NORDCO

Quality/Performance

Spiker SS

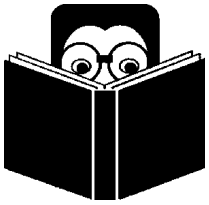
Operation and Maintenance Manual For S/N 390101 Through 390199

Reorder Part 49453900
Last Revision: Rev. C – October 2004

This manual is a guide for the operation and routine maintenance of a NORDCO Railroad Maintenance Machine. It covers product technical information, basic operating and maintenance procedures, and safety information and is provided for use by the qualified personnel who will supervise, operate or service the equipment described herein.

Measurements in this manual are given in both metric and customary U.S. unit equivalents.

Personnel responsible for the operation and maintenance of this equipment should thoroughly study the manual before commencing operation or maintenance procedures.



This manual should be considered a permanent part of your machine and should remain with the machine at all times.

Additional copies of this manual are available either as a part (Operation Manual only) or a whole (operation and parts manual), at a nominal cost, through our Part Sales Department. Additional service information, parts, and application information is available through these Nordco product support resources:

NORDCO Sales:	**Milwaukee, Wisconsin** (414) 766-2180 sales@nordco.com
NORDCO Parts:	**Milwaukee, Wisconsin** 1-800-647-1724 parts@nordco.com
NORDCO Service:	1-800-445-9258 service@nordco.com

We ask that if you have any comments or suggestions about this manual, let us hear from you. We are here to be of service to you, our customers. Direct your comments and inquiries to:

Technical Documentation Department
NORDCO Inc.
245 W. Forest Hill Avenue
Oak Creek, WI 53154

HAZARDOUS MATERIAL DATA

In an effort to provide information necessary for your employee safety training program and to meet the requirements of OSHA Hazard Communication Standard 1910.1200, we have OSHA Form 20 Safety Data Sheets available that cover the material contained in this machine.

If you are interested in receiving this information, please refer to the Name, model, and Serial Number of your machine when calling or writing, and direct your inquiries to:

Vice-President of Operations
NORDCO Inc.
245 W. Forest Hill Avenue
Oak Creek, WI 53154

Fax: (414) 766-2299
Phone: (414) 766-2288

SAFETY

Please read and comply with all of the safety precautions in this manual and those supporting optional equipment for this machine.

DO NOT use this machine for work operations other than for which it was intended.

NORDCO is not responsible for any modifications made without authorization or written approval. Replace all NORDCO and OEM parts with genuine NORDCO or OEM parts. Use of non-OEM parts could compromise the safety of your machine.

FOLLOW SAFETY INSTRUCTIONS

Carefully read all safety messages in this manual. Learn how to operate the machine and how to use controls properly. Do not let anyone operate this machine without instruction.

GENERAL SAFETY TIPS

Only trained and authorized personnel should be allowed to operate this machine. In addition, all personnel at the worksite (gang) should be aware of the safety concerns and their individual responsibilities **prior to working this machine.** General guidelines include:

1. Handle fuel safely.

2. Prepare for emergencies. Keep a first aid kit and fire extinguisher handy.

3. Wear good-fitting pants and shirt, no baggy or loose clothing.

5. Protect your head and eyes from flying debris by wearing a hard hat and safety goggles/glasses.

6. Wear leather gloves to protect your hands from vibration or flying metal particles.

7. Use safety-toed work boots.

SAFETY ALERT SYMBOLS!

These are the safety alert symbols. These symbols mean pay attention! Your safety or the safety of others is at risk!



DANGER typically defines the most serious hazards. DANGER usually means that improper use could result in severe bodily harm or even death.



WARNING means that improper use could result in bodily harm and/or extensive machine damage.



CAUTION means that improper use could result in machine damage.

SAFETY DURING WORK

NORDCO recommends the use of a **Command** position. This means that the machine is **never** running unless someone is **sitting** at the control station. To prevent injury to personnel or damage to the machine, it is highly recommended to:

1. Make certain that no one is in the path of this machine. Before moving this machine, whether in work or travel mode, make certain that all personnel have left the area before moving this machine.

2. Make certain that the steps and path for entering or exiting the machine are clear of mud, debris, equipment, and any other obstacles that may prevent emergency exit from the machine.

3. Always use the steps and handles provided for entering or exiting this machine. **DO NOT USE THE VALVE BANKS AS HAND-HOLDS FOR ENTERING OR EXITING THE MACHINE!**

4. **NEVER** exit the machine while the machine is moving.

5. Slow down the work cycle and use slower travel speeds in congested or populated areas. Use a commonly understood signal so that others can warn the operator to slow or halt work in a possible hazardous situation.

6. Halt work if visibility is poor. Strong rains, fog, and extremely dusty and blowing conditions can obscure visibility in your work area. Wait for weather to improve before continuing work.

7. Anyone standing near the machine is at risk of being injured. Make certain they keep away from the workheads and any other moving assembly during working operations.

8. There are standard guards in place on this machine. These are to be removed **only** when service or maintenance is being performed in that area. Reinstall guards after work has been completed.

9. Check and service the fire extinguisher (if so provided) at regular intervals. Make certain all personnel are trained in its use. Note - Non-use of fire extinguisher still requires that it be recharged at the interval stated on its last inspection notice.

10. There are lockups on this machine that are used for both work and travel. These should be kept clear and free of debris, grease, etc. See **Lockup** section for instructions on their use.

11. Inspect hazard decals and replace when they become unreadable or are damaged.

12. Seatbelts should be used at all times. Whenever the engine is running, the operator should be in his/her seat at the operator station with the seat belt properly installed.

13. Keep the operator station floor and logic box console free of tools and/or personal items.

SAFETY DURING TRAVEL

Traveling in this machine requires all steps listed above, in addition:

1. Riders on this machine during travel are limited to the amount of seats available. Never allow the total number of personnel riding on this machine to exceed the number of seats available.

2. Always make certain that lockups provided on this machine are free of debris or grease and are in place prior to travel. When traveling on steep inclines, placing the machine in the deadman brake mode is suggested.

3. Operate the machine carefully when bad weather conditions exist. Icy or wet conditions limit the stopping ability of the brake system. Maintain a distance between machines that will allow you room to stop.

4. Halt travel if visibility is poor. Strong rains, fog, and extremely dusty and blowing conditions can obscure visibility in your area. Wait for weather situation to improve before continuing travel.

5. A travel alarm has been provided on this machine that signals others that you have changed your direction of travel. Make certain it is working properly **BEFORE** travel. Use a signal person in high traffic areas where noise may drown out the alarm and whenever the operators view is obstructed.

6. Anyone standing near the machine is at risk of being injured. Make certain they keep away from the machine during travel operations.

SAFETY DURING MAINTENANCE

Alert others in the area that service or maintenance is being performed on this machine. Become familiar with, and use, your company's **lockout-tagout** procedures when performing maintenance on this machine. See **LOCKOUT-TAGOUT REQUIREMENTS** later in this Safety Section.

Do not start the engine if repairs or work is being performed alone. You should always have at least two people working together if the engine must be run during service. One person needs to remain in the **command** position (at the controls), ready to stop the machine and shut off engine if the need arises.



SAFETY ALERTS

WORDING
Improper use of this machine for any type of operation can cause serious injury or death.
To avoid serious injury or death, make certain that the area around and under the machine is clear of all personnel and obstructions before travelling or working.
Serious injury or death can result from reaching into driving components while machine is running! Make observations from a safe distance.
Do not permit unauthorized personnel to ride in or on the machine, or on the drawbard between the machine and the towing vehicle. Falling from a moving vehicle may cause serious injury or death.
Shut off engine when checking battery electrolyte level. Do not check or fill battery in presence of open flame, sparks, or when smoking. Battery fumes are flammable and/or explosive and if ignited will result in severe bodily injury or death.



SAFETY ALERTS

WORDING
Improper use of this machine for any type of operation can cause serious injury or death.
To avoid serious injury or death, make certain that the area around and under the machine is clear of all personnel and obstructions before travelling or working.
Failure to engage all lockup devices before propelling at travel speed can result in injury to personnel and/or damage to the machine.
Tighten fittings only when system is not pressurized. High pressure leaks can cause personal injury.
Always turn off machine when performing maintenance, making adjustments, or whenever unintended movement of machine could occur; unless directed otherwise. Failure to comply could result in personal injury and/or damage to the machine.
Any machine can be hazardous when raised. Take all necessary precautions before raising the machine. Do not, under any circumstances, climb under machine when using the turntable.
To avoid serious personal injury, stay clear of brake springs when using hydraulic compression to place brake lock pins.
Exhaust emissions caused by the use of the engine on this machine may cause cancer, birth defects, or other reproductive harm if inhaled.
To avoid possible personal injury and/or engine damage from accidental engine startup, always disconnect the battery before servicing this machine.



SAFETY ALERTS

WORDING
Before starting a new or overhauled engine that has been in storage, consult the engine manufacturer's manual for initial start instructions. Failure to follow those instructions can result in serious engine damage.
Never shut off battery disconnect switch with the engine running. This could cause damage to the voltage regulator, alternator, and/or electrical system.

LOCKOUT AND/OR TAGOUT PROCEDURES

It is your company's responsibility to develop **Lockout/Tagout Procedures**, train you in their proper and safe use, and to periodically inspect your work area to verify that you are complying with the procedures. **Lockout/Tagout Procedures must be followed!**

This machine is completely locked out when the ignition switch and battery disconnect switch have been turned to the "OFF" position and battery disconnect cover closed and locked. HOWEVER, some energy is stored in the cylinders and hoses; and these must be relieved of pressure prior to service and maintenance.

NORDCO has provided the means to lockout this machine. NORDCO cannot be held responsible for injury caused by failure to comply with your company's **Lockout/Tagout Procedures.**

ENERGY SOURCES

The list on the following pages provides information on energy sources located on this machine and instructions for inserting manual lockups, if applicable. It is your company's responsibility to incorporate these instructions into their **Lockout/Tagout Procedures.**



IMPORTANT NOTICE! (5/03)

Some machines have been equipped with optional **Power Lockup** devices. If so, there are two Energy Source lists, one for manual lockup and one for power lockup. Please make certain you are referring to the correct list when shutting down energy sources.

LOCKOUT/TAGOUT – PROCEDURES
MACHINES WITH MANUAL LOCKUPS

When servicing or performing maintenance on:	Energy Source to be locked out:	Use this procedure:
Electrical System (Battery, Wiring Harnesses, Junction and Control Boxes, Prox Switches)	Electrical	1) Turn the ignition switch to the OFF position (Control Box in Seat Area). 2) Turn the battery disconnect switch to the OFF position and close and lock the disconnect switch box. **This will cut off electrical power supply to the machine.**
Engine	Electrical	1) Turn the ignition switch to the OFF position (Control Box in Seat Area). 2) Turn the battery disconnect switch to the OFF position and close and lock the disconnect switch box. **This will cut off electrical power supply to the machine and prevent accidental startup of engine while servicing.**
Propulsion System	Hydraulic	1) Turn the ignition switch to the OFF position (Operator Box in Seat Area). 2) Turn the battery disconnect switch to the OFF position and close and lock the disconnect switch box. **This will cut off hydraulic pressure to hydraulic components of the machine.**
Workheads **(Two per workhead, four per machine)**	Hydraulic Gravity	1) Raise the workheads. 2) Install workhead lockup pin. 3) Turn off pump. 4) Turn the ignition switch to the OFF position (Operator Box in Seat Area). 5) Turn the battery disconnect switch to the OFF position and close and lock the disconnect switch box. 6) Bleed component hydraulic pressure by slowly loosening hose fittings. **This will cut off hydraulic pressure to hydraulic components of the machine.**
Nipper (Optional) **(One per machine)**	Hydraulic Gravity	1) Raise the nipper assembly. 2) Install nipper lockup pin (located behind control box in seat area) 3) Turn off pump. 4) Turn the ignition switch to the OFF position (Operator Box in Seat Area). 5) Turn the battery disconnect switch to the OFF position and close and lock the disconnect switch box. 6) Bleed component hydraulic pressure by slowly loosening hose fittings. **This will cut off hydraulic pressure to hydraulic components of the machine.**

When servicing or performing maintenance on:	Energy Source to be locked out:	Use this procedure:
Gager (Optional) **(One per machine)**	Hydraulic Gravity	1) Raise the nipper assembly. 2) Install nipper lockup pin (located behind control box in seat area) 3) Turn off pump. 4) Turn the ignition switch to the OFF position (Operator Box in Seat Area). 5) Turn the battery disconnect switch to the OFF position and close and lock the disconnect switch box. 6) Bleed component hydraulic pressure by slowly loosening hose fittings. **This will cut off hydraulic pressure to hydraulic components of the machine.**

SAFETY DECALS ON THIS MACHINE

Safety decals and plaques that have been placed on this machine are to be kept clean and legible. Replace any decals or plaques that have become illegible or are missing.

When repairing or replacing components that had safety decals on them, it is your responsibility to replace the safety decals. These can be ordered from the Parts Sales Department.

Safety Decals on this Machine are:

PART NO.	DESCRIPTION
5642 0001	General Machine Cautions
5642 0002	Caution! Watch Your Step
5642 0003	Danger! Do Not Climb Under Machine...
5642 0005	Warning! Hand Hazard
5642 0006	Danger! Before Servicing...
5642 4501	Caution! Before Welding...
5642 0010	Lockout Area
5642 0011	Lockout Area
5642 0012	Lockup Points
960010	Caution! To Prevent Workhead….
2930 0186	Caution! Hearing Protection Required

GENERAL

This manual contains information for the “Spiker SS” machine manufactured by NORDCO INC., Milwaukee, Wisconsin. Information is provided in this manual for operation and maintenance of the machine. Information regarding operation and maintenance of OEM parts not of NORDCO manufacture can be found at the back of this manual, behind the tab marked “Component Data”.

Become familiar with all safety instructions, controls and instruments before operating this machine. Follow all instructions carefully.

ABOUT THIS MANUAL

This manual has been broken down into sections which have been separated by index tabs. Contents of these sections are as follows:

TAB	CONTAINS
Operation	Includes all information necessary to set up and operate the machine.
Maintenance	Includes lubrication, maintenance, and mechanical adjustment instructions**.**
Troubleshooting	Includes basic troubleshooting for all components on the machine, as well as functional hydraulics, electrical schematics, logic sequence charts, and cabling locations.
Mechanical	Includes individual parts breakdown drawings and lists for each assembly
Hydraulic	Includes all piping and functional drawings for a standard machine; for optional equipment that requires additional drawings, see tab “Customer Options”.
Electrical	Includes all electrical schematics, logic schematics, logic boxes, control boxes, cables and cabling layout drawings for the machine
Component Data	Includes parts breakdowns and service instructions for components installed on the machine that are not of NORDCO’s manufacture.
Customer Options	Includes parts breakdowns, lists, and drawings for all equipment on the machine that is optional.

OPTIONAL EQUIPMENT

The specifications that following include **Customer Selectable Features** such as the engine. This means that an engine is required to run the machine, but the customer has a choice as to what type of engine they want to have installed. This differs from **Optional Equipment** such as a remote engine drain system. Optional equipment are those items that are not considered a vital operating part to the machine, but the customer wants them installed. Sheets for the **Optional Equipment** have been included behind the tab **Customer Options**. It is recommended that you know what options you have on your machine.

SPECIFICATIONS

GENERAL

Gross Weight ..... 17,700 lbs (8,027 kg)*
Length ..... 216 inches (5.4 m/5486 mm)
Width ..... 96 inches (2.5 m/2438 mm)
Height ..... 102 inches (2.45 m/2590 mm)
Travel Speed ..... 25 mph maximum (40 km/h)
Rated Draw Bar Pull ..... 1,650 lbs. (750 kg)
Turntable ..... Hydraulically Operated
Wheel Base ..... 163 inches (4.1 m/4100 mm)
Towing Speed ..... 20 mph maximum (32 km/h)
Spiking Energy ..... 192 Ft.-Lbs. (260 Joules)

CAPACITIES

Fuel Tank ..... 35 gallons (132 liters)
Hydraulic Oil Tank ..... 50 gallons (189 liters)
Oil Cooler ..... 100 gpm (378 L/mn)

ENGINE

Make/Model ..... Hatz 4L41C
Type ..... 4-Cylinder Air Cooled
Rated Horsepower ..... 63@2250 RPM
Engine Operating RPM ..... 2250 RPM

HYDRAULIC SYSTEM

Pressure Settings:
- Relief Valve - Main Pump ..... 3,000 psi (200 bar)
- Compensator - Main Pump ..... 2, 500 psi (172 bar)

Main Pump (45 GPM) ..... Sundstrand Series 45
Control Valves ..... Husco

ELECTRICAL SYSTEM

Battery ..... 12 Vdc,0 Amp
Ground ..... Negative

DRIVE SYSTEM

Drive Type ..... Dual Axle Drive
Propulsion Motor Type ..... Hydraulic

AXLE/WHEELS

Axle Size ..... 3-inch, Standard

Wheel Type ..... Cast Steel
Wheel Size ..... 16 inch (406 mm) diameter
Brake Type ..... Four wheel shoe type, spring actuated, hydraulic release - standard

Items or capacities may vary according to options on your machine.
*** Approximate weight. Actual weight may vary according to options on your machine. Actual weight of your machine is as stenciled.**

All rights reserved. In view of the constant improvements to our equipment, the specification data and other technical information included in this manual are subject to change. No part of this manual may be reproduced in any form or by any means without our written permission.

NOTES

Before operating this machine, read and understand the Safety Section of this Manual.

BEFORE OPERATION



Improper use of this machine for any type of operation can cause serious injury or death.

It is always good practice to become totally familiar with the machines you are going to operate.

OPERATOR'S STATION

Almost all the controls for running this machine are located in the Operator's Station. This includes but is not limited to the gage box, remote operator control boxes, propulsion and braking foot pedals.

Located next to each Operator's seat is a **Remote Operator Control Box.** These are used during work operations and allow operators to choose between Automatic Feed Operation, single feed operation, and turning feed operation off.

Each operator is responsible for a particular workhead on the machine. Each workhead consists of two gun assemblies (left and right). Each operator has two **hydraulic valve banks** that control the function of the guns in front of them. The left operator controls guns 1 and 2, the right operator controls guns 3 and 4. Carriage movement is controlled by a valve in the right hand valve bank at each operator seat. Moving the hand controller forward and back, and left and right, allows you to center the carriage manually.

Foot pedals can be located in front of either operator.

Always use your seat belt when sitting in the operator's seats. Always use the handrails and steps provided to climb on to and off of the machine.

WORKHEAD COMPONENTS

CARRIAGE

The position (forward/backward - left/right) is controlled by a set of valves in the right valve bank at each operator station.

CARRIAGE GUIDE WHEEL

Located between the outer and inner carriages is the guide wheel. This guide roller functions as a workhead stabilizer and is controlled by a hydraulic cylinder (up and down movement of guide roller) and a second hydraulic cylinder controls the left/right movement of the carriage assembly. The guide wheel is controlled by the center valve handle on the right hand valve bank at each station.

WORKHEAD

The workhead assembly includes the hammer and spike feeding assembly.

PROPULSION/DRIVE SYSTEM

The machine is dual axle, single chain, single drive sprocket system with a hydraulic motor located on each end of the machine.

BOOM/WINCH

The boom/winch system is in place to allow the operator to easily lift kegs of spikes onto the rear storage deck. The winch is capable of lifting loads up to 300 lbs. It is not designed or intended to be used for towing. The boom and winch should be locked up for travel or when not being used. See lockup requirements in the **Lockup** section of this manual.

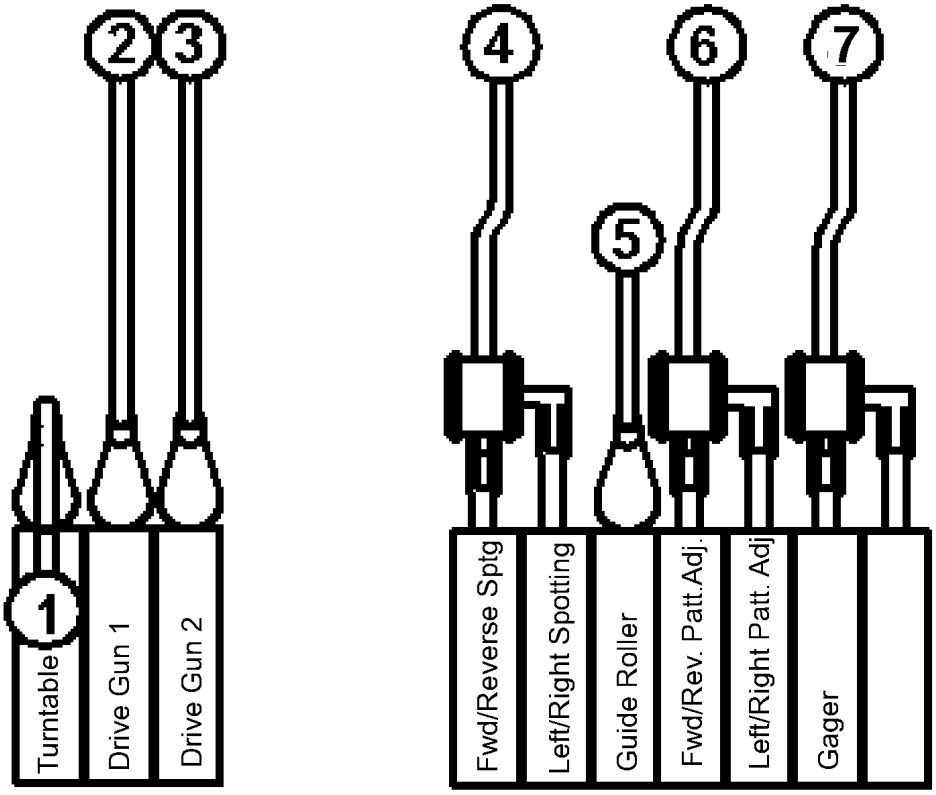
GAGER (Optional)

Located in front of the workhead bays. A wheel and roller assembly allows the indicator assembly to ride the rail continuously during gaging operations. A compression spring holds the assembly tight to the rail. The gage of the rail is indicated on the Gager Pointer Assembly in front of the operator. Two large hydraulic cylinders with levers control the in/out movement of the rail. These assemblies must be locked up for travel. See lockup requirements in the LOCKUP section of this manual.

NIPPER ASSEMBLY (Optional)

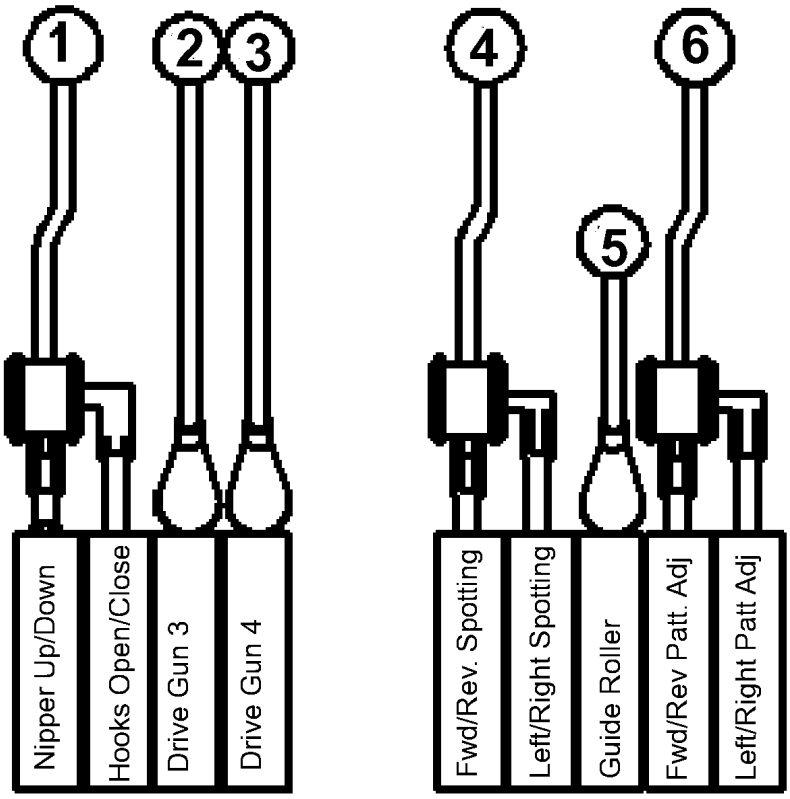
Located in the center of the machine, between the workheads is the nipper assembly. It is used to pull the tie up to the rail to secure the tie plate to the tie during spiking operations. A large hydraulic cylinder controls the up/down position of the nipper assembly, while a second and small hydraulic cylinder controls the open/close position of the nipper tie hooks. This assembly must be locked up for travel. See lockup requirements in the LOCKUP section of this manual.

FIGURE 1. CONTROLS
LEFT OPERATOR VALVE BANKS



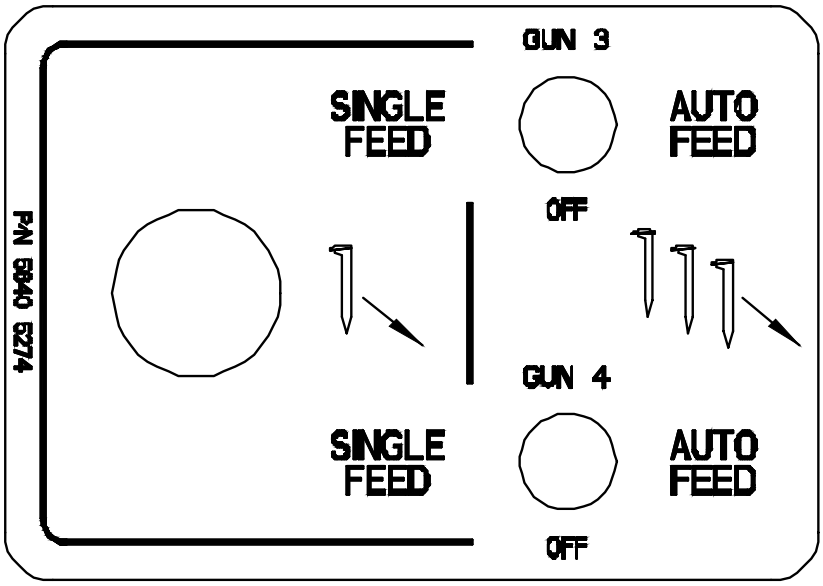
Control	Valve Handle Position	Functional Description
1 Turntable	Up Down	Lowers turntable to tie Raises turntable off of tie
2 Drive Gun 1	Fwd Rev	Drives spike Raises hammer
3 Drive Gun 2	Fwd Rev	Drives spike Raises hammer
4 Carriage Spotting	Fwd Rev Left Right	Moves carriage forward Brings carriage back Moves carriage to right Moves carriage to left
5 Guide Roller	Fwd Rev	Lowers guide roller Raises guide roller
6 Pattern Adjust	Fwd Rev Left Right	Moves workhead forward Brings workhead back Moves workhead to left Moves workhead to right
7 Gager	Fwd Right Back - Left	Pushes rail in Pushes rail out Retracts Gager Cylinders

FIGURE 2. CONTROLS
RIGHT OPERATOR VALVE BANKS



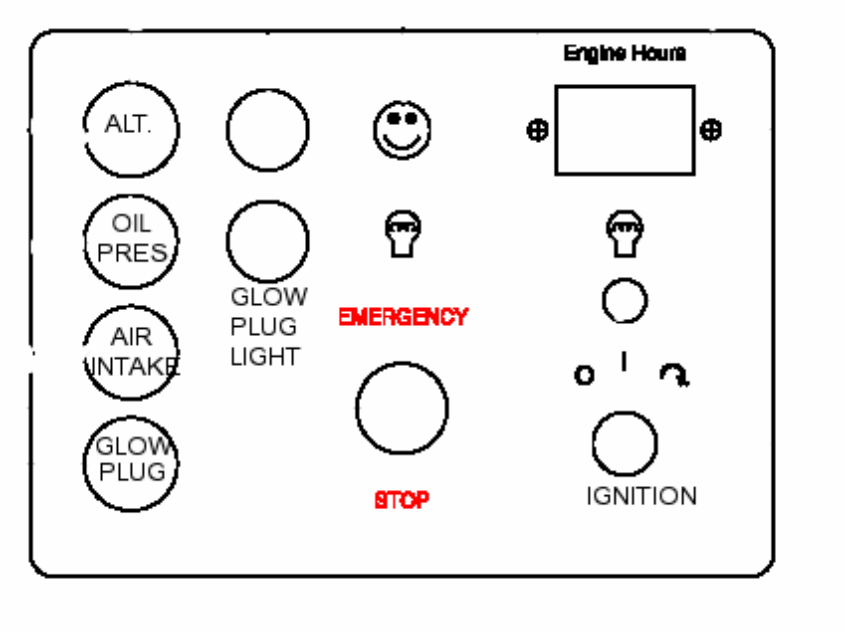
Control	Valve Handle Position	Functional Description
1 Nippers	Fwd Rev Left Right	Brings nipper down Brings nipper up Opens tie hook Closes tie hook
2 Drive Gun 3	Fwd Rev	Drives spike Raises hammer
3 Drive Gun 4	Fwd Rev	Drives spike Raises hammer
4 Carriage Spotting	Fwd Rev Left Right	Moves carriage forward Brings carriage back Moves carriage to right Moves carriage to left
5 Guide Roller	Fwd Rev	Lowers guide roller Raises guide roller
6 Pattern Adjust	Fwd Rev Left Right	Moves workhead forward Brings workhead back Moves workhead to left Moves workhead to right

FIGURE 3. CONTROLS
REMOTE OPERATOR CONTROL BOX



INSTRUMENT OR CONTROL		FUNCTIONAL DESCRIPTION
Horn		Press to sound horn
Gun 1/2 Or Gun 3/4	Single Feed Off Auto Feed	Three position switch, momentary left position, default off. Feeds one spike into jaws at a time. Feeds consecutive spikes into jaws.
Single Feed Button		Large black button on left side of box. Press to feed single spike into jaw. Only used when gun switch is in “Single Feed” position.
Bottom Switch		Two position switch. Turns both guns ON or OFF.

FIGURE 4. CONTROLS
ENGINE INDICATOR LIGHT BOX

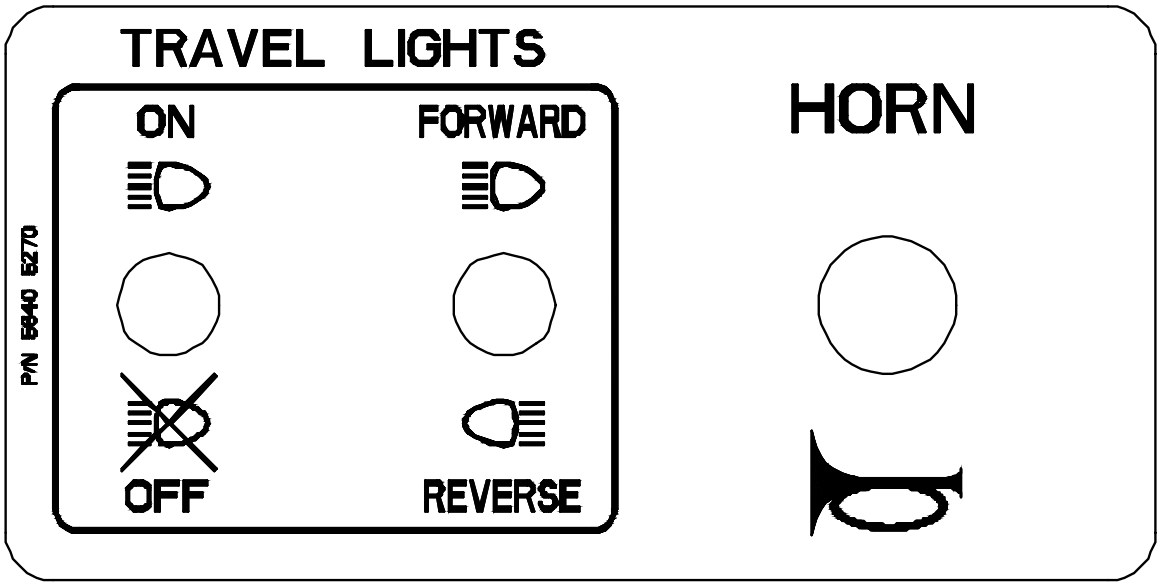


INSTRUMENT OR CONTROL	FUNCTIONAL DESCRIPTION
Engine TEMPERATURE Light	Indicates temperature of engine or cooling system. Normal reading is 180° F to 202° F (82° - 95° C) **Note: High engine temperature will shutdown the machine at 248° F (120° C).**
Alt. Charge Light	Indicates charge system is functioning. Normal reading is 11-14 volts.
Engine Oil Pressure Light	Indicates abnormal oil pressure. Exceeding 40-60 psi (3-4 bar). **Note: Low engine pressure will shutdown the machine at 20 psi.**
Ignition Switch	Switches power to all circuits. Used for normal engine shutdown.
Emergency Stop	Press button to shut down engine. Pull out button to reset. See "EMERGENCY STOPPING" at the end of this OPERATION section.
Air Inlet Light	Indicates restriction in air inlet system
Green Light	Indicates all systems functioning properly.
Glow Plug Button	Press button in cold startup conditions to preheat combustion chamber. Button should be pressed no longer than 30 second intervals.
Glow Plug Light	Indicates glow plugs are in use.
Hourmeter	Records operating hours when ignition is in RUN position.

WARNING!

ETHER SHOULD NEVER BE USED ON THIS ENGINE!

FIGURE 5. FEED CONTROL BOX
TRAVEL LIGHTS



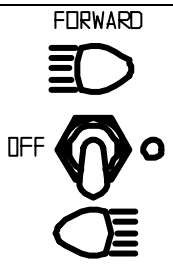
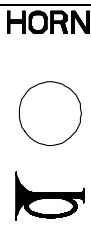
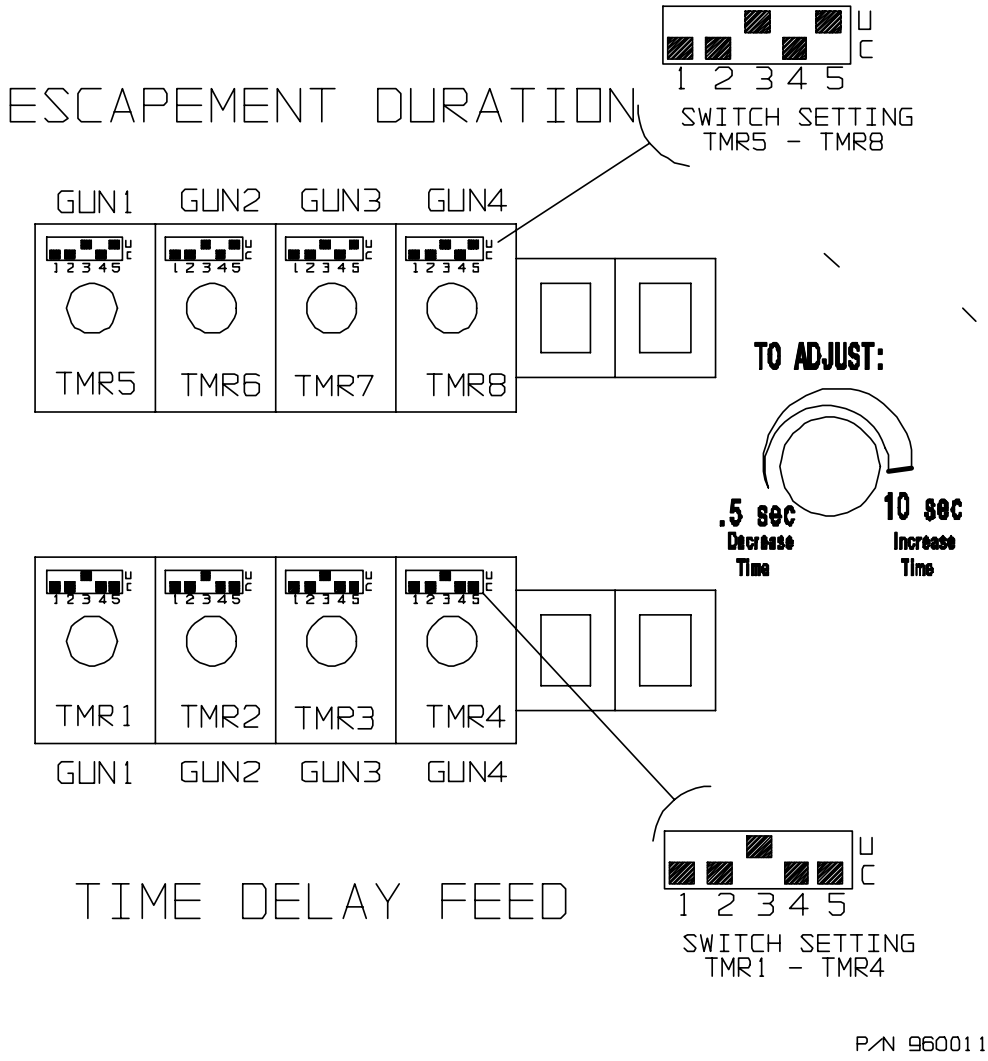
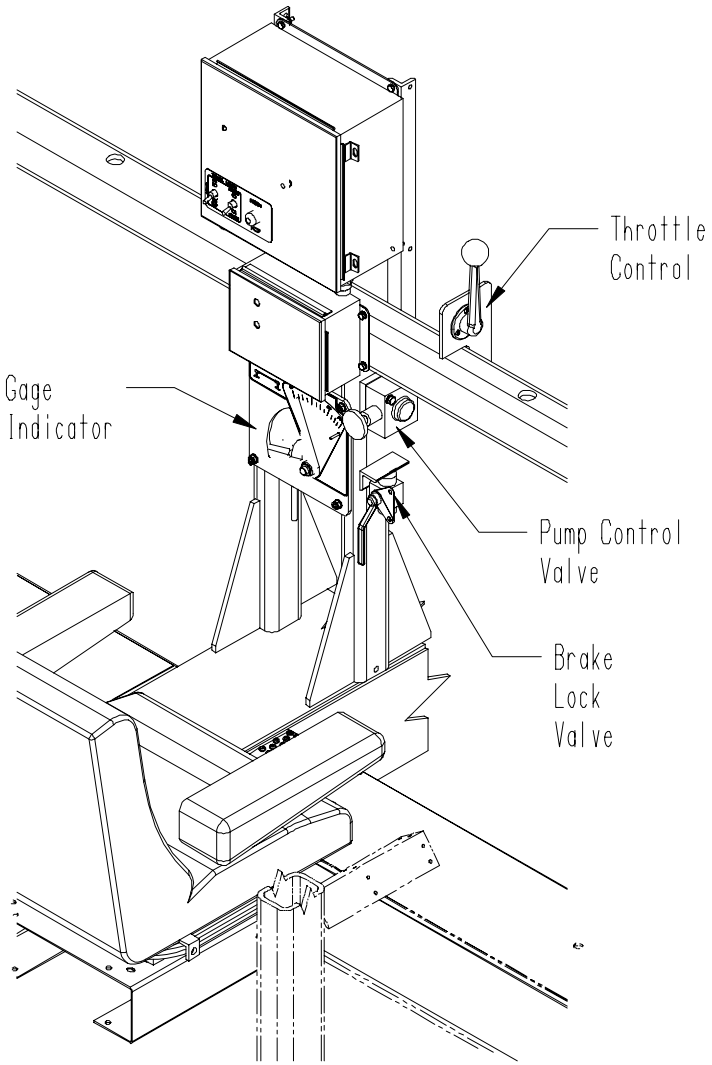
INTERNATIONAL SYMBOL	INSTRUMENT OR CONTROL	FUNCTIONAL DESCRIPTION
	**Travel Lights** FWD/REV	Select light for direction of travel, DOWN for reverse travel, UP for forward travel. This switch also enables the travel alarm, in which the alarm will sound whenever the machine is traveling in a direction OPPOSITE of the position of the switch.
	**Travel Lights ON/OFF**	Turns travel lights ON or OFF.
	**HORN**	Press to sound horn.

FIGURE 6. FEED CONTROL BOX
TIMER CONTROLS (Inside Box)



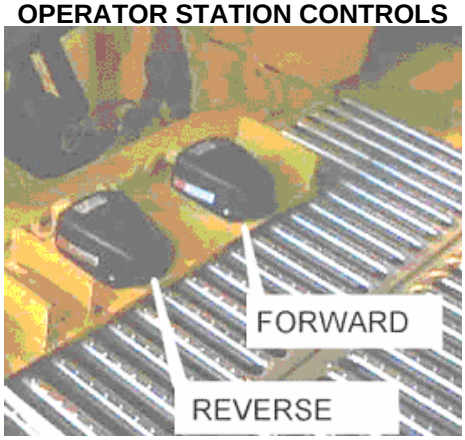
TIMER CONTROL	FUNCTIONAL DESCRIPTION
Escapement Duration	Time adjustable for rail height. Increase in rail height requires additional time before jaws release. Decrease in rail height requires less time before jaws release.
Feed Time Delay	
DIP SWITCH	Must not be reset. In the event that you experience problems in feed time delay or escapement duration, make certain that the switches are set to the configuration shown above.

FIGURE 7
MISC. OPERATOR STATION CONTROLS



Control or Instrument	Function
Throttle Controls	Engine speed is increased by pulling the throttle lever back toward the operator and decreased by pushing the lever away from the operator. Note: For normal operation the engine should be run with the throttle pulled all the way back.
Pump Control Valve	Push in the button to stop the pump. Pull out the button to start the pump.
Brake Lock Valve	Close the valve when you need to release brakes using hand pump.
Gage Indicator (Opt.)	Shows the gage of the track.

FIGURE 8
OPERATOR STATION CONTROLS



Control or Instrument	Function
Coast Pedal (Left Pedal)	Brakes release when pressed. (Brakes automatically apply when pedal is released)
Reverse Propel Pedal	Press this pedal to propel the machine in reverse.
Forward Propel Pedal	Press this pedal to propel the machine forward.

REMOTE CONTROLS AND INDICATORS

Item	Control or Instrument	Function
1	Emergency Pump (Optional)	Located on frame near the engine. Pump is used when there is a loss of system pressure and movement of hydraulic cylinders is necessary. System pressure is supplied by pumping hand lever or by switch on electric pump.
3	Battery Disconnect Switch	Located inside of battery box. Two position switch marked with "ON/OFF" plaque. This must be OFF and locked during service.
4	Winch Motor Control Valve Hand Lever	The lever is mounted on the winch boom. Moving the valve hand lever up raises the load, midway stops the winch spool motion, and down lowers the load.
5	Fuel Tank Level Gauge	Located on top of fuel tank, this tube indicates the level of fuel in the tank.
6	Hydraulic Oil Tank Sight Level	Located on hydraulic oil tank, it indicates the level of hydraulic oil in the tank.
7	Hydraulic Oil Temperature Gauge	Located on the bottom of the hydraulic oil sight level. Indicates temperature of the hydraulic oil. Normal operating temperature is 80° to 150° F (49° to 66° C).

Preparing the Machine for Work

As with any machine, pre-operational checks and preventative maintenance should be performed before using the machine. We suggest that you follow the guidelines listed below before actually operating the machine.

1. Position the machine on level track so fluid levels can be accurately checked and filled if necessary.

2. See TOWING section if machine is to be towed to worksite.

3. Know and understand the use of all machine controls and instruments as described earlier in this manual.

4. Perform the pre-operational inspection of the entire machine as specified on the next page. Find defects and correct them before serious damage or failure results.

5. If necessary, follow any applicable instructions under MAINTENANCE FOR EXTREME CONDITIONS.

6. Perform applicable preventative-maintenance procedures in MAINTENANCE AND SERVICE section.

7. Be ready to operate the machine with an alert and safety-conscious attitude.

8. Understand the use of the machine's Lock-Ups. See LOCK-UPS section.
9. Make sure the unit is setup for rail size being worked on. Adjustments, if required, are described in the MACHINE SETUP.

10. Wear proper safety clothing.

Before you begin the pre-operational checklist you should become familiar with the controls that you will be checking. Knowing these controls and their functions may will help you in troubleshooting the machine at a later time.

TABLE OP-7: PRE-OPERATIONAL CHECKLIST

NORDCO recommends that the following checks be performed WITHOUT electrical power, due to a possible battery drain.

MAIN CONTROLS STATUS
☒ Gages checked for broken glass. ☒ Emergency Stop pushbutton is pulled out. ☒ The following switches are in the off position: Pump On/Off Ignition Travel Lights ☒ Engine throttle is set to low
MACHINE FLUID LEVEL CHECK (See recommended fluids in Maintenance Section)
☒ Hydraulic Oil Tank is full ☒ Fuel Tank is full ☒ Engine Oil Reservoir is full
MACHINE INSPECTION
☒ Inspect for Leaks. Pay particular attention to hydraulic and fuel lines. ☒ Inspect all controls, wiring and switches for secure mounting ☒ Battery Disconnect Switch OFF
MACHINE LOCK-UPS AND GUARDS
☒ Make certain Mechanical Lock-Up devices are in place (for traveling) ☒ Propulsion Chain guard(s) in place

WARNING!

Exhaust emissions caused by the use of the engine on this machine may cause cancer, birth defects, or other reproductive harm if inhaled.

CAUTION!

Before starting a new or overhauled engine that has been in storage, consult the engine manufacturer's manual for initial start instructions. Failure to follow those instructions can result in serious engine damage.

Engine Operation

WARNING!

ETHER SHOULD NEVER BE USED ON THIS ENGINE!

NOTE: Avoid unnecessary idling. When prolonged idling is needed, maintain at least 800-1100 rpm.

1. Ensure the suction strainer valve (See Figure) on the hydraulic oil tank is open and the Battery Disconnect Switch is on.

2. Make certain EMERGENCY STOP pushbuttons on both the main (feed) control panel and remote operator control boxes have been pulled out. Make certain the pump is OFF.

3. NOTE: See Emergency Stopping Procedures at the end of the OPERATION section.

4. Turn the ignition switch to the right until the engine starts. Release the ignition switch (will spring back to centered position) Allow 5-7 minutes of warmup if first start of the day.

   NOTE: Engine will not start if emergency stop pushbuttons are pushed in.

5. If the engine fails to start within 30 seconds allow the starting motor to cool a few minutes before trying again.

6. Slowly pull the throttle lever toward you, gradually increasing the rpms of the engine. **Do not pull lever fully forward, you do not want full engine rpm's at this time.**

7. Perform the startup check on the next page.

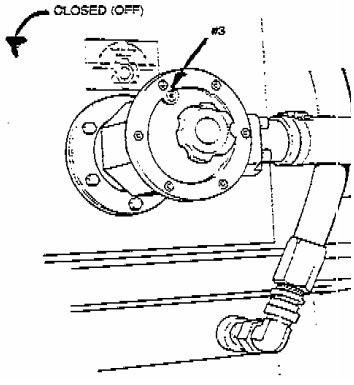


TABLE 10. STARTUP CHECKS		
LIGHT/HORN STATUS		
☒ LIGHTS FUNCTION:		
☒ Travel Lights	☒ Work Lights	☒ Brake or Marker Lights
☒ HORNS/ALARMS FUNCTION:		
☒ Travel Alarm	☒ Horn Button (Main Control Panel)	
OPERATOR CONTROLS FUNCTION		
☒ Foot pedals		
LOCK-UP DEVICES ENGAGED (See Lock-ups - Next Page)		
☒ Turntable/Setoff:	Valve handle locked in DOWN position.	
☒ Nipper Frame:	Locked	
☒ Workheads:	Locked	
☒ Winch Boom:	Locked in place	
☒ Winch Cable:	Secured to mast	



Failure to engage all lockup devices before propelling at travel speed can result in injury to personnel and/or damage to the machine.

LOCK-UPS

There are areas designated on the machine as lock-up points. Lock-up points are those areas required to be locked up prior to working travel through crossings, switches or other rail obstructions or during high speed travel (non-working travel), as well as during maintenance and service of this machine – UNLESS lockup of the assembly prevents access to area being maintained. These have been painted red and have a decal located next to or on the area requiring locking up.

All lockups, with the exception of the boom and winch, should be unlocked prior to performing work operations. The boom and winch should only be unlocked when required and then immediately relocked upon completion of lifting work.

Some machines have been equipped with hydraulically operated lockups. Refer to customer options tab for more information on these lockups.

Use the procedures on the following pages to install or remove lock-ups

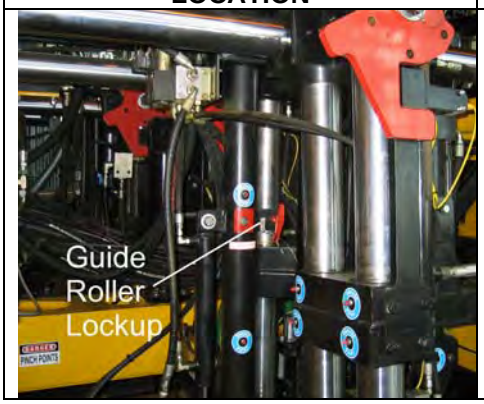
WORKHEADS

There is one lock-up device per gun assembly, two per workhead. They must be unlocked prior to performing service to the workhead or during work operations. Use the following procedure to lock or unlock the assemblies.

LOCATION	LOCKUP PROCEDURE	WHEN USED
	Lower each hammer assembly so lock-up wheel can be rotated. Pull lock pin and rotate wheel to the lock-up position. Raise hammer assembly into lock-up position and insert lock-up pin	During working travel through crossings, at switches, frogs, and other rail obstructions, during high speed (non-working) travel.

GUIDE ROLLER ASSEMBLY

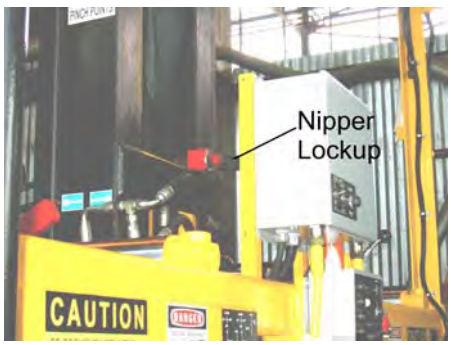
There is one lock-up device per guide roller assembly, two per machine. Both must be unlocked prior to performing service to the guide roller or during work operations. Use the following procedure to lock or unlock the assemblies.

LOCATION	LOCKUP PROCEDURE	WHEN USED
	1. Raise guide roller assemblies to allow the insertion of the lock pins. 2. Verify that the assembly is fully raised. (You will not be able to access hole if assembly has not been fully raised.) 4. Insert pin in hole on guide roller shaft.	During working travel through crossings, at switches, frogs, and other rail obstructions, during high speed (non-working) travel. Both must be locked during maintenance and service on this machine.

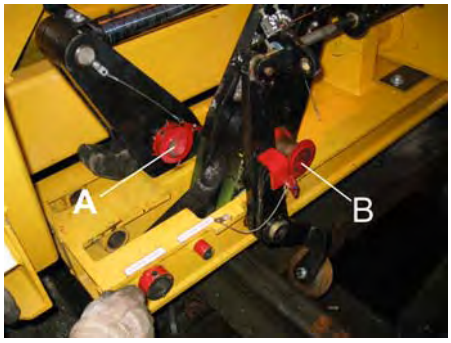
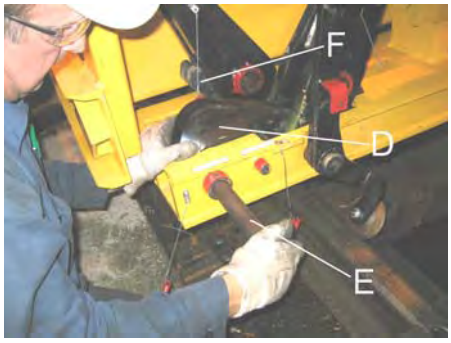
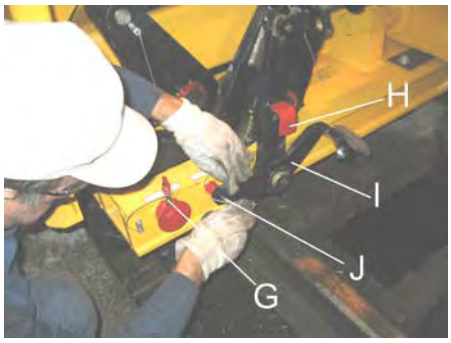
BOOM AND WINCH

LOCATION	LOCKUP PROCEDURE	WHEN USED
 	1. Swing boom in toward operators until it can't go any further. 2. Pull down on the lock handle 3. Secure cable to boom.	At all times when boom and winch are not being used and during working travel through crossings, at switches, frogs, and other rail obstructions, during high speed (non-working) travel.

NIPPERS

LOCATION	LOCKUP PROCEDURE	WHEN USED
 Non-removable lock-up pin located on the nipper assembly behind the engine control box.	1. Using the control valve, raise the assembly to allow the insertion of the lock pin. 2. When handle is in outer slot, nipper is unlocked. When handle is in inner slot, nipper is locked.	During working travel through crossings, at switches, frogs, and other rail obstructions, during high speed (non-working) travel.

GAGER

LOCATION	LOCKUP PROCEDURE	WHEN USED
  	1. Make certain workheads are moved back toward the operator. This will allow insertion of the long lockup pin (E) which was stored in the toolbox. 2. Move gager valve handles to the “retract” position. 3. Turn off machine. 4. Remove gager arm lock pin “A” first, and then remove pin “B”. (A and B) . These pins MUST be removed in this order. 5. Hold Outer Gager Lever (D) up until lever is above hole in frame. Begin sliding in long lockup pin (E) until lockup pin passes into other side of frame. 6. Push down on Inner Gager Lever (F) and continue pushing lockup pin (E) until it enters hole in frame. 7. Insert arm lock pins (A and B) into their original holes for storage. 8. Insert lockpin (G) into hole in long lockup pin neck. 9. Remove lockpin (H) holding Indicator lever (I) in place. 10. Move Indicator lever (I) up and insert lock pin (J) to lock in place.	During working travel through crossings, at switches, frogs, and other rail obstructions, during high speed (non-working) travel.

TRAVEL

It is important that you read about and understand all operating controls, Cautions, Warnings, and Dangers before traveling.

WARNING!

Failure to engage all lockup devices before propelling at travel speed can result in injury to personnel and/or damage to the machine.

ENGINE SPEEDS

Engine speed is controlled by the throttle lever located in front of the right operator. Engine speed should be set to maximum (pulled completely forward) when working or traveling.

PROPELLING AND BRAKING

Propelling at Work Speeds

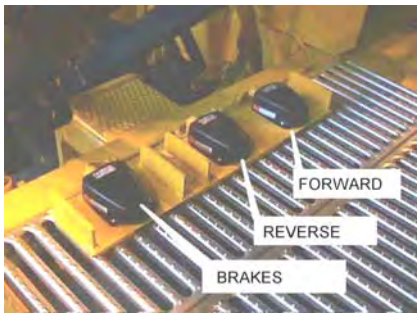
1. Lock-ups should be unlocked. Refer to Lock-ups section
2. Press the appropriate foot pedal to propel the machine.

Braking

A “deadman” (or coast pedal) brake pedal has been provided on this machine. This pedal must be pressed to release the brakes.

TRAVELING ON A INCLINE

Before traveling down an incline, test the brakes to make sure that they are fully functional.



Machine Setup

There are some adjustments which may have to be made due to varying conditions such as rail height and base width. Adjustments must be made to compensate for these conditions before operations can begin.



Serious injury or death can result from reaching into driving components while machine is running!

Make observations from a safe distance.

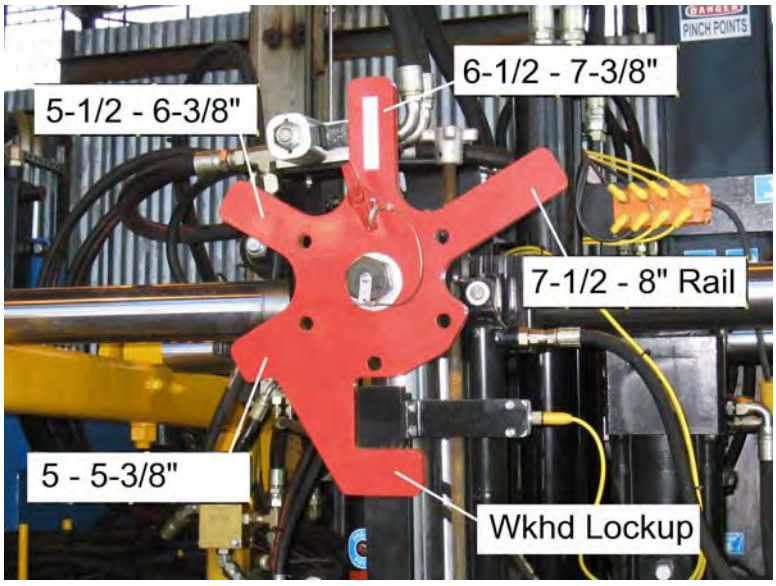


Always turn off machine when performing maintenance, making adjustments, or whenever unintended movement of machine could occur; unless directed otherwise. Failure to comply could result in personal injury and/or damage to the machine.

Read and understand all OPERATION procedures, warnings, and cautions before making adjustments.

JAW DEPTH/RAIL HEIGHT ADJUSTMENT

Adjust lockup wheel to corresponding rail height. Insert lock pin.



Note: Adjustment of rail height requires timers be set accordingly in the Feed Control Box. See Next Page.

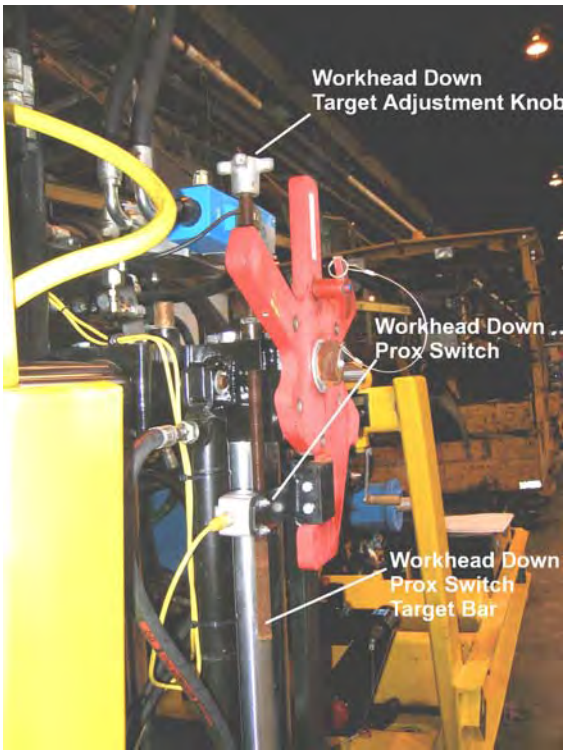
Workhead Spike Pattern Adjustments

Adjustments to the outer workhead are done using the right hand valve stack.

Forward/Backward Adjustments

The guide wheel must be lowered into position before these adjustments can be made.

Carriage spotting adjustments are made using the RH valve stack. The LH joystick controls the side to side spotting and the front-back spotting.



Workhead Spike Pattern Adjustments (Hydraulic)

Spike pattern adjustments must be made after the guide wheel has been lowered.

Pattern adjustments are made using the RH valve stack. The RH joystick controls the fwd back, in/out position of the workhead.

Workhead Down Adjustments

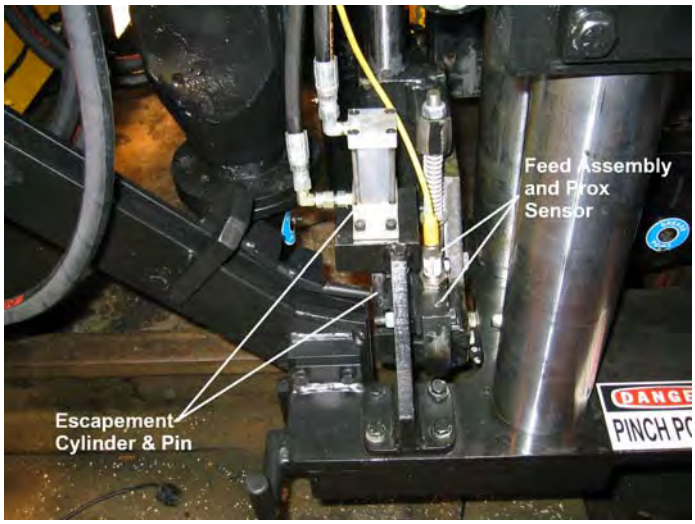
The down position of the hammer (the point at which the spike is initially driven and the jaw mounting assembly pivots and retracts) is adjusted by turning the workhead down target adjustment knob.

By turning the adjustment knob clockwise, you increase the time before release, by turning it clockwise, you decrease the time before release.

Timing Adjustments

Spike Feed Delay

The speed at which spikes feed into the jaws is controlled via timers inside the Feed Control Box in the Operation Station. The experience level of the operator will determine the timing of the spike feed.



Less Experienced Operators: Turn the timer pot clockwise to increase the length of time before the spikes feed.

More Experienced Operators: Turn the timer pot counterclockwise to decrease the time before the spikes feed.

Escapement Duration

The length of time that the spikes remain in the jaws before being released and spiked into the rail can also be set via a timer in the Feed Control Box.

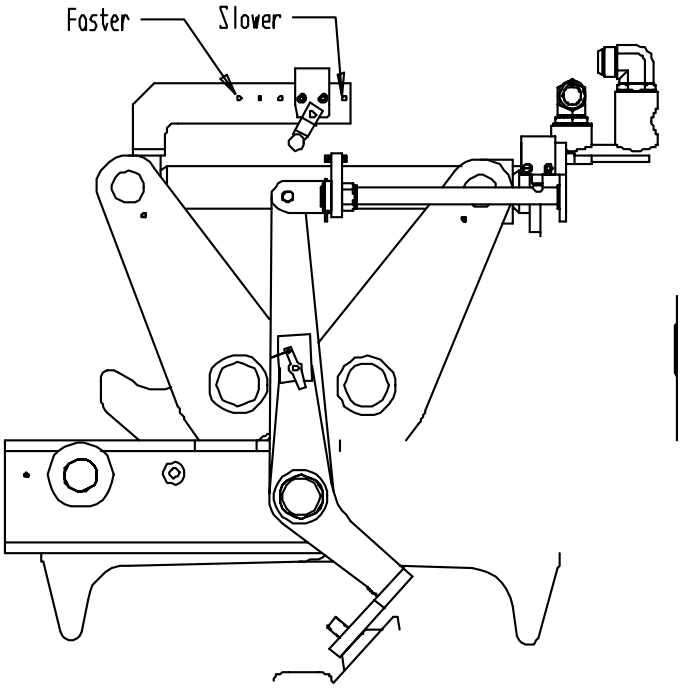
Turn the timer pot clockwise to increase the length of time the spikes remain in the jaws before being released. Turn the timer pot counterclockwise to decrease the time.

Note: The higher the rail height setting, the longer the time duration.

Gaging Speed Adjustments (Optional Gager)

There is a limit switch on the gager indicator assembly that controls slow speed "Gage Out". The faster the "slow speed", the shorter amount of time the operator has to read the gage at the pointer assembly in the operator station.

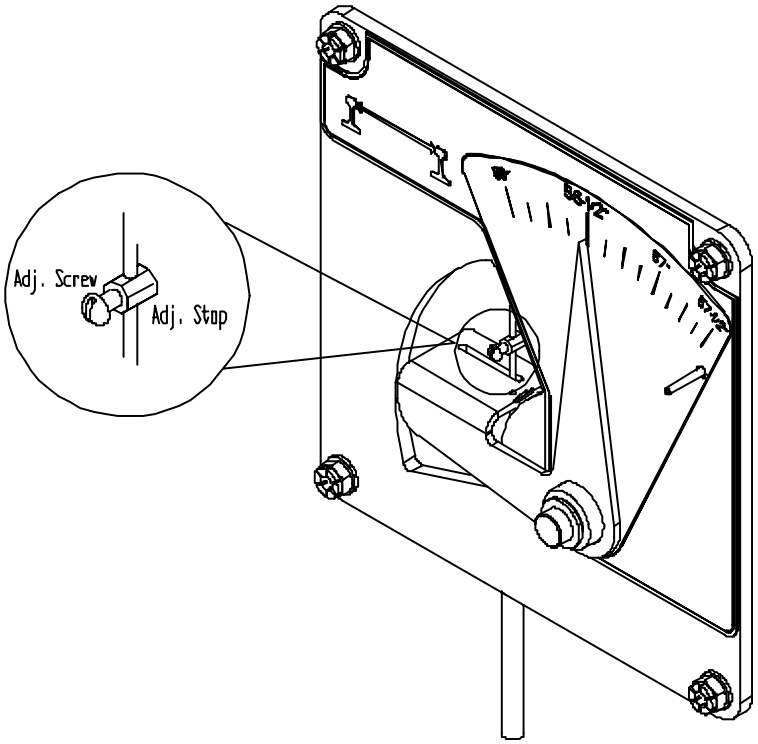
Looking at the mounting bracket from the operator end of the machine, left holes speed up the gaging out process, right holes slow it down.



Gager Pointer Adjustments (Optional Gager)

It is recommended that the accuracy of the gager pointer be checked, and adjusted as necessary, on a daily basis:

1. Make certain that the gager roller assembly is pinned in the Operating Position, with the indicator roller on the ball of the rail.
2. With a tape measure, measure the distance between the rails.
3. Verify that the distance measured is the distance indicated on the gager pointer. If the distance matches, you are set to go.
4. If it does not match, loosen the adjustment screw and stop (located in the faceplate opening on the gager pointer). Set the pointer to the correct distance and tighten the adjustment screw.



MACHINE OPERATION



To avoid serious injury or death, make certain that the area around and under the machine is clear of all personnel and obstructions before travelling or working.



Failure to engage all lockup devices before propelling at travel speed can result in injury to personnel and/or damage to the machine.

Work Operation – Machines without Nipper and Gager:

1. Make certain all STARTUP procedures have been followed, and all adjustments made, before beginning working operations.

2. Make certain all workhead lockups have been removed.

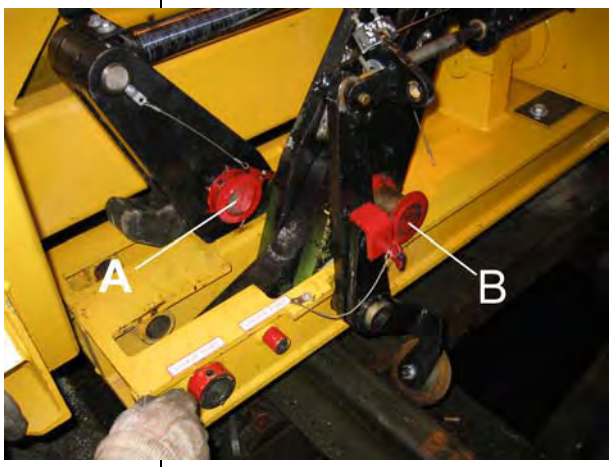
3. Make certain all spike trays are filled.

4. Run the machine over the tie plate to be spiked. Move Guide Roller Valve handle to the full forward position to lower guide rollers to the rail.

5. Position machine so inner workhead is aligned with hole in tie plate. To verify position, put feed to “manual”, feed a spike and slowly push the Gun 1 or Gun 3 valve handle forward until jaw assembly swings into position under the hammer. Using the applicable valve lever on the right hand valve bank, adjust until spike is directly above hole in tie plate.

6. Drive spikes. Spike driving is controlled using the valve levers on the LH valve stack for each operator. Push appropriate levers forward to drive spikes, pull levers back to raise hammer.

Work Operation – Machines with Gager, without Nipper:



1. Make certain all STARTUP procedures have been followed, and all adjustments made, before beginning working operations.

2. Make certain all workhead and gager lockups have been removed.

3. Reinsert gager arm lockpins (A and B) to their original position. Pin up gager indicator roller assembly to the Operating position.

4. Make certain all spike trays have been filled.

5. Run the machine over the tie plate to be spiked. Move Guide Roller Valve handle to the full forward position to lower guide rollers to the rail.

6. Verify the gage of the rail as indicated on the Gager Pointer assembly at the Operator Station. To adjust you **must**:

    a. Push rail all the way in (push gager valve handle forward) until cylinder bottoms out.

    b. Bring rail out to correct gage (move gager valve handle to the right).

    c. Position machine so inner workhead is aligned with hole in tie plate. To verify position, put feed to “manual”, feed a spike and slowly push the Gun 1 or Gun 3 valve handle forward until jaw assembly swings into position under the hammer. Using the applicable valve lever on the right hand valve bank, adjust until spike is directly above hole in tie plate.

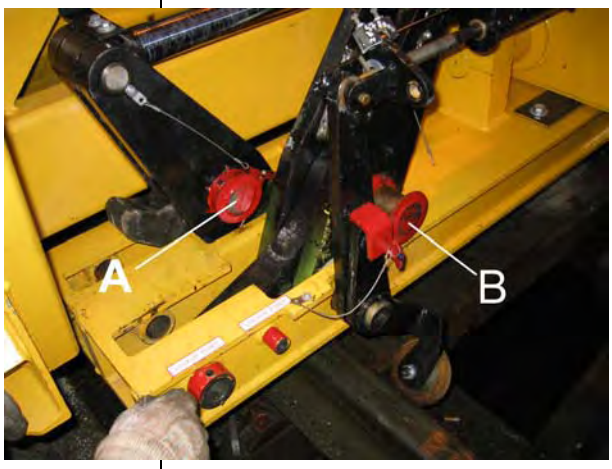
    d. Make certain all spike trays have been filled.

    e. Drive spikes. Spike driving is controlled using the valve levers on the LH valve stack for each operator. Push appropriate levers forward to drive spikes, pull levers back to raise hammer.

    f. Retract gager cylinders by moving the gager valve hand to the full back and left position. This will provide full system pressure for the next gage adjustment.

7. Propel to next position.

Work Operation – Machines with Gager and Nipper:



1. Make certain all STARTUP procedures have been followed, and all adjustments made, before beginning working operations.

2. Make certain all workhead, gager and nipper lockups have been removed. (Nipper lockup is located behind the control box in front of the operator.)

3. Reinsert gager arm lockpins (A and B) to their original position. Pin up gager indicator roller assembly to the Operating position.

4. Make certain all spike trays have been filled.

5. Run the machine over the tie plate to be spiked. Move Guide Roller Valve handle to the full forward position to lower guide rollers to the rail.

6. Position machine so inner workhead is aligned with hole in tie plate. To verify position, put feed to “manual”, feed a spike and slowly push the Gun 1 or Gun 3 valve handle forward until jaw assembly swings into position under the hammer. Using the applicable valve lever on the right hand valve bank, adjust until spike is directly above hole in tie plate.

7. Push rail all the way in (push gager valve handle forward) until cylinder bottoms out. Verify the gage of the rail on the Gager Pointer assembly at the Operator Station

8. Bring rail out to correct gage (move gager valve handle to the right).

9. Move the Nipper Valve handle to the forward and right position. This will lower the nipper assembly and close the nipper hooks around the tie. Pull back on the nipper valve handle to pull the tie to the rail.

10. Drive spikes. Spike driving is controlled using the valve levers on the LH valve stack for each operator. Push appropriate levers forward to drive spikes, pull levers back to raise hammer.

11. Move the Nipper valve handle to forward and left position, this will cause the tie hooks to open. Pull handle toward you to raise the nipper assembly.

12. Retract gager cylinders by moving the gager valve hand to the full back and left position. This will provide full system pressure for the next gage adjustment.

13. Propel to next position.

Winch Operation

Your machine is equipped with a hydraulic winch for loading materials onto the deck of the machine.

In order for the winch to be fully operational, it must have the interlock pin set so that the boom can swing fully from left to right without the lock resetting in another hole. This is accomplished by pulling the interlock handle on the boom mast out until the spring compresses enough to allow the spring pin to move behind the bar located beneath the bracket. Releasing handle allows free movement of boom.

To raise a load:	Pull valve handle to left
To stop a load:	Release valve handle
To lower the load:	Pull valve handle to right

Under no circumstances is the winch to be used for towing or for lifting loads in excess of 300 pounds.

After winch work is complete, secure cable to boom. Refer to LOCKUP section for instructions on locking up the boom and winch assembly.

Emergency Procedures

1. If a hydraulic hose fails, shut down the machine immediately, determine cause of failure, correct condition.

2. If indications on gauges are not within the normal range, shut down the engine. Repair before further operation.

3. Emergency cylinder actuation requires the optional Hand Pump.

EMERGENCY STOPPING

The emergency shutdown should be used only when the engine does not respond to the normal stop engine procedure or in the event of an emergency where time is critical.

To shut down the engine, push the EMERGENCY STOP pushbutton located in the upper center of the Logic Box control panel or on either Remote Operator Control Box.

Never use the emergency shutdown system except in an emergency. **DO NOT USE THIS METHOD AS A SHORTCUT TO TURNING OFF THE ENGINE!!**

AFTER OPERATION

General

1. Install lock-ups. See LOCK-UPS section.

2. Set engine throttle speed to low position and turn pump off. Let engine idle for 5 minutes.

3. Shut off engine by returning ignition switch to the full counterclockwise position.



To avoid possible personal injury and/or engine damage from accidental engine startup, always disconnect the battery before servicing this machine.

4. Return all switches to their "Pre-Operational" state using the Pre-Operational Checklist as a guide.

5. Turn off battery disconnect switch. Lock battery box.

Parking or Locating Machine

1. Park or locate machine on level track area, if possible; and where it will not be exposed to excessive dust.

2. If the machine was towed, disconnect towing vehicle and set the brakes. Move the towing vehicle well clear of the parked machine.

Rotating Machine

The machine has a turntable which allows the machine to be lifted off of the tracks and rotated. The only function of this turntable is to rotate the machine. The turntable base is stored under the machine.

To lift and rotate the machine, proceed with the following steps:

WARNING!

Any machine can be hazardous when raised. Take all necessary precautions before raising the machine. Do not, under any circumstances, climb under machine when using the turntable.

1. **NOTE:** The only hand contact with the turntable base should be to position it correctly across ties. At this point, the turntable should still be attached to, and its weight supported by, the winch assembly.

2. Rotate turntable base across rails.

3. Unlock set-off valve handle. Slowly lift valve handle to lower turntable onto rails.

4. Move the Turntable Valve hand lever upward and hold until the machine is fully raised off the track. Center the hand lever.

5. Use manpower to rotate the machine. The wheels should be directly above the track after rotating the machine.

6. Slowly move the Set-Off Valve hand lever downward. The Turntable Cylinder will retract and the machine will lower onto the track.

Rotating Machine (with Turntable Lockup)

Use of the Turntable and Turntable Lockup requires hydraulic and electrical power to the machine.

To lift and rotate the machine, proceed with the following steps:

WARNING!

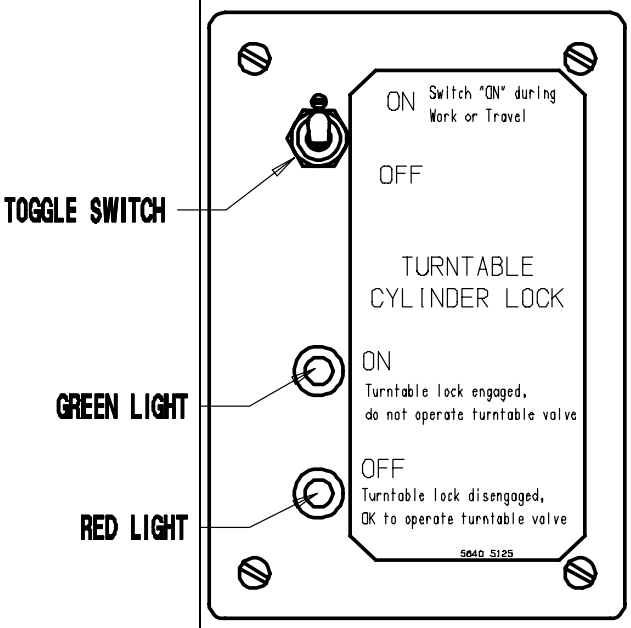
Any machine can be hazardous when raised. Take all necessary precautions before raising the machine. Do not, under any circumstances, climb under machine when using the turntable.

1. Attach winch (if supplied) cable hook to turntable base and lift off machine. Lower into position using the winch assembly.

   NOTE: The only hand contact with the turntable base should be to position it correctly across ties. At this point, the turntable should still be attached to, and its weight supported by, the winch assembly.

   NOTE: Use of the winch is not required if using an Aluminum turntable base.

2. Center turntable base across two solid and level ties. Disconnect winch cable. Propel machine over turntable base.



3. Locate the Turntable Valve and Turntable Lockup Box on the right hand side of the machine (in front of the workhead bay).

4. Unlock Turntable valve handle. Slowly lift handle to lower turntable cylinder rod until it comes into contact with base.

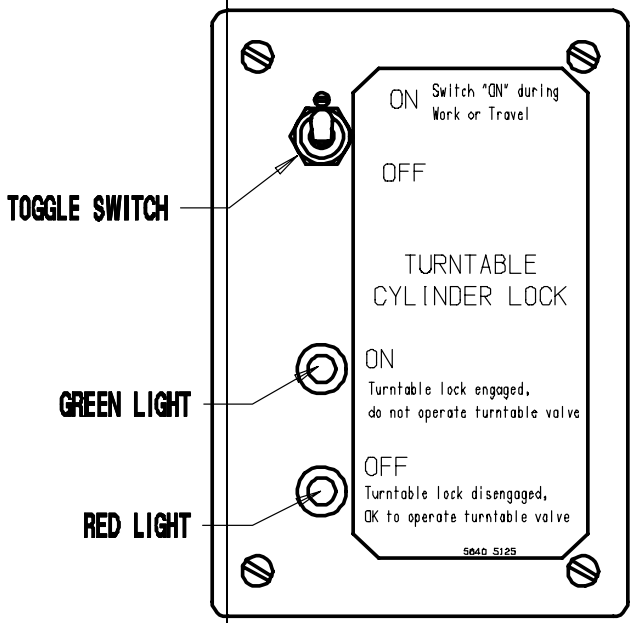
5. Reposition machine as necessary to allow rod to enter base.

6. Move the Turntable Valve hand lever upward and hold until the machine is fully raised off the track. Center the hand lever.

7. Use necessary manpower to rotate the machine. The wheels should be directly above the track after rotating the machine. It is suggested to turn the machine in the clockwise direction.

8. Slowly move the Turntable Valve hand lever downward. The Turntable Cylinder will retract and the machine will lower onto the track. When the turntable is fully retracted, reapply the lock on the turntable valve handle.

9. Using the toggle switch on the Turntable Lockup Box, place the switch in the ON position. The GREEN indicator light should come on indicating that the turntable cylinder lock is ON.



Towing

Maximum towing speed is 20 mph. Reduce speed accordingly as dictated by weather or track conditions.



Do not permit unauthorized personnel to ride in or on the machine, or on the drawbard between the machine and the towing vehicle. Falling from a moving vehicle may cause serious injury or death.

Remember that the machine weight may approach the weight of the towing vehicle. Maintain increased stopping distance accordingly.

The following steps must be taken before towing your machine:

1. Install Lock-Ups. See LOCK-UPS section.
2. Make certain turntable has been raised.
3. Remove drive chain(s) if machine is to be towed a long distance.
4. Inspect the towing vehicle coupler for damage or loose parts.
5. Back towing vehicle to the machine and engage the couplers. Keep hands and fingers clear of the coupling device and all other pinch points.
6. Ensure that the coupling device is fully engaged, closed, and locked.
7. Ensure that the coupling device and rear frame members on the towing vehicles will not interfere with or restrict motion of any part of the machine when maneuvering.

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NORDCO'S SERVICE NETWORK

Need assistance? It's only a phone call away! If you experience problems, contact your original sales representative first, he is the one listed on the front page of this manual. If you cannot reach him, we suggest that you contact the representative closest to your work area BEFORE calling NORDCO's Service Manager. See map on the next page for the alternate representative closest to your work area.

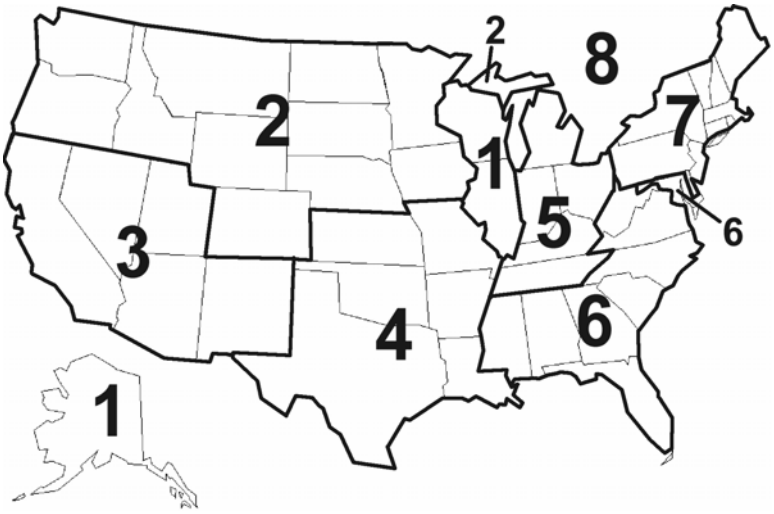
REQUESTING ASSISTANCE

If you have any questions regarding maintenance and service on this machine, please call your local Nordco Representative or:

Nordco Service Manager
(414) 769-4603 (Wisconsin)
1-800-445-9258 (USA and Canada)

The process will be faster if you have the following information in hand **before calling**:

1. The Machine and Model Name: Spiker "SS"
2. The Serial Number



SERVICE NETWORK

No.	Representative	Phone Number
1.	Nordco Service Manager	1-800-445-9258 or (414) 769-4603
2.	Russell Railway Supply	(952) 835-5125
3. & 4.	James H. Lynde	(913) 648-7379
5.	Stanley H. Smith Inc.	(606) 885-3353
6.	Dwayne Lambing	(770) 424-0401
7.	North American Equipment Company	(716) 675-2040 or (859) 885-3353
8.	North American Equipment Ltd. (Canada)	(905) 628-9997
International:	American Equipment	(561) 997-2080

LUBRICATION AND MAINTENANCE

Service points on this machine (adjustments, inspections, lubrication, etc.) are indicated on the following illustration. The items listed on the chart are preceded by a “D1, W1, M1, Q1 and A1" designation. These points are shown on the illustration and refer to the service interval (D=Daily, W=Weekly, M=Monthly, Q=Quarterly and A=Annually) for this point of the machine. Maintenance instructions are given for each and are separated by Service Interval.

DAILY (OR 8 HOURS, WHICHEVER COMES FIRST)			
Key: =  = Refer to Mfr's Manual in Component Data  = More Detailed Instructions Follow			
LOC	ITEM	SYM	TASK
ENG	**D1.**		Follow Engine Mfr's recommendations for daily maintenance
	D2.		Check Engine Oil Level, fill as required.
	D3.		Check Engine Air Cleaner Indicator (Optional)
HYDRAULIC	**D4.**		Check Case Drain Filter Indicator (Optional)(Requires machine running and working)
	D5.		- Reserved for Future Use -
	D6.		Check Hydraulic Oil Level and Quality (Sight inspection at Gauge). Fill as req'd.
	D7.		Check Hydraulic Oil Filter Indicators at Logic Box (requires maching running and working)
	D8.		Inspect Hoses and Fittings for Leaks
	D9.		Check Top Off Filter Indicator Gauge (Optional) while in Use
	D10.		- Reserved for Future Use -
WORKHEADS & GUIDE ROLLERS	**D11.**		- Reserved for Future Use -
	D12.		Grease Hammer (1 per hammer, 4 total)
	D13.		Grease Gun Up/Down Shaft (2 per gun, 8 total)
	D14.		Grease Carriage Shaft (2 per carriage, 8 total)
	D15.		Grease Guide Roller Up/Down Cylinder (2 fittings per cylinder)
	D16.		Grease Guide Roller Up/Down Shaft (1 fitting per assembly)
	D17.		Grease Pattern Adjust Cylinder Bearings (2 per cylinder, 8 total)
	D18.		- Reserved for Future Use -
	D19.		- Reserved for Future Use -
	D20.		- Reserved for Future Use -
MISC.	**D21.**		Fill Fuel Tank – End of Day
	D22.		Inspect electrical connections/harnesses for tightness
	D23.		Inspect hoses/connections for leaks
	D24.		- Reserved for Future Use -
	D25.		- Reserved for Future Use -

*Optional Assemblies

Detailed Daily Instructions

D2. Check Engine Oil Level	
Check the oil level daily with the engine stopped. If necessary, add sufficient oil to raise the level to the proper mark on the dipstick. All diesel engines are designed to use some oil, so periodic addition of oil is normal. If the oil level is constantly above normal and excess lube oil has not been added to the crankcase, contact the engine maker's authorized service outlet listed in the Engine Manual. Fuel or coolant dilution of lube oil can result in serious engine damage. **Never** operate the engine with the oil level below the "L" (low) mark or above the "H" (high) mark on the oil dipstick. Wait at least 15 minutes after shutting off the engine to check the oil. This allows time for the oil to drain to the oil pan. **Check Engine Manufacturer's Manual for Engine Oil Capacity.**	

D6. Check Hydraulic Oil Level and Quality – Sight Inspection Only	
Inspect the oil level on a daily basis (or **every 10 hours** of operation) by reading the sight gauge located on the side of the reservoir. At full level, the oil should be to the top of the sight gauge. The hydraulic system uses SAE-20 (ISO 46) oil. Before filling the system with hydraulic oil, be sure that the fluid is as specified and that it is clean. Do not use cloth strainers or fluid that has been stored in contaminated containers. Care should be taken to keep the hydraulic oil free of dust, water, sealing compounds and other foreign matter. While using the sight gauge, verify oil quality. If oil becomes dark or milky colored, it should be changed immediately. NOTE: Always add hydraulic oil to reservoir through a filter. NEVER OVERFILL RESERVOIR. Never use hydraulic brake fluid in lieu of hydraulic oil.	

D27. Inspect Electrical Connections/Harnesses for Tightness	
Daily inspection of the harnesses connected to the controllers, operator control boxes (both left and right control boxes), footswitches, and logic box are required. Harnesses that may not have proper connection could cause problems in starting and stopping the machine. In addition to harness connections, the footswitch should be inspected on a regular basis to guard against wear, deterioration, etc. If you notice excessive wear or **breakdown, replace the switch.**	

D28. Inspect Hoses and Fittings for Leaks	
1. Look for loose or disconnected hoses. An oil spot below the machine is a good indication of a loose hose or hydraulic component. 2. Make certain shut-off valve on suction strainer is OPEN. Opening valve can often correct what appears to be a malfunction. 3. Inspect all vital hose connections, especially at main pump and the main pump hose connection at the manifold. 4. Look for cover damage and/or indications of twisted, worn, crimped, brittle, cracked, or leaking hoses. Hoses with their outer cover worn through or otherwise damages should be considered unfit for further **service.**	

WEEKLY (OR 40 HOURS, WHICHEVER COMES FIRST)			
Key: =  = Refer to Mfr's Manual in Component Data  = More Detailed Instructions Follow			
LOC	ITEM	SYM	TASK
MISCELLANEOUS	**W1.**		Perform all Daily Lubrication and Maintenance Procedures
	W2.		Check Battery Condition.
	W3.		Oil Propulsion Chains
	W4.		Oil Propulsion Chain Adjusting Nuts
	W5.		Grease Brake Lever Pivot
	W6.		Grease Axle Bearings
	W7.		Check Suction Strainer Element[a]
	W8.		Grease Nipper Hooks (1 per hook, 4 total)
	W9.		Grease Nipper Guide Blocks (2 per block, 4 total)
	W10.		Grease Gager Lever Housing*
	W13.		Grease Gager Lever Arms*
	W14.		Grease Gager Buggy Wheels*
	W15.		Grease Gager Housing Mounting (2 total)*
	W16.		- Reserved for Future Use -
	W17.		- Reserved for Future Use -
	W18.		- Reserved for Future Use -

a. Check Suction Strainer Element first 40 hours of operation and yearly after initial inspection.

*Optional Equipment

Detailed Weekly Instructions

W3. Oil Propulsion Chains	
When inspecting the drive chain, the chain should be nearly taut, with 1/4" (.635 Cm) play when depressed at the center. If not, adjustment is necessary see below. If the chain is too tight, the eccentricity of the sprockets may cause the chain to stretch and/or break. If the chain is too loose, the starting and stopping of the machine will shock load the chain, resulting in short chain life or failure. A worn or stretched chain will also cause short sprocket life as the load will not be carried by all of the teeth on the sprocket - resulting in excessive load on a few teeth. To adjust the drive chain: 1. Remove propulsion chain guard. 2. Unscrew the adjusting screw locknut, but do not remove it from the screw. 3. Turn adjusting screw clockwise (CW) to tighten the chain or counter-clockwise (CCW) to loosen the chain. 4. Once the desired tightness has been reached, tighten the adjusting screw locknut. 5. Reinstall the chain guard.	

W6. Grease Axle Bearings	
Periodic inspection of the axle bearings and spacers for wear and breakdown are required to keep this machine functioning properly. Inspect hardware for proper fit and secure all loose nuts and bolts. Check spacers (A) for wear. The wheel bearing grease fittings are located on the underside of the pillow blocks. Remote wheel bearing grease fittings for the wheels are located on the outside of the suspension arm. Weather conditions affect the time intervals of greasing. In general, a small amount of grease should be ok. Overgreasing may cause seal failure. Grease hardens with age. When this occurs, the bearing should be taken apart, cleaned, and relubricated following the manufacturer's instructions on the **component data** sheet. **If supplied, check automatic greasing assemblies for proper charge.**	

W7. Check Suction Strainer Element	
Located on the side of the reservoir, remove and inspect the filter after the **first 40 hours** of operation and **every year** thereafter. Clean as required. To access filter: 1. Turn off engine, Make certain suction valve is closed (off)(ccw). 2. Remove padlock (1) and pull out plug attached to cable. 3. Using Allen wrench, turn screw (2) inside of plug housing clockwise to open (counterclockwise to close). 4. Remove six capscrews and lift off front cover. Reverse process to reattach cover. NOTE:If for any reason removal of suction line filter is necessary, you must seal the hydraulic tank to prevent external contamination.	

MONTHLY (OR 150 HOURS, WHICHEVER COMES FIRST)			
Key: =  = Refer to Mfr's Manual in Component Data  = More Detailed Instructions Follow			
LOC	ITEM	SYM	TASK
MISCELLANEOUS	**M1.**		Perform all Daily and Weekly Lubrication and Maintenance Procedures
	M2.		Check Fan and Alternator Belts
	M3.		Change Engine Oil and Filters
	M4.		Check Brake Shoes for Wear
	M5.		Run Pressure Checks on Main Pump and Propulsion
	M6.		Check Oil Cooler, clean as necessary
	M7.		Grease Winch Boom
	M8.		- Reserved for Future Use -
	M9.		- Reserved for Future Use -

Detailed Monthly Instructions

M2. Check Fan, Alternator Belts	
Check the belts and tighten the fan drive, battery-charging alternator and other accessory drive belts. Belts should be neither too tight nor too loose. Belts that are too tight impose excess loads on the crankshaft, fan, and/or alternator bearings, shortening both belt and bearing life. Excessively overtightened belts can result in crankshaft breakage. A loose belt will slip and may cause damage to accessory components. Replace all belts in a set when one is worn. Single belts of similar size should not be used as a substitute for a matched belt set. Premature belt wear can result because of belt length variation.	

M4. Check Brake Shoes for Wear	
Replace brake shoes when the pad is less than 1/4 (.64 cm) thick. To replace brake shoes: 1. Put the brake selection switch in the SERVICE modes. 2. Turn WORK/TRAVEL switch to the WORK mode. 3. Chock all wheels. 4. Turn the battery disconnect switch to the OFF position. Secure a lockout/tagout tag to the disconnect switch following **Lockup/Tagout** procedures. 5. Remove the bolt (A) from the side of the brake canisters and screw the bolt into the bottom of the canisters to secure springs. 7. Remove the lower cotter pin and pin (B) holding brake shoe bracket to brake lever. 8. Lift up the brake bracket to gain access to the brake shoe. 9. Remove brake shoe mounting hardware and replace brake shoe. Make certain you have reinstalled the mounting hardware! 10. Lower the brake bracket and reinstall the pin and cotter pin. 11. Remove the brake lockup bolt from the bottom of the cannister. Repeat Steps 6 through 11 for all brake shoes that need replacing. 12. Return machine to service following the **Lockout/Tagout** procedures. Turn on machine. **Adjustments:** When towing, it is recommended that the brake spring be locked up to prevent unintentional setting of the brake systems. • Remove the bolt from the side of the brake canisters and screw the bolt into the bottom of the canisters to secure springs.	

M5. Run Pressure Checks on Main Pump and Propulsion	
Pressure checks should be performed **every 250 hours or monthly** after the engine and hydraulics have thoroughly warmed up (oil temperature has reached 100°F [37.8°C] minimum). Before performing these checks, **read and understand all OPERATION instructions, warnings and cautions.** The pressure check instructions can be found in the APPENDIX B **PERIODIC ADJUSTMENTS – HYDRAULIC** section of this manual following this section. These testing procedures require at least two workers in order to be performed correctly.	

QUARTERLY (OR 500 HOURS, WHICHEVER COMES FIRST)			
Key: =  = Refer to Mfr's Manual in Component Data  = More Detailed Instructions Follow			
LOC	ITEM	SYM	TASK
MISCELLANEOUS	**Q1.**		Perform all Daily, Weekly and Monthly Lubrication and Maintenance Procedures
	Q2.		Drain Fuel Tank. Replace Fuel Filters and Fuel Tank Breathers
	Q3.		Check Cooling System Hoses
	Q4.		Test Hydraulic Oil Cleanliness, replace filters as necessary
	Q5.		Replace Hydraulic Tank Breathers
	Q6.		- Reserved for Future Use -
	Q7.		- Reserved for Future Use -
	Q8		- Reserved for Future Use -

Detailed Quarterly Instructions

Q4. Test Hydraulic Oil Cleanliness	
Proper fluid condition is essential for long and productive life of hydraulic components and systems. Thorough precautions should always be observed to insure the hydraulic system is clean: 1. Filter each change of oil to prevent introduction of contaminants into the system. 2. Maintain the proper oil level and regularly service filters, breathers, and reservoirs. 3. Take precautions to prevent moisture contamination. Change fluid whenever contamination occurs because even small amounts of water can affect system performance as well as induce corrosion and oil breakdown.	

YEARLY (OR 2000 HOURS, WHICHEVER COMES FIRST)			
Key: =  = Refer to Mfr's Manual in Component Data  = More Detailed Instructions Follow			
LOC	ITEM	SYM	TASK
MISCELLANEOUS	**Y1.**		Perform all Daily, Weekly, Monthly and Quarterly Lubrication and Maintenance Procedures
	Y2.		Steam Clean Oil Cooler
	Y3.		Inspect Wheels for Excessive Wear
	Y4.		Inspect Suction Strainer Element.
	Y5.		Drain and Replace Hydraulic Oil in Tank. Replace all Filter Elements.
	Y6.		- Reserved for Future Use -
	Y7.		- Reserved for Future Use -
	Y8		- Reserved for Future Use -

TROUBLESHOOTING - GENERAL

Troubleshooting is a matter of quickly and logically isolating the cause of a problem and taking corrective action. Operating experience, a thorough understanding of the information in this manual, and accurate maintenance and operation records are the best troubleshooting tools an operator can have. The Model C Machine is a group of rather simple systems. If you understand the basic workings of these systems individually and how they relate to each other, troubleshooting becomes a relatively simple task.

This general portion of the troubleshooting guide has been broken down into four sections, engine, hydraulics, electrical, and mechanical; and is intended to give you basic troubleshooting guidelines.

Local conditions and operating methods may result in problems, causes and remedies not covered in this guide. To use the guide most efficiently, locate a problem that matches the one being experience and, in a step-by-step method, check the causes listed until the correct remedy is found and the problem solved.



Always turn off machine when performing maintenance, making adjustments, or whenever unintended movement of machine could occur; unless directed otherwise. Failure to comply could result in personal injury and/or damage to the machine.

ENGINE TROUBLESHOOTING

When the temperature of diesel fuel is elevated, as occurs when the fuel is circulated through an operating engine, it may pose the following hazards which should be guarded against. Refer to the engine manual for details.

WARNING!

Exhaust emissions caused by the use of the engine on this machine may cause cancer, birth defects, or other reproductive harm if inhaled.

WARNING!

To avoid possible personal injury and/or engine damage from accidental engine startup, always disconnect the battery before servicing this machine.

The following precautions should be taken to minimize the possibilities of injuries from heated diesel fuel:

1. Whenever possible, it is recommended that the engine and fuel be given an opportunity to cool down to ambient temperature before performing service operations which could result in the spillage of fuel from the engine or machine fuel system. When this is not possible, protective clothing (face shield, insulated gloves, apron) should be worn when performing these operations.

2. Keep open flames, sparks or other potential ignition sources away and do not smoke during vehicle refueling and service operations which could result in the escape of liquid or vaporized diesel fuel.

3. Engine or machine fuel systems service operations should be performed in a well ventilated area that is kept free of bystanders.

For engine problems not listed in the troubleshooting charts, please refer to the Engine Manual.

ELECTRICAL TROUBLESHOOTING

INSPECTION

Inspect the electrical system for clues to the malfunction. Check to see if the unit can be operated without further damage to the system. Always check these items before turning on switches or running the machine:

1. Look for bare wires that could cause grounds or shorts. Shorted wires can damage the charging system.

2. Look for loose or broken wires.

3. Inspect all connections, especially battery connection points. Cleaning harness connectors or ground connections can often correct what appears to be a malfunction.

4. Check the battery electrolyte level. Continued loss of electrolyte fluid indicates overcharing or cracked battery case.

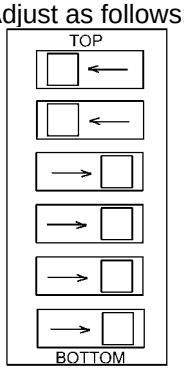
5. Inspect for overheated parts after the unit has been stopped for a while. They will often smell like burned insulation. Put your hand on the alternator. Heat in these parts, when the machine has not been operated for some time, is a sure clue to charging circuit problems.

Many electrical failures cannot be detected even if the machine is started. If your visual inspection does not indicate the possible malfunction refer to the electrical system troubleshooting guide that follows.

The Electrical Schematic for this machine can be found at the back of this TROUBLESHOOTING section and behind the Electrical tab of the manual.

ELECTRICAL SYSTEM
TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	SOLUTION
Battery uses too much water	Cracked battery case. High Ambient Temperature. Shorted Cell. Battery being Overcharged.	Replace battery. Refill with water. Check specific gravity. Alternator problem. Check charging voltage ≈14.6V, repair or replace alternator.
Cracked Battery Case	Frozen battery	Keep battery fully charged in cold weather. Replace battery.
Low Battery Output	Low water level. Dirty or wet battery top causing discharge. Corroded or loose battery cables. Broken Battery post. Wrong size replacement battery.	Add distilled water. Clean and wipe dry battery top. Clean and tighten battery cables. Wiggle battery post by hand. If post wiggles or turns, replace battery. Replace battery with type specified under "Machine Specifications".
Starting Motor will not turn.	Battery disconnect switch turned off. Defective ignition switch Faulty Relay Corroded battery terminals.	Turn switch to "ON" position. Repair or replace. Replace Inspect and clean if necessary.
Hourmeter does not work.	Hourmeter Wiring harness shorted Corroded or failed hourmeter groundwire.	Replace Hourmeter. Replace wiring harness. Replace groundwire.
Horn does not sound	Wiring Harness Connection at horn loose. Horn circuit breaker blown. Horn broken. Horn Relay. Horn Switch.	Check harness, repair or replace. Tighten connection. Reset circuit breaker, see page 89 Check horn, repair or replace. Check relay. Check switch, repair or replace.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Backup Alarm does not sound.	Backup Alarm switch not turned on	Turn on.
	Wiring harness	Check harness, repair or replace.
	Connection at alarm loose.	Tighten connection.
	Backup Alarm	Check alarm, repair or replace.
	Backup alarm switch faulty.	Check switch, repair or replace.
Travel Lights do not work.	Wiring harness	Check harness, repair or replace.
	Connection at light loose.	Tighten connection.
	Light circuit breaker blown.	Reset circuit breaker, see page 89
	Light switch defective.	Repair or replace switch.
	Connection at switch loose.	Tighten connection.
	Connection at circuit breaker panel loose.	Tighten connection.
	Bulb or socket in light defective.	Replace bulb or socket.
Work Lights do not work.	Wiring harness	Check harness, repair or replace.
	Connection at light loose.	Tighten connection.
	Light circuit breaker blown.	Reset circuit breaker. See next page.
	Bulb or socket in light defective.	Replace bulb or socket.
Cooling Fan not working	Loose connection at back of fan	Tighten.
	Loose connection at circuit breaker panel.	Tighten.
	Loose connection on relay.	Tighten.
	Dip Switch settings not correct.	Adjust as follows: 
Brake Lights do not	Wiring harness.	Check harness, repair or

PROBLEM	POSSIBLE CAUSE	SOLUTION
work		replace.
	Connection at light loose.	Tighten connection.
	Light Circuit breaker blown.	Reset circuit breaker. See page 98
	Bulb or socket in light defective.	Replace bulb or socket.

HYDRAULIC SYSTEM

Particularly after start-up of an installation, components should be checked regularly at short intervals for correct operation and possible leakage.

INSPECTION

Inspect the hydraulic system for clues to the malfunction. Check to see if the unit can be operated without further damage. If not, shut down machine immediately. Always check these items before starting the machine:

1. Check hydraulic oil level.

2. Look for loose or disconnected hoses. An oil spot below the machine is a good indication of a loose hose or hydraulic component.

3. Make certain shut-off valve on suction strainer is OPEN. Opening valve can often correct what appears to be a malfunction.

4. Inspect all vital hose connections, especially at main pump and the main pump hose connection at the manifold.



Tighten fittings only when system is not pressurized. High pressure leaks can cause personal injury.

5. Look for cover damage and/or indications of twisted, worn, crimped, brittle, cracked, or leaking hoses. Hoses with their outer cover worn through or otherwise damages should be considered unfit for further service.

While machine is running, and before working, inspect for leaks. If the machine has not been run for some time, oil may thicken causing a variety of malfunctions. If this is true, make certain that the oil tank has been properly drained, cleaned and refilled.

If your visual inspection does not indicate the possible malfunction, refer to the troubleshooting guide that follows.

FLUID CONTAMINATION

Contamination comes in many forms. It may be air, water and cutting oils, rust, chips and grit. It is usually easier to keep contaminants **out** of a system rather than remove them after they are **in** the system.

Bulk handling and the re-use of oil containers almost guarantees you that "new" oil will be dirty. Make it a practice to filter all "new" oil before adding it to your system. Make it another practice to change filters on a regular basis **before** they become clogged.

LOCATING LEAK SOURCES

Petroleum oils are used in most hydraulic application to lubricate parts as well as transmit power. As oil temperature increases, however, the lubricating film thins out. The result is rubbing parts supported by the oil film move closer together; friction and wear increase; seal materials age more quickly, become stiff and hard, and may readily permit leakage.

The first step in locating leaks is to eliminate the possibility that an over-filled reservoir or spill created the "suspected" leak. The next step would be to clean the suspected area and watch. Leaks usually occur in fittings, hoses, O-rings, and other seals.

Most leaks occur at fittings, but too often, finding the fitting that is leaking is difficult because the fluid runs along the hose and drips off at some other point. Leaks in high pressure lines sometimes are difficult to pin-point because the fluid comes out as a mist.

Once you find the location of a leak, the specific cause has to tbe determined before it can be corrected. A scratch in a fitting seat or a cut in a seal lip that is big enough to leak excessively can still be too small to find with the naked eye. The use of a magnifying glass would assist you.

HOSE LIFE

Hose leakage or failure many times occurs where the end fitting grips the hose. Check the system for pressure spikes or surge. If bulges or bubbles occur on a flexible hose, a leak is taking place within the layers. The hose should be replaced.

High oil temperatures (over 200 degrees Fahrenheit, 93 degrees Celcius) quickly harden or stiffen a rubber hose. When pressure pulses flex a hardened hose, it fails by cracking. Every increase of 25° F (14°C) cuts hose life in half. Use a replacement hose rated for actual fluid temperatures. Keep a log of hose use so replacement can be made before failure occurs.

If a hose is installed with a twist in it, high operating pressures tend to force it straight. This can loosen the fitting or even burst the hose at the point of the strain.

HYDRAULIC SYSTEM
TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	SOLUTION
Hydraulic pump does not develop pressure	No hydraulic oil in tank (NOTE: if pump is run without oil in tank, pump damage will occur.)	Check oil level. Refill tank.
	Shut-off valve closed. (NOTE: if pump is run with valve closed, pump damage will occur.)	Open valve completely.
	Main relief valve bypassing. (NOTE: oil blowing past any relief valve can cause oil to overheat.)	Increase pressure setting on relief valve. (See Pressure checks)
	Main pump compensator setting is too low.	Adjust compensator setting. (See Pressure Checks)
	Pump is defective.	Refer to pump manual or replace pump.
	Destroke valve stuck.	Repair or replace.
	Pump valve turned off.	Turn on.
Hydraulic pump excessively noisy	Cold oil.	Allow unit to warm up.
	Low oil level.	Check and add oil.
	Oil viscosity too high (oil too thick)	Drain and add correct oil as specified under "RECOMMENDED LUBRICANTS".
	System relief valve set too low.	Increase pressure setting on relief valve (see Pressure Checks)
	Intake hose to pump restricted.	Inspect and repair.
	Defective pump.	See pump manual, repair or replace pump.
Machine will not propel	Main pump not developing pressure.	See above.
	Propulsion crossover relief setting too low.	Increase relief setting. (See Pressure checks)
Hydraulic Oil Overheats	Oil viscosity too high (oil too thick)	Drain and add correct oil as specified under "RECOMMENDED LUBRICANTS".
	System relief valve set too low.	Increase pressure setting on relief valve (see Pressure Checks)
	Oil lines damaged causing excessive internal restriction	Inspect and repair.

PROBLEM	POSSIBLE CAUSE	SOLUTION
	Propulsion crossover relief setting too low.	Check and reset
Hydraulic Oil Foams	Water in oil	Inspect oil for water. Drain and add correct oil as specified under "RECOMMENDED LUBRICANTS".
	Using wrong oil	Drain and add correct oil as specified under "RECOMMENDED LUBRICANTS".
	Low hydraulic level	Fill
	Damaged hydraulic oil lines	Inspect, repair or replace.
	Air leak in suction line to hydraulic pump or pump shaft seal leaking	Inspect, repair or replace.

MECHANICAL TROUBLESHOOTING

INSPECTION

Inspect the mechanical system for clues to the malfunction. Check to see if the unit can be operated without further damage.



Always turn off machine when performing maintenance, making adjustments, or whenever unintended movement of machine could occur; unless directed otherwise. Failure to comply could result in personal injury and/or damage to the machine.

MECHANICAL SYSTEM
TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	SOLUTION
Machine will not propel.	Main pump not developing pressure.	See Hydraulic Troubleshooting.
	Brakes not releasing.	See next problem.
	Propulsion crossover relief setting too low.	Increase relief setting.
	Defective motor or broken drive chain.	Repair or replace motor or chain.
Brakes will not release	Relief valve setting too low.	Adjust relief setting.
	Brake valve not shifting.	Check valve spool for free motion and that solenoid is being energized.
	Brake cylinder bypassing oil.	Inspect and repack cylinder.
Brakes will not apply.	Brake valve not shifting.	Check valve spool for free motion and that solenoid is being energized.
	Broken spring in brake chamber.	Inspect spring and replace if necessary.
	Brake shoes worn.	Inspect shoes and replace it necessary.
Spikes not feeding completely into jaws.	Bent jaw.	Inspect and replace if necessary.
	Jaw or pins worn.	Inspect and replace if necessary.
	Escapement duration set too low.	Adjust time delay.
Spikes not going in straight.	Jaw and tray not properly aligned.	Check for loose bolts or bent components.
	Jaws worn.	Replace jaws.