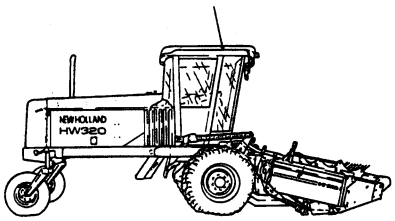
Please cut where indicated and insert the label into the plastic pocket on the spine of the binder.



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HW300, HW320, HW340

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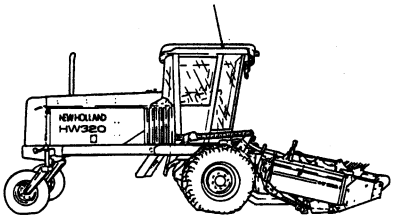

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Vol. 1

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DIODES

Diodes act as rectifiers permitting electrical current to flow through them in one direction but not the other. Diodes are used to prevent arcing at the contact points of relays and momentary switches. The windrower header tilt down solenoid has a diode in the circuit and there is a diode in the header soft lower circuit. Diodes are also used in the alternator to change the alternating current to direct current.

Diodes can fail in either an open condition, in which no current passes in either direction, or a closed condition in which current flows in both directions. Failure usually occurs because of an overload or a short circuit.

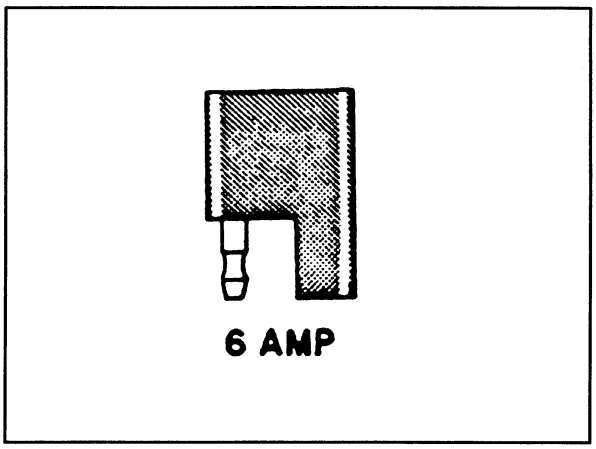


Figure 1-4

CAUTION: DO NOT SHORT WIRES TO GROUND TO DETERMINE IF VOLTAGE IS PRESENT (SPARK TEST). THIS WILL CAUSE DIODES TO FAIL.

the HW340 cannot withstand the full battery voltage, less than six volts DC is supplied to the header forward and header reverse outputs.

If an output is shorted, the WES will make no attempt to cut power at that output. However, the driver internal to the WES is self-protected and removes output voltage when the driver overheats from too much current. The output voltage is restored when the driver cools.

8. **ENGINE HOURS**

   This item allows modification of the engine hours clock. When this item is selected, pressing the right turn signal selects the digit to be changed. The selected digit blinks. The "hand" switch changes the value. The new value will be stored in the non-volatile memory when the ignition key is turned off.

9. **HEADER HOURS**

   This item allows modification of the header hours clock. When this item is selected, pressing the right turn signal selects the digit to be changed. The selected digit blinks. The "hand" switch changes the value. The new value will be stored in the non-volatile memory when the ignition key is turned off.

10. **FAULT HISTORY**

    This item allows examination of the fault/warning history of the windrower sensors and outputs. Information is tabulated on the state of each sensor and output. Type of fault/warning, number of occurrences, and engine hours at the last event are saved. The "hand" switch selects a description of the fault or warning. The bottom text line will display the number of occurrences of the fault and the engine hours at the last occurrence when the right turn signal is pressed. All of the history information can be cleared by using the initialization turn-off method with a value of 10 displayed at power off (see menu item 13).

11. **REV LEVEL** - Displayed as 8-digit software part number, production rev. level (letter), test rev. level (number).

    This is the number of the software release.

12. **HEADER TEST**

    On the HW340, when the header drive switch is turned ON, the header can be turned slowly in the forward or reverse direction for special purposes, such as bleeding air from the hydraulic system. Increase or decrease the speed by pressing the header speed increase/decrease switch. In order to allow engine start, the fuel solenoid is activated whenever either the header drive switch or the header reverse switch is turned on. The fuel solenoid will be turned off whenever this menu item is exited or the ignition key is turned off.

13. **INITIALIZE**

    (Special item, reserved for engineering development, manufacturing and service personnel.)

    When operating the initialization, the display is set to a value by pressing the "hand" switch when the ignition key is turned off. Each value code corresponds to a result as follows:

WES Does Not Power Up (Switched Power Failure)

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
1.	Key off.	Check 10A WES fuse, F-02 in right console.	Fuse blown. Fuse good.	Replace fuse. Go to next step.
2.	Uncouple the middle connector in the floor under the right console (C004).	Check continuity of FM102-B at pin B to ground.	No continuity. Continuity.	Open circuit or poor connection in FM102-B between C004 and ground point "A". Check ground point "A" for proper connection. Repair. Go to next step.
3.	Reconnect C004. Disconnect C002 from the bottom of the console module.	Check continuity of CM102-B at pin D1 to ground.	No continuity. Continuity.	Open circuit or poor connection in CM102-B between C004 and C002. Repair. Go to next step.
4.	Key on.	Check for battery voltage of CM57-O/LT BL at pin C3 of C002.	Battery voltage. Low or no voltage.	Defective console module. Replace. Go to next step.
5.	Turn key off. Reconnect C002. Remove 10A WES fuse, F-02, in right console. Turn key on.	Check for voltage of CM40-O/R at the fuse holder.	Battery voltage. Low or no voltage.	Open circuit or poor connection in CM57-O/LT BL between fuse holder and C002. Repair. Go to next step.
6.	Turn key off. Reinstall 10A fuse. Turn key on.	Check for voltage at IGN terminal of key switch.	Battery voltage. Low or no voltage.	Open circuit or poor connection in CM40-O/R between key switch and fuse holder. Repair. Go to next step.
7.	Key off.	Check for voltage at BAT terminal of key switch.	Battery voltage. Low or no voltage.	Defective key switch. Replace. Go to next step.
8.	Uncouple the rear connector under the floor of the right console, C005.	Check for voltage of FM19-R/W at pin 8 of C005.	Battery voltage. Low or no voltage.	Open circuit or poor connection in CM19-R/W between C005 and key switch. Repair. Go to next step.

GROUND SPEED CIRCUIT

Operation

The brake disc located in the brake housing on the right wheel has a series of holes that pass by the ground speed magnetic pickup as the wheel is turning. As these holes move by the pickup, a signal is generated and fed to the WES, which converts this signal to a reading on the display.

Troubleshooting

Before attempting to troubleshoot a problem, review the information under the "General Troubleshooting" heading in this section along with the material in the "General Electrical" section of this book.

Operate the machine and observe the problem. Follow the systematic step-by-step instructions in the chart to locate and correct the problem. Follow all the instructions carefully.

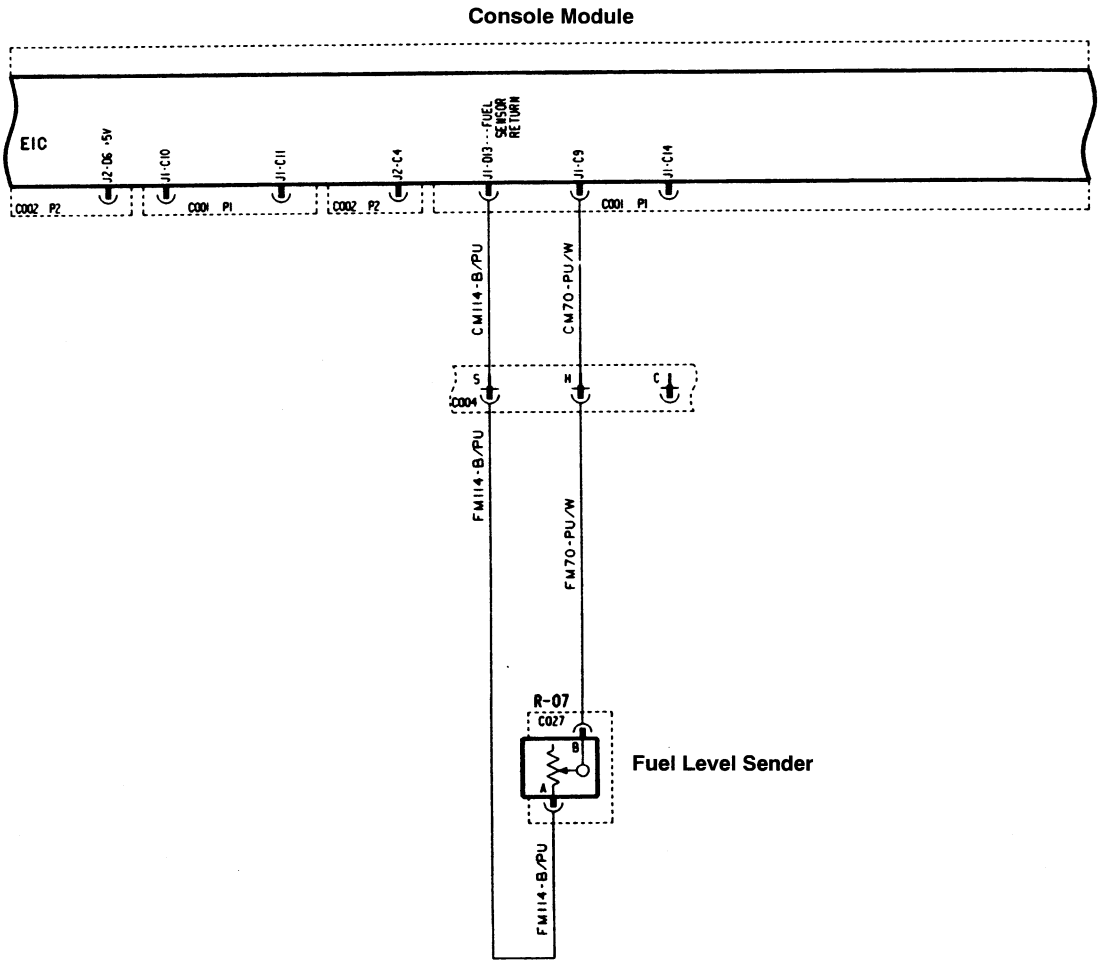
Ground Speed Display Does Not Function

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
1.	Disconnect the ground speed magnetic speed pickup.	Check the resistance of the pickup.	Resistance is less than 1000 ohms or greater than 5000 ohms. Resistance is between 1000 and 5000 ohms.	Pickup is defective. Replace. Go to next step.
2.	Same as step 1.	Check FM98-B (ground) wire for continuity between the sender connector, C048, and ground.	No continuity. Continuity.	Open circuit or poor connection in FM98-B. Repair. Go to next step.
3.	Uncouple connector C012 in the right console.	Check for continuity in FM41-O/Y from the ground speed pickup to pin W in the connector.	No continuity. Continuity.	Open circuit or poor connection in the wire between connector C012 and the speed pickup. Repair or replace. Go to next step.
4.	Disconnect C002 on the bottom of the EIC.	Check for continuity of CM41-O/Y from the W pin of connector C012 and the D11 pin on C002 plug.	No continuity. Continuity.	Open circuit or poor connection in the wire between connector C012 and C002 plug. Repair or replace. Defective console module. Replace.

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
15.	Key off. Thermostat switch in max cool position. Disconnect wires to the thermostat switch, S-25.	Check continuity of the thermostat switch.	No continuity. Continuity.	Faulty thermostat switch. Replace. Go to next step.
16.	Reconnect all switches. Key on. A/C-FAN switch in A/C position. Thermostat set to max cool position.	Check voltage of AC2-T/GY wire at thermostat switch.	Battery voltage. Low or no voltage.	Open circuit or poor connection in CA87-T/DK BL, CM87-T/DK BL, or FM87-T/DK BL between thermostat and A/C clutch relay. Repair. Open circuit or poor connection in AC1-T/Y or AC2-T/Y wires between 6A circuit breaker and thermostat switch. Repair.

Front and Rear Work Lights Do Not Work

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
1.	If both the road lights and work lights do not function, refer to "Road and Tail Lights Do Not Work" section.			
2.	Key off.	Check both 20A work light fuse and 20A road light fuse.	Fuse blown. Fuse good.	Replace fuse. Go to next step.
3.	Key off.	Swap A/C power and work light relays. Check for work light operation. (Key must be on for work lights to operate.)	Lights work. Lights do not work.	Defective work light relay. Replace. Go to next step.
4.	Key off. Remove work light relay.	Check voltage of FM74-R/Y at the #30 socket of the work light relay base.	Low or no voltage. Battery voltage.	Go to next step. Go to step 6.
5.	Same as step 4.	Check voltage of FM46-R at the 20A work lights fuse.	Low or no voltage. Battery voltage.	Open circuit or poor connection in FM46-R between seat/service light circuit breaker and fuse. Repair. Open circuit or poor connection in FM74-R/Y between fuse and relay.
6.	Key off. Uncouple the connector, C045, at the road/work light switch.	Pull light switch to work light position. Check continuity of switch between terminals B and H.	No continuity. Continuity.	Defective switch. Replace. Go to next step.
7.	Key off. Uncouple square 9 pin connector, C010, in right console.	Check continuity of CA66-DK BL/W between light switch connector and C010 at pin 2.	No continuity. Continuity.	Open circuit or poor connection in CA66-DK BL/W between light switch and C010. Repair. Go to next step.



FUEL LEVEL GAUGE CIRCUIT

Figure 1-34

ENGINE FUEL SOLENOID CIRCUIT (HW340 SN 620761 AND ABOVE, ALL HW320 AND HW300)

Operation

The engine fuel solenoid controls fuel feed to the engine. When the ignition switch is turned to start, the relay K-07 is energized and completes the circuit to the fuel solenoid L-16 through the ignition terminal of the key switch. When the start switch is released, power to the solenoid is delivered through the WES. If the engine coolant temperature is too high, the engine oil pressure is too low or the hydraulic oil charge pressure is too low, the WES cuts power to the fuel solenoid and the engine is shut off. The solenoid is built into the fuel injector pump and is grounded by this contact with the engine. The relay, K-07, is attached to the bottom lug on the fuse strip in the right console. It is most easily reached by removing the panel on the side of the cab below the window on the right side.

Troubleshooting

If the hydraulic oil pressure, the engine oil pressure or the engine coolant temperature goes out of limits the WES will cut power to the fuel solenoid and shut off the engine. The bottom line on the display identifies the fault condition. Check these faults before troubleshooting the fuel solenoid circuit.

Before attempting to troubleshoot a problem, review the information under the "General Troubleshooting" heading in this section along with the material in the "General Electrical" portion of this section.

Operate the machine and observe the problem. Match the problem to one of the headings on the following charts. Follow the systematic step-by-step instructions in the chart to locate and correct the problem. Follow all the instructions carefully.

Starter Will Not Turn Over Engine

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
1.	Key off.	Check 5A start fuse in right console.	Blown fuse. Good fuse.	Replace fuse. Go to next step.
2.	Key off.	Check voltage at both posts of the 25 A key main circuit breaker located in the main electrical panel.	No or low voltage on both posts. Battery voltage on one post only. Battery voltage on both posts.	Open circuit or poor connection in FM16-R between circuit breaker and start relay. Repair. Defective circuit breaker. Replace. Go to next step.
3.	Key off.	Check voltage at the BAT terminal of the key switch.	No or low voltage. Battery voltage.	Open circuit or poor connection in FM19-R/W or CM19-R/W between key switch and circuit breaker. Repair. Go to next step.
4.	Remove 5A start fuse.	Check voltage at START terminal of key switch while holding key in "start" position.	No or low voltage. Battery voltage.	Defective switch. Replace. Go to next step.
5.	Key off.	Check continuity of CM2-W/B between key switch and 5A start fuse.	No continuity. Continuity.	Open circuit in CM2-W/B between switch and fuse. Go to next step.

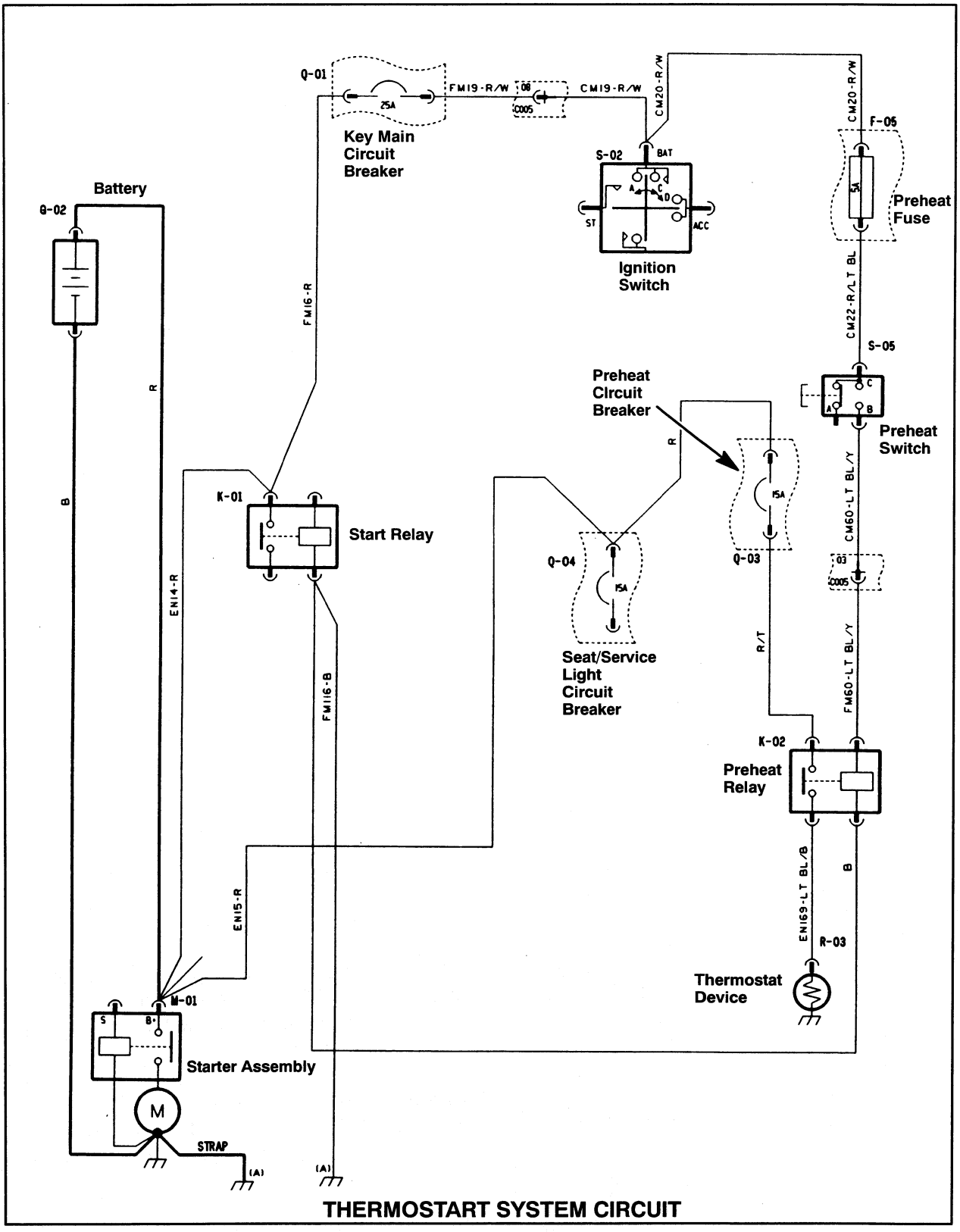

Q-01
25A
FM19-R/W
C005
CM19-R/W
CM20-R/W
Key Main
Circuit
Breaker
S-02
BAT
ST
ACC
Ignition
Switch
F-05
5A
Preheat
Fuse
Battery
G-02
FM16-R
R
B
CM22-R/LT BL
S-05
Preheat
Circuit
Breaker
Preheat
Switch
K-01
Start Relay
EN14-R
Q-04
15A
Seat/Service
Light
Circuit
Breaker
Q-03
CM60-LT BL/Y
C005
R/T
FM60-LT BL/Y
FM116-B
K-02
Preheat
Relay
EN15-R
EN169-LT BL/B
R-03
Thermostat
Device
M-01
S
B+
Starter Assembly
M
STRAP
(A)
THERMOSTART SYSTEM CIRCUIT

Figure 1-48

Troubleshooting

Perform these tests first:

- Batteries should be fully charged (specific gravity of 1.28 g/cm^3) in order for these tests to be valid.
- Check the ground strap from the engine block to the frame. There must be a good connection.
- Check battery plus (+) connection to the electrical system. Battery cables should be clean, tight and corrosion free.
- Ambient temperature should be between 20° and 30° C (68° and 86° F). Temperatures outside this range will strongly affect results.
- Check that alternator belt is adjusted to the proper tension.

Troubleshooting

Before attempting to troubleshoot a problem, review the information under the "General Troubleshooting" heading in this section along with the material in the "General Electrical" portion of this section.

Operate the machine and observe the problem. Follow the systematic step-by-step instructions in the chart to locate and correct the problem. Follow all the instructions carefully.

HYDRAULIC OIL TEMPERATURE SWITCH CIRCUIT

Operation

The hydraulic oil temperature switch is mounted in a tee in the hydraulic line just behind the front frame. A small voltage is applied by the WES to the hydraulic oil temperature switch, S-16, which is normally open. If the temperature of the hydraulic oil exceeds 99° C (210° F), the switch closes and the current flow through the circuit is sensed by the EIC. After one second, the display will show "W06 HYD OIL TEMP".

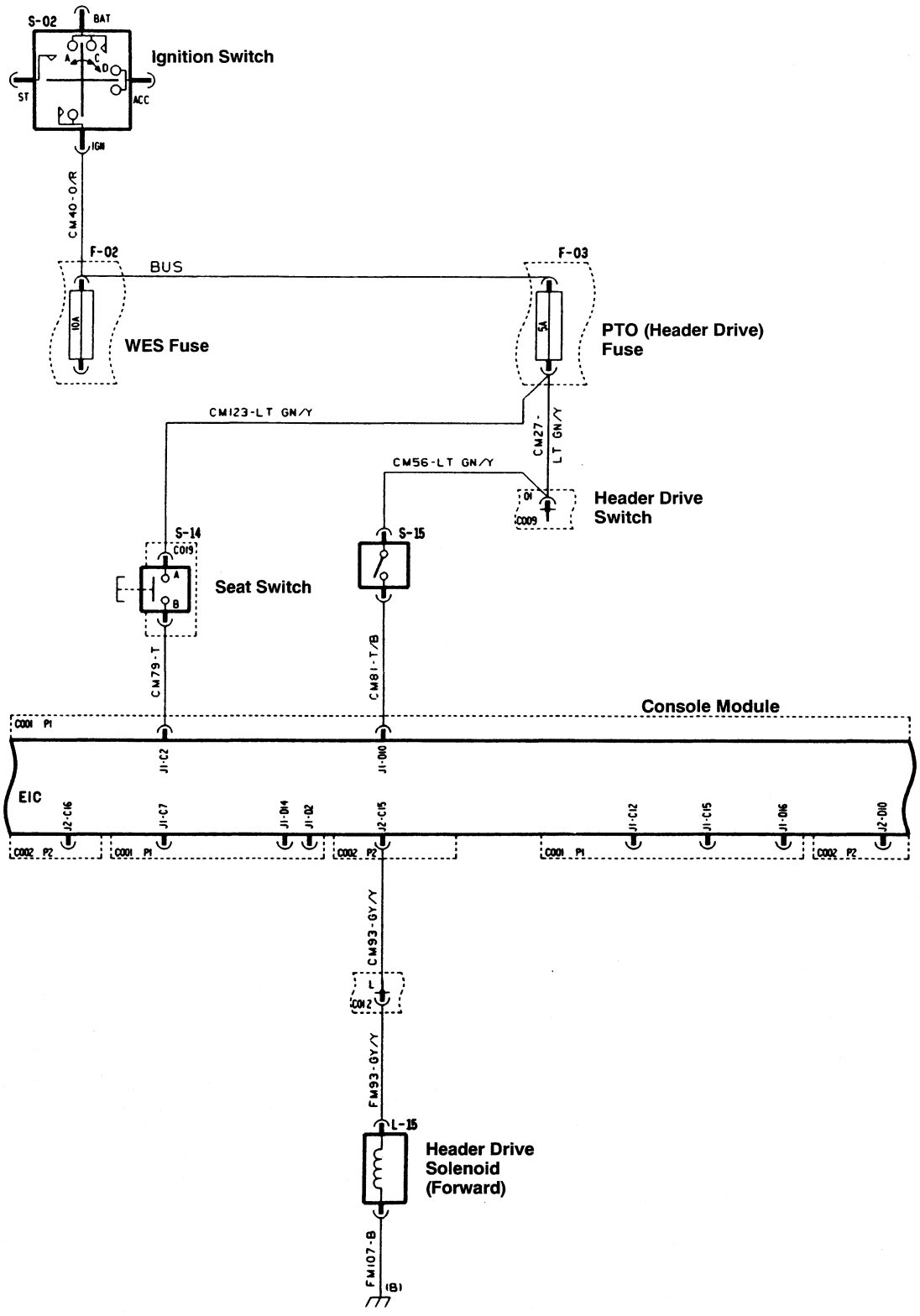
Troubleshooting

Before attempting to troubleshoot a problem, review the information under the "General Troubleshooting" heading in this section along with the material in the "General Electrical" portion of this section.

Operate the machine and observe the problem. Match the problem to one of the headings on the following charts. Follow the systematic step-by-step instructions in the chart to locate and correct the problem. Follow all the instructions carefully.

Hydraulic Oil Temperature Sender Does Not Function

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
1.	Press and hold the "open book" and "hand" buttons while turning the key on. Press the open book until menu item 6-DIAG: INPUTS is displayed.	Disconnect the hydraulic oil temperature sender. Jumper FM3-W and FM169-B.	Beep and flash. No beep or flash.	Defective sender. Replace. Go to next step.
2.	Same as step 1.	Ground FM3-W to frame.	Beep and flash. No beep or flash.	Open circuit or poor connection in FM169-B to ground point "B". Repair. Go to next step.
3.	Key off. Uncouple the front connector, C012, under the floor of the right console.	Check continuity of FM3-W between C012 at pin U and sender.	No continuity. Continuity.	Open circuit between C012 and sender. Repair. Go to next step.
4.	Key off. Disconnect C001 from top of the console module.	Check continuity of CM3-W between C001 at pin C12 and C012 at pin U.	No continuity. Continuity.	Open circuit in CM3-W between C001 and C012. Repair. Defective console module. Replace.



HEADER DRIVE CIRCUIT (HW300 AND HW320)

Figure 1-64

Header Will Not Reverse (HW300 and HW320)

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
1.	Press and hold the "open book" and "hand" buttons on the warning module while turning the key on. Press the "open book" button until menu item 6-DIAG: INPUTS is displayed.	Turn header reverse switch on.	Beep from WES and hazard lights flash. No beep or flash.	Go to step 5. Go to next step.
2.	Key off. Header reverse switch on.	Check continuity through header reverse switch.	No continuity. Continuity.	Defective switch. Replace. Go to next step.
3.	Key off. Disconnect top connector, C001, from console module.	Check continuity of CM136-GY/R between C001 at pin C7 and header reverse switch.	No continuity. Continuity.	Open circuit in CM136-GY/R between C001 and switch. Repair. Go to next step.
4.	Key off.	Check continuity of CM194-B between reverse switch and ground.	Continuity. No continuity.	Defective console module. Replace. Open circuit in B wire between switch and ground. Check ground point "D".
5.	Key off.	Check continuity of FM106-B between header reverse solenoid and ground.	No continuity. Continuity.	Open circuit in FM106-B between solenoid and ground. Check ground point "B". Repair. Go to next step.
6.	Press and hold the "open book" and "hand" buttons on the warning module while turning the key on. Press the "open book" button until menu item 7-DIAG: OUTPUT is displayed. Press the "hand" button until A-HDR DR REV is displayed. Press right turn signal to display 1.	Check voltage of FM171-B/R at header reverse solenoid.	Battery voltage. Low or no voltage.	Defective valve or solenoid. Replace. Go to next step.

Troubleshooting

The header raise and the header tilt up functions depend on oil supplied through the master valve. If the header raise or header tilt up do not work but the lower and tilt down functions work, check the master valve solenoid circuit first.

For safety reasons, the header lower function is not supported by the diagnostic routine in the WES. Therefore, troubleshooting follows a different course from other output functions.

Before attempting to troubleshoot a problem, review the information under the "General Troubleshooting" heading in this section along with the material in the "General Electrical" portion of this section.

Operate the machine and observe the problem. Match the problem to one of the headings on the following charts. Follow the systematic step-by-step instructions in the chart to locate and correct the problem. Follow all the instructions carefully.

Header Will Not Raise

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
1.	Key off.	Check 10A hydraulic control fuse.	Blown fuse. Good fuse.	Replace fuse. Go to next step.
2.	Press and hold the "open book" and "hand" buttons on the warning module while turning the key on. Press the "open book" button until menu item 6-DIAG: INPUTS is displayed.	Press the top (tilt back) of the header tilt switch.	Beep and flash of hazard lights. No beep or flash.	Go to next step. Open circuit or poor connection in CM37-O/GY between 10A hydraulic control fuse and C009 (rectangular 8 pin connector in right console). Repair.
3.	Same as step 2.	Press the top (raise) of the header lift switch.	Beep and flash of hazard lights. No beep or flash.	Go to step 7. Go to next step.
4.	Same as step 2.	Using a short wire or paper clip, jumper wires HA37-O/GY and HA8-Y at the header lift switch.	Beep and flash of hazard lights. No beep or flash.	Defective switch. Replace. Go to next step.

Troubleshooting

If the flotation trim control is not functioning on either side, first make sure the master solenoid is working properly. (See the chart "Master Hydraulic Solenoid Does Not Work").

The following charts cover the double switch option. If the single switch option is provided, only the switch S-10 is used with L-08 and L-09 solenoids. For troubleshooting, use the charts for the left-side trim only.

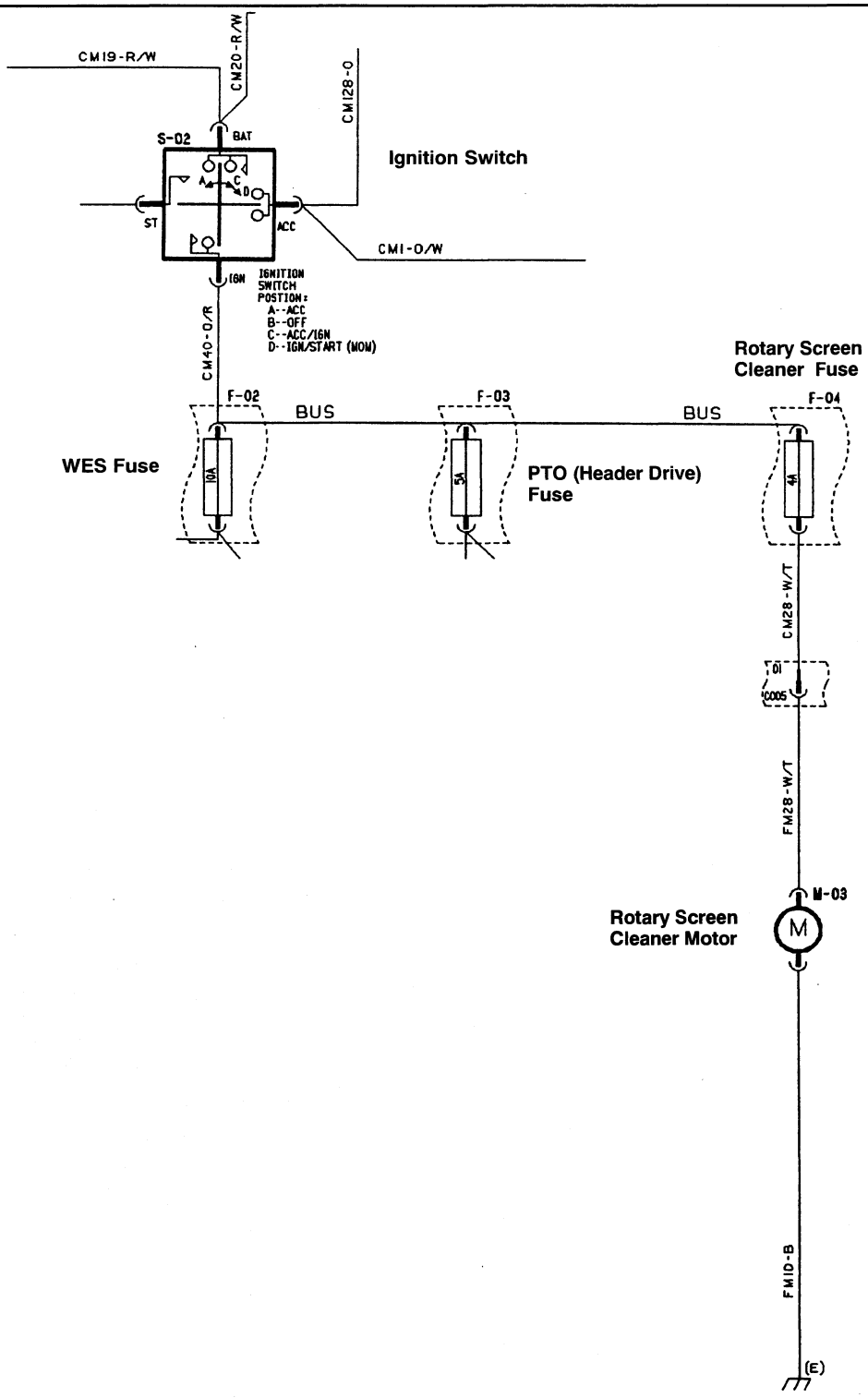
Before attempting to troubleshoot a problem, review the information under the "General Troubleshooting" heading in this section along with the material in the "General Electrical" portion of this section.

Operate the machine and observe the problem. Match the problem to one of the headings on the following charts. Follow the systematic step-by-step instructions in the chart to locate and correct the problem. Follow all the instructions carefully.

No Float Trim Functions Work (HW320 and HW340)

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
1.	Key off.	Check 10A hydraulic control fuse, F-08.	Fuse blown. Fuse good.	Replace fuse. Go to next step.
2.	Press and hold the "open book" and "hand" buttons on the warning module while turning the key on. Press the "open book" button until menu item 6-DIAG: INPUTS is displayed.	Place the 2-speed transmission switch in the high position.	No beep or flash of hazard lights. Beep and flash of hazard lights.	Faulty connection or open circuit in CM38-OMY between 2-speed switch and 10A hydraulic control fuse. Go to next step.
3.	Same as step 2.	Press the left flotation trim switch in each direction.	No beep or flash of hazard lights. Beep and flash of hazard lights.	Faulty connection or open circuit in CM132-O/GY between left trim switch and 2-speed switch. Go to next step.
4.	Same as step 2.	Press the right flotation trim switch (if equipped) in each direction.	No beep or flash of hazard lights. Beep and flash of hazard lights.	Faulty connection or open circuit in CM50-O/GY between left and right trim switches. Go to troubleshooting charts on the following pages.

MISCELLANEOUS CIRCUITS



ROTARY SCREEN CLEANER CIRCUIT

Figure 1-81

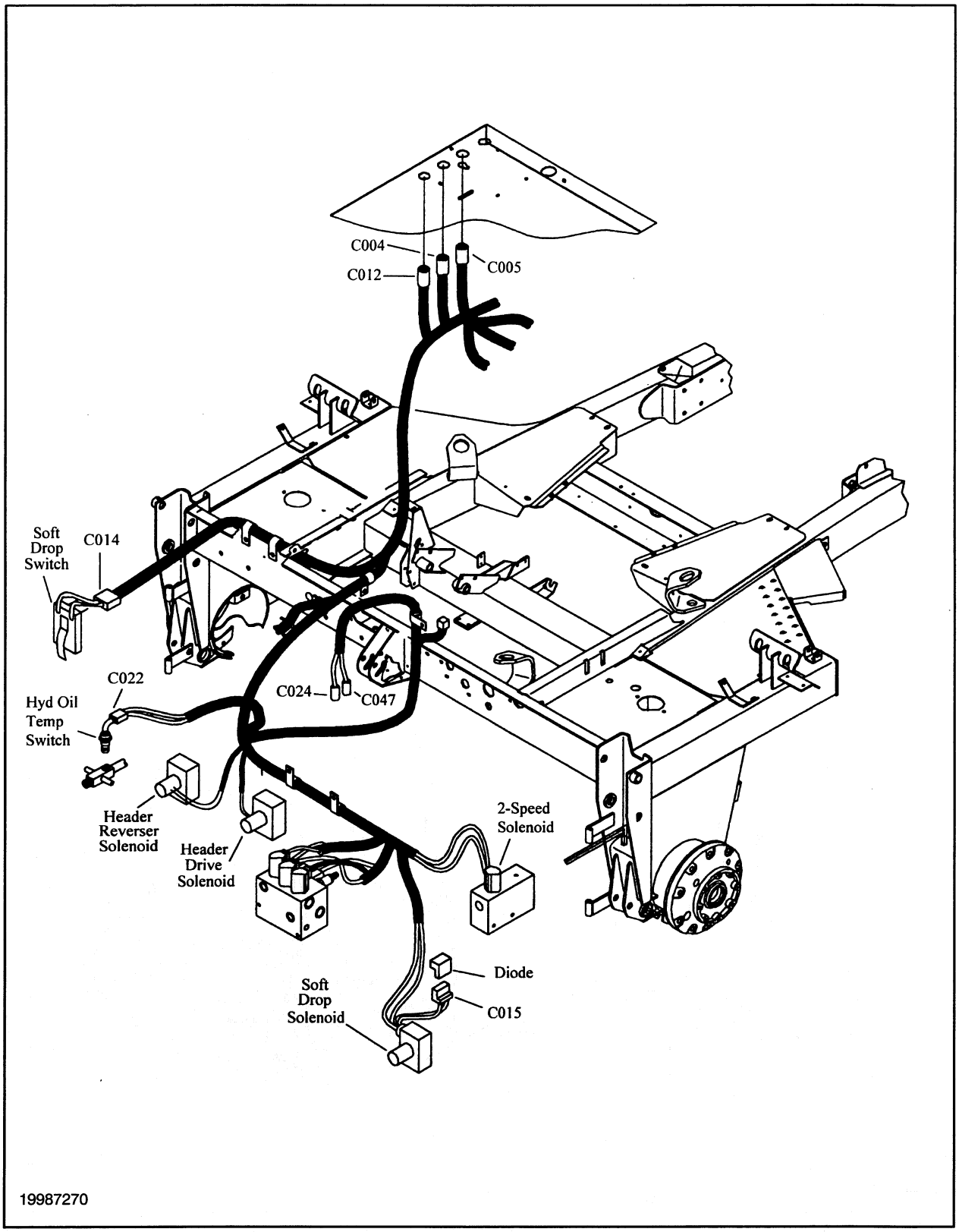
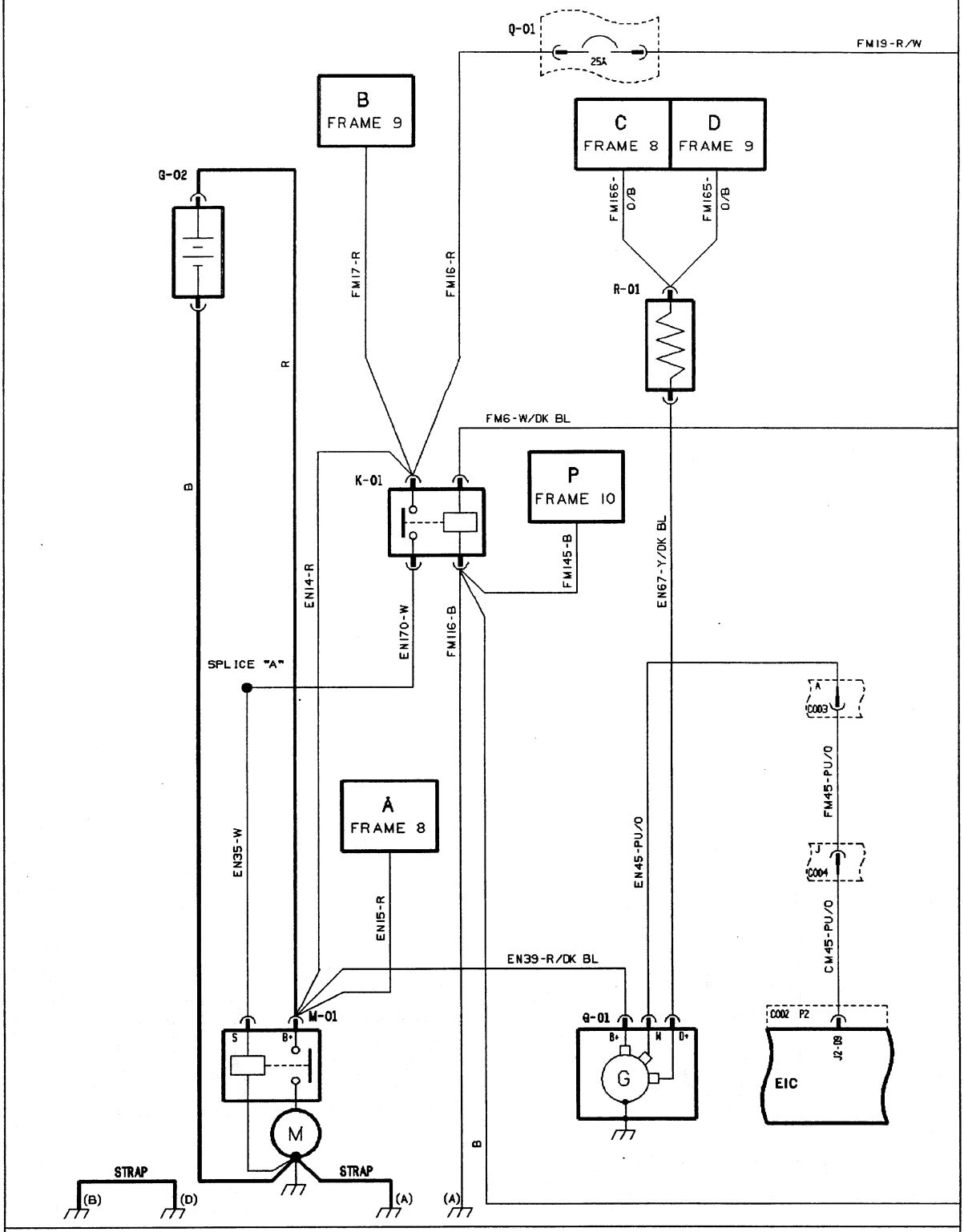

C004
C012
C005
Soft
Drop
Switch
C014
C022
Hyd Oil
Temp
Switch
C024
C047
Header
Reverser
Solenoid
Header
Drive
Solenoid
2-Speed
Solenoid
Diode
C015
Soft
Drop
Solenoid
19987270

Figure 1-85

FRAME 1 - HW300 AND HW320



FRAME -1

G-01 ALTERNATOR
G-02 LEFT HAND BATTERY
K-01 START RELAY
M-01 STARTER ASSY
Q-01 KEY MAIN CIRCUIT BREAKER
R-01 ALTERNATOR EXCITE RESISTOR

Figure 1-95

FRAME 7 - ALL MODELS

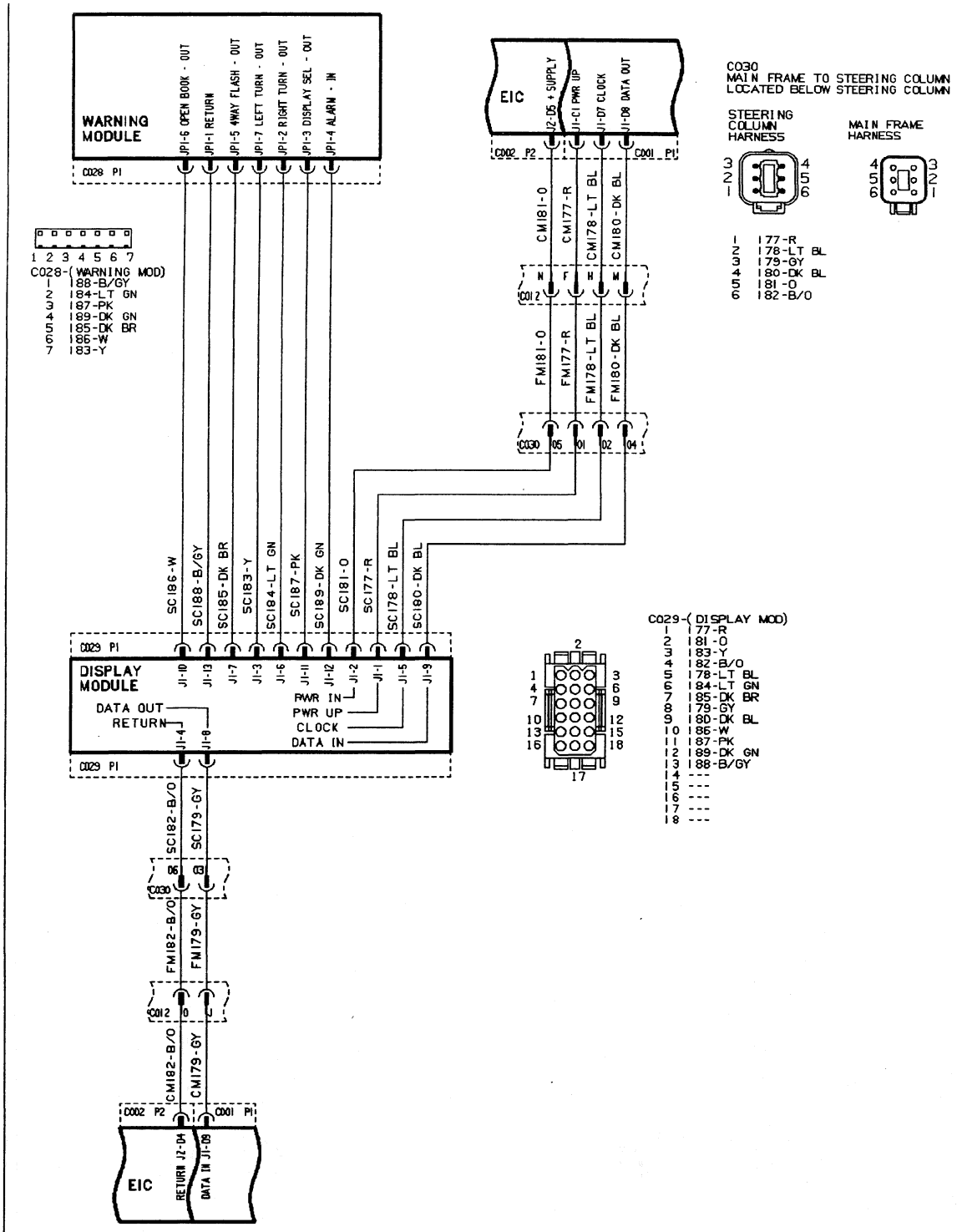
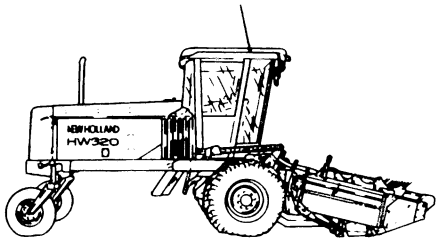


Figure 1-105



NEW HOLLAND

REPAIR MANUAL

HW300
HW320
HW340

Section 2 - Hydraulic Systems

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HEADER DRIVE VALVE: HYDRAFORCE

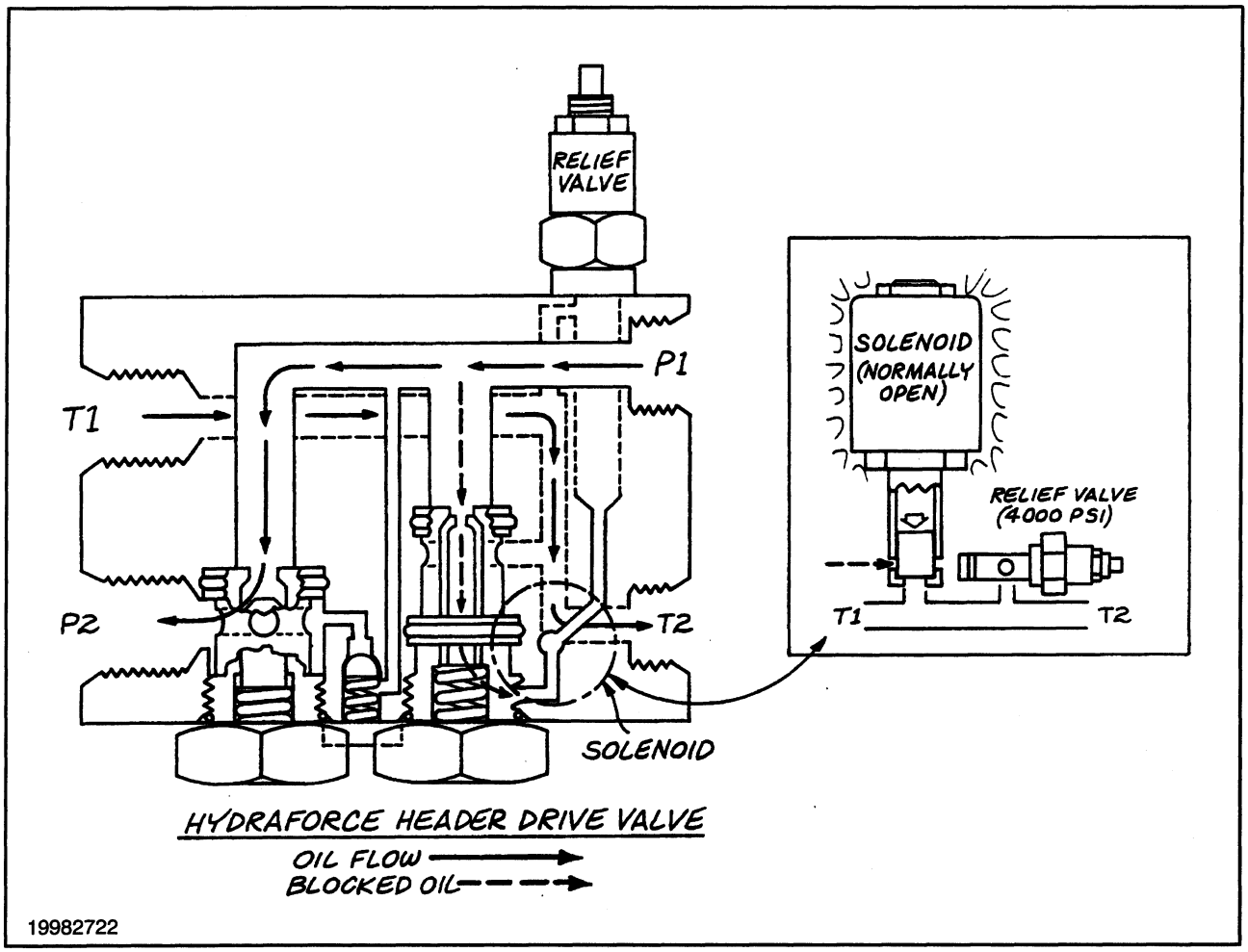


Figure 2-11

VALVE OPERATION - HEADER RUNNING

Switching on the header drive energizes the solenoid valve, closing it and blocking flow from behind the shuttle valve. Because there is no flow through the orifice, the pressure equalizes and the spring closes the shuttle valve. Oil from the pump forces the motor check valve open, turning the header drive motor. Oil returning from the motor flows through the header drive valve (from port T1 to T2) and into the hydraulic oil cooler.

Switching off the header drive opens the header solenoid valve, allowing oil to be relieved from the back side of the orifice of the shuttle valve. The shuttle valve opens and the oil bypasses the motor. The motor check valve closes, stopping the header from creeping.

TROUBLESHOOTING HEADER DRIVE MOTOR

In troubleshooting a pump-motor system, it is necessary to isolate the pump from the motor to determine which unit is malfunctioning. A worn pump or worn motor will each give the same symptoms. A flowmeter could be installed into the pump output line to pressure flow check it, but a case drain flow check is much easier and should diagnose a problem. The following troubleshooting suggestions are based on the assumption that the pump is within operating specifications.

PROBLEM	CAUSE	CORRECTION
Motor turns while unloaded but slows down or stops when load is applied.	Scored back plate.	Remove back plate and examine surface condition of flat area. If scored, replace back plate. Do not lap.
	Scored connector plate.	Disassemble motor, check finish on connector plate and back plate, replace if necessary.
	Scored or worn piston shoes.	Disassemble motor, examine condition of shoes on pistons, replace pistons as a complete set if necessary.
	Low relief valve pressure.	Check relief valve for proper pressure setting, adjust or replace relief valve.
Motor will not turn.	Severely scored back plate and connector plate.	Disassemble motor completely. Inspect all parts, clean all parts, replace all worn parts and flush hydraulic system.
	Contaminate particle holding connector off back plate.	Disassemble motor, inspect and clean parts, replace necessary parts.

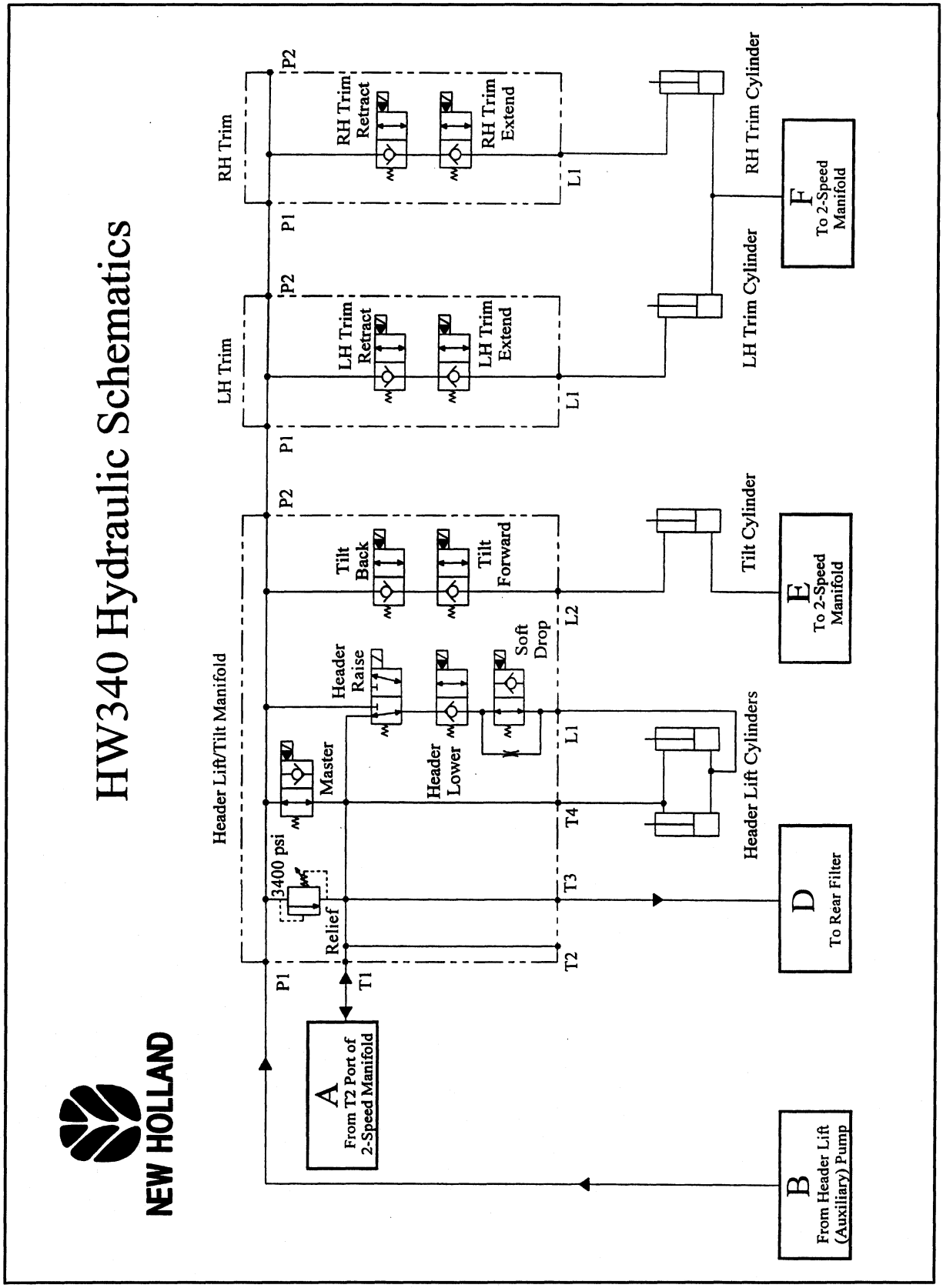

HW340 Hydraulic Schematics
NEW HOLLAND
RH Trim
LH Trim
Header Lift/Tilt Manifold
RH Trim Retract
RH Trim Extend
LH Trim Retract
LH Trim Extend
Tilt Back
Tilt Forward
Header Raise
Header Lower
Soft Drop
Master
3400 psi
Relief
P1
P2
T1
T2
T3
T4
L1
L2
RH Trim Cylinder
LH Trim Cylinder
Tilt Cylinder
Header Lift Cylinders
A
From T2 Port of 2-Speed Manifold
B
From Header Lift (Auxiliary) Pump
D
To Rear Filter
E
To 2-Speed Manifold
F
To 2-Speed Manifold

Figure 2-29

Charge Check Valve

The charge check valve allows charge oil to flow into a main circuit when the circuit is functioning as the low pressure circuit. This prevents oil from entering the charge circuit from a main circuit that is at a higher pressure.

All main circuits can operate as either the high- or low-pressure circuit. All main circuits share a common fluid supply from the charge pump circuit. Thus, the charge check valve functions as a main circuit check valve. This prevents fluid from flowing from a high-pressure main circuit to a low-pressure circuit.

Main Circuit Pressure Limiter

When either side of the main circuit exceeds its high pressure limit, the pressure limiter destrokes the pump, reducing pressure in the circuit.

The pressure limiter also functions as a pilot valve for the main circuit high-pressure relief valve.

Main Circuit High-pressure Relief

If pressure continues to rise after the pressure limiter destrokes the pump, the high-pressure relief valve opens. The relief valve works with the limiter to further reduce pressure in the main circuit by allowing fluid to flow from the high-pressure side into the low-pressure side.

The sequenced operation of the pressure limiter and relief valve helps to protect the hydraulic system against overheating and pressure spikes.

Main Circuit Bypass

The main circuit bypass allows for manual adjustment of the pressure limiter and the high-pressure relief valve. This lowers the circuit pressure to near zero when the system is not operating.

This also allows fluid from the main circuit to bypass the header drive pump and flow back into the system reservoir.

E. Controls

The main controls on the header drive pump include the electric displacement control (EDC), and the hydraulic servo controls.

These controls provide hydraulic output from the header drive pump in proportion to an electric input signal

The EDC includes an electro-hydraulic pressure control pilot (PCP) valve, 14, attached to a spring-centered 4-way servo control valve, 15. The PCP and servo control valves are on the top front section of the header drive pump case, 1.

The PCP valve, 14, uses an electric input signal to control the flow of hydraulic fluid to the servo control valve, 15.

The servo control valve, 15, directs hydraulic fluid to either side of a double acting servo piston assembly, 17.

A pressure relief valve for each servo circuit protects the servo system from excessive hydraulic pressures.

The servo piston attaches to the pump swash plate, 6, by a link assembly, 16, that allows the servo piston to control the angle of the swash plate. This controls the direction and hydraulic power delivered by the pump at a given speed.

Case Pressure

The case pressures in the header drive pump and motor should not exceed 5.2 bar (75 PSI) cold. Continuous case pressure when warm should not exceed 2.8 bar (40 PSI) in the pump and 1.7 bar (25 PSI) in the motor.

Check the pump case pressure at 4. This port is on the top of the header drive pump. This fitting is a 1-1/16-12M straight thread O ring boss fitting, NH01365 and NH00725. Use a 20 bar (300 PSI) pressure gauge. The pressure should not exceed 5.2 bar (75 PSI).

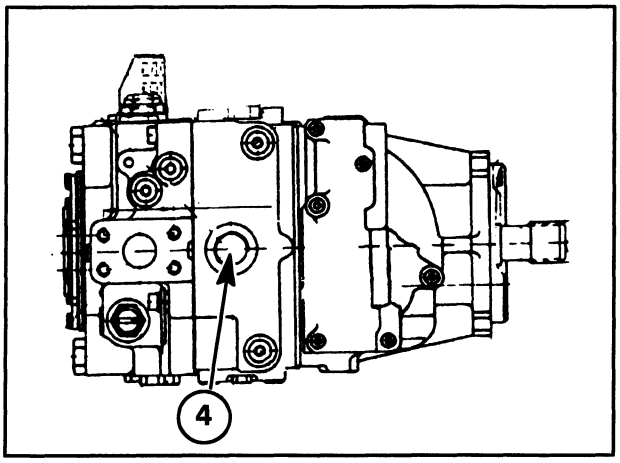


Figure 2-48

Check motor case pressure at 3 using a 7/16-20M JIC 37° x 7/8-14M O ring boss fitting, NH00753.

High Pressure

The two multi-function valves determine high system pressure. The relief valve setting is 483 bar (7000 PSI). The pressure limiter will start destroking the servos as 290 bar (4200 PSI).

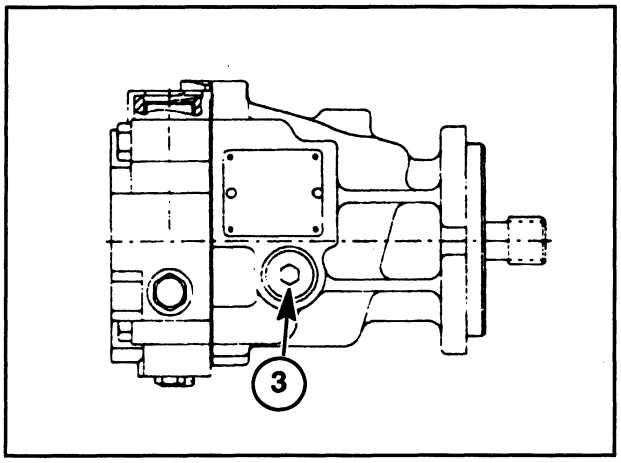


Figure 2-49

Problem	Cause	Correction
Header drive will not stop running	Faulty linkage or control valve	Repair or replace control valve
	Servo control piston is out of adjustment	See an authorized Sauer-Sundstrand service center
	Displacement control servo valve spool not returning to its center position	Readjust the controls. See neutral adjustment under "Minor Repairs."
	Displacement servo control valve spool jammed, sticking in one direction	Contact authorized Sauer-Sundstrand service center to repair or replace servo control valve
System operates too hot (motor case exceeds 82° C /180° F)	Low charge pressure due to low fluid level	Add fluid
	Hydraulic oil cooler clogged	Clean cooler air passages
	Fluid in cooler being bypassed	Repair or replace stuck cooler bypass valve
	Clogged filter or suction line, resulting in high vacuum and low charge pressure	Replace the filter; clean or replace the lines
	Excessive internal leakage, causing low pressure in one or both directions	Contact authorized Sauer-Sundstrand service center to repair or replace a stuck high-pressure relief valve
	Low charge pressure that may drop to near zero as the system nears maximum pressure	Refer to first problem, "System will not operate in either direction"
	Loss of power	Replace the pump/motor
	Case drain lines improperly plumbed	Inspect plumbing and reinstall as needed
	Continued operation at high pressure	Consult operator's manual for proper machine operation

j. Stop the engine and connect the EDC, 1, to the wiring harness, 2.

k. Start the engine and set its speed to 2100 RPM.

l. With the engine running, alternately engage the hydrostatic pump in forward and reverse. Repeat this step several times.

m. Observe the header drive. Disengaging the pump should stop the header from rotating.

Neutral adjustment is complete when the pump consistently returns to neutral after cycling between forward and reverse.

If the pump does not return to neutral, refer to the Troubleshooting section.

n. Stop the engine.

o. Remove the pressure gauges from the pump servo gauge ports, 1, and reinstall plugs in the ports

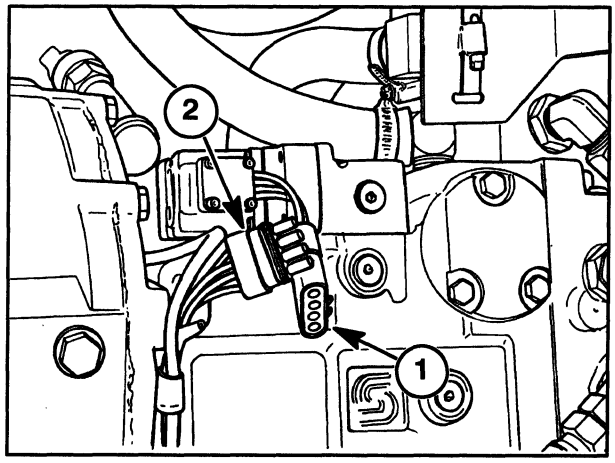


Figure 2-64

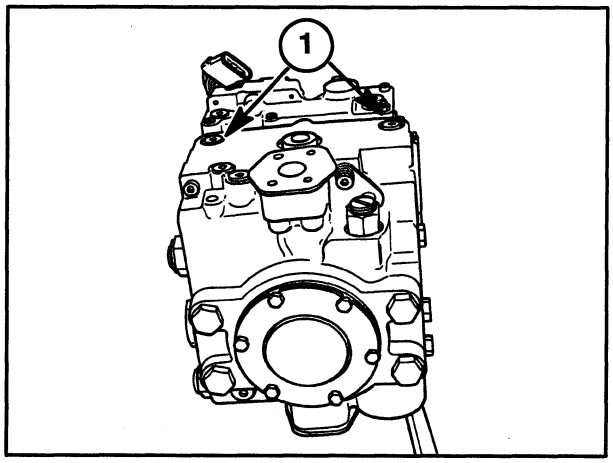


Figure 2-65

2. Install new O rings, 1, in the PCP valve, 2. Coat the new O rings with petroleum jelly to install them.

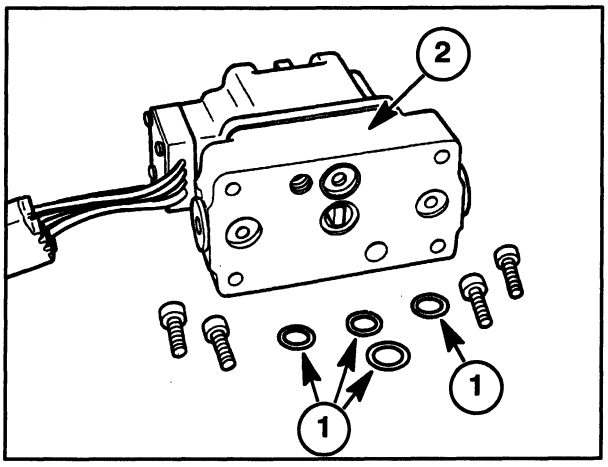


Figure 2-82

3. Place the PCP valve, 1, against the face of the EDC servo control housing, 2.

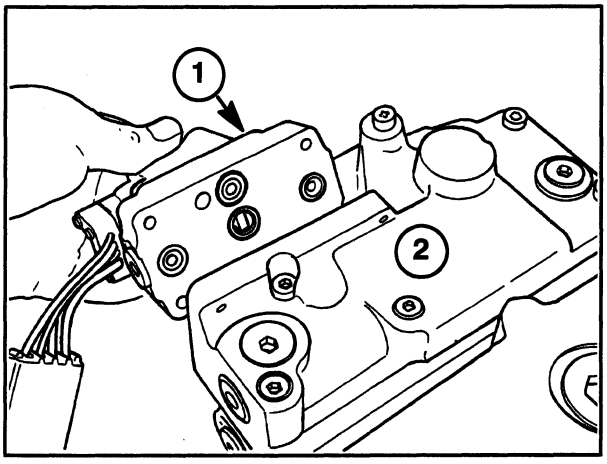


Figure 2-83

4. Install the four hex screws, 1. Tighten them to 5.4 N·m (48 in. lbs) torque.

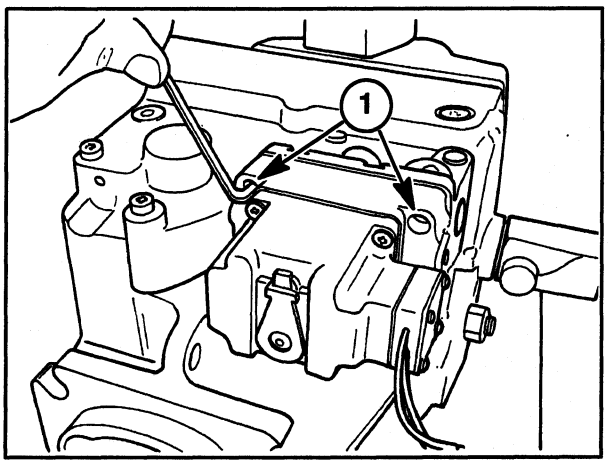


Figure 2-84

22. Connect the cooling return hose to the inner port, 1, of the cooling circuit manifold, 2.
23. Attach the hose support bracket, 3, and hoses to the windrower with the two bolts, 4.

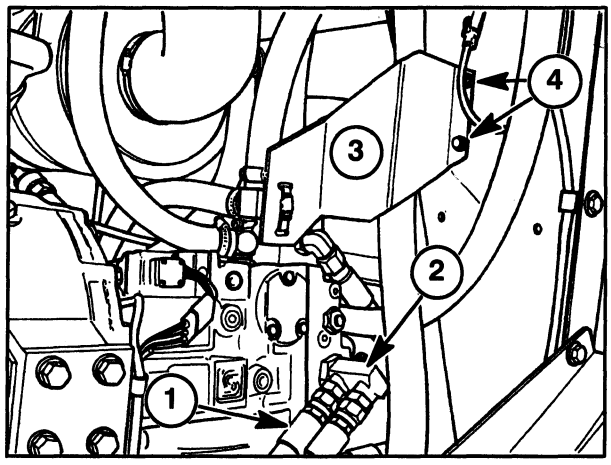


Figure 2-106

Header Drive Pump Start-up Procedure

Use the following steps to safely start the header drive system after installing the pump:

1. Install a tee fitting with a 35 bar (500 PSI) pressure gauge into the (outer) cooling circuit supply line, 1.
2. Fill the hydraulic reservoir with 134D universal hydraulic fluid. The fluid should pass through a 10 micron filter before entering the reservoir to protect against contamination.
3. Disconnect the fuel solenoid wire from the fuel injection pump to keep the engine from starting.
4. Crank the engine with the starter motor until charge pressure registers on the gauge.

   IMPORTANT: Do not operate the starter motor continuously for more than 30 seconds. Let the starter motor cool for at least two minutes after each 30 seconds' running time.
5. Bleed excess air from the high-pressure main lines through the high-pressure ports.
6. Recheck the fluid level in the hydraulic reservoir and add fluid until the reservoir is up to the FULL line.

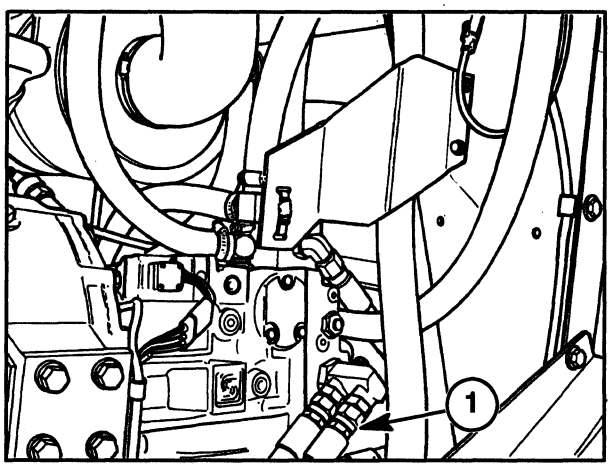


Figure 2-107

CAUTION: DO NOT START THE ENGINE UNLESS THE PUMP IS IN NEUTRAL (0° SWASH PLATE ANGLE). TAKE PRECAUTIONS TO PREVENT INJURY WHEN RUNNING THE HEADER PUMP DURING START-UP.

Header Lift - Neutral Position

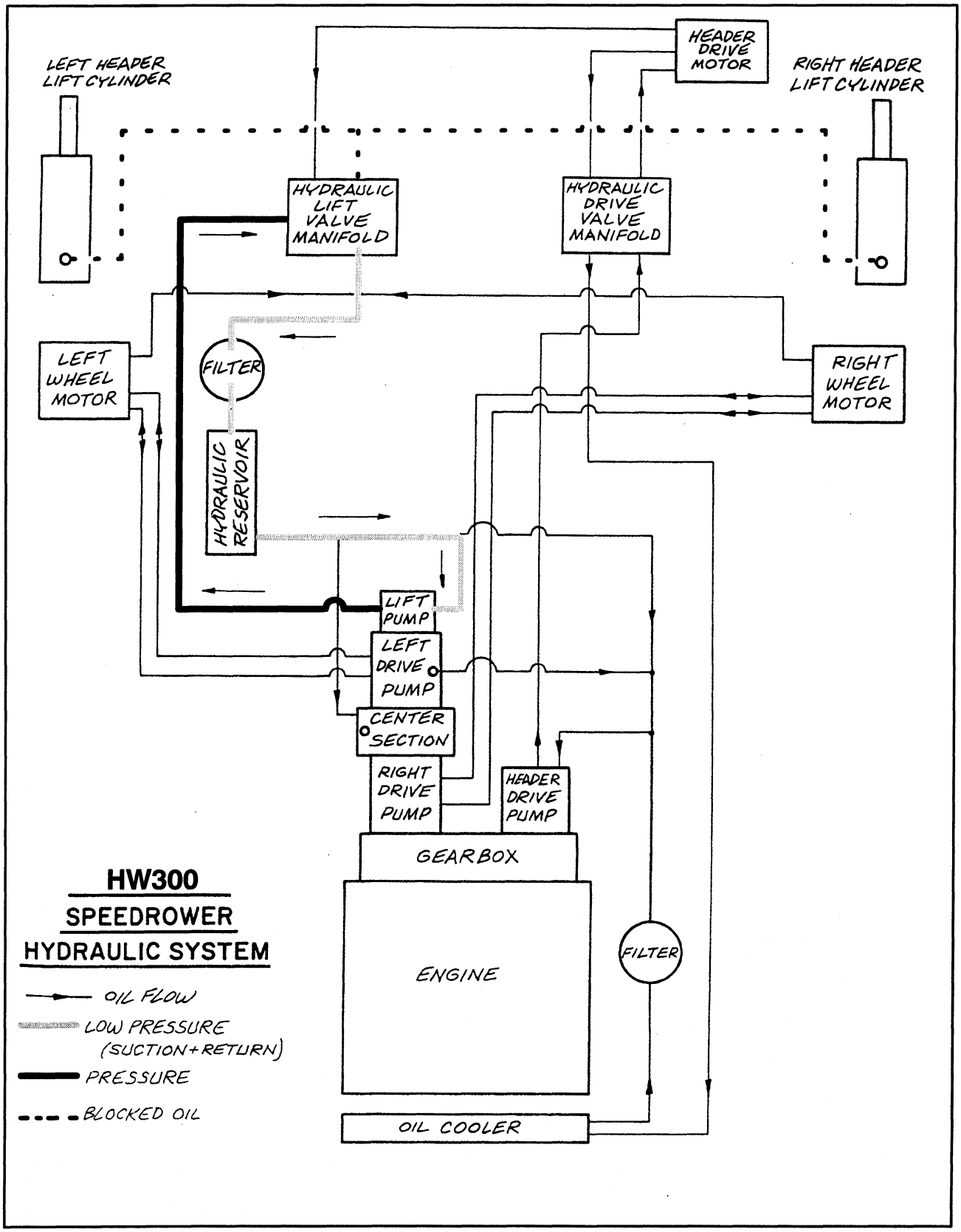


Figure 2-120

TROUBLESHOOTING HEADER LIFT

Header Will Not Lift, No Hydraulic Tilt Or Flotation Installed

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
1.		Check oil level in reservoir	No or low oil	Refill with 134D, find and repair leak
			Oil OK	Go to next step
2.		Check filter	Filter plugged	Replace
			Filter OK	Go to next step
3.	Install pressure gauge	Start engine, activate raise switch	Pressure OK	Mechanical binding problem Find and repair
				No power at raise solenoid valve Go to next step
				Raise solenoid valve problem Go to step 5 & 9
			Pressure low	Go to step 6
			No pressure	Go to next step
4.		Refer to electrical troubleshooting in Section 2	Electrical problem	Repair
			Electrical system OK	Go to next step
5.		Check raise coil for resistance	Coil resistance is greater than 10 ohms	Coil is defective Replace
			Coil resistance is less than 10 ohms	Go to next step

CYLINDERS

The tilt cylinder and the flotation trim cylinders are double-acting cylinders. The barrel side of the cylinders are connected to hydrostatic charge pressure, which keeps them full of oil and stabilizes them.

VALVE OPERATION

NOTE: If the header lift does not work properly, troubleshoot it first.

NOTE: Torque the solenoid valve cartridge to 27 N·m (20 ft lbs) and the coil nut to 5.6 - 8.5 N·m (50 - 75 in. lbs). Overtorquing could make the solenoid valve stick.

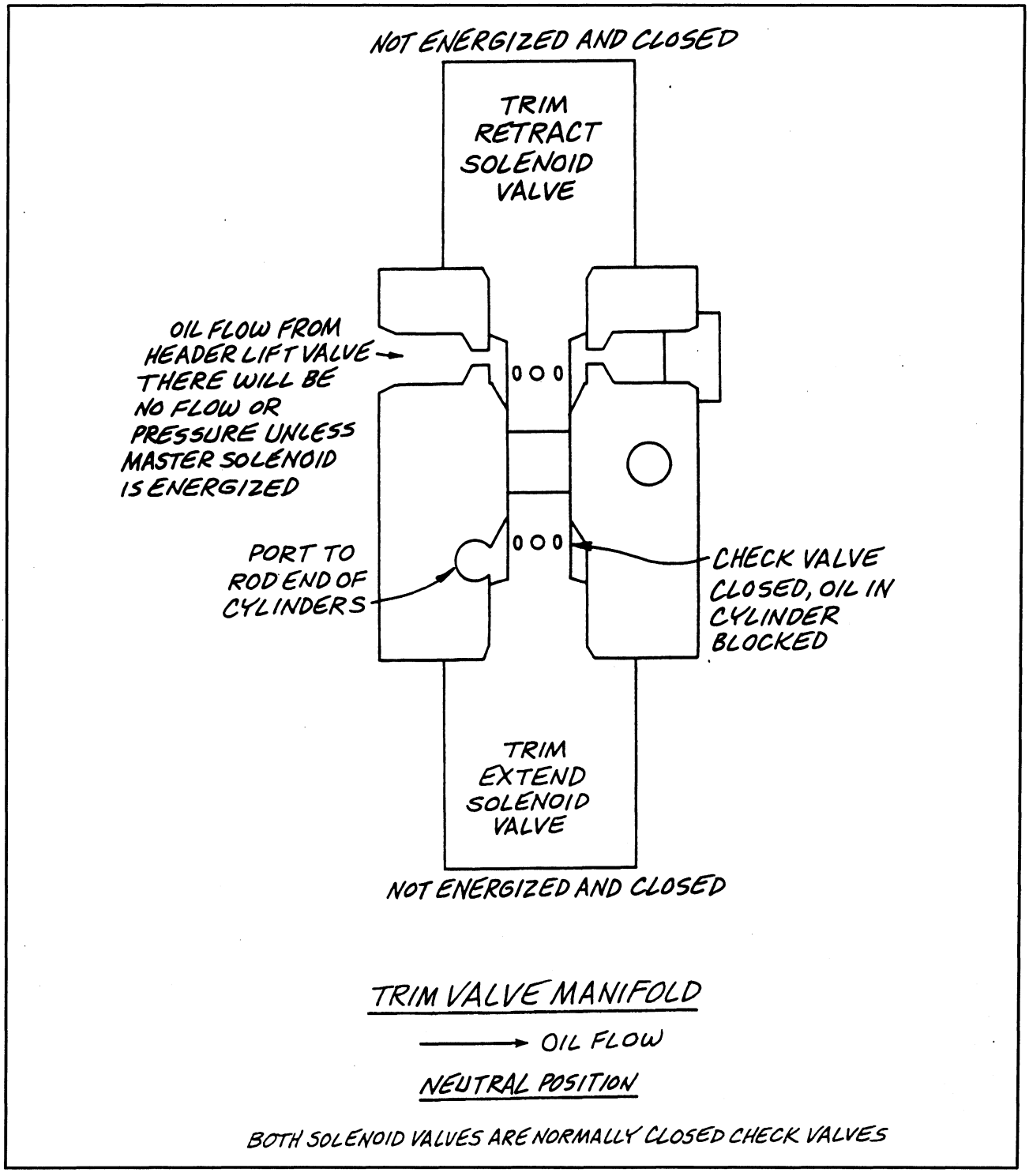

NOT ENERGIZED AND CLOSED
TRIM RETRACT SOLENOID VALVE
OIL FLOW FROM HEADER LIFT VALVE
THERE WILL BE NO FLOW OR PRESSURE UNLESS MASTER SOLENOID IS ENERGIZED
PORT TO ROD END OF CYLINDERS
CHECK VALVE CLOSED, OIL IN CYLINDER BLOCKED
TRIM EXTEND SOLENOID VALVE
NOT ENERGIZED AND CLOSED
TRIM VALVE MANIFOLD
OIL FLOW
NEUTRAL POSITION
BOTH SOLENOID VALVES ARE NORMALLY CLOSED CHECK VALVES

Figure 2-155

Flotation Trim Cylinders Will Not Extend, Header Lift Works Properly

STEP	PRETEST INSTRUCTIONS	TEST	RESULT	PROBABLE CAUSE AND CORRECTION
1.		Check power to trim extend solenoid valve	No power at trim extend solenoid valve Power at trim extend solenoid valve	Refer to electrical troubleshooting in Section 1 Go to next step
2.		Check trim extend coil for resistance	Coil resistance is greater than 10 ohms Coil resistance is less than 10 ohms	Coil is defective Replace Go to next step
3.	Remove trim extend solenoid valve	Check trim extend solenoid valve for being stuck closed	Solenoid valve stuck closed Solenoid valve OK	Replace Problem exists in a component addressed prior to this step

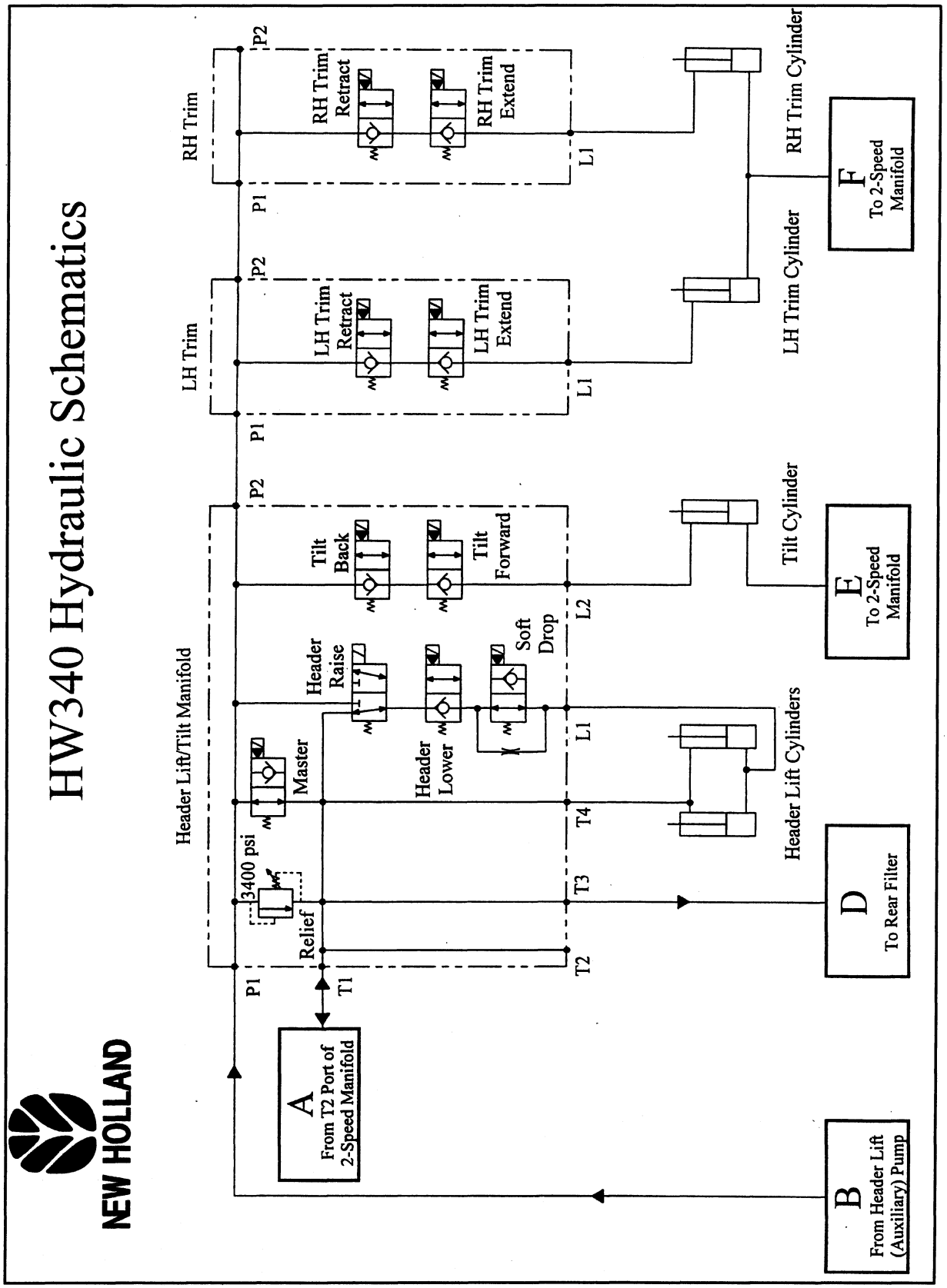

HW340 Hydraulic Schematics
NEW HOLLAND
RH Trim
LH Trim
Header Lift/Tilt Manifold
RH Trim Retract
RH Trim Extend
LH Trim Retract
LH Trim Extend
Tilt Back
Tilt Forward
Header Raise
Header Lower
Soft Drop
Master
3400 psi
Relief
P1
P2
T1
T2
T3
T4
L1
L2
RH Trim Cylinder
LH Trim Cylinder
Tilt Cylinder
Header Lift Cylinders
A
From T2 Port of 2-Speed Manifold
B
From Header Lift (Auxiliary) Pump
D
To Rear Filter
E
To 2-Speed Manifold
F
To 2-Speed Manifold

Figure 2-166

Operating Principles

The two-speed motors on the HW320 and HW340 are controlled by an electrohydraulic valve manifold, 1, mounted on the left side of the frame beneath the cab.

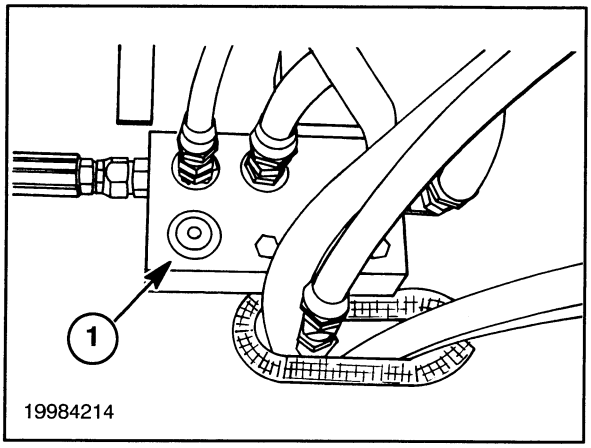


Figure 3-5

The valve has two ports, one normally open and the other normally closed. These ports switch while power is applied.

The additional P-parts, 2, are for tapping into charge pressure for the tilt and trim cylinders, and for the FNR servo assist cylinder.

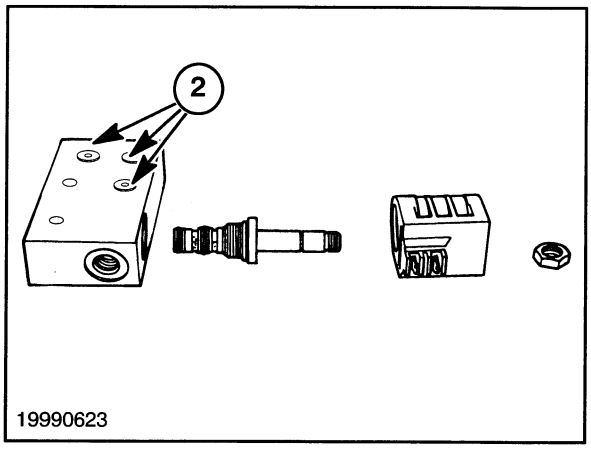


Figure 3-6

RESERVOIR

The hydraulic reservoir sits in a cavity of the fuel tank, and supplies oil to the charge pump, header lift pump and leader drive pump. A mesh screen screws into the inlet adapter fitting to filter out large particles. Two 10-micron filters, filter oil in the hydraulic system. The hydraulic reservoir capacity is 38 L (10 gals.). To prevent cavitation or aeration (bubbles) in the system, maintain the proper oil level in the reservoir.

Refer to the specifications at the end of this section for the proper grade and type of oil used in the hydraulic reservoir.

Neutral Standing Adjustment

WARNING: BEFORE ADJUSTING THE TRANSMISSION LINKAGE, JACK BOTH WHEELS OFF THE GROUND AND BLOCK THE MACHINE SECURELY SO THAT IT DOES NOT FALL. KEEP OTHER PERSONS AWAY FROM THE WHEELS AND OTHER MOVING PARTS BEFORE STARTING THE ENGINE.

Before making the neutral standing adjustment, adjust the steering creep.

Adjust the forward and reverse creep as follows:

1. Block both wheels off the ground.
2. Engage the parking brake and center the steering wheel in the locked position.
3. Start the engine.
4. Disengage the parking brake.
5. Running the engine at half to full throttle, cycle the FNR lever from forward to reverse a few times.
6. Return the FNR lever to the neutral position.
7. If the wheels rotate FORWARD, loosen the jam nuts, 1, on the rear of the shift joint, 2, and draw up the nuts on the front side. Repeat the previous steps until the wheels stop with the FNR lever in neutral.
8. If the wheels rotate, BACKWARD, loosen the jam nuts, 3, on the front of the shift joint, 2, and draw up the nuts on the rear side. Repeat the previous steps until the wheels stop with the FNR lever in neutral.

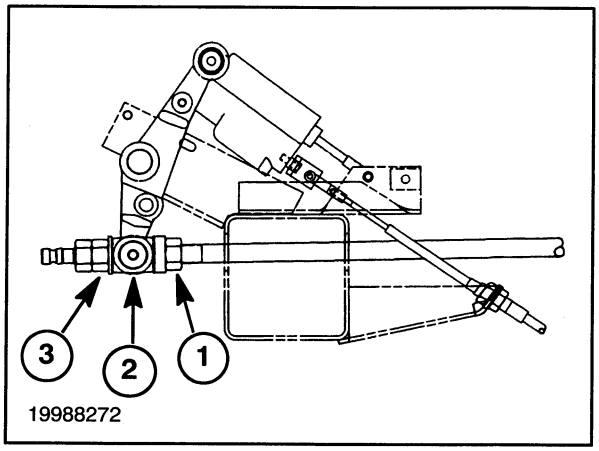


Figure 3-17

Charge Pump Relief Valve

If charge pressure is low, inspect the charge relief valve. Before removing the relief valve plug, 1, the reservoir must be drained or the inlet blocked to prevent oil from leaking through the passage on the back side of the relief valve. This passage runs through the pump case to the reservoir.

Inspect the poppet for foreign material, which may hold the poppet open, and for scoring or wear on both the poppet and seat area.

To adjust the charge pressure, change the shim thickness behind the spring. Shim thicknesses are 0.25 mm, 0.51 mm and 1.27 mm (0.010″, 0.020″ and 0.050″) and are serviced in the charge relief valve kit. The charge relief valve is factory set to 15 bar (220 PSI). Refer to "Charge Pressure Test" in this section of the manual for the setting procedure.

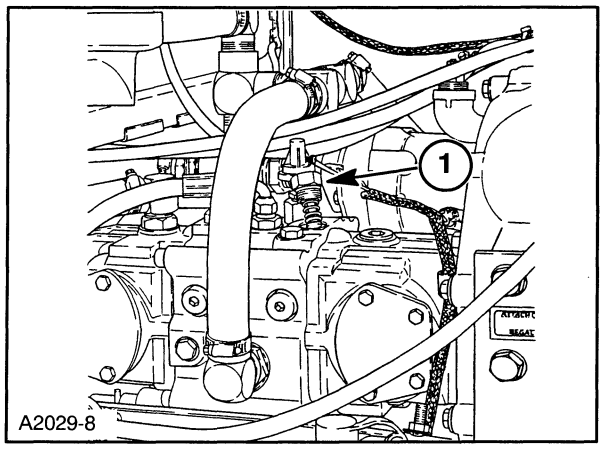


Figure 3-27

Check Valve

The check valves are part of the high-pressure relief valves. Since all of the main hydraulic lines can be under high pressure, four charge check valves direct the charge supply into the low-pressure line. Any charge flow (pressurized hydraulic oil) not used for the closed circuit discharges via a direct operating charge relief valve, through the pump and motor housings, and back to the system reservoir.

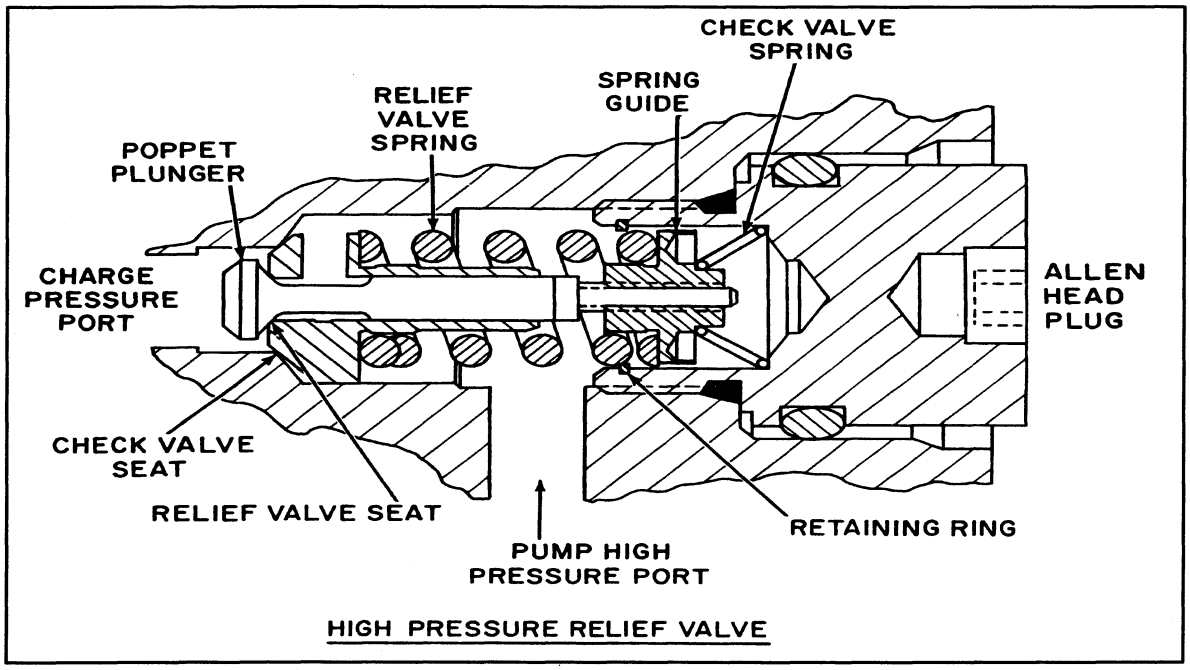


Figure 3-28

Case Pressure Test (Pump)

Case pressure readings can help locate restrictions in the return lines, oil cooler and return filter. The case pressures in the hydrostatic pump or motor should not exceed 5.2 bar (75 PSI) cold or 2.8 bar (40 PSI) continuous.

Check the pump case pressure at port, 1, on the pump body.

With the system warm, the case pressure should be very minimal due to the suction port location of the header drive pump.

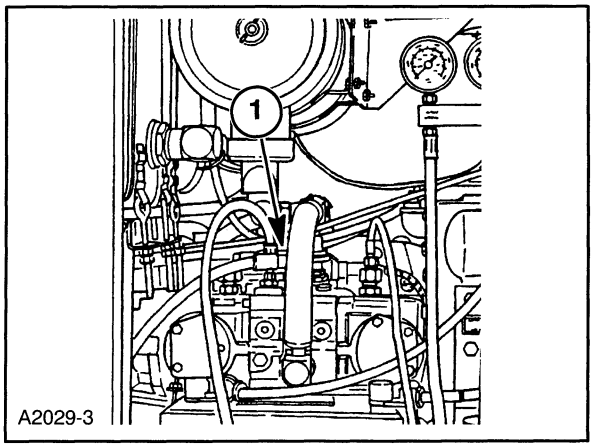


Figure 3-36

Case Pressure Test (Motor)

Check the motor case pressure using the following procedure:

1. Loosen the elbow, 1, and rotate it clear of the motor housing. If necessary, use a straight fitting.
2. Install a tee to make room for both the pressure gauge and return line.

   IMPORTANT: Do not deadhead the case drain line. Use a tee to accommodate the additional pressure gauge input while maintaining the return line.

The case pressures in the hydrostatic pump or motor should not exceed 5.2 bar (75 PSI) cold or 2.8 bar (40 PSI) continuous.

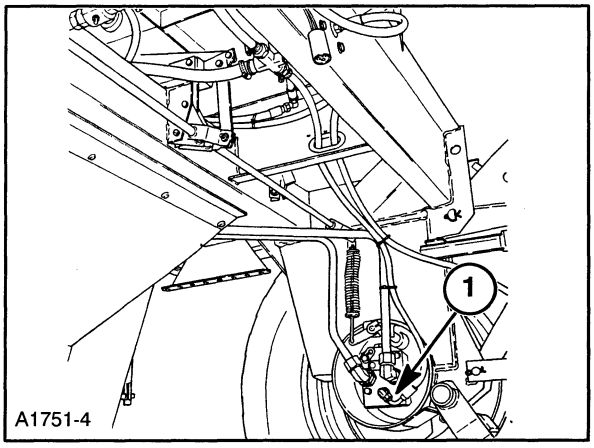


Figure 3-37

MINOR REPAIRS

This section covers minor repairs that can be done without voiding the warranty on the hydrostatic transmissions. Minor repairs include:

1. Shaft seals in the pumps and motors
2. Charge pump replacement
3. O ring seal between the center sections
4. O ring seal between the front pump and adapter plate
5. O ring seal between the adapter plate and header lift pump
6. Trunnion seals on the control shafts
7. High-pressure relief valve and check valve
8. Charge relief valves in the pump and motor
9. Shuttle valve inspection in the motor

Items 1 through 5 will require the pump to be removed or separated from the machine for repairs. Items 6 through 9 do not require complete removal of the pump and motor.

Any major repair to the hydrostatic transmission should be performed by an authorized Sauer-Sundstrand repair station (see the list at the end of this section). Work done by persons not authorized by Sauer-Sundstrand will void any remaining warranty on the transmission.

Cleanliness is extremely important to ensure satisfactory hydrostatic system life on either new or repaired units. Clean the parts in a clean solvent wash and dry them thoroughly. Air drying is usually adequate. As with any precision equipment, keep all parts free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material.

Replace all gaskets and O ring seals when making a repair. Lightly lubricate all O ring seals with clean petroleum jelly prior to assembly. Clean all gasket sealing surfaces prior to installing new gaskets.

NOTE: Some of the illustrations in this section show a completely disassembled component; however, minor repairs do not involve complete disassembly of a component.

9. Use the arbor press to install the new seal into the seal cover. Be careful not to damage seal.

   NOTE: Lubricate new seals with an assembly grease.

10. Place the trunnion bearing shims, 1, into the pump housing against the outer race of the trunnion bearing.
11. Install spacer, 2, against the shim pack. Do not alter the shim thickness.
12. Install a new square O ring seal, 3, into the groove in the pump housing, and retain with petroleum jelly.
13. Wrap the end of the swash plate control shaft with thin plastic to prevent damage to the seal lip during installation.
14. Slide the seal cover assembly over the swash plate control shaft and onto the housing. Install the cap screws and torque to 24 - 30 N·m (18 - 22 ft lbs). Reinstall the control linkage onto the swash plate control shaft.

    NOTE: Use a medium-strength thread locking compound to control arm cap screws, 1.

Refer to "Neutral Adjustments" in this section for proper adjustment.

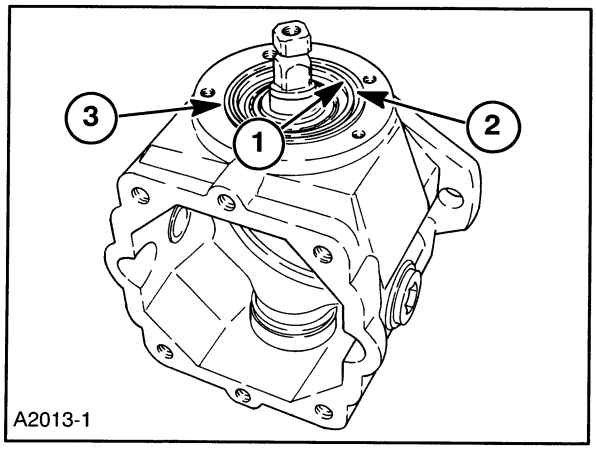


Figure 3-57

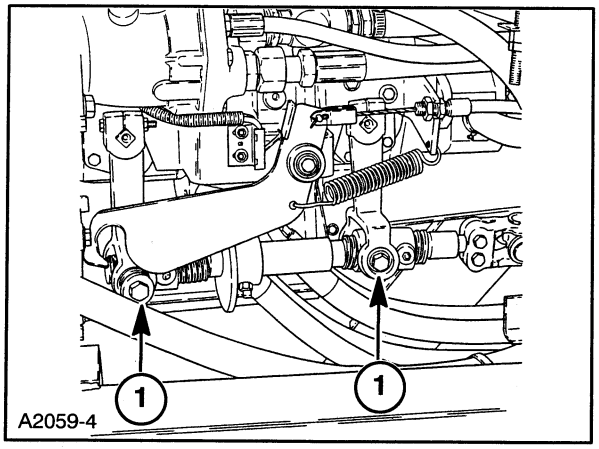


Figure 3-58

START-UP AND MAINTENANCE

START-UP

Use the following start-up procedure when starting a new installation or when restarting an installation in which either the pump or motor had been removed from the system.

WARNING: THE FOLLOWING PROCEDURE MAY REQUIRE THE MACHINE TO BE DISABLED (WORK FUNCTION DISCONNECTED, WHEELS RAISED OFF THE GROUND, ETC.) WHILE PERFORMING THE PROCEDURE IN ORDER TO PREVENT INJURY TO THE TECHNICIAN AND BYSTANDERS.

1. Prior to installing the pump and/or motor, inspect the unit for damage incurred during shipping and handling. Make sure all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.
2. Fill the reservoir with recommended hydraulic fluid which should be passed through a 10-micron (nominal, no bypass) filter prior to entering the reservoir. See the oil recommendations in "Specifications" (at the end of this section).
3. The inlet line leading from the reservoir to the pump must be filled prior to start-up. Check the inlet line for properly tightened fittings and make sure it is free of restrictions and air leaks.
4. Be certain to fill the pump and/or motor housing with clean hydraulic fluid prior to start-up. Fill the housing by pouring filtered oil into the upper case drain port.
5. Install a 0 - 35 bar (0 - 500 PSI) pressure gauge in the charge pressure gauge port to monitor the charge pressure during start-up.
6. Install the control linkage to the pump control shafts. Torque the cap screw on the arm to 25 N·m (19 ft lbs). Refer to "Neutral Adjustment" in this section for the proper linkage adjustment.
7. Disconnect the fuel solenoid wire from the injection pump to keep the engine from starting. Rotate the engine over until charge pressure can be read on the gauge. Recheck the oil level in the hydraulic reservoir before starting the engine.
8. Once charge pressure has been established, connect the fuel solenoid wire and start the engine. With the engine running, the charge pressure should be 7 bar (100 PSI) minimum.

   If charge pressure is not to specifications, shut off the engine and determine the cause of the low-pressure reading.
9. Excess air may be bled from the high-pressure lines through the high-pressure gauge ports.

WARNING: DO NOT START THE ENGINE UNLESS THE PUMP IS IN NEUTRAL POSITION (0° SWASH PLATE ANGLE). DISCONNECT THE MOTOR OUTPUT SHAFT OR RAISE THE DRIVE WHEELS TO PREVENT MACHINE MOVEMENT IN CASE PUMP IS ACTUATED DURING INITIAL START-UP.

10. Recheck the oil level in the reservoir before running the machine.
11. With the motor output shaft disconnected or the drive wheels raised off the ground, run the system at full input and output speeds in both directions. Operate the system for at least 15 minutes.
12. Shut down the engine, remove the gauges, and plug the ports. Check the reservoir level and add fluid if necessary.

    The transmission is now ready for operation.

Disassembly

Wash the planetary final drive hub thoroughly before disassembly. Remove the level plug, 1, and drain the oil from the housing.

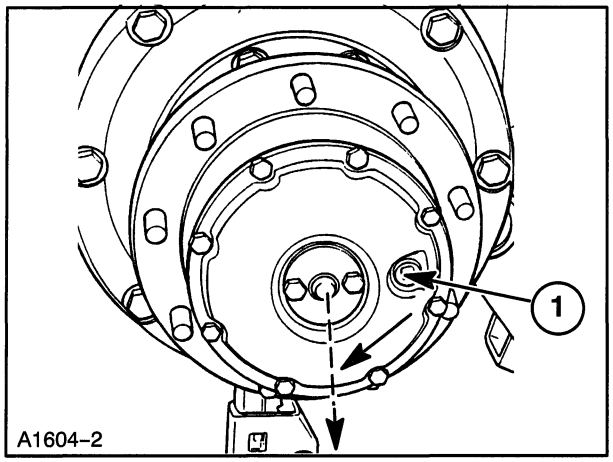


Figure 4-13

1. Position the final drive hub assembly on a bench with the input shaft side down.

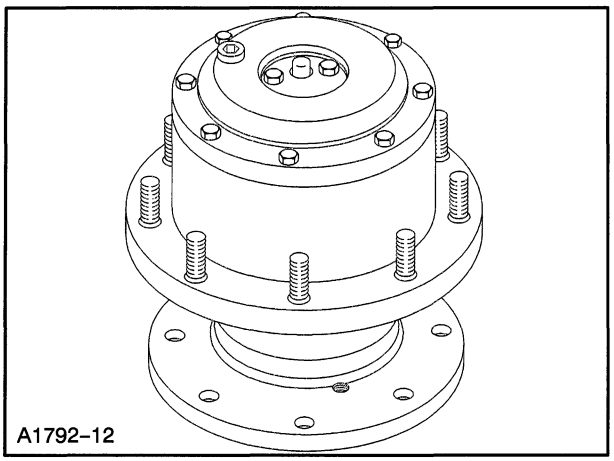


Figure 4-14

2. Remove the disengagement cover, 1.
3. Remove bolts, 3, and the large cover, 2.

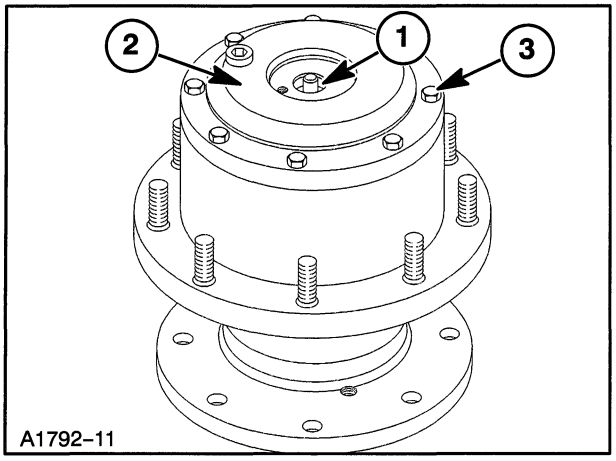


Figure 4-15

LABOR GUIDE

The following labor amounts are listed as a guide only. Working conditions and experience will vary the amount of time it actually takes to complete each job.

Job	Labor-Hours
R & R one planetary final drive, includes jacking, blocking, R&R wheel/tire, torquing hardware and filling with oil	1.0
Rebuild one planetary final drive, does not include R & R	1.0

6. The coupler, 1, which is between the hub and brake, may stay on the brake shaft or it may come off with the hub. Remove the coupler and inspect its internal splines for wear. Replace the coupler if the splines show wear or damage.

   NOTE: Remove the torque hub together with the outer portion of the brake housing only if you have a method of lifting 350 lbs. If removing the brake shaft, bearing or seal, remove the torque hub as well.

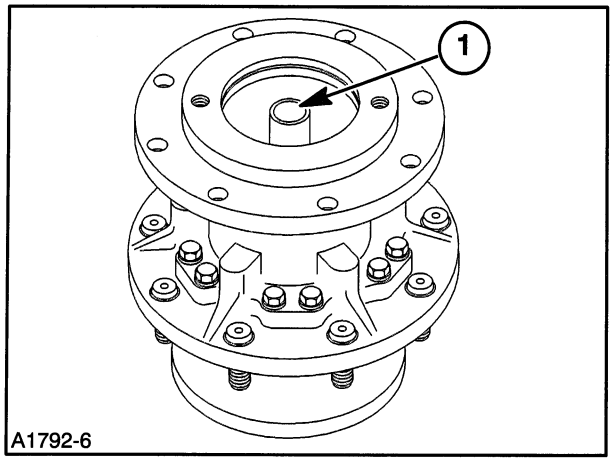


Figure 5-8

7. Open the drain plug, 1, to allow the lubricant to drain from the brake housing.

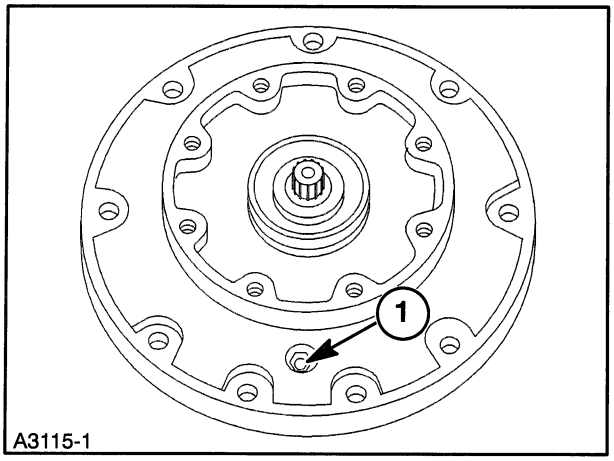


Figure 5-9

8. Remove the brake housing cover, 1, by removing nine cap screws, 2. Tap the housing cover with a soft hammer if necessary to loosen it from the housing.

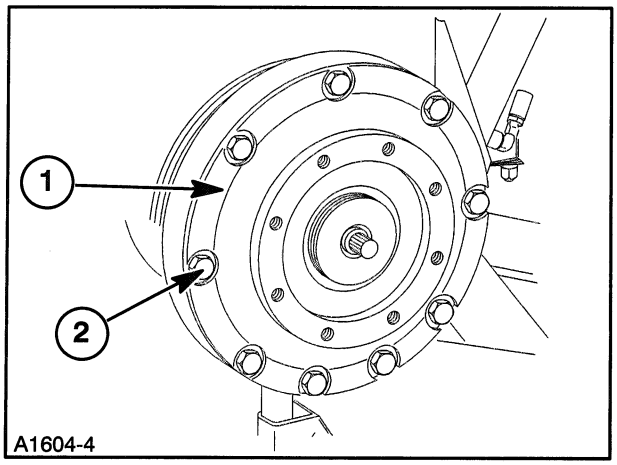


Figure 5-10

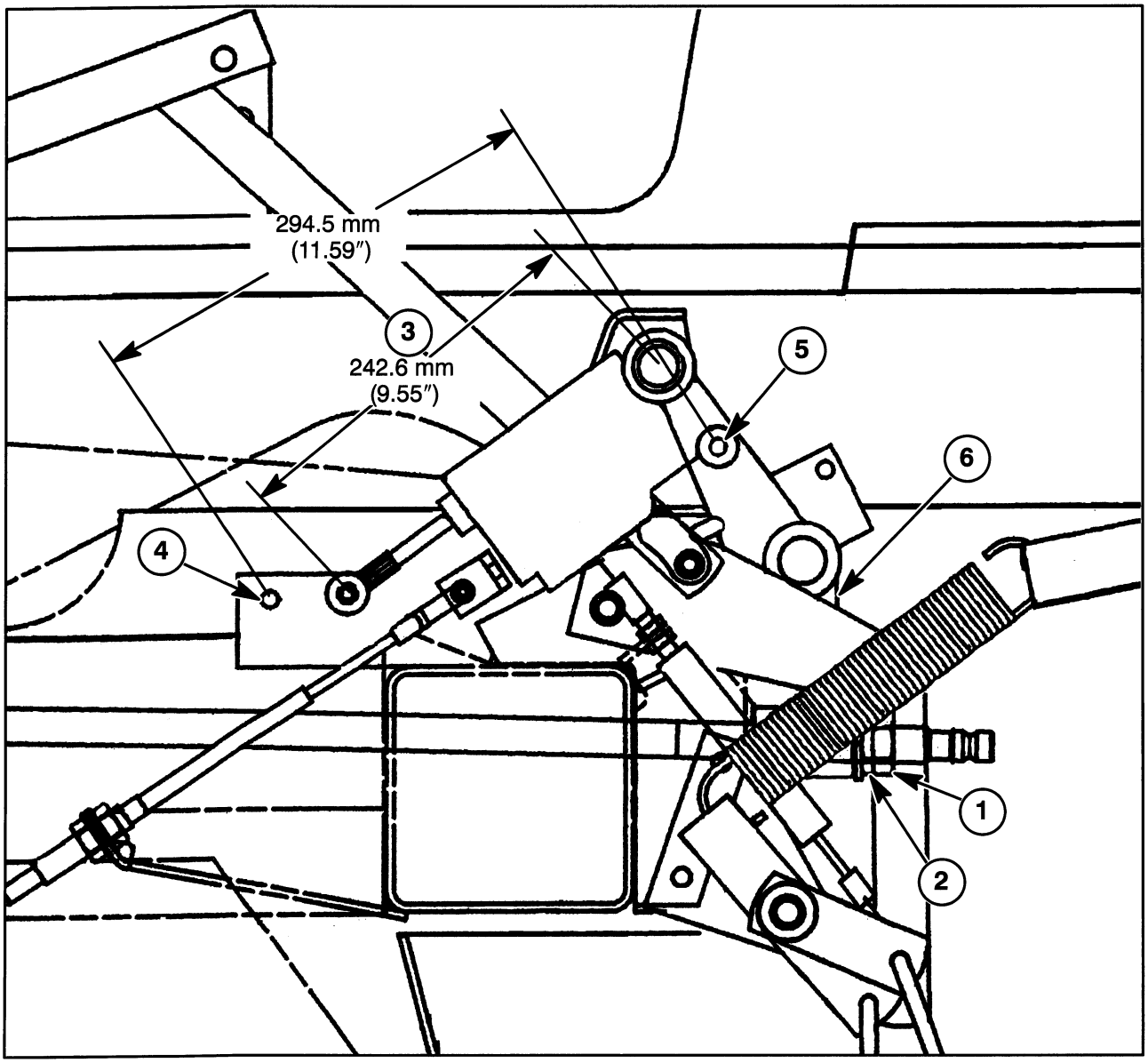
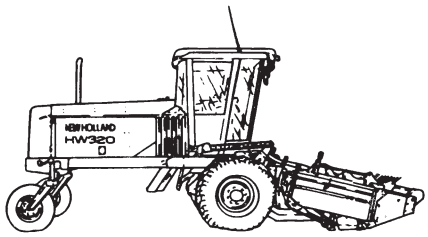


Figure 5-36

13. **HW320/340**: Move the FNR lever in the cab to neutral.

14. **HW320/340**: Adjust the servo and cable to obtain a servo length of 242.6 mm (9.55″).

    An alternate method is to measure servo length from the center of the gauge hole in the frame, 4, to the center of the pin, 5, in the side of the shift arm. This dimension should be 294.5 mm (11.59″).



NEW HOLLAND

REPAIR MANUAL

HW300
HW320
HW340

Section 6 - Engine

NEW HOLLAND

SERVICE

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4. Using a suitable container, drain the oil from the engine by removing the plug, 1, Figure 6-3, 4-cylinder engine, Figure 6-4, 6-cylinder engine, from the bottom of the oil pan.

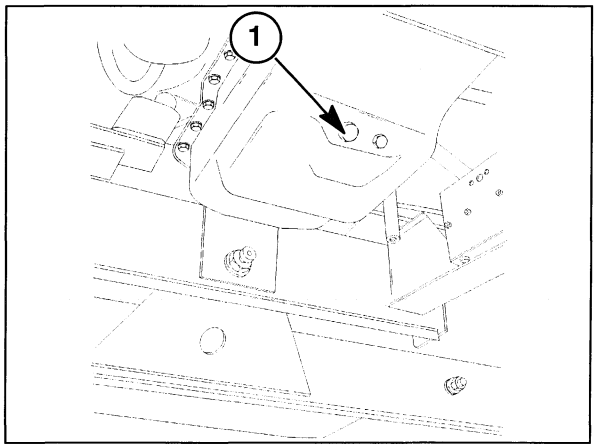


Figure 6-3

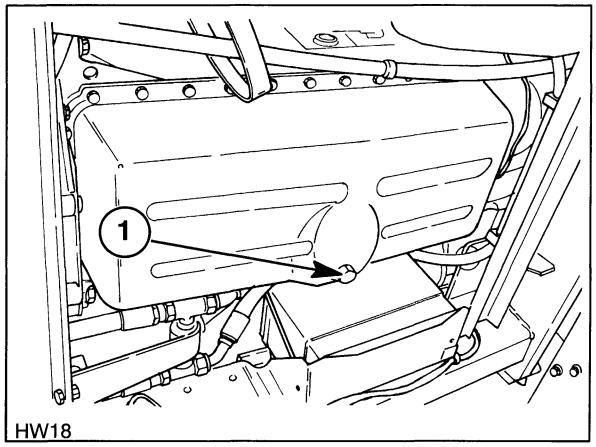


Figure 6-4

5. Remove the cap screws, 1, from the transfer case cover.

   NOTE: Fig. 6-29: has additional parts removed for clarity.

6. Remove the two cap screws from the steering shaft, 3. Spread the yoke and remove it from the worm shaft.

7. Remove the transfer case cover evenly. Use a flat chisel in several locations to separate the cover from the housing.

8. Move the cover, with the pumps attached, away from the engine as far as possible to allow the engine to be lifted out of the frame.

   IMPORTANT: Support the hydrostatic and hydraulic pumps when separating them from the engine. Do not allow them to hang from the hydraulic hoses and fittings.

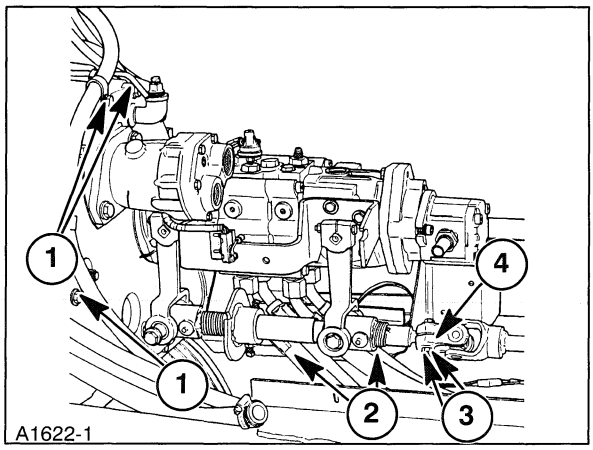


Figure 6-29

REMOVING THE RADIATOR

On the HW340, remove the radiator to ease 6-cylinder engine removal. On the HW300/320, the radiator may remain in the windrower. If the radiator remains in the machine, protect it with a piece of thin plywood or other material during engine removal. If you are not removing the radiator, skip ahead to "Removing the Engine."

Swing the hinged air intake hood and air conditioner condenser/hydraulic oil cooler aside.

1. Drain the cooling system using a suitable container, Figure 6-30, 4-cylinder engine, Figure 6-31, 6-cylinder engine. Remove the drain plug, 1 (HW300/320) or open the petcock (HW340) or heater hose to drain the anti-freeze from the system. Remove the radiator cap to speed up the draining process.

   WARNING: HOT FLUID WILL BURN YOUR SKIN. DRAIN THE FLUID AFTER THE MACHINE COOLS TO PREVENT PERSONAL INJURY.

2. Remove all hoses from the radiator.

3. HW300/320: Disconnect the engine oil cooler inlet line, 2.

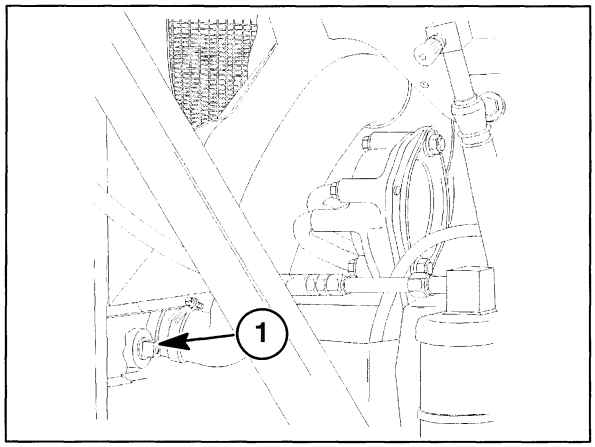


Figure 6-30

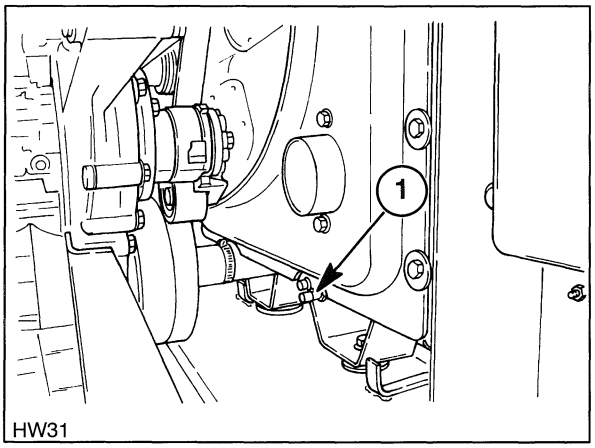


Figure 6-31

20. Install the upper and lower radiator hoses. Install the drain plug or heater hose in the lower part of the radiator. Fill the radiator with a 50/50 mixture of FNH antifreeze and clean water. If FNH antifreeze is not available, use a heavy duty antifreeze plus conditioner and water. The cooling system capacity is about 15 qts. (14.2 L) total.
21. Reconnect the engine oil cooler lines to the bottom of the radiator or engine block.
22. Check to make sure the engine is filled with the proper grade and quantity of oil.

INSTALLING THE RADIATOR

Radiator installation is the reverse of removal but with the following requirements:

1. Use the correct grade and quantity of heavy duty anti-freeze. The recommended mix is water 50%, with FNH anti-freeze 50% (ESN-97B18-D).
2. Refill the system through the radiator pressure cap. Reinstall the 0.9 bar (13 PSI) radiator cap and continue filling through the expansion tank until the coolant is visible in the expansion tank. Put the expansion tank cap back on.
3. If you loosened or removed the engine oil cooler tubes, check the engine oil level.
4. Run the engine for several minutes, checking for leaks. Top off any fluid levels that may have settled during testing.

INSTALLING THE HOOD

Do not tighten any hardware until the hood is in position.

1. Lift the hood into place, being careful not to damage the air cleaner or any other parts.

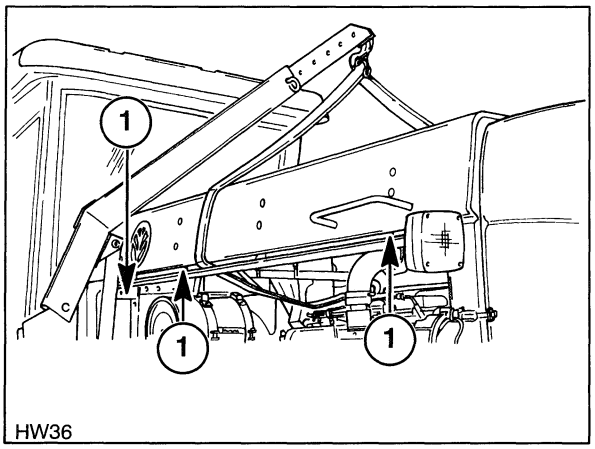


Figure 6-50

25. Attach the flywheel to the crankshaft with six Allen-head bolts. Apply a film of Loctite #271 to the threads of the bolts. Tighten in the proper sequence to 270 N·m (200 ft. lbs.).

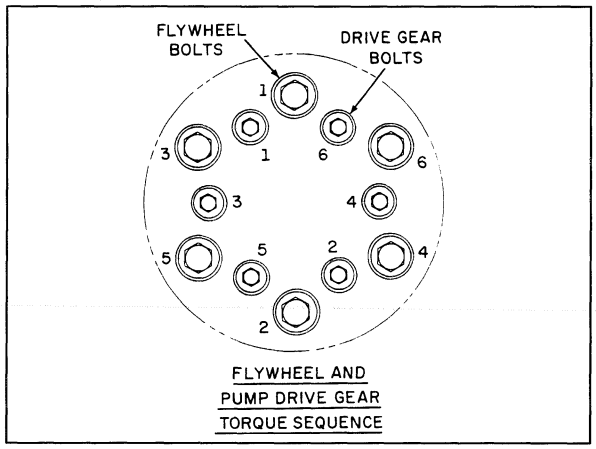


Figure 6-73

CYLINDER HEAD

Inspection and Repair

1. Change the cylinder head core plugs if they are discolored (rusty) or leaking. Before installing new plugs, remove all the old sealer from the cylinder head. Apply anaerobic sealant G (#ESE-M4G217-A) to the new plug mating faces, and drive the new plugs into place.

   The 4-cylinder head requires four core plugs in the top and one in the rear of the cylinder head, and three in the intake face.

   The 6-cylinder head requires six plugs in the top, one for each cylinder (similar to the 4-cylinder head), along with one in the rear and five in the intake face.

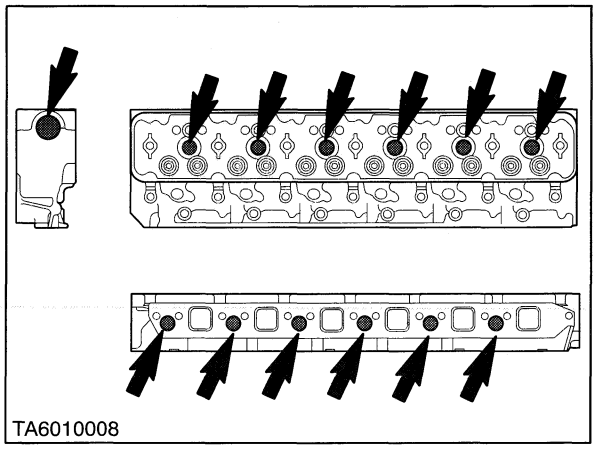


Figure 6-92

2. Scrape all gasket surfaces clean and wash cylinder head in a suitable solvent, also cleaning valve guide bores.

   NOTE: Remove all injector washers prior to cleaning.

3. Inspect the cylinder head for nicks and burrs on mating face. Remove them using a suitable abrasive. Make sure faces are clean after repair.

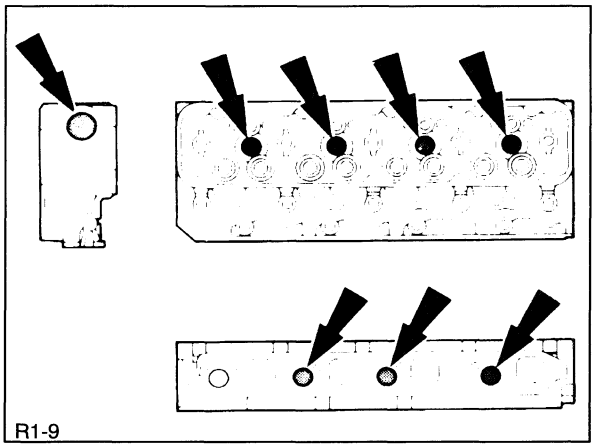


Figure 6-93

6. Rotate the gears and check the backlash using a feeler gauge or dial indicator at four equal points on the gears. Repair or replace if the backlash exceeds the following:

4-cylinder:

Backlash to crankshaft gear (2):
0.15 mm - 0.46 mm (0.006″ - 0.018″)

Backlash to camshaft gear (1):
0.15 mm - 0.46 mm (0.006″ - 0.018″)

Backlash to fuel injection pump gear (4):
0.10 mm - 0.53 mm (0.004″ - 0.021″)

6-cylinder:

Backlash to crankshaft gear (2):
0.10 mm - 0.35 mm (0.004″ - 0.014″)

Backlash to camshaft gear (1):
0.20 mm - 0.56 mm (0.008″ - 0.022″)

Backlash to fuel injection pump gear (4):
0.10 mm - 0.15 mm (0.004″ - 0.006″)

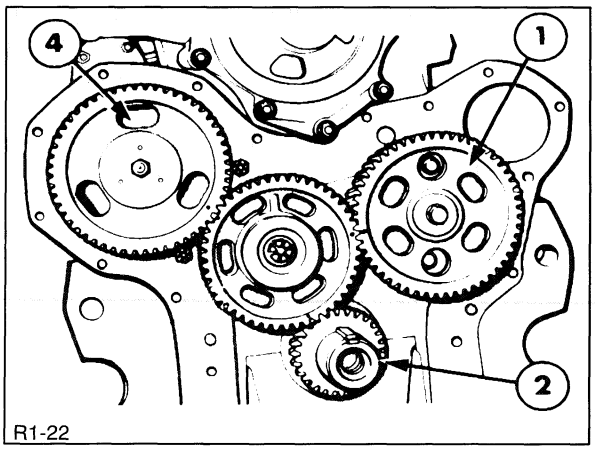


Figure 6-109

CAMSHAFT AND FUEL PUMP DRIVE GEARS

Removal

1. Pry the camshaft gear, 3, away from the thrust plate using a lever, 1. Use a dial indicator or feeler gauge, 2, to measure the clearance. If the measured clearance is not between 0.05 mm - 0.18 mm (0.002″ - 0.007″), install a new camshaft thrust plate, 4.
2. Remove the camshaft idler gear retaining bolt, gear, and adapter from the block, then remove the camshaft gear bolt and disassemble.

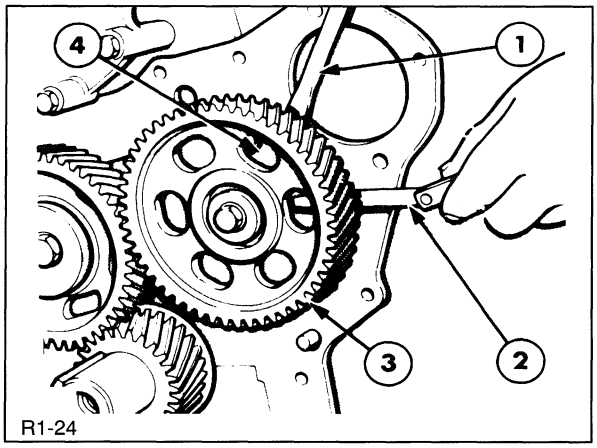


Figure 6-110

Where special tooling is not available for the removal or installation of the connecting rod bushing, a standard bushing can be installed in the following manner:

a. Place the connecting rod securely in a bench press.

b. Manufacture a press tool, 1, from suitable bar stock, grinding the end face at an angle matching the connecting rod bushing side face, 3.

c. Place the tool on the old bushing, 2, and gently drive it out. Make a guide to assist alignment of the bar stock during this operation.

d. Use the same procedure to install a new bushing, using a suitable piece of bar stock with the end face machined flat to suit the standard parallel bushing. Use a guide as described and gently drive in the new bushing. Align the bushing gap as shown, 4.

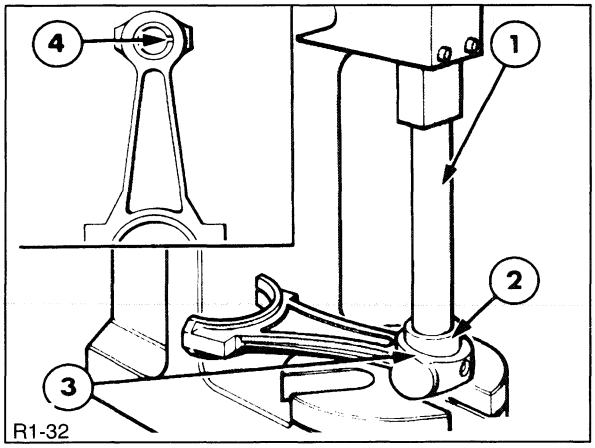


Figure 6-127

3. After installation, grind the side faces of the new bushing to match the side faces of the connecting rod. Remove all sharp edges and clean loose chippings from the connecting rod before reassembly into the engine.

4. With a new bushing installed, drill a hole through the top of the connecting rod using a 4.6 mm (3/16″) bit, and drill through the existing oil hole, 2.

5. Use an expanding reamer to get the correct bushing-to-piston pin clearance of 0.013 mm - 0.025 mm (0.0005″ - 0.0010″). Remove burrs and chippings before reinstalling.

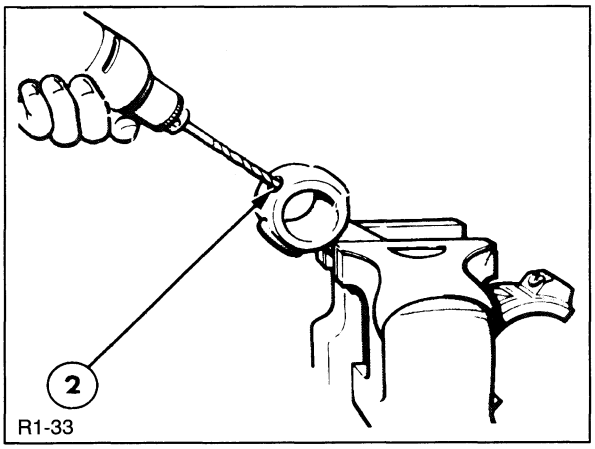


Figure 6-128

PISTON ASSEMBLY

Installation

1. Select the correct bearing liners (see "Reassembling the Crankshaft" later in this section) and install them in the rod and cap. Install the liner tang properly in the slots of the rod and cap.
2. Turn the crankshaft to position #1 with the crankpin at the bottom of the stroke. Lubricate all parts with new engine oil.
3. Using a ring compressor, 2, and a soft drive, 1, slide the pistons into the bores, making sure the grade letter on the pistons is toward the front of the engine.
4. Seat the connecting rod bearing liner on the crankpin, with the bearing cap installed on the connecting rod as a matched set. Install new bolts lubricated with oil and tighten to 149 N·m (110 ft. lbs.).

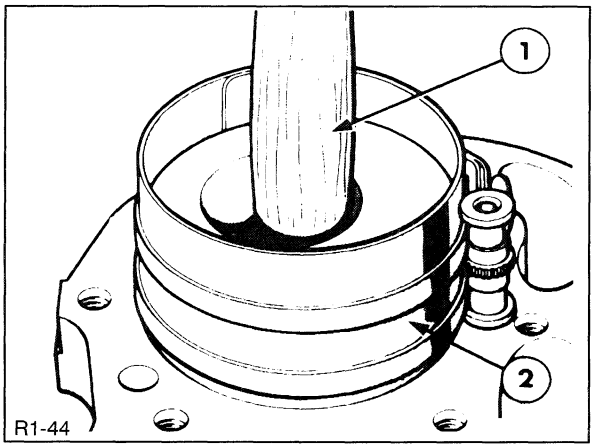


Figure 6-141

5. Using feeler gauges, 1, check the side clearance for each connecting rod at the crankshaft. The clearance should fall between 0.13 mm - 0.33 mm (0.005″ - 0.013″).
6. Reinstall the oil pump tube/screen, balancer and oil pan. Refill the engine oil and coolant and run the engine, checking for leaks.

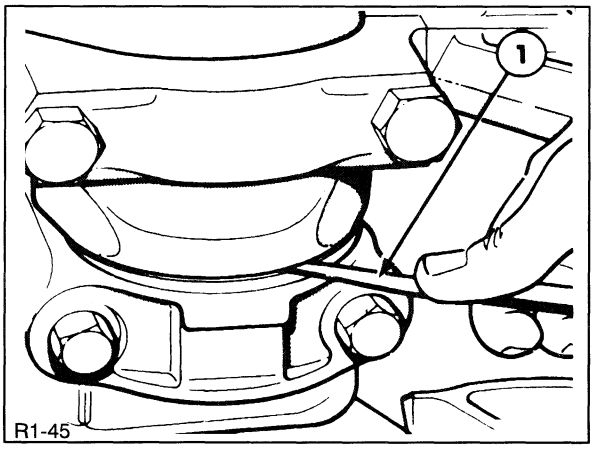


Figure 6-142

Inspection and Repair

1. Wash all parts in a suitable solvent and inspect the inside of the pump plate and body for excessive wear or damage. If visually okay, inspect in the following manner:

2. Invert the pump plate/rotor assembly, 1, and place the outer rotor, 2, over the inner rotor. Placing a straightedge, 3, across the top of both, slide a feeler gauge, 4, between the straightedge and inner rotor. The wear (play) should fall within 0.025 mm - 0.089 mm (0.001″ - 0.0035″).

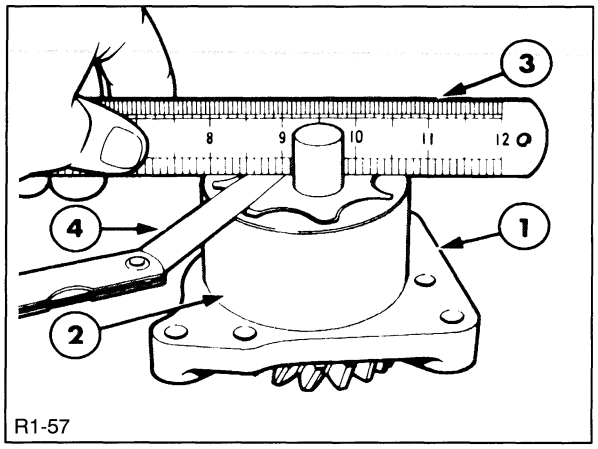


Figure 6-157

3. Place the outer rotor, 1, in the pump body, 2, and check the clearance by inserting a feeler gauge, 3, between the rotor and body. If the clearance exceeds 0.55 mm (0.022″), install a new pump.

   NOTE: If not to specification, replace the oil pump. Reduced pump pressure through wear could result in reduced engine life.

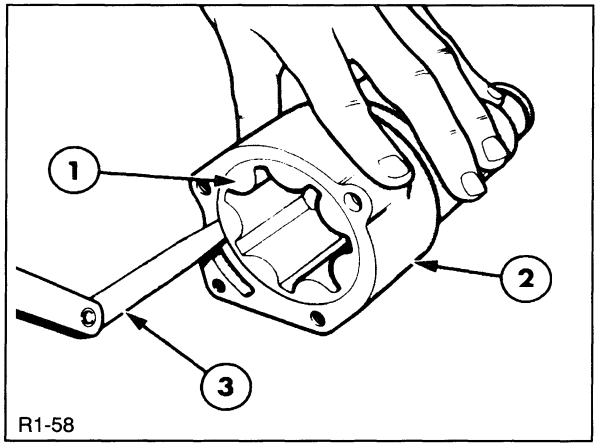


Figure 6-158

Inspection and Repair

1. Inspect the camshaft journals, lobes, for damage, pitting, or heat discoloration. If any of these conditions exist install a new camshaft.
2. Inspect the oil pump drive gear on camshaft, and the mating gear on the oil pump, for broken or worn teeth. If any wear or damage is apparent fit new gears.
3. Check each tappet, 1, for wear or damage and measure the diameters. Replace any that are not within the following specification:

   Tappet diameter
   25.118 mm - 25.130 mm (0.9889″ - 0.9894″)

   Tappet bore diameter
   25.15 mm - 25.17 mm (0.990″ - 0.991″).
4. Measure the diameter of the bearing journals to determine whether they are out-of-round. Install a new camshaft if the journals exceed the following specifications:

   Bearing journal diameter
   60.693 mm - 60.719 mm (2.3895″-2.3905″).

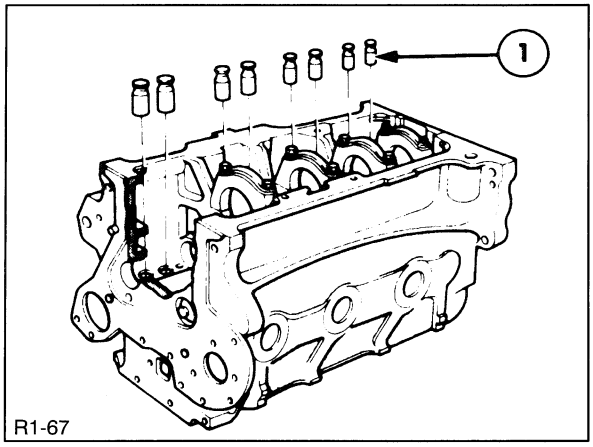


Figure 6-175

ENGINE OIL CAPACITIES (LESS OIL FILTER)

Model	Litres	U.S Qts
4 CYL	11.6	16.00
6 CYL	18	19

ENGINE OIL CAPACITIES (WITH OIL FILTER)

Model	Litres	U.S Qts
4 CYL	13.6	17.0
6 CYL	19	20

THERMOSTAT

Opening Temperature	81°C (178°F)
Fully Open	94° (201°F)

WATER PUMP

Type	Centrifugal
Drive	Poly V-Belt

FAN BELT

Belt Tension	Maintained by Tensioner

COOLING SYSTEM CAPACITIES (WITHOUT CAB)

Model	Litres	U.S Qts
4 CYL	15.2	15.0
6 CYL	26	27.5

COOLING FLUID

Content Mixture - Water 50%, Ford Antifreeze WSN - M97B18 - D 50%.
If Ford Antifreeze is not used, a heavy duty antifreeze must be used with a 5% solution of inhibitor. This inhibitor must be added to the cooling system and is available from New Holland, Part No FW 15.

SPEED ADJUSTMENTS

Idle Speed Adjustment

1. With the engine running and at normal temperature, disconnect the throttle cable at the injection pump, 1.
2. Loosen the locknut, 2, and adjust the idle speed adjustment screw, 3, until the engine idles at 750 RPM.
3. Operate the throttle lever several times, and recheck the idle speed. If there is excessive free play in the hand throttle after adjustment, proceed to "Throttle Linkage Adjustment" in this section.

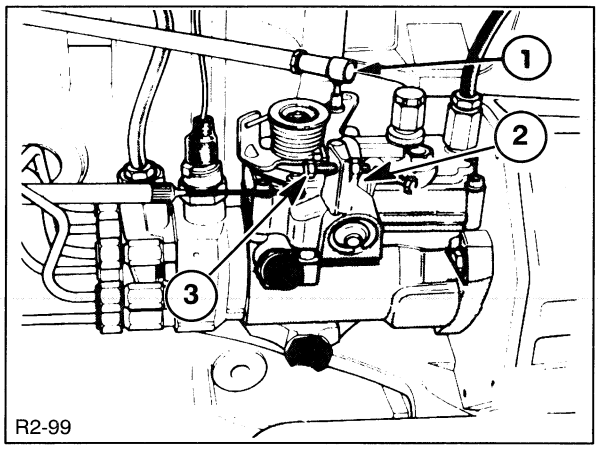


Figure 6-187

Maximum No-Load Speed Adjustment (DPS only)

IMPORTANT: The DP200 series' maximum no-load speed screw is adjusted and sealed at the factory for correct fuel delivery and maximum no-load speed. Only Lucas-authorized service professionals should adjust the maximum no-load speed. Unauthorized tampering will void the warranty.

If the maximum no-load speed is not up to spec (about 2200 RPM), adjust it as follows:

1. With the engine running and at normal operating temperature, disconnect the throttle cable, 1, at the injection pump.
2. Cut and remove the maximum no-load speed screw sealing wire and remove the locking sleeve.
3. Set the throttle lever at the injection pump in the maximum no-load speed position. Loosen the locknut, 2, and adjust the screw, 3, until the engine reaches 2200 RPM (the maximum no-load speed).
4. Tighten the locknut to 7-9 N·m (5-7 ft. lbs.) and secure the adjustment with a new sealing wire and locking sleeve.
5. Adjust the cable length, if necessary, to reconnect to the fuel injection pump.
6. Reconnect the throttle cable and recheck the maximum no-load speed and idle speed. If the cable will not allow the engine to reach its maximum no-load speed or idle speed, proceed to "Throttle Linkage Adjustments." in the following section.

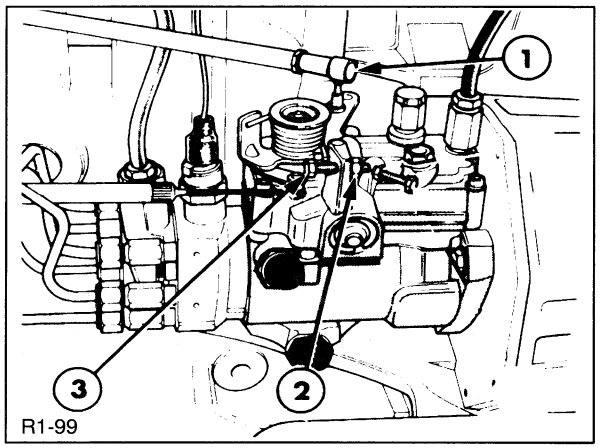


Figure 6-188

FUEL SYSTEM	HW300	HW320	HW340
Fuel Sedimenter	Single & Serviceable	Single & Serviceable	Disposable element, serviceable bowl
Fuel Filter Change Interval	600 Hours	600 Hours	600 Hours
No-Load Speed (RPM)			
High Idle	2200	2170	2300
Low Idle	1000	1000	800
Rated Speed	2100	2100	2100

GENERAL TORQUES

	N·m	ft. lbs.
Throttle Cable Locknuts	12	9
Throttle Lever Stop Bolt Locknut	10	7
Thermostart Plug	37	27
Thermostart Pipe Union	10	7
Thermostart Connector to Fuel Pump	11	8
Thermostart Tube to Connector	10	7
Fuel Tank Sender Retaining Ring	24	18
Fuel Filter Element Retaining Bolt	10	7
Fuel Filter Body Retaining Bolts	30	22
Air Cleaner Retaining Bolts	23	17
Air Cleaner Hose Clamps	2	1.5
Air Cleaner Restriction Indicator Switch	12	9
Leak Off Pipe to Injector Line	24	18
Injector Nozzle Retaining Nut	70	50
Injector Retaining Bolts	22	17
Injector Leak-Off Line Banjo Bolts	11	8
High Pressure Gland Nuts, at Injector,	24	18
and Fuel Injection Pump	7	5
Fuel Pump to Front Plate Attaching Bolts	24	18
Fuel Pump Gear Retaining Nut	77	58
Fuel Filter to Engine Retaining Bolts	30	22
Fuel Separator Retaining Bolts	30	22
Fuel Tube to Filter Connector	11	8
Tube Connector to Filter Body	11	8
Fuel Tube Jubilee Clips	4	3

GENERAL TORQUES

	N·m	ft. lbs.
Throttle Cable Locknuts	12	9
Thermostart Plug	37	27
Thermostart Pipe Union	10	7
Leak Off Pipe to Injector Line	24	18
Fuel Tank Sender Retaining Ring	24	18
Fuel Filter Element Retaining Bolt	10	7
Fuel Filter Body Retaining Bolts	30	22
Air Cleaner Hose Clamps	2	1.5
Air Cleaner Restriction Indicator Switch	12	9
Injector Nozzle Retaining Nut	70	50
Injector Retaining Bolts	22	17
Injector Leak-Off Line Banjo Bolts	12	8
High Pressure Gland Nuts, at Injector and Fuel Injection Pump	24	18

AIR CLEANER

DESCRIPTION AND OPERATION

The air cleaner, 1, removes impurities from the air while at the same time allowing enough air to enter the engine to ensure complete combustion of the fuel.

The windrowers have a dry air cleaner assembly that operates in the following manner. Air is drawn through a stack screen mounted in front of the radiator and acts as the first defense against chaff and dirt being sucked into the engine.

The air then passes through a tube, mounted on the underside of the hood, into the air cleaner system, which consists of inner and outer elements within a metal casing located under the right rear portion of the hood.

As air enters the cleaner, the heavier particles of dirt collect at the outside of the container and pass through an aspirator tube connected to the muffler (optional). This allows the heavier particles to pass out of the system through the exhaust pipe. The lighter particles collect on the primary element, where they stay until cleaned off at the service interval.

The inner secondary element lies within the outer element and protects the engine in the event that dust passes through the outer element.

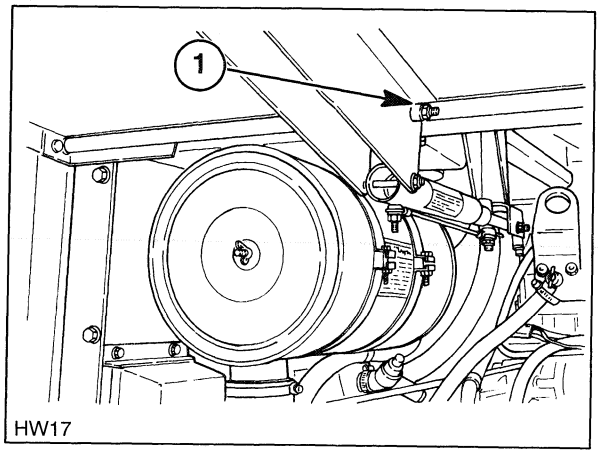


Figure 6-230

A restrictor indicator switch, 1, is mounted in the outlet tube of the air cleaner. If the cleaner element becomes blocked, the vacuum in the air cleaner outlet pipe will increase and trip the vacuum switch. Tripping the switch is tripped, a warning light will illuminate in the vehicle's instrument panel.

If the air cleaner restriction warning light illuminates when the engine is running, stop the engine as soon as possible, or within at least one hour, and investigate the cause.

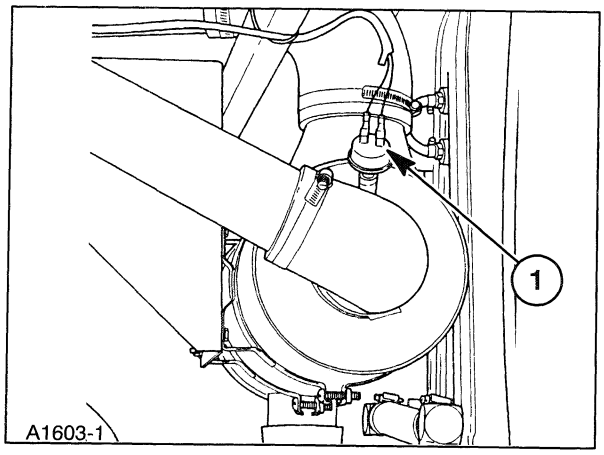


Figure 6-231

INSPECTION

1. Inspect the compressor housing assembly for the following defects:

   a. Wheel rub damage in the contour area that cannot be polished out with 80 grit silicon carbide abrasive cloth.

   b. Worn, broken, or corroded snap ring grooves.

   c. Nicks, dents, or distortion that could prevent proper sealing between the compressor housing and the CHRA.

   NOTE: Replace the compressor housing if any of the above defects are found.

2. Inspect the turbine housing assembly for the following defects:

   a. Wheel rub damage in the contour area that cannot be polished out with 60 grit silicon carbide abrasive cloth.

   b. Worn, broken, or corroded snap ring grooves (snap ring turbine housing models).

   c. Nicks, dents, or distortion that could prevent proper sealing between the turbine housing and the CHRA.

   NOTE: If there is any compressor or turbine wheel blade damage, replace the CHRA. Operating a turbocharger with damaged blades will result in further damage to component parts or the engine. Blades cannot be straightened in service.

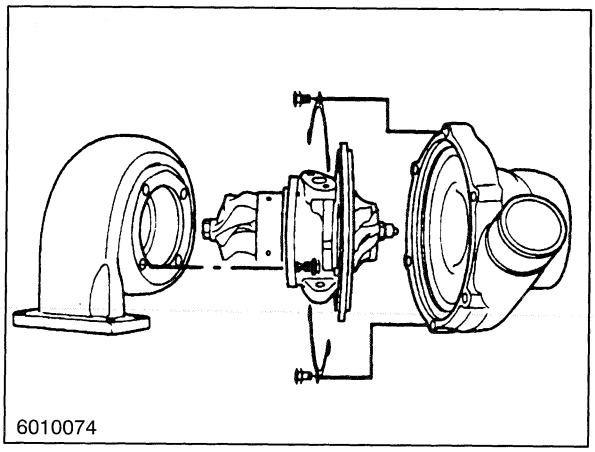


Figure 6-246

CENTER HOUSING AND ROTATING ASSEMBLY (CHRA)

IMPORTANT: The CHRA, as an assembly, is balanced at the factory under precise conditions. Do not disassemble it in any way. Disassembly will destroy the balance, requiring installation of a new CHRA.

Center Shaft Radial Check

Measure the journal bearing radial clearance whenever there is reason to suspect that the bearings are worn enough to allow either the compressor wheel or the turbine wheel to rub on its housing. This may be heard as a high-pitched whine.

FUEL FILTER

The fuel filter is the canister just in front of the sedimenter and it gets clean fuel from the supply pump. The filtered fuel flows back out of the center tube of the filter and into the injection pump.

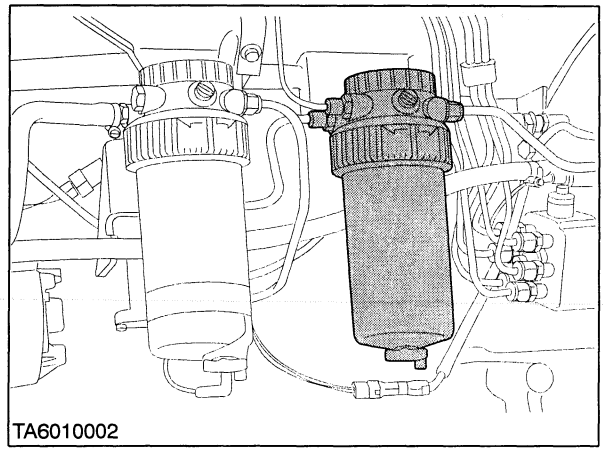


Figure 6-255

FUEL INJECTION PUMP

The fuel injection pump includes a vane-type supply pump, internal mechanical governor,. manifold atmospheric pressure (MAP) sensor, fuel shutoff solenoid, pressure control valve, injection timing unit, and high-pressure distributor pump. The fuel enters the pump at the front near the engine front cover.

7. Apply liquid soap and water solution to all joints and connections and watch for leaks, which will show up in the form of bubbles as air leaks through the soapy solution. Pay particular attention to any joint where a fuel line enters or exits a component. Repair any leaks.
8. Reconnect the supply line, open the return line valve and prime the system with fuel.
9. Start the engine and run it for about 10 minutes.
10. Bleed the system if necessary.

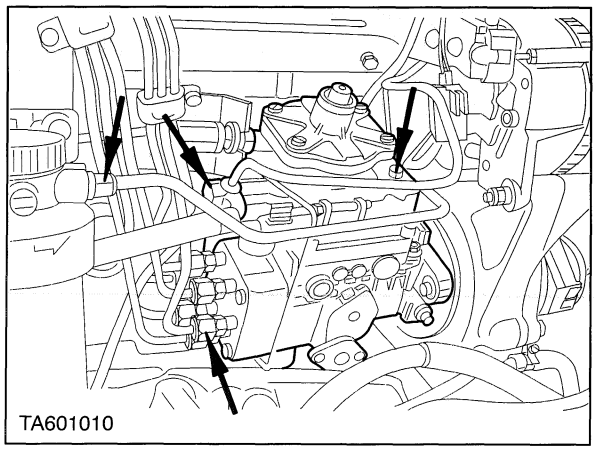


Figure 6-271

Testing for Leakback (Injection Pump to Tank)

The injection pump cavity must remain full of fuel while the engine is off. If fuel from the cavity drains back into the tank, the cavity must refill before the engine will start. This can cause very difficult cold starting.

A one-way check valve in the supply pump and the overflow keep fuel from escaping the cavity under normal conditions.

1. Install a clear line several feet long to the supply pump inlet port.
2. Install a clear line several feet long to the return port on the pump.
3. Place a container of CLEAN fuel on the floor and insert both lines into the container.
4. Start the engine. Fuel will be drawn out of the container by the inlet line and return via the return line.
5. Run the engine until the system is completely free of air; then shut off the engine.
6. Leave the engine shut off overnight (if overnight is not possible, leave it off for at least four hours).

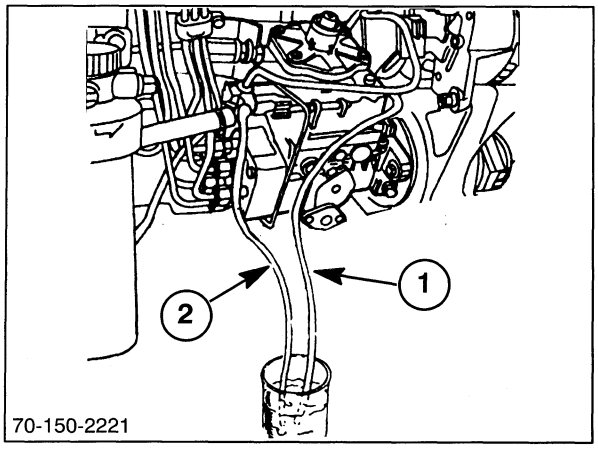


Figure 6-272

Injector Installation

The installation is the reverse of the removal procedure, noting the following points:

1. Install a new cork seal on the underside of the retaining flange.
2. Tighten the retaining bolts to 23 N·m (17 ft. lbs.) torque.
3. Bleed the fuel system as necessary (refer to "Injection system bleeding").

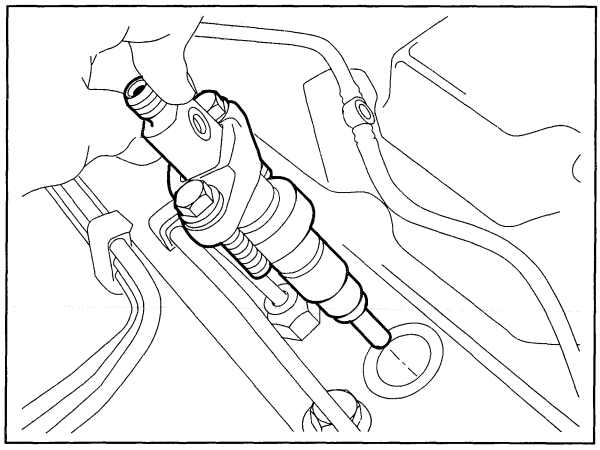


Figure 6-292

5. With large buildups of dust, you may use compressed air (not exceeding 2 bar/30 PSI) to clean the element. Insert an air line inside the element. With the nozzle about 150mm (6″) from the element, blow air through the element from the inside to the outside.

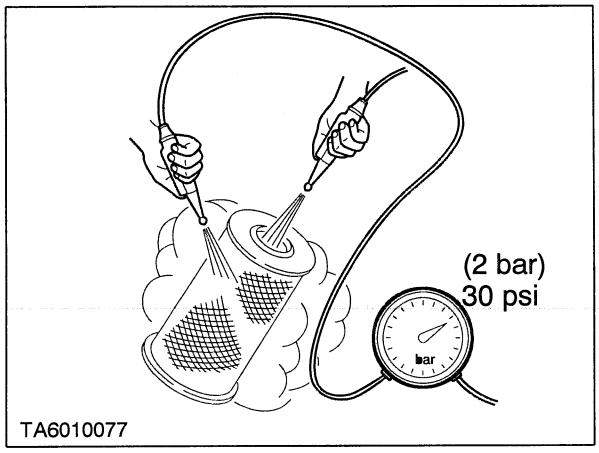


Figure 6-300

6. If the filter element is oily or heavily contaminated, wash it in warm water containing a small amount of non-sudsing detergent. Allow it to soak for 15 minutes; keeping the end of the element above the water line.

   IMPORTANT: Use only warm, soapy water to clean a heavily soiled element. The use of fuel oils, gasoline, solvents or boiling water can damage the element.

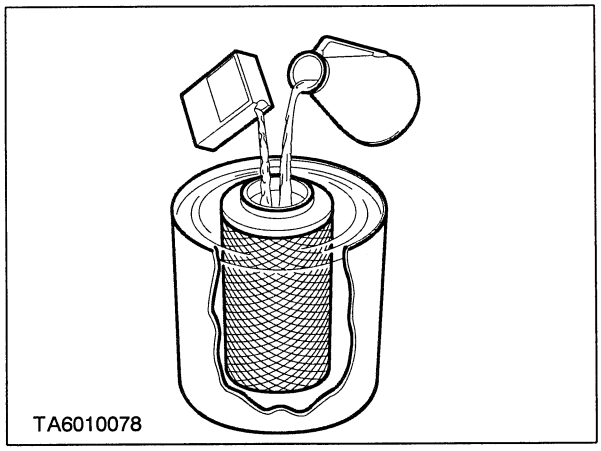


Figure 6-301

COOLING SYSTEMS

DESCRIPTION AND OPERATION

The function of the water pump mounted at the front of the engine is to maintain a continuous flow of coolant around the cooling system. This is essential to ensure correct engine temperature and performance during vehicle operation.

A poly V-belt from the crankshaft pulley drives the pump. A spring-loaded belt tensioner, bolted to the front of the engine, maintains fan belt tension.

The cooling system on the windrower engines is the recirculating bypass type, with full-length water jackets for each cylinder. The coolant flows from the bottom tank of the radiator into the water pump, which passes the coolant to the cylinder block. The coolant then flows through cored passages to cool the cylinder walls.

Passages in the cylinder head gasket allow coolant to flow from the cylinder block into the cylinder head. Cored passages also conduct coolant to the fuel injector nozzle locations before re-entering the water pump below the thermostat.

ROTARY SCREEN CLEANER

The HW320 and HW340 have a rotary vacuum screen cleaner to keep chaff from clogging the radiator intake screen. (This is optional on the HW300.)

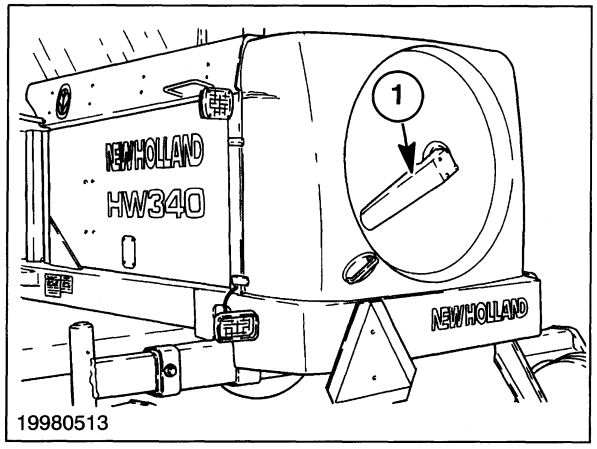


Figure 6-314

Installation

Thermostat installation is the reverse of removal with the following requirements:

1. Figure 6-333, 4-cylinder, & 6-334, 6-cylinder, coat a new gasket, 3, with sealer and place it in the recess on the thermostat housing, prior to installing the thermostat.
2. Coat the edge of the thermostat, 2, with grease and install with the heat element in the cylinder head.
3. Reinstall the thermostat housing, 1, and tighten the bolts to 24 N·m (18 ft. lbs.).

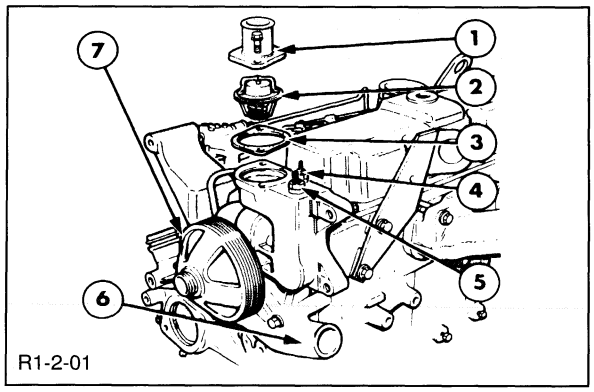


Figure 6-333

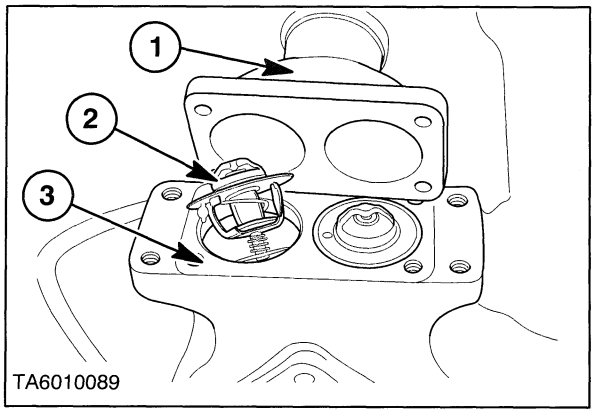


Figure 6-334

TEMPERATURE WARNING SENDERS

The temperature sender and temperature warning light are on the left side of the thermostat housing.

Installation

If a problem occurs, see Section 1, Electrical Systems. If installing new sensors, apply sealant to the threaded portion of the new sensor body and tighten the sensors to 16-24 N·m (12-18 ft. lbs.).

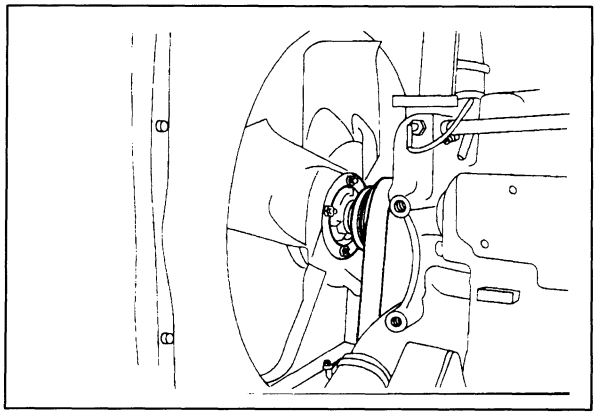


Figure 6-335

FAN BLADE

Removal

To remove the fan blade from the water pump spigot, hold the fan blade and remove the four attaching screws.

Reassembly

Reinstall the fan blade with the four attaching screws. Tighten the screws to 20-25 N·m (15-18 ft. lbs.).

Reassembly: 6-Cylinder

1. To install the bearing into the pump cover, place the cover rear face down onto suitable blocks to allow the shaft to protrude through the underside. Install the bearing with the longer, stepped end of the shaft in the body. Use a sleeve that contacts the bearing outer race only and press the bearing into the body.

   Once installed in the body the bearing case end face must be flush with the pump front face to within 0 - 0.152 mm (0 - 0.006″), reference "A."

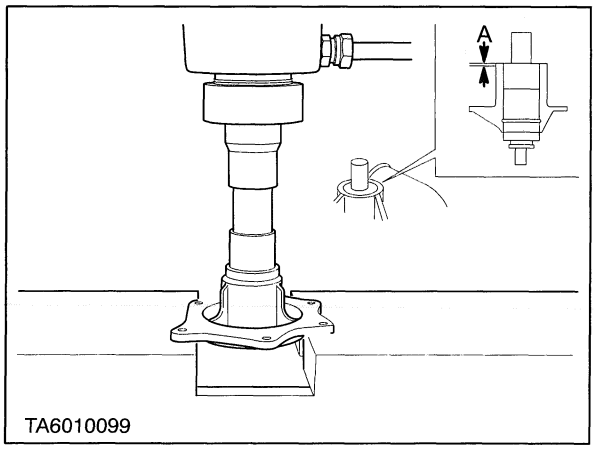


Figure 6-355

2. With the water pump front face down and the shaft supported, 2, place the seal assembly, 1, on the end of the shaft with its smallest diameter facing up.

   To insert the seal assembly, place Tool #FT6209 or FNH04672, 2, over the seal and press until the lip on the seal body seats on the pump body.

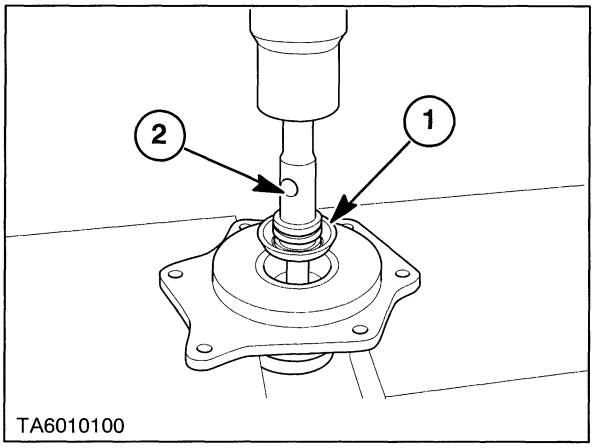


Figure 6-356

3. With the water pump rear face up and the shaft supported, place the impeller over the shaft and press the impeller into the water pump body. Installed correctly, the clearance between the face of the impeller fins and the operating face of the water pump should be 0.25mm - 0.88mm (0.010″ - 0.035″).

   The rear face of the impeller should be aligned with the lip around the opening in the rear face of the pump.

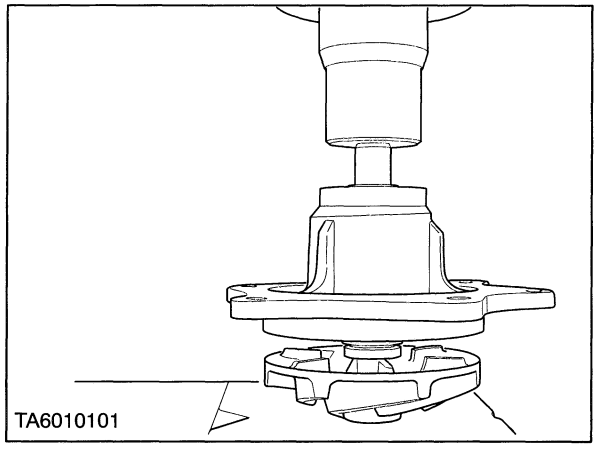


Figure 6-357

FUEL SYSTEM

Problem	Possible Causes	Correction
Fuel not reaching injection pump	Fuel shutoff valve close	Check that the fuel shutoff valve at the fuel tank is open.
	Restricted fuel filters	Check and flush the fuel filters clean.
	Air in system	Bleed the fuel filters.
	Fuel leakage	Check the fuel lines and connectors for damage.
Fuel reaching nozzles but engine will not start	Low cranking speed	Check the cranking speed
	Incorrect throttle adjustment	Check the throttle control rod travel
	Incorrect pump timing	Check the pump timing
	Fuel leakage	Check the fuel lines and connectors for leakage
	Faulty injectors	See Injector troubleshooting
	Low compression	Check the engine compression
Engine hard to start	Low cranking speed	Check the cranking speed
	Incorrect pump timing	Check the pump timing
	Restricted fuel filters	Check and flush the fuel filters clean
	Contaminated fuel	Check for water in the fuel
	Low compression	Check the engine compression
	Air in system	Check for air leaks on the suction side of the system
Engine starts and stops	Fuel starvation	Check and flush clean restricted fuel lines or fuel filters
	Contaminated fuel	Check for water in the fuel
	Restricted air intake	Check for restrictions in the air intake
	Engine overheating	Check cooling system
	Air in system	Check for air leaks on the suction side of the system
Erratic engine operation (surge, misfiring, poor governor regulation)	Fuel leakage	Checking the injector lines and connectors for leakage
	Fuel starvation	Check and flush clean restricted fuel lines or filters
	Incorrect pump timing	Check the pump timing
	Contaminated fuel	Check for water in the fuel
	Air in system	Bleed the fuel system
	Faulty or sticking injector nozzles	See injector troubleshooting

ENGINE OIL CONSUMPTION

EVALUATING OIL CONSUMPTION

Maximum engine oil consumption should be no more than 2-1/2 tenths of one percent (0.0025) of fuel consumed by volume, or just less than one liter (about 1.0 qt.) in 379 liters (100 gals.).

To determine oil consumption, check the oil level with the tractor parked in a level position. Then follow these steps:

1. Check the oil level prior to starting the day's work. Be sure the level is between the "add" and the "full" mark.
2. Operate the tractor for about one hour under normal load conditions to warm the engine.
3. Stop the engine and leave it off for 15 to 20 minutes. Then check the oil level and carefully add oil to bring it up to the full mark.
4. Fill the fuel tank to the base of the filler neck. This will be the start of the oil consumption test and an accurate record of oil and fuel used must be kept from this point until the test is completed.
5. Continue operating the tractor for the remainder of the day. Recheck the oil level after the engine has been stopped for 15 to 20 seconds. If the engine consumed only a small amount of oil, continue the test the following day.
6. Following the test period, carefully add oil to bring the level up to the full mark. Fill the fuel tank. These levels must be the same as of the beginning of the test in Step 3.
7. Total up all oil and fuel added during the test.
8. Calculate the oil consumption by taking the total amount of oil used and dividing it by the total amount of fuel used. Be sure to use the same increments of measurement for fuel and oil when calculating consumption. For example, oil typically comes in liters or quarts, while fuel comes in liters or gallons. To equalize gallons and quarts, either multiply gallons of fuel by 4 or divide quarts of oil by 4. Two examples of oil consumption calculations are as follows:

   1.5 qts. oil added per 75 gallons (300 qts) fuel: 1.5/300 = 0.005 (0.5%) oil consumption (excessive oil consumption)

   1.0 qt. oil added per 100 gallons fuel (400 qts.): 1.0/400 = 0.0025 (0.25%) oil consumption (acceptable oil consumption)

   1.5 L oil added per 300 L fuel: 1.5/300 = 0.005 (0.5%) oil consumption (excessive oil consumption)

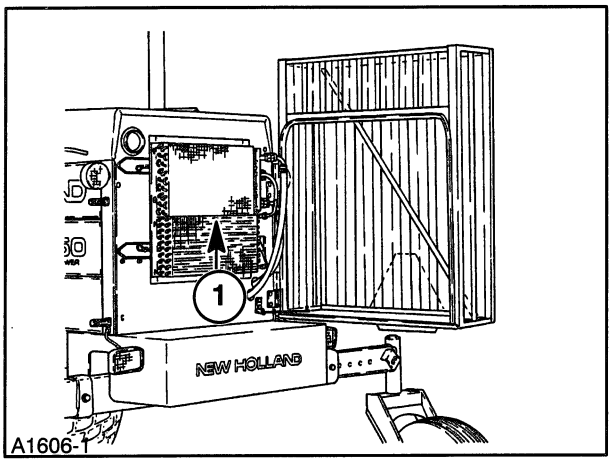
   1.0 L oil added per 400 L fuel: 1.0/400 = 0.0025 (0.25%) oil consumption (acceptable oil consumption)

   NOTE: Change oil and filters prior to any tests for oil consumption.

CONDENSER

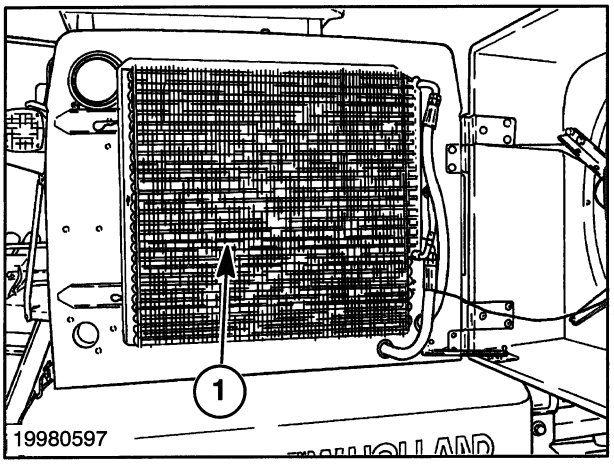
The condenser, 1, is in front of the radiator and consists of a number of turns of continuous coil mounted in a series of thin cooling fins.

Hot refrigerant vapor under pressure flows from the compressor to the condenser. Air passing over the condenser coils cools the refrigerant, causing it to revert from a vapor back to a liquid. This charge of state (from vapor to liquid) releases a large quantity of heat, which passes to the outside air through the condenser.



HW300

Figure 7-11



HW320/340

Figure 7-12

RECEIVER/DRIER

The warm liquid refrigerant flows from the condenser into the receiver/drier, 1. It passes through a filter and desiccant (drier) and into an outlet line to the thermostatic expansion valve. The refrigerant enters the thermostatic expansion valve as a high-pressure WARM LIQUID. Its pressure and temperature fall as it passes through the metering orifice and it becomes a low-pressure COLD VAPOR AND ATOMIZED LIQUID.

The receiver/drier is a storage tank that receives the high-pressure warm liquid refrigerant from the condenser and delivers the refrigerant to the thermostatic expansion valve.

The receiver stores enough liquid refrigerant to maintain a steady flow to the thermostatic expansion valve under widely differing operating conditions.

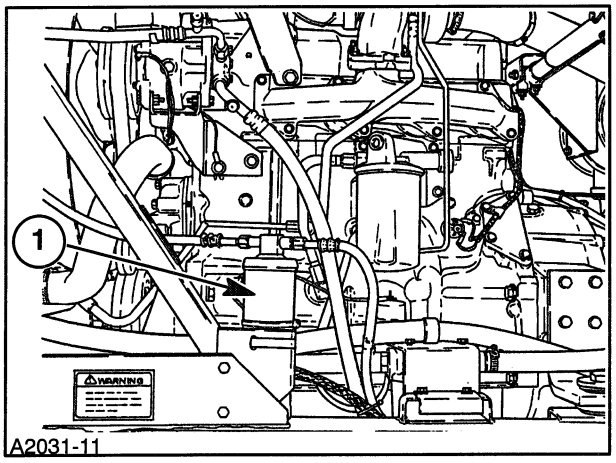


Figure 7-13

TROUBLESHOOTING AND SERVICING

AIR CONDITIONING SYSTEM

GENERAL SAFETY AND SERVICE PRECAUTIONS

WARNING: REFRIGERANTS SUCH AS R134A HAVE POTENTIALLY DANGEROUS PHYSICAL AND CHEMICAL PROPERTIES. ALL REFRIGERANTS ARE STORED AS A LIQUID UNDER HIGH PRESSURE, AND ALL OF THEM CAN BE HARMFUL OR FATAL IF TREATED IMPROPERLY. IMPROPER HANDLING CAN LEAD TO PHYSICAL INJURY, FROSTBITE, BLINDNESS, POSSIBLE POISONING AND/OR DEATH BY ASPHYXIATION OR CARDIAC ARREST. R134A CAN BE FLAMMABLE UNDER CERTAIN CONDITIONS.

Review the material safety data sheet provided by the refrigerant manufacturer for safe and proper handling information as well as instructions on what to do if an emergency should arise. Read and understand the applicable material safety data sheet before you begin work on an air conditioning system.

Likewise, your service equipment comes with a thorough set of operating instructions that should allow you to perform refrigeration system service work easily, efficiently and safely. Read and understand the operating instructions for your service equipment before you start work.

The following safety warnings are generally recognized minimum precautions that you must follow when servicing air conditioning systems.

1. Be familiar with the operation of the windrower.
2. Read, understand, and follow the instructions provided by the manufacturer of all the service equipment with which you will be working and operation of the windrower.
3. Wear safety goggles at all times when servicing an air conditioning system, extraction or recycling equipment, or otherwise handling refrigerant. Liquid splashed in the eye can cause frostbite and/or irritation.
4. Wear appropriate rubber gloves and other clothing whenever there is a potential for splashing liquid refrigerant on your skin. The refrigerant is a solvent for natural oils and will dry out your skin, causing irritation and cracking. Read and follow the information in the material safety data sheet provided by your refrigerant supplier regarding the proper handling of refrigerant.

CAUTION: AVOID BREATHING A/C REFRIGERANT AND LUBRICANT VAPOR OR MIST. EXPOSURE MAY IRRITATE EYES, NOSE AND THROAT. TO REMOVE R134A FROM THE A/C SYSTEM, USE SERVICE EQUIPMENT CERTIFIED TO MEET THE REQUIREMENTS OF SAE J2210 (R134A RECYCLING EQUIPMENT). IF ACCIDENTAL SYSTEM DISCHARGE OCCURS, VENTILATE WORK AREA BEFORE RESUMING SERVICE. REFRIGERANT AND LUBRICANT MANUFACTURERS CAN PROVIDE ADDITIONAL HEALTH AND SAFETY INFORMATION.

5. Never mix R134a with air for leak testing. In general, do not use or mix with pressurized air. Pressurized, air rich mixtures of R134a and air can be flammable when exposed to an ignition source.
6. Never perform operations other than routine maintenance on your extraction or recycling equipment without first consulting the manufacturer's authorized personnel. Removal of fittings and filters can cause refrigerant under pressure to escape. Use the proper safety equipment, including safety goggles.

REFRIGERANT EXTRACTION AND RECYCLING EQUIPMENT

Both extraction and recycling equipment are in use and available to service technicians. Both types of equipment will remove the refrigerant from an air conditioning system. However, extraction equipment only pulls the refrigerant from the air conditioning system and stores it in an appropriate container. Extraction equipment does not clean the refrigerant. Its only purpose is to recover the refrigerant from an air conditioning system prior to disassembling and servicing it.

Always recycle or reclaim recovered refrigerant before putting it back into an air conditioning system. During service operations involving a partial recharge, or while the air conditioning system is in use, refrigerant can pick up moisture, lubricants, microscopic metal chips, and other potential contaminants. In many cases, these contaminants contribute to or are the primary cause of the system failure. Putting used, uncleaned refrigerant back into an air conditioning system may result in poor system performance.

NOTE: Reuse of unrecycled, unreclaimed refrigerant will void the warranty.

Equipment that removes refrigerant from a mobile air conditioning system (usually called "recovery" equipment) may allow you to put the used refrigerant back into the system without first cleaning it to minimize performance. You may also use such equipment to pull refrigerant from non-mobile air conditioning systems. Non-mobile air conditioning systems use refrigerants and contain contaminants that are different from those in mobile air conditioning systems. Recovery equipment may therefore allow the mixing of different types of refrigerants or introduce contaminants that may not be removable by recycling equipment available in the service shop.

If you want to remove, clean and reuse R134a refrigerant, you must use a machine that both extracts and recycles refrigerant from mobile air conditioning systems. Dedicate that machine to R134a only.

Recycling equipment meeting SAE standards J1990 and J2210 is designed to extract and recycle refrigerants that have been in mobile air conditioning systems only. R134a refrigerant also is used in non-mobile air conditioning or refrigeration systems. Non-mobile systems may introduce contaminants to the refrigerant that equipment meeting SAE J1990 and J2210 cannot remove. This equipment is not intended for use on non-mobile systems.

Using Extraction Equipment

Extraction equipment is relatively small and easily portable. It is best used if a shop must service vehicles, such as agricultural or off-highway equipment, that cannot easily be brought into the shop. It is also convenient for shops that must deal with a variety of different refrigerant types and exchange recovered refrigerant for reclaimed refrigerant at some central location.

Always use extraction equipment on those refrigerants for which it was designed. The lubricants, hoses, and seals in this equipment have been designed to work with only one refrigerant.

To help avoid a mix-up of service equipment and refrigerants, equipment hoses designed for use with each refrigerant are easily identifiable. New service hoses used with R134a must have a black stripe along the entire hose length and carry the designation "SAE J 2196/R134a." (Hoses labeled "SAE J 2196" and lacking the black stripe were used for R12.)

PROBLEM	POSSIBLE CAUSES	CORRECTION
Cont'd	Cont'd	Remove the sensing bulb from the evaporator outlet tube Clean the surface of the tube and sensing bulb Clamp the sensing bulb to the outlet tube Retest If the expansion valve is defective, proceed as follows: Discharge the system Replace the expansion valve Evacuate the system Charge the system Retest
Gauge Readings Low pressure - low High pressure - high Insufficient cooling	Restriction in liquid line	Discharge the system Replace the receiver/drier Inspect all lines and tubing from compressor outlet to expansion valve. Replace if needed. Evacuate the system Charge the system Retest
Gauge Readings Low pressure - high High pressure - low Evaporator air not cold	Internal leak in compressor (reed valves, gasket, worn or scored piston rings or cylinder)	Discharge the system Replace the compressor Evacuate the system Charge the system Retest

EXAMPLE 8

SYMPTOMS

1. Insufficient or no cooling.
2. Low side pressure is too high. The gauge should read 21 - 207 kPa (3 - 30 PSI).
3. High side pressure is too high. See the pressure-temperature chart for correct gauge readings.
4. Evaporator and suction hose (to compressor) surfaces show considerable moisture.

DIAGNOSIS: the thermostatic expansion valve is allowing too much refrigerant to flow through the evaporator coils. The valve may be stuck open, or the temperature sensing bulb may be incorrectly mounted.

CORRECTIVE PROCEDURES

1. Check for a sticking expansion valve:
   a. Operate the system at maximum cooling.
   b. Check the low side gauge. The pressure should drop slowly.
2. If the test indicates that the expansion valve is defective, proceed as follows:
   a. Extract the refrigerant from the system.
   b. Replace the expansion valve.
   c. Evacuate the system.
   d. Charge the system.
   e. Performance test the system.

***NOTE: Test procedure based upon ambient temperature of 95° F. For proper high side gauge reading for other ambient temperatures, refer to the pressure-temperature chart.**

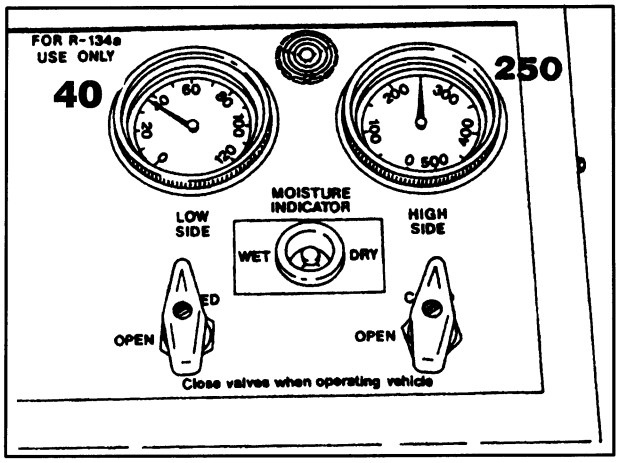


Figure 7-34

Ambient Temperature*		High Pressure Gauge Reading	High-Pressure Gauge Reading
°C	°F	bar	PSI
21	70	7.9 - 9.2	114 - 134
24	75	8.7 - 10.1	126 - 146
26	80	9.7 - 11.1	141 - 161
29.5	85	11 - 12.4	159 - 179
32	90	11.6 - 13	168 - 188
35	95	12.5 - 13.9	181 - 201
38	100	13.9 - 15.2	201 - 221
40.5	105	15 - 16.4	218 - 238
43	110	17 - 18.4	246 - 266
46	115	19.1 - 20.5	277 - 297
49	120	21.2 - 22.6	307 - 327