



SERVICE MANUAL

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

PRELIMINARY

RT600E

Crane Model Number
Crane Serial Number

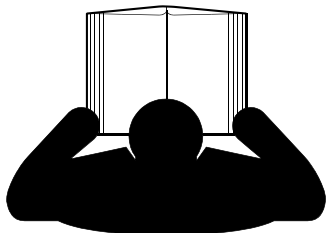
This Manual is Divided into the following Sections:

SECTION 1	INTRODUCTION
SECTION 2	HYDRAULIC SYSTEM
SECTION 3	ELECTRIC SYSTEM
SECTION 4	BOOM
SECTION 5	HOIST AND COUNTERWEIGHT
SECTION 6	SWING SYSTEM
SECTION 7	POWER TRAIN
SECTION 8	UNDERCARRIAGE
SECTION 9	LUBRICATION

NOTICE

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

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



! WARNING

To prevent death or serious injury:

- Avoid unsafe operation and maintenance.
- This crane must be operated and maintained by trained and experienced personnel. Manitowoc is not responsible for qualifying these personnel.
- Do not operate or work on this crane without first reading and understanding Operator's Manual and Rating Plate supplied with crane.
- Store Operator's Manual in holder provided on crane.
- Attach laminated Capacity Charts supplied with crane to chain in operator's cab.
- If Operator's Manual or Capacity Charts are missing from cab, contact your distributor for new ones.

To Contact Us:



Manitowoc Cranes, Inc.
2401 South 30th Street
Manitowoc, WI 54220
(920) 684-6621
(920) 683-6277 (fax)



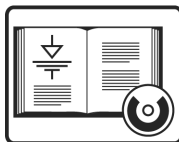
Grove Worldwide
1565 Buchanan Trail East
P.O. Box 21
Shady Grove, PA 17256
(717) 597-8121
(717) 597-4062 (fax)



National Crane Corporation
1565 Buchanan Trail East
P.O. Box 21
Shady Grove, PA 17256
(717) 597-8121
(717) 597-4062 (fax)



Grove Worldwide
1565 Buchanan Trail East
P.O. Box 21
Shady Grove, PA 17256
(717) 597-8121
(717) 597-4062 (fax)



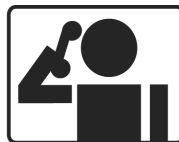
**Technical
Publications**



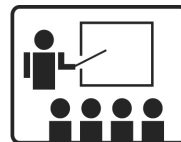
**Field
Service**



Parts



**Factory
Service**



Training

See end of this manual for Alphabetical Index

SECTION 1 Introduction

Description 1-1
 List Of Specifications 1-1
 General 1-1
 Dimensions 1-1
 Capacities 1-1
 Torque Converter 1-1
 Transmission. 1-1
 Engine. 1-1
 Axles 1-1
 Brakes. 1-1
 Wheels And Tires 1-2
 Swing Gearbox 1-2
 Boom. 1-2
 Swivel Assembly. 1-2
 Hydraulic Pumps. 1-2
 Hoists 1-2
 General Maintenance 1-6
 Cleanliness 1-6
 Removal and Installation. 1-6
 Disassembly and Assembly 1-6
 Pressing Parts. 1-6
 Locks. 1-6
 Wires and Cables 1-7
 Shims 1-7
 Bearings 1-7
 Gaskets 1-7
 Batteries 1-7
 Hydraulic Systems 1-8
 Electrical System 1-9
 Fatigue of Welded Structures 1-9
 Loctite 1-10
 Fasteners and Torque Values. 1-10
 Dynamic Shock Loads 1-11
 Wire Rope 1-13
 General 1-13
 Environmental Conditions. 1-13
 Lubrication 1-14
 Precautions and Recommendations During Inspection or Replacement 1-14
 Wire Rope Inspection (Running Ropes and Pendant Cables) 1-15
 Wire Rope Inspection (Boom Extension and Retraction Cables) 1-15
 Wire Rope Replacement (All Wire Rope) 1-16
 Seizing Wire Rope 1-16
 Installing FLEX-X 35 Wire Rope 1-17
 Procedures for Cutting and Preparing FLEX-X 35 1-18

SECTION 2 Hydraulic and Pressure Settings

Description. 2-1
 Maintenance 2-4
 Hydraulic Oil Recommendations. 2-4
 Draining And Flushing. 2-4
 Removing Air From The Hydraulic System. 2-5
 Parts Replacement 2-5
 Directional Control Valves. 2-5

Supply Pressure And Return Circuit	2-6
Description	2-6
Hydraulic Reservoir And Filter	2-6
Pump Distribution	2-7
Maintenance	2-9
Return Hydraulic Filter Assembly	2-10
oil cooler	2-12
Description	2-12
Hydraulic Pumps	2-13
Description	2-13
Maintenance	2-13
Pressure Setting Procedures	2-17
Procedure A - For Checking Main Control Valve Reliefs	2-17
Procedure B - For Checking Directional Control Valve Pilot Supply Pressure (Figure 2-7) and (Figure 2-8)	2-18
Procedure C - For Checking Swing Brake Pilot Supply Pressure (Figure 2-9)	2-19
Procedure D - For Checking Service Brake and Air Conditioning Circuit Relief Pressure (Figure 2-10)	2-19
Procedure E- For Checking The Service Brake Dual Accumulator Charge Valve Pressure Limits	2-20
Procedure F- For Checking Accumulator Pre-Charge Pressure	2-20
Procedure G- For Pre-charging Accumulator	2-21
Procedure H - For Checking the Front Steer Pressure	2-21
Procedure I - For Checking Swing Valve Work Port Relief Pressure	2-21
Procedure J- For Checking Outrigger Rear Steer Valve Relief	2-22
Valves	2-23
General	2-23
Directional Control Valves	2-26
Description	2-26
Maintenance	2-26
Hydraulic Remote Control Valve	2-29
Description	2-29
Maintenance	2-29
Outrigger/Rear Steer Valve	2-32
Description	2-32
Maintenance	2-32
Functional Check	2-32
Outrigger Control Manifold	2-34
Description	2-34
Maintenance	2-34
Pilot Operated Check Valve	2-36
Description	2-36
Maintenance	2-36
Holding Valve	2-37
Description	2-37
Maintenance	2-37
Swing Power Brake Valve	2-38
Description	2-38
Maintenance	2-38
Throttle Foot Valve	2-39
Description	2-39
Maintenance	2-39
Tandem Brake Valve W/ Treadle Pedal	2-40
Description	2-40
Maintenance	2-40
Service Brake Dual Accumulator Charge Valve	2-41
Description	2-41

Maintenance	2-41
Service Brake Hydraulic Accumulator	2-42
Description	2-42
Maintenance	2-42
Servicing	2-42
Swing Brake And Lmi Lockout Valve	2-43
Description	2-43
Maintenance	2-43
Axle Oscillation Lockout Valve	2-46
Description	2-46
Maintenance	2-46
High Speed Boost Selector Valve	2-47
Description	2-47
Maintenance	2-47
Cross Axle Differential Lock Valve	2-48
Description	2-48
Maintenance	2-48
Solenoid Valves	2-49
Description	2-49
Maintenance	2-49
Installation	2-49
Check Valves	2-50
Description	2-50
Maintenance	2-50
Flow Control Valve	2-51
Description	2-51
Maintenance	2-51
Cylinders	2-52
General	2-52
Maintenance	2-52
Surface Protection for Cylinder Rods	2-52
Lift Cylinder	2-54
Description	2-54
Maintenance	2-54
Telescope Cylinder	2-57
Description	2-57
Maintenance	2-57
Axle Oscillation Lockout Cylinder	2-62
Description	2-62
Maintenance	2-62
Steer Cylinder	2-65
Description	2-65
Maintenance	2-65
Outrigger Extension Cylinder	2-68
Description	2-68
Maintenance	2-68
Outrigger Stabilizer Cylinder	2-71
Description	2-71
Maintenance	2-71
Throttle Control Cylinder	2-74
Description	2-74
Park Brake Cylinder	2-75
Description	2-75
SECTION 3	Electrical System
Description	3-1

General	3-1
Alternator	3-1
Battery	3-1
Relay Panel And Fuse Panel	3-1
Relays	3-2
Maintenance	3-5
General	3-5
General Troubleshooting	3-5
Troubleshooting Engine Starting Problems	3-5
Troubleshooting Engine Charging Problems	3-6
Troubleshooting Accessories	3-6
Troubleshooting Swivel-caused Electrical Problems	3-6
Connector Troubleshooting	3-6
Control Module Diagnostic Light	3-7
Troubleshooting Lights	3-9
Troubleshooting Gauges And Meters	3-9
Troubleshooting Alarms, Indicators, and Emergency Components	3-10
Troubleshooting Crane Components and Accessories	3-10
Alternator Replacement	3-11
Starter Replacement	3-12
Battery Replacement	3-12
Relay Panel Component Replacement	3-12
Instrument Replacement	3-13
Switch Replacement	3-13
Windshield Wiper Assembly Replacement	3-14
Windshield Washer Assembly Replacement	3-15
Skylight Wiper Assembly Replacement	3-16

SECTION 4 **Boom**

Description	4-1
Theory Of Operation	4-1
Maintenance	4-1
Boom Nose Sheaves	4-7
Boom Extension And Retraction Cable	4-11
Telescope Circuit	4-13
Description	4-13
Theory Of Operation	4-13
Maintenance	4-13
Lift Circuit	4-16
Description	4-16
Theory Of Operation	4-16
Maintenance	4-16
Swingaway Boom Extension	4-20
Description	4-20
Maintenance	4-20
Hook Block	4-26
Description	4-26
Maintenance	4-26

SECTION 5 **Hoist And Counterweight**

Description	5-1
Theory Of Operation	5-1
Maintenance	5-1
Warm-up Procedure	5-1
Hoist To Boom Alignment	5-4
Preparation	5-4

Tools Required 5-4
 Procedure 5-4
 Piston Motor and Control Valve 5-6
 Description 5-6
 Maintenance 5-6
 Idler Drum And Cable Follower 5-7
 Description 5-7
 Maintenance 5-7
 Hoist Drum Rotation Indicator System 5-10
 Description 5-10
 Maintenance 5-10
 Counterweight 5-13
 Description 5-13
 Maintenance 5-13

SECTION 6 Swing System

Description 6-1
 Theory Of Operation 6-1
 Maintenance 6-3
 Troubleshooting 6-3
 Swing Motor 6-7
 Description 6-7
 Maintenance 6-7
 Swing Gearbox And Brake 6-9
 Description 6-9
 Maintenance 6-9
 Swing Bearing 6-11
 Description 6-11
 Maintenance 6-11
 Swivels 6-16
 Description 6-16
 Hydraulic Swivel 6-18
 Description 6-18
 Theory Of Operation 6-18
 Maintenance 6-18
 2 Port Water Swivel 6-20
 Description 6-20
 Maintenance 6-20
 Electrical Swivel 6-22
 Description 6-22
 Theory Of Operation 6-22
 Maintenance 6-22

SECTION 7 Power Train

Description 7-1
 Maintenance 7-1
 Electronic Control System 7-4
 Description 7-4
 Fuel System 7-5
 Description 7-5
 Maintenance 7-5
 Air Intake System 7-6
 Description 7-6
 Maintenance 7-6
 Water Cooling System 7-11
 Description 7-11

Maintenance 7-11
 Drive Train 7-16
 Description 7-16
 Maintenance 7-16
 Transmission/torque Converter 7-17
 Description 7-17
 Theory Of Operation 7-17
 Maintenance 7-18

SECTION 8. Undercarriage

Axles 8-1
 Descriptions 8-1
 Maintenance 8-1
 Wheels And Tires 8-3
 Steering Systems 8-4
 Description 8-4
 Theory Of Operation 8-4
 Maintenance 8-5
 Hydraulic Pumps 8-7
 Front Steering Control Valve 8-8
 Description 8-8
 Maintenance 8-8
 Integrated Outrigger/rear Steer Control Valve 8-8
 Description 8-8
 Maintenance 8-8
 Steer Cylinders 8-9
 Description 8-9
 Maintenance 8-9
 Rear Axle Oscillation Lockout System 8-9
 Description 8-9
 Theory Of Operation 8-9
 Axle Oscillation Lockout Cylinders 8-11
 Description 8-11
 Maintenance 8-11
 Axle Oscillation Lockout Valve 8-11
 Description 8-11
 Maintenance 8-11
 Brake System 8-13
 Description 8-13
 Theory Of Operation 8-13
 Maintenance 8-14
 Service Brakes 8-15
 Parking Brake Actuator 8-21
 Parking Brake 8-22
 Park Brake Solenoid Valve 8-22
 Outrigger Circuit 8-24
 Description 8-24
 Theory Of Operation 8-24
 Maintenance 8-24
 Outrigger Beam 8-28
 Extension Cylinder 8-32
 Stabilizer Cylinder 8-33
 Outrigger Control Valves 8-34

SECTION 9. Lubrication

General 9-1

Arctic Conditions Below -18°C (0°F) 9-1
Arctic Conditions Down To -40°F..... 9-1
lubrication points 9-2
 Surface Protection for Cylinder Rods 9-2
Wire Rope Lubrication 9-10



SECTION 1 INTRODUCTION

TABLE OF CONTENTS

Description	1-1
List Of Specifications	1-1
General	1-1
Dimensions	1-1
Capacities	1-1
Torque Converter	1-1
Transmission	1-1
Engine	1-1
Cummins 6BTAA5.9	1-1
Axles	1-1
Brakes	1-1
Wheels And Tires	1-2
Swing Gearbox	1-2
Boom	1-2
Swivel Assembly	1-2
Hydraulic Pumps	1-2
Hoists	1-2
General Maintenance	1-6
Cleanliness	1-6
Removal and Installation	1-6
Disassembly and Assembly	1-6
Pressing Parts	1-6
Locks	1-6
Wires and Cables	1-7
Shims	1-7
Bearings	1-7
Antifriction Bearings	1-7
Double Row, Tapered Roller	1-7
Heating Bearings	1-7
Installation	1-7
Preload	1-7
Sleeve Bearings	1-7
Gaskets	1-7
Batteries	1-7
Hydraulic Systems	1-8
Cleanliness	1-8
Keep the System Clean	1-8
Sealing Elements	1-8
Hydraulic Lines	1-8
Visual Inspection of Hoses and Fittings	1-8
Electrical System	1-9
Connectors, Harnesses, Wires, and Connectors	1-9
Fatigue of Welded Structures	1-9
Loctite	1-10
Application of Medium Strength Loctite	1-10
Fasteners and Torque Values	1-10
Dynamic Shock Loads	1-11
Wire Rope	1-13
General	1-13
Environmental Conditions	1-13
Lubrication	1-14

Precautions and Recommendations During Inspection or Replacement	1-14
Wire Rope Inspection (Running Ropes and Pendant Cables)	1-15
Frequent Inspection	1-15
Periodic Inspection	1-15
Wire Rope Inspection (Boom Extension and Retraction Cables)	1-15
Periodic Inspection.	1-15
Wire Rope Replacement (All Wire Rope)	1-16
Seizing Wire Rope	1-16
Method 1	1-16
Method 2	1-16
Installing FLEX-X 35 Wire Rope	1-17
Procedures for Cutting and Preparing FLEX-X 35.	1-18

SECTION 1 INTRODUCTION

DESCRIPTION

This Manual provides information for the maintenance of the Model RT600E Grove Crane.

The lift capacities are listed on the Load Chart in the cab.

The crane incorporates an all welded parallel box construction steel frame, utilizing two drive steer axles. Axle steering is accomplished utilizing hydraulic steer cylinders. The engine is mounted at the rear of the crane carrier and provides motive power through a six speed forward and three speed reverse transmission. The outriggers are single stage, double box, telescopic beam type outriggers.

The superstructure is capable of 360 degree rotation in either direction. All crane functions are controlled from the fully - enclosed cab mounted on the superstructure. One boom is available on the crane; a four section, full power, synchronized, 10.06 to 32.0 meter (33 to 105 foot) boom. Additional reach is obtained by utilizing one of two optional boom extensions; a 8.8 meter (29 foot) fixed length offsettable swingaway and a 8.8 to 15.5 meter (29 to 51 foot) offsettable telescoping swingaway.

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

NOTE: Refer to (Figure 1-1) for basic crane nomenclature.

LIST OF SPECIFICATIONS

General

Model	RT600E Series
Rated Capacity	See Load Chart in cab
Drive	4 x 4 x 4
Gross Weight	See Axle Weight
.....	Distribution Table

Dimensions

NOTE: Dimensions listed are for a crane with all components fully retracted in the travel mode with 23.5 x 25 tires.

Wheelbase	3759 mm (148 in)
Overall Crane Length	12,776 mm (503 in)
Overall Crane Width	3022 mm (119 in)
Overall Crane Height	3503 mm (137.9 in)
Tail-Swing	3912 mm (154 in)
Outrigger Spread	
Retracted	2883 mm (113.5 in)
Mid Extend	4877 mm (192 in)

Fully Extended

6858 mm (270 in)

Capacities

Fuel Tank	220 liters (58 gal)
Coolant System	See Engine
.....	Specifications
Engine Lubrication System	See Engine
.....	Specifications
Hydraulic Tank (Reservoir Capacity)	
Total	560 liters (148 gal)
at Full Level	507 liters (134 gal)
at Add Level	469 liters (124 gal)
Expansion Space	57 liters (15 gal)
Hoists	11.4 liters (12 qt)
Swing Gearbox	1.3 liters (2.75 pt)
Axle Planetary Ends	1.6 liters (3.5 pt)
Axle Differentials	9.5 liters (20 pt)
Transmission (includes Torque Converter)	
.....	25.6 liters (27 qt)

Torque Converter

Stall Ratio	1.943:1
Charge Pump Capacity	79.5 l/min (21 gpm)
.....	@ 2000 rpm

Transmission

Gear Ratios	
Forward	
1st	8.75
2nd	5.09
3rd	3.31
4th	1.93
5th	1.30
6th	0.76
Reverse	
1st	8.75
2nd	3.31
3rd	1.30

Engine

Cummins 6BTA5.9

Bore	102 mm (4.02 in)
Stroke	120 mm (4.72 in)
Displacement	5.88 liters (359 cu in)
Firing Order	1-5-3-6-2-4
Lube Amount	14.2 liters (15 qt)
Coolant System	34 liters (36 qt)

Axles

Total Ratio	24.6:1
Carrier Ratio	6.833:1
Planetary Ratio	3.60:1

Brakes

Type	Hydraulic Disc
Size	470 x 16 mm (18.5 x 0.625 in)

Wheels And Tires

Lugs 12
 Torque 515 to 542 Nm (380 - 400 ft lb)
 Tire Size
 Standard 23.5 x 25, 24 ply rating
 Optional 23.5R25, 24 ply rating
 For roading and lifting pressures, refer to the Load Chart Book in the cab.

Swing Gearbox

Reduction Ratio 36:1
 Output Torque 45,000 in lb

Boom

Length 10.06 to 32.0 meters (33 to 105 ft)
 Power 4 Section, Full Power
 Elevation -2 to +78 degrees
 Extensions
 Fixed* 8.8 meters (29 ft)
 Telescope* 8.8 or 15.5 meters (29 or 51 ft)
 *Extensions are offsettable at 0, 25, or 45 degrees.

Swivel Assembly

Electrical 15 Slip Rings
 Hydraulic 10 ports
 Water 2 ports

Hydraulic Pumps

Pump #1

Type Gear
 Sections 2
 Output - @ 2781 rpm w/no load
 Section 1 117.3 l/min (31 gpm)
 Section 2 79.4 l/min (21 gpm)

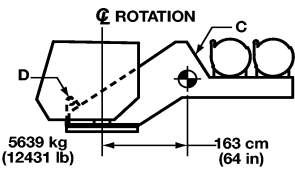
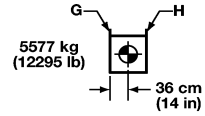
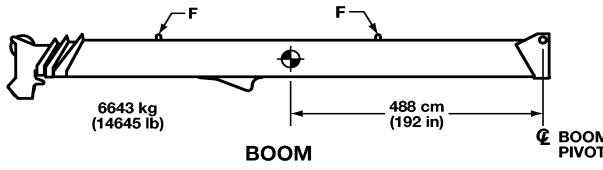
Pump #2

Type Gear
 Sections
 w/o Air Cond. 1
 w/ Air Cond. 2
 Output - @ 2781 rpm w/no load
 Section 1 116 l/min (30.6 gpm)
 Section 2 101 l/min (26.6 gpm)

Hoists

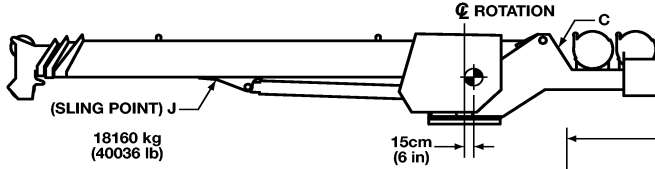
Drum Dimensions
 Diameter 381 mm (15 in)
 Length 395 mm (15 in)
 Cable
 Diameter 19 mm (3/4 in)
 Length 137 m (450 ft)
 Max. Permissible Line Pull (6x36)
 74.7 kN (16,800 lb)
 Max. Single Line Speed ... 180.7 m/min (593 fpm)
 Hoist Motor Displacement
 10.5 cm³ (6.4 in³) per revolution

TRANSPORTATION AND LIFTING DATA RT600E SERIES

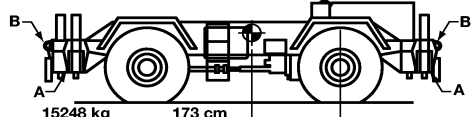


COUNTERWEIGHT (CWT)

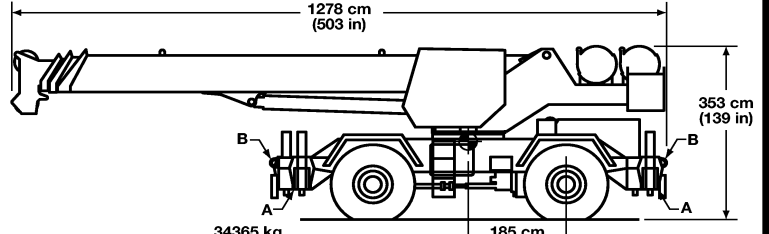
TURNTABLE (T/T)



SUPERSTRUCTURE (S/S)



CARRIER



TOTAL UNIT (WITH BOOM EXT)

FITTINGS	NO./UNIT	TOTAL UNIT		CARRIER		S/S	T/T	BOOM	CWT	FITTING CAPACITY (TONS)				
		LIFT	TOW	LIFT	TOW					TIE DOWN				
										LIFT	TOW	FORE & AFT	SIDE	DOWN
A	4	X		X						33	SEE NOTE #5			
B	4	X	X	X	X						73	73	19	21
C	2					X	X			52				
D	2						X			50				
E	2							X		6				
F	2							X		6				
G	2								X	5.3				
H	2								X	5.3				
J	1					X				14				

- Lifting of entire crane or major crane assemblies must be accomplished by utilizing specific fittings indicated on above chart. Use of fittings for purposes other than those designated on chart is prohibited. Fitting capacities are maximum allowable loads per individual fitting.
- Rigging personnel shall be responsible for proper selection and placement of all slings and load handling devices.
- Dimensions and weights shown are for largest configuration available. Weights do not include boom extension and / or jib, except where noted.
- Rigging personnel shall verify dimensions as required for clearance
- Extend outrigger beams 46 cm (18 in) and sling around beams.
- Do not use pintle hooks or counterweight lugs for lifting or tie down of entire crane.

6902

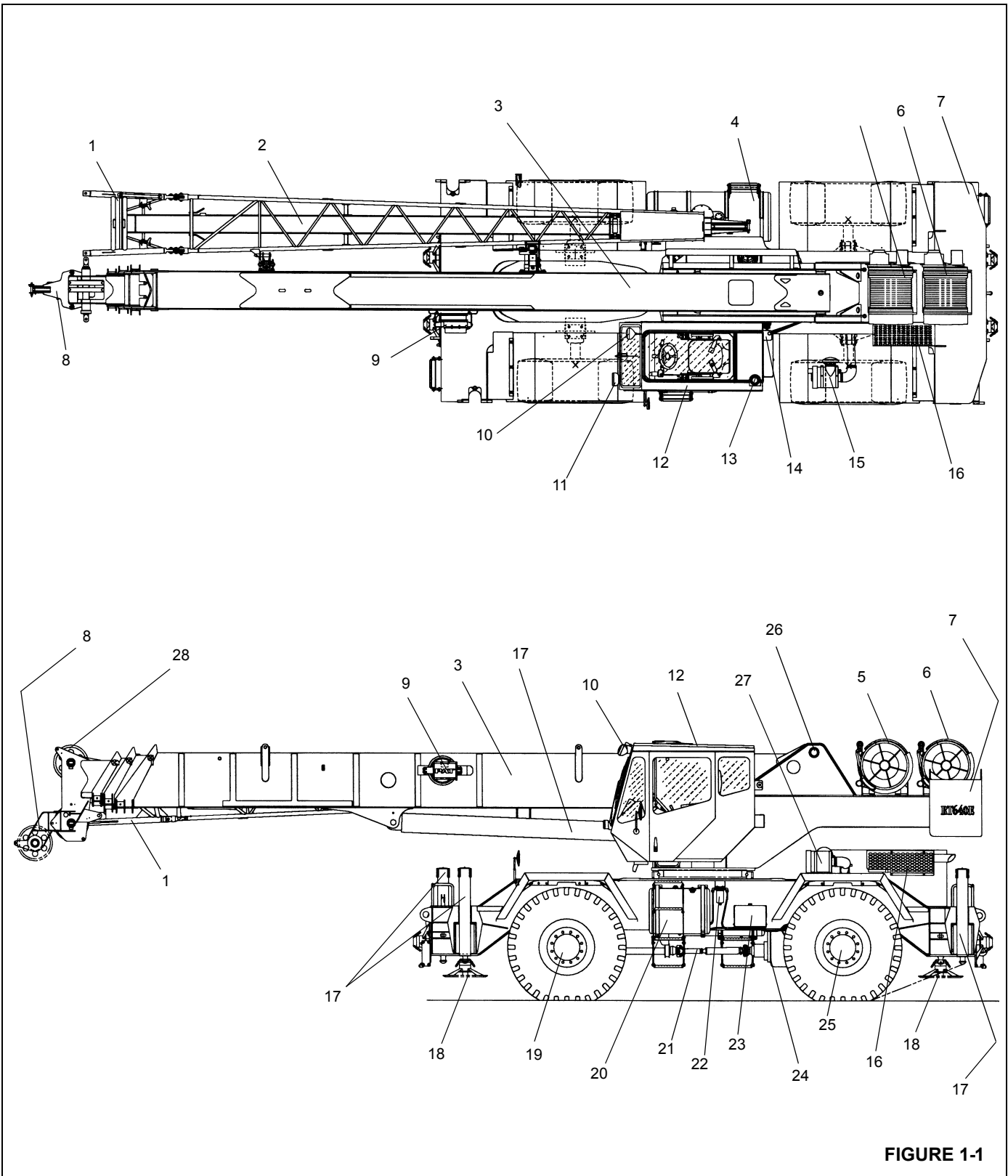


FIGURE 1-1

Item	Description
1	Swingaway
2	Swingaway Extension
3	Boom
4	Hydraulic Tank
5	Main Hoist
6	Auxiliary Hoist
7	Counterweight
8	Auxiliary Boom Nose
9	LMI Cable Reel
10	Spotlight
11	Work Light
12	Cab
13	Beacon Light
14	Windshield Washer Fluid Container

Item	Description
15	Air Intake Cleaner
16	Muffler
17	Outrigger Jack Cylinder
18	Outrigger Float
19	Front Axle
20	Fuel Tank
21	Driveline
22	Fuel Water Separator
23	Battery
24	Transmission
25	Rear Axle
26	Boom Pivot
27	Air Intake Cleaner
28	Boom Nose Sheaves

GENERAL MAINTENANCE

These general suggestions should be helpful in following the instructions in this manual. In analyzing a system malfunction, use a systematic procedure to locate and correct the problem.

1. Determine the problem.
2. List possible causes.
3. Devise checks.
4. Conduct checks in a logical order to determine the cause.
5. Consider the remaining service life of components against the cost of parts and labor necessary to replace them.
6. Make the necessary repair.
7. Recheck to ensure that nothing has been overlooked.
8. Functionally test the failed part in its system.

NOTE: Your safety and that of others is always the number one consideration when working around machines. Safety is a matter of thoroughly understanding the job to be done and the application of good common sense. It is not just a matter of do's and don'ts. Stay clear of all moving parts.

Cleanliness

An important item in preserving the long life of the machine is keeping dirt out of working parts. Enclosed compartments, seals, and filters have been provided to keep the supply of air, fuel, and lubricants clean. It is important that these enclosures be maintained.

Whenever hydraulic, fuel, lubricating oil lines, or air lines are disconnected, clean the adjacent area as well as the point of disconnect. As soon as the disconnection is made, cap, plug, or tape each line or opening to prevent entry of foreign material. The same recommendations for cleaning and covering apply when access covers or inspection plates are removed.

Clean and inspect all parts. Be sure all passages and holes are open. Cover all parts to keep them clean. Be sure parts are clean when they are installed. Leave new parts in their containers until ready for assembly.

Clean the rust preventive compound from all machined surfaces of new parts before installing them.

Removal and Installation

When performing maintenance, do not attempt to manually lift heavy parts when hoisting equipment should be used. Never locate or leave heavy parts in an unstable position. When raising a portion of a crane or a complete crane,

ensure the crane is blocked securely and the weight is supported by blocks rather than by lifting equipment.

When using hoisting equipment, follow the hoist manufacturers recommendations and use lifting devices that will allow you to achieve the proper balance of the assemblies being lifted and to ensure safe handling. Unless otherwise specified, all removals requiring hoisting equipment should be accomplished using an adjustable lifting attachment. All supporting members (chains and

cables) should be parallel to each other and as near perpendicular as possible to the top of the object being lifted.

CAUTION

The capacity of an eyebolt diminishes as the angle between the supporting members and the object becomes less than 90°. Eyebolts and brackets should never be bent and should only have stress in tension.

Some removals require the use of lifting fixtures to obtain proper balance. The weights of some components are given in their respective sections of the manual.

If a part resists removal, check to be certain all nuts and bolts have been removed and that an adjacent part is not interfering.

Disassembly and Assembly

When assembling or disassembling a component or system, complete each step in turn. Do not partially assemble one part and start assembling some other part. Make all adjustments as recommended. Always check the job after it is completed to see that nothing has been overlooked. Recheck the various adjustments by operating the machine before returning it to the job.

Pressing Parts

When pressing one part into another, use an anti-seize compound or a molybdenum disulfide base compound to lubricate the mating surfaces.

Assemble tapered parts dry. Before assembling parts with tapered splines, be sure the splines are clean, dry, and free from burrs. Position the parts together by hand to mesh the splines before applying pressure.

Parts which are fitted together with tapered splines are always very tight. If they are not tight, inspect the tapered splines and discard the part if the splines are worn.

Locks

Lockwashers, flat metal locks, or cotter pins are used to lock nuts and bolts.

Flat metal locks must be installed properly to be effective. Bend one end of the lock around the edge of the part. Bend the other end against one flat surface of the nut or bolt head.

Always use new locking devices on components which have moving parts.

When installing lockwashers on housings made of aluminum, use a flat washer between the lockwasher and the housing.

Wires and Cables

Batteries should always be disconnected prior to working on the electrical system.

When removing or disconnecting a group of wires or cables, tag each one to ensure proper identification during assembly.

Shims

When shims are removed, tie them together and identify them as to location. Keep shims clean and flat until they are reinstalled.

Bearings

Antifriction Bearings

When an antifriction bearing is removed, cover it to keep out dirt and abrasives. Wash bearings in non-flammable cleaning solution and allow them to drain dry. The bearing may be dried with compressed air BUT do not spin the bearing. Discard the bearings if the races and balls or rollers are pitted, scored, or burned. If the bearing is serviceable, coat it with oil and wrap it in clean waxed paper. Do not unwrap new bearings until time of installation. The life of an antifriction bearing will be shortened if not properly lubricated. Dirt in an antifriction bearing can cause the bearing to lock resulting in the shaft turning in the inner race or the outer race turning within the cage.

Double Row, Tapered Roller

Double row, tapered roller bearings are precision fit during manufacture and components are not interchangeable. The cups, cones, and spacers are usually etched with the same serial number and letter designator. If no letter designators are found, wire the components together to assure correct installation. Reusable bearing components should be installed in their original positions.

Heating Bearings

Bearings which require expansion for installation should be heated in oil not to exceed 121 °C (250 °F). When more than one part is heated to aid in assembly, they must be allowed to cool and then pressed together again. Parts often separate as they cool and contract.

Installation

Lubricate new or used bearings before installation. Bearings that are to be preloaded must have a film of oil over the entire assembly to obtain accurate pre-loading. When installing a bearing, spacer, or washer against a shoulder on a shaft, be sure the chamfered side is toward the shoulder.

When pressing bearings into a retainer or bore, uniformly apply pressure to the outer race. If the bearing is pressed on the shaft, uniformly apply pressure on the inner race.

Preload

Preload is an initial load placed on the bearing at the time of assembly. Whether a tapered roller bearing should have preload could depend on any of several conditions: rigidity of the housings and shaft, bearing spread, speed of operation, etc.

To determine whether a bearing requires preload or end clearance, consult the disassembly and assembly instructions pertaining to that bearing.

Care should be exercised in applying preload. Misapplication of preload to bearings requiring end clearance can result in bearing failure.

Sleeve Bearings

Do not install sleeve bearings with a hammer. Use a press and be sure to apply the pressure directly in line with the bore. If it is necessary to drive on a bearing, use a bearing driver or a bar with a smooth flat end. If a sleeve bearing has an oil hole, align it with the oil hole in the mating part.

Gaskets

Be sure the holes in the gaskets correspond with the lubricant passages in the mating parts. If it is necessary to make gaskets, select material of the proper type and thickness. Be sure to cut holes in the right places. Blank gaskets can cause serious damage.

When removed, always install new cylinder head and manifold gaskets using recommended gasket compound on head gaskets to allow uniform sealing.

Batteries

Clean batteries by scrubbing them with a solution of baking soda and water. Rinse with clear water. After cleaning, dry thoroughly and coat terminals and connections with an anti corrosion compound or grease.

If the machine is to be stored or not used for an extended period of time, the batteries should be removed. Store the batteries in a cool (not subfreezing), dry place, preferably on wooden shelves. Never store on concrete. A small charge should be introduced periodically to keep the specific gravity rating at recommended level.

Hydraulic Systems



DANGER

Exercise extreme care around pressurized hydraulic systems. Do not work on a hydraulic system while it is in operation or until all pressure is released.

Cleanliness

Contaminants in a hydraulic system affect operation and will result in serious damage to the system components. Dirty hydraulic systems are a major cause of component failures.

Keep the System Clean

When removing components of a hydraulic system, cover all openings on both the component and the crane.

If evidence of foreign particles is found in the hydraulic system, flush the system.

Disassemble and assemble hydraulic components on a clean surface.

Clean all metal parts in a nonflammable cleaning fluid. Then lubricate all components to aid in assembly.

Sealing Elements

Inspect all sealing elements (O-ring, gaskets, etc.) when disassembling and assembling the hydraulic system components. Installation of new elements is always recommended.

Hydraulic Lines

When installing metal tubes, tighten all bolts finger-tight. Then, in order, tighten the bolts at the rigid end, the adjustable end, and the mounting brackets. After tubes are mounted, install the hoses. Connect both ends of the hose with all bolts finger-tight. Position the hose so it does not rub the machine or another hose and has a minimum of bending and twisting. Tighten bolts in both couplings.

Due to manufacturing methods there is a natural curvature to a hydraulic hose. The hose should be installed so any bend is with this curvature.

Visual Inspection of Hoses and Fittings

CAUTION

Ensure that the hydraulic hose is depressurized before loosening the connections.

1. Visually inspect hoses and fittings once a month or every 250 hours for the following:
 - a. Leaks at hose fitting or in hose
 - b. Damaged, cut, or abraded cover
 - c. Exposed reinforcement
 - d. Kinked, crushed, flattened, or twisted hose
 - e. Hard, stiff, heat cracked, or charred hose
 - f. Blistered, soft, degraded, or loose cover
 - g. Cracked, damaged, or badly corroded fittings
 - h. Fitting slippage on hose
 - i. Other signs of significant deterioration

If any of the above conditions exist, evaluate hose assemblies for correction or replacement. For replacement of hose assemblies, refer to your Manitowoc CraneCARE Parts Manual.

2. At the same service interval, visually inspect all other hydraulic components and valves for the following:
 - a. Leaking Ports
 - b. Leaking valve sections or manifolds and valves installed into cylinders or onto motors.
 - c. Damaged or missing hose clamps, guard, or shields.
 - d. Excessive dirt and debris around the hose assemblies.

If any of these conditions exist, address them appropriately.

3. All hydraulic hose assemblies are recommended to be replaced after 8000 hours of service life.