Harsco Track Technologies™
MK VI Tamper
w/Jupiter Control System
Operation and Maintenance Manual

HTT Australia, On Track, New Zealand

HTT
Harsco Track Technologies
Harsco

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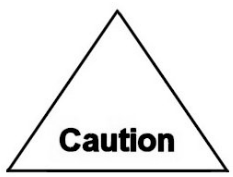

THIS MANUAL CONTAINS VITAL INFORMATION FOR THE SAFE USE AND EFFICIENT OPERATION OF THIS MACHINE. CAREFULLY READ THE OPERATOR'S MANUAL BEFORE USING THE MACHINE. FAILURE TO ADHERE TO THE INSTRUCTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

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Preface

Conventions Used In This Manual

italics	Indicates references to other manuals, such as the *Parts Manual.*
bold	Indicates a control lever, pushbutton or toggle switch. Indicates button or switch..
Double quotation marks (" ")	Indicates button or switch.. Indicates the title of other chapters, sections, or pages in this manual, such as "Appendix A'.

NOTE

The note symbol is used to indicate additional information or special conditions you need to know about concerning a procedure or the machine.

The caution and warning symbols are used to alert you or call attention to a condition that could cause bodily injury or damage to the machine.

How To Use This Manual

Make sure you read "Chapter 1" before you read any other chapters in this manual because it describes safety rules and safety features.

If you are **NOT** familiar with all of the machine components, make sure you read all of the chapters and all of the appendices before you try to operate the machine or perform maintenance or repairs on the machine.

If you are already familiar with the machine, you should read all of the chapters that apply to the type of operation you need to perform, such as the procedure for starting and setting-up the machine for work. All references to left or right are determined from the operators seat.

TABLE OF CONTENTS

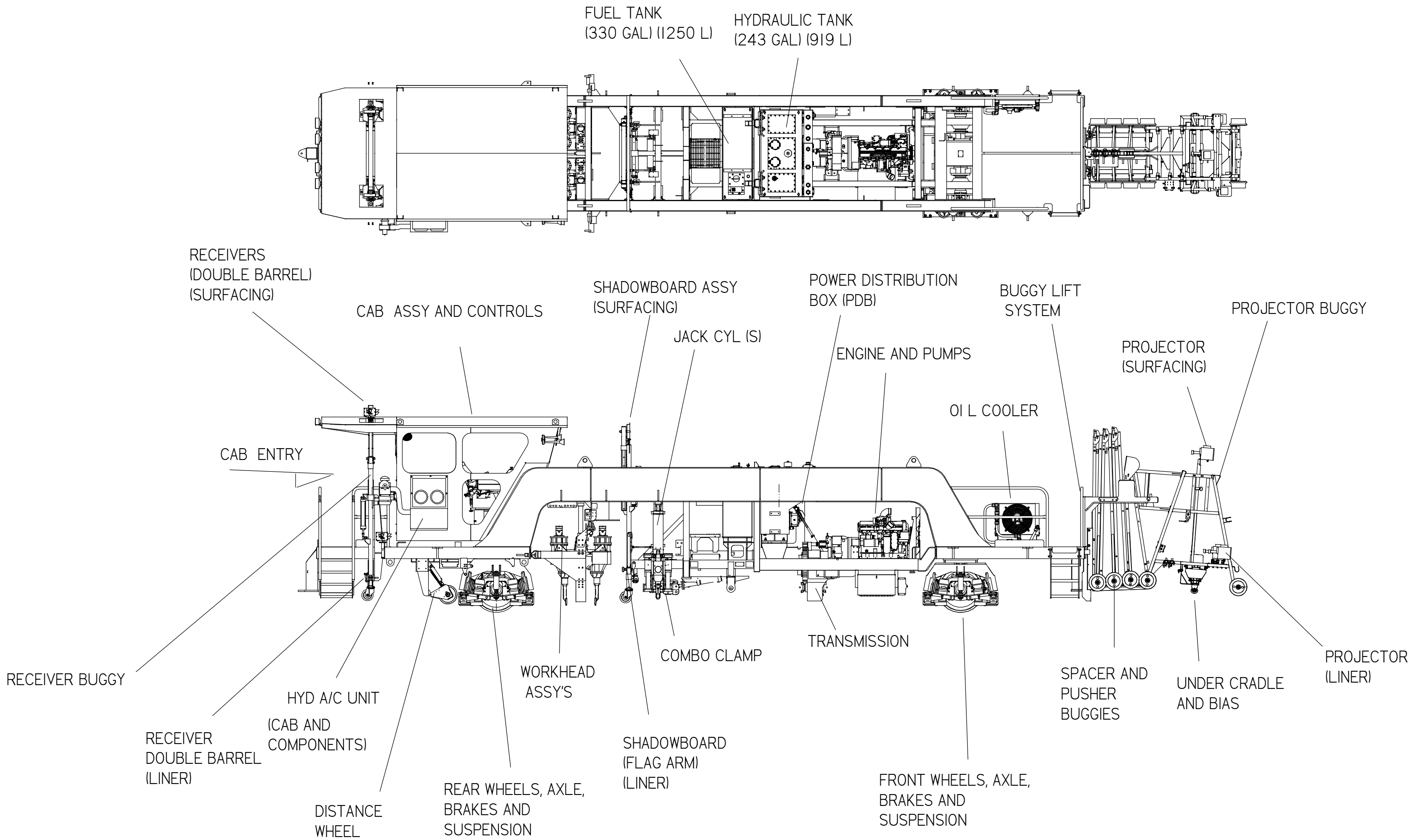
CHAPTER 1

CHAPTER 2

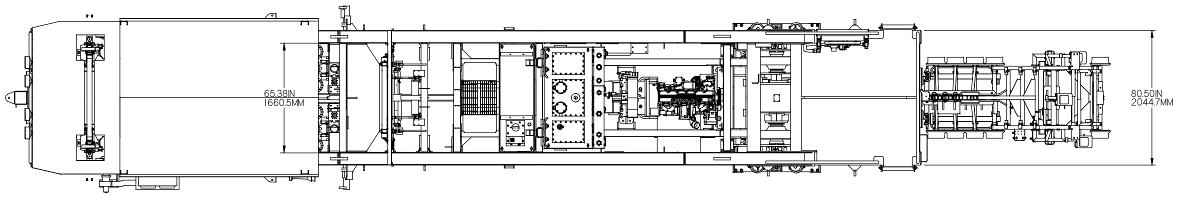
CHAPTER 3

CHAPTER 5

MK VI TAMPER
COMPONENT LOCATION



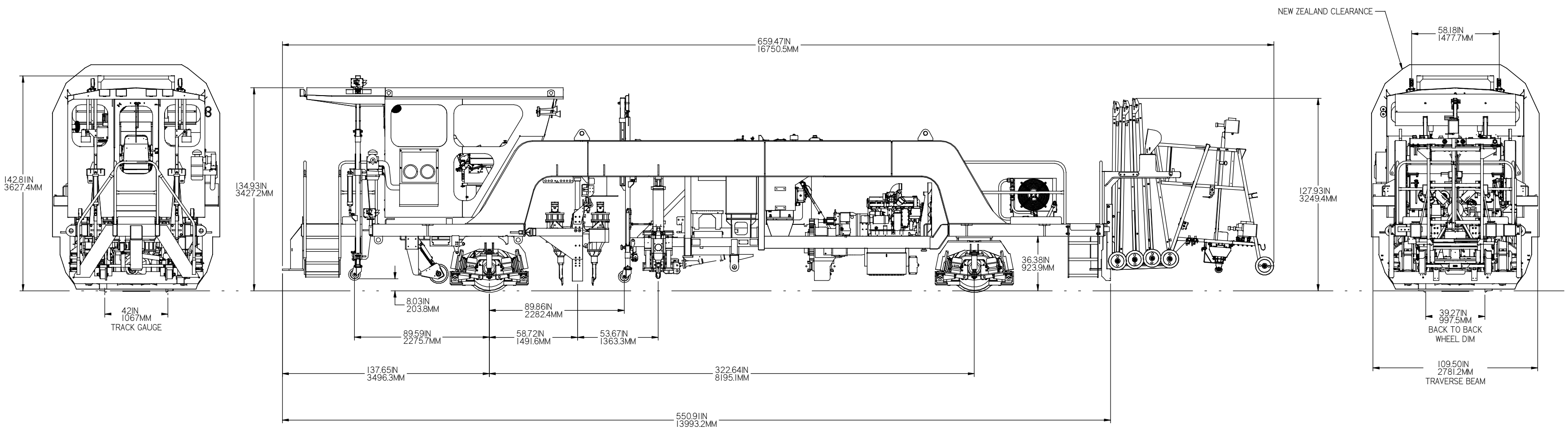
MK VI TAMPER
PHYSICAL DATA



FLUID CAPACITIES

HYDRAULIC TANK 919 L (243 GAL)
FUEL TANK 1250 L (330 GAL)

GAUGE: 42 INCHES (1067 MM)



ESTIMATED WEIGHT = 75,000 POUNDS

SOLID EDGE DRAWING

IMPLIED TOLERANCES
ALL DIMENSIONS ARE IN INCHES - TOLERANCE UNLESS OTHERWISE SPECIFIED

NOMINAL SIZE RANGE OVER	TO	INCH PLUS OR MINUS 2 PLACE DECIMAL	3 PLACE DECIMAL	NOMINAL SIZE RANGE OVER	TO	METRIC PLUS OR MINUS 1 PLACE DECIMAL	2 PLACE DECIMAL
0	6	.03	.005	0	150	.8	.127
6	24	.04	.008	150	600	1.0	.203
24	-	.06	.010	-	600	1.5	.254

UNLESS OTHERWISE SPECIFIED ALL MACHINED SURFACES WILL HAVE;
A SURFACE FINISH OF 125 MICROINCHES
ANGULAR TOLERANCE OF ± .50°
CONCENTRICITY WITHIN .010

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED ALL WELDS SHOULD ADHERE TO THE LATEST HTT WELDING SPECIFICATION 101

CHANGE	R/L	REVISION	DATE
10*****	A	NEW RELEASE	-/-/07

Description: MBOM MK VI NEW ZEALAND
Drawing Number: ----------
Machine Type: MK VI NZ 42
Model: 4013043.asm
Drawn: jrowell
Date Drawn: -/-/07
Weight: 0.0 lbm
Scale: ----
APVD Desg: ---
APVD ChEng: ---
Mat'l

HTT
Harsco Track Technologies
Harsco
Columbia, SC

Part Number: 4013043
Size: D
Sheet: 1 of 1

Plotted by jrowell on 5/4/2007 4013043_general_arrangement.dft

MARK VI ENERGY CONTROL PROCEDURE

PURPOSE

This procedure informs appropriate personnel of the location and proper means of removal and restoration of electrical, mechanical, hydraulic and pneumatic energy for this machine. This procedure is provided to help protect personnel from the unexpected release of energy while performing maintenance, making adjustments or dealing with emergency shutdown conditions.

This procedure will be used by personnel responsible for lockout and tagout.

SCOPE

This procedure must comply with railroad safety rules. It is to be used in conjunction with an operator's manual, when servicing or repairing machine. Any alterations to this machine may invalidate this Energy Control Procedure and/or lockout tagout procedures.

MODEL:	MARK VI	MANUFACTURER	Harsco Track Technologies	ISSUE DATE	10/28/98
ENERGY SOURCES:		ELECTRICAL	12VDC/24VDC/120VAC	COMPRESSED AIR	X
		HYDRAULIC	X	MECHANICAL	X
STORED ENERGY:		RAISED LOAD	X	COIL SPRINGS	X
		BATTERY	X	AIR TANK	X
		HYDRAULIC PRESS	X		

PROCEDURE TO REMOVE MACHINE FROM ENERGY SOURCE

1. The person who will be doing the maintenance or adjustments must familiarize themselves with the type of energy sources for this machine and understand fully the hazards of the energy.
2. Stop machine and set parking brake.
3. Lock Workheads, Clamp Frame, Shadowboard Buggy, Receiver Buggy, and Projector Buggy with folding reference system in the secured travel position unless one or more of these work components is the area requiring maintenance, and the anticipated work will require that component to be resting on the rail or ballast. Any work component not locked in travel position should be lowered until its full weight is on the rail or ballast.
4. Return throttle to idle position.
5. Stop engine. (Stop engine switch is located on Engine control panel)
6. Turn battery master switch to "OFF" position. (Switch is located under right engine frame member)
7. Drain air system by pulling air reservoir drain valve control ring until all air pressure has escaped.
8. Verify that all energy sources are de-energized by operating the controls to make sure the equipment will not operate (attempt to start engine).

PROCEDURE TO RESTORE MACHINE TO SERVICE

1. Check the machine and surrounding area to make sure all tools, etc. have been removed from machine.
2. Verify that everyone is clear of the machine while it is being restored to power.
3. Verify that all controls are in neutral or off position.
4. Turn battery master switch to "ON" position.
5. Start engine.
6. Verify that all energy sources are energized by observing information on control panels.
7. Test all functions of the machine which were affected by the repairs.

Chapter 1

Safety

Read this chapter before you attempt to operate or perform maintenance on the equipment described in this manual. This chapter describes the following:

- Safety rules
- Safety features
- Safety locks

Safety Rules

1. Follow all rules and regulations issued by your railroad concerning self-propelled track equipment.
2. Read this section very carefully and make sure you know what safety features and safety devices are provided with the equipment.
3. Carefully read all instructions, notes, cautions, and warnings that are provided in all other chapters in this manual.
4. Know the positions and functions of all controls before attempting to operate this machine.
5. Before operating the equipment, perform a visual inspection of the equipment components, and any attachments. Check for broken, loose, or worn parts.
6. Before starting the engine, check all fluid levels; engine oil, coolant, hydraulic oil and fuel. Keep FULL. Check for any leaks, loose or damaged parts, worn or damaged belts, and any change in engine appearance.
7. Before moving the machine on the track (travel), make sure all working components and attachments are secured by the appropriate safety devices, such as safety locks
8. If the machine is equipped with safety bars, make sure all bars are securely fastened in their horizontal position before moving the machine.
9. Activate the horn several times to alert all those in and around the machine that the machine is going to move, either forward or reverse.
10. Before moving or operating the equipment, make sure all personnel are safely away from the equipment.
11. Make sure the equipment and the engine have stopped and all work components are locked in their safety locks before performing service or maintenance tasks. Also, make sure the computer switch is OFF.

12. **Be sure to turn OFF the main battery switch before performing any welding (repairs).** *Failure to turn OFF the battery switch will result in equipment damage.*

13. Keep all equipment and components clean.

NOTE: The MKVI machine is equipped with a MOTION ALARM. This audible alarm is activated during the first three (3) seconds of movement or change of direction except when indexing.

Safety Features

The following emergency shutdown systems are provided as standard equipment on this machine.

Emergency Engine Shutdowns

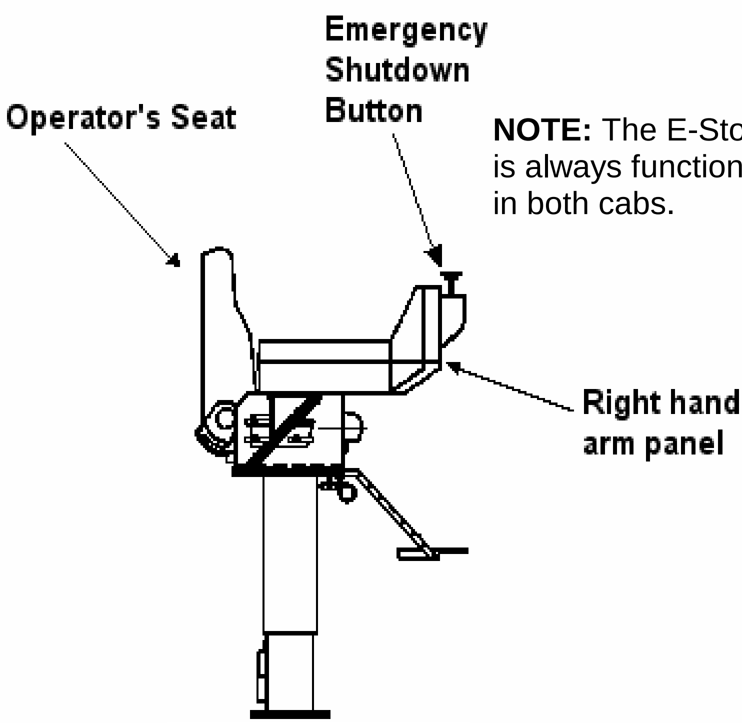


Figure 1-1: Front Cab E-Stop

NOTE: The E-Stop is always functional in both cabs.

The engine has an **AUTOMATIC EMERGENCY SHUT-DOWN** system which is automatically activated if the engine oil pressure is too low or if the engine coolant temperature is too high.

The **MANUAL EMERGENCY ENGINE SHUT-DOWN** buttons are located on the center console in the front cab and on the front of the right arm control panel in the rear cab. Refer to Figure 1-1 and 2-1.

NOTE: The emergency shutdown push buttons must be reset to start the engine. Push to shut down the engine and pull to reset.

Pressing the E-Stop button stops the engine and dumps air brake pressure causing the spring parking brakes to apply.

Spring Parking Brakes

The Spring Parking Brake Control (Air Deactivated) will not release if the air pressure in the braking system is less than 60 PSI. When released, the Spring Parking Brake automatically applies if the air pressure in the braking system drops below 60 PSI.

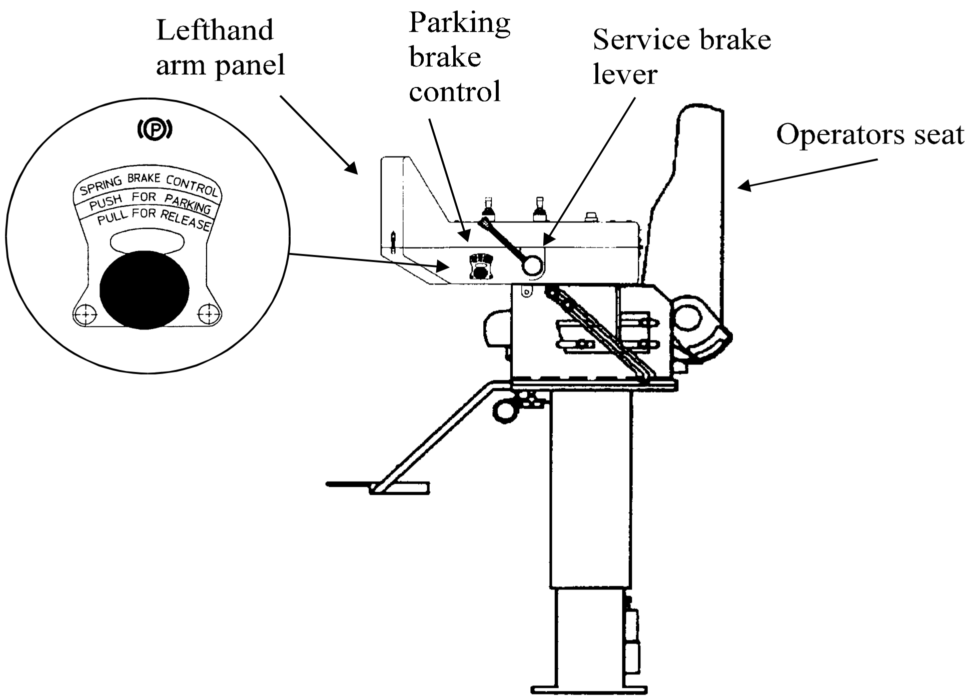
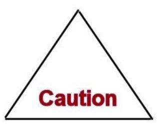


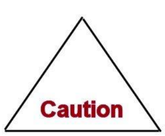
Figure 1-2 Seat Assembly.



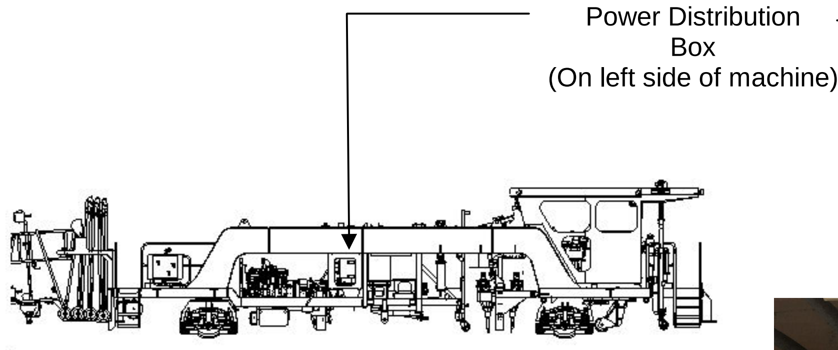
The Brake System is service brake priority. Service brake must be released for the parking brake to apply.

The **SPRING PARKING BRAKE CONTROL** is located on the right side of the operator's seat in the front cab and on the outside edge of the left arm console panel in the rear cab. The spring parking brakes are released when the control knob is **PULLED OUTWARD** (air is applied to the spring portion of the brake chamber) and applied when the control Knob is **PUSHED INWARD** (air is released from the spring portion of the brake chamber). Refer to Figure 1-2.

Note: *Brakes can only be released from the active or cab in control.*



ALWAYS START AND END WITH THE SPRING PARKING CONTROL BRAKE IN THE "APPLIED" POSITION (Push In the push/pull knob) AND THE TRAVEL/SERVICE HAND BRAKE LEVER IN THE "RELEASED" POSITION (push lever forward (toward front of seat). Spring Parking Brake is also commonly referred to as the MAXI BRAKE CONTROL. *Service and Parking Brakes can only be applied from the cab that has control.*



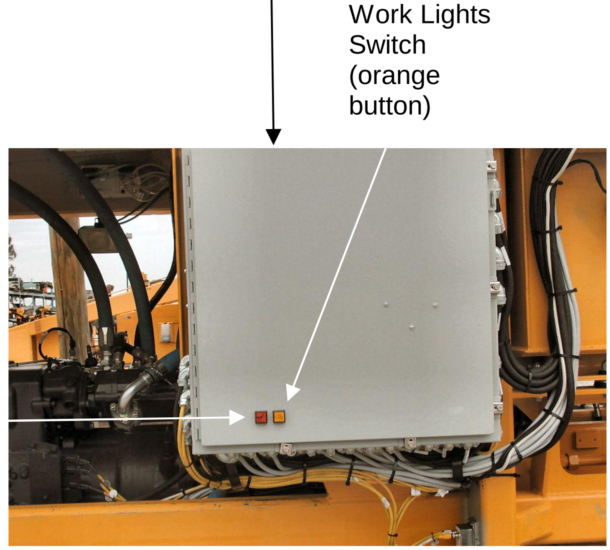


Figure 1-3

Emergency Pump ON/OFF Push Button

If there is a problem with the engine or the hydraulic system and the working components are NOT in their safety locks, IE workheads, clamp frame, etc., the emergency pump can be used to place the working components in their safety locks. Press (inward) the **EMERGENCY PUMP ON/OFF PUSH BUTTON** (red) to activate (start) the emergency pump. The emergency pump switch is located on the Power Distribution Box cover the left side of the machine. Once the pump has started, have someone activate the control(s) for the desired work component to raise it into its safety lock. *Raise only one (1) component at a time*. When all of the work components are secured in their safety locks, turn the emergency pump OFF by releasing the button. Refer to Figure 1-3 and 1-4.

NOTE

The EMERGENCY PUMP is a small pump mounted to a 24 VDC starter motor. DO NOT RUN the Emergency Pump longer than 1 minute when the pump is -loaded (2500 PSI) or more than 5 minutes when NOT loaded. Allow the motor ample cooling time before restarting the emergency pump.

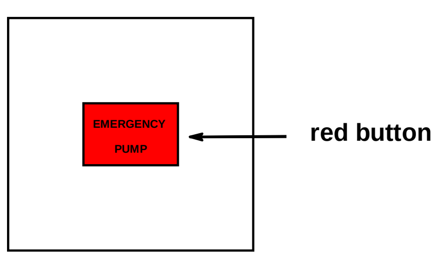


Figure 1-4: Emergency Pump Button

The emergency pump ONLY provides enough oil (volume) to lift the work components, such as the workheads, into their safety locks. The emergency pump does NOT provide enough oil (volume) to move/travel the machine or to use the machine to perform work.

If the Jupiter Control System is disabled, you can manually shift the appropriate hydraulic valves to raise the components into their safety locks.

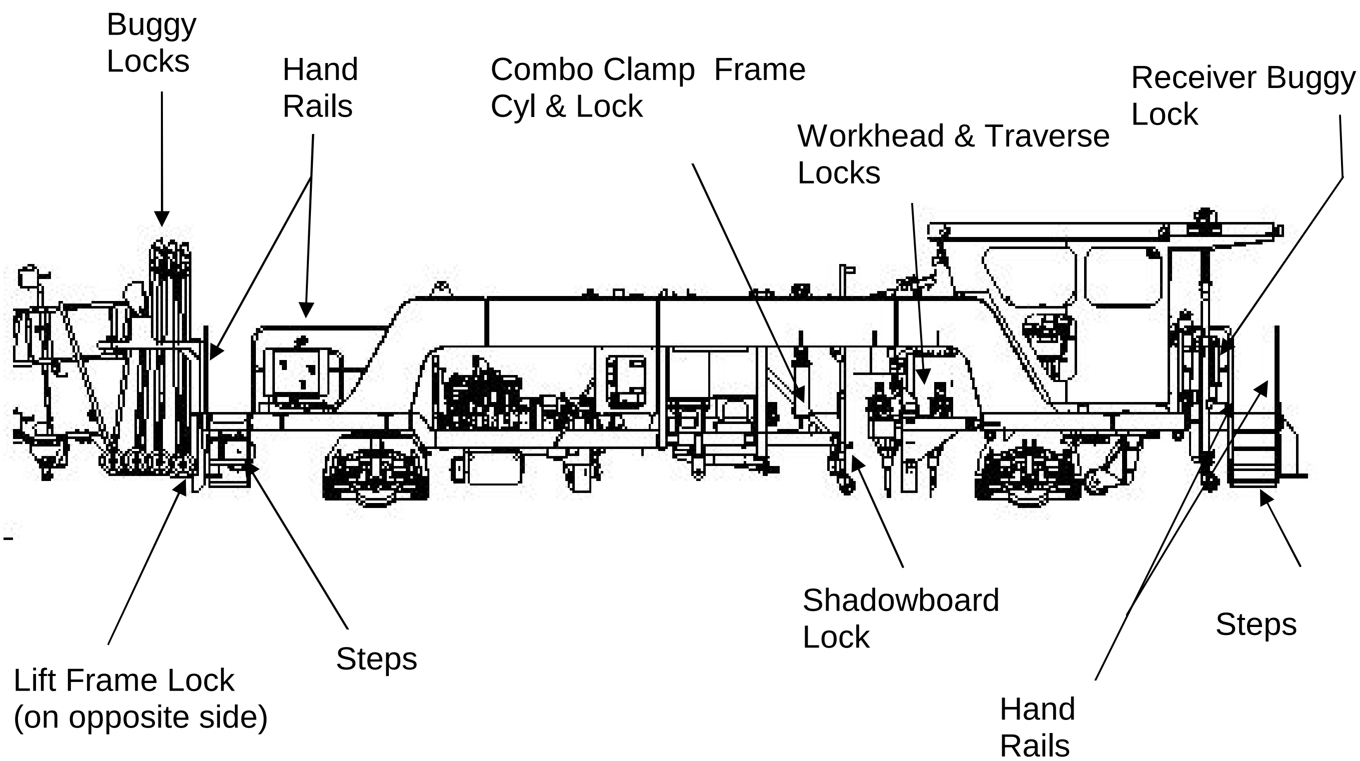


Figure 1-5
Machine Safety Locks

Safety Locks

All working components on the machine, such as the workheads, have safety locks which should always be used to prevent damage to the machine when traveling and to prevent injury to personnel. Refer to Figure 1-5 for the general location of the Safety/Travel Locks.

Pre-Travel Component Checklist: (See CAUTION on the following page)

•	
•	
•	
Projector Buggy	
• Lower Surfacing Projector	
• Remove and Store Lining Projectors	
• Raise and Lock Projector Buggy	

Clamp Frame	
• Raise and Lock Clamp Frame	
• Shadowboard Assembly	
• Raise and Lock Shadowboard Assembly	
• Tilt and Lock upper Shadowboard	
Workheads	
• Raise and Lock Workheads	
• Raise and Lock Traverse Extensions	
Light Shields	
• Place light shields in stored position	
Receiver Buggy	
• Lower Surfacing Receivers	
• Move Lining Receivers to stored position	
• Raise and Lock receiver buggy	

Do not attempt to perform any of these instructions unless you are trained and qualified to operate this machine. Failure to properly store the work components before travel may cause personal injury, damage to the machine or track structures.

Workhead Locks

There are two (2) manually controlled and operated traverse locks that keep the work heads from moving or drifting when traveling. In addition, four (4) pneumatically controlled workhead locks (one per workhead) are used to keep the workheads locked up during travel. Refer to Figure 1-6.

The workheads should be placed in their safety locks for track travel, maintenance and repairs. Failure to lock the workheads may cause serious damage or bodily injury.

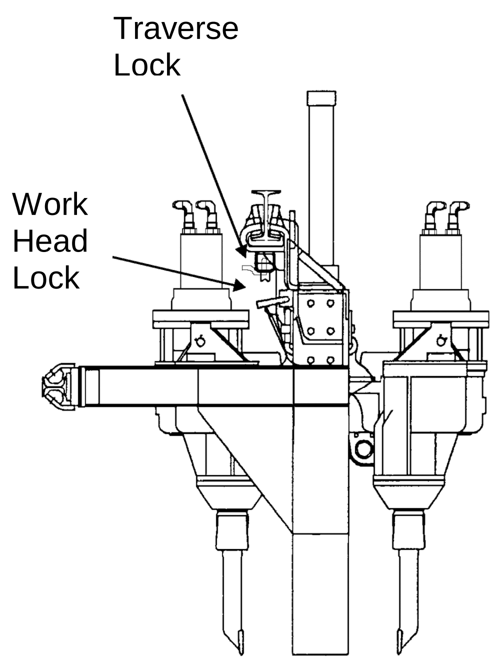
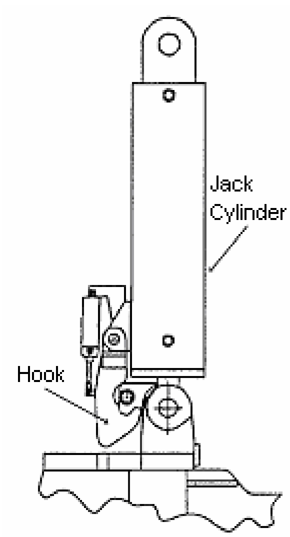
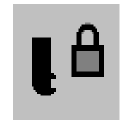


Figure 1-6
Workhead Locks

Clamp Frame Locks



There are two (2) air controlled and operated locks for the clamp frame, one (1) on each jack cylinder. These locks are used to secure the clamps in the "raised" position for travel. Refer to Figure 1-7. When the clamps are locked, the lock icon on the main screen will appear gray (locked) as shown at right. When unlocked, this icon will be yellow.



The machine will NOT move in TRAVEL MODE when:

1.) Traverse Beam Extensions are not fully up and locked.
2.) Workheads are unlocked (downfeed lock)
3.) Clamp frame is unlocked

Figure 1-7
Clamp Frame Locks

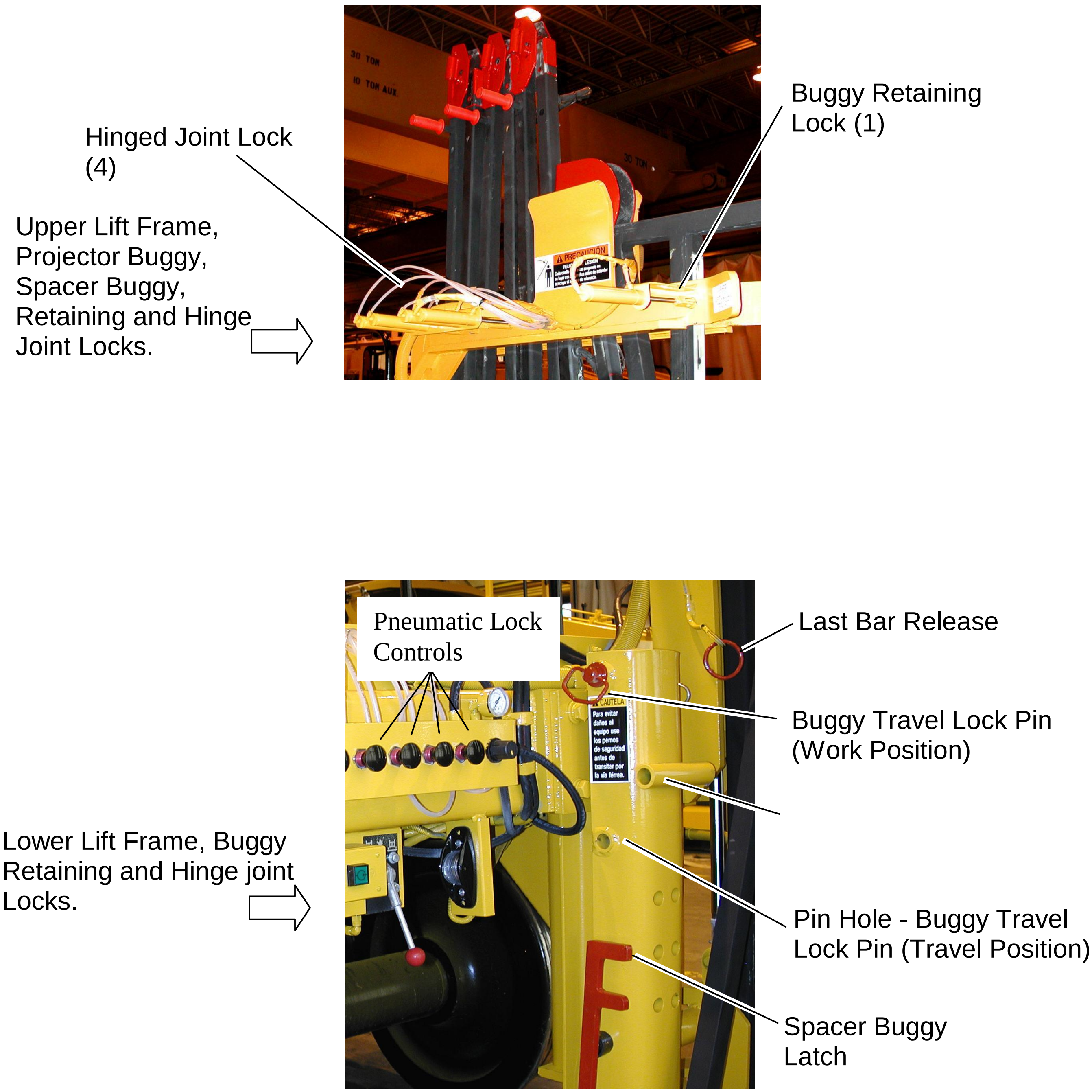


Figure 1-8
Lift Frame and Projector Buggy Locks

Projector Buggy Locks

A forklift type, buggy lift system is used on this machine for positioning the pusher buggies and projector buggy for work or travel. At the front of the lift frame, two (2) manual type locking pins are used to secure the projector buggy on the lift frame for travel.

Two (2) air activated cylinder type locks are used to secure the lift frame in the travel position. When the pusher bar is positioned for work, each hinged joint must be secured with the locking pin provided. A total of four (4) locking pins are provided for the hinge joints. Refer to figures 1-5 and 1-8.

The surfacing projector is mounted on an actuator assembly so that it can be lowered to meet travel clearances and raised for Work. To prevent damage, be certain that the projector has been LOWERED before TRAVEL is initiated.

Shadowboard Assembly Lock

The Shadowboard Assembly lock is air operated and is used to secure the Shadowboard frame in the “raised” position for travel. As shown below, a tilt feature is available as an option. Refer to Figure 1-9.

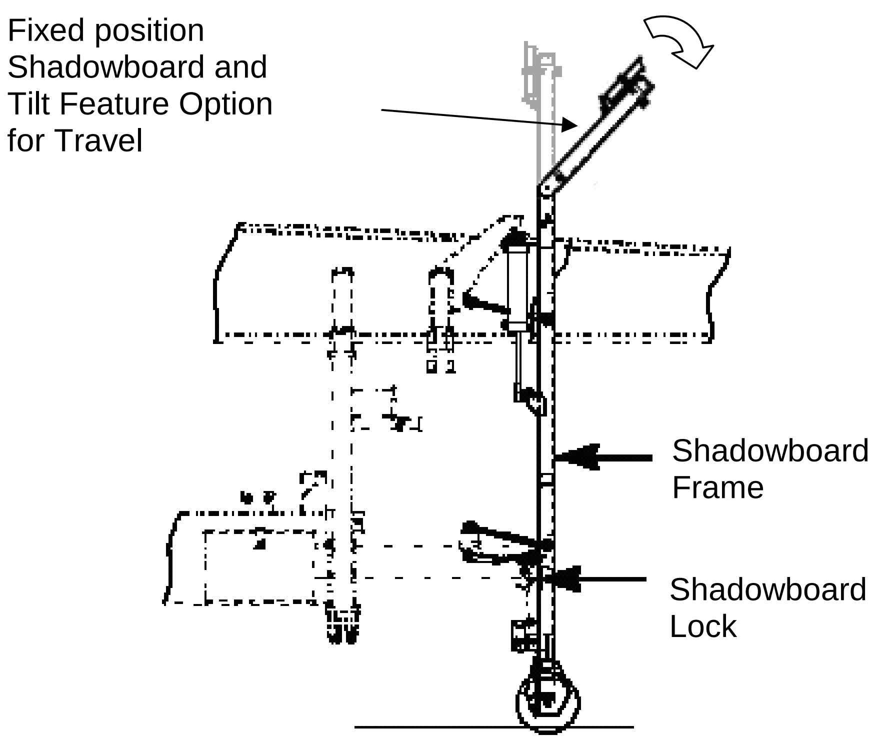


Figure 1-9
Shadowboard Assembly Locks

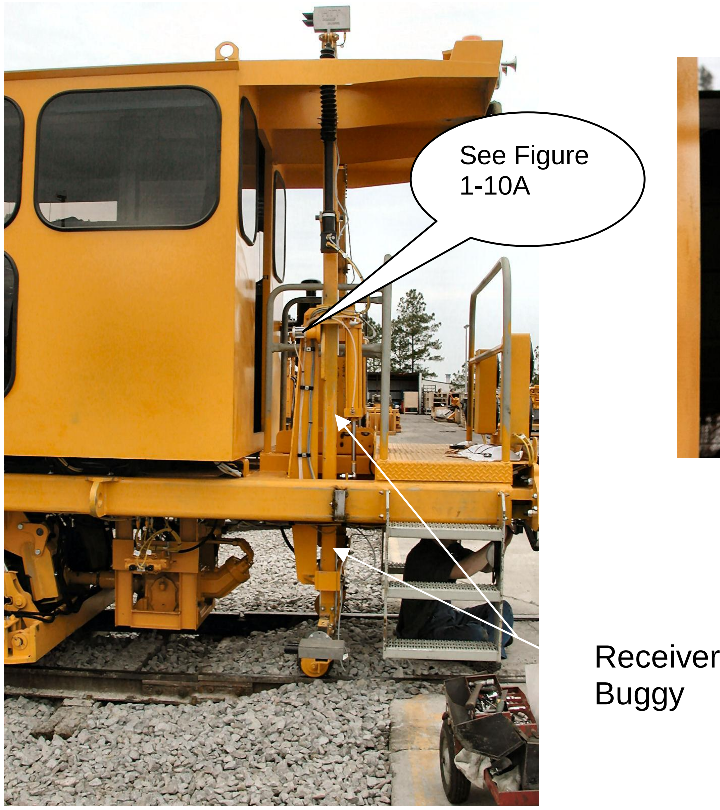


Figure 1-10
Receiver Buggy

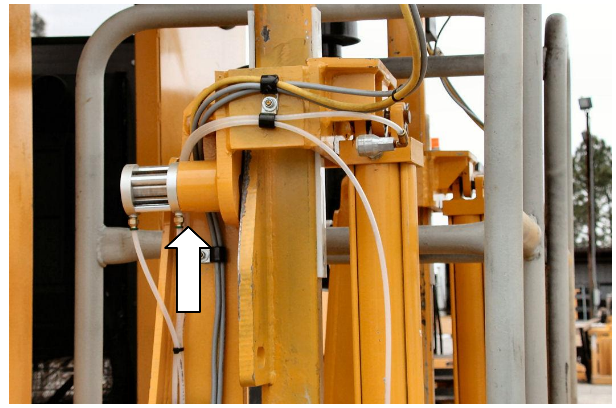


Figure 1-10A
Receiver Buggy Lock
(Typical on opposite side)

NOTE Surfacing Receivers will automatically lower when travel mode is selected.

Caution Verify that all receivers are lowered before track travel.

Receiver Buggy Assembly Lock

The lock is air controlled and operated. The lock is used to secure the receiver buggy components in the “raised” position for travel. Refer to Figure 1-10 and 1-10A

Steps, Platforms and Hand Rails

This Mark VI is fitted with steps and platforms on components such as: the fuel tank area, workhead traverse beam and shadowboard frame assembly. Hand or grab rails have also been added in some of these areas. These features provide safer access to components when servicing or making repairs. Refer to Figure 1-5 and 1-11

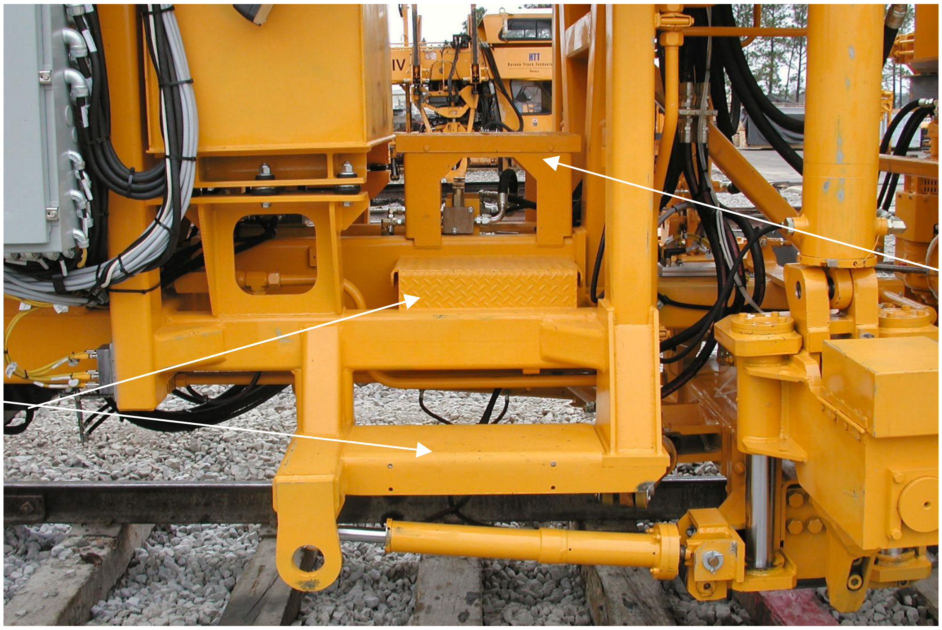
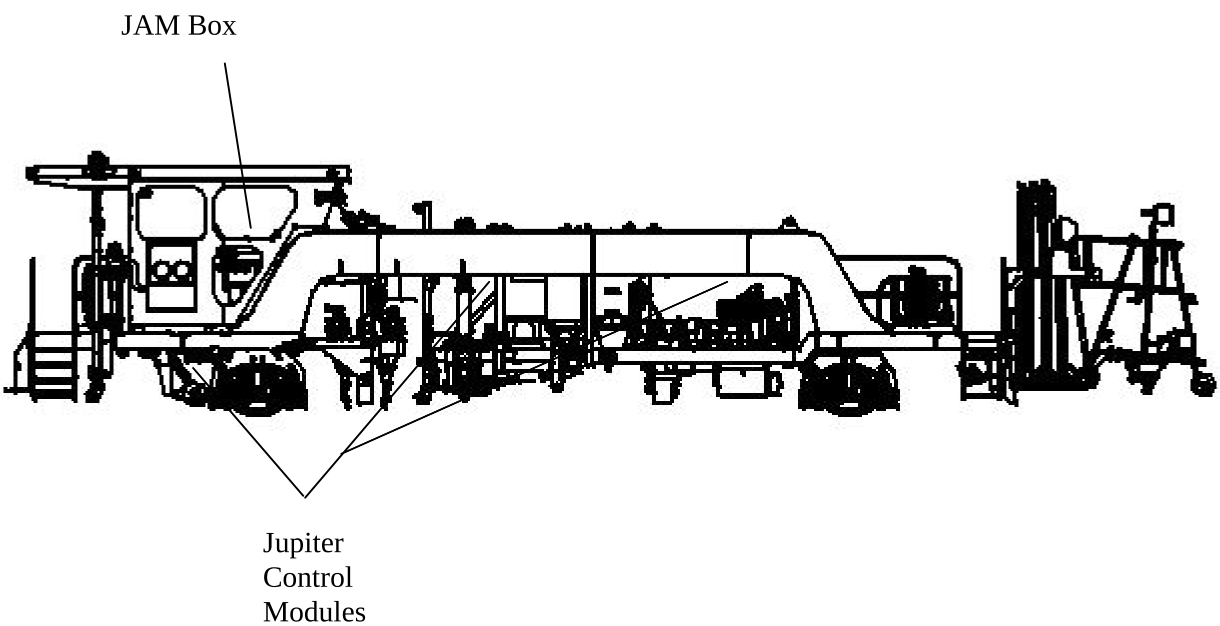


Figure 1-11

Chapter 2

MACHINE CONTROLS - Travel Mode



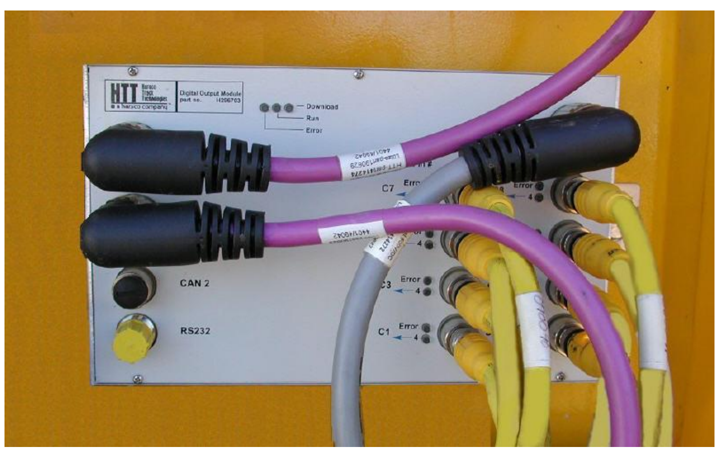


Figure 2-1
Jupiter Control Module

All machine controls for the MKVI Tamper are strategically located to give the operator the utmost in visibility while traveling or working.

This MKVI Tamper is equipped with a state-of-the-art Jupiter Computer Control System that allows the operator to easily access most machine functions. The Jupiter Control System is a distributed I/O (input/output) system that features comprehensive diagnostics, simplified electrical system, improved reliability and scalable platform.

Comprehensive Diagnostics

Graphical diagnostic screens in conjunction with the diagnostic features of each Jupiter 2000 module, simplify the job of the operator or technician. Operators/technicians can rapidly locate and solve most control system problems without the use of a schematic or multi-meter. This is done by accessing the Diagnostic screens of Jupiter 2000 and following the instructions as outlined in the Troubleshooting Section of this manual.

Simplified Electrical System

The use of shorter wire runs and Jupiter 2000 remote I/O devices, help simplify the electrical systems through the use of only 3 module types. In addition, like module types and cables are interchangeable.

Improved Reliability

The rugged design of the Jupiter 2000 modules improves the reliability of the electrical control system. Jupiter modules are built to operate at extreme temperatures (-40°c to +70°c) (-40 F to 158 F). All modules are waterproof and fully potted for extreme vibrations. Pre-molded cables and cord sets eliminate field wiring and reduce the likelihood of open/short circuits. Each module provides a layer of electrical (and logical) isolation from the rest of the system thereby containing problems and simplifying repair. The increased capacity of output channels handles a wide range of load conditions.

Scalable Platform

The modular design of the Jupiter 2000 control system makes it possible to install Jupiter 2000 on small machines as well as large complex machines. This feature will lead to a common control system on an entire fleet of machines. The use of common control system components that are interchangeable from machine to machine enables inventory reduction, common schematics, reduced service technician training and a common set of features and diagnostic tools between wide varieties of machines.

Cab Controls

All cab controls are well placed and within easy reach of the operator. This centralized placement of controls provides the operator with maximum comfort as well as excellent visibility. The general layout of the cab components is illustrated in figure 2-2. Each component is numbered and identified in the table below. Refer to the following pages for a brief description of each component.

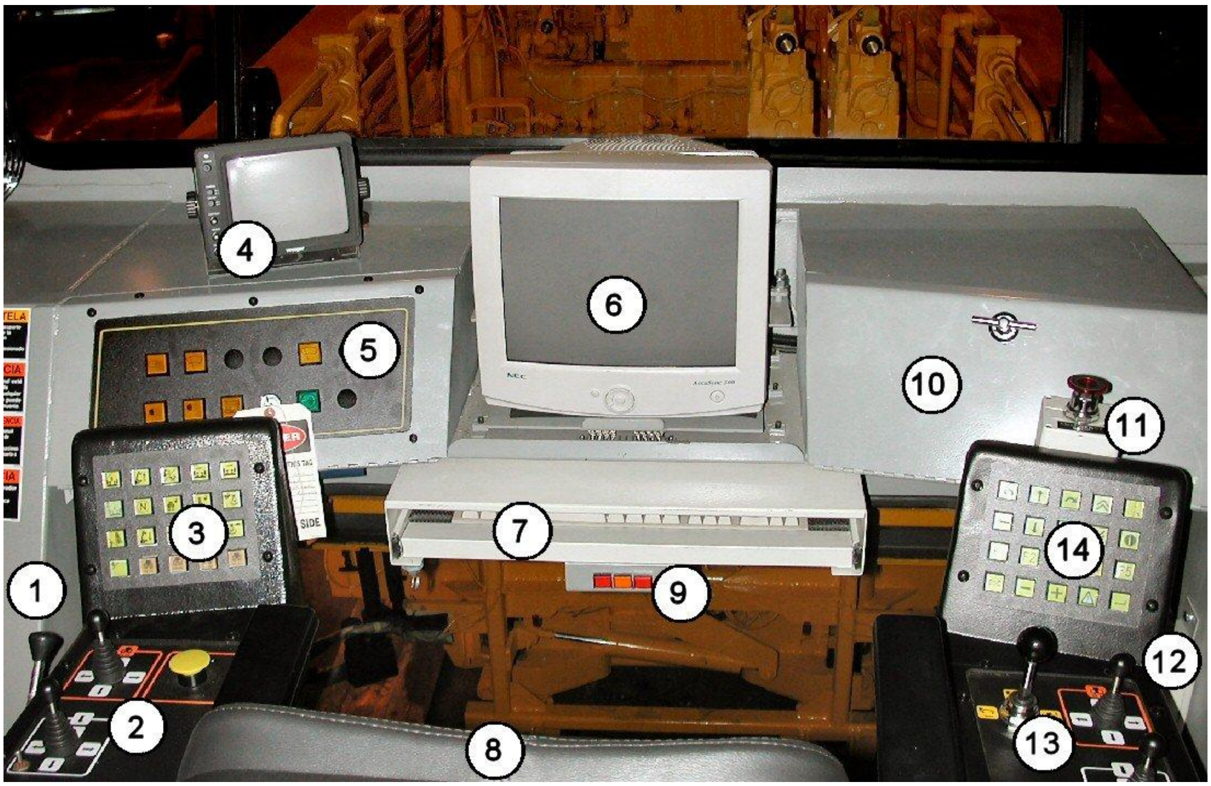


Figure 2-2

1.) Service Brake Lever	8.) Operator Seat
2.) Left Arm Console	9.) Surface Liner Indicator Lights
3.) Left Hand Keypad	10.) Storage Box
4.) Closed Circuit TV System Monitor	11.) Emergency Shutdown Button
5.) Engine Control Panel	12.) Power Supply for Monitor & Printer
6.) * Color Monitor	13.) Right Arm Console
7.) Keyboard	14.) Right Hand Keypad

***** *A flat panel XGA monitor is used on current models.*

1.) **Service Brake Lever**

This lever controls the application and the release of the vehicle Service Brakes. Forward Position – Brake Release; Rear Position – Brake Applied

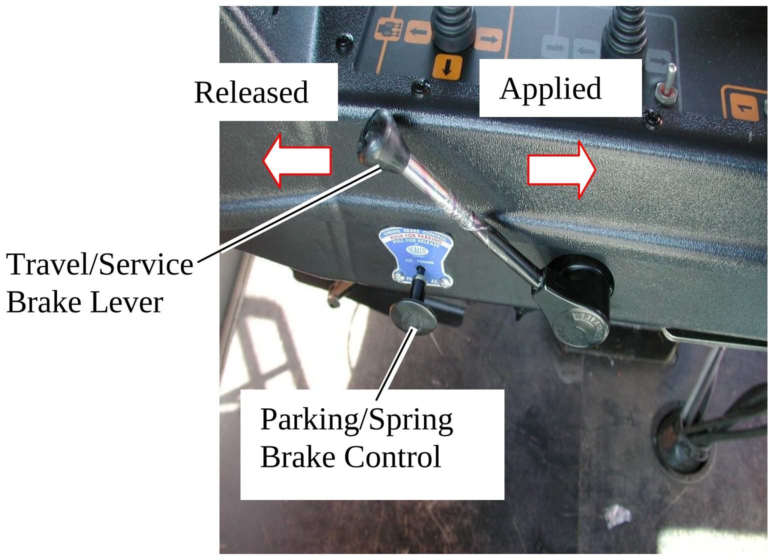


Figure 2-3
Service Brake Lever

2.) **Left Arm Console**

The Left Hand Arm Console houses controls that are used in both travel and work modes such as: the Left Hand Workhead Joystick, Left Hand Clamp Frame Joystick, Work Mode and Travel Selectors. Refer to Figure 2-4.

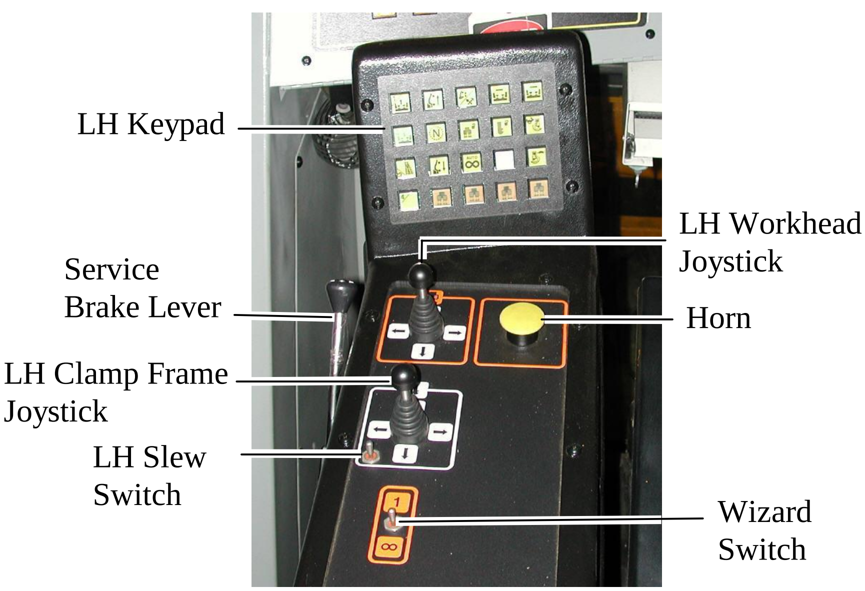


Figure 2-4
Left Arm Console and Keypad

3.) **Left Hand Keypad**

Houses pushbutton type switches that control Work and Travel mode functions of the machine. Refer to Figure 2-5.

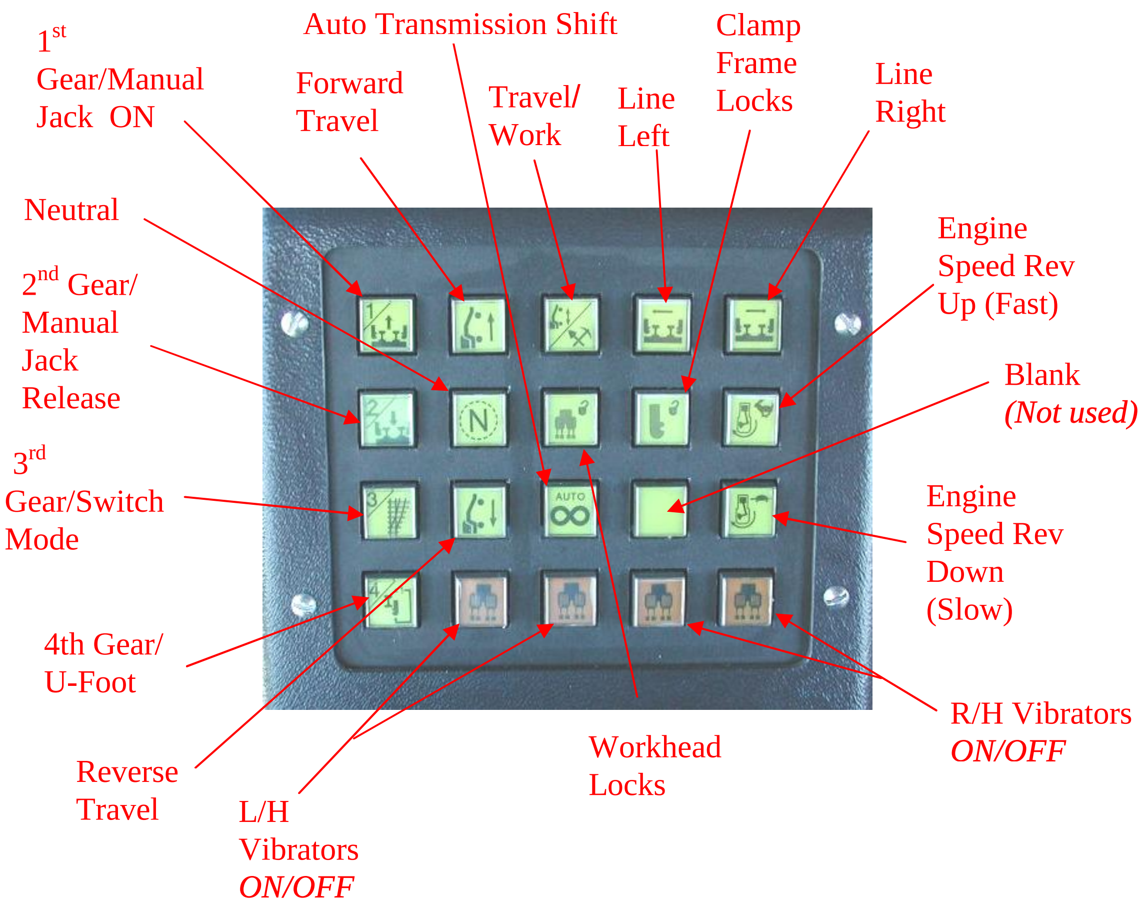


Figure 2-5
Left Hand Keypad Switches

4.) **Closed Circuit TV System**

In conjunction with a video camera mounted on the front of the machine, this monitor permits the operator to view the track area ahead of the machine. Refer to Figure 2-2.

5.) **Engine Control Panel (ECP)**

This panel contains controls concerned with starting, normal shutdown of the engine, wipers/washers operation and machine lighting control.

Engine Control Panel (ECP)-
Earlier Models

Figure 2-6
Engine Control Panel (ECP)-
Current Models

1.) Work Lights ON/OFF	5.) Front Travel Lights ON/OFF
2.) Front Windshield Wipers ON/OFF	6.) Jupiter Computer ON/OFF
3.) Rear Windshield Wipers ON/OFF	7.) Power/Ignition Switch
4.) Rear Travel Lights ON/OFF	8.) Permissive Start Switch
9.) Engine STOP	

6.) **Color XGA Monitor**

A 15 in., XGA, color, flat panel monitor mounted in front of the operator seat, displays all screens and menus concerned with operation of the machine. Refer to Figure 2-2.

7.) **Keyboard**

As standard equipment, a fixed position keyboard has been provided. The keyboard features an enhanced key layout with 12 function keys, separate cursor and numeric keypads. Refer to Figure 2-2.

8.) **Operator Seat**

An air suspension type seat with seat belt, back, arm and height adjustments is used on this MKVI Tamper model.

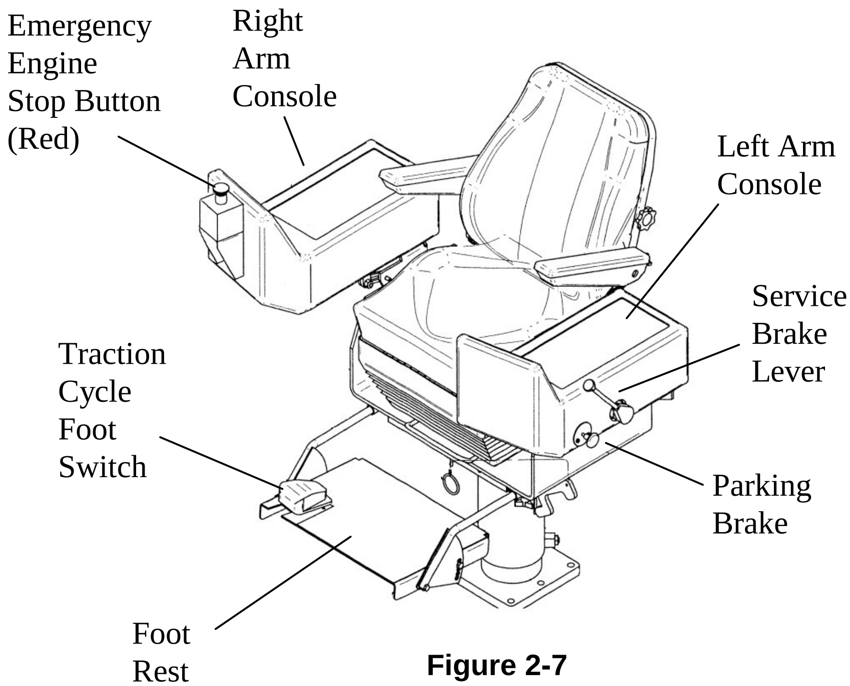


Figure 2-7
Operator's Seat - Rear Cab

9.) **Surface Liner Indicator Lights**

Two (2) red lights – surfacing. One (1) amber light – lining. Refer to Figure 2-2.

10.) **Storage Box**

Hinged metal cover with T handle type lock. Refer to Figure 2-2.

11.) **Emergency Shutdown Button**

For emergency use only. When activated, this switch will shut down the engine and apply the emergency brakes. Refer to Figure 2-2.

12.) **Power Supply**

Provides 110VAC power for monitor and printer. Refer to Figure 2-2.

13.) **Right Arm Console**

This panel contains controls concerned mainly with work related functions and operator input to the computer.

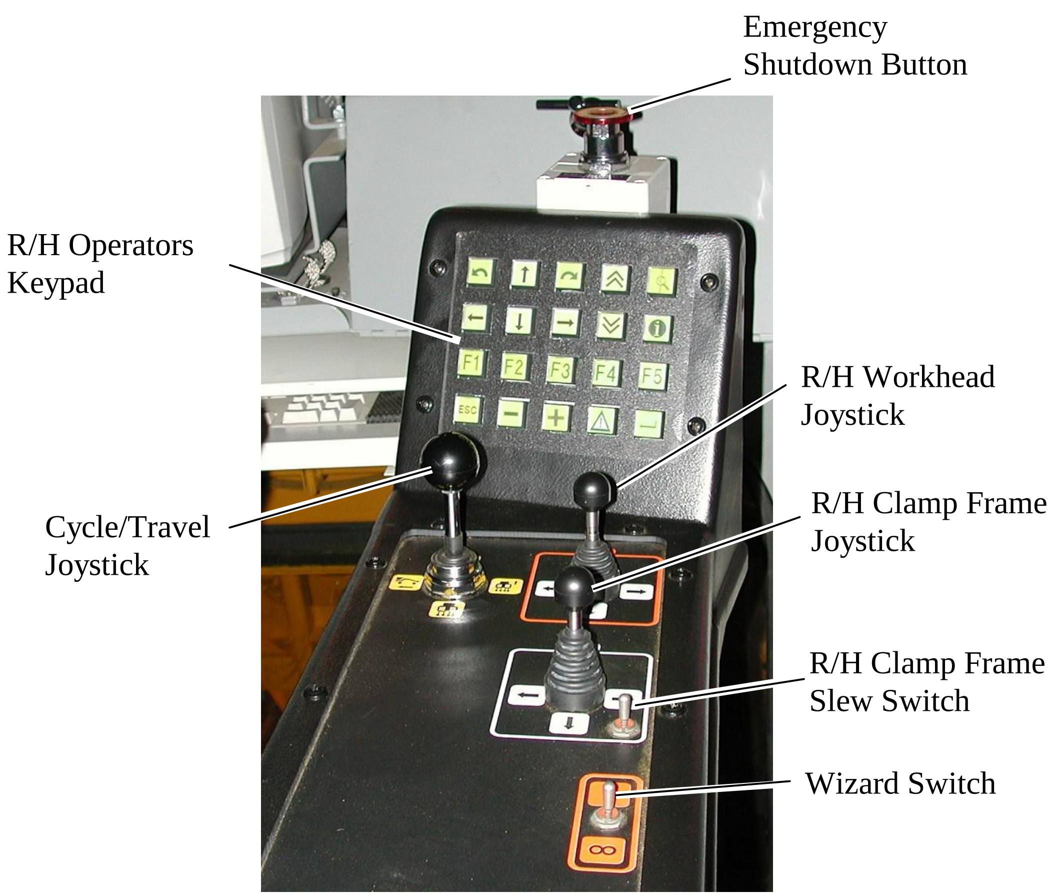


Figure 2-8
Operator's Seat - Rear Cab

14.) **Right Hand Keypad**

Houses pushbutton type switches that control Work and Travel mode functions of the machine.

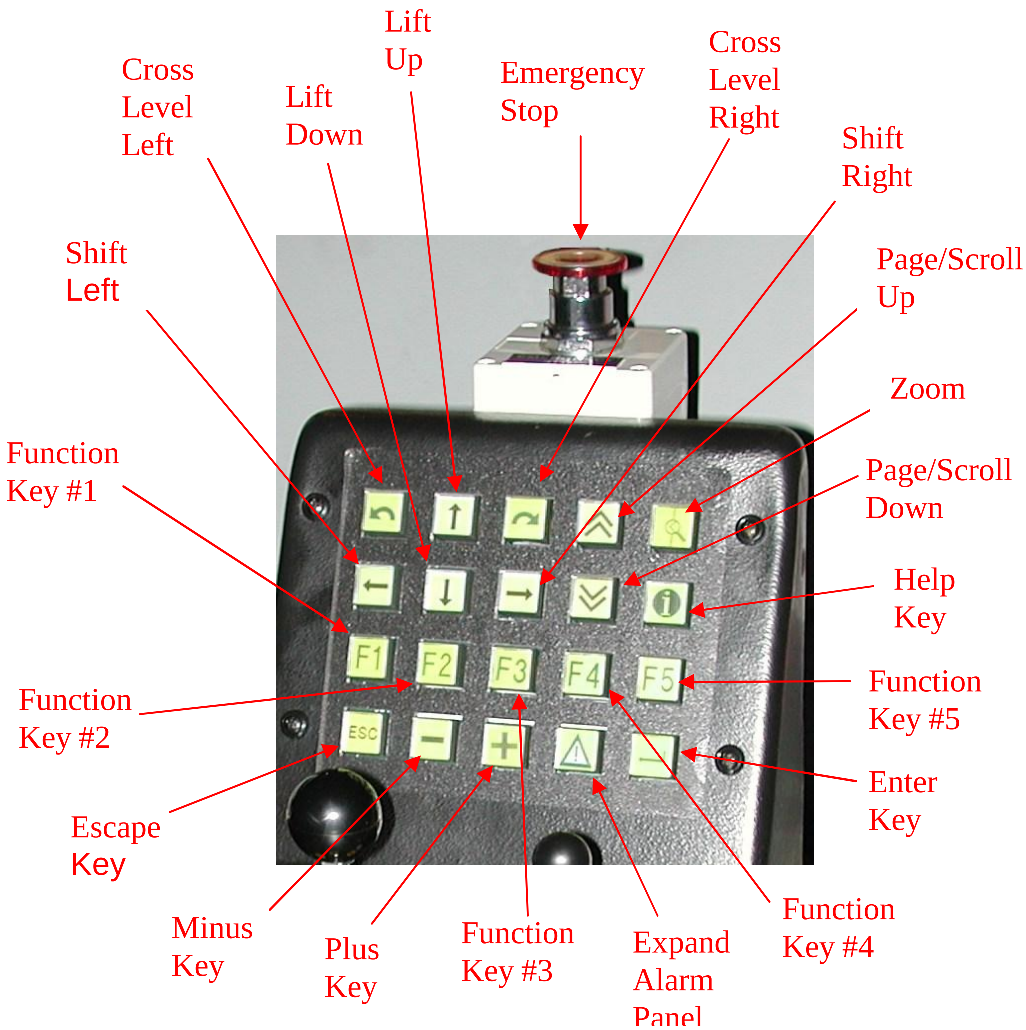


Figure 2-8A
Right Hand Keypad Switches

Starting the Engine

1. Make sure you read *"Safety"*, before you attempt starting the engine.

ALWAYS START AND END WITH THE SPRING PARKING CONTROL BRAKE IN THE "APPLIED" POSITION (Push In the push/pull knob) AND **THE TRAVEL/SERVICE HAND BRAKE LEVER IN THE "RELEASED" POSITION** (push lever forward (toward front of seat) .Parking Brake is also commonly referred to as the MAXIBRAKE CONTROL.

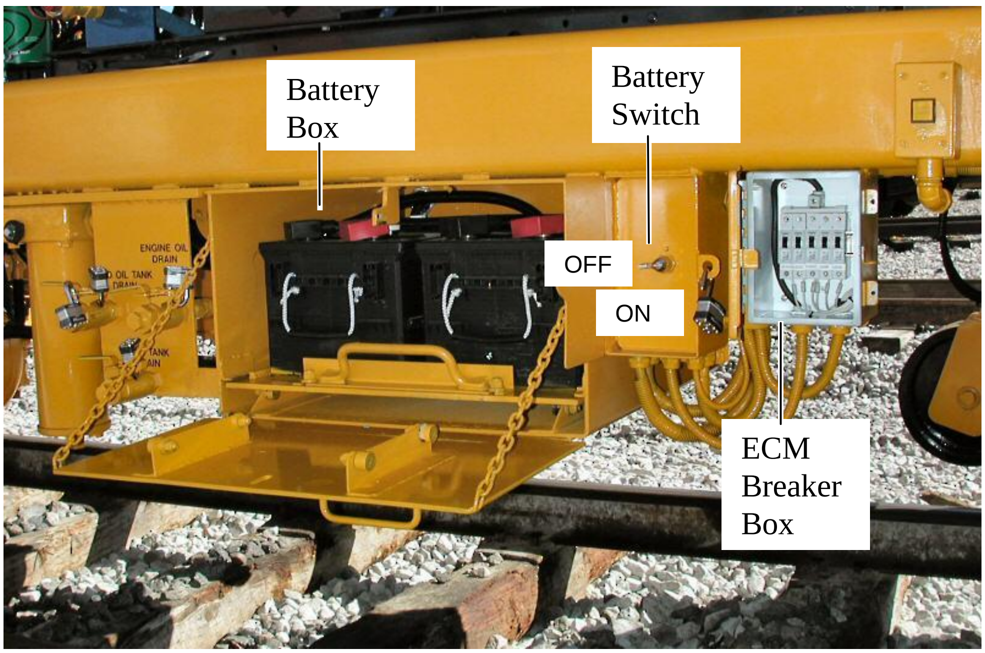


Figure 2-9
Battery Box and Battery Switch Location (right side of machine)

2. Make sure you perform the recommended scheduled maintenance. Check the diesel fuel level; check the engine and hydraulic oil level; check coolant level, etc. Refer to Chapter 4 for "Lubrication Charts and Scheduled Maintenance".

3. Turn **ON** the **Battery Switch**. The Battery Switch is located next to the battery box on the right side of the machine just below the engine. Refer to Figure 2-9.

NOTE

ECM Breaker Box provides power to the engine control module **even if the battery switch is turned OFF**.

4. Move to the cab interior and access the operator seat. The seat can be adjusted up or down or swivel side to side to meet operator requirements for work or travel. Refer to Figure 2-7. A seat belt is provided as standard equipment on most MK VI models and should be whenever the machine is in operation.

5. Set the transmission neutral switch to the **NEUTRAL** position (button pressed inward) then 1st gear and/or AUTO with any gear selected. The transmission selector switches are located on the **Left Hand Keypad**. The position of these switches is monitored by the Jupiter Control System and is also displayed on a pop up menu on the main screen of the computer. Refer to Figure 2-12.

NOTE

The transmission gear selector switches 1-4 are located on the Left Hand Keypad. These switches are dual function. When travel mode is selected, the switches control gear selection. In the work mode, the switches control work related functions such as Manual Jack ON and Manual Jack Release.

6 Position the **TRAVEL /WORK Mode Selector Switch** for TRAVEL MODE. The **Travel/Work Mode Selector Switch** is located on the **Left Hand Keypad**. This is a dual function, momentary type, push button switch. Refer to Figure 2-5.

7 **TO START THE ENGINE**, insert the key into the **Power/Ignition** switch then press and hold the **Permissive Start** switch. Turn the key to the right (clockwise). The permissive and ignition switches are located on the **Engine Control Panel** (ECP) in front of the operator seat. Refer to Figure 2-6.

Continue turning the **Power/Ignition key** switch to the right (clockwise). Release the switch when the engine starts. *Continue to hold the **Permissive Start** switch to allow the engine oil pressure to build then release switch.* The engine is factory set to run at the recommended idle speed of 900 rpm's.

Caution

DO NOT ENGAGE THE STARTING MOTOR FOR MORE THAN 30 SECONDS. WAIT 2 MINUTES BETWEEN UNSUCCESSFUL ATTEMPTS. If engine does not start after three attempts (3 tries), refer to the engine operator's manual.

8. Once the engine has been successfully started, permit it to run at the **Idle** speed for about a minute before slowly raising the engine rpm.

9. Turn ON Jupiter using the push button on the ENGINE CONTROL PANEL (ECP). Refer to Figure 2-6.

NOTE

If temperature is below 32°F or 0°C, operate the engine at a moderate speed for about 5 minutes before full loads are applied. Also, before increasing the engine rpm, refer to Hydraulic Oil on page 2-17**.**

10. Check the engine indicator icon on the Main Screen. If any of the icons are **ON** (red - lighted), the problem(s) must be corrected before moving or traveling the machine. Refer to Figure 2-11.

NOTE

If the engine oil pressure is too low (< 10 psi) or if the engine water temperature is too high (> 220°F or 104°C), the engine will shut down automatically**.**

NOTE

If Jupiter is ON when the ignition switch is turned ON, red indicator light/icons noting **LOW ENGINE OIL PRESS, HIGH COOLANT TEMPERATURE, LOW BATTERY and LOW FUEL LEVEL** will come ON; this is normal. If any remain ON after the engine has started the problem(s) **must** be corrected before continuing. Refer to Figure 2-11.These indicators are not dependent on key switch position. You can start the engine with Jupiter ON or OFF however we strongly recommended that the engine be started BEFORE turning ON Jupiter. If ON, Jupiter will be turned OFF while start up takes place then reboot.

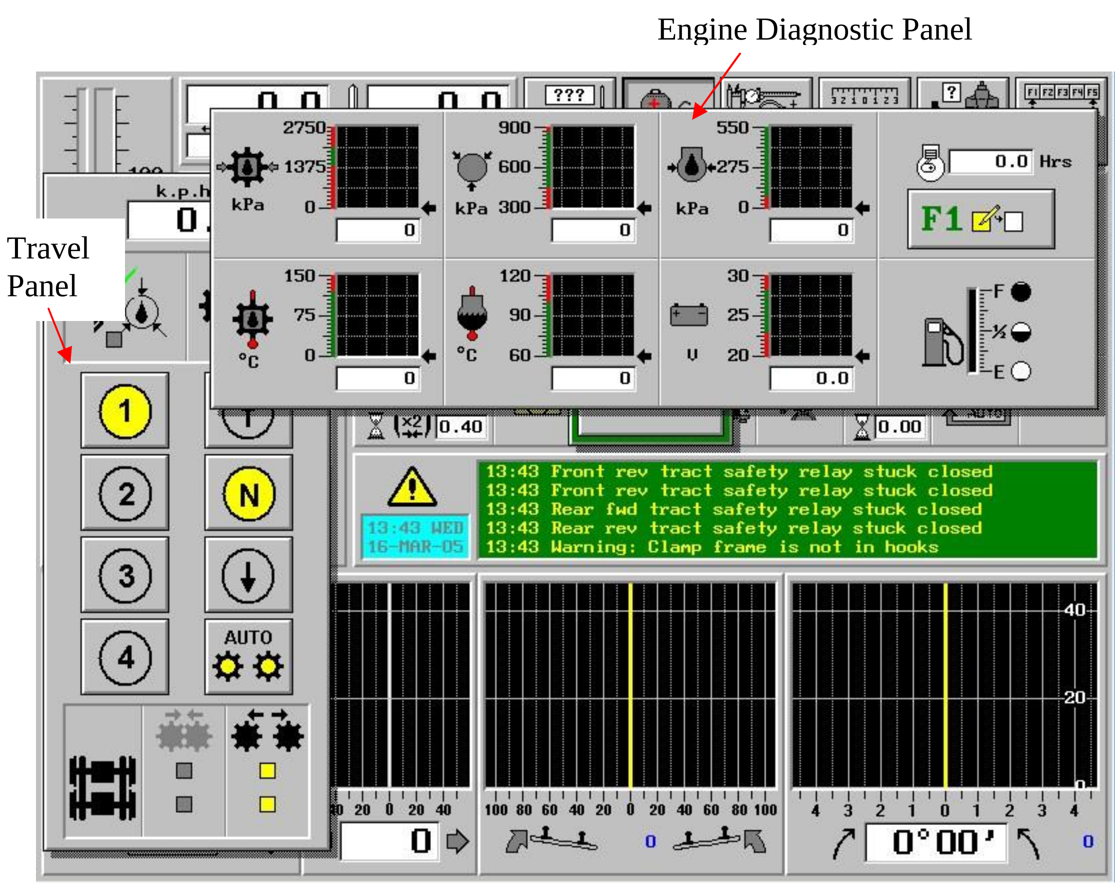


Figure 2-10
Travel Screens

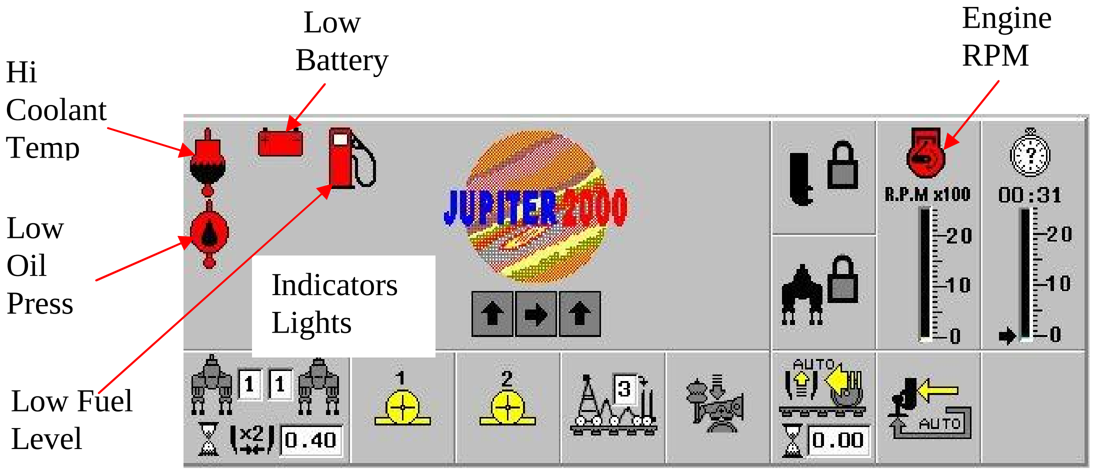


Figure 2-11
Main Screen Indicator Lights

11. **TO SHUTDOWN THE ENGINE,** under normal conditions, turn the ignition key counterclockwise to the **OFF** position for earlier models. For current models, press Engine Stop Button located to the left of the Permissive Switch on the Engine Control Panel. (Figure 2-6). In an emergency situation, press the large (RED) Emergency Stop Button located on the Right Arm Console (Figure 2-7). Emergency Stop buttons are also located on the outside corners of the machine. Refer to *Chapter 1, "Safety"*. For additional information on normal shutdown, refer to the *Engine Shutdown Procedure* at the end of this section.

Turning the Power ON

Once the main battery switch has been turned ON, press the Jupiter Control System Switch to boot up the Jupiter Network. Refer to figures 2-2 and 2-6. The color monitor has its own power switch located on the lower left (underside) of the display. Move the toggle switch to the ON position.

Hydraulic Oil

When the hydraulic oil temperature is below 70°F or 21°C the hydraulic oil may NOT be warm enough to increase the engine rpm to maximum (2100 rpm) for production work.

Hydraulic Oil Warm Up Procedure

The Warm-up option is under the F5 options button, first main toolbar button set. F5 opens the options menu. Use the plus or minus key to move the yellow border over top of the warm-up symbol, then press F5 to turn ON warm-up. The machine must be in **WORK MODE**.

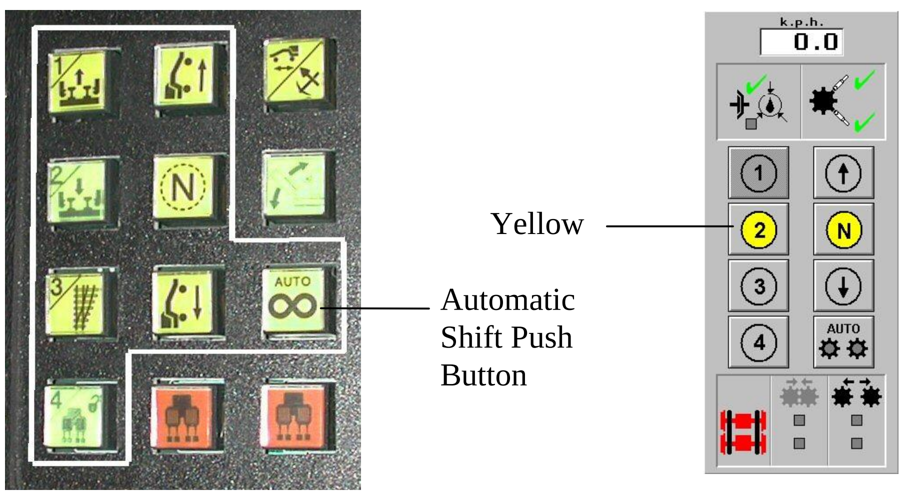
System Air

The system air pressure gauge is a graphical display. The **LOW AIR PRESSURE** indicator icon will remain **ON** until the system air pressure reaches the recommended minimum of approximately 60 PSI.

With zero air pressure, as in when the engine is started and idling at 1000 rpm; the air system low air indicator icon should turn off after approximately two minutes. If, after approximately three minutes the system air pressure is still less than (below) the recommended minimum of 60 PSI, then the problem **MUST BE CORRECTED** before trying to **TRAVEL** or **WORK** the machine. **NOTE:** Normal system air pressure is 90 PSI.

Speed Controls

There are four (4) speed control push buttons are located on the Left Hand Keypad. These buttons are also active when Travel Mode is selected. There are two directional control buttons, Reverse Travel, Forward Travel and a Neutral button. Four gear control buttons, 1st, 2nd, 3rd, 4th and the Automatic Shift button (*side ways eight*) are also provided. Refer to Figure 2-12.



Left Hand Keypad (Cab)

Figure 2-12
Speed Controls and Travel Panel

Pop-Up Travel Panel

When Travel Mode is selected, the main screen will display a pictorial view of the speed control push buttons. The buttons on the Pop-Up Travel Panel will illuminate (yellow) to indicate the gear selected and the travel direction. Refer to Figure 2-9.

The Automatic Shift Push Button is the push button with the side ways eight. When this button is depressed, the travel speed will be selected by the travel speed (up or down) and will illuminate (yellow) to indicate the selected gear.

Traveling the Machine

This section describes the recommended procedure to move (travel) the machine on the track.

NOTE

The horn control push button is located on Left Hand Arm Console (yellow). Use the horn push button to alert personnel in and around the machine that it is about to move or is moving.

The transmission used on this MK VI model may be shifted UP or DOWN while the machine is moving. In addition, Travel is inhibited if the engine speed is above 1100 rpm and machine is at rest. Automatic Mode will be prohibited if the proximity switches on the Power Shift Transmission and engine speed sensors fail.

Pre-Travel Checklist:

Laser Liner	
• Remove and Store laser assembly	
• Store Battery in battery charger compartment	
• Store laser cart on projector buggy	
Projector Buggy	
• Lower Surfacing Projector	
• Remove and Store Lining Projectors	
• Raise and Lock Projector Buggy	
Clamp Frame	
• Raise and Lock Clamp Frame	
Shadowboard Assembly	
• Raise and Lock Shadowboard Assembly	
Workheads	
• Raise and Lock Workheads	
Light Shields	
• Place light shields in stored position	
Receiver Buggy	
• Lower Surfacing Receivers	
• Move Lining Receivers to stored position	
• Raise and Lock receiver buggy	

Procedure:

1. Make sure you read “Safety”, before you attempt to move/travel the machine and the appropriate cab has been selected.
2. Make sure all of the machine components, such as the work heads and buggies (projectors and receivers), are in the “locked up” position and are secured in their safety locks.

Caution

ALWAYS START AND END WITH THE SPRING PARKING CONTROL BRAKE IN THE “APPLIED” POSITION (Push In the push/pull knob) AND THE TRAVEL/SERVICE HAND BRAKE LEVER IN THE “RELEASED” POSITION (push lever forward (toward front of seat)).

NOTE

Note, the Parking brake is also commonly referred to as the **MAXIBRAKE CONTROL**.

3. Make sure the engine is running at the recommended idle speed of 900 RPM.
4. Make sure TRAVEL MODE is selected. The push button is located on the left hand keypad.
5. Make sure the speed control selector switches are set correctly. Travel direction to NEUTRAL and the gear selector set to 1st gear and/or auto with any gear selected. These controls are located on the left hand keypad.
6. Select the direction of travel, forward or reverse.

NOTE

A beeper type audible MOVEMENT ALARM feature is provided on this machine. The alarm will sound as follows: Front and Rear Alarms – Sound together for the first three (3) seconds of any movement or change in direction. The alarm will not sound when indexing unless the machine has been motionless for two seconds or changes direction.

7. Apply the Service Brakes. Pull the lever rearward (toward rear of seat) then release the Parking/Spring Brake (pull out the push/pull knob). These controls are located on the left arm console. Refer to Figure 2-3.
8. Press and hold the **Traction/Cycle Foot Pedal.** This will engage the traction system. The foot pedal is located on the foot rest of the operator’s seat in either cab. Refer to Figure 2-7.
9. Slowly release the service brake lever, this should allow the machine to move in the direction selected.

NOTE

When the Traction/Cycle Foot Pedal is released, traction is disabled. The Service Hand Brake Lever IS TO BE USED to SLOW or STOP the machine. To continue traveling, press and hold the traction/cycle foot pedal.

10. Press the throttle control button (rabbit) to increase engine and machine speeds. The throttle controls are located on the left hand keypad. Press the throttle control button (turtle) to decrease engine speed. The position of the throttle is displayed on the RPM x 100 graph on the main screen.
11. When the automatic button is pressed the operating system will select the appropriate travel speed (traveling and stopping). If automatic is NOT pressed then the speeds (1st – 4th) will need to be selected manually.

NOTE *Note the automatic speed selection is based on the travel speed the machine can obtain for the engine RPM selected.*

To slow down or stop the machine, press the throttle control button (turtle) to decrease the engine speed RPMs. Release the traction/cycle foot pedal and apply the TRAVEL/SERVICE BRAKE lever until the desired speed is reached and/or the machine stops.

After the machine comes to a complete STOP, press the neutral transmission button. APPLY the PARKING/SPRING BRAKE by pushing the control knob IN. Then release the Travel/Service brake by pushing the hand lever forward (away from the operator seat).

NOTE When WORK MODE is selected, the machine operates in low gear and no speed selection is permitted.

Follow instructions for either shutting down the engine or Set-up for work.

Shutting Down the Engine

This section describes the recommended procedure to shutdown the engine.

Normal Shutdown Procedure:

Caution ALWAYS START AND END WITH THE SPRING PARKING CONTROL BRAKE IN THE "APPLIED" POSITION (Push In the push/pull knob) AND THE TRAVEL/SERVICE HAND BRAKE LEVER IN THE"RELEASED" POSITION (push lever forward (toward front of seat) Note, the Parking Brake is also commonly referred to as the MAXI BRAKE CONTROL.

1. Make sure all work components, such as the workheads, projector buggy, Clamp Frame, shadowboard assembly and receiver buggy are in the "raised" (travel) position and are secured in their safety locks.

   NOTE It has been a common practice of some railroads to lower one workhead into the ballast as a safety precaution.

2. Reduce engine speed to SLOW or IDLE position (Turtle - SLOW, Rabbit- FAST). Idle speed is 900 rpm.
3. Ensure that the SPEED SELECTOR is set to the NEUTRAL position.
4. To prevent damage to the turbocharger, permit the engine to idle (cool down) for a minimum of 2 1/2 minutes.
5. For earlier models, turn the key in the power/ignition switch to the OFF position. (counterclockwise) and remove the key if leaving the cab. For current models, press the Engine Stop Button, located to the left of the Permissive Switch, on the Engine Control Panel; then turn the key in the power/ignition switch to the OFF position (counterclockwise) and remove the key if leaving the cab. Refer to Figure 2-6**.**

   NOTE On this MK VI Tamper model, the PARKING/SPRING APPLIED BRAKE will apply when the engine is turned off. (Service Brake must be released)

6. Move the SERVICE HAND BRAKE LEVER forward to the RELEASE position.
7. Turn the main battery switch to the OFF position.

Emergency Shutdown Procedure:

There are five (5) emergency stop buttons used to shutdown the machine in case of an emergency, one button is located above the right hand keypad, the other 4 buttons are located on the outside corners of the machine. Push to activate and pull to reset. When activated this control will shutdown the engine and the spring brakes will be applied.

Towing the Machine

Towing the Machine – Clark Transmission

This section describes the recommended procedure to TOW the MACHINE; WITH and WITHOUT the Engine Running.

NOTE When towing the MKVI, the drive shaft of the Front Transmission must be disengaged and the Rear Transmission must be shifted into Neutral. Refer to Figure 2-12A and 2-12B

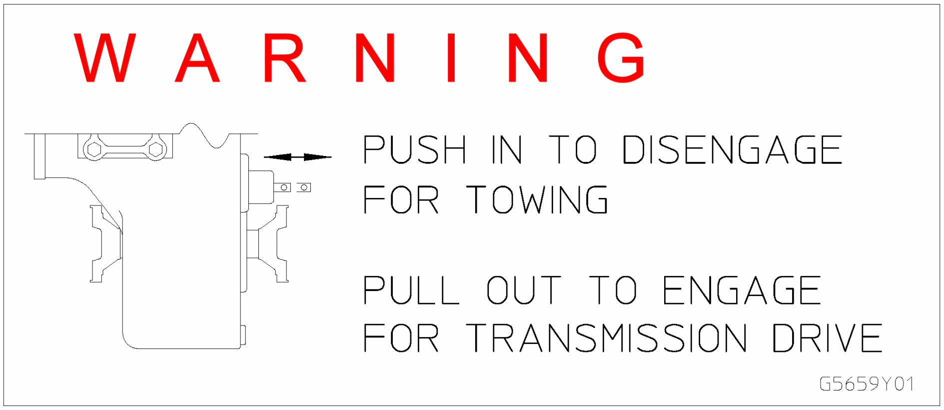


Figure 2-12A
Front Transmission Disengage Warning Label

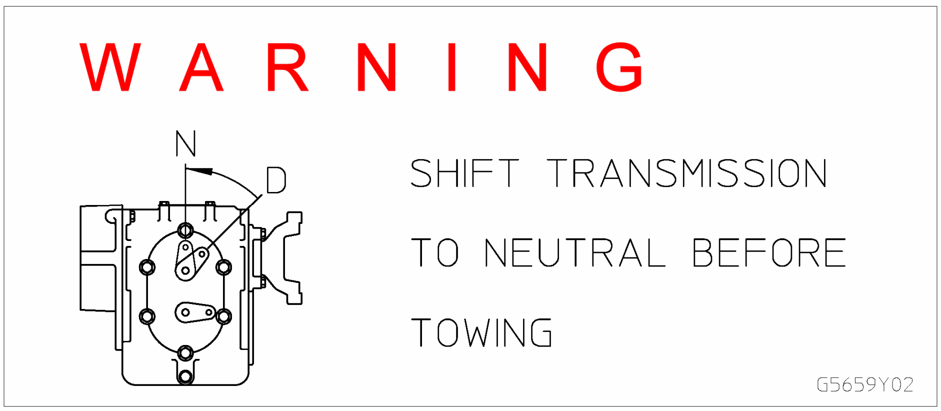


Figure 2-12B
Rear Transmission Warning Label

Procedure: WITH ENGINE RUNNING

1. Make sure you read “Safety”, before you attempt to move/travel the machine.

Caution **ALWAYS START AND END WITH THE SPRING PARKING BRAKE CONTROL IN THE “APPLIED” POSITION** (Push In the push/pull knob) **and THE TRAVEL/SERVICE HAND BRAKE LEVER IN THE “RELEASED” POSITION (push lever forward (toward the front of the seat)).**

NOTE *The parking brake is also commonly referred to as the MAXI BRAKE CONTROL.*

2. Make sure the **TRAVEL/WORK** push button is in the **TRAVEL** position. The push button is located on the engine control panel.
3. Make sure the transmission control selector switches are set correctly: travel direction to NEUTRAL and the gear selector set to 1st gear and/or auto with any gear selected.

   Anytime the computer is ON and travel is selected and if NO transmission direction (FWD, REV or NEU) is selected (all buttons up) and/or NO gear (1st-4th or Auto) is selected (all buttons up) then the computer beeper will beep and no alarm message will be displayed.
4. Make sure the machine engine is properly started (running), the hydraulic oil is warm and the air system has reached the normal operating pressure (90 PSI).
5. The computer may be turned ON or OFF.
6. Set the engine to a moderate speed (1200 to 1500 RPMs).
7. Make sure all machine components, such as the workheads and buggies (projectors and receivers), are in the “locked up” position and are secured in their safety locks.
8. Attach or secure the machine to the towing machine.
9. Apply (pull lever rearward (toward rear of seat)) the travel/service hand brake then release (pull out the push/pull knob) the Spring Parking Brake. Both of these controls are located on the Operator’s L/H arm panel, figure 2-3.
10. Slowly release the travel/service brake lever when the towing machine stars to move.
11. Slowly apply the **TRAVEL/SERVICE BRAKE** lever when stopping.
12. After the machine comes to a complete stop at the new location; APPLY the SPRING PARKING BRAKE by pushing the control knob IN. Then release the Travel/Service brake by pushing the hand lever forward (toward front of seat).
13. Disconnect the machine from the towing machine.

Procedure: WITHOUT ENGINE RUNNING and Computer OFF

NOTE The Drive Shaft of the Front Transmission must be disengaged and the rear transmission must be shifted into neutral before towing the MKVI. Refer to figure 2-12A and figure 2-12B.

1. Make sure all of the machine components, such as the workheads and buggies (projectors and receivers), are in the “locked up” position and are secured in their safety locks.
2. Attach or secure the machine to the towing machine.
3. Manually release the SPRING PARKING BRAKE spring.
4. Tow the machine to the new location; manually reapply or engage the SPRING PARKING BRAKE spring.

5 Disconnect the machine from the towing machine.

MACHINE CONTROLS (Work Mode)

Left Hand Operators Arm Console and Keypad Controls

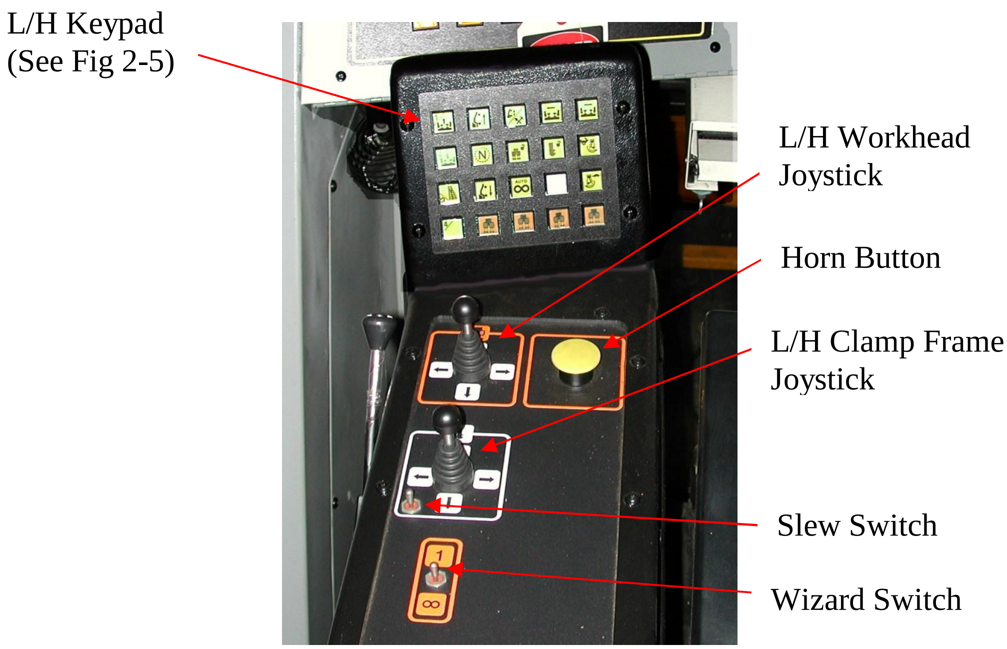


Figure 2-13
Left Hand Arm Console And Keypad

Left Hand Workhead Joystick

This is a manual control for operating of the left hand workhead. The left workhead joystick is also used in conjunction with the Wizard Switch for the manual squeeze-in function of the left or both workheads. Refer to Figure 2-13.

- When the joystick is moved to the left, the workhead moves laterally (traverse) to the left.
- When the joystick is moved to the right, the workhead moves laterally (traverse) to the right.
- When the joystick is pushed forward (toward keypad), the workhead lifts (upfeed) beyond the workhead upper proximity switch for lockup.
- When the joystick is pulled backward (away from keypad), the corresponding workhead drops to the ballast. Note, when the joystick is held back, only the left workhead will complete a tamping cycle provided the vibrators are turned on.

NOTE *If the Wizard Switch is enabled, moved forward to position #1, and the joystick is pulled backwards; the left workhead will squeeze–in. If however, the Wizard Switch is moved backwards to the side ways eight push button position, both workheads will squeeze–in provided the vibrators are turned on.*

Left Hand Clamp Frame Joystick

This is a manual control for positioning the left side of the clamp frame such as setting up for work, travel and switch mode operations. A toggle type SLEW switch is also provided to permit forward and backward adjustments to this side of the Clamp Frame. Refer to Figure 2-13.

- When the joystick is moved to the left, the left Clamp Frame hook moves laterally to the left (OUT) to its outer limit.
- When the joystick is moved to the right, the hook moves laterally to the right (IN).
- When the joystick is pushed forward (toward keypad), this raises the left Clamp Frame hook.
- When the joystick is pulled backwards (away from keypad), this lowers the left Clamp Frame hook to its lower limit.

Right Hand Arm Console and Keypad Controls

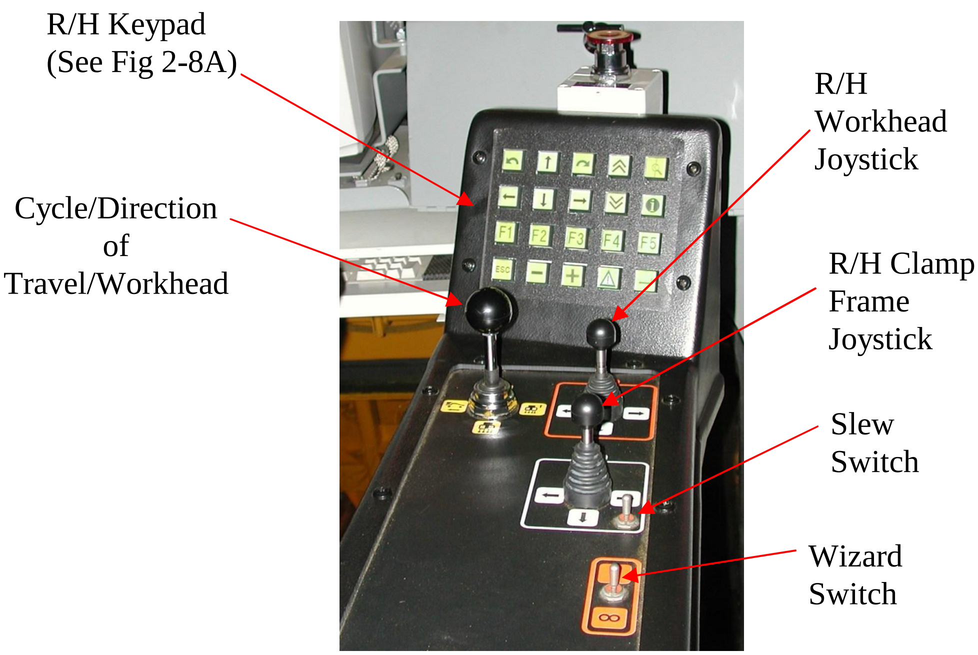


Figure 2-14
Right Hand Arm Console and Keypad

Cycle/Forward/Reverse/Workhead Joystick

- When the joystick is moved to the right, both workheads will rise or upfeed to the W/H upper proximity switches.
- When the joystick is moved to the left the machine travels in reverse.
- When the joystick is pushed forward (toward keypad), the machine travels forward.
- When the joystick is pulled backward (away from keypad), this starts CYCLE. The foot switch located on the floor in front of the operator seat, is another method of starting cycle. (If the vibrators are on).

Right Hand Workhead Joystick

This is a manual control for operating the R/H workhead. The right workhead joystick is also used in conjunction with the Wizard Switch for the manual squeeze-in function of the right or both workheads.

- When the joystick is moved to the right, the workhead moves laterally (traverse) to the right (OUT).
- When the joystick is moved to the left, the workhead moves laterally (traverse) to the left (IN).
- When the joystick is pushed forward (toward keypad), the workhead raises (upfeed) beyond the upper proximity switch for lockup.
- When the joystick is pulled backward (away from keypad), the corresponding workhead drops to the ballast. Note, when the joystick is held back, only the right workhead will complete a tamping cycle provided the vibrators are turned on.

NOTE *If the Wizard Switch is enabled, moved forward to position #1, and the joystick is pulled backwards; the right workhead will squeeze–in. If however, the Wizard Switch is moved backwards to the side ways eight push button position, both workheads will squeeze–in.*

Right Hand Clamp Frame Joystick

This is a manual control for positioning the right side of the Clamp Frame such as setting up for work, travel and switch mode operations. A toggle type SLEW switch is also provided to permit forward and backwards adjustments to this side of the Clamp Frame. Refer to Figure 2-14.

- When the joystick is moved to the right, the right Clamp Frame hook moves laterally to the right (OUT) to its outer limit.
- When the joystick is moved to the left, the hook moves laterally to the left (IN).
- When the joystick is pushed forward (toward keypad), this raises the right Clamp Frame hook.
- When the joystick is pulled backward (away from keypad), this lowers the right Clamp Frame hook to its lower limit.

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Chapter 3

Jupiter Screens and Controls

Jupiter Controls Overview

Jupiter 2000 is a distributed I/O system developed by HTT to meet the demanding control requirements of railway maintenance equipment. The distributed I/O intelligent control system uses a Control Area Network (CAN) to communicate with other modules distributed around the machine. An industrial network cable is used to connect the individual modules together. Jupiter has many advanced features that are designed to make the operator's job easier. One such feature is "on-screen diagnostics" that make it possible for the operator or technician to identify and correct problems before they become disabling.

The Face of Jupiter - *Main View*

The following Main or Work screen is the primary screen of Jupiter that the operator sees while the machine is working. All major work functions are controlled and monitored from the cab.

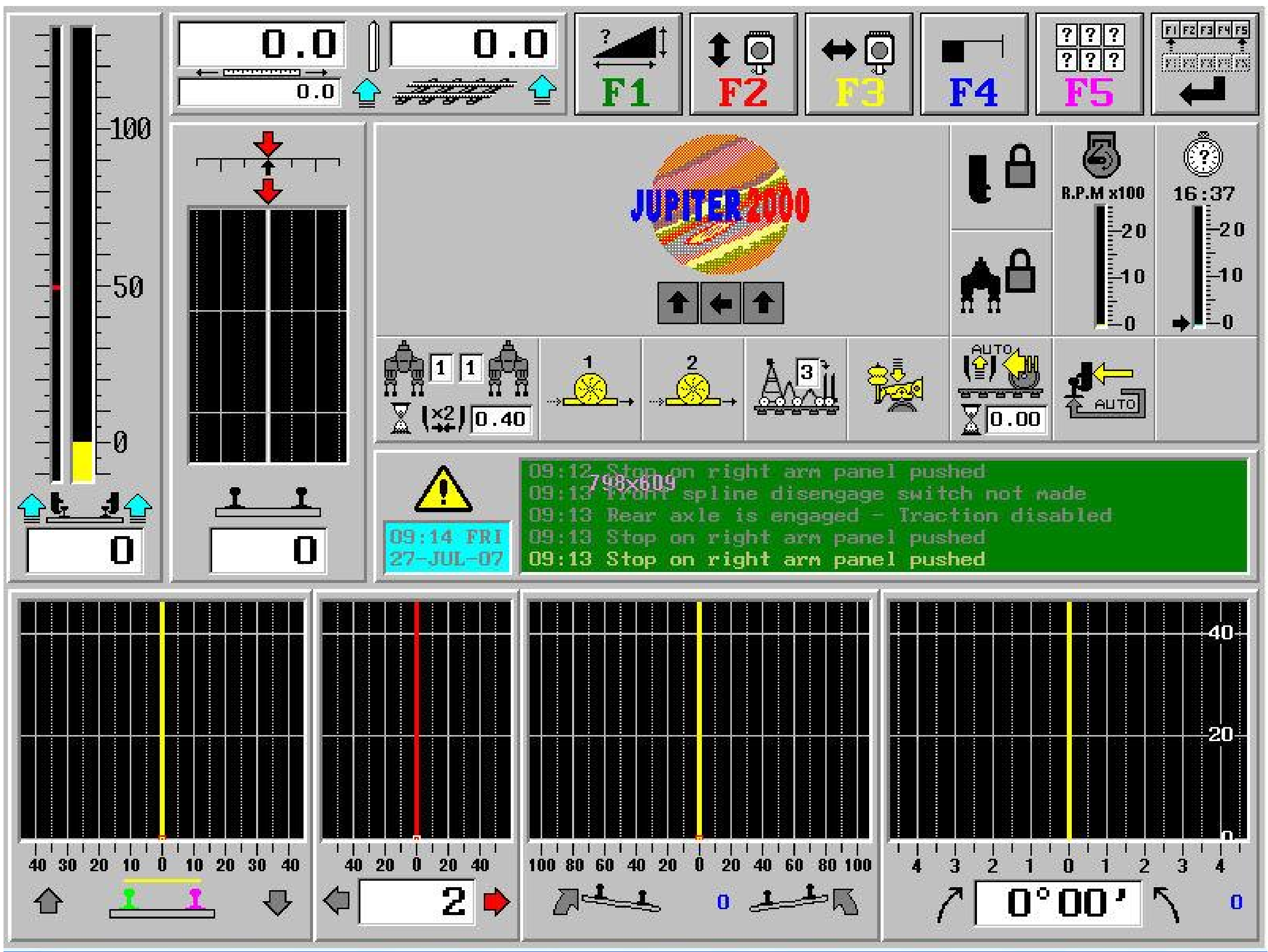
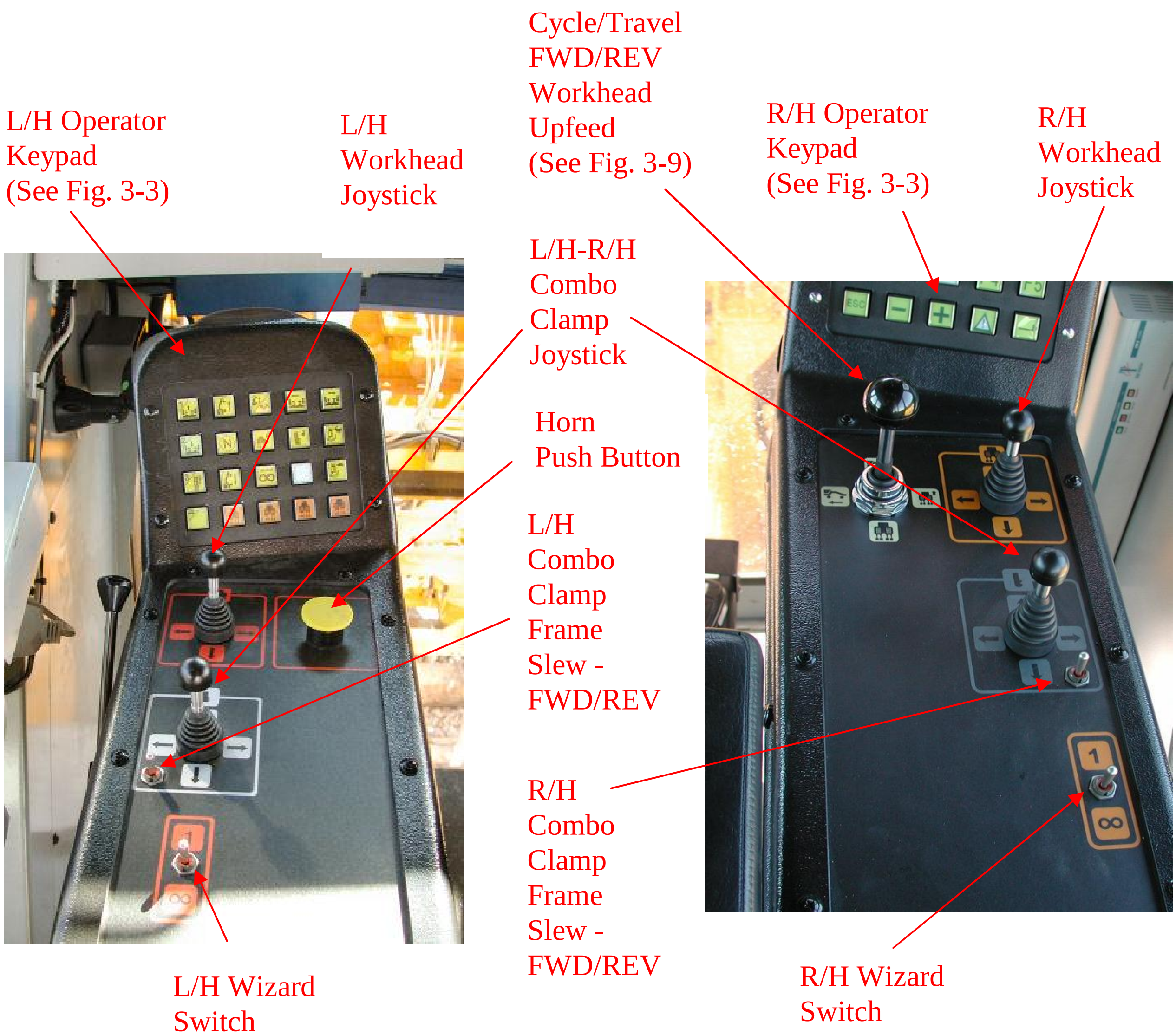


Figure 3-1

The track ahead, the operational status of the machine and the accuracy of results can all be clearly seen from this main panel. A high degree of emphasis has been given to presenting information in a graphical and symbolic fashion so that an occasional momentary glance by the operator is all that is necessary while operating the machine.

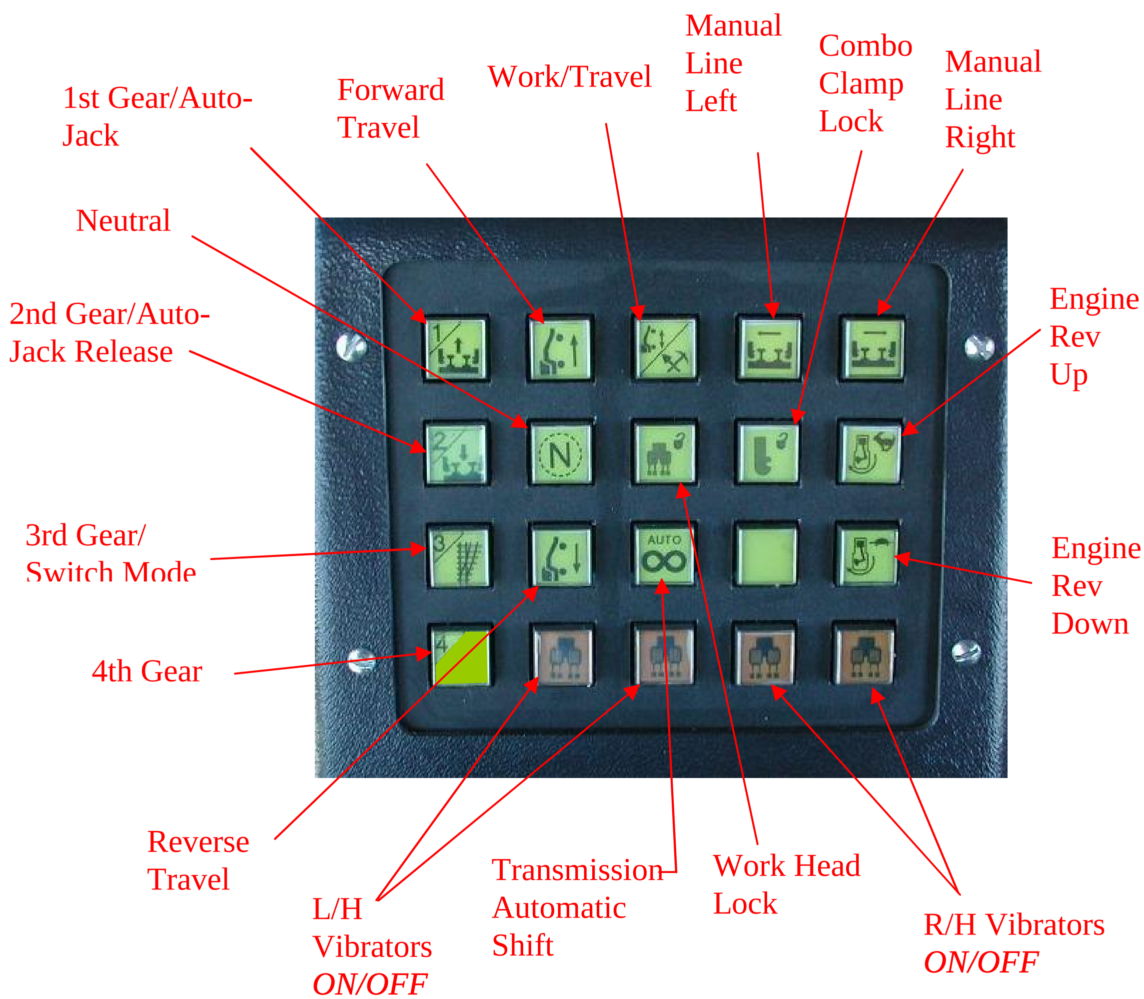
L/H Operator Keypad

In work mode, the left hand arm panel keypad is used for direct manual control of the machine components such as the combo clamp frame and workheads. The keys on the far left side of the keypad serve two different functions depending on machine mode. In *travel mode*, the far left buttons control the transmission gears (first through forth). In *work mode* the same buttons control work functions such as auto-jack/release. (Refer to Figure 3-3.)

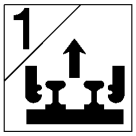


L/H Console **R/H Console**

Figure 3-2



L/H Operator Keypad
Figure 3-3

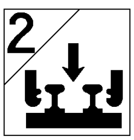


1st Gear (Travel) - Autojack (Work)

Press this key to jack, line and HOLD the track. If this key is released before jacking is complete, lifting will stop before the desired lift has been reached. When lifting a turnout rail in a switch, exercise caution, as the shadowboard is not on this rail. If the turnout rail becomes detached from the tie, release the AUTO JACK button to stop lifting. Re-pressing the key will cause interrupted lifting to resume. This key performs the same function in both SWITCH and PRODUCTION modes. NOTE: In PRODUCTION mode, forward travel will also release the track. However, in switch mode, the autojack release button must be pressed to release the track.

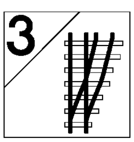
NOTE: This key should be used on any initial start up of lifting and/or lining

While the track is being held, workheads can be individually cycled and moved laterally to tamp the tie in all the desired positions before releasing the track.



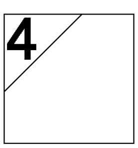
2nd Gear (Travel) - Autojack Release (Work)

Press AUTO JACK RELEASE to release the track after jacking via the AUTOJACK button. If this button is held, the hooks will downfeed to the lower limit switches and out to the outer limit switches.



3rd Gear (Travel) - Switch Mode (Work)

Press Switch key to activate switch mode. This key toggles between production and switch modes.



4th Gear (Travel)

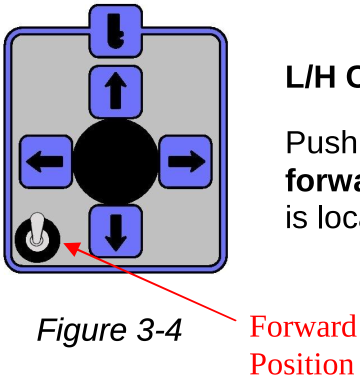


Figure 3-4

L/H Combo Clamp Frame Slew (Forward)

Pushing the toggle switch forward slews the *left side* of the clamp frame **forward** (away from operator) until the switch is released. The toggle switch is located on the *L/H Arm Console.* See figure 3-2.

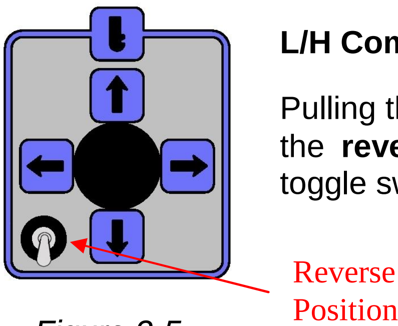


Figure 3-5

L/H Combo Clamp Frame Slew (Reverse)

Pulling the toggle switch backwards slews the *left side* of the clamp frame in the **reverse** direction (toward operator) until the switch is released. The toggle switch is located on the *L/H Arm Console.* See figure 3-2.

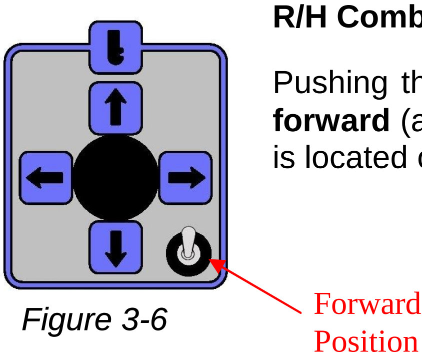


Figure 3-6

R/H Combo Clamp Frame Slew (Forward)

Pushing the toggle switch forward slews the *right side* of the clamp frame **forward** (away from operator) until the switch is released. The toggle switch is located on the *R/H Arm Console.* See figure 3-2.

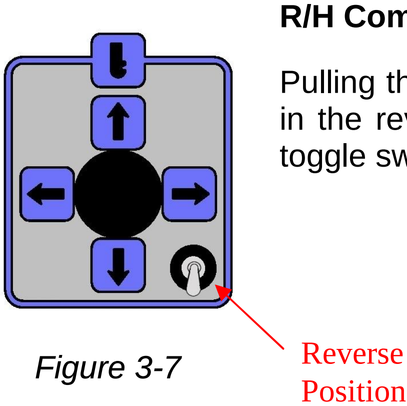
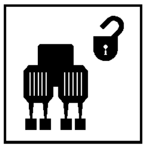


Figure 3-7

R/H Combo Clamp Frame Slew (Reverse)

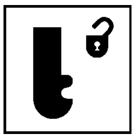
Pulling the toggle switch backwards slews the right side of the clamp frame in the reverse direction (toward operator) until the switch is released. The toggle switch is located on the R/H Arm Console. See figure 3-2.

SAFETY LOCK CONTROL KEYS



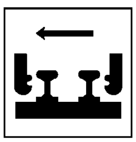
Workhead Locks *(Used to Lock Workhead for Travel and Unlock for Work)*

Pressing this key toggles the status of the workhead locks. If the workhead locks are open, the indicator bulb on the monitor will be lit.

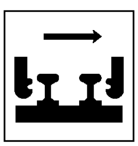


Combo Clamp Frame Locks *(Used to Lock the Combo Clamp for Travel and Unlock for Work)*

Pressing this key toggles the status of the clamp frame locks. If the clamp frame locks are open, the indicator bulb on the monitor will be lit.



Combo Clamp Frame Manual Line (Left)
While this key is held, the clamp frame will be manually moved to the operator's left.



Combo Clamp Frame Manual Line (Right)

While this key is held, the clamp frame will be manually moved to the operator's right.

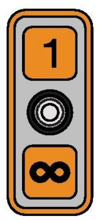
WIZZARD SWITCH

This section describes the function and proper use of the *wizard switch*. The *wizard switch* is located on both left and right arm consoles. Refer to figure 3-8 (next page).

Wizard Switch Function

Hold either wizard switch in the 1 position *AND*:

1. Push either workhead joystick forward and the corresponding workhead will squeeze out until the workhead joystick is released.
2. Pull either workhead joystick back and the corresponding workhead will squeeze in until the workhead joystick is released.



Wizard Switch
(Refer to Figure 3-8 on next page)

Hold either wizard switch in the  position *AND*:

1. Push either workhead joystick forward and ***all*** workheads will squeeze out until the workhead joystick is released.
2. Pull either workhead joystick back and ***all*** workheads will squeeze in until the workhead joystick is released.
3. If held while the workheads are downfeeding, wiggle squeeze will be initiated for the current cycle only. Wiggle squeeze is a feature to help the workhead penetrate in cemented ballast by alternately squeezing in and out for very short periods of time.
4. If held while squeezing in, squeeze sustain will be initiated for the current cycle only. Squeeze sustain will ignore the squeeze pressure setting and squeeze by the long timer. This feature would be used where additional squeeze time is desired, such as in fouled ballast.

The squeeze in / out feature may be used to partially squeeze-in one or all workheads before initiating cycle to clear tightly spaced or slightly skewed ties

Horn Push Button

This electrical switch controls the operation of the pneumatic (air) horns located on the roof exterior of the front and rear cabs Refer to Figure 3-8.

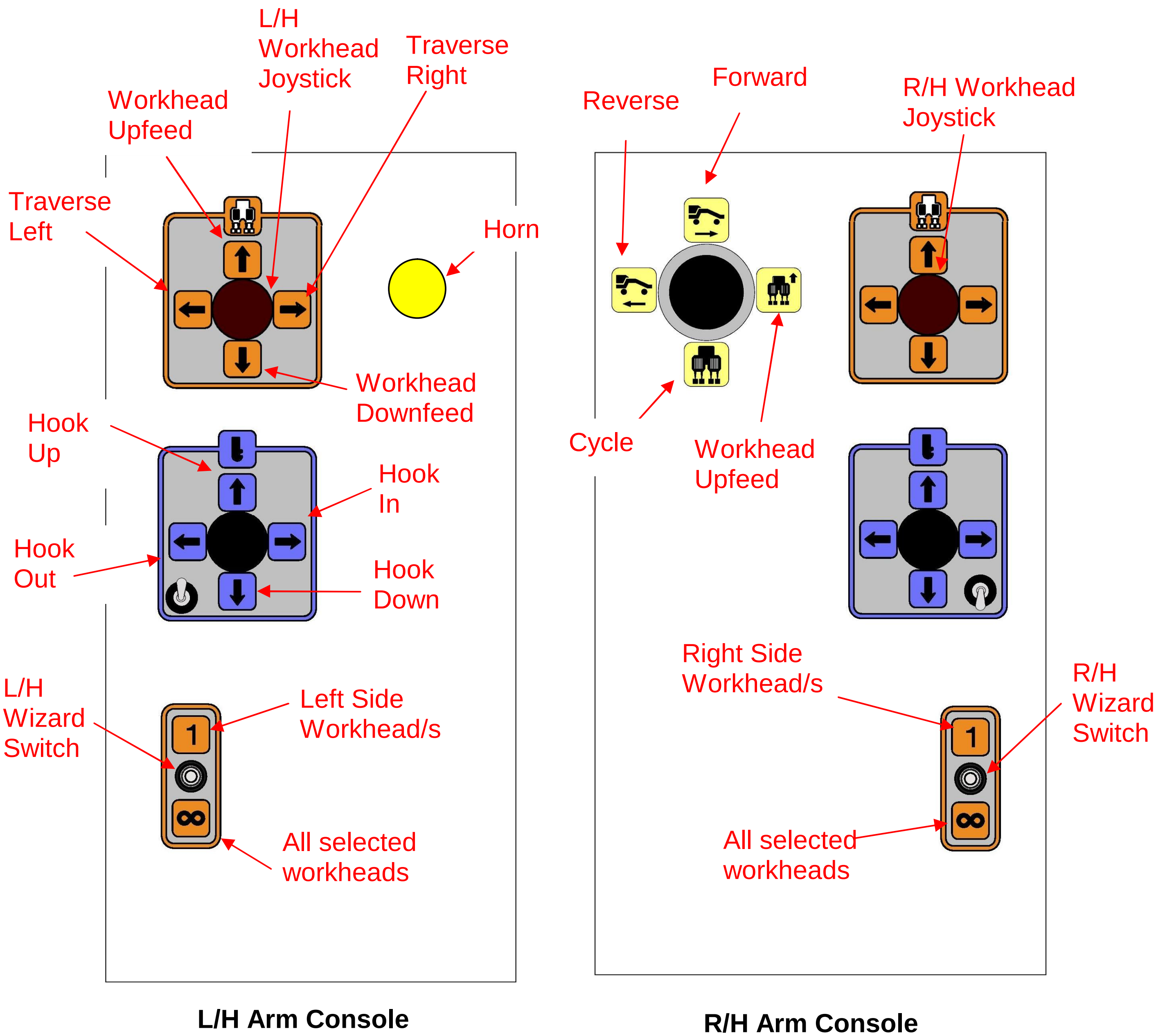
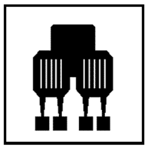

L/H Workhead Joystick
Traverse Right
Workhead Upfeed
Traverse Left
Horn
Workhead Downfeed
Hook Up
Hook In
Hook Out
Hook Down
L/H Wizard Switch
Left Side Workhead/s
All selected workheads
Reverse
Forward
R/H Workhead Joystick
Cycle
Workhead Upfeed
Right Side Workhead/s
R/H Wizard Switch
All selected workheads
1
1
L/H Arm Console
R/H Arm Console

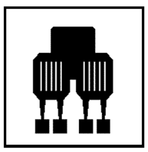
Figure 3-8

Left Vibrators *(ON/OFF Switch)*



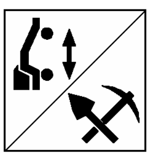
Press this key to toggle the status of the left workhead vibrators on/off. Pressing EITHER of the two most left workhead keys will toggle both vibrators for the left side of the machine. *(Does not apply to split tool machines)*

Right Vibrators *(ON/OFF Switch)*



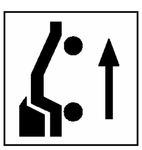
Press this key to toggle the status of the right workhead vibrators on/off. Pressing EITHER of the two most right workhead keys will toggle both vibrators for the right side of the machine. *(Does not apply to split tool machines)*

Work/Travel Mode



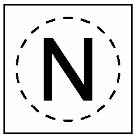
Press this key to toggle between the WORK and TRAVEL modes. Pressing the button IN places the machine in WORK MODE. If the button is out, the machine is in TRAVEL mode. *(Does not apply to split tool machines)*

Forward Travel



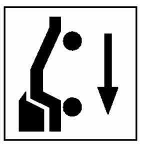
Press this key to select the **FORWARD** direction of travel. **Use only in travel mode.**

Neutral



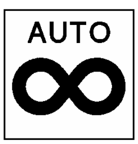
Press this key to place the transmissions in NEUTRAL.

Reverse Travel



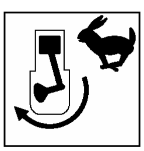
Press this key to select the **REVERSE** direction of travel. **Use only in travel mode.**

Automatic



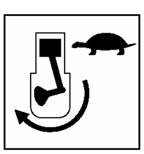
Press this key to place the transmission in AUTOMATIC. The machine will then determine and select the appropriate gear (1st through 4th) based on engine speed.

Engine Rev. -Up



Press this key to **INCREASE** engine RPM.
(NOTE: Max. =2100 RPM - Min.=1000 RPM)

Engine Rev. -Down



Press this key to **DECREASE** engine RPM.
(NOTE: Max. =2100 RPM - Min.=1000 RPM)

The R/H Operator Keypad

The right hand keypad provides graphical operator input (rubber banding) without using a pointing device such as a mouse.

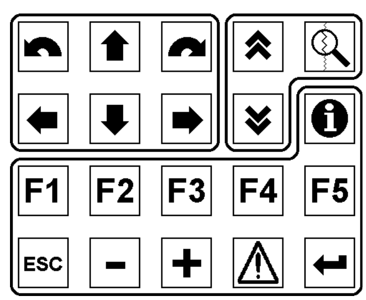
Cursor Group

Expanded Track View Group Keys

Lower Group Function Keys

R/H Operator Keypad

Figure 3-9



One of the most important keys on this keypad is the help key which is in the right column of keys, second from the top (with the international "**i**" symbol for information). Regardless of the panel, menu or dialog box that is open at the time, pressing this key will give you help information relevant to the situation. See the section on help near the end of this chapter, *page 3-89*.

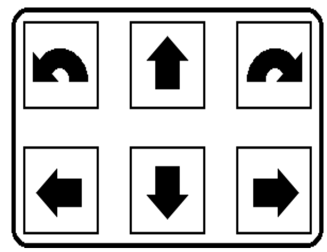
Many of the keys on the right keypad appear similar to keys on the PC keyboard (F1 through F5, ESC, ENTER and so on). A feature of System V is that almost all of the keys on the right keypad have a counterpart on the PC keyboard and either may be used for convenience.

On the screen, the function buttons (F1-F5) directly activate one of the five "toolbar" buttons seen at the top right hand side of the screen. Pressing the ENTER key replaces the primary toolbar buttons with a second set of toolbar buttons. There are three sets of main toolbar buttons that are described in detail starting at page 3-25.

Pressing the ENTER key cycles between the three toolbar sets. After a toolbar set has been selected, it remains selected until a time-out elapses (7.5 seconds) without selecting any of the available functions. After this time-out occurs, the toolbar buttons revert to the first set. This helps keep the operation of the function buttons on the right keypad consistent while the machine is being operated so that the operator does not have to look at the screen in order to invoke a frequently used operation. The time-out allows more than one button in a toolbar set to be used before automatically reverting to the first set.

The Cursor Group

The six buttons at the top left of the right keypad are known as the cursor group and are used for two different purposes.



Normally these keys control manual adjustments to lift, line and superelevation. Manual corrections of this type are typically additive to any automated ramping or "best fit" control of the corresponding graph so that the operator remains in complete control at all times. As will be seen later, these keys are also extensively used for selecting and dragging best-fit and ramp lines, *page 3-59*. For now, the operation of these keys during normal tamping only will be discussed.

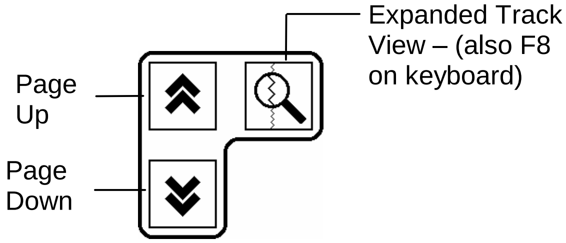
Each time a lift (vertical arrow) key is pressed, lift at the shadowboard will be changed by 1/32 in. (.794 mm) How this change is displayed on the screen will depend on the manner in which surface is being applied. When the machine is automatically controlling surface according to an established plan, the change will be shown on the left slider of the lift panel. When not working according to an established plan for lift, the change will be seen in the right (yellow) slider and in the numerical display just below the surface sliders.

Each time a shift (horizontal arrow) key is pressed, throws at the shadowboard will be changed by 1/16 in. (1.6 mm) and the manual display at the bottom of the *Throws Panel* will change accordingly.

The left and right curved arrow buttons in this group are used to apply superelevation or crosslevel correction by /1/32 in.(.794 mm) for each button press. The correction is displayed in the crosslevel panel (when top red correction arrow is in line with center black arrow the correction is zero). The rotation implied by the arrows on these keys also indicates the effect they have on superelevation (when looking forward). The top left arrow button moves the red crosslevel correction arrow to the left which will raise the right rail. The top right arrow button moves the red crosslevel correction arrow to the right, and will raise the left rail. Note, that after a correction is applied using these keys, the effect of the correction will not be seen by the inclinometer (the green trace in the crosslevel panel) until the machine has worked approximately 15 feet (4.6 m), which is the distance between the shadowboard (where the correction is applied) and the receiver buggy (where the inclinometer is mounted).

The Expanded Track View Group Keys

When the operator wishes to automate the control of Lift, Line or Superelevation ahead of the machine, the first step is to expand the track view at the bottom of the screen. The key that does this is the Expanded Track View Key (magnifying glass) at the top right of the operator's R/H keypad.



Pressing the expanded track view key again returns the screen to the main or work track view. The track distance seen on the main or work screen is 150 feet. (46 m) When the track graph is expanded, 450 feet (137 m) of track ahead of the machine is visible.

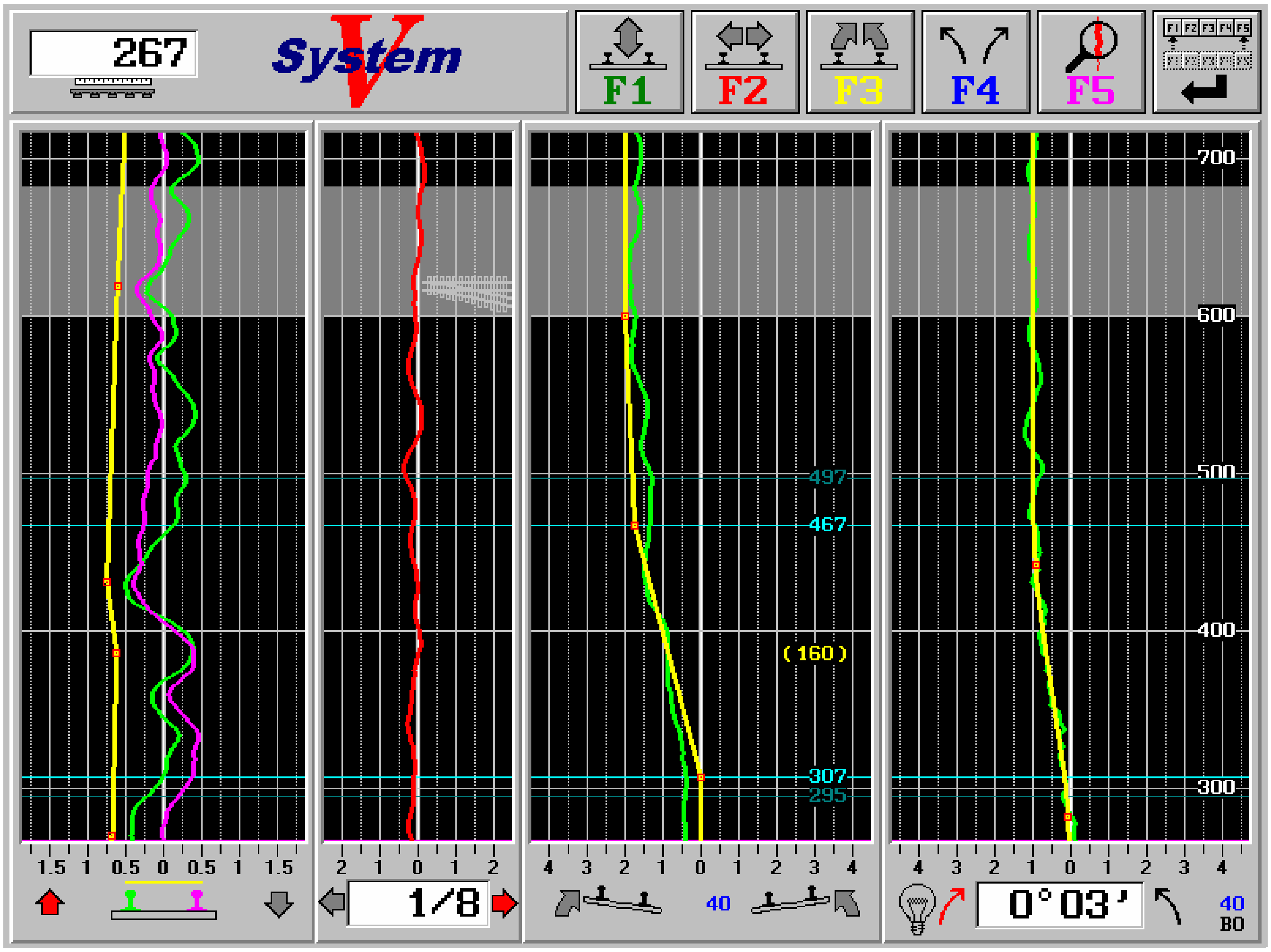
To the left of the expanded track view key are two keys with "corporal stripes" (page up and page down) which provide moving from transition point to transition point of recorded data. In the expanded track view the operator can enter or modify any ramps, record track, apply or change "best fits" to recordings, enter or change fixed points or recall previous recordings from the machine's filing system (memory). The operator can expand the track view at any time, either to obtain access to functionality available in the expanded view or to simply "look ahead" momentarily while tamping. Another example of a powerful System V feature is that the operator can manually change the best fit information of a curve by dragging (rubber banding) control points on the best fit line.

The Expanded Track View

The expanded track view is selected by using the Expanded Track View key (magnifying glass) located on the Operators R/H Arm Panel keypad, 450 feet of track can be seen at one time. It is also possible to compress hundreds of feet onto this view (F5 first toolbar, expanded track view, *page 3-59*) so that complete curves or recordings can be seen at once. Each of the panels that make up this view (Surface, Throws, Superelevation and Line) are described in detail later, *page 3-58*.

If no track has been recorded (or recalled from memory) since the machine was turned on, the Surface, Throws, Superelevation and Line fit lines are straight vertical lines positioned on zero. If desired, the operator can select and drag (rubber band) these lines to create work-in, work-out ramps or any other desired control, if track is to be tamped without previously recording it. This is done in exactly the same way that fit and throw lines are modified after recording and "best-fitting". **Note:** The machine (after hunting light) will always Ramp up or down to the machine default.

Continued on Next Page

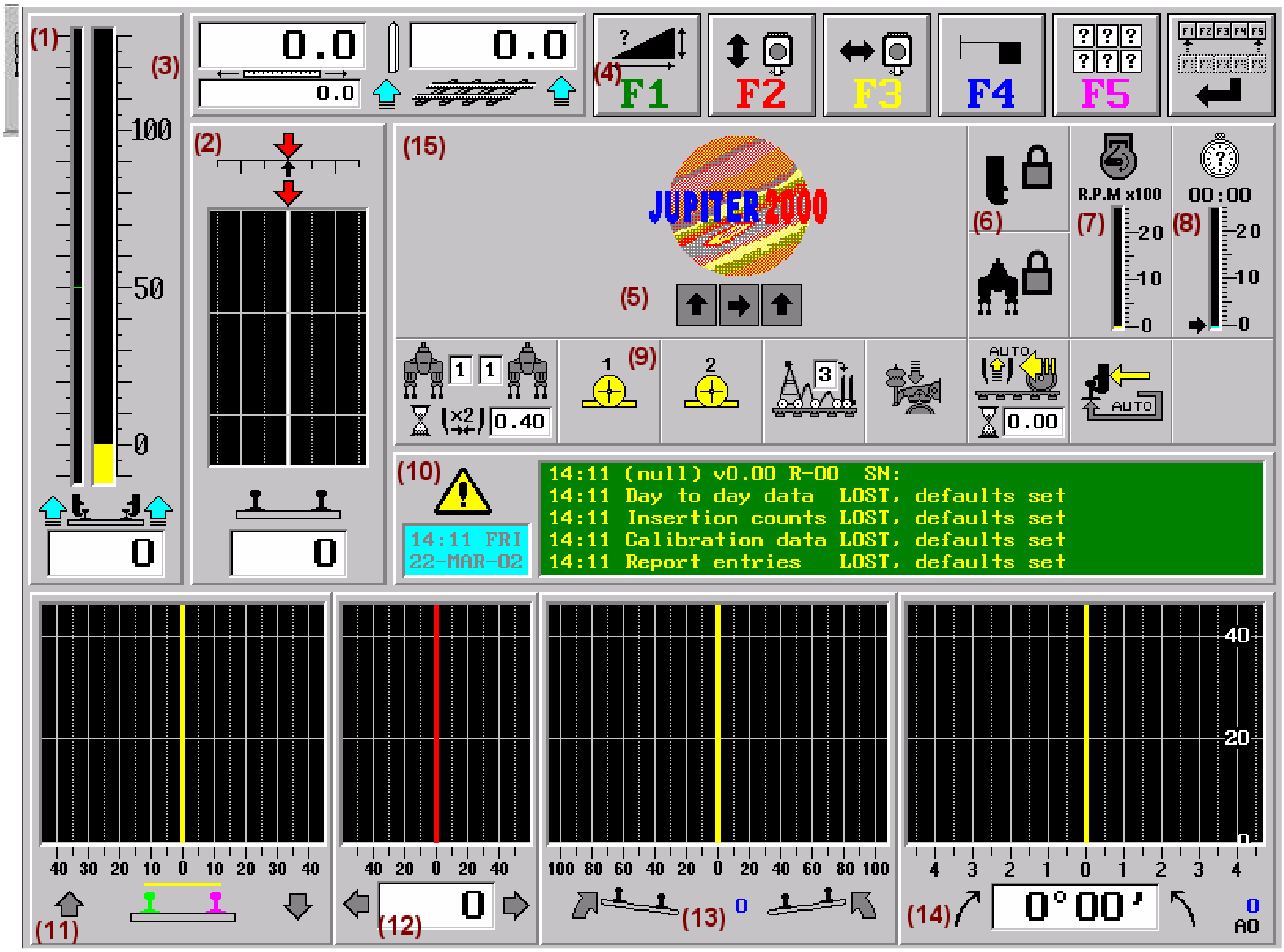


EXPANDED TRACK VIEW

The Expanded Track View has a different primary toolbar button set from the Main or Work screen. In this primary set, buttons F1 through F4 select Surface, Throws, Superelevation and Line for modification respectively. The F5 button toggles between the compressed view (if available) and the normal expanded track view (450 feet (137 m) of track is visible).
The expanded track view has three toolbar button sets. The ENTER key cycles between these in the same way as it cycles the three toolbar sets available from the main or work screen. Some of the main screen toolbar buttons are duplicated in the expanded track view sets for convenience (turning projectors on and off, changing reference and so on).

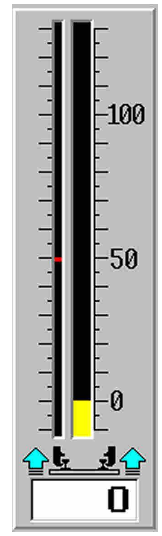
Main or Work Screen Components

The System V main or work screen is composed of several panels, which are updated continuously as the machine is operated. Each panel is devoted to a particular function or group of functions, which are discussed below.



(1)	The Lift Panel	(9)	The Status Panel
(2)	The Superelevation/Crosslevel Panel	(10)	The Alarm Panel
(3)	The Distance and Milepost Panel	(11)	The Surface Graph Panel
(4)	The Main or Work, 1st Toolbar Set	(12)	The Throws Graph Panel
(5)	The Surface & Liner Indicators	(13)	The Superelevation Graph Panel
(6)	Clamp & Workhead Lock Indicators	(14)	The Line Graph Panel
(7)	The Engine RPM Indicator	(15)	The Engine Status Alarms
(8)	The Work Rate Indicator		

The Lift indicator Panel



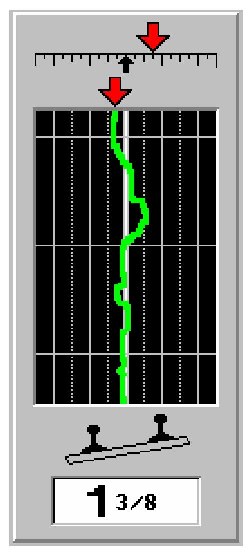
The lift panel is located on the far left of the main screen. There are two "thermometer" style displays showing lift in 1/16 inch (1.6mm) increments. The right hand yellow "slider" gives the current lift being applied. The left hand slider shows the total amount of any manual correction the operator has applied during any planned ramps, (a green bar is an increase, a red bar is a decrease).

Lift displayed by the yellow slider is also displayed numerically in an information box at the bottom of the lift window. When the lift value exceeds the range of the thermometer, the value must be read from this box. Located below the lift sliders is a symbol indicating the currently applied lift. The blue arrows point upward when positive lift is applied; conversely, the blue arrows point downward when negative lift is applied. The numeric display does not indicate the sign, only the magnitude of applied lift in the indicated direction.

When using optional prerecorded surface data, System V can automatically vary the lift to compensate for errors at the projector, to minimize lift and to automatically work into and out of fixed points (I.E. bridge) . The operator retains full control at all times and may increase or decrease the value of lift being applied by the computer. Note, such adjustments will show in the left hand slider.

The lift expressed by the yellow slider corresponds to the lift that will be applied on the next cycle to the track. When the track being tamped has not been prerecorded, this value will be an average value and will exclude variations in lift arising from track errors. When System V is automatically controlling lift from prerecorded surface data, the indicated lift value should accurately reflect actual lift for a properly calibrated machine in good conditions. Poor conditions such as inadequate or foul ballast may result in settlement that would result in the actual lift being less than the indicated value.

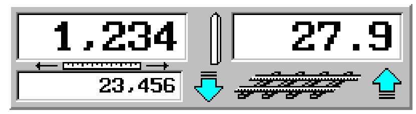
The Superelevation/Crosslevel Indicator Panel



At the top of the superelevation or crosslevel window is a red arrow and scale that indicates the amount of crosslevel correction, in 1/16 inch (1.6 mm) increments, that has been entered by the operator. The operator can adjust this value when experiencing a sustained error that results in superelevation at the inclinometer. The superelevation correction keys (curved arrows) are located on the right hand keypad and change the value by 1/32 inch (.794 mm) per press. The red arrow at the top of the panel indicates the operator's superelevation or crosslevel adjustments.

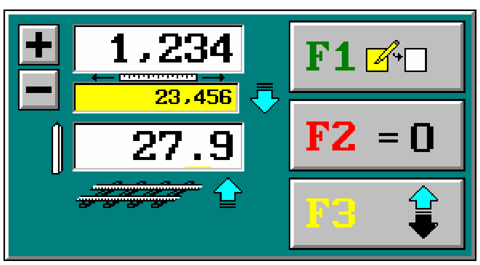
The 'strip chart' type graph in the center of the window displays a plot of superelevation or crosslevel with respect to design or desired crosslevel. When the crosslevel at the C point (receivers) exactly matches the desired crosslevel, there will be a green trace down the center of the graph. There is a delay of about 15 feet (4.6 m) in the display of corrections to crosslevel. The scale is divided in 50 foot increments and displays a total of 150 feet (46 m) of track behind C point (receivers). The white information box under the superelevation strip chart indicates the design or desired superelevation value at the shadowboard. The design value will remain steady unless in a spiral or superelevation ramp.

The Distance/Milepost Indicator Panel



The distance window displays the distance moved while working, along with the milepost position. The distance window appears on both the main screen and the expanded track view. The larger distance box (upper left on panel) is where the distance is automatically set to zero at the start of each new recording. The auxiliary distance box, lower left with small digits, is used to read accumulative footage and should be zeroed at the start of the day. At the discretion of the operator, this distance can be used to accumulate track tamped or to synchronize with line-side features where location is marked in feet (or ignored completely). The values displayed are updated by a distance wheel when the machine is in work mode; or, by the front transmission sensors when the machine is in travel mode.

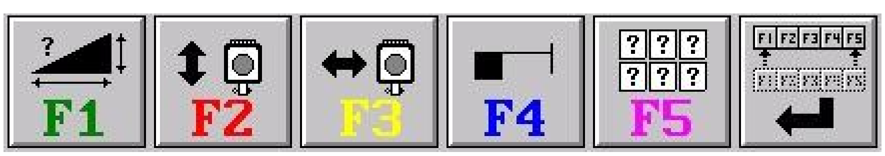
Like the footage counter, the auxiliary distance counter can be set to count down with forward movement as indicated by the adjacent cyan up/down arrow on the distance panel. The set distance menu (F1 on the second toolbar of the main screen) accommodates the auxiliary distance box as follows:

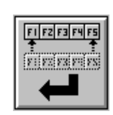


The F1 button selects one of three fields to work with. The F2 button will set the selected (highlighted) field to zero. The F3 button selects the counting direction for the selected field and is therefore disabled when the normal footage is selected (which only counts up in the forward direction).

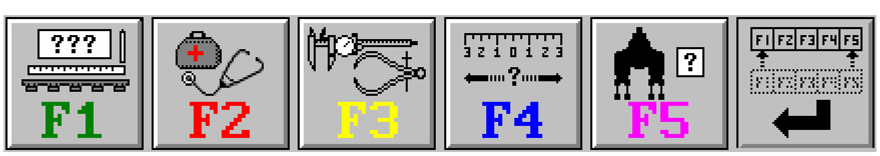
Main or Work View - Toolbar Sets

When the computer initially starts up, the first toolbar set below will be displayed.

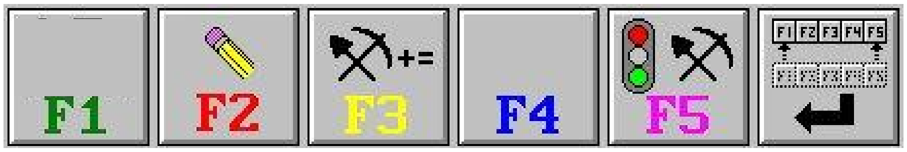




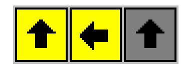
By pressing the “ENTER” key, the second toolbar set will be displayed as below.



Again, pressing the “ENTER” key will display the third and last main toolbar set (see following page).

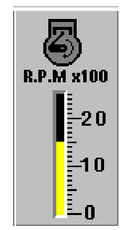


The Receiver Indicators



While the projector(s) are on, the receiver indicators reveal the status of the beams (cut/uncut) as seen at the corresponding receiver. Shown are the two surface receiver indicators on the sides and the lining receiver indicator in the center. The arrow for the lining receiver indicator (center) changes direction according to the lining reference selected.

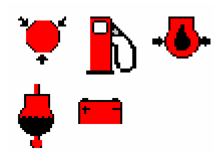
The Engine RPM Indicator



The on screen display of engine RPM is used for information only.

NOTE: The engine symbol in the tachometer display will turn red if the engine speed is less than 500 RPM or greater than 2500 RPM.

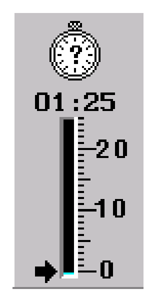
The Machine System Alarms



The Computer monitors various machine and engine functions such as system air pressure, diesel fuel level, engine oil pressure, engine water temperature and the status of the engine charging system.

When one or more of these parameters is "in alarm" (the value exceeds allowable, or even possible level or limits), the corresponding symbol will be displayed on the main screen status panel, colored red and flashing. In addition, the computer beeper will emit five short beeps every minute that one or more of these parameters are out of tolerance. For more information on the alarm system go to F2 Diagnostic menu on the second main toolbar, then see F2 engine diagnostic panel.

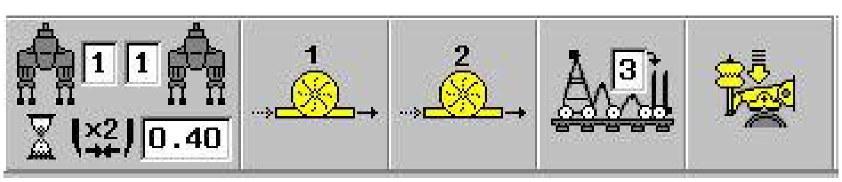
The Work Rate Indicator



The work rate indicator shows the time elapsed for the current work mode, (elapsed time varies with the mode; i.e., work, travel, repairs, trains, etc.) the speed of working in ties per minute, (blue slider) and the maximum work speed achieved in the current work period (the black arrow).

The Status Indicators Panel

The status panel displays the status of various machine functions.



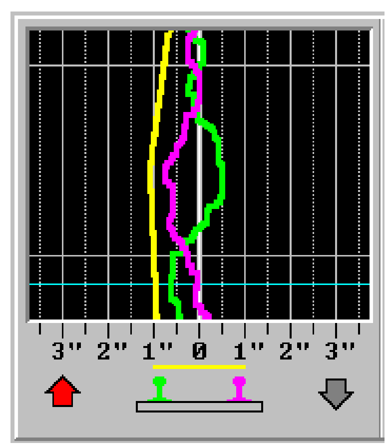
The Alarm Panel

The alarm panel is located in the middle of the main screen below the status panel. It displays messages and alarms as they occur during machine operation, as well as the current time and date. Pressing the alarm button (yellow triangle with an exclamation mark on the R/H Operator Keypad or F7) expands the alarm box so that more of the previous messages can be seen at once. Each alarm message is tagged with the time the alarm was posted and can be compared easily to the current time displayed on the clock. In addition, messages will "age" or "fade" after first appearing so that the most recent messages will attract the most attention. When a curve file is loaded and the machine is working within the limits of the recording, the alarm icon (yellow triangle with an exclamation mark) will be replaced with an estimation time to completion box. This box will give the time to complete working the recorded curve at the present work rate (ties per minute).

NOTE: Time and date can be set from expanded view defaults panel, F5 third toolbar set and the hours display is in 24hours.

The Surface Graph Panel - *Main Screen*

The surface graph panel is displayed at the lower left corner of the screen. While tamping, the machine is assumed to be currently positioned at the bottom of the window so that the panel indicates the next 150 feet (46 m)of desired surface information to be applied as tamping proceeds. The horizontal gray lines are 100 feet (30.5 m) apart. The horizontal light cyan line indicates where a lining transition point lies when fitted recorded track data is available.



When the track ahead of the machine has been recorded, with optional surface fitting software, the green trace represents the surface profile for the left rail and the purple trace represents the surface profile for the right rail. Surface profiles are calculated results based on measurements made when the track is recorded. The yellow trace marks the surface fit that is used to establish the lift to be applied. The desired surface fit is computed automatically by the built-in surface fitting functions, or it can be set manually using the "rubber banding" edit control points available from the expanded track view. (Machine must have Surface Fitting Option.)

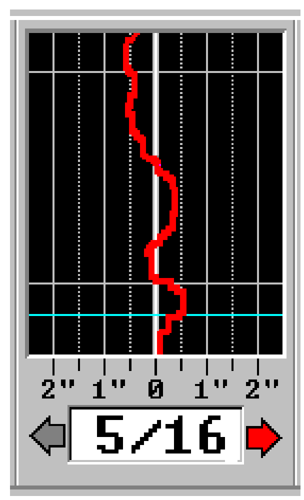
For surface recordings, high points are to the left and low points are to the right in this view. The distance from the yellow fit line to the purple or green trace is an estimation of the amount each rail will be lifted (note that inadequate ballast or poor conditions will reduce the accuracy of this estimate). If track has not been recorded, the distance of the yellow fit line to the zero or base line is a measure of the overall lift being applied (the actual lift will be more or less, depending on track errors).

NOTE: Any manual adjustment to recorded surface is displayed in the left hand slider of the surface lift panel. Also ***Surface Fit Option:*** Plotting a curve with the surface projector **ON, Enable** surface fit and plotting with surface projector **OFF, Disable** surface fit. After a curve is plotted, the *option cannot be turned ON or OFF*.

Moving the yellow fit line to the left increases lift and to the right decreases lift. The vertical arrow indicators on the panel are drawn to indicate this. When the current surface lift value given by the yellow line is greater than zero, the left arrow turns red. When less than zero, the right arrow turns red. When zero, neither arrow turns red. The number found on the lift slider will match the magnitude of the yellow fit line at the bottom of this window (current footage).

The Throws Graph Panel - *Main Screen*

The throws graph panel is displayed at the bottom of the screen to the right of the surface graph panel. While tamping, the machine is assumed to currently be positioned at the bottom of the window so that the panel indicates the next 150 feet (46 m) of lateral track movement. The horizontal gray lines are 100 feet (30.5m) apart. The horizontal light cyan line indicates where a lining transition point lies when fitted recorded track data is played back.

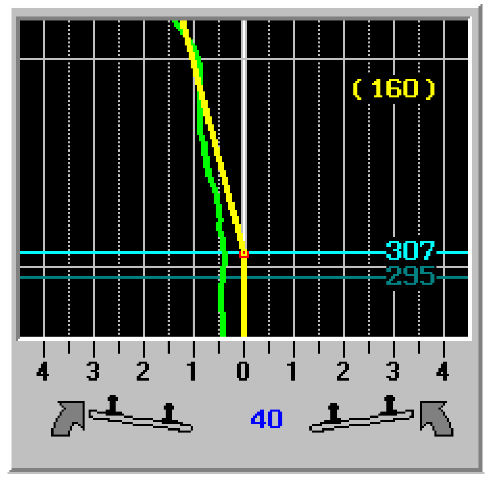


At the bottom of this panel, the numerical value in the white display, between the arrows, is the total manual correction to throws that has been entered since work commenced. The red arrow indicates the direction in which this manual correction is being applied.

Throws are computed automatically by the built-in curve fitting functions. Throws may be manually adjusted by the operator using the "rubber banding" edit controls provided in the expanded track view.

The Superelevation Graph Panel - ***Main Screen***

The superelevation graph panel is displayed at the bottom of the screen to the right of the throws graph panel. While tamping, the machine is assumed to currently be positioned at the bottom of the window so that the panel indicates the next 150 feet (46 m) of design superelevation to be applied as tamping proceeds. The horizontal gray lines are 100 feet (30.5m) apart. The horizontal light cyan line indicates where a lining transition point lies for fitted recorded track data. The distance (307) mark at where this transition lies is also displayed here. The length (160) of the transition is displayed in yellow text in parentheses. The horizontal cyan line is a marked feature line. The distance (295) mark at where this marked feature lies is also displayed here. The numerical value in blue between the two track symbols at the base of this panel, (40 in this instance) is the distance from the current location of the machine to the next transition point.



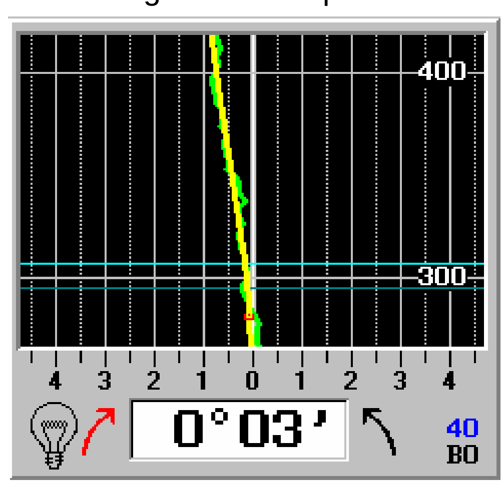
The yellow trace indicates the design or desired superelevation or crosslevel to be achieved by the machine during tamping. When a track recording is used to control the machine, the green trace indicates the recorded superelevation data. The number displayed on the superelevation graph panel will match the magnitude of the yellow trace at the bottom of this window (current footage).

All values displayed to the left of the centerline (which is zero) indicate the rail is banked toward the right. Conversely, all values displayed to the right of the centerline indicate the rail is banked toward the left. The arrows indicate this convention, and are painted red according to the current desired value (yellow trace) being used by the machine.

NOTE: Neither arrow is red if the desired superelevation is zero.

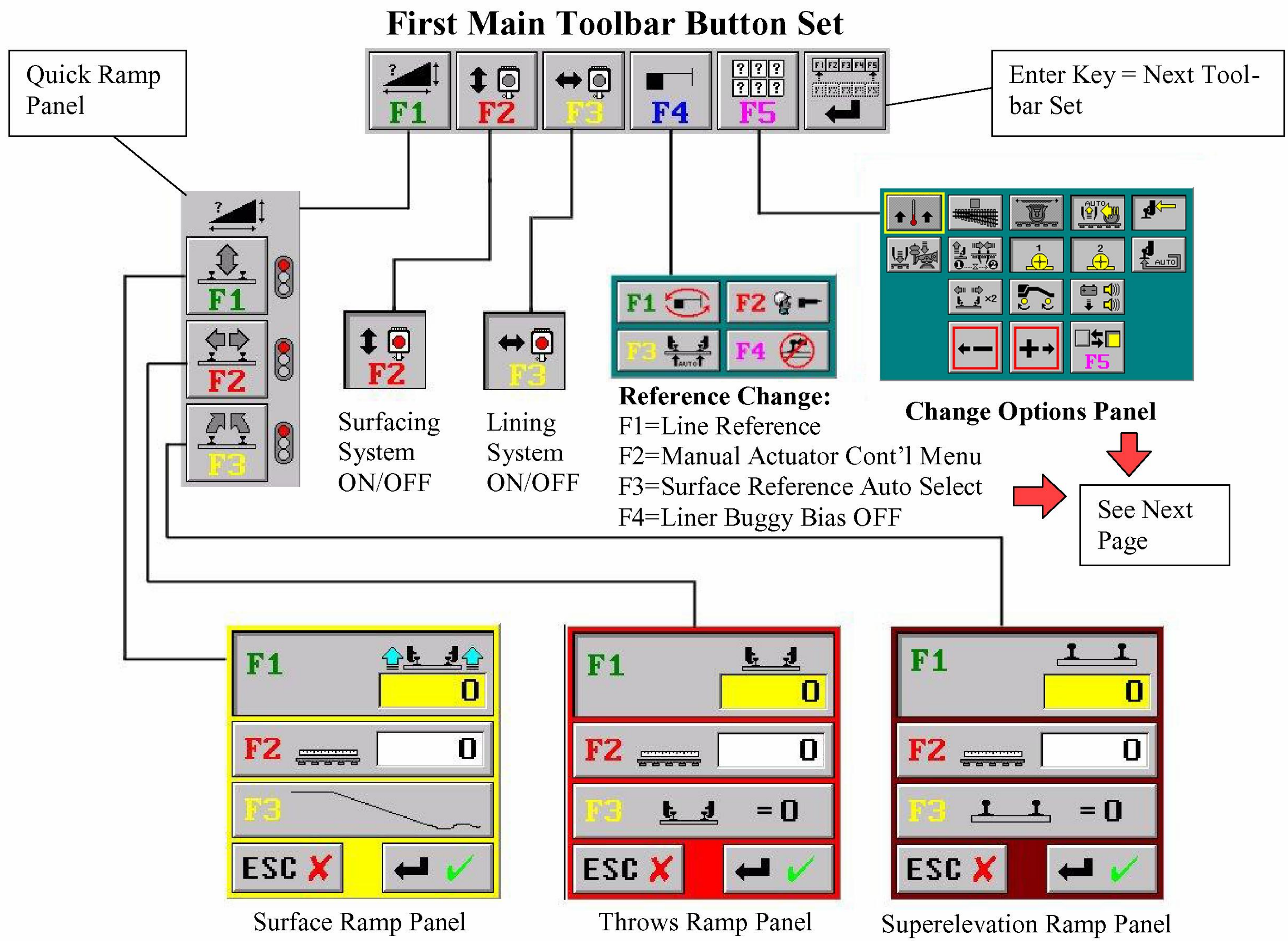
The Line Graph Panel - *Main Screen*

The line graph panel is displayed at the bottom of the screen to the right of the superelevation graph panel. While tamping, the machine is assumed to currently be positioned at the bottom of the window so that the panel indicates the next 150 feet (46 m) of design lining (expressed in degrees of curvature) to be applied as tamping proceeds. The horizontal gray lines are 100 feet (30.5m) apart. The distance value associated with each horizontal gray line is also displayed here. The horizontal light cyan line indicates where a curve lining transition point lies for fitted recorded curve data or when manually set by the operator (build a curve). The horizontal cyan line is a flag or marked feature line. The blue numerical value, (40 in this instance) at the bottom right of the display, is the distance from the current location of the

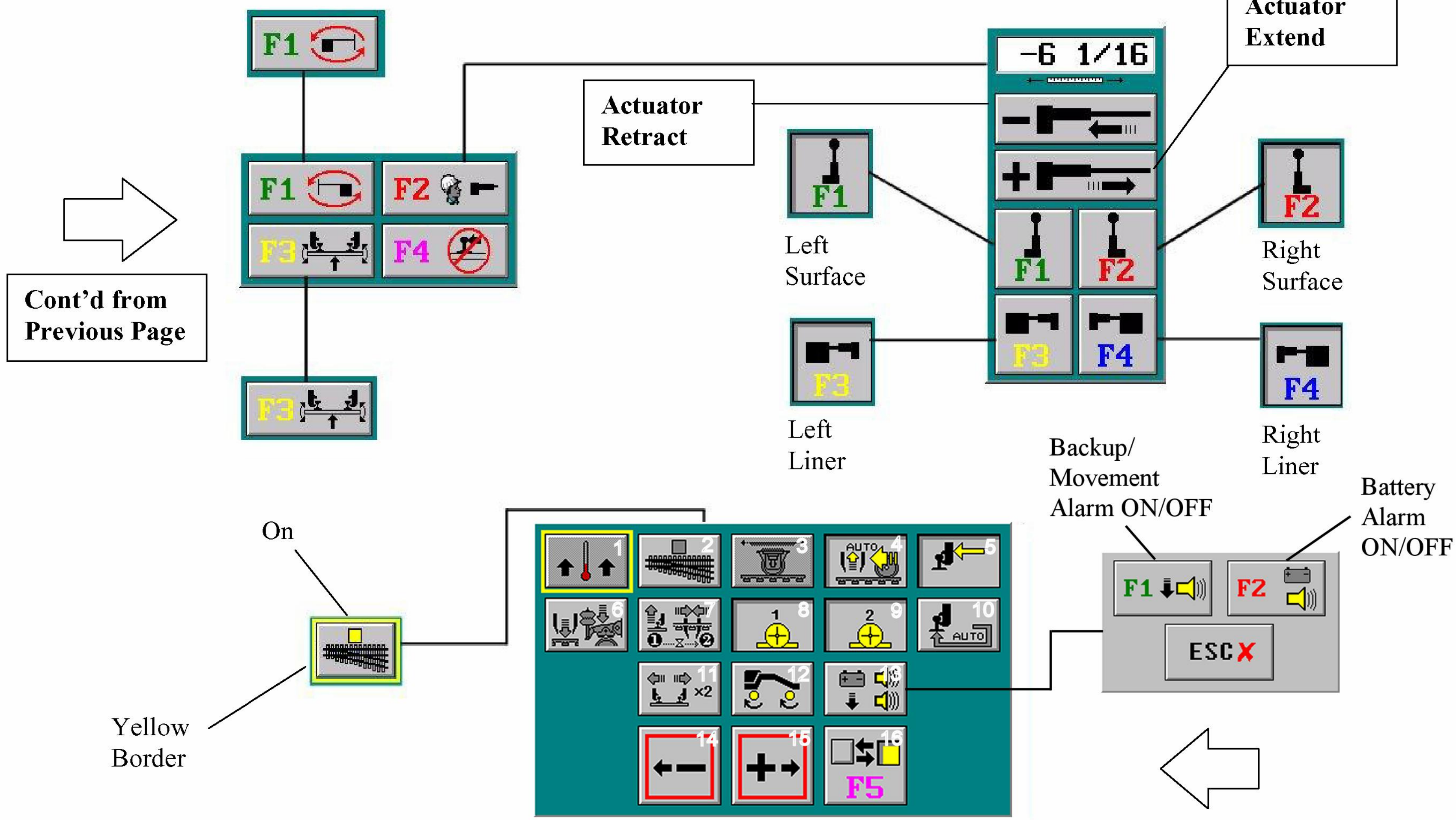


machine to the next transition point. The alphabetical letter and numerical value, at the bottom right under the blue numerical value, (40) is the best fit and sensitivity (B0 in this instance) of the recorded curve. The light bulb, bottom left, is the on/off symbol for the optional LineLite liner system.

The yellow trace indicates the curve fit for the track. The green trace indicates the recorded curve geometry. When the yellow trace is drawn to the left of the centerline, right-hand curvature is assumed as indicated by the left arrow. When the yellow trace is drawn to the right of the centerline, left-hand curvature is assumed as indicated by the right arrow. The yellow trace is drawn directly up the centerline for tangent track. The white information box at the bottom of the panel indicates the degree of curvature assumed at the current footage, and the corresponding arrow is painted red to indicate the direction of curvature (left or right).

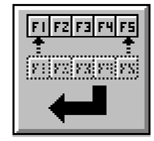

First Main Toolbar Button Set
Quick Ramp Panel
Enter Key = Next Tool-bar Set
F1
F2
F3
F4
F5
Surfacing System ON/OFF
Lining System ON/OFF
Reference Change:
F1=Line Reference
F2=Manual Actuator Cont'l Menu
F3=Surface Reference Auto Select
F4=Liner Buggy Bias OFF
Change Options Panel
See Next Page
ESC
Surface Ramp Panel
Throws Ramp Panel
Superelevation Ramp Panel

First Main Toolbar Set – Cont'd



Change Options Panel: **(1)** WarmUp Hydraulic Oil (ON/OFF) **(2)** Switch Mode ON/OFF **(3)** Slip Rear Traction ON/OFF **(4)** Auto Traction ON/OFF **(5)** Clamp Pressure Sustain ON/OFF **(6)** Index Brake ON/OFF **(7)** Squeeze Waits on Lift **(8)** P1 Pump ON/OFF **(9)** P2 Pump ON/OFF **(10)** Auto Underfoot Lifting **(11)** Lining System Double Shift **(12)** Axle Traction Disengage **(13)** Backup/ Movement Alarm Select **(14)** Move Yellow Border Left to Select **(15)** Move Yellow Border Right to Select **(16)** Sets Option Border in Yellow, Toggles ON/OFF

Main or Work Screen Toolbar Buttons

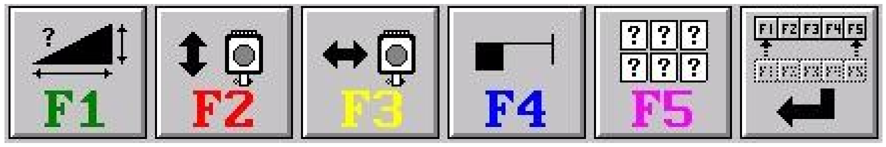


ENTER Key

The toolbar buttons are located in the top right corner of the screen. Each button corresponds to its counterpart on the R/H keypad on the operator R/H armrest. There are three sets of toolbar buttons for the main screen display, and three sets for the expanded track view.

Pressing the ENTER key (the bottom right button on the operator's R/H keypad) changes the toolbar to the next set of buttons.

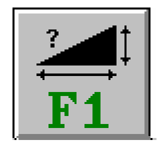
The First Toolbar Button Set - *Main View*



Main View - First Toolbar Set

The first toolbar button set is present whenever the machine is started, whenever the display is switched from the expanded track view mode back to the Main screen, or whenever more than 7.5 seconds lapses without the selection of a current toolbar button.

F1 - The Quick Ramp Panel

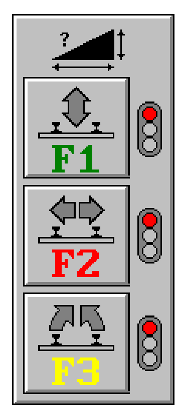


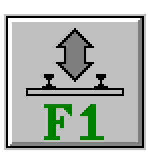
Pressing this button opens the Quick Ramp panel (shown below) that is used to apply (or cancel) smooth variations or ramps to surface, throws and superelevation.

NOTE: It is intended that this panel be used in cases where the result of a recording and best fit is NOT used to control the selected parameter. I.e. you would not use F3 to change the superelevation ramping of a fitted curve spiral or F1 to change the surface of track with recorded surface (if fitted). Using quick-ramp features in such cases will discard or modify existing fit information, possibly causing severe problems in line, surface or superelevation.

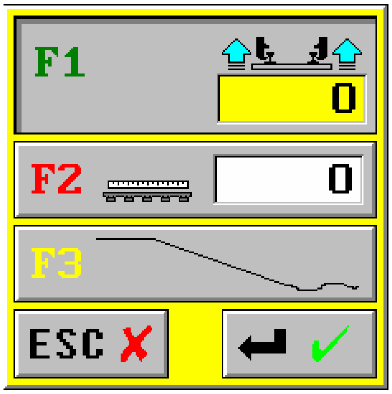
While the Quick-Ramp panel is open, the ramping status of surface, throws and superelevation will be indicated by the pressed or released state of the corresponding button and traffic light symbol. When a parameter is being ramped, the corresponding button will appear depressed and the traffic light symbol will show green. When a parameter is not being ramped, the button will appear released and the traffic light symbol will be red. If ramping is in progress, pushing the corresponding button will stop the current ramp at the current value. If no ramp is in progress, a ramp panel for the corresponding parameter will open.

<u>F1 - Surface Quick-Ramp</u>





Pressing F1 opens the Surface Quick-Ramp Panel. When the Quick-Ramp panel for surface opens, the F1 button will be initially depressed. If you wish to ramp down the lift until the machine is no longer lifting, simply press F3. A value of 1-1/2 inches (38 mm) below zero will be applied and the F2 button will be automatically selected so the length over which to ramp out can be changed before pressing ENTER to begin.



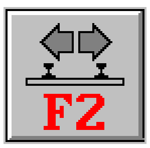
Otherwise enter the value of lift to be ramped to at the end of the desired ramp by either using the PC keyboard to type in a number or use the plus and minus keys. Press F2 and use the plus and minus keys (or type the number) to specify the length of the desired ramp.

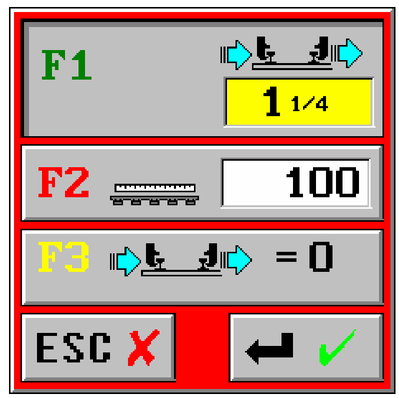
NOTE: On all quick ramp panels, the F2 (Footage Panel) will default to the previously used footage. If this is undesirable, type in the desired footage or use the plus(+) or minus(-) key to select the desired footage.

After the target value (at the end of the ramp) and the length of the ramp has been specified, you can either press ESCAPE to postpone starting the ramp or ENTER to begin the ramp right now. If you press ESCAPE, the values you have entered will be retained until you again open this panel.

NOTE: This panel should not be used if the surface fitting option is being used to control lift. Using this panel in this case would delete the surface fit and all surface control points ahead of the machine.

F2 - Throws Quick-Ramp Panel





Pressing F2 opens the Throws Quick-Ramp Panel. When the Quick-Ramp panel for throws opens, the F1 button will be initially depressed. If you wish to ramp throws to zero, simply press F3 and the F2 button will be automatically selected so the length over which to ramp throws to zero can be changed before pressing ENTER to begin.

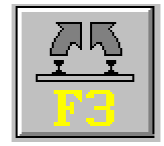
Otherwise enter the value of throws to be ramped to at the end of the desired ramp by either using the PC keyboard to type in a number or use the plus and minus keys. Press F2 and use the plus and minus keys (or type the number) to specify the length of the desired ramp.

NOTE: On all quick ramp panels, the F2 (Footage Panel) will default to the previously used footage. If this is undesirable, type in the desired footage or use the plus(+) or minus(-) keys to select the desired footage.

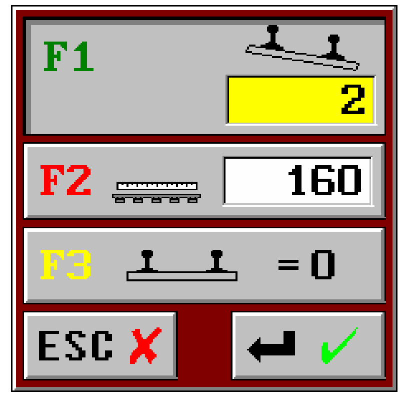
After the target value (at the end of the ramp) and the length of the ramp has been specified, you can either press ESCAPE to postpone starting the ramp or ENTER to begin the ramp right now. If you press ESCAPE, the values you have entered are retained until you again open this panel.

NOTE: This panel should not be used where track has been recorded and throws control points have been entered or recorded in order to line track to stakes or monuments. Entering a throws ramp will delete any throws control points ahead of the machine. This panel CANNOT be opened if Line-Lite is active.

F3 - SuperElevation Quick-Ramp Panel



Pressing F3 opens the SuperElevation Quick-Ramp Panel. When the Quick-Ramp panel for superelevation opens, the F1 button will be initially depressed. If you wish to ramp superelevation to zero, simply press F3 and the F2 button will be automatically selected so the length over which to ramp superelevation to zero can be changed before pressing ENTER to begin.



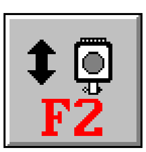
Otherwise enter the value of superelevation to be ramped to at the end of the desired ramp by either using the PC keyboard to type in a number or use the plus and minus keys. Press F2 and use the plus and minus keys (or type the number) to specify the length of the desired ramp.

NOTE: On all quick ramp panels, the F2 (Footage Panel) will default to the previously used footage. If this is undesirable, type in the desired footage or use the plus(+) or minus(-) key to select the desired footage.

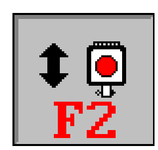
After the target value (at the end of the ramp) and the length of the ramp has been specified, you can either press ESCAPE to postpone starting the ramp or ENTER to begin the ramp right now. If you press ESCAPE, the values you have entered will be retained until you again open this panel.

NOTE: This panel should not be used where track has been recorded and superelevation is being controlled using the best fit of the recording. Entering a superelevation ramp will delete any superelevation transitions and control points ahead of the machine. system.

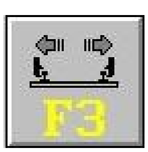
F2 - The Surface Projector (System) ON/OFF Button



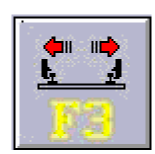
Pressing F2 on the first toolbar button set turns the surface projector on or off. The surface projector is OFF when the button is not pressed inward (left) and ON when the button is pressed inward (right). Note that the circle drawn in the projector is dark gray when projector is off and red when on. Turning the surface projector on enables the lifting system and causes the surfacing receivers to go to their zero position.



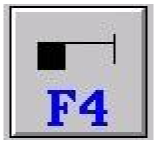
F3 - The Liner Projector (System) ON/OFF Button



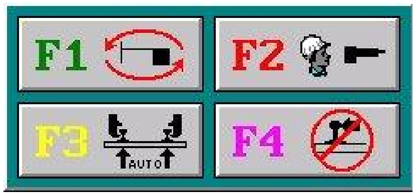
Pressing F3 on the first toolbar button set turns the lining system on or off. The lining system is OFF when the button is not pressed inward (left) and ON when the button is pressed inward (right). Note that the arrows are dark gray when the lining system is off and red when on. When the lining system is on, bias is applied to the measuring buggies, the lining system is enabled and the lining actuator will go to the zero position.



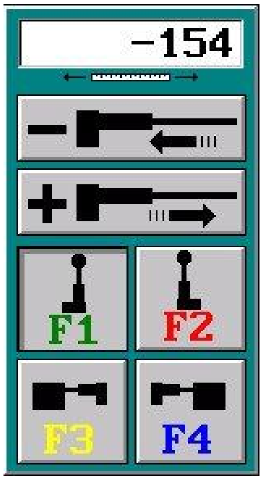
F4 - The Surface or Line Reference Selector Panel



Pressing F4 on the first toolbar button opens a panel to select the reference rail for lining or the method of surface reference as follows:



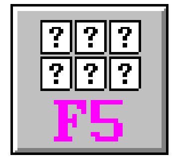
Pressing F1 either once or twice indicates lining system reference. The F2 button brings up the "Manual Actuator Control Menu". The F3 button determines if the *reference rail for surface* will be either automatically selected or by centerline reference. The bias wheels will be released when F4 button is pressed. Bias will automatically be restored when this panel is closed, if the lining system is on. Pressing the ENTER or ESC key closes this panel and saves any changes made.



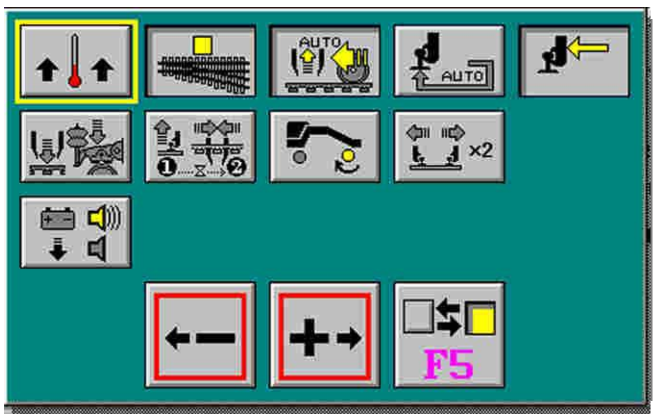
The "Manual Actuator Control Menu" offers manual controls for extending and retracting the (left /right) *surface actuator cylinders* and (left/right) *liner actuator cylinders*. Pressing the (+) *Actuator Extend* button extends the actuator cylinder while pressing the (-) *Actuator Retract* button retracts the actuator cylinder. In the example at right, F1 (left surface receiver) has been selected. The actuator extend/retract buttons are now available to either raise or lower left surface receiver.

F5 - Change Options Panel

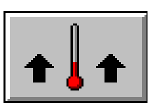
Pressing F5 on the first toolbar opens an options panel. Use this panel to change various machine options.



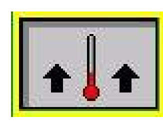
Use the plus or minus key to move the yellow border to the option you wish to change. Then press the F5 key to toggle the state of the option surrounded by the yellow border. Press the ENTER or ESC key to close this panel (all changes will be saved).
The option that is selected when this panel is closed (i.e. the button that is surrounded by the yellow border) will again be selected the next time this panel is opened. This allows the currently selected option to be easily changed from the first toolbar button set. **NOTE:** *The warm-up button will be highlighted initially during computer boot up*. In the following paragraphs, the purpose of each option that appears on the option panel will be explained.



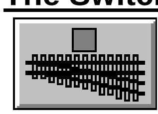
<u>The Warm-up ON/OFF Mode</u>



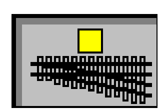
When pressed on and in work mode, (as shown right), the warm-up valve becomes energized causing the P1 and P2 pumps to pressurize. The hydraulic oil is diverted through an orifice to assist in warming the hydraulic oil. (Optional fast warm-up turns on vibrator reliefs to do a faster warm-up.)



<u>The Switch Mode ON/OFF Mode</u>



Switch mode is off when the button is not pressed inward as shown at the left. Switch mode is on when the button is pressed inward as shown at the right.



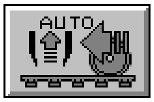
The switch mode indicator, shown on the status panel, will appear in place of the auto traction symbol (or the blanked square) whenever switch mode is activated, since auto traction will be disabled while the machine is working in switch mode. Switch mode is intended to be turned on when tamping portions of switches so as to provide certain operational changes and overrides that are of help when tamping switches. Some of the overrides in switch mode will require the operator to exercise more caution than would be necessary in production mode.

Switch mode is activated and deactivated from the Change Options panel, opened by pressing the F5 key on the first toolbar set. **Note:** The change options panel can also be opened by pressing the switch mode key on the left keypad.

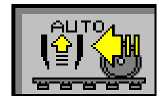
IN SWITCH MODE:

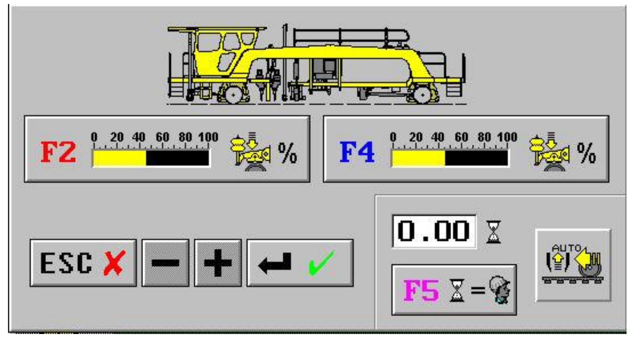
- Autojack traction is inhibited, as clearance may be restricted.
- Cycle will cause track to be lifted, lined and held in position so that workhead(s) can be traversed laterally to tamp the tie in other lateral positions.
- Cycling with manual workhead joysticks will not initiate lifting and lining as it will in production mode. This allows for the tamping of ties without lifting where lifting is impossible or impractical.
- Traction is not inhibited by clamp or workhead status and the machine can be moved at any time. Traction after "auto-jack" (jack and hold) will release the track in production mode but **NOT** in switch mode.
- If a clamp hook is already at a limit switch, using a clamp hook joystick will allow the operator to continue outfeeding or downfeeding the hook past the switch.
- If a clamp hook derails it will not automatically outfeed and downfeed to the limit switches due to possible lack of clearance. The clamp joysticks will have to be used to manually reposition the clamps prior to another cycle.
- When jacking the track using the "auto-jack" button (top left in the L/H operator keypad), releasing the button before lift has completed will cause the lift to terminate prematurely. This may be critical when lifting a turnout rail, which is not carrying the shadowboard, and that rail becomes detached from the tie.
- In Production mode, the clamp hooks normally outfeed to the limit switch. In switch mode, outfeed will occur only while the operator holds down the auto-jack-release button. This may be necessary when the hook is unable to outfeed to the limit switch due to lack of clearance with an adjacent track component.
- There is an independent set of insertion counters for switch mode.

The Auto Traction ON/OFF and Traction Delay Mode



When Auto Traction is off, the option button for this feature will appear as shown the left. When Auto Traction is on, the option button will appear depressed as shown to the right and the left facing arrow will be yellow. With Auto Traction OFF, no symbol will be displayed in the status panel main screen.





The value displayed in the lower right hand box is the delay in seconds that will be applied after squeeze pressure is achieved before traction is automatically engaged. To change the delay, press F5 to enable the plus minus keys and use this to change the delay time. If you want to change the delay to zero, press F5 again. In most conditions it will be possible to operate with a delay of zero (best production). Combinations of tie height, tie spacing, downhill grades, rain and so on may require increasing or decreasing this delay so as to prevent clipping of the tie by the tamping tools

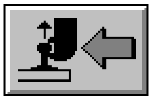
- F2 Front Decel Braking
- F4 Rear Decel Braking

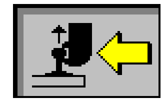
This panel allows the operator to change the decel (deceleration) braking rate. Select one of the parameters listed above (F2 and F4). Press the plus key or minus key to increase/decrease the selected parameter.

Press the accept button to save the changes and remove this panel. Press ESC to discard the changes and remove this panel.

NOTE: An excessively high percentage for hydraulic deceleration may result in wheel slippage during tamp cycles. Conversely, setting this percentage too low may cause stress on the workheads as insertion may occur before the machine has come to a full stop

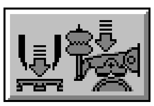
The Clamp Pressure Sustain ON/OFF Mode

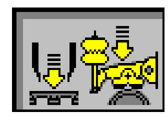




The Clamp Pressure Sustain option is OFF when the button is not pressed inward (left) and the arrow on the button will be dark in color. When ON, the button is pressed inward (right) and the arrow on the button will be yellow. When this option is OFF, hook in hydraulic valves will turn OFF when hook pressure is made. When this option is ON, hook in hydraulic valves will stay ON when hook pressure is made. This feature should be off unless rail or components have a slope that forces the hook out while lifting.

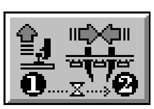
The Use Index Brake in Cycle ON/OFF Mode

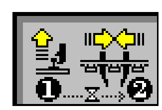




The Use Index Brake In Cycle option is OFF when the button is not pressed inward (left) and the symbols on the button will be dark in color. When ON, the button is pressed inward (right) and the symbols on the button will be yellow. When this option is ON, the index brake on the rear axle will be applied during dynamic braking in work mode. When this option is OFF, the index brake is not used to stop the machine while tamping track and braking will be hydraulic. Note, that if the machine is idle for more than two seconds, the P1 and P2 pumps will shut down and the index brake will be applied until work resumes. As braking between ties is almost completely hydraulic, setting this option to OFF can save wear and decrease the frequency of adjustments without compromising production. It may however be necessary to set this option to ON when working downhill.

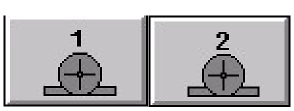
The Squeeze Waits On Lift ON/OFF Mode





The Squeeze Waits On Lift option is OFF when the button is not pressed inward (left) and the symbols on the button are dark in color. When ON, the button is pressed inward (right) and the symbols on the button will be yellow. When this option is ON, workhead squeeze will not commence until lift is complete. It is recommended that this option only be used when single tamping with an intermediate to large lift or when making large changes to superelevation. This mode is of little value for small lifts and double tamping.

The PI or P2 ON/OFF Pump Mode



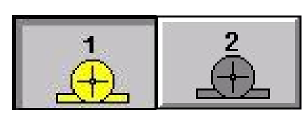


Fig. 2

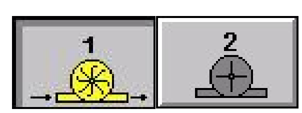
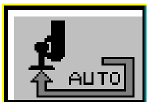
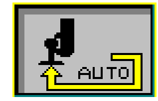


Fig. 3

The pump option is OFF when the button is not pressed inward as in figure 1 and the symbol on the button is dark in color. When ON, the button is pressed inward as in figure 2 (pump 1) and the symbol on the button will be yellow. There is a separate button for each pump, P1 and P2. When a pump button is on, the associated pump is enabled and will run when needed. When a pump button is off, the associated pump is disabled and will not run at any time. In figure 2, pump 1 is enabled but not running. In figure 3, pump 1 is enabled and running.

Underfoot Lifting

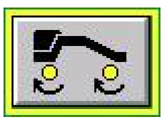




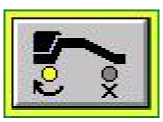
When enabled, this feature will automatically respond to a clamp hook slipping off a joint bar or similar by raising the workheads, moving the slipped hook below the foot of the rail, and automatically restarting the cycle. When the cycle is completed, the hooks will automatically return to their normal position before traction is enabled.

Because this feature is dependent on the clamp frame being positioned between the ties, the operator can disable it when working in an area where such alignment is not practical.

Axle Traction Disengage - Front/Rear/Both



Both Axles Engaged



Front Disengage

On MK VI models, Front Axle Engaged is displayed for the travel mode and "Both Axles Engaged" displayed for the work mode.

NOTE: The Axle Traction Disengage Switch is actually a single icon (on the Change Options Panel) that changes upon selection. For clarity purposes only, the icons are shown at left as three separate switches

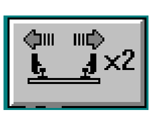
Should a problem occur with the transmission, drive train or hydraulic motor, power can be shifted away from the problem transmission/axle allowing the operator to move the machine using only the power from the operational transmission/axle.

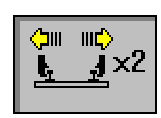
- To Disengage the Front Axle - Select "Front Disengage"(F5):

The traction valve (near the problem transmission) will be disengaged placing the (non-functioning) transmission into Neutral. Lubrication will continue in the disconnected transmission, thus providing lubrication to the components that are still rotating.

NOTE: Should a problem occur in the mechanical components of the transmission, it may be necessary to remove the traction chain or coupling chain to prevent the transmission from turning when the machine is moved.

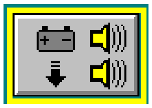
Double Shift





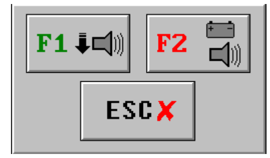
When enabled, this feature will cause track to be lined twice for each cycle. This feature is considered by some to be of help when additional lateral resistance to lining is encountered (such as cemented ballast).

Movement and Battery Alarm



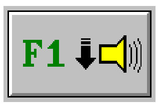
Movement and Battery Alarm

Selecting the Movement and Battery Alarm switch (left) from the Change Options Panel displays the Movement and Battery Alarm Panel (right). This panel allows the operator to turn ON/OFF the Movement Alarm or Battery Alarm. The “speaker” symbol (right) displays the state of the switch; yellow for ON or gray for OFF.



Movement and Battery Alarm Panel

NOTE: Two audible movement alarms are used; one at the front of the machine and one at the rear. These alarms emit a “beeping” sound that can be heard by workers in and around the machine.



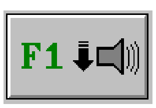
Continuous Movement Alarm (Enabled)

Pressing the F1 key on the Movement and Battery Alarm Panel will enable the Continuous Movement Alarm (left). The Movement switch has two separate alarm functions:

- If enabled (yellow) serves as a Continuous Movement Alarm
- If disabled (gray) serves as a Change of Direction Alarm.

When the Continuous Movement Alarm is enabled, the rearmost alarm on the machine will sound *continuously* as the machine moves in the reverse direction. Note that the front alarm will be disabled during reverse movement and will not sound.

NOTE: The movement alarm is also referred to as the backup alarm.



Change of Direction Alarm (Enabled)

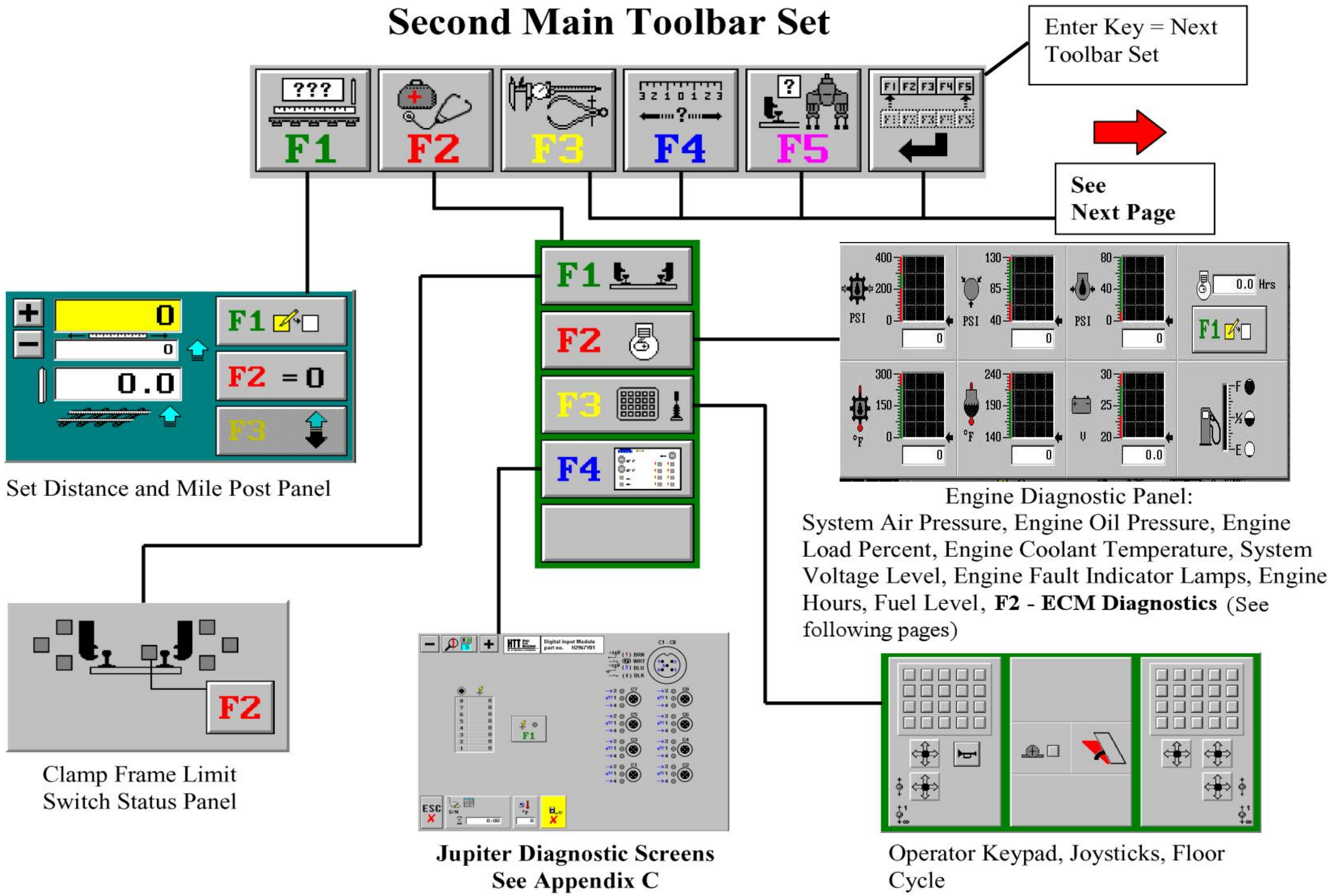
Pressing the F1 switch again will disable the Continuous Movement Alarm and enable the Change of Direction Alarm (left).

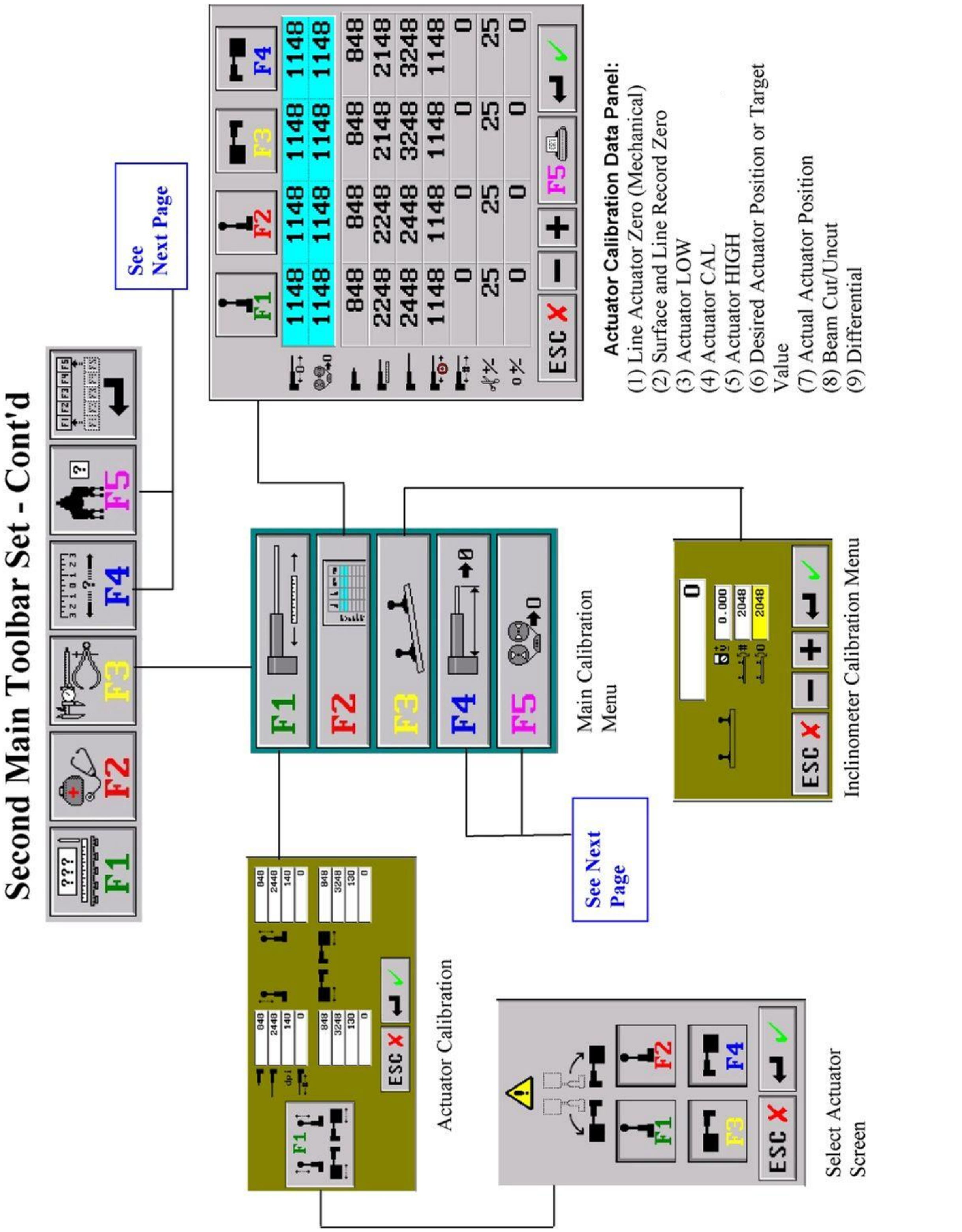
With the Change of Direction Alarm enabled (default), both front and rear movement alarms will sound for three (3) seconds when a change of machine direction is detected. Also, if the machine has not moved for 3 minutes or more, both alarms will sound when the machine begins to move again (in either direction).

Battery Alarm (Enabled)

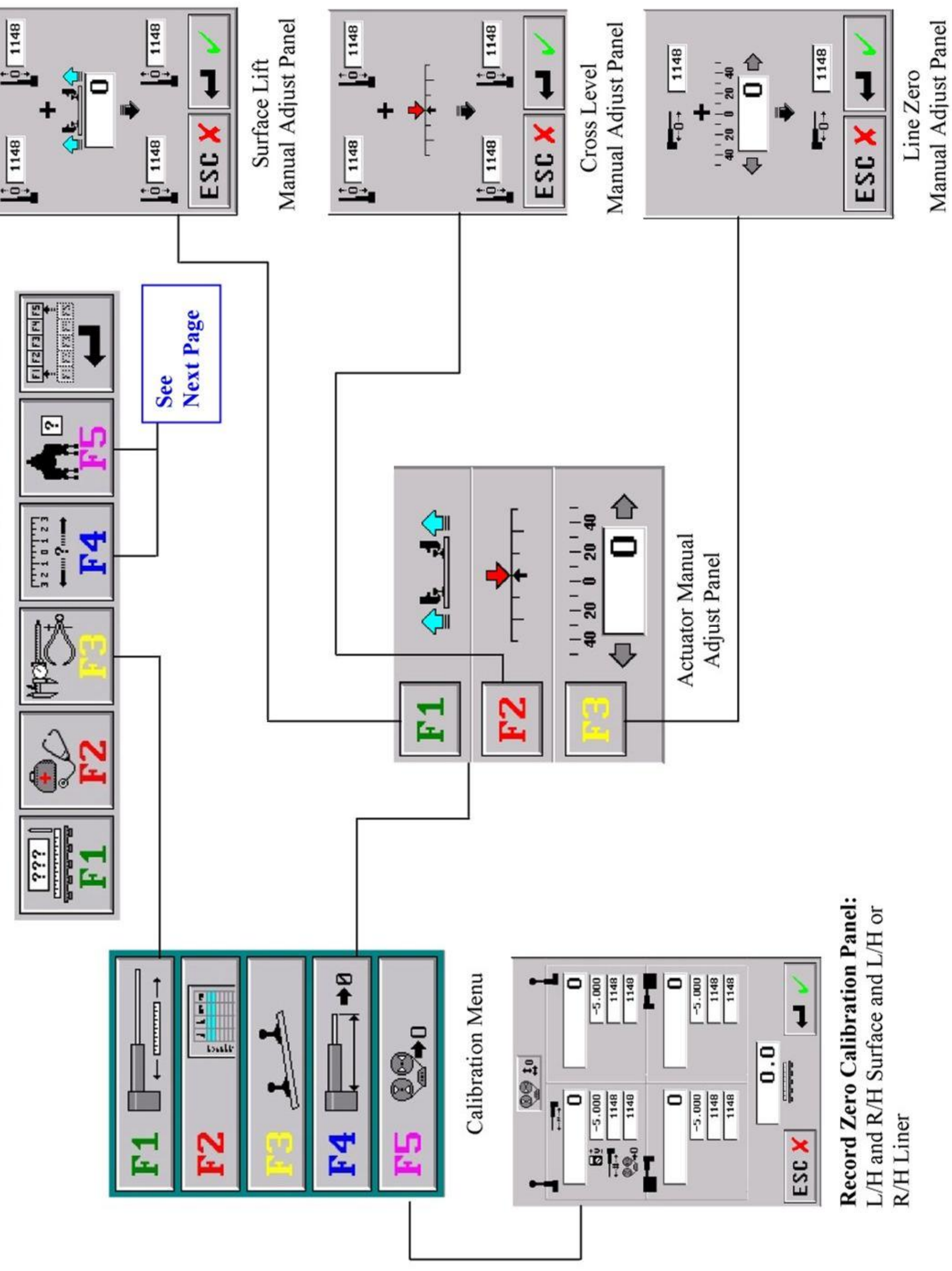
Press the F2 button to enable or disable the Battery Alarm. When the battery alarm is enabled (default), both front and rear movement alarms will sound once every two (2) minutes whenever the system is ON and engine is not running. This alarm is a reminder that the batteries are being charged. Disable this alarm if it becomes necessary to keep the control system ON while the engine is OFF.

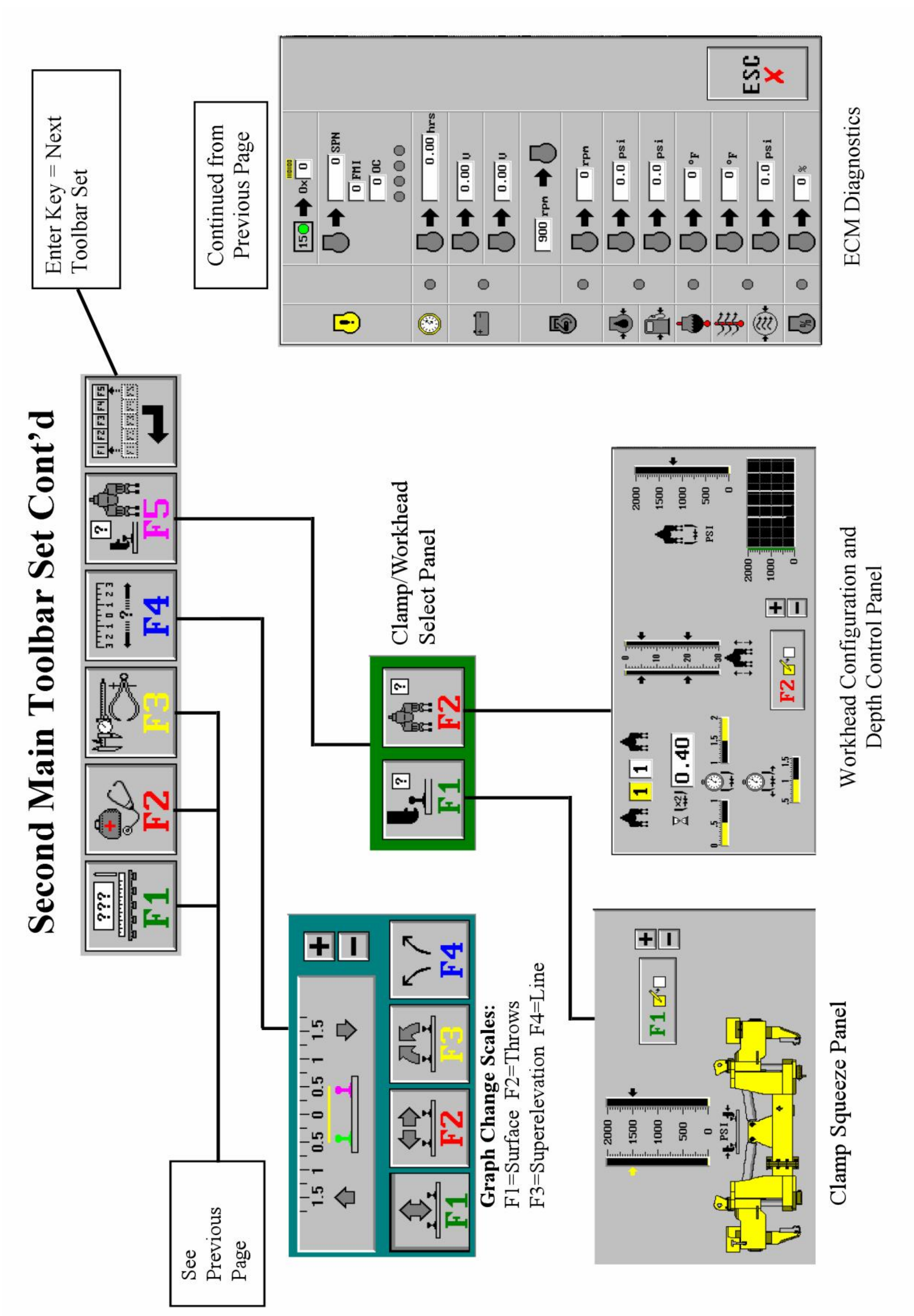
Second Main Toolbar Set




Second Main Toolbar Set - Cont'd
See Next Page
Main Calibration Menu
Inclinometer Calibration Menu
See Next Page
Actuator Calibration
Select Actuator Screen
Actuator Calibration Data Panel:
(1) Line Actuator Zero (Mechanical)
(2) Surface and Line Record Zero
(3) Actuator LOW
(4) Actuator CAL
(5) Actuator HIGH
(6) Desired Actuator Position or Target Value
(7) Actual Actuator Position
(8) Beam Cut/Uncut
(9) Differential

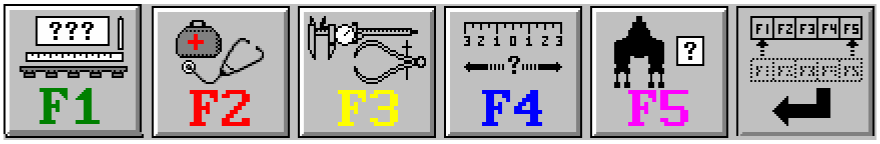
Second Main Toolbar Set - Cont'd




Second Main Toolbar Set Cont'd
Enter Key = Next Toolbar Set
Continued from Previous Page
ECM Diagnostics
ESC
Clamp/Workhead Select Panel
Workhead Configuration and Depth Control Panel
Clamp Squeeze Panel
Graph Change Scales:
F1=Surface F2=Throws
F3=Superelevation F4=Line
See Previous Page

The Second Toolbar Button Set - *Main View*

The second toolbar button set is displayed whenever the ENTER key has been pressed from the first toolbar button set (main view).



F1 - Set Distance or Mile Post Panel

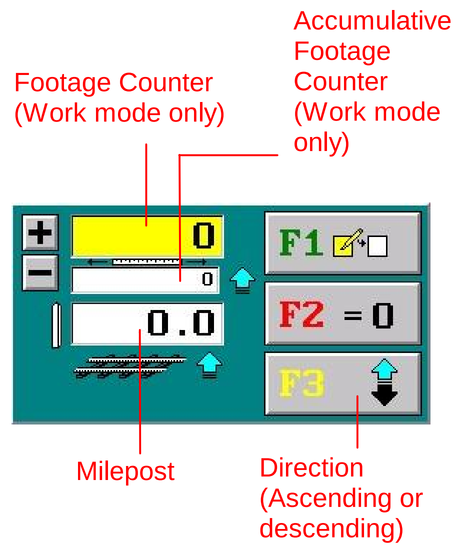
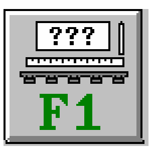


Fig. 1
Distance Settings Panel

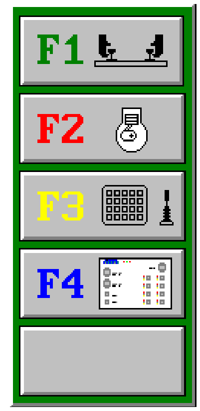
Pressing this button opens the *Distance Settings Panel* (figure 1) that is used to set the current machine distance and milepost location. The larger footage box (footage counter) is automatically set to zero at the start of each new recording. The second box (accumulative footage) can only be changed



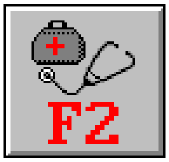
by the operator and is not used internally for any purpose. At the discretion of the operator, this footage can be used to accumulate track tamped or to synchronize with the line-side features where location is marked in feet (or ignored completely). The accumulative footage counter can be set to count down with forward movement as indicated by the left cyan up/down arrow on the distance panel. The F1 button selects one of the three fields to work with. The F2 button will set the selected highlighted field to zero. The F3 button selects the counting direction for the selected field.

Holding down a plus or minus key while the milepost box is highlighted changes the milepost by .10 mile (1.61 km), 1 mile (1.61 km), 10 mile (16.km) and 100 mile (62 km) increments depending upon how long the key remains pressed. Pressing F3 toggles the direction of travel for the milepost counter. When the arrow pointing upward is light blue, the value in the milepost box will increase as the machine moves forward. However, when the arrow pointing downward is light blue, the value in the milepost box will decrease as the machine moves forward. Pressing the ESC key or the ENTER key closes this panel and saves any changes made.

NOTE: The PC keyboard can be used to directly type in a value for the field currently selected (yellow highlight box).

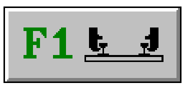


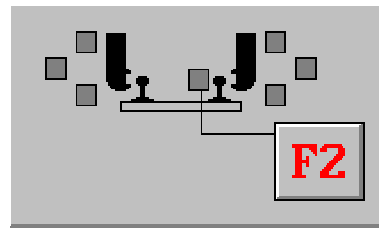
F2 - Diagnostics Menu



Pressing the F2 button on the second toolbar button set opens the diagnostics menu. The diagnostics menu is used to verify various inputs and/or outputs to or from the computer, such as combo clamp frame limit switches, workhead and clamp frame pressure transducers, operator control switches or the status of Jupiter I/O modules.

F1 - Clamp Frame Diagnostic Panel



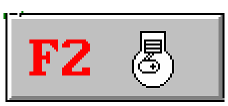


Pressing F1 on the diagnostics menu opens the clamp frame limit switch panel. This panel displays the limit switches (and bias cylinder) as viewed by the operator. The respective boxes (left) will light up yellow when the upper, lower or outer limit switches for a side are made. The F2 key can be used to turn clamp bias ON or OFF. Set the clamp frame setup screen for monitoring and setting the clamp squeeze pressure transducers. Note that the machine may be operated normally while this screen is being displayed in order to observe the switches during cycle.

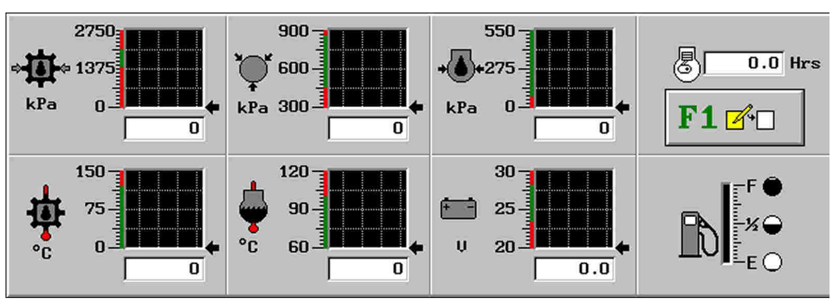
Press the ESC key to close this panel.

F2 - Engine Diagnostic Panel (used on machines without mechanical gauges)

Pressing F2 on the diagnostic menu opens the engine diagnostic panel. This panel shows the status of the air pressure, engine oil pressure and engine hours along the top, with engine water temperature, battery voltage and fuel level along the bottom.



For each of the parameters shown (except for fuel level) the associated graph plots the actual value over the preceding one hour of operation. The value in the small white box underneath each graph gives the current reading for the channel.



Use the F1 button to highlight the engine hours white box at the top right of the panel. This allows discrepancies between this panel and the engine hour meter in the engine compartment to be corrected (as will eventually occur if the engine remains running while the computer is off).

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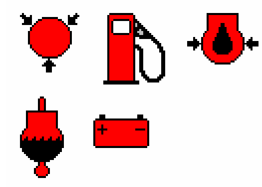
When any of the displayed parameters exceed the allowable levels, engine diagnostic panel will open automatically. Once this panel has been used to view an out of range parameter and closed using Esc or Enter keys, the panel will not automatically open again unless a problem occurs for a different parameter.



When a parameter is "in alarm" (the value exceeds allowable, or even possible levels), the corresponding symbol will be colored red and flash. These flashing symbols will also be seen on the main screen. In addition, the beeper will emit a short series of five beeps every minute, this indicates that one or more of these parameters is out of tolerance. The battery voltage also displays a low or high voltage alarm in the alarm panel. The fuel level is out of tolerance when at less than 10%.

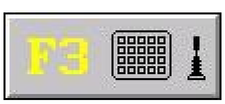
NOTE: When a value for a parameter exceeds possible levels (caused by a faulty sender or open circuit wiring), the associated graph will be blanked out and dashes will show in the associated white box.

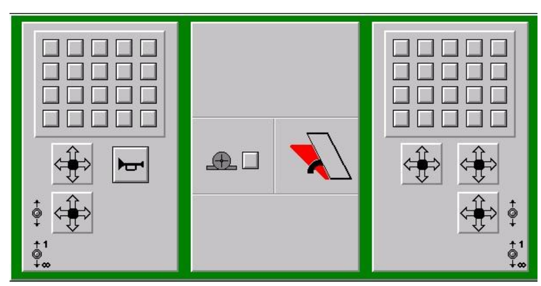
Listed below are the allowable values for each parameter

1) System Air Pressure: Maximum 125 PSI (8.5 bar) and Minimum 65 PSI (4.4 bar)
2) Engine Oil Pressure: Maximum 100 PSI (7 bar) and Minimum 12 PSI (.8 bar)
3) Engine Water Temperature: Maximum 215°F (102°C) and Minimum 0°F (-18°C)
4) Battery Voltage: Maximum 29 VDC & Minimum 23.6 VDC
5) Fuel: Minimum 18 Gallons (68 Liters)
6) Transmission Oil Temperature: Maximum 302°F (150°C) & Minimum 32°F (0°C)
7) Transmission Oil Pressure: 0-400 PSI (0-27 bar)

8) Hydraulic Oil Temperature OK between 70 - 180°F (21 to 82° C)

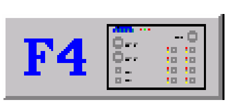
F3 - Operator Keypad and Joystick Diagnostic Panel

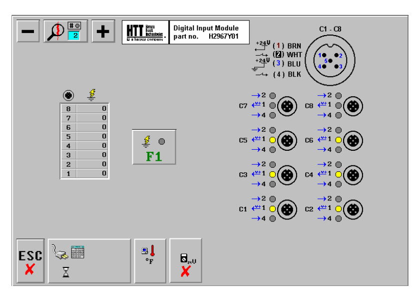




Pressing the F3 key on the diagnostics menu opens the keypad/joystick diagnostic panel. This panel displays keypads, joysticks and switch positions for both the left and right operator control panels. When this panel is open, the normal operation of each control is disabled. Pressing and holding the ESC key for one second closes this panel and restores normal control functions.

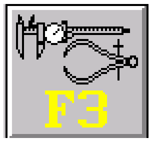
F4 - Jupiter Diagnostic Screens





Pressing the F4 key on the diagnostics menu opens a Jupiter Diagnostic Screen Panel. The Jupiter diagnostic screens provide the operator with a means of checking the integrity of the Jupiter Network. Most diagnostic checks can be performed without having to leave the operator's seat. *See Jupiter Troubleshooting Guide for Jupiter Diagnostics.*

F3 - Calibration Menu



Pressing the F3 key on the second toolbar button set opens the calibration menu (Fig. 2). From this menu, the operator may choose to calibrate actuators, view calibration data, view or calibrate inclinometer, reset actuator zero or record surface or line zeros.

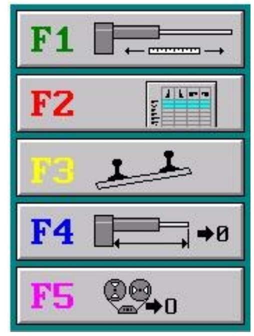
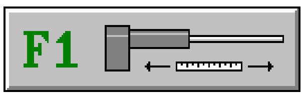
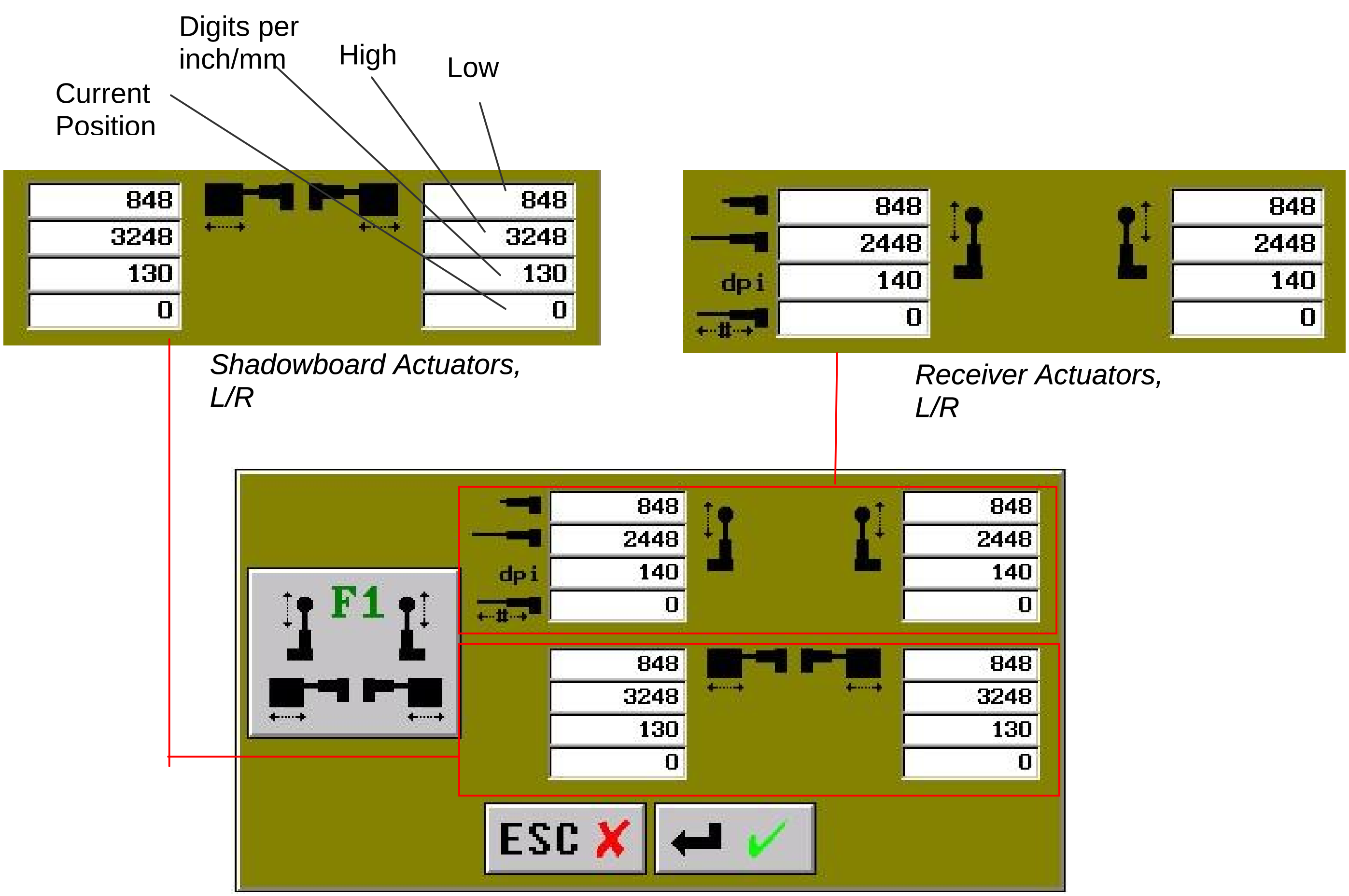


Fig. 2

Pressing F1 opens the Calibration Readout Screen *(See Fig. 3).*

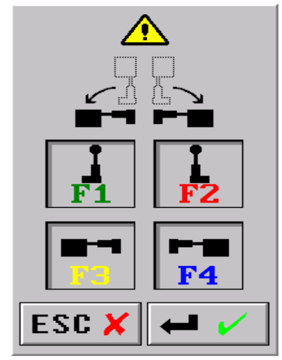


The Actuator Calibration Screen contains four groups of information boxes. Each group contains four small boxes that represent LOW, HIGH, DIGITS PER INCH and CURRENT POSITION for each actuator. The two upper groups of information boxes are for the surfacing receiver actuators; the lower two are for the liner linear actuators. LOW, HIGH and CURRENT POSITION are all digital values. *(See Fig. 3).*



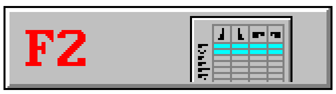
Actuator Calibration Menu
Fig. 3

On the *Select Actuator Screen*, there are four buttons (F1 - F4). In the default position, all four buttons are pressed in (See Fig. 4). Buttons may be selected individually or in groups. After selecting the desired actuators for calibration, press ENTER to start the automatic calibration process or ESC to cancel the selection. The screen will then go back to the Actuator Calibration Screen indicating calibration is complete. Hit ENTER to accept the new values or ESC to cancel. Pressing the enter button on any or all the actuators selected will cause the actuator to immediately go to it's high setting then low setting and Automatically set the dpi setting based on the high and low settings.



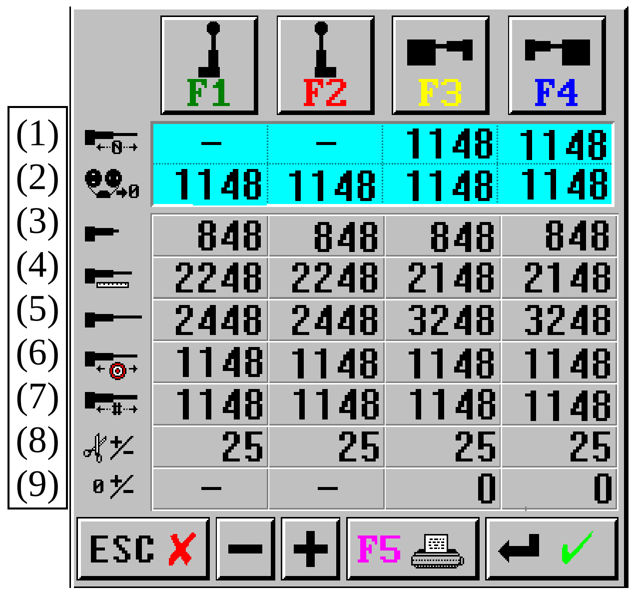
Select Actuator Screen
Fig. 4

F2 - Actuator Calibration Data Panel



Pressing the F2 key on the calibration menu opens the actuator calibration data Panel. The calibration data panel is mainly used for printing calibration data, modifying the surface or line record zeros and line zeros. This panel is the only panel that allows manual adjustments to the line zeros and surface or line record zeros.

The actuator calibration data panel provides a table of data pertaining to F1, F2 surface actuators and the F3, F4 liner actuators. This data consists of the line zeros, record zeros, LOW's, HIGH's, actuator target (desired) values, actuator actual values, beam differentials and zero differentials. The light blue data table area is used to modify the line zeros and surface or line record zeros. The light gray data table is information pertaining to actuator values. The light gray actuator values are displayed for convenience and cannot be changed from this panel.



Actuator Calibration Data Panel:
(1) Line Actuator Zero (Mechanical) **(2)** Surface and Line Record Zero **(3)** Actuator LOW **(4)** Default Numbers **(5)** Actuator HIGH **(6)** Desired Actuator Position or Target Value **(7)** Actual Actuator Position **(8)** Beam Cut/Uncut **(9)** Differential

NOTE: When selecting one of the function buttons (F1-F4) the background color changes from light blue to yellow. Pressing F3 or F4 multiple times, toggle between line zero and record zero. When highlighted the value can be modified using the plus or minus keys or the PC keyboard can be used to enter the appropriate value.

First row of values in the light blue area are actuator zero values. There are NO zero values for the F1 and F2 surface actuator unless the machine is equipped with the optional surface fit software which is illustrated by a dash in the value field. The F3 or F4 line zero value is the position of the liner shadowboard when properly lining tangent track. If the lining zero needs modifying (tweaking) from this panel, select the proper line zero value, use the plus or minus keys to modify the zero value. The modified zero value shown in the table is used during the next tamping cycles. As long as the zero value remains selected (highlighted yellow) in the table, pressing the ENTER key accepts the new value in the table and exits the “edit” mode for the selected actuator. Pressing the ESC key discards any changes, retains the old zero value in the table and exits the “edit” mode for the selected actuator. The new value is used during machine operation while this panel remains on the screen. **Pressing the ENTER key when no function button is pressed accepts all changes made to this panel** and returns to the actuator calibration selection menu. **Pressing the ESC key when no function button is pressed discards all changes made to this panel** and returns to the actuator calibration selection menu.

WARNING: *DO NOT Surface Track with F1 or F2 Surface Record Zero Selected (highlighted in yellow).*

NOTE: Normally the throws shift is used to modify “tweak” the lining of tangent track. When a sustained throws shift is added to either reference, the (F4) Line Zero Shift Panel (main view - second toolbar set, F3 calibration menu) can be used to automatically update the line zero value for the presently selected reference and zeros the throws shift value.

Immediately following the line zero values are the record zero values for each actuator. Pressing the F1or F2 selects the respective L/H or R/H surface record zero value for modifying. The surface record zeros may need to be modified, because of a sustained correction in the superelevation panel or the desired surface does not match the actual surface. Pressing the F3 or F4 selects the respective L/H or R/H line record zero value for modifying. The line record zero may need to be modified if all best fit curve tangents are greater than 0° 03¢ (degrees).

NOTE: The surface and line record zero values are normally set using the F5 Set Record Zero Panel (main view - second toolbar set, F3 calibration menu). The Record Zero process can be performed multiple times. Surfacing actuators move to the record zero position when the surface projector is OFF.

First row of values in the light gray table are actuator’s LOW’s, followed by actuator’s default numbers and then the actuator’s HIGH’s.

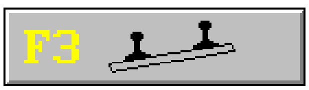
Immediately following the actuator’s HIGHs is the actuator’s target (desired) values. The target (desired) value is defined as the current actuator setting required to achieve the desired geometry during production. When lining tangent track with no applied shift, the lining actuator desired or target position is equivalent to it's lining zero position. Any applied shift offsets the lining actuator desired position by the corresponding digits in the appropriate direction.

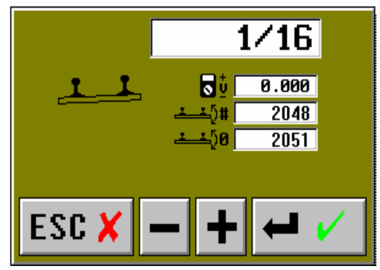
Immediately following the actuator’s target values are the actuator’s actual values. The actual value is defined as the actual value given by the actuator’s potentiometer. For normal operation, the actual position should not deviate more than 1 to 2 digits from the target position.

Immediately following the actuator’s actual values are the beams cut/uncut differentials. The beams cut/uncut differentials are updated whenever the actuator’s are hunting the beam and the update of this value is NOT instant. This value is the average difference in actuator position where the shadowboard cuts and uncuts the beam and is made up of thousands of beam cuts and uncuts.

Immediately following the beam differentials are the zeros differentials. There is no zero differential value displayed for the surface actuators unless the machine is equipped with the surface fit option, which is illustrated by a dash in the value. The line/record zero differential is the difference between the lining zero and record zero in digits for lining shadowboard actuators. Normally this value is between zero and 25 digits, if less than (below) zero digits or greater than (above) 25 digits, check the angle of the lining shadowboard blade, I.E. blade must be perpendicular to the track. To check the angle, move the machine until the surfacing shadowboard is positioned on zero crosslevel. Use a plumb bob to check the liner shadowboard blade (lining edge) angle, if not vertical. Then adjust the liner shadowboard adjustment screws until the lining shadowboard blade (lining edge) is vertical. Press F5 to printout the data present on this panel along with the inclinometer setting, buggy information, workhead setting, default setting, etc.

F3 Inclinometer Calibration Panel



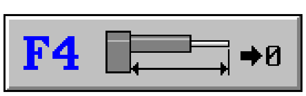


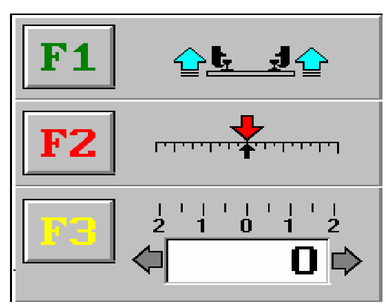
Inclinometer Calibration Panel

Pressing the F3 button on the calibration menu opens the inclinometer calibration Panel. The large information box displays the current inclinometer reading in inches. The upper two small information boxes display the current inclinometer reading as a voltage and in digits, respectively.

The bottom small information box displays the current inclinometer zero in digits. Pressing the plus or minus keys changes the current inclinometer zero by a digit per press (there are about four digits per sixteenth of an inch).
By pressing the plus or minus keys, the operator can adjust the inclinometer zero so that the displayed tilt on the inclinometer panel matches what is measured by a level board at the receiver buggy. Pressing the ENTER key saves all changes permanently and closes the panel. Pressing the ESC key discards any changes and closes the panel. **NOTE**: 2048 corresponds to zero volts for the inclinometer.

F4 Zero's Adjust Panel

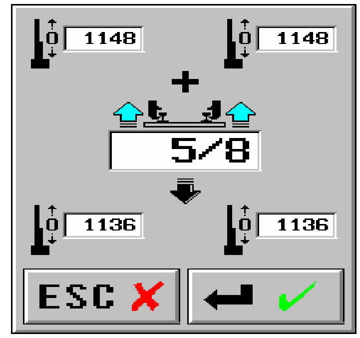




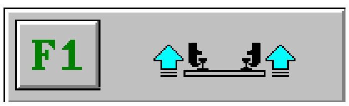
Zero's Adjust Panel

Pressing the F4 button on the calibration menu opens the Actuator Zero Adjust menu panel.
This panel consists of three buttons. Select F1 to adjust surface actuator zeros to the applied lift. Select F2 to adjust surface actuator zeros for cross-level correction. Select F3 to adjust line actuator zeros for throws correction.

F1-Surface Zero Manual Adjust Panel



Use this panel when the lift as shown on the lift panel does not seem to match the actual amount of lift being applied to the track. The record zero procedure accessed through F5 on the calibration menu is normally used to set surface zeros. This panel allows you to manually change these zeros in order to adjust the indicated value of lift on the lift panel and yellow slider. Use the up and down cursor keys to vary the indicated lift in the large white box. Increase this value if the machine appears to lift track higher than is being indicated. Decrease this value if the screen indicates values higher than the track is actually being lifted. I.e. set this value to the actual lift being produced.



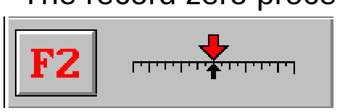
The values displayed at the top of this panel are the current surface actuator zeros. The values displayed at the bottom of this panel are what the surface actuator zeros will become in order to apply the desired correction to indicated lift.

NOTE: Subsequently using the record zero procedure (F5 on calibration menu) with the surface projector ON will result in new zero values for the surface actuators and any previous manual variation applied with the above panel will be lost.

Press ESC if you do not want the surface zeros to be changed.

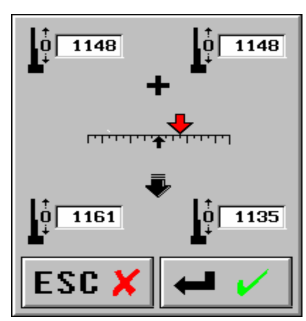
F2-Surface Zero Manual Adjust – Superelevation Correction

Use this panel when a persistent amount of superelevation correction is needed for the machine to leave the correct superelevation.



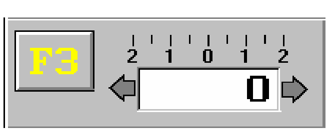
The record zero procedure accessed through F5 on the calibration menu is normally used to set surface zeros. This panel allows you to manually change these zeros in equal and opposite directions so that superelevation correction can be set to zero.

Use the left and right superelevation correction keys on the right hand keypad to vary the indicated superelevation correction in the center of this panel.



The values displayed at the top of this panel are the current surface actuator zeros. The values displayed at the bottom of this panel are what the surface actuator zeros will become so that the superelevation correction can be set to zero. When the ENTER key is pressed, the new surface zeros will be installed and the superelevation correction will be set to zero without changing the current lift target positions.

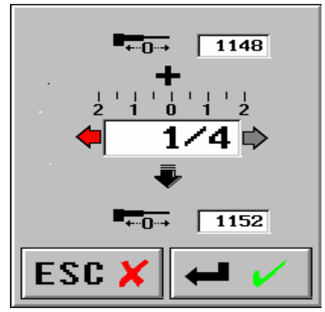
NOTE: Subsequently using the record zero procedure (F5 on calibration menu) with the surface projector ON will result in new zero values for the surface actuators and any previous manual variation applied with the above panel will be lost.



Press ESC if you do not want the surface zeros to be changed.

F3-Line Zero Manual Adjust

If the LINE ZERO is accurate, lining tangent track with a shift of zero will result in balanced left and right throws to improve the line without displacing track to the left or right overall.



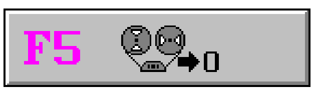
If a sustained shift is needed to prevent track being continuously displaced left or right, this panel will apply this shift to the current line zero and set the shift to zero.

The value in the upper right box is the current line zero for the present line reference. The value in the lower right box is the new line zero that will be applied by pressing ENTER. The value in the large white box is the current throws shift, which can also be seen at the bottom of the throws panel.

Press ESC if you do not want the current line zero to be changed.

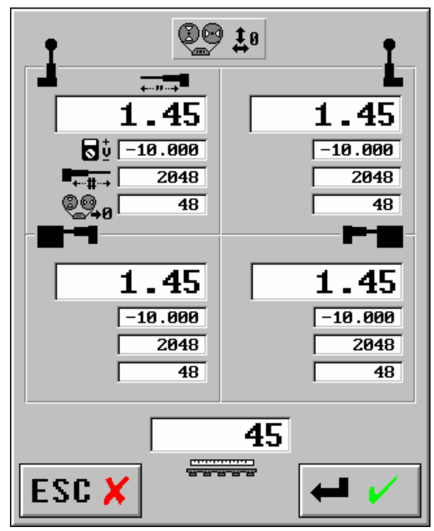
F5 - Record Zero Calibration Panel

Pressing F5 on the calibration menu opens the record zero



calibration panel which provides for the recording and calculation of “record zero” values for surface and line. Before selecting this procedure the machine would be setup for work on tangent track (without vertical curvature) with one or both projector systems turned on. It’s recommended that a F2 Erase/Wipe be preformed before starting this procedure.

The values displayed in the large white boxes are in inches with respect to the pre-existing zeros. Therefore the closer the final values are to zero, the less change you are making. Below each large white box are three smaller boxes that show actuator position in volts and digits followed by the record zero in digits. Just above the ESC and ENTER buttons is a display showing the number of feet that have been recorded since the procedure started.

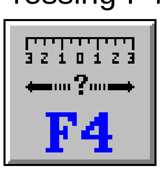


Record Zero Calibration Panel

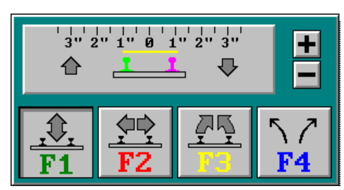
If the surface projector is off, the record zero for surface actuators will not be changed.

F4 - Change Graph Scales Panel

Pressing F4 on the second toolbar button set opens the graph



scaling panel. This panel is used to change the scale in a graph. The graphs consist of surface, throws, superelevation and line.



Graph Scales Panel

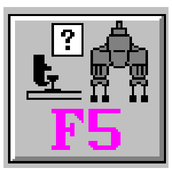
The best fit will automatically select the appropriate scale for each graph, but it may be necessary to adjust one or more of these graph scales to view some portion of the recorded track.

Function buttons F1 through F4 selects a graph scale for modification. Then use the plus/minus (+/-) keys to change the selected scaling.

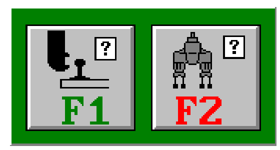
F1 selects the surface lift graph. This graph has four scales to select from; 0 to 1.75 inches (44 mm), 0 to 3.5 inches (89 mm), 0 to 7 inches (178 mm) and 0 to 14 inches.(356 mm) F2 selects the line throws graph. This graph has four scales to select from; 0 to 2 inches (51 mm), 0 to 4 inches (107 mm), 0 to 8 inches (203 mm) and 0 to 16 inches (406 mm). F3 selects the superelevation/crosslevel graph. This graph has four scales to select from; 0 to 4 inches (107 mm), 0 to 8 inches (203 mm), 0 to 16 inches (406 mm) and 0 to 32 (813 mm) inches. F4 selects the line graph. This graph has four scales to select from; 0 to 4.5 degrees, 0 to 9 degrees, 0 to 18 degrees and 0 to 36 degrees.

Press ENTER or ESC accepts any graph scale changes and closes the panel.

F5 - The Workhead Configuration and Depth Control Panel

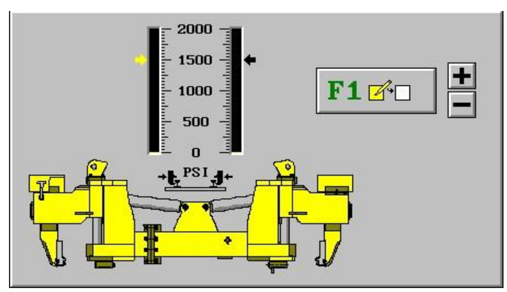


Pressing F5 on the second toolbar button set opens the Clamp/Workhead select panel. Select either F1 for the Clamp Squeeze Panel or F2 for the W/H Configuration and Depth Control Panel.



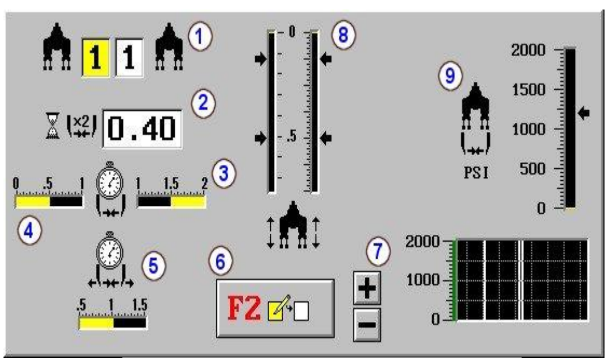
Clamp/Workhead Select Panel

The Clamp Squeeze Panel (right) displays the adjustable values of the clamp frame pressure "switches". The default values for all can be reset by the operator. The F1 key is used to select which item to adjust. Use the plus/minus keys adjust the selected arrow to the desired setting.



Clamp Squeeze Panel

The normal hook pressure setting is 800 - 1000 PSI (54 – 68 bar). If high ballast conditions exist it may be necessary to raise the hook pressure to approximately 1500 PSI (102 Bar). Press the ESC key or ENTER key to close the panel.



Workhead Configuration and Depth Control Panel

Pressing the F2 button will bring up the Workhead Configuration and Depth Control Panel (left). This panel allows you to change the settings used to control the workheads. Use the F2 key to select the value to change. See the list below for a description of each switch and its function.

When changing superelevation substantially in a curve, there are times that it may be desirable to multi-tamp one rail and single tamp the other. The computer is programmed to allow the workheads to tamp a varying number of tamps individually.

NOTE: When workhead(s) are down feeding and before the lower (transducer) position is reached, if the Workhead Squeeze In and Out keys (operator L/H keypad) are pressed together, the squeeze cylinders will pulse in/out to help penetrate foul or cemented ballast.

1.) Tamps Per Cycle – Use this timer to select the number of tamps per cycle for each side.

2.) Multi-Tamp Timer - When tamping a tie more than once (double, triple etc.), the multi-tamp timer box indicates the time for which the workhead is raised after squeezing before reversing direction prior to the next squeeze. The displayed value is the delay in seconds. A nominal setting is 0.25 seconds; 0.40 is the default time. This timer can be set from 0.00 to 2 seconds. Pressing the plus or minus keys changes the time by 0.01, 0.10 and 1 second depending on how long the key is held down.

3.) Maximum Squeeze Timer: - The workheads will finish squeezing if this time is reached even if the squeeze pressure switch is not made. The maximum squeeze timer can be adjusted between one and two seconds. For nominal ballast conditions the setting is 1.5 seconds (default), but when tamping in loose (new construction) ballast a typical setting may be about 1.2 to 1.3 seconds. Pressing the ENTER or ESC keys removes the panel and saves any changes made.

4.) Minimum Squeeze Timer - The squeeze pressure switch will be ignored until the workheads have squeezed for this amount of time. The minimum squeeze timer can be adjusted between zero and one second. For nominal ballast conditions the setting is 0.5 (one half) second (default), but when tamping in foul or cemented ballast a typical setting may be about 0.7 to 0.8 seconds. Note that in extremely fouled conditions, the Workhead Squeeze-In key, located on the operator's L/H keypad, can be used to extend the squeeze duration (time). Press and hold this key before Squeeze-In normally terminates will extend the squeezing until the key is released. This feature may be useful where additional squeeze time is desirable for a few tamps.

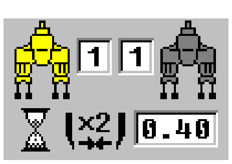
5.) Wiggle Timer - "Wiggling" allows the workheads to penetrate compacted ballast by alternately squeezing the paddles in and out as the workheads come to depth. The wiggle timer determines the amount of time before wiggling will begin. The default wiggle time is one second. The operator can adjust this time from 0.5 to 1.5 seconds using the increment or decrement buttons as appropriate.

6.) F2 - Use the F2 key to select the value to change.

7.) Plus/Minus Keys – Use the Plus/Minus keys to increase or decrease selected value.

8.) Workhead Depth Control - Use the plus or minus keys to change the high and low positions for each workhead.

NOTE: There are two high positions for each workhead. High positions are independent for switch mode and production mode. When in switch mode, it is recommended that the high positions be set so that the workheads clear the top of the rail. This allows the workheads to be traversed without upfeeding beforehand which can save a lot of time when tamping a switch.



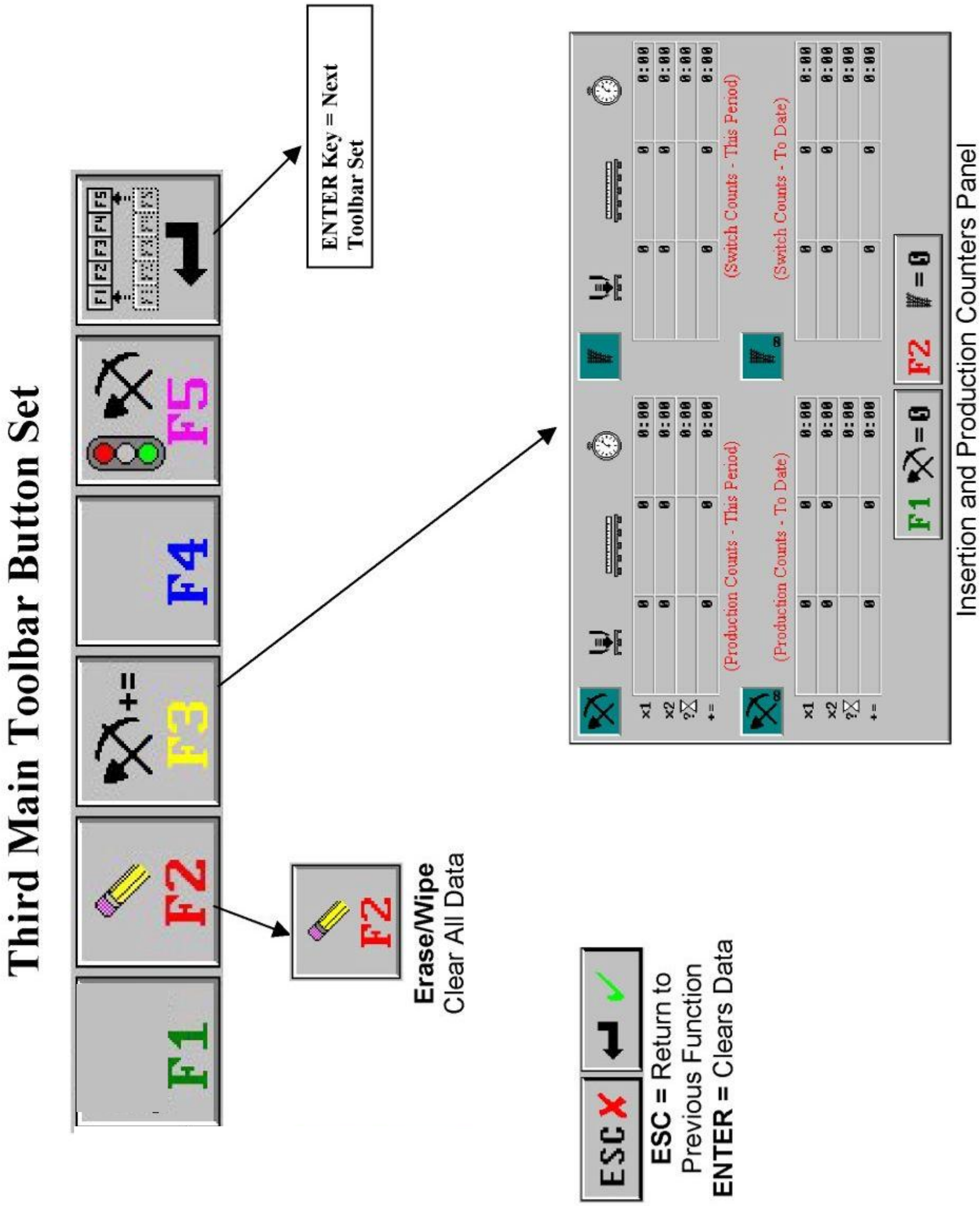
The switch mode key on the left hand keypad can be used to toggle between switch mode and production mode while the workhead panel is open which makes it easy to see and change each of the possible high positions.

9.) Workhead Squeeze Pressure - Use the plus or minus keys to set the adjustable workhead squeeze pressure "switch". The normal squeeze pressure setting is between 1200 and 1600 PSI (83 -110 Bar). Adjustment may be needed for certain ballast conditions. The diagnostic histogram in the bottom right corner of the panel continuously displays the current workhead squeeze pressure.

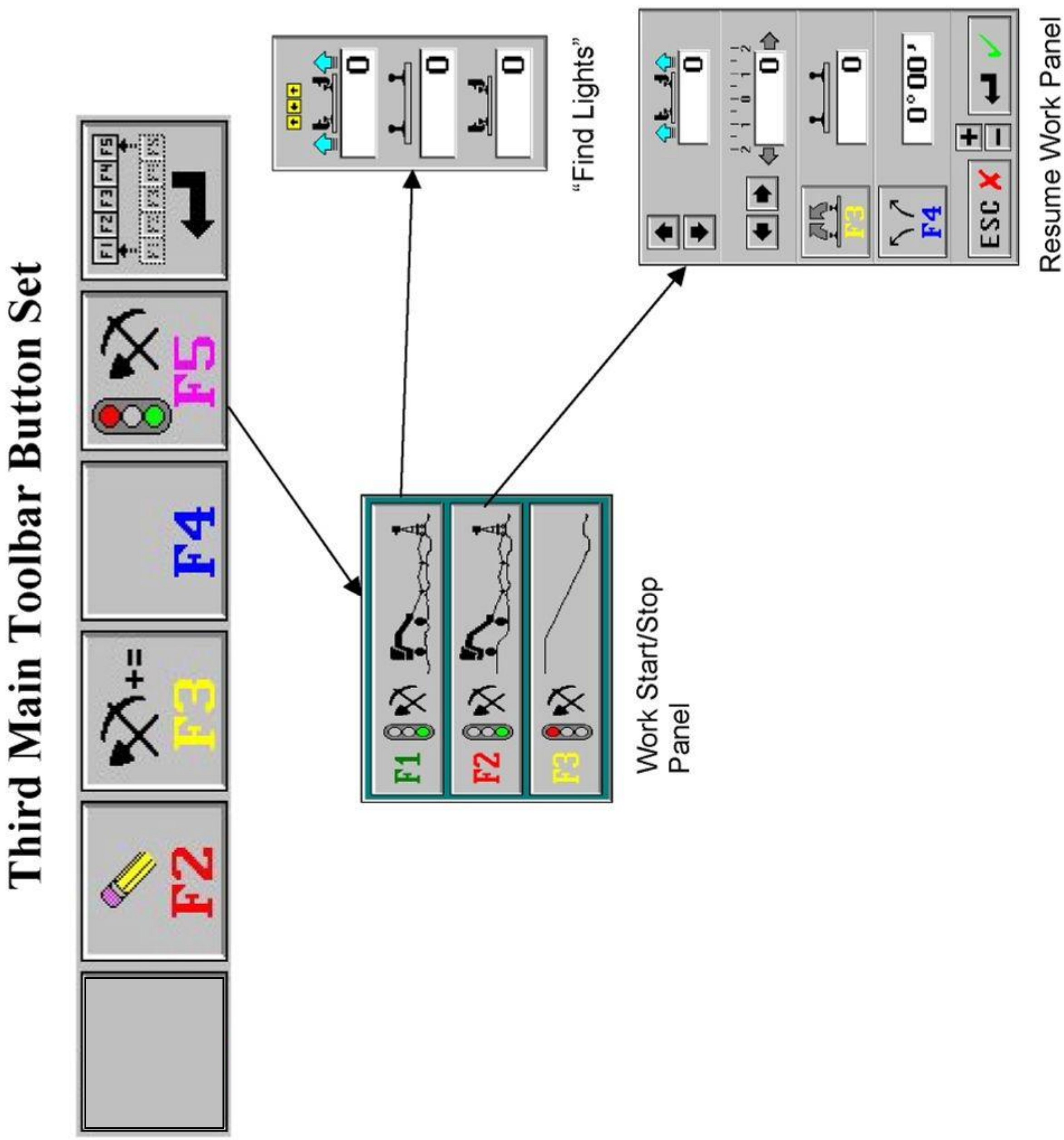
The Workhead Indicators - *Main View Status Panel*

The workhead vibrator indicators are shown to the left on the status panel. The vibrator symbol corresponds to the left or right side of the machine. When the vibrator symbol is dark gray the vibrator is OFF, and ON when symbol is yellow. The number of tamps per cycle is shown in the small box next to the corresponding vibrator symbol. This value can be changed using the workhead configuration panel or by entering a shortcut key sequence. The white box under the right vibrator symbol displays the multi-tamp timer setting (0.40 is the default time). This value can only be changed using the workhead configuration panel.

NOTE: The shortcut sequence to adjust the number of tamps for the left or right vibrator is as follows: First if there is a pop out panel active, use the ESC key to remove the popped out panel, so that pressing the plus or minus keys is not interpreted as a required change to an item on the pop out panel. Next, to increase the number of tamps hold down the plus key, or to decrease the number of tamps hold down the minus key, then press a vibrator key associated with the workhead(s) for which the number of tamps is to be changed. If a plus or minus keys is being held down, pressing a vibrator key will not have the usual effect of turning that vibrator on or off.



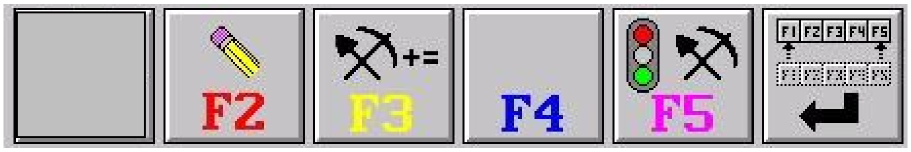
Third Main Toolbar Button Set
F1
F2
F3
F4
F5
ENTER Key = Next Toolbar Set
F2
Erase/Wipe
Clear All Data
ESC
ESC = Return to Previous Function
ENTER = Clears Data
(Production Counts - This Period)
(Production Counts - To Date)
(Switch Counts - This Period)
(Switch Counts - To Date)
F1
F2
Insertion and Production Counters Panel



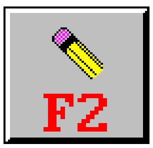
Third Main Toolbar Button Set
F2
F3
F4
F5
F1
F2
F3
Work Start/Stop Panel
“Find Lights”
0
0
0
0
0
0
0°00’
F3
F4
ESC
Resume Work Panel

The Third Toolbar Button Set

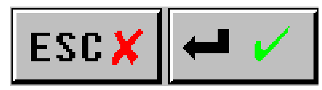
The third toolbar button set is present whenever the ENTER key has been pressed from the second toolbar button set.



F2 – Erase/Wipe Track Button



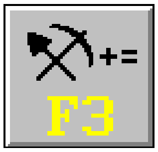
Pressing F2 on the third toolbar button set pops out the ESC/ENTER panel. ENTER will clear the previously worked track or track recording that can be seen in the Expanded Track View. ESC returns to the toolbar set. If ENTER is pressed, the yellow fit lines and red throws line will default to straight lines on zero. Clearing the Expanded track view in this way may be needed when preparing to tamp track at a different work location, such as when starting a new work day. It is not necessary to do this prior to starting a new recording.



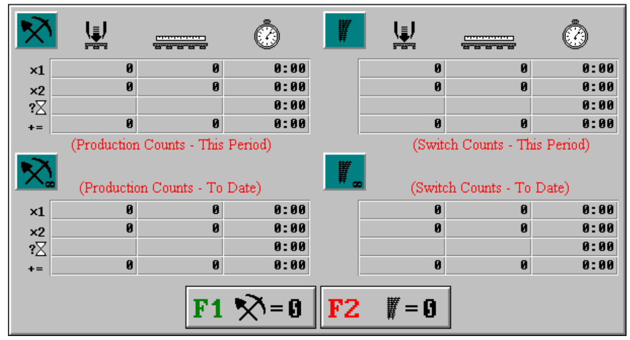
ESC or ENTER Key

NOTE: When a recording is cleared in this way it is *not* deleted from the machine's filing system (memory). It will still be possible to "reload" the cleared recording at a later time if desired.

F3 - Insertion and Production Counters Panel



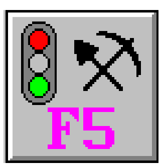
Pressing the F3 button on the second toolbar button set opens the Insertion and production counters panel. A standard machine is equipped with panels, which accumulate totals for switch and production mode tamping. Single and double tamping insertion counts are shown, along with distance tamped and time taken. Triple and quadruple tamp insertions are combined with double tamps on this panel.



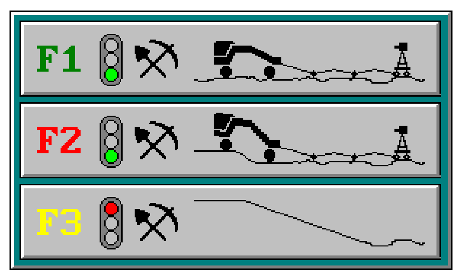
Insertion and Production Counter Panel

Data to the left on this panel applies to work done in production mode. Data on the right side of the panel applies to work done in switch mode. Like a trip meter on the odometer of a car, the upper counts can be reset (use F1 and F2 to clear these counts for production and switch counts respectively). The operator cannot reset the lower counts.

F5 – Work Start/Stop/Resume Panel



Pressing F5 on the third toolbar button set opens the Work Start/Stop/Resume panel. This button is duplicated on the second toolbar set of the expanded view. This panel is used to: ramp-in at a new location (F1), resume work previously interrupted by a ramp-out (F2) and ramp-out and save values (F3).



F1 “Finding the Lights” or Ramp-in at new location.

F2 Resume Work; When F2 is pressed the resume work panel pops out.

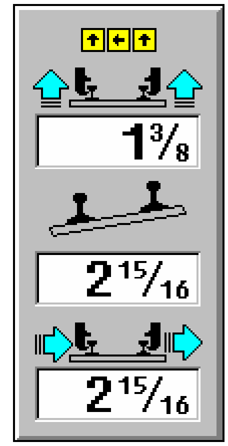
F3 Run-out or Ramp-Out of Surface and/or Line.

NOTE: Before selecting this function, ensure that the machine buggies are properly setup, the proper number of buggies are selected, the proper lining reference is selected and desired projector(s) is on.

The F1-F3 keys on this panel are used as follows:

F1 “Finding the Lights”: This procedure applies to unrecorded track.

When starting at a new location (unrecorded track) use the F2 Wipe button (third toolbar set) to clear all previous track data and set the starting footage to zero. If superelevation or curvature is not zero for the track to be tamped, then use the manual change procedures to set the proper superelevation or curvature. The surface lift will automatically ramp to the lift default value. If the default value for lift is not the desired lift then use the surface lift change panel to enter the appropriate lift before using “finding the lights.” (See NOTE on Setting Manual Lift). When F1 “finding the lights” (zero setup) is selected, the dialog information panel will appear showing lift, superelevation and line at the shadowboard. These numbers are determined from the current beam position and the inclinometer reading. If the values displayed on this panel are large, it may be desirable to move the machine slightly (if possible), but NOT more than five feet in either direction (zero feet), before pressing ENTER.



“Find the Lights”

When the ENTER key is pressed, hunting of the beam will stop and the actuators will be positioned at the point of cutoff. Point of cutoff sets control points so that the first tie to be tamped will not be lifted, lined or changed in superelevation. Surfacing and lining will automatically ramp at preset rates to the desired values. For example, if no manual changes were made, the superelevation would automatically ramp to zero and line would automatically ramp to the established liner zero and surface would automatically ramp to the default lift value.

If ESC is pressed, the procedure will be aborted and the actuators will be returned to their original positions.

NOTE: <u>Setting Manual Lift</u> The procedure for entering a manual lift is as follows: After an F2 wipe, open the surface lift change panel. Press either the up or down arrow key on the operator’s R/H keypad <u>only once.</u> This will install a control point at zero feet and the desired lift will be zero. To increase the lift press the left arrow key or use the right arrow key to decrease the lift. Press the ENTER key after the appropriate surface lift is set. This accepts the changes and pops off the surface lift change panel.

<u>Default Values for Surface Lift</u> The surface lift default value is the upper lift value in the Defaults Table Panel (F5 on the third expanded view toolbar button set). If no lift is set, then this value is used to set the desired surface lift at the end of a ramp-in. In this instance the default lift is 1 inch and the ramp rate is 80 feet.

Using the “Finding the Light” procedure when surface and line is previously recorded.

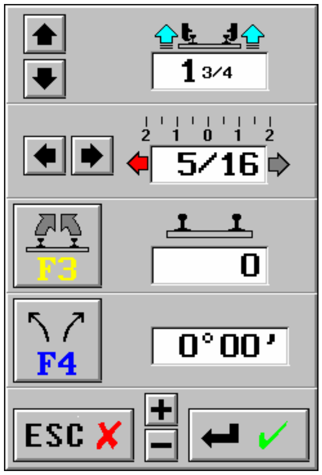
When recording track with the surfacing system on and the machine has surface fit software, the recording will contain a plot of both surface rails. After the recording is complete, System V will automatically best fit the surface and line. The surface fit will normally have control points at each location of maximum and minimum lift.

The best fit automatically sets a starting lift, this lift is usually close to the “finding the lights” position. Using F1 “Finding the Light” is recommended before starting to tamp recorded track. When F1 “finding the lights” (zero setup) is selected, the dialog information panel will appear showing lift, superelevation and line at the shadowboard. When the ENTER key is pressed, hunting of the beams will stop, the actuators will be positioned at the point of cutoff and the yellow fit line is ramped to the appropriate best fit lift.

NOTE: With best fit of surface, the F1 “Finding the Light” can be used at any starting location of recorded track.

If ESC is pressed, the procedure will be aborted and the actuators will be returned to their original positions.

F2 “Resume Work”; The Resume Work panel will open using the values that were stored by the F3 key of the work Start/Stop/Resume panel thereby giving the opportunity to inspect, retain or change the display values before they are applied. If values were not stored using the Work Start/Stop/Resume Panel this panel, the Resume Work Panel, allows you to re-enter this data manually before pressing ENTER to resume work.



Resume Work Panel

NOTE: Any adjustment made to surface, throws (line shift) or line is an “A” point adjustment.

Use the up/down cursor keys to change the lift (if necessary).

Use the left/right cursor keys to change the shift (if necessary).

The F3 and F4 keys can be used to select superelevation and curvature for modification prior to resuming work.

F3 Begin a run-out at this location. When this button is pushed, the current values of lift (and line shift) will be memorized for future reference. A surface ramp-out will be visible in the surface trace panel. The default rate of change for surface is used. If desired, use the surface rubber band panel to change the length of the ramp-out before continuing. Manual changes to both lift and line can, of course, continue to be made while the ramp-out is in progress.

Using the F2 - Wipe Button (third toolbar), or F1- Record Button (second toolbar) will not cause the memorized values at the start of a run-out to be lost.

An example is where tangent track is being tamped as the machine approaches an unrecorded curve which also needs to be tamped and lined. The procedure would be as follows:

- At a suitable point to begin recording the curve, stop tamping and press the F3 button on the above panel. It doesn't matter that no run-out is to be performed, the F3 key is just being used to save the current value of lift and shift.

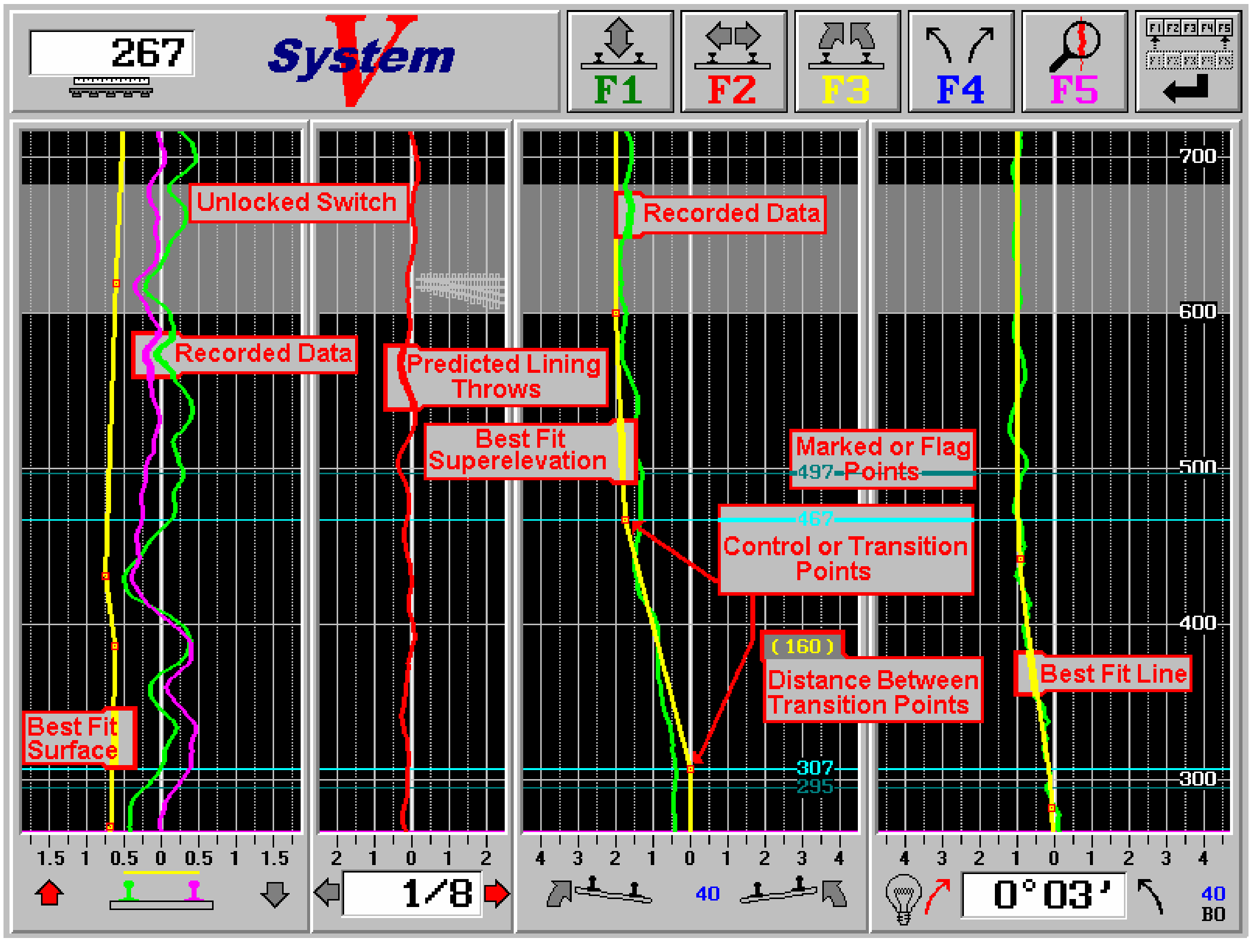
- Record the curve in the usual way.

- Return to zero feet and press the F2 button on the Work Start/Stop Panel. This will restore the lift that was in use before recording the curve.

- Resume tamping.

NOTE: If you forget to use the F3 button to perform a run-out (done manually instead), the values in the F2 resume panel will be the values of the last run-out. The F2 values can be modified and when modifying, they are modified as an “A” point value. Also, F1 (find the lights) can be used a few feet prior to the start of the run-out to ramp the surface back to the original value.

EXPANDED TRACK OVERVIEW



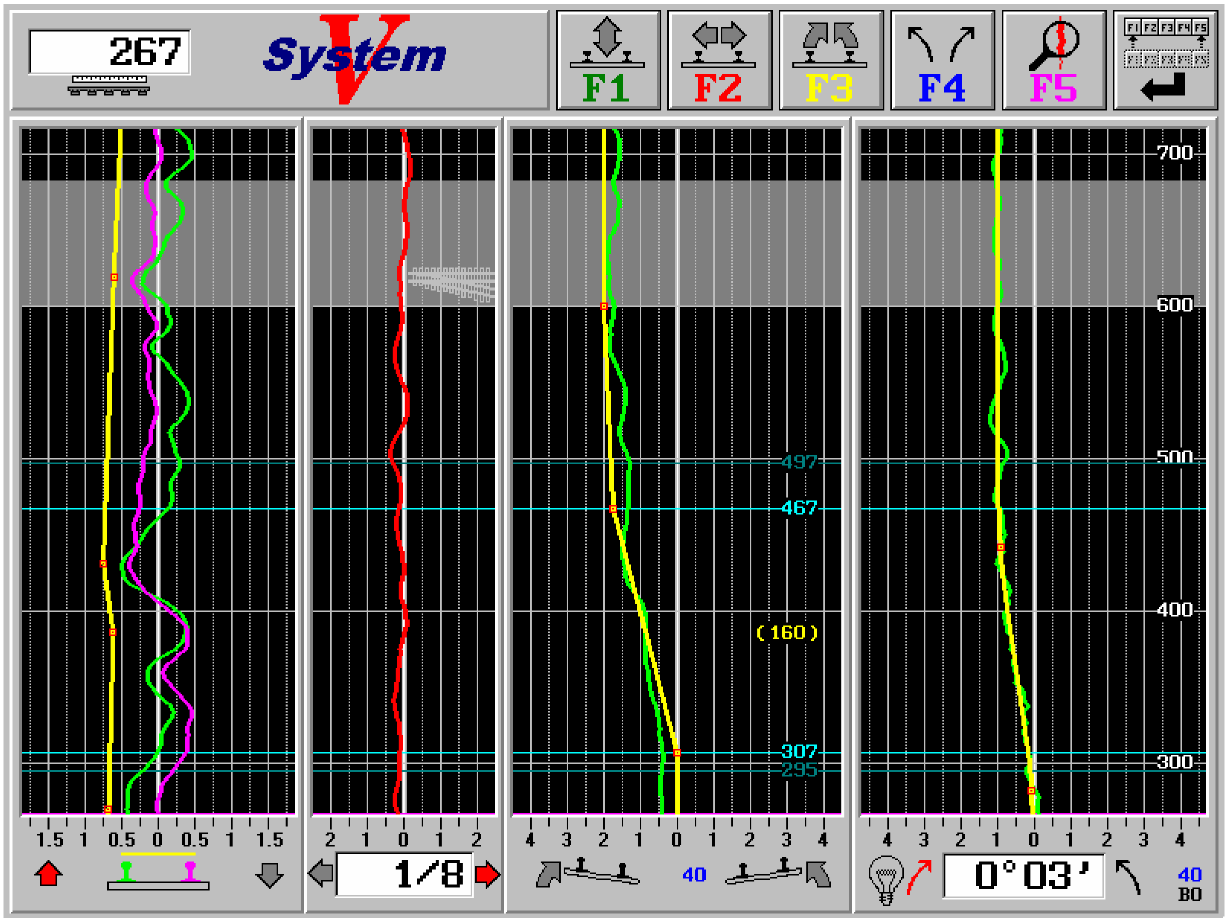
(1) Surface View (with optional Surface Fitting Software): Green Trace = L/H Rail as Recorded, Purple Trace = R/H Rail as Recorded & Yellow Line = Surface Fit or Predicted Lift.

(2) Throws View: Red Trace = Predicted Lining Throws. The numerical value in the white display, between the arrows, is the manual correction applied by the operator (applied in addition to throws).

(3) SuperElevation or CrossLevel View: Green Trace = Superelevation/Crosslevel as Recorded, Yellow Line = Predicted Superelevation/Crosslevel, Light Cyan Horizontal Line = Transitions and Cyan Horizontal Line = Flag or Marker Points. The numerical value in blue between the two track symbols at the base of this panel (40 in this instance) is the distance from the current location of the machine to the next transition point.

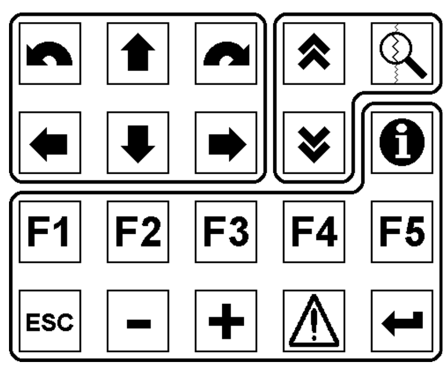
(4) Line View: Green Trace = Track Line as Recorded & Yellow Line = Predicted Lining. The numerical value in the white display, between the line arrows, is the degree of curvature. Light Bulb = ON/OFF for the optional LineLite system. The 40 & B0, bottom right of display, is the distance to the next transition and best fit style/sensitivity.

EXPANDED TRACK VIEW



To View this Screen, Press the Magnifying Glass Button on the R/H Operator Keypad.
The Expanded Track View utilizes a different primary toolbar button set than the work screen.

In this primary set, buttons F1 through F4 select Surface, Throws, SuperElevation and Line for modification respectively. The F5 button toggles between the Normal Expanded Track View (450 feet of track) and the Compressed View (complete track or curve).

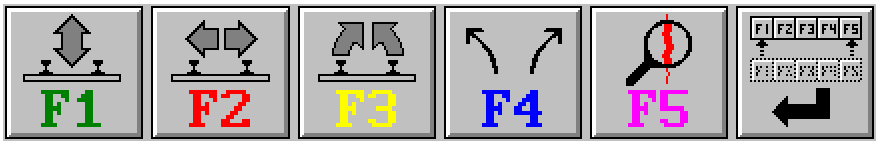


The expanded track view has three toolbar button sets. The ENTER key cycles between these in the same way as it cycles the three toolbar sets available from the normal work screen.

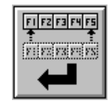
Some of the work screen toolbar buttons are duplicated in the Expanded Track View sets for convenience (turning projectors on and off, changing reference and so on).Certain functions can not be performed from the Main or Work view toolbars, such as ramps-in, ramps-out, best fitting, etc. These functions, plus many other options (described on page 3-56 / 65) become available by utilizing the Expanded Track View Button (magnifying glass) as shown, (Located on Operator R/H Arm Panel). The corporal stripes allow you to page forward and back through track data.

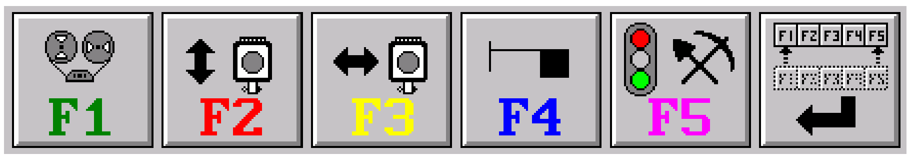
NOTE: When no other panel is open, using the plus and minus keys allows you to page in smaller steps than the corporal keys.

Pressing the expanded track view button (key) will change the display to the expanded track view screen, along with the first of the expanded track view toolbars, as shown below.

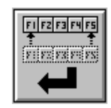


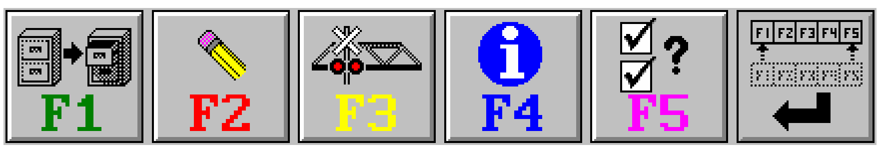
By depressing the "Enter" key, the second toolbar for the expanded track view will appear as shown below.





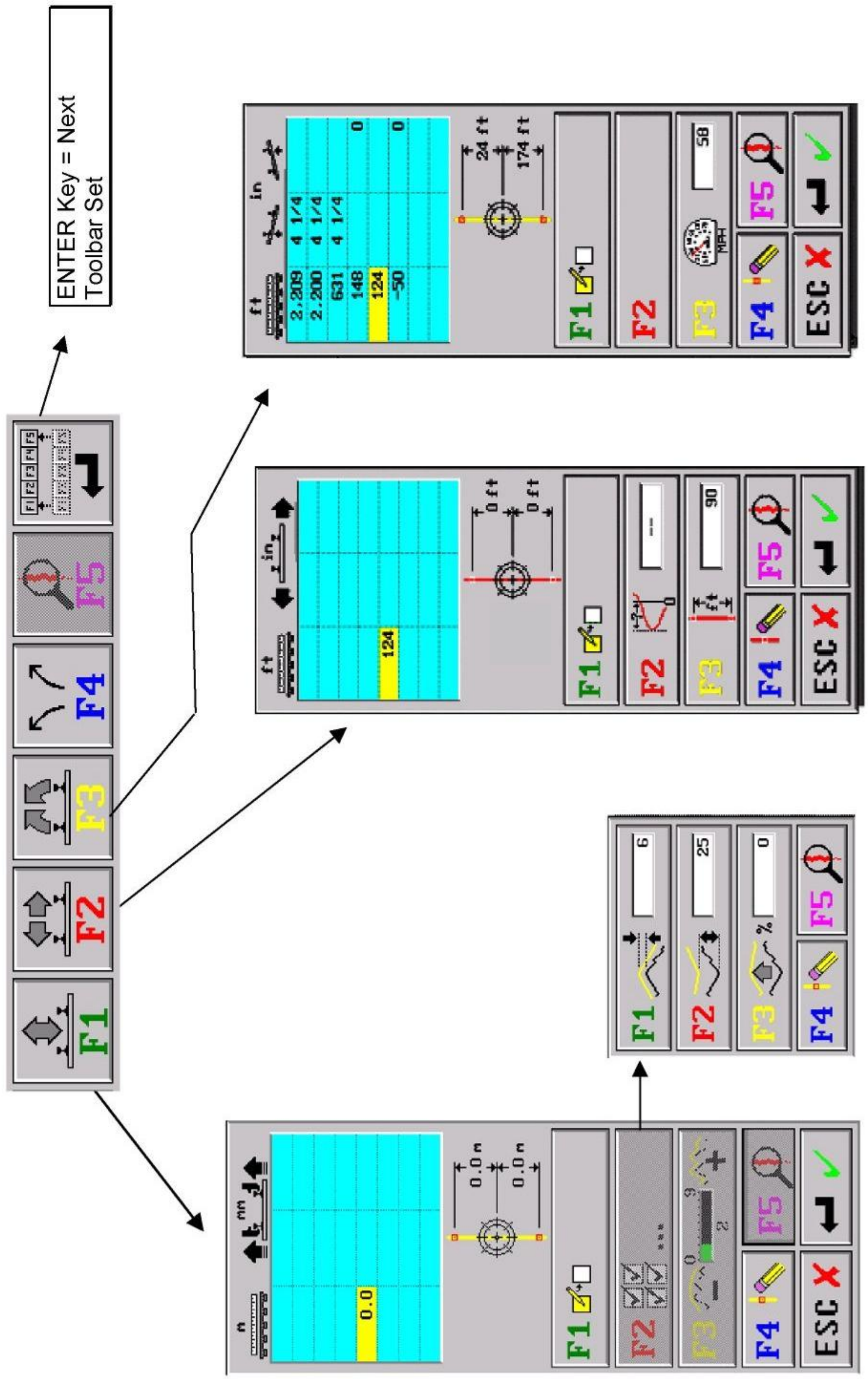
As above, pressing the "Enter" key again will bring up the third toolbar in the expanded track view group, (shown below).



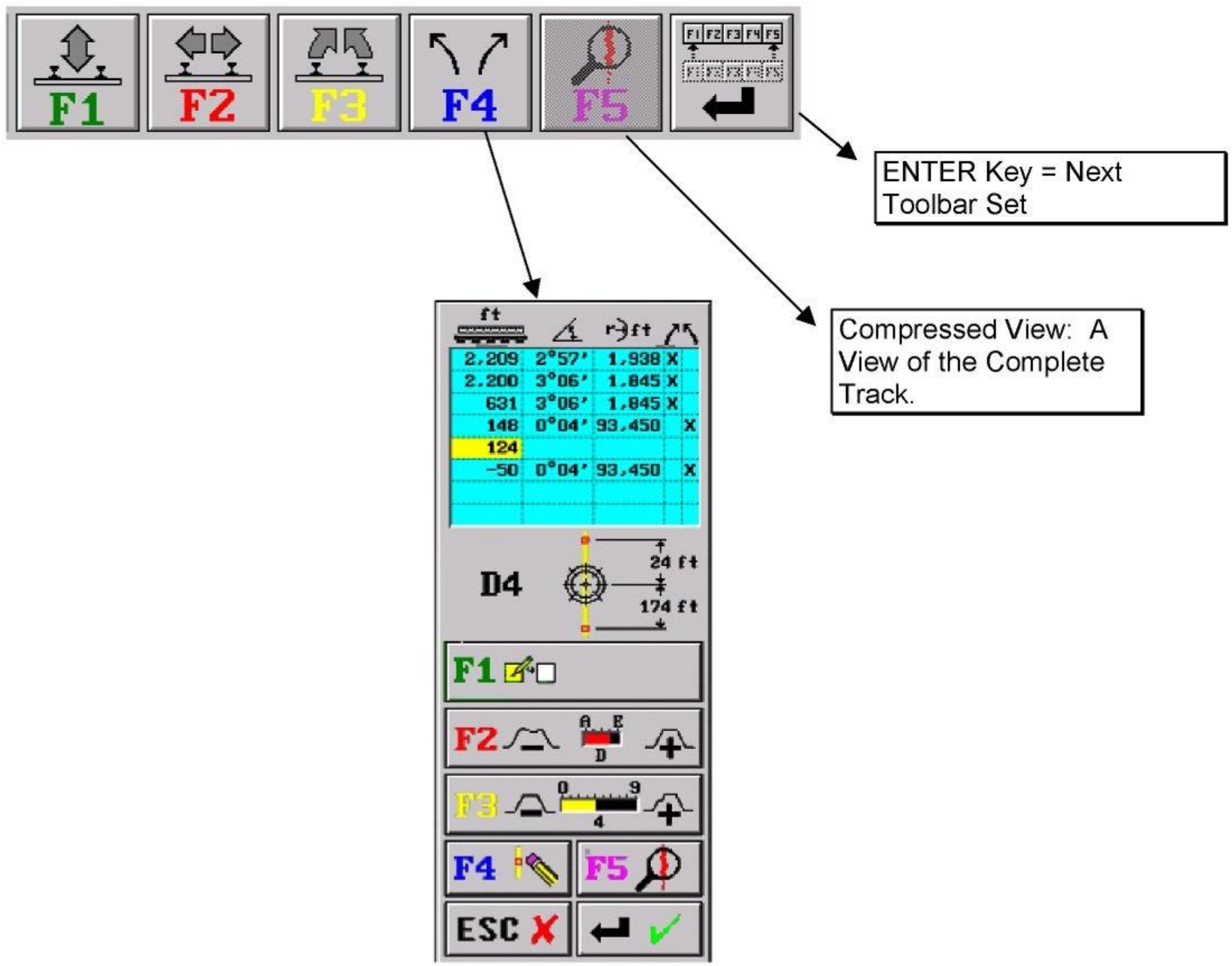


The following is a brief description of the functions and options on each toolbar.

First Expanded Track View Toolbar Set



First Expanded Track View Toolbar Set Cont'd

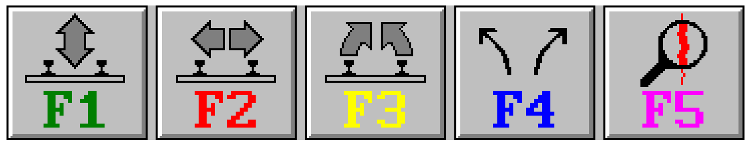


Expanded Track View Toolbar Buttons

The Expanded Track View must first be selected before the operator can enter or modify ramps, record track, change best fits to recordings, enter or change fixed points or recall previous recordings from the machines file system (memory). This function is provided by the toolbar buttons available in the expanded view in combination with the right keypad.

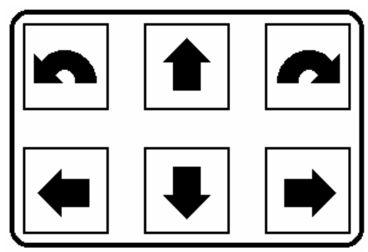
The First Toolbar Button Set - *Expanded Track View*

The first toolbar button set in the Expanded Track View provides the entry point for operator control of all work programmed for the track ahead of the machine. This same toolbar set is used for modifying "best fits" of recorded track and for control information for track that is not recorded before being tamped.



Each of the first four function buttons on this toolbar select a graph for control. These graphs are laid out in the same sequence as the track graph panels on the screen, namely F1-Surface, F2-Throws, F3-Superelevation and F4-Line. The F5 key toggles between a compressed view, which shows a complete track recording and best fit at once or the standard Expanded Track View which is 450 feet in length.

The other toolbar button sets provide for recording track or recalling previously recorded track from the machines file system (memory).



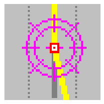
As soon as a graph has been selected by pressing F1, F2, F3 or F4 in this toolbar button set, the appropriate panel will open and the selected graph will be in rubber banding mode. While in this mode, the interpretation of the keys in the upper half of the right keypad will be different until the rubber banding mode is terminated by pressing the ENTER key to Accept, or ESC key to Discard changes made.

NOTE: Although graphs can be accessed in any sequence, changing some will impact others. Changing superelevation will influence the optional surface fit. Changing the best fit for line will change the fit for superelevation and so on. It is strongly recommended that a particular sequence of graphs be followed when changes are made. That sequence is LINE, SUPERELEVATION, THROWS and finally SURFACE (skipping over any that do not need changing). Note that for consistency with the rest of this manual, the following sections will not appear in this sequence.

Rubber Banding

To avoid repetition, some general terms, concepts and keypad usage that apply to rubber banding will be described in this section. For each graph, control is applied through a sequence of control points. The variation of control between control points is assumed to change in a straight line from one point to the next. If you imagine an elastic or rubber band stretched between the control points, then you have a clear picture of what happens to control at intervening points when any one point is moved.

When a graph is selected for modification, a target or cursor is positioned at the current location. The "corporal" keys jump (or snap) the target to the next available control point. Using any of the up, down, left or right cursor keys on the right keypad will "drag" the selected control point in the direction of the arrow on the key. While in the rubber banding mode, a panel adjacent to the graph being modified will be open showing details of the control point currently selected. When a control point is dragged, the numerical effect is immediately shown on this panel.



Target

Pressing the plus/minus (+/-) keys will move the target or cursor along a "rubber band line" *between* two control points, at a rate of one foot per press. Holding one of these keys down will allow auto-repeat to move the cursor continuously. To accelerate the rate of the cursor, hold down both plus/minus keys together, but first select the plus or minus key for direction. This allows any track location to be selected quickly. When the target has been placed between control points, *using an up/down/left/right key will create a new control point* at the selected track location. The operator simply continues to use the cursor keys until the newly created control point is positioned appropriately. This is the method of inserting control points. When a control point is dragged to or beyond another control point, the two points will be combined.

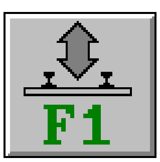
Pressing the ENTER key exits the rubber banding mode and *RETAINS* any changes made. Pressing the ESC key exits the rubber banding mode and *DISCARDS* any changes that have been made. Either way, the cursor keys revert to their normal function of providing manual control over lift, line and superelevation as described in the normal or work view section.

In the rubber banding mode, the superelevation change keys on the right keypad (the curved arrow keys in the cursor group) provide a short cut to selecting the adjacent graph for modification (rubber banding). Pressing one of these keys is equivalent to pressing the ENTER key (changes are retained) and selecting for change the adjacent graph.

Hints: To see what is underneath a “rubber band” panel, press and hold down the alarm key on the right hand keypad. When you release the key, the panel will automatically revert to the last display.

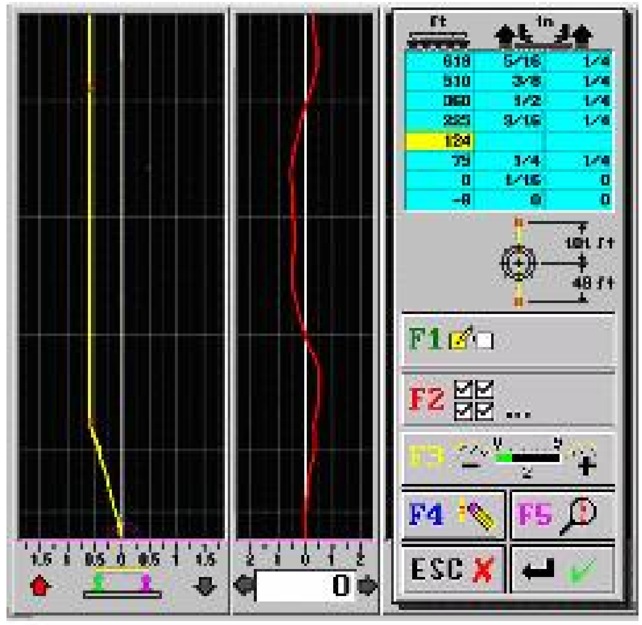
F1 - The Surface Lift Change Panel - ***Expanded Track View***

Pressing the F1 button on the first toolbar button set opens the Surface Lift Change Panel.



The surface lift change panel is used to create or modify existing surface lift, run-ins or run-outs (ramps) and modify lift between control points. This procedure is sometimes called “rubber banding or rubber band mode.”

When surface is being modified in the rubber band mode (adding, deleting or modifying control points) the surface lift change panel is open to the right of the surface graph.



Ramping Surface at the Default Rate

To facilitate the ramping in and out of lift on track that has not been prerecorded or without surface fitting, the rubber-banding mode of surface includes a special feature that is not available for the other graphs. At the last control point, press the "up corporal" key. Next use either the left or right cursor arrow key to apply the default run-in or run-out rate for surface. Continue using the left/right arrows until the lift at the end of the ramp has been reached. Up or down cursor arrow keys can then be used to modify ramp length if necessary. Press ENTER to ACCEPT or ESC to DISCARD changes.

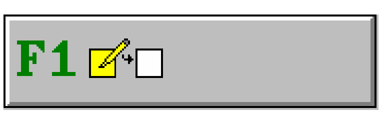
NOTE: Without recorded surface the F2 and F3 keys on this panel have no effect. There is a shortcut sequence that accepts changes and opens another graph change panel. When a function (rubber band) panel is open the right curved arrow (crosslevel) key accepts changes and moves one function panel to the right. The left curved arrow (crosslevel) key accepts changes and move one function panel to the left.

The following description is for a machine equipped with Optional Surface Fitting Software.

When recording track with the surfacing system on, the recording will contain a plot of both surface rails. After track recording is complete, System V will automatically best fit the surface, superelevation and line. The surface fit will normally have control points at each location of maximum and minimum lift as described by the F2 and F3 keys in this panel. Before proceeding with any rubber band style changes (adding, deleting or modifying control points), make necessary adjustment to the default value and/or F2 or F3 to achieve a desired overall fit. Making any change using F2 or F3 will result in any manual changes (made by dragging control points) being discarded. Press ENTER to ACCEPT or ESC to DISCARD changes.

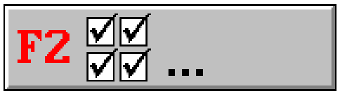
When Starting on Lifted Track (See F5 – Work Start/Stop Panel, page 3-54).

F1 – Change Control Points



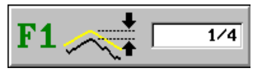
Press the F1 button to select a cell on the control points cell table. When a cell is highlighted yellow, the PC keyboard can be used to type in a new value. Selecting another existing control point can be done by pressing “corporal up” or “corporal down”. Selecting a location between existing control points press plus/minus key. When there is no control point at the selected location, all cells in the table will be blank except for the location.

F2 - Surface Fit Panel Button



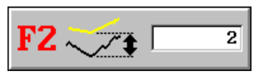
Press the F2 button to open an additional surface fit panel. This additional panel will provide the operator with five (5) surface fit options to choose from. These buttons (described below) allow the operator to make the necessary adjustments required to achieve best fit.

<u>F1 – Surface Change - Minimum Lift</u>



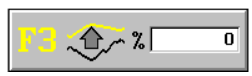
The minimum lift (expected clearance over high points) is displayed in the white box on this button. If it is desired to change this number, press F1. The button will depress and the white box will turn yellow to indicate this value can be changed. Use the plus and minus keys to change the value. When you have finished making changes to this value, press ENTER or any Function Key to ACCEPT changes. Press ESC to DISCARD changes.

<u>F2 – Surface Change – Maximum Lift</u>



The maximum allowable lift at any location is displayed in the white box on this button. If it is desired to change this number, press F2. The button will depress and the white box will turn yellow to indicate this value can be changed. Use the plus and minus keys to change the value. When you have finished making changes to this value, press ENTER or any Function Key to ACCEPT changes. Press ESC to DISCARD changes.

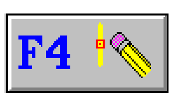
<u>F3 – Low Point Compensation Percentage</u>



The Low Point Compensation Percentage is displayed in the white box on this button and is used to apply more lift to low points in an effort to combat “track memory”. If it is desired to change this number, press F3. The button will depress and the white box will turn yellow to indicate this value can be changed. Use the plus and minus keys to change the value. When you have finished making changes to this value, press ENTER or any Function Key to ACCEPT changes. Press ESC to DISCARD

NOTE: When finding the lights, if a lift value is not set in the surface lift panel or without surface data recorded (optional surface fitting), the starting ramp will ramp to the lift default value, in the defaults table panel. (upper number in this panel) This value is used to set the surface lift. *(Described on page 3-54 or 3-80), Work Start/Stop/Resume Panel).*

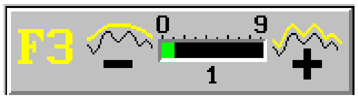
<u>F4 - Delete a Control Point</u>.



<u>F5 - Zoom this View Only, while Depressing the F5 key.</u>

NOTE: Any manual adjustment to recorded surface is displayed in the left hand slider of the surface lift panel. Also ***Surface Fit Option:*** Plotting a curve with the surface projector **ON, Enable** surface fit and plotting with surface projector **OFF, Disable** surface fit. After a curve is plotted, the *option cannot be turned ON or OFF*.

F3 - Surface Fit Sensitivity Button

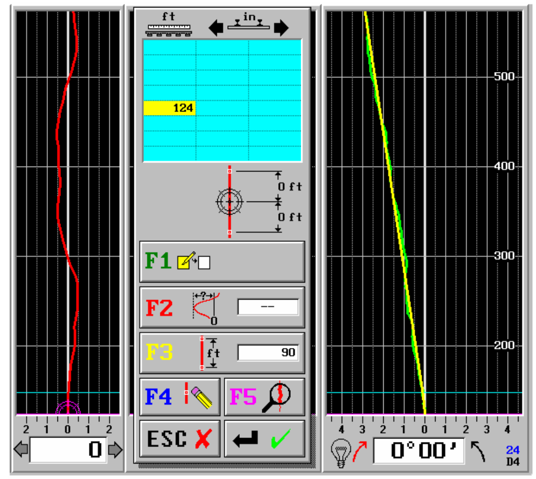


Use the F3 button to change the *surface sensitivity*. When the F3 button is pressed, the button will appear "pressed in", allowing the operator to increase or decrease the value by using either the plus (+) or minus (-) keys. Note that entering a larger the value will increase the variation of the lift. The greater this variation, the smaller the lift and therefore the less ballast required.

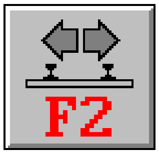
F4 - Delete a Control Point (See Previous Page)

F5 – Zoom this view only (See Previous Page)

F2 - The Lining Throws Change Panel - *Expanded Track View*



Pressing F2 on the first toolbar button set pops out the



Lining Throws Change Panel. When throws are being modified in the rubber band mode, the following panel is open to the right of the throws graph. Before proceeding with rubber band style changes, the default value for maximum throw should be examined. Making any

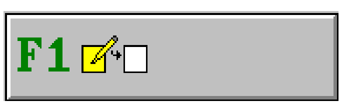
changes using the F2 key will discard any manual changes previously made.

Rubber banding works somewhat differently for throws than it does for any of the other graphs. The usual purpose of making changes to throws is to provide lining to monuments or stakes. As such points are usually a fixed distance apart, the "corporal" keys jump by a distance that can be set by the F3 button on this panel. Default is 100 feet.

For newly recorded track, there will be no control points for throws. The normal sequence is to use the corporal and plus/minus keys to move the cursor or target to the distance of the first monument or stake. Left and right arrow keys will then insert a control point and modify the throw to the desired value. The up corporal key will jump forward by the default distance to the next monument where the process is repeated.

Although the same procedures can be used for track that has not been previously recorded (the red throws line will initially be a straight line on zero), the actual throws that result behind the machine will depend on existing track errors (which are unknown).

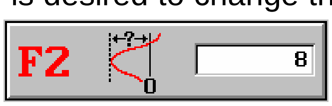
F1 – Change Control Points



Press the F1 button to select a cell on the control points cell table. When a cell is highlighted yellow, the PC keyboard can be used to type in a new value. Selecting another existing control point can be done by pressing “corporal up” or “corporal down”. Selecting a location between existing control points press plus/minus key. When there is no control point at the selected location, all cells in the table will be blank except for the location.

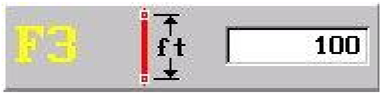
F2 - Throws Change - Maximum Throw

The maximum allowable throw at any location is displayed in the white box on this button. If it is desired to change this number, press F2. The button will depress and the white box will turn



yellow to indicate this value can be changed. Use the plus or minus keys to change the value. When you have finished making changes to this value, press ENTER or any Function Key to ACCEPT changes. Press ESC to DISCARD changes.

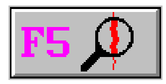
F3 - Throws Change - Default Peg Spacing



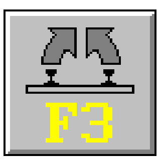
The default distance between throws that will be entered is displayed in the white box on this button. If it is desired to change this number, press F3. The button will depress and the white box will turn yellow to indicate this value can be changed. Use the plus or minus keys to change the value. When you have finished making changes to this value, Press ENTER or any Function Key to ACCEPT changes. Press ESC to DISCARD changes.

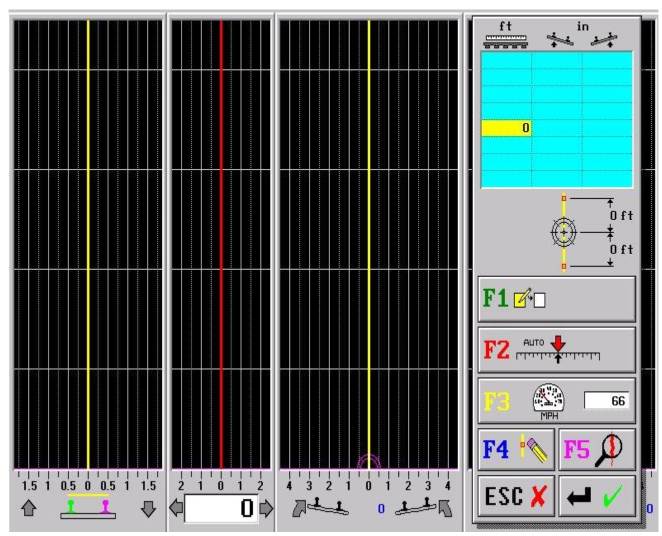
F4 - Delete a Control Point.

F5 - Zoom this View Only, While Depressing the F5 key.



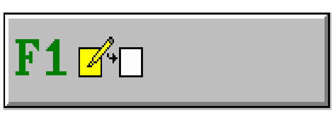
<u>F3 - The Superelevation/Crosslevel Change Panel - Expanded Track</u>





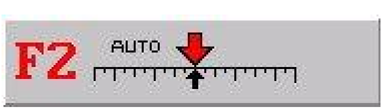
Pressing F3 on the first toolbar button set pops out the Superelevation Change Panel. When super elevation is being modified in the rubber band mode, the following panel is open to the right of the superelevation graph.

F1 – Change Control Points



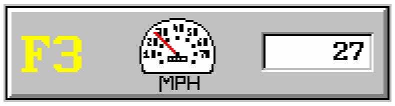
Press the F1 button to select a cell on the control points cell table. When a cell is highlighted yellow, the PC keyboard can be used to type in a new value. Selecting another existing control point can be done by pressing “corporal up” or “corporal down". To select a location between existing control points, press the plus or minus key. When there is no control point at the selected location, all cells in the table will be blank except for the location. To drag C control point, use the up/down arrow keys when the target is on a control point.

F2 - Superelevation Compensation (Enable/Disable).



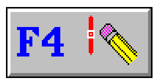
Use the F2 button to enable or disable Superelevation compensa-tion. When enabled, this feature will automatically apply additional correction to the preexisting error in super. The success of this compensation is monitored at the inclinometer and automatically adjusted. The black arrow on the superelevation panel shows the amount of compensation. It is recommended that this feature **NOT** be used when tamping turnouts as the weight of the turnout will be more dominant. **NOTE: This feature will only work on pre-recorded track.**

F3 - Superelevation Change - Train Speed

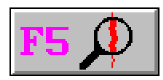


Press F3 if the superelevation in curve bodies is to be set using a train speed. This is influenced by track curvature and unbalance, which is set on the defaults screen. When F3 is pressed, this screen button will appear depressed and the white box will turn yellow to indicate the train speed can be changed. Use the plus/minus keys to change the value (if necessary). When you have finished making changes to this value, press ENTER or any Function Key to ACCEPT changes. Press ESC to DISCARD changes. The resulting rate of change of superelevation in spirals will be checked against the default allowable limit and the ramp rate will be shown in red where this is exceeded. In such cases it will be necessary to manually correct this, usually by extending ramp distances.

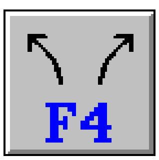
F4 - Delete a Control Point.

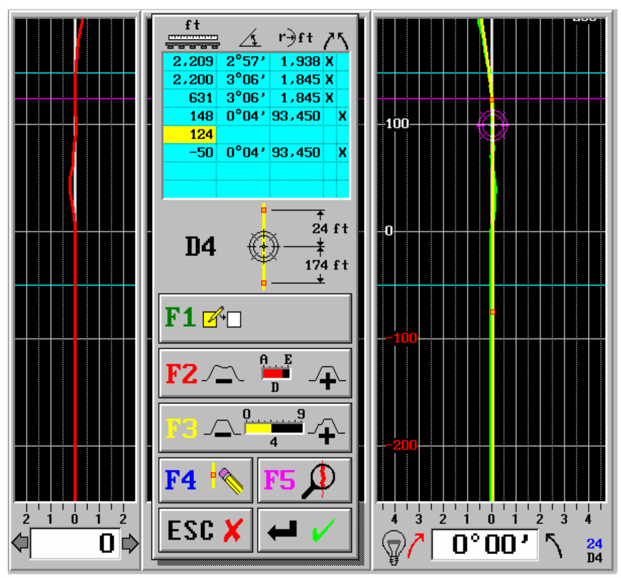


F5 - Zoom this View Only, While Depressing the F5 key.



__F4 - The Line Change Panel__ - *Expanded Track View*





Pressing F4 on the first toolbar button set pops out the Line Change Panel. When line is being modified in the rubber band mode, the line rubber band panel is opened to the left of the line graph. The F2 and F3 buttons are used to change the fit style and fit sensitivity that influence how the fit (the yellow line) is computed from the recorded curvature (the green line). See the following sections for details on fit style and sensitivity. Selecting F2 or F3 (and any subsequent change to these values) will result in a new fit being computed. When a new fit is computed, any manual changes previously made by rubber banding will be discarded. For this reason, corrections using rubber banding are best made after you are satisfied with the fit and the resulting throws.

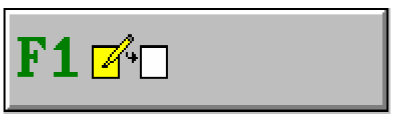
NOTE: For each control point in line, there is a cyan (light blue) line drawn horizontally across the graphs. This line is shown at the true location of the start or end of spirals. The associated control point is shown at a location several feet before the cyan line at a position where the recording of a spiral *appears* to start or end.

This separation is known as the graph offset[*]. The footage value for the point in the rubber band panel is for the true position (the cyan line). When dragging a point to match tags on the track, the location of the cyan line is what is important. When dragging a point to match the shape of a recorded curve, the location of the gun-sight or target is what is important.

When dragging a control point left or right (changing the degree of curvature), if the next point ahead has the same value, it also will be dragged. This makes it easy to keep the curvature of the body of a curve the same at each end.

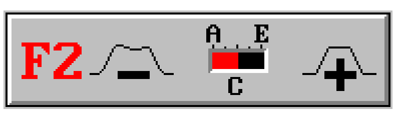
When dragging a control point up or down (changing the location or footage of a point), if there is a control point in superelevation at the same location, it also will be dragged.

F1 – Change Control Points



Press the F1 button to select a cell on the control points cell table. When a cell is highlighted yellow, the PC keyboard can be used to type in a new value. Selecting another existing control point can be done by pressing “corporal up” or “corporal down”. To select a location between existing control points press the plus/minus key. When there is no control point at the selected location, all cells in the table will be blank except for the location.

F2 - Best Fit Style or Method



Use this button to select the STYLE or METHOD of best fit to be used. The button will appear depressed to indicate the best-fit style can be changed. Use the plus/minus keys to change this selection. When you have finished making changes, Press F2 to end this mode.

The smallest throws (weakest correction) will result when using Style A. The largest throws with the most correction will result when using Style E. The default Style is C. To change default*, see Defaults Table, Third Toolbar F5, Page 3-86.*

The current possible selections are:

A – Average fit — The fit for line is established purely by using an average of the recorded data. This style is best suited for areas such as yards where it is difficult or impossible to establish the true design geometry of the track.

NOTE: The fit sensitivity (see next) will effect the length of this average (as well as the number and location of transitions for locating

[*] The graph offset represents an effect arising from the distance between the shadowboard and projector being much longer than the distance between the shadowboard and the receiver. This makes the recording of a curve appear to occur before the true position of the curve. This effect will vary depending on the number of buggies selected.

superelevation changes). ***Average fits cannot be rubber banded.***

B – Smoothed body[⊕] Gradual variations in curvature are permitted. **No Correction** is made for estimated **Projector** movement due to track errors.

C – Smoothed body Gradual variations in curvature are permitted. This Fit Style **Corrects** for estimated **Projector** movement due to track errors.

D – Constant body Curvature outside of spirals is forced to be constant. **No Correction** is made for estimated **Projector** movement due to track errors.

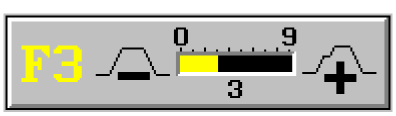
E – Constant body Curvature outside of spirals is forced to be constant. This Fit Style **Corrects** for estimated **Projector** movement due to track errors.

F3 - Best Fit Sensitivity

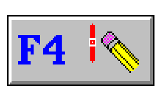
This button provides the operator with a way of fine tuning the best fit. The button will appear depressed to indicate the best-fit sensitivity can be changed. Use the plus/minus keys to increase or decrease this value. When you have finished making changes, press F3 to end this mode.

Sometimes an error in the spiral or body[*] of a curve may appear to be an additional body. On other occasions, a small body in a compound curve may be interpreted as a defect or error. Changing the best-fit sensitivity provides influence over how System-V distinguishes between these situations and is frequently the easiest way to get the desired result.

Increasing fit sensitivity increases the tendency to recognize more curves with smaller bodies and decrease throws. Decreasing sensitivity will tend to recognize fewer curves with larger bodies and increase throws. In general, it is desirable to use the lowest sensitivity and increase it only if the fit fails to recognize spirals or compound curvature. For this reason, the default value for a new recording is always zero.



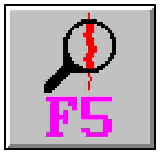
F4 - Delete a Control Point.



F5 - Zooms Throws & Line View Only, While Depressing the F5 key

F5 - The Compressed Track View - *Expanded Track View*

[⊕] On long curves with bodies over 400 feet, permitting gradual variations in curvature will often result in smaller, more balanced throws, without compromising the ability to correct errors.
[1] Body is a shorthand term for a length of constant curvature. A curve with more than one body is referred to as a compound curve.



Pressing F5 on the first toolbar button set selects the Compressed Track View. When the compressed view is selected the screen display will change to a complete section of recorded (plotted) or worked track over 450 feet in length. Pressing either the ESC or ENTER key will change the display to its previous view. To see an example of the compressed view see Figure 1: Standard Machine Without Optional Surface Fitting Software or Figure 2: Machine With Optional Surfacing Fitting Software.

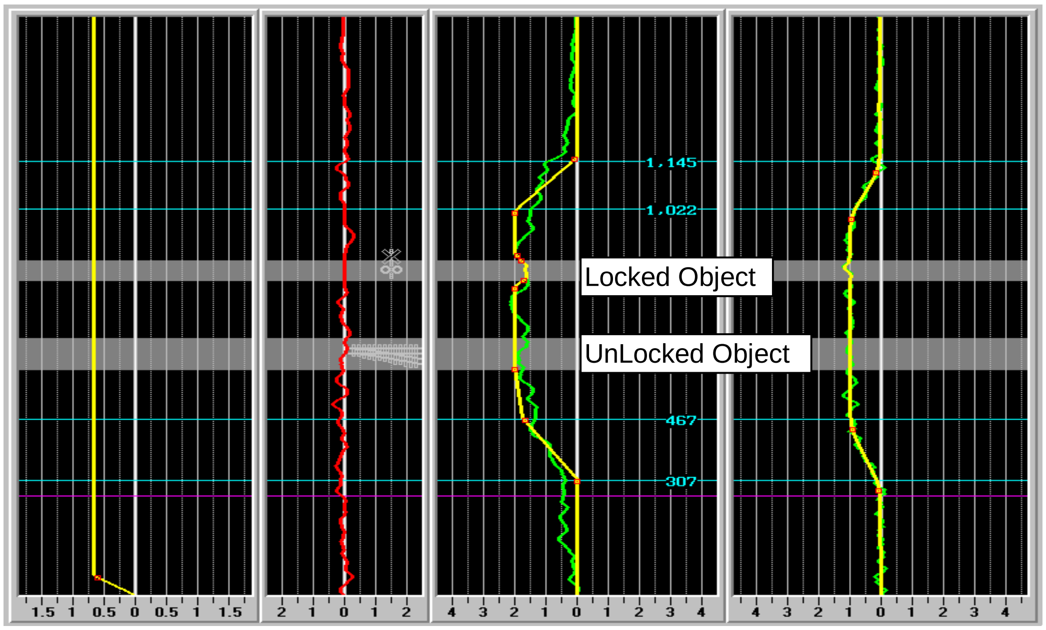


Fig. 1: *Standard Machine Without Optional Surface Fitting Software*

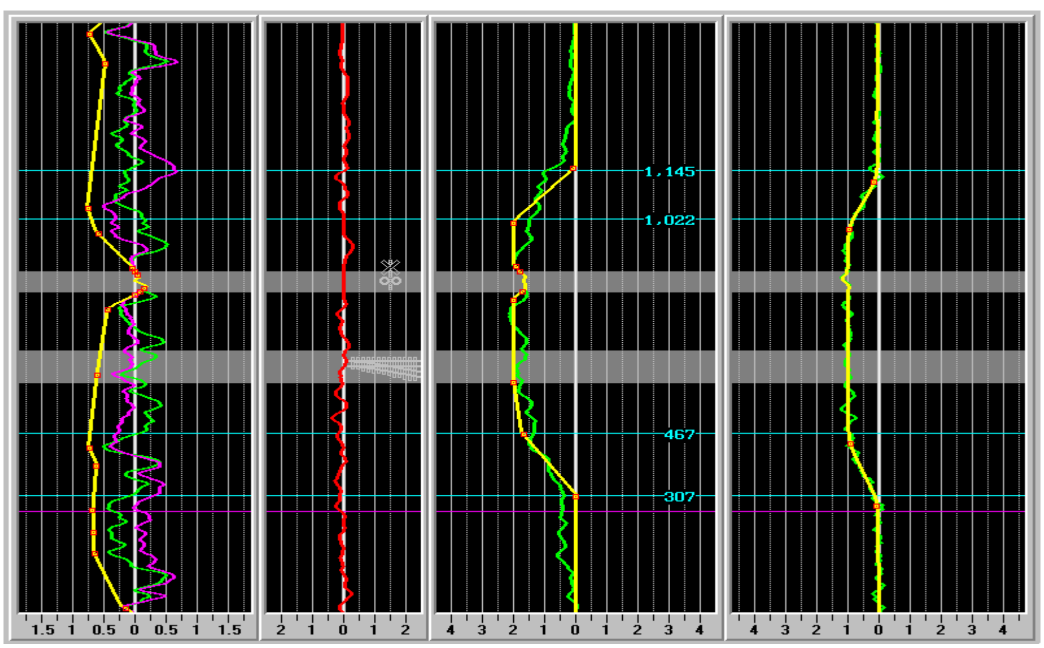
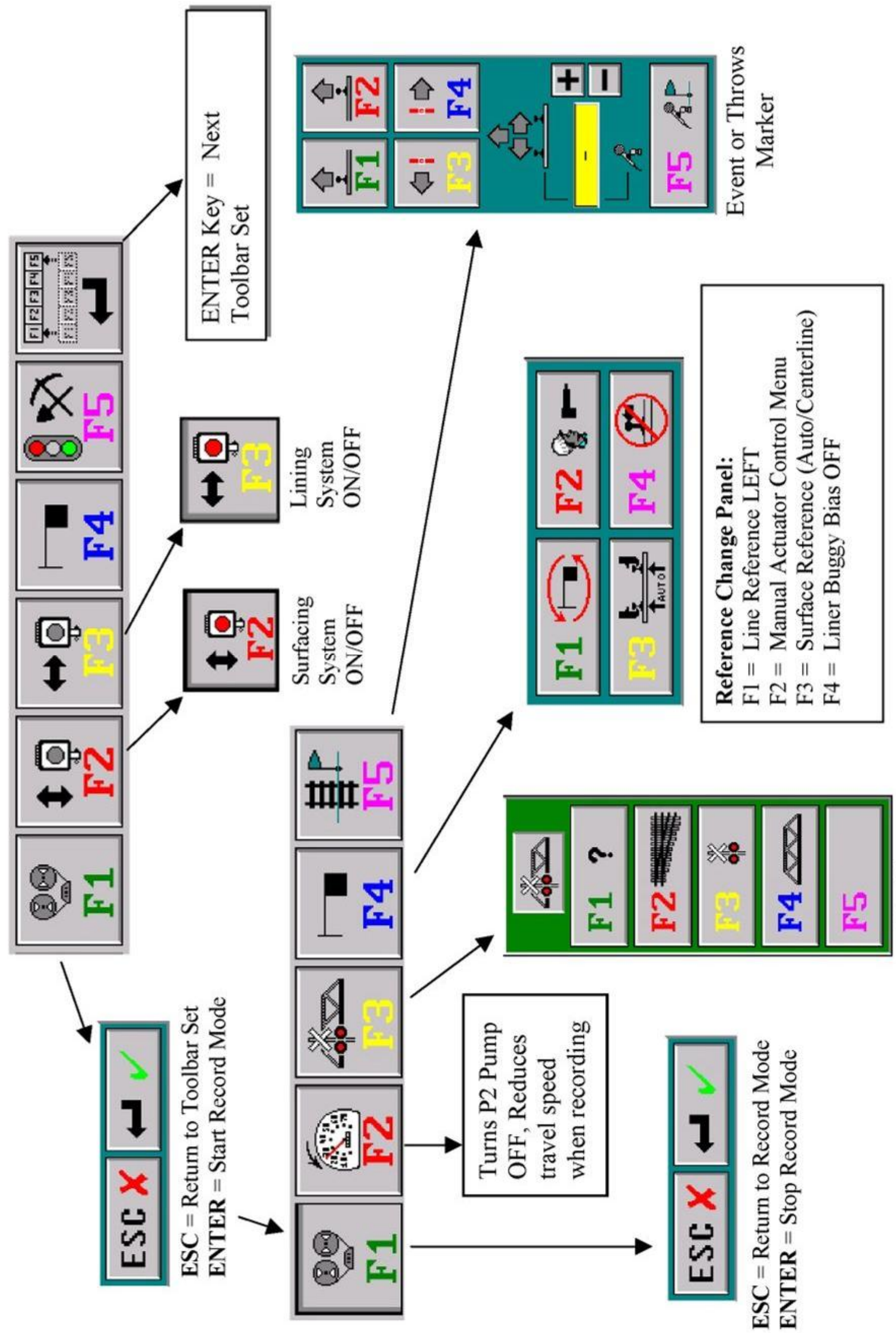
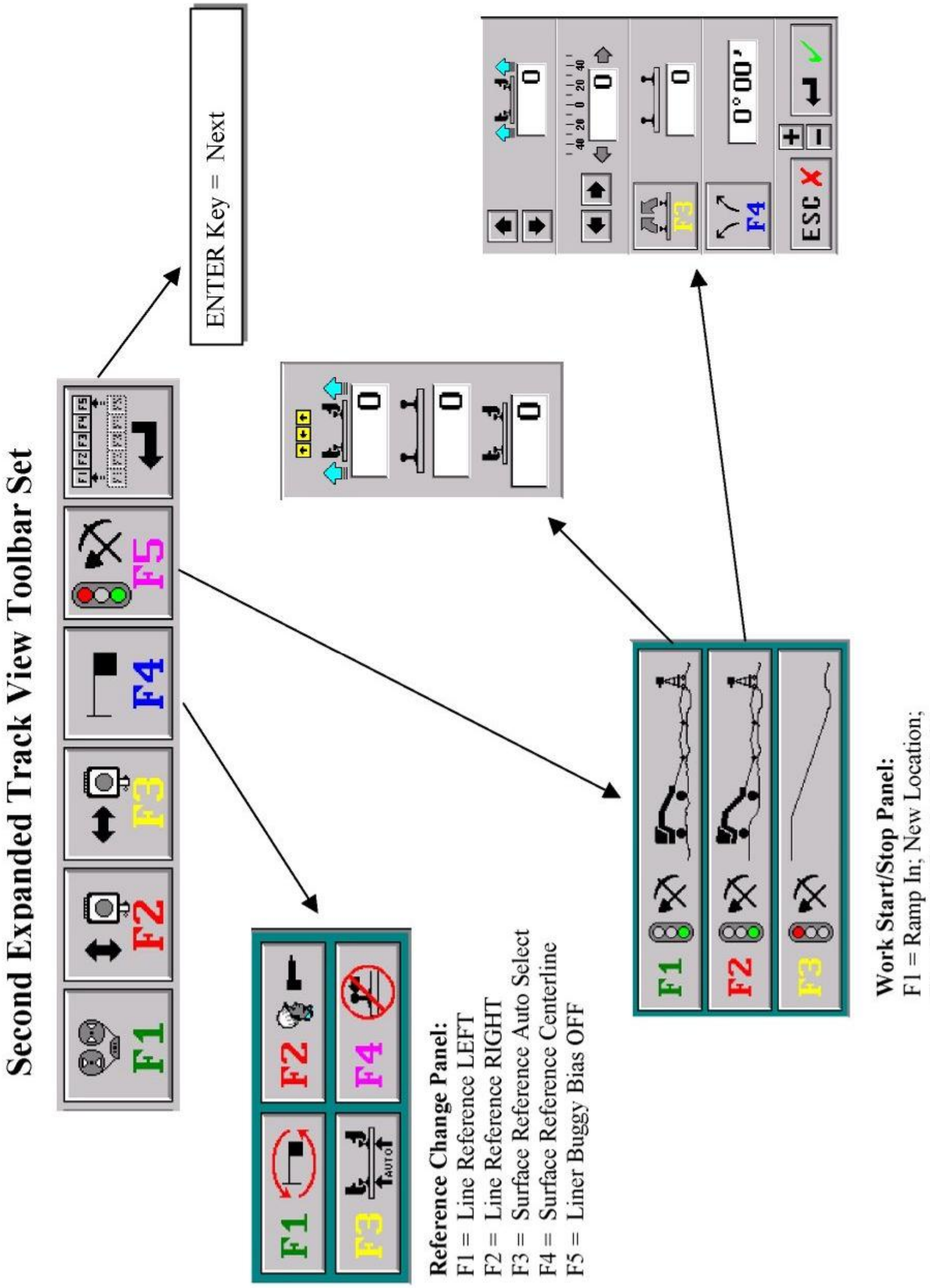


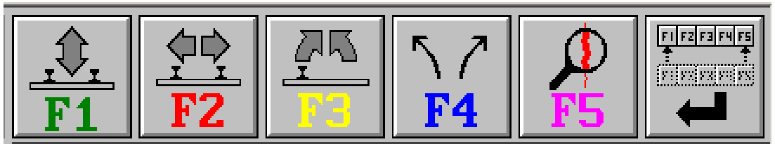
Fig. 2: *Machine With Optional Surfacing Fitting Software*

Second Expanded Track View Toolbar Set




Second Expanded Track View Toolbar Set
F1
F2
F3
F4
F5
ENTER Key = Next
F1
F2
F3
F4
Reference Change Panel:
F1 = Line Reference LEFT
F2 = Line Reference RIGHT
F3 = Surface Reference Auto Select
F4 = Surface Reference Centerline
F5 = Liner Buggy Bias OFF
F1
F2
F3
Work Start/Stop Panel:
F1 = Ramp In; New Location;
F2 = Resume Previous Work;
F3 = Ramp Out
0
0
0
0
0
0
0°00'
F3
F4
ESC

The Second Toolbar Set - *Expanded Track View*

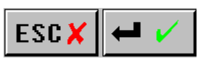


Track Recording Toolbar Set

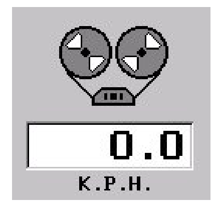
This is the second toolbar button set for the Expanded Track View. Prior to recording track (using the F1 key), it may be necessary to turn on/off one or both of the projectors, to change the lining system reference or select one of the F5 Work-Start/Stop Panel Options. For this reason, F2, F3 and F4 are identical to buttons on the Work Screen first toolbar button set and have been duplicated here for convenience.

<u>F1 – Start /Stop Track Record Mode and Recording Toolbar Button Set</u>

Pressing the F1 button on the second toolbar button set pops out the ESC/ENTER panel.



ENTER will place the machine in record mode. The recorder icon will appear and the reels of the icon will begin to rotate when the projector beam begins hunting successfully. The operator can make a recording in work and then return to the starting point in the travel mode. ESC will return to the toolbar set. While in record mode, the toolbar button set will change to the track recording toolbar button set. This second toolbar set will remain selected instead of returning to the primary toolbar set after a time-out. As the machine is moved forward, measured values for the track will be plotted. To end record mode, press F1, then the ENTER key. Pressing ESC will return to the record mode.

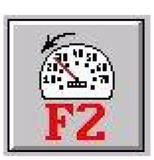


When recording is complete, a best fit will be automatically performed for all recorded data according to default values, *see page 3-86.* The graph change procedures described earlier (first expanded track view toolbar set) provide for ways of changing the fits or the results of fits. The remaining buttons on the record mode toolbar will now be described

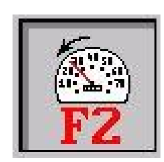
NOTE: *When F1 Track Record is selected and started, all the previous data is cleared and the starting footage is set to zero. Therefore, a F2 Wipe is not needed before the start of a recording.*

When recording a curve, it is recommended that the starting location (tie) be marked. Marking a tie at the starting location has several benefits; (1) Curves can be recorded, then worked later. (2) With a marked tie the distance wheel encoder can be checked for proper operation. After recording a curve, the distance footage should always return to zero feet when traveling to the starting location (marked tie) in work mode. (3) Marking a starting location allows for multiple recordings.

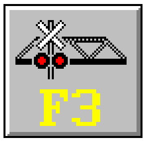
F2 – Slow Record Speed



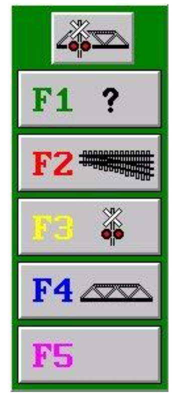
Pressing F2 during record will turn on or off the P2 pump to reduce recording speed. When speed is reduced, the button will appear depressed as shown to the right. A reduced recording speed is required for recording.



F3 – Start/Stop Fixed Point



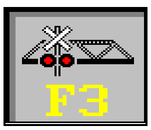
Pressing the F3 button while recording will open a menu of track features as follows:



- F1 - Start a GENERAL PURPOSE fixed point
- F2 - Start a SWITCH or turnout
- F3 - Start a ROAD CROSSING
- F4 - Start a BRIDGE
- F5 - *Currently Unavailable*

F2, F3 and F4 - Feature Marking - Start Feature

When the shadowboard reaches a location to be marked as the start of a feature, use one of these function buttons to mark the beginning of a track feature or fixed point, F2 for a switch, F3 for road crossings and F4 bridges. After a feature has been selected, the track feature menu will "pop off" and the Feature Marking toolbar button will remain depressed as shown.



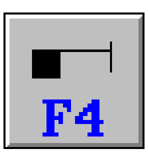
To end the feature, press the F3 button. The Feature Marking toolbar button will return to the normal (un-depressed) state to confirm the feature being marked is terminated.

Track features marked in this way are initially assumed to be fixed (not to be lined, lifted or moved). If it is desired to mark a feature for reference purposes only, (for example, a ballast topped bridge) the manual entry table for track features can be used to unlock (or lock) track features to modify their "fixed" status.

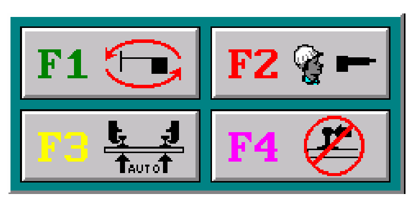
F1- Feature Marking - Other Features

The FIRST key on the feature marking menu is for general purposes (generic) and can be used to mark any track feature and works the same way as the other buttons on this panel.

F4 – Change Liner Reference While Recording



The F4 record mode toolbar button changes the lining system reference to enable the recording of reverse curves. When F4 is pressed while recording, the reference rail panel will pop out, the lining system actuator will stop hunting and the lining projector will turn off. The lining reference can now be changed and the buggies will bias to the selected side.

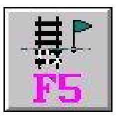


The operator should move the projector and receiver to the opposite side, and then move the machine backwards and forwards by a few feet to ensure the buggies reference properly against the opposite rail. After pressing the ENTER key to accept the new reference, the operator should wait until hunting of the lining reference beam resumes on the new side.

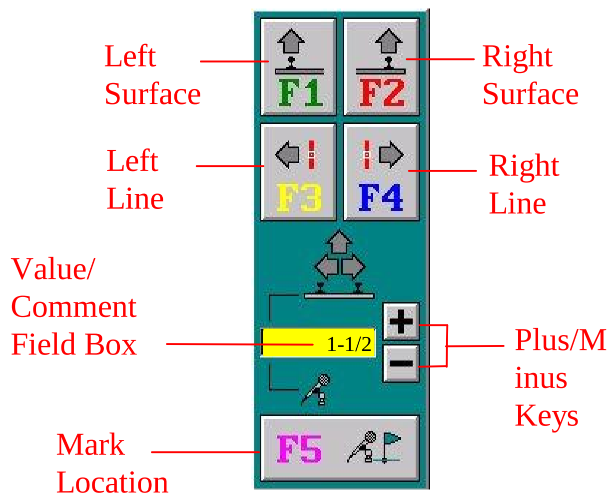
If the machine has the dual reference option, the operator only needs to move the machine backwards and forwards a few feet in order for the buggies to register properly on the new bias rail before pressing ENTER. As soon as hunting of the lining reference resumes on the new side, recording can re-start.

The bias will be released when F4 button is pressed. Bias will automatically be restored when this panel is closed, if the lining system is on. One purpose for F4 is to re-rail a derailed buggy when plotting.

F5 – Mark Location



Pressing the F5 key opens the Event Marker Panel shown at right.



Event Marker Panel

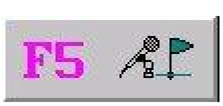
To enter design lift and/or line throws information using automatic feature marking:

1. Enter the known correction value into the Value/Comment Field Box by using the Plus/Minus keys or keyboard.
2. Press the F2 key to save the new value. (Right Surface in this case) See note below.
3. Move the machine to the next stake (point).
4. Repeat steps 1 through 3 until all known values have been entered.

NOTE: The F2 key saves the entered *right* surface value. If a different surface or liner reference is being used, press the appropriate key (F1, F3 or F4) to save the value. ***Do not press ENTER until all known values have been entered using the steps 1 through 4 (above). Pressing the ENTER key prematurely will cancel the automatic feature marking process.***

Mark Location and Value/Comment Field Box

The F5 key can be used for two purposes:



- To mark a location
- To allow the operator to enter a comment in the Value/Comment Field Box.

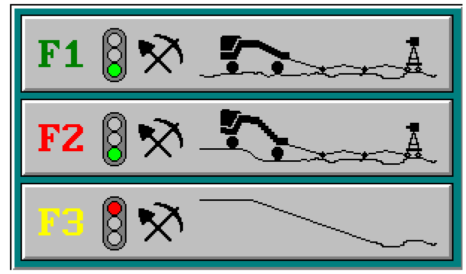
During recording, pressing the F5 key will mark the track graph with a cyan line (light blue) and the appropriate footage. When this key is used to mark tangent points or similar locations indicating design geometry, the horizontal lines make excellent reference grids for rubber banding the best fit to align with the marked locations.

> **NOTE:** *If the value you entered prior to pressing the F1 or F2 is not a proper number, (example: using an "L" instead of the digit "1"), pressing F1 or F2 will result in a beep and your entry will be discarded.*

Entering design line information at each station ensures that each throw will be applied at the correct location. This is the preferred method of entering throws information. Although it is acceptable to enter the throws information after recording by means of the throws panel, it is **not recommend** due to the fact that entering data in such a manner increases the possibility of making mistakes such as leaving out stations etc.

NOTE: Design throws data entered by using the throws panel can be modified after the recording is complete by using the throws rubber band panel. *Note that the design throws entries are not cleared when refitting a curve.* Instead they remain in memory and are applied after the curve is fit to insure correct movements at each stake. The only method of permanently deleting recorded throws is to use the F4 key on the throws rubber band panel and erase every point before pressing ENTER.

<u>F5 - Work Start/Stop/Resume Panel</u>



Pressing F5 on the third toolbar button set opens the Work Start/Stop/Resume panel. This button is duplicated on the third main toolbar set. This panel is used to: ramp-in at a new location (F1), resume work previously interrupted by a ramp-out (F2) and ramp-out and save values (F3).

F1 "Finding the Lights" or Ramp-in at new location.

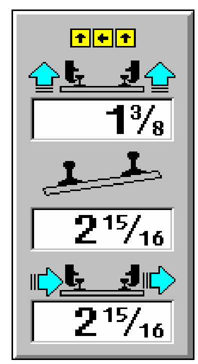
F2 Resume Work; When F2 is pressed the resume work panel pops out.

F3 Run-out or Ramp-Out of Surface and/or Line.

NOTE: Before selecting this function, ensure that the machine buggies are properly setup, the proper number of buggies are selected, the proper lining reference is selected and desired projector(s) is on.

The keys on this panel are used as follows:

F1 "Finding the Lights": This procedure applies to unrecorded track.



"Find the Light"

When starting at a new location (unrecorded track) use the F2 Wipe button (third toolbar set) to clear all previous track data and set the starting footage to zero. If superelevation or curvature is not zero for the track to be tamped, then use the manual change procedures to set the proper superelevation or curvature. The surface lift will automatically ramp to the lift default value. If the default value for lift is not the desired lift then use the surface lift change panel to enter the appropriate lift before using "finding the lights." (See NOTE on Setting Manual Lift). When F1 "finding the lights" (zero setup) is selected, the dialog information panel will appear showing lift, superelevation and line at the shadowboard. These numbers are determined from the current beam position and the inclinometer reading. If the values displayed on this panel are large, it may be desirable to move the machine slightly (if possible), but NOT more than five feet in either direction (zero feet), before pressing ENTER.

When the ENTER key is pressed, hunting of the beam will stop and the actuators will be positioned at the point of cutoff. Point of cutoff sets control points so that the first tie to be tamped will not be lifted, lined or changed in superelevation. Surfacing and lining will automatically ramp at preset rates to the desired values. For example, if no manual changes were made the superelevation would automatically ramp to zero and line would automatically ramp to the established liner zero and surface would automatically ramp to the default lift value.

If ESC is pressed, the procedure will be aborted and the actuators will be returned to their original positions.

NOTE: Setting Manual Lift The procedure for entering a manual lift is as follows: After an F2 wipe, open the surface lift change panel. Press either the up or down arrow key on the operator's R/H keypad only once. This will install a control point at zero feet and the desired lift will be zero. To increase the lift press the left arrow key or use the right arrow key to decrease the lift. Press the ENTER key after the appropriate surface lift is set. This accepts the changes and pops off the surface lift change panel.

Default Values for Surface Lift The surface lift default value is the upper lift value in the Defaults Table Panel (F5 on the third expanded view toolbar button set). If no lift is set, then this value is used to set the desired surface lift at the end of a ramp-in. In this instance the default lift is 1 inch and the ramp rate is 80 feet.

Using the "Finding the Light" procedure when surface and line is previously recorded.

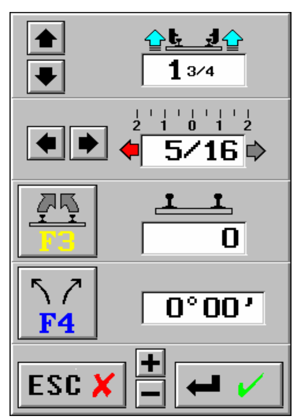
When recording track with the surfacing system on and the machine has surface fit software, the recording will contain a plot of both surface rails. After the recording is complete, System V will automatically best fit the surface and line. The surface fit will normally have control points at each location of maximum and minimum lift.

The best fit automatically sets a starting lift, this lift is usually close to the "finding the lights" position. Using F1 "Finding the Light" is recommended before starting to tamp recorded track. When F1 "finding the lights" (zero setup) is selected, the dialog information panel will appear showing lift, superelevation and line at the shadowboard. When the ENTER key is pressed, hunting of the beams will stop, the actuators will be positioned at the point of cutoff and the yellow fit line is ramped to the appropriate best fit lift.

NOTE: With best fit of surface, the F1 "Finding the Light" can be used at any starting location of recorded track.

If ESC is pressed, the procedure will be aborted and the actuators will be returned to their original positions.

F2 "Resume Work". The Resume Work panel will open using the values that were stored by the F3 key of the work start/stop panel thereby giving the opportunity to inspect, retain or change the display values before they are applied. If values were not stored using the Work Start/Stop Panel this panel, the Resume Work Panel, allows you to re-enter this data manually before pressing ENTER to resume work.



Resume Work Panel

NOTE: Any adjustment made to surface, throws (line shift) or line is an "A" point adjustment.

Use the up/down cursor keys to change the lift (if necessary).

Use the left/right cursor keys to change the shift (if necessary).

The F3 and F4 keys can be used to select superelevation and curvature for modification prior to resuming work.

F3 Begin a run-out at this location. When this button is pushed, the current values of lift (and line shift) will be memorized for future reference. A surface ramp-out will be visible in the surface trace panel. The default rate of change for surface is used. If desired, use the surface rubber band panel to change the length of the ramp-out before continuing. Manual changes to both lift and line can, of course, continue to be made while the ramp-out is in progress.

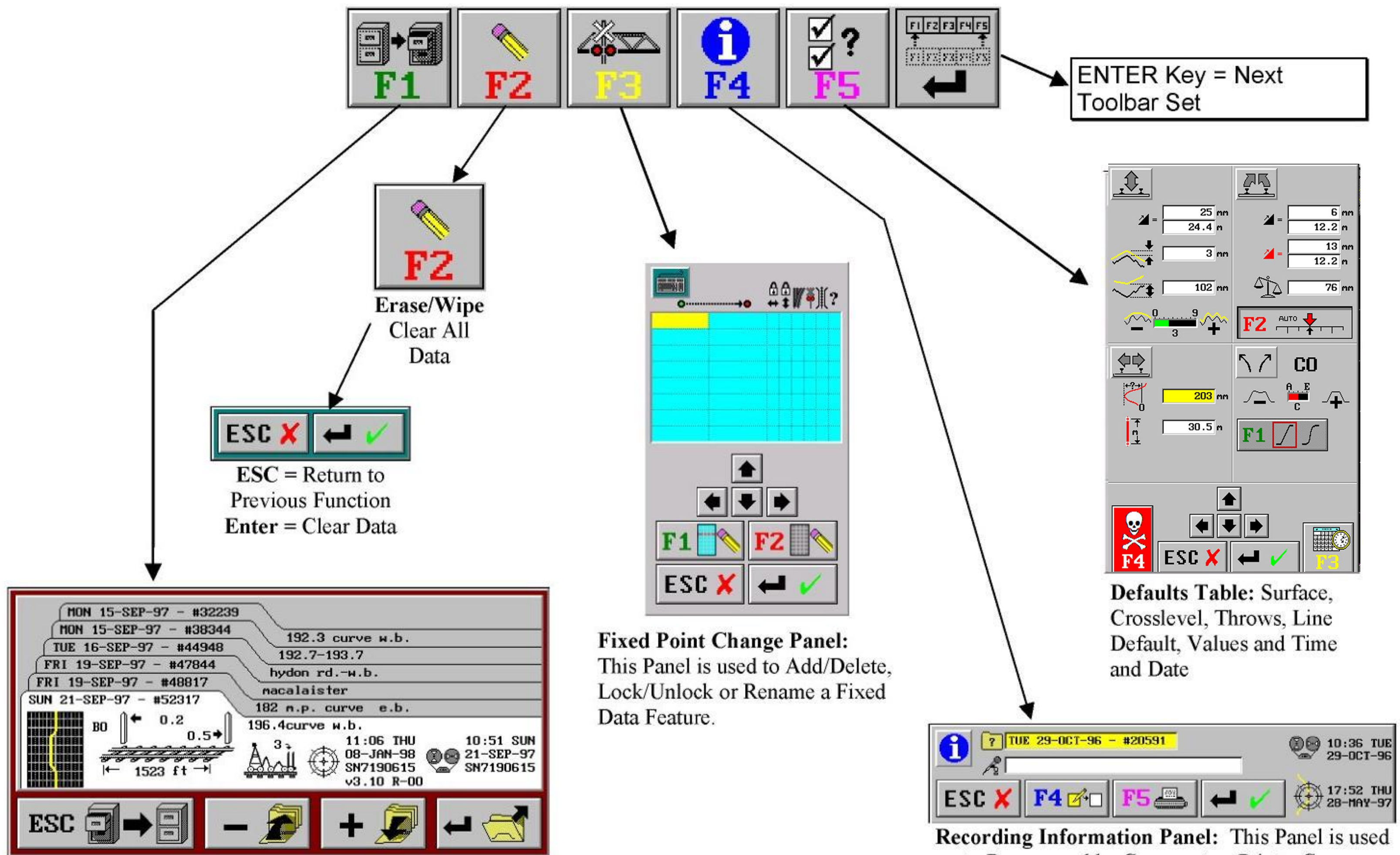
Using the F2 - Wipe Button (third toolbar), or F1- Record Button (second toolbar) will not cause the memorized values at the start of a run-out to be lost.

An example is where tangent track is being tamped as the machine approaches an unrecorded curve which also needs to be tamped and lined. The procedure would be as follows:

- At a suitable point to begin recording the curve, stop tamping and press the F3 button on the above panel. It doesn't matter that no run-out is to be performed, the F3 key is just being used to save the current value of lift and shift.
- Record the curve in the usual way.
- Return to zero feet and press the F2 button on the Work Start/Stop/Resume Panel. This will restore the lift that was in use before recording the curve.
- Resume tamping.

NOTE: If you forget to use the F3 button to perform a run-out (done manually instead), the values in the F2 resume panel will be the values of the last run-out. The F2 values can be modified and when modifying, they are modified as an “A” point value. Also, F1 (find the lights) can be used a few feet prior to the start of the run-out to ramp the surface back to the original value.

Third Expanded Track View Toolbar Set



Erase/Wipe Clear All Data

ESC = Return to Previous Function
Enter = Clear Data

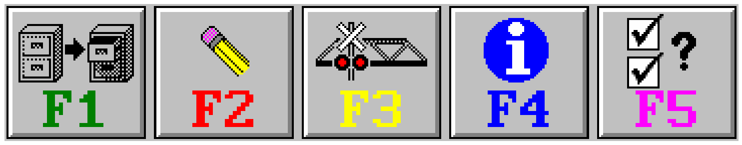
Track Recording File Panel: This Panel is used to Load Previous Recorded Curve Data Files.

Fixed Point Change Panel: This Panel is used to Add/Delete, Lock/Unlock or Rename a Fixed Data Feature.

Defaults Table: Surface, Crosslevel, Throws, Line Default, Values and Time and Date

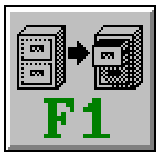
Recording Information Panel: This Panel is used to Rename, add a Comment or Print a Curve.

The Third Toolbar Set - *Expanded Track View*

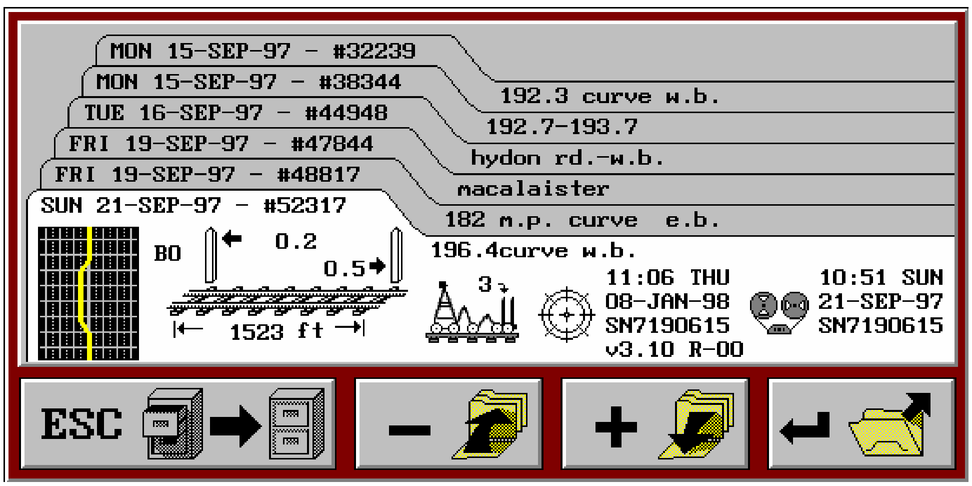


The third (and last) toolbar button set for the Expanded Track View provides ways of controlling and accessing information stored in the machines memory.

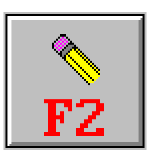
F1 - Track Recording File Panel



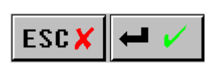
Pressing F1 on the third toolbar button set will open the Track Recording File Panel (file cabinet). This panel will open showing folders containing information about each track recording in memory. The most recent recording is at the front. If this is the one you want, simply press the ENTER key to recall this information into the Expanded Track View. Frequently the time and date the recording was made (or last changed) will be enough to identify the desired recording. Names, comments, location (mile post), length of recording or the "thumbnail" sketch of the recording curvature further assist in identifying previously stored information. Other details of the curve file can be seen, just to the top right of the thumbnail is the fit style and sensitivity used to fit this curve (B0 in this example above), number of buggies used and the version and release of the software that generated the fit. Use the plus/minus keys until the desired recording is on the front folder and press the ENTER key. Pressing the ESC key will close this panel *without* recalling information from memory.



F2 - Erase/Wipe Track Button



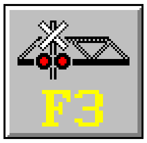
Pressing F2 on the third toolbar button set will pop out the ESC/ENTER key. ENTER will clear the recording that can be seen in the Expanded Track View. The yellow fit lines and red throws line will default to straight lines on zero. Clearing the Expanded track view in this way may be needed when preparing to tamp track that has not been recorded. It is not necessary to do this prior to starting a new recording. ESC will back out of the F2 function and return to the previous function.



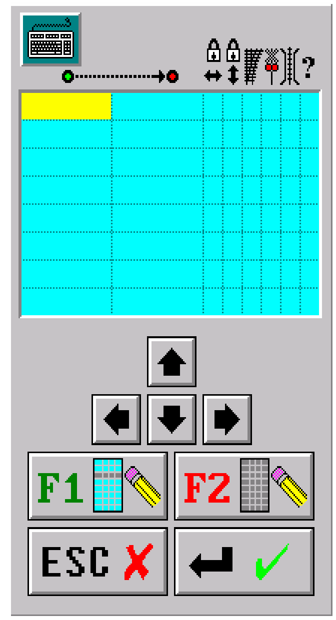
Note that when a recording is cleared in this way it is *not* deleted from the machines memory. It will still be possible to "reload" the cleared recording at a later time if desired.

F3 - Feature Marking - Table Entries

Pressing the F3 button in the third toolbar button set will open the following manual entry table for track features or fixed points.



The first two columns on this table are the locations for the start and end of each feature. The remaining columns indicate the locked/unlocked status and type of each feature. Using the plus (+) key locks a fixed feature and using the minus (-) key, unlocks a feature. When a feature is locked, it is assumed that the track cannot or should not be moved. When a feature is unlocked, it is shown for reference purposes only and will have no impact on the operation of the machine through the feature (ballast decked bridges for example).



When this table panel opens, it will already contain all pre-existing track features (if any). On this screen, using the arrow keys on the right keypad (or computer keyboard) moves cell selection in the direction of the arrow. The number (if any) in the selected cell can then be changed or re-entered using either the computer keyboard or the plus/minus (+/-) keys on the right keypad. Page-up or page-down (or the corporal keys on the keypad) will jump through the available data a page at a time.

If you wish to add one or more fixed points, simply use the arrow keys until a blank row has been selected, then enter the start and stop for each new fixed point. Fixed points can be entered in any sequence, regardless of whether they are before or after fixed points already entered.

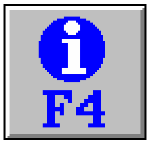
All points will be sorted in order of location before the fit is again displayed.

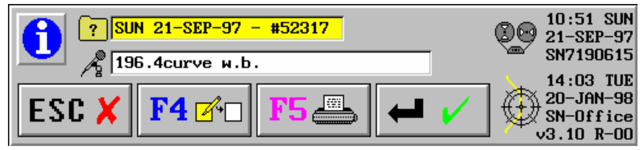
Pressing ENTER closes the panel and accepts all entries. Pressing ESC closes the table panel and discards any changes made using the panel. Changes made using the table can be viewed in the graphs.

Pressing the F1 button will delete the currently selected fixed point (with the yellow cell).
Pressing the F2 button will delete all fixed points.

WARNING: Any change on this panel will result in a new best fit of all graphs that would discard any manual changes made through rubber banding.

F4 - Recording Information Panel





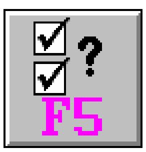
Pressing the F4 button in the third toolbar button set will open the Recording Information Panel. This panel is used to rename, add a comment or print the current curve data file.

The upper line can be used to rename the recording. The lower line can be used to enter a comment or any other relevant information. Information entered on this panel makes it easier to identify recordings in the machines memory. Although this feature is entirely optional, it is highly recommended that it be put to good use. At the top right side of the panel is the date and time the recording was first made. At the bottom right side of the panel is the date, time of any subsequent changes, software version and release number used to generate the fit. This panel can be used at any time that a recording is loaded.

Press F4 to move the highlight to the next box. Press the F5 button to print the recorded file loaded. Press ENTER to accept changes or Press ESC to discard changes.

F5 - Defaults Table Panel

Pressing the F5 button in the third toolbar button set will open the following panel of system defaults.

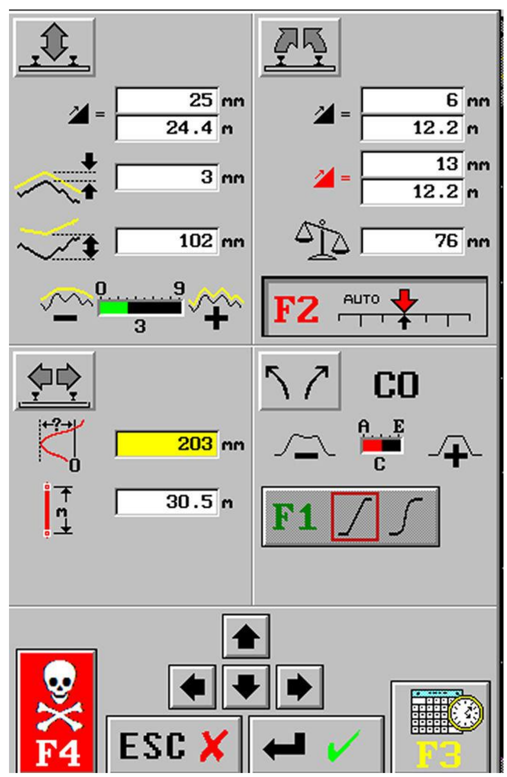


This panel displays a number of values and settings which are used as initial values when a new recording of track is created. Subsequent changes to the values for the recording or curve are kept with the recording and do not effect the values on this panel.

* Any changes to these fields or items will be applied to the current recording upon pressing ENTER. Changes to all other fields will not take effect until the start of the next recording.

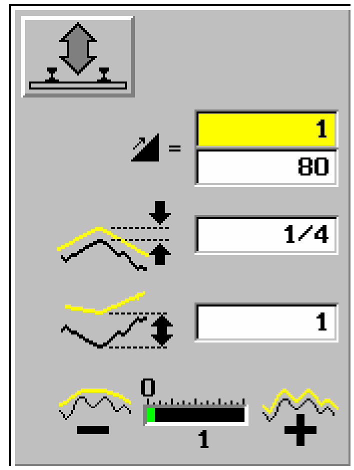
The panel is divided into four parts, namely surface, superelevation, throws and line. Use the arrow keys on the right keypad (or computer keyboard) to highlight the value to be changed (this is shown by changing the display with the value to a yellow color or by surrounding it with a red rectangle).

Pressing ENTER closes the panel and accepts all entries. Pressing ESC closes the panel and discards any changes made using the panel.



Defaults Table Pane

Lift Default Values

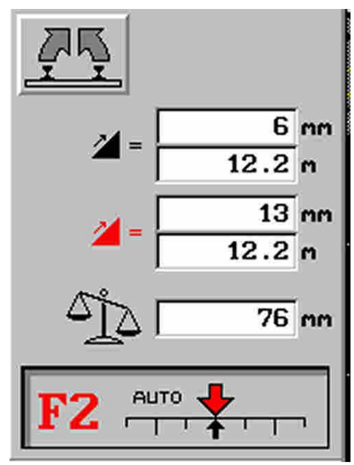


Lift Default Values

The upper number on this panel is the default lift. After “finding the lights”, if a surface lift was not set in the lift panel, (expanded view) a surface ramp up to the default lift value will automatically be constructed. For machines with surface fitting, this default lift value is used as the terminating lift at the end of a recording in case surfacing is to continue beyond the end of recording. The upper two numbers on this panel give the default work-in/work-out rate for surface in terms of inches/mm over a length in feet/meters (one inch (25 mm) per 80 feet (24 m) in the example). Changing either or both of these numbers will change this default rate.

The remaining three items on this panel are the minimum lift, maximum lift and fit sensitivity to be used when making an optional surface fit to recorded values for surface. Increasing surface fit sensitivity causes the yellow fit line to tend to follow actual rail surface profile and decrease the amount of ballast needed. Decreasing surface sensitivity tends to fill the "valleys" between high points and increase the amount of ballast needed.

Superelevation/Crosslevel Default Values



Superelevation Default Values

The upper two numbers on this panel give the default ramp rate for superelevation to be used for start of work and ramping into and out of fixed points. The second pair of numbers (adjacent to the red symbol) gives the maximum permissible rate of change for superelevation. Superelevation ramps that exceed this value will be brought to the operator’s attention by displaying the offending ramp rate on the superelevation rubber band panel in red.

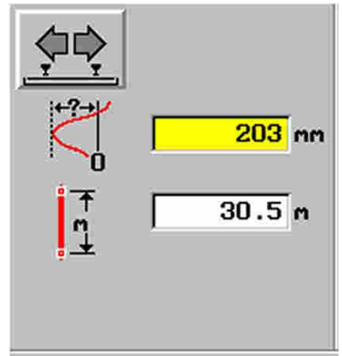
The last value is the unbalance value (in inches/mm of superelevation) which is used in combination with train speed to compute superelevation in curves. There are different formulas available to compute this relationship and the formula to be used must be specified by the railroad when a machine is ordered.

Use the F2 button to enable or disable Superelevation compensation. When enabled, this feature will automatically apply additional correction to the preexisting error in the *Superelevation/Crosslevel Change Panel*.

Pressing the F2 button turns off or on the default setting for Automatic Superelevation/Crosslevel Correction. When on, the button will be show as locked in a pressed position. Reference page 3-69 under the *Superelevation/Crosslevel Change Panel* heading for information on this feature

Throws Default Values

The upper number on this panel gives the default maximum throw that will result from applying a best fit. The lower number is the default distance between throws (monuments).

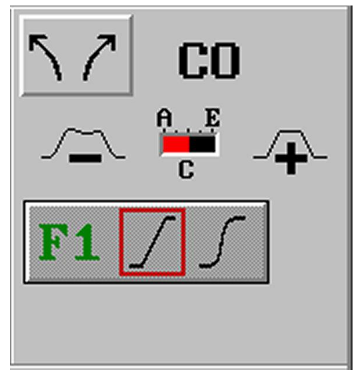


Throws Default Values

Line Default Values

This last panel provides a way of setting the default best fit style/method for a new recording.

- A = Average Fit,
- B = Smoothed Body (No Projector Correction)
- C = Smoothed Body (Corrects for Projector)
- D = Constant Body (No Projector Correction)
- E = Constant Body (Corrects for Projector)



Line Default Values

The slider controls the best fit style or method. When the slider is selected, it will be surrounded by a red rectangle. Use the plus/minus (+/-) keys to change the values.

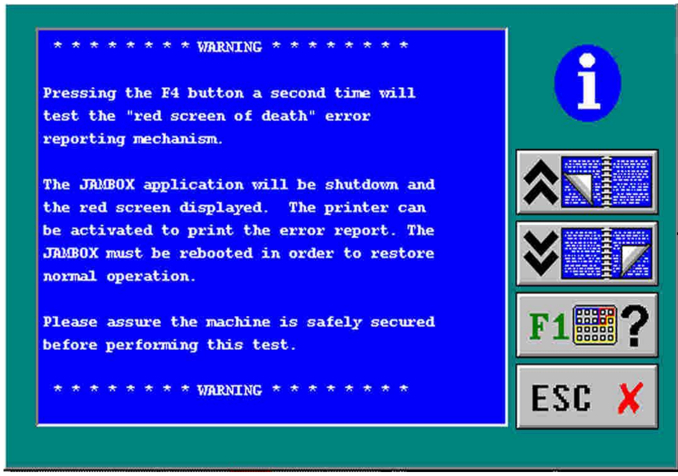
F1 and F2 keys indicate the type of spiral. F1 is for 3rd order or cubic spirals (which is standard and used on most low speed track). F2 is an option available for 5th order spirals (known as "S" curves) sometimes used on high-speed track. This selection sets the default value for next curve to be recorded. To change the current curve, set as desired and re-fit curve. Default and standard is F1.

NOTE: The default best-fit sensitivity is always zero and can no longer be set from this panel. Changes to the best fit style default only apply to the next recorded curve. Smoothed Body C is the Factory Default.

The F4 button tests the red screen error reporting mechanism and sends software release information to the printer. Note that pressing this button will cause the main computer to shutdown (putting machine into Fallback operation) and it will have to be rebooted to resume normal operation.

Pressing the F4 button once will bring up the Warning Screen shown on the next page. Pressing the button a second time will activate the "Red Screen Test "reporting feature. If this occurs, the JAMBOX applications will shutdown and a red screen will be displayed also shown on the next page. **Make sure that the machine is safe and secured BEFORE performing this test. The printer can be activated however to print the error report.**

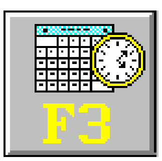
NOTE: To restore normal operations, the JAMBOX MUST be rebooted.



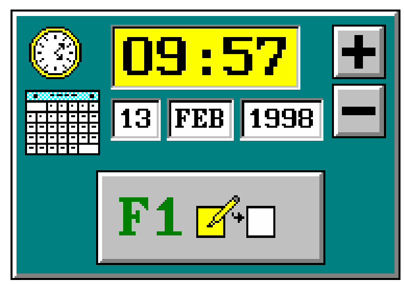
Warning Screen

Red Screen

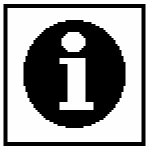
Time and Date



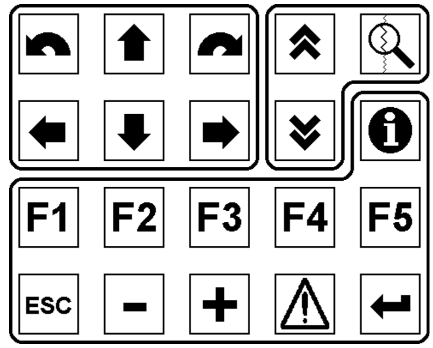
Pressing the F3 button on the Default Panel opens the Time and Date Panel. The hour field of the systems clock will be initially highlighted. Pressing the plus or minus key will change the hour by one digit for each press. If there are any other changes to be made, press F1 until the item you wish to modify is colored yellow. Use the plus or minus key to change the item. Continue until all items on this panel are correct. Pressing ENTER closes the panel and accepts all entries. Pressing ESC closes this panel and discards any changes made.



HELP INFORMATION

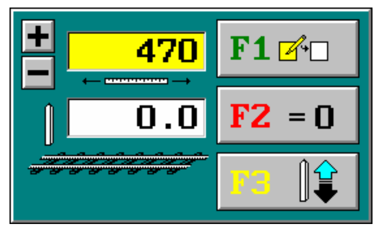


One of the most important keys on this keypad is the help key, which is in the right column of keys, second from the top (with the international "**i**" symbol for information). Regardless of the panel, menu or dialog box that is open at the time, pressing this key will give you help information relevant to the situation.



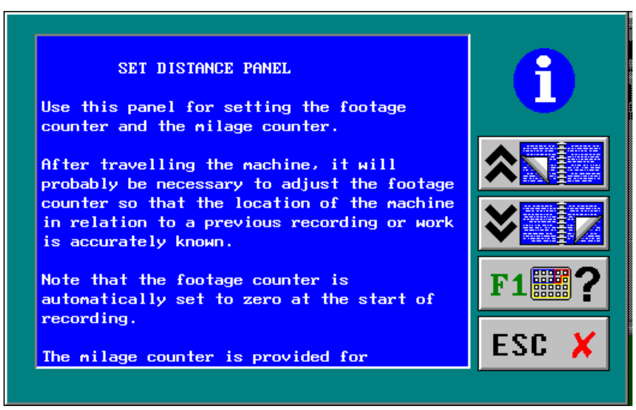
Many of the keys on the right keypad appear similar to keys on the PC keyboard (F1 through F5, ESC, ENTER and so on). A feature of System V is that almost all of the keys on the right keypad have a counterpart on the PC keyboard and either may be used for convenience.

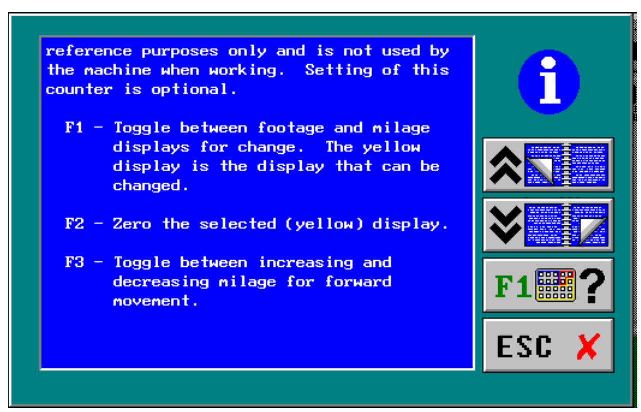
EXAMPLE:
From the work screen, pressing F1 pops out the Distance menu.



Pressing the Help key, pops out the Help screen. Note there are two pages to this help screen. Use the corporal keys to page up or down.

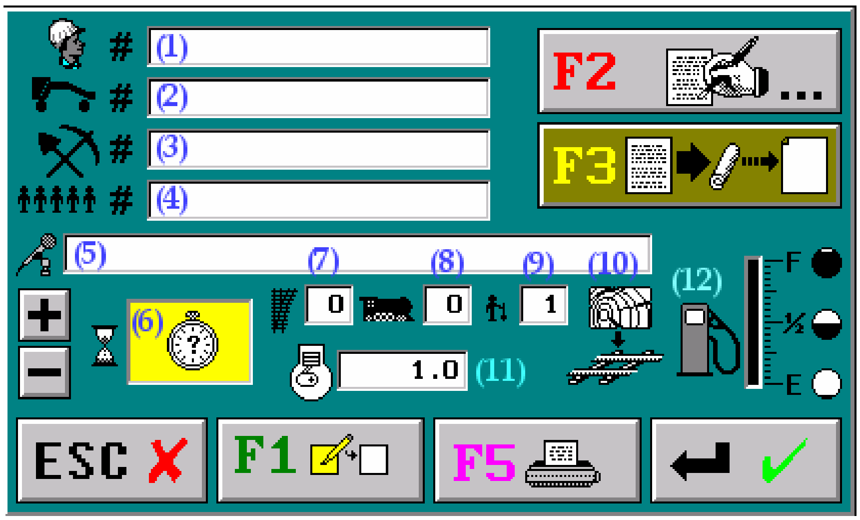
Help screen F1 places the help system in push button/joystick help mode. While in this mode, using any push button or joystick will result in the relevant help information being displayed. Any key or joystick on either panel can be used in this mode without initiating the associated function (outputs disabled) until the mode is terminated by holding down the ESC key for more than one second.





Production Reporting (OPTION)

The Production Reporting option for the MK VI provides comprehensive and detailed reports on the work completed by the machine. To test whether your machine is equipped with this option, press the spacebar on the PC keyboard. If there is no response, your machine does not have this option.



The production report view has twelve different fields (elements), these fields are listed below. The F2, F3, ESC, F1, F5, ENTER and Plus/Minus Keys are explained in the following text.

1. Operator I D Number or Name, etc.. Up to 20 characters may be typed into this field.
2. Machine I D or Serial Number or Name, etc.. Up to 20 characters may be typed into this field.
3. Work Order Number or Name, etc.. Up to 20 characters may be typed into this field.
4. Gang I D Number or Name, etc.. Up to 20 characters may be typed into this field.
5. Comment. Up to 35 characters may be typed into this field.
6. Present type of Delay, Work or Travel Mode.
7. Number of Switch(s) Worked (0-99).
8. Number of Train(s) causing a delay (0-99). See note.
9. Manpower or Personnel in gang (0-99). See note.
10. Tie type: Wood, Concrete or Steel.
11. Engine Hours. Set at the start and end of a production period (day).
12. Fuel Level. Set at the start and end of a production period (day).

NOTE: After working a switch or clearing a train, change the appropriate field number to 1, then press ENTER. After working a second switch or clearing a train second, change the field number to 2, then press ENTER, etc. or when ending a report enter the total number of switches worked or trains causing a delay.

The Manual Entry Screen

A machine equipped with production reporting is continuously recording all relevant information automatically at all times. In addition, the operator can manually enter information by pressing the spacebar on the PC keyboard, which opens the production report screen.

It is important to note that this screen can be opened at any time during the course of the day's production to manually enter information such as a comment, a change in the type of tie being tamped, to note a fuel level, and so on. When the ENTER key is pressed, any change to any of the information on this screen will be entered into the data. When the ESC key is pressed, No changes are saved. In general, the information on this screen should be used to indicate the CURRENT status of the machine. Ideally, changes should be entered as they happen.

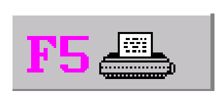
Use the F1 button to shift the highlight field to each entry that is to be changed. For text entries (such as operator ID, comment), use the keyboard to type out the appropriate information. For all other entries, use the plus (+) and minus (-) keys to change them (production mode, tie type etc.).

The F2 key opens another panel so that additional entries can be made if a custom report package is installed on the machine.

Reports are normally based on calendar days. If it is desirable to split a day's production into separate reports (for example, if the machine is moved from one location to another), use the F3 key to indicate a new report is being started and the entries currently on the screen are to be used to start the new report. The new report is not actually started unless the F3 button on the screen is pressed in when the enter key is pressed. The F3 button on the screen will stay pressed until the F3 key is pressed again, allowing the operator to change his mind about starting another report.

A new report is automatically started whenever the computer has been turned off for longer than 8 hours or the computer has been running non-stop for more than 24 hours since the report was started.

Selecting and Making Reports

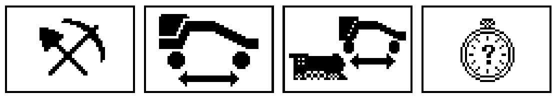


Pressing F5 on the Production Reporting Manual Entry panel will cause the following view to open: The time each new report was started is displayed in this view.
A snapshot of the current report is the first report that may be printed. A previous report can be selected by pressing the plus or minus key. The F5 key will commence printing the selected report and pops this view off the screen. Pressing the F5 key whenever it is already pressed in aborts any printing in progress.

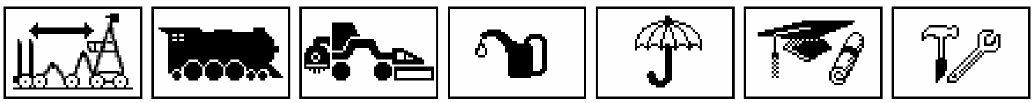
Production and Delay Modes

The production, travel, train-travel and "unknown delay" modes shown below (from left to right) are automatically selected by the computer. Production mode is set whenever the machine is cycling. The mode is automatically changed to "unknown delay" whenever cycling has ceased for more than a ten second grace period, unless tamping in switch mode, where a 90-second grace period is allowed.

The mode is changed to travel whenever the work mode switch is in the travel position, and it is changed to "unknown delay" when the work mode switch is in the work position. If the "train" mode (see modes below) is selected prior to switching the work mode switch to travel, however, then train-travel is chosen. When the work mode is switched back to the work position, train-travel mode is changed back to train mode. Train-travel mode can be used to log the time spent traveling to and from a siding to clear trains.

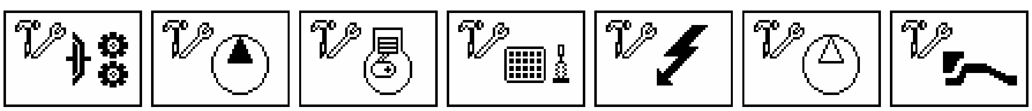


The modes shown below, from left to right, are setup, train, other maintenance-of-way, service, weather, training and general repairs delay modes. The operator can select any one of these modes to indicate the reasons for production delays.



Only the operator can change the mode into and out of training mode. The actual machine production, however, will continue to be accurately reported in the printed report regardless of training mode status. This feature allows the operator to attribute a slow production day to training time.

Additional repair modes are provided to further qualify time spent repairing the machine. These modes are drive-train assembly repair, hydraulic system repair, engine repair, operator console repair, electrical system repair, pneumatic system repair, and cab & frame assembly repair, shown from left to right below.



If a black-colored version of any of these icons is selected, this indicates that repairs are being performed on the machine, but the time spent repairing the machine is not impacting the railroad's ability to do work, such as the case when there is no available track time for working. If a red icon is chosen, however, the machine is considered down, where the time spent repairing the machine is keeping the machine from performing its regular work during available track time.

Chapter 4

This chapter is intended to illustrate how the HTT Delta surfacing and System V lining systems work. A Mark IV tamper is depicted in many of the figures, however the principles of operation are the same for the Mark VI.

DELTA LEVELING SYSTEM

Surfacing Track

Surfacing track is defined as the smoothing of the track structure both longitudinally as well as transversely.

The surfacing system currently used on the MK VI tamper is sometimes referred to as the "Delta" system. This system consists of 3 points that are directly referenced to the rails.

The 3 point surfacing system consists of:

1. Projector
2. Shadowboard
3. Receiver Group
    A. Photo-cells
    B. Inclinometer

During normal operation the projector emits an infrared light which spreads out, shines over the shadow board into both receivers. Refer to figure 4-1.

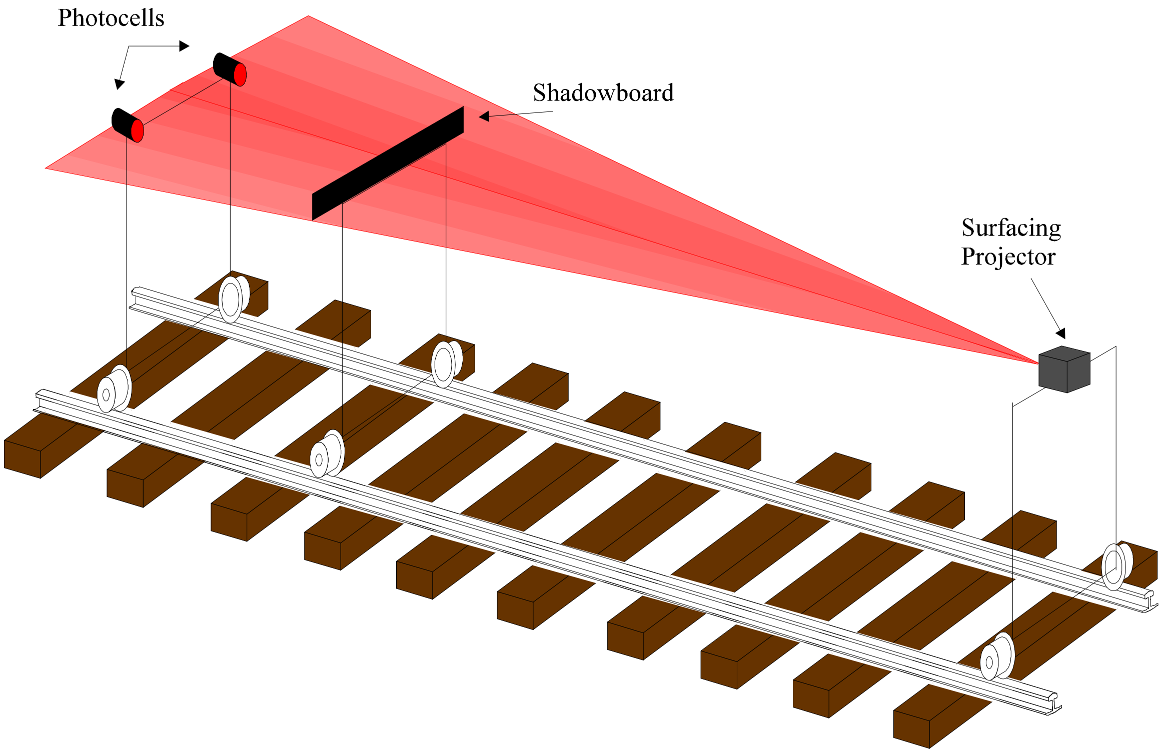


Figure 4-1

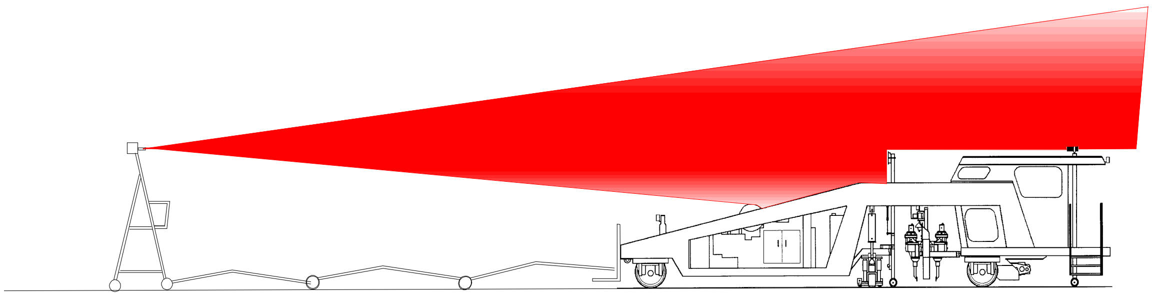


Figure 4-2

Theory of Operation

When the operator initiates cycle and the surfacing receivers “see” the light from the surface projector, the program enables the outputs which supply power to the jack valve coils. Jacking continues until the rising shadow board prevents the receivers from “seeing” the light beam. When the light beam is blocked, the program de-energizes the outputs to the jacking coil. (There are lights on the operator’s control panel that indicate when the left and right receivers are “seeing” the light from the projector. (See figure 4-6).

The total lift that is applied to the track is controlled by changing the receiver (photocell) height using a linear actuator. Receiver (Actuator) height can be changed manually by the operator using the lift up/down arrow push button on the operator R/H keypad. The height can also be controlled by the software during automatic ramping and with the “Surface Fit” option.

Projector

The projector is the device that produces the infrared beam and projects it back to the machine at a preset frequency. The voltage to the motors is set at 15 VDC which produces 482 (+ or - 5%) pulses per second. Refer to figure 4-2 and 4-3.

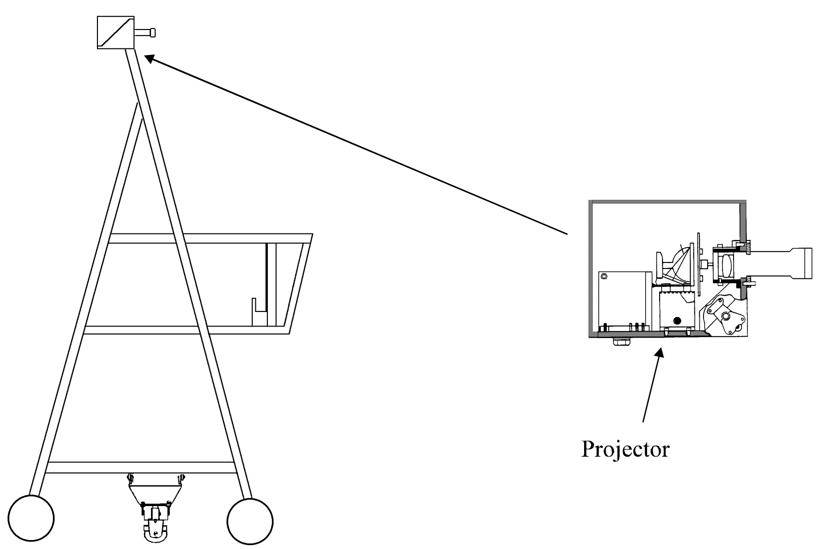


Figure 4-3

Shadowboard

The shadowboard blocks the light beam during the jacking cycle. It is at a fixed height (3607 mm for the Mark VI) and referenced directly to the rail just behind the clamp frame. Under normal operating conditions, the rail clamps lock on to the rail at which time jacking commences. The jacks lift the rail. The shadowboard also rises until the shadowboard intercepts the infrared light beam. At this point the jack valves would de-energize and jacking would cease. Refer to figure 4-2 and 4-4.

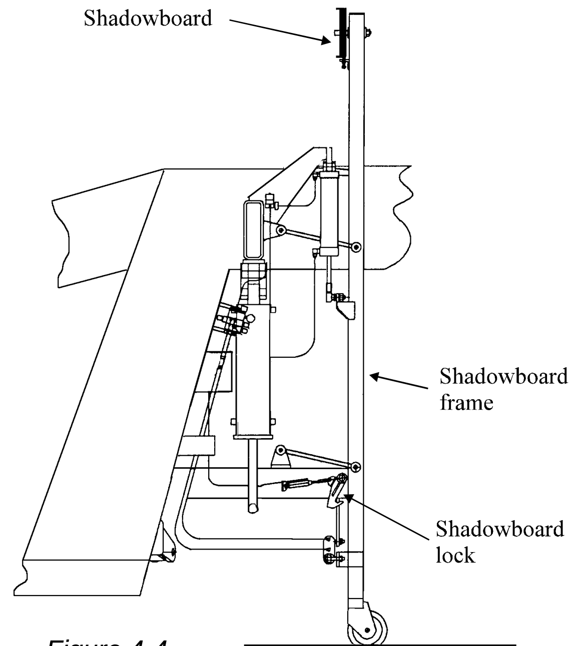


Figure 4-4

Receiver System

When the photocells see the light beam from the projector, they send an electrical signal to the computer through a Jupiter digital input module. Refer to figure 4-5.

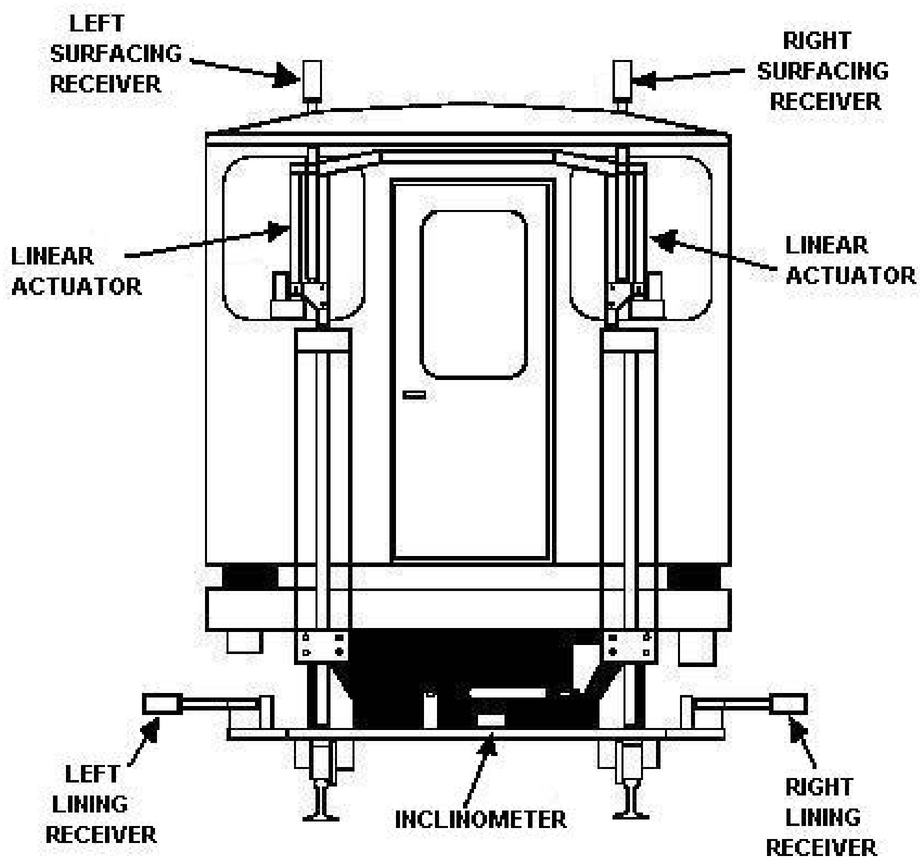


Figure 4-5

Surface Indicator Lights

There are two (2) surface indicator lights (red) located in the center of the main computer screen and on the center panel in front of the operator. Refer to figure 4-6. If the computer receives a signal from the receivers, the left and/or right surface indicator lights illuminate which indicates to the operator that jacking is occurring.

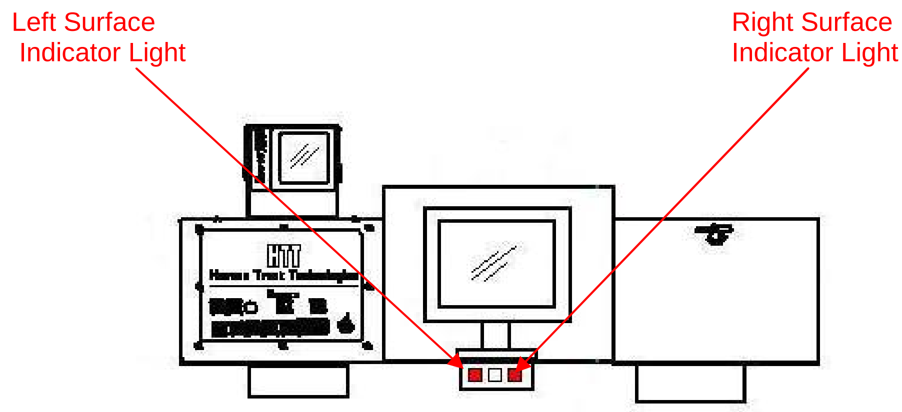


Figure 4-6

- If the lights are not illuminated, this indicates that the shadowboard has the beam light blocked, and jacking will not take place.
- If the left surface indicator is ON, the left rail will be lifted.
- If the right surface indicator is ON, the right rail will be lifted.

NOTE: It is important that both indicator lights be on before cycle is initiated so that both rails will be lifted. If only one (1) indicator is ON when cycle is initiated, only one (1) rail will be lift and the track will not be brought to the right crosslevel.

Inclinometer

System V uses an inclinometer to measure crosslevel. The inclinometer is mounted on the lower receiver buggy cross member. When crosslevel varies, the inclinometer output signal varies proportionally which tells the computer what the crosslevel is at the receiver buggy. The computer uses this information along with other inputs to properly position the receivers. Refer to figure 4-5.

Error Correction Ratio

The MK VI makes corrections to the track using an error correction ratio which is calculated by dividing the total length of the surfacing system (from projector to receivers) by the distance from the shadowboard to the receivers. Refer to figure 4-7.

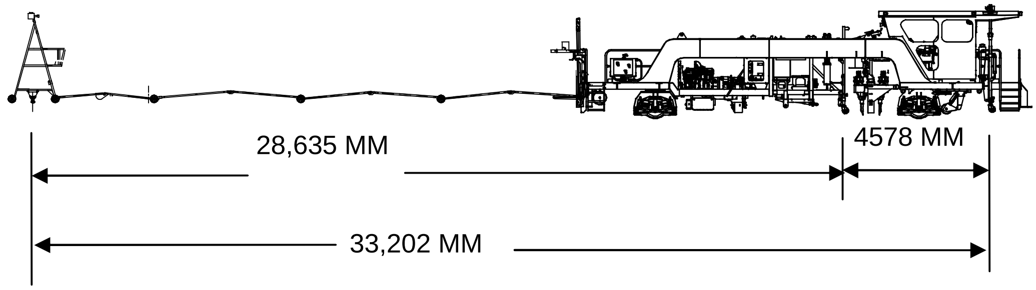


Figure 4-7
(*Shown with 3 Buggies deployed)*
Please note that dimensions used in the following scenario are for explanation purposes. Actual dimensions may vary base upon the number of buggies deployed and track conditions.

- Distance from projector buggy to receiver buggy = 33,213 mm
- Distance from receiver buggy to shadowboard = 4578 mm

The error correction ratio is 33,213 mm / 4578 mm = 7.2 mm

The correction ratio described above combined with the illustrations will help you to both visualize and understand how the correction ratio affects the track being lifted.

Scenario for removing a 44 mm dip.

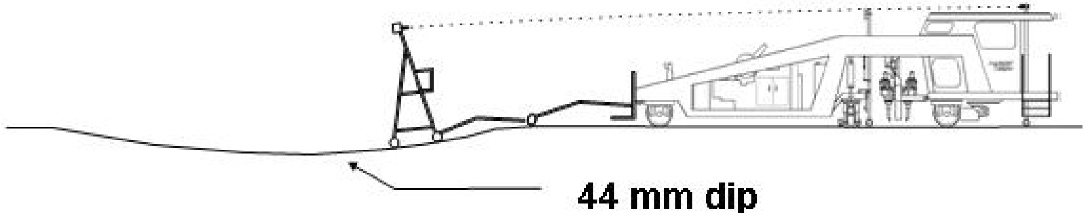


Figure 4-8

If the projector buggy were to move into a 44 mm dip, the track back at the machine would be affected by 6 mm. (44 / 7.2 = 6) Refer to figure 4-8 and 4-9.

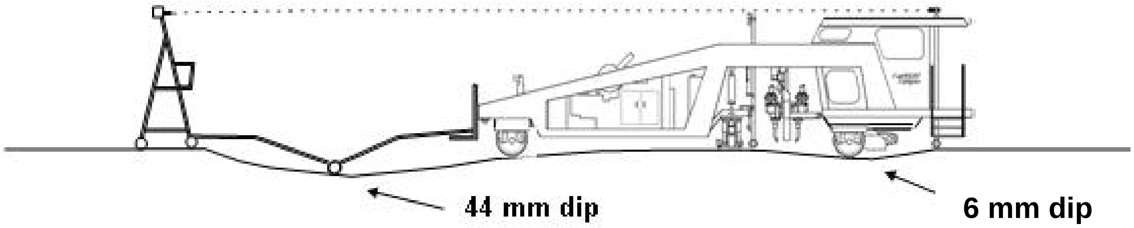


Figure 4-9

Once the shadowboard reached the 44 mm dip however, it would remove this error 100%. Refer to figure 4-10.

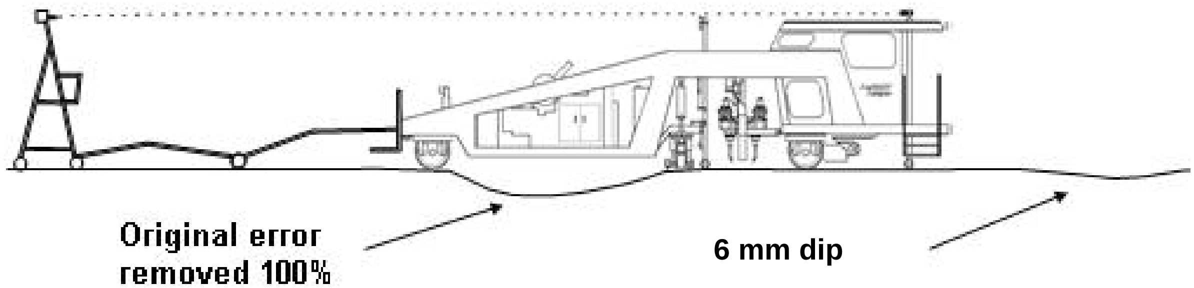


Figure 4-10

Therefore, what the machine has done is: removed the original 44 mm dip and transposed it to the shadowboard. In addition it has also reduced the dip to 7.2 mm error. Refer to figures 4-10 and 4-11.

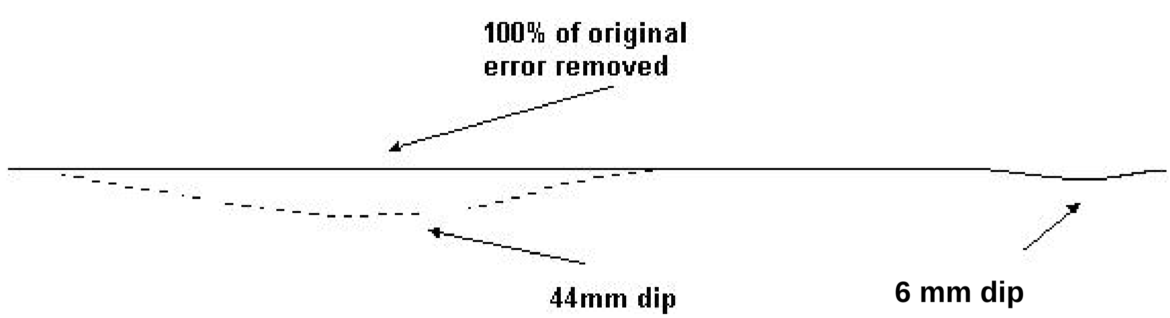


Figure 4-11

Surfacing capabilities

Lifting Track

The Delta system enables the surfacing machine to perform the following functions: out of face surfacing, spot surfacing, run in, run out, surfacing into fixed objects, surfacing away from fixed objects, etc.

- Quality surfacing requires that all track errors be removed.

- Quality surfacing can only be accomplished when the track has been lifted high enough.

How Much Lift?

The amount of lift applied to the track is very important to provide an acceptable surface. If the machine does NOT lift the track high enough to remove all of the errors, the surface will NOT be acceptable.

For example, assume the track is being lifted by 25 mm. Also, assume there are some 50 mm errors (high spots) in the track.

Because the track is NOT being lifted 50 mm to correct these high spots, there will be 25 mm errors left in the track after it has been surfaced. Refer to figure 4-12.

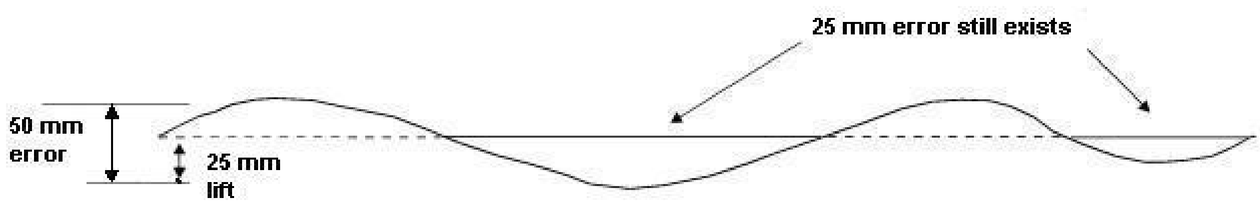


Figure 4-12

When you are surfacing track, you must make sure the track is lifted high enough to correct any high spots in the track.

Out of Face Surfacing vs Spot Surfacing

- Out of face surfacing means smoothing the track both longitudinally as well as transversely continuously over a given section of track, generally in access of 30 meters in length.

- Spot surfacing refers to the smoothing of short sections of track both longitudinally as well as transversely. These sections generally measure less than 30 meters in length.

Run-In or Run-Out

Run-in is the transition from existing track surface to surfaced track. Run-off is the transition from surfaced track to existing track surface. In general the same rules that apply to a run-in also apply to a run-out.

There are several factors that influence the length of the transition or run-in:

a) Amount of lift.
b) Train speed.
c) Run-up temporary or permanent.

- A **short run-out** serves slow speed traffic and for sections of track that will be reworked in the near future (temporary fixes).

- A **long run-out** serves high-speed traffic and is considered to be a permanent fix.

NOTE: The factory default for lift is 25 mm (1”) over a 24 m (80 feet) long ramp is considered a long run-in or out. 25 mm over 18 m (1” over 60 feet) is considered a medium run-in or out. 25 mm over 12 m (1” over 40 feet) is considered a short run-in or out.

The ramp rates should always be set to the acceptable value for the class track being worked. F5 Work Start/Stop/Resume Panel is normally used to create most ramps in or out. For a description see F5 work start/stop/resume panel starting at page 3-54 or 3-76. Automatic run-out ramps are always ramped from the present surface lift to 38 mm (1-1/2”) below zero lift.

The superelevation defaults should be set for the normal elevation ramp rate to be applied when “finding the lights” and the maximum elevation ramp rate warning when rubber banding. The F5 Defaults Table Panel is used to set the superelevation defaults (F5 is on the expanded track view, third toolbar set).

NOTE: The factory default for a normal elevation ramp rate is 6 mm over 12 m (¼” over 40 feet) and the maximum elevation warning ramp rate is 13 mm over 12 m (½” over 40 feet).

Calibrating and Setting Defaults for the Surfacing System.

Why Calibrate the Surface?

The surfacing system uses many components in the process of getting information from the track to the computer. These include mechanical components (actuator potentiometer, inclinometer), computer hardware (circuit boards, Jupiter modules), and the software (logic and defaults). Surface calibration is simple a means of adjusting the hardware and software so that the surface information is correctly applied to the track.

When setting up new machines or replacing a surface actuator, the surface system requires the actuator(s) be calibrated and new record zeros set. To calibrate an actuator see F1 - Actuator Calibration Menu (page 3-42) for a description of the calibration procedure (F1 is under F3 calibration menu, second main toolbar set). After the actuators are properly calibrated the surface record zeros will need to be set. To set new record zeros see F5 -

Record Zero Calibration Panel (3-48) for a description of the surface record zero procedure (F5 is under F3 calibration menu, second main toolbar set). Note the surface record zero process can be performed multiple times.

The surfacing system also requires that the inclinometer zero is properly set. To calibrate an inclinometer zero see F3 - Inclinometer Calibration Panel (page 3-46) for a description (F3 is under F3 calibrate menu, second main toolbar set).

The surface defaults should be set to the normal average lift and lift ramp rate for the type of track to be worked. The F5 Defaults Table Panel is used to set the surface defaults (F5 is on the expanded track view, third toolbar set page 3-83).

Select the machine options that apply to the type of track to be worked. F5 Change Options Panel is located on the first main toolbar set (page 3-23).

Example (1): Working tangent track with slight grades (small hills or valleys), a low lift and single tamping. Options that may be selected are Auto Traction with zero traction delay, Index Brake in Cycle (OFF), Clamp Pressure Sustain (ON or OFF), and Squeeze Waits On Lift (OFF).

Example (2) Working tangent track with steep grades (large hills or valleys), a medium to large lift and single tamping. Options that may be selected are Auto Traction with some traction delay, Index Brake in Cycle (ON), Clamp Pressure Sustain (ON or OFF), and Squeeze Waits On Lift (ON or OFF).

Lining System

Basic Explanation

The MK IV uses a three point lining system which utilizes the same principles of operation as the surfacing Delta system. The liner uses a modulated infra-red light in conjunction with a liner shadowboard and liner receiver.

Remember that when surfacing track with the Delta Leveling System, the track has only one way to move and that is an upward movement. In lining, all three points are lying over on their side and will allow the lining system to move the track and lining shadowboard in two directions, left or right. Refer to figure 4-21

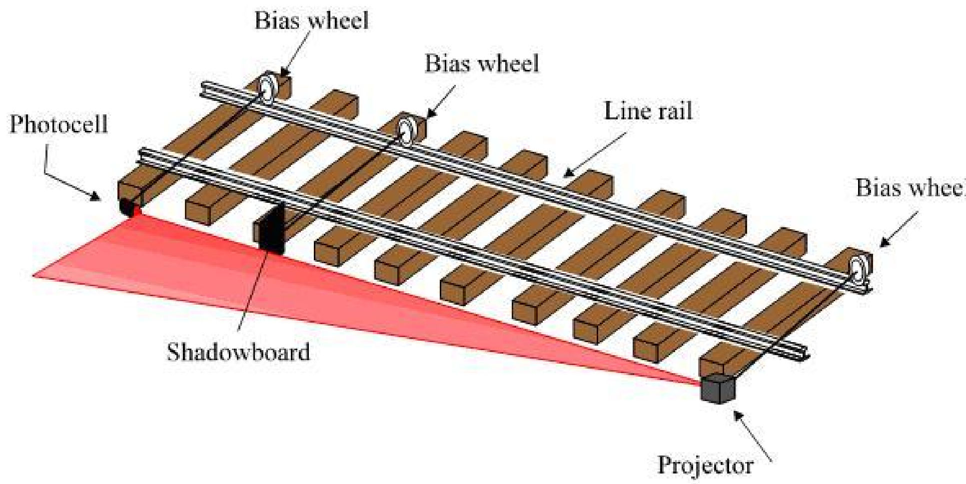


Figure 4-21

Each lining station must have its components installed on the same side of the machine. This means that in a curve the lining projector, shadowboard and receiver must be placed on the low rail of the curve. Each station's reference wheels must be biased against the high rail or Line Rail, so they cannot move away from it.

NOTE: The line rail will always be opposite to the side the components are installed on. The line rail will always be the high or outside rail in a curve.

Biasing Requirements

Each station; projector, shadowboard and receiver have a method of keeping the line rail reference wheels held tightly against the rail.

- Air cylinders are used to bias the shadowboard and receiver buggies.
- Springs are used to reference the front buggy lining components. Control Over Track Movement.

In surfacing track with the MK VI receiver height determines the amount of lift in one direction (up). The liner shadowboard likewise controls the amount of track movement, only now it is in two directions (left or right).

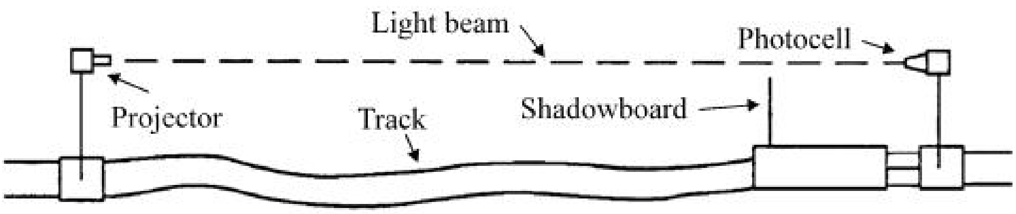


Figure 4-22

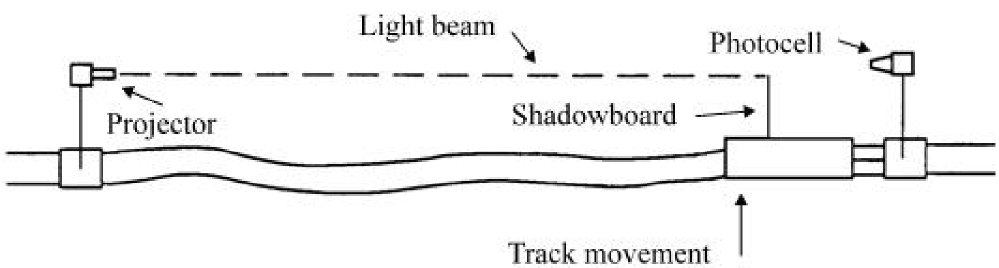


Figure 4-23

In the situation where the liner photocell can see the projector light when lining takes place, the track and liner shadowboard must be moved until the outside vertical edge of the shadowboard mask intercepts and blocks any further light being seen by the photocell. At this point lining stops. Refer to figure 4-22 and 4-23.

Located below the monitor, in front of the operator seat and on the main screen, is the liner indicator light. If the shadowboard is positioned so that the photocell can see the projector light beam, the light indicator will be on. Should the shadowboard not allow the photocell to see the projector light beam, the indicator light will be off. Refer to figure 4-24.

Liner Indicator Light
(middle light)

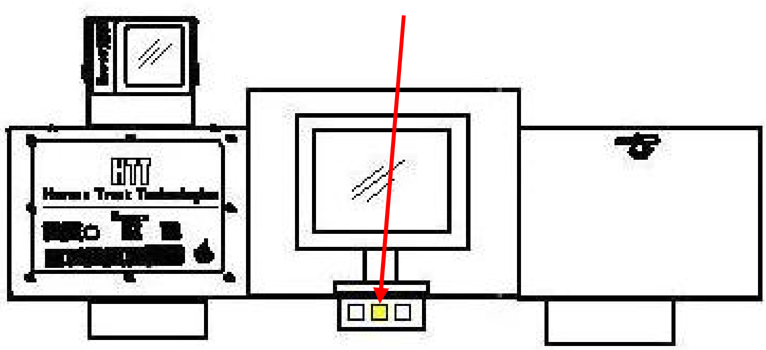


Figure 4-24

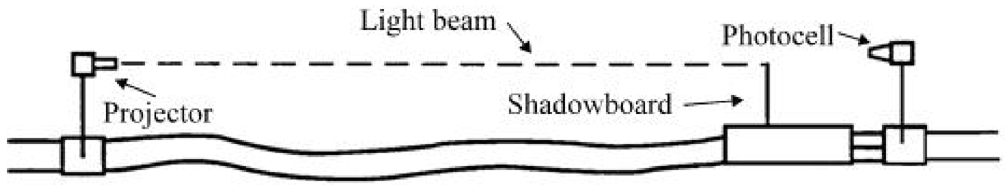


Figure 4-25

Figure 4-25 shows the shadowboard blocking the projector light from being seen by the receiver.

When lining takes place, the track and shadowboard must be moved to the left until the beam light comes on, (figure 4-26), then reverses direction moving the track and shadowboard to the right until cut off occurs. Figure 4-27.

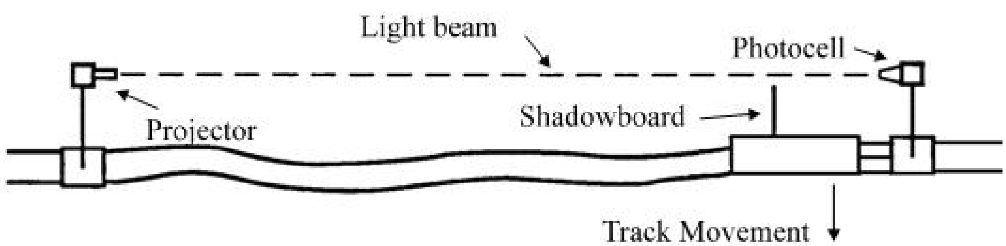


Figure 4-26

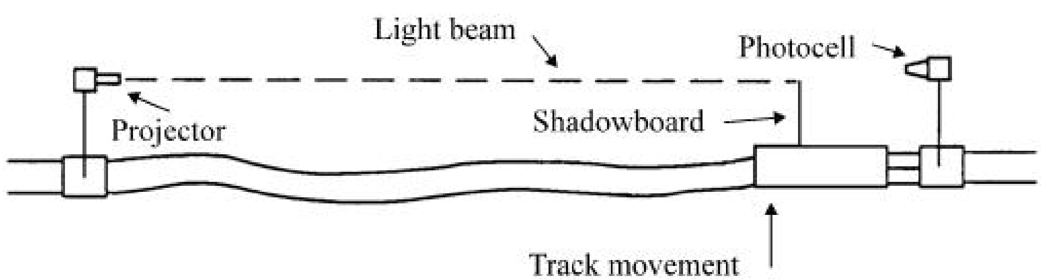


Figure 4-27

Refer to the examples in figure 4-27, the last movement the liner must do is to move the track and shadowboard in the same direction that the shadowboard is installed, always stopping on the outside vertical edge of the shadowboard.

Theory of Operation

When the operator initiates cycle with the F3 liner projector ON, the program enables the digital output modules which supplies power to the lining valve coils. **During cycle, if the lining shadowboard has the light beam blocked:** The program enables the appropriate lining coil and moves the track until the photocell sees the light beam. When the photocell sees the light beam the program disables the lining coil. The program then enables the other lining coil to reverse the lining direction until the light beam is blocked by the shadowboard.

When the beam is blocked, the Jupiter Control System turns off the line light beam indicator and this completes a lining cycle**. During cycle, if the photocell sees the light beam:** The program enables the appropriate lining coil and moves the track until the lining shadowboard blocks the light beam. When the light beam is blocked the Jupiter Control System is de-energized, turns off the line light beam indicator and this completes a lining cycle.

The track is controlled by changing the shadowboard linear actuator position. Actuator position can be changed manually by using the throws left or right arrow push button on the operator R/H keypad or automatically by the computer controlled best fit.

Calibrating and Setting Defaults for the Lining System.

Why Calibrate the Liner?

The liner uses many components in the process of getting information from the track to the computer. These include mechanical components (actuator potentiometer, inclinometer), computer hardware (circuit boards, etc.) and the program software (defaults). Liner calibration is simply a means of adjusting the hardware and software so that the lining information is correctly applied to the track.

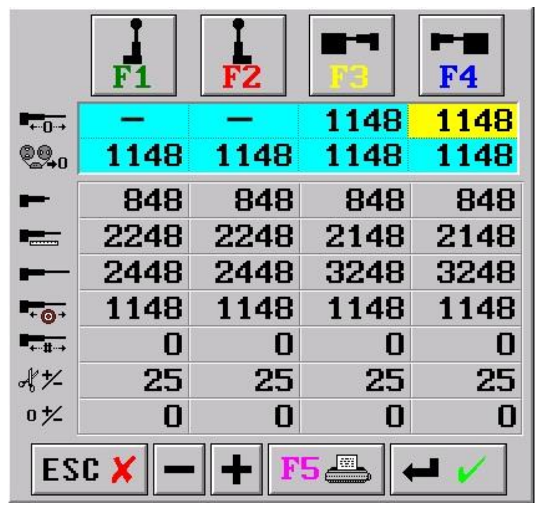


Illustration #1

When setting up new machines or replacing a L/H or R/H liner actuator, the liner system requires the actuator(s) be properly calibrated and the line record zero(s) be set. To calibrate either the L/H or R/H actuator see F1 - Actuator Calibration Menu (page 3-42) for a description of the calibration procedure (F1 is under F3 calibration menu, second main toolbar set). After the actuator(s) is properly calibrated the L/H or R/H line record zero will need to be set. To set a new record zero see F5 - Record Zero Calibration Panel (page 3-48) for a description of the L/H or R/H line record zero procedure (F5 is under F3 calibration menu, second main toolbar set).

NOTE: L/H or R/H line record zero process can be performed multiple times.

After the L/H or R/H actuator has been calibrated and the line record zero is set, the next step is to set the line zero for the track reference to be worked. Press F3 on the second main toolbar set to open the calibration menu. From the calibration menu select F2 Actuator Calibration Data Panel. After the data panel opens select the appropriate line zero (F3 or F4) for changing (F4 is selected in ***illustration #1***, for a complete description of this panel see page 3-41). The selected line zero will be highlighted in yellow. The record zero value that was previously established will be used to enter a new approximate (starting or rough) line zero. Use either the PC keyboard or the plus/minus key to enter or adjust the highlighted line zero value to the present record zero value plus 7 digits. The record zero value is displayed in light blue under the presently selected line zero value. ***In illustration #2*** the F4 right record zero value (light blue) is 1148 digits. When adding 7 digits to this value, the value to be entered in F4 right line zero (highlighted in yellow) is 1155 digits (1148 + 7 = 1155). When the number is entered correctly the line/record differential value (gray table, 0 +/- value) will be 7 digits. After the F4 line zero is correctly entered (value in yellow), press the ENTER key to accept the new line zero value (highlighted yellow box will change to light blue). Pressing ENTER a second time accepts all changes to the panel and closes this panel or ESC will discard all changes. The next step is to start lining a section of tangent track, position the machine on a minimum of 600 feet of tangent track, turn ON the lining and/or surfacing projector(s). Move the machine forward and or backward to insure the liner gauge wheels are biased properly. Clear all data from the main track graphs by using the F2 Erase/Wipe track button on the third main toolbar set. After the F2 wipe, the starting footage will be zero feet and all panel graph yellow fit lines will be on zero. Select the F5 Work Start/Stop/Resume Panel (see page 3-54) on the third main toolbar button set. This will open the work start/stop/resume panel, select F1 "finding the lights." When F1 is selected the actuator(s) moves to the photocell cutoff position and the actuator will hunt on the cutoff position. After about 5 to 10 seconds of hunting press the ENTER key to accept this starting position or the ESC discards this starting position. When Enter is selected the program will automatically establish a default line ramp to zero line and if the surface projector was selected a ramp to the default surface will be established (for a complete description see page 3-84 lift default values). Start surfacing and lining the track to be worked. When the machine has completed the line ramp back to zero line, start observing the overall displacement of the track, there should not be a sustained right or left movement of the track. If the track is being shifted off of zero line, use either the left or right throws arrow key (R/H keypad) to add a throws shift to correct this problem. The amount of throws shift entered can be viewed in the white box under the throws graph, main or expanded screen. Note throws shift changes should be made in increments no larger than 1/8" every 3 or 4 ties. When satisfied with the lining of tangent track the F3 line zero manual adjust panel is used to set a new line zero for the line reference selected, for a complete description of F3 line zero manual adjust panel see page 3-47. The F3 line zero manual adjust panel is under F3 actuator manual zero adjust panel and the F3 actuator manual zero adjust panel is under F3 calibrate menu of the second main toolbar set. After the new line zero is updated, press F3 on the second main toolbar set to open the calibration menu. From the calibration menu select F2 Actuator Calibration Data Panel. After the data panel opens check the new line/record differential value (0 +/-). Normally this differential value is between zero and +25 digits. If less than (below) zero digits or greater than (above) 25 digits, check the angle of the lining shadowboard blade, I.E. blade must be perpendicular to the track. Also, when getting a record "0"(zero) use a "b" style on the defaults panel.

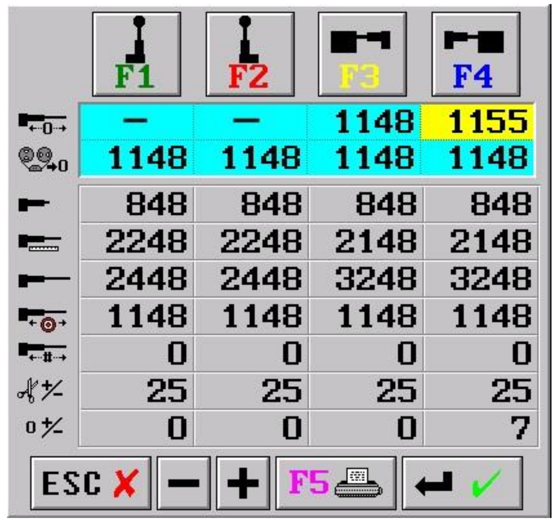


Illustration #2

Other items to check, combo clamp bias pressure could be too low or high, R/H and L/H lining cylinder safety relief's may be improperly set, lining system light beam differential may be above 1/16 inch light ON/OFF and lining system reference wheels may not be properly biasing. Note this completes the setting of the record and line zeros for the presently selected line reference. This procedure may need to be preformed to the other line reference.

The line and throws defaults should be set to the normal curve type for the track to be worked. The F5 Defaults Table Panel is used to set the line and throws defaults (F5 is on the expanded track view, third toolbar set).

TAMPING

The entire tamping cycle of the MK VI is automatically controlled by the operator and can be preset to suit various ballast conditions. Before any tamping is undertaken it is necessary to understand the tamp cycle and the adjustments that affect it.

Adjusting Workhead Opening

To prevent hitting ties during downfeed the workhead opening should be set the same as the average distance between tie centers.

Before making any adjustments, place the WORK/TRAVEL switch in the TRAVEL mode. Failure to do so could result in unintended movement of the machine or work components. START AND END WITH THE SPRING PARKING CONTROL BRAKE IN THE "APPLIED" POSITION (Push In the push/pull knob) AND **THE TRAVEL/SERVICE HAND BRAKE LEVER IN THE "RELEASED" POSITION** (push lever forward (toward front of seat). Parking Brake is also commonly referred to as the MAXI BRAKE CONTROL.

Procedure:

1. Determine the average spacing between the centers of the ties at the work site. Refer to figure 4-31. Using the average spacing from fig. 4-31, the workhead opening should be 483 mm.

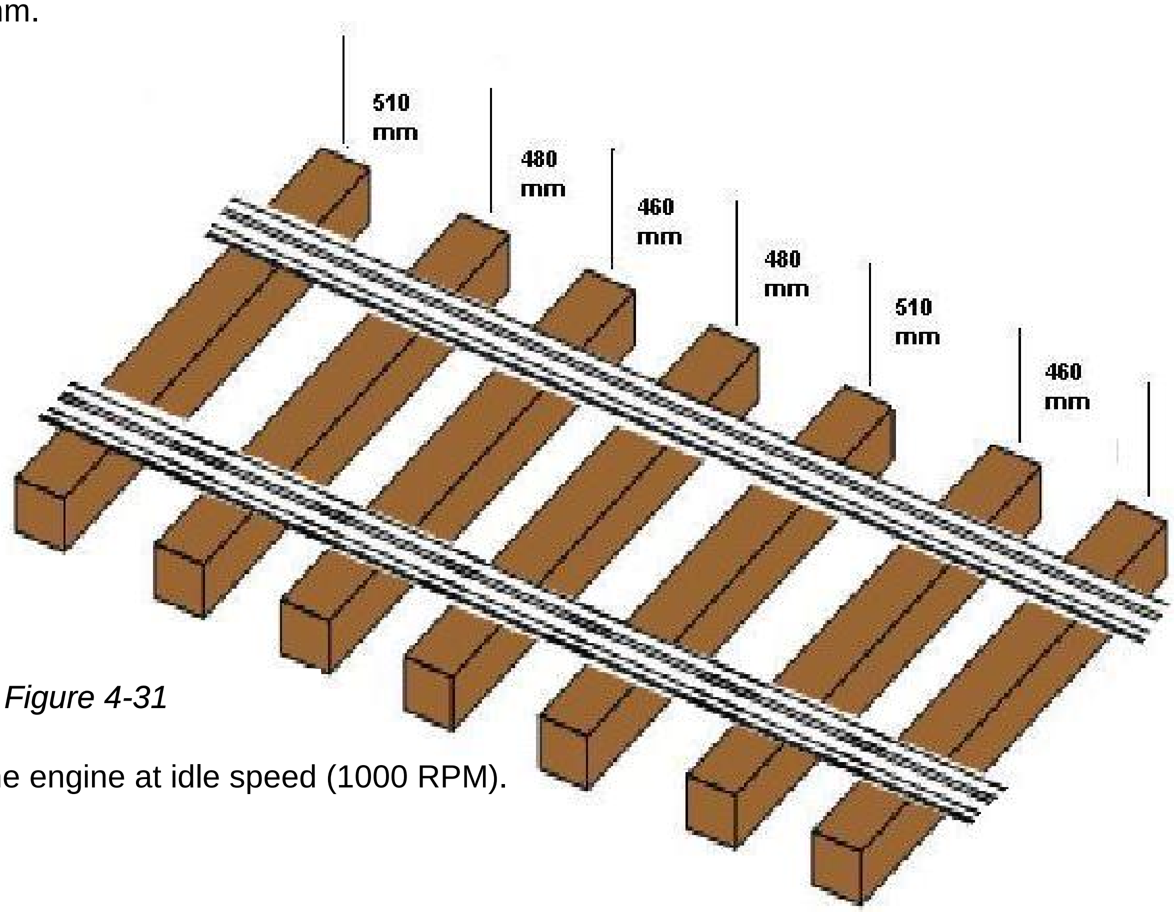


Figure 4-31

2. Start the engine at idle speed (1000 RPM).

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NOTE: Check the Main screen to make sure both pumps are on. If pumps are off turn pumps on

3. Place the **TRAVEL/WORK** switch, to the **WORK** position.

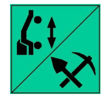


Figure 4-32

NOTE: Make sure the workheads are in the raised position and secured in their safety locks. Refer to section 1 for Safety lock information.

4. Push the manual workhead joystick forward to raise and squeeze out the respective workhead

5. Place the **TRAVEL/WORK** switch, to the **TRAVEL** position then measure the distance between the tamping tools on both workheads. Refer to figure 4-33.

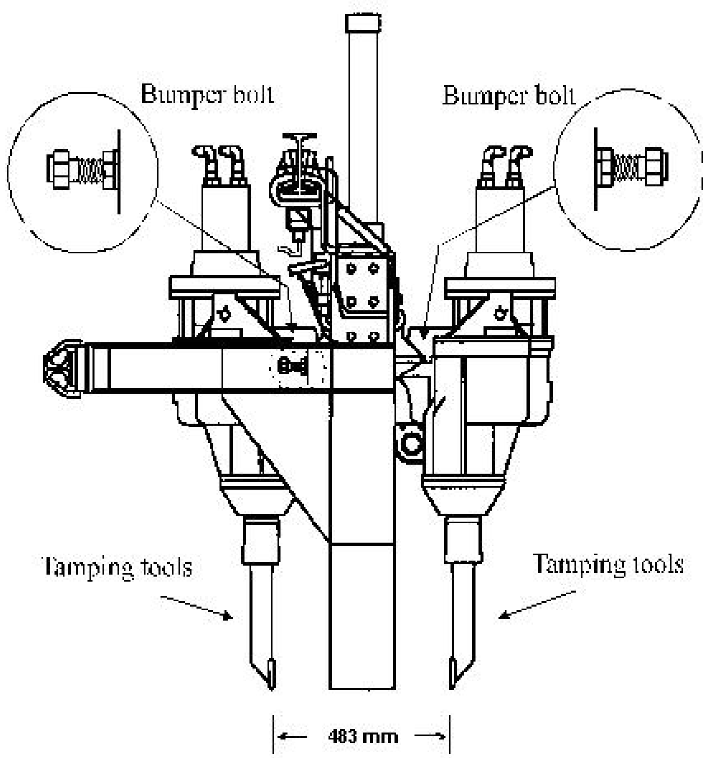


Figure 4-33

6. Place the **TRAVEL/WORK** switch, to the **WORK** Position. Then Press and hold the workhead wizard button while momentarily pushing the left or right workhead joystick in

order to squeeze in the desired workheads. Place the **TRAVEL/WORK** switch, to the **TRAVEL** position before making adjustment to the bumper bolts.

7. Loosen the jam nuts on the bumper screws. There are four (4) adjusting bolts on each workhead, two (2) on each side. Refer to figure 4-34.

8. To increase the workhead opening, turn the adjusting bolts clockwise. To decrease the workhead opening, turn the adjusting bolts counterclockwise. Make sure both bolts on the same workhead are adjusted equally.
9. Repeat item 4 thru 9 until the proper distance between the tamping tools is obtained.

10. Tighten the jam nuts on all adjusting bolts.

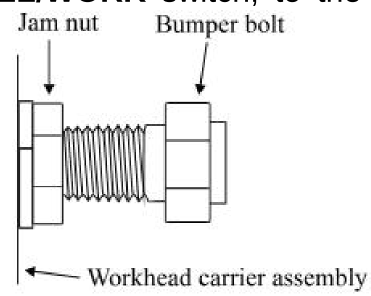


Figure 4-34

Tamp Cycle

The Tamp Cycle consists of three phases:

1) Downfeed
2) Squeeze-In
3) Squeeze Out & Upfeed

Downfeed

When cycle is engaged the selected workheads move downward until they reach their lower string pot setting.

NOTE: *Manual string pots are sometimes called transducers.*

The lower string pot position must be set so the tamping tools will stop at the proper depth in the ballast. The proper depth is when the top of the tamping tools stop approximately ¼" – ½"((6-12 mm) below the bottom of the tie. Refer to figure 4-35.

If the tamping tools are NOT set deep enough, the tools will squeeze the sides of the tie during the squeeze-in movement instead of underneath the tie. Consequently improper ballast compaction and poor quality tamping will result. Refer to figure 4-36.

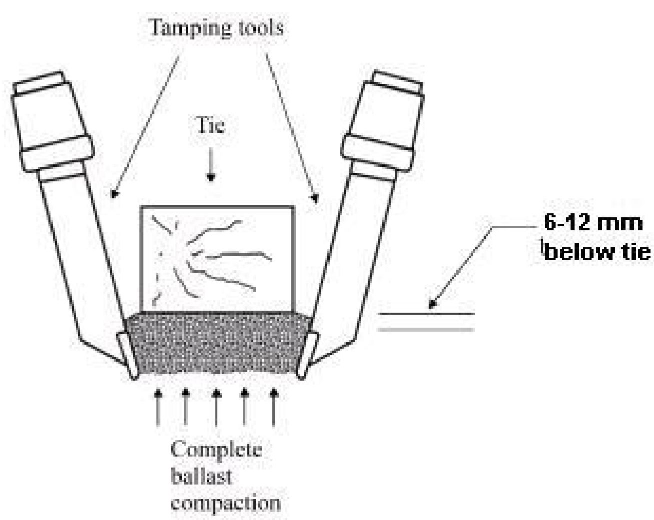


Figure 4-35

If the tamping tools are set too deep, the ballast will flow over the tops of the tamping tools again resulting in poor quality tamping. Refer to figure 4-36.

The main consequence of improperly set transducers, is poor ballast compaction that ultimately affects both surface and crosslevel.

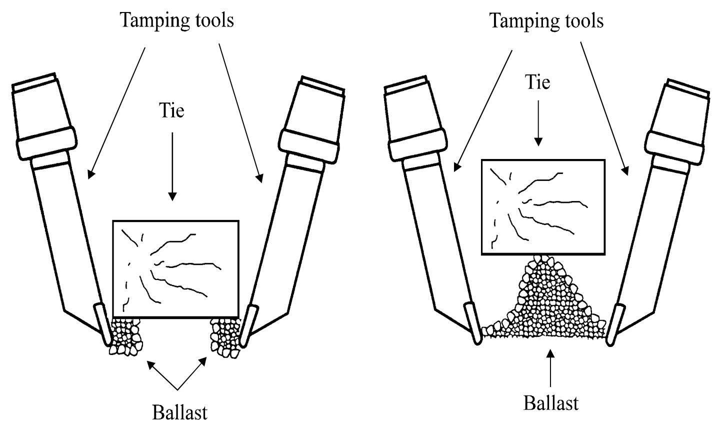


Figure 4-36

NOTE: A quick check is to mark the shank of the tamping tools at a distance above the top of the paddle (blade) equal to the thickness of the tie. Do the same on all four workheads. Then when tamping, observe the mark on the tamping tools, the marks should be at the top of the tie being tamped.

1. When adjustments are complete secure the workheads in their safety (travel) locks.

NOTE: The lower transducer settings must be adjusted for the size of rail you are working on and must be re-adjusted every time you change rail sizes or tie sizes.

Setting Lower (Squeeze) Position

When setting the lower (squeeze) position, on the Variable Workhead Depth Control Panel, it is best to adjust one workhead at a time.

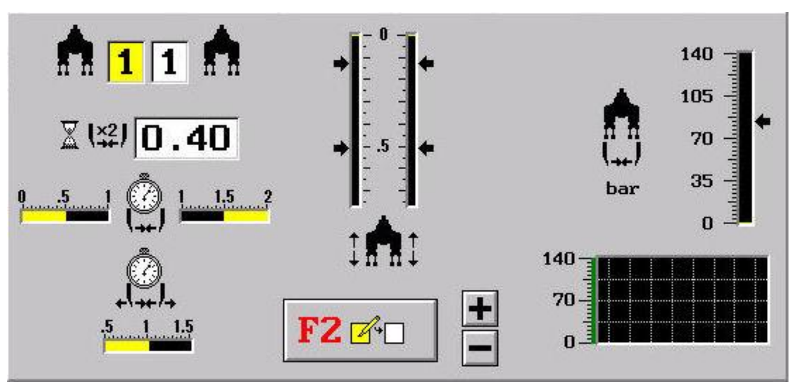


Figure 4-37A

1. Position the machine over a tie to be tamped.
2. Select the F5 key on the second main toolbar then F2 to activate the Variable Workhead Depth Control Panel. Refer to 4-37A.
3. Make sure the workhead transducers are calibrated to zero. To calibrate a workhead transducer, simply upfeed the selected workhead until it is in the uppermost position against the workhead carrier by using the workhead joystick. Hold the workhead joystick forward for about five seconds. After five seconds the transducer position will automatically be set to zero. It is necessary to carry out this procedure if a workhead transducer is changed or the "day to day" information saved by the computer is lost.
4. Press the F2 key until the desired workhead lower position arrow is highlighted. Use the plus and minus keys to change the selected workhead depth.

5. Once the lower position arrows are set pressing Enter or ESC will save the settings and exit the panel. For a detailed description refer to chapter 3, F5-Workhead Configuration and Depth Control Panel (second main toolbar set).

Squeeze-In

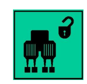
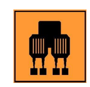
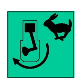
Once the lower (squeeze) position on the transducers, has been activated, the squeeze in function is started automatically. There are two important factors in the squeeze-in portion of the tamp cycle. Squeeze speed and squeeze pressure.

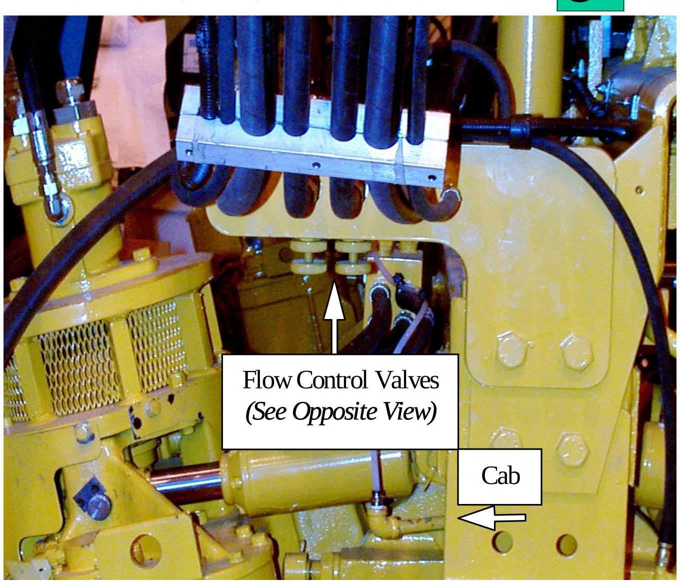
Adjusting Workhead Squeeze-In Speed

The rate of squeeze-in (squeeze speed) is controlled by adjustable hydraulic flow controls. The flow control valves regulate the speed of squeeze-in to insure tamping is not finished prior to the finish of lifting and/or lining. Refer to figure 4-38.

NOTE: When making adjustment as described below. Ensure that the Squeeze-In Minimum timer is set to 0.5 second and the Maximum timer is set to 2 seconds. Fully close the squeeze-in valves then open the squeeze-in valves two and one half turns (flow control valves are 5 turn valves.).

Procedure:

1. Position workhead over a tie to be tamped.
2. Place the **TRAVEL/WORK** switch, to the **WORK** position. 
3. Set the engine throttle to 1000 RPM. Unlock the workheads by pressing the **W/H LOCK** button located on the left keypad. 
4. Turn the workheads (vibrator motors) **ON** by pressing the **LEFT and RIGHT W/H ON/OFF** buttons. 
5. Increase engine rpm to maximum. 



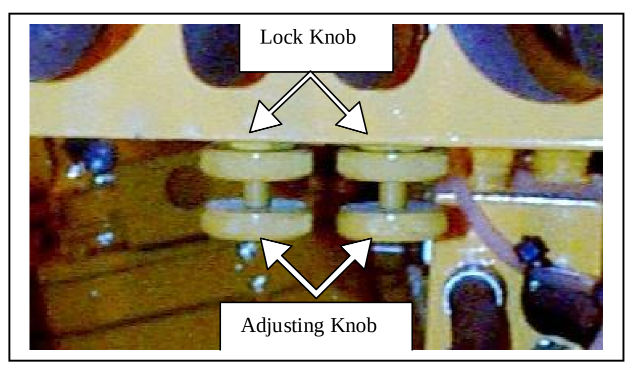


Figure 4-38

6. Downfeed the left workhead and allow it to squeeze, visually observing the speed that it squeezes (about 1.2 sec.).
7. Downfeed the right workhead and allow it to squeeze, visually observing the speed that it squeezes (about 1.2 sec.).

8. Adjust the left and right flow control valves until both heads are squeezing the same speed.

9. Once the flow control valves have been set, if it becomes necessary to slow them down or speed them up, turn each flow control valve exactly the same amount. A good indication of proper setting would be for the squeeze cycle to finish approximately 1 - 1 ½ seconds after the surface lights have gone out.

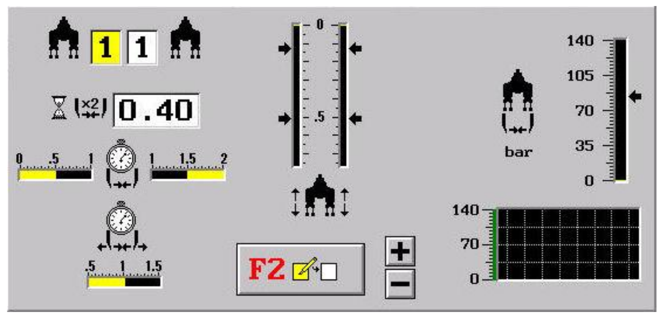


Figure 4-39

In addition to flow control valves, there is a squeeze-in timer. Adjustment of the squeeze time can be done by pressing F5 on the second main tool bar set, then pressing F2 will display the workhead configuration dialog box shown in Figure 4-39.

Press the F2 button until the “adjust the minimum squeeze time.” box is illuminated. Pressing the F2 button one more time will illuminate the “adjust the maximum squeeze time” box. Use the plus or minus keys to adjust the times. The time can be adjusted by 0.01, 0.10 and 1 second. For a detailed description see chapter 3, F5 - Workhead Configuration and Depth Control Panel (second main toolbar set).

The minimum squeeze time determines the minimum time squeeze pressure will be sustained even when the desired squeeze pressure is reached. The maximum squeeze time is the time the squeeze pressure will be released regardless of whether or not desired squeeze pressure is reached.

Squeeze Pressure

Proper adjustment of the squeeze pressure transducer is very important in order to achieve quality tamping. The proper setting for the squeeze pressure transducer on the MK VI is between 1200 - 1600 PSI (83-110 bar). If the pressure needs to be adjusted follow the recommended procedure described below.

NOTE: When making adjustment as described below. Ensure that the Squeeze-In Minimum timer is set to 0.5 second and the Maximum timer is set to 2 seconds.

Procedure:

Go to the Workhead Configuration dialog Box (2nd main toolbar, F5 then F-2). Adjust the squeeze pressure transducer to 1200 P.S.I (83 bar) by using the plus/minus keys. Refer to figure 4-39.

NOTE: If the machine is working in an area where the ballast is extremely cemented or foul, it may be necessary to either increase the squeeze pressure transducer setting to a maximum of 1600 psi (110 bar) or use the squeeze sustain feature. If you increase the squeeze pressure transducer setting, be sure to return the transducer setting to its original value as soon as the machine is out of these adverse conditions.

After completing the adjustment raise the workheads to their up and locked position. Ensure that the brakes are properly applied, place TRAVEL/WORK switch to the TRAVEL position, idle the engine for a minimum of 2 ½ minutes before shutting down.

Remember: The squeeze-in flow controls are used to coordinate tamping and jacking, whereas squeeze pressure controls the amount of pressure being applied under the tie.

Upfeed and Squeeze-Out

Once the squeeze pressure transducer setting has been activated, squeeze-out and upfeed will begin. The upper transducer (standby) position controls the height of the workheads and are adjustable for varying conditions. Under normal conditions the height of the workheads should be set so that the tamping tools clear the ties by approximately 2-3 inches (50—75 mm).

Setting Upper (Standby) Position

When setting the upper (standby) position, on the Workhead Configuration Dialog Box, it is best to adjust one workhead at a time.

1. Select the F5 key on the second main toolbar and then F2 to activate the Workhead configuration Dialog Box. Refer to figure 4-37A.
2. Make sure the workhead transducers are calibrated to zero. To calibrate a workhead transducer, simply upfeed the selected workhead until it is in the uppermost position against the workhead carrier by using the workhead joystick. Hold the workhead joystick forward for about five seconds. After five seconds the transducer position will automatically be set to zero. It is necessary to carry out this procedure if a workhead transducer is changed or the “day to day” information saved by the computer is lost.
3. Press the F2 key until the desired workhead upper (standby) position arrow is highlighted. Use the plus and minus keys to change the selected workhead height.
4. Once the upper position arrow is set press ESC to save the settings and exit the panel.

NOTE: There are two high positions for each workhead. High positions are independent for switch mode and production mode. When in switch mode, it is recommended that the high positions be set so that the workheads clear the top of the rail. This allows the workheads to be traversed without upfeeding beforehand which can save a lot of time when tamping a switch.

The switch mode key on the left hand keypad can be used to toggle between switch mode and production mode while the workhead panel is open which makes it easy to see and change each of the possible high positions.

Squeeze-Out

The speed of squeeze-out is adjustable by flow control valves located above the rear workheads. Refer to 4-38. These should be adjusted equally, **not wide open**, to prevent the workheads from breaking the workhead bumper bolts. NOTE: Usually 1 ½ turns in from fully open.

Tamping Tools

Although tamping tools would not be considered an adjustment, they have a great impact on the quality of track being tamped.

Tamping tools should be kept tight and in good condition. If all of the above adjustments were set properly, and the tamping tools were worn out, the quality of track being produced would not be acceptable.

Once the tamping tools have between 20% and 30% wear, the quality of track being produced starts to drop off drastically. Therefore, maintaining good quality tamping tools is very critical to properly tamped track. Refer to figure 4-41.

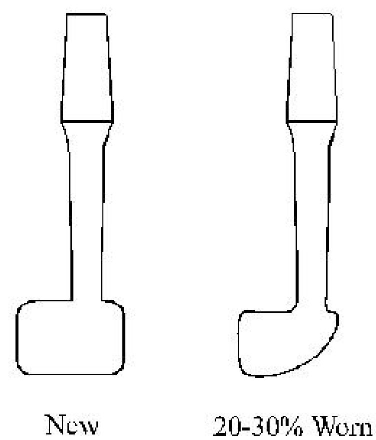


Figure 4-41

In summary, if your tamper is not producing quality track, it may require a "tune up". All of the above adjustments and procedures should be reviewed to insure the machine is capable of putting up quality track.

There are a number of other conditions that have not been mentioned but could have an effect on the quality of track being produced.

Track Conditions

If the machine is properly adjusted, and in good working order, yet the quality of track being produced is unacceptable, there are a number of other factors that should be considered.

Track conditions play a big part in the final outcome of newly surfaced track. For example, if the track does not have enough ballast to handle the amount of lift being made, then, no matter how well a tamping machine is adjusted, the track will not hold up.

Listed below are a number of conditions that would prevent a machine from doing a good job.

1. Lack of Ballast
2 Foul or Muddy Ballast
3. Bad Ties
4. Surface Bent Rail

Double Tamping

The number of tamps per tie is a question that is frequently brought up and a good point to consider.

Normally, if a machine is tuned up properly, and the track conditions are average, single tamping should be sufficient.

- If the ballast is extremely foul or cemented, double tamping may be required to carry enough ballast under the tie to properly support the track.
- If the raise is over 2" (50 mm), double tamping may be necessary to properly compact the ballast under the ties.

Center Bound Track.

Under normal conditions it is desirable to have a void under the center area of the tie. See figure 4-42.

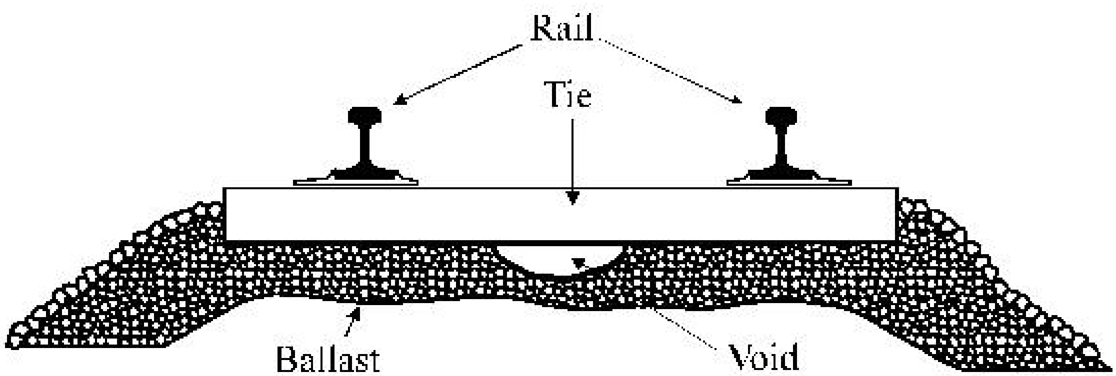


Figure 4-42

Center Bound Track is a condition where the ballast is compacted underneath for the full length of the tie. Once train traffic starts to move over this condition, the trains will actually "tamp" or settle the ballast under the rail area, but not the center of the tie. This will result in a "teeter totter" action resulting in damaged and broken ties. See figure 4-43. Therefore, it must be understood, that we may be able to tamp "too good".

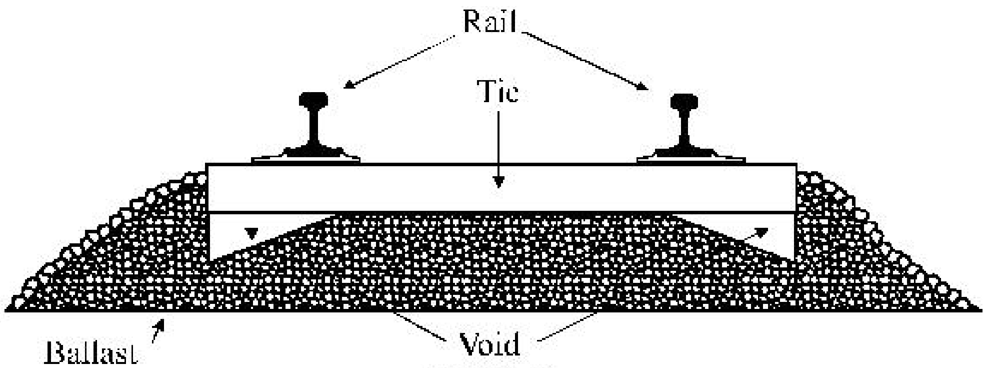


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Figure 4-43

Combo Clamp Frame

The combo clamp frame is a multi-purpose rail lifting assembly capable of clamping and jacking the rails in both production and switch modes. See figure 4-44.

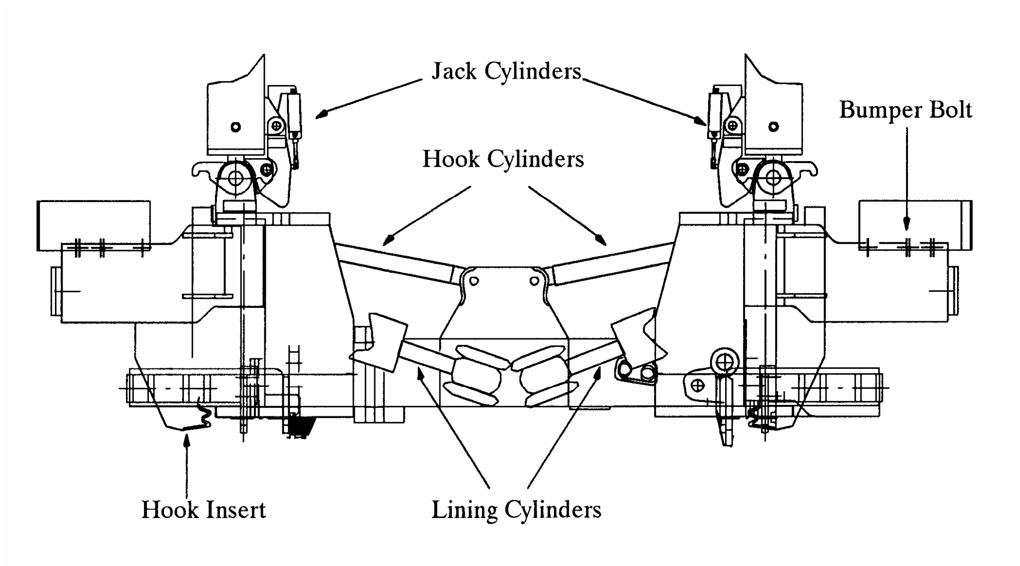


Figure 4-44

Theory of Operation

Jacking

When CYCLE is engaged, the left and right hook-in valves are energized which supply oil to the hook cylinders. The hook cylinders retract the hooks (hook-in) until the hook bumper bolts strike the hook frame. The clamp frame bias cylinder and pad assembly, located on the lower portion of the clamp frame between the rails, simultaneously extends to prevent the rail from tipping.

When the hook pressure transducer setting is reached, the two (2) pressure transducers will indicate to the computer that the hooks are in position and ready for the jacking sequence. The computer then starts the jacking and lining operations.

Jack Release

Once the line operation is complete the jack down valves are energized and the hooks are lowered to the lower limit switches. When the lower limit switches are made the hook out valves are energized and the hook cylinders extend the hooks until they contact the hook outer limit switches. During the hook down and out sequence the bias valve de-energizes and the bias cylinder is retracted (down and out sequence).

If the hook should slip off the rail during the jacking process the hook frame will rise until it contacts the upper limit switch. If the upper limit switch is contacted during the jacking cycle the computer will automatically abort jacking and start the hook down and out sequence in production mode.

Before work can be carried out using the “combo frame” There are certain adjustments which must be performed.

Adjustments

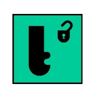
Before making any adjustments, place the WORK/TRAVEL switch in the TRAVEL mode. Failure to do so could result in unintended movement of the machine or work components. START AND END WITH THE SPRING PARKING CONTROL BRAKE IN THE “APPLIED” POSITION (Push In the push/pull knob) AND **THE TRAVEL/SERVICE HAND BRAKE LEVER IN THE “RELEASED” POSITION** (push lever forward (toward front of seat)). Parking Brake is also commonly referred to as the MAXI BRAKE CONTROL.

Combo Clamp Frame Lower Limit Switches

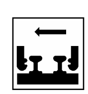
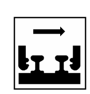
Procedure:

1. Place the **WORK** /**TRAVEL** switch, to the **WORK** position.

2. Move the joysticks (manual hook control levers) on the left and right console panels to the **UP** position to raise the combo clamp frame up in the travel locks.

3. Release the combo clamp frame travel locks by pushing the combo clamp frame lock push button on the left keypad. 

4. Move the joysticks (manual hook control levers) on the right and left console control panels, to the **DOWN** position. The jack cylinders will extend and the clamp assembly will move down onto the top of the rails.

5. If misalignment occurs, use the manual line left/right controls on the left keypad to center the clamp frame between the rails.  

6. Once the combo clamp frame reaches the top of the rail, the hook assemblies are lowered to a point set by the position of the lower limit switches.

7. With the hook frame resting at the lower limit switch there should be approximately ½ inch (12 mm) clearance between the top of the hook insert and the bottom of the rail-head. See figure 4-45.

8. Adjust as necessary. Loosen the two (2) mounting screws and raise or lower the limit switch until the desired clearance is achieved.

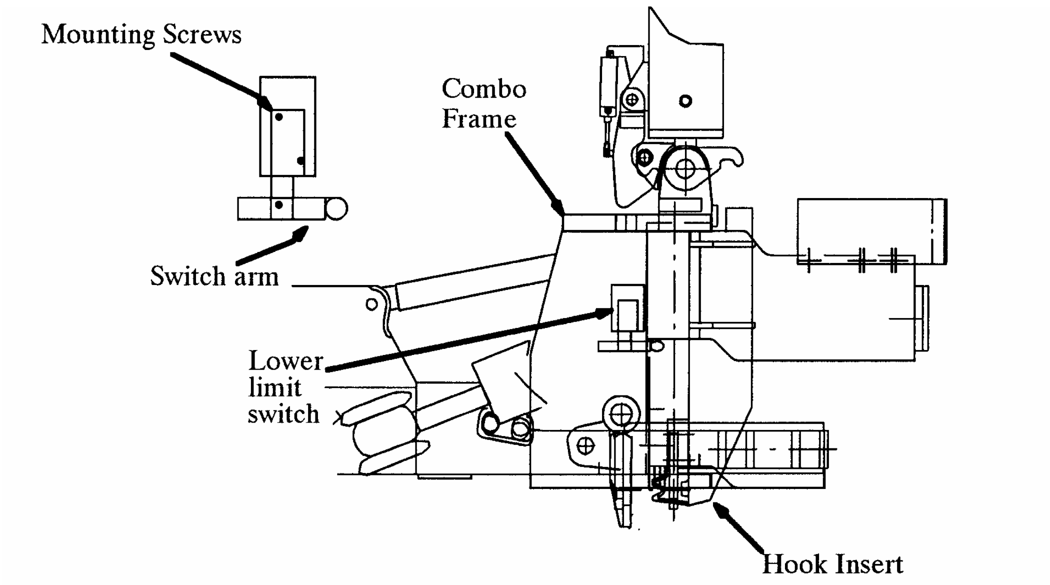


Figure 4-45

Combo Frame Outer Limit Switches

The outer limit switches are set to allow the hooks to clear any normal obstruction from the side of the rail such as joint bar bolts.

Procedure:

1. Measure from the web of the rail to the outermost normal obstruction that will be encountered. The most normal obstruction encountered will be joint bar bolts.
2. Manually extend the left and right hooks out until they stop at the outer limit switch.
3. Measure from the outside edge of the hook insert to the web of the rail. This measurement should exceed the measurement from step 1 by ½ inch (12 mm). Refer to figure 4-46.
4. Adjust as necessary. Loosen the two (2) mounting screws and slide the limit switch horizontally.
5. Tighten the mounting screws and repeat step 3. Readjust if necessary until the desired clearance is achieved.

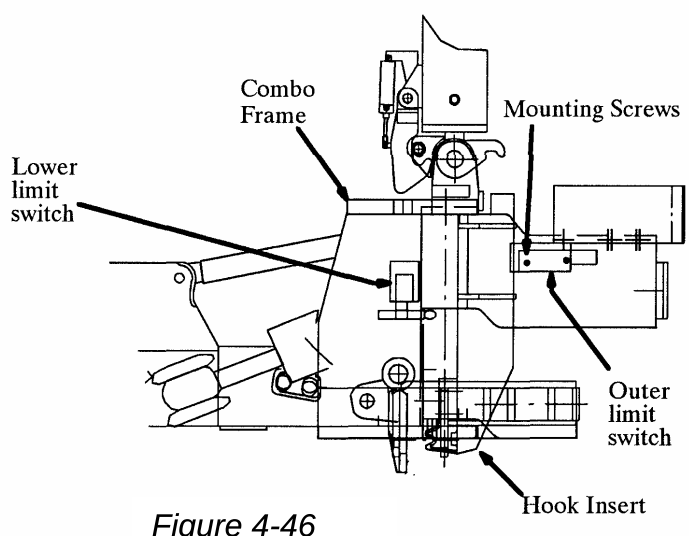


Figure 4-46

Combo Clamp Frame Upper Limit Switches

The upper limit switches prevent the hook assembly from lifting the combo frame off the rail in the event the hooks slip during jacking. Refer to Figure 4-47.

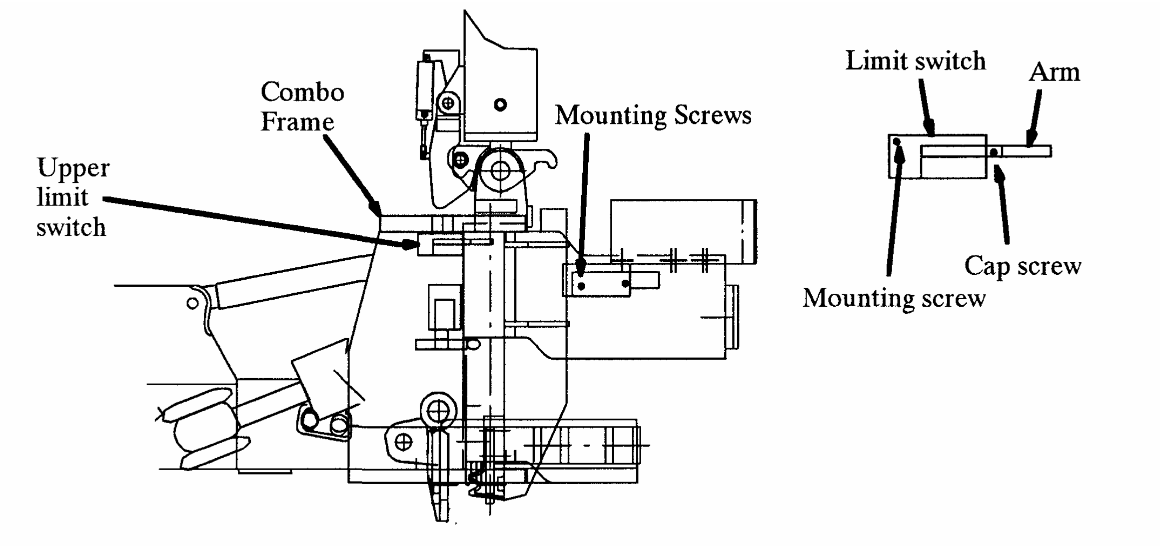


Figure 4-47

Procedure:

1. Move the joysticks (manual hook control levers) on the left and right console panels to the **UP** position to raise the hook assembly up.

2. If the clamp frame is lifted off the rail before the hook assembly stops at the upper limit switch it will be necessary to re-adjust the switch.

NOTE: The hook frame should stop approximately 1 inch (25 mm) from the top of the clamp frame guide rods.

3. Adjust as necessary. Loosen the setscrew on the limit switch arm and turn the arm to the desired position.

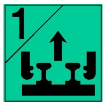
4. Tighten the setscrew and repeat step 2. Readjust if necessary until the desired clearance is achieved.

Bumper Bolts

In most circumstances it is undesirable to mark or strike the rail in any fashion. To prevent the hooks from contacting the rail the clamp frame incorporates adjustable bumper bolts.

Procedure:

1. Move the joysticks (manual hook control levers) on the right and left console control panels, to the **DOWN** position until the hook assembly is resting on the lower limit switches.

2. Press the Autojack button located on the L/H arm panel. 

   Pressing the Autojack button will cause the left and right hooks to move laterally in towards the rail until they contact the bumper bolts. The Bias cylinder will also automatically extend the bias plate until it contacts the rail.

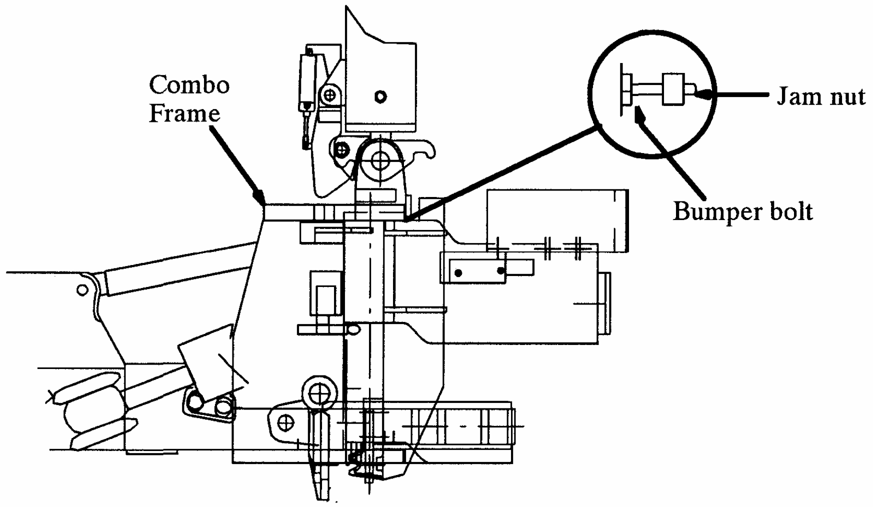


Figure 4-48

3. Visually observe the distance the hook inserts stop from the rail. Ideally there should be a 1/8 inch (3 mm) gap between the hook insert and the web of the rail. This will vary slightly due to variations in the track gauge. Refer to Figure 4-48.

4. If the hook insert strikes the rail it will be necessary to turn the bumper bolt out toward the clamp frame. If the gap between the hook insert and the rail is greater than 1/8 inch (3 mm), it will be necessary to turn the bumper bolt in.

5. Loosen the bumper bolt jam nut and adjust the bumper bolts as necessary.

Hook Pressure Transducers

The left and right hook pressure transducers are used to signal the computer that the hooks are ready and the jacking cycle can begin.

During normal PRODUCTION mode operation when the operator initiates cycle the left and right hooks move in towards the rail until they contact the bumper bolts. Pressure in the hook cylinders build up to the setting of the pressure transducers that complete an input circuit to the computer.

The computer scans the switches and when it receives an input from the left and right hook pressure transducers jacking will begin. The normal hook pressure transducer setting is approximately 300 PSI (21 bar). If high ballast conditions exist it may be necessary to raise the hook pressure in order to displace the ballast trapped between the hook insert and the web of the rail.

Procedure:

1. Go to the workhead clamp frame diagnostic menu by pressing F5 on the 2nd main tool bar. Then press F1 to get into clamp Frame Diagnostics Box. Highlight the hook pressure transducer icon by pressing F1 until the highlighted arrow is lit by the transducer that needs to be changed and set to the recommended pressure by using the plus / minus keys. See figure 4-49.

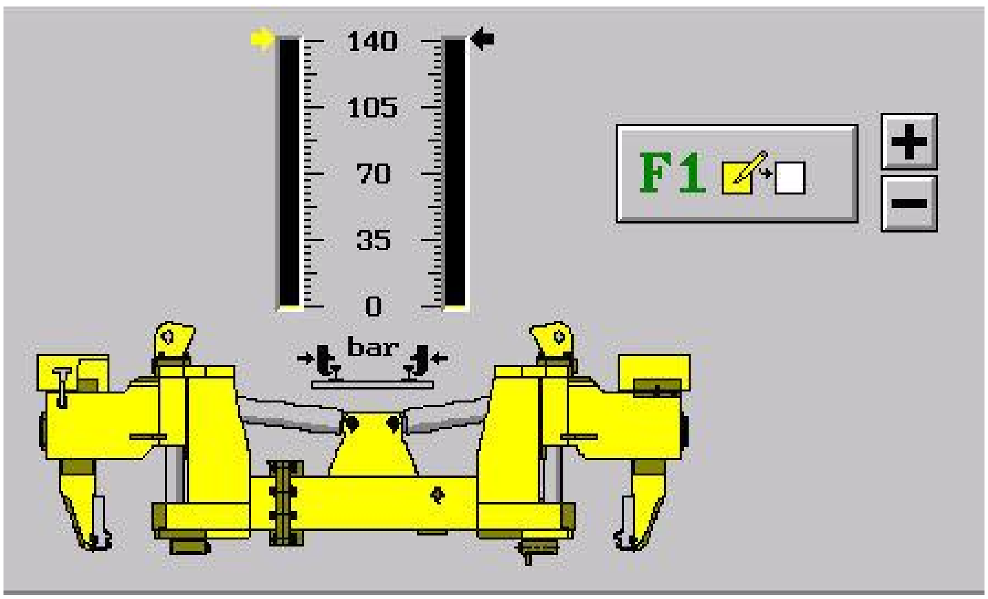


Figure 4-49

Setting-Up the Machine for Work

Procedure:

1. Read "*Safety*" Section 1 in this manual, before you continue with this procedure. Refer to Section 2 for Control Panel details.

2. Upon arriving at the work site stop the machine, lower the engine throttle to 1000 rpm and set the spring applied parking brake and release the travel/service brake. Place the **TRAVEL/WORK** switch to the **TRAVEL** position. Refer to figure 4-50

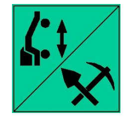
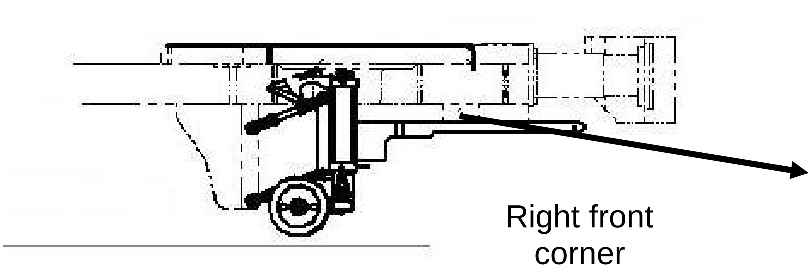


Figure 4-50

3. **The surfacing & lining buggy system must be unloaded into the work position with the machine located on tangent track.**

Setup - Buggies

1. Take the lining projector from the cab and proceed to the front of the machine, raise the projector buggy lift mechanism by lifting the left and right buggy lift toggle valve handles, and pull out on the lock valve to unlock the lift frame. See Figure 4-51.



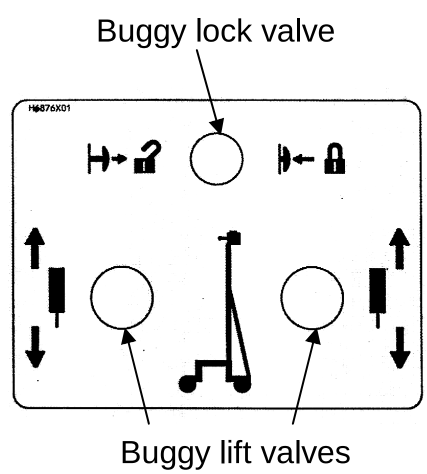


Figure 4-51

2. Once the buggy lock is released lower the buggy frame to the rail by pushing down on the left and right buggy lift toggle valve handles. Install liner projector.

Keep hands and fingers clear of all pinch points. All pinch points are clearly defined or painted red.

3. Remove the projector buggy travel lock pins from the left and right lift arms and slowly push the projector buggy away from the machine to unfold the pusher bar.

4. Install the lock pins at each of the 3 pusher bar hinge joints when the bar is straight.

5. Raise the surfacing shadowboard out of its safety lock by turning the air valve switch to the raise position. Release the shadowboard lock and lower the shadowboard to the rail. Remove the liner locks pins and manually lower the liner shadowboard to the working or horizontal position.

6. Move liner light shield from its travel position, against the side of the machine, to its work position perpendicular to the machine. These light shields are used to prevent the light emitted from the surfacing projector from entering the lining receiver.

7. Raise the receiver buggy out of its safety lock by turning the air valve switch to the raise position. Release the air actuated safety lock and lower the receiver buggy to the rail. Lower liner receiver to work position.

8. Return to the cab of the machine. Place the **TRAVEL/WORK** switch to the **WORK** position and set the machine parameters for work.

Setup - Machine Parameters

1. The warm up function should be OFF.

   - Press F5, on the First Main Toolbar, to Change Options
   - Use the plus or minus buttons to highlight warm up
   - Press F5 to turn OFF, then ENTER or ESC to return to the main toolbar set

NOTE: Whatever option was previously turned on will still be highlighted, therefore, all that is required is to press F5 on the main screen, then F5 on the options screen, which will turn ON/OFF that option.

2. Scan the information or status boxes on the screen to see what parameters are set. See figure 4-52.

   - Tamps per cycle
   - P1 & P2 pumps ON
   - Travel / marker lighting
   - Indexing brake ON
   - Auto Traction ON
   - Clamp Pressure Sustain ON

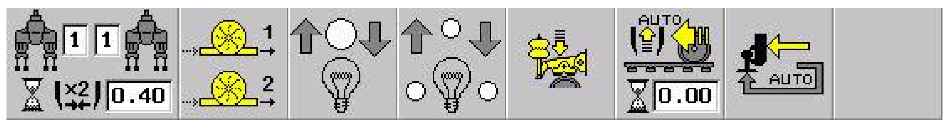


Figure 4-52

NOTE: For more information or help regarding setting options or key function refer to section 3. SOFTWARE GUIDE.

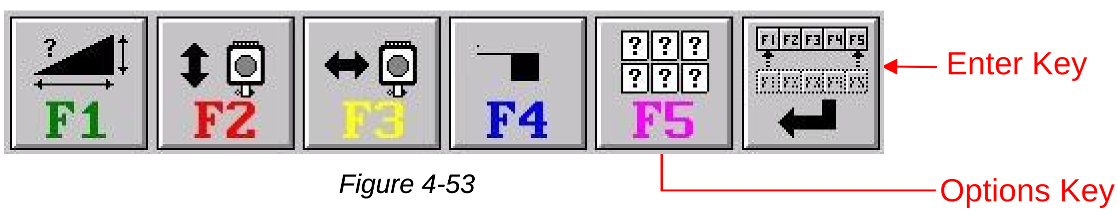


Figure 4-53

3. Press ENTER to access each of the 3 toolbars. Set options as required. See figure 4-53.

   A) Press F1-Set Distance & Mile Post (Distance Monument) on the Second Main Toolbar to access the distance and milepost (distance Monument) panel. See figure 4-54.

   B) If the distance panel is highlighted, press F2 to zero this panel. Press F1 again to move the highlighted area to the accumulated distance panel, press F2 to zero this distance. Press F1 to highlight the milepost (Distance Monument) panel. Use the plus (+) or minus (-) key to set the milepost (Distance Monument) setting. Press F3, if necessary, to have the mileposts (Distance Monuments) ascending or descending.

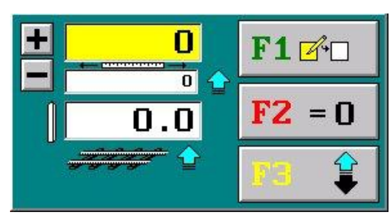
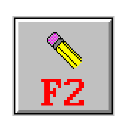


Figure 4-54



NOTE: The F2-Wipe will clear all track parameter and sets the starting distance to zero. It does not reset the cumulative distance to zero. This will need to be set from the distance and milepost (Distance Monument) toolbar. The PC keyboard can be used to enter the milepost (Distance Monument) numbers.

B) Press F4-Reference Change on the First Main Toolbar to access the reference rail panel (figure 4-55). From this panel pressing F1 will select the reference rail for lining.

Pressing F3 on the 3rd main tool bar (figure 4-56) selects Auto Surfacing where the computer automatically selects reference rail for surfacing and pressing F3 again sets the track centerline as the reference for surfacing.

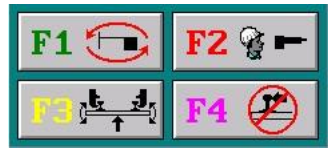


Figure 4-55

D) Press F3-Insertion & Production Count on the Third Main Toolbar to open the production and switch counts panel. To reset the daily counts to zero, press F1 resets production and F2 resets switch counts.

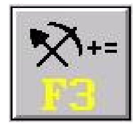


Figure 4-56

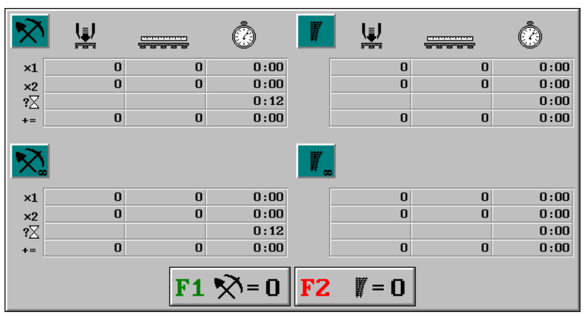
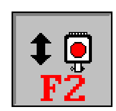
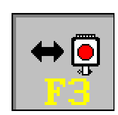


Figure 4-57

E) Press F2-Surface Projector ON/OFF on the First Main Toolbar to enable the surfacing system. The projector emblem will be red if activated, or gray, not activated. Turning this projector ON enables the surface projector, lifting system and sets the surfacing actuators to their zero position.



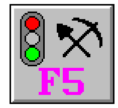
F) Press F3-Line Projector ON/OFF on the First Main Toolbar to enable the Lining system. The projector emblem will be red if activated, or gray, not activated. Turning this projector ON enables the lining projector, lining system and sets the lining actuator to it's zero position.



G) Move the machine to the first tie to be tamped (at least 5 ft or 2 meters); this will also allow the liner gauge wheels to properly bias to the reference rail.

H) Clear any existing track, track recording or fit, by using the F2-Wipe button. The F2-Wipe button is located on the third main toolbar button set.

4. Press F5-Work Start/Stop/Resume on the Third Main Toolbar to open the Work Start/Stop/Resume Panel. Press F1-"Find the Lights" on the Work Start/Stop/Resume Panel to initiate the hunting of the surface and line light beams. When the surface and line lights start to blink wait about 5 seconds, then press the ENTER key to set up the ramps for surface, crosslevel and line (defaults ramps) or press ESC to return to the Work Start/Stop/Resume Panel. This work setup procedure is typically used when setting up the machine prior to commencing work. This procedure is sometimes known as "finding the lights". When this procedure is complete, control points will be set such that the first tie to be tamped will not be lifted, lined or changed in superelevation. The machine is now ready to commence work.



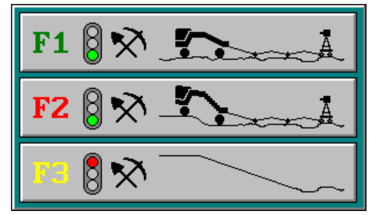


Figure 4-58

NOTE: Once zero setup has been selected, the pop out information panel (figure 4-59) will appear showing lift, superelevation and line at the shadowboard determined from current beam position and the inclinometer reading. If the values displayed on this panel are large, it may be desirable to move the machine slightly (if possible) before pressing ENTER.

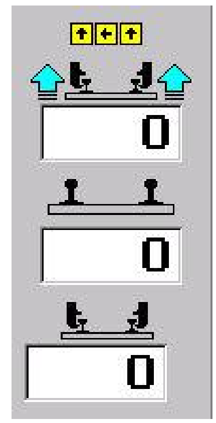


Figure 4-59

OTHER SETUP or ADJUSTMENT OPTIONS:

A) If it is desired to setup on, and tamp track without recording it, first clear the existing recording and fit (if any) using the curve wipe toolbar button in the third main toolbar set and use the manual change procedures to set the required lift, superelevation and curvature for the track to be tamped. On tangent track, it is only necessary to set the required value of surface.

Before selecting this function, ensure the reference systems are deployed, properly registering against the rails and that both projectors are on (unless lifting or lining is intentionally disabled). If the distance displayed at the top left of the screen needs changing to match the footage of the starting location (recorded track only) change it now. Best results are achieved when recording starts about fifteen feet (5 meters) before the intended start of work location.

Once zero setup has been selected, the popout information panel will appear showing lift, superelevation and line at the shadowboard determined from current beam position and the inclinometer reading. For lift and line, these are the pulls that would have resulted if a cycle were to be initiated at the current location without "finding the lights".

When the ENTER key is pressed, hunting of the beam will stop and the actuators will be positioned at the point of cutoff. If ESC is pressed, the procedure will be aborted and the actuators will be returned to their original positions. If the values displayed on this panel are large, it may be desirable to move the machine slightly (if possible) before pressing ENTER.

Appropriate work-in rates will be applied to the operating parameters from the current location. Subsequent manual changes will probably not be necessary and the machine is ready to begin work.

B) Press the Expanded Track View Screen key (magnifying glass) to get to the first toolbar button set of the expanded track view screen. The first four buttons selects a parameter for control.

- Press F1 for Surface
- Press F2 for Throws
- Press F3 for Superelevation
- Press F4 for Line
- Press F5 to toggle between a compressed view and the standard Expanded Track view.

As soon as a parameter has been selected by pressing F1, F2, F3 or F4 in this toolbar button set, the appropriate dialog box will open and the selected parameter will be in rubber banding mode. While in this mode, the interpretation of the keys in the upper half of the right keypad will be different until the rubber banding mode is terminated by pressing the ENTER or ESC key.

Note: Although parameters can be accessed in any sequence, changing some will impact others. Changing superelevation will influence the surface fit. Changing the best fit for line will change the fit for superelevation and so on. It is therefore strongly recommended that a particular sequence of parameters be followed when changes are to be made. That sequence is: LINE, SUPERELEVATION, THROWS and finally SURFACE (skipping over any that do not need changing). Note that for consistency with the rest of this manual, the following sections will not appear in this sequence.

<u>Rubber Banding</u>

To avoid repetition, some general terms, concepts and keypad usage that apply to rubber banding will be described in this section.

For each parameter, control is applied through a sequence of control points. The variation of control between control points is assumed to change in a straight line from one point to the next. If you imagine an elastic or rubber band stretched between the control points, then you have a clear picture of what happens to control at intervening points when any one point is moved.

When a parameter is selected for modification, a target or cursor is positioned at the current location. The “corporal” keys jump (or snap) the target between the available control points. Using any of the up, down, left or right cursor keys on the right keypad will “drag” the selected control point in the direction of the arrow on the key. While in the rubber banding mode, a dialog box adjacent to the parameter being modified will be open showing details of the control point currently selected. When a control point is dragged, the numerical effect is immediately shown on this panel.

Pressing the plus / minus (+/-) keys will move the target or cursor along a “rubber band line” *between* two control points, at a rate of one foot per press. Holding one of these keys down will auto-repeat to move the cursor continuously. If BOTH the plus and minus keys are held down together, the cursor will move at an accelerated rate (in the direction first selected) to allow any track location to be selected quickly. When the target has been placed between control points in this manner, using an up/down/left/right key will *create* a control point at the selected track location.

The operator simply continues to use the cursor keys until the newly created control point is positioned appropriately. This is the method of inserting control points.

When a control point is dragged to or beyond another control point, the two points will be combined.

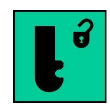
Pressing the ESC key exits the rubber banding mode and *discards* any changes that have been made. Pressing the ENTER key exits the rubber banding mode and retains any changes made. Either way, the cursor keys revert to their normal function of providing manual control over lift, line and superelevation.

After pre-recording a given distance track (up to 12,000ft or 3650 meters allowed at this time) return to the point where recording was started. Set line, superelevation, throws and surface parameters. The machine is now ready to surface and line track.

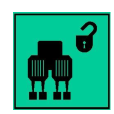
Working

With the lift, cross level and line parameters now set we are ready to begin surfacing track.

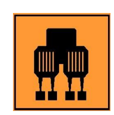
1. Move the joysticks (manual hook control levers) on the left and right console panels to the **UP** position to raise the combo clamp frame up in the travel locks.



2. Release the combo clamp frame travel locks by pushing the lock release push button located on the left arm panel keypad.
3. Move the joysticks (manual hook control levers) on the right and left console control panels, to the **DOWN** position. The jack cylinders will extend and the clamp assembly will move down onto the top of the rails. If misalignment occurs, use the manual line left/right controls on the left keypad to center the clamp frame between the rails.



4. Unlock the workheads by pressing the **W/H LOCK** button located on the L/H arm panel keypad.



5. Turn the left and right workheads (vibrator motor) **ON** by pressing the **LEFT** and **RIGHT W/H ON/OFF** buttons (orange).
6. Increase engine rpm to maximum.
7. Locate the machine (workheads) over the first tie to be tamped.

NOTE: It is always best to test the jacking & lining before actually tamping the track by first using the **MANUAL JACK** to **CUT-OFF** push button located on the L/H operator key pad (L/H arm console). The **MAUNAL JACK RELEASE** will reset the jacking & lining system.

8. Initiate CYCLE by depressing the floor cycle switch located on the footrest of the operator's seat or by pulling back on the cycle joystick located on the R/H arm panel.

NOTE: When in Autocycle, the cycle foot pedal or joystick would be held until the machine is located over the next tie.

9. The machine will jack, line and tamp the track simultaneously, then automatically index forward until the cycle switch used is released. Reactivating one of the cycle switches restarts the tamping, jacking and lining cycle.

Use the manual lift, elevation and line shift buttons located on the right-hand arm panel keypad to make adjustments to the lift, elevation and line as required. Refer to section 2 for keypad information.

Smart Cycle

Where tie spacing permits, this feature automates the task of ending forward traction and starting the next cycle. At all times, the software monitors tie spacing, the rate of deceleration between the end of traction and the start of cycle, the forward speed of the machine at the start of cycle and the distance taken to stop the machine after start of cycle. When activated by the operator, the software takes over the task of tamping and will continue tamping ties automatically **while cycle is held**.

Prior to this feature, the workhead and clamp frame joysticks were inactive during cycle. These are now used during cycle to control smart cycle in an intuitive and natural manner. Anytime during an operator initiated cycle, moving either workhead joystick forward or rearward will activate smart cycle. Smart cycle will remain active, moving the machine and tamping ties until the operator releases cycle. The operator can apply corrections using the workhead joysticks so as to maintain accurate positioning in relation to the ties. Each time a workhead joystick is moved rearward, the target position for the next tie is moved back (short) by two inches (50 mm). Each time a workhead joystick is moved forward, the target position for the next tie is moved forward (long) by two inches (50 mm).

The clamp frame joysticks are used during smart cycle to control the forward speed of the machine at the time the work-heads begin downward movement. Moving either clamp joystick forward will increase speed by an increment. Moving a clamp joystick rearward will cause the machine to be traveling slower when the workheads enter the ballast.

At maximum speed, smart cycle can simultaneously initiate the workheads cycle and terminate traction. A good operator will take at least a tenth of a second to do this (releasing and reapplying cycle). Over the course of an hour, this small difference will amount to an additional 20 to 30 ties being tamped based on speed alone. However the greatest gains in production are from reduced interruption to tamping now that a lower level of concentration is required to maintain proper position in relation to ties. When tamping every second or third tie, adjustment of speed will be more important.

Smart cycle reduces the level of stress and fatigue. Continuously holding cycle by keeping the foot pedal down (or cycle lever pulled) results in less discomfort over a period of time than the repetitive motion needed for manual control. An operator can improve comfort even further by changing from pedal to joystick to improve circulation. By overlapping when changing from one to the other, smart cycle will continue uninterrupted. When working manually, an operator has a strong preference (foot pedal or cycle joystick) and is less likely to do this.

NOTES: Whenever the tie spacing or conditions vary significantly, tamp five or six ties cleanly[1] in manual mode before invoking smart cycle.

Left, right or both joysticks can be used to control smart cycle. If both joysticks are used together, they will have twice the effect of one (4 inches or 50 mm for cycle spacing and double the normal speed increment for the clamp joysticks).

Tie spacing corrections (work-head joysticks) can be made at any time and will affect the next tie to be tamped up until the work-heads begin downward.

Releasing cycle at any time will cancel the automatic mode of smart cycle. Subsequent tamping will be purely manual until a work-head joystick is again moved forward or backward during cycle.

The auto underfoot-lifting option can be used while smart cycle is active. For this feature to be useful, it will be necessary to position the clamp frame between ties. It will take some effort to overcome the habit of releasing cycle in response to a damp hook slipping off (which would cancel smart cycle as well as aborting cycle).

When smart cycle is activated, the average forward speed over the preceding five ties is used to establish the desired forward speed at start of cycle. This value will remain unchanged once smart cycle is active unless a clamp joystick is moved forward or rearward. When tamping every tie, this speed should be a maximum. If it is not, move either clamp joystick forward.

Clamp Hook Out

In or near switches or turnouts, it is at times desirable to have either or both clamp hooks run to the outermost position beyond the outer limit switch at the end of cycle. This prevents the hooks from fouling wider track components in the switch area.

To activate this feature, simply run the hook out past the outer switch prior to cycle. At the end of cycle, the hook will run past the outer switch and return to the full outer position (or until auto-jack-release is released during switch mode). This mode will remain active until the clamp joystick is used to position the hook on the outer switch in an outward direction. This will cancel the feature and the hook will stop out feeding past the limit switch. Using the clamp joysticks to control this feature is fast, simple and intuitive while not adding to screen or menu complexity.

As the machine does not have to be in switch mode to use this feature, more of a switch or turnout can be tamped with the benefit of auto-traction thereby saving considerable time.

Clamp Hook Digging

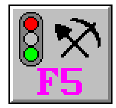
If the clamp hook is being moved down using the joystick and the lower switch is made for more than a second, the hook will simultaneously begin to alternate between in-feeding and out-feeding while maintaining down pressure. This speeds up positioning the hook to lift under the foot of the rail where excessive or cemented ballast would otherwise impede or prevent achieving this position.

Where manual traction has not been used to correct for stopping short or overrunning the next tie.[1]

Prior to this feature, the nature of the clamp joysticks is such that lateral and downward directions cannot be simultaneously selected. Using a clamp joystick to manually dig down into ballast was difficult and time consuming.

Run-out

1. Mark the last tie tamped before starting the run out if it is necessary to return to the same spot later in the day.
2. Press F5-Work Start/Stop/Resume on the Third Main Toolbar to open the Work Start/Stop/Resume Panel. Press F3-Ramp Out , when the F3 button is pressed a lift ramp is installed from the present lift to a minus 1 ½ inch (38 mm) lift at the default lift rate.



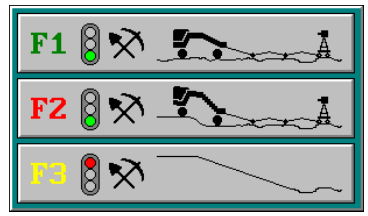


Figure 4-60

3. If possible it is best to keep the ramp less than 50 feet (15 meters) in length (projector to shadowboard) to keep the receiver from going out on unsurfaced track.

NOTE: When running out, ensure that the projector lights go out so that a smooth transition is made to unsurfaced track.

4. If the track has been pre-recorded, the operator may press F2-Throws Change Panel from the expanded track view screen and set the throws graph to where there will be no throws at the end of the run-off.

Preparing to Travel

1. Set the spring applied parking brake and release the travel/service brake.
2. Turn the L/H and R/H vibrators OFF by pressing in on the vibrator buttons on the bottom row of the L/H keypad.
3. Raise the workheads using the left and right workhead manual joysticks to their up most position. Lock the workheads into their safety locks by pressing the workhead lock button on the L/H keypad. Lower the workheads into the locks to ensure that they are truly locked.
4. Raise the clamp frame by using the two outside clamp frame joysticks. Pushing them forward will cause the clamp frame to rise to the upper limit switches of the clamp frame. Release the joysticks and push them again to cause the clamp frame to come up to its up most limits.

   Lock the clamp frame by pressing the clamp frame lock on the L/H keypad. Lower the clamps into their locks to ensure that they are truly locked.

7. Dismount the cab, go to the front of the machine. Remove the lock pins from the three hinged joints in the pusher bar. Flex each joint slightly then push the projector buggy toward the machine until it fully engages the lift arms. Install the projector buggy travel lock safety pins in each of the lift arms. Raise the lift mechanism by lifting the left and right

buggy lift valves. When the buggy is all the way up, engage the travel lock by pushing in on the travel lock valve. Then lower the buggy into the locks.

8. Remove the lining projector and store the projector cradle in its travel position.

Keep hands and fingers clear of all pinch points. All pinch points are clearly defined or painted red.

9. Raise the surfacing shadowboard by activating the valve located just ahead of the R/H workheads. Lock into place. Also, swing the liner shadowboards up to their travel positions and install the lock pins.
10. Swing the liner splashboard back against the side of the machine for track travel purposes.
11. Raise the receiver buggy by activating the valve on the R/H rear of the machine. Lower it into its locks and store the lining photocell.

Set the travel/service brake, release the spring applied parking brake, and select either forward or reverse travel and automatic on the L/H arm console. Release the travel/service brake, depress the foot pedal on the foot console in front of the operator and increase RPM's to maximum.

Restarting a Run-out

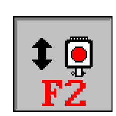
Keep hands and fingers clear of all pinch points. All pinch points are clearly defined or painted red.

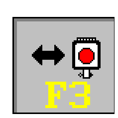
Make a note of the lift reading before starting a run -out.

1. Mark the tie where run-out began.
2. Return to the start of the run-out. Follow procedure for SETTING-UP the MACHINE for WORK and SETUP – BUGGIES.
3. Place the TRAVEL/WORK switch to the Work position.

NOTE: The surface & line reference and mile post settings should be checked.

4. Press F2-Surface Projector ON/OFF on the First Main Toolbar to enable the surfacing system. The projector emblem will be red if activated, or gray, not activated. Turning this projector ON enables the surface projector and lifting system.

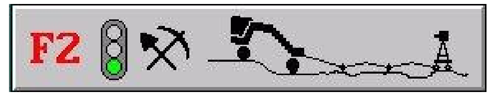




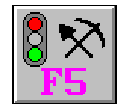
5. Press F3-Line Projector ON/OFF on the First Main Toolbar to enable the Lining system. The projector emblem will be red if activated, or gray, not activated. Turning this projector ON enables the lining projector and lining system.

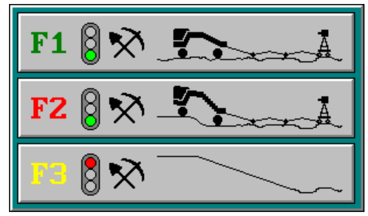
6. Move the machine to the first tie to be tamped (at least 5 ft or 1.5 meters); this will also allow the liner gauge wheels to properly bias to the reference rail.

7. Clear any existing track, track recording or fit, by using the F2-Wipe button. The F2-Wipe button is located on the third main toolbar button set.



8. Press F5-Work Start/Stop/Resume on the Third Main Toolbar to open the Work Start/Stop/Resume Panel. Press F2-Resume WORK to open the resume work panel.





This panel is used to resume or restore the lift, throws, superelevation and line of the previous run-out.

NOTE: "Resume Work"; The Resume Work panel will open using the values that were stored by the F3 key of the work start/stop/Resume panel thereby giving the opportunity to inspect, retain or change the display values before they are applied.

If the values were not stored using the Work Start/Stop/Resume Panel, the Resume Work Panel, allows you to re-enter this data manually before pressing ENTER to resume work.

Any adjustment made to surface, throws (line shift) or line is an "A" point adjustment.

The F3 and F4 keys can be used to select superelevation and curvature for modification prior to resuming work. Press the Enter key to accept or ESC will close this panel and returns to the WORK START/STOP/RESUME panel.

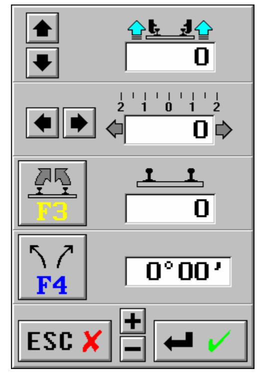


Figure 4-64

10. Follow the WORKING procedure before tamping commences. Refer to page 4-38.

Switch Lifting

Numerous variations will be encountered by different operators when lifting and lining switches and turnouts. There are a few rules to follow to successfully lift and line a switch to satisfaction.

- Ensure that all ties in the area to be lifted are secured to the rail by the appropriate fastening devices.
- Ensure that all ties in the area to be lifted are of good quality.
- Ensure there is enough ballast in the area to hold up the ties being lifted.
- If possible, have the raise established before entering into switch mode.
- ALWAYS visually inspect the bias wheels on the projector and receiver buggies to ensure they stay biased to the appropriate rail, especially in the point and frog areas.

When approaching the points of a switch, approximately three ties before the points the machine has to be switched into switch mode. Record the lift being established at this point. The projector is on the main line. Do a surface "hunt" or manually lower the receivers to the point of cutoff. Record this figure from the lift window.

Back the machine and all buggies to the point where the switch can be thrown to the turnout side. Throw the switch to the turnout side and carefully move the machine back to the same tie that it was originally on.

Do a surface "hunt" again with the projector now in the siding. Record this figure from the lift window. This will normally be a different figure from the one previously recorded. Whatever the difference was between the first two figures, i.e. from lights on to lights off, add this to the last figure and now the machine will be raising the track to the same height as it was when on the main line.

Turn the liner off. Commence tamping the track. When the machine enters into the frog area, (shadowboard) manually raise the outside receiver approximately ½". Continue through the frog area. When out of the frog area lower the one receiver back down to its original crosslevel status. Make a run off into the siding.

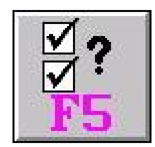
Throw the switch to allow the machine to be backed out of the siding. Throw the switch points back to the main line. Traverse the machine forward, returning to the same tie previously mentioned (three ties before the points). Re-enter the lift that was previously being made before going into switch mode. Turn the liner ON. Commence lifting, lining and tamping the switch. The turnout side is now up and supported and will allow easier lifting and lining of the switch.

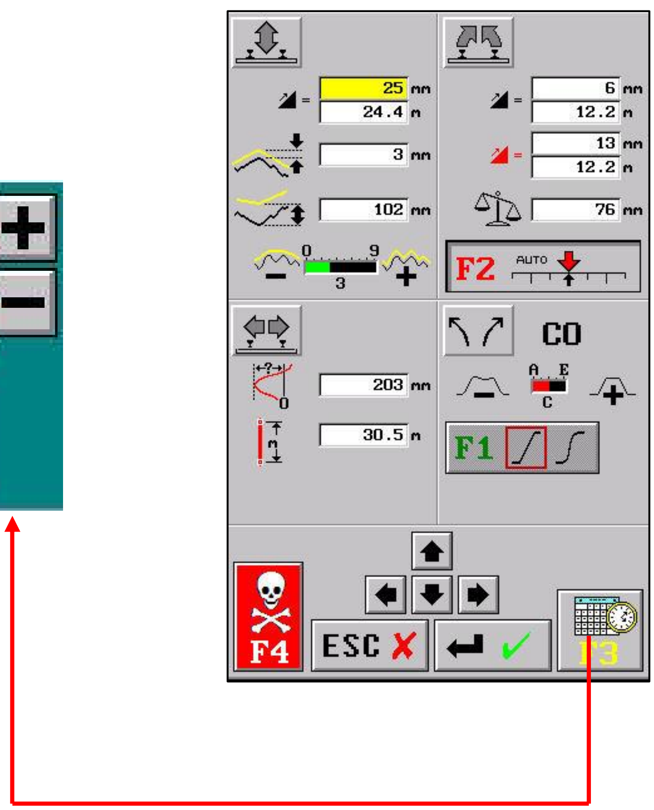
Each tie should be raised and tamped to ensure a good surface throughout the switch. All points of each tie should be tamped to consolidate the ballast at all points possible.

When lining the switch, make sure the workheads are not traversed out into the area whereas to interrupt the lining projector light.

Time and Date

Time and date are set from the defaults panel (F5 on the third toolbar of the expanded view). Press F3 to access the *Time and Date Set Panel.* Use the F1 key to toggle between the (desired) active fields. Press the plus/minus keys to adjust the time and date. **NOTE:** Yellow highlighting indicates active field.





Time and Date
Set Panel

Figure 4-65

LUBRICATION CHARTS AND SCHEDULED MAINTENANCE

MARK VI FLUID REQUIREMENTS			
COMPONENT	FLUID TYPE	SPECIFICATION	APPROX QTY. SEE NOTE 2
ENGINE	CRANKCASE OIL	SHELL ROTELLA T SAE 15W40 WITH XLA OR EQUIVALENT	23 QTS (22 L) MINIMUM
RADIATOR	ENGINE COOLANT	ANTIFREEZE PER ASTM D 6210	12 GAL (45 L) SEE NOTE 4
FUEL TANK	DIESEL FUEL	ASTM GRADE 2-D CLIMATIZED DIESEL FUEL	330 GAL (1250 L)
HYDRAULIC TANK	HYDRAULIC OIL	QUAKER STATE GRADE ISO-46 SEE NOTE 8	243 GAL (919 L)
WORKHEADS	VIBRATOR CRANKCASE OIL	SHELL ROTELLA T SAE 15W40 WITH XLA OR EQUIVALENT	6 QTS (5.7 L) PER VIBRATOR
CLARK 36000 TRANSMISSION (FRONT)	TRANSMISSION FLUID	TYPE THF J20C APPROVED	17 GAL (64 L) SEE NOTE 5
FUNK 12700 TRANSMISSION (REAR)	GEAR OIL	MULTI GEAR LUBE SAE 80W90	4 QTS (3.8 L)
TRACTION CLUTCH (if so equipped)	TRANSMISSION FLUID	TYPE THF J20C APPROVED	LESS THAN 1 QT. (FILL TO CHECK PORT)
EATON RS461 AXLE (FRONT & REAR)	GEAR OIL	MULTI GEAR LUBE SAE 80W90	7 GAL (26.5 L) SEE NOTE 7

SERVICE CHART

TYPE LUBE — A1 — FREQUENCY OF USE

2 — NO. OF FITTINGS

A GREASE, E.P. GRADE 2	B GEAR LUBE, E.P.90
C GRADE ISO-46	D WHITE LUBE, NON-DRYING
E MOLYBDENUM DISULPHIDE	F OIL 10W-30/10W-40
G TYPE THF J20C APPROVED	H 15W-40 OIL TYPE CE/SF

1 DAILY	2 WEEKLY	3 MONTHLY	4 SEMI-ANNUALLY	5 ANNUALLY

	COMPONENT	REMARKS
	DAILY / 10 HOURS	
1	ENGINE AIR FILTER	CHECK INDICATOR, IF RED - CHANGE FILTER
	ENGINE COOLANT LEVEL	ADD AS NEEDED (50/50 MIX)
	HYDRAULIC OIL FILTER	CHECK INDICATOR WHILE RUNNING AT OPERATING TEMPERATURE. REPLACE IF NECESSARY.
H1	ENGINE OIL LEVEL	CHECK LEVEL / ADD AS NEEDED
F1	VIBRATOR OIL LEVEL	MAINTAIN OIL AT 1/2 TO 3/4 FULL IN SIGHT GLASS WITH VIBRATORS IN VERTICAL POSITION
C1	HYDRAULIC OIL LEVEL	MAINTAIN 3/4 MINIMUM IN SIGHT GLASS
A1	VIBRATOR HOUSING PIVOT SHAFT	1 FITTING PER VIBRATOR
	WORKHEAD PIVOT SHAFT	2 FITTINGS PER VIBRATOR
	COMBO CLAMP FRAME	7 FITTINGS
	REAR SUSPENSION LOCKOUTS	4 FITTINGS
G1	FRONT TRANSMISSION OIL LEVEL	CHECK OIL LEVEL ADD AS NEEDED
	WEEKLY / 50 HOURS	
2	BATTERY	CHECK ELECTROLYTE LEVEL, ADD AS NEEDED
D2	LINER SHADOWBOARD GUIDE ARMS	1 FITTING PER GUIDE ARM
	SURFACING RECEIVER GUIDE ARMS	1 FITTING PER GUIDE ARM
A2	SHADOW BOARD LOCK	2 FITTINGS
	DRIVE SHAFTS	3 FITTINGS PER SHAFT, TWO GREASE SHOTS
B2	AXLES & REAR TRANSMISSION	CHECK OIL LEVEL, ADD AS NEEDED
	MONTHLY / 200 HOURS	
H3	ENGINE OIL AND FILTER	CHANGE OIL (23.7 QUARTS) AND FILTER
3	FUEL FILTERS (2)	CHANGE
	ENGINE FAN BEARING	CHECK FOR WOBBLE OR EXCESSIVE END PLAY
	AIR SYSTEM FILTER	CLEAN FILTER
	FRONT TRANSMISSION FILTER	CHANGE
	FRONT TRANSMISSION SCREEN	CLEAN
F3	VIBRATORS	CHANGE OIL
A3	FRONT AXLE PIVOT BUSHING	2 FITTINGS
	FRONT & REAR BRAKE LINKAGE	8 FITTINGS
	PROJECTOR BUGGY PUSHER BAR	4 FITTINGS
E3	WORKHEAD TRAVERSE CHAIN	CLEAN AND LUBE
	SEMI-ANNUALLY	
4	AIR DRYER	CHANGE DESICCANT
G4	FRONT TRANSMISSION	CHANGE OIL
	ANNUALLY	
5	HYDRAULIC SUCTION STRAINER	CLEAN STRAINER AND MAGNETIC PLUG
C5	HYDRAULIC TANK	DRAIN AND CLEAN
B5	AXLES & REAR TRANSMISSION	CHANGE OIL

SEE ENGINE & TRANSMISSION MANUALS FOR COMPLETE LUBRICATION AND PREVENTIVE MAINTENANCE INFORMATION, ESPECIALLY WHEN OPERATING IN EXTREME TEMPERATURE CONDITIONS.

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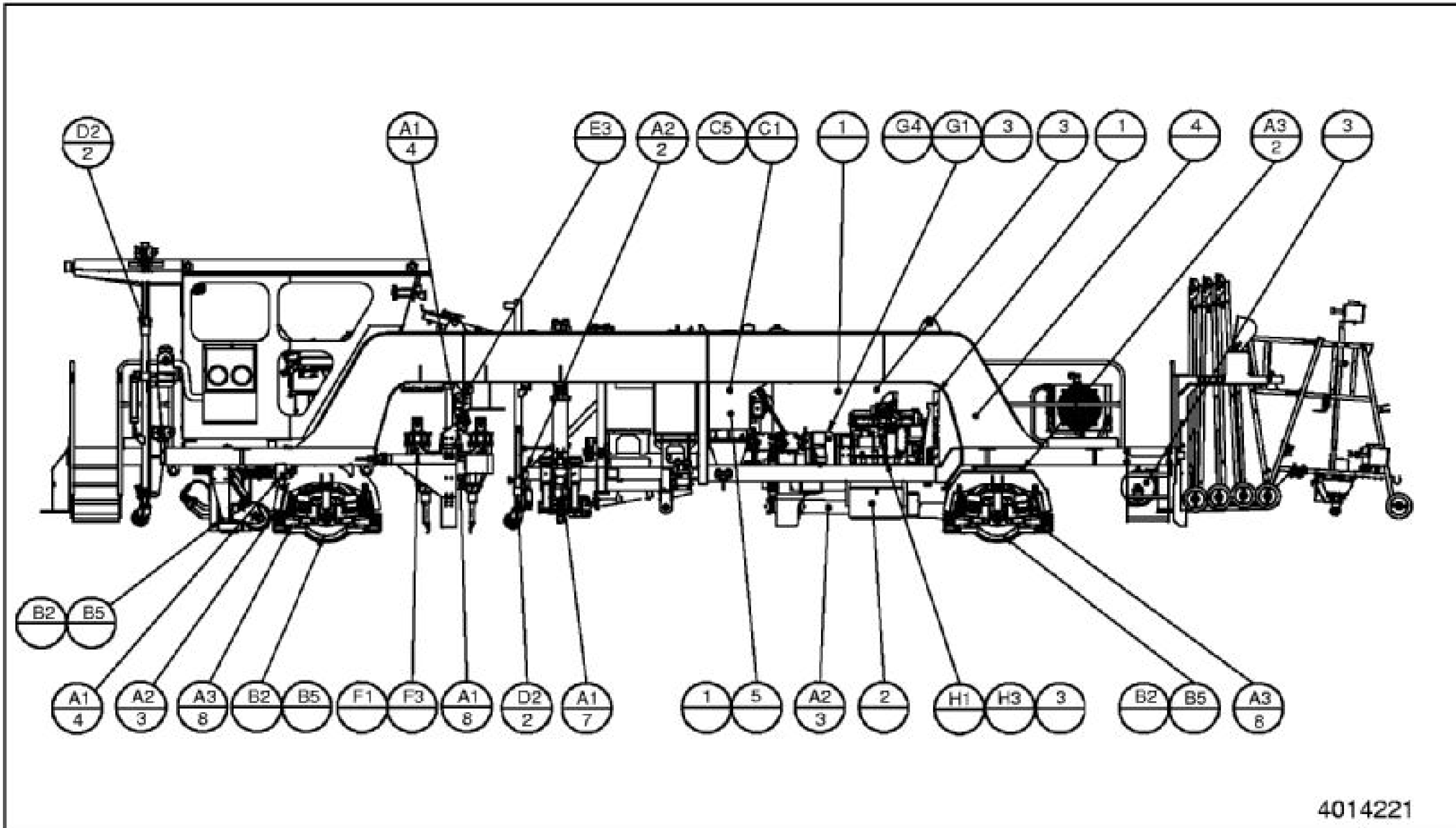


D2 2
A1 4
E3
A2 2
C5
C1
1
G4
G1
3
3
1
4
A3 2
3
B2
B5
A1 4
A2 3
A3 8
B2
B5
F1
F3
A1 8
D2 2
A1 7
1
5
A2 3
2
H1
H3
3
B2
B5
A3 6
4014221

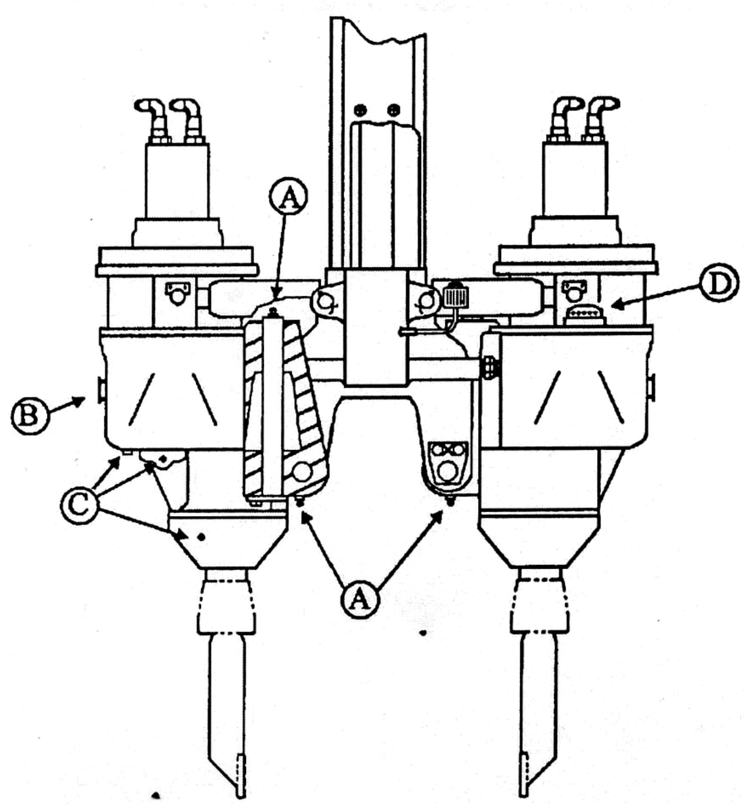
Workhead Assembly

A. Grease daily with EP grease. Grease with components warm to ensure positive grease flow. Grease in raised and lowered positions until new grease displaces old grease. One top, two bottom, each vibrator.

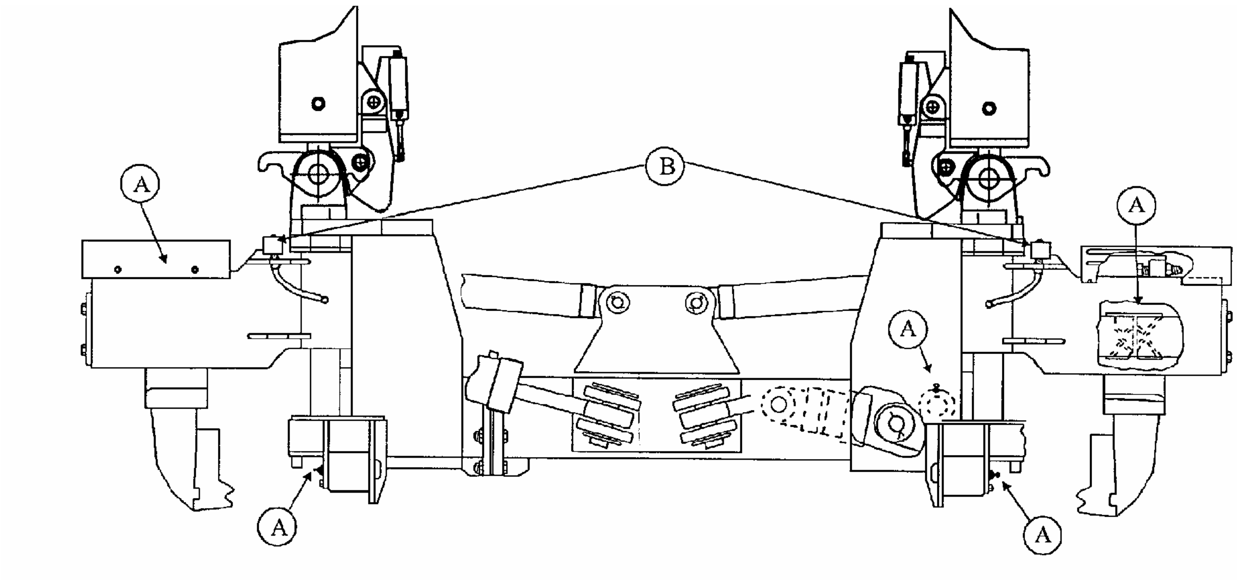
B. Check oil level daily. Should be 1/2 to 3/4 full in sight glass with workhead in upright position. SAE 10W40 XHD.

C. Change vibrator oil every 200 hours by removing all six plugs. Refill to sight glass with SAE 10W40 XHD. (6 quarts.)

D. Vibrator oil fill location.



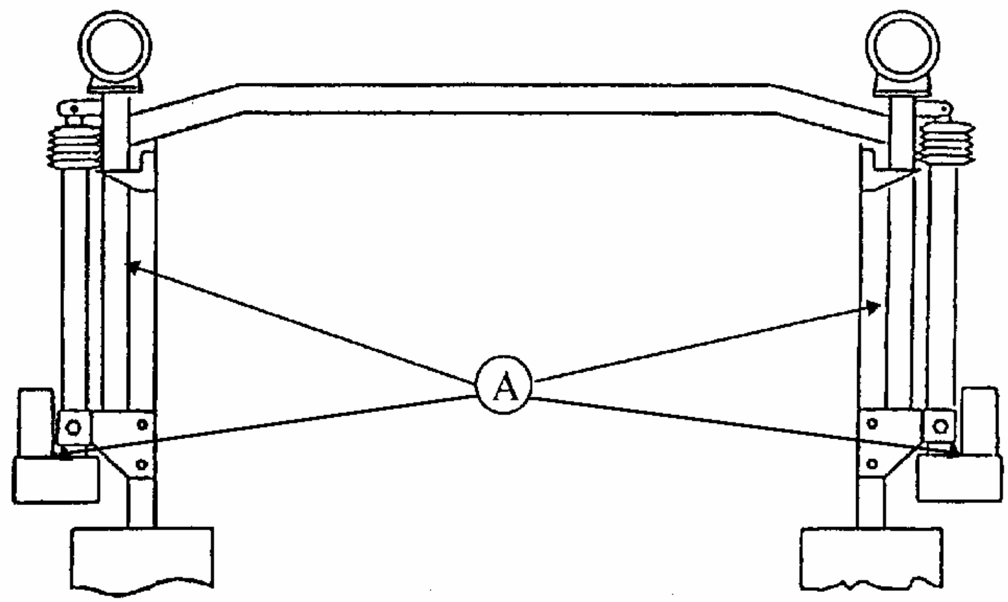
COMBO CLAMP FRAME



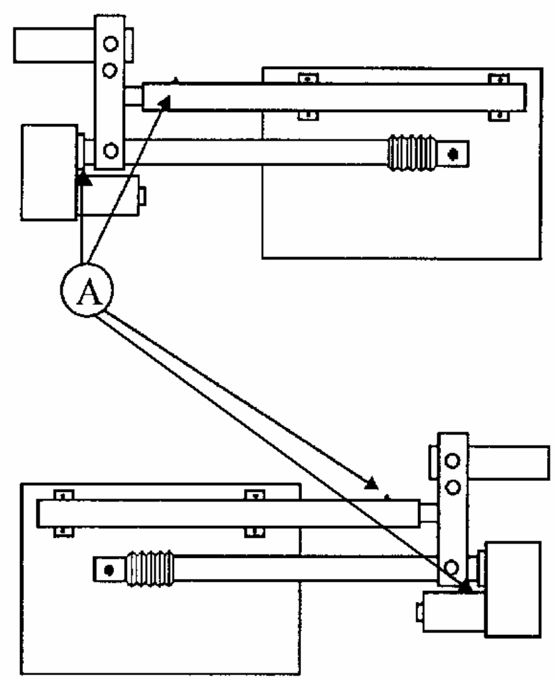
Grease Daily with EP grease	Right	-	Bias Plate Shaft	1 grease zerk
			Wheel Shafts	2 grease zerks
			Hook Extend Rod	1 grease zerk
	Left	-	Wheel Shafts	2 grease zerk
			Hook Extend Rod	1 grease zerks

Actuators.

Surfacing Actuators



Lining Actuators



A. Grease sparingly with Lubri-Plate. Once per month.

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Chapter 5

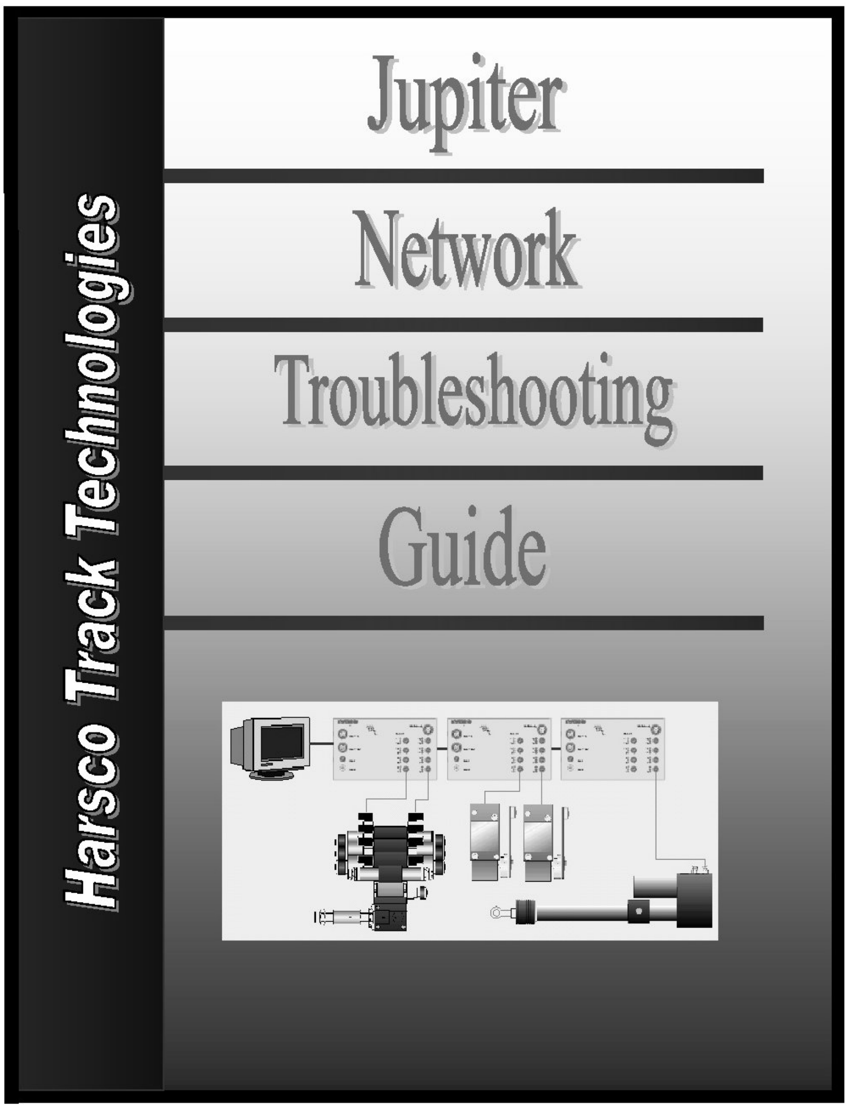
GENERAL TROUBLESHOOTING PROCEDURES

Most troubles can be categorized into six general areas:

1. **Operator Problem**
2. **Mechanical Problem**
3. **Hydraulic Problem**
4. **Electrical Problem**
5. **Pneumatic Problem**
6. **Jupiter Network Problem**

Isolate the problem to one or more of these systems.

For Jupiter related problems, refer to the "Jupiter Network Troubleshooting Guide" in rear of this manual (Appendix A).



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Rev. 1

Linear Actuators

Surfacing receivers on the *MK VI* Tamper are moved up and down by specially designed ball-screw linear actuators.

There are two linear actuators on the *MK VI* used to operate the left and right surfacing receivers. The linear actuators require 24 Volts DC power and have a stroke (maximum extension) of 18 inches (229 mm) . See figure 5-1.

All of the actuators have 10-turn 10,000 Ohm potentiometers (pots). These pots provide continuous feedback voltages to the analog input module. When electrical power is connected to the potentiometer, an output voltage is produced which is proportional to the actuator location. This voltage is then converted from an analog signal (volts) to a digital signal or number, which the computer system can use.

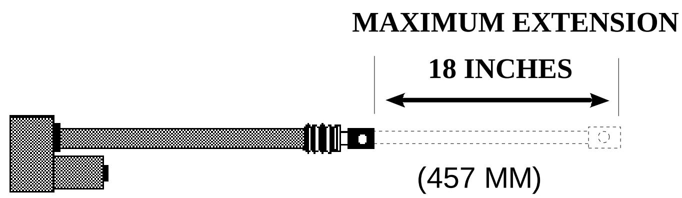


Figure 5-1

For example, when the motor on the actuator is turned ON, the gear on the motor shaft turns which drives the gear mounted on the potentiometer shaft. If the actuator is driven up or out the feedback voltage (signal) from the potentiometer should rise in the positive direction (toward +9.5 VDC). If the actuator is driven down or in, the feedback voltage (signal) from the potentiometer should decrease or move in the negative direction (toward -9.5 VDC).

Potentiometer Installation

The following procedure can be used to “zero" a potentiometer (pot) in a linear actuator.

1. Remove the screws from the pot mounting bracket.
2. Carefully remove the pot by moving it away from the worm gear. Make sure you do NOT damage the pot.
3. Center the linear actuator rod by moving it out **EXACTLY** nine (9) inches (from the fully retracted position), using the manual override switches.
4. **Gently** turn the pot, in either direction, as far as possible (until it stops).
5. Center (zero) the pot by turning it in the opposite direction for a total of five (5) complete turns (the pot has a total of 10 turns from one end to the other).
6. Install the pot in the linear actuator.
7. Install the linear actuator on the machine.

Actuator Calibration

Why Calibrate the System?

The *MK VI* uses many components in the process of getting information from the track to the computer. These include mechanical components, computer hardware (circuit boards, etc.) and the program software. The mechanical components are subject to wear and mis-adjustment. The electrical components vary in the way they convert signals, due to component tolerances and other conditions. But they must all work together in order to work properly. Calibration is simply adjusting the hardware and software so that the information it uses is correct and in the format required by the program.

You need to set up an actuator if any one of the following conditions exist.

- The machine is being used for the first time.
- An actuator is repaired/replaced.
- The potentiometer (pot) located in an actuator is replaced.
- The pot gear in an actuator is replaced.
- The set up has changed because the set screw, which is located on the pot gear, was loose and the gear slipped. Loctite should be used to secure the screw.
- The linear actuator motor has been changed.

NOTE: If the quality of surface is not up to standard and a problem is suspected, it is highly recommended to re-calibrate the actuator as a quick and simple troubleshooting technique.

If you need to replace a motor in a linear actuator, make sure the replacement motor is 36 volts DC. The machine is 24 volts DC which means the speed of the motor is reduced. This assures that the movement of the linear actuators is accurate.

Make sure the four (4) values referred to as control constants are set up for each linear actuator. These values are stored on the JAM Box and backed up in permanent storage. For actuator setup information refer to section 4.

Troubleshooting

1. Actuator will NOT move.

- Press the actuator manual override button in and try to move the actuator with the manual switches. The manual override is wired directly and by-passes the computer control.
- Check for 24 volts DC at the motor.

2. Actuator moves but ACTUAL values on screen do not change.

- Check for broken or damaged cable or loose wire(s) to the pot.
- The wires are NOT connected to the correct terminals on the pot or the pot has failed.
- Check voltage (+9 and -9 VDC) output from the Jupiter Diagnostic Screen.

3. Actuator does not indicate current Position.

- Check voltage (+9 and -9 VDC) output from power supply to the pot.
- Check for broken or damaged cable or loose wire(s) to the pot.

4. Actuator retracts without computer control.

- Check for problem with the +9 VDC wire (pin #1 on pot).
- Check the red and yellow wires on the motor (may be reversed).

5. Actuator extends without computer control.

- Check for problem with the -9 VDC wire (pin #3 on pot).
- Check the red and yellow wires on the motor (may be reversed).

Inclinometer

The *MK VI* uses an inclinometer, mounted on the receiver buggy, for several functions. It is used by the surfacing system to monitor the track level behind the machine and by the measuring system to measure curve elevation.

The inclinometer outputs a voltage signal which is sent to the analog input module. As the track tilt changes, the voltage sent back to the input module will change. The processor, reacting to the voltage change, will instruct the module to turn on the appropriate surfacing actuator motor relays. The actuator(s) are driven up/down as necessary in order to maintain proper cross level behind the machine.

The measuring system processor, uses the inclinometer information during the curve recording process to locate existing ramps and areas of bad cross level. This cross level information is used during the curve lining process to achieve greater correction of lining than would be possible if the signal was not used.

The inclinometer is fully self-contained and designed to operate from a standard DC power source. The output is an analog DC signal directly proportional to the sine of the angle of tilt. The maximum tilt of the inclinometer used on the *MK VI* is ±14.5 degrees from horizontal. The output voltage will be +5 volts DC when tilted +14.5 degrees and -5 volts DC when tilted -14.5 degrees.

The core of this gravity-referenced sensor is a FLEXURE-supported torque-balance system, rugged enough to withstand severe shock and vibration and still maintain accuracy. The electronics and sensor are enclosed within the sealed housing which is filled with a light oil for dampening purposes, permitting operation in hostile environments.

Principles of Operation

As the inclinometer is moved the **TILT ANGLE "0"**, and the **PADDLE "A"** tries to move in the direction of the tilt (due to force of gravity). The result in change is relative to where **PADDLE "A"** is to the **POSITION SENSOR "B"** which produces an error signal input to the **SERVO AMPLIFIER**. This drives **TORQUE MOTOR "C".** The motor immediately drives the **PADDLE "A"** back until the **SENSOR "B"** detects that the **PADDLE "A"** has returned to its original position, less a minor displacement to produce an error signal. In order to hold **PADDLE "A"** at null position a current is required; this current is supplied by the **SERVO AMPLIFIER** and is proportional to the sine of the angle of tilt. By permitting the current to pass through a stable resistor **R1**, a directly proportional voltage output is developed. Stops are provided on both sides of the **PADDLE** to limit its travel when not powered.

When power is applied, the **PADDLE** moves to its null position for a few seconds until an error signal can be established by the **SENSOR** system. See Figure 5-10.

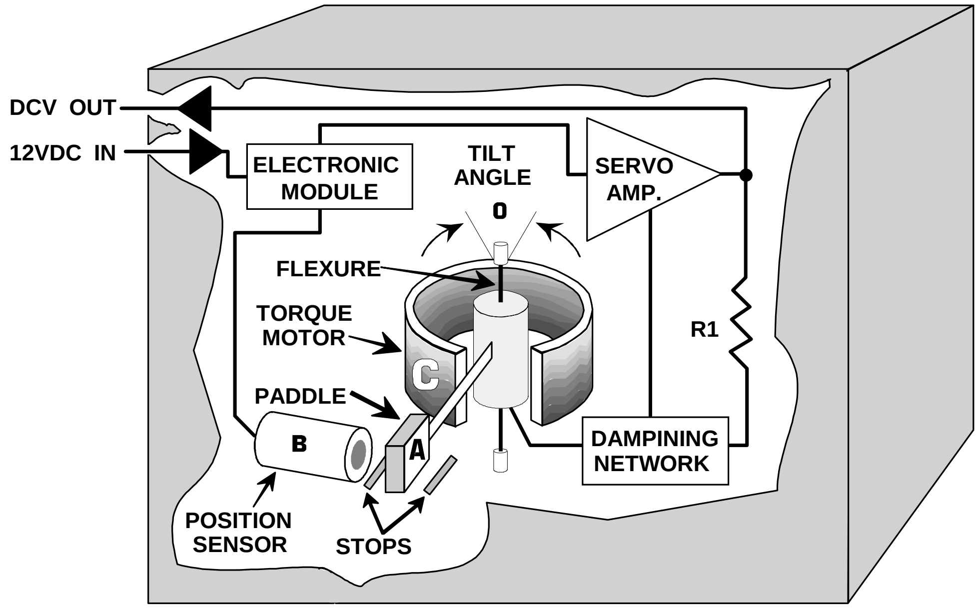


Figure 5-10

Inclinometer Zero

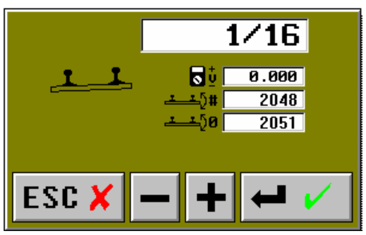


Figure 5-11

The inclinometer screen is used to set a zero for the surface leveling system. See Figure 5-11.

The operator must measure the cross level of the track with a level board and then use the plus (+) and minus (-) keys to change the value displayed in the inclinometer reading information box to match the actual track level. Once the zero is set this window may also be used to display the actual cross level of the rail at any time.

Troubleshooting

Power for the inclinometer is supplied by the main power supply through the analog input module. The voltages applied to the inclinometer are +12 and -12 volts DC. Ground for this circuit is provided by a common wire (**COM**). A signal wire provides the signal back to the analog input module where it is fed to the JAM Box.

If a problem is suspected with the inclinometer, stop the machine and access the INCLINOMETER READING screen (shown in figure 5-11) and monitor the inclinometer voltage and digits. The output voltage seen should be very stable and the digits should not fluctuate more than ±5 digits. The following tests can be performed if the readings appear suspicious, absent or erratic.

NOTE: The INCLINOMETER READING screen will display default values if the signal is missing. The digits box should read -4048 and the voltage box should read -10.

1. Place a spacer under one of the receiver buggy wheels. The calibration factor for the inclinometer is 68 digits per inch of track elevation. If a block of lumber 2” x 4” x 1 1/2" thick (51 x 102 x 43 mm) is placed under one of the wheels the screen value displayed would change by approximately 102 digits (1.5 x 68). The inclinometer signal changes in the positive direction for right hand curves and in the negative direction for left hand curves.

PIN CONFIGURATION FOR INCLINOMETER CONNECTOR PLUG

Pin A: (+ 12 VDC) Pin B: (COMMON)

Pin D: (SIGNAL) Pin C: (- 12 VDC)

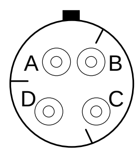


Figure 5-12

2. Disconnect the cannon plug from the inclinometer for the following tests.

   With the computer turned on measure power supply voltages to the inclinometer. Use pin B (COMMON) as the ground for these measurements. Refer to the plug pin connections shown in figure 5-12.

   - Pin: B to Pin: A (+12 VDC) plus or minus 0.1 volts
   - Pin: B to Pin: C (-12 VDC) plus or minus 0.1 volts

3. If the voltages at #2 are not present verify continuity of all wires in the cable. The best way to check the cable is to run an “overland” wire to the MCB box and ring out each conductor of the cable. This should be done with the computer turned OFF.

4. Unbolt the inclinometer from the cross bar and ensure that the mating surface is clean and free of bumps or weld marks etc. Bolting the inclinometer to an uneven surface can cause problems or even unit failure. Measure the signal voltage at the Analog Input Module. You should see a voltage change when the inclinometer is tilted from side to side. The signal is positive from the zero signal for right rail elevation and negative for left rail elevation.

Troubleshooting Encoder Using a Logic Probe

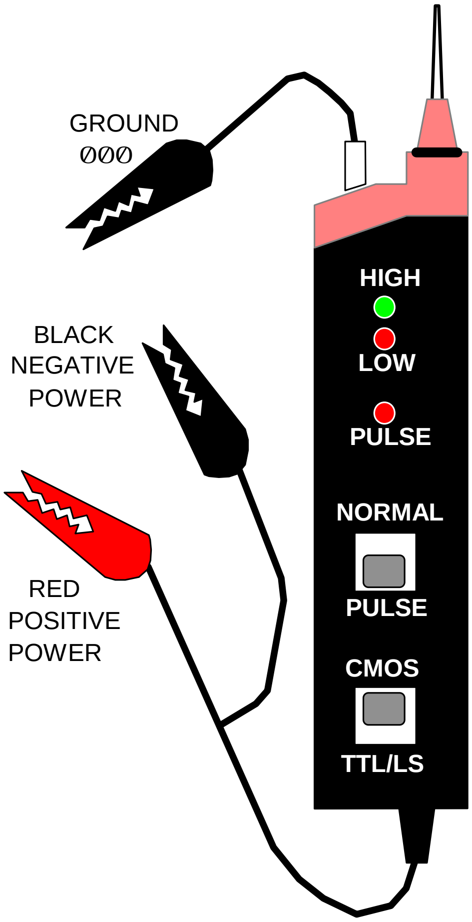


Figure 5-15

Indicators On The Probe

- **HIGH** input signal at high state or near supply voltage when this LED is on.
- **LOW** input signal at low state or near supply ground when this LED is on.
- **PULSE** transition from HIGH to LOW to HIGH has occurred when this LED is on.

Set the logic probe to PULSE and CMOS. Attach BLACK lead to COMMON (pin 18) and the RED lead to +12 VDC (pin 17). Spinning the encoder shaft in either direction should produce pulses on terminals of the P2 connector. Place the probe on these terminals 2 or 4, one at a time and watch the HIGH LOW LEDs blink. See Figure 5-14

Switches On The Probe

- **MEM/PULSE** In **PULSE** position the PULSE LED blinks with each input pulse. In the **MEM** position transitions are latched into. This will hold the state of a very fast pulse. To reset, move switch to PULSE and back to MEM.
- **DTL-TTL/CMOS** CMOS selects the voltage range for the supply and input signals. CMOS devices have a high supply voltage to reduce the current draw. They are typically powered by +12 to +15 VDC. **DTL-TTL** devices are typical ICs with a supply of +5 VDC.

Power Shift Transmissions

What is a Power Shift Transmission?

A power shift transmission has two or more gear reductions, or speeds, and is capable of shifting gears while moving and under load. This is accomplished by the special design of the transmission.

All gears in a power shift transmission are always engaged or meshing. They are never disengaged and re-engaged as in non-power shift transmissions, which can cause wear and chipping teeth and improper shifting. What determines the gear ratio in a power shift transmission is one or more clutches. Even though all mating gears are engaged and meshing, power cannot be transmitted unless one of the clutches is activated. Unless that occurs, the clutches simply slip freely, as they are designed to do, allowing the transmission to freewheel.

When one of the clutches is engaged, it effectively engages that gear allowing power to be transmitted. To shift gears, the currently actuated clutch is disengaged, and a movement later, the other clutch is engaged. This prevents the shocks caused by shifting non-power shift transmissions, resulting in smoother operation and longer life.

In addition, since the clutches are actuated by oil pressure distributed through valving, operation of transmission shifting can be done remotely and be interlocked in such a way as to reduce or eliminate the possibility of improper operation.

Power Shift Transmission Operation

A power shift transmission requires a source of lubrication and clutch pressure oil for its operation. A small hydraulic pump, which is part of the *MK VI* transmission, is used for this purpose. Transmission lubrication oil is pumped to the control valve on the side of the transmission. When in neutral, no voltage is applied to the valves, so the oil flows through a filter and then to certain lubrication points within the transmission.

When the appropriate solenoid valves are actuated, pressure is routed to corresponding clutches, engaging that gear.

Checking Transmission Oil Level

When the transmission oil level is checked, at intervals outlined on the machine lubrication chart, the engine should be running so that continuous flow is supplied to the transmissions.

Emergency Travel Override Control Switch

The Emergency Travel Override Control Switch is located inside the Master Control Box, it determines the shifting mode of the transmissions. Normally, this switch will be left in the Automatic position. In this position, the Jupiter Control System has control of all gears. If a problem with the computer system prevents its operation, moving the switch to the Manual position will bypass the computer circuitry and shift the transmission into a lower gear.

Available Gears

The two transmissions are identical, each with a low and high gear, both of which are controlled by the power shift clutches and valves. The front transmission has a hydraulic drive motor with a fixed displacement of 125 cc. The rear transmission has a hydraulic drive motor with a changeable displacement of 160 cc to approximately 40 cc. The stroke of this motor is controlled electrically giving it effectively two speeds or "gears".

By combining the transmission gears with the motor displacement, four effective speeds are produced. These are:

Gear	Approx. Max Speed
1st	10 mph (16 kph)
2nd	20 mph (32 kph)
3rd	34 mph (55 kph)
4th	50 mph (80 kph)

The Jupiter Control System, using the push buttons located at the operator's station, controls these gears electrically through the transmission solenoid valves. Shifting is controlled and limited by the computer system to help prevent improper operation.

The various gears listed above are available in Travel mode only; in Work mode, only first gear is engaged.

Computer Transmission Control

Whenever the machine is placed into Travel mode, a window appears on the computer monitor giving additional information, as shown on the diagram. The panel shown on the computer duplicates the positioning and marking of the buttons at the operator's station (s).

The panel shown on the computer, duplicates the positioning of the buttons on the Front Control Panel or the Left Hand Keypad.

At the top of the panel, the speed of the machine is displayed. Just below and to the right is the status panel for the two speed tachometers. A green check indicates the tachometer is functioning properly and a red “X” indicates a problem. Only one tachometer has to be functioning properly for accurate speed measurements.

The mechanical disconnect status and limit switches are shown to the left of the tachometer status panel. Two small status boxes represents the mechanical disconnect limit switches (lower box-yellow when engaged) The green check or red “X” indicates this condition is acceptable for the current mode. NOTE: the mechanical disconnect should NOT be engaged in travel mode and should be engaged in the work mode.

The first column of four buttons indicate the four travel gears, 1st through 4th. Again the button that has been depressed will be shown are the depressed and yellow on the screen; the red arrow shows the gear chosen by the computer.

In the second column, the top three buttons control the direction of travel. The top button indicates travel in forward direction; the third button indicates travel in reverse; the second button indicates neutral, with no gear engaged. Whenever a button is depressed, the button will appear depressed on the screen, and will turn yellow. The red arrow to the left of the buttons indicates the selection chosen by the computer, which may under certain circumstances be different, as will be explained.

The fouth button in the second column, indicated by the word "AUTO" and 2 horizontal gears symbol, is used for Automatic gear shifting. This button is located in the third column on the Front Engine Control Panel and the Left Keypad.

Foot Switch Operation

Whenever the foot switch is not depressed while in the Travel mode, the transmissions shift to Neutral. When the foot switch is depressed again, the selected gear and direction will be chosen, as long as they are appropriate.

Direction Interlocks

The computer system will not allow a change in direction (forward to reverse or reverse to forward) at a speed above 1 mph. Therefore, if, while traveling at speed in one direction, the button for the other direction is depressed, the direction will not be changed. The button will be shown depressed, but the red arrow will stay at the position of the original direction. If the machine is slowed to under 1 mph, then the opposite direction will automatically be selected. In addition to the fact that the red arrow is not at the selected direction, a message will appear in the Mark VI's alarms screen.

Speed Interlocks

Since the computer is constantly monitoring machine speed and desired gear, it is able to prevent improper shifting. If a new gear is selected which has a maximum speed lower than the current machine speed, shifting does not occur. The selected button appearing depressed and yellow, but the red arrow staying at the previously selected gear will indicate this. A message will also appear in the alarm panel. Shifting will only occur when the machine speed has slowed to the allowable range for the selected gear.

No interlock is required to up-shift, for example from 2^{nd} to 3^{rd}. Starting in a higher gear may be desirable under slippery conditions in order to help prevent wheel slip. When attempting to shift back to a lower gear, however, the computer will check the actual speed against the allowable speed for that gear to determine if shifting can be allowed.

Speed Indicators

Two speed sensors are used. These will display the speed being provided by each transmission. The speed sensors located on the output yoke of the transmission sends an electrical pulse for each gear tooth that passes its location. The computer then counts and keeps track of the pulses to determine distance along the track, and calculate speed using distance and time. The speed display is in miles per hour or kilometers per hour, as requested when the machine is ordered.

The two speed displays should be the same. If the signal from the sensor is intermittent or unavailable, the speeds will be different. These two speed displays can be used in troubleshooting a bad speed sensor, to determine which may be bad and if the problem is intermittent or continuous.

The computer decides which of the two signals to use; the speed corresponding to the signal it uses will be displayed as the larger speed display at the bottom of the screen. In first gear, where wheel slip is most likely to occur, the computer uses the lower of the indicated speeds if both sensors are considered as working correctly. In second and higher gears, the higher of the two sensor speeds is used.

Every time the foot switch is lifted, and the transmissions are therefore in Neutral, the computer compares both speed signals. As long as the two signals are the same within a certain tolerance, it considers both sensors as working. If one signal is lower by a significant amount, it considers that sensor as bad. A speed from a sensor that is considered, as bad is not used; however, the next time the foot switch is lifted, both sensors are checked again.

When a sensor is considered bad, that speed indicator will be shown in yellow rather than the normal white. If later found to be operating correctly, it will again be shown in white.

When one sensor is considered to be bad, Automatic shift mode is disabled, as covered below.

Automatic Shift Mode

While in Automatic Shift mode (the automatic button depressed), shifting is controlled automatically by the computer. Note that a speed will normally remain selected and shown, but automatic shift mode overrides this value.

Automatic mode will upshift from 1st to 4th at various speeds as appropriate, and also downshift automatically. Operation in each gear will be at proper speeds to provide safe operation with good performance. If the foot switch is lifted and re-engaged, the computer will shift into the most suitable gear automatically.

Normally, Automatic shift mode provides the easiest operation and best performance and acceleration. Therefore, it may be best to use this feature most of the time in Travel mode. Use of the selected gear (by un-selecting Automatic mode) is appropriate when limited acceleration is desired to help prevent wheel slip under bad traction conditions or when it is desired to limit maximum speed.

In the event that one of the speed sensors is considered as bad, the computer will disable Automatic shift mode. A red “X” beside the Automatic button will indicate this. When this occurs, normal manual shifting will be allowed, within the required speed limitations, but automatic shifting cannot be made safely, and therefore, will not be allowed.

Emergency Towing

When towing this machine, it is essential that the "towing disconnect" shifter on the front powershift transmission be in the disconnected position. It is equally important that the gearbox on each rear axle be disengaged as well. If the transmission and gearboxes are not disconnected, towing the machine will cause severe damage.

Connecting and disconnecting the transmission and gearboxes is done by a pneumatic cylinder on each side. Because disconnecting for towing is so important, the pneumatic circuit is designed such that anytime the machine is turned off, the machine defaults to the towing condition.

Despite these design features, when beginning to tow the machine, the operator should verify that there is no wheel slip, or any other sign that would indicate that one or more of the components is not disconnected.

Projectors, Receivers and Photocells

The projector system that is currently being used on all Tampers with a surfacing system has been used since 1964. A number of improvements have been made to this system to improve the operation and the reliability. However, to maintain this reliability, there are a number of things we need to know about how this system operates. We will now look at the operational theory of the light system.

Mounted on the projector buggy is a 24 volt infra red projector. The projector is producing a modulated beam of light that is transmitted back to two receivers on the rear of the machine. This beam is modulated at a frequency of 482 impulses of light per second. The receivers are designed to receive this frequency and will not work properly with any other frequency. This is done to prevent the receivers from picking up light from other sources such as signal lights, train headlights, automobile headlights etc. Refer to figure 5-17.

On a Mark VI machine the projector chopper motors are DC. motors and are affected by the voltage at the chopper motor. The voltage to the motors must be set at 15 volts DC and can be adjusted with the R1 potentiometer located on the motor speed board (measure between pin 5 and pin 15 and adjust R1 to 15 volts). At this voltage the projectors are producing a frequency of 482 impulses per second (+ or - 5%). If this frequency is either lower or higher than this designated frequency, the signal strength to the receivers is diminished. If this frequency gets outside the operating band width of the receiver, the receiver will not work. When the signal strength is diminished, cross level problems will start to be encountered.

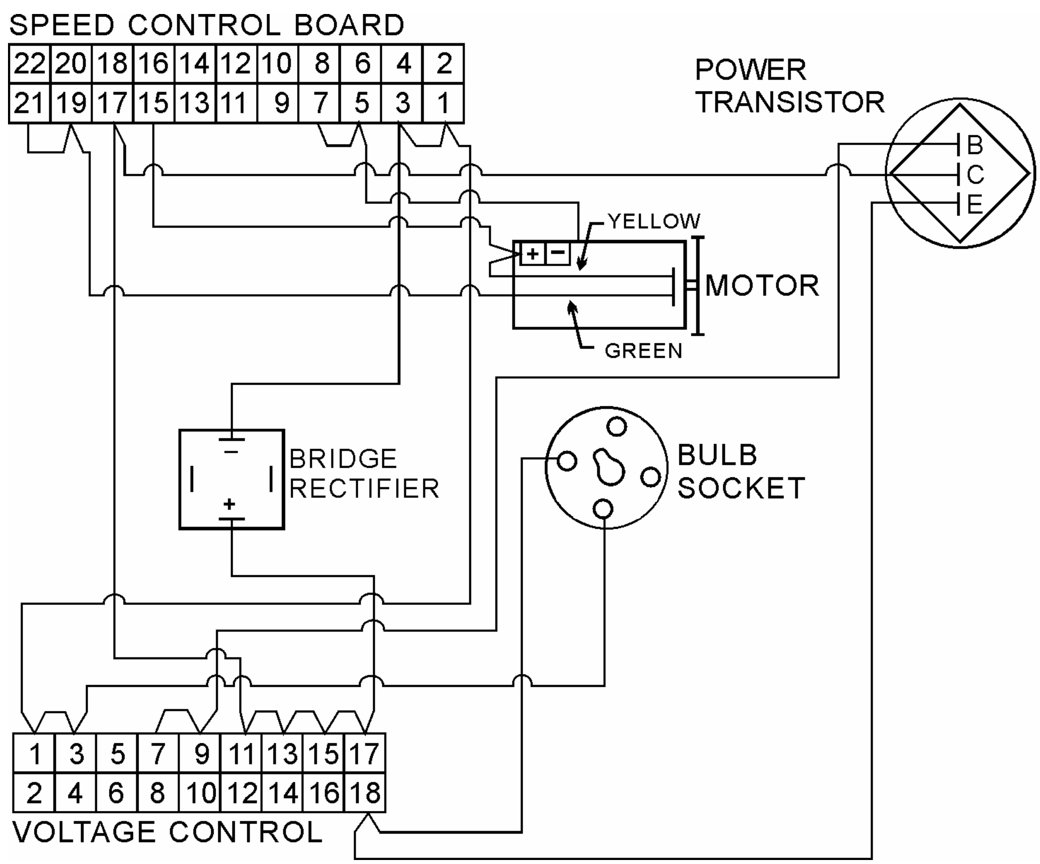


Figure 5-17

The next major concern in the projectors is the amount of light that's being produced, along with the alignment and focus. The intensity of the light from the projector bulb is determined by the bulb voltage. This voltage is approximately 17 volts and can not be altered therefore eliminating any major problems. The focus and/or the alignment can cause cross level problems, therefore needs to be checked periodically.

Focusing Procedure

To focus the new style Halogen bulbs, it will be necessary to turn the projector on. Remove the red filter lens cap, and position a piece of white paper perfectly vertical approximately 6" - 8" away from the projector tube. Make the necessary adjustments to the bulb base to insure that the image on the paper has a well defined circular pattern of light, i.e., no shaded areas on the perimeter of the circle. See Figure 5-18.

As you can see by the adjustments described herein, the projector plays a very important role in producing quality surfaced track with good cross level.

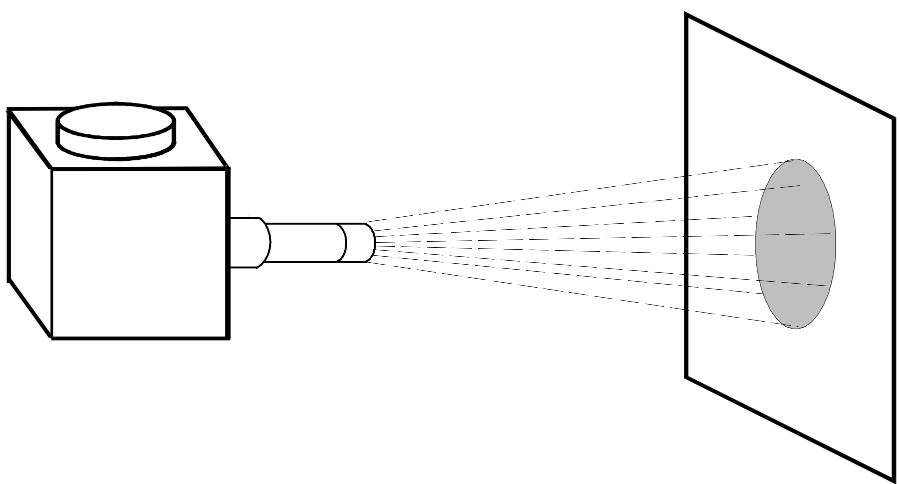


Figure 5-18

Double Barrel Receivers

The Double Barrel Recieves are state of the are solid state electronic, optical receivers designed to mimimize effects of dust and reflected light. No receiver amplifier is used with the Double Barrell receivers**.**

Operation

The Double Barrel receivers pick up the light beam from the projectors and converts the light into an electrical signal that is directed to a Jupiter input module. When the input module receives a high signal (+24 volts DC) from the Double Barrel receiver Jupiter turns on the corresponding indicator lights to illuminate which indicates that jacking or lining will occur. When the operator initiates cycle, the computer energizes the jacking or lining outputs, which supply power to the valves. Jacking or lining occurs until the shadowboard intersects the infrared light beam. With the light beam now blocked, the computer de-energizes the outputs and turns off the indicator lights.

Troubleshooting

In troubleshooting this system, you may encounter one of the following problems.

1. No surface light .

- No projector light.
- Chopper disc in projector not turning proper speed.
- Projector not aligned or out of focus.
- Shadowboard blocking the beam.
- Defective receiver.
- Improperly connected or defective receiver cable.

2. Surface light won't go out.

- Light shining or reflecting around shadowboard.
- Defective receiver

3. Intermittent surface light or beam light.

- Chopper disc in projector not turning proper speed (15 volts DC at motor).
- Projector not aligned or out of focus.
- Defective receiver.
- Defective amplifier or differential potentinometer not properly set.
- Improperly connected or defective photocell cable.

If you suspect the problem to be in the receiver, swapping it out with a known working unit is one way to diagnose the problem.

Chapter 6

HYDRAULICS

Hydraulic power is the conversion of mechanical energy into fluid (hydraulic) power and reconverting this back into mechanical power. This system is used extensively in the railroad industry because of its many advantages. Some of these advantages are:

A. Relatively simple design
B. Flexibility and portability
C. Smoothness and quietness of operation
D. Easy to control
E. Relatively low cost
F. Automatic overload protection

Hydraulics is divided into two sciences. These are **hydrodynamics** and **hydrostatics**.

Hydrodynamics is the study of moving liquids. A water wheel or turbine is turned by the energy of fluids forced against blades or vanes. This system uses the energy stored in moving liquids to do work.

Hydrostatics use liquids in a confined area. The liquid must move or flow to cause motion, but the movement is incidental to the force output. The transfer of energy takes place because a quantity of liquid is subjected to pressure.

With the above information in mind, we must look at the practical aspects of hydrodynamics and hydrostatics. There are several terms of importance. Two of the most important are **pressure** and **flow**.

Pressure and flow are interrelated when considering hydraulics, however, each has its own particular job to do, and, has its own individual operating characteristics. Pressure is directly related to the force or power that is exerted in a hydraulic circuit.

Flow is responsible for movement, or, causes motion.

Both flow and pressure are normally present in any operable hydraulic circuit, and, one without the other, generally is of little use.

Since they do have their own individual operating characteristics, we must consider the study and troubleshooting of each one separately.

Flow - Flow is measured in G.P.M. (gallons per minute), and the instrument for measuring this is a flow meter. To check the flow in a particular circuit, the flow meter would have to be installed between the pump and the circuit being tested, or, in series with the load.

Normally, flow meters are quite expensive, and are relatively difficult to hook into a circuit. Therefore, these devices are rarely used.

Pressure - Pressure is the amount of force or the power being applied in a hydraulic circuit, and is measured in PSI (pounds per square inch) or BAR (Bar x 14.7 = PSI). The device for measuring pressure is the pressure gauge.

The pressure gauge is an inexpensive device, and can be easily installed in a circuit by means of quick disconnect fittings.

When troubleshooting hydraulic circuits, both the power (pressure) and the flow (G.P.M.) would have to be known to properly diagnose a hydraulic circuit problem.

If either the flow or the pressure were to change in a hydraulic circuit, the operating characteristic of that circuit would also change. Let's see how the circuit could be affected.

If the pressure were to drop, the machine would have less power to perform its duties. If the pressure dropped low enough, the machine functions would stop. If the pressure were increased above its normal setting, component damage could occur.

Now, let us see what would happen to the same circuit if the proper pressure were maintained, but the flow (G.P.M.) decreased.

If the flow decreased, the machine would simply slow down. It would still have the power (pressure) to do the work, but it would just do it slower. If the flow (G.P.M.) were increased, the machine would work faster. Although this may sound like an advantage, it could possibly do more harm, than good. As an example:

A. Cause machine to be too violent.
B. Cause valves and other components to stick.
C. Cause overheating.

A properly designed hydraulic circuit has the correct pressure and flows built in to do the work required of it.

NOTE: If you should have reason to change the circuit in any way, it should be approved by the equipment manufacturer first.

As we grow older, the wear and tear of living on our bodies tend to make us slow down. The same thing applies in hydraulic circuits.

In hydraulics however, the slow down is generally caused by aeration or cavitation. As with our bodies, we can accelerate or slow down this aging process by taking care of, or abusing the system.

Aeration and cavitation are caused by two different problems, but the resultant damage to the system is the same.

Aeration in hydraulic circuits is generally caused by a pump sucking air. This air can enter the system from either a defective inlet line or, the fluid level in the tank being too low. In either case, the hydraulic system will be making a noise. This noise sounds like the pump is pumping marbles through the system.

This condition should be corrected as soon as possible to prevent wear and tear on the pump.

Cavitation is caused by a vacuum in the hydraulic fluid, and is prevalent in the pump when the inlet conditions are critical.

Pump cavitation may be caused by a restricted inlet line; by sharp bends in the inlet line; by a clogged inlet strainer; by a fluid that is too high in viscosity.

Cavitation in a circuit can generally be detected by listening to the system. Cavitation generates a high pitch screaming sound. This noise will increase as the degree of cavitation increases and the pressure increases.

To prevent cavitation in hydraulic circuits, the system should be warmed up at a slower speed than the system normally runs at. This warm up period will depend on the ambient temperature, type of oil used, pressure settings, number of pumps in system, etc.

The most common cause of cavitation however, is due to **improper warm up** of the system.

In both cavitation and aeration, the results is a shorter pump life.

When cavitation and/or aeration occurs, the pump immediately starts to lose flow. This loss is very minute in the beginning, but gradually gets worse. Strangely enough, the pressure is not affected as much as the flow.

Therefore, the end results is, the machine starts to slow down. It may still have the power to do the work, but, it just does it slower.

PVH Piston Pump

The hydraulic system on the MKVI is a closed center type with main system oil supplied by two variable displacement Rexroth pressure compensated piston pumps. The pumps are mounted to a double pump drive and are driven directly from the engine. The pumps are left hand rotation (viewed from shaft end), each with a displacement of 6 cubic inch per revolution (54.55 GPM @ 2100 RPM).

Load Limiter (Pressure Compensator)

The pressure compensator control automatically varies pump displacement to provide only the flow required to satisfy the load demand while maintaining a constant preset pressure. The control begins to reduce pump displacement upon system pressure rise of approximately 100 PSI below the compensator setting. At system pressure below the compensator setting, the pump operates at maximum displacement and at the load pressure.

This pressure compensator or "constant pressure control" is a spring offset, 3-way valve. Its purpose is to limit system pressure to some desired preset level by varying pump

Pressure Compensated Flow Controls

In combination with the the "PVH" pressure compensated pumps, pressure compensated flow controls are used throughout the hydraulic circuit on the **MKVI** tamper. Pressure compensated flow controls provide a means whereby various flows throughout the hydraulic circuit can be adjusted, while maintaining a constant pressure across the system. The system pressure is maintained despite varying load requirements. The symbol for a pressure compensated flow control is shown below in figure 6-2.

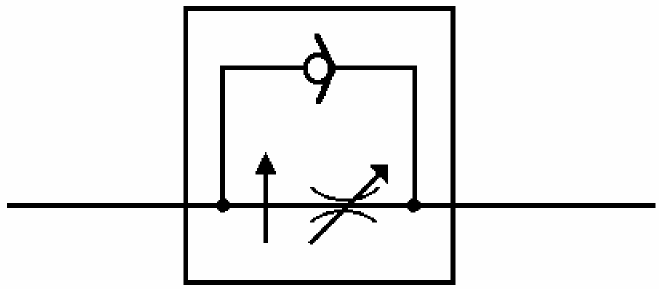


Figure 6-2

MKVI Flow Control Setup

Right Hand Workheads

- HT 57.1: Downfeed cartridgeopen 5 turns
  Upfeed cartridge open 4 turns

Left Hand Workheads

- HT 57.2: Downfeed cartridge open 5 turns
  Upfeed cartridge open 4 turns

Start commissioning the machine with the these settings. Work the machine until the hydraulic oil is at operating temperature while observing workhead upfeed speed. If one side upfeeds faster than the other, turn the flow control (initial setting of 4 turns) on the fast side, clockwise until both sides upfeed at the same speed.

Right Hook Regen

- HT 19.4 open 1 1/2 turns.

Left Hook Regen

- HT 19.1 open 1 1/2 turns.

Start commissioning at 1 1/2 turns. Open to 2 1/2 turns MAXIMUM if necessary.

Right Hook Clamp Valve

- HT 19.3 open 3 turns.

Left Hook Clamp Valve

- HT 19.2 open 3 turns.

Work machine while observing the hook extend speed. The hooks should open fast enough to clear any track obstruction. If necessary open HT 19.3 or HT 19.2 (counter-clockwise) until the hooks clear all normal track obstructions.

- Right Jacking Valve

HT 58.1open 2 1/2 turns.

- Left Jacking Valve

HT 58.2 open 2 1/2 turns.

Lining Valve

- HT 25.7 Open 3 1/2 turns.

Set the flow controls as suggested and adjust if necessary to **balance** components.

Installation

The pressure compensated flow controls used on the MKVI tamper are installed as a **meter-in** flow control. This simply means that the flow on the **pressure** or "in" side of the circuit is being controlled. A meter-out valve controls flow on the tank or "out" line. Since the valve used on the MKVI can also be used in the meter-out configuration by rotating 180 degrees, care must be taken to ensure that the meter-in notch on the flow control is installed facing the solenoid valve. See Figure 6-3.

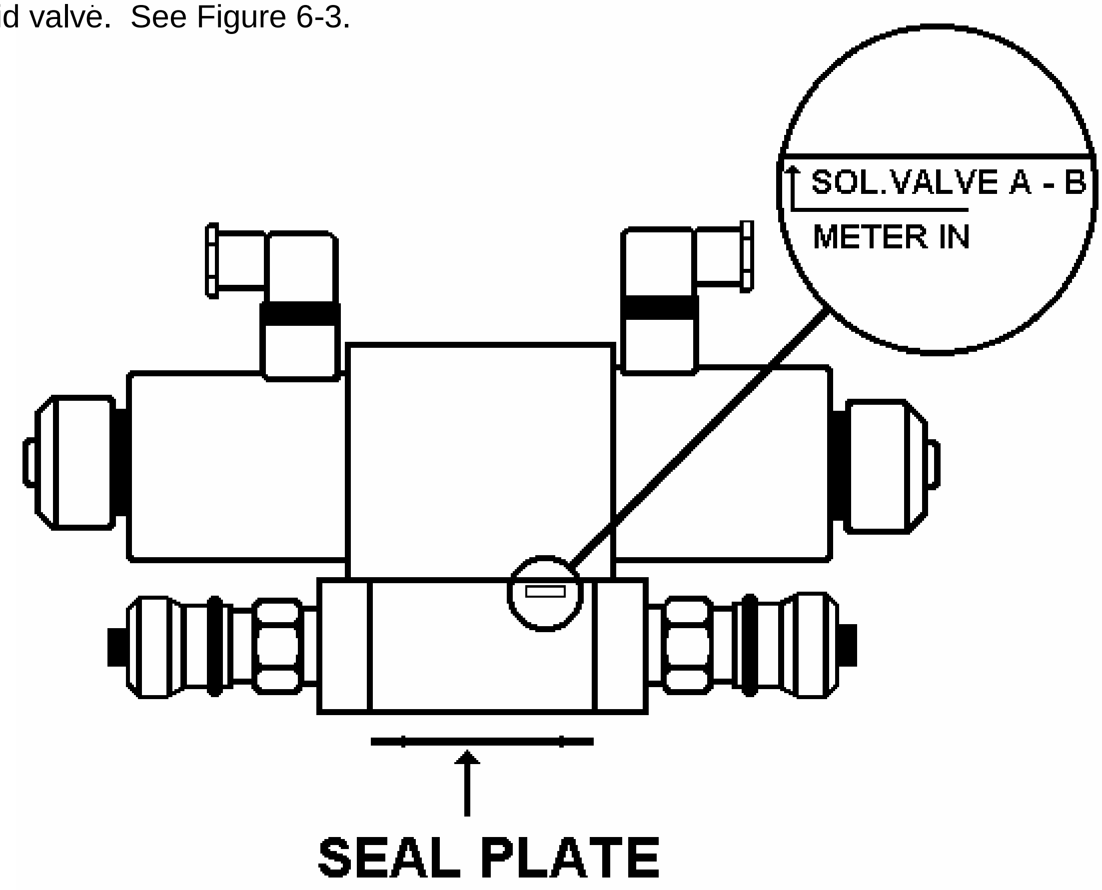
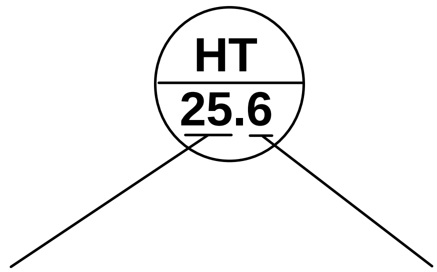


Figure 6-3

Hydraulic Schematic Parts List

The information circled on the hydraulic schematic is reference information pertaining to the parts list below. The numbers in the circle indicate the item number and the accumulative quantity. See figure and example parts list shown below.



Item number on parts list.

**At least 6 per machine.
(If there is no number,
the machine has only one).**

*******Example Parts List - See Parts Manual for Ordering*******

ITEM	PART NUMBER	DESCRIPTION
1	A6602Y05	Variable Displacement Piston Pump
2	CO993Y01	DO1 24 VDC Solenoid Valve
3	A1070Y29	DO1 Relief Sandwich
4	0-3361006-0-03	DO1 Subplate
5	0-3336021-0-18	3 PSI 16 SAE Check Valve
6	L41208	3 PSI 1/4 NPT Check Valve
7	L41228	1/4 NPT Quick Disconnect
8	A0758Y06	Orifice Fitting
9	A0758Y14	Orifice Fitting
10	A0713Y11	Double Gear Pump
11	0-3321014-0-04	Vibrator Motor
12	C1140Y04	Relief Valve
13	0-3336003-0-02	D05 Check Valve
14	0-3333037-0-08	DO5 24 VDC Solenoid Valve
15	L40549	3 PSI 3/4 NPT Check Valve
16	A3448Y11	Gear Pump
17	B4376Y03	Filter Element (5 Micron)
18	0-3302006-0-03	Oil Cooler
19	D4376Y01	Return filter
20	A0757Y04	DO2 4 Station Manifold
21	0-3333037-0-09	DO2 24 VDC Solenoid Valve
22	0-3333037-0-18	DO2 24 VDC Solenoid Valve
23	0-3333037-0-10	DO2 24 VDC Solenoid Valve
24	0-3334013-0-05	DO2 Reducing Valve Sandwich

Chapter 7

Electrical System

This section contains a brief overview of the 24 volt DC power system used on the MKVI Tamper. Power to the DC circuits is distributed through several electrical boxes, at various locations on the machine. Abbreviations are used for these boxes in many portions of the discussion and on the schematics. Only selected boxes will be discussed. Listed below are the abbreviations used. Refer to Figure 7-1 and the electrical schematic for details.

- Power Distribution Box PDB
- Front Control Panel FCP
- Left Hand (Seat) Console LHC
- Master Control Box MCB
- Right Hand (Seat) Console RHC

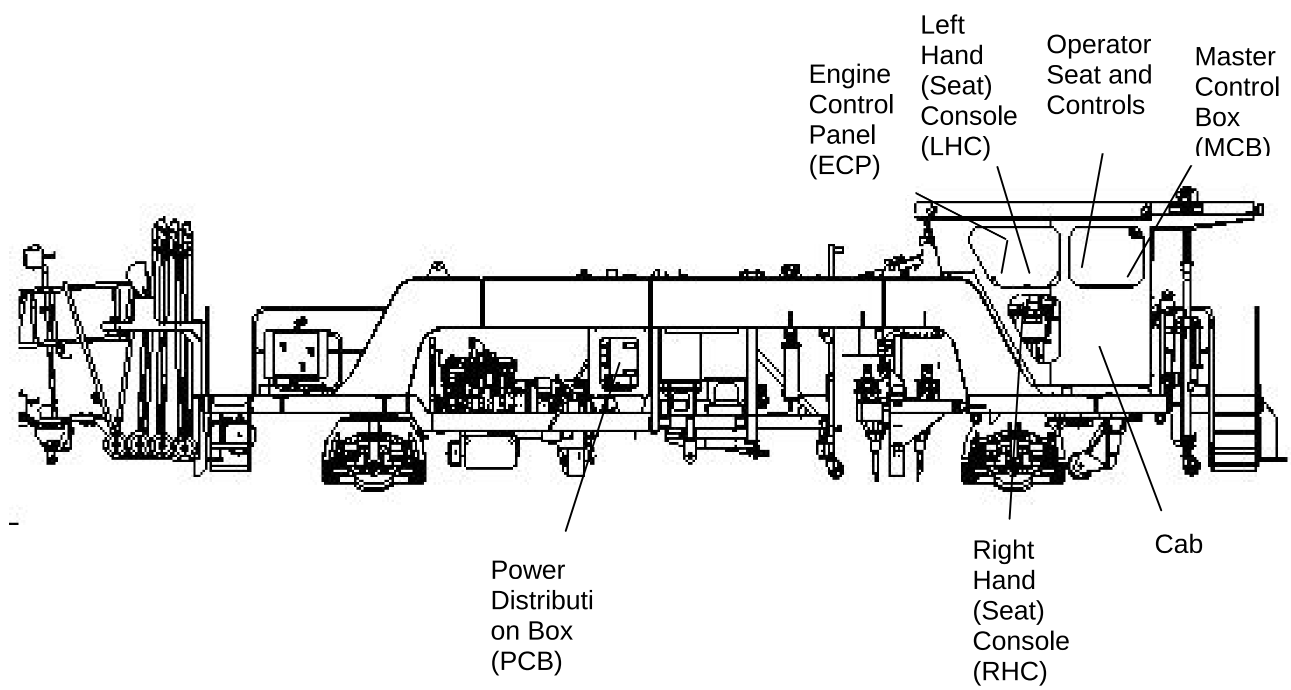


Figure 7-1

Power Distribution Box (PDB)

The Power Distribution Box is located on the left side of the machine. Refer to figure 7-1. It contains various electrical components such as; power relays, circuit breakers, diode modules and terminal blocks.

Note: Relay RL 0101 is part of the emergency shutdown system and **must be energized** for the engine to run. If the oil pressure switch, water temperature switch or emergency stop switch cause a break in the circuit; power to RL 0101 will be interrupted causing the fuel supply solenoid to shut down. Refer to the assembly drawing in the parts manual and the electrical schematic in this manual for further details.

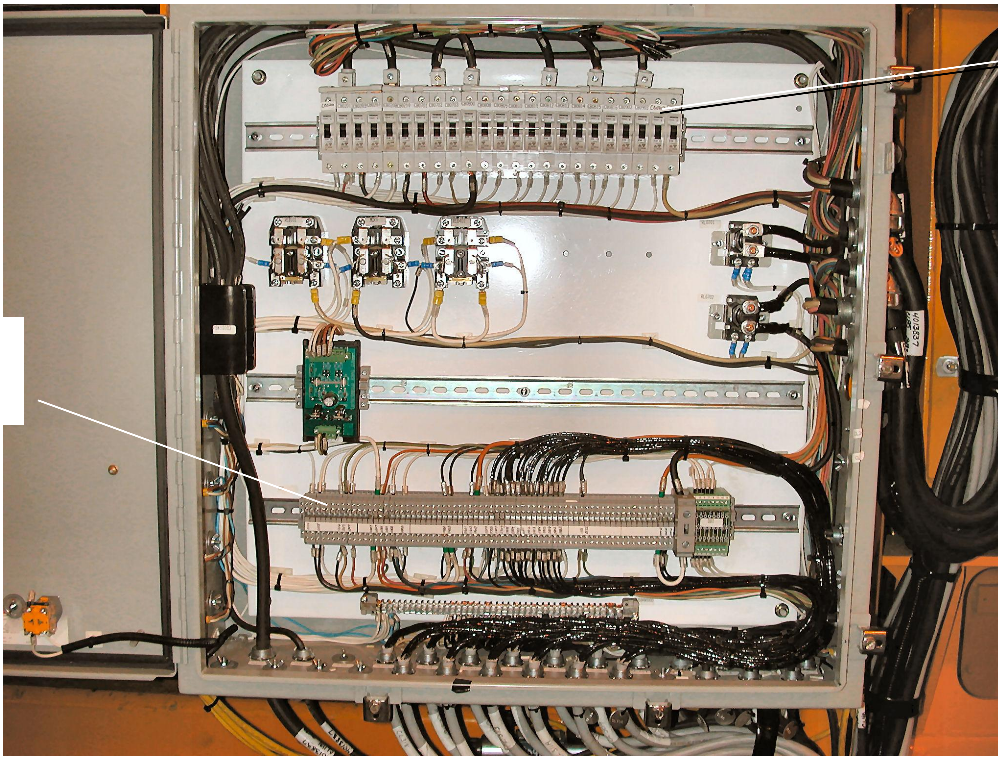


Figure 7-1A Power Distribution Box

It should be noted that circuit breakers are used to protect various CAN modules and circuits. The larger block of circuit breakers is located in the PDB and the smaller block of circuit breakers is located in the MCB. Refer to Figure 7-1, 7-1A, the assembly drawing in the parts manual and the electrical schematic in this manual for further details.

Engine Control Panel (ECP)

The Engine Control Panel is positioned in the left front of the operator seat assembly. This panel houses control switches for the windshield wipers, travel lights, work lights, starting the engine, stopping the engine and Jupiter power on or off. (Refer to Chapter 2, Figure 2-2, 2-4 and 2-7)

All engine gauges such as, oil pressure, water temperature, ammeter, tachometer, and air pressure are graphic gauges displayed on the the Main Screen of the computer. Also included are the throttle controls and transmission gear selectors.

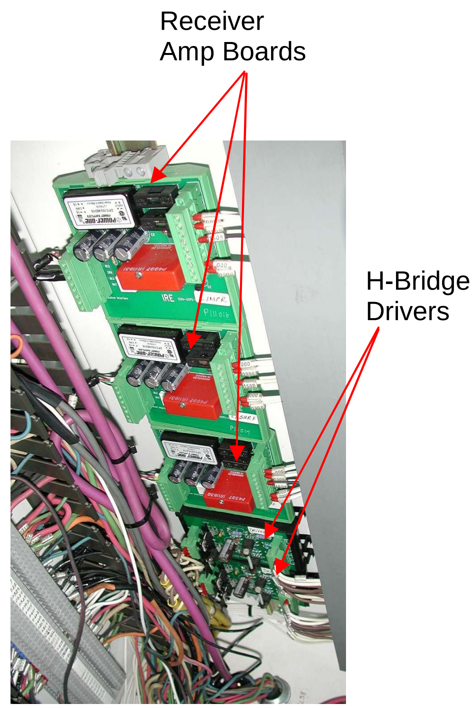
Left and Right Hand Arm Consoles

The Left and Right Hand Arm Consoles houses controls that are used in both travel and work modes such as: the Workhead Joysticks, Clamp Frame Joysticks, Work Mode and Travel Selectors.

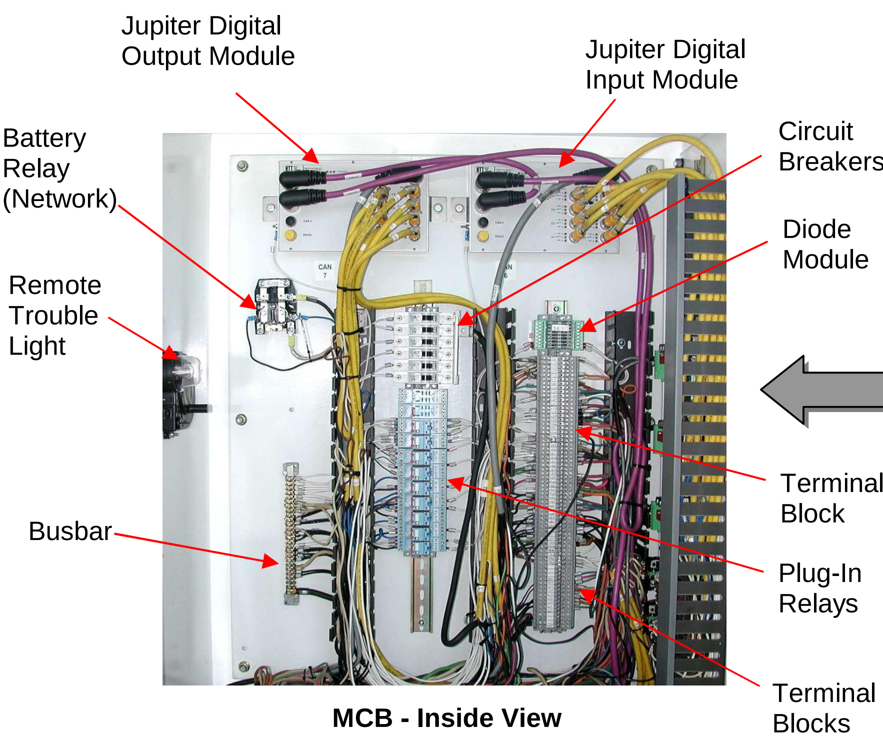
Master Control Box (MCB)

Figure 7-2

The Master Control Box is located in the left rear portion of the cab and houses computer system components such as Jupiter Digital Input and Output Modules as well as Master Control Relays and, various circuit breakers, relays, fuses, and diode modules. Refer to Figures 7-2, 7-3 and 7-4.



Inside Panel (Right)
Figure 7-4



MCB - Inside View
Figure 7-3

ELECTRICAL SCHEMATIC READING

Electrical schematic diagrams are graphic pictures of how an electrical system has been assembled. Symbols represent the components used in the system and lines show the wires or conductors within that electrical system. Schematic diagrams do NOT show physical characteristics or locations of individual components nor does it show the lengths or actual location of wiring. Note, all circuit breakers and most standard relays are page related.

Drawing Numbers

Each schematic has its own drawing number which identifies a specific electrical system for a specific machine. This number can be found in the lower or upper corners of each print. Also found on each drawing is the name or description of the electrical drawing, usually naming the machine. Be sure the drawing is the correct schematic for the machine.

NOTE: Although two drawings look exactly the same, if a number difference exists, there will be a distinct difference in electrical requirements.

Number of Sheets Used

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Figure 7-5

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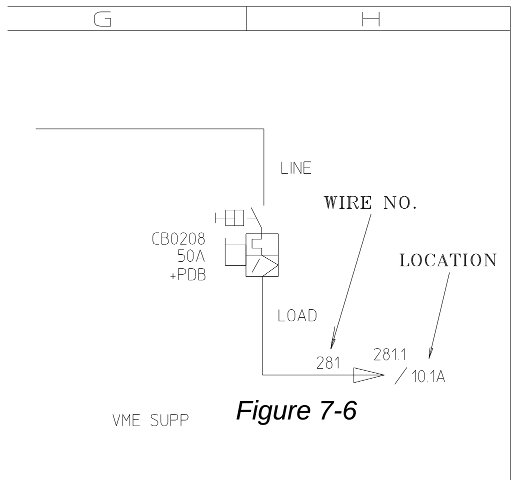

Figure 7-6

For Electrical Schematic Drawings, Refer to the Electrical Section of the Parts Manual

Chapter 8

Electrical System

This section contains a brief overview of the 24 volt DC power system used on the MKVI Tamper. Power to the DC circuits is distributed through several electrical boxes, at various locations on the machine. Abbreviations are used for these boxes in many portions of the discussion and on the schematics. Only selected boxes will be discussed. Listed below are the abbreviations used. Refer to Figure 7-1 and the electrical schematic for details.

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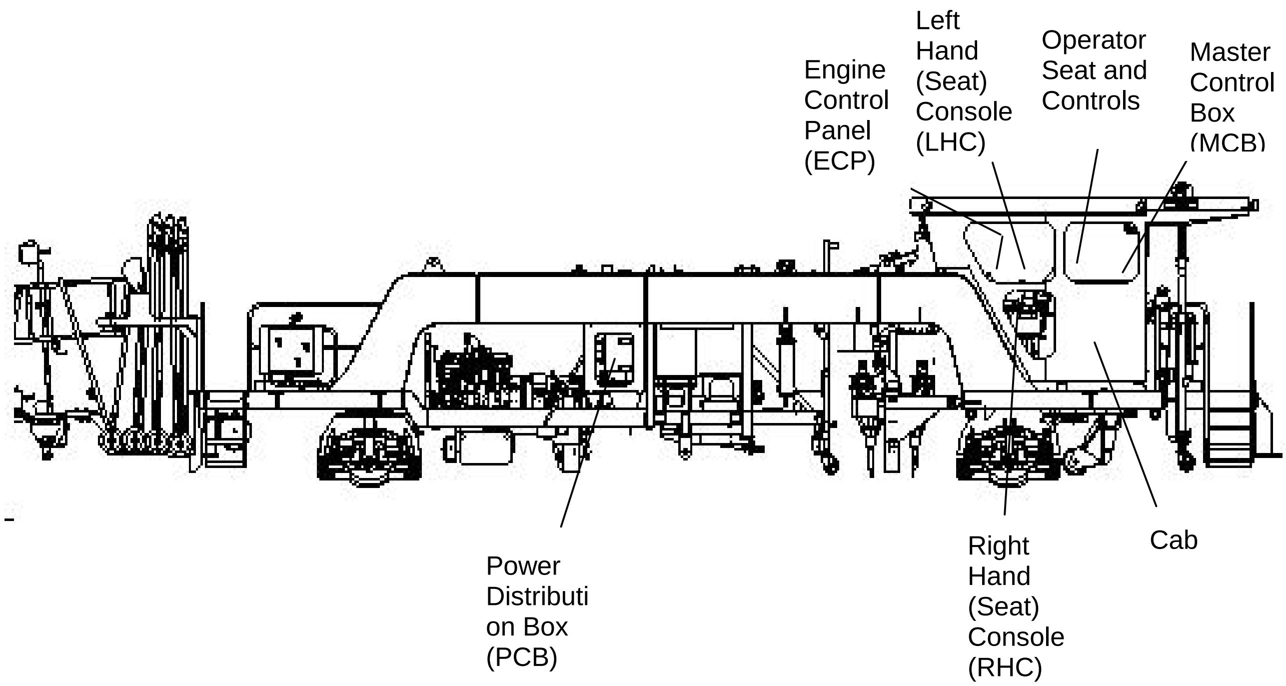

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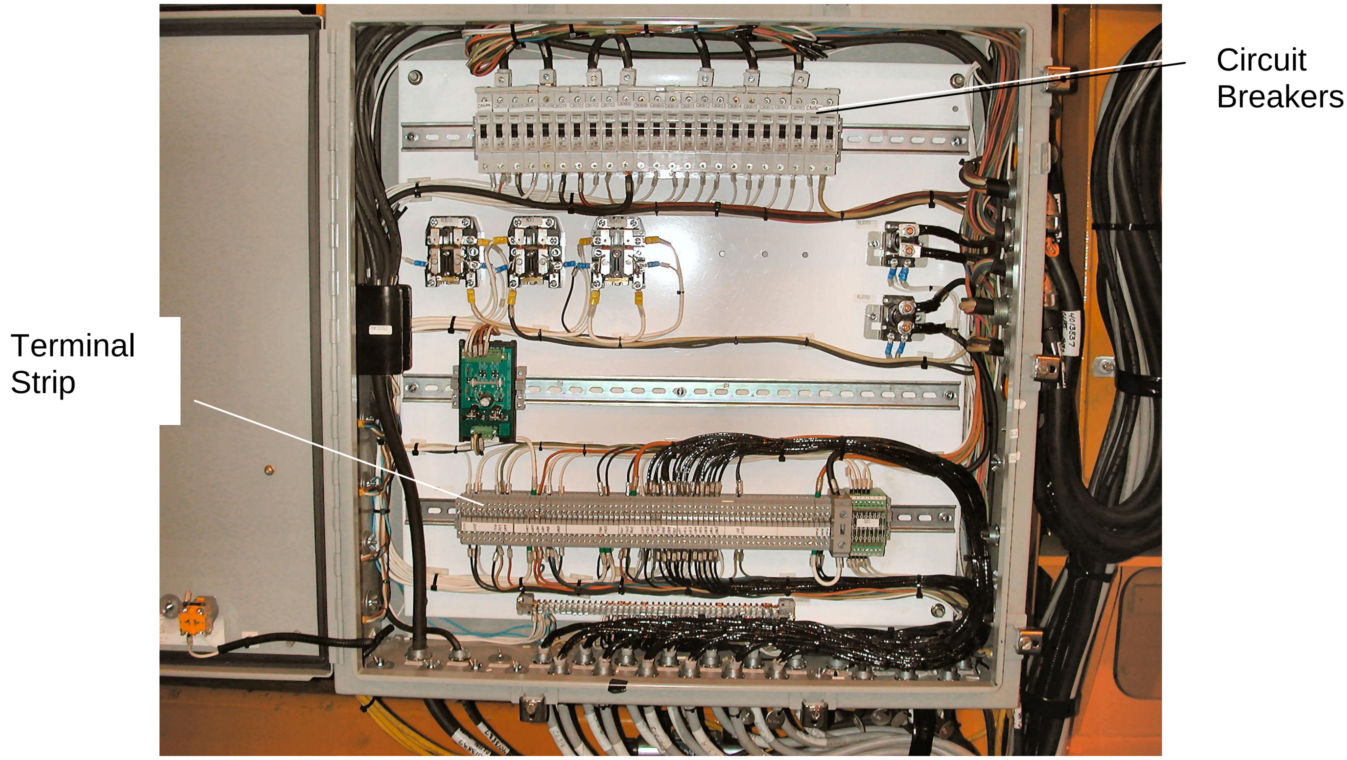

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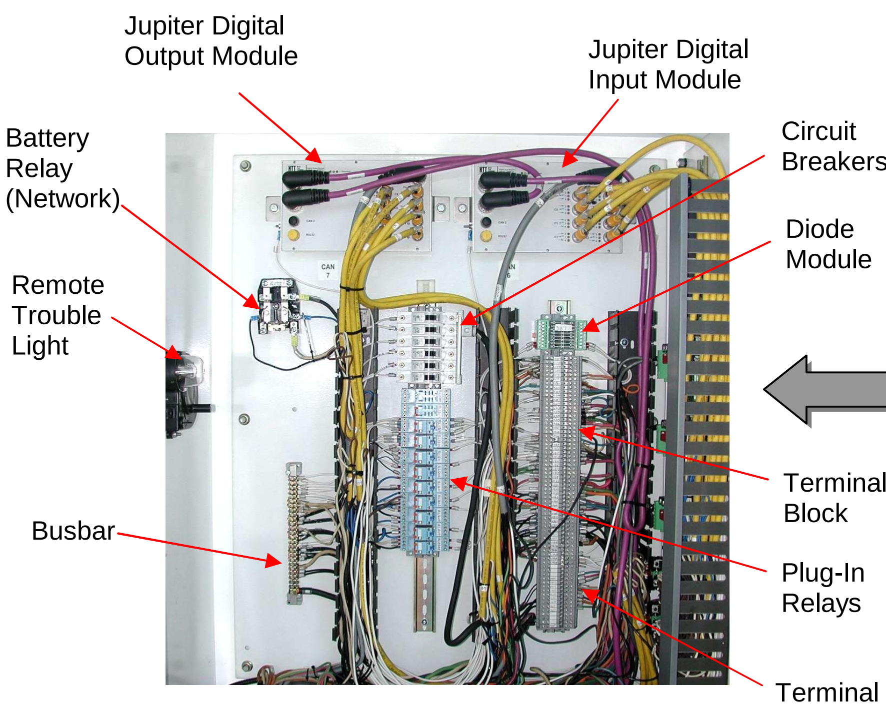
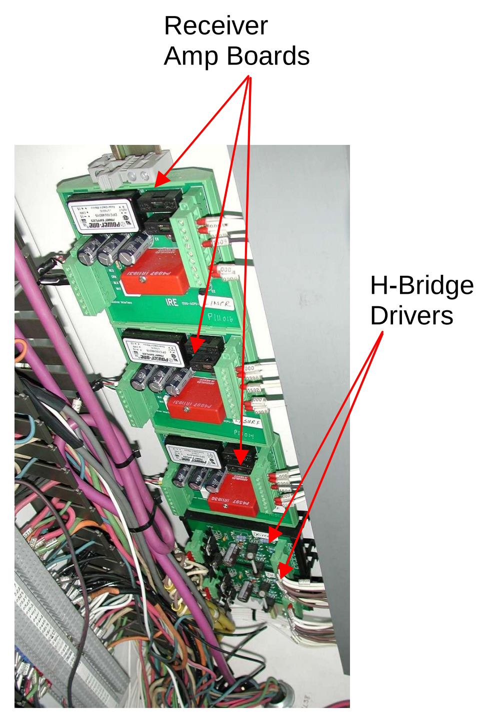


MCB - Inside View
Figure 7-3



Inside Panel (Right)
Figure 7-4

ELECTRICAL SCHEMATIC READING

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LOC
ASS
SHEET 1 OUT OF 30
DRAWN W. GRIER DATE 6/20/05
CHECKED E.P. DATE 6/20/05
APP-ENG W. GRIER DATE 6/20/05
APP-MFG DATE
FOR REFERENCE ONLY
Harsco Track Technologies
a harsco company
2401 Edmund Road-Box 20
Cayce-West Columbia,
South Carolina 29171-0020
(803) 822-9160
DESCRIPTION (30) ELECT SCHEMATIC
MACHINE TYPE MK VI
ENG.DWG.NO. 4013198

Figure 7-5

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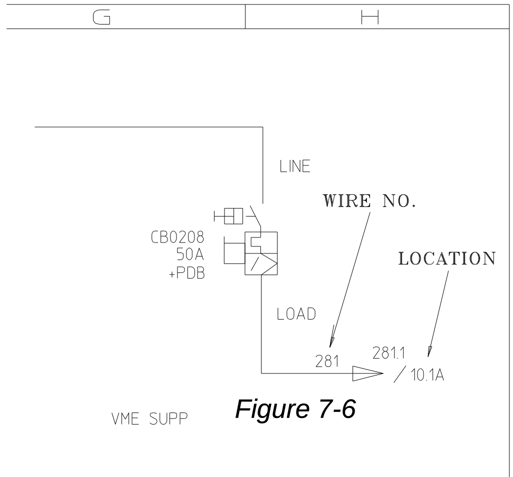


Figure 7-6

For Electrical Schematic Drawings, Refer to the Electrical Section of the Parts Manual

Curve Geometry

This chapter describes the geometry of curves, explains how a curve is measured and describes some of the graphs that may be displayed on System V for a curve. This chapter also describes lining and superelevation.

Curve Without a Spiral

The simplest railroad curve is a length of track which has constant curvature, or radius, with straight track at each end, and no transition (spiral) between the straight and the curved track. The only measurements needed to line a curve like this are the degree of curvature and the length of the curve. This type of curve is fairly rare in normal track use. One place it does occur is in yards and sidings, where no superelevation is required and which do not justify the extra time and length of track needed to construct spirals.

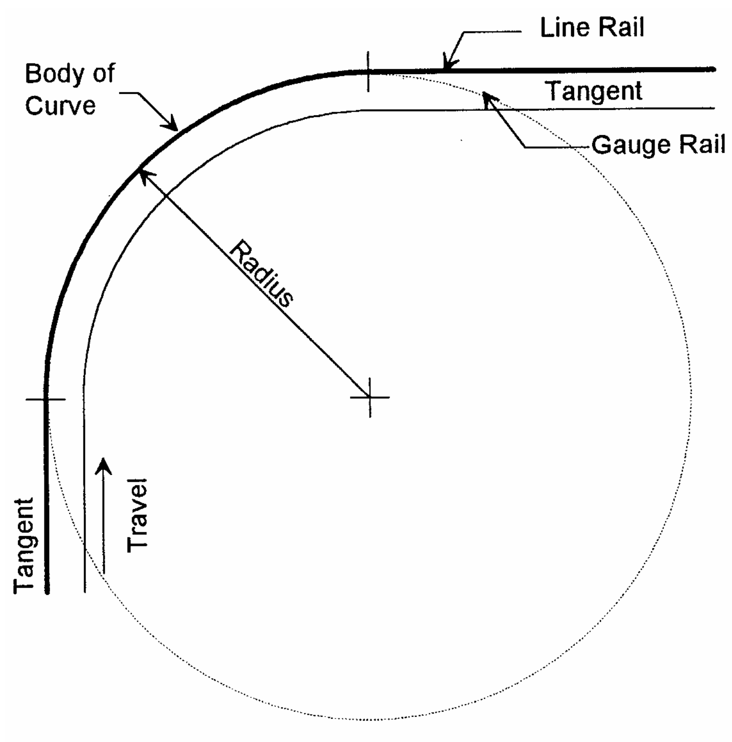


Figure A-1 Simple Curve

For our hypothetical curve, let us assume for now that it is an absolutely perfect curve, with no defects at all. Consider the curve shown in Figure A–1. This figure shows a constant radius curve with tangent rail at either end. It has no spiral, or transition curve. The Line rail, or High rail, located on the outside of the curve, is the one we're interested in; the Gauge or Reference rail, located opposite the Line rail, is not normally used in lining track. In the diagram shown, the curve is Right hand, and the Line rail is the Left rail, looking forward in the direction of travel. The measuring devices used in a curve Reference system Bias against, or press and roll against, the Line rail. Although both rails are shown in this first diagram, later diagrams will show only the Line rail, the one we'll be using for lining track.

In Figure A–2, the same curve is redrawn showing curve stations every 31 feet (9 m) (the reason for the 31 foot distance will be explained later). A curve station is simply a location measured along the track which is used in measuring the curve. Although the curve is not drawn to scale, you can appreciate that some of the curve stations occur on the tangent track before and after the curve, while some occur within the curve. We have also constructed this curve so that curve stations occur at exactly the point of tangents (between the tangents and the curves).

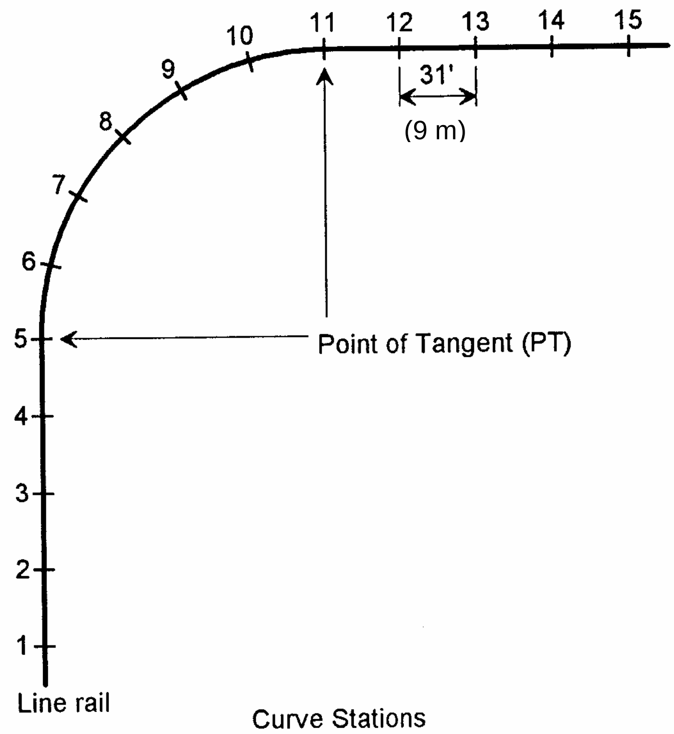


Figure A-2 Curve Stations

Measuring a Curve Using a 1 Foot (.305 m) Long Device

First, let us assume that we have a very small measuring system, only a foot or so long, which can accurately measure the curvature. With a very accurate curve, we could construct such a measuring device using a micrometer. Although this is not practical, it will help show later the problems which occur when we use a measuring system of normal length.

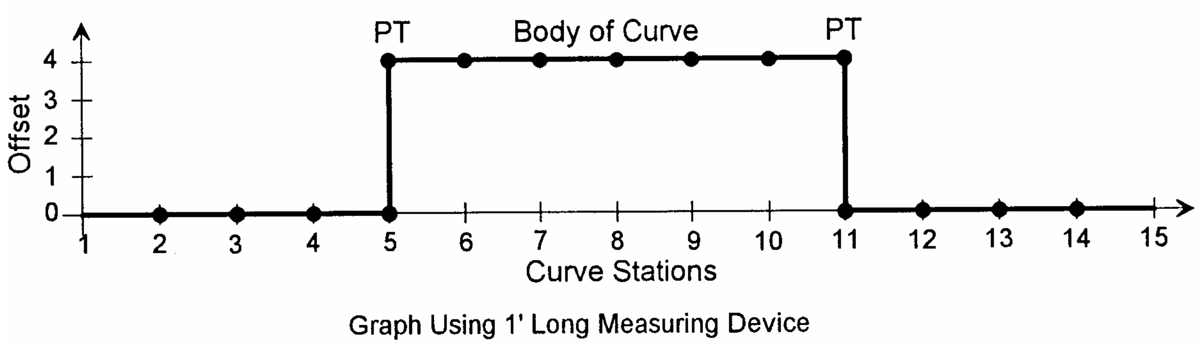


Figure A-3 Graph Using 1' (.305 m) Long Measuring Device

Figure A–3 shows the graph which results from measuring the curve with our small one foot long measuring device. This graph measures Offset along the curve. Here, Offset is the readout from the measuring device; it could be hundredths of an inch or converted to degrees of curve as shown here. It is a measure of the curvature of the curve. As you might expect, the graph reads Zero along the tangent before the curve as well as the tangent after the curve. At the curve body, the Offset instantly (or over the one foot device length) goes from zero to the maximum Offset in the curve (4 degrees). This occurs instantly because there is no Spiral, or Transition, between the tangent and the curve.

This is a very real and accurate description of the curve as it really is, without any spiral. The problem is, that our method of measurement is not practical. Such a short measuring device could not accurately measure a real curve. Although our example curve is “perfect,” in real life, there is no such thing. Such a short measuring device would measure mostly the small defects, while masking the shape of the curve, which is what we’re after.

Using the 62 Foot (19 m) String

In practice, curves must be measured with a longer Reference system. One of the systems currently used for String-Lining or measuring a curve is the 62 foot (19 m) chord. Why 62 feet (19 m)? Well, it just so happens that if you use a 62 foot (19 m) long string, stretched tight at each end against the gauge side of the ball of the rail, the Offset distance in inches between the string and the edge of the rail at the center of the string is exactly equal to the degree of curve. For example, if you measure 4 inches (102 mm), then the curve is a 4 degree curve.

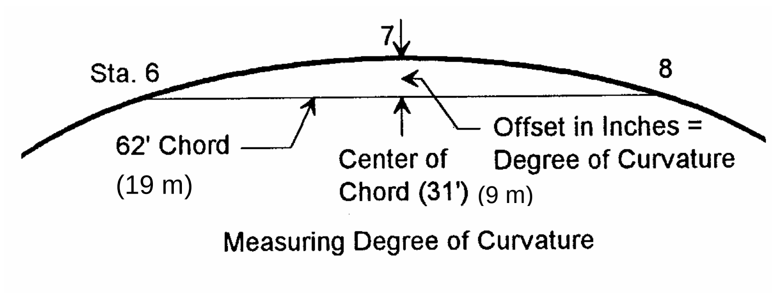


Figure A-4 Measuring Degree of Curvature

Figure A–4 illustrates this arrangement. This is commonly used to both string-line a curve and to check its actual curvature. The “Chord” referred to in the diagram and in other descriptions is the straight distance between any two points on a curve; it is not intended to mean a “cord,” or string, although that could be where it got its name.

To use the 62 foot (19 m) string to measure our sample curve, first place the string between stations 1 and 3, and measure the Offset at station 2 (this is at the mid-point of the string). The offset is zero (0) because both ends of the string are on tangent track. Then, the string is placed between stations 2 and 4, and the offset is measured as station 3. This pattern is repeated until station 15 is reached. The result of the measurements is the graph shown in Figure A–5.

The 62 foot (19 m) chord arrangement works out quite well. Naturally, on tangent track, we would read zero Offset, and in a curve we would read the actual degree of curvature for the curve. However, a problem occurs whenever the curvature is not constant, neither zero nor a constant curvature. Even though we know that our example curve is either zero degrees on the tangents or four degrees in the body, when our new “measuring system”, the 62 foot chord, is used at the PT point, we get readings somewhere in between zero and four degrees! How can this be, since we know we don’t have a Spiral? Well, as you move the leading edge of the 62 foot (19 m) string into the curve, it will be into the curve while the other end is on straight track; it is not completely on tangent or curved track. We will, therefore, get a reading somewhere between zero and four degrees.

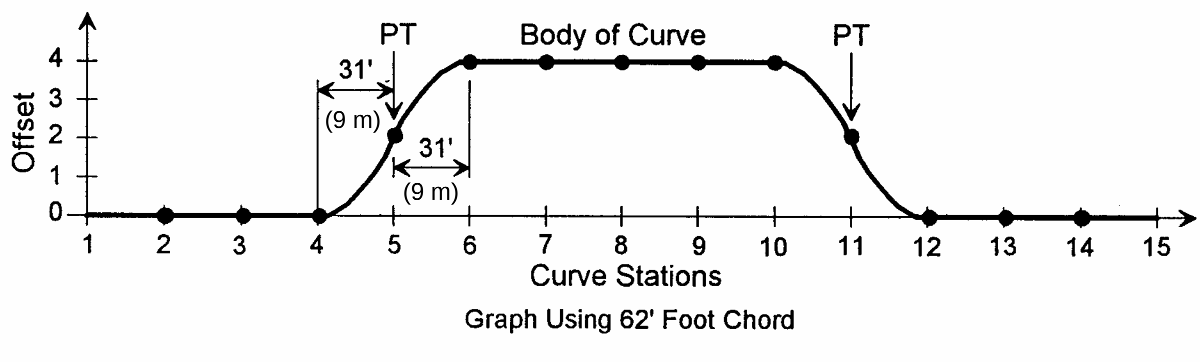


Figure A-5 Graph Using 62 Foot (19 m) Chord

As we move our measuring system along the track, plotting the measured degree of curvature, we get the graph as shown in Figure A–5. The heavy dots represent the Offset readings at 31 foot (9 m) intervals (at each curve station). Notice that at the Point of Tangent (PT) points, the apparent Offset is only 2 degrees, one-half that in the body of the curve. This is because when the center of our 62 foot (19 m) measuring system is at the PT point, the leading half of the system is in the curve, while the trailing half is on tangent track. This gives an Offset reading of one-half of what it would be if the entire system were within the curve. Also notice that if we would take readings continuously, just beyond station 4 the Offset reading begins to curve. With our example system, when the Center of our string is at station 4, the leading end is at station 5, the PT point. Therefore, as the system moves beyond this point, we get an Offset reading due to the fact that the leading end is entering the curve. And the graph of this reading is not straight, since the curve is not straight, but is curved.

Therefore, even this simple 62 foot (19 m) chord measuring system has “disguised” the curve. From looking at the graph, it “looks” like some sort of transition curve or spiral begins at station 4 and ends at station 6, even though we know it doesn’t exist! The length of the measuring system causes this. The graph will always begin curving when the leading point of the measuring system enters the curve (in this case, 31 feet (9 m) before the Center of the measuring system reaches the PT). And the “rounded” area of the graph caused by the measuring system will always be the same length as the measuring system, in this case 62 feet (19 m), or two station lengths.

So, a long measuring system, while necessary, makes it look like there’s a spiral where there is none. It also makes the actual PT point much more difficult to locate. These are all problems we can work around, but we must know that they exist.

Graphing Using a Machine

As discussed previously in “Overview” the System V uses a three-point lining system. Most three-point systems are not symmetrical, that is the distance from the Projector to the Shadowboard is usually much more than the distance from the Shadowboard to the Receiver. This is done to improve the Correction Ratio for the machine. When using this system to measure, or record, a curve, this means that we not only have a measuring system of substantial length, but that it records the curve differently when entering and leaving. These factors must be taken into account by any lining system.

For our example curve with no spirals, let us assume, for simplicity, we have a machine with the following dimensions: a projector to shadowboard distance of 80 feet, and a shadowboard to receiver distance of 20 feet (6 m). This is similar to our string-lining geometry, except for the distances. With the string, the distance from the leading point to the point where measurements are made is 31 feet (9 m), as is the distance from there to the trailing point. With the three-point liner, all measurements are taken at the shadowboard, in this case 80 feet from the leading point.

Figure A–6 shows the resulting graph after measuring the Offset using a machine reference system described above. As might be expected, even though this curve has no transitions or spirals, the long measuring system makes it look like there are spirals. As before, the “rounded” portion of the curve is the same length as the machine length, here 100 feet (30 m)(80’ (24 m) + 20’ (6 m) = 100’ (30 m)). But the beginning of the curved portion starts earlier than before. In fact, it starts when the Projector enters the curve, at which time the Shadowboard is 80 feet (24 m) before the PT of the curve. And it ends when the Shadowboard is 20 feet (6 m) past the PT, which is when the Receiver reaches the PT. This curve is not at all like you might have expected; it really does look like it has spirals, even though it does not. All because of the effect of the measuring system length. Also notice that the Offset reading when the Shadowboard is at the beginning of the curve (the PT point) is not 1/2 the maximum of 4 degrees, as it was with the 62 string, which was a symmetrical system.

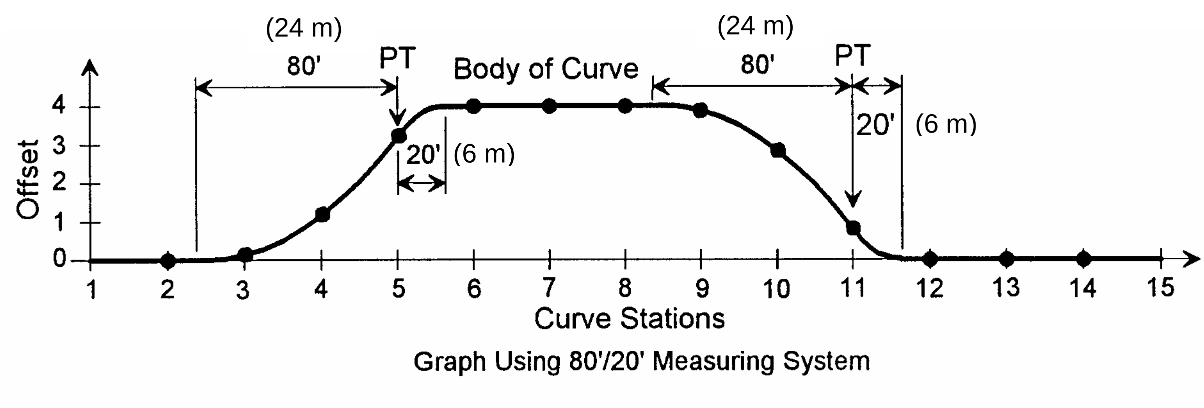


Figure A-6 Graph Using 80’/20’ (24 m /6 m) Measuring System

In summary, the normal measuring system used on liners makes the curve intersection points (PT) appear before they actually occur, and make it appear that there are spirals where there are none or make an existing spiral appear longer by the length equal to the length of the machine.

Why Do We Need Spirals?

A Spiral is just a Transition curve which smoothly changes from straight or tangent track, to the curvature of the main body of the curve. There are at least three reasons the railroad uses spirals: (1) On tight curves, the coupler movement required gets very large; it is greatest when going from tangent to curved track. A spiral reduces the required coupler movement, preventing binding and derailments. (2) At high speeds, if a train goes directly from tangent to curved track, a large overturning force is created. This is like driving your car at 60 mph (96.5 kph) and then immediately turning the steering wheel ninety degrees. You and your car would violently lean in the direction opposite to the curve. With a spiral, this change in direction occurs gradually, greatly reducing this force. This is exactly the same as moving the steering wheel slowly by ninety degrees. (3) Most railroad curves require superelevation in the bodies. The spiral length usually is the same as the ramping length required by the superelevation. This gives the smoothest ride to passengers and freight, by reducing or eliminating the side force on the train.

Exactly What is a Spiral?

A Spiral, or Transition curve, in its most general sense is any curve which gradually changes in curvature and direction from tangent track to curved track. It can also occur between two curves of different curvature. In practice, generally spirals are Cubic Spirals. They are called this because the distance away from a continuation of straight track varies with the cube of the distance along the track. Consider the enlarged Spiral shown in Figure A–7:

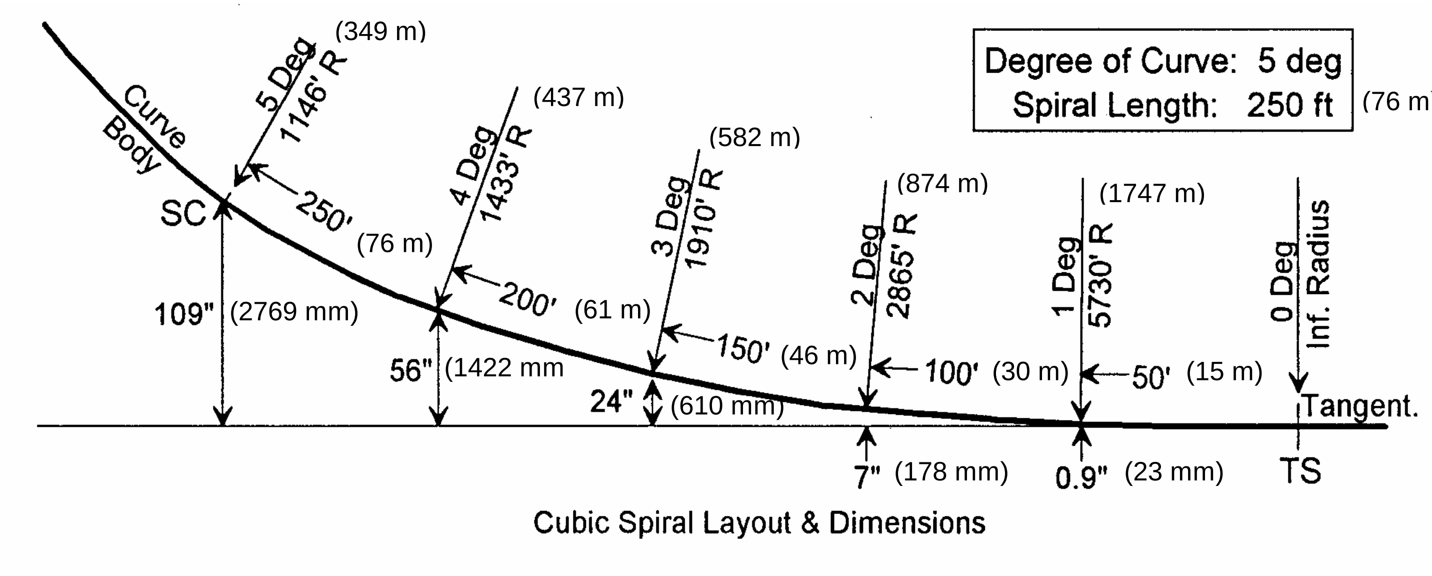


Figure A-7 Cubic Spiral Layout & Dimensions

This is a drawing of a 250 foot (76 m) long spiral into a five degree curve. The vertical scale has been exaggerated to better demonstrate the shape of the spiral. At the end of the spiral, the curved track is 109 inches (2769 mm), or a little over nine feet (2.7 m), from where tangent track would be. But half-way into the spiral, at a distance of 125 feet (38 m), the curved track is not half this distance from the curved track; it would be one-half cubed, (1/2)3, or one-eighth of this distance: only 13.6 inches (345 mm). At each distance along the track, the distance from tangent track is given: at 50 (15 m) feet it is only nine-tenths of an inch, in 100 feet about 7 inches (.178 mm), and so on. At a distance of 25 feet (8 m) from the TS the distance from tangent would only be one-eighth of an inch No wonder it's very difficult to judge the actual beginning of a spiral by eye!

As the distance along the spiral increases, the distance of the curve from a continuation of the tangent track also increases. What happens to the degree of curve? In this example, a five degree curve, after we travel 50 feet (15 m)(1/5 of the total spiral length of 250 feet -76 m), the degree of curvature is one (1) degree. After 100 feet (30 m), it is two (2) degrees, and so forth. The degree of curvature increases linearly along the spiral. This is important, and in fact comes in very handy as you'll see later, since the Offset we measure is proportional to degree of curvature.

The Radius of the curve along the spiral also varies. In the United States we rarely refer to the Radius of the curve, but the radius is also shown in this figure at each position. Notice that if you double the degree of curvature, you reduce the radius by half. Of course, at the beginning of the spiral, the TS (Tangent to Spiral) point, the degree of curvature is zero (0) and the radius is infinite. At the end of the spiral, the SC (Spiral to Curve) point, the degree of curvature reaches the main curve body degree of curvature, and the radius is determined by that value.

A Curve with Spirals

Figure A–8 shows a standard railroad curve with spirals. It consists of a length of tangent track, followed by a spiral, then the curve body, another spiral out of the curve, and finally the tangent track beyond. This is the most common curve occurring in railroad track. To understand how the spirals look to a measuring system, we can make a graph simulating what this entire curve would look like. First, we will graph what it would look like to our one foot long measuring device. This allows us to look at the shape of the curve, while ignoring machine effects.

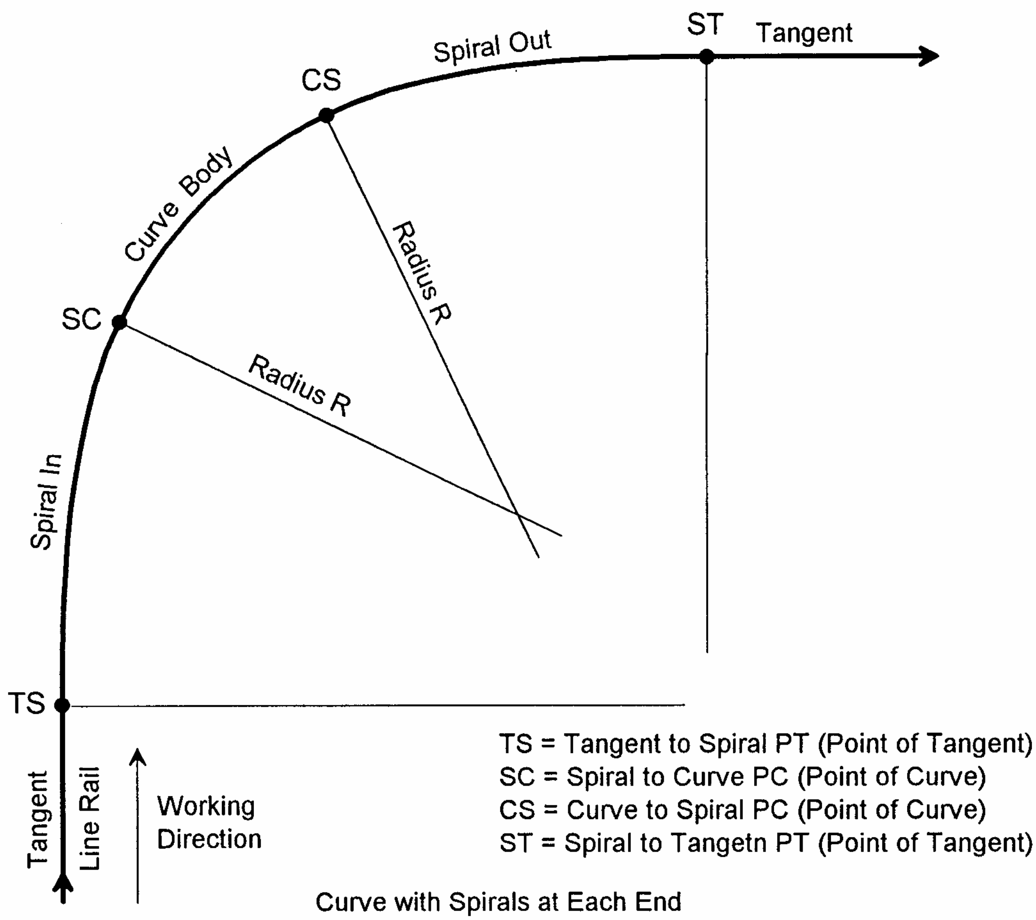


Figure A-8 Curve with Spirals at Each End

Graphing Spirals Using a 1' Measuring Device

Figure A–9 shows the graph of the curve in Figure A–8 as measured by our very short measuring device. By using this very short device, the "rounding" effect that longer measuring systems have is eliminated. As the figure shows, the Offset is zero (0) at each tangent and four (4) degrees within the body of the curve, the same as measured before. But unlike the curve without spirals (Figure A–3), the change from tangent to curve is not instantaneous. Rather, it occurs over the spiral length. The Offset (degree of curvature) increases in a straight line along the spiral from zero to the curve maximum Offset. This increase was also indicated in Figure A–7, the cubic spiral layout. Likewise, during the spiral out of the curve, the Offset decreases in a straight line back to zero. Notice also that from this graph it is very easy to pick out the transition points (TS, SC, CS and ST).

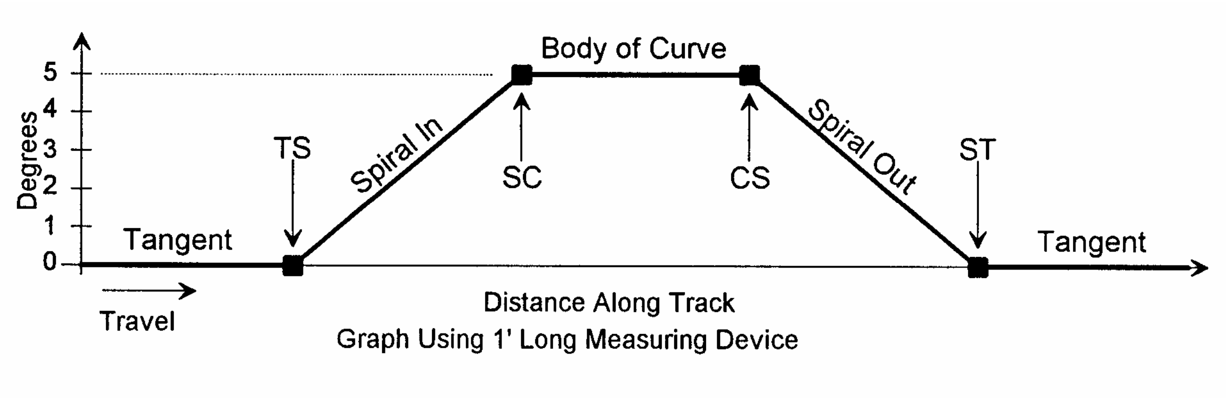


Figure A-9 Graph Using 1' (.305 m) Long Measuring Device

Graphing Spirals with 62' String

Again, the one foot long measuring device isn't realistic. As a next step, let's look at the same curve measured with a 62 foot (19 m) long string. But rather than show a graph with only points located every 31 feet (19 m), we'll show a continuous line representing the measurements taken by the string on a continuous basis, as in Figure A–10.

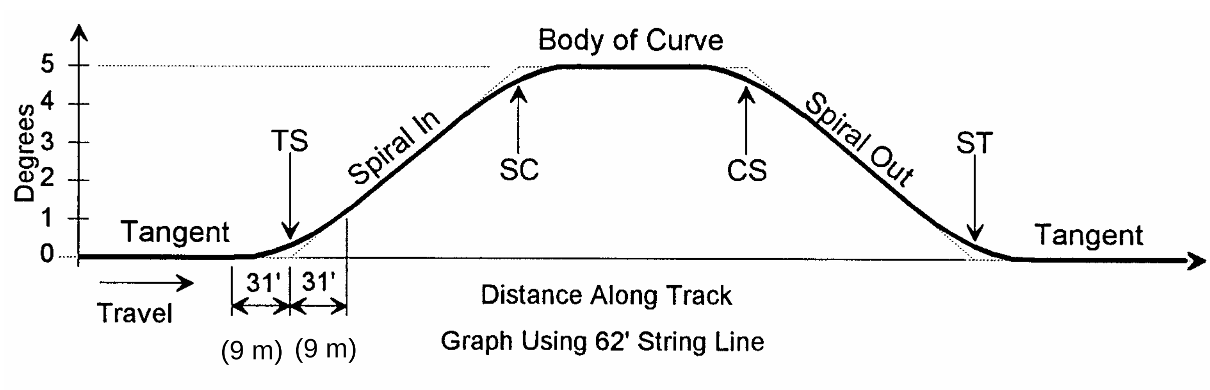


Figure A-10 Graph Using 62' (19 m) String Line

As reference, this figure shows the graph as measured with our one foot long system as a dotted line, and the graph measured with the 62 foot (19 m) string as a solid line on top of it. Notice that the string shows exactly the same graph except in the "rounded" areas near each transition point. Actually, the rounded area extends 31 feet (9 m) on each side of each transition point. As before, when entering the curve (in this case the spiral curve), the measured Offset begins to curve 31 feet before the transition, and continues to curve until 31 feet (9 m) after the transition. This is the same at each transition. Still, by extending the straight portion of the Spiral graph, it's pretty easy to locate the transition points.

Graphing Spirals Using a Machine

Finally, let's look at the same curve and graph produced by our example measuring and lining system, with the dimensions of eighty (80) feet (24 m) from the Projector to the Shadowboard and twenty (20) feet (6 m) from the Shadowboard to the Receiver. In Figure A–11 the graph produced by this system is shown by a solid line with the graph from our one foot measuring device shown dotted again for reference.

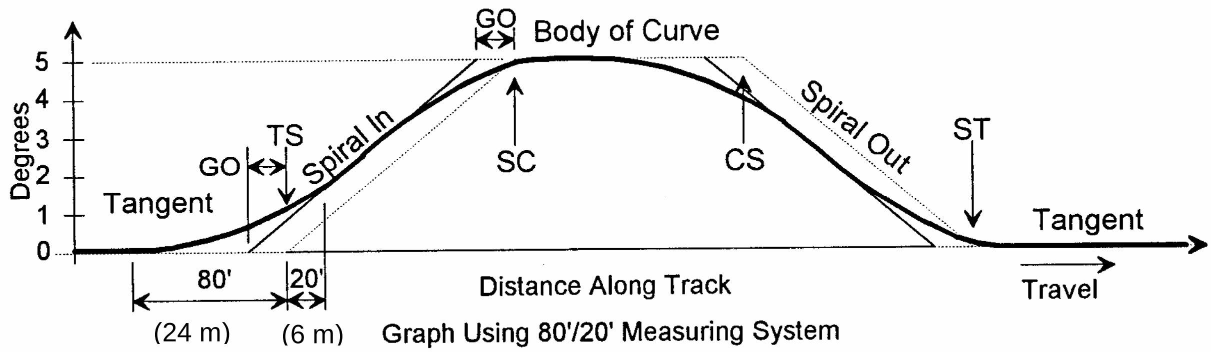


Figure A-11 Graph Using 80'/20' (24 m/6 m) Measuring System

There is quite some change! Some effects of the 100 foot (30 m) long machine are expected: From what we discussed previously, we would expect the graph to begin to curve eighty feet (24 m) before the transition, as it does. We also would expect this "rounded" area to continue until twenty feet after the transition, as it does. This is the same effect we saw with the curve with no spirals. And outside the rounded areas, the graph is zero at tangents and five (5) degrees in the body, as expected.

What is not expected, however, is the part of the graph lines in the Spirals. They don't line up with the graph from the short measuring system or the graph from the 62 foot (19 m) string! Why is this? The reason is something called Graph Offset.

Graph Offset

There are several differences in the graph which results when measuring a curve with a machine rather than a string. Figure A–12 shows an enlarged view of the Spiral into the curve. First, let's go over the graph of the Offset to understand what is occurring at each position. The machine is first entirely on tangent track, during area AB. (Remember, the distance location on the graph represents the Shadowboard position.) When the Shadowboard reaches position B, the Projector is just entering the Spiral at C. During this area marked BD the Projector is in the Spiral, while the Receiver is still on Tangent track. Area BD is the same length as the machine, and is the "rounded" area of the graph. When the Shadowboard is at the beginning of the curve, marked point C and the TS point, the Offset is already quite large. When the Shadowboard reaches point D, the Receiver is just entering the Spiral; then the entire machine is within the Spiral, for a distance marked DE. This is the only part of the Spiral which is graphed with a straight line.

When the Shadowboard reaches point E, the Projector is just entering the Full Body of the curve, at F. This again creates the "rounding" effect. The Projector is in the Body and the Receiver in the Spiral during the distance marked EG. When the Shadowboard reaches point G, the Receiver is just entering the curve Body. From that point on, during the body of the curve, marked GH, the Offset remains constant.

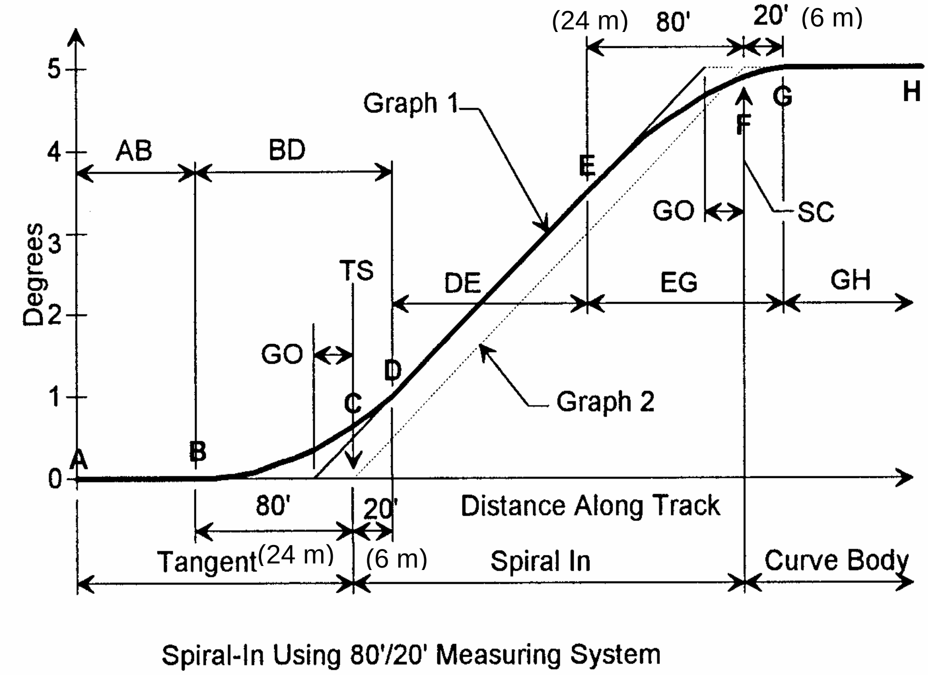


Figure A-12 Spiral-In Using 80'/20' Measuring System

Notice that the straight line portion of the graph created by the machine (Graph 1) is not in the same location as the straight dotted line (Graph 2) which goes between the TS and SC points. On Spirals into a curve, the graph created (Graph 1) occurs before the expected location (Graph 2). The Graph Offset (GO) is the distance between Graphs 1 and 2. Any Spiral Transitions we locate by extending the graph in the spiral must be moved ahead by the Graph Offset distance.

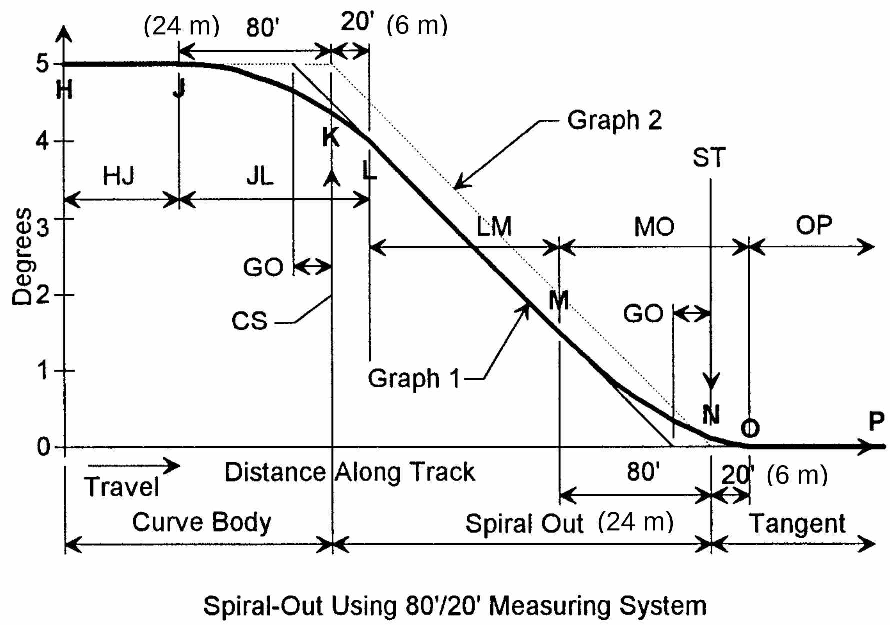


Figure A-13 Spiral-Out Using 80'/20'(24 m/6 m) Measuring System

Notice that the same thing happens on the Spiral Out of the curve, although it appears to be different. As shown in Figure A–13, the recorded Graph 1 again occurs before the expected location (Graph 2). The Graph Offset occurs in the same way, and all the same rules apply in finding transition points and other locations. As with the Spiral In, the "rounded" portions of the graph occur over a machine length beginning eighty (80) feet (24 m) before the transition point and ending twenty (20) feet (6 m) after the transition point.

In summary, the recorded graphs of curves using a standard measuring system displays three important features: (1) The graphs are rounded over a machine length at each transition. (2) This rounding begins when the Projector passes the transition point and ends when the Receiver passes it. (3) The Actual transition point locations are a Graph Offset distance (normally 20 to 25 feet (6 to 8 m) beyond the apparent transition distances found by examining the graphs of the spirals.

Superelevation Ramping Location

As discussed in the previous section, the recorded graph of a curve appears to be located before the true transition points, by a distance known as Graph Offset. Superelevation, however, is normally ramped in using actual curve transition points, and will therefore not correspond to the graph location. This is normal and correct, and although somewhat confusing, System V knows all the required values and will properly locate Superelevation Ramping.

Superelevation

Superelevation, also called Crosslevel, is the number of inches or mm the height of the Line rail is raised above the height of the Gauge (Reference) rail. When you are surfacing track, both rails are raised, so that the surface can be improved and defects removed or minimized. The amount of raise, on average, is called the Lift. Superelevation, however, indicates how much higher the Line rail is above the Gauge rail. Actual Super is the condition of the Super before surfacing. Desired Super is the calculated amount of Superelevation, to which you will be setting the track. Please refer Figure A–14.

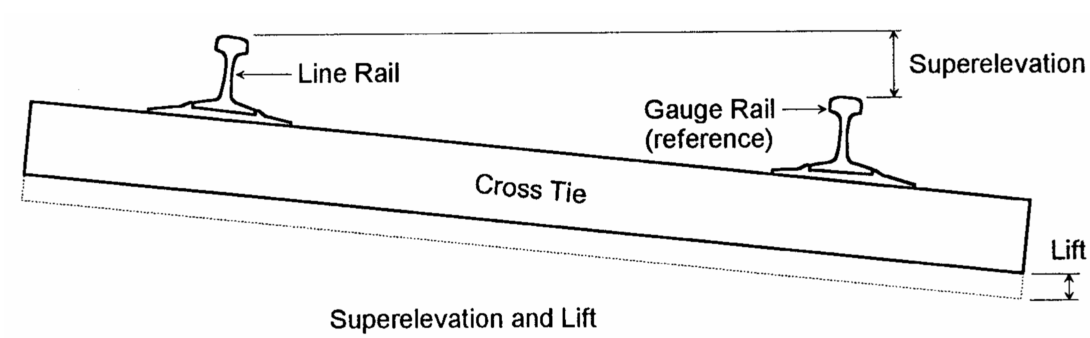


Figure A-14 Superelevation and Lift

On Tangent track, the Superelevation will normally always be zero (0), because the Line rail and the Gauge rail are normally at the same level. The Superelevation value during curves will be determined by the degree of curve and the rated train speed. This information may be obtained from track charts or your Engineering department. The Super will normally remain constant throughout the body of the curve. It will ramp from zero (0) at the beginning of the Spiral into the curve, to its maximum value at the beginning of the full Curve body. On the Spiral out of the curve, it will ramp from its maximum value at the end of the Curve body, to zero at the end of the Spiral.

Special conditions sometimes require the transition points used for the ramping of Superelevation to be somewhat different from those used in Lining the curve. This is acceptable provided it is approved by your Engineering department or Survey team.

Throws

Throws, the movement of the rail during Lining, is a simple concept, but is not so simple to measure. Where throws are referred to, it means the actual sideways movement of the track in reference to a non-moving object. One way of measuring Throws is to drive a stake in the ground beyond the area of the roadbed affected by the tamping operation. Measure to a particular part of the rail before the tamper reaches the track, and again after the tamper has lined and surfaced and is completely past the area. An alternate method is to measure from the ball of the rail to the ball of the neighboring rail, in double-track territory. You can also estimate the Throw by holding a tape measure just to the side of and at the end of the tie, while holding the other end firmly against the ground. (Be careful of tamping tools and thrown stones while doing any measuring.) This is not as exact a method, but can give you a rough idea of the Throw.

You can not estimate Throws by observing from the cab. What you see from the cab is the local movement of the rail at the lining head in relationship to the rail previously lined. The amount of movement you see from the cab will usually be less than the actual movement. Also, oftentimes when observing from the cab it will appear that the rail is being moved opposite to the direction it is actually moving.

Although you can estimate direction of throws by observing the ballast at either end of the ties, it is very difficult to estimate the actual Throw. Differing types and depths of ballast, as well as the amount of Lift, affect the appearance of the ballast at the ends of the ties.

Appendix A

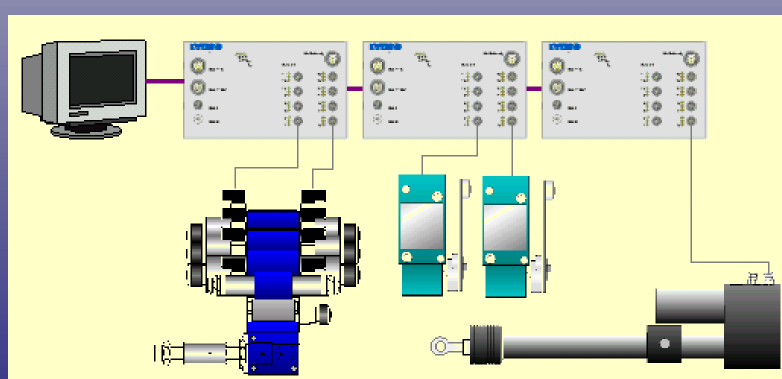
Harsco Track Technologies

Jupiter

Network

Troubleshooting

Guide



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Rev. 1

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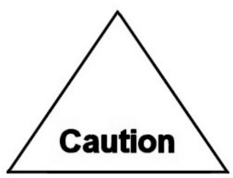

THIS MANUAL CONTAINS VITAL INFORMATION FOR THE SAFE USE AND EFFICIENT OPERATION OF THIS MACHINE. CAREFULLY READ THE OPERATOR'S MANUAL BEFORE USING THE MACHINE. FAILURE TO ADHERE TO THE INSTRUCTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

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Contents

Introduction

What is Jupiter?

Jupiter 2000 is a distributed I/O system developed by HTT to meet the demanding control requirements of railway maintenance equipment.

Performance superior to commercially available systems was needed in terms of ruggedness, reliability, speed, simplicity and diagnostic capability. The distributed I/O intelligent control system uses a Control Area Network (CAN) to communicate with modules distributed about the machine. An industrial network cable connects a series of I/O modules strategically positioned around a machine to be in close proximity to the devices with which they interact.

Of the many features of Jupiter 2000, the comprehensive and powerful diagnostic capabilities may be the most important. While diagnostics are a tremendous asset when isolating and correcting failures, it is comforting to know that every component is under continuous diagnostic scrutiny from the moment it is turned on. It is frequently possible to identify problems before they become disabling.

The "plug and play" capability of Jupiter allows modules to be exchanged between completely different machines with ease. All devices that connect to the Jupiter 2000 system incorporate connectors to facilitate rapid field replacement. The majority of the cables in the system are identical and vary only in length. Only a few spare cables (equal in length to the longest in actual use) need be carried to make it possible to replace any cable on a machine.

Jupiter 2000 Features:

- **Comprehensive Diagnostics**

  Jupiter 2000 diagnostic capabilities can dramatically reduce electrical trouble shooting time required to restore machine operation. The use of graphical diagnostic screens in conjunction with the diagnostic features of each Jupiter 2000 module simplifies the job of the operator or technician. Operators/technicians can rapidly locate and solve most control system problems without the use of a schematic or multi-meter.
  - ✓ All output channels detect and report short circuits
  - ✓ All output channels detect and report open circuits
  - ✓ Output channels monitor and display load current in Amps
  - ✓ All digital I/O channels include status LED indicators
  - ✓ Module status is monitored and reported in the case of failure
  - ✓ Network communication is monitored and reported in case of failure
  - ✓ Graphical diagnostics screens available

- **Simplified Electrical System**

  The use of Jupiter 2000 remote I/O devices helps simplify electrical systems through:
  - ✓ the reduction of wires and wire terminations
  - ✓ the use of quick disconnect cables
  - ✓ shorter wire runs
  - ✓ only 4 module types
  - ✓ like module types and cables are interchangeable

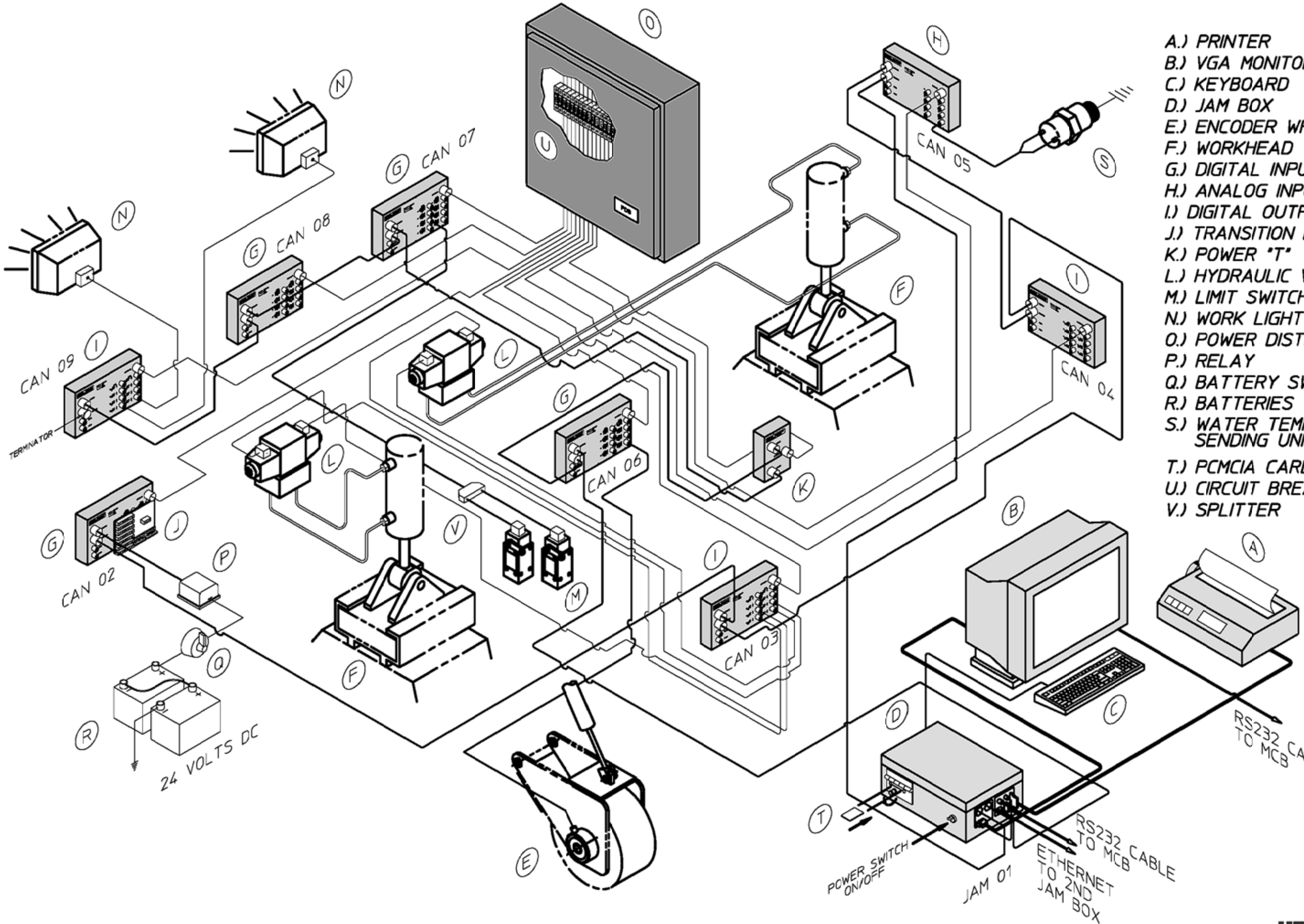
- **Improved Reliability**

  The rugged design of the Jupiter 2000 modules improves the reliability of the electrical control system. Jupiter modules are built to operate at extreme temperatures (-40°c to +70°c). All modules are IP67 rated (waterproof), CE labeled and fully potted for extreme vibrations. Pre-molded cables and cord sets eliminate field wiring and reduce the likelihood of open/short circuits. Each module provides a layer of electrical (and logical) isolation from the rest of the system thereby containing problems and simplifying repair. The increased capacity of output channels handles a wide range of load conditions.

- **Scalable Platform**

  The modular design of the Jupiter 2000 control system makes it possible to install Jupiter 2000 on small machines as well as large complex machines. This feature will lead to a common control system on an entire fleet of machines. The use of common control system components that are interchangeable from machine to machine enables inventory reduction, common schematics, reduced service technician training and a common set of features and diagnostic tools between a wide variety of machines.

Simplified Jupiter Network



A.) PRINTER
B.) VGA MONITOR
C.) KEYBOARD
D.) JAM BOX
E.) ENCODER WHEEL
F.) WORKHEAD
G.) DIGITAL INPUT MODULE
H.) ANALOG INPUT MODULE
I.) DIGITAL OUTPUT MODULE
J.) TRANSITION BOARD
K.) POWER "T"
L.) HYDRAULIC VALVE
M.) LIMIT SWITCH
N.) WORK LIGHT
O.) POWER DISTRIBUTION BOX
P.) RELAY
Q.) BATTERY SWITCH
R.) BATTERIES
S.) WATER TEMPERATURE SENDING UNIT
T.) PCMCIA CARD
U.) CIRCUIT BREAKERS
V.) SPLITTER

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Section A

(Jupiter Components)

Jupiter Components

- **JAM Box**
- **Digital Input Module**
- **Network Cables**
- **Analog Input Module**
- **Digital Output Module**
- **Power "T"**

J.A.M. Box
Figure 1-1

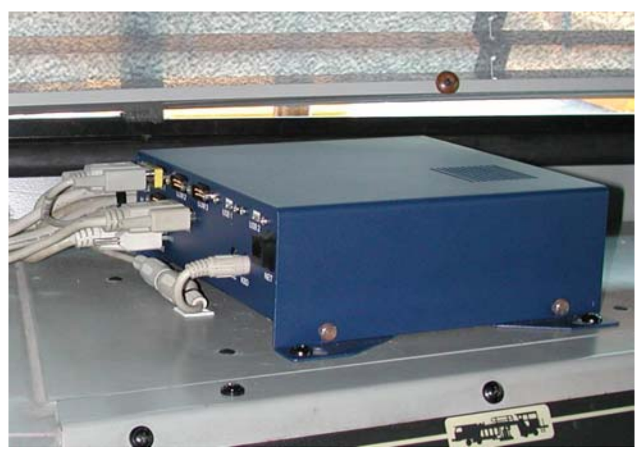
The JAM Box: The J.A.M, which stands for *Jupiter Application Master* is the system controller for the Jupiter Network. All machine functions under Jupiter control are processed by the JAM Box (while active).

The JAM box contains a microprocessor board that is responsible for distributing programming information to the Jupiter modules within the network.

Two USB ports on the back of the JAM box allow the technician to connect the JAM box to another computer (via USB cables) in order to make changes in software programming. Each JAM box comes preloaded with software specific to that machine.

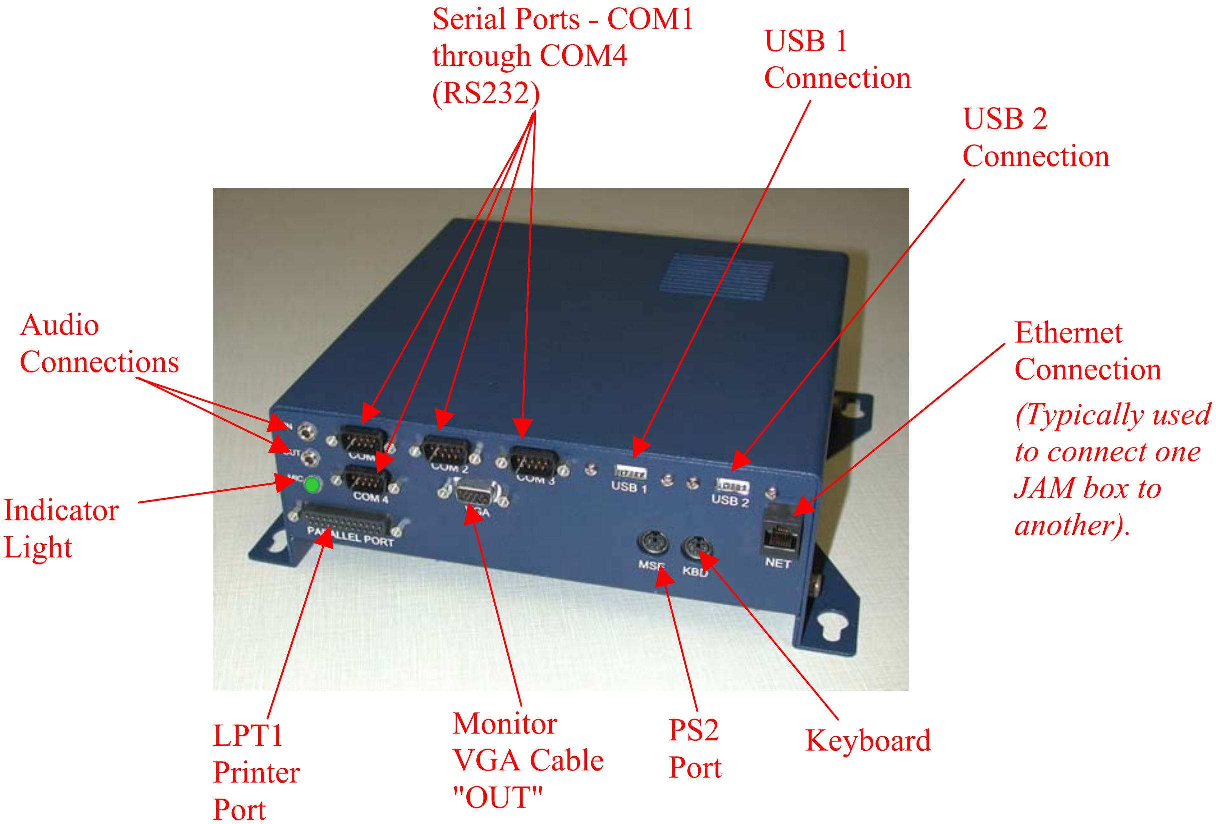
The JAM Box Installed: Figure 1-2 shows the JAM box mounted on the top surface of the *left engine control panel* with cables attached. On this particular machine, the engine control panel is located in front of the operator's seat on the left hand side.

When referring to the *Network Diagnostic View* on the operator interface, note that the jam box will appear as module "#01". (in front of the operator's seat).

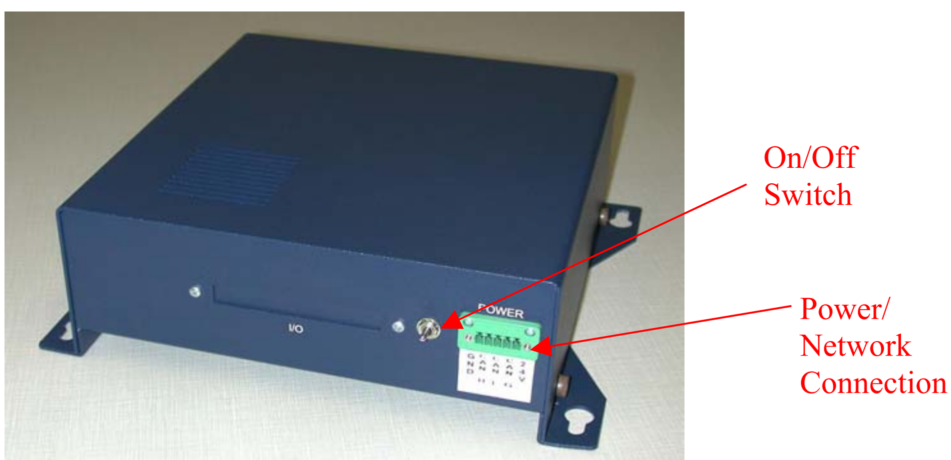


J.A.M. Box Installed
Figure 1-2

The JAM Box Cont'd.



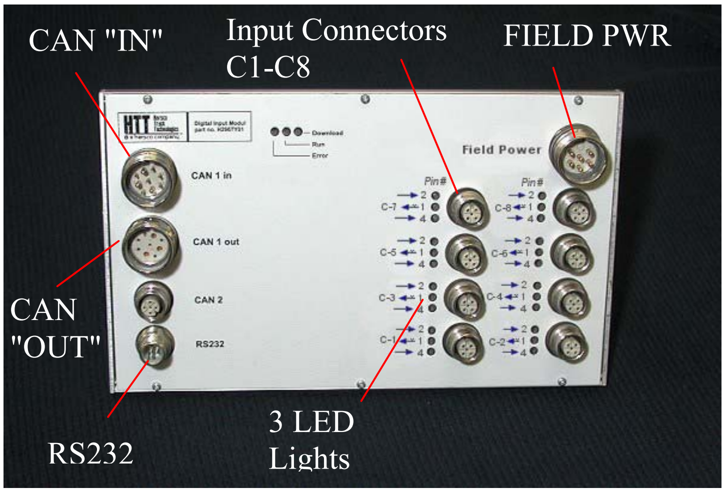
J.A.M. Box - Rear View
Figure 1-3



J.A.M. Box - Front View
Figure 1-4

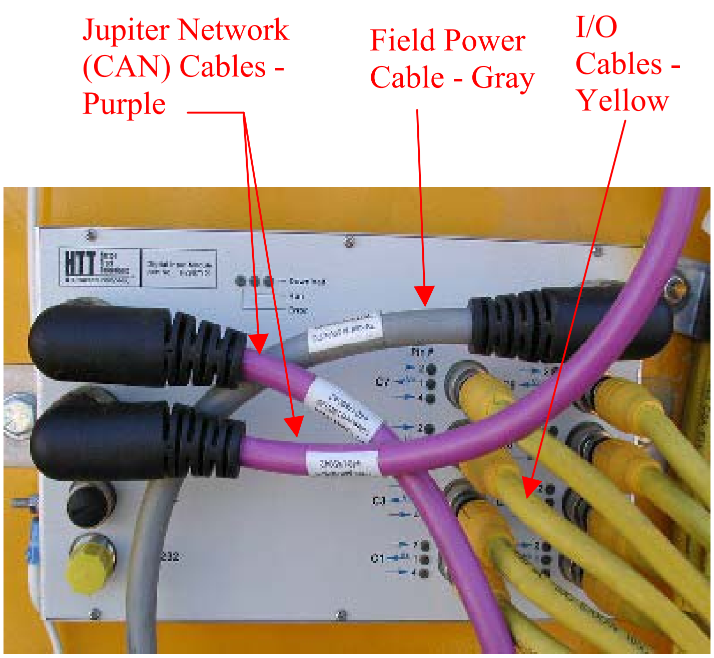
Digital Input Modules and Network Cables

Note	All modules are auto configured and require no jumpers or dip switches. Jupiter Modules are also fall back capable allowing the machine to still function in the event of module failure.



Digital Input Module
Figure 1-5

Digital Input Module: The *Digital Input Module* consists of 16 optically isolated digital inputs. There are three LEDs for each *Input Connector*. Each connector (C1-C8) provides a 24V output (pin 1) and two digital input channels (pins 2 & 4). Devices connected to the *Digital Input Module* include limit switches, pressure switches, encoders etc.



Digital Input Module and Network Cables
Figure 1-6

Cable Colors: The Jupiter network is connected by a series of colored (pre molded) network cables. *All Jupiter Network Cables are wired using this same color scheme.*

Gray: Field Power
Purple: Jupiter Network Cables (CAN)
Yellow: Input or Output Cables

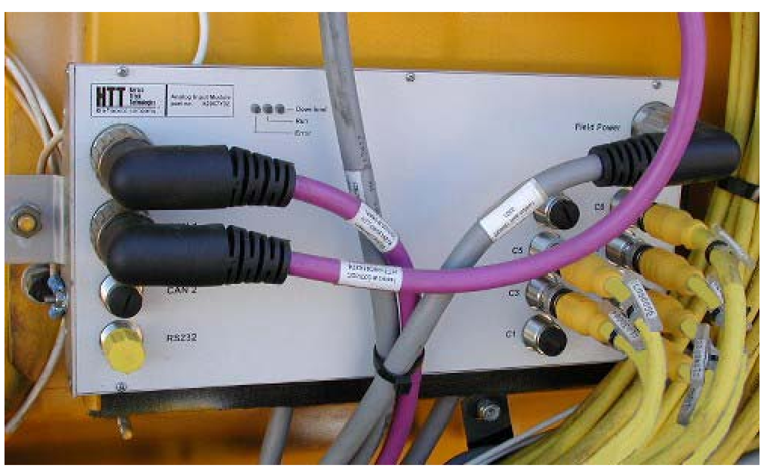
Network cables should be purchased according to the *cable type and length* required.

Note	Do not splice, cut, or damage the Jupiter cables. Network cables are pre-molded to withstand the rugged environment found on Railway Maintenance Equipment.

Analog Input Module

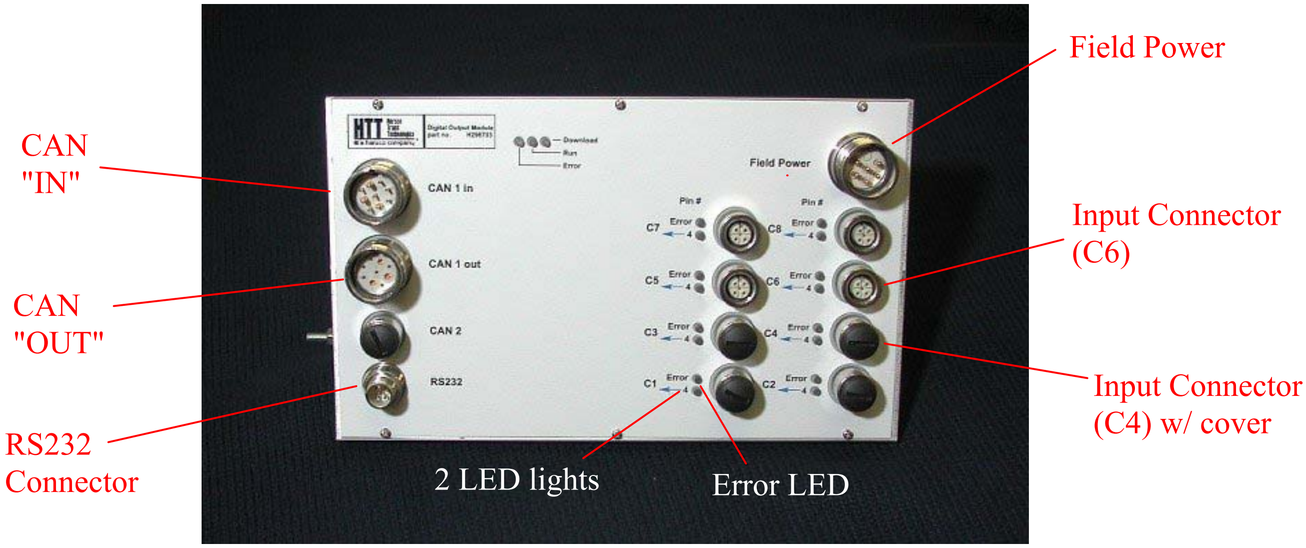
Analog Input Module
Figure 1-7

Analog Input Module: The *Analog Input Module* consists of 8 optically isolated analog input channels. Each connector provides a single –10V to + 10V analog input (pin 2), 24V DC supply (+24V pin 1, 24V return pin 5) and a 10V reference supply (+10V pin 4, 10V return pin 3). Devices connected to the *Analog Input Module* include string pots, pressure transducers, inclinometers etc.



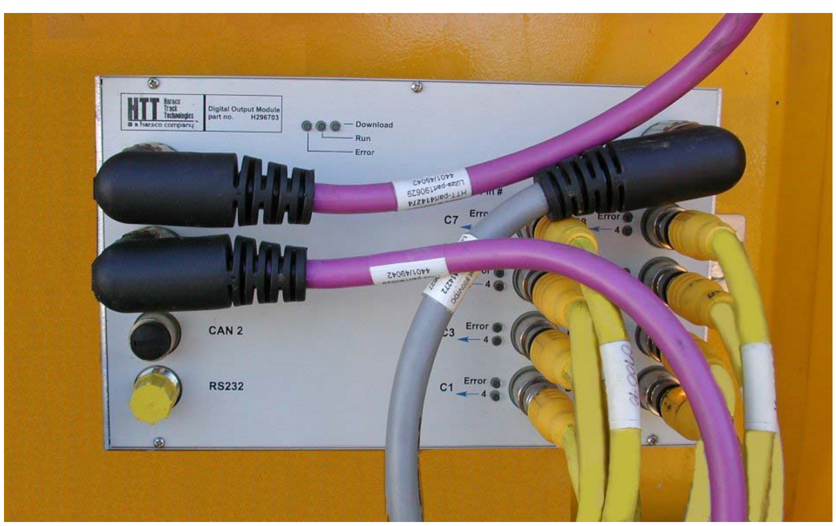
Analog Input Module Installed
Figure 1-8

Digital Output Module



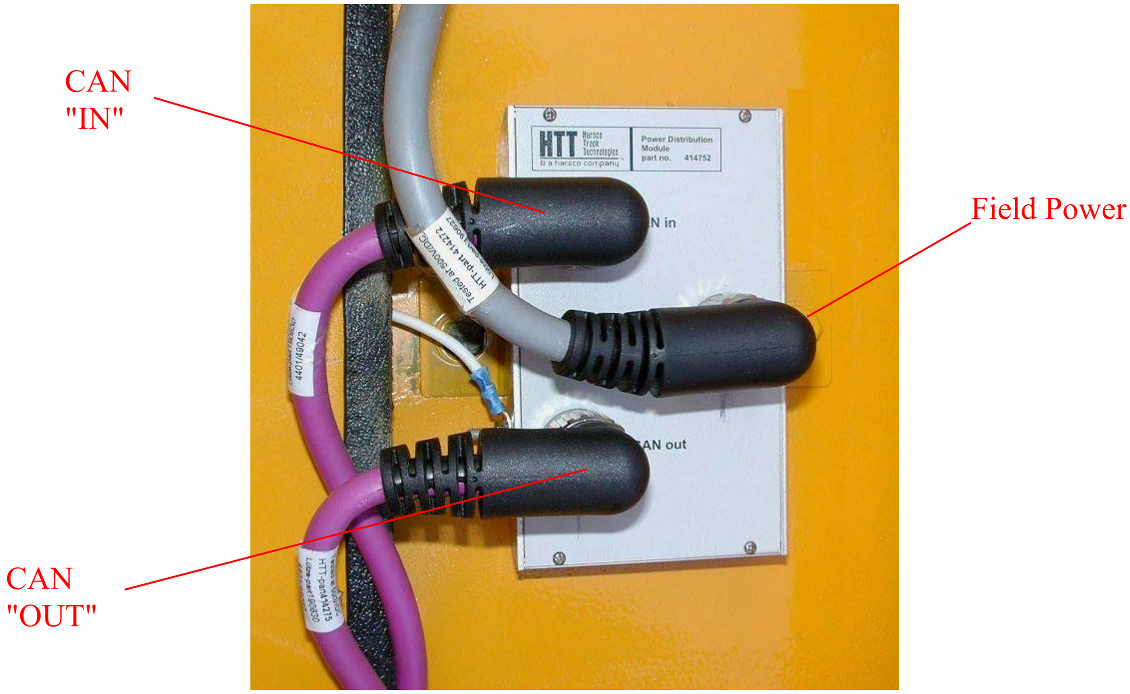
Digital Output Module
Figure 1-9

Digital Output Module: The *Digital Output Module* consists of eight optically isolated 24V digital output channels. Each connector (C1-C8) provides a 24V output channel capable of driving 3 Amp loads. There are two LED's per connector. The top LED on each connector indicates a short circuit or open circuit condition. This LED (red) will be continuously on in the event of a short circuit or flash in the event of an open circuit. The bottom LED (orange) on each connector reflects the ON/OFF status of the channel. Devices connected to the *Digital Output Module* include valve coils, lights, relays etc.



Digital Output Module Installed
Figure 1-10

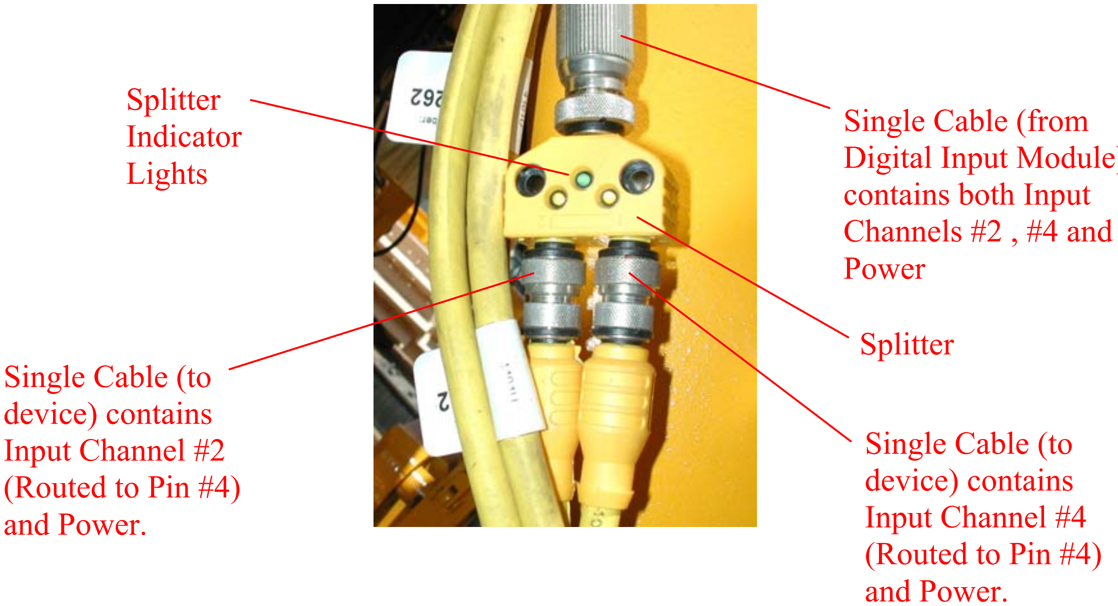
Power-T Module



Power-T Module Installed
Figure 1-11

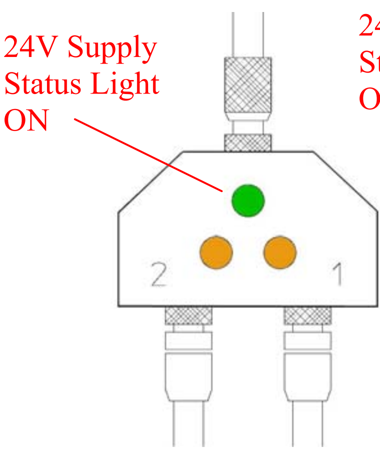
Power-T Module: The Power-T Module is used to introduce additional power for large networks. All connections except the 24V network power (shown above as "CAN IN") connect straight through this device.

Splitter

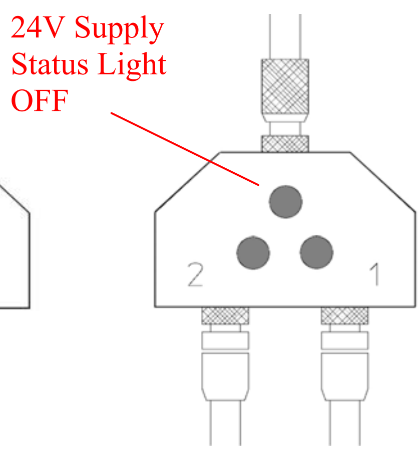


Splitter Installed
Figure 1-12

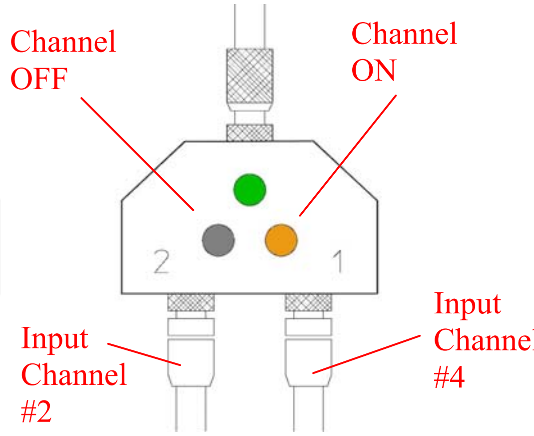
Splitter: The splitter is used only with digital input modules and simply reroutes existing input and power signals. In the figure above, the single cable going into the splitter (from the top) has two input channels (#2 and #4). After passing through the splitter, pins #2 and #4 have been separated allowing each channel to run through a separate cable.



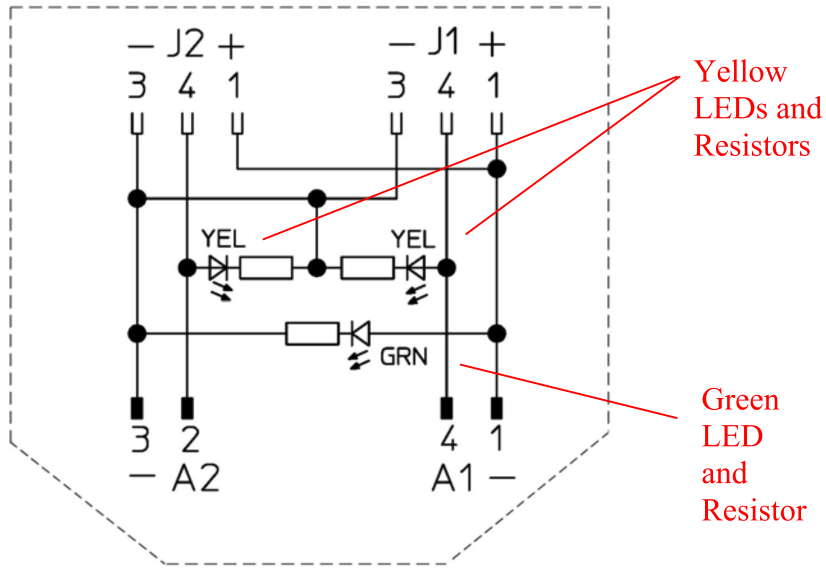
Powered - Both Channels ON
Figure 1-13



No Power - Splitter Inactive
Figure 1-14



Powered - One Channel ON
Figure 1-15



Splitter Schematic
Figure 1-16

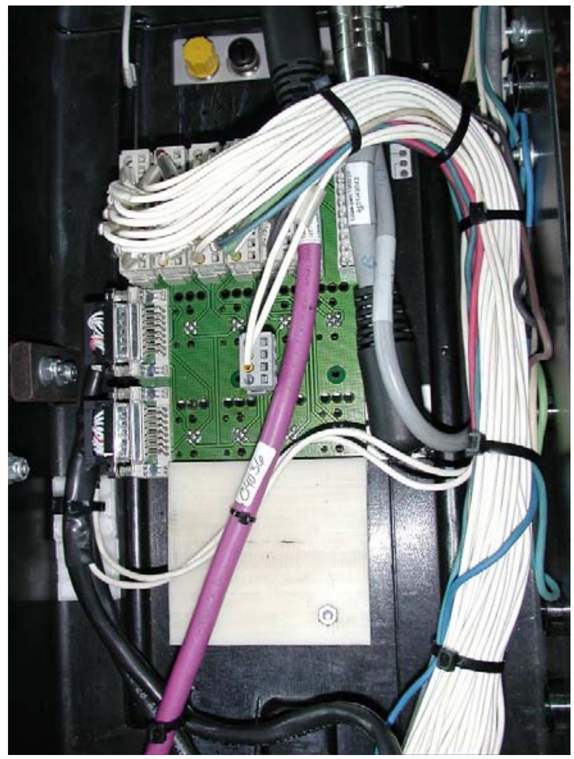
Splitter Indicator Lights: The splitter has three indicators lights that display its current condition. In figure 1-13, the *24V Status Light* is green (lighted) indicating the splitter is receiving supply voltage. The two orange lights below the *24V Status Light* indicate both input channels are active and in use. In Figure 1-14, the *24V Status Light and the Channel Indicator Lights* are OFF. **All splitter indicator lights will appear dark if no power is present**. In figure 1-15, the *24V Status and Input Channel #4 lights* are both ON while channel #2 is OFF.

Note: Splitter connection #1 will always correspond to the #4 Input Channel on the Digital Input module. Splitter connection #2 will always correspond to the #2 Input Channel on the Digital Input module (See Figure 1-15).

Transition Board

Note: The Transition Board is *not* used on machines with touchscreen monitors. As of this printing, the transition board is used on MKIV and MKVI machines only.

The transition board, located inside the right hand arm console of MKIV and MKVI machines, is physically plugged into connectors C1 through C-8 of the Digital Input Module. The transition board's main function is to provide a means for reading a high concentration of inputs with a single input module. The transition board can read 96 inputs and drive two 24-volt outputs.



Transition Board
(Inside View - R/H Arm Console)
Fig. 1-17

Section B
(Network and Power Connections)

Network and Power Connections

The intent of this section is to describe the connectors common to different module types.

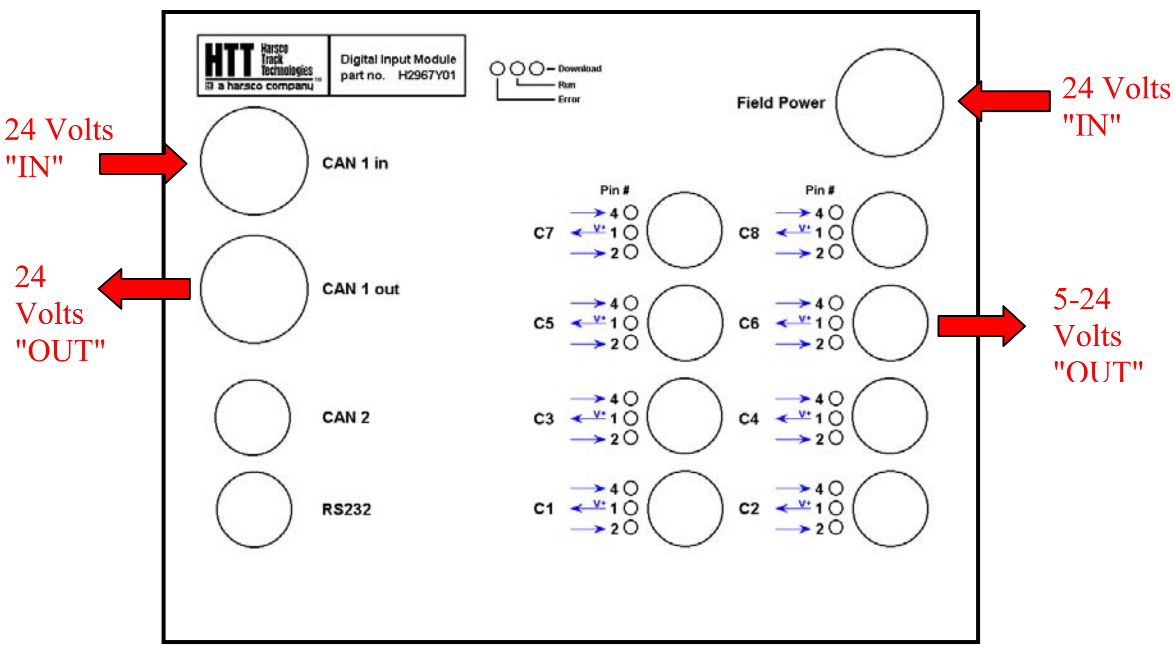
CAN 1 IN: The CAN 1 IN connector provides 24VDC power to the network and processing components of the module. This connection also contains the Jupiter network connections. The other end of the cable connected to this connector plugs into the CAN 1 OUT connector of the preceding module or JAM Box in the network.

CAN 1 OUT: The CAN 1 OUT connector continues the network connection to the next module in the network. Where this module is the last module in the network a special network terminator is installed on this connector.

CAN 2: The CAN 2 connector provides an independent network connection for each module. This independent network connection is used for communicating with other systems such as electronic engine control units and CAN based devices.

RS232: The RS232 connector provides a serial communication port equivalent to those typically found on PCs. This port can be used to communicate with other computer systems or equipment.

Field Power: The field power connector provides a 24V DC supply used to power I/O devices connected to C1-C8.



Jupiter Module
Figure 1-12

Section C

(Jupiter Network Troubleshooting)

Jupiter Network Troubleshooting

FLOW CHARTS ARE PROVIDED IN THIS SECTION

This section has flow charts that can be used to troubleshoot the Jupiter Network. Make sure you read this page before using the flow charts.

Troubleshooting Practices

This Appendix is limited to the discussion of troubleshooting procedures for the *Jupiter Network only*. If a Jupiter related problem occurs, a diagnostic screen will appear on the monitor showing which module in the network should be checked for potential problems. If a particular component does not work properly but the Jupiter system diagnostic checks show that the network is operating properly, the problem is likely to be in some other system area. Below is a list of six general areas where troubles can occur:

1. **Operator Problems**
2. **Mechanical Problems**
3. **Hydraulic Problems**
4. **Electrical Problems**
5. **Pneumatic Problems**
6. **Jupiter Network Problems**

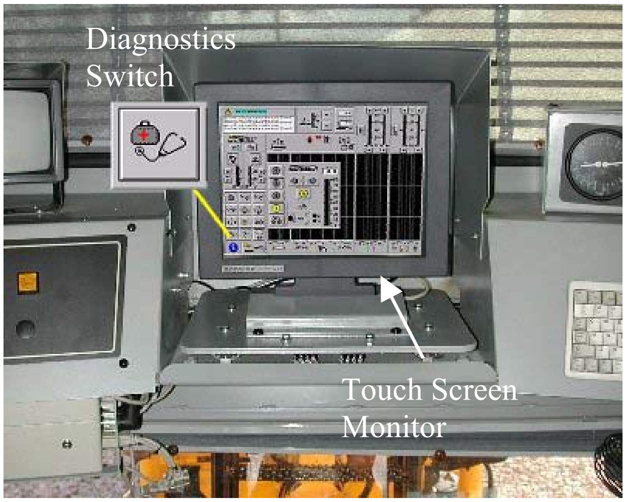
Isolating the problem to one or more of these systems and referring to the correct troubleshooting chapter will greatly help in resolving most problems.

Jupiter Diagnostics Overview

Jupiter utilizes "Touch Screen" technology for troubleshooting various Jupiter modules and connections throughout the network. In most cases, the operator/technician can perform all the necessary diagnostic checks and isolate a network problem without having to leave the operator's seat. When a network problem is encountered, the operator/technician can simply run through the diagnostic screens and determine which module in the network is displaying the error. At this point the operator/technician can check that particular module for short circuits, open circuits, voltage problems etc. just by viewing the diagnostic screen panels. Many problems can be corrected simply by reconnecting cables ends that have become loose or rerouting a cable that was wired incorrectly. Figures C-5 though C-7 cover most Jupiter Network problems and their solutions.

Troubleshooting the Jupiter Network

NOTE	When testing the Jupiter network, be aware that battery *voltage will gradually drop if the engine is not running*. Running the engine at idle speed while conducting Jupiter Diagnostic testing will help the battery to remain charged.



The "Touch Screen" monitor (left) allows the operator/technician to access and troubleshoot the Jupiter network. The system should boot up automatically at engine startup. Once it boots, press the *Graphical Diagnostic Switch* (left) to begin troubleshooting the system.

If the system does not come up, refer to the troubleshooting flow charts at the end of this chapter for possible causes and solutions.

This first menu to appear is the ***Diagnostics Menu***. Press the *Input/Output Diagnostics Switch* (outlined in red - Fig. C-2). This will bring up one of four diagnostic (pop-up) screens listed below. Refer to page C-3 for details.

1.) Network Diagnostics Screen
2.) Thumbnail Diagnostics Screen
3.) Input Diagnostics Screens
4.) Output Diagnostics Screen

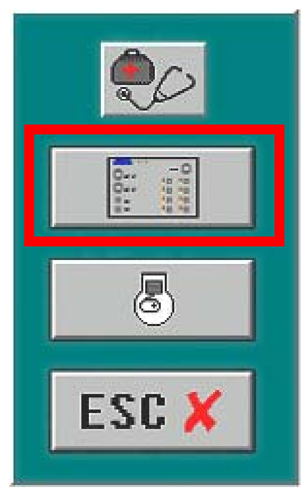
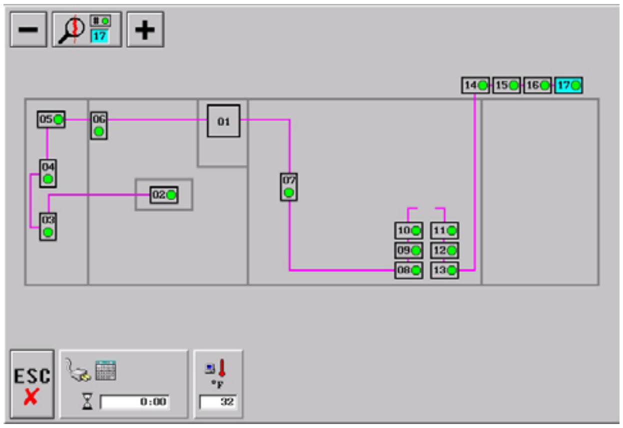


Fig. C-2

Diagnostic Screens - Four Ways to View

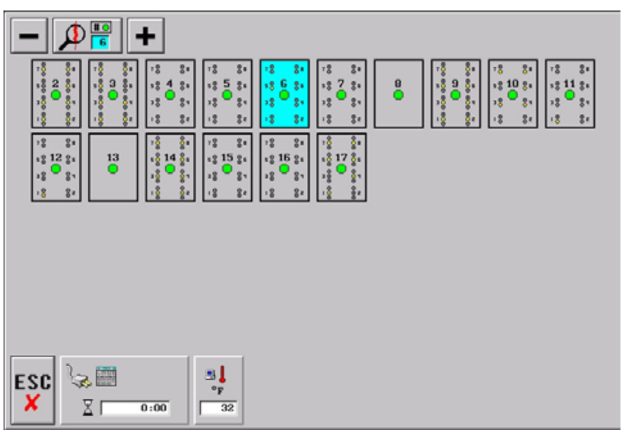
There four basic diagnostic screens used to troubleshoot the Jupiter Network:



Network Diagnostics View
Fig. C-3

1.) Network Diagnostics View
This view gives the operator/technician an overall top view of the machine and network modules. By using this screen, the operator can find the module producing the error and know roughly where on the machine the problem lies.

See Page C-6 (Fig. C-7) **for Details**

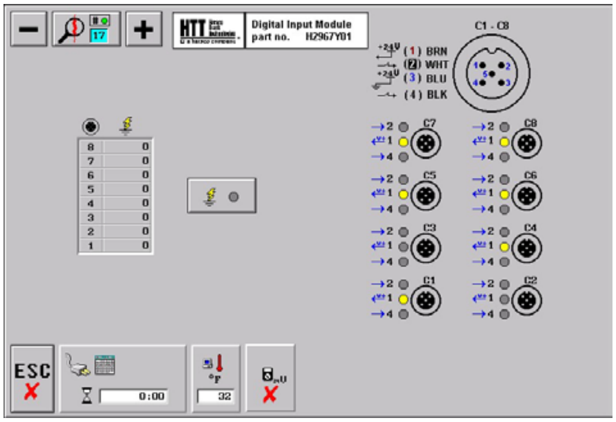


Thumbnail Diagnostics View
Fig. C-4

2.) Thumbnail Diagnostics View
The *Thumbnail Diagnostics View* gives the operator/technician an intermediate look at the network modules. This is useful for quickly observing the status of more than one module.

See Page C-9 (Fig. C-11) **for Details**

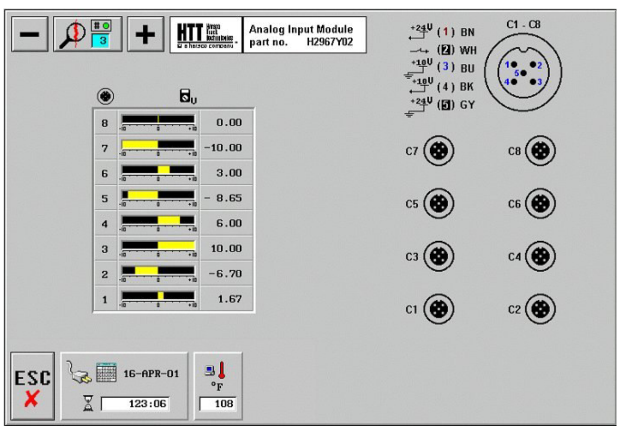
Diagnostic Screens - Four Ways to View Cont'd.



Digital Input Detail View
Fig. C-5A

3.) Input Diagnostics Detail Views
This screen gives the operator/technician a close up view of an individual *input module*. Once the operator/technician has narrowed down a problem to a specific *input module*, this screen can be used to test for short circuits.

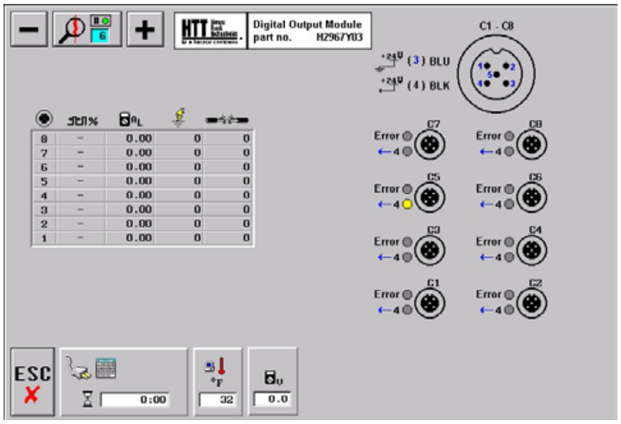
See Page C-10 (Fig. C-13) **for Details**



Analog Input Detail View
Fig. C-5B

The *Analog Input Module* is the second type of Input Module. Both types of input modules, *Digital and Analog* are shown in figures C-5A and C-5B.

See Page C-15 (Fig. C-23) **for Details**



Digital Output Detail View

Fig. C-6

4.) Output Diagnostics Detail View
This screen gives the operator/technician a close up view of an individual *output module*. Once the operator/technician has narrowed down a problem to a specific *output module*, this screen can be used to test for shorts, open circuits and so forth.

See Page C-17 (Fig. C-24) **for Details**

The Network Diagnostics View

The Network Diagnostics View gives the operator/technician a way to view the entire Jupiter Network at once. From here he can select and zoom-in to view specific modules.

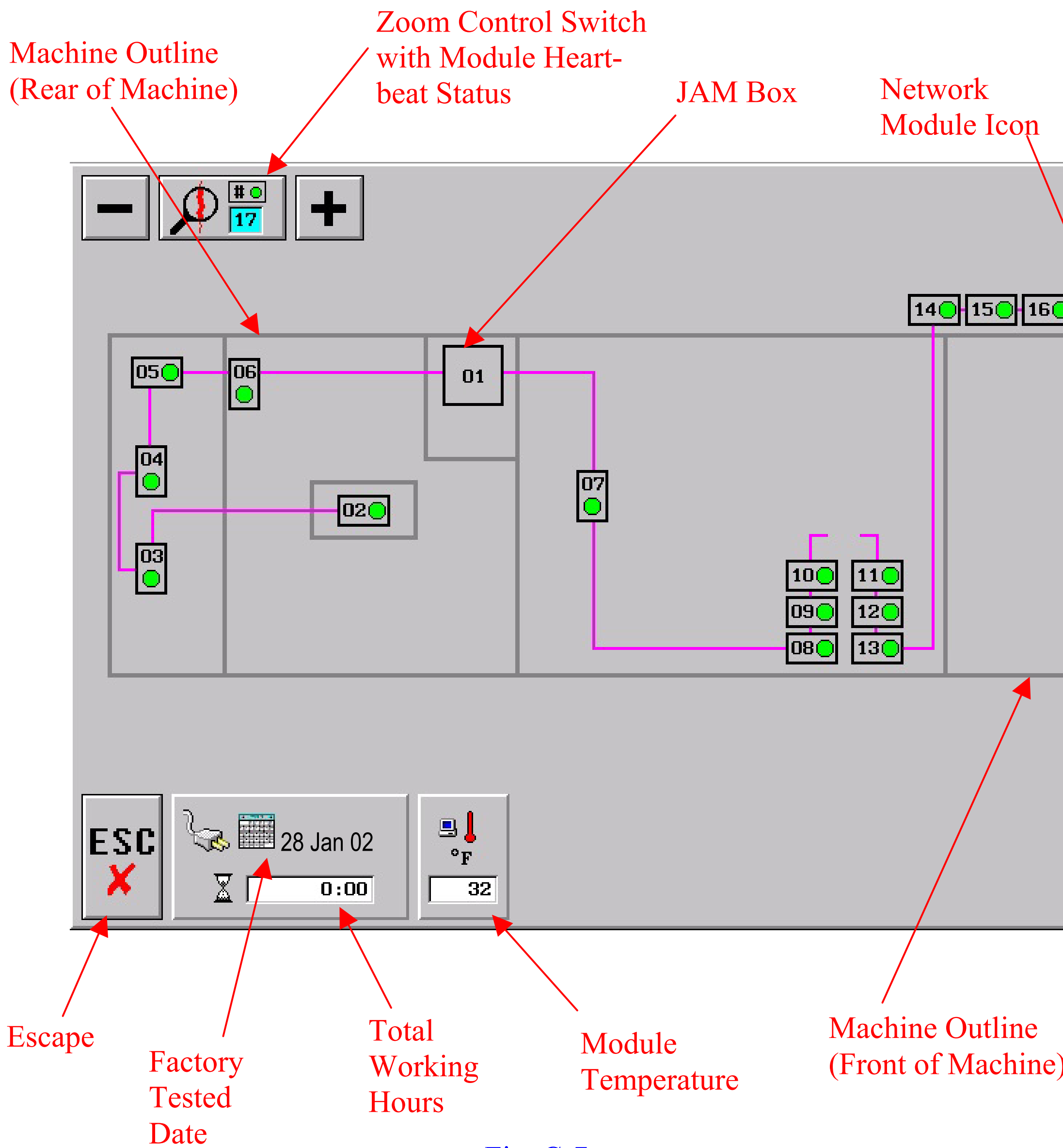


Fig. C-7

Machine Outline - Is an outline of the outermost portions of the Machine if viewed from the top. For clarity, the outline is displayed as a box so not to be confused with network cables.

Zoom Control Switch - Pressing the Zoom Control Switch causes the screen to change to a different Diagnostic View (see figs. C-3 - C-6). To go up one module, press the Plus switch. To go down one module, press the Minus switch. The Module Number Display will show the current module number. See fig. C-9 (below) for Heartbeat Status indicator light.

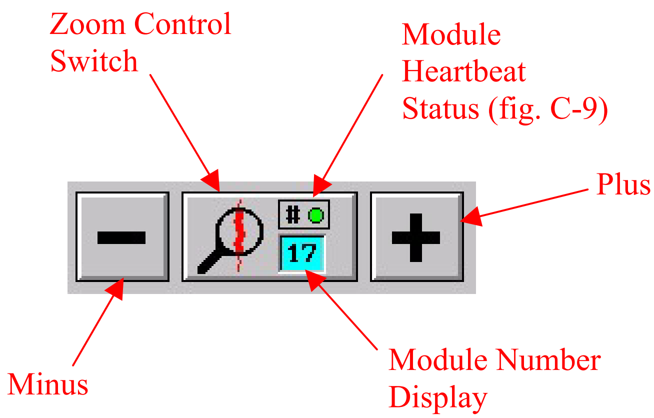


Fig. C-8

Module Heartbeat Status- Displays the health status of the module. Each module is numbered and contains a diagnostic LED (light). The color of the LED will indicate whether there is a problem with that specific module or not.

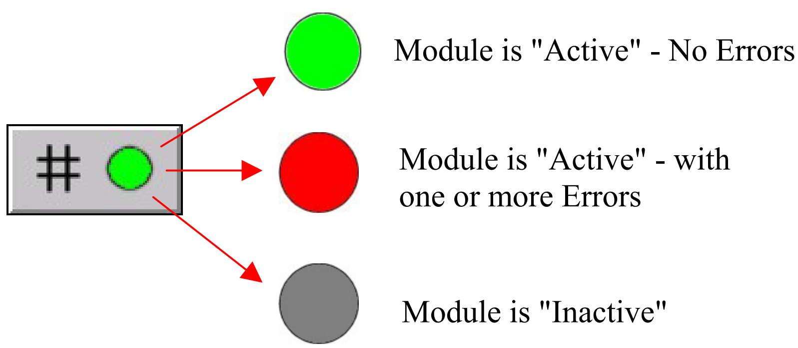


Fig. C-9

JAM Box - The JAM box is the main CPU for the entire Jupiter Network. The JAM box will always be labeled "01" and the icon will look slightly larger when viewed in the Network Diagnostics View.

Network Module Icon-This module was randomly selected to use as an example and happens to be the last module in the network. The cyan color indicates the module has been selected. The "17" will match the Module Number Display in fig. C-8. This number will change depending on which module is selected. Pressing the Network Module Icon will bring up the Input or Output Diagnostics Detail View. To display detailed information for any module, touch the desired Network Module Icon. Go to the Zoom Control Switch (Fig.C-8). Press the minus button to move to the previous module. Press the plus button to move to the next nodule. Press the zoom button to switch between the four views (See Figures C-3 - C-6)

Heartbeat Status
(See Fig. C-9)

Module
Number

Fig. C-10

Factory Tested Date - The date the machine was tested for proper operation. Used primarily for warranty purposes.

Total Working Hours - Displays the total number of hours the module has worked. This may differ from other modules have been replaced or exchanged with modules on other machines.

Module Temperature - Displays the current module temperature. Network modules are designed to handle temperatures from -40º F. to 158º F.

Escape - Press the escape switch to remove a panel from view.

The Thumbnail Diagnostics View

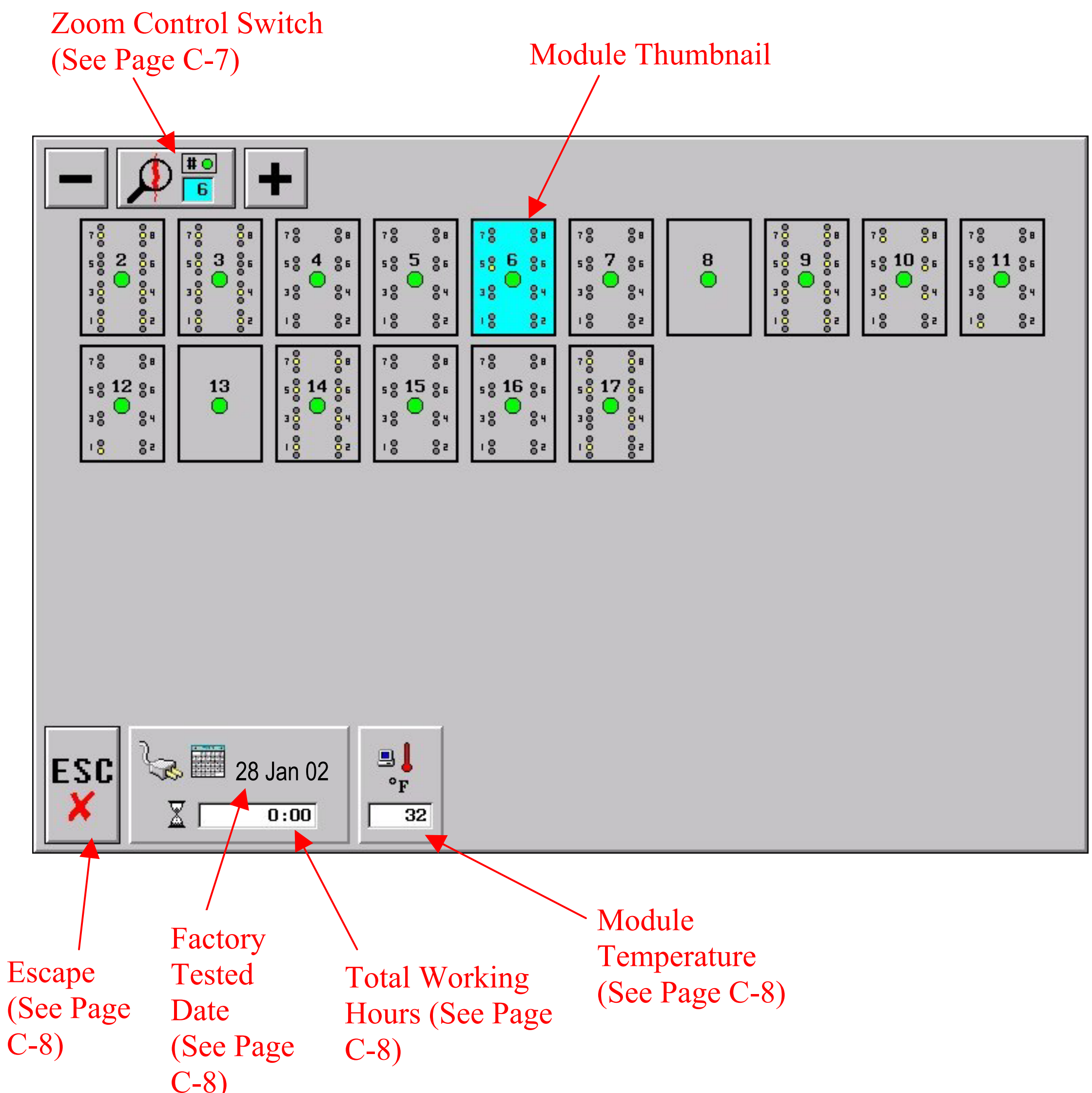


Fig. C-11

Module Thumbnail - The *Module Thumbnail* is a smaller version of the Input (or Output Module) Detail View. All the LED lights of the *Module Thumbnail* are active and functional. The dot in the center indicates Heartbeat Status.

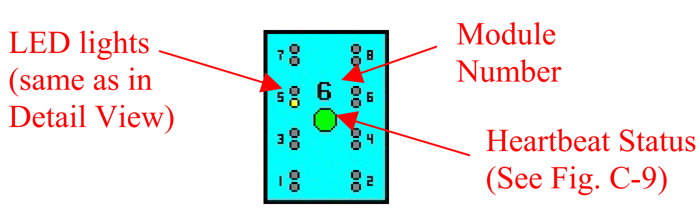


Fig. C-12

The Digital Input Diagnostics Detail View

Two basic types of input modules will be discussed:

1. **Digital Input Modules**
2. **Analog Input Modules**

Below is an example of a **Digital Input Module** shown in the *Detail View.*

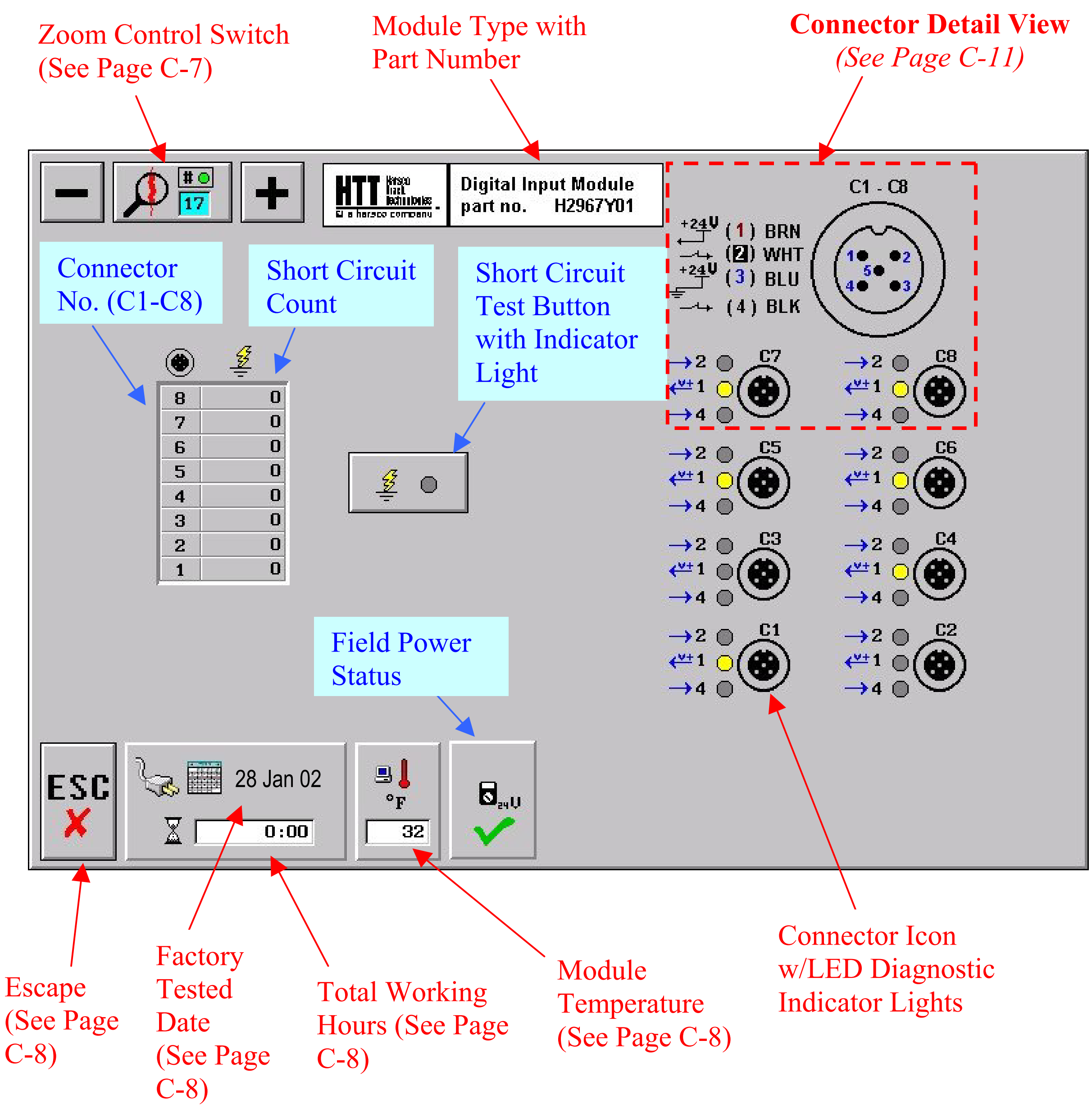


Fig. C-13

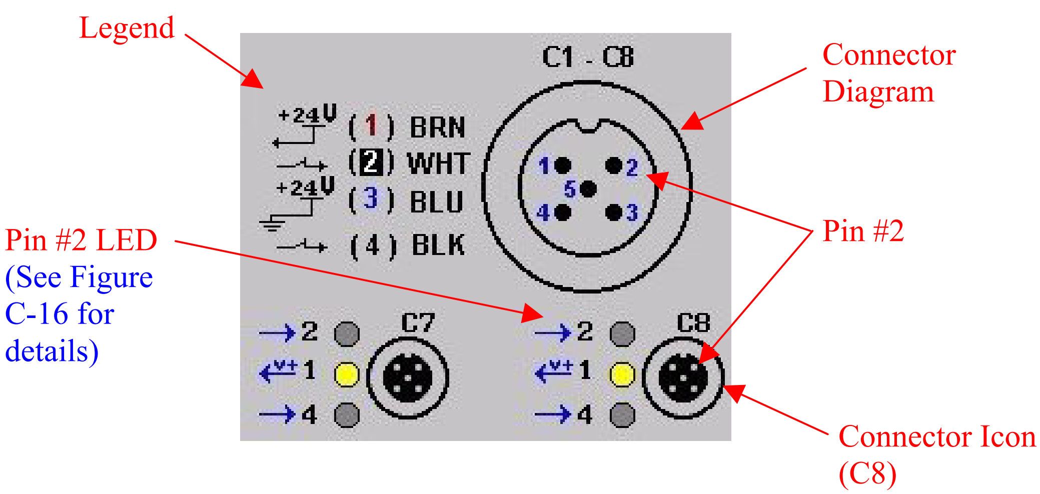
The Digital Input Diagnostics Detail View Cont'd

Module Type and Part No. - Each module is labeled with the *module type* and *part number* for easy identification. There are three main module types:

- **Digital Input Modules -** Part No. H2967Y01
- **Analog Input Modules -** Part No. H2967Y02
- **Digital Output Modules -** Part No. H2967Y03

The Harsco Track Technology Part Numbers listed above are for reference purposes and may be used to order replacement modules.

Connector Diagram - The *connector diagram* is an enlarged pictorial view of the *connector icon* with its pin numbers. The legend at left provides wiring information for troubleshooting. The term *"channel"* is sometimes used to describe the individual circuits. In this case, **Pins #2 and #4** are both *"input channels"* whereas **Pin #1** is a 24-Volt "*output channel*". **Pin #5** is not used.



Connector Detail View
(From Page C-10)
Fig. C-14

The Digital Input Diagnostics Detail View Cont'd

Field Power Status - Field Power is 24 volt DC Power that comes from the battery via a circuit breaker located in the Power Distribution Box. Field Power is used to power devices such as limit switches, solenoids and other electrical components. Refer to Fig. C-13 for the *field power status* indicator light location.

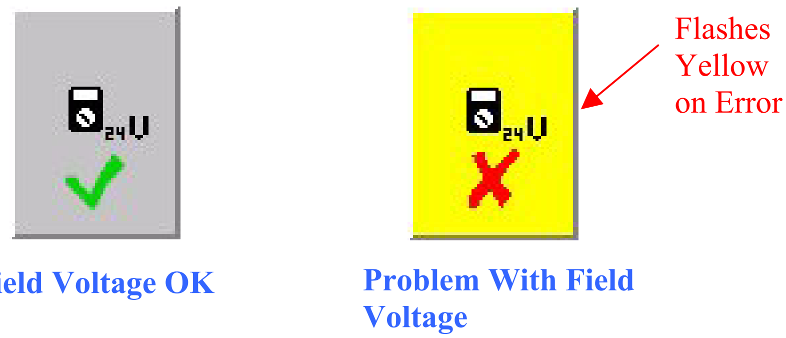


Fig. C-15

Connector Icon w/LED Diagnostic Indicator Lights - The Figure below shows the different color codes and their meanings for a typical *Digital Input Module*. The *green* light means the circuit on that particular channel is *complete*. If the light turns gray, it means the circuit is now *incomplete*.

NOTE	*On Digital Input Modules, the LED Diagnostic Indicator Lights* **do not turn red to indicate shorts or open circuits**. See page C-14 for short detection.

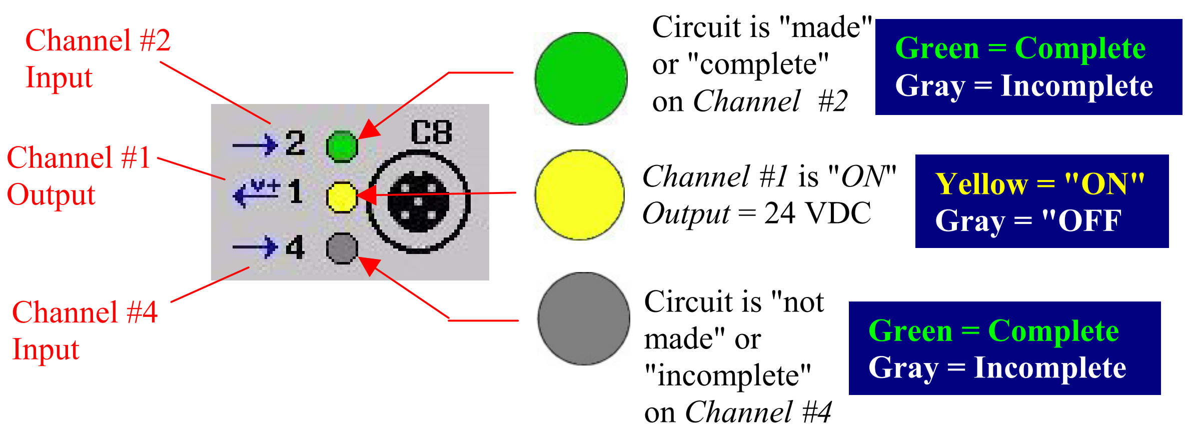


Fig. C-16

The Digital Input Diagnostics Detail View Cont'd

Connector Icon w/LED Diagnostic Indicator Lights Cont'd - The Figures below shows different color combinations and their meanings. Connector # 8 is used in all these examples. The same color-coding applies to all the connectors (C1-C8) in this module.

Fig. C-17

Channel #2 - Input - Circuit is "incomplete"
Channel #1 - Output - "ON" producing 24 Volts DC
Channel #4 - Input - Circuit is "complete"

Fig. C-18

Channel #2 - Input - Circuit is "complete"
Channel #1 - Output - "ON" producing 24 Volts DC
Channel #4 - Input - Circuit is "complete"

Fig. C-19

Channel #2 - Input - Circuit is "incomplete"
Channel #1 - Output - "OFF" *not* producing 24 Volts DC
Channel #4 - Input - Circuit is "complete"

Fig. C-20

Channel #2 - Input - Circuit is "incomplete"
Channel #1 - Output - "ON" producing 24 Volts DC
Channel #4 - Input - Circuit is "incomplete"

Fig. C-21

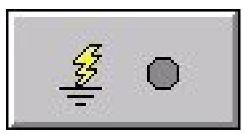
Channel #2 - Input - Circuit is "incomplete"
Channel #1 - Output - "OFF" *not* producing 24 Volts DC
Channel #4 - Input - Circuit is "incomplete"

The Digital Input Diagnostics Detail View Cont'd

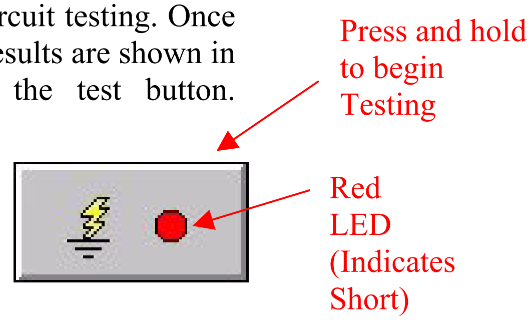
Short Circuit Test Button with Indicator Light - This button has two functions:

1. *<u>It acts as a short circuit detector</u>* -A red LED light will come on if a short is detected in a circuit that is part of the *Digital Input Module.*

2. *<u>It acts as short circuit test button</u>* - Pressing this button begins short circuit testing. Once testing is completed, the results are shown in a table to the left of the test button.

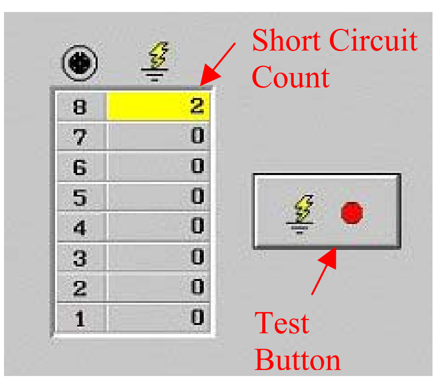


No Short Detected
(Normal Condition)
Fig. C-22



Short Detected
(Testing Needed)
Fig. C-22

Short Circuit Count w/Connector Number - This table shows the total number of short circuits found during testing.



After short circuit testing, the example at left shows a total of two short circuits found on the #8 Connector. *Refer to the flow charts at the end of this section for troubleshooting.* Once the short has been physically corrected out on the machine, the yellow highlighting will disappear and the *red LED* on the test button will turn gray. The computer must be rebooted in order to reset the *Short Circuit Count* number from "2" back to zero.

The Analog Input Diagnostics Detail View

Below is an example of an **Analog Input Module** shown in the *Detail View.*

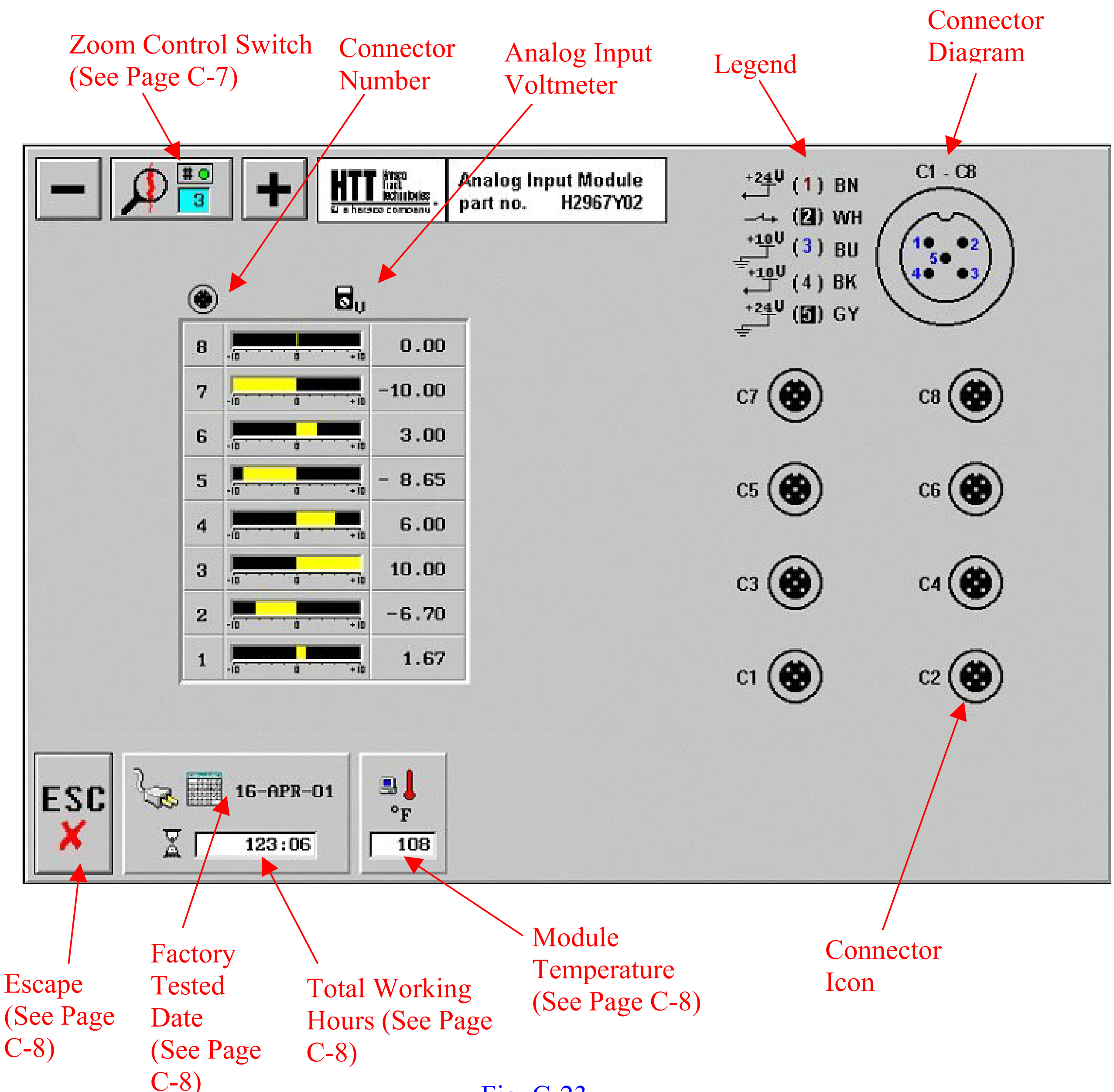


Fig. C-23

The Analog Input Diagnostics Detail View Cont'd

Pin 1 - An isolated 24 Volt output to provide power for transducers or devices connected to this connector (if needed). The return for this output is *Pin 5*.

Pin 2 - Signal input, from -10 to +10 volts. (Fig. C-23)

Pin 3 - Output ground for the 10 volts output reference voltage on pin 4.

Pin 4 - An isolated high precision reference voltage (10 volts) for use with devices such as string pots and actuators that act as a voltage divider to generate the input signal to *Pin 2*.

Pin 5 - Return or ground for *Pin 1* (if used).

Analog Input Voltmeter - The Analog Input Voltmeter measures voltages from a specific device in the network. Analog input voltages range between +10 and -10 VDC. This part of the graphical interface screen does not respond to touch. Voltages will vary depending on the type of device being used. No error LEDs or pop-up screens will appear if the voltage is out of range (±10 VDC). (Fig. C-23)

The Digital Output Diagnostics Detail View

Below is an example of a **Digital Output Module** shown in the *Detail View.*

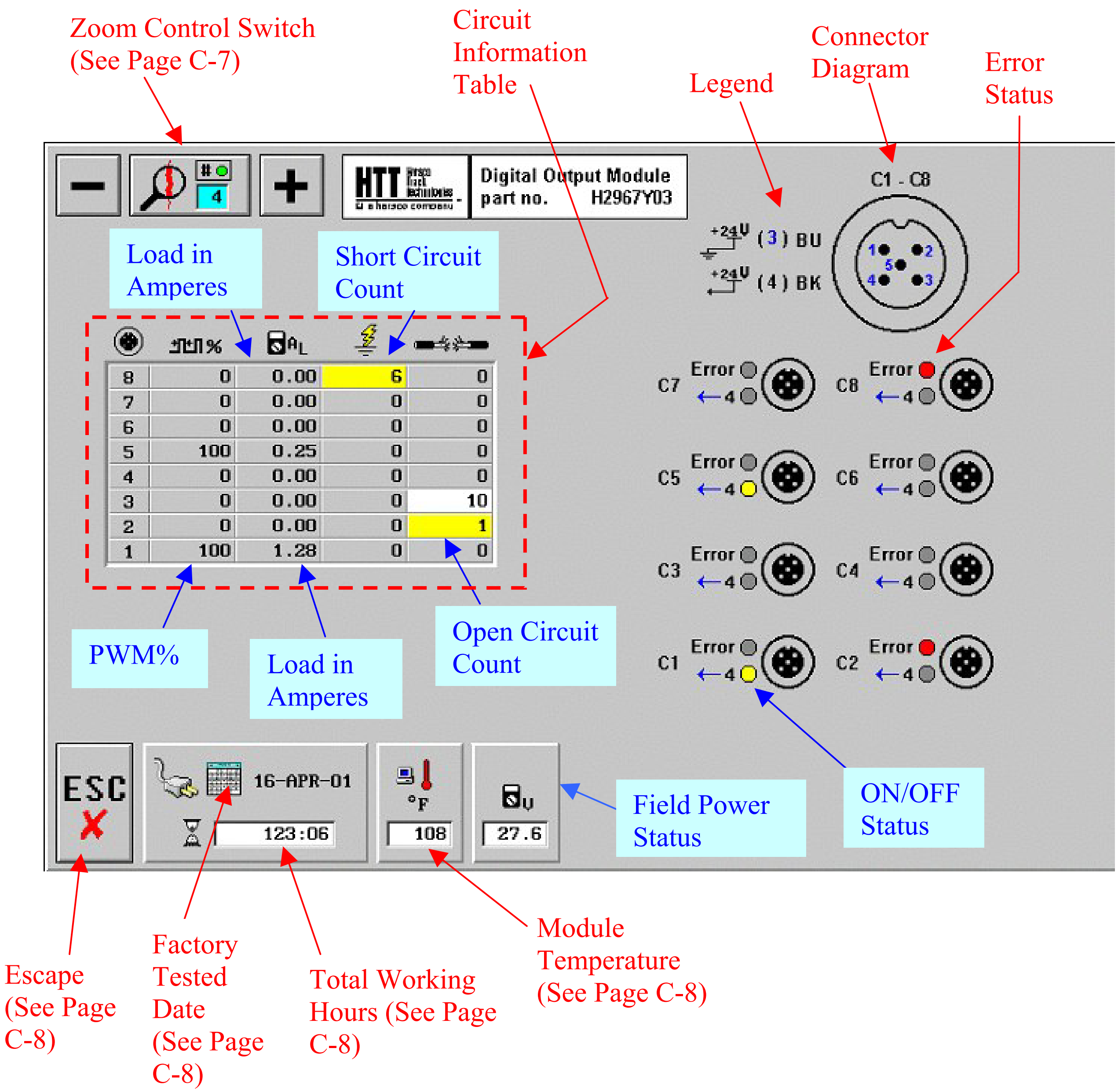


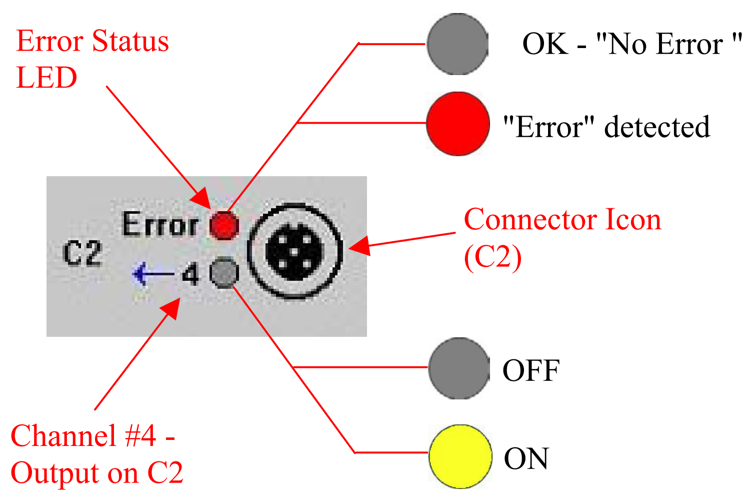
Fig. C-24

The Digital Output Diagnostics Detail View Cont'd

Connector Diagram and Legend - On a *Digital Output Module* only 2 pins are used. **Pin#3** is the 24 Volt Output and **Pin#4** is the 24 Volt ground.

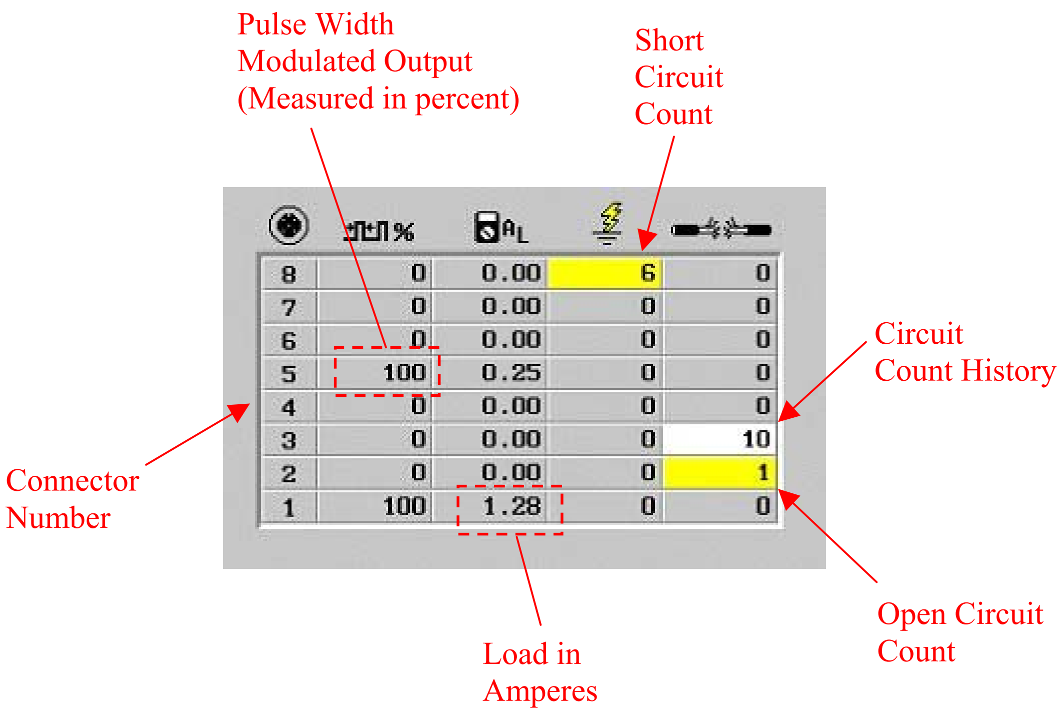
Error Status and ON/OFF Status - The red LED shown below will come on *automatically* if a *short circuit* or *open circuit* is detected. Once the defective circuit has been repaired, the error status LED will switch back to *gray* meaning the circuit is OK and free of circuit errors. Refer to the next page for detailed information on *short circuit counts* and *open circuits counts* and how they relate to the error status light.

NOTE	**If the red "Error" LED light is present, there will be a corresponding numerical value highlighted in yellow in the *Circuit Information Table. See Figure C-26***



Error Status & ON/OFF Status
Fig. C-25

The Digital Output Diagnostics Detail View Cont'd



8	0	0.00	6	0
7	0	0.00	0	0
6	0	0.00	0	0
5	100	0.25	0	0
4	0	0.00	0	0
3	0	0.00	0	10
2	0	0.00	0	1
1	100	1.28	0	0

Circuit Information Table
Fig. C-26

Open Circuit Count - The table in figure C-26 shows a single open circuit (highlighted in yellow) on connector number two (C2). The yellow highlighting will remain until the open circuit is fixed. Once it's repaired, the yellow band will change to white indicating the open circuit is no longer present. *"Error Status LED" (fig. C-25)* will change to gray.

NOTE

When a short circuit or open circuit is repaired, the *Circuit Information Table* will display a white highlighted band meaning that the circuit previously had errors but those errors have been corrected. This is referred to as *Open Circuit Count History*. **The CPU (JAM box) must be rebooted to reset this number back to zero.**

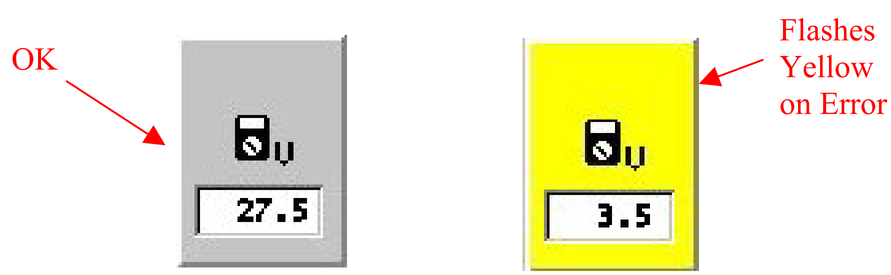
The Digital Output Diagnostics Detail View Cont'd

Circuit Count History -When an Open/Short circuit is repaired, the *Circuit Information Table* will display a white highlighted band meaning that the circuit previously had errors but those errors have been corrected. This is referred to as *Circuit Count History*.

Short Circuit Count - The table in figure C-26 shows a total of six short circuits (highlighted in yellow) on connector number eight (C8). The yellow highlighting will remain until the short circuit is repaired. Once it's repaired, the yellow band will change to white indicating the short circuit is no longer present.

Load in Amperes - The amount of electrical current flowing through the output circuit. This load may vary depending on the device. The maximum allowable load is three amps (continuous). If the load happens to be over three amps, that specific circuit will automatically be shut down.

Field Power Status - This voltage indicator is similar to the one shown on *page C-12 (figure C-15)*. The only difference is in how the voltage is displayed. In this case the actual voltage amount is displayed within the icon. In the other it appears as a "green check" or "red X". **Normal Field Power is approximately 28 VDC with the engine running**.

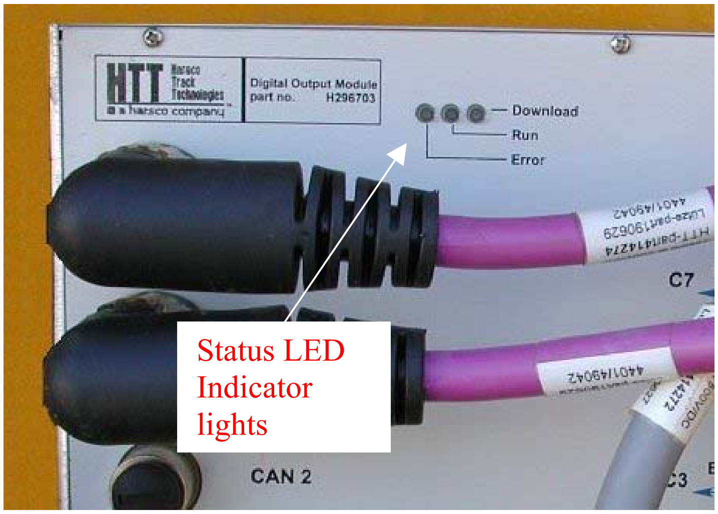


Field Power Status
Figure C-27

The Digital Output Diagnostics Detail View Cont'd

PWM% *(Pulse Width Modulation)* Primarily used with servo and proportional hydraulic valves, PWM provides digitally enhanced control of valve position. *PWM* is measured in percent. Many devices do not use a *Pulse Width Modulation.* In Fig. C-26, only output connectors C5 and C1 use *Pulse Width Modulation.* A zero value in this column means that the channel is off. A value of 100 indicates the channel is continuously on and PWM is not being used. If no number is displayed in the column, PWM is not being used.

Status LED Indicator Lights



All module types have three status indicators on the front panel labeled as:

- Error (red)
- Run (green)
- Download (orange)

During normal operation, the Error and Download indicators will remain off and the green Run indicator will alternate between on and off at approximately half second intervals.

As the labeling suggests, the red (Error) indicator will illuminate if any communication errors occur on the Jupiter network. If this indicator remains on, this module is unable to communicate and any outputs will switch to safe states. This will be confirmed on diagnostic screens by the absence of the heartbeat indication for this module. Check to ensure that the network (purple) cables between this module and the adjacent modules are properly connected and not damaged. If the error persists it will be necessary to replace this module.

The orange or download indicator will illuminate briefly when the system is turned on. When a module is being programmed (by the JAM), this light will flash rapidly (do not turn off the system during a programming phase until normal operation resumes). This programming phase lasts for several seconds and is automatically invoked under the following circumstances:

- The machine is being turned on for the first time after one or more modules have been replaced and the internal module programming does not match what is necessary for the machine.
- An HTT service technician has changed the machine software. This will usually result in all modules being reprogrammed.

If the orange indicator remains on continuously, the internal programming of the module is faulty. Replace the module.

For a properly functioning module, the status indicators will always flash. Failure to do so indicates a problem. In addition to the above-mentioned descriptions, there are some additional interpretations of status led combinations:

Green and orange blink together (also indicated on JAM alarm panel)**:**

This combination indicates that the automatic addressing mechanism in the Jupiter network has failed. During initialization, the modules interact with each other (the JAM does not take part in this process) to establish their address on the network. If the network address cannot be established in this way, a module will use the last known good address. If modules have not been replaced or moved, this will cause no problems. This can be confirmed on diagnostic screens by ensuring the heartbeat status for all modules is present.

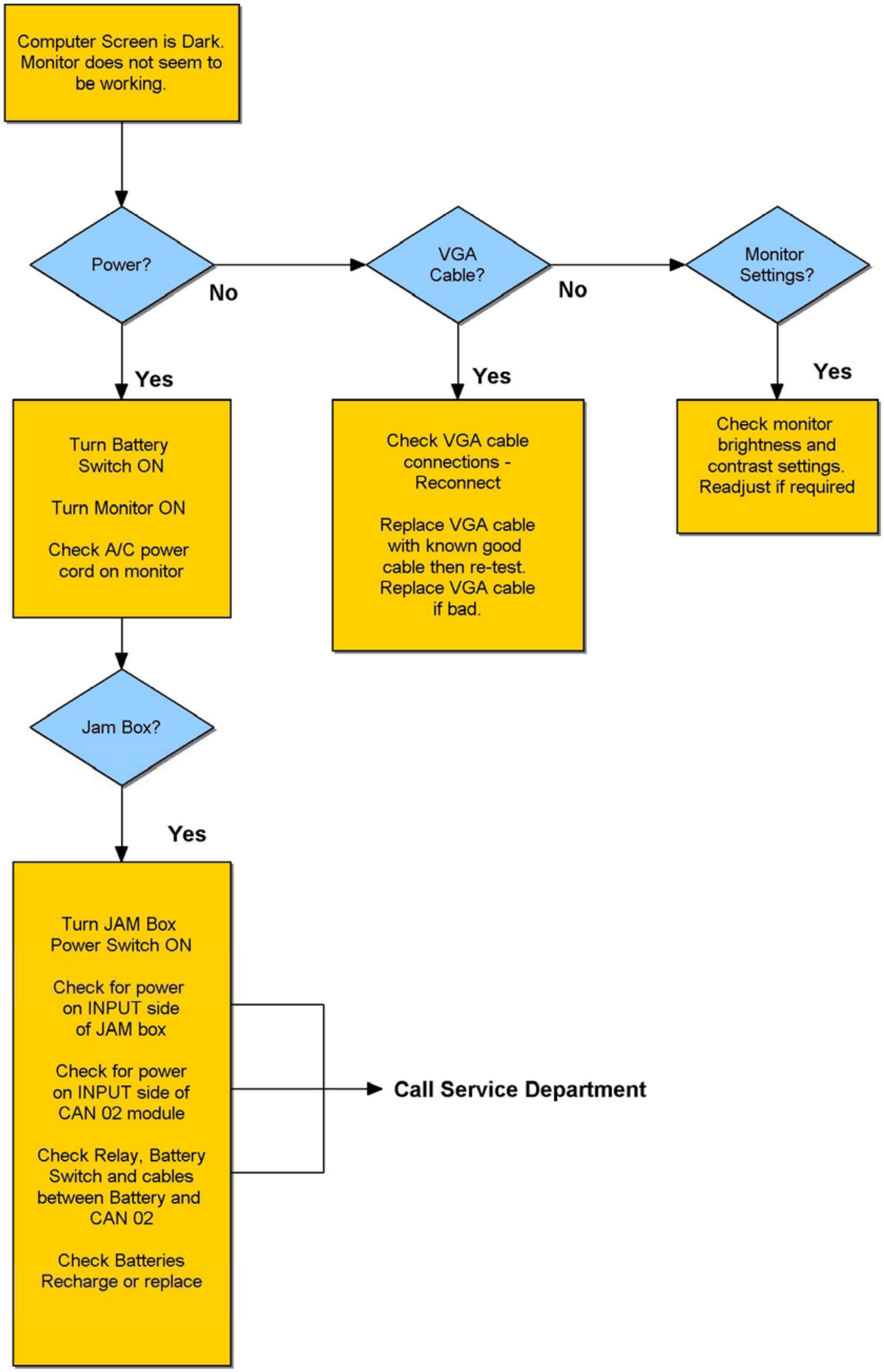
This problem must be corrected after replacing or moving modules before attempting to operate the machine. Check the network connection (purple cable) between the first module (to have this problem) and the preceding module. Both cable and module should be free of damage and securely connected. If necessary, replace this cable and/or module and ensure this error has been eliminated on all modules.

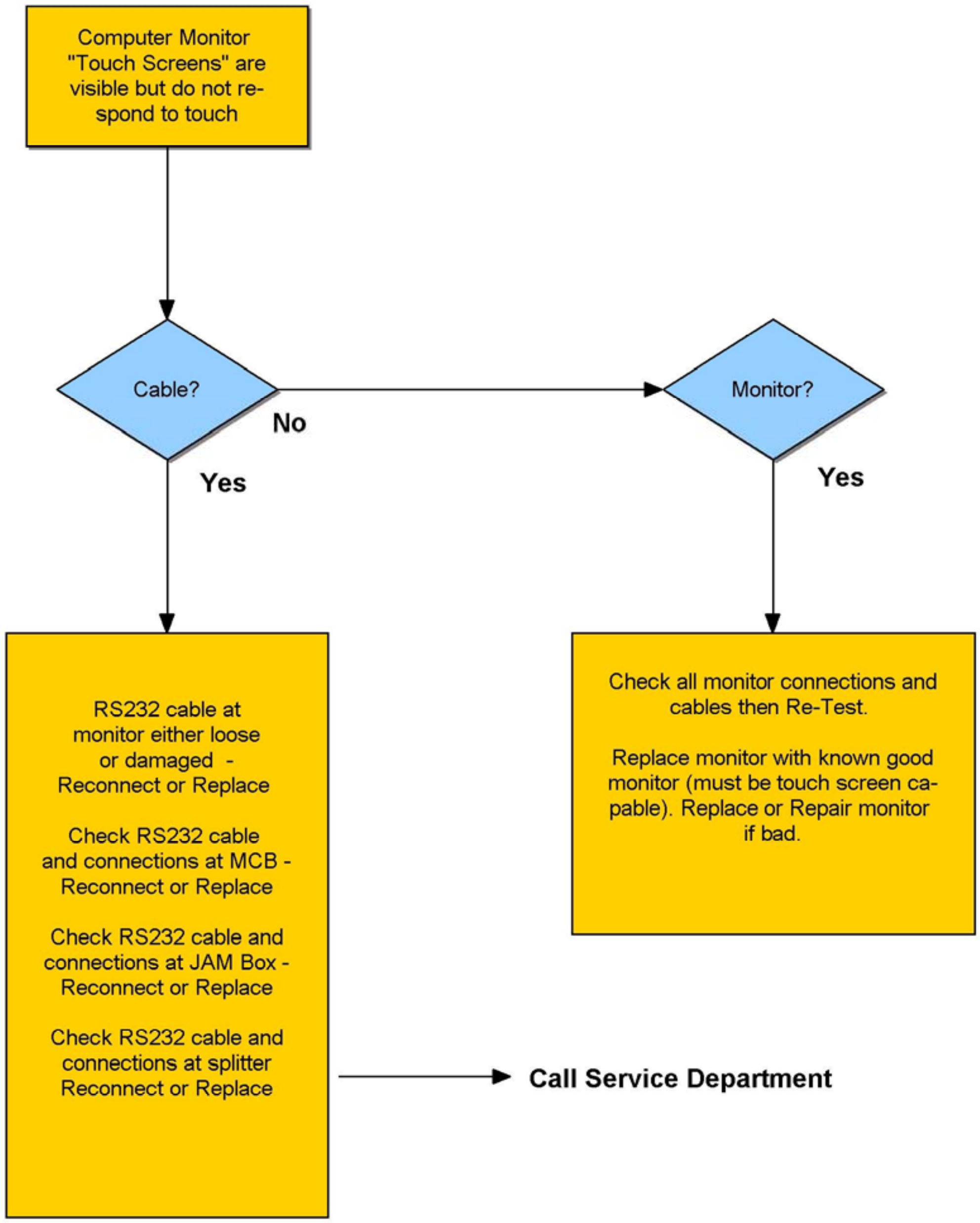
Note: When this error occurs on a module, it is also expected to occur on every *"downstream"* module in the network, even if there is no problem with the *"downstream"* network cables and modules. A *"downstream"* module is a module with a higher number in the network. Similarly, if a module is not indicating this error, this error should not exist on any *"upstream"* module. If the last module in the network does not indicate this error, all modules in the network have successfully established their proper address during initialization.

Red and orange blink together:

The automatic addressing mechanism in the Jupiter network has failed and the network address for this module is invalid. This module will not attempt to communicate. The comments of the preceding section apply.

RED	GREEN	ORANGE	
off	off	off	Cable not plugged in
off	off	on	Bios is booting software
off	off	blink	Software is downloading
off	on	off	Software is initializing
off	blink	off	Normal operation
off	blink	blink	Daisy-chain error
blink	blink	off	CAN bus errors
on	blink	off	Bus warn
blink	off	blink	Daisy chain failure
on	off	off	Bus Off!


Computer Screen is Dark. Monitor does not seem to be working.
Power?
No
Yes
VGA Cable?
No
Yes
Monitor Settings?
Yes
Turn Battery Switch ON
Turn Monitor ON
Check A/C power cord on monitor
Check VGA cable connections - Reconnect
Replace VGA cable with known good cable then re-test. Replace VGA cable if bad.
Check monitor brightness and contrast settings. Readjust if required
Jam Box?
Yes
Turn JAM Box Power Switch ON
Check for power on INPUT side of JAM box
Check for power on INPUT side of CAN 02 module
Check Relay, Battery Switch and cables between Battery and CAN 02
Check Batteries Recharge or replace
Call Service Department

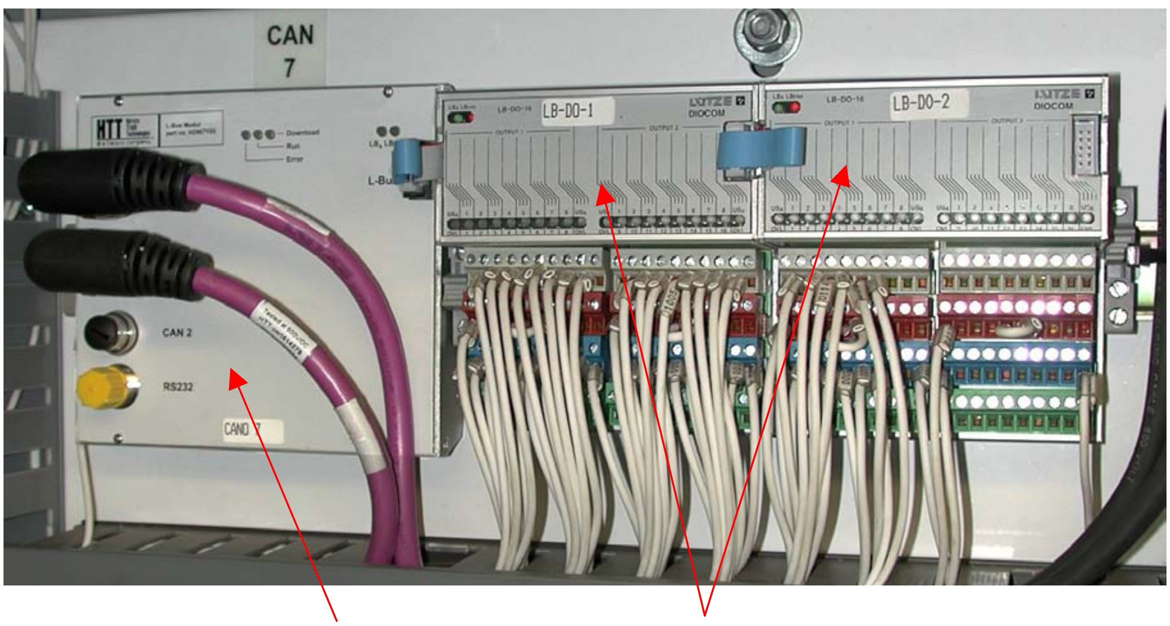

Computer Monitor "Touch Screens" are visible but do not re-spond to touch
Cable?
No
Yes
Monitor?
Yes
RS232 cable at monitor either loose or damaged - Reconnect or Replace
Check RS232 cable and connections at MCB - Reconnect or Replace
Check RS232 cable and connections at JAM Box - Reconnect or Replace
Check RS232 cable and connections at splitter Reconnect or Replace
Call Service Department
Check all monitor connections and cables then Re-Test.
Replace monitor with known good monitor (must be touch screen ca-pable). Replace or Repair monitor if bad.

Appendix

Enhancements to the Jupiter Network

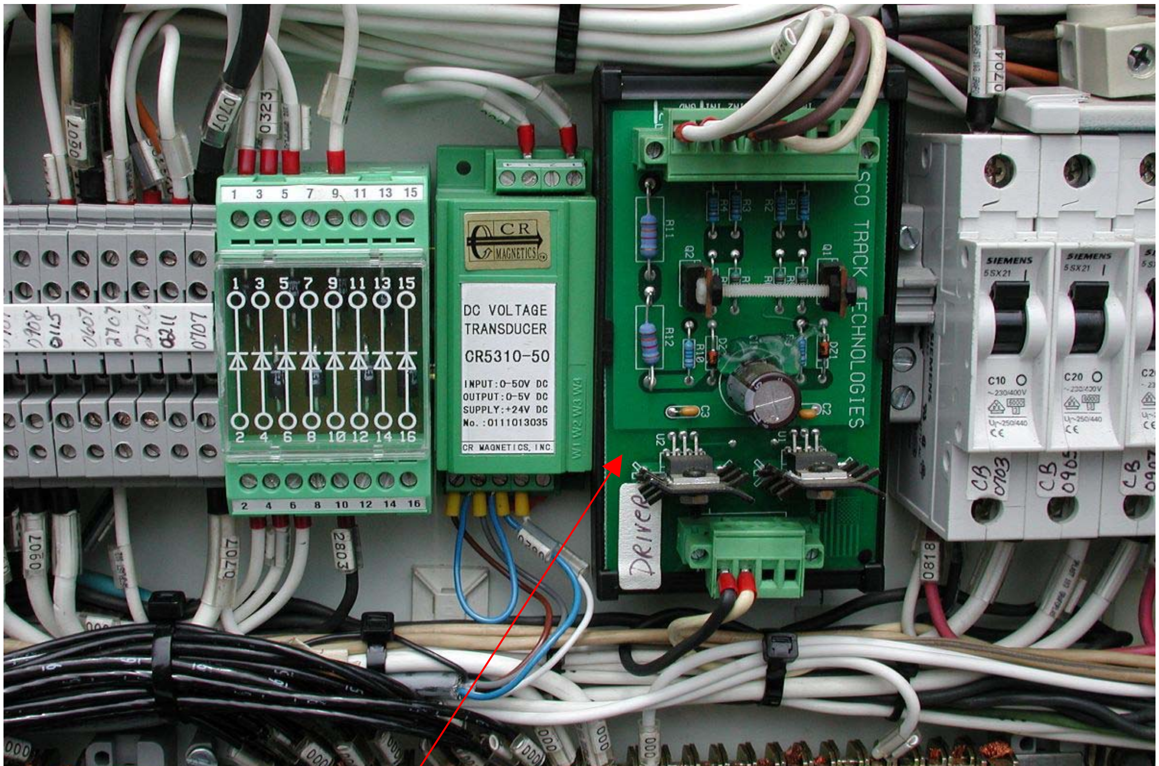
The basic components of the Jupiter Control System have been discussed in the previous sections. As the system evolves however, new components will be added in order to improve overall network efficiency, reliability and ease of service. The use of such components depends largely on machine design and the customer requirements. For this reason, some of the components listed in this section may be on one machine but not on others. The following is a brief overview of some of the most recent Jupiter Control System additions.

L-Bus Jupiter Network Module



The L-Bus Module provides access to a sub-network, which can include digital IN/OUT and analog IN/OUT. This module is used where there is a large concentration of INPUTS/OUTPUTS in a small area.

H-Bridge Driver



H-Bridge Driver

The H-Bridge driver is used to control electric motors by allowing the direction of current in the DC motor to be reversed. This allows the DC motor to run in two different directions. A typical use is to drive the surface and lining actuators in a Tamper, causing them to extend or retract as necessary.

Jupiter Alarm Messages

Module bus recovery initiated

Address handshake error

Address change (new or moved module)

Incorrect module type

Stored address used

End of network not seen

Missing modules (crc)

Dead module detected.

Glossary

Actuator - A linear ball screw jack which is used to extend and retract the Shadowboard. It has an attached Potentiometer, which is used to indicate the Shadowboard position.

Alpha - Alphabetic, normally using the letters of the alphabet, A through Z.

Alphanumeric - A character set that contains both letters (A-Z) and digits (0-9). Other characters, such as punctuation marks, may also be allowed.

Alt - The Alt (Alternate) keys, located on either end of the space bar on the keyboard.

Amperes - Unit of measurement for electric current.

Analog - Pertaining to data in the form of continuously variable physical quantities. This is in contrast with **Digital**.

Analog-to-Digital Converter - A device that translates variable voltage **Output** (from potentiometers, variable transformers, etc.) to **Digital** numbers, for use by the computer.

Analog Input Module - The *Analog Input Module* consists of eight (8) analog input channels. Devices connected to the *Analog Input Module* include string pots, pressure transducers, inclinometers etc. (Variable Input Signal).

Analog Output - An output of a varying voltage; the opposite of a digital output, which is either off or on.

ANSI - (pronounced "An-See") American National Standards Institute. One of several organizations that develop standards for the electronics and computer industries.

AREA - *American Railway Engineering Association.*

Arrow Keys - Another name for the **Cursor** keys **Left**, **Right**, **Up** and **Down**, which are marked by arrows on the keyboard.

ASCII - (pronounced "Ass-Key") American Standard Code for Information Interchange. One of the few genuine standards in the microcomputer world. This code assigns **Binary** (on/off) values to the characters used in transmitting and receiving information.

ASCII Character - A 1-byte character from the **ASCII** character set, including alphabetic and **Numeric** characters, punctuation symbols, and various graphic characters.

Backspace - Pressing the Backspace key. Moves the text from the **Cursor** position on to the left, erasing the character to the left. Used to correct mistakes while typing.

Backup - The process of duplicating a disk or file onto a separate disk. Good insurance against loss of the original.

Binary - Refers to the computer numbering system consisting of two numerals, 0 and 1.

BIOS - *Basic Input / Output System*: The BIOS is built-in software that determines what a computer can do without accessing programs from a disk. On PCs, the BIOS contains all the code required to control the keyboard, display screen, disk drives, serial communications, and a number of miscellaneous functions. The BIOS is typically placed in a ROM chip that comes with the computer (it is often called a *ROM BIOS*). This ensures that the BIOS will always be available and will not be damaged by disk failures. It also makes it possible for a computer to boot itself.

Bit - Binary digit. A bit is represented logically by 0 or 1 and electrically by 0 volts (low condition) and (typically) 5 volts (high condition). Other ways are available to physically represent **Binary** digits (tones, different voltages, lights, etc.), but the logic is always the same.

Boot - To load a program into the **Computer**. The term comes from “bootstrap,” which in turn comes from “pulling a boot on by the bootstrap.” In simple terms, it means the computer is loading and starting an **Operating system**.

Bug - An error or defect in a program.

Byte - A collection of **Bits** that makes up a **Character** or other designation. Generally a byte is 8 data bits.

CAN - *Control Area Network:* Industrial serial communication network protocol based on broadcast messages.

Control Area Network - Network cables are PURPLE in color and connect to the IN and OUT CAN cable connectors. (Input, Output & Analog Modules)

Caps Lock - Pressing this key makes any letters typed capitals. It does not change non-**Alpha** keys to their shifted values; use the Shift key to do this.

Card - A printed Circuit Board that contains electronic components that form the entire circuit. Also called an adapter.

Character - A single letter, number or symbol, which takes one Byte to specify.

Chip - Another name for an **IC**, or **Integrated circuit**. Derived from the "chip" of silicon contained within the IC. Chips are either housed in a plastic or ceramic carrier device with pins for making electrical connections.

Circuit - A complete electronic path.

Circuit board - The collection of **Circuits** gathered together on a sheet of plastic, usually with all contacts made through a strip of pins. The circuit board is usually made by chemically etching metal-coated plastic.

Clock - The source of a **Computer's** timing signals. Every operation of the **CPU** is synchronized by the clock.

CMOS - *Complementary Metal Oxide Semiconductor*. A type of **Chip** design that requires very little power to operate. In an AT type of system, a batter-powered **CMOS** memory and clock **Chip** is used to store and maintain the clock setting and system **Configuration** information.

Command- An instruction that tells the Computer to start, stop or continue an operation.

COMMAND.COM - An **Operating system** file, which is loaded last when the **Computer** is booted. The command interpreter or user **Interface** and program loader portion of **DOS**.

Common - The ground or return path for an electrical signal.

Computer - Device capable of accepting **Data**, applying prescribed processes to this data, and displaying the results or information produced.

Config - *Configuration*: Used in describing or specifying information for the **Computer**. The calculation options, **Calibration** values and display selections are all saved in configuration files.

CONFIG.SYS - A file, which may be created to tell DOS how to configure itself when the machine starts up. CONFIG.SYS can load **Device drivers**, set the number of **DOS** buffers, and so on.

Configuration - The form and **Setup** used for a particular piece of **Hardware** or **Software**.

Configuration File - A file kept by the **Software** to record various aspects of the **Software's** configuration, such as the printer it uses. **CONFIG.SYS** is the **DOS** configuration file.

Console - The unit in your system from which you communicate to the **Computer**, such as the **Keyboard**.

Continuity - In electronics, an unbroken pathway. Testing for continuity normally means testing to find out whether a wire or other conductor is complete and unbroken (by measuring 0 ohms). A broken wire will show infinite resistance (or infinite ohms).

Coprocessor - Additional **Computer** processing unit designed to handle specific tasks in conjunction with the main or **Central Processing Unit**.

CPS - *Cycles Per Second:* Usually expressed as "Hertz" (Hz). For printers, this also can mean Characters Per Second, which is used to measure the speed of a printer.

CPU - *Central Processing Unit:* The **Computer's Microprocessor Chip**, the brains of the outfit. Typically, this is an **IC** using VLSI (very large scale integration) technology to pack several different functions into a small area. The most common electronic device in the **CPU** is the transistor, of which there are usually 30,000 to 1,000,000 or more.

Crash - A malfunction that brings work to a halt. A system crash is usually caused by a **Software** malfunction, and you ordinarily can restart the system by rebooting the machine.

CRT - *Cathode Ray Tube:* A term used to describe a television or **Monitor** screen tube.

Ctrl - The Ctrl (Control) keys, located at either end of the **Alpha** section of the **Keyboard**.

Current - The flow of electrons through a conductor of electricity. Electrical current energy is measured in amperes, or amps.

Cursor - The small flashing mark, or highlighted word(s), that appears on the monitor screen to indicate the point at which any **Input** from the keyboard will be placed. Also used in describing the keys which move the cursor position, including the **Arrow Keys**, **PgUp**, **Home**, etc.

Cursor keypad - The area of the **Keyboard** just to the right of the main typing area, which is used to move the **Cursor**.

Data - Groups of facts that are processed into information. Data is a graphic or textual representation of facts, concepts, numbers, letters, symbols, or instructions used for communication or processing.

DC - Direct current, such as that provided by a **Power supply** or batteries.

Default - An assumption the **Computer** makes when no other parameters are specified. The term is used in **Software** to describe any action the **Computer** or program takes on its own with embedded values.

Delete - Pressing the Del or Delete key on the **Cursor keypad**, or **Numeric keypad** if the **NumLock** light is Off. Deletes the **Character** at the **Cursor** location, and moves characters to the right over by one place.

Device Driver - A memory-resident program, loaded by CONFIG.SYS, that controls an unusual device, such as expanded memory.

Diagnostics - Programs used to check the operation of a **Computer** system. These programs allow the operator to check the system for any problems and to indicate in what area the problem lies.

DC Voltage Transducer - A device that senses DC voltage and outputs a voltage proportional to that which it senses.

Digital - Consisting of Digits and stored as bytes of **Computer** data, rather than continuously variable values. The opposite of **Analog**.

Digital-to-Analog Converter - A device that translates **Digital** numbers in the **Computer** to variable voltage signals, often for use with **Comparator Cards**.

Digital Input Module - *The Digital Input Module* consists of sixteen (16) digital inputs. Devices connected to the *Digital Input Module* include limit switches, pressure switches, encoders etc. (Digital Input = ON or OFF NO In-between).
NOTE: Input or Output cables are YELLOW in color.

DIP - *Dual Inline Package:* The plastic or ceramic carrier device that houses a Chip or other electrical device.

DIP Switch - A tiny switch (or group of switches) found on a **Circuit Board**. Named for the form factor of the carrier device in which the switch is housed **(DIP)**.

Directory - An area of a disk that stores the titles given to the files saved on the disk. The directory serves as a “table of contents” for the files saved on the disk. The directory contains data that identifies the name of the file, the size, the attributes (system, hidden, read-only, etc.), the date and time of creation, and a pointer to the location of the file. You may see a directory of the current disk by typing **‘DIR’** at the **DOS** prompt.

Disk - Normally the same as Diskette.

Digital Output Module - The *Digital Output Module* consists of eight (8) 24V digital output channels. Devices connected to the *Digital Output Module* include valve coils, lights, relays etc. (Digital Output = ON or OFF NO In-between). **NOTE:** Input or Output cables are YELLOW in color.

Distributed I/O - Using a communication network (CAN Bus) to connect strategically located I/O modules around a machine to reduce the wiring.

DOS - *Disk Operating System***:** A collection of programs stored on the **DOS** disk. These programs contain routines that allow the system and user to manage information and the **Hardware** resources of the **Computer**. A DOS must be loaded into the **Computer** before you start other programs.

Diskcopy - A means of making a backup copy of a disk. Normally, **CLU** or **Main Menu** should be used to make copies of disks.

Diskette - A floppy disk. The disk is made of a flexible material that is coated with magnetic substance. The disk spins inside its protective jacket, and the read/write head comes almost in contact with the recording surface to read or write data.

Distance Wheel - An additional non-powered wheel riding on the rail and used to measure distance traveled.

Down - Pressing the Down **Arrow Key** on the **Cursor keypad**, or **Numeric keypad** if the **NumLock** light is Off.

Drive - A mechanical device that manipulates data storage media, like a **Disk** drive.

Drop-Down Menu - A sub-menu which drops down from a higher level **Menu**. Used to simplify the operation by reducing the number of selections available at any given time.

Edit - The process of rearranging or changing **Data** or information.

EGA - *Enhanced Graphics Adapter*: A high-resolution color display with 640 by 350 **Pixels**.

Encoder (Distance) - A device that translates (encodes) one type of information to another. The Encoder is located on the **Distance Wheel** and translates revolutions and direction into electronic signals and sends them to the Digital Input Module.

End - Pressing the End key on the **Cursor keypad**, or **Numeric keypad** if the **NumLock** light is Off. Usually moves the **Cursor** to the last of any list of items.

EPROM - *Erasable Programmable Read-Only Memory*: A type of Read-Only Memory **(ROM)** where the data pattern may be erased to allow a new pattern. EPROMs are usually erased by ultraviolet light and recorded by a higher than normal voltage programming signal.

Erase - To delete a data or curve data file. May be accomplished by using **CLU**.

Error message - A word or combination of words to indicate to the user that an error occurred while the program was operating.

Esc - The Escape key, in the upper left of the **Keyboard**. Often used to escape out of **Menus** and other procedures.

Ethernet Port - Ethernet network port. Provides communication network for two or more JAM Boxes.

Exit - To exit or quit what you are currently doing. It may apply to a procedure within the program or the program itself, depending on the operation.

Fallback Control - If the JAM computer fails the next module in-line takes over with limited functionality intended to pack-up machine and clear track.

Field Power - The field power connector provides a 24V DC supply used to power I/O devices connected to C1-C8. **NOTE:** Field Power Cables are GRAY in color.

File - A collection of information that is kept somewhere other than in the **Random-access memory**, usually on disks.

File name - The name given to the disk file. Must be one to eight characters long and may be followed by a file name extension, which can be one to three characters long. A file name can be made up of any combination of letters and numbers but should be descriptive of the information contained on the file.

FileName - A curve or data file name, corresponding to the **DOS** rules for naming files. The same as **FileName**.

Fixed disk - Referred to also as a hard disk. A disk that cannot be removed from its controlling **Hardware** or housing.

Floppy disk - Same as Diskette.

Form Feed - A button on the **Printer** which causes the paper to advance forward one sheet.

Format - To prepare a **Disk** by **Formatting**. Also can mean the form which data is stored in.

Formatting - Preparing a **Disk** so that the **Computer** can read or write to it. Formatting checks the disk for defects and constructs an organizational system to manage information on the disk.

FPU - *Floating Point Unit*: Another name for the **Math Coprocessor**.

Frame Ground - An electrical ground which is firmly connected to the physical frame of the machine.

Function Keys - Special-purpose keys that can be programmed to perform various operations. These keys serve many different functions depending on the program being used.

Hard Disk - Also referred to as a **Fixed Disk**. A disk that cannot be removed from its controlling **Hardware** or housing.

Hardware - Physical components that make up a **Microcomputer**, **Monitor**, **Printer**, etc.

H-Bridge Driver - A device that allows the direction of current flow in a DC motor to be reversed. This allows the DC motor to run in two different directions. A typical use is to drive the surface and lining actuators in a tamper, causing them to extend or retract as necessary. Used to control electric Motors (IE actuators & Throttle.

HD - *High Density:* In the case of 3½" **Floppy Disks**, a 1.44 MB disk.

Highlight - The brighter or different-colored selection, usually in **Menus** and information tables, which designates the current **Cursor** position.

Home - Pressing the Home key on the **Cursor keypad**, or **Numeric keypad** if the **NumLock** light is Off. Usually moves the **Cursor** to the first of any list of items.

IC - *Integrated Circuit:* A device that contains many electronic components such as transistors, to accomplish many functions in a small space.

I/O – *Input / Output:* A circuit path that allows independent communications between the processor and external devices.

I/O Card - A **Computer** card used to send and **Receiver** information between the **Computer** and its peripherals.

INC - *Inclinometer:* A miniature level which gives an electrical **Output** proportional to its angle, or inclination. Used to measure and set **Crosslevel** or **Superelevation**.

Input - Data sent to the **Computer** from the **Keyboard**, disk drives and other devices.

Input-Output (I/O) - A **Card** or device used to both receive **(Input)** information from external sources and send **(Output)** information to external sources.

Insert - Pressing the **Ins** or Insert key on the **Cursor keypad**, or **Numeric keypad** if the NumLock light is Off. Sometimes toggles between Overtyping or Inserting text while typing.

Interface. A communications device that allows one device to communicate with another. The interface matches the **Output** of one device to the **Input** of the other device.

Inverter (24VDC to 110 VAC) - A device that converts a DC voltage to an AC voltage.

JAM Box - *J.A.M.* stands for *Jupiter Application Master*. The **JAM BOX** is the main system controller for the Jupiter Network and is responsible for distributing programming information to Jupiter Network Modules. Software is loaded into the JAM Box via a PCMCIA Card. Newer JAM Boxes use USB Memory Sticks for this purpose.

Keyboard - The typewriter-like device used to type information and make selections during the program.

KB - *Kilobyte* - A unit of information storage. One kilobyte equals 1,024 bytes.

L-Bus Module - Provides access to a sub-network which can include digital in/out and analog in/out. This module will be used where there is a large concentration of I/O in a small location.

Left - Pressing the Left arrow key on the **Cursor keypad**, or **Numeric keypad** if the NumLock light is Off.

Linear Actuator - A linear ball screw jack that is used to extend and retract the **Shadowboard**. It has an attached potentiometer, which is used to indicate the **Shadowboard** position.

Load - To retrieve **Curve Data** or other information from a **Disk** and place into **Computer** memory for display and calculation.

LVDT - *Linear Variable Displacement Transducer -* A device used to measure linear movement. It **Outputs** a voltage that is proportional to the linear displacement.

Main Menu Bar - The main horizontal **Menu** from which all other menus and selections are made.

MB - *MegaByte*: A unit of information storage. One megabyte equals 1,024 **Kilobytes**, which equals 1,048,576 **Bytes**.

Memory - Any component in a **Computer** system that stores information for future use.

Menu - A selection table or listing, from which you can make the desired selection.

MHZ – *Megahertz:* A measurement of millions of cycles per second, often used to measure the clock speed of **CPUs**.

Microprocessor - A solid state **Central Processing Unit** that is much like a **Computer** on a **Chip**. It is an **Integrated Circuit** that accepts coded instructions for execution.

Monitor - The **CRT** or TV-like screen used to view (or monitor) **Computer** programs.

Motherboard - The main **Circuit board** in the **Computer**, which contains the **CPU** and other circuits, as well as the slots into which **Interface Cards** are inserted.

Mouse - An input device that controls the movement of a cursor or pointer on a screen, allowing an operator to interface with a computer.

Numeric - Numbers, in combinations using Digits from 0 through 9.

Numeric keypad - The area of the **Keyboard** to the extreme right, which may be used to type numbers (if the **NumLock** key is lit) or to move using the **Cursor** keys.

Open Circuit - A circuit without a connection to ground; the net resistance of the circuit is infinite.

Open Circuit Counts - Number of open circuits detected since power up for a given channel.

Operating system - Collection of programs for operating the **Computer**. Operating systems perform housekeeping tasks such as **Input/Output** between the **Computer** and **Peripherals** and accepting and interpreting information from the **Keyboard**.

Output - Information or the act of sending the information processed by the **Computer** to a mass storage device such as a video display, a **Printer** or **Disk drive**.

Overload - A condition in which a device draws more current than can be safely supplied to it.

Overwrite - To write **Data** on top of existing data, erasing the original data.

Parallel Printer Port - A special large connection port, to which the cable from the printer attaches. A parallel cable transmits many bits of information at the same time, as opposed to a Serial cable, which can only transmit one **Byte** of information at a time.

PCMCIA - *Personal Computer Memory Card International Association***:** Association of computer manufacturers that developed a set of specifications for PC cards e.g. size, types of devices, etc.

PC Card - An external plug-in device for computers. Some examples include phone modems, ethernet modems, and flash memory devices.

Peripheral - Any piece of equipment used in **Computer** systems that is an attachment to the **Computer** itself. **Disk drives**, terminals, and **Printers** are all examples of peripherals.

PgDn or PageDown - Pressing the PgDn key in the **Cursor keypad** to the right of the main typing area, or on the **Numeric keypad**. Usually moves information on screen one screen, or page, at a time.

PgUp or PageUp - Pressing the PgUp key in the **Cursor keypad** to the right of the main typing area, or on the **Numeric keypad**. Usually moves information on screen one screen, or page, at a time.

Pin Out - A mapping of pins on a connector to corresponding wires.

Pixel - From Picture Element. The smallest dot displayed in any particular graphics resolution.

Port - Plug or socket that allows an external device such as a **Printer** to be attached to the adapter **Card** in the **Computer**.

POST - *Power-On Self Test:* A series of tests run by the **Computer** at power on. When power is initially applied, the **Computer** will automatically scan and test many of its circuits and sound a beep from the internal speaker if this initial test indicates proper system performance.

Potentiometer - A variable resistor which is used to indicate the position of the **Shadowboard**. Also called a Pot.

Power supply - Electrical/electronic circuit that supplies all operating voltage and current to the **Computer** system.

Power-T Module - The Power-T Module is used to introduce additional power for large networks. All connections except the 24V network power connect straight through this device.

Printer - The device used to make hardcopy, or printed reports or copies of **Computer** information.

Processor speed - The clock rate at which a **Microprocessor** processes data.

Program - Set of instructions or steps telling the **Computer** how to handle a problem or task.

Proprietary - Anything that is invented by a company and not used by any other company. Proprietary is the opposite of Standard.

Pulses - Intermittent transmissions of electrical voltage or current used to transmit information.

PWM - Pulse Width Modulation - Used to control proportional valves and various other proportional signals. A method of modifying digital output signals to simulate an analog voltage. Used to control proportional valves and various other proportional signals.

Quit - To leave a program or mode (such as **Record**). The program or mode will have to be restarted after Quitting.

QWERTY - The name given to the standard alphabetic **Keyboard** layout, derived from the key order starting at the upper left of the keyboard.

RAM - *Random-access memory:* All memory accessible at any instant (randomly) by the **Microprocessor**.

ROM - *Read-Only Memory:* A type of memory that has values permanently burned in. These locations are used to hold important programs or data that must be available to the **Computer** when the power is first turned on.

Read-only file - A file in which a setting has been made in the attribute **Byte** of its **Directory** listing so that **DOS** will not allow **Software** to write into or over the file.

Read/write head - A tiny electromagnetic device that reads and writes **Data** on a **Disk** track.

Resolution - A reference to the size of the **Pixels** used in graphics. In medium-resolution graphics, pixels are large. In high-resolution graphics, pixels are small.

Reverse Polarity - A condition in which the supply voltage and return voltage (ground) connections in a circuit are reversed. Certain devices can be severely damaged by this condition.

Reverse video - Letters displayed on screen or printout in reverse colors to the majority of the screen. This is often used to locate the **Cursor** position.

Right - Pressing the Right arrow key on the **Cursor keypad**, or **Numeric keypad** if the **NumLock** light is Off.

ROM BIOS - *Read-Only Memory Basic Input / Output System:* A **BIOS** that is encoded in a form of read-only memory for protection. This is often applied to important start-up programs that must be present in a system for it to operate.

Root Directory - The main **Directory** of any **Hard disk** or **Floppy disk** created upon **Formatting** the disk. If the disk has other **Subdirectories**, being in the root **Directory** means not being in any subdirectory.

Routine - Set of instructions that are used frequently. May be considered as a subdivision of a program with two or more instructions that are functionally related.

RS 232 - The RS232 connector provides a serial communication port equivalent to those typically found on PCs. This port can be used to communicate with other computer systems or equipment.

RVDT - *Rotary Variable Displacement Transducer:* A device used to measure angular movement. It outputs a voltage that is proportional to the angular displacement.

Save - To place curve **Data** or other information on a **Disk** for permanent storage (information in memory is lost when the **Computer** is turned off).

Select - To choose, usually be moving the **Cursor (Highlight)** to the desired position and pressing **Enter**, or by pressing a corresponding **Highlighted** key and pressing **Enter**.

Shift - (1) The Shift keys, located at either end of the **Alpha** section of the **Keyboard**. Gives the shifted values for characters (i.e. capital **'A'** for **'a'**, and **'?'** for **'/'**). (2) A manual correction of the **Shadowboard** position, commonly used in **run-out** or to make **Shifts** in the final track location.

Short Circuit - A direct path between a power supply and ground; the net resistance of the circuit is zero ohms.

Short Circuit Count - Number of shorts circuits detected since power up for a given channel.

Signal Conditioner - A device used to modify signals. Typical uses include limiting/reducing noise in a signal, or limiting voltage.

Software - A series of instructions loaded into the **Computer** that tells the Computer how to accomplish a problem or task.

SSR - *Solid State Relay:* Electrical relays which have no moving parts, used in positioning the **Shadowboard** and other tasks.

Source disk - A **Disk** that contains information that is to be copied onto another disk.

Splitter - The splitter is used only with digital input modules and allows two (2) devises to be connected to one (1) Digital Input module connector which has two (2) channels.

Storage - Device or medium onto or into which data can be entered, held and retrieved at a later time. Synonymous with **Memory**.

Subdirectory - A **Directory** listed inside another directory.

System Board - The **Circuit board** containing the main **Computer CPU**. It may be a **Motherboard**, into which other boards are inserted, or may itself insert into a **Passive Backplane**, along with the other boards.

System files - The two **DOS** files IO.SYS and MSDOS.SYS are the system files. A third file, **COMMAND.COM**, is the **Shell**. The system files are hidden on the disk.

Transducer - A device that emits a voltage proportional to the amount of pressure it senses. (IE Pressure)

Transition Board - The transition board's main function is to provide a means of reading a high concentration of inputs with a single input module. The transition board can read 96 inputs and drive (2) 24V 0.5 Amp Outputs. **EX:** MK IV & MKVI Tampers. **NOTE:** The Transition Board is ***not*** used on machines with touch screen monitors.

Travel Safety Relay - A relay which prevents a machine from tractioning unless an operator is physically operating a switch such as a foot pedal or a cycle joystick. This prevents the machine from tractioning due to a fault such as a short circuit.

Touch Screen - Operator interface device; allows an operator to control a machine by physically touching a screen instead of pushbuttons or a keyboard.

TSR - *Terminate and Stay Resident:* A program that remains in memory after it loads. Also called a memory-resident program.

Up - Pressing the Up **Arrow key** on the **Cursor keypad**, or **Numeric keypad** if the **NumLock** light is Off.

Update - To modify information already contained in a **File** or program with current information.

USB - *Universal Serial Bus:* This port can be used to communicate with other computer systems or equipment. This device will likely replace most existing serial and parallel ports.

Utility - Programs that carry out routine procedures to make **Computer** use easier.

VGA - *Video Graphics Array:* A high-resolution color display with 640 by 480 **Pixels**.

Appendix B

Appendix B

Hydraulic System Troubleshooting

This section contains flow charts which can be used to troubleshoot a hydraulic system. Make sure you read this page before using the flow charts.

Excessive Noise Problem

Excessive noise means wear, alignment not correct, cavitation or air in the fluid. Contaminated fluid can cause a relief valve to stick and chatter. These noises may be caused by dirty filters or fluid, high fluid viscosity, excessive drive speed, low reservoir/tank level, loose input lines, or worn couplings.
If there is excessive noise, go to the circle labeled A in the flow chart.

Excessive Heat Problem

Excessive heat can be caused by a coupling that is not aligned properly and is placing an excessive load on bearings, by hydraulic fluids with a low viscosity, and by cavitation and slippage in a pump.
If there is excessive heat, go to the circle labeled D in the flow chart.

Flow Problem

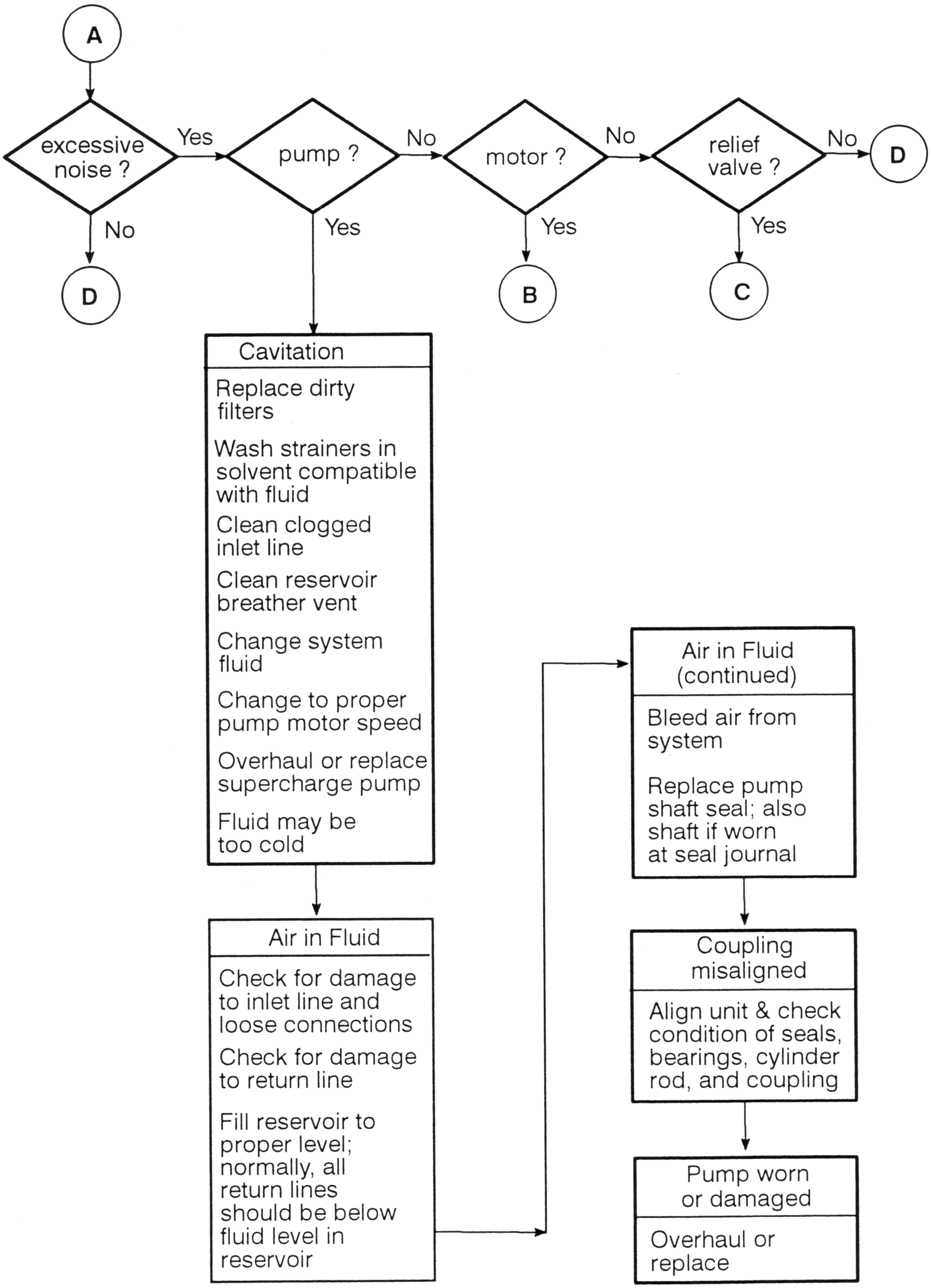
If the flow of hydraulic fluid is not correct, movement of the equipment may be slow, erratic, or excessive. Also, valves and other components may stick" and the equipment may overheat.
If the fluid flow is NOT correct, go to the circle labeled H in the flow chart.

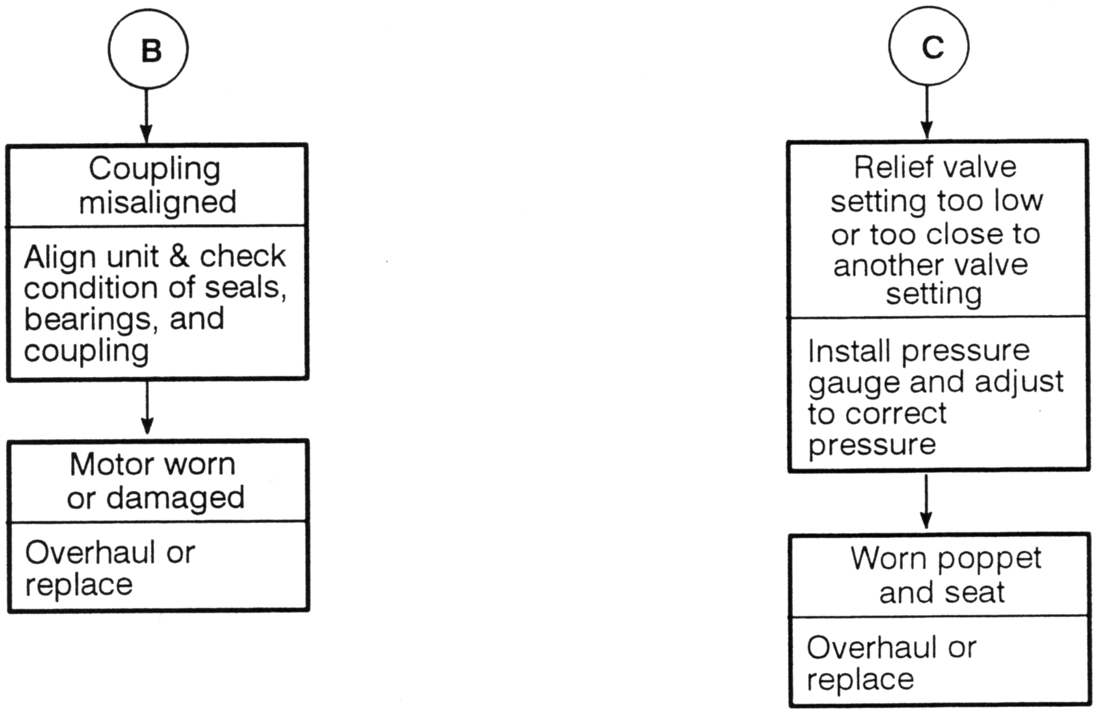
Pressure Problem

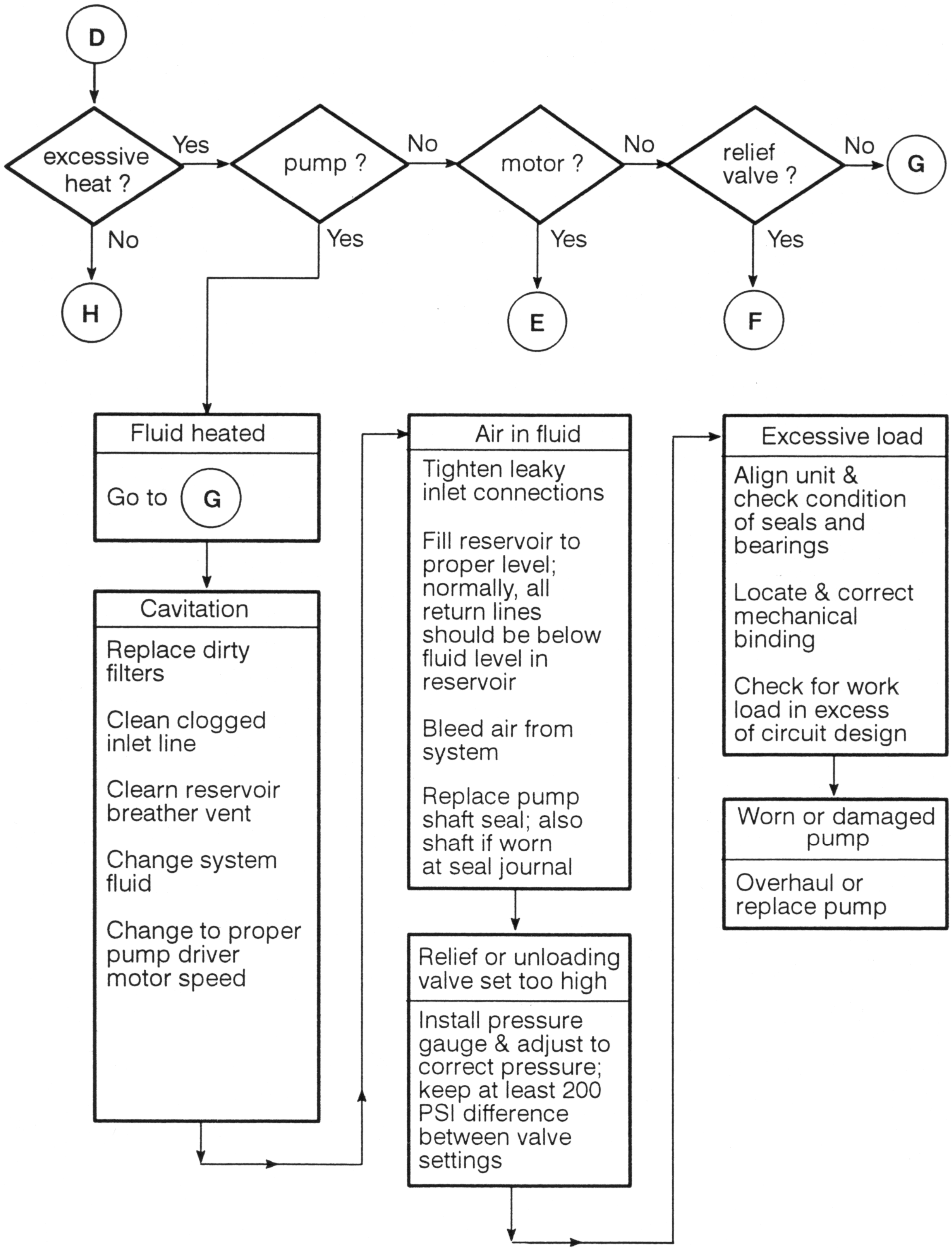
You should know the correct operating pressure and you should check and set the pressure periodically using a pressure gauge. The correct pressure should be the lowest pressure, which will permit the system to operate properly but below the maximum rating of the system.
If the pressure is NOT correct, go to the circle labeled K in the flow chart.

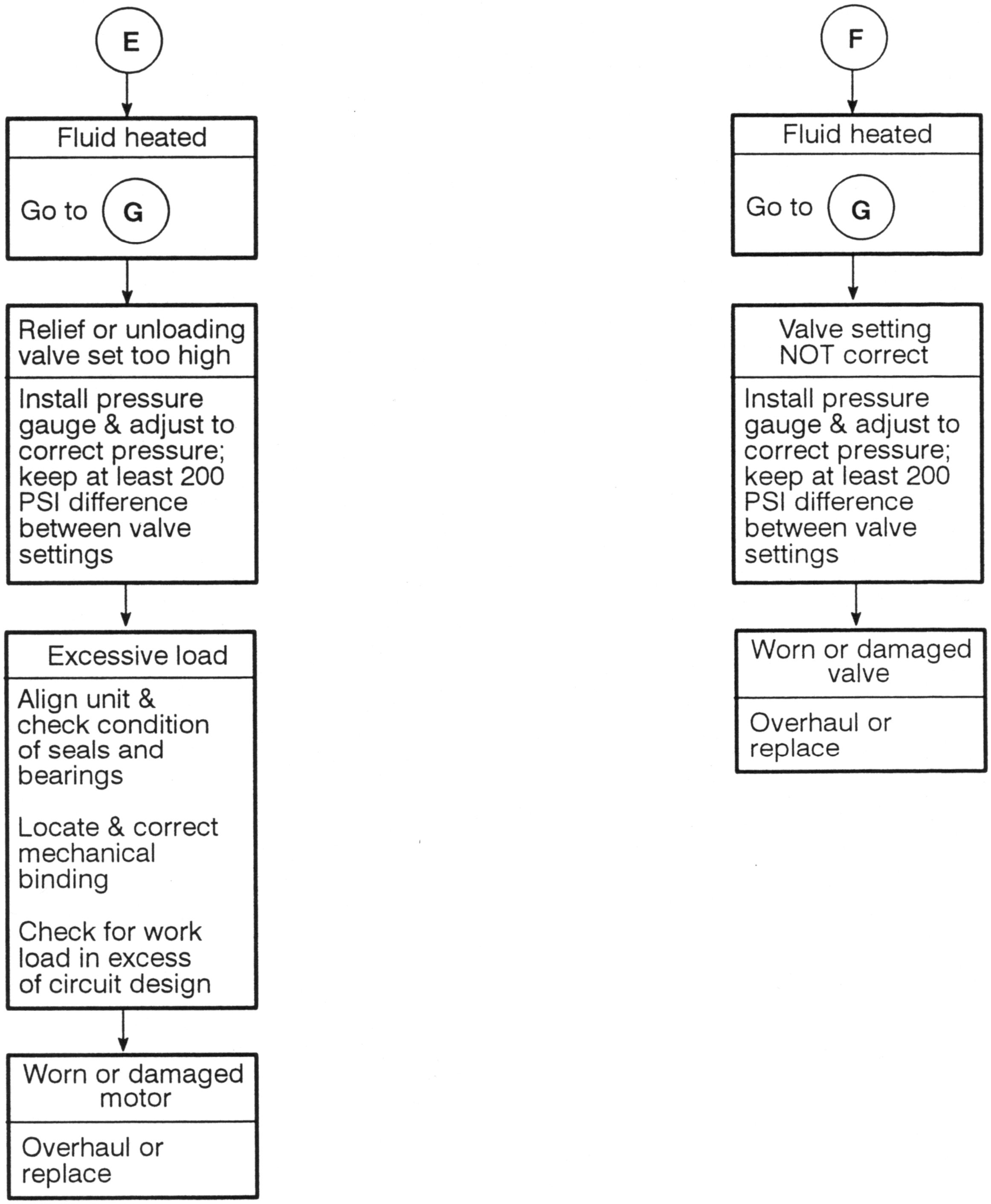
NOTE

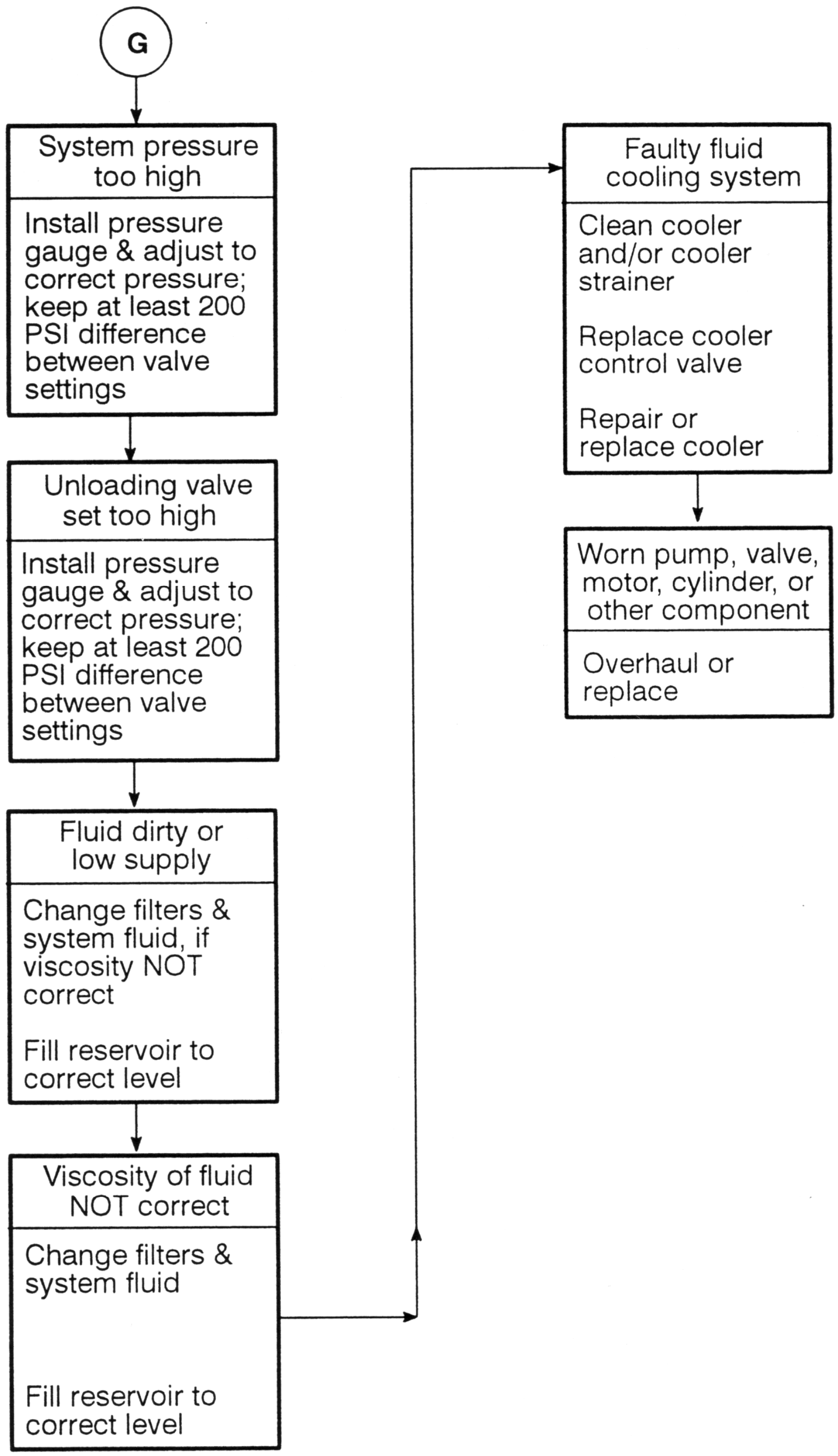
If the problem is NOT excessive noise or excessive heat, go to the circle labeled N in the flow chart.

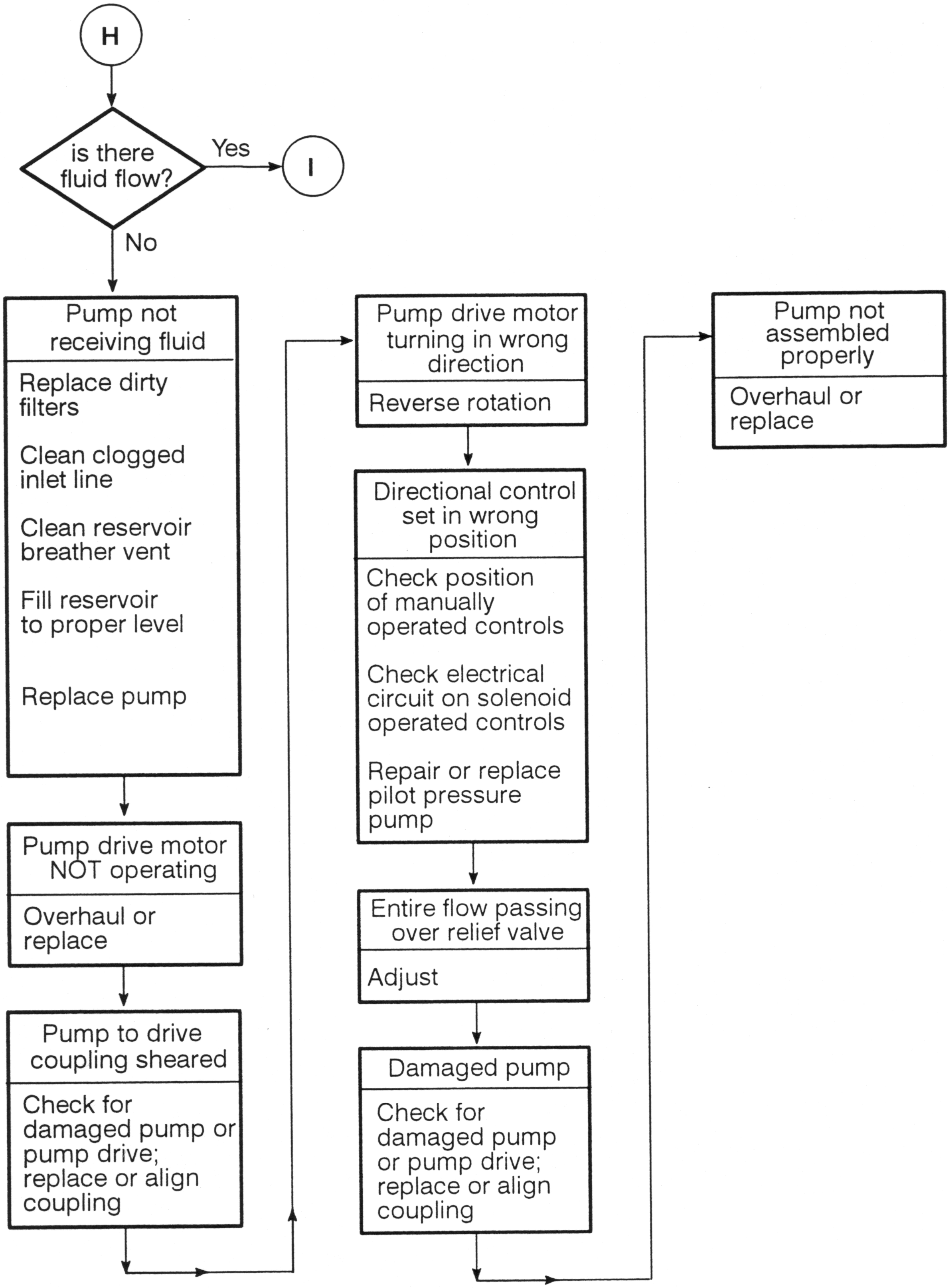

A
excessive noise ?
Yes
No
D
pump ?
No
Yes
motor ?
No
Yes
B
relief valve ?
No
D
Yes
C
Cavitation
Replace dirty filters
Wash strainers in solvent compatible with fluid
Clean clogged inlet line
Clean reservoir breather vent
Change system fluid
Change to proper pump motor speed
Overhaul or replace supercharge pump
Fluid may be too cold
Air in Fluid
Check for damage to inlet line and loose connections
Check for damage to return line
Fill reservoir to proper level; normally, all return lines should be below fluid level in reservoir
Air in Fluid (continued)
Bleed air from system
Replace pump shaft seal; also shaft if worn at seal journal
Coupling misaligned
Align unit & check condition of seals, bearings, cylinder rod, and coupling
Pump worn or damaged
Overhaul or replace

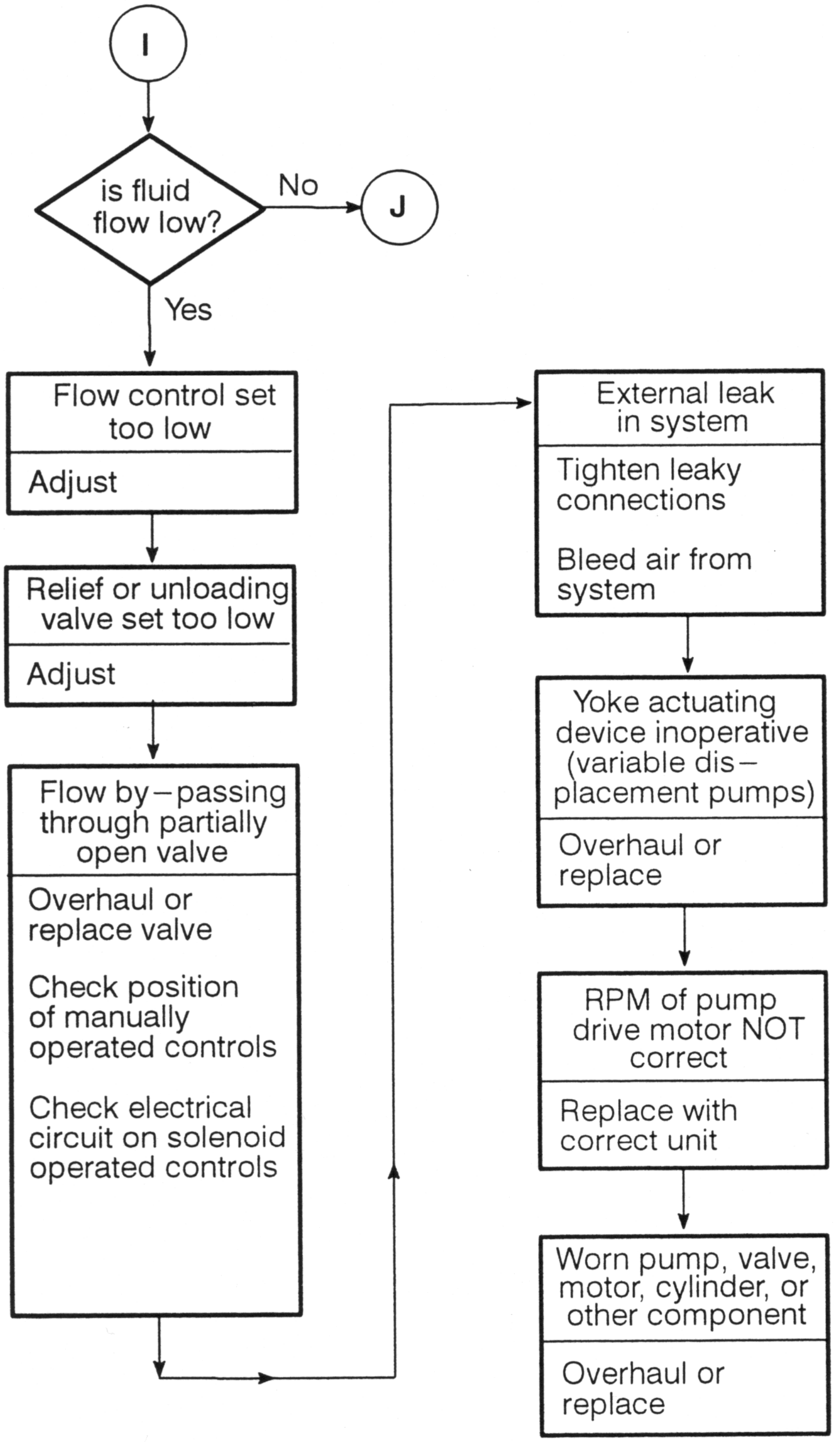

B
Coupling misaligned
Align unit & check condition of seals, bearings, and coupling
Motor worn or damaged
Overhaul or replace
C
Relief valve setting too low or too close to another valve setting
Install pressure gauge and adjust to correct pressure
Worn poppet and seat
Overhaul or replace

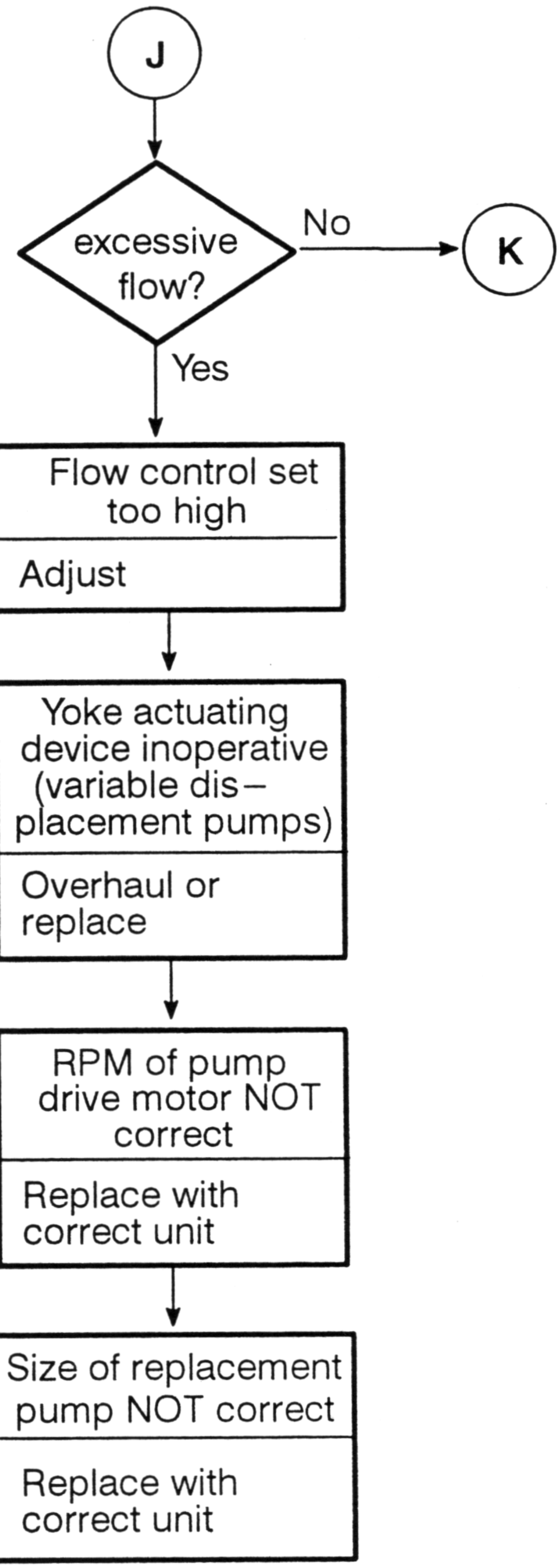

D
excessive heat ?
Yes
No
H
pump ?
No
Yes
motor ?
No
Yes
E
relief valve ?
No
Yes
F
G
Fluid heated
Go to G
Cavitation
Replace dirty filters
Clean clogged inlet line
Clearn reservoir breather vent
Change system fluid
Change to proper pump driver motor speed
Air in fluid
Tighten leaky inlet connections
Fill reservoir to proper level; normally, all return lines should be below fluid level in reservoir
Bleed air from system
Replace pump shaft seal; also shaft if worn at seal journal
Relief or unloading valve set too high
Install pressure gauge & adjust to correct pressure; keep at least 200 PSI difference between valve settings
Excessive load
Align unit & check condition of seals and bearings
Locate & correct mechanical binding
Check for work load in excess of circuit design
Worn or damaged pump
Overhaul or replace pump

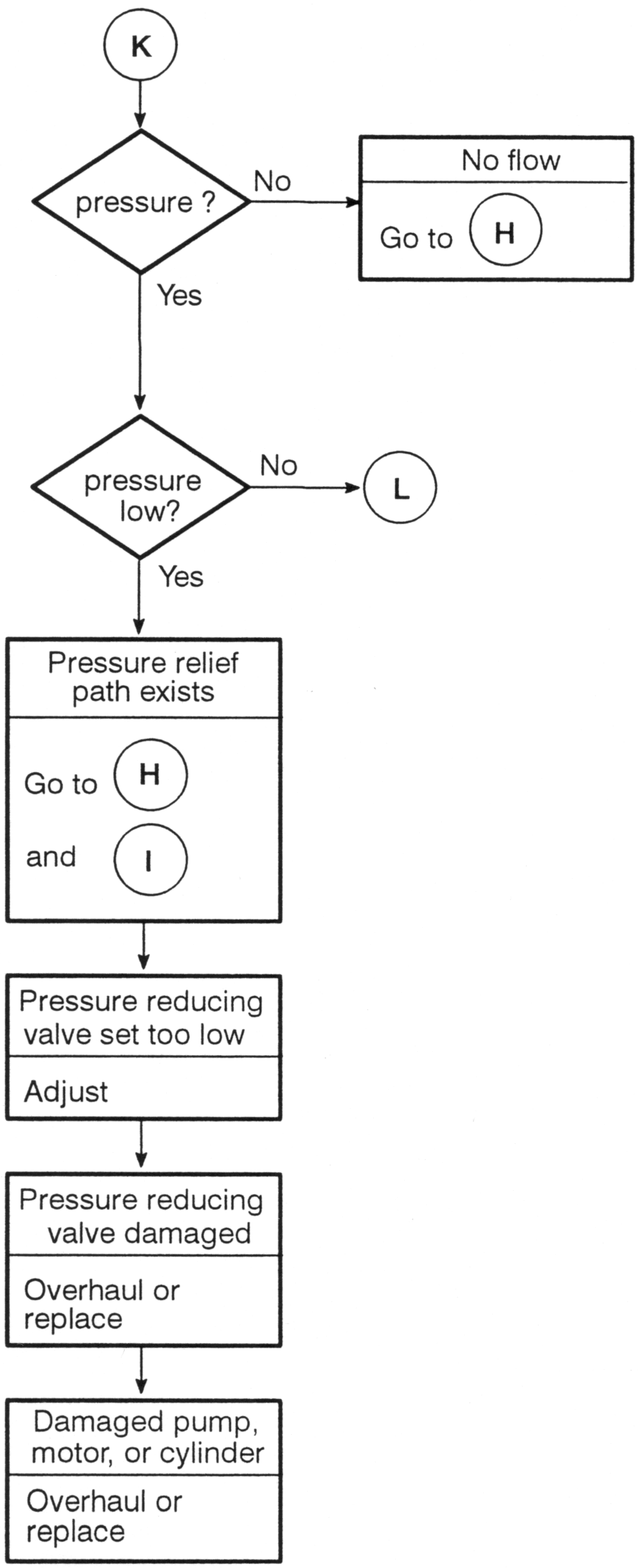

E
Fluid heated
Go to G
Relief or unloading valve set too high
Install pressure gauge & adjust to correct pressure; keep at least 200 PSI difference between valve settings
Excessive load
Align unit & check condition of seals and bearings
Locate & correct mechanical binding
Check for work load in excess of circuit design
Worn or damaged motor
Overhaul or replace
F
Fluid heated
Go to G
Valve setting NOT correct
Install pressure gauge & adjust to correct pressure; keep at least 200 PSI difference between valve settings
Worn or damaged valve
Overhaul or replace

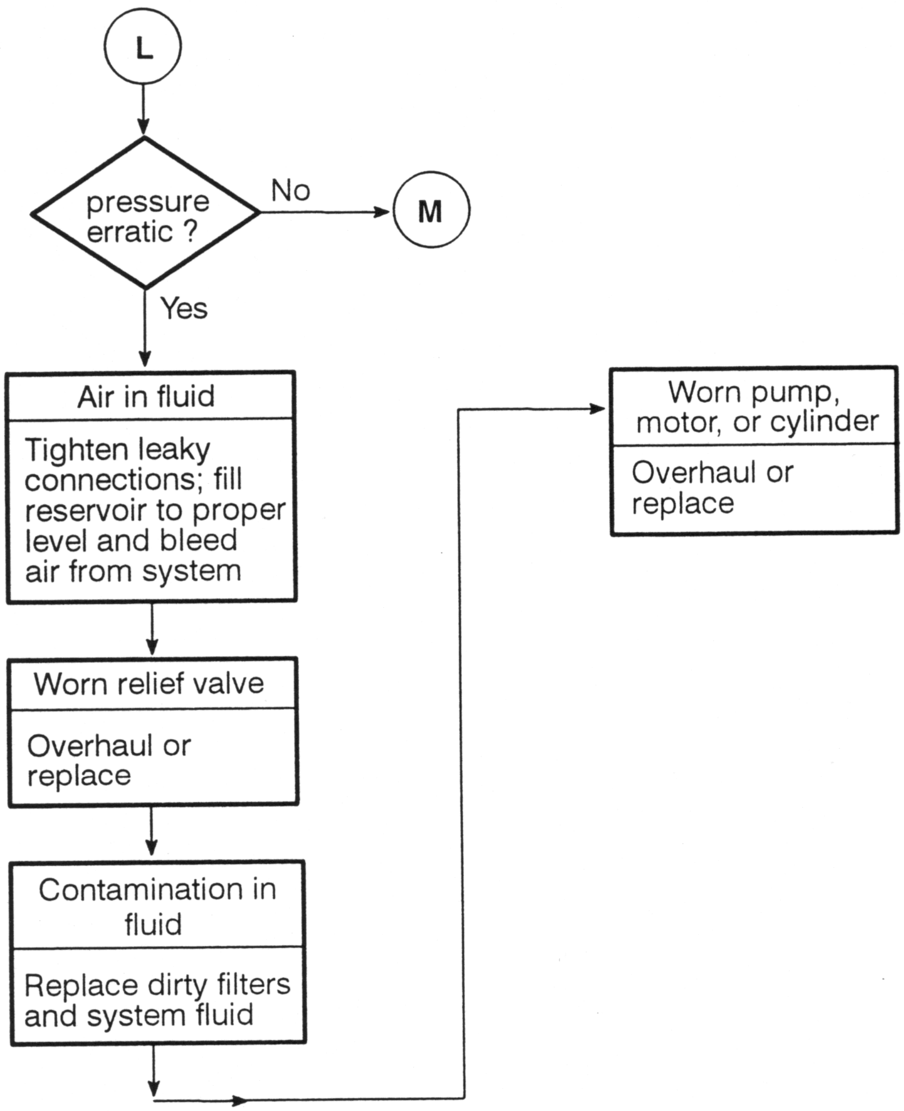

G
System pressure too high
Install pressure gauge & adjust to correct pressure; keep at least 200 PSI difference between valve settings
Unloading valve set too high
Install pressure gauge & adjust to correct pressure; keep at least 200 PSI difference between valve settings
Fluid dirty or low supply
Change filters & system fluid, if viscosity NOT correct
Fill reservoir to correct level
Viscosity of fluid NOT correct
Change filters & system fluid
Fill reservoir to correct level
Faulty fluid cooling system
Clean cooler and/or cooler strainer
Replace cooler control valve
Repair or replace cooler
Worn pump, valve, motor, cylinder, or other component
Overhaul or replace

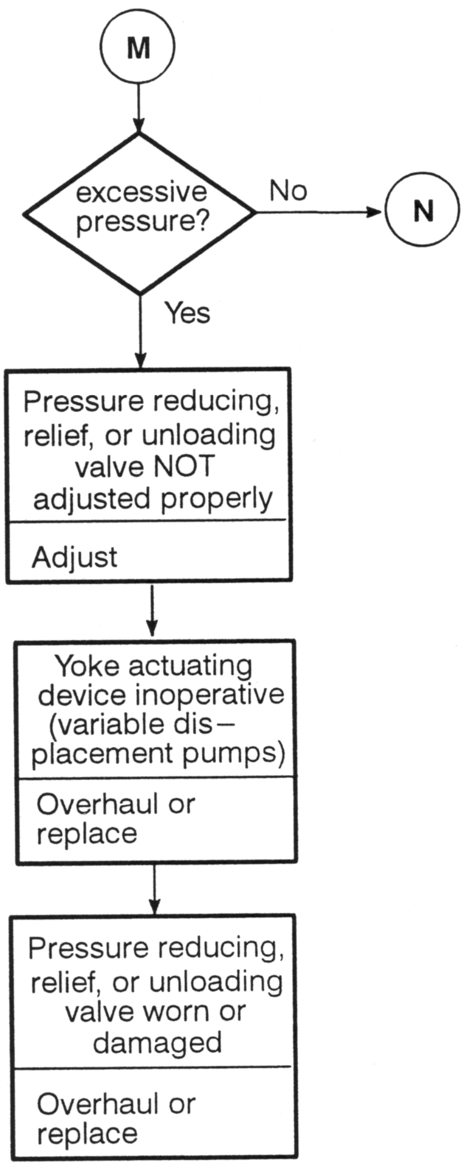

H
is there fluid flow?
Yes
I
No
Pump not receiving fluid
Replace dirty filters
Clean clogged inlet line
Clean reservoir breather vent
Fill reservoir to proper level
Replace pump
Pump drive motor NOT operating
Overhaul or replace
Pump to drive coupling sheared
Check for damaged pump or pump drive; replace or align coupling
Pump drive motor turning in wrong direction
Reverse rotation
Directional control set in wrong position
Check position of manually operated controls
Check electrical circuit on solenoid operated controls
Repair or replace pilot pressure pump
Entire flow passing over relief valve
Adjust
Damaged pump
Check for damaged pump or pump drive; replace or align coupling
Pump not assembled properly
Overhaul or replace

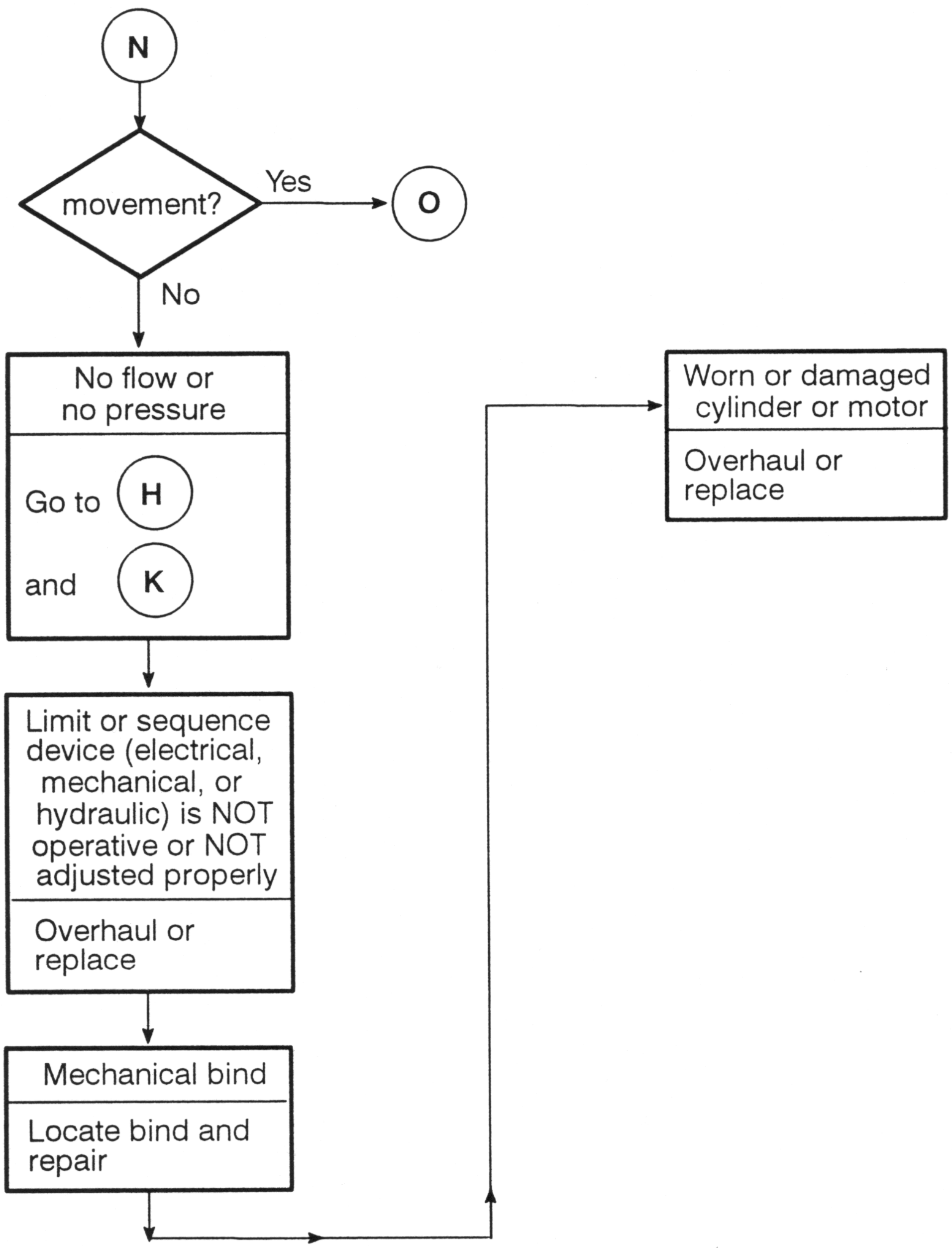

I
is fluid flow low?
No
J
Yes
Flow control set too low
Adjust
Relief or unloading valve set too low
Adjust
Flow by–passing through partially open valve
Overhaul or replace valve
Check position of manually operated controls
Check electrical circuit on solenoid operated controls
External leak in system
Tighten leaky connections
Bleed air from system
Yoke actuating device inoperative (variable dis–placement pumps)
Overhaul or replace
RPM of pump drive motor NOT correct
Replace with correct unit
Worn pump, valve, motor, cylinder, or other component
Overhaul or replace

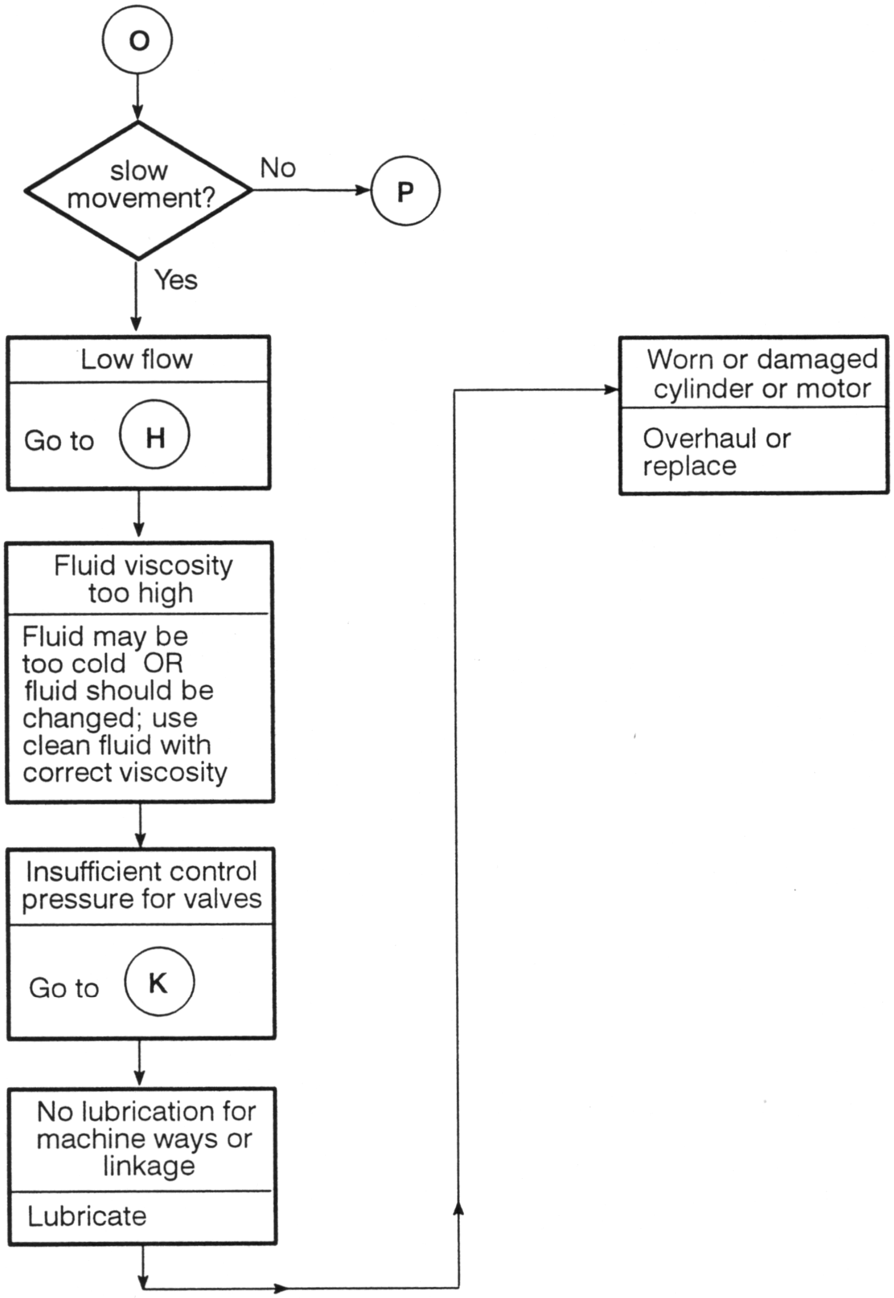

J
excessive flow?
No
K
Yes
Flow control set too high
Adjust
Yoke actuating device inoperative (variable dis– placement pumps)
Overhaul or replace
RPM of pump drive motor NOT correct
Replace with correct unit
Size of replacement pump NOT correct
Replace with correct unit


K
pressure ?
No
No flow
Go to H
Yes
pressure low?
No
L
Yes
Pressure relief path exists
Go to H
and I
Pressure reducing valve set too low
Adjust
Pressure reducing valve damaged
Overhaul or replace
Damaged pump, motor, or cylinder
Overhaul or replace

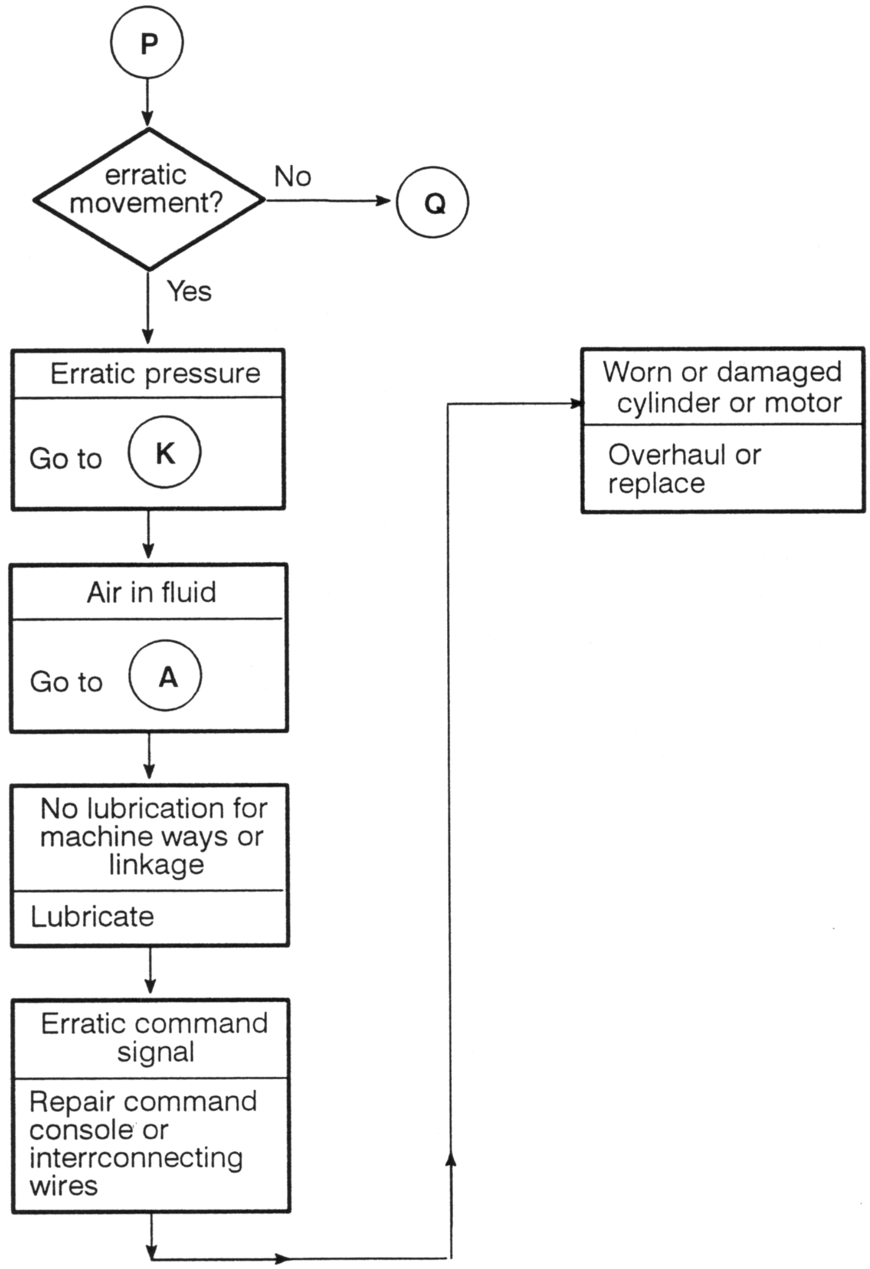

L
pressure erratic ?
No
M
Yes
Air in fluid
Tighten leaky connections; fill reservoir to proper level and bleed air from system
Worn relief valve
Overhaul or replace
Contamination in fluid
Replace dirty filters and system fluid
Worn pump, motor, or cylinder
Overhaul or replace

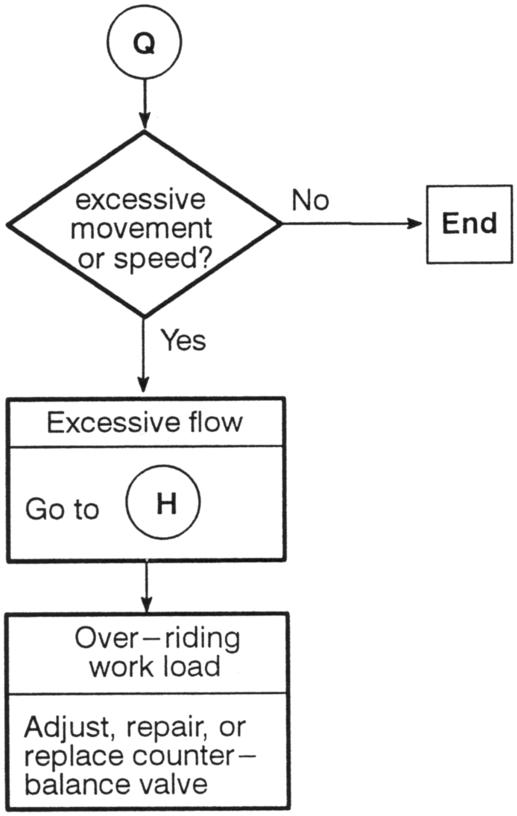

M
excessive pressure?
No
N
Yes
Pressure reducing, relief, or unloading valve NOT adjusted properly
Adjust
Yoke actuating device inoperative (variable dis– placement pumps)
Overhaul or replace
Pressure reducing, relief, or unloading valve worn or damaged
Overhaul or replace


N
movement?
Yes
O
No
No flow or no pressure
Go to H and K
Limit or sequence device (electrical, mechanical, or hydraulic) is NOT operative or NOT adjusted properly
Overhaul or replace
Mechanical bind
Locate bind and repair
Worn or damaged cylinder or motor
Overhaul or replace



O
slow movement?
No
P
Yes
Low flow
Go to H
Fluid viscosity too high
Fluid may be too cold OR fluid should be changed; use clean fluid with correct viscosity
Insufficient control pressure for valves
Go to K
No lubrication for machine ways or linkage
Lubricate
Worn or damaged cylinder or motor
Overhaul or replace


P
erratic movement?
No
Q
Yes
Erratic pressure
Go to K
Air in fluid
Go to A
No lubrication for machine ways or linkage
Lubricate
Erratic command signal
Repair command console or interrconnecting wires
Worn or damaged cylinder or motor
Overhaul or replace


Q
excessive movement or speed?
No
End
Yes
Excessive flow
Go to
H
Over–riding work load
Adjust, repair, or replace counter–balance valve

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