

Harsco Track Technologies™
Tie Inserter/Extractor
Operation and Maintenance
Manual

Model: TR-10

(Phase III w/20 MPH Axles, John Deere Tier II and Tier III
Engines and Norfolk Southern Extractor)



Harsco Track Technologies

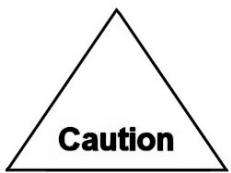
Harsco

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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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CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of it's constituents are known to the State of California to cause cancer; birth defects, and other reproductive harm.

Preface

Conventions Used In This Manual

<i>italics</i>	Indicates references to other manuals, such as the <i>Parts Manual</i> .
bold and upper case (in text)	Indicates a control lever, pushbutton or switch. Indicates button or switch..
Double quotation marks (“ ”)	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.

Except where noted, all references to left or right are determined from the operators station.

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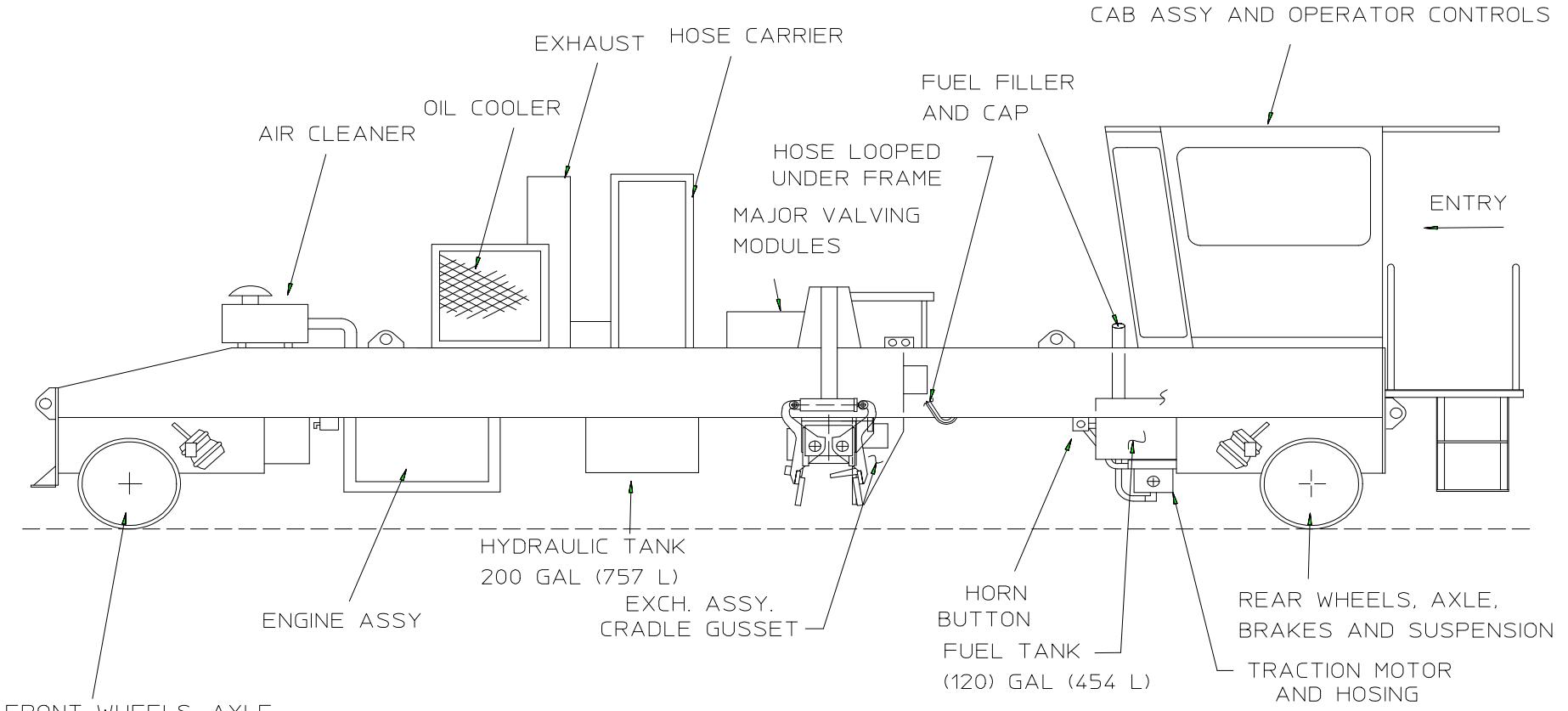
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TR-10 COMPONENT LOCATOR

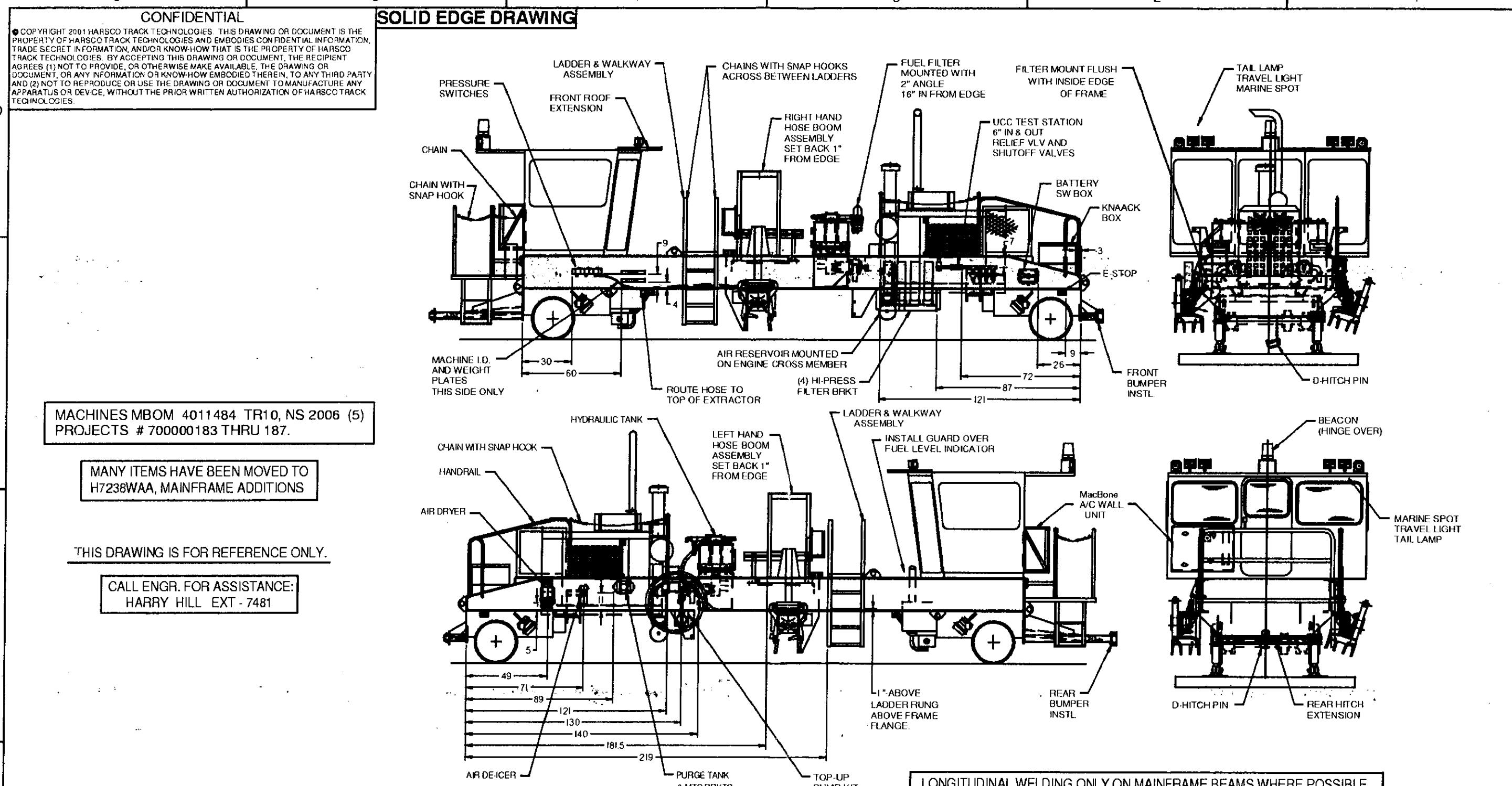
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CONFIDENTIAL5
SOLID EDGE DRAWING

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3

2

1



IMPLIED TOLERANCES										Description	Drawing Number	Machine Type	HTT				
ALL DIMENSIONS ARE IN INCHES - TOLERANCE UNLESS OTHERWISE SPECIFIED																	
NOMINAL SIZE RANGE		INCH PLUS OR MINUS		NOMINAL SIZE RANGE		METRIC PLUS OR MINUS		UNLESS OTHERWISE SPECIFIED ALL MACHINED SURFACES WILL HAVE:									
OVER	TO	2 PLACE DECIMAL	3 PLACE DECIMAL	OVER	TO	1 PLACE DECIMAL	2 PLACE DECIMAL	A SURFACE FINISH OF 125 MICRONCHES	ANGULAR TOLERANCE OF ± 50°	CONCENTRICITY WITHIN .010							
0	6	.03	.005	0	150	.8	.13										
6	24	.04	.008	150	600	1.0	.20										
24	-	.06	.010		600	1.5	.25										
UNLESS OTHERWISE SPECIFIED ALL WELDS SHOULD ADHERE TO THE LATEST HTT WELDING SPECIFICATION 101!										Matl	DOCUMENT ONLY						
										Part Number	4012209	Size	B	Sheet	1 of 1		

ENERGY CONTROL PROCEDURE TR-10

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 <u>TR-10</u>	MFR	<u>Harsco Track Technologies</u>	ISSUE DATE	<u>8/17/98</u>
ENERGY SOURCES:	ELECTRICAL	<u>24 VDC</u>	COMPRESSED AIR	<u>X</u>
	HYDRAULIC	<u>X</u>	MECHANICAL	<u>X</u>
STORED ENERGY:	RAISED LOAD	<u>X</u>	COIL SPRINGS	<u>X</u>
	BATTERY	<u>X</u>	AIR TANK	<u>X</u>
	HYDRAULIC PRESS	<u>X</u>		

PROCEDURE TO REMOVE MACHINE FROM ENERGY SOURCE

1. The person who will be doing the maintenance or adjustments must familiarize himself with the type of energy sources for this machine and understand fully the hazards of the energy.
2. Stop machine and set parking brake, located on right rear wall of cab.
3. Lock Tie Exchanger in the secured travel position unless this is the area to be worked on and the anticipated work will require the exchanger to be resting on the ground. Lock the Rail Lifting Clamps in the secured travel position unless this is the area to be worked on and the anticipated work will require the clamp assembly to be resting on the ground. Lock switches are located in arms of operators seat.
4. Suspension lockouts should be in the unlocked position, located at four corners of machine.
5. Return throttle to idle position, located on right rear wall of cab.
6. Stop engine, ignition switch located on right side of overhead control panel.
7. Turn battery master switch to "OFF" position. Switch is located at front of machine adjacent to batteries.
8. Drain air systems by opening valve on air tank, located near right front corner of engine.
9. 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. Close drain valve on air tank.
5. Turn battery master switch to "ON" position.
6. Start engine.
7. Verify that all energy sources are energized by observing gauges.
8. Test all functions of the machine which were affected by the repairs.

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Chapter 1

Safety

Because railroad equipment is large, heavy, and powerful, you should be very careful while operating and performing maintenance and repairs on the equipment. Harsco Track Technology designed the equipment to be as safe and productive as possible; however, it is impossible to predict every situation that may occur. Make sure you and all other personnel, such as the work crew, practice good safety habits.

Make sure you read this chapter before you attempt to operate or perform maintenance on the machine. This chapter describes the following:

- D Safety rules
- D Safety features
- D Safety locks

Safety Rules

1. Follow all rules and regulations issued by your railroad; these rules and regulations should describe the proper use, care, and service of self-propelled track equipment.
2. Read this section very carefully and make sure you know what safety features are provided with the machine.
3. Carefully read all instructions, notes, cautions, and warnings that are provided in all chapters in this manual.
4. Before operating the machine, perform a visual inspection of the machine and its components. For example, check for broken, loose, or worn parts.
5. While the machine is being operated, make sure you and all other personnel are NOT close to any moving parts, such as the tie exchanger.
6. Do not perform any welding (repairs) unless all electrical power to the machine is turned OFF.

7. Make sure the machine and the engine have stopped before you perform any maintenance tasks.
8. Keep all equipment and components clean.
9. Make sure you wear a hard hat, safety glasses, and safety shoes when you are working. Also, do NOT wear loose fitting or torn clothes and make sure you remove all jewelry, such as rings and watches.
10. Before you move or operate the machine, make sure all personnel are safely away from the equipment.
11. Use the air horn, if available, to indicate that you are going to move the machine, both forward and reverse.
12. Before you start the engine, perform any scheduled maintenance, such as checking the engine oil level, etc. Additional information is provided in "Appendix A".
13. Make sure the engine is stopped before you refuel, service, or make repairs to the engine and other equipment.
14. Do NOT go near the machine or any components while they are being operated. For example, do NOT go near the tie exchanger while it is being extended or retracted.
15. Try to guard against any other potentially dangerous situations, such as working near equipment while it is being moved or operated.
16. When you stop the machine, such as a work break, make sure the parking brakes are applied and the work/travel switch is in the OFF position



When the parking brakes are released, the machine does NOT have any brakes. Therefore, if you push or tow the machine or if the machine rolls down a grade, you must use other methods to stop it.

17. Do NOT permit anyone to ride on the machine outside the cab.

Safety Features

Emergency Shut Down

The machine has both automatic and manual emergency engine shut down systems.

The automatic emergency engine shut down system will activate if the engine water (coolant) temperature is too high or if the engine oil pressure is too low.

NOTE

The AUTOMATIC EMERGENCY SHUTDOWN feature will activate when the temperature and oil pressure sensors indicate the engine is operating over or under normal operating conditions. See John Deere engine manual

The DIAGNOSTIC feature of the control system is designed to show and record operation and anomalies that present themselves as "Fault Codes". Refer to the John Deere Tier II engine manual and the engine controller manual (Appendix E) for details concerning the Engine Diagnostics.

The manual emergency engine shut down system activate by pushing IN the EMERGENCY SHUTDOWN (red) button which is located on the left console (front). This button should be used only in case of emergency and MUST BE reset to restart the engine.

Refer to Figure 1–1.

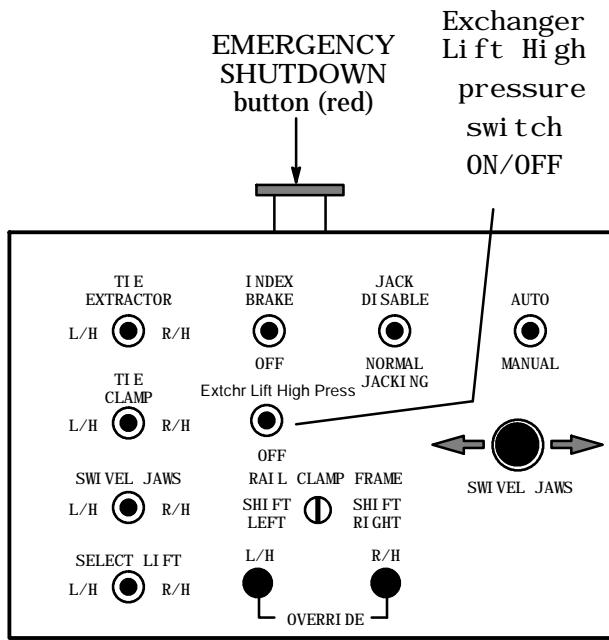


Figure 1–1: Left console

NOTE

You must manually pull out the emergency shut down button before you can restart the engine.



Figure 1–1B: Engine Controller (John Deere Tier II)

Remember, for normal shutdown of the engine, the operator need only turn the KEYED/Auto/Off/Run switch counter clockwise to the OFF position. (Refer Figure 1–1B)

Parking/Spring Brakes

The parking (spring) brakes are automatically applied, on all four wheels, if the air pressure is lost or drops below 45 PSI.

Also, the parking brakes can be manually operated using the knob that is located behind the operator's seat (right side of the cab); refer to Figure 1–2. To apply the parking brakes, push the knob DOWN; to release the parking brakes, pull the knob UP.

NOTE

Some models are fitted with the optional LOW AIR PRESSURE alarm that will sound if the air pressure drops below 45 PSI.

Parking/Spring Brake Control Knob
push down to apply,
pull up to release

Clamp Pressure
Control Valve

Extractor Down Press
Control Valve

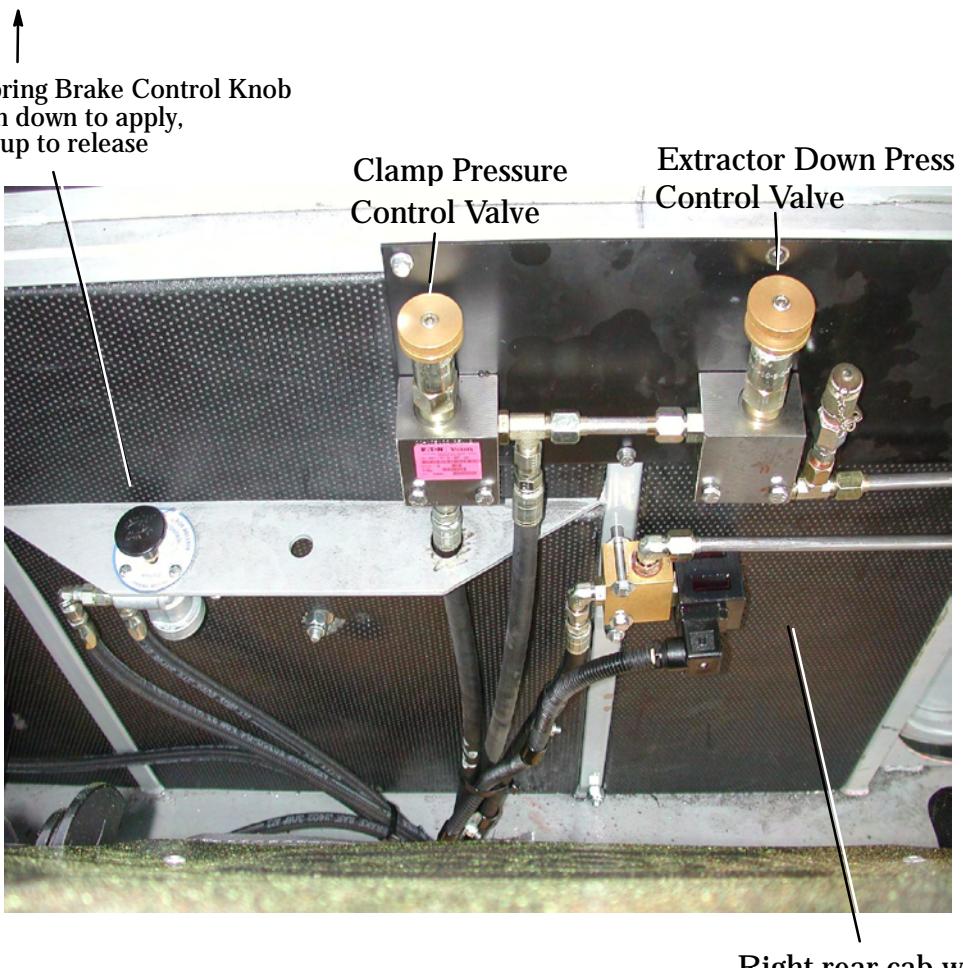
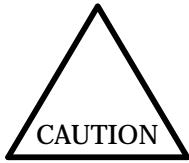


Figure 1–2: Parking/Spring brake knob



If you need to perform maintenance on the Parking/Spring(spring) brakes, make sure you secure (cage) the spring. First, remove the release tool from the storage bracket located on the side of the brake chamber housing. Second, install the release tool in the opening at the top of the brake chamber. Then, tighten the release tool (bolt) until the spring is caged.

Emergency Pump (Optional)

If there is a problem with the hydraulic system, you can use the emergency pump to operate the hydraulic components of the machine, such as the tie exchangers. Also, the machine must be in Work mode.

To use the emergency pump, press and hold the emergency pump (red) button which is located on the left side of the overhead control panel. When you are finished using the emergency pump, release the button. Refer to Figure 1–3.

NOTE

Do NOT use the emergency pump to perform work.



Emergency Control Switch
(Momentary)

Figure 1–3: Overhead Control Panel (left side)

Safety Locks

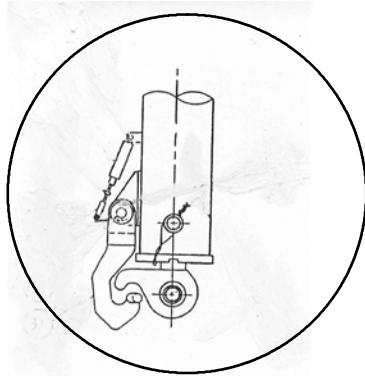
The work components, the clamp frame and the tie exchangers, have safety locks which are used to prevent damage to those work components when the machine is NOT being used to perform work, such as during track travel.

Clamp Frame

The clamp frame has two (2) air operated locks.

The procedure to unlock and lower the clamp frame is provided in “Chapter 4”.

To raise and lock the clamp frame, make sure it is unlocked. Then, move the AUTO/MANUAL toggle switch, which is located on the left console, to the MANUAL position. Then, press, and hold, the OVERRI DE (red) buttons, which are also located on the left console, until both sides of the clamp frame are positioned in the locks. Then, close the locks by moving the CLAMP FRAME toggle valve, which is located on the right console, to the ON position.



Clamp Frame Lock
(Typical on opposite side)



Figure 1–4: Clamp frame locks location

Tie Exchangers

The tie exchangers have four (4) air operated locks: two (2) locks are used to lock the complete tie exchanger assembly in the fully raised (lifted) position and two (2) locks are used to lock the right and left tie exchanger (jaws) in the fully retracted position. Refer to Figure 1–5 and 1–6.

The procedure to unlock the tie exchanger assembly and unlock the tie exchanger on the “working” side of the machine is provided in “Chapter 4”.

To lock the tie exchanger on the working side of the machine, use the joystick to fully retract the tie exchanger. Then, apply the lock by moving the TIE EXCH LEFT or TIE EXCH RI GHT toggle valve, which is located on the right console, to the ON position.

After the tie exchanger is retracted, make sure the tie exchanger assembly is NOT locked. Then, use the joystick to raise (lift) the tie exchanger assembly until it is positioned in the locks. Then, lock the assembly by moving the TIE EXCH LI FT toggle valve, which is located on the right console, to the ON position. Then, use the joystick to lower the assembly until it is firmly “seated” in the locks.



Figure 1–5: Exchanger/Extractor (lift) lock (Typical on opposite side)



Figure 1–6: Exchanger/Extractor (retract) lock (Typical on opposite side)

Chapter 2

How to Start Up the Machine

Procedure:

1. Make sure you read “Chapter 1”, *Safety*, before you try to start up the machine.
2. Make sure you perform all scheduled maintenance on the machine. For example, make sure you check the engine oil level, check the hydraulic fluid level, and engine coolant level. Additional information is provided in “Appendix A”.
3. Make sure the knobs on the two (2) towing valves are pushed IN (as far as possible). Refer to Figure 2–A.

One valve is located on the left (front side) of the machine and the other valve is located on the right (rear side) of the machine.

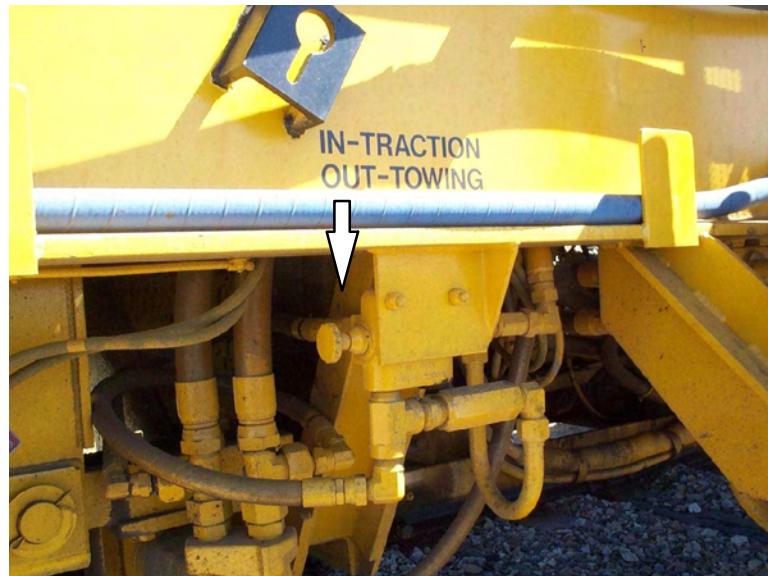
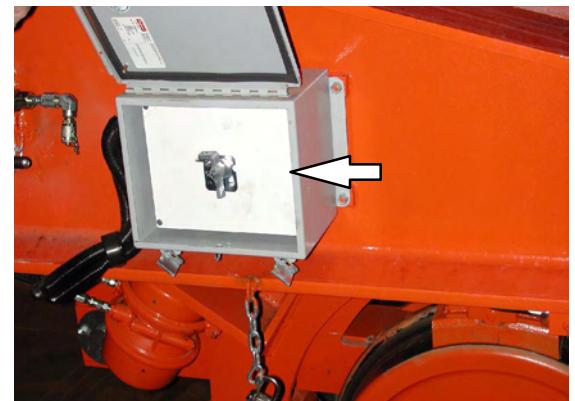


Figure 2–A: Traction/Towing Valve



Battery Switch Box Location



Battery Switch Box and Switch

Figure 2–B: Battery Switch Location (front right side)

4. Turn the battery switch to the ON position. The switch is located on the front right side of the machine frame. Refer to Figure 2–B.
5. Access the cab. Refer to Figure 2–C and 2–D, Cab Interior Layout. Then, make sure the parking brakes are applied; the Parking/Spring brake knob, which is located behind the operator seat (right side), should be pushed DOWN. When the air pressure is less than (<) 45 PSI, the Parking brakes are automatically applied.

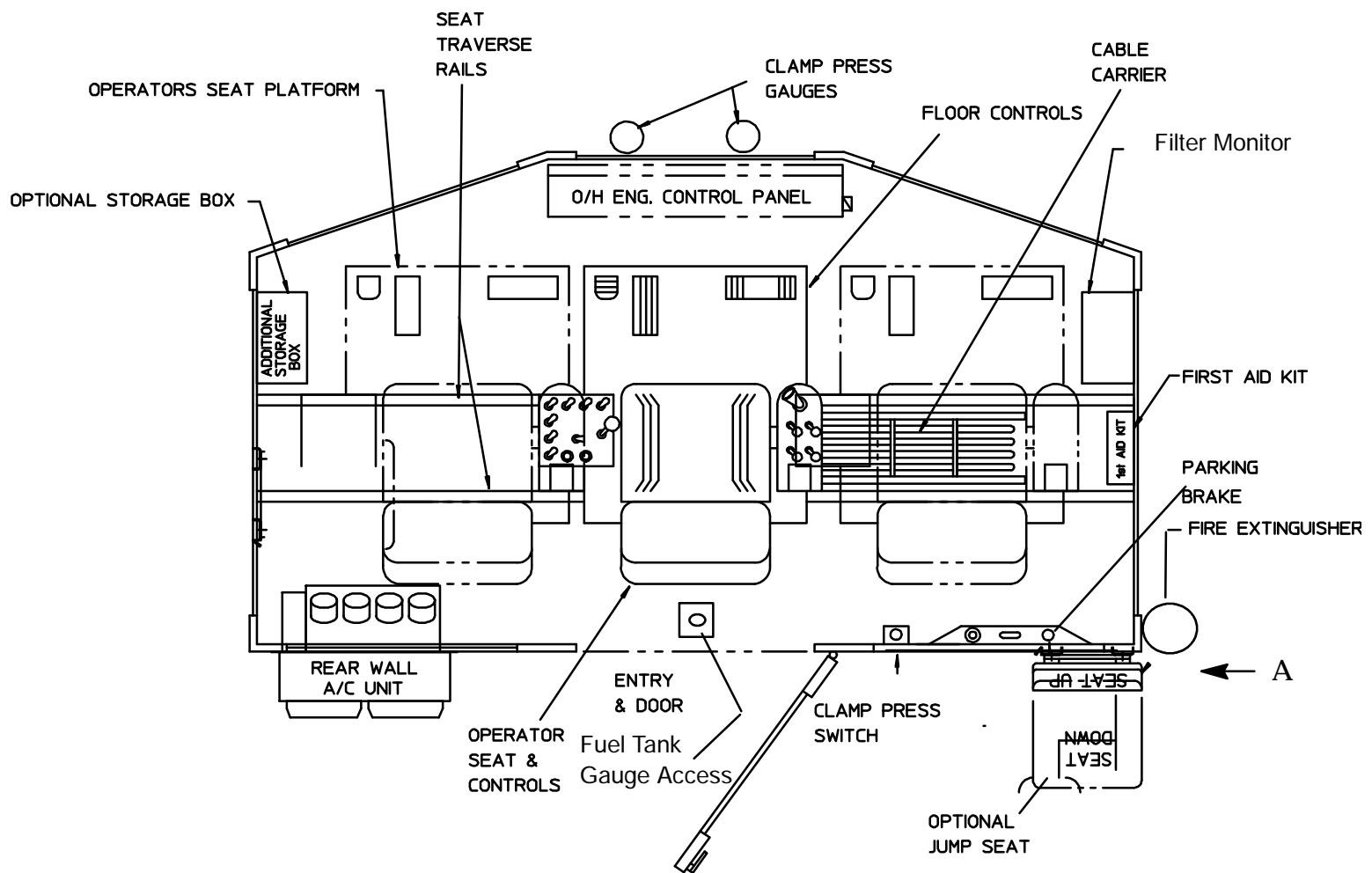


Figure 2-C: Cab Interior layout

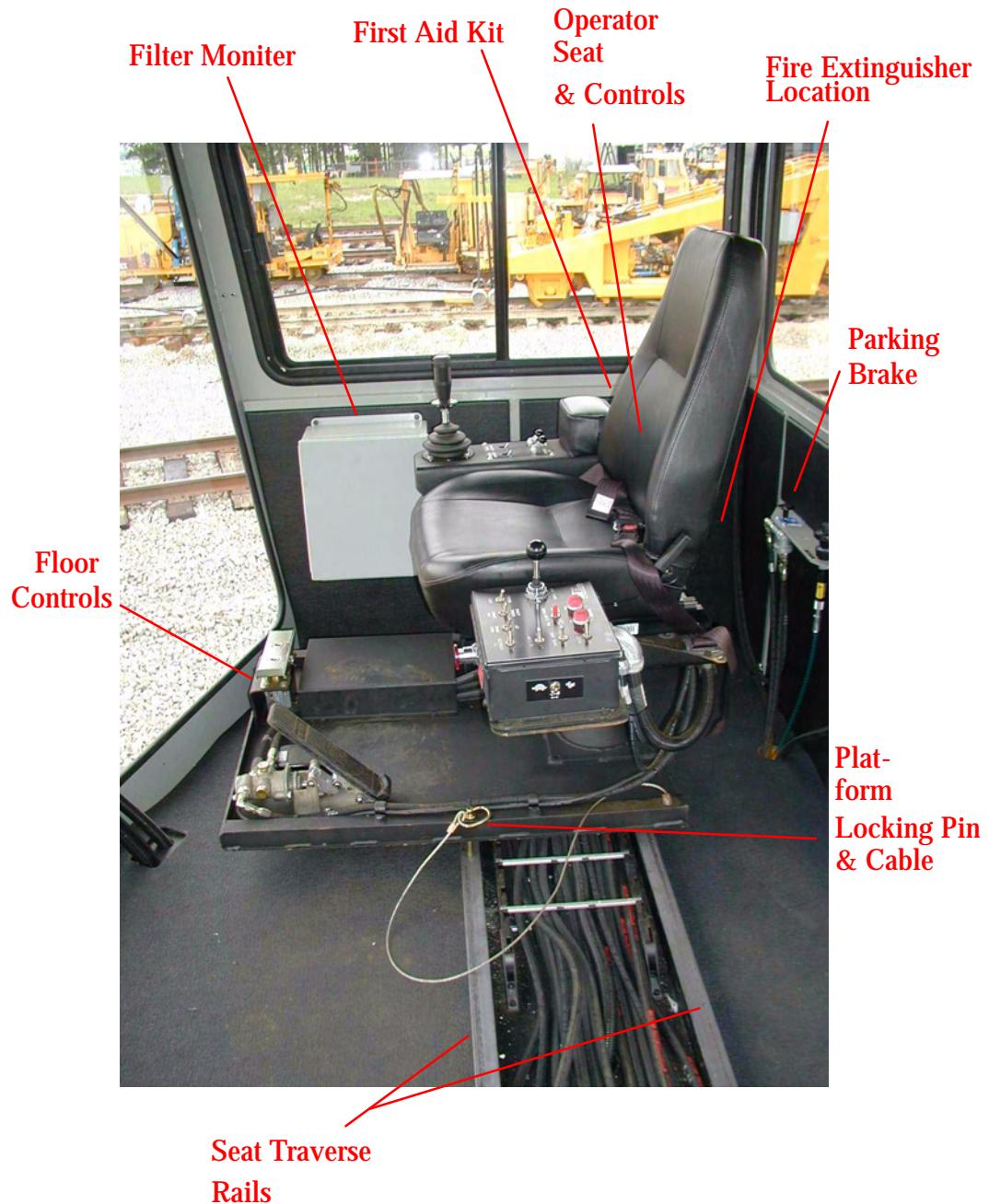


Figure 2–D: Cab Interior layout (side view)

6. Move the Travel/Work switch, which is located on the overhead control panel (right side), to the OFF position (middle).

Refer to Figure 2–2.

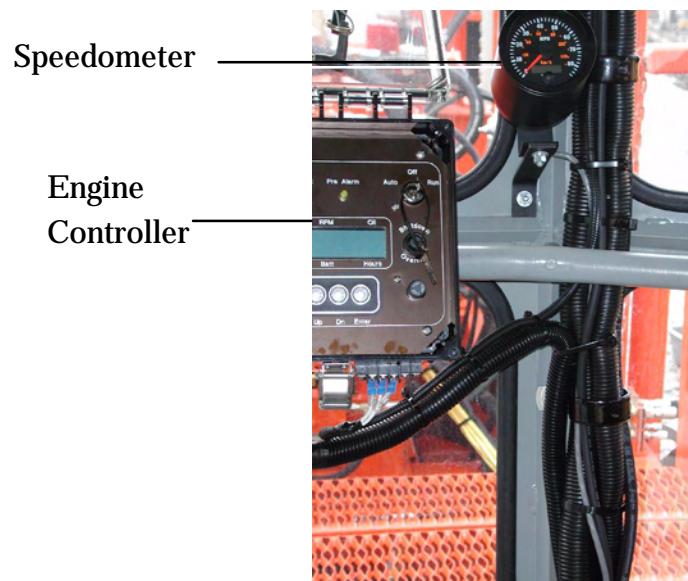
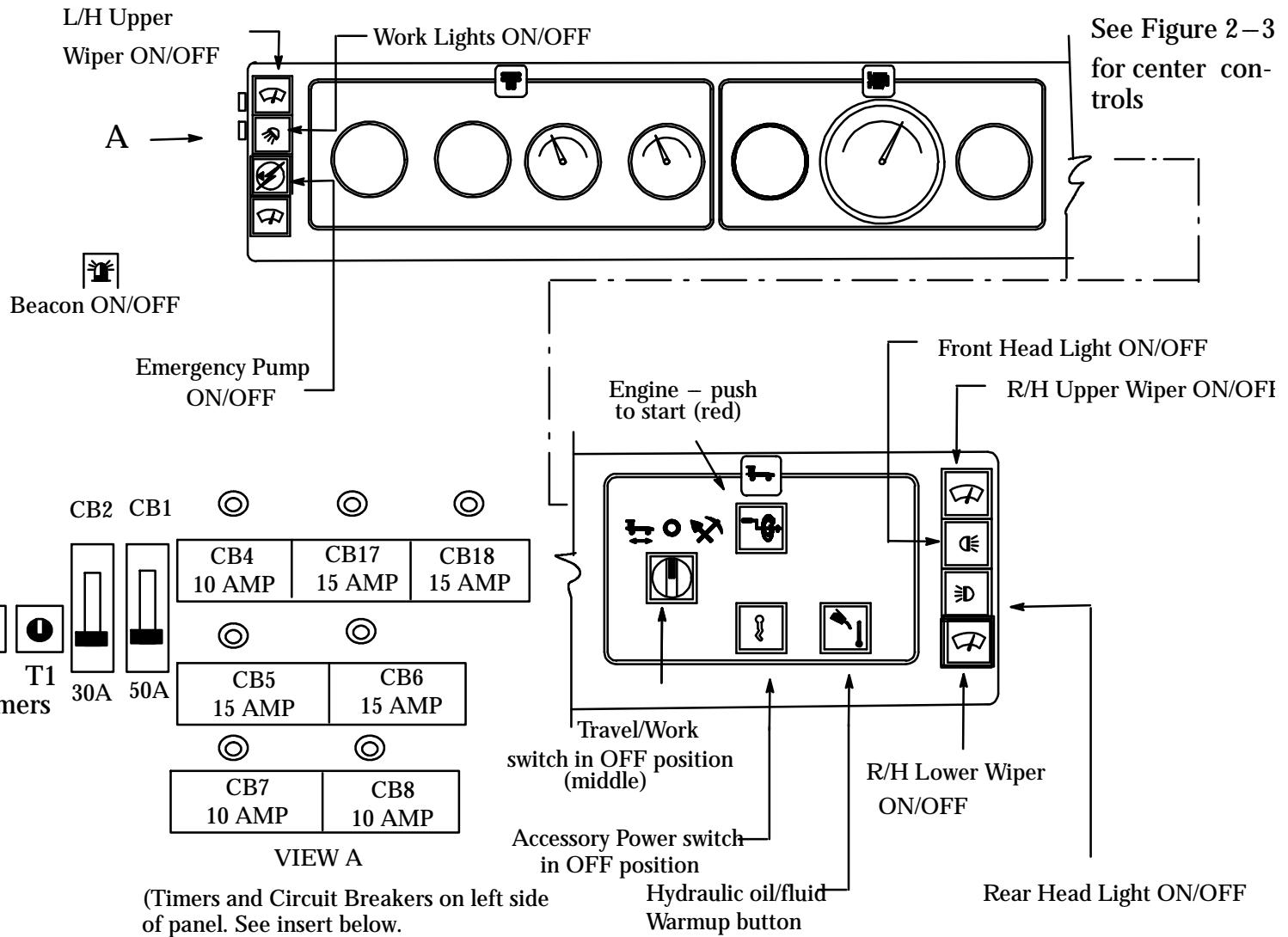


Figure 2–E: Optional Speedometer



Figure 2–1: Overhead Control Panel



Insert

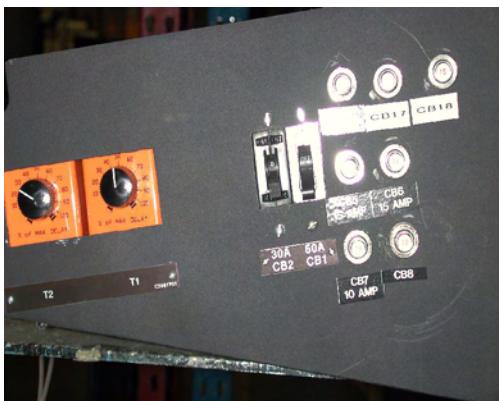


Figure 2-2 Overhead Control Panel Details



Figure 2–3 Overhead Control Panel (center controls)

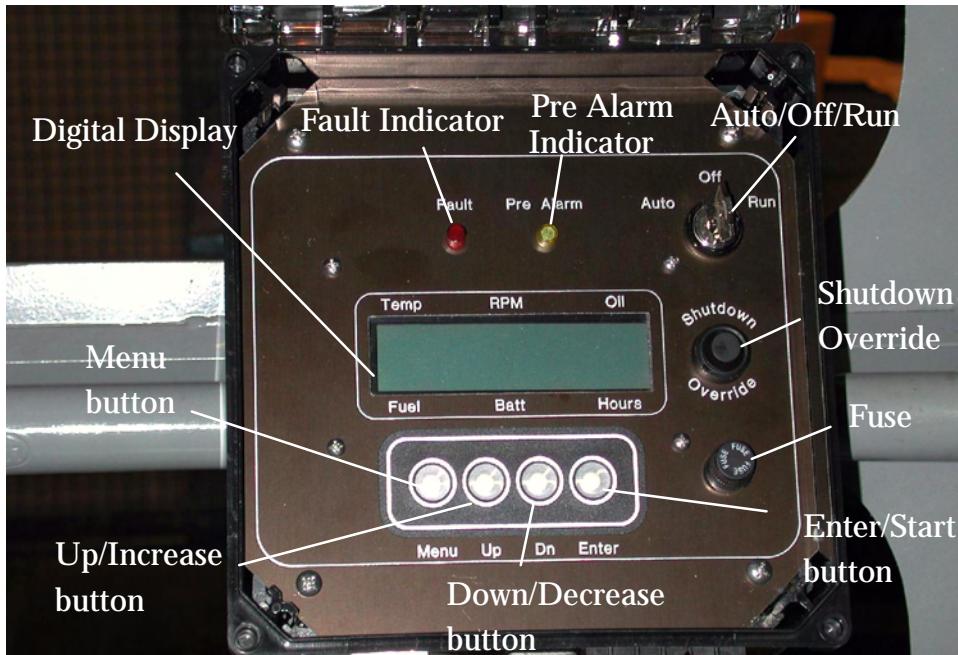


Figure 2–4 Engine controller (John Deere engine)

This TR-10 model is equipped with a mechanical Engine Controller. The unit is programmable and houses all of the controls concerned with operation of the Model 6068HF457 Tier II John Deere Diesel Engine. Refer to *Appendix E* and *F* detail instructions.

7. Insert the key in the AUTO/OFF/RUN switch located in the Engine Controller (John Deere) located below the Overhead Control panel and

in front of the operator seat. Turn the key to the right (clockwise) to the RUN position. Notice that the digital display in the center of the control box will prompt you to: *“Press and Hold the ENTER BUTTON to Crank”*

8. Press and hold the ENTER button to start the engine and release the button as soon as the engine starts.

NOTE

If the engine does NOT start, try again. If the engine still does NOT start after three (3) refer to the engine maintenance manual.

9. When the engine starts, use the UP or Down buttons to adjust the engine speed to the recommended idle speed of approximately 800 – 1000 RPM. There is a tachometer located on the overhead control panel.
10. Check all of the gauges on the overhead control panel. Make sure the engine oil pressure, engine water temperature, etc. are correct.

Do NOT operate the machine until any problems are corrected.

11. Permit the hydraulic fluid/oil to warm up by pressing the WARM-UP button which is located on the overhead control panel. The machine should NOT be used for work until the hydraulic fluid/oil temperature is a minimum of 86° F. Refer to Figure 2-2.

After the hydraulic oil is warmed up, turn off the warm up by pressing the WARM-UP push button..

The machine is now ready to track travel (refer to “Chapter 3) or ready to be set up to perform work (refer to “Chapter 4”).



DO NOT operate the Air Conditioner unit with the engine speed at IDLE. Damage to the hydraulic motor could result from excessive low engine speed. The unit is located on the left rear wall of the cab. Refer to Figure 2-5.

Increase the speed of the engine to 2000 RPM for efficient cooling. Refer to the manufacturer operating instructions in *“Appendix D”* for additional information .

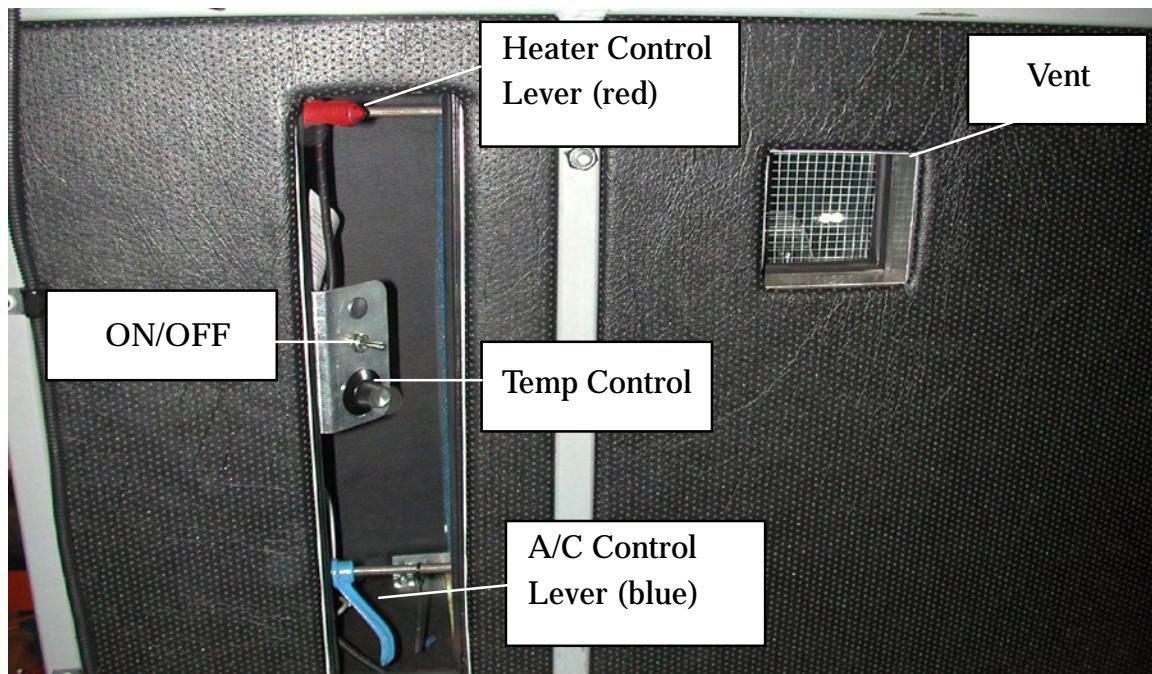


Figure 2–5: Hydraulic Air Conditioner (located on the left rear wall of the cab)

Chapter 3

How to Travel the Machine

Procedure:

1. Make sure you read “Chapter 1”, *Safety*, before you try to travel (move) the machine.
2. If the machine has NOT been performing work, make sure the machine is started up and the engine is running properly. If necessary, refer to “Chapter 2”.
3. Make sure you perform all scheduled maintenance on the machine, such as check the engine oil level, check the hydraulic fluid/oil level, and check the engine water temperature. Additional information is provided in “Appendix A”.
4. If the machine has NOT been performing work, skip to step 5; you do NOT need to perform this step.

If the machine has been performing work, the suspension must be unlocked before the machine can track travel. Perform the following procedure.

- a. Move the machine until the tie exchanger is positioned over a tie on level and tangent track.
- b. Use the joystick to lower the jaws onto the end of the tie.

Continue to lower the jaws until the machine is raised high enough to permit the locking plate to clear the bottom edge of the frame.

Do NOT raise the wheels off the track.

- c. Locate the “T” handles at the front and rear of the machine (next to the wheels). Refer to Figure 3–1.

Then, pull the handles DOWN only on the side of the machine that is raised.

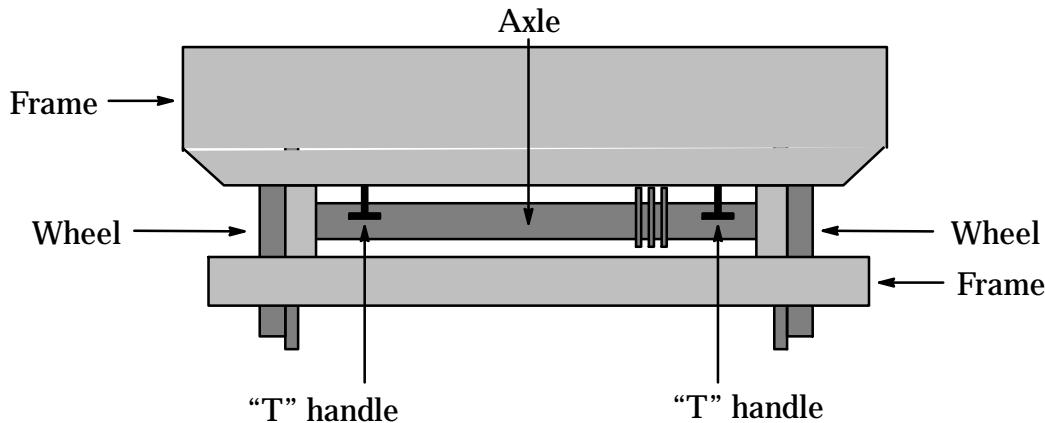


Figure 3–1: “T” handles

- d. Rotate the locking plates until they are perpendicular with the axles (approximately 90°).
 - e. Align the hole in each locking plate with the corresponding hole in each suspension bracket.
 - f. Make sure the suspension is unlocked; check to make sure the spring loaded pins on both “T” handles were “engaged” when the holes were aligned.
 - g. Use the joystick to slowly and carefully raise the jaws.
 - h. Move the SELECT LI FT , TIE EXTRACTOR, TIE CLAMP, and SWI VEL JAWS toggle switches to select the other side of the machine. Then, lock the tie exchanger on the new “working” side of the machine and unlock the tie exchanger on the new “non–working” side of the machine.
 - i. Repeat steps a through g for the other side of the machine. Then, continue with step 5.
-
- 5. Make sure all work components, such as the tie exchangers on both sides of the machine, are raised and locked in their travel position. If necessary, refer to “Chapter 1”.

6. Turn the Travel/Work switch, which is located on the overhead control panel (right side), to the left (counterclockwise); this is the TRAVEL position.

Refer to Figure 3–2.

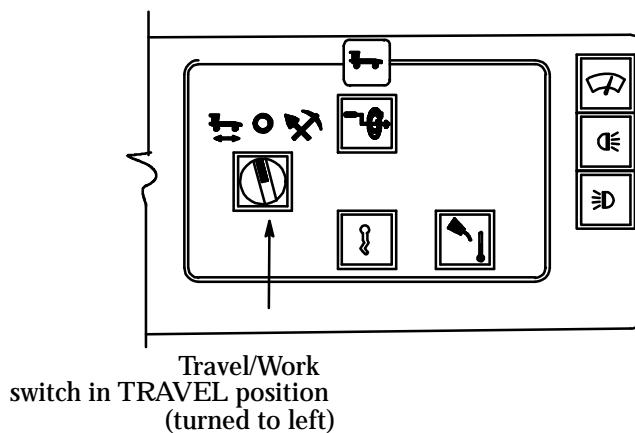


Figure 3–2: Travel/Work switch

7. Select the travel speed using the toggle switch which is located on the side of the left console. (Swivel head control box) Refer to Figure 3–3.

To select slow travel, move the switch forward (toward the front of the machine). To select fast travel, move the switch backward (toward the rear of the machine).

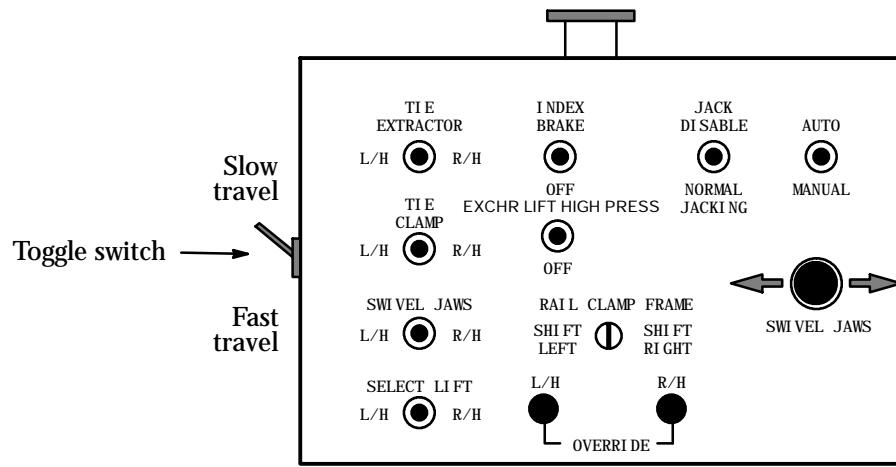


Figure 3–3: Left console or Swivel Head control box

- Using the UP button on the engine control box, increase engine speed to the recommended operating speed of approximately 2000 RPM.

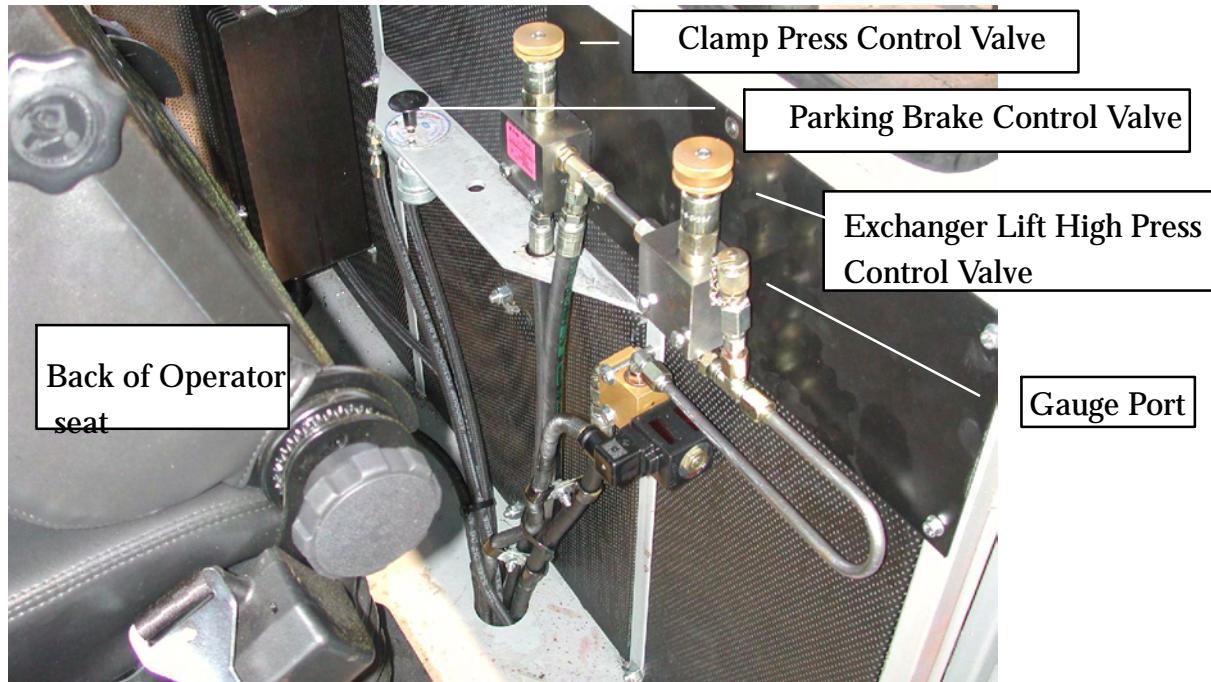


Figure 3–4: Parking/Spring brake, Clamp and Exchanger Lift Pressure controls

9. Move the INDEX BRAKE switch, which is located on the left console, to the OFF position. Refer to Figure 3–3.

10. Release the parking brakes by pulling UP the Parking/Spring brake knob which is located behind the operator seat (right side). Refer to Figure 3–4.

If the Parking/Spring brake knob will NOT remain in the UP position, check the air pressure; it must be a minimum of 45 PSI.

11. To travel forward, slowly press down on the right side of the Traction pedal which is located on the floor in front of the operator seat.

To travel backward (reverse), slowly press down on the left side of the Traction pedal. If your machine is equipped with a back up alarm (optional), the back up alarm (beeping noise) will be automatically sounded.

Refer to Figure 3–5.

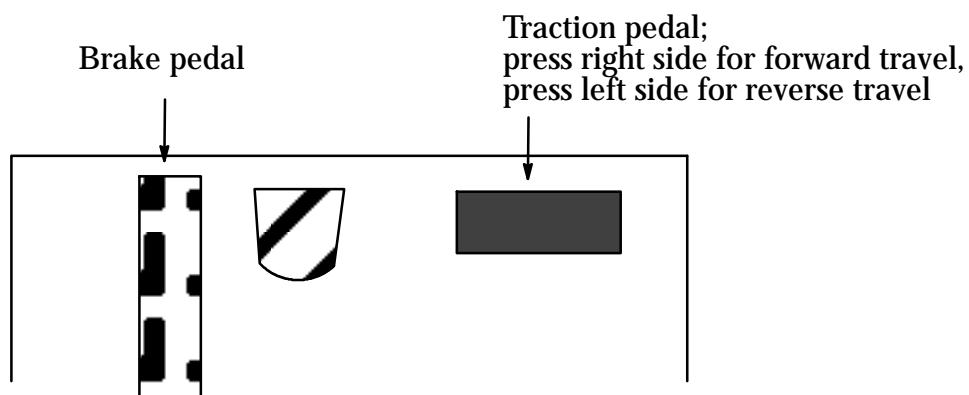


Figure 3–5: Floor pedals

NOTE

To prevent possible damage to the machine's drive train components, do NOT change travel direction while the machine is moving; wait until the machine comes to a complete stop.

12. To increase travel speed, apply more pressure to the Traction pedal. To decrease travel speed, release pressure from the Traction pedal.

NOTE

If you selected slow travel, you can increase speed by moving the speed selector switch to the fast travel position. Also, if you selected fast travel, you can decrease speed by moving the speed selector switch to the slow travel position. The speed selector switch is located on the left console. Refer to Figure 3–3.

13. To slow down the machine, release the Traction pedal and slowly push DOWN the brake pedal which is located on the floor. Refer to Figure 3–5.
14. When the machine has come to a complete stop, make sure you apply the parking brakes by pushing DOWN the Parking/Spring brake knob. Refer to Figure 3–4.

Chapter 4

How to Set Up the Machine to Perform Work

Procedure:

1. Make sure you read “Chapter 1”, *Safety*, before you try to use the machine for work.
2. Make sure you perform all scheduled maintenance on the machine, such as check the engine oil level, check the hydraulic fluid/oil level, etc. Additional information is provided in “Appendix A”.

NOTE

If your machine is equipped with the Top-Up Pump option, refer to the operating instructions on page 4–8 – 4–9.

3. Make sure the machine is started up correctly, such as the hydraulic fluid is warmed up properly. If necessary, refer to “Chapter 2”.
4. Move/travel the machine so the tie exchanger is located over a tie on level and tangent track. If necessary, refer to “Chapter 3”.
5. Set engine speed to the recommended operating speed of approximately 2000 RPM.
6. Turn the Travel/Work switch, which is located on the overhead control panel, to the right (clockwise); this is the WORK position.

Refer to Figure 4–1.

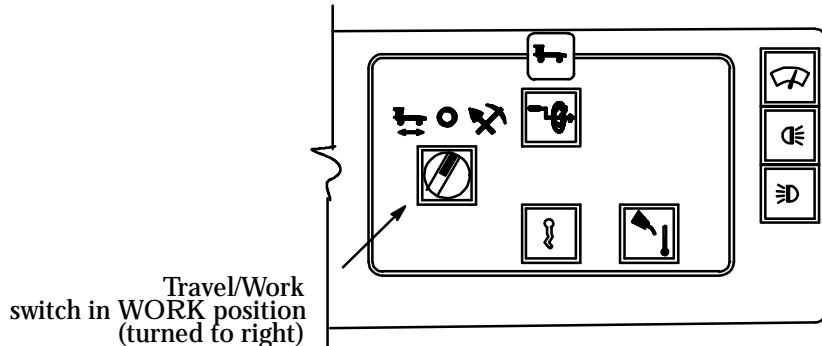


Figure 4–1: Travel/Work switch

7. If necessary, you can increase or decrease the amount of pressure applied to the jaws when they are closed (squeeze). The tie should NOT be able to "slip" out of the jaws when you are working. The default (initial) pressure is approximately 1000 PSI. There are two (2) pressure gauges located on the outside (front) of the cab.

To adjust the pressure, turn the control knob, which is located behind the operator seat (to the right of the Parking Brake control), until the gauges indicate the desired pressure. Refer to Figure 4–1A.

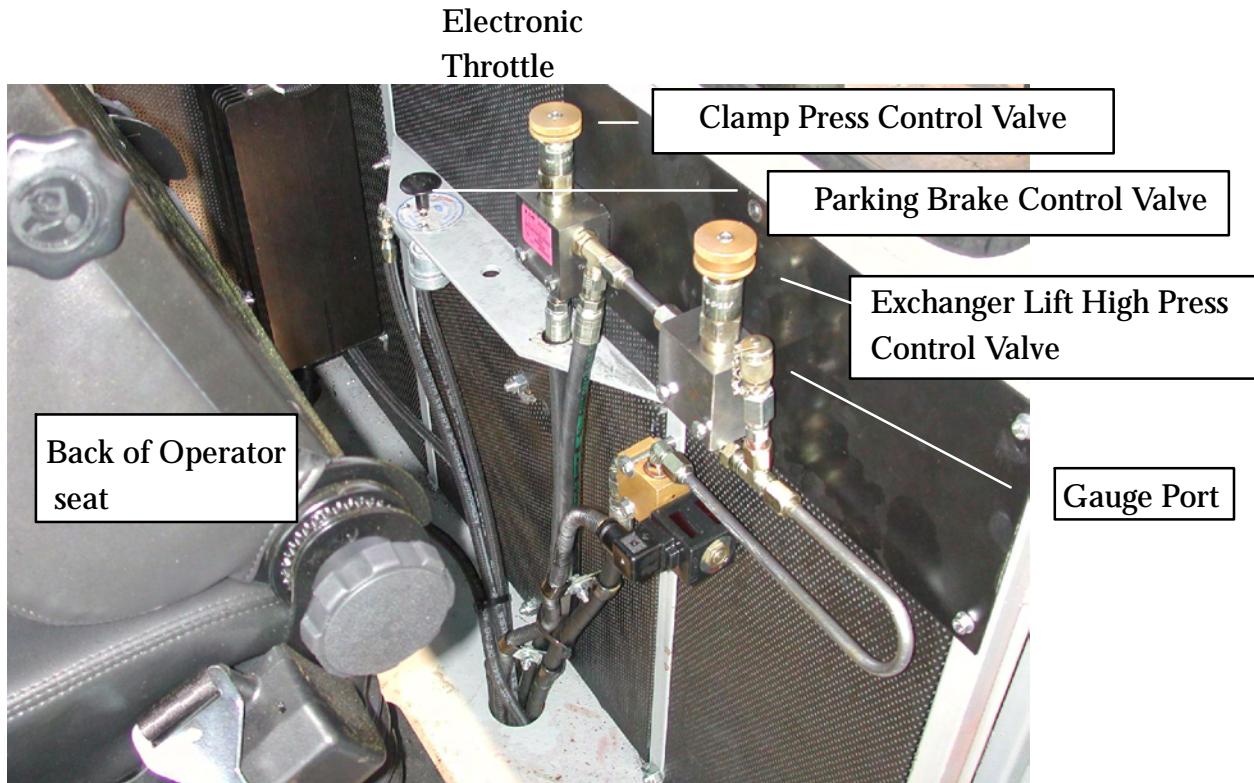


Figure 4–1A: Parking Brake, Clamp pressure and Exchanger Lift High Pressure control valves (located on the rear inside wall of the cab)

- Move the INDEX BRAKE toggle switch to the INDEX BRAKE position. Also, move the AUTO/MANUAL toggle switch to the MANUAL position.

Refer to Figure 4–2.

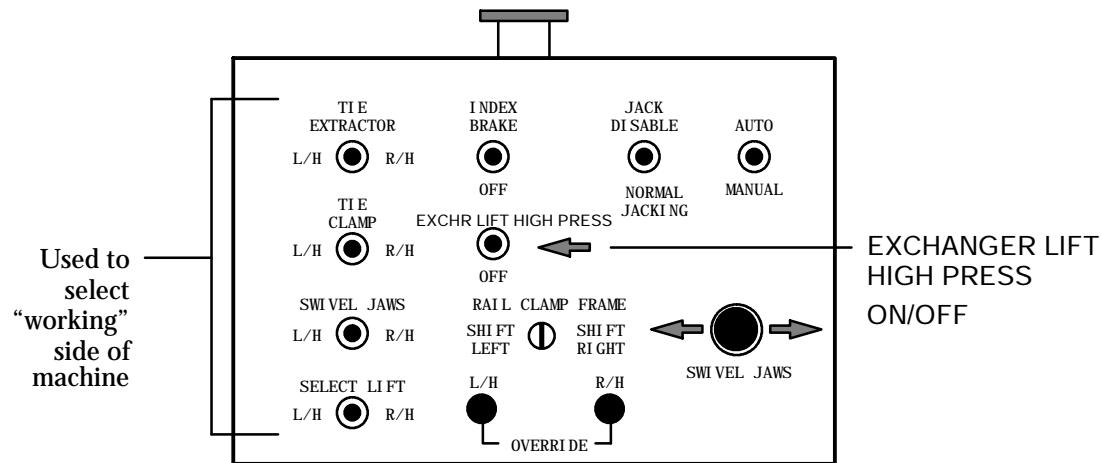


Figure 4–2: Left console (Swivel head control box)

NOTE

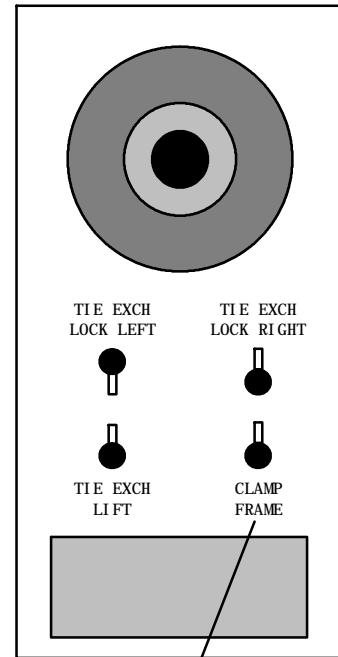
This TR–10 model is equipped with a High Extractor Down Pressure switch located in Left console (Swivel head control box). When activated, this 2 position switch permits the operator to increase the down pressure on the extractor as track conditions warranted. Refer to Figure 4–2.

- Raise the clamp frame (in the travel locks) by pressing the two (2) OVERRI DE (red) buttons, both L/H (left side) and R/H (right side).

Refer to Figure 4–2.

- Unlock the clamp frame by moving the CLAMP FRAME toggle valve which is located on the right console.

Refer to Figure 4–3.



Lock/unlock lever
for clamp frame

Figure 4–3: Right console

11. Move the AUTO/MANUAL toggle switch, which is located on the left console, to the AUTO position; the clamp frame should slowly “float” down onto the rails.
12. If necessary, you can align the clamp frame with the rails, either SHIFT LEFT or SHIFT RIGHT, using the RAIL CLAMP FRAME switch which is located on the left console. Refer to Figure 4–2.
13. Move the SELECT LI FT toggle switch, which is located on the left console, to the L/H position. Then, push the joystick, which is located on the right console, forward to raise the left tie exchanger.
14. Move the SELECT LI FT toggle switch, which is located on the left console, to the R/H position. Then, push the joystick, which is located on the right console, forward to raise the right tie exchanger.

15. Unlock both tie exchangers by moving the TIE EXCH LI FT toggle valve, which is located on the right console, to the OFF position.

Refer to Figure 4–3.

16. Move the SELECT LI FT toggle switch, which is located on the left console, to select the “non–working” side of the machine, either L/H (left side) or R/H (right side).
17. Pull the joystick backward to lower the tie exchanger until the bottom of the jaws are high enough (above the top of the rail) to clear road crossings and switches.
18. Move the SELECT LI FT toggle switch, to select the “working” side of the machine.
19. Move the TIE EXTRACTOR, TIE CLAMP, and SWIVEL JAWS toggle switches, which are also located on the left console, to select the “working” side of the machine, either L/H or R/H.
20. Pull the joystick backward to lower the tie exchanger (jaws) onto the end of the tie.
21. Make sure the tie exchanger on the “non–working” side of the machine is locked. For example, if the left side is the working side, make sure the tie exchanger on the right side of the machine is locked by moving the TIE EXCH LOCK RI GHT toggle valve, which is located on the right console, to the ON position. Refer to Figure 4–3.
22. Unlock the tie exchanger on the “working” side of the machine so it can be extended/retracted. For example, if the left side is the working side, move the joystick to the right (retract), move the TIE EXCH LOCK LEFT toggle valve to the OFF position, and then move the joystick to the left (extend).
23. Lock the suspension for work by performing the following procedure.
 - a. Pull the joystick backward to lower the jaws until the machine is raised high enough to permit the locking plate to clear the bottom edge of the frame.

Do NOT raise the wheels off the track.

- b. Locate the “T” handles at the front and rear of the machine (next to the wheels). Then, pull the handles DOWN only on the side of the machine that is raised.

- c. Rotate the locking plates until they are parallel with the axles (approximately 90°).
- d. Align the hole in each locking plate with the corresponding hole in each suspension bracket.
- e. Make sure the suspension is locked; check to make sure the spring loaded pins on both “T” handles were “engaged” when the holes were aligned.
- f. Carefully raise the jaws by slowly pushing the joystick forward until the bottom of the jaws clear the top of the tie.
- g. Repeat steps 18 through 23 for the “non-working” side of the machine. Then, continue with step 24.

NOTE

The suspension must be unlocked before the machine can track travel. Refer to “Chapter 3”.

24. Move the SELECT LIFT, TIE EXTRACTOR, TIE CLAMP, and SWIVEL JAWS toggle switches to select the “working” side of the machine. Also, make sure the tie exchanger on the “non-working” side of the machine is locked and the tie exchanger on the “working” side of the machine is unlocked.
25. If necessary, you can adjust the height (lift) for the rails using the two (2) timers, T1 and T2, that are located on the left side of the overhead control panel. The timers should be adjusted for the average condition of the ties.

For example, if the tie plate has been embedded in the tie an average of 1/2”, there is a 1/2” lip between the tie and the tie plate. The timers should be set so the rail is lifted high enough to clear the 1/2” lip and high enough to clear the top of the tie.

Refer to Figure 4–4.

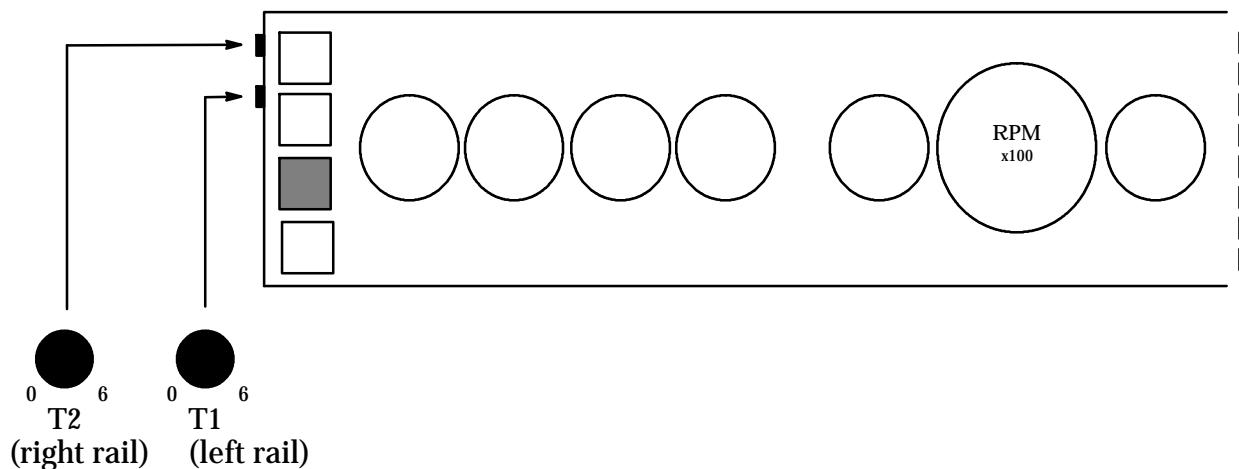


Figure 4–4: Overhead control panel

It is recommended that you turn both timers (knobs/dials) to the 1 position. Then, press the button on top of the joystick to clamp and lift the rails.

If the rails are NOT lifted high enough, press and release (momentarily) the Traction pedal to release the rails, turn the timers to the 2 position, and then press the button on top of the joystick to clamp and lift the rails again. Continue until the rails are lifted high enough to clear the tie plates.

If the timers are turned to the 6 (highest) position and one or both of the rails are still NOT being lifted high enough, you can jack/raise each rail higher using the OVERRI DE buttons (red) which are located on the left console. Refer to Figure 4–2.

26. If necessary, you can move the seat/foot pedal assembly to the “working” side of the machine so you can have a good view of the tie, jaws, etc. while you are performing work.

Unlock the assembly by removing the pin that is located in the floor under the left console, slide the assembly to the working side of the machine, align the hole on the assembly with the hole on the floor, and then lock the assembly by inserting the pin.

The machine is now ready to perform work; refer to “Chapter 5”.

Top – Up Pump Option Operation

This optional feature allows faster and more efficient method of fulling the hydraulic tank. The Top – Up Pump Kit contains a heavy duty hand pump, a 20 foot long, 1 inch diameter suction hose and two in-line filters. These components are located on the left side of the machine frame below the oil cooler and hydraulic tank.

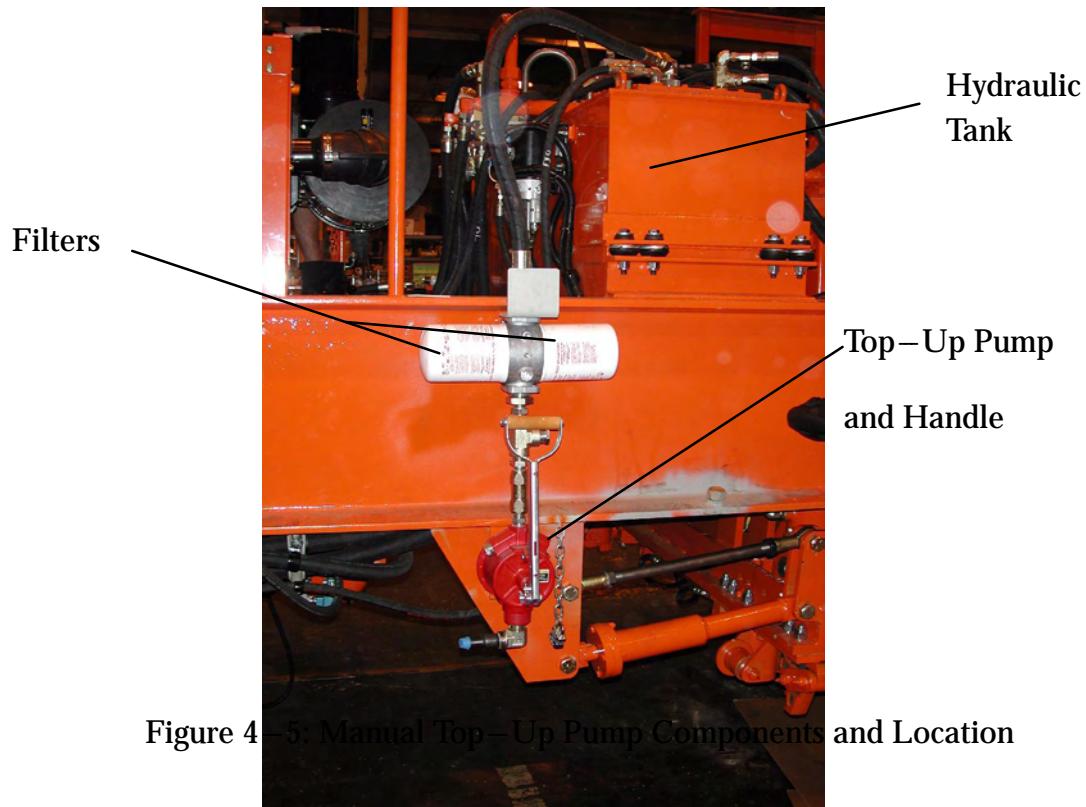


Figure 4-5: Manual Top – Up Pump Components and Location

Procedure:

Locate the machine in area with ample room to perform this operation safely.

- S Shut Down the engine and apply the Parking Brake.
- S Remove the suction hose from the storage bracket and insert open end into drum or container and secure. Refer to Figure 4-5.
- S Release pump handle from travel position then move handle up and down to begin pumping operation.
- S Monitor the oil level in the hydraulic tank using the sight gauge provided on the side of the tank. Refer to Figure 4-6. Stop pumping operation when the proper level is reached (FULL) and return pump handle to the travel position and secure.
- S When the Top-Up operation is completed, remove the suction hose from the container and return it to the storage position and secure. Refer to Figure 4-5.

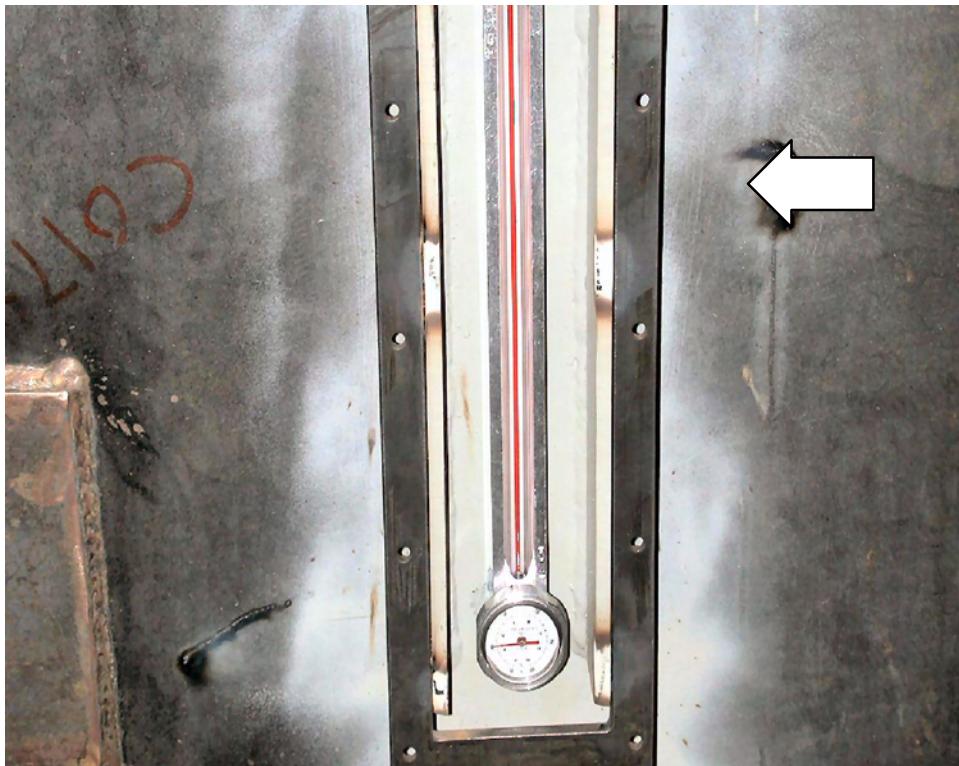


Figure 4–6: Hydraulic Tank Sight Gauge Location

Chapter 5

How to Perform Work

Requirements

1. Make sure you read “Chapter 1”, *Safety*, before you use the machine to perform work.
2. Make sure you perform any scheduled maintenance, such as make sure the hydraulic fluid level and temperature are correct. Additional information is provided in “Appendix A”.
3. Make sure the machine is set up properly to perform work, such as the Travel/Work switch is in the Work position and the toggle switches on the left console have been moved to the correct position to select the “working” side of the machine. If necessary, refer to “Chapter 4”.
4. Release the parking brakes by pulling UP the Parking/Spring brake knob which is located behind the operator seat (right side). If the Parking/Spring brake knob will NOT remain in the UP position, check the air pressure; it must be a minimum of 45 PSI.

Refer to Figure 5–1.

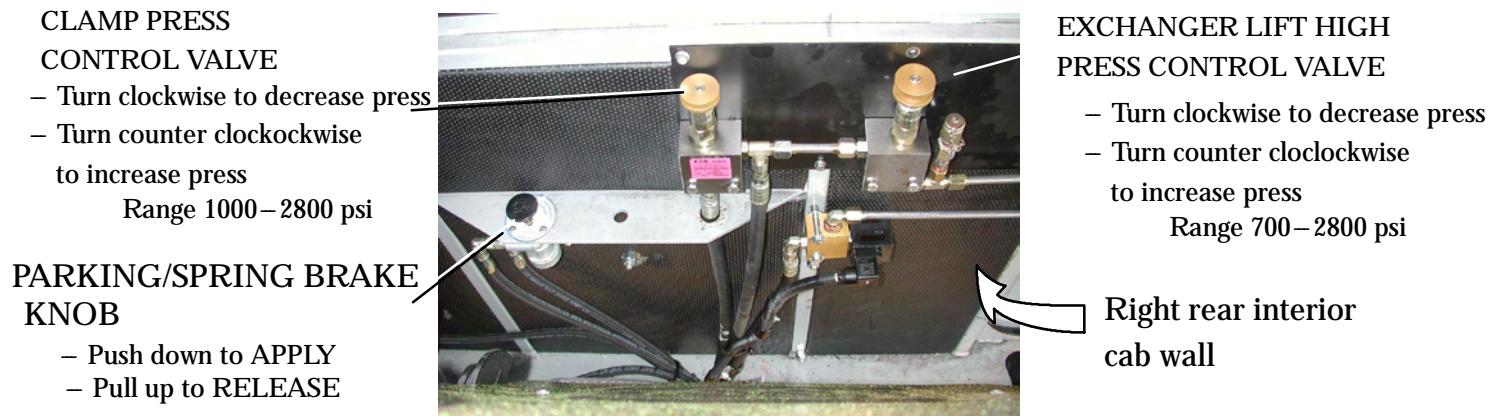


Figure 5–1: Control Valves on right rear cab wall

Extracting Ties

1. Move the machine to the first tie to be extracted.

To travel forward, press down on the right side of the Traction pedal which is located on the floor in front of the operator seat. When the machine is in Work mode, slow travel is automatically selected.

To travel backward (reverse), press down on the left side of the Traction pedal. When you are traveling backward (reverse travel), the back up alarm (optional) is automatically sounded.

Refer to Figure 5–2.

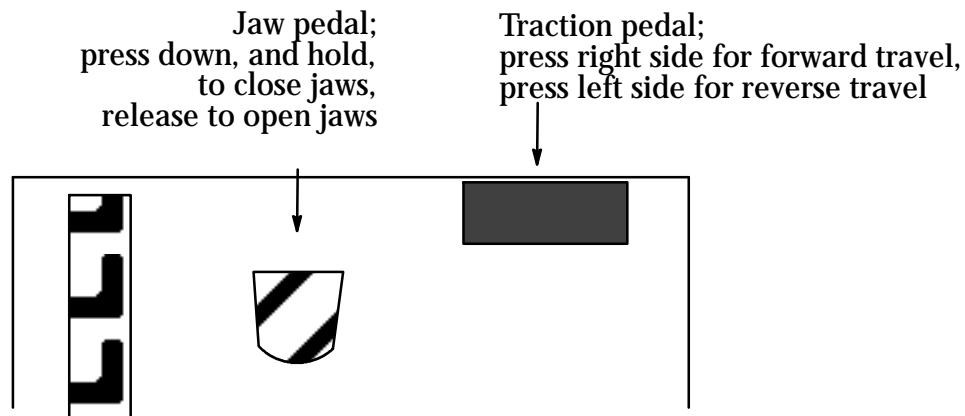


Figure 5–2: Floor pedals

2. When the machine is positioned properly, make sure the jaws are open by releasing the jaw pedal which is located on the floor in front of the operator seat.

Refer to Figure 5–2.

3. Move the JACK DISABLE/NORMAL JACKING toggle switch, which is located on the left console, to the NORMAL JACKING position; the clamps will be applied to the rails and the track will be raised/lifted.

Refer to Figure 5–3.

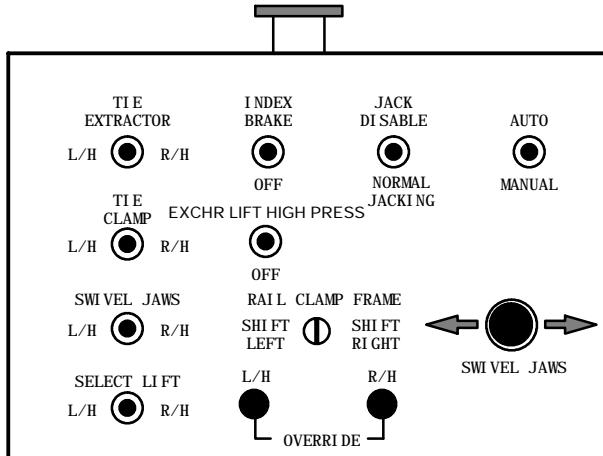


Figure 5–3: Left console (Swivel head control box)

4. Press the button located on top of the joystick; the rails are automatically clamped and then jacked (raised).

Refer to Figure 5–4.

NOTE

If you need to lift either or both rails higher than the “cutoff” point, you can press one or both of the OVERRI DE (red) buttons which are located on the left console. Refer to Figure 5–3.

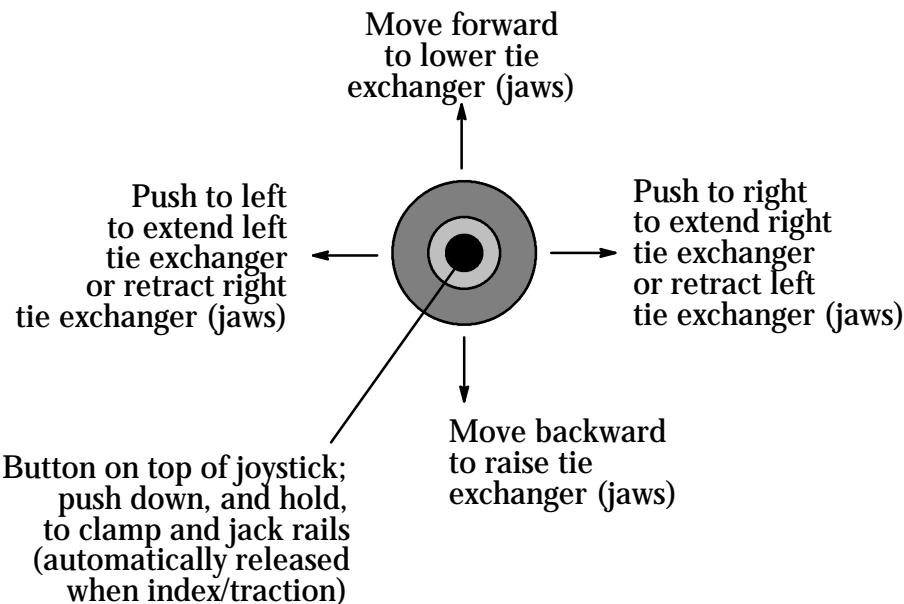


Figure 5–4: Right console

5. Lower the jaws by moving the joystick forward.
6. If necessary, you can swivel (tilt) the jaws using the SWI VEL JAWS control knob which is located on the left console.

For example, to swivel the jaws to the right (counterclockwise), move the control knob to the right.

Refer to Figure 5–3.

7. When the jaws are positioned properly (centered with the tie end), close the jaws by pressing, and holding, the jaw pedal.

Refer to Figure 5–2.

NOTE

You must continue to press down and hold the jaw pedal to keep the jaws closed (maintain squeeze pressure) on the tie. If you remove your foot from the jaw pedal, the jaws will automatically open and the tie will be dropped.

8. Use the joystick to extend the tie exchanger (extract the tie).

For example, if the “working” side of the machine is the left side, move the joystick to the left to extract the tie to the left side of the machine (extend the tie exchanger).

If the tie can NOT be extracted with one (1) movement, open the jaws by releasing the jaw pedal, use the joystick to retract the tie exchanger, close the jaws on the tie by pressing, and holding, the jaw pedal, and then use the joystick to extend the tie exchanger again.

- 9. When the tie has been extracted far enough, open the jaws by releasing the jaw pedal. Then, move the joystick backward to raise the tie exchanger.**
- 10. Move/travel the machine to the next tie to be worked; the rail clamps are automatically opened and the rails are lowered when you index (travel) the machine.**
- 11. Repeat this procedure for each tie to be extracted.**

Inserting Ties

- 1. Move the machine to the first tie to be inserted.**

To travel forward, press down on the right side of the Traction pedal which is located on the floor in front of the operator seat. When the machine is in Work mode, slow travel is automatically selected.

To travel backward (reverse), press down on the left side of the Traction pedal. When you are traveling backward (reverse travel), the back up alarm (optional) is automatically sounded.

Refer to Figure 5–5.

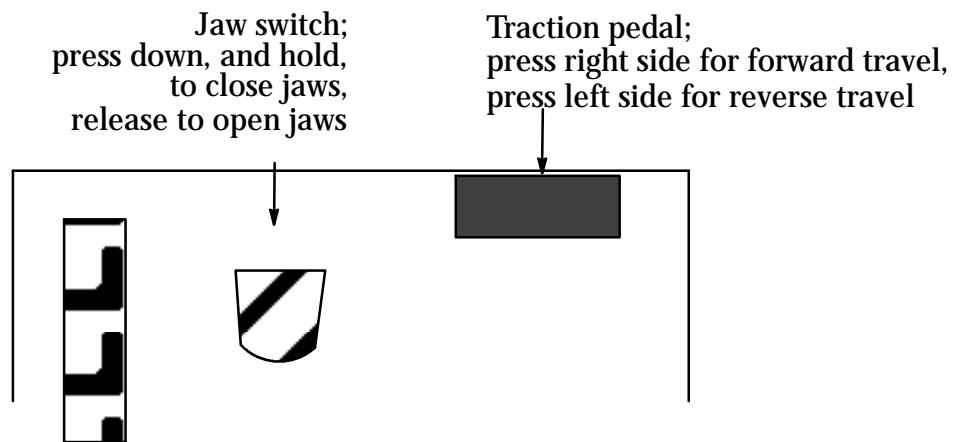


Figure 5–5: Floor pedals

2. Move the JACK DISABLE/NORMAL JACKING toggle switch, which is located on the left console, to the JACK DISABLE position; the clamps will be applied to the rails but the track will NOT be raised/lifted.

Refer to Figure 5–4.

3. Make sure the jaws are open by releasing the jaw pedal which is located on the floor in front of the operator seat. Refer to Figure 5–5.

4. Press the button located on top of the joystick; the rails are automatically clamped (locked) but are NOT jacked (raised).

Refer to Figure 5–6.

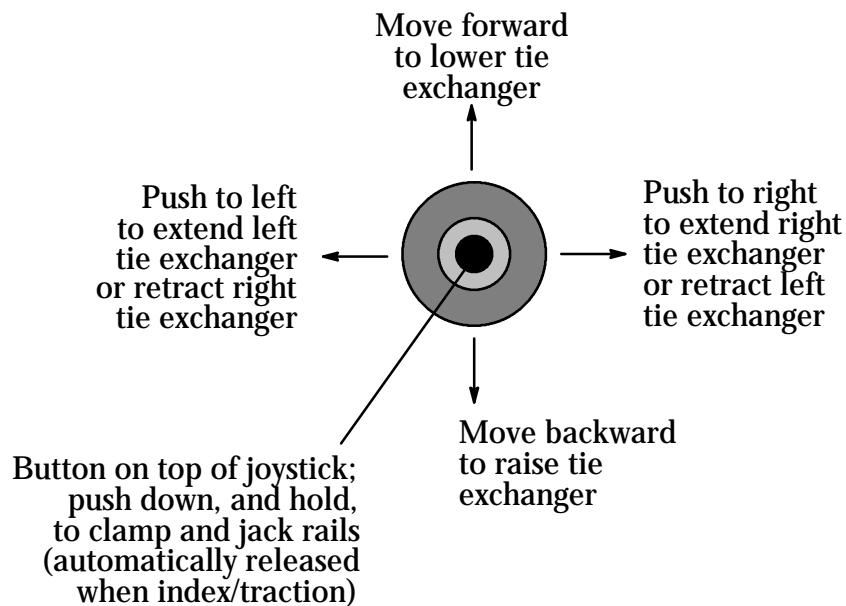


Figure 5–6: Right console

5. Use the joystick to extend the tie exchanger.

For example, if the “working” side of the machine is the left side, move the joystick to the left to extend the tie exchanger to the left side of the machine.

6. Lower the jaws by moving the joystick forward.

7. If necessary, you can swivel (tilt) the jaws using the SWI VEL JAWS control knob which is located on the left console.

For example, to swivel the jaws to the right (counterclockwise), move the control knob to the right.

Refer to Figure 5–3.

8. When the jaws are positioned properly (centered with the tie end), close the jaws by pressing, and holding, the jaw pedal. Refer to Figure 5–5.

NOTE

You must continue to press down and hold the jaw pedal to keep the jaws closed (maintain squeeze pressure) on the tie. If you remove your foot from the jaw pedal, the jaws will automatically open and the tie will be dropped.

9. Use the joystick to retract the tie exchanger (insert the tie).

For example, if the “working” side of the machine is the left side, move the joystick to the right to insert the tie from the left side of the machine (retract the tie exchanger).

If the tie can NOT be inserted with one (1) movement, open the jaws by releasing the jaw pedal, use the joystick to extend the tie exchanger, close the jaws on the tie by pressing, and holding, the jaw pedal, and then use the joystick to retract the tie exchanger again.

10. When the tie has been inserted far enough, open the jaws by releasing the jaw pedal. Then, move the joystick backward to raise the tie exchanger.
11. Move/travel the machine to the next tie to be worked; the rail clamps are automatically opened when you index (travel) the machine.
12. Repeat this procedure for each tie to be inserted.

Chapter 6

How to Shut Down the Machine

Procedure:

1. Make sure all work components, such as the exchanger and clamp frame, are placed in their safety locks (travel position).
2. Apply the parking brakes by pushing DOWN the Parking/Spring brake knob. Refer to Figure 6–1.

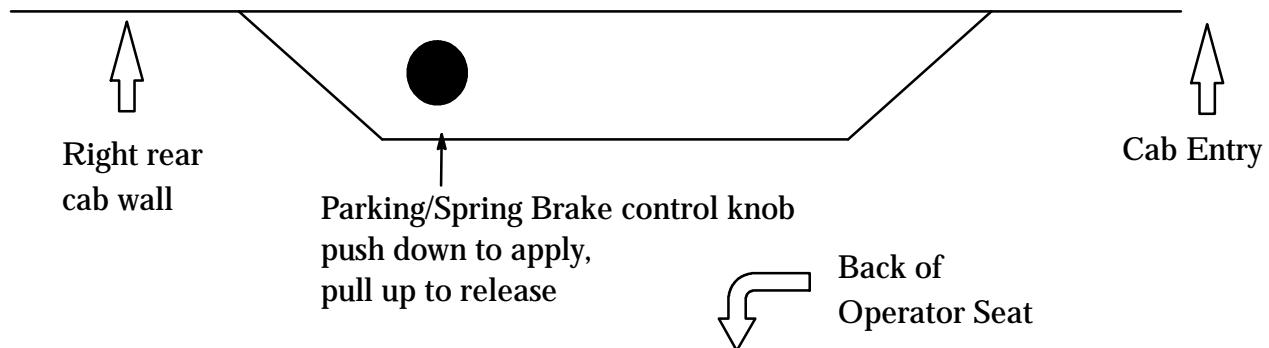


Figure 6–1: Parking/Spring Brake control

3. Move the Travel/Work switch, which is located on the overhead control panel, to the OFF (middle) position. Refer to Figure 6–2.

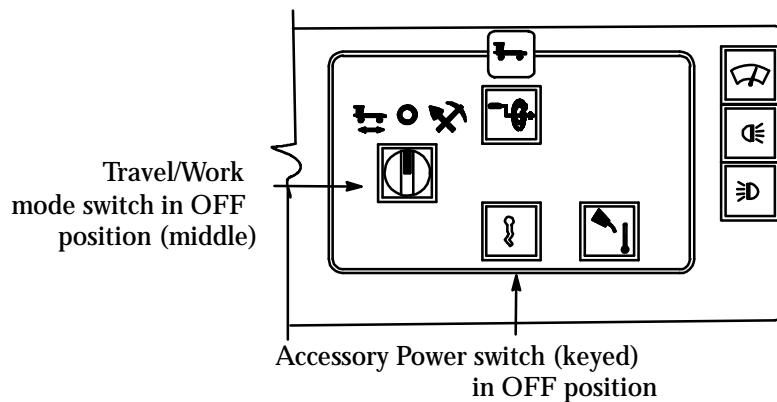


Figure 6–2: Engine (overhead) control panel

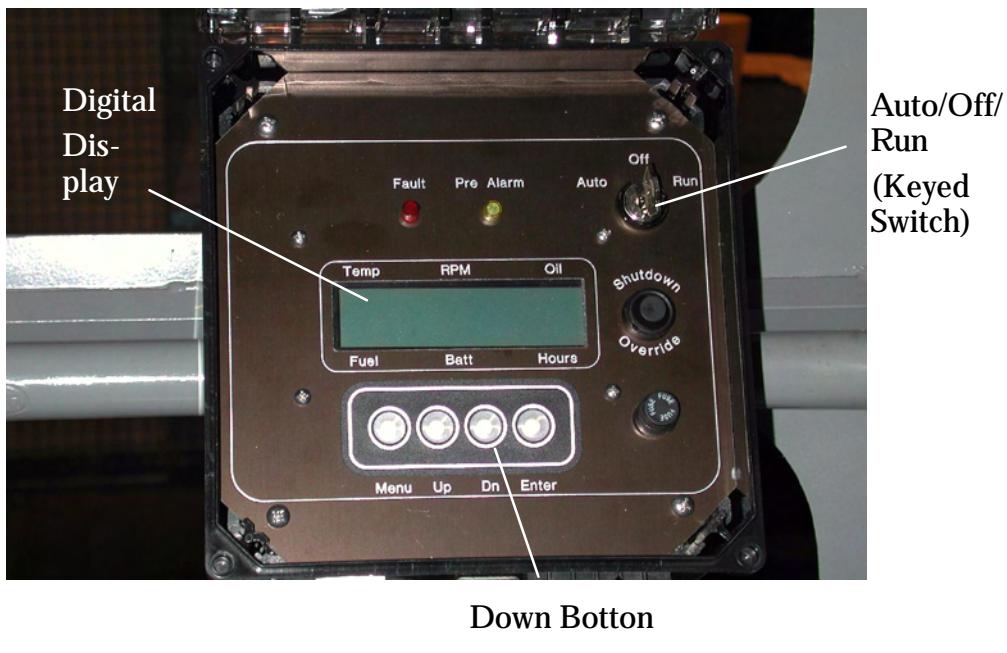


Figure 6–2A: Engine Controller (Refer to *Appendix E and F* for detail instructions)

4. Turn OFF all buttons/switches, such as the work lights, headlights, etc.
5. Using the Down (Dn) button on the Engine Controller, lower the engine speed to the recommended idle speed of approximately 800 – 1000 RPM. Engine speed is shown on the Digital Display. Refer to Figure 6–2A.

NOTE

Permit the engine to “cool” down by leaving it running at the idle speed for approximately 5 minutes.

6. Turn the key in the Auto/Off/Run switch to the left (counterclockwise) to the OFF position to shut down the engine. Remove the key if you are leaving the cab.
7. Exit the cab and make sure the door is locked.
8. Turn the main battery switch, which is located in the battery compartment in front of the machine, to the OFF position. Refer to Figure 2–B.

NOTE

If this machine is going to be towed by another machine, make sure the knobs on the two (2) towing valves are pulled OUT (as far as possible). Refer to Figure 6–3.

One valve is located on the left (front) of the machine and the other valve is located on the right (middle) of the machine.

Then, make sure the towing valves are pushed IN before you start up the machine.



Figure 6–3: Traction/Towing Valve

Appendix A

Appendix A Lubrication and Maintenance

SERVICE CHART									
DAILY OR 10 HOURS					EXAMPLE OF SYMBOLS			MONTHLY OR 200 HOURS	
1	ENGINE OIL LEVEL	SEE ENGINE MANUAL. ADD AS NEEDED	Type Lubrication Required	Frequency of Use	(A) GREASE E.P. GRADE 2	(B) HYD OL ISO 46	FUEL FILTERS	CHANGE	
	ENGINE AIR FILTER	CHECK INDICATOR, REPLACE ELEMENTS IF NECESSARY	(C) POLYBODIUM DISULPHIDE	(D) NUMBER OF ZERK PLUGS	(1) DAILY	(2) WEEKLY	ENGINE OIL AND FILTER	CHANGE SEE ENGINE MANUAL	
	ENGINE COOLING SYSTEM	ADD AS NEEDED 150-50 MOG	(1) DAILY	(2) MONTHLY	(3) ANNUALLY	(4) ANNUALLY	ENGINE FAN BEARING	SEE ENGINE MANUAL	
	HYDRAULIC OIL FILTERS	CHECK INDICATOR WHILE OPERATING. REPLACE IF NECESSARY	(5) WEEKLY OR 50 HOURS				AXLE BEARING BLOCK	1 ZERK PER BEARING	
	TIE EXCHANGER CLAMPS & PIVOTS	6 ZERKS PER SIDE. GREASE GENEROUSLY	(2) BATTERY	CHECK ELECTROLYTE LEVEL. ADD AS NEEDED			DRIVE CHAIN	CLEAN AND LUBE	
A1	TIE EXCHANGER CRADLE	2 ZERKS GREASE GENEROUSLY							
	RAIL CLAMPS	20 ZERKS GREASE GENEROUSLY	SEE ENGINE MANUAL FOR COMPLETE LUBRICATION AND PREVENTIVE MAINTENANCE INFORMATION				ANNUALLY		
B1	HYDRAULIC OIL TANK	KEEP FULL					(4) HYDRAULIC SUCTION STRANERS	CLEAN STRAINERS AND MAGNETIC PLUG	
							(B4) HYDRAULIC TANK	DRAIN AND CLEAN	

Appendix B

Appendix B

Troubleshooting A Hydraulic System

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 labelled 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 labelled 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 labelled H in the flow chart.

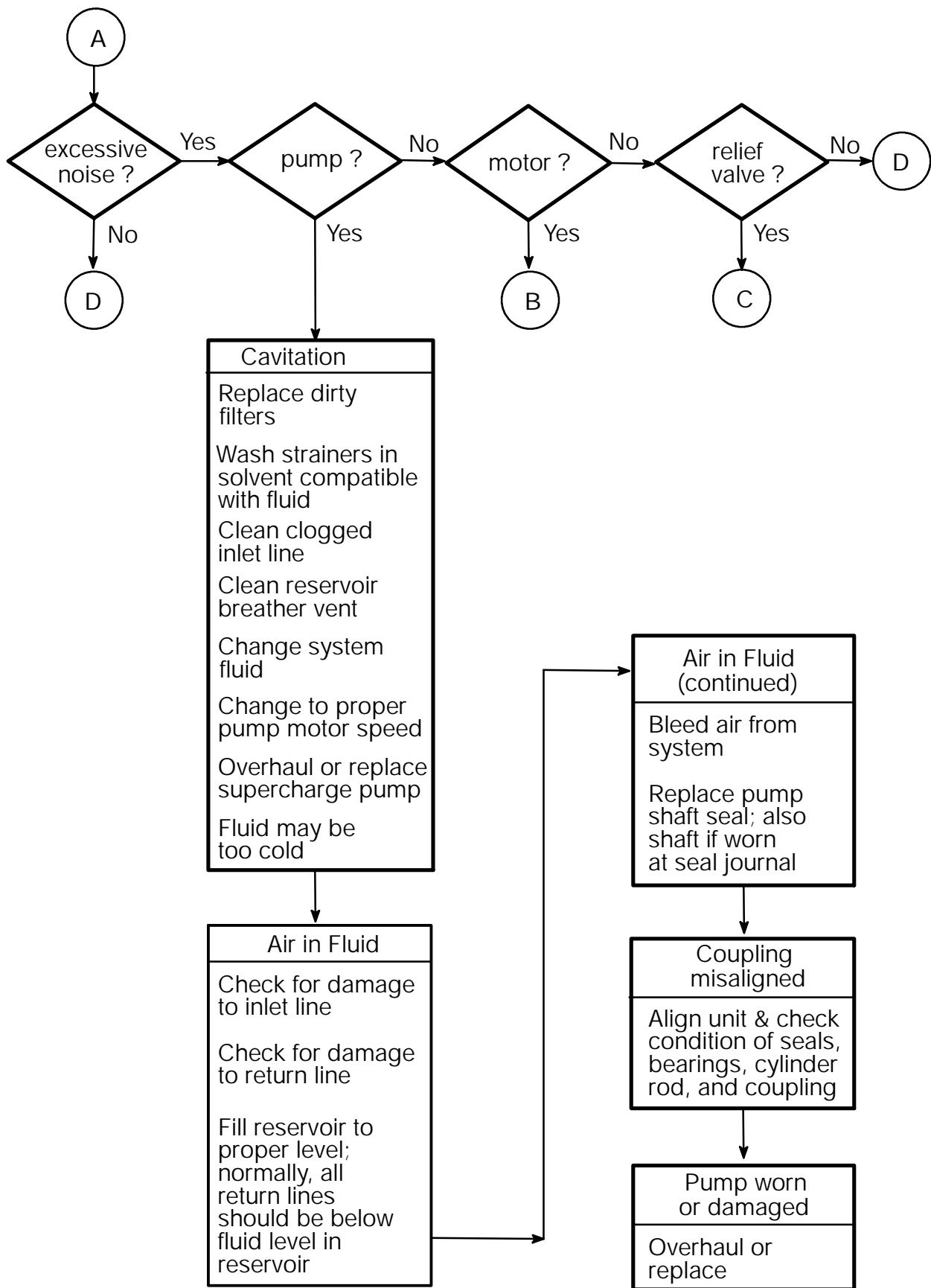
Pressure Problem

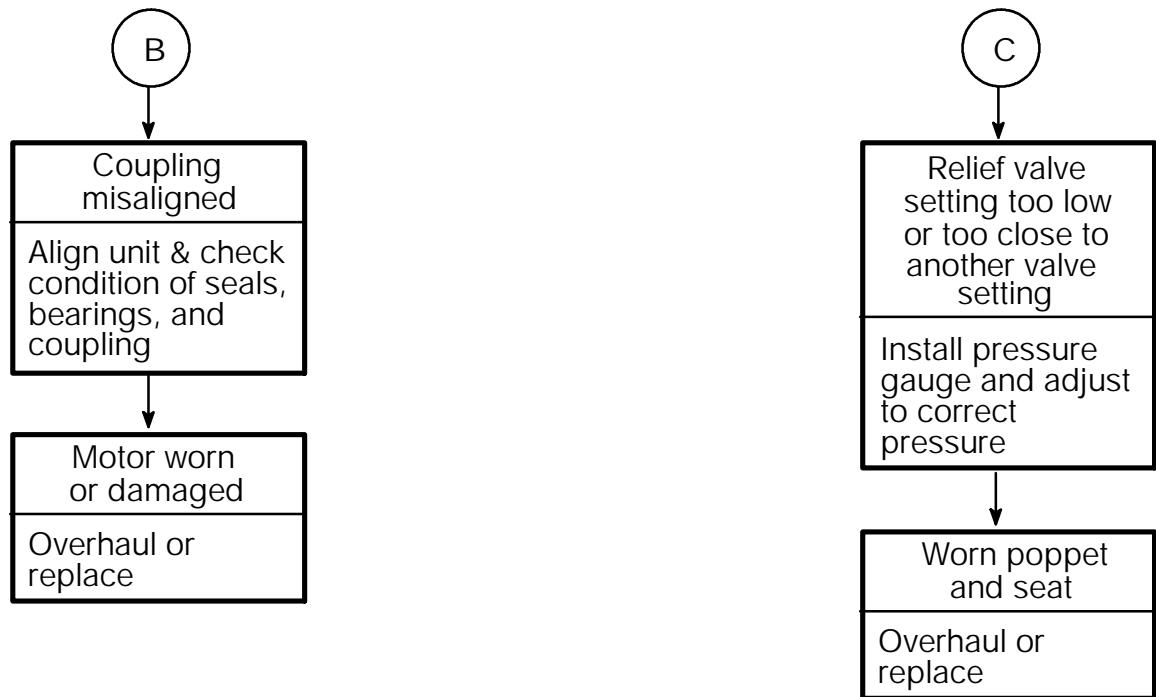
You should know the correct operating pressure and you should check and set the pressure periodically using a pressure gauge. The correct pressure should be the lowest pressure which will permit the system to operate properly but below the maximum rating of the system.

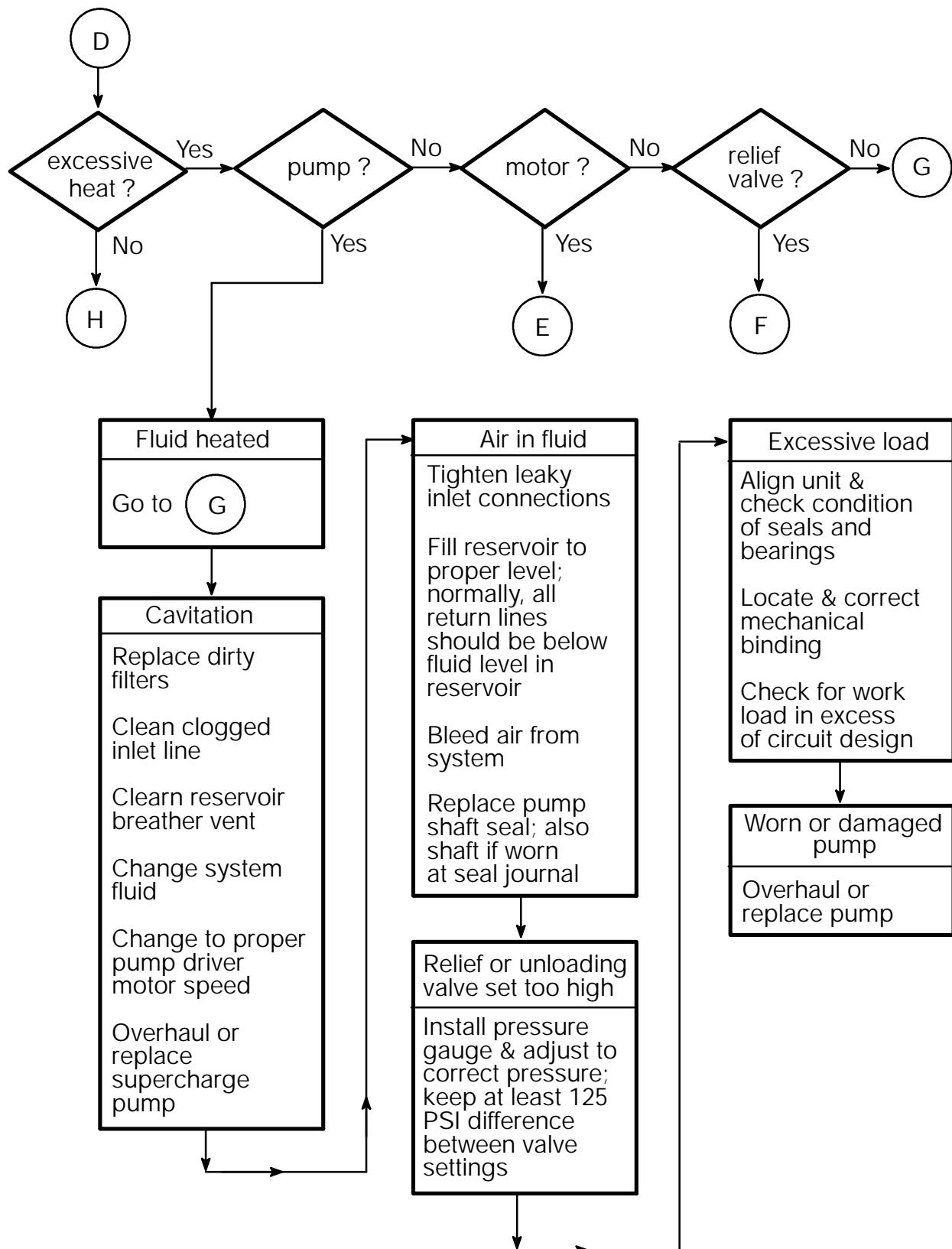
If the pressure is NOT correct, go to the circle labelled K in the flow chart.

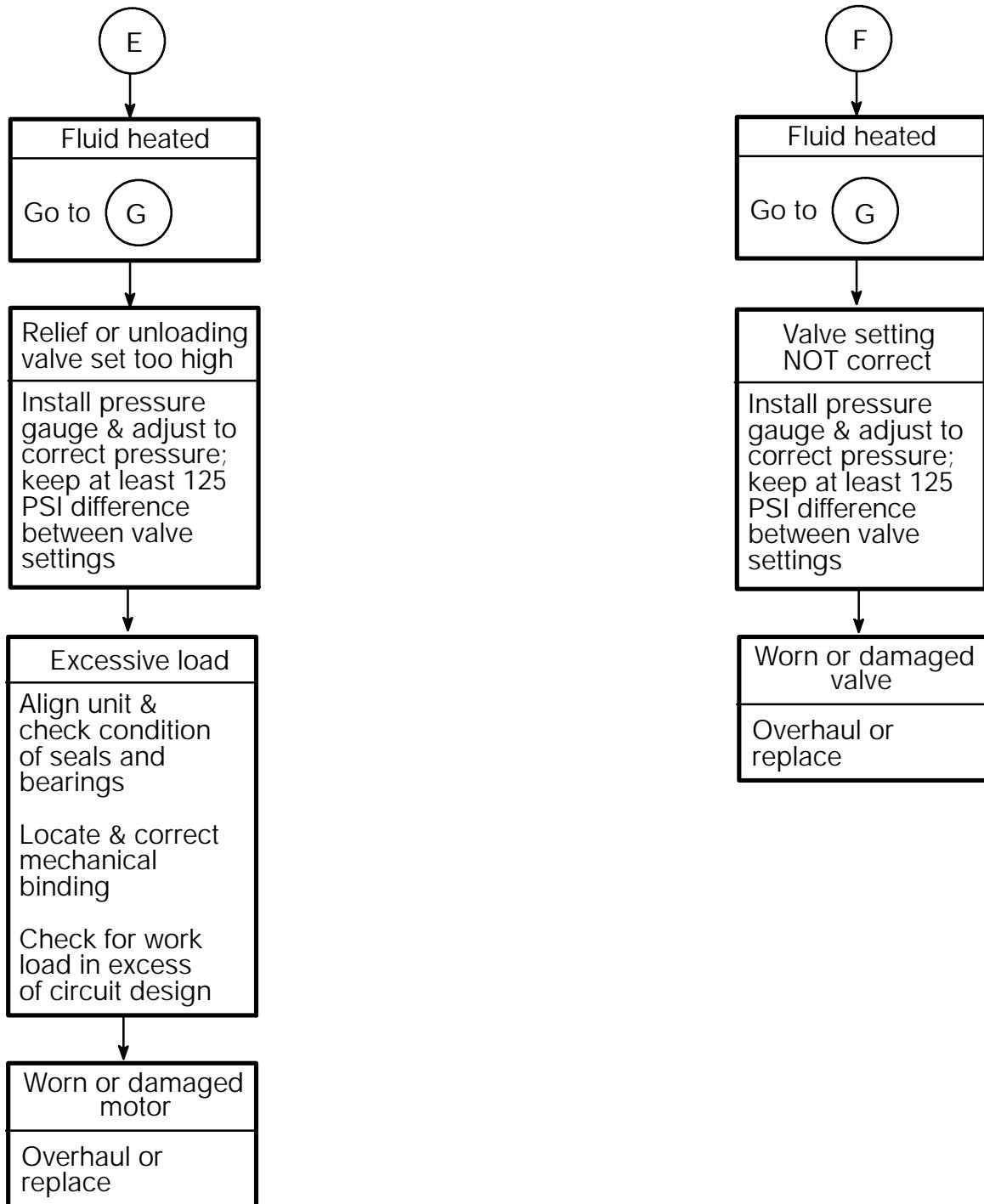
NOTE

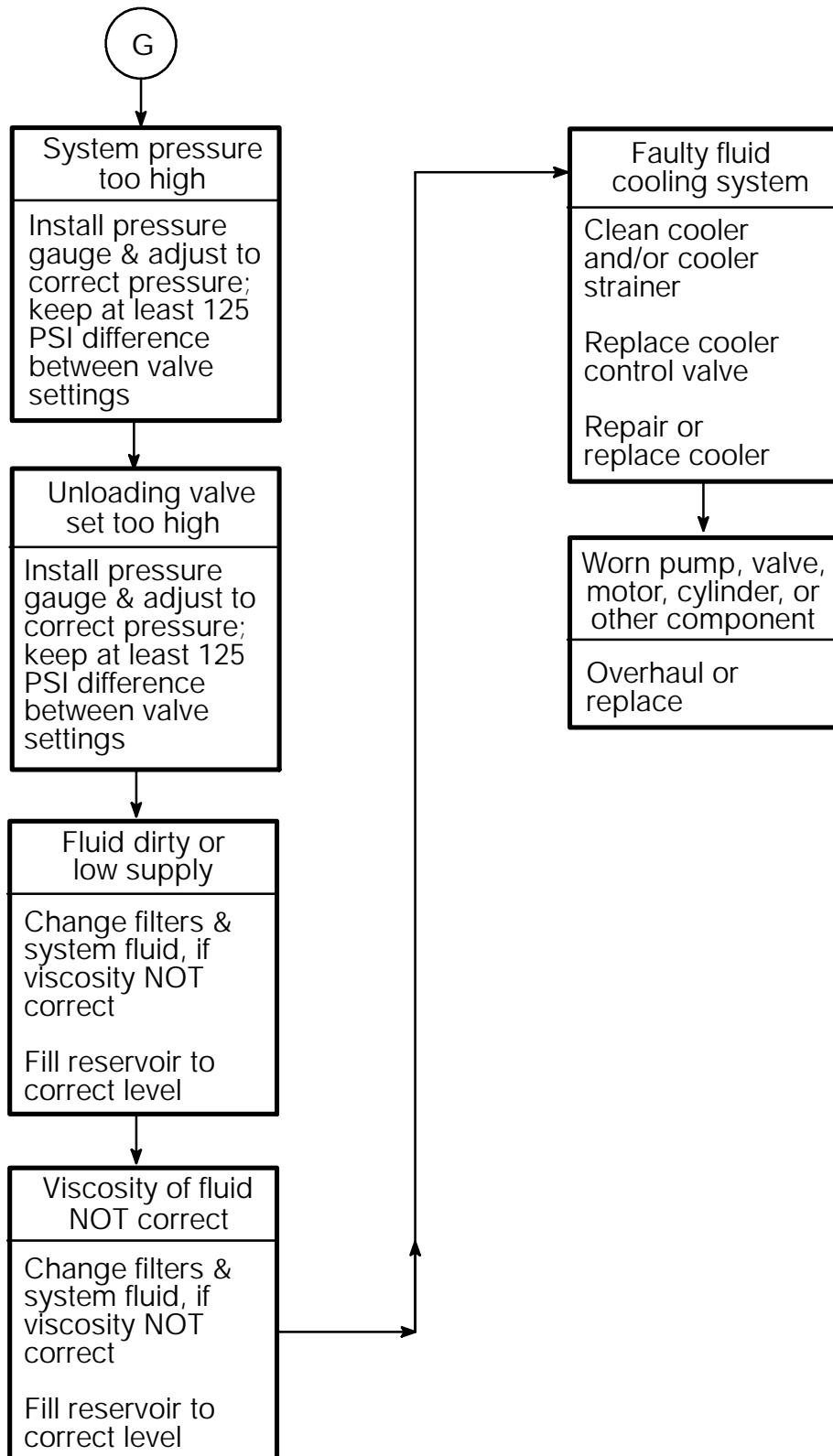
If the problem is NOT excessive noise or excessive heat, go to the circle labelled N in the flow chart.

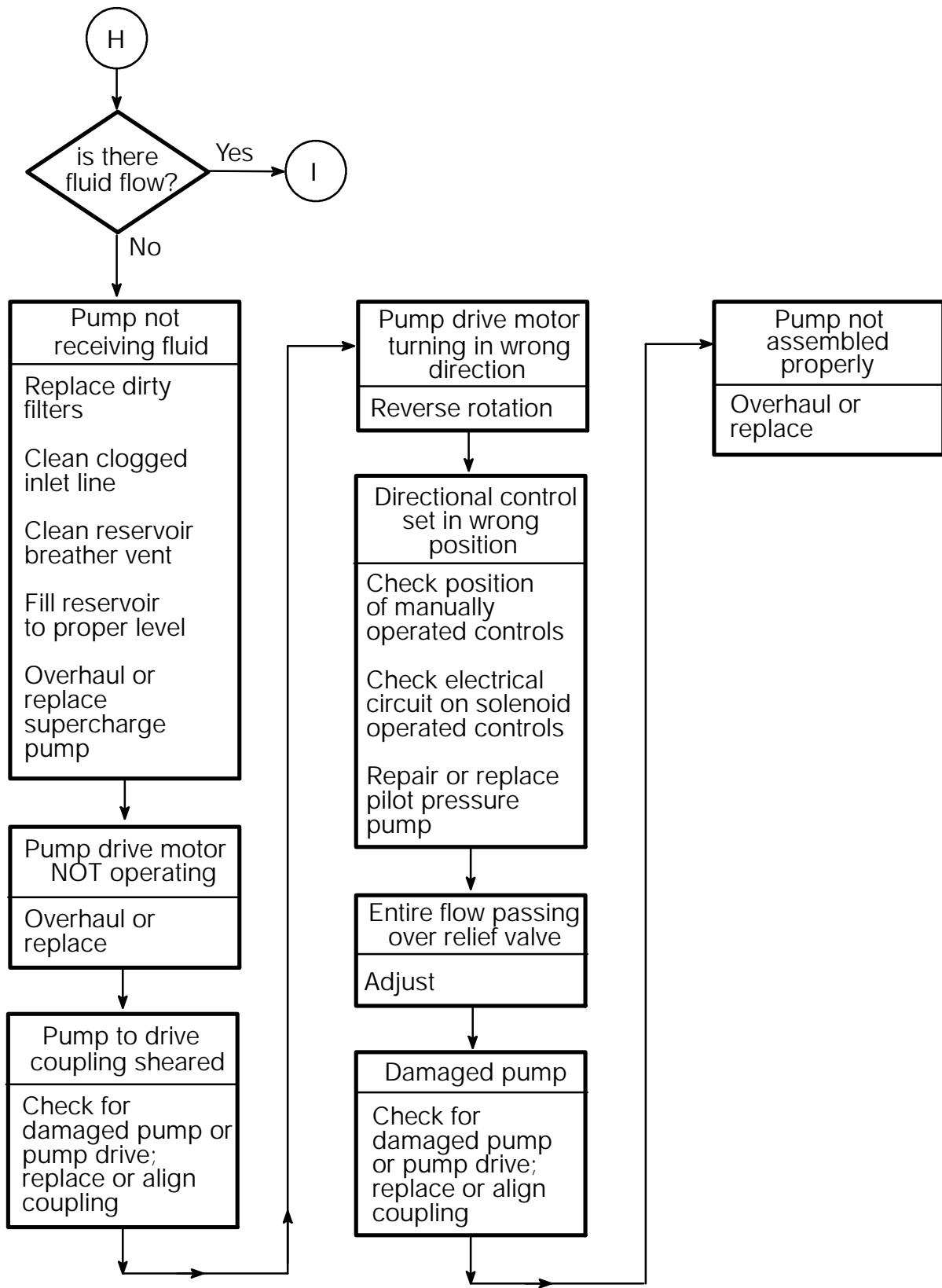


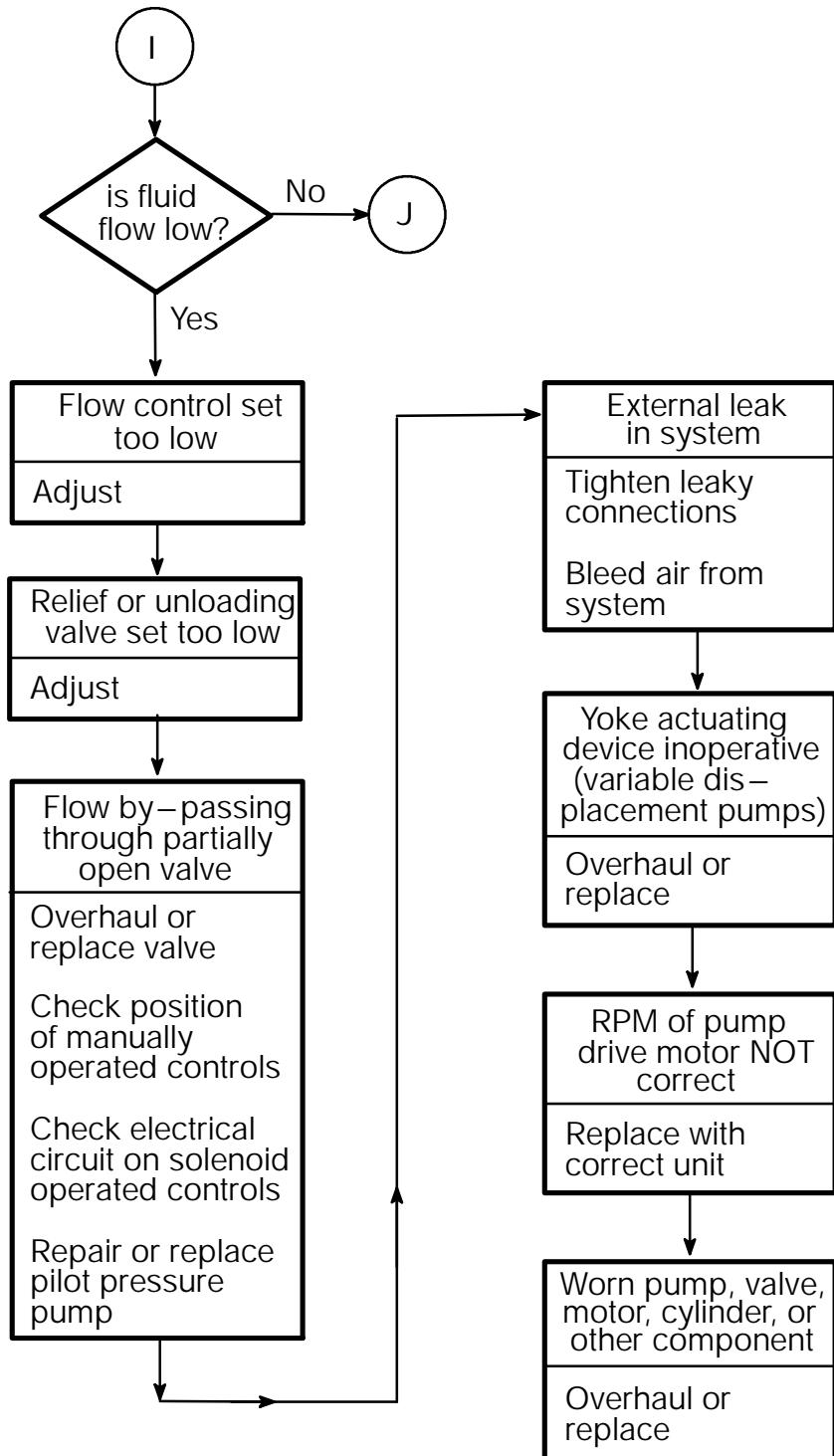


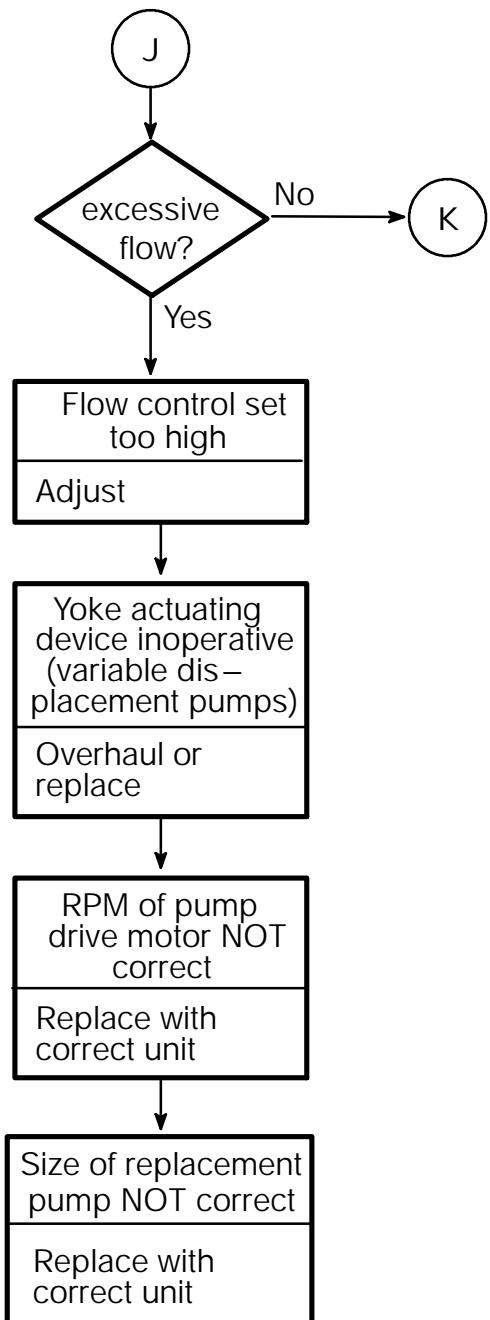


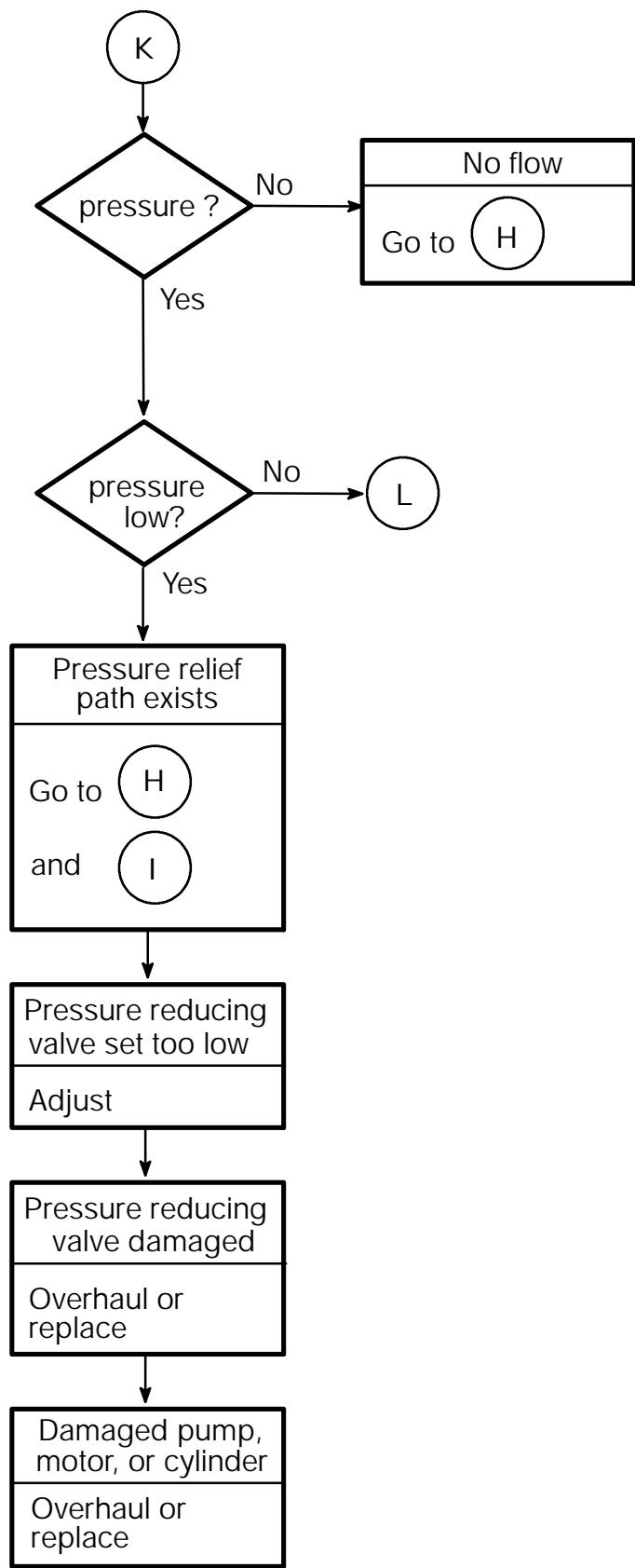


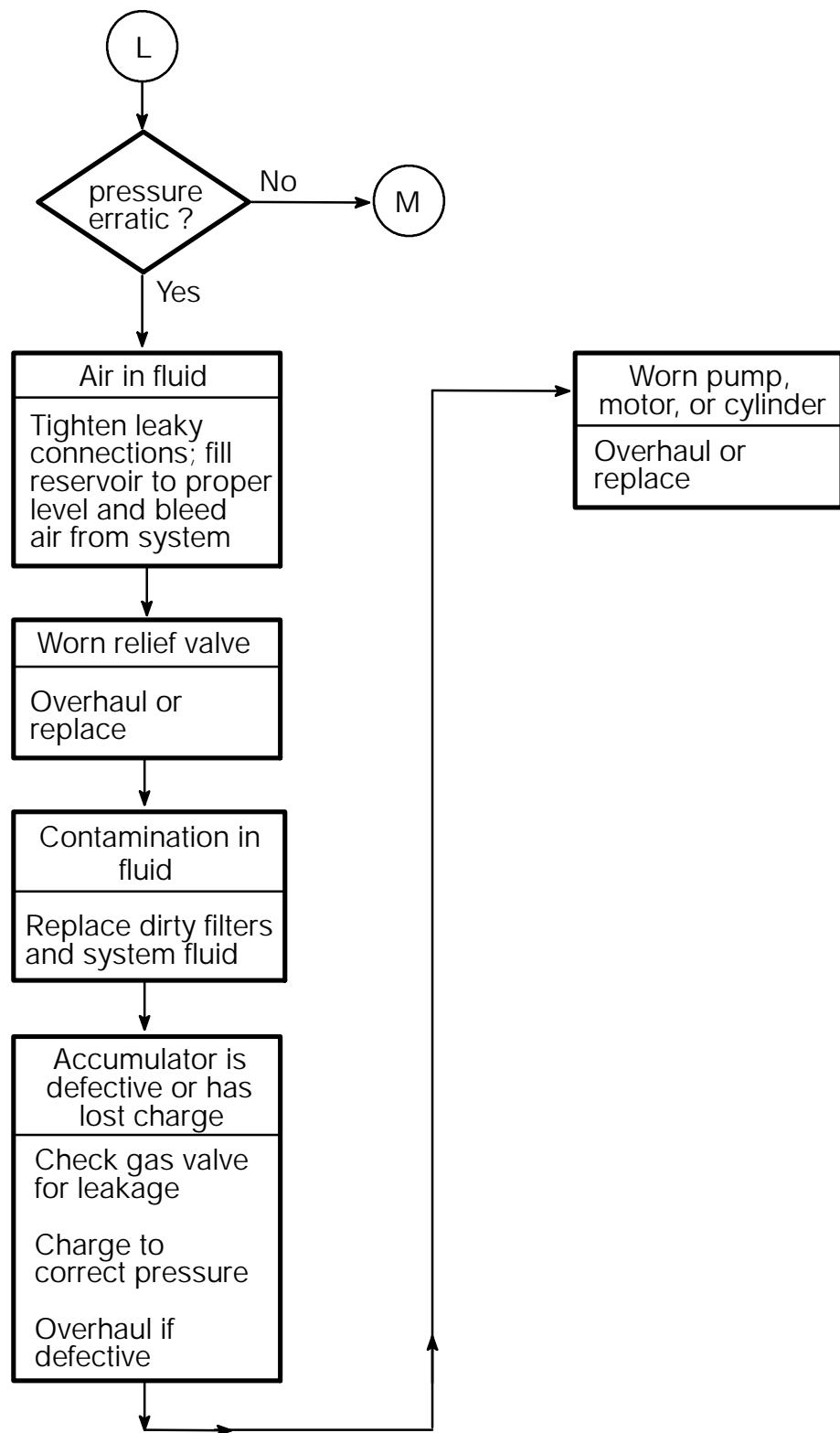


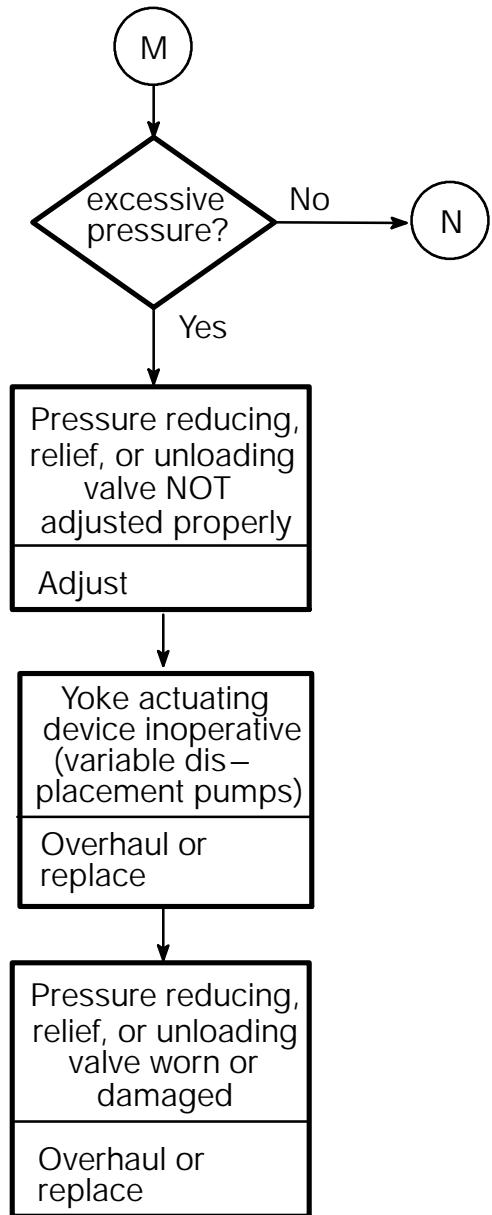


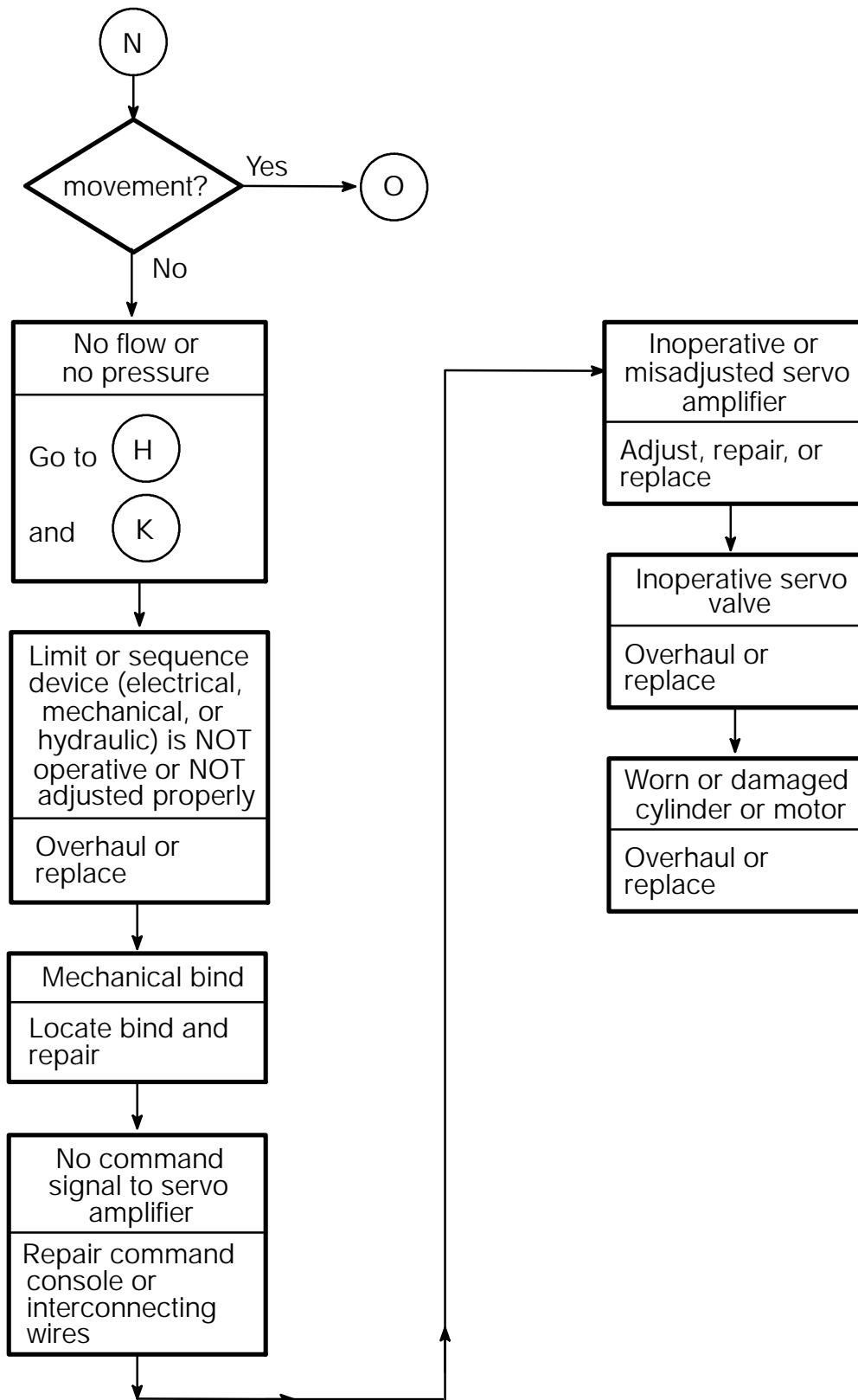


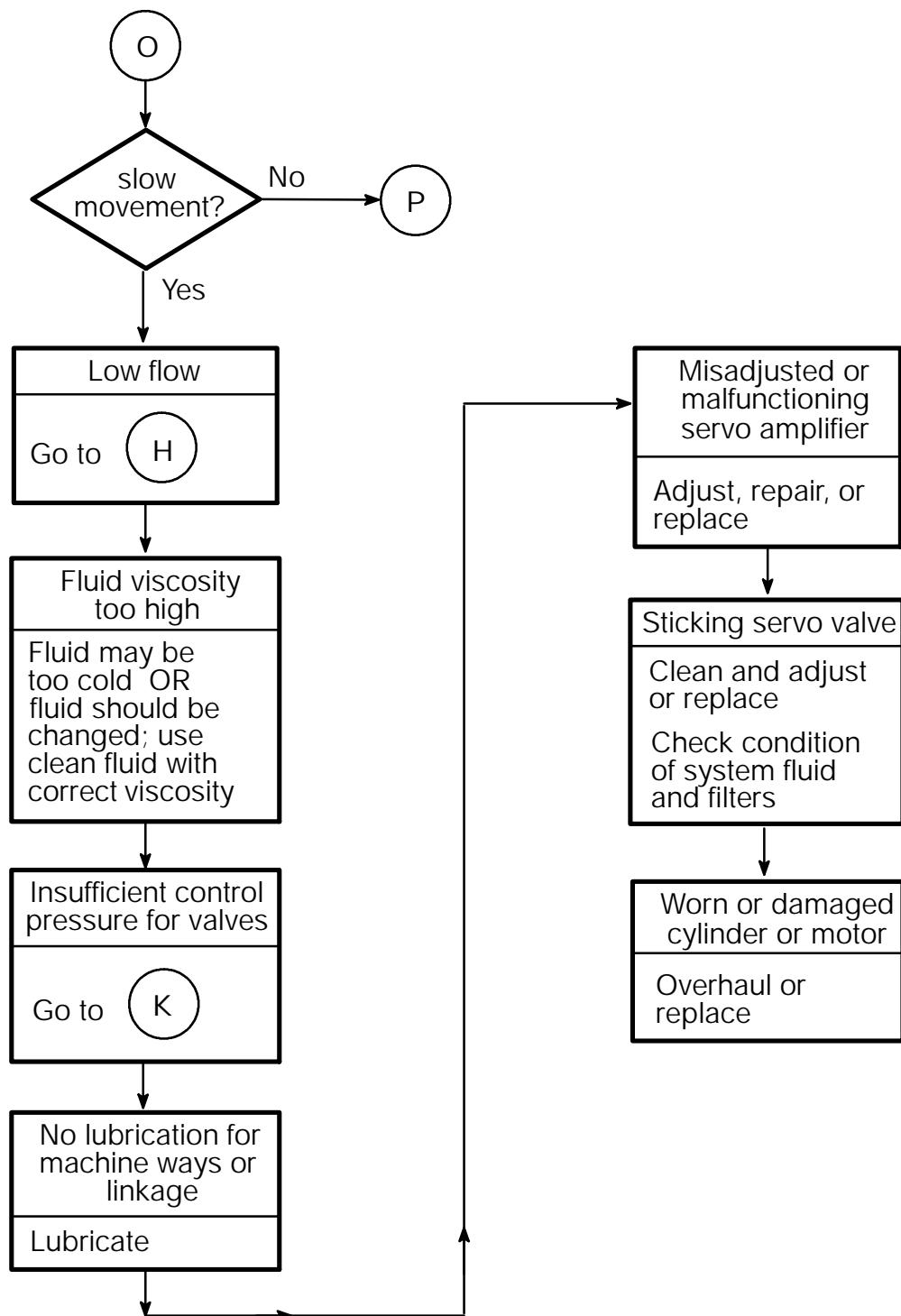


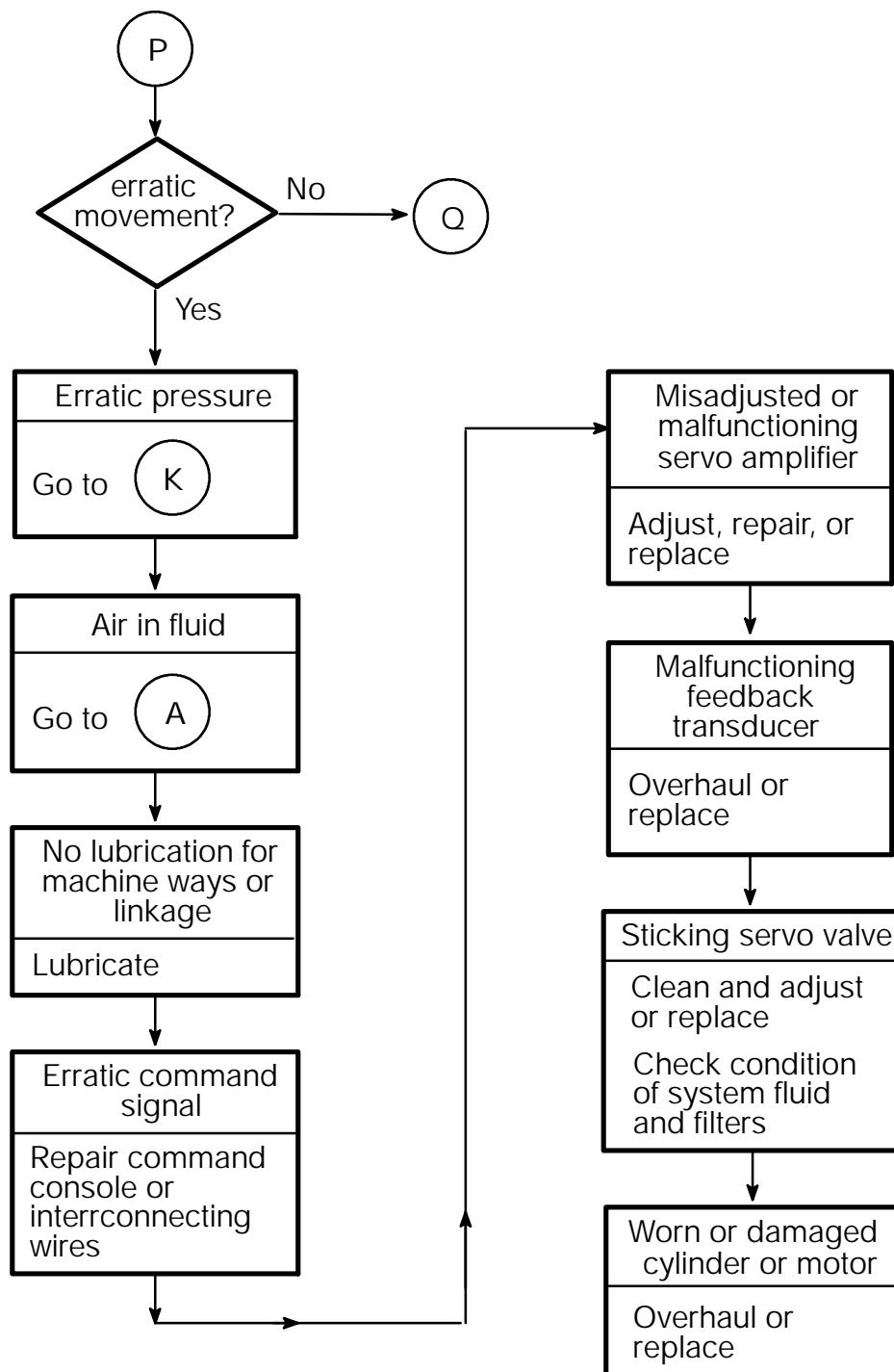


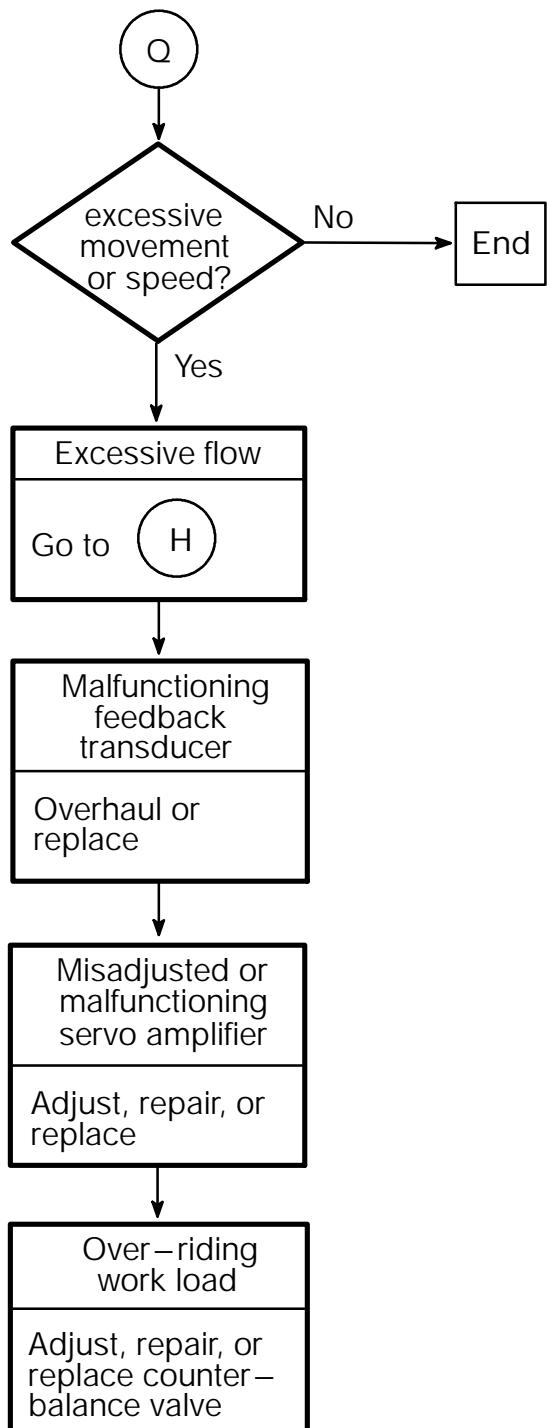












Appendix C

Control Panels & Console

Engine (Overhead) Control Panel

The overhead control panel is located in the cab, above the front windshield. Refer to Figure B-1.

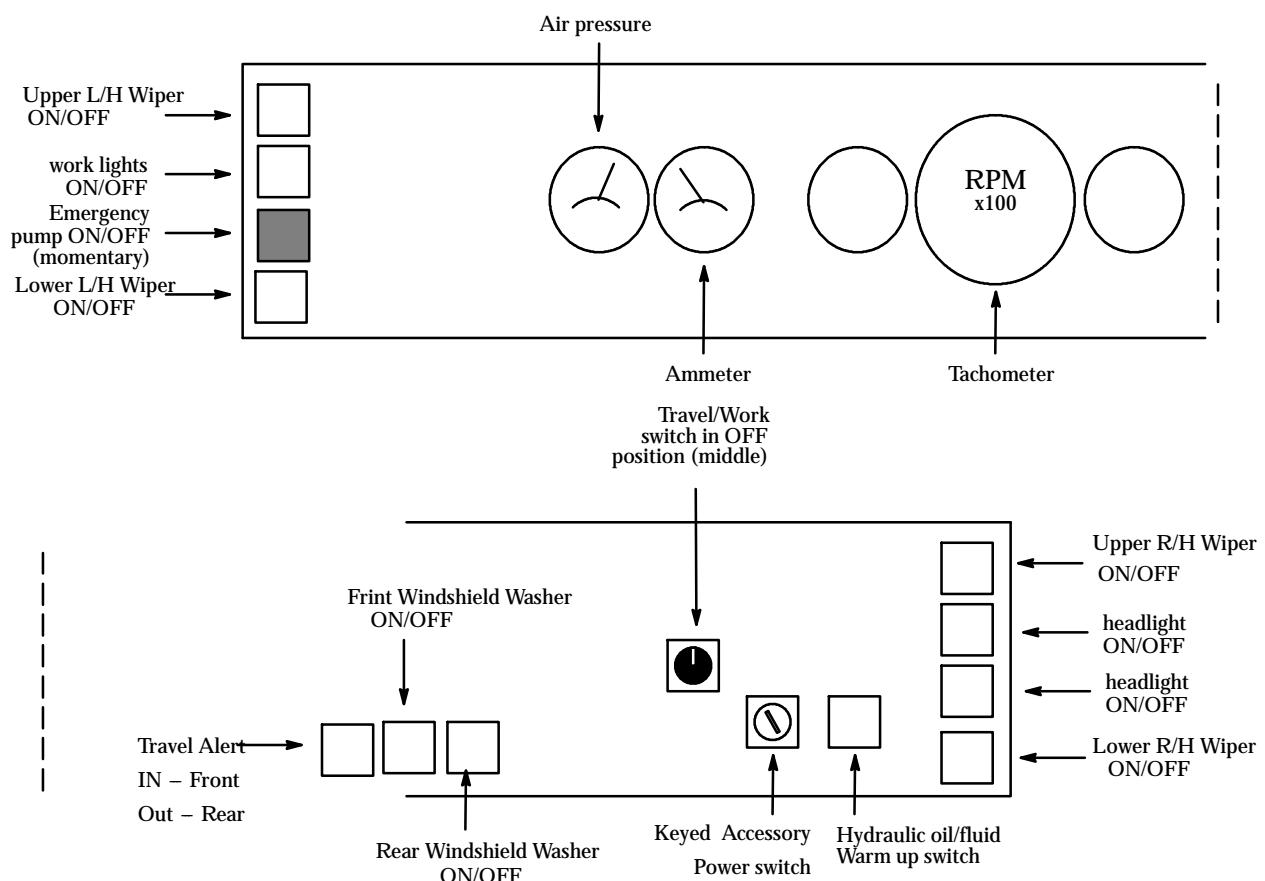


Figure B-1: Overhead control panel

Parking Brake Control

The throttle/brake controls are located behind the operator seat. Refer to Figure B-2.

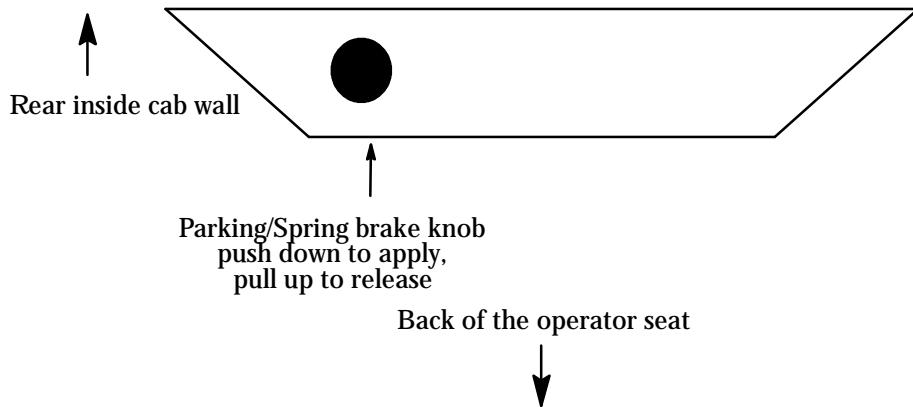


Figure B-2: Parking/SpringBrake control

Floor Pedals

The floor pedals are located in front of the operator seat. Refer to Figure B-3.

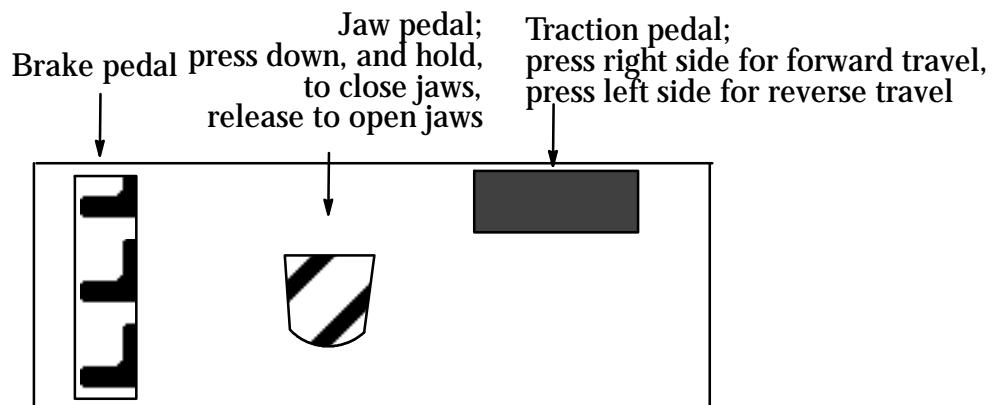


Figure B-3: Floor pedals

Right Console

The right console is located on the right side of the operator seat. Refer to Figure B-4.

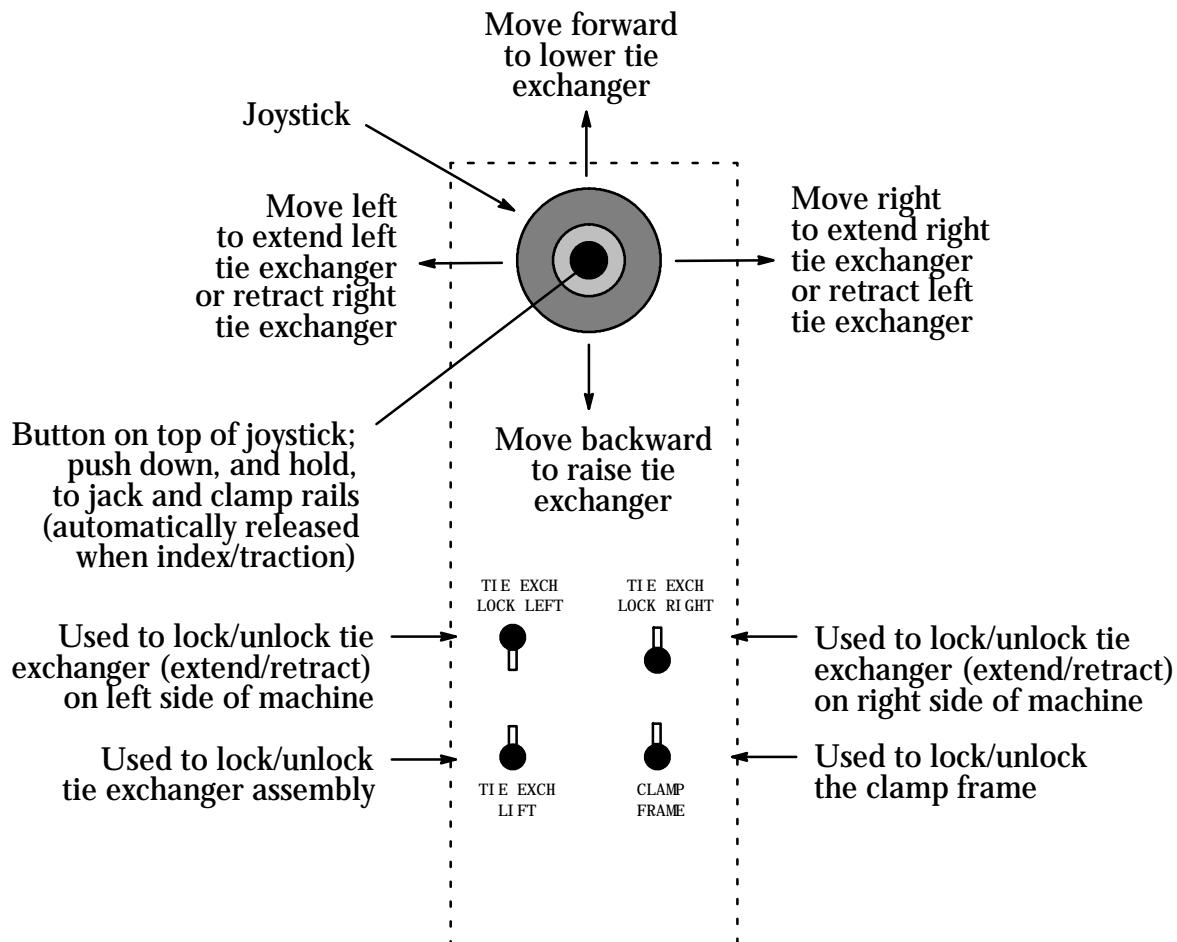


Figure B-4: Right console

Left Console

The left console is located on the left side of the operator seat. Refer to Figure B-5.

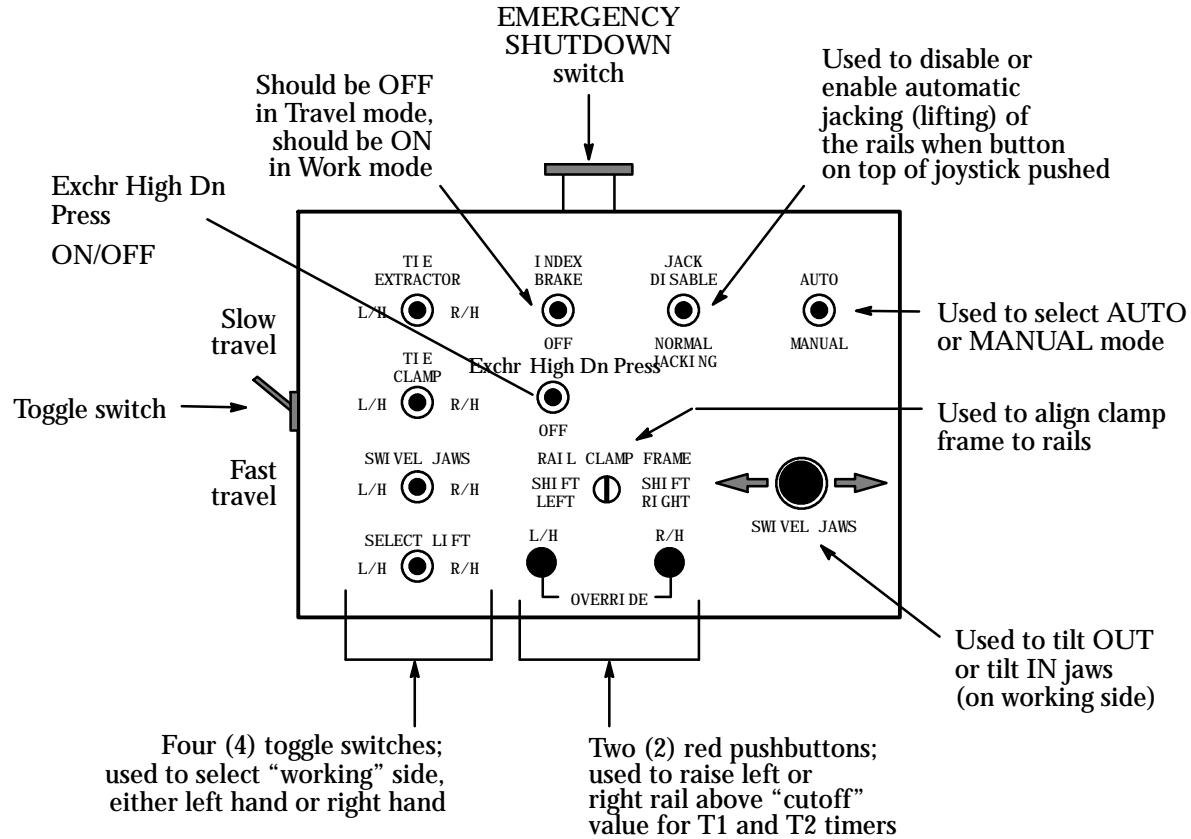


Figure B-5: Left console/Swivel head control box

Engine Controller

See *Appendix E and F* for information concerning this unit.

Appendix D



MODEL CHV24-7

Self Contained, Side or Vertically Mounted
Hydraulically Driven
Air Conditioning and Heating Unit

- INSTALLATION
- OPERATION
- MAINTENANCE

*Literature #E2505-01
Revision Date 05/25/05*

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INSTALLATION, OPERATION & MAINTENANCE

MACBONE MODEL CHV24-7

(Serial numbers 01 and up)

PRODUCT DESCRIPTION

The *MacBone* Series CHV24, 24,000 BTU/hr., cooling, heating, dehumidifying and pressurizing unit, is a vertical or "side-mounted", unitary, or self-contained unit, with a closed, precharged refrigeration circuit, driven by a single, integral, hydraulic motor. Heating is derived from the circulation of hot engine coolant, engine oil or hydraulic oil through the unit. Heating capacity is 30,000 BTU/Hr. at a fluid flow rate of 1.5 GPM at 140° F. The design concept is derived from the need for an air conditioning unit for industrial applications where the unit can be quickly removed for service without involving the sealed refrigeration circuit. Cooling is provided by a thermostatically controlled automotive type compressor, using refrigerant 134A. The condenser fan and evaporator blower share a common shaft, driven by the hydraulic motor with sufficient power to produce substantial condenser air flow even with a filter on the outside coil, thus insuring reliable performance even in a heavily dust laden environment. Substantial power delivered to the inside air blower also assures delivery of full system capacity under all conditions. Induction of 10% outside air provides cab pressurization to exclude dust and other contaminants from entering the cab environment.

Hydraulic drive input is usually, but not necessarily, from a pump driven by the vehicle's engine and utilizing the vehicle's hydraulic reservoir. Required flow is a constant 10 GPM at a variable pressure from 600 to 1400 PSIG. System pressure relief, provided by the installer, should be set at 1650 PSI. Electrical input of 3.5 amps, at 12 or 24 VDC, is used only to activate the compressor clutch. There are no electrically driven fans or blowers in the MacBone design. All CHV24-7 models accept either 12 or 24 V.D.C.

For the CHV24 series units, a required sub base with shock mounts is supplied with the unit. All units, measure 37.5" wide (horizontal dimension) by 27.5" high and protrude 15" from the surface on which they are mounted. There is no protrusion inside the space being cooled. The total weight is 142 pounds. Hydraulic lines are #8, supply and return, up to 40'. The motor has an external case drain to protect its shaft seal and this drain is intended to be returned directly to the hydraulic tank by a #6 line. Seven 1/2 inch SAE mounting bolts provide for quick removal for service or replacement. The dual V belt drive system has an automatic tensioner and operates in a closed, ventilated area. Recommended operating time before overhaul is 6000 hours. Recommended unit life is four overhaul cycles. Note, however, that at the end of the 1999 season, we are finding units with up to 6000 hours in need of drive belts only. We also note that four overhaul cycles will not be the limit.

UNCRATING

The MacBone Series CHV24 shipping pallet usually contains the following:

1. The CHV24 Series unit complete with 3 primary shock mounts.
 2. The subbase, complete with an additional 4 shock mounts to which the unit will be secured.
 3. The unit weather cover.
 4. Supply and return air ducts with air seal trim. (shipped inside the unit under the evaporator cover)
- Remove the pallet straps and packing. Remove the weather cover by removing 4 nuts from 4 studs along one edge of the cover and by also removing the 4 bolts and nuts along the other edge.

From the accessible side of the subbase, with a $\frac{1}{4}$ wrench, remove the 3 bolts which secure the subbase to the unit. For access to 4 additional such bolts, remove the 10 screws which secure the evaporator section cover and remove the cover. Remove the two air ducts which were placed in front of the evaporator for shipment. Inside the unit, locate and remove the 4 additional bolts which secure the unit to the subbase.

SUB BASE AND AIR DUCT INSTALLATION

GENERAL: The sub base is designed to be secured to the wall of the cab to be cooled. The wall surface must be flat and strong enough to support the 216 pound total weight of the CHV24 Series air conditioning unit, sub base, air ducts and accessories.

LOCATION: When installed, the area around the unit must be open on the condenser filter end and across the bottom to allow air flow to and from the condenser.

When installed, holes will be cut in the cab wall to match the rectangular return air hole and the square discharge air hole in the sub base. Be sure this cutting will not sever vital structures. Since the system controls are accessed by reaching into the return air area, this area must be accessible from the cab. The supply air, at full fan speed, is discharged at very high velocity, so the discharge air should not be located where it will blow directly onto an operator's station.

IMPORTANT

Since most all vertical units will be installed below the cab window level, the discharge and return air ducts will be low in the cab, possibly resulting in stratification of the cooled air in large cabs. In smaller cabs, stratification is usually not a problem. Stratification means the cold air, being heavier than warm air, and being discharged and returned at knee level, will tend to cool only the lower level of the cab. To address this phenomenon, either the discharge air must be deflected or ducted to the ceiling, or the return air ducted so as to draw from the ceiling. The MacBone model ST24-D, 90° curved deflector, installed on the discharge duct and oriented so as to deflect the discharge air upward will usually take care of the stratification problem. If not, contact us for other solutions which have been field tested.

Note: If the return air area cannot be placed within reach of the operator, remote controls, which can be placed anywhere, are available. These remote controls are simply manual valves and a toggle switch so are inexpensive and reliable.

SECURING: When a suitable location has been selected, drill the sub base and the wall for four to six through bolts which will secure the sub base to the wall.

I M P O R T A N T

For best security, place at least one mounting bolt within several inches of each of the four rubber shock mounts and in the upper right and left corners, BUT DO NOT allow any portion of the bolt head or washer to be closer than one inch from the edge of either the return air or supply air hole. This restricted area is reserved for the air duct securing flanges and is painted red. Use additional mounting bolts as appropriate.

On the larger surface of the subbase, which is to be mated to the vertical wall, run a bead of caulking, like silicone, around the outside edge, around the return air and supply air holes and around each of the bolt holes you drilled.

Now secure the sub base with the securing bolts inserted FROM THE OUTSIDE. Fastener heads must not exceed 1/2" in height to insure they will not hit the bottom of the unit when the unit is secured to the subbase. If the nuts must be out, cut the bolts flush with the tops of the nuts.

Using whatever tools it takes, cut the return and discharge air holes through the wall to conform to the holes in the subbase. You may wish to cut these holes before securing the subbase. If you cut the holes first, it's OK to make them $\frac{1}{4}$ " larger all around.

AIR DUCTS: Before placing the CHV24 Series unit onto the subbase, the supply and return air ducts must be placed through the subbase from the outside toward the inside of the cab. The rubber edge trim remains outside of the cab. These ducts are essential since they provide the necessary air seal between the unit and the cab. Without them, dust laden outside air will come in and cooled air will leak out. It is important that you use sealer under the duct flanges. Remember, the rubber trim goes between the air duct and the unit to maintain a weather seal between the subbase and the unit.

The two ducts are available in any length. To determine the optimum length, measure from the sub base surface to the surface inside the cab. Specify this length with the initial order; otherwise, 1" ducts will be shipped with the unit. Ducts longer than the optimum length are OK, but they should not be shorter.

Each duct is secured onto two studs protruding from the subbase. The securing nut and washer are furnished on the studs. Use caulking between the duct flange and the subbase.

ORDERING AIR DUCTS

GENERAL: Each unit has two air ducts and each is vitally important to the operation of the unit. Without the ducts, which provide a seal between the cab and the unit, return and discharge air will leak to the outside, resulting in substantial loss of capacity.

SPECIFYING: We keep return and discharge ducts on hand, ready to be trimmed to the length you need. The ducts should not be any longer than required to reach the surface of the cab wall. If they are too long, they become knee knockers. If much too short, air can leak into the wall structure. Measure the distance from the subbase surface to the wall surface and specify this as the duct length. Specify this length for each duct. If no length is specified with the order, 1" ducts will be supplied.

MODEL CHV24-7 INSTALLATION

GENERAL: With the sub base and air ducts in place, the unit will be secured to the subbase shock mounts with seven 1/2" SAE x 1/2" long hex head cap screws and lock washers which were removed earlier. Needed to complete the installation, will be a 12 or 24 VDC power supply, controlled by the engine ignition or power switch, a 10 GPM, constant volume, variable pressure hydraulic oil supply, # 8 hydraulic supply and return lines, 1650 PSI relief valve, # 6 case drain line, and #8 hot oil or hot water lines, if the heating feature is to be utilized.

MOUNTING THE UNIT: Lower the unit onto the subbase so that the 4 mounting holes in the unit chassis, line up with the 4 shock mounts on the vertical portion of the subbase and the 3 shock mounts on the bottom of the unit line up with the 3 mounting holes in the bottom of the subbase. Using the 7 1/2 SAE hex bolts and lock washers removed earlier, secure the unit to the seven shock mounts. Grease the threads and torque to 25 foot pounds. Do not fail to use the lock washers.

HYDRAULIC CONNECTIONS

The *MacBone* series CHV24-7 units require continuous oil flow at a constant volume of 10 GPM, at a variable pressure between 600 to 1400 PSIG. A competent hydraulics engineer or *MacBone* engineering must be consulted to specify the hydraulic oil system components. Constant volume at variable pressure is unusual and is frequently misunderstood. To avoid motor shaft seal blowouts, the hydraulic motor has an external case drain, which must be routed directly to the reservoir. With this external case drain, motor backpressure is not a factor, so #8 supply and return hoses are recommended. A relief valve ahead of the *MacBone* unit must be installed and set at 1650 PSI. If unit return oil will be used to power any downstream devices, consult *MacBone* engineering for limitations.

The SUPPLY hose connects to the fitting on the rear of the motor located closest to the cab wall. The RETURN hose connects to the other fitting on the rear of the motor. The #6 JIC case drain exits downward and is located toward the front of the motor. Route the hoses from the unit to the hydraulic oil tank and 10 GPM system hydraulic pump as appropriate.

HEATER CONNECTIONS: Model CHV24-7 units incorporate a heater coil designed to use either engine hot water or hot oil. The #8 JIC male inlet and outlet connections are located to the left of the hydraulic line connections. Either connection may be the inlet or outlet.

If engine hot water is to be used, route 2 hoses to the appropriate taps on the engine where differential pressure will provide water flow to the unit.

If hot oil is to be used, we recommend a minimum flow rate of 1.5 GPM at 150° F, and a max pressure of 100 PSI. For more information on this, please call MacBone engineering.

ELECTRICAL CONNECTIONS

All MacBone units have 12 VDC compressor clutch coils. For 24 VDC operation, power to the clutch passes through a power resistor, which reduces the voltage to the clutch to 12 VDC. Power should be supplied to the MacBone unit, fused to protect the wire, from the vehicle's engine control switch so that when the vehicle's engine is shut down, power to the MacBone unit is shut down also. Otherwise, the MacBone compressor clutch will drain the machine's battery.

Input + DC power for the MacBone unit is connected to the 5/16" red terminal on the MacBone Voltage Sensing Module located next to the system controls. Either +12 VDC or +24 VDC may be connected to this terminal. The MacBone Voltage Module will automatically determine the supply voltage and apply it properly to provide the required 12 VDC to the clutch. The ground is provided through a grounding spring mounted to the bottom of the MacBone unit chassis on the control panel end. Make sure that the grounding spring contacts the MacBone unit subbase and that the subbase is grounded to the machine. Without a ground, the clutch will not engage and unit will not cool.

SYSTEM CHECKOUT

Before re-installing the evaporator section cover, check system operation as follows: Push the cooling toggle switch away from you. Set both control handles in the horizontal position. Turn the thermostat fully clockwise. Turn the ignition or machine power switch on and off and confirm hearing the compressor clutch click in and out or confirm seeing the clutch disk, on the front of the clutch pulley, move in and out.

Note: If the temperature is below 60° F; the thermostat will not close so you will have to put a jumper wire across the two thermostat terminals to activate the compressor clutch circuit.

Next, keeping both control handles in the horizontal position, start the engine which drives the system's hydraulic pump and leave at idle. If the oil is cold, the unit may turn over slowly. As the oil warms up, the unit will probably stop.

With the engine still at idle, bring the unit on by turning the blue handle from horizontal, slowly toward vertical. As unit speed comes up, be sure all the components are operating freely and that the unit operates smoothly and quietly. CONFIRM that the motor pulley turns clockwise when facing the motor shaft. If not, the hydraulic drive system must be reviewed and corrected.

--CAUTION--

If you observe the operation of the unit with the cover off, stay clear of the condenser fan and belt drive system.

! IMPORTANT---IMPORTANT---IMPORTANT !

If all seems well, slowly increase engine speed to full operating RPM. At full RPM, unit motor speed should be 2000 +/- 50 RPM. Motor speed must never exceed 2200 RPM. This is a good point to check with a strobe tachometer. If the motor speed is not 2000 +/- 50 RPM, refer the problem to your hydraulic system design technician. If the temperature is above 60°F, the unit should now be cooling. If below 60°F, use a jumper across the thermostat terminals to engage the compressor for cooling so it can be checked out. Turn off the cooling by pulling the toggle switch down.

Now move the red handle to the vertical position to allow engine water or hot oil to flow through the heating coil. When the engine water or oil warms up, the unit will heat if the flow and temperature are sufficient. If heating is not obtained there is probably no flow.

If all looks and sounds well, and the unit cools and heats, remove the jumper from the thermostat, if used, install the evaporator cover with the (10) screws you removed and then secure the weather cover with the (4) nuts and (4) screws and nuts removed earlier. From the cab, make sure the compressor toggle switch is in towards you (off) and set the blue and red handles to horizontal. The MacBone system is now secure and ready for subsequent operation.

SYSTEM OPERATION

GENERAL: The *MacBone* unit's electrical requirement comes from the vehicle's engine control or ignition switch at 12 or 24 VDC. Ideally, hydraulic drive oil is supplied by a dedicated pump driven by the engine. Full MacBone unit speed may require full engine speed unless a variable volume oil pump is employed.

INITIAL STARTUP: Place the cooling toggle switch to the off position which is toward the operator. Place both the RED and BLUE control handles in the horizontal position. Turn on the ignition. Start the engine. If the hydraulic oil is cold, the unit may roll over slowly.

After engine warm-up, bring the engine up to full operating speed. Slowly turn the BLUE control handle toward vertical, which will control the speed of the unit. The faster the unit runs the more cooling capacity it will have. You may run the unit at any speed at any time.

FOR COOLING: With the unit at half to full speed, push the cooling toggle away from the cab and turn the thermostat knob fully clockwise. As the cab cools to the desired temperature, turn the thermostat counterclockwise until you hear the compressor cycle off. The thermostat will now cycle the compressor to maintain that temperature. You may change the unit speed at any time with the blue handle.

FOR HEATING: Pull the cooling toggle switch toward the cab to off. Adjust the airflow with the BLUE handle. Move the RED control handle toward vertical to allow hot water to pass though the coil. The thermostat does not control the heat output. Heat output is controlled manually by adjusting the red handle: horizontal is off; vertical is maximum. Again, you may change the unit speed at any time with the blue handle and change heat output at any time with the RED handle.

TO STOP: Return both the red and blue handles to the horizontal position to shut the unit down. Before powering down the engine, we recommend that you shut down the unit, however this is not necessary: NO OPERATIONAL SEQUENCE OF ANY SORT WILL DO ANY DAMAGE TO THE *MACBONE* UNIT.

SPECIAL FEATURE: On chilly, damp days or whenever humid conditions require dehumidification, operate the cooling cycle for dehumidification and, at the same time, open the heat valve to keep the temperature comfortable. This feature is of particular value when on-board equipment is sensitive to humid conditions.

SERVICE

FILTER CLEANING: (See diagram on page 12) The condenser coil filter, or "outside" filter, is located on the end of the unit and is washable and reusable several times before replacement is required. To remove the filter, pull the filter out at the bottom and slide it down from under the weather cover and the cross bar. Use the reverse procedure to reinstall. The evaporator or "inside" filter, which is also washable and reusable, is located just outboard of the control handles and is accessible by removing the weather cover and the large evaporator cover which is secured with (10) self tapping screws, or can be folded and removed and replaced through the return air inlet.

The outside air filter, which is washable and reusable, is located in the same area as the inside filter and is secured with two wing nuts.

The drive section filter which is washable and reusable is identical to the outside air filter and is secured with (2) wing nuts. This filter is located just ahead of the condenser fan and covers the hole in the motor bulkhead which allows condenser fan air to ventilate the belt drive section of the unit.

-- W A R N I N G --

THE STANDARD *MACBONE* INSIDE AND OUTSIDE AIR FILTERS ARE COARSE AND WILL FILTER OUT ONLY DEBRIS AND LARGE PARTICLES. IF THE MACHINE'S OPERATING ENVIRONMENT CONTAINS AIRBORNE PARTICLES, HAZARDOUS TO THE HEALTH OF THE MACHINE'S OPERATORS, THE STANDARD FILTERS MUST BE REPLACED WITH TYPES DESIGNED TO MEET DEFINED AIR QUALITY STANDARDS. CONTACT *MACBONE* ENGINEERING FOR FILTER TYPES AND AVAILABILITY.

OUTSIDE OR CONDENSER FILTER: Blow or wash clean as required. As this filter clogs, the system head pressure will rise and system capacity will drop. Ultimately, the high-pressure refrigerant relief valve will open and begin to periodically vent refrigerant. If you have reason to believe this has happened, check the refrigerant per the next paragraph.

-- W A R N I N G --

REFRIGERANT CHARGING MUST BE DONE BY A LICENSED AND PROPERLY EQUIPPED TECHNICIAN

REFRIGERANT CHECK: Refrigerant used is R-134A with a full charge of 2 lb., plus or minus 10%. A sight glass is located along the lower inside edge of the unit next to the hose connection area. While observing the glass, have someone turn the unit to the cooling mode. The glass should run clear within 30 seconds. If it does not clear, refrigerant is needed. Evacuate and recharge to 2 lb. or recharge to a clear glass plus 4 ounces.

LUBRICATION: The bearings in the hydraulic drive motor are supply oil lubricated. The compressor bearings are lubricated internally and the idler bearings are sealed, leaving only the two fan shaft bearings to be field lubricated. Lube these two bearings ONCE PER YEAR, stopping at the first sign of grease emerging from the bearing seals. No other lubrication is required or recommended.

BELTS: The (2) belts are Goodyear AX46, *MacBone* part no. D5010-46. A suitable replacement is the Gates AX46. The MacBone unit belt drive utilizes a spring loaded, backside idler so non-notched belts are not recommended. While the Gates AX46 is a suitable replacement, the Goodyear AX46 will provide better performance because its notches are closer together and not so deep. Belt replacement should be made annually or at 1500 hours, whichever comes first. To remove the old belts, cut the belts in half and discard. Do not try removing belts by rolling them off the pulleys; cut them.

To install the new belts, proceed as follows after becoming familiar with the belt diagram on page 14:

1. **TOOLS REQUIRED:**
3/8 drive ratchet w/ 6" extension
3/8 drive sockets; 1/2" and 9/16".
1/4" end wrench
2. EXTEND the idler tension spring by turning the 9/16 bolt on top of the spring clockwise until the spring-nut reaches its uppermost position, which allows the spring to extend and relax.
3. With the 1/4" end wrench, remove the (4) 1/4" hex head screws which hold the blower air inlet ring in place. Set the ring and (4) screws aside.
4. With the 1/2" ratchet, loosen and then completely remove the set bolt, located just behind the blower, which secures the blower shaft coupling to the fan shaft.
5. Move the coupling/blower assembly off the shaft and place the (2) new belts through the gap.
6. Replace the coupling on the shaft and line the setbolt hole up with the détente drilled in the shaft. Install the set bolt and torque to 10 foot pounds.

SUGGESTION

As you finger tighten the set bolt, rock the coupling gently to be sure you can feel the set bolt entering the drilled détente.

7. Replace the blower inlet ring. Tighten the 1/4" screws snugly but don't strip them out.

--CAUTION--

DO NOT FAIL TO REINSTALL THE INLET RING. AIR FLOW AND COOLING CAPACITY WILL BE SEVERELY REDUCED IF THE INLET RING IS LEFT OFF.

SUGGESTION

We have tried every possible belt replacement procedure and have concluded the following is by far the best way to get the new belts pulled onto the pulleys.

8. Place one belt around the innermost compressor pulley groove, then OVER the motor pulley, then UNDER the idler, then start it OVER the fan shaft pulley. Now roll the belt into place onto the innermost fan shaft pulley groove by using the condenser fan blade to rotate the fan shaft. Install the second belt the SAME way in the outermost groove.
9. With the 9/16 socket, turn the idler spring bolt counterclockwise, to compress the idler spring. Using a business card as a gauge, compress the spring until the card is snug between the mid spring coils. This first adjustment should be checked after a day of operation and reset if necessary. Though this adjustment may be checked and corrected from time to time; it is, after the first readjustment, good for the life of the belts. Never tighten the spring so tight that the coils touch.
10. Finally, the idler tracking must be checked and possibly adjusted. To do this, the idler pulley can be adjusted from left to right on the idler shaft by rotating the idler adjusting, self locking, nut which is screwed onto the idler shaft. The idler is kept tight against the adjusting nut by a spring on the other side of the idler. Looking at the condenser fan from the shaft side, rotate the fan by hand in the clockwise direction. Adjust the idler pulley nut tighter or looser until the drive belts track evenly on the idler pulley. If the belts are not adjusted to track evenly, the idler will make excessive noise and will wear prematurely.

SPEED CONTROL VALVE: A ball valve, controlled by the blue handle, is the hydraulic motor bypass valve. With use, the stem packing will begin to weep so it must be inspected periodically and tightened as necessary using a 9/16" open-end wrench.

HELPFUL HINTS FROM THE FIELD

The device with the knob on it, next to the cooling toggle switch, is a comfort thermostat, NOT a freezestat. DO NOT INSERT THE THERMOSTAT SENSING TUBE INTO THE EVAPORATOR COIL FINS. Leave it coiled around the thermostat as originally assembled.

The electrical module which changes 24 volts to 12 volts for the MacBone unit compressor clutch, WILL NOT WORK ON A 2-WAY RADIO or any other device except the MacBone unit. Wish it would but IT WON'T.

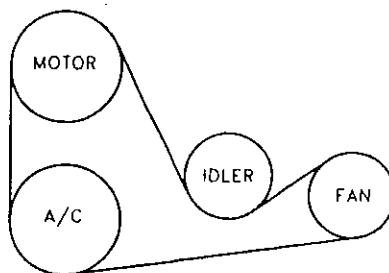
The hydraulic oil supply should be 10 GPM for a unit motor speed of 2000 RPM with the blue handle in the vertical position and the engine at full speed. Every GPM less changes the unit motor speed 200 RPM less and capacity by about 2400 BTU's/HR less. Never exceed 2200 RPM which is obtained at 11 GPM. At 2000 RPM on the motor, the fan shaft runs at 2400 RPM. At 2200, the fan shaft is 2640 RPM. The fan red line or possible blade hub disintegration speed is 3000 RPM, which occurs at a motor speed of 2500 RPM or drive oil flow at 12.5 GPM.

When changing belts, it helps to have a small hand when putting the first belt under the compressor's innermost pulley groove.

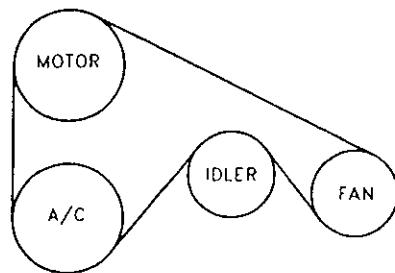
The discharge air is very sensitive to being restricted, so please do not attach any sort of grill, duct, deflector or anything else to the discharge without consulting MacBone engineering. Restricted air flow results in diminished cooling capacity.

The hydraulic bypass control valve, which is controlled by the blue handle, has a packing gland which must be checked periodically to be sure it is snug and not leaking hydraulic fluid. The packing gland nut is tightened with a 9/16" wrench and can be done through the unit's side under the hose connection.

BELT DRIVE SYSTEM
(2) GOODYEAR AX46, MACBONE PT# D5010-46
 Substitute: GATES AX46. Use only notched belts.

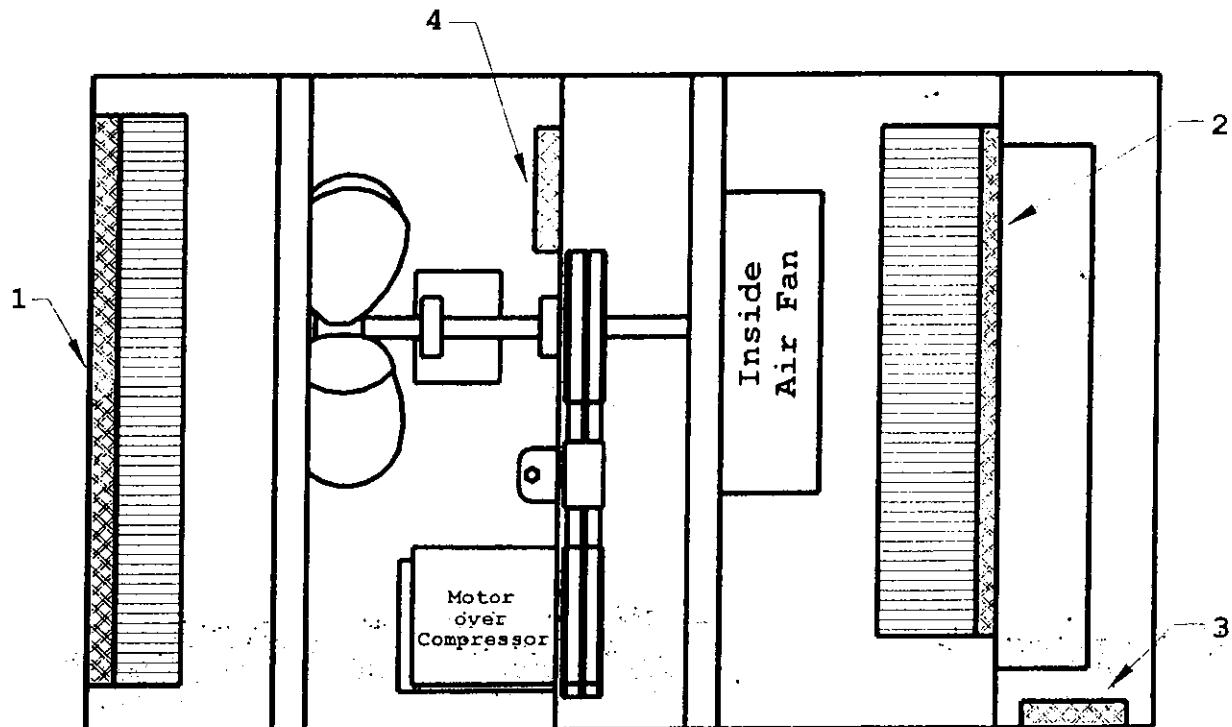


THE RIGHT WAY



THE WRONG WAY

AIR FILTER LOCATIONS

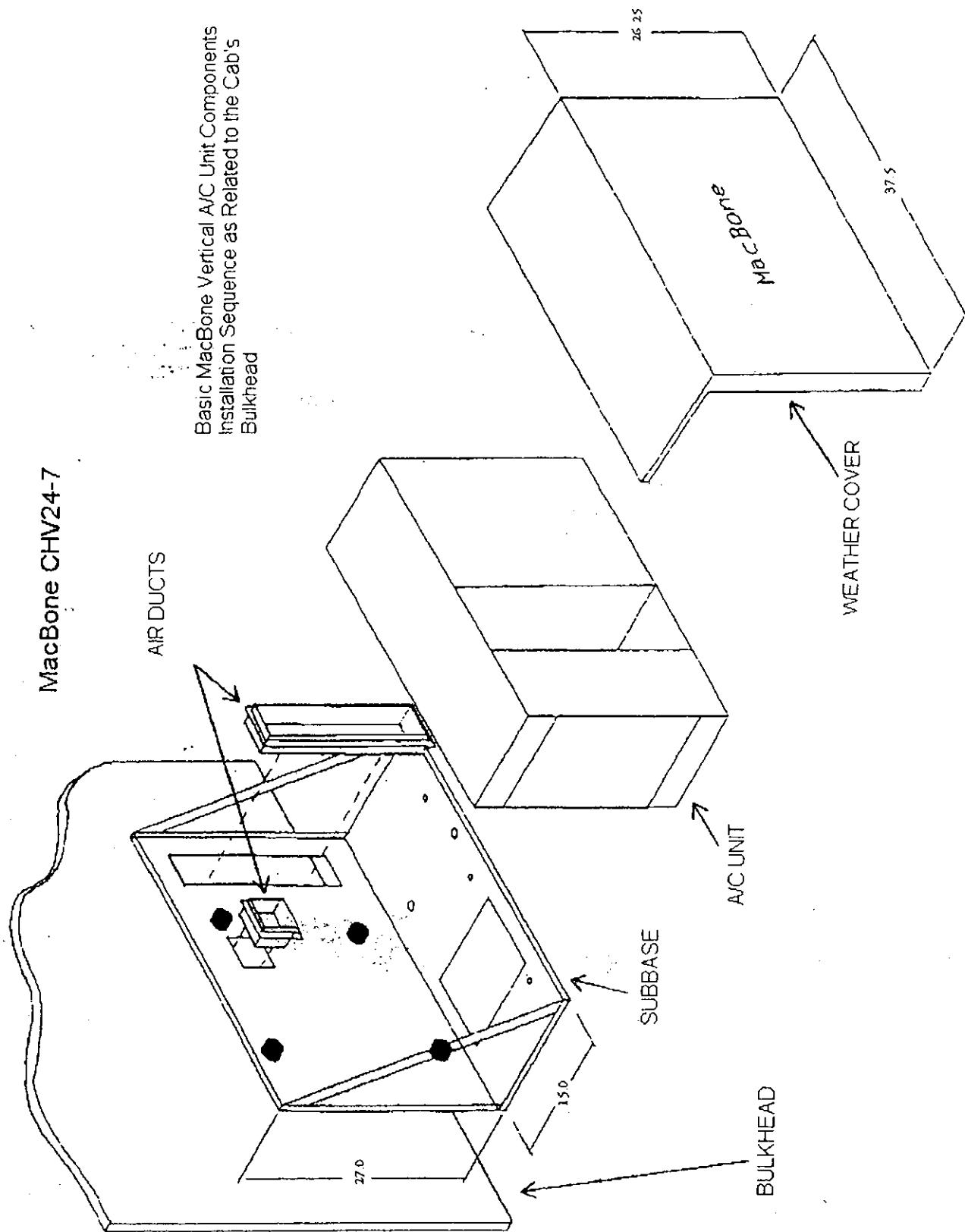


- 1 Condenser air filter
- 2 Inside air return filter
- 3 Outside air intake filter
- 4 Drive air filter

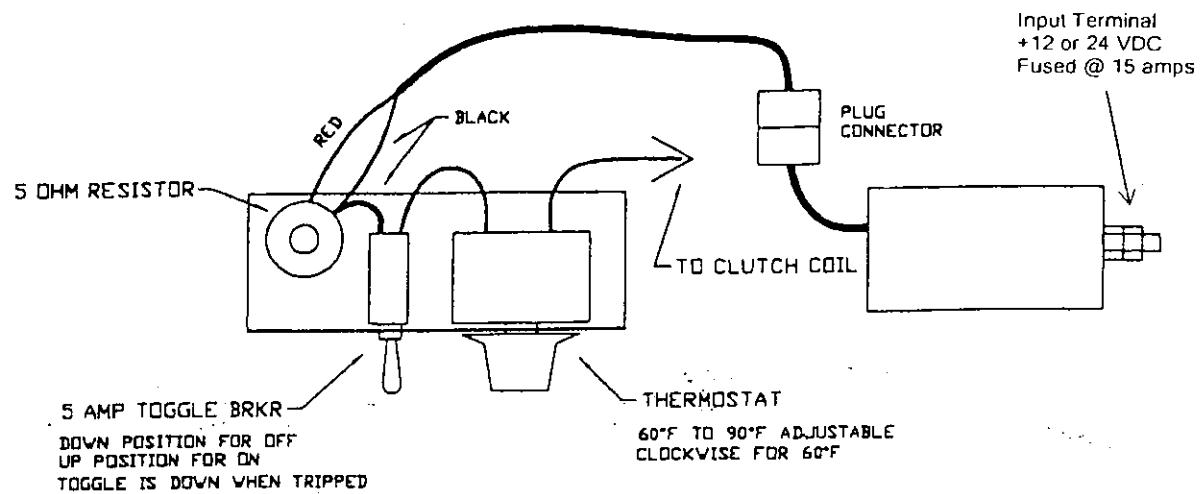
Part# A4101-01	11"x 20"x 1"
Part# A4101-05	7"x 23½"x ½"
Part# A4101-03	5"x 6"x 1"
Part# A4101-03	5"x 6"x 1"

MacBone CHV24-7

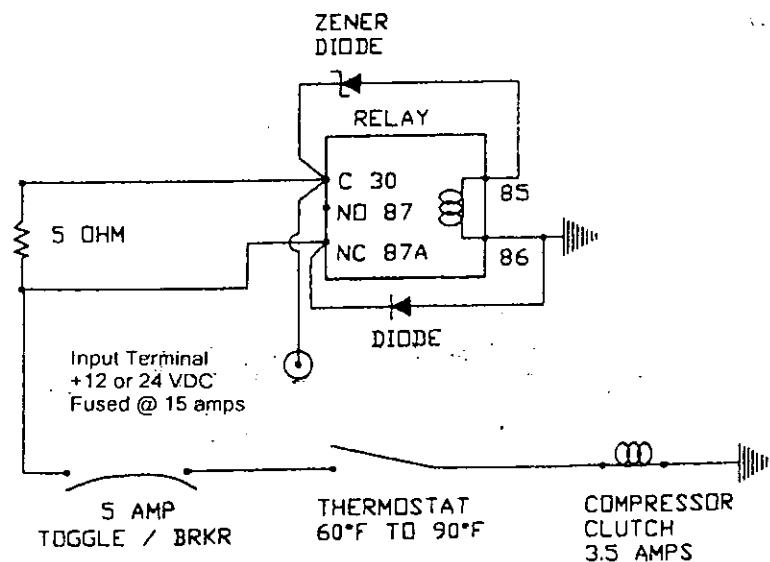
Basic MacBone Vertical A/C Unit Components
Installation Sequence as Related to the Cab's
Bulkhead



WIRING

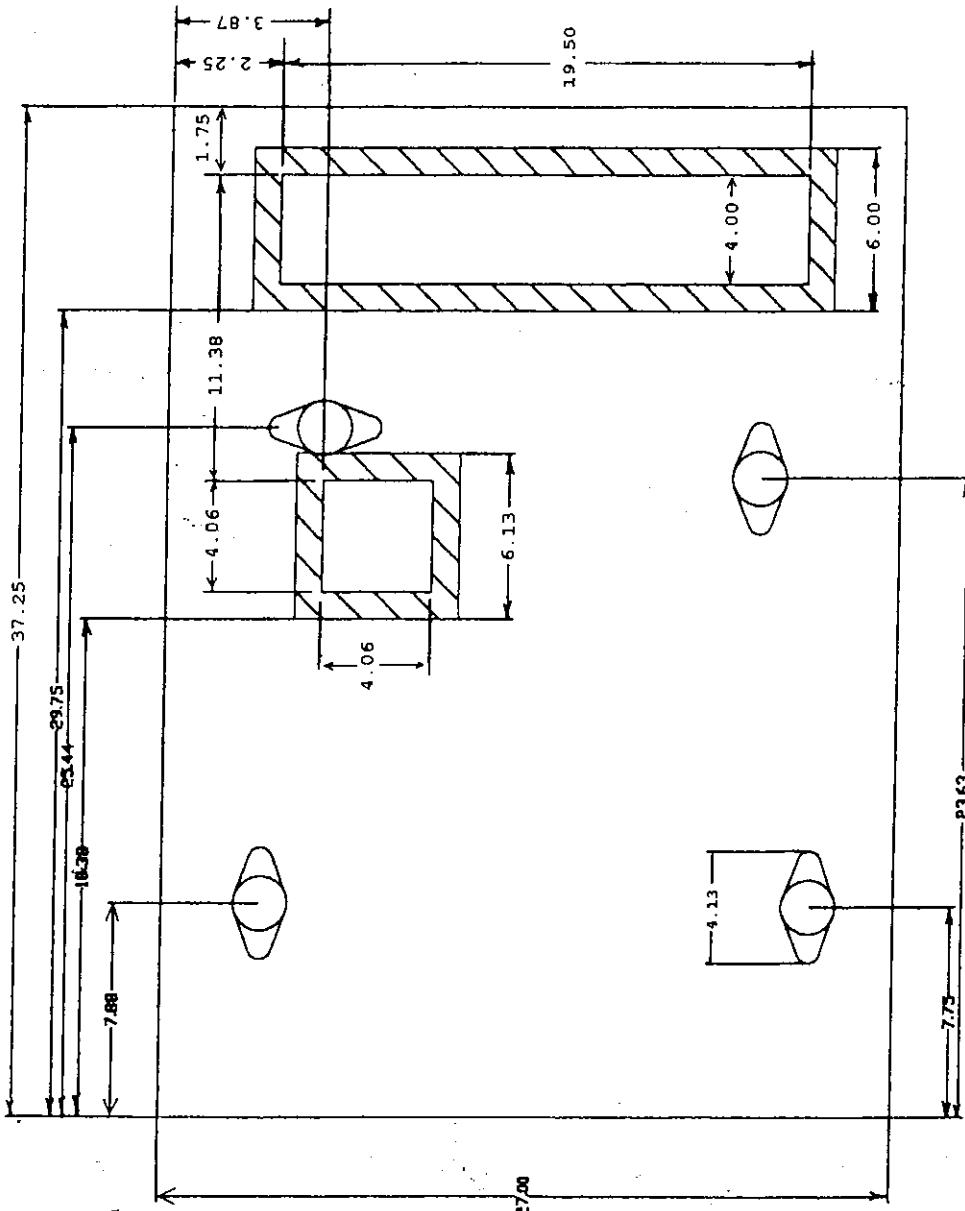


BASIC WIRING



WIRING SCHEMATIC

CHV24-7 Sub Base Dimensions for Mounting



NOTE:
Do Not place bolts in
cross-hatched areas (red on
sub base)
Sub Base must be through
bolted in upper corners.

SPECIFICATIONS

Color: Equipment yellow. Other colors are available on request.

Size: Installed on the sub base with the top in place: 37 1/2" wide by 27 1/4" high x 15" deep from the cab wall outward.

Weight: Basic unit, 148# (67 kg). Unit with subbase, air ducts and top, 214# (97 kg).

Capacity: 24,000 BTU's/Hr. cooling at a unit motor speed of 2000 RPM at standard rating conditions. 30,000 BTU's/Hr. heating with supply oil or water at 150° at 1.5 GPM.

Air Flow: Nominal 800 CFM delivered from the unit.

Electrical: 3.5 AMPS at 12 or 24 VDC.

Hydraulic Pump: Net pump output should be 10 GPM, 600 to 1400 PSI, constant volume, variable pressure. A dedicated pump is the only efficient way. Call MacBone engineering for other possible options.

Unit Motor: Motor displacement is 1.000000000000 cubic inch/rev. and requires 10 GPM to operate at 2000 RPM. Drives compressor and fans through a dual V Belt drive, tensioned by a spring loaded idler.

Hydraulic Lines: Supply and return hoses, 1/2" I.D. (#8). Case drain, 3/8" I.D. (#6).

Refrigerant: R-134A, approximately 2 lb.

Drive Belts: (2) "A" section (1/2" wide) belts, Goodyear AX46.

Speed Control: Variable, manually operated.

Heat Control: Variable, manually operated.

Cooling Control: Thermostat, operator adjustable from 60°F to 90°F.

Air Filters: The inside or evaporator air filter is 7 1/4" x 23 1/2" x 1/2". The outside or condenser air filter is 11" x 20" x 1". Filters are washable and reusable or may be replaced with locally available filter material.

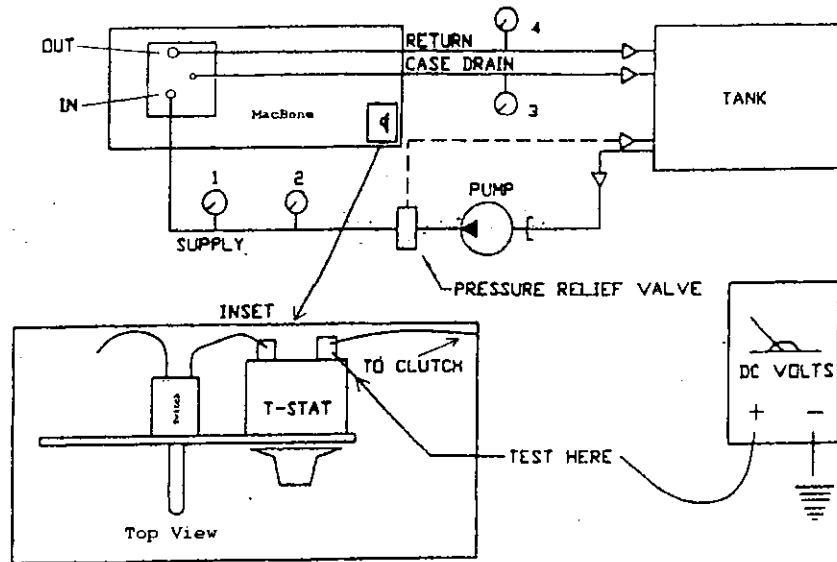
Lubrication: Fan shaft bearings are greased annually.

Service: Weekly, air filters should be cleaned. Monthly, the speed control valve stem packing nut should be tightened if leaking. Annually, the unit should be removed for cleaning, inspection of the (4) shock mounts and duct seals, lubrication of the fan shaft bearings and belt replacement.

Overhaul: Factory replacement of all wear-limited components should be considered after 6000 hours of operating time.

Materials: All sheet metal parts are galvanized steel with exterior surfaces painted. All fasteners are grade 5 plated steel with self-locking nuts. Coils are copper tubes with aluminum fins. Refrigerant and heating fluid lines are copper with sleeved and flared or silver soldered joints. Hydraulic lines are steel, SAE 100R2 type, with a 4,000 PSI working pressure.

MACBONE A/C UNIT HYDRAULIC & ELECTRICAL TROUBLESHOOTING



1. Oil Flow Rate:
 - Blue handle in vertical position.
 - Engine at full operating RPM.
 - Reading taken at position 1.
 - First reading taken with compressor not engaged.
 - Second reading taken with compressor engaged.

Design flow rate is 10 GPM at all times but may be from 6 GPM to 11 GPM. For every 1 GPM below 10 GPM, cooling capacity drops by 10%. Full capacity is 24,000 BTU'S/HR @ 10 GPM. Over 11 GPM can result in shortened unit life and 12.5 GPM is red line.

2. Unit Pressure Drop:
 - Blue handle in vertical position.
 - Engine at full operating RPM.
 - First reading taken with compressor not engaged.
 - Second reading taken with compressor engaged.
 - Readings taken at position 2 and 4.

Unit pressure drop is supply pressure minus return pressure. If return is absolutely known to return directly back to the tank, return pressure may be assumed to be zero, otherwise, install a test gauge at position 4 compressor not engaged, expect a pressure drop of 200 to 600 PSIG. Compressor engaged, look for 1300 to 1500 PSIG.

3. Case Drain Back Pressure: -Blue handle in vertical position
-Engine at full operating RPM
-Clutch engaged and unit cooling
-Reading taken at position 3.

Back pressure must not exceed 25 PSIG.

4. Clutch Voltage: -Control panel switch in on position.
-Thermostat turned clockwise until it stops.
- Electrical energized.
- Engine running; battery voltage 12.5 to 14, or 25 to 28

Clutch voltage is measured from chassis ground (negative) to the thermostat terminal furthermost from the cooling toggle switch.

Expect voltages ranging from 10.5 to 14.0 VDC.

0 ~ 5.0	VDC	The compressor clutch will not engage.
5.0 – 10.5	VDC	The clutch will slip, overheat and fail.
10.5 – 14.0	VDC	The compressor will run normally.

5. Clutch Coil Resistance: - D.C. power to the unit OFF
- Cooling switch OFF

Clutch coil resistance is measured from ground to the thermostat terminal furthermost from the cooling control switch.

Expect resistance readings from 3.6 to 4.0 OHMS.

6. Power Resistor resistance: - DC power to the unit OFF

Follow the red wire from the top of the power resistor to the 3 pole plug. Disconnect the plug and measure the D.C. resistance between the black and red pins in the plug with only 2 pins. Expect be 4.7 to 5.0 OHMS.

Test Report

Conduct these tests and with this report in hand, call 1-888-MacBone (1-888-622-2663) for review and assistance.

MacBone Data Plate:

Test Date: _____

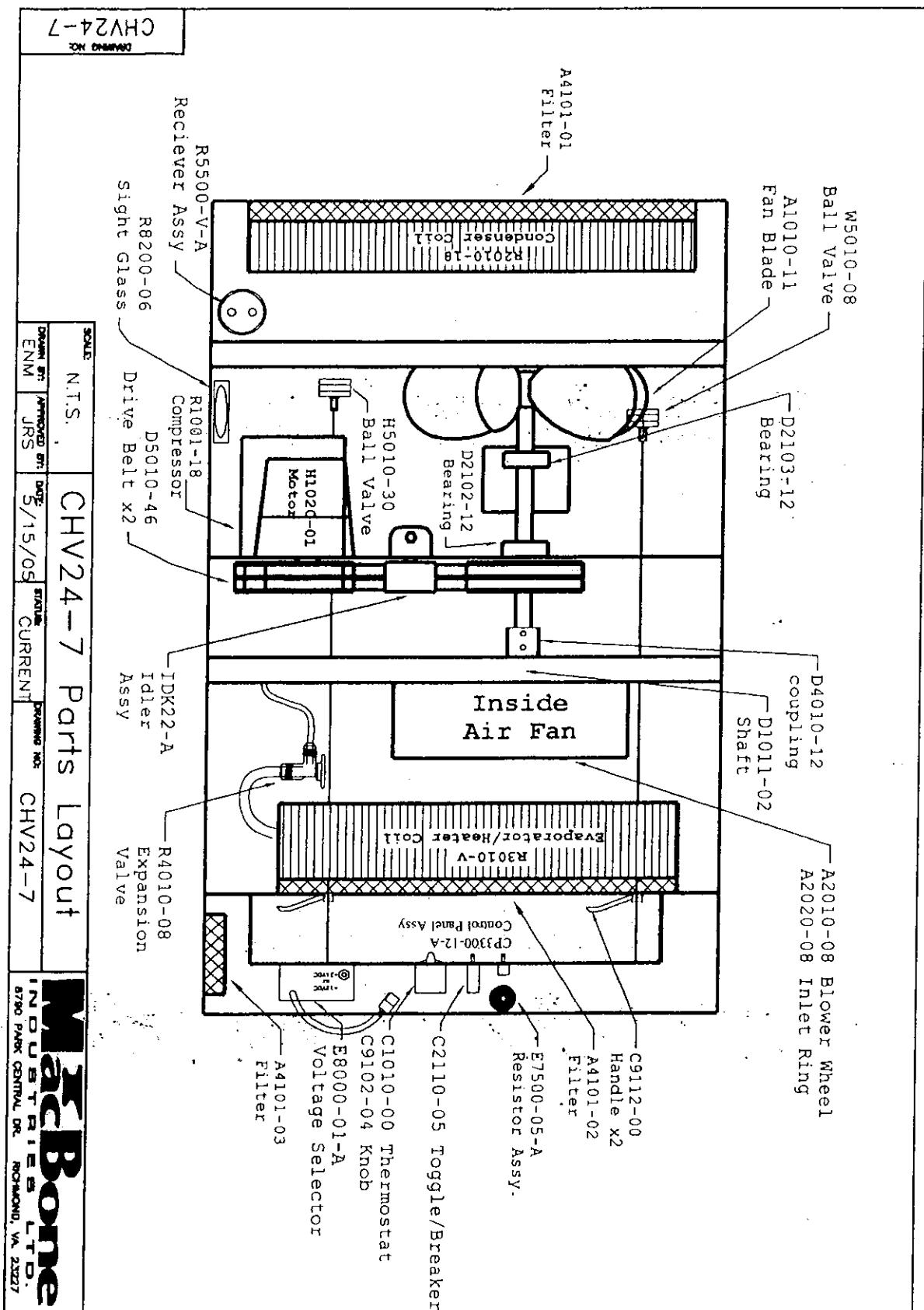
Production Number _____

Test Made by: _____

Model Number _____

Serial Number _____

	Clutch Disengaged	Clutch Engaged
1. Oil flow rate:	GPM	GPM
2. Unit pressure drop:	PSIG	PSIG
3. Case drain pressure:	PSIG	PSIG
4. Motor Speed:	RPM	RPM
5. Clutch voltage:	VDC	VDC
6. Clutch coil resistance:	OHMS	
7. Resistor resistance	OHMS	



MacBone M/W Heating and Air Conditioning Limited Warranty

MacBone air conditioning units are warranted against failure of materials or faulty workmanship for a period of 24 months from the date of purchase. If, after examination by MacBone Industries Ltd., a failure is determined to be the result of faulty workmanship or materials, the air conditioner will be repaired at no charge, for labor or materials, at the MacBone manufacturing facility in Richmond, Virginia, USA. Under some circumstances, under this limited warranty, parts may be supplied at no charge, to a qualified user's or owner's service shop, however, the labor to remove or install such parts is not normally provided.

To request an adjustment under this limited warranty, with the model and serial number available for reference, contact MacBone Industries to arrange a prompt response suited to your circumstances. You may write, fax, e-mail, or call, toll free, 888-MACBONE.

This limited warranty covers the air conditioner only, and DOES NOT cover any portion of the hydraulic oil supply system, such as the oil reservoir, oil pump, flow control devices or relief valves. This limited warranty also DOES NOT obligate MacBone Industries Ltd., to any costs associated with removal or replacement of the air conditioning unit. This limited warranty does not apply if the air conditioner has been mishandled, abused, altered or improperly installed. The warranty herein is in lieu of any other expressed or implied warranty of merchantability, or any other obligation on the part of MacBone Industries Ltd. All implied warranties are limited to the initial 24-month period. The above exclusion of consequential damages, and the 24-month limited warranty period may not apply in all states. This warranty may also convey specific legal rights as well as other rights, which vary from state to state.

Address: MacBone Industries Ltd.
8790 Park Central Drive
Richmond, VA 23227

Phone: (804) 264-3603

Fax: (804) 264-3070

Web : www.macbone.com

e-mail: sales@macbone.com

Toll Free: 888-MACBONE



*****ATTENTION ALL MACBONE A/C/ USERS*****

The MacBone M/W machine air conditioning unit is a one piece, self contained design, which is light, small compact and powerful; however, except for belt and filter replacement, the unit is not intended to be serviced in the field. Should there ever be an operational problem with a MacBone unit, it should be returned to our Richmond, Virginia, facility for evaluation, repair and next day shipment back to you.

Here's why. The MacBone product is very reliable; because, in response to any glitch, we make design changes so the problem won't happen again. However, if a problem is fixed in the field, we lose the opportunity to improve our design.

Here's what we recommend. Typically, you can remove a MacBone unit and put it on a pallet to us in far less time than it takes to even analyze a problem, let alone fix it. And, upon receipt of the unit, we can take full advantage of seeing the problem first hand which affords us the opportunity to fix the cause so it doesn't happen again. In a fully implemented MacBone program, all of your machines would be MacBone equipped with a spare unit available in the service truck. If an operational problem occurs, swap the unit out with the spare, send the old unit to us via motor freight, and we will repair it, if under warranty at no charge, including freight back to you, and return it no more than 2 days, to go back in your service truck. Currently, two U.S. railroads have this program in place and have essentially eliminated all A/C related downtime. And even without a spare on hand, it still may prove quicker, as well as less costly, to put the unit on a pallet back to us for evaluation, repair and immediate return to you for reinstallation.

Remember, if a MacBone unit does not do what it is supposed to do, the first tool you pick up is a telephone, and call, toll free, 888-MACBONE. We are available all day, every day, and urge you to call; what we hear from you is our most valuable product improvement information and we don't want to miss it!

Appendix E

CONTROLS, INCORPORATED
Engine & Generator Control Systems

TECHNICAL MANUAL

Model EMGRT1
Mechanical Engine Controller

Revision 9
3/20/06

Table of Contents

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Section 1 – General Description

The EMGRT1 Advanced Power Unit Control System was designed to be a universal Engine Control for mechanical engine applications. The four common engine parameters, oil pressure, engine temperature, speed, and battery voltage along with fuel level and engine hours are displayed on a large 32 character, two line super twist, extended temperature, back-lit LCD display.

An “Auto/Off/Run” key switch allows simple operation and a four-button keypad is used to control engine starting and program settings.

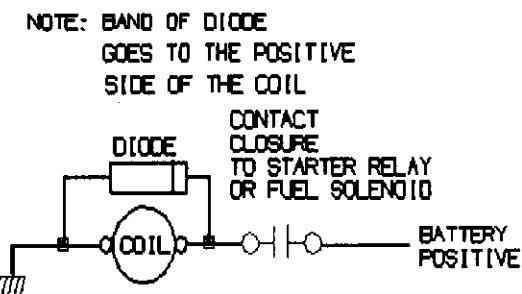


Section 2 – Installation Instructions

NOTE: Disconnect battery and place key switch in the OFF position.

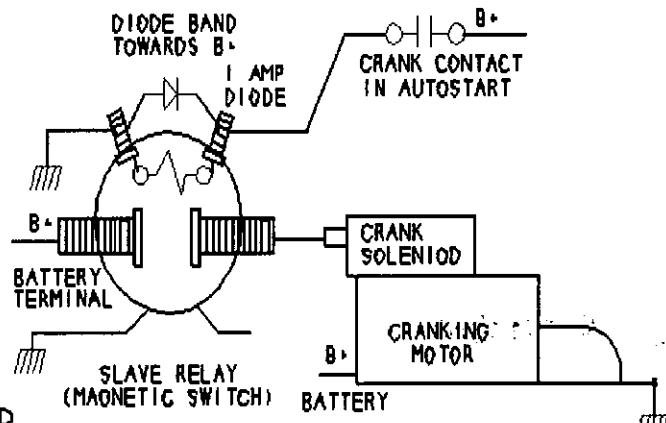
1. Mount the control in the desired location using vibration isolators.
2. Connect the control wiring harness to the Deutsch 16 pin connector located on the bottom of the control enclosure. If no Deutsch connector is supplied, use corresponding wire color code on page 7.
3. Install a suppression diode across the cranking motor slave relay and fuel solenoid. Some slave relays have diodes internally connected. Check with relay manufacturer for details. We recommend using a NAIS Relay, part number CB1-D-M-12V for 12vdc or CB1-D-M-24V for 24 vdc systems. These have internally connected suppression diodes.
4. Connect any auxiliary inputs per schematic. Note: access to these positions may require adding holes to the enclosure. PCB mounted terminal strips are used to connect to the control board.
5. After checking that the key switch is in the OFF position, connect the Battery Positive (+) and Negative (-) per schematic.

DIODE INSTALLATION



WHEN THE SWITCH IS OPENED
THE DIODE CLAMPS THE REVERSE
NEGATIVE VOLTAGE SPIKE
GENERATED WHEN THE COIL FIELD
COLLAPSES. THIS PREVENTS
GLITCHES TO THE MICROPROCESSOR

ENGINE STARTING SYSTEM



Section 3 – Controller Inputs

KEY SWITCH

A three position key switch “Auto/Off/Run” is used to start and stop the engine. In the Off position, the control does not draw power. Run position will begin the start sequence. Auto position will wait to start until the remote start signal is received.

LOCAL RESET

Clearing a fault requires the operator to “Reset” the control. This can be accomplished by placing the key switch in the OFF position.

KEY PAD

A four button keypad, labeled with “Menu”, “Up”, “Dn”, “Enter”, is used to program the control and start the engine in the Run position

DUAL FLOAT CONNECTION

The EMGRT1 has a remote start input located on the bottom of the enclosure. The receptacle is designed mate to a dual float or single float switch mechanism. This input will activate the remote start sequence when the float or floats call for the engine to start. In the single float configuration, the float is closed and the engine will start and run. When the float opens, the engine will stop. In a dual float configuration, both floats must be closed to start and run the engine. Once the engine has started, it will continue to run until both the upper and lower floats open causing the engine to stop.

ENGINE SENDERS

Engine information is collected using senders. Oil pressure, engine temperature, battery voltage and speed are measured. Fuel level is optional.

OIL PRESSURE SENDER

The oil pressure sender is a resistive type measurement device. The sender scale is 0 – 100 psi which corresponds to resistance scale of 240 – 33 ohms. The Controls, Inc part number is an SD0006. The Stewart Warner part number for the sender is an F-279-B and may be available at a local parts store. Any sender with these characteristics will suffice.

FUEL LEVEL SENDERS

The fuel level sender is based on a 0 to 100% level. The resistance scale of the default fuel level sender is 240 – 33 ohms respectively. If a sender is attached, the % fuel will be displayed and a corresponding 20% pre alarm and a 1% shut down will become active.

SPEED SENDER

Engine RPM is measured through a mag pick up located either on the injector pump housing or the flywheel housing. A minimum of 3 VAC output is required for the control panel to sense the speed of the engine.

LOW COOLANT LEVEL

A digital input is available on the circuit board terminal strip position 9. Connecting a normally open, low coolant level switch to this input will activate a shutdown with a “Low Coolant Level” message on the LCD display. The switch function needs to close the circuit to ground when activated. A pre alarm will also be displayed if the engine is not running.

LOW OIL LEVEL

A digital input is available on the circuit board terminal strip position 10. Connecting a normally open, low oil level switch to this input will activate a shutdown with a “Low Oil Level” message on the LCD display. The switch function needs to close the circuit to ground when activated. A pre alarm will also be displayed if the engine is not running.

LOW FUEL LEVEL

A digital input is available on the circuit board terminal strip position 11. Connecting a normally open low fuel level switch to this input will activate a shutdown with a “Low Fuel Level” message on the LCD display. The switch function needs to close the circuit to ground when activated. A pre alarm will also be displayed if the engine is not running.

Section 4 – Controller Outputs

LCD DISPLAY

A 32 Character 2 Line Backlit Liquid Crystal Display provides the visual indications to the operator. Top row shows a continuous display of Engine Temp / RPM / Oil Pressure while the bottom row displays Fuel Level (if a sender is used) / Battery Voltage / Engine Hours. Shutdown messages will be displayed and pre alarm messages will periodically scroll across.

FUEL RELAY

The fuel relay is rated at 10 amps and provides battery power to the fuel solenoid. In some cases, power is also supplied to the battery charging alternator. If so, a blocking diode must be used to prevent the alternator from back feeding the fuel solenoid. This run signal is located at terminal 18.

CRANK RELAY

The crank relay is rated at 10 amps and provides battery power to starter motor slave relay. This signal is located at terminal 19.

PRE ALARM RELAY

The pre alarm relay is a rated at 2 amps and closes on all pre alarms. This relay is used to drive an alarm horn mounted to the side of the enclosure. The common is located on terminal 20 and the normally open contact is located on terminal 21.

FAULT RELAY

The fault relay is a dry contact Form C rated at 2 amps and closes on all faults. The common is located on terminal 22 and the normally open is located on terminal 23.

GLOW PLUG RELAY

The glow plug relay is a switch B+ signal rated at 2 amps and closes prior to engine start. The signal is located on terminal 25.

Section 5 – Control Board Configuration

TERMINAL STRIP CONNECTIONS (Located on Circuit Board)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

TERMINAL STRIP CONNECTOR DEFINITIONS

1	Battery Positive	16	N/A
2	Battery Negative	17	Battery Positive Common Contact
3	MPU +	18	Power to Fuel Solenoid
4	MPU -	19	Power to Crank Solenoid
5	Oil Pressure	20	Pre Alarm Common
6	Temperature	21	Pre Alarm Normally Open
7	Fuel Level Sender	22	Fault Common
8	Dual Float Connection	23	Fault Normally Open
9	Low Water Level	24	Dual Float Connection
10	Low Oil Level	25	Power to Glow Plug Relay
11	Low Fuel Level	26	Dual Float Connection
12	Emergency Stop		

BULKHEAD PLUG PIN / WIRE COLOR

Pin	Color	Function
S	RED	Battery + to EM Plus
D	Yellow/R	Battery + to Start Slave Relay
F	Black	Battery -
R	Brown/R	Battery + to Fuel Solenoid
G	Brown/R	Battery + to Charge Alt Excite
P	Black*	MPU + *Twisted Pair
A	Clear *	MPU - *Twisted Pair
C	Blue	Oil Pressure
H	Green	Temperature
E	LT. Blue	Fuel Level
J	Violet/Red	Battery + to Glow Plug Relay

Section 6 – Dipswitch Configuration

DIPSWITCH LOCATION

The dipswitch bank is located inside the enclosure on the bottom of the control board. You must remove the four large stainless steel screws to gain access to the inside of the control. There is one bank of red dipswitches and they are numbered from top to bottom, 1 to 8. The OFF position is considered to be when the switch is push toward the inside of the board. The ON position is considered to be when the switch is pushed toward the outside edge of the circuit board.

CHANGING DIPSWITCH SETTING

When making a change to a dipswitch setting, you need to cycle the power to the control before those settings become active. (Excluding dipswitch 2)

Dipswitch 1	Not Used
Dipswitch 2	Turn ON to recalibrate DC voltage to a known 12.6 vdc source.
Dipswitch 3	Not Used
Dipswitch 4	Turn ON to change the 8 second delay prior to start to 4 seconds.
Dipswitch 5	Turn ON to enable Self Charging Battery System (SCBS). See SCBS prior to use.
Dipswitch 6	Not Used
Dipswitch 7	Turn ON to enable Glow Plug operation.
Dipswitch 8	Turn ON to restrict the ability to change the "CONTROL FUNCTION" and "ENGINE FUNCTION" settings.

Section 7 – Key Pad Operation

MENUS

The control panel has menus to view, set and adjust parameters. These menus are accessible via a four button key pad located on the face of the control panel.

Engine Function Menu

Control Function Menu

ACCESSING MENUS

- 1) Access menus – Press and Hold ENTER Button, then press MENU button simultaneously.
- 2) Pressing the DN Button will scroll down through the menus listed above. The UP Button will scroll up.
- 3) Press ENTER Button to access the individual menu options or information.
- 4) Press MENU Button to back out of the previously chosen option.

CHANGING PARAMETERS

- 1) In order to make changes Dipswitch 8 must be placed in the OFF position and the control must be turned OFF and then to AUTO.
- 2) Once the changes are complete and you desire to lock out any further changes, place the control in the OFF position and change Dipswitch 8 to ON. The control will allow the viewing of the settings, but not the ability to change them.

Section 8 – Control Set Up

The EMGRT1 has been programmed at the factory for power unit applications. Changes may be made to the control configuration using the front panel keypad. To gain access to the Engine and Control Functions menu, press and maintain the Enter button. While holding the Enter button, press the Menu button

Default Configuration Tables

Engine Settings EMGRT1

Sender	Type	LLPA	LLA	HLPA	HLA
Speed	MPU	Na	Na	Na	2550
Oil Press	SW to PSI	15	20	Na	Na
Engine Temp	SW to F	Na	Na	230	235
Battery	Analog	12/24	Na	15/30	Na

LLPA = Low Level Pre Alarm

LLA = Low Level Alarm

HLPA = High Level Pre Alarm

HLA = High Level Alarm

Na = Not Activated

Control Settings

Parameter	Setting	PA	A	AWRO
Number of Cranks	5			
Crank Duration	10 Sec			
Crank Rest Duration	10 Sec			
<i>Optional Digital Inputs</i>				
Digital Input 1	Low Water Level	Yes		Yes
Digital Input 2	Low Oil Level	Yes		Yes
Digital Input 3	Low Fuel Level	Yes		Yes

PA = Pre Alarm

A = Alarm

AWRO = Alarm While Running Only

Programming Guide

ENGINE STARTING

1. Turn key to "Run" position. A "Press & Hold Enter to Crank" message will appear in the display.
2. Press ENTER to start engine.

MULTI FUNCTION KEY PAD

A four button keypad, labeled with MENU, UP, DN, ENTER is used to:

1. View and Program the EM Plus settings.
 2. Start Engine.
-

ACCESSING MENUS

1. Turn Key Switch to "Auto" Position
2. Press and hold ENTER, then press MENU button to access the seven menus.
3. To make changes, Turn Dip Switch 8 OFF (the left).

Menu Name	Menu Function
ENGINE FUNCTION	Configure Engine Senders, Alarms and Thresholds
CONTROL FUNCTIONS	Configure Control Settings, Digital Inputs, Running Time

3. Utilize DN and UP buttons to shift between menus.
4. Press ENTER to access a menu or option.
5. Press MENU to back out of a menu or option.

LOCK OUT CAPABILITY

1. Turn Dipswitch 8 to ON Position to lock values.
2. Allows operator to view programming only.

ENGINE FUNCTIONS

(Press Enter to Access Below)

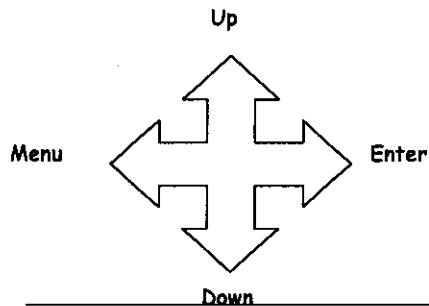
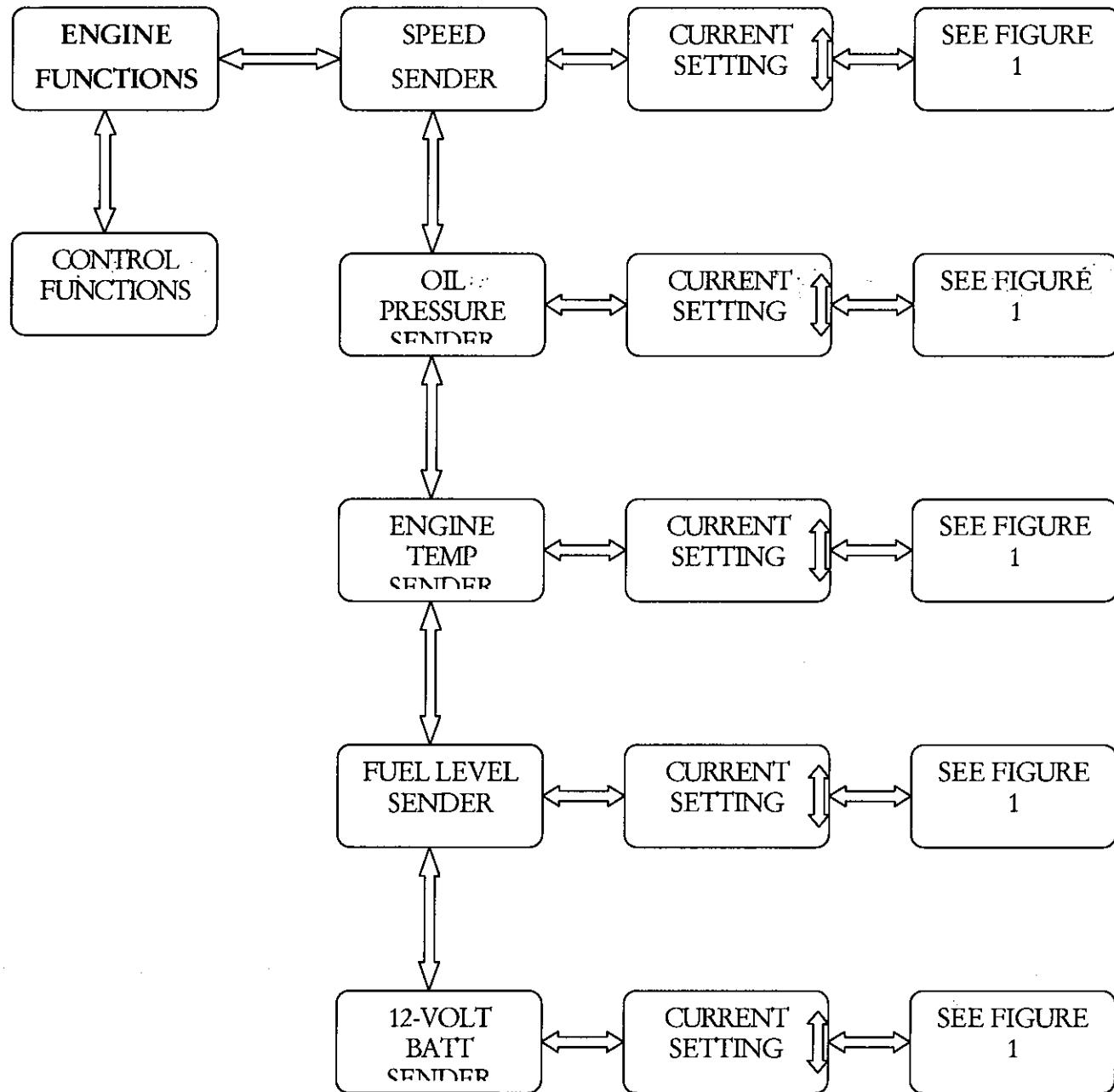
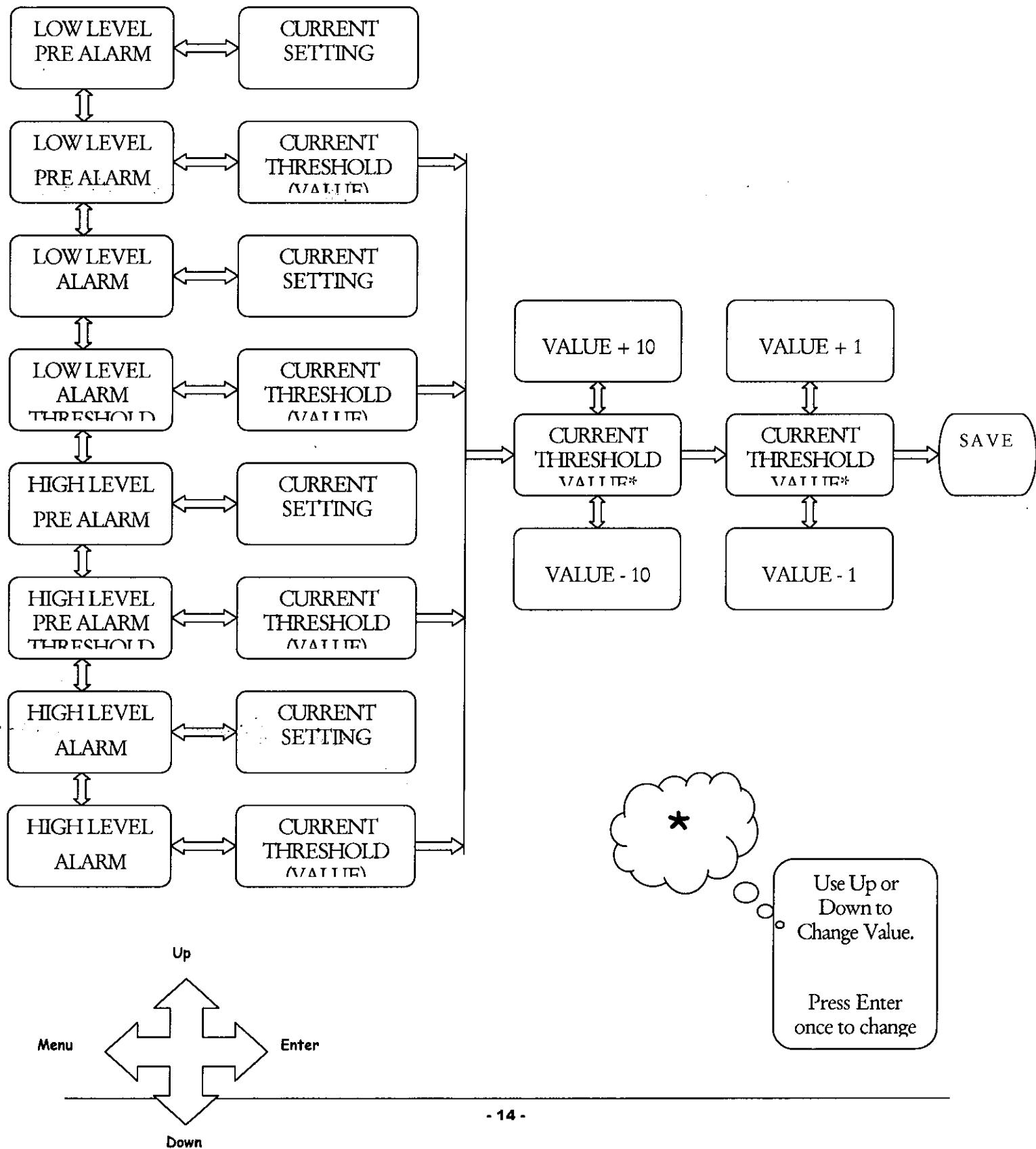


FIGURE 1

Section 9 – Sequence of Operation

OFF POSITION

1. With the Key Switch in OFF, the control will not be powered.

RUN POSITION

START SEQUENCE

The EMGRT1 verifies the engine is stopped prior to initiating the Start Sequence.

1. With the Key in the RUN position, the Fuel Relay will close battery positive (+) to the Fuel Solenoid.
2. If the Glow Plug option is enabled, a preheat sequence will take place. The length of time the glow plug remains active will depend on the engine temperature.
3. The LCD will display “Push & Hold Enter to Crank”. Pressing the Enter button will close the crank relay. The button must be depressed to continue cranking. The EMGRT1 will sense the engine speed and open the crank relay once the engine starts. If a crank rest period is reached prior to the engine starting, the crank relay will open and starting will be inhibited for a 10 sec period.
4. The LCD display will display “Cranking 1 of X” during cranking. During crank rest, the Crank relay will open and LCD will display “Resting 1 of X”.
5. For starter protection, EMGRT1 senses a running engine through two different inputs. The Primary Crank Termination signal is engine speed. If the speed sender is failed, Oil Pressure build up can cause the EMGRT1 to enter the Running Mode. **NOTE:** The EMGRT1 will re-initiate the start sequence if the engine has stalled and a Run request is still detected.

ENGINE PROTECTION BYPASS

1. After Crank Termination is detected, the EMGRT1 will enter the “Engine Protection Bypass” period. Oil Pressure, Fuel Rate, Engine Temp, DC Battery and Hours will be displayed. Only Speed will be monitored for protection.
2. Upon completion of the Bypass period, the LCD will display “Engine Protection Enabled”. This means any programmed EMGRT1 engine pre alarm or fault will become active.

RUN MODE

1. The EMGRT1 is in a monitoring mode of all programmed parameters.
2. If a pre alarm occurs during the Run Mode, the Yellow LED will light and the Pre Alarm Relay will close. If the affected parameter is a continuously displayed parameter (Oil Press, DC Volts, Temp) with pre alarms active in the EMGRT1 control, the value will flash. If the affected parameter is monitored, but not displayed continuously, a message will be flashed on the LCD every 15 seconds.
3. If an EMGRT1 monitored fault occurs during the Run Mode, the Red LED will light and the Fault Relay will close. The Fuel Relay will open causing the engine to stop. A message on the LCD will indicate what fault occurred. The EMGRT1 control must be "Reset" by placing the Key in the OFF position prior to a restart attempt.

AUTO POSITION

1. The EMGRT1 will display "Unit in Auto".
2. If a remote start signal is received, the control will begin *an 8 second countdown* prior to starting the engine. Alarm Horn will sound.
3. If the Glow Plug option is enabled, a preheat operation will take place prior to the engine cranking. The length of time the glow plug relay is enabled will vary based on engine temperature.
4. The control monitors the engine as in the RUN MODE.
5. Once the Remote Start signal has been removed the control will stop power to the fuel system causing the engine to stop.
6. Once the engine has stopped, the LCD will display "Unit in Auto" and the control will be waiting another Remote Start signal.

Section 10 – Self-Charging Battery System

The Self Charging Battery System (SCBS) included with this control is designed to maintain a high level of battery capacity during extended periods of standby operation. However, care must be taken when using this system due to the ability of the control to start and run the engine while in the "Auto" mode.

Conditions

- 1) Control must be in "Auto".
- 2) Dipswitch 5 must be in the ON position.
- 3) Displayed DC Voltage must be at or below 12.2 for 1 minute.

Results

- 1) Control will begin the 8-second countdown to starting.
- 2) Control will start and run the engine at the programmed Warm Up speed for 15 minutes. During this run the display will flash a message of "Engine Start Low Battery Charge".
- 3) Control will stop the engine and wait a minimum of 60 minutes before the SCBS will initiate another run.

Section 11 – Warranty

CONTROLS, INC. is herein called "Seller". The person, firm or corporation to whom or which the sale is made is herein called "Buyer". Seller warrants to the Buyer that all products furnished under this order will conform to Seller's specification, drawings as described in its current catalog or quotation and will be free from defects in materials and workmanship. Seller must approve other special requirements asked for by the Buyer in its purchase order in writing. Parts replaced or repaired in the warranty period shall carry the unexpired portion of the original warranty. The foregoing is subject to the provisions that in no case will the total warranty period extend beyond twelve (12) months from date seller ships equipment from point of sale.

The Liability of Seller thereunder is limited to replacing or repairing at Seller's factory any part or parts which have been returned to the Seller and which are proved by buyer as defective or not conforming to Seller's specifications, drawings or other written descriptions, accepted by Seller, provided that such part or parts are returned by the buyer within thirty (30) days after such defect is discovered. All items returned to Seller for repair or replacement must be sent freight prepaid to its factory. Buyer must obtain Seller's Return Goods Authorization prior to returning items. The above conditions must be met if warranty is valid. Seller will not be liable for any damage done by unauthorized repair work, unauthorized misapplication in non-suitable environment.

In no event shall the Seller be liable for loss, damage, or expense directly or indirectly arising from the use of the units, or from any other cause, except as expressly stated in the warranty. Seller makes no warranties, express or implied, including any warranty as to merchantability or fitness for a particular purpose or use. Seller is not liable for and buyer waives any right or action it has or may have against seller for any consequential or special damages arising out of any breach of warranty, and for any damages buyer may claim for damage to any property or injury or death to any person arising out of its purchase or the use, operation or maintenance of the product. Seller will not be liable for any labor subcontracted or performed by buyer for preparation of warranted item for return to Seller's factory or for preparation work for field repair or replacement. The Seller will not consider invoicing of Seller for labor either performed or subcontracted by buyer as a liability. This warranty shall be exclusive of any and all other warranties express or implied and may be modified only by a writing signed by an officer of the Seller. With respect to accessories supplied by Seller, but manufactured by others, there is no warranty of any kind, express or implied, and specifically there is no warranty of merchantability or fitness, except as may be set forth in any warranty the manufacturers have made to Seller and which can be passed to the Buyer.

Buyer has not relied and shall not rely on any oral representation regarding the products sold thereunder and any oral representation shall not bind seller and shall not be part of warranty.

Appendix F

HONEYWELL UDC1200 & UDC1700 MICRO-PRO

UNIVERSAL DIGITAL CONTROLLER PRODUCT MANUAL (51-52-25-123-EN)

2. SELECT MODE

Select mode is used to access the configuration and operation menu functions. It can be accessed at any time by holding down  and pressing . In select mode, press  or  to choose the required mode, press  to enter. An unlock code is required to prevent unauthorised entry to Configuration, & Setup modes. Press  or  to enter the unlock code, then press  to proceed.

Mode	Upper Display	Lower Display	Description	Default Unlock Codes
Operator	OPEr	SLCt	Normal operation	None
Set Up	SETP	SLCt	Tailor settings to the application	10
Configuration	Conf	SLCt	Configure the instrument for use	20
Product Info	Info	SLCt	Check manufacturing information	None
Auto-Tuning	Autn	SLCt	Invoke Pre-Tune or Self-Tune	0

Note: The instrument will always return automatically to Operator mode if there is no key activity for 2 minutes.

3. CONFIGURATION MODE

First select Configuration mode from Select mode (refer to section 2).

Press  to scroll through the parameters, then press  or  to set the required value. Press  to accept the change, otherwise parameter will revert to previous value. To exit from Configuration mode, hold down  and press  to return to Select mode.

*Note: Parameters displayed depends on how instrument has been configured. Refer to user guide (available from your supplier) for further details. Parameters marked * are repeated in Setup Mode.*

4. SETUP MODE

Note: Configuration must be completed before adjusting Setup parameters.

First select Setup mode from Select mode (refer to section 2). The MAN LED  will light while in Setup mode. Press  to scroll through the parameters, then press  or  to set the required value.

To exit from Setup mode, hold down  and press  to return to Select mode.

Note: Parameters displayed depends on how instrument has been configured.

CONFIGURATION RECORD SHEET

<i>Parameter</i>	<i>Lower display</i>	<i>Setting</i>
Input Range/Type	inPt	J.F
Scale Range Upper Limit	rUL	-
Scale Range Lower Limit	rLL	-
Decimal point position	dPos	-
Control Type	cTyp	SnGL
Primary Output Control Action	cCtrl	dir
Alarm 1 Type	ALR1	P-HI
High Alm 1 value*	PHA1	160
Low Alm 1 value*	PLA1	-
Band Alm 1 value*	bAL1	-
Dev. Alm 1 value*	dAL1	-
Alm 1 Hysteresis*	RHY1	-
Alarm 2 Type*	ALR2	-
High Alm 2 value*	PHA2	-
Low Alm 2 value*	PLA2	-
Band Alm 2 value*	bAL2	-
Dev. Alm 2 Value*	dAL2	-
Alm 2 Hysteresis*	RHY2	-
Loop Alarm	LAEn	-
Loop Alarm Time*		-
Alarm Inhibit	Inh	-
Output 1 Usage	USE 1	Pri
Linear Output 1 Range	cTyp 1	-
Retransmit Output 1 Scale maximum	ro1H	-
Retransmit Output 1 Scale minimum	ro1L	-
Output 2 Usage	USE 2	-
Lin. O/P 2 Range	cTyp2	-
Retransmit Output 2 Scale maximum	ro2H	-
Retransmit Output 2 Scale minimum	ro2L	-
Output 3 Usage	USE 3	-
Linear Output 3 Range	cTyp3	-
Retransmit Output 3 Scale maximum	ro3H	-
Retransmit Output 3 Scale minimum	ro3L	-
Display Strategy	dSP	-
Comms Protocol	Prot	-
Bit rate	bAud	-
Comms Address	Addr	-
Comms Write	cEn	-
Digital Input Usage	dIn	-
Config Lock Code	cLoc	-

SETUP RECORD SHEET

<i>Parameter</i>	<i>Lower display</i>	<i>Setting</i>
Input Filter Time constant	F, IT	-
Process Variable Offset	OFFS	-
Primary (Heat) power	PPbU	-
Secondary (Cool) power	SPbU	-
Primary Proportional Band	Pb P	0.0
Secondary Proportional Band	Pb S	-
Automatic Reset (Integral Time)	ARSt	-
Rate (Derivative Time)	rATE	-
Overlap/Deadband	DL	-
Manual Reset (Bias)	b, AS	-
Primary ON/OFF Differential	d, FP	-
Secondary ON/OFF Diff.	d, FS	-
Prim. & Sec. ON/OFF Diff.	d, FF	-
Setpoint Upper Limit	SPuL	200
Setpoint Lower limit	SPLL	75
Primary Output Power Limit	OPuL	-
Output 1 Cycle Time	CT1	-
Output 2 Cycle Time	CT2	-
Output 3 Cycle Time	CT3	-
High Alarm 1 value	PHAI	160
Low Alarm 1 value	PLAI	-
Deviation Alarm 1 Value	dRAL1	-
Band Alarm 1 value	baL1	-
Alarm 1 Hysteresis	AHY1	-
High Alarm 2 value	PHA2	-
Low Alarm 2 value	PLA2	-
Deviation Alarm 2 Value	dRAL2	-
Band Alarm 2 value	baL2	-
Alarm 2 Hysteresis	AHY2	-
Loop Alarm Time	LAT1	-
Auto Pre-tune	APT	-
Auto/manual Control selection	PoEn	EnAb
Setpoint ramping	SPr	-
SP Ramp Rate Value	rP	-
SP Value	SP	190
SP1 Value	SP1	-
SP2 Value	SP2	-
Setup Lock Code	5loc	-

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