a single size hole. Left and right side plates are orientated from the driver's seat of the front cab.

d. Remove two bolts from each side holding boom point crane pin end caps and remove end caps.

e. With supplied hardware, assembly and bolt the Top Lead Section and the required number of Lower Lead Sections together to form a single tower structure.

f. Place Right Adapter Plate on clean Boom Point Crane Pin and install end can and two bolts. Tighten bolts.

g. Place Left Adapter Plate on clean Boom Point Crane Pin and install Pin End Can and two bolts. Tighten bolts. (See Figure 11).

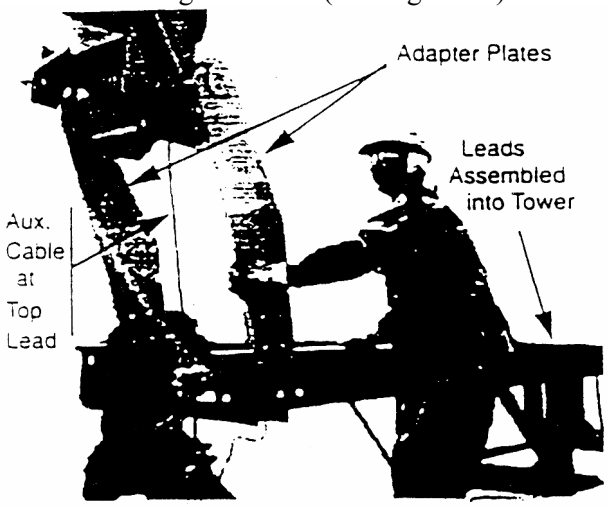


Figure 11. Installing Adapter Plates on Leads.

h. Remove sheave cable guide pin, as shown in Figure 12, to eliminate cable rub when lead tower is hoisted into upright position.

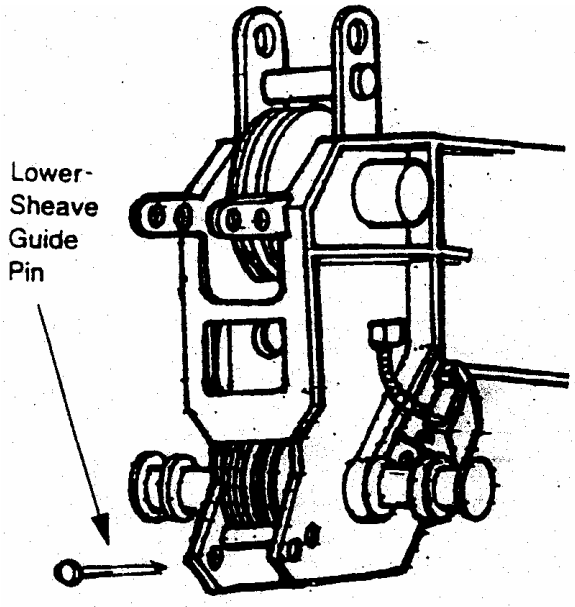


Figure 12. Remove Lower Sheave Cable Guide Pin To Avoid Cable Interference When Lifting Lead Tower into Upright position.

i. Pay-out Auxiliary Hoist Cable and Attach bucket and wedge assy. Using a small chain or cable, connect cable bucket to the top lead section. (To prevent damage to the auxiliary load cable). (See Figure 13).

j. Pay-in Auxiliary Hoist Cable and raise Lead Sections tower upward into position at the Adapter Plates.

k. Pivot Right Adapter Plate upward and align lead section hole 6 with adapter plate hole 6. Install one bolt/washer, as shown in Figure 8 or 9, thru Adapter hole #6 into hole in Top Lead Section. Install nut but do not tighten.

l. Pivot Left Adapter Plate upward and align lead section hole 6 with adapter plate hole 6. Install one bolt/washer, as shown in Figure 8 or 9, thru Adapter hole #6 into hole in Top Lead Section. Install nut but do not tighten.

m. Raise auxiliary hoist to pivot Adapter Plates/ (on #6 bolts) up until remaining bolt holes in Adapter Plates are aligned with holes in Top Lead Section. Use of a hole head bar helps in aligning holes. (See Figure 13).

CAUTION

All nuts, bolts, and lockwashers should be installed and tightened. Rounded heads on bolts, or damaged bolts, nuts, and lockwashers should be replaced. Proper tightening is necessary to prevent adapter leads coming loose from the Lead Section.

n. Install and tighten all adapter nuts and bolts on each Adapter Plate as shown in Figure 13.

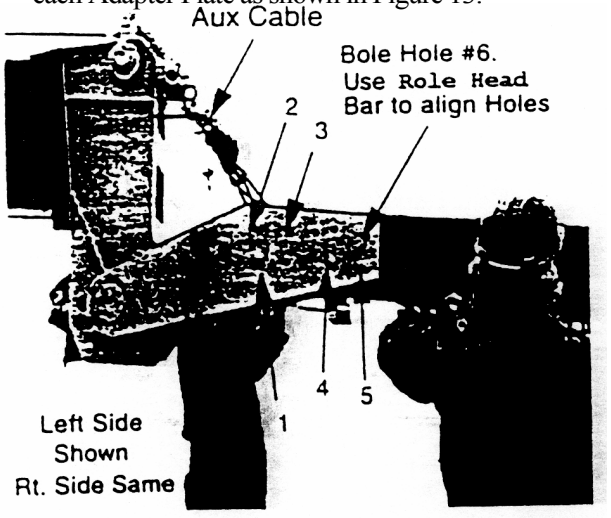


Figure 13. Raise Lead Sections and Align Holes in Adapter Plates with Holes in Top Lead Section

o. Remove Auxiliary Cable from Top Lead crossover member and pay-out approximately 20 feet past end of last Lower Lead Section along ground.

p. To prepare to hoist Hammer later, prepare MAIN CABLE now. Pay-off Main Hoist cable and route along top of lead section tower and continue cable payoff to at least 20 feet along ground past end of tower, and attach wedge and socket.

q. Align cable in lower sheave and install lower sheave guide pin. (See Figure 14).

r. Set LMI for two part line operation.

CAUTION

When setting LMI to two part of line for pile driving, it should be understood this is to keep the LMI system from locking out while hammering. (Not for increasing lift capacity).

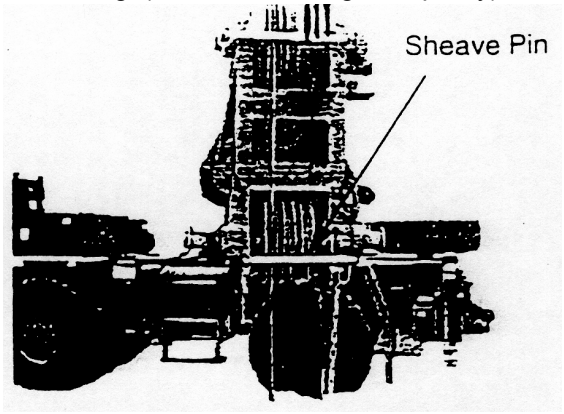


Figure 14. Install Lower Sheave Guide Pin

(5). RAISING THE LEAD SECTIONS.

a. Raise and telescope boom to place the lead sections so that they hang vertically from the boom pivot point. (See Figure 15).

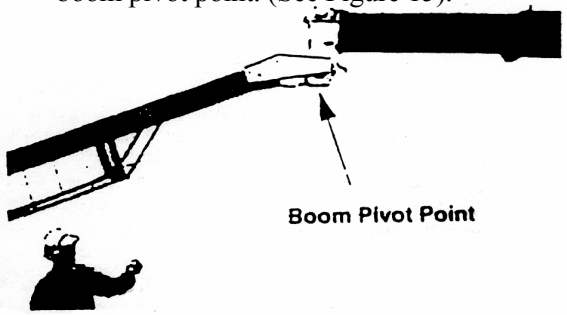


Figure 15. Raise up the Lead Tower Using the Boom

b. Lower lead sections firmly onto the ground at the top of the Hammer which is positioned.

with the fuel tank up. (See Figure 16).

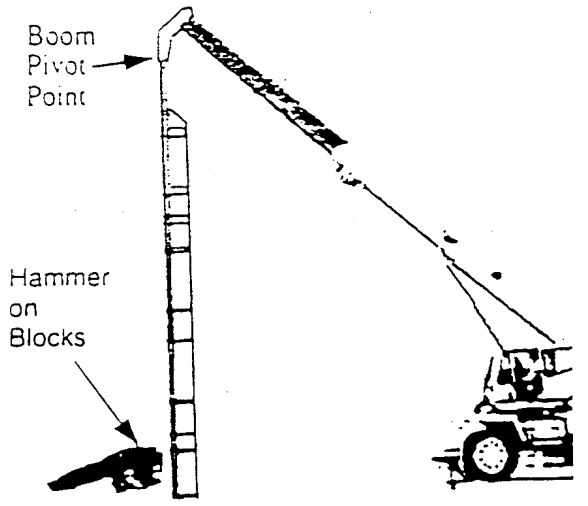


Figure 16. Ensure hammer is Lying On The Ground With The Fuel Tank Up. Raise And Place The Lead Sections Vertically Near The Hammer.

WARNING

To ensure personnel safety, when servicing the Pile Driver, the superstructure must be locked into position. Before any personnel are dispatched to conduct service operations on the Pile Driver, move Swing Brake Lock Toggle Switch to the "ON" position.

(6). INSTALLING THE HAMMER IN THE LEAD SECTIONS

CAUTION

Ensure the two front angle hammer guides are installed and the two rear guides are removed before placing Hammer in lead section.

a. Install headache ball to main hoist line with headache ball 20 ft. past lead tower to hoisting eye at top of hammer (not starting device cable). Chain is not recommended because links will crack under the continual vibrations from pile driving. (See Figure 17).

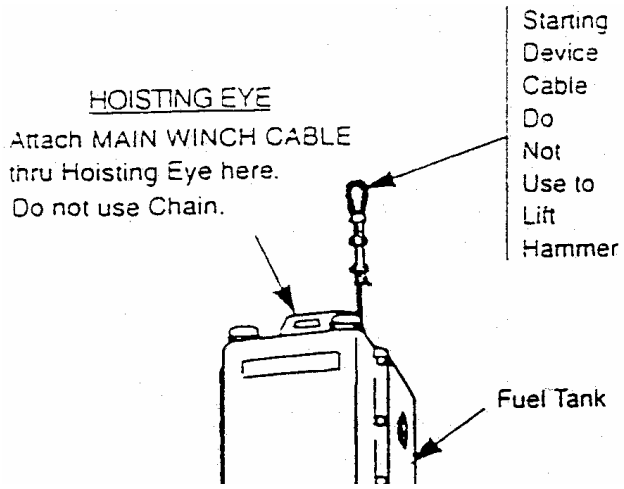


Figure 17. Hooking Main Winch Cable To Top Of Hammer. (Do not use Chain)

c. Attach two tag lines to opposite corners of the Lower Lead Section. These tag lines are used by ground personnel to help in guiding the Hammer into the leads when the Hammer is raised into the Lead Sections (See Figure 18).

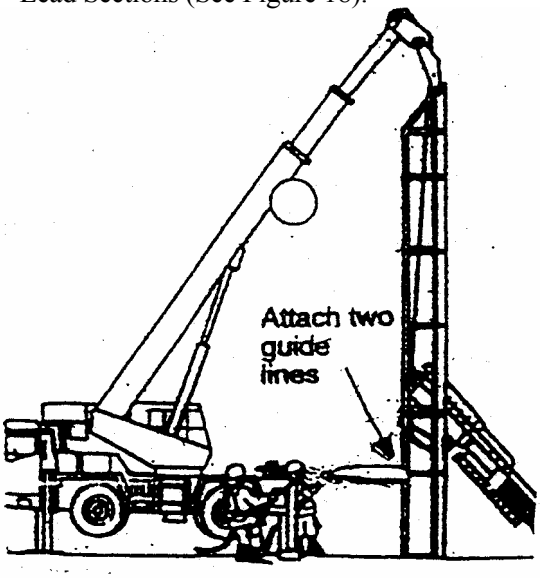


Figure 18. Attaching Two Tag Lines To Opposite Corners Of The Hammer To Guide It As It Is Raised Into Position Inside The Lead Sections.

d. Pay-in the Main Hoist Cable thereby raising the hammer off of the ground and upward into the leads. (See Figure 18).

CAUTION

Do not attach a main cable to the loop in the starting devise cable (rope) to lift the Hammer. Use Hoist Eye on top of Hammer.

e. Install two rear angle hammer guides to secure Hammer in leads.

f. Tighten all mounting hardware and secure with safety wire if applicable.

CAUTION

A Pile Driver is subject to constant vibrations when running.

These vibrations may cause bolts and nuts to work loose.

To insure personnel safety and rigidity of the structure, all nuts, bolts, and lockwashers should be installed and tightened.

Bolts with rounded heads, or damaged bolts, nuts, or lockwashers must be replaced so that proper tightening can be obtained.

Proper tightening will prevent lead sections from loosening during operation at the Adapter Plates.

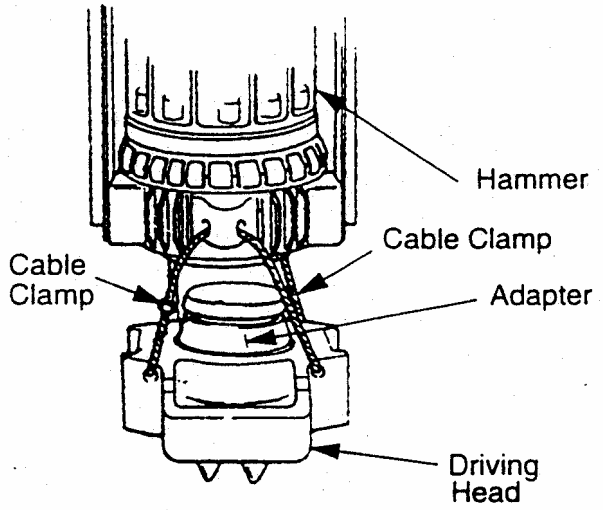


Figure 19. Hammer, Adapter, and Driving Head Assembly.

(6). ASSEMBLING THE ADAPTER/DRIVING HEAD TO THE HAMMER. (See Figure 19).

NOTE

Ensure that Driving Head in upright on the ground, with the Adapter nestled on top of it, as in Figure 20, prior to beginning the following procedures.

a. Raise boom to lift Lead Sections, containing hammer, high enough to clear Adapter/Driving Head.

b. Using Main Winch Hoist/Cable, raise Hammer slowly in Lead Sections high enough to. allow sufficient clearance between the Hammer and the space that will be needed when the Adapter/Driving Head is in place.

c. Position the Lead section and Hammer over the top of the Adapter and the Driving Head.

d. Lower the lead section to the ground, keeping the Hammer raised and off of the Adapter/ Driving Head.

e. Apply slight boom pressure downward to the Lead Sections to stabilize and secure to the ground.

f. Lower the Hammer onto the Adapter/Driving Head.

g. Cable the Hammer. Adapter, and Driving Head together by installing the short attached cable through the Adapter and then through the Hammer. With cable in place. tighten clamps to secure Adapter/Driving Head to the Hammer. (See Figure 20).

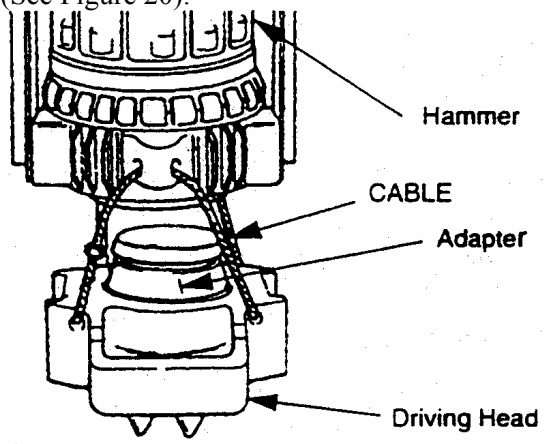


Figure 20. Installing Cable and Clamps through Driving Head, Adapter, and Hammer.

h. Hook auxiliary hoist cable to Hammer starting device cable.

(7). INSTALLING CATWALK BETWEEN CRANE AND PILE DRIVER.

NOTE

Catwalk is installed onto fabricated brackets previously bolted onto cab mount brackets.

Catwalks are made from 8’ to 10’ lengths of Outer and Inner Sections. Total assembled length is adjustable by sliding outer sections over inner section prior to Inserting pins to fasten sections together. Rails and chains are added.

These are general directions. Refer to TM on Catwalk being installed for specific information.

a. Ensure ATEC crane spare tire has been removed from superstructure and set aside. See L-3. (2).

b. Bolt, but do not tighten, an Outer Section to the Crane Superstructure Fabricated Extension brackets as shown in Figure 21.

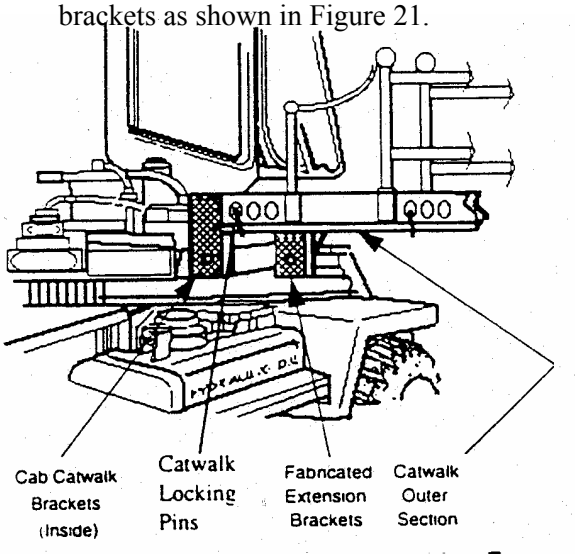


Figure 21. Begin Installation by Attaching Extension Brackets and then Catwalk Outer Section to Crane Extension Brackets.

c. Slide the Inner Section into the Outer Section that is bolted to the crane superstructure.

d. Slide the last Outer Section over the end of the Inner Section.

e. Keeping the Catwalk level, slide forward to Lead Section.

f. Install and tighten bolts, lockwashers, and nuts to fasten the Outer Lead Section to the Lead Section.

g. Insert Catwalk Locking Pins into Outer Section thru the Inner section, at overlap, to lock the Catwalk sections together. (See Figure 21).

h. Attach rails and chains to Catwalk assembled frame sections. Install and tighten all hardware.

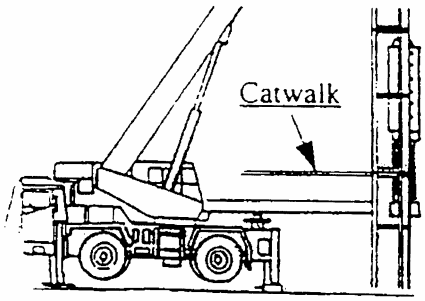
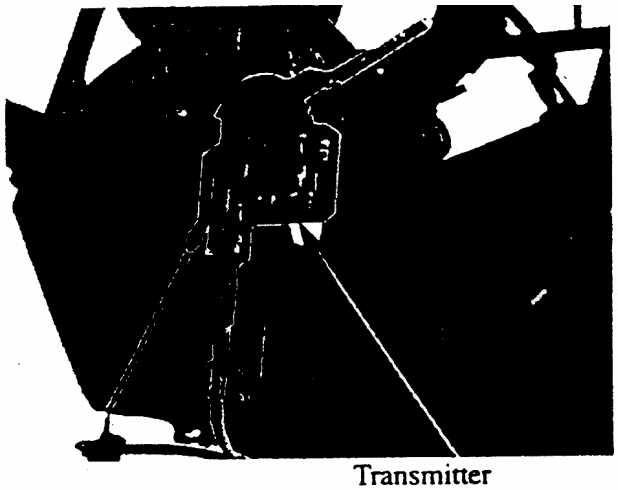


Figure 22. Catwalk In Place Between Crane and Leads.

(8). INSTALLING TRANSMITTER AND HYD. HOSE.

a. Mount the transmitter on the crane within easy reach of the operator.(See Figure. 23).



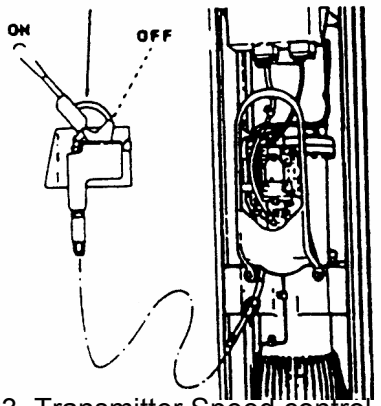


Figure 23. Transmitter Speed control mounted on Cab near Door (Upper illustration) and Receiver on Hammer (Lower illustration).

a. Connect the Hydraulic hose to the transmitter.

b. Connect the hydraulic hose to the receiver on the Hammer.

c. Complete job by bleeding air from system.

See next section L-4. (3).

NOTE

Check for tightness of all hardware fasteners.

L-4. OPERATION OF PILEDRIVER

(1). PMCS

a. Perform PMCS (Preventative Maintenance Checks and Services).

NOTE

Ensure swing brake toggle switch is in the ON position prior to operating Hammer.

(2). VENT COVERS

a. Remove and store two exhaust and two intake vent covers. (there are two vent covers per valve). (see Figure 24).

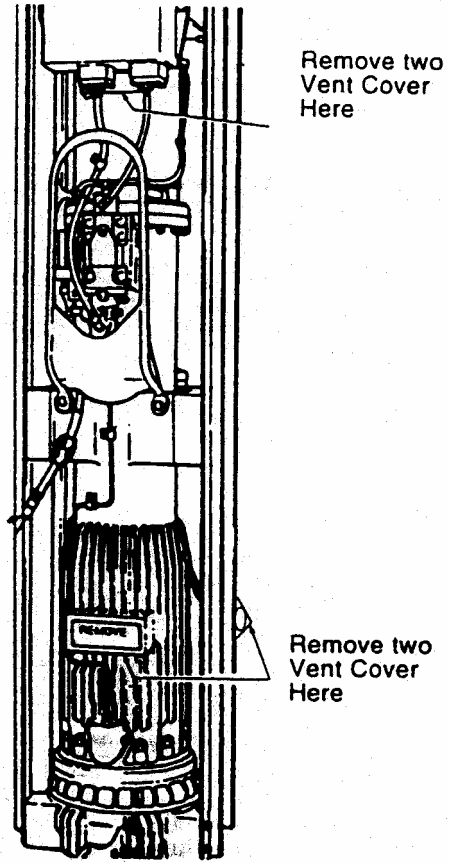


Figure 24. Removing the Four Valve Vent Covers.

(3). BLEEDING AIR FROM TRANSMITTER SYSTEM.

a. Bleed the hydraulic transmitter control system. (See Figure 25).

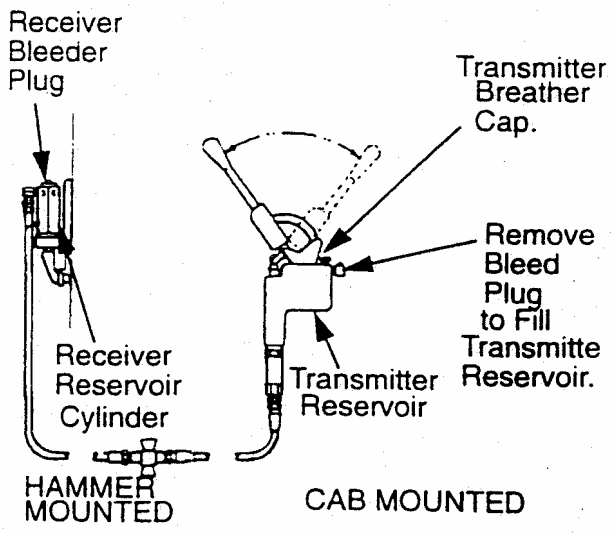


Figure 25. Bleed cap locations of the Transmitter Control System Components.

a. Make sure hydraulic hose is connected to the Hammer and the Transmitter. Ensure all connection are tight.

b. Open breather cap on top of transmitter. Breather cap must be open before operating and left open during operation. (See Figure 27).

c. With the transmitter lever in the FULL ON position, fill the reservoir through elbow fitting located on the side of the transmitter. Fill until oil is visible at the top of the fitting.

d. After filling the reservoir, trapped air can now be bled from the system.

e. To do this, pull the transmitter lever all the way back (towards operator) and hold the handle in this SYNCHRONOUS POSITION against the internal spring for a few seconds. (See Figure 26).

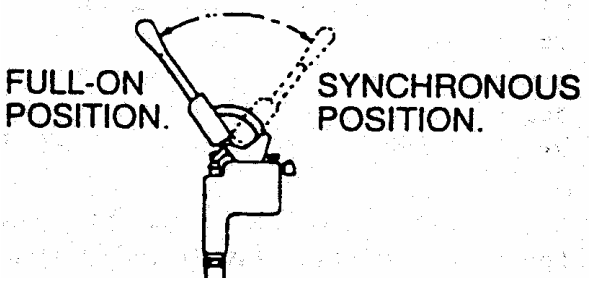


Figure 26. Transmitter positions.

NOTE

This SYNCHRONOUS POSITION permits the oil to flow from the transmitter reservoir into the system and allows trapped air to be worked out of the system.

e. Alternately work lever from the FULL ON position to the SYNCHRONOUS POSITION to allow any trapped air in the Double Relief Valve and Lower Reservoir to work out of the system.

f. Release the transmitter lever. The spring loaded lever should return.

g. Remove the bleed plug located at the top of the Receiver Reservoir Cylinder. (See Figure 26).

NOTE

The final step to bleed the system of air requires that the receiver bleeder plug, be replaced and tightened, each time, prior to moving the lever to the SYNCHRONOUS POSITION.

h. Replace and tighten the Receiver Reservoir Bleeder plug and move the lever back from FULL ON position to the SYNCHRONOUS POSITION.

i. Release spring loaded lever and allow to return to OFF position. Remove plug, replace and tighten plug and once again move lever to the SYNCHRONOUS POSITION.

j. Keep repeating this procedure until trapped air is purged which is when the fuel rack opens with the lever moved to the SYNCHRONOUS POSITION.

(4). FUELING THE SYSTEM.

a. Add diesel fuel to the Hammer Fuel Tank. See Figure 27.

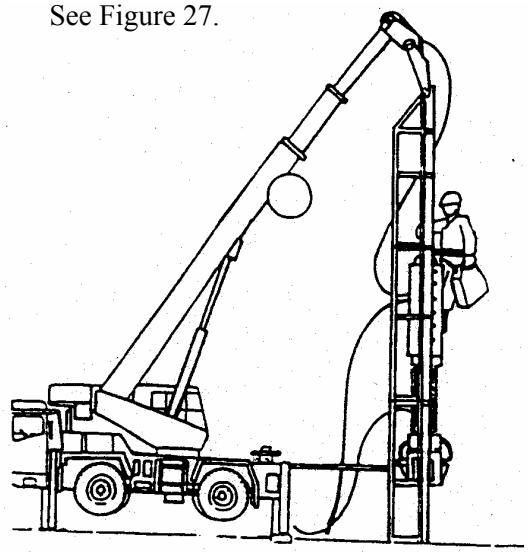


Figure 27. Add Fuel to the Hammer Fuel Tank.

(5) HOISTING THE PILE (POST) INTO PLACE ON THE LEADS. (See Figure 28).

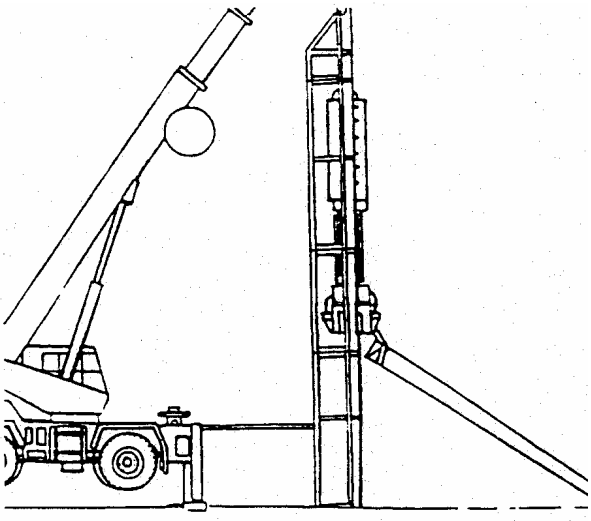


Figure 28. Positioning Pile Into Lead Sections.

a. Attach two pile lifting slings around lead guide brackets for the hammer.

b. Attach other end of sling to the pile using timber hitch found in FM 5-125. Ensure the sling is at least five feet from the bottom of the Driving Head and Adapter.

c. Lift hammer in lead sections to proper height using main hoist to allow the pile to be placed under the hammer Driving Head.

d. Reel in auxiliary hoist simultaneously, keeping the slack out of the cable.

WARNING

To avoid serious injury, do not use hands or fingers to guide piling into place on leads. Use guide lines to keep safe distance from piling.

f. Position pile under Hammer Driving Head and the point where pile is to be driven. Tie guide line near the top of the pile using timber hitch. This is used to help align piling into lead sections.

g. Lower Hammer to top of pile.

CAUTION

It is important that the entire weight of the hammer is on the pile. This places the Adapter and Hammer Driving Head In its UP POSITION which allows latching the rope of the starting device.

L-5. STARTING THE HAMMER ENGINE

WARNING

Prior to starting the hammer engine and while the pile driver is running, each person, including the crane operator, who is within a 50 ft. radius of the crane footprint, must wear a hearing protection device.

This distance is shown on decals located inside each cab and above the engine hood on each side of the crane carrier.

NOTE

The hammer engine starting device is an off-center linkage mechanism designed to engage with a machined shoulder on the ram for lifting the ram and starting the hammer.

It consists of a lifting lever, locking lever. a release lever, and a latching block.

A wire rope is connected to the housing and extends upward through two guide rollers mounted on the cylinder head.

(1). ENGAGE STARTING DEVICE (See Figure 29).

a. Raise auxiliary hoist line to snug position.

b. Have ground guide pull down on and hold the latch rope. The crane operator will lower auxiliary cable to within 6 to 12 inches above the hammer until the lifting lever latches with the ram.

c. Ground guide can now release the latch rope.

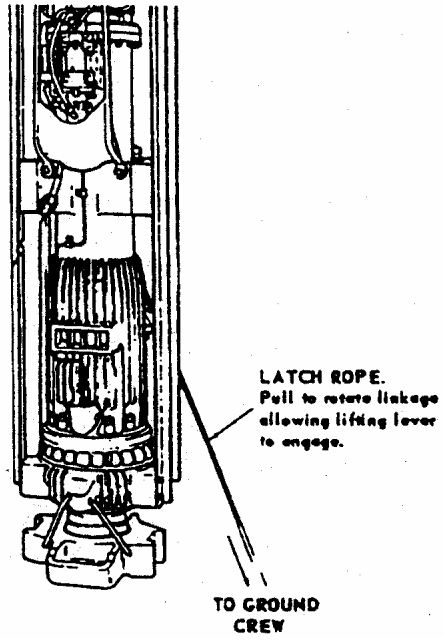


Figure 29. Latch Rope Starting Device.

CAUTION

Do not pull latch rope at any time while hammer is in operation. Engagement of the starting device while Hammer is in operation will cause damage to the ram and starting device.

d. The Crane operator uses the auxiliary hoist to raise the ram to the top of its stroke. The operator should raise the ram slowly. Do not raise the ram too far above the top of its stroke as this will raise the entire hammer off the top of the pile.

CAUTION

Do not raise the hammer off the pile. The starting device cable must not be used to lift the hammer. To lift the Hammer, use the lifting eye attached to the Hammer as shown in Figure 30.

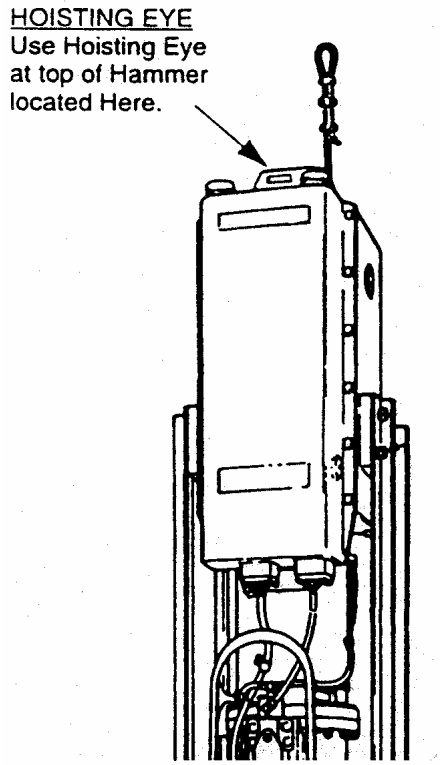


Figure 30. Use Hoist Eye On Top Of Hammer To Raise And Lower Hammer/Adapter/Driving Head Unit.

e. Move the transmitter lever to provide 1/2 to 3/4 movement of the fuel pump rack opening.

hammer to fire.

f. Lower auxiliary cable to release the ram and allow it to free fall. After the release of the ram. position the starting device cable with the auxiliary hoist line in the appropriate center position of the starting device rover

L-6. RUNNING HAMMER ENGINE.

The diesel hammer cylinder should now be running. Move the transmitter control lever to a position that will allow the hammer to operate at a steady, smooth rate without jumping.

NOTE

Unwind cable slowly to eliminate shock loading which causes wear and damage to the crane. Fast unwinding causes bird nesting of the winch drums.

L-7. WHILE HAMMER IS RUNNING

a. Payout main and auxiliary hoist lines to spool out as pile is driven downward.

b. Keep Hammer in good alignment with the center of the pile to avoid breaking the pile or the Hammer slipping off the pile.

c. Keep the latch rope and the hydraulic hose clear of the pile being driven.

d. Crane lifting capabilities must not be exceeded.

e. Operator should follow signals from ONE ground guide except when an emergency stop is given by ANYONE.

f. A fire extinguisher should be readily available to the operator and the ground crew.

WARNING

Conduct all fire extinguishing operations from outside the cab and ventilate the cab thoroughly prior to reentry. The fire extinguisher is located inside the cab below the main control panel on the left side.

Hard hats and gloves must be worn by all personnel around the pile driving equipment.

WARNING

Do not allow personnel under or on crane boom, hammer, lead sections, or pile during driving operation. Pile driving involves shock loading and vibration.

L-8. STOPPING THE PILE DRIVER

(1). STOPPING THE HAMMER.

a. Return the transmitter lever to the 'OFF' position to stop the hammer.

CAUTION

To stop the hammer in an emergency, raise the hammer off the pile by using the main hoist.

NOTE

If additional piling are to be driven outside of the 25 ft. radius, move the crane by the "Pick and Carry" method below.

(2). PICK AND CARRY METHOD TO MOVE CRANE:

a. Over Rear outriggers are extended.

b. Put piles in line adjacent to each other.

c. Two lead section.

d. Adapter plates l/2 stel/serious twists to brake.

e. Proper unhooking of pile driver.

1. Remove Anvil and Pile Cap.
2. Remove rear angle guides.
3. Remove Hammer from lead sections using main hoist.
4. Extend/raise boom distance of lead section and lower leads to ground.
5. Retract and lower boom.
6. Ground crew should have tag lines secured to leads to assist operator in lowering operation.

(3). PILE DRIVING CONTINUING

a. Continue pile driving by following steps (d). through (h) until last pile is driven.

L-9. RELOCATING PILE DRIVER.

NOTE

Attached catwalk will swing with pile driver.

a. Raise leads and hammer off ground. (See Figure 26).

b. Move swing brake toggle lock switch to "UNLOCK" position.

c. Swing leads to tear down area.

d. Lower leads and hammer onto ground.

e. Move swing brake toggle lock switch to "LOCK" position.

f. Perform PMCS.

NOTE

If the Hammer is to be shut down for an extended period or moved, the transmitter breather cap must be closed, and the four valve vent caps on the Hammer installed.

WARNING

Watch for warm and/or hot metal surfaces on the Pile Driver and Hammer. When climbing or working from the lead sections, ensure that a good hand and foot grip is used.

L-10 DISASSEMBLING THE PILE DRIVER.

WARNING

Care should be used when disassembling the pile driver so that oil or fuel is not spilled onto equipment, clothes, or ground. All spillage should be cleaned up immediately. This will prevent slippery surfaces and an environmental hazard.

(1). REMOVAL OF HYDRAULIC TRANSMITTER SYSTEM.

a. Disconnect hydraulic hose from the receiver on the hammer. Ensure oil is captured in a container or absorbed with absorbent material. Install cap, drain, roll, and stow transmitter hose.

b. Disconnect hydraulic hose from the Transmitter. Drain all remaining fluid from the hose into a suitable container or absorbent rag.

c. Remove the hydraulic transmitter from the crane cab and stow.

(2). REMOVE CATWALK

a. Remove rails and chains from Catwalk.

a. Remove rails and chains from Catwalk.

b. Remove the two locking pins securing outer section to superstructure.

c. Disconnect Catwalk from superstructure.

d. Disconnect the outer and inner sections leaving the outer section attached to the Pile Driver.

d. Remove the tow locking pin on the remaining outer section from the Pile Driver.

WARNING

Watch for warm and/or hot metal surfaces on the Pile Driver and Hammer. When climbing or working from the lead sections, ensure that a good hand and foot grip is used.

e. Remove the outer section from the Pile Driver.

f. Install all hardware removed from Catwalk. back into original holes. Stow sections, rails and chains.

(3). REPLACE VENT COVERS

a. Replace vent and exhaust port covers on the hammer.

(4). UNREEVE ADAPTER CABLE.

a. To unreeve the cable securing the Driving Head and Adapter to the Hammer use the following steps:

b. Remove cable clamps.

c. Remove cable assembly.

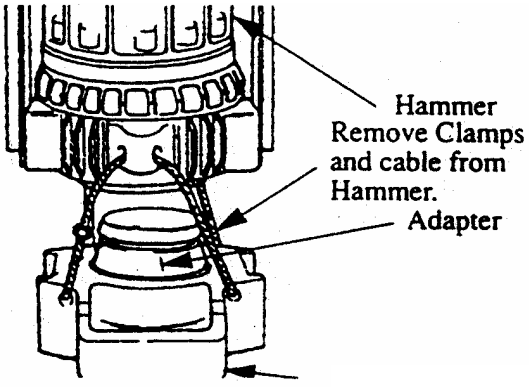


Figure 31. Removing the Adapter/Driving Head cable.

(5). REMOVE DRIVING HEAD/ADAPTER.

a. Separating the Driving Head and Adapter from the Hammer. (See Figure 31).

a. Raise Hammer approximately 2 feet in lead sections.

b. Raise lead sections off ground vertically to allow sufficient clearance over the Driving Head and Adapter.

c. Swing the Hammer and the Leads to one side of the Driving Head. (leaving Driving Head and Adapter on ground), and lower leads vertically to the ground. Lower boom down enough to just stabilize the end of the leads at the lower end.

(6). REMOVE HAMMER.

a. To remove the Hammer from the Pile Driver leads use following step: (See Figure 32).

CAUTION

Hammer must always be placed on cribbing and never be allowed to lay directly on ground.

b. Lower the Hammer onto cribbing. Drain fuel and oil from Hammer. Refer to Hammer TM. Use rags and containers to catch oil.

c. Remove the Rear Angle Guides.

d. Disconnect the auxiliary hoist cable from the starting device cable.

e. Attach two tag lines to Hammer to help control sway.

f. Let a small amount of slack into main hoist line that's holding the Hammer.

WARNING

Keep clear of hammer. It may sway or fall.

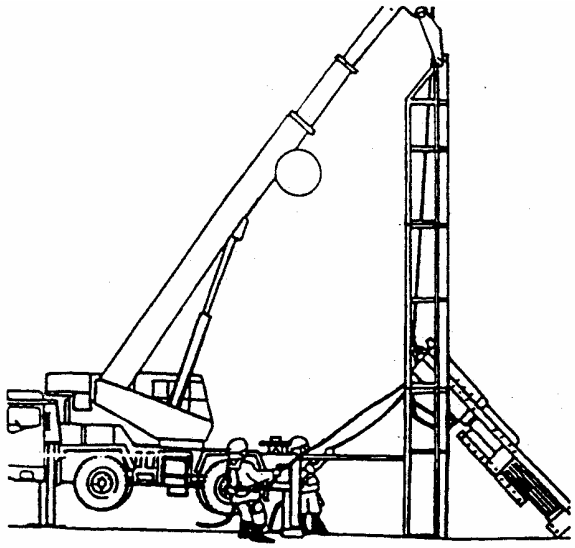


Figure 32. Removing the Hammer from Pile Driver Leads. Use Guide Ropes and Personnel as Needed.

f. Retract and raise boom while lowering the hoist to keep Hammer in place and to leave enough slack in main hoist line to "lay" Hammer down.

g. Disconnect main hoist from Hammer.

h. Install rear angle guide and hardware on Hammer.

(7) LEAD SECTION TOWER REMOVAL.

a. To remove the Lead Sections from Adapter Plate attach auxiliary hoist line to the top lead section.

b. From each side remove all bolts, nuts, and washers, except # 6.

c. Loosen. but do not remove, Number 6 bolt and nut on each side. Use guide ropes and personnel as needed.

d. Lower lead sections onto cribbing.

e. Remove Number 6 bolt and nut from each side of the adapter plates and pivot downward. (See Figure 33).

f. Remove the end cap bolts from each side of pivot shaft extension and remove and stow plates. Place end caps bolts and cap back onto extension shaft and finger tight.

g. Place hardware back in adapter plate holes and finger tighten, and stow adapter places.

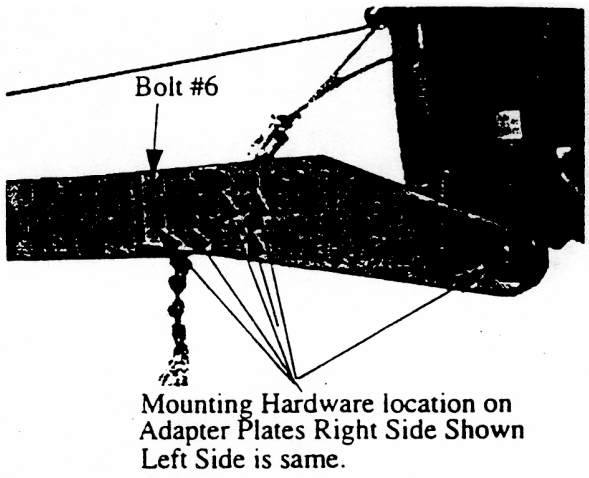


Figure 33. Removing Adapter plates from Boom.

(8). DISASSEMBLING LEAD SECTIONS.

a. Remove all nuts and bolts from Lead Sections.

b. Separate the lead sections.

c. Install all nuts, lockwashers, and bolts, in lead sections.

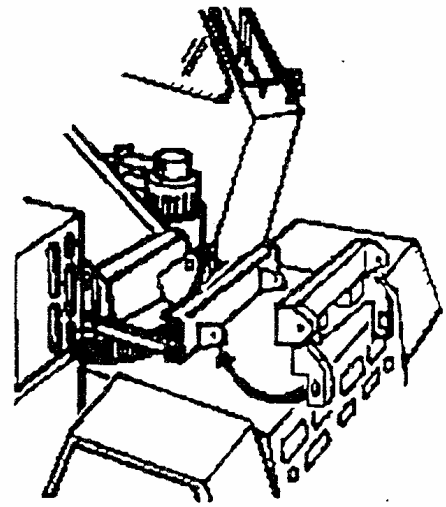
d. Inspect all equipment for serviceability, paint damage, fatigue cracks, bent or broken sections, and completeness of hardware..

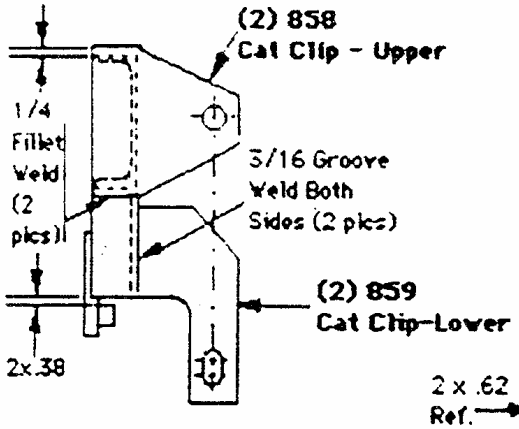
e. Locate adapter plates previously removed and store with lead sections.

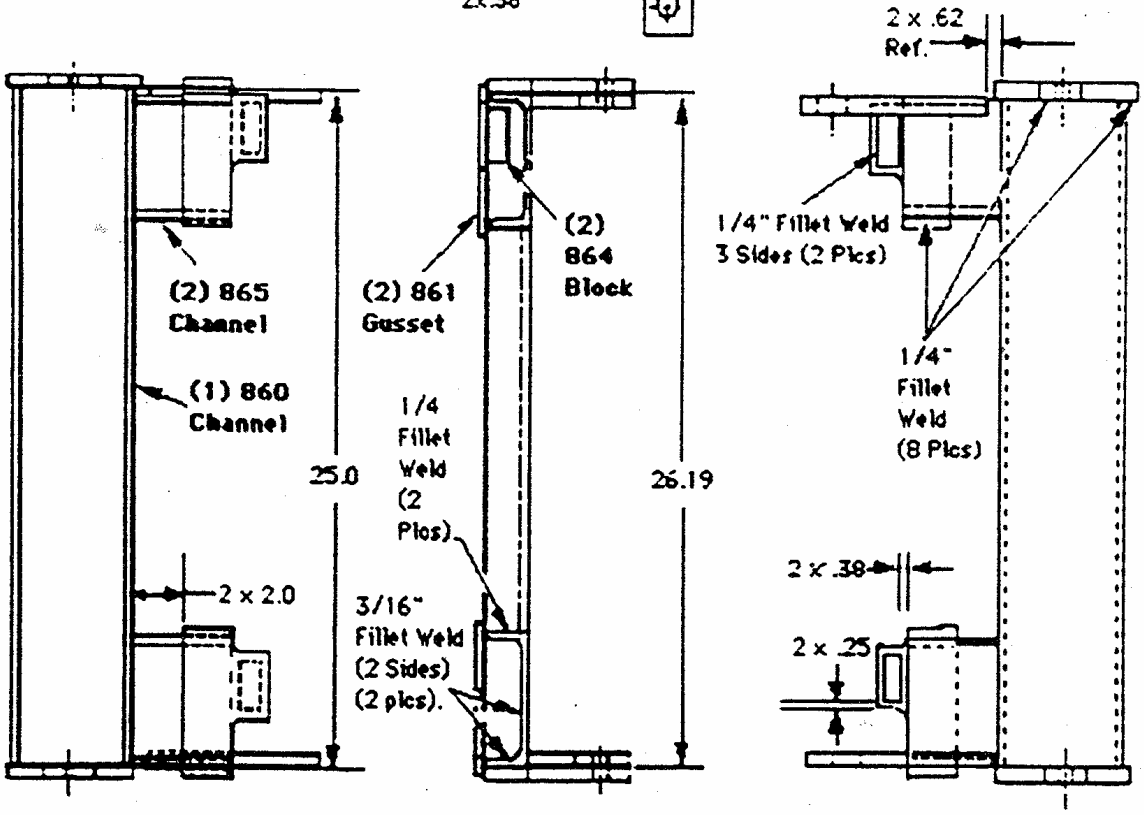
CATWALK WELDMENT BRACKET

Needed to raise catwalk above spare tire carrier on AT422T Grove when swinging boom from 12:00 to 10:00 position. Fabricate from steel stock on site.

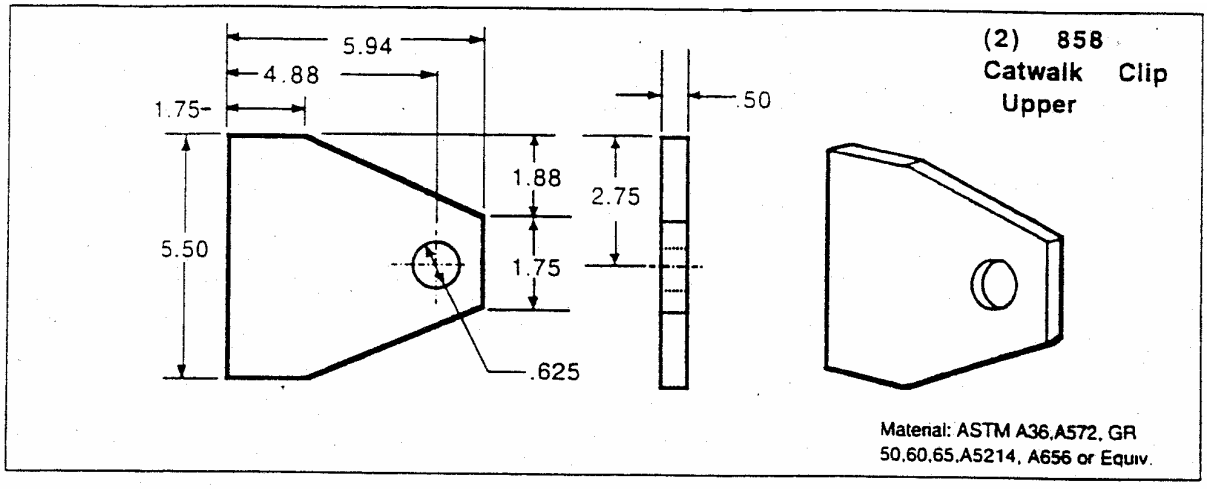
Quantities, Details. and Sizes.	
1. (2)	858 Cat Clip - Upper (.50 x 5.94 x 5.50)
2. (2)	859 Cat Clip - Lower (.50 x 4.19x 7.62)
3. (1)	860 Channel (5 x 1.75 x 25.19)
4. (2)	861 Gusset (5.62 x 3.38)
5. (2)	864 Block (.75 x .75 x 2.0)
6. (2)	865 Channel (5 x 1.75 x 4)

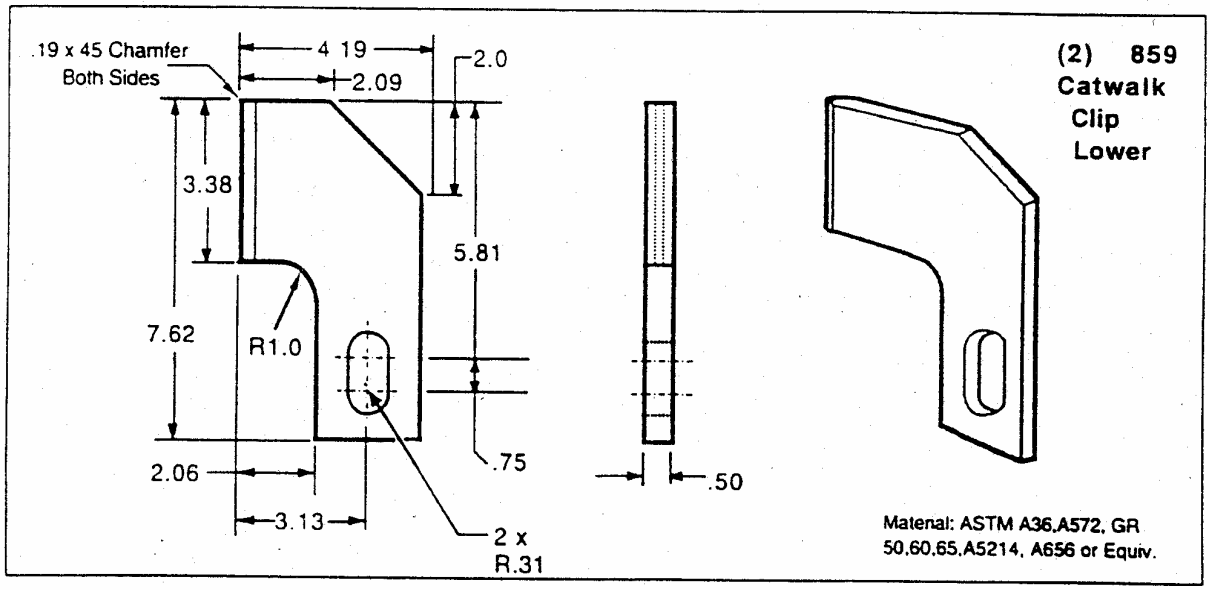


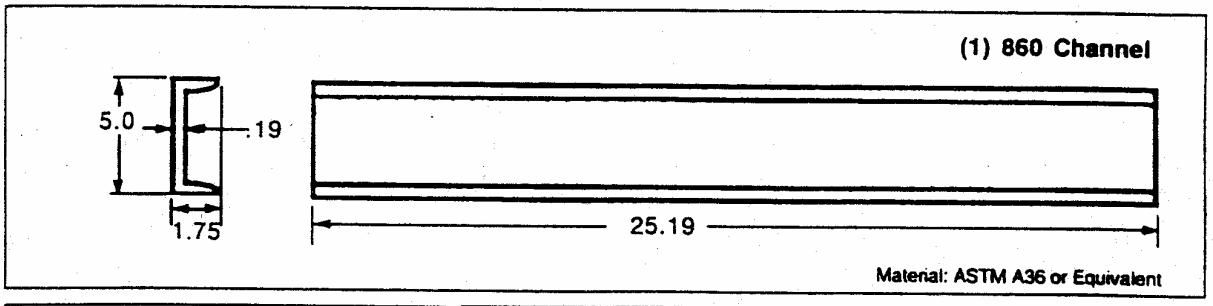


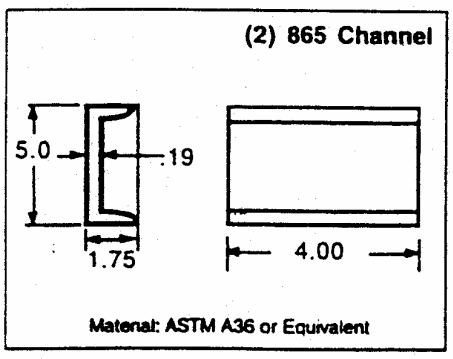


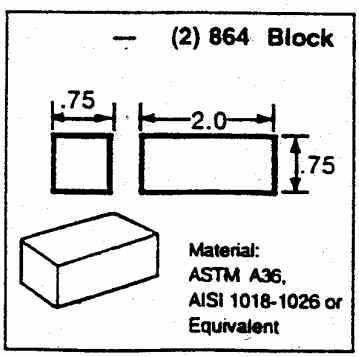
Details of Catwalk Bracket

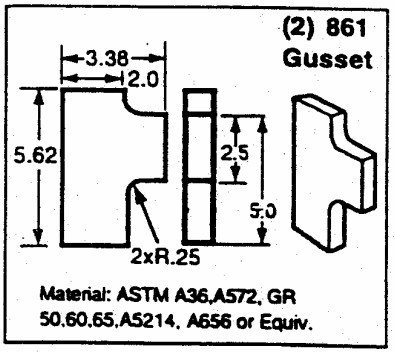




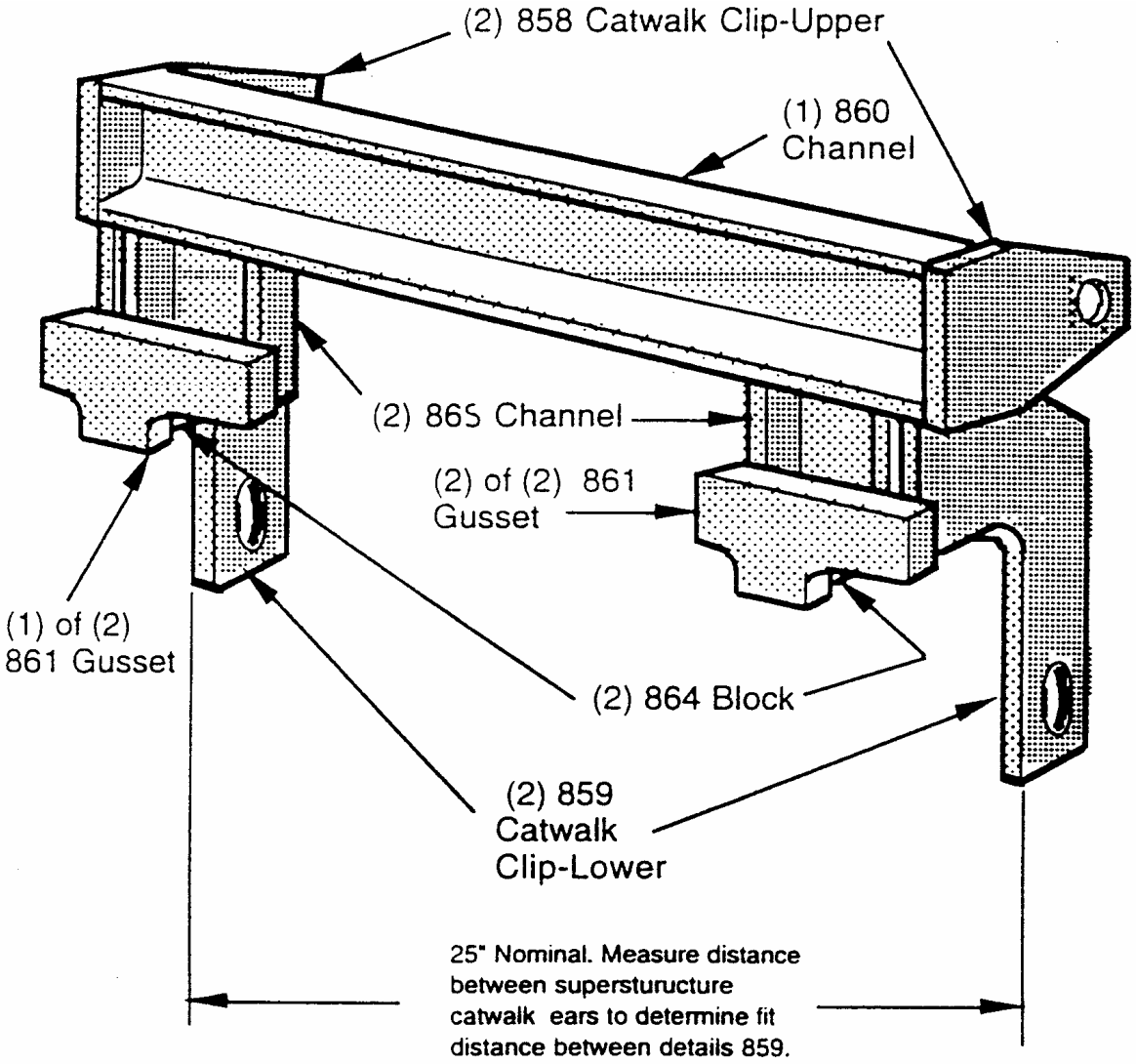








CATWALK BRACKET ASSEMBLY
for Grove Crane AT422T



NOTES:

1. Fabricate from steel material according to weldment detail descriptions. When completed, bracket will be a one piece weldment.
2. Remove all burrs and sharp edges.
3. All dimensions are in decimal two places and may be converted to fractions with a tolerance of +/- 1/16th.
4. Prepare and paint assembled weldment to prevent rust.
5. Identify completed bracket with “Grove Crane AT422T - Catwalk”.
6. Store with catwalk when not in use.
7. Use (4) 5/8 size bolts/nuts plus flat and lock washers to attach bracket to the existing two superstructure frame brackets and the catwalk.
8. Ensure distance between Details 859 and superstructure frame brackets allows for a 1/16 for clearance between superstructure welded catwalk mounting ears.

APPENDIX M

LUBRICATION

TABLE OF CONTENTS

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 to be used, the location of the lubrication points, the frequency of lubrication, and other information.

The service intervals specified are for normal operation where moderate temperature, humidity, and atmospheric conditions prevail. In areas of extreme conditions, the service periods and lubrication specifications should be altered to meet existing conditions.

LUBRICANTS

CAUTION

Chassis grease lubricants must not be applied with air pressure devices as this lubricant is used on sealed fittings.

SYMBOL DESCRIPTION

AFC Anti-Freeze Coolant. Formulated for engine coolant systems to provide effective engine cooling and anti-freeze properties as provided in MIL-A-46153.

ASC Anti-Seize Compound. This compound is of such composition, structure, and consistency to prevent the seizure of mating components and meet the requirements of MIL-A-907.

GAA Multipurpose Grease. Lubrication grease of such composition, structure, and consistence to meet the performance requirements of MIL-G-10924. Grease is inhibited to prevent rusting and have excellent resistance to both heat and water.

HFC R-134a Refrigerant. Environmentally friendly refrigerant formulated to meet the requirements of Grove Specification A6-829-013460 and SAE J1503.

GO Extreme Pressure Multipurpose Gear Lubricant. This gear lubricant is compounded to achieve high load carrying capacity and meet the requirements of MIL-2105C. SAE 85/140 viscosity will be used for year-round service except as specified for specific components.

OE/HDO A high quality multipurpose engine\hydraulic oil formulated to provide desired engine performance levels, chatter-free performance of wet brake and wet clutches, good gear lubrication, and hydraulic performance. Shall meet the requirements of MIL-L-2104. Refer to specific component for viscosity and temperature requirements.

OEA Multipurpose Arctic Lubricant. This is a high quality multipurpose oil formulated to meet the performance requirements of MIL-L-46167 and provide desired component performance in temperatures between -50ºF and +10ºF (-59ºC and 50ºC).

PAG Refrigeration Oil. Specially formulated oil for use with refrigeration components. Meets the requirements of Grove Specification A6-829-013436 and compatible with R-134a.

LUBRICATION POINTS

All oil levels are to be checked with the crane parked on a level surface in transport position, and while the oil is cold, unless otherwise specified.

On plug type check points, the oil levels are to be at the bottom edge of the check port.

On all hoists with a check plug in the drum, the fill plug shall be directly on top of the hoist, and the check plug level.

All grease fittings are SAE STANDARD unless otherwise indicated. Grease nonsealed fittings until grease is seen extruding from the fitting. One pump of a standard one pound (0.45 kg) grease gun equals one ounce (28 grams) of GAA.

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.

The following describe the lubrication points and gives the lube type, lube interval, lube amount, and application of each. Each lubrication point is numbered, and this number corresponds to the index number shown on the Lubrication Chart.

1. Angle Gearbox.

Lube Type -	GAA
Lube Interval -	1000 miles (1600 km)
Lube Amount -	Until grease extrudes
Application -	1 fitting

2. Not Used

3. Differentials.

Lube Type -	GO-85/140 [0ºF to +120ºF (-18ºC to 49ºC)] GO-75 [-50ºF to +120ºF (-46ºC to 49ºC)]
Lube Interval -	Check every 200 hours. Drain and fill every 6,000 miles (10,000 km), 1000 hours, or yearly.
Lube Amount -	14 quarts (13 liters)
Application -	Check/fill plug in differential housing

4. Planetary Ends and Wheel Bearings.

Lube Type - GO-85/140 [0ºF to +120ºF (-18ºC to 49ºC)]
GO-75 [-50ºF to +120ºF (-46ºC to 49ºC)]
Lube Interval - Check every 200 hours. Drain and fill every 6000 miles (10,000 km), 1000 hours, or yearly.
Lube Amount - 2.5 quarts (2.4 liters)
Application - Fill plug in axle end. The oil should be at the edge of the port opening

5. Upper Kingpin Bearings.

Lube Type - GAA
Lube Interval - 500 hours or 3000 miles (5000 km)
Lube Amount - Until grease extrudes
Application - 4 fittings

6. Lower Kingpin Bearings.

Lube Type - GAA
Lube Interval - 500 hours or 3000 miles (5000 km)
Lube Amount - Until grease extrudes
Application - 4 fittings

7. Lockout Cylinder Pivot Pins.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Until grease extrudes
Application - 8 fittings

8. Torque Rod Bushing.

Lube Type - GAA
Lube Interval - 1000 miles (1600 km)
Lube Amount - Until grease extrudes
Application - 2 fittings

9. Not Used

10. Engine.

Lube Type - OE/HDO-15/40 [-5ºF to +120ºF (-21ºC to 49ºC)]
OEA [-50ºF to +10ºF (-46ºC to -12ºC)]
OE/HDO-40 [100ºF to +120ºF (38ºC to 49ºC)]
Lube Interval - Check level daily. Drain and refill every 250 hours, 6000 miles (10,000 km), or semi-annually. Change oil filter elements when changing oil.

NOTE

If oil filter elements are being changed in temperatures at or below 30ºF (-1ºC) or oil is being changed to arctic grade (OEA), use filter element installation procedures annotated on cartridge **plus** 1/4 turn.

Lube Amount - 17.3 quarts (16.4 L)
Application - Fill to full mark on dipstick.

Complete the following steps after each engine oil change to make sure the engine receives the correct oil flow through the lubricating oil system.

- Disconnect electrical wire from fuel pump solenoid valve.
- Rotate the crankshaft, using the starter motor, until oil pressure appears on the gauge, or warning light goes out.
- Connect electrical wire to fuel pump solenoid valve.
- Start engine.
- Refer to Fuel System - Bleeding, TM 5-3810-307-24-1-1, for instructions to vent the fuel system.

11. Transmission and Torque Converter.

Lube Type - OE/HDO-10 [-10ºF to +120ºF (-23ºC to 49ºC)]
OEA [-50ºF to +10ºF (-46ºC to -12ºC)]
OE/HDO-30 [100ºF to +120ºF (38ºC to 49ºC)]

NOTE

When checking oil level, the oil temperature must be stabilized at 180 degrees to 200 degrees F (82.2 degrees to 93.3 degrees C) to properly check the oil level. Do not at-tempt 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 the shift levers in forward and high range with the brakes applied and then accelerating the engine to half or three-quarter throttle. Hold the stall until the desired converter temperature is reached and stabilized.

CAUTION

Full throttle stall speeds for an excessive length of time will over-heat the converter and cause serious damage.

Lube Interval - Check level daily. Drain and refill every 1000 hours. Change oil filter element when changing oil.

NOTE

If oil filter element is being changed in temperatures at or below 30ºF (-1ºC) or oil is being changed to arctic grade (OEA), use filter element installation procedures annotated on cartridge **plus** 1/4 turn.

Lube Amount - 28 quarts (26.5 L)
Application - Fill to full mark on dipstick.

12. Drive Line Slip Joints and U-joints.

Lube Type - GAA
Lube Interval - 1000 miles (1600 km)
Lube Amount - Until grease extrudes
Application - 6 fittings

13. Engine Cooling System.

Lube Type - AFC
Lube Interval - Check level daily. Drain and refill every 6000 hours.
Lube Amount - 10.5 gallons (39.7 L)
Application - Fill radiator to top of filler neck and coolant recovery bottle to marking on bottle.

14. Not Used

15. Outrigger Beams.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Thoroughly coat bottom of outrigger beams
Application - By brush

16. Jack Cylinder Support Tubes.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Thoroughly coat inside of jack cylinder support tubes before installing jack cylinders
Application - By brush

17. Turntable Swing Box.

Lube Type - GO-85/140

CAUTION

When checking the swing gear box oil level, place the dipstick into the sleeve until the cap is flush with the end of the sleeve. Do not screw the cap onto the sleeve to check the level.

Lube Interval - Check every 200 hours. Drain and refill every 1000 hours
Lube Amount - Capacity 2 quarts (1.89 L)
Application - Fill to full mark on dipstick

18. Turntable Gear and Drive Pinion.

Lube Type - GAA
Lube Interval - Check daily and apply as necessary

NOTE

Apply after each pressure wash.

Lube Amount - Coat all teeth
Application - By brush

19. Turntable Bearing.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Until grease extrudes the whole circumference of the bearing
Application - 2 grease fittings at the front of the turntable

Rotate the turntable 90 degrees and apply grease to the fittings. Continue rotating 90 degrees and grease the fittings until the whole bearing is greased.

20. Swing Brake.

Lube Type - OE/HDO-10
Lube Interval - Check every 1000 hours. Drain and refill every 2000 hours.
Lube Amount - 0.5 pint (0.2L)
Application - Drain oil from lower bleed plug. Fill through upper bleed plug until level with bottom of upper plug.

21. Not Used

22. Upper Lift Cylinder Pivot.

Lube Type - GAA
Lube Interval - 500 hours
Lube Amount - Until grease extrudes
Application - 1 fitting

23. Lower Lift Cylinder Pivot.

Lube Type - GAA
Lube Interval - 500 hours
Lube Amount - Until grease extrudes
Application - 1 fitting

24. Not Used

25. Hydraulic Tank.

Lube Type - OE/HDO-10
Lube Interval - Check level daily. Drain and refill every 2000 hours. Replace both hydraulic filters.
Lube Amount - Capacity 64.4 gallons (243 L)
Application - Fill through the cap on top of the tank. When tank is drained, clean the magnetic pipe plug. Replace both the in-tank and steering system hydraulic filters when changing oil.

26. Not Used

27. Pintle Hook.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Until grease extrudes
Application - 3 fittings

28. Air Conditioners.

Lube Type - HFC
Lube Interval - Drain and refill annually
Lube Amount - As required to fully charge system
Full Charge:
Superstructure - 3.50 lbs
Carrier - 2.50 lbs.
Application - Charge ports on applicable compressor

29. Air Conditioners.

Lube Type - PAG
Lube Interval - Drain and refill annually
Lube Amount - 5.0 ozs when charging system
Application - Charge ports on compressor

30. Door Hinges.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Until grease extrudes
Application - 3 fittings

31. Boom Rest.

Lube Type - GAA
Lube Interval - 1000 hours
Lube Amount - Thoroughly coat top surface of boom rest
Application - By brush

32. Hook Block Trunnion Bearings.

Lube Type - GAA
Lube Interval - 100 hours
Lube Amount - Until grease extrudes
Application - 3 fittings

33. Hook Block Thrust Bearing.

Lube Type - GAA
Lube Interval - 100 hours
Lube Amount - Until grease extrudes
Application - 1 fitting

34. Hook Block Sheaves.

Lube Type - GAA
Lube Interval - 100 hours
Lube Amount - Until grease extrudes
Application - 1 fitting per sheave

35. Boom Nose Sheaves.

Lube Type - GAA
Lube Interval - 100 hours
Lube Amount - Until grease extrudes
Application - 1 fitting per sheave

36. Telescope Cylinder Wear Pads.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Thoroughly coat the area the wear pad moves on
Application - By brush, 3 places
The wear pads are located on the cylinder support foot.

37. Adjustable Wear Pads.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Thoroughly coat the area the wear pad moves on
Application - By brush, 8 places

38. Boom Section Wear Pads.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Thoroughly coat bottom rails, top plates of boom, and inside surface of side plates
Application - By brush, 12 places

39. Telescope Cylinder Pivot Pin.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Until grease extrudes
Application - 1 fitting

40. Retract and Extend Pulleys.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Until grease extrudes
Application - 2 fittings

41. Boom Pivot Shaft.

Lube Type - GAA
Lube Interval - 250 hours or monthly
Lube Amount - Until grease extrudes
Application - 2 fittings

42. Pile Driver Attachment Shafts.

Lube Type - ASC
Lube Interval - 250 hours
Lube Amount - Thoroughly coat surfaces of shafts
Application - By brush

43. Cable Follower Arms.

Lube Type - GAA
Lube Interval - 250 hours
Lube Amount - Until grease extrudes
Application - 2 fittings

44. Main Hoist.

Lube type -	GO-85/140
Lube Interval -	Drain and refill every 1000 hours
Lube Amount -	9 quarts (8.5 L)
Application -	The oil should be level with the bottom of the check-fill plug.

45. Auxiliary Hoist.

Lube type -	GO-85/140
Lube Interval -	Drain and refill every 1000 hours
Lube Amount -	9 quarts (8.5 L)
Application -	The oil should be level with the bottom of the check-fill plug

46. Hoist Cables (Wire Rope).

Lube Type -	OE/HDO-10
Lube Interval -	500 hours
Lube Amount -	Thoroughly coat cables
Application -	By spray, drip, or brush

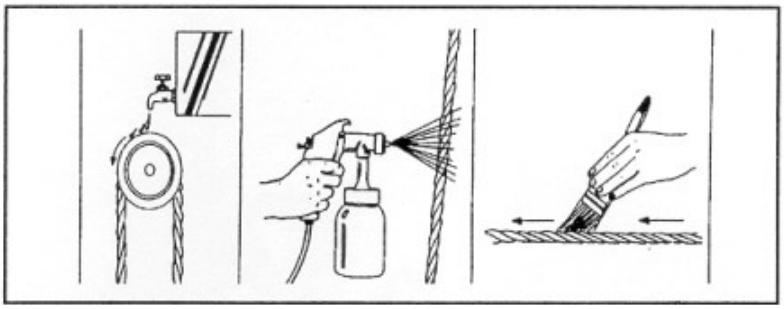
WIRE ROPE LUBRICATION

Wire rope is lubricated during manufacturing so the strands, and individual wires in strands, may move and adjust 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 throughout the life of a rope to replace factory lubricant which is used or lost.

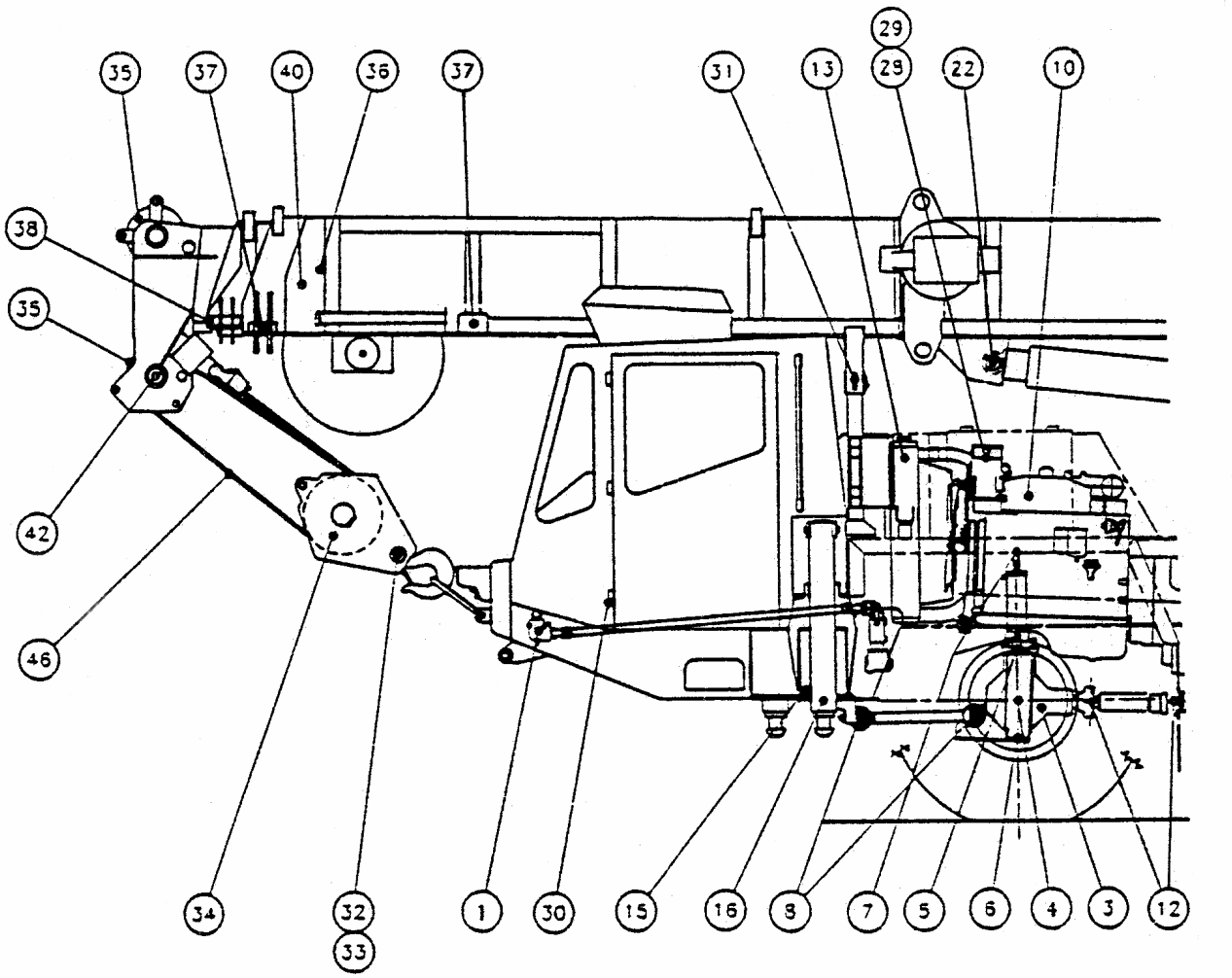
The surface of some ropes may become covered with dirt, rock dust, or other material during their operation. This covering can prevent field applied lubricants from properly penetrating into the rope. Therefore, these ropes should be cleaned before being lubricated.

Lubricant may be applied effectively by various methods. It may be dripped on, sprayed on, or put on by brushing, but in any case it should be applied at a place where the rope is being bent, such as at a sheave. It should be applied at the top of the bend, because at that point the strands are spread by bending and are more easily penetrated. The service life of rope will be directly proportional to the amount of lubricant reaching the working parts of the rope.

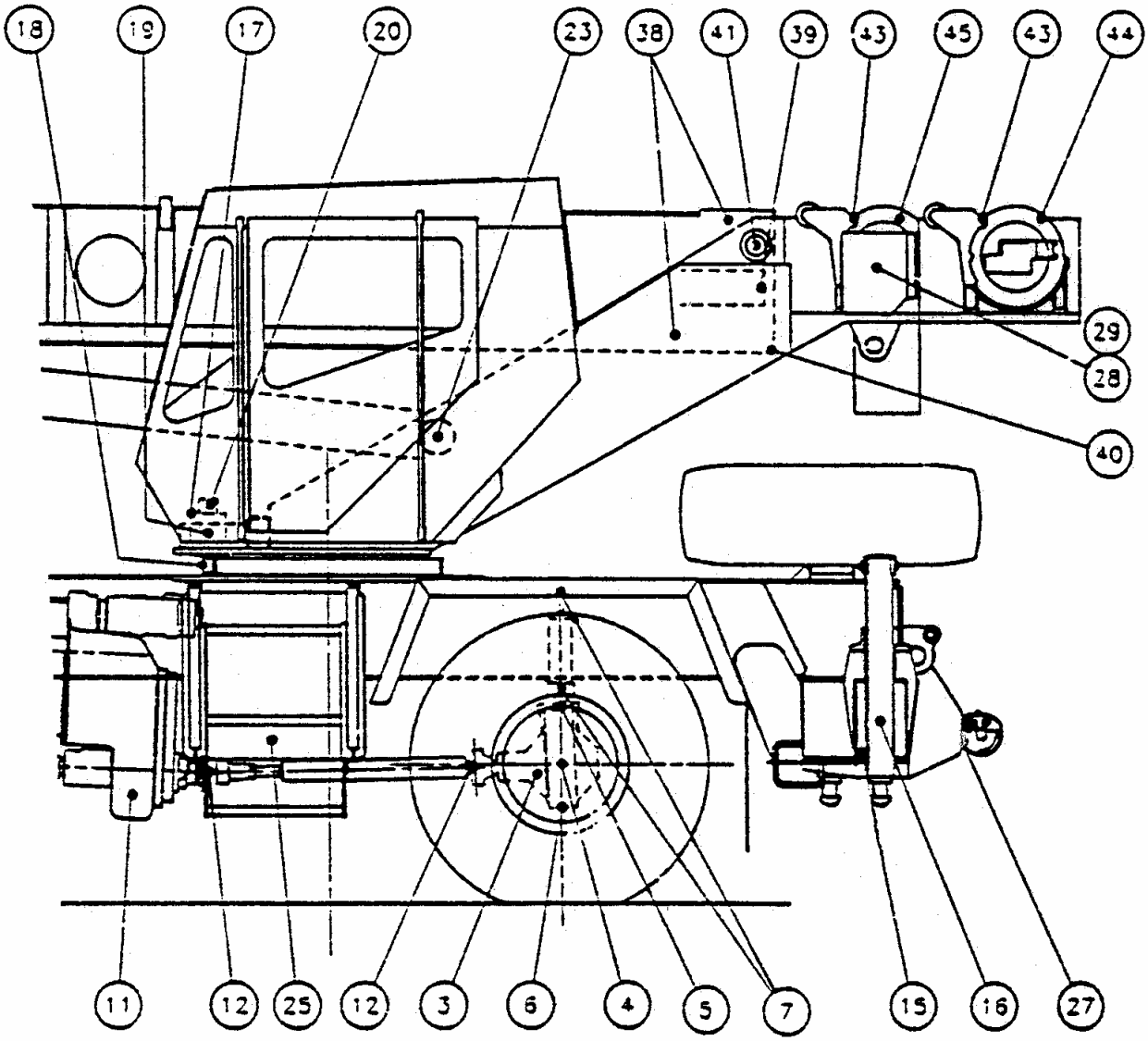
When properly applied, the lubricant will reduce friction, protect against corrosion, adhere to every wire, and be pliable and not crack or separate when cold and yet not drip when warm.



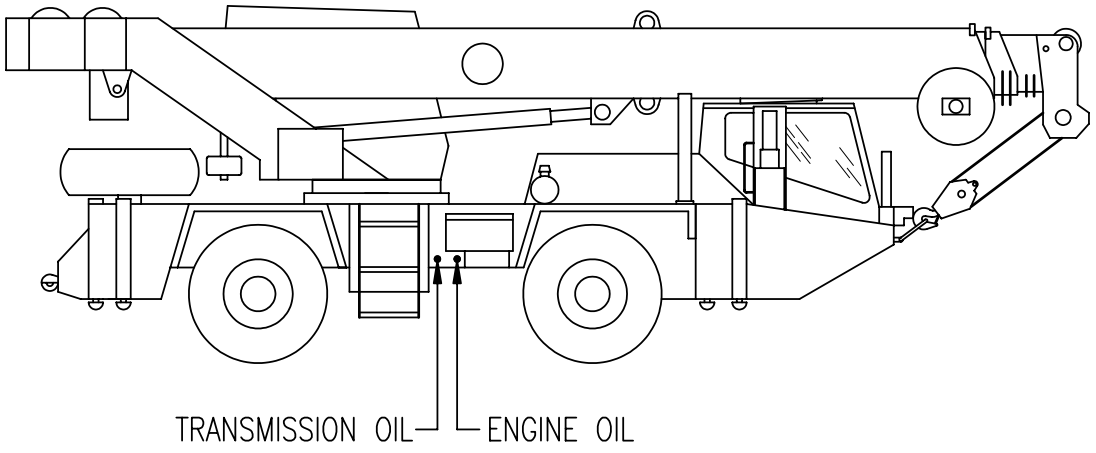
Wire Rope Lubrication

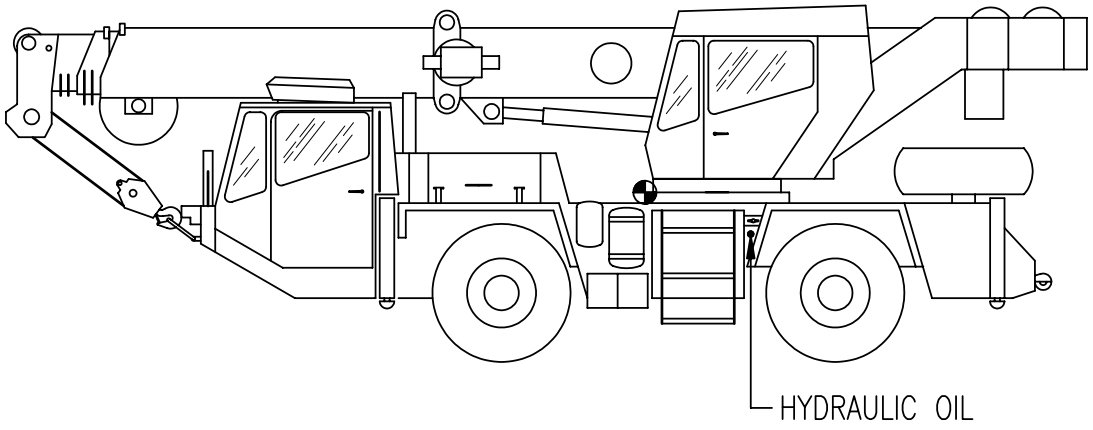


Lubrication Chart (Sheet 1 of 3)



Lubrication Chart (Sheet 2 of 3)





OIL SAMPLE POINTS

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By order of the Secretary of the Army:

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General United States Army
Chief of Staff

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** Reference to line numbers within the paragraph or subparagraph.*

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PUBLICATION/FORM NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	FEDERAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPROTED	RECOMMENDED ACTION

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