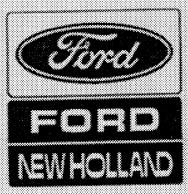


SE4840 REPAIR MANUAL

Please insert these additional sections into your SE4840 Repair Manual binder

PRINTED IN ENGLAND

FORD

Repair Manual – Series 40 Tractors

CONTENTS

SE 4840

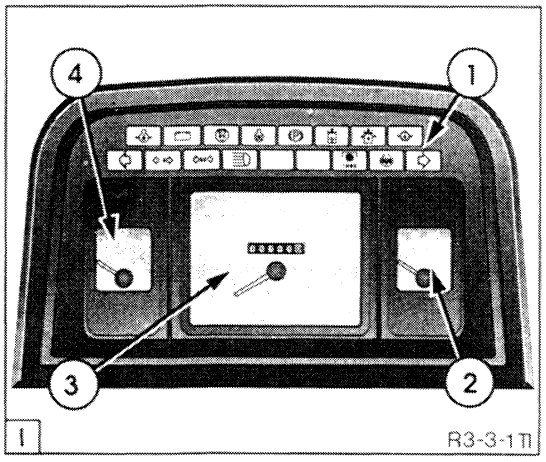
CONTENTS (Continued)

PART 3
ELECTRICAL SYSTEMS

Chapter 3
ANALOGUE INSTRUMENT CLUSTER (AIC) and ANALOGUE/ELECTRONIC INSTRUMENT CLUSTER (AEIC)

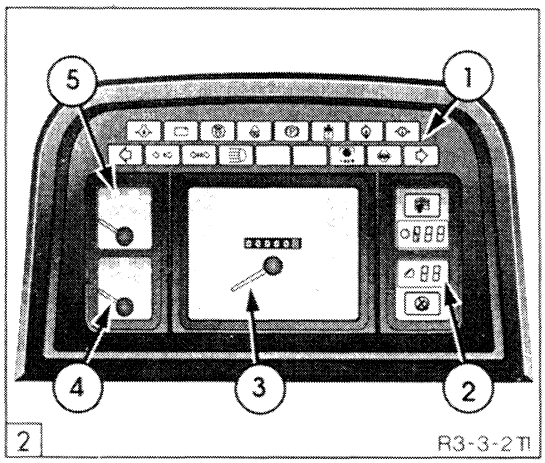
A. DESCRIPTION AND OPERATION

Overall Description



Analogue Instrument Cluster (AIC)

1. Upper Section
2. Right Hand Display (Coolant Temperature Gauge)
3. Main Display
4. Left hand Display (Fuel Gauge)



Analogue/Electronic Instrument Cluster (AEIC)

1. Upper Section
2. Right hand Display
3. Main Display
4. Left hand Display (Fuel Gauge)
5. Left Hand Display (Coolant temperature Gauge)

The AIC and AEIC panels are shown in Figure 1 and Figure 2 above with all displays activated.

When the key-start switch is turned on, the cluster self-tests. the audible alarm sounds and the malfunction warning lamps (items 1, 2, 3, 6, 7 and 8 of Figure 3) illuminate briefly.

1. The **Upper Section** has seventeen coloured lights providing operating information and warning of system malfunction.

2. The **Right-Hand Display** of the AEIC consists of two Liquid Crystal Displays (LCD's) providing Tractor Performance (implement and hydraulics) information and transmission gear and range selection. The right hand display of the AIC panel contains an analogue type coolant temperature gauge.

3. The **Left-Hand Display** of the AEIC panel contains two analogue type gauges providing information on engine coolant temperature and fuel level. The left hand display of the AIC contains the fuel level gauge only.

4. The **Main Display** is a multi-function gauge for indicating Engine rev/min and, operating hours.

UPPER SECTION

Certain tractor malfunctions are identified by a warning light.

The lights function as follows:
(with reference to Figure 3)

Upper Row - Left to Right

1. Low Engine Oil Pressure
   - Light illuminates
2. Alternator Not Charging
   - Light illuminates.
3. Air cleaner unservicable
   - Light illuminates
4. Thermostart
   - Light illuminates when Thermostart is activated.
5. Parking Brake and Brake/Clutch Fluid Level
   - Key-start on, flashing light indicates parking brake applied or low fluid level in brake/clutch reservoir.
   - Key–start off, handbrake off, warning buzzer sounds for 2 minutes.

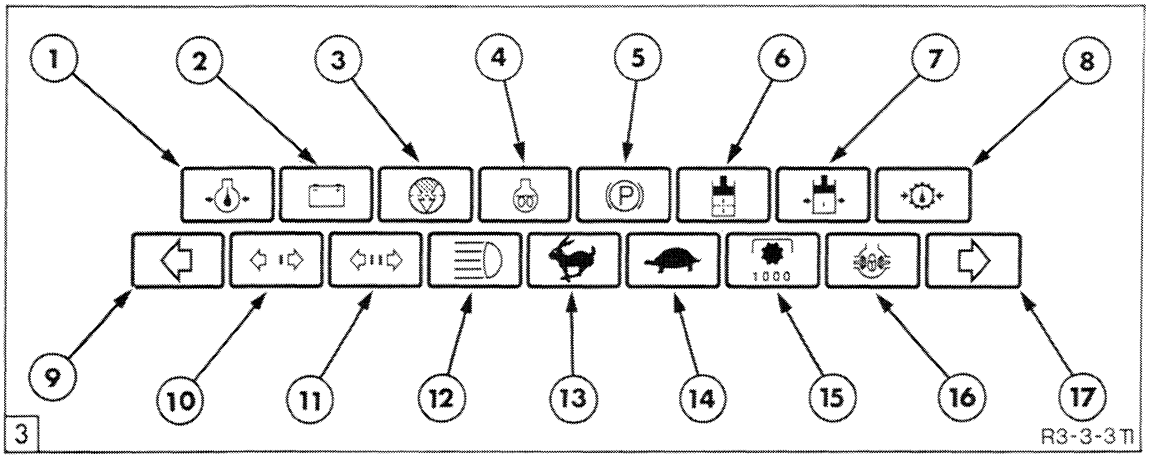
NOTE: *The warning lights 6 and 7 may serve differing functions, dependent upon whether a variable displacement piston pump, identified by the use of three hydraulic filters or a fixed displacement gear pump, identified by having a single hydraulic filter, is fitted.*

6. Tractors with variable displacement piston pump
   - Constant light:- Steering intake filter blocked or partially blocked.

6. Tractors with fixed displacement gear Gear Pump
   - Constant light:– Steering/hydraulic intake filter blocked or partially blocked.
7. Tractors with variable displacement piston pump
   - Charge pump intake and pressure filters blocked or partially blocked.
7. Light not used on tractors with fixed displacement gear pump.
8. Transmission/steering oil pressure low
   - Light illuminates

Lower Row - Left to Right

9. Left turn indicator



Indicator Lights

1. Engine oil pressure (red)
2. Alternator charge (red)
3. Air cleaner (amber)
4. Thermostart (amber)
5. Parking brake and brake/clutch fluid level (red)
6. Steering intake filter (red)
7. Charge pump filters (red)
8. Transmission and steering oil pressure (red)
9. Left turn indicator (green)
10. Trailer turn signal (when attached) (green)
11. Second trailer turn signal (when attached) (green)
12. Headlight main beam (blue)
13. Dual power – high
14. Dual power – Low
15. 1000 rev/min P.T.O. (amber)
16. Differential lock (amber)
17. Right turn indicator (green)

10. Trailer turn signal

- Light flashes in unison with tractor/ trailer turn signals if trailer attached.

11. Second trailer turn signal

- Light flashes in unison with tractor left-hand turn lamp
- Light should flash in unison with tractor/ trailer turn signals if second trailer attached.

12. Headlight Main Beam

- Light illuminates when tractor lights are switched to main beam.

13. Dual Power – High
(8x2 transmission, AIC only)

- Light illuminates when in direct drive.

14. Dual Power – Low
(8x2 transmission, AIC only)

- Light illuminates when underdrive is selected.

15. 1000 rev/min P.T.O. (shiftable P.T.O. only)

- Constant light indicates that 1000 rev/ min P.T.O. speed is selected. If P.T.O. overspeeds in the economy range, the light flashes for 5 seconds then remains constant.

16. Differential lock

- Light illuminates when differential lock is engaged.

17. Right turn indicator

- Light flashes in unison with tractor right-hand turn lamp.

B. FUNCTION SENDERS AND SWITCHES

With reference to Figure 4

B. ENGINE COOLANT TEMPERATURE SENDER
The temperature sender resistance changes proportionally with coolant temperature, causing modulation of the signal voltage (maximum voltage 5.0 volts) which is fed back to the instrument cluster to operate the temperature gauge.

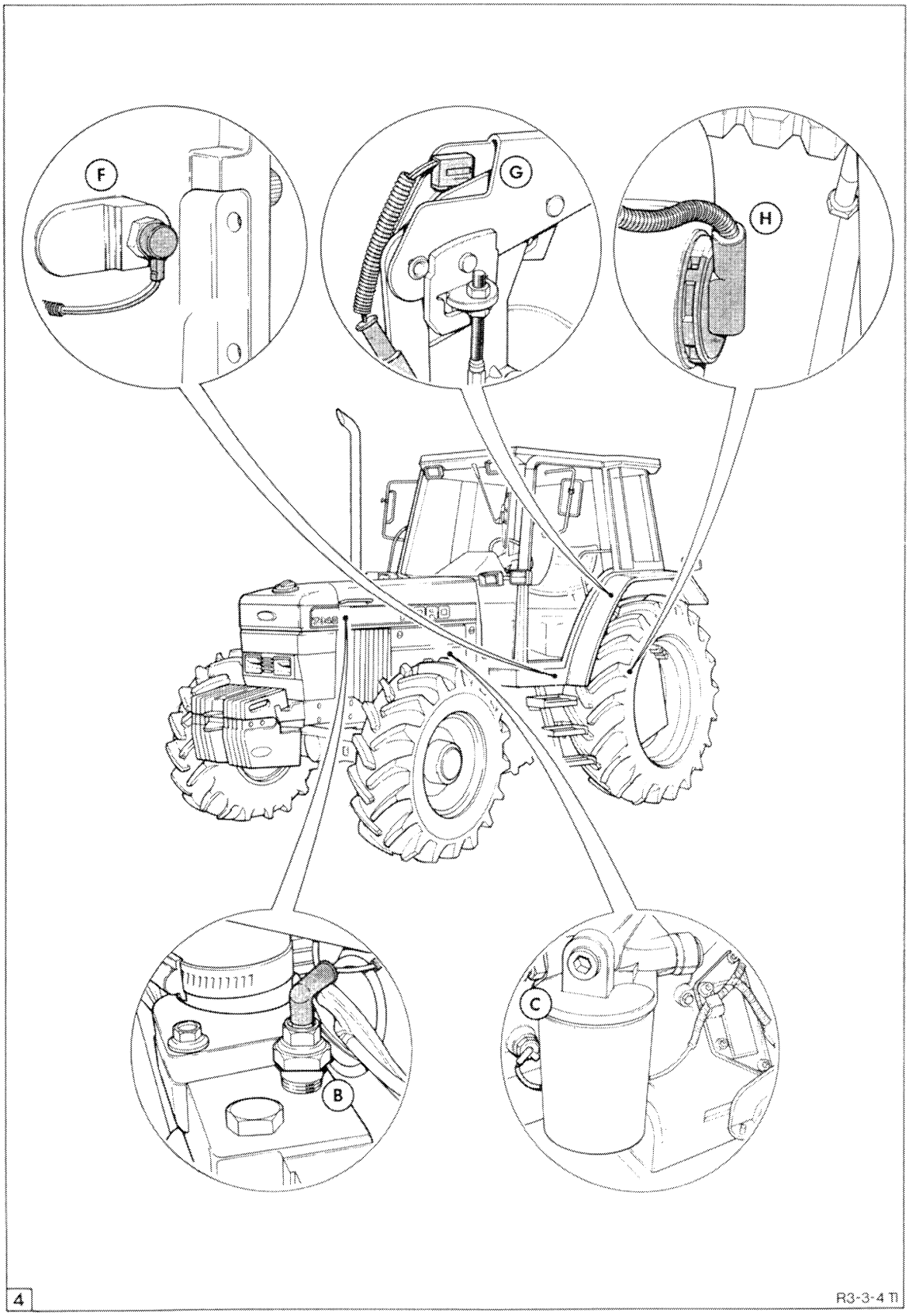
Sender Resistance	Gauge Indication
710–580 Ohms	COLD
Less than 100 Ohms	HOT

C. ENGINE OIL PRESSURE SWITCH
The switch is normally closed when the engine oil pressure is below 0.68bar (10 lbf.in^2) operating the engine oil pressure warning light.

F. TRANSMISSION SPEED SENSOR (With 16x16 Transmission Only)
Senses transmission output (wheel speed) and generates a signal for EECIV micro–computer for transmission control.

G. PARKING BRAKE SWITCH
Switched closed with parking brake applied, warning light illuminated with key switch on, alarm activated if parking brake on.

H. AUXILIARY FUEL TANK SENDER (Where Fitted)
Connected in series with main fuel tank sender. Refer to 'N'.



4

R3-3-4 TI

With reference to Figure 5

J. TWO SPEED SHIFTABLE PTO SWITCH (Two speed shiftable PTO only)
Operates '1000 RPM PTO' cluster light when 1000 rpm PTO selected With two speed PTO lever.

K. BRAKE AND CLUTCH FLUID LEVEL SWITCH (SL/SLE MODELS)
Operates fluid level/parking brake warning light when fluid level drops to minimum level, switch normally open.

L. AIR CLEANER RESTRICTION SWITCH
Switch normally open but closes when the vacuum in the air intake tube exceeds 25 in.H_2O, operating the air cleaner restriction warning lamp.

M. ALTERNATOR
Engine rpm displays are computed from a square wave frequency output from the alternator.
(Frequency 142.5–855.0Hz : 480–3060 rpm displayed)

N. MAIN FUEL TANK SENDER
Signals from both sender potentiometers determine the fuel level displayed by the gauge.

NOTE: *Where an auxiliary fuel tank is fitted the two senders total resistance is equivalent to the single main tank installation sender resistance. This allows a common gauge to be fitted to all models.*

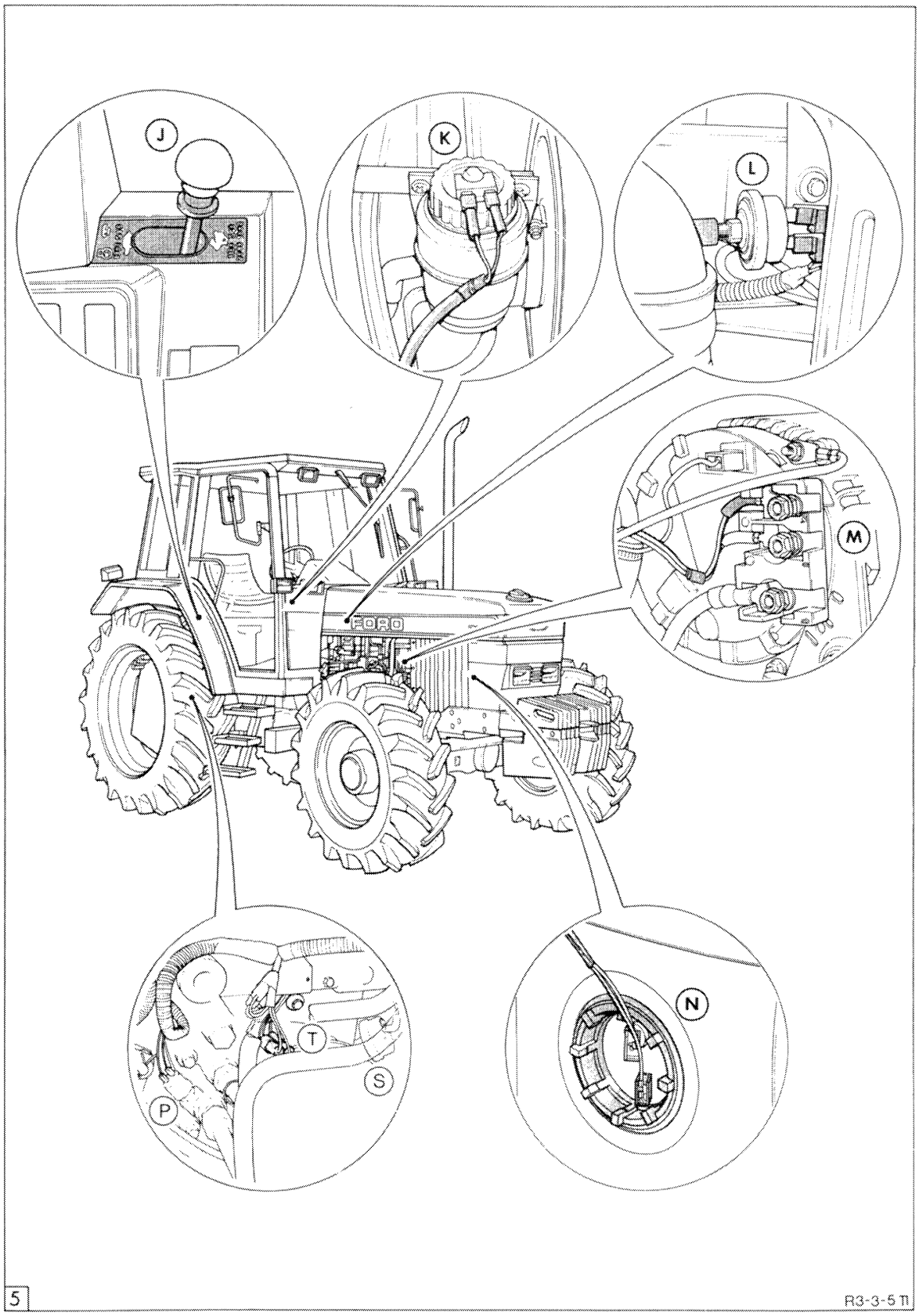
Sender Resistance	Gauge Indication
31–49 Ohms	FULL
230–250 Ohms	EMPTY

TRANSMISSION SWITCHES (Fixed Displacement Gear Pump)

P. TRANSMISSION PRESSURE SWITCH (Light 8, Figure 3)
Operates when the hydraulic pressure oil to the transmission falls below 5.5 bar (80 lbf.in^2). The switch is normally closed, opening when the pressure exceeds 8.3 bar (120 lbf.in^2). When the pressure falls below 5.5 bar (80 lbf.in^2) the switch closes and the transmission/steering hydraulic pressure warning light illuminates.

S. HYDRAULIC OIL FILTER RESTRICTION SWITCH (Light 6, Figure 3)
The switch is normally open and closes when the vacuum created by the oil being drawn into the filter exceeds 10–16 in.Hg. (254–406 mm.Hg.). The transmission / steering hydraulic pressure warning light will illuminate when the switch is closed.

T. TRANSMISSION OIL LOW TEMPERATURE SWITCH
The low temperature switch prevents the filter restriction light illuminating when the oil temperature is below 40°C (104°F). The switch is normally open below 40°C (104°F) and closes above 40°C (104°F) to complete the warning light circuit.

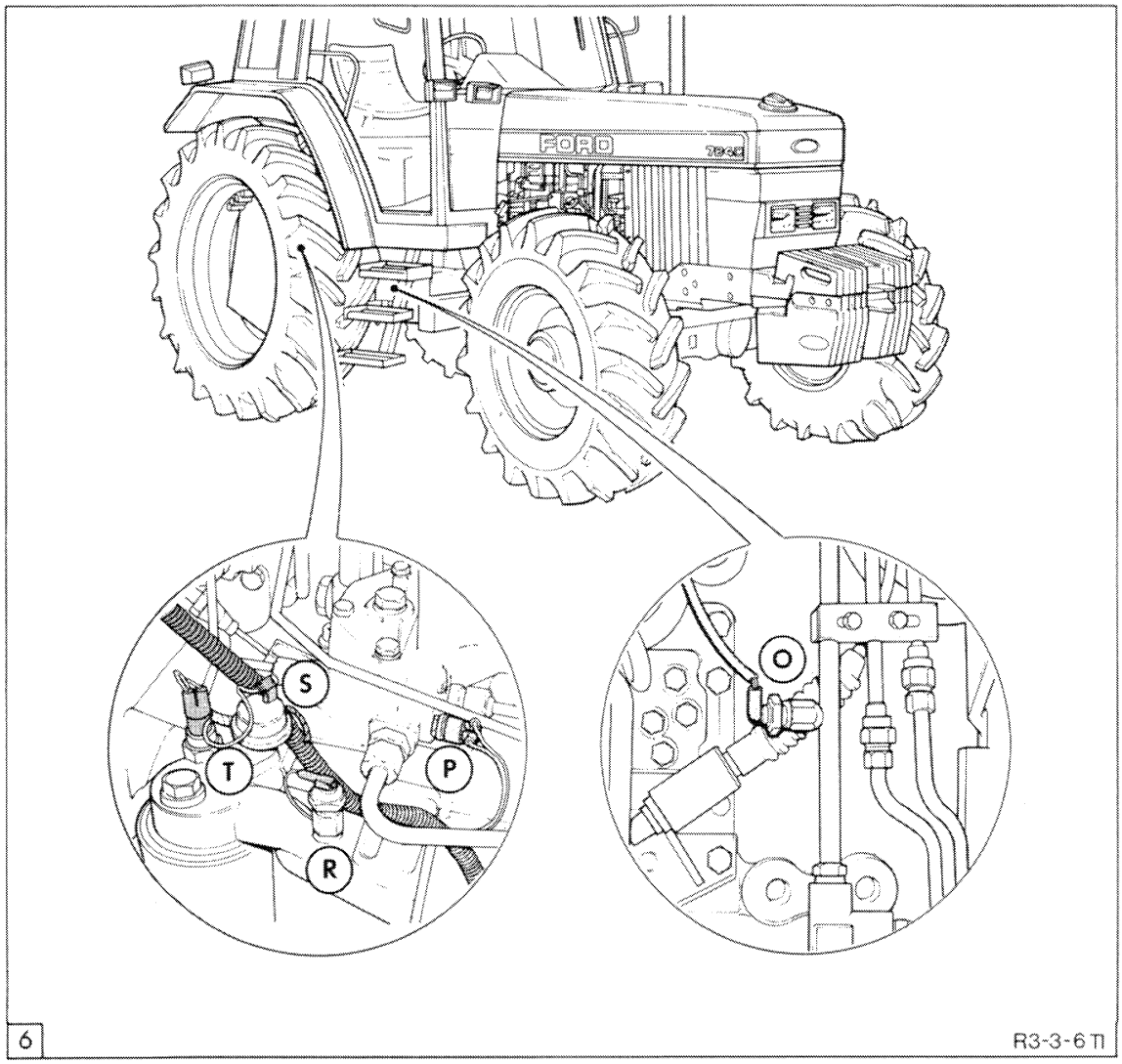


5

R3-3-5 11

TRANSMISSION SWITCHES (Variable Displacement Piston Pump)

With reference to Figure 6



6 R3-3-6 TI

O. STEERING OIL / LUBRICATION PRESSURE SWITCH (Light 8, Figure 3)
Operates when the pressure in the steering return / transmission lubrication circuit falls below 0.8 bar (12 lbf.in^2). A normally closed switch which is held open when pressure exceeds that detailed above, when the switch closes the warning light is illuminated.

P. TRANSMISSION PRESSURE SWITCH (Light 8, Figure 3)
Operates when the pressure for the 16x16 transmission circuit falls below 15 bar (215 lbf.in^2). A normally closed switch which is opened when the pressure exceeds 16.8 bar (245 lbf.in2), when the switch closes, the warning light is illuminated.

R. CHARGE PRESSURE SWITCH (Light 7, Figure 3)
Operates when the charge pressure for the variable displacement piston pump falls below 0.8 bar (12 lbf.in^2). A normally closed switch which is held open when pressure exceeds that detailed above, when the switch closes a warning light flashes.

S. STEERING OIL FILTER RESTRICTION SWITCH (Light 6, Figure 3)
The switch is normally open and closes when the vacuum created by the oil being drawn into the filter exceeds 16 in.Hg. (406 mm.Hg.).

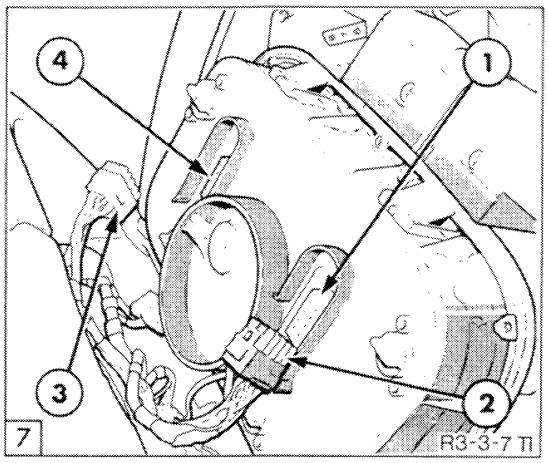
T. TRANSMISSION OIL LOW TEMPERATURE SWITCH
The low temperature switch prevents the filter restriction/low pressure light illuminating when the oil temperature is below 40°C (104°F). The switch is

normally open below 40°C (104°F) and then closes above 40°C (104°F) to complete the warning light circuit.

C. SERVICE ACCESS

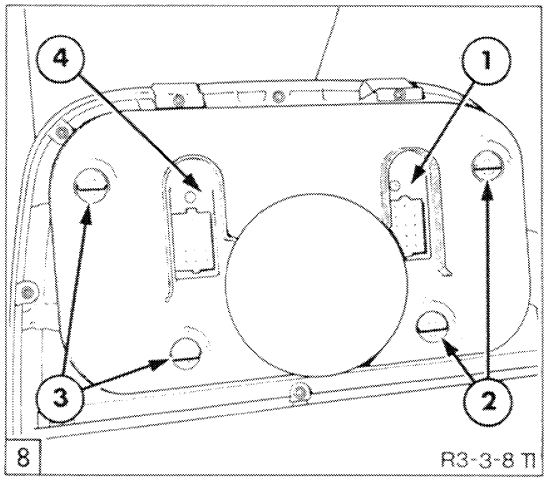
Cluster Removal

To remove either the AIC or AEIC instrument clusters remove the two retaining screws located at the bottom of the cluster and gently lift away. When there is sufficient clearance, disconnect the two multipin connectors from the rear of the cluster and remove the cluster from the tractor, Figure 7.



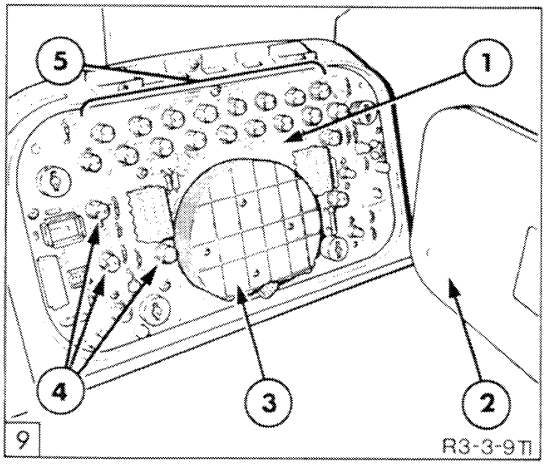
Harness Connectors

1. Multipin Socket
2. J1 Harness Connector
3. J2 Harness Connector
4. Multipin Socket



Rear Cover

1. Multipin Socket
2. Quick Release Fasteners
3. Quick Release Fasteners
4. Multipin Socket



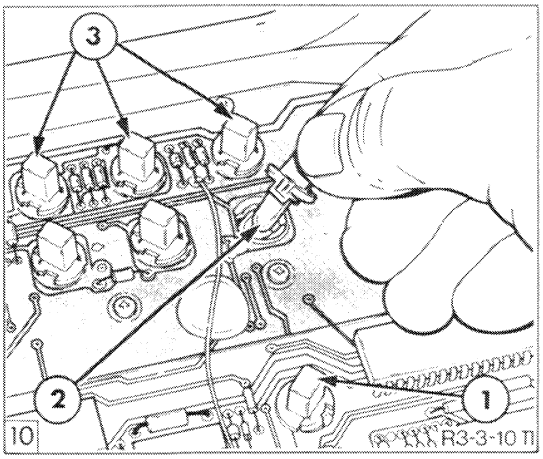
Service Accessibility

1. Circuit Board
2. Rear Cover
3. Proofmeter
4. Illumination Lights
5. Indicator Lights

Cluster Serviceable Components

To gain access to the components of the cluster, remove the rear cover as shown in Figure 8.

The Cluster indicator lights can now be replaced. To remove a light rotate the lamp body anti–clockwise and withdraw. Replacement is the reverse, turning the lamp body clockwise to secure.



Light Replacement

1. Cluster illumination Light
2. Bulb
3. Indicator lights (17)

To replace any components other than indicator/illumination lights it is necessary to remove the eight screws retaining the circuit board assembly to the housing. With the circuit board assembly removed from the housing it is possible to replace the following components using the procedures detailed:

- **Fuel and temperature gauges** – Remove the single nut on the reverse side of the gauge and gently push the gauge from the circuit board.

- **Tachometer** – Disconnect the electrical connector from the circuit board to the tachometer. Remove the four crosshead screws from around the dial face and gently withdraw the tachometer assembly.

- **Liquid Crystal display (LCD) Module** – Carefully disconnect the white electrical connector to the circuit board by pushing the connector horizontally away from the circuit board. Remove the two roundheaded crosshead screws securing the module to the circuit board and withdraw the module.

- **Circuit Board** With the above components and the lights removed the circuit board can be replaced.

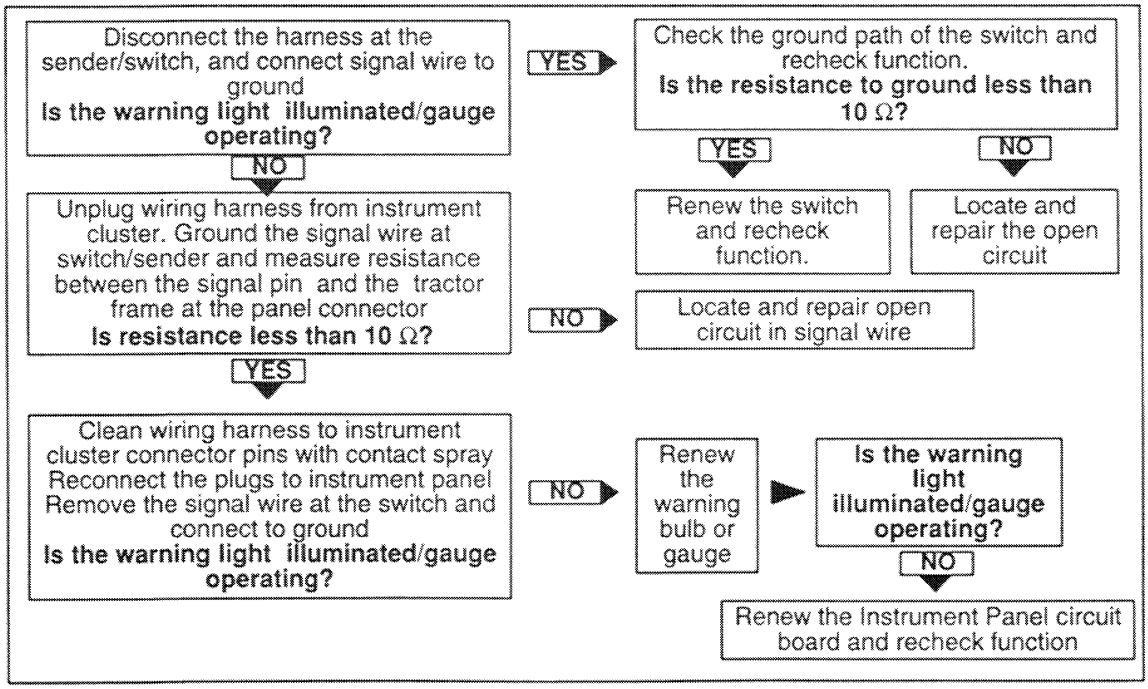
NOTE: *Adjacent to the LCD module white connector on early AEIC instrument panels are four red switches. The switches should all be in the down, i.e, 'off position'.*

NOTE: *Do not attempt to dismantle the outer housing assembly. The housing is sealed during production and any tampering will lead to the ingress of moisture into the cluster assembly.*

D. FAULT FINDING

Common Test Procedure for ALL of the Switch Circuits Connecting to Ground

Switches/senders affected:– Handbrake switch, Brake fluid level switch, Engine temperature sender, Engine vacuum switch, Transmission oil temperature switch, Transmission oil pressure switch, Power assisted steering pressure switch, Low charge pressure switch, Hydraulic oil filter restriction switch, Fuel gauge sender/s.



The following tables detail the instrument connector pins of connectors J1 and J2, the wire colours, connections in a particular circuit and the final component or destination of the wiring from the instrument cluster connector. Use the tables in conjunction with the wiring diagrams in Chapter 2 of this Part to aid fault finding of particular circuits.

NOTE: *If a fault cannot be found in the wiring or component of a particular circuit and the instrument cluster fault persists, remove and inspect the circuit board of the cluster. Inspect the board for continuity of the circuits and burnt out components. If in doubt substitute the circuit board for one of known performance.*

Table 1 – J1 Instrument Cluster Connector Terminal Identification

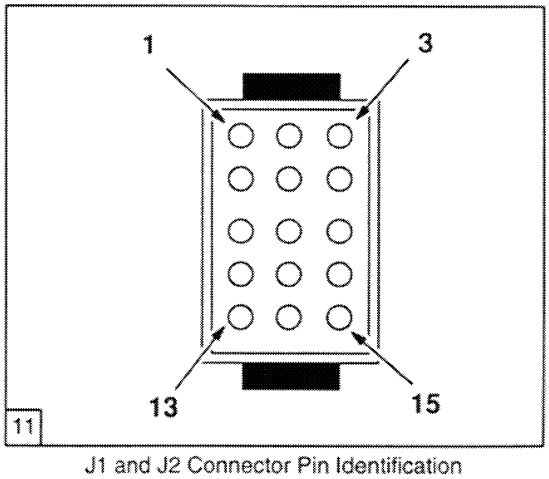
Instrument Connector Pin	Wire Colour	Connections in Circuit	Final Component (Destination)	Cluster Function
J1–1	G/R	ISO/NASO Module & C1–L	Trailer Socket & LH side lamp	Left Hand Indicator
J1–2	B	–	Earth (Ground)	–
J1–3	LG/Y	–	Flasher Unit	1st Trailer Indicator
J1–4	N/R	Fuse 19 & E1–3	Thermostart	Thermostart Indicator
J1–5	LG/R	–	Flasher Unit	2nd Trailer Indicator
J1–6	U/W	Fuse 1 & E1–1	Main Beam Lamp	Main Beam Indicator
J1–7	W/N	E1–C	Engine oil Pressure Switch	Engine Oil Pressure
J1–8	Y	–	D.P Switch & Solenoid	D.P. High
J1–9	Y/N	–	D.P. Switch	D.P. Low
J1–10	B/S	E1–B	Vacuum Switch	Air Cleaner Restriction
J1–11	O/P	–	PTO Module (2 spd. Shiftable)	1000 rev/min Indicator
J1–12	Y/B	C1–D	Diff–Lock Switch	Diff –Lock Indicator
J1–13	G/B	–	Fuel Sender Aux/ Main Connector	Fuel Gauge
J1–14	N/Y	E1–W	Alternator (D+ Terminal)	Battery Charge Lamp & Tacho
J1–15	W/S	E1–F	Alternator (W Terminal)	Tachometer

Table 2 – J2 Instrument Cluster Connector Terminal Identification

Instrument Connector Pin	Wire Colour	Connections in Circuit	Final Component (Destination)	Cluster Function
J2–1	R/N/B	C1–M	Low Charge Switch	Low Charge Pressure
J2–2	Y/O	C1–B	PAS Pressure Switch & Trans. Oil Pressure Switch	Steering/trans Lube pressure
J2–3	B/N	C1–C	Trans. Temp. Switch & HPL Filter Switch	Hydraulic Filter Restriction
J2–4	G/W	ISO/NASO Module & C1–H	Trailer Socket RH Side Lamps	Right Hand Indicator
J2–5	LG/N	–	Flasher Unit	Brake Warning Lamp
J2–6	S/U	–	Buzzer	Audible Alarm
J2–7	LN/TQ	C4–3	EECIV (E3–55)	LCD Module Display
J2–8	R/K	E1–H	Brake Fluid level Switch & Handbrake Switch	Brake Warning Lamp
J2–9	P	–	Fuse 20	LCD Module Display
J2–10	LN/O	–	EECIV (E3–54)	LCD Module Display
J2–11		–NOT USED–		
J2–12	G	–	Fuse 9	Positive Feed to Gauges
J2–13	G/B/W	–	Earth (Ground)	–
J2–14	R	–	Fuse 3	Panel Lights
J2–15	G/U	E1–G	Engine Temp. Sender	Temperature Gauge

Key To Colours

B	– Black	G	– Green
N	– Brown	LG	– Light Green
LN	– Tan	U	– Blue
S	– Slate	TQ	– Turquoise
R	– Red	P	– Purple
O	– Orange	K	– Pink
Y	– Yellow	W	– White



J1 and J2 Connector Pin Identification

J1 Connector is a 'BRICK RED' colour (male pins)
J2 Connector is a 'TAN' Colour (female pins)

PART 3
ELECTRICAL SYSTEMS
Chapter 4
CHARGING SYSTEMS

A. INTRODUCTION

Magnet Marelli (Lucas) A127 type alternators are used on Series 40 model tractors. Used in 55 Amp form with an external cooling fan on less cab models and in 100 Amp form with an internal cooling fan on with cab models. The alternator is mounted high at the front of the engine and is driven from a crankshaft pulley via a 'poly v' drive belt. The alternators feature integral regulators with temperature sensed regulation.

Alternator Operation

With reference to Figure 4.

When the key start switch is turned on a small current flows from the battery through the rotor field wiring. The circuit is made via the charge indicator warning lamp, alternator terminal 'D+' the rotor field winding, the alternator regulator and ground.

At this stage the warning light is illuminated and the rotor partially magnetised.

When the engine is started and the partially magnetised rotor revolves within the stator windings a 3–phase alternating current is generated. A constant portion of the generated current is converted to direct current by the three field diodes incorporated in the rectifier pack.

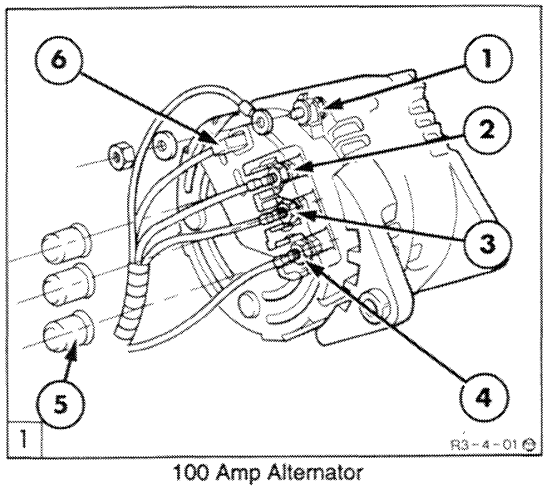
This direct current is fed back to supplement the current flowing through the rotor field winding.

This action results in an ever increasing magnetic influence of the rotor along with an associated rapid rise in generated output current and voltage.

During the rise in generated output voltage (reflected at the 'D+' terminal) the brilliance of the warning lamp is reduced and when the voltage at the 'D+' terminal equates to that at the battery side of the warning light the lamp is extinquished.

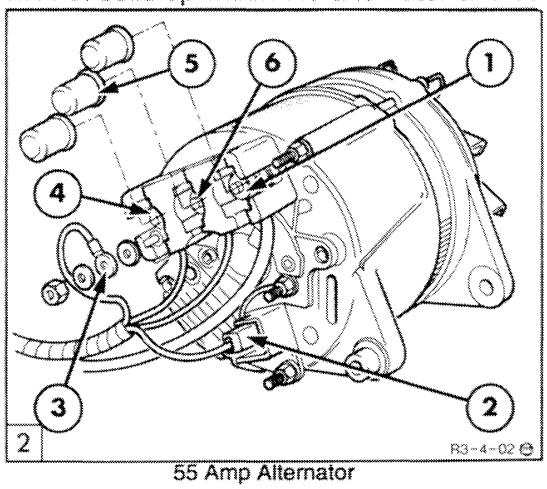
The voltage continues to rise until the predetermined regulated voltage level is reached.

In the event of drive belt breakage the voltage will not build up within the alternator and so



100 Amp Alternator

1. Earth (Ground) Connection
2. Engine Speed Sensor Connection (W Terminal)
3. Warning Lamp (D+ terminal)
4. Output Connection (B+ Terminal)
5. Protective Terminal Sleeve
6. Battery Temperature Sensor Connection



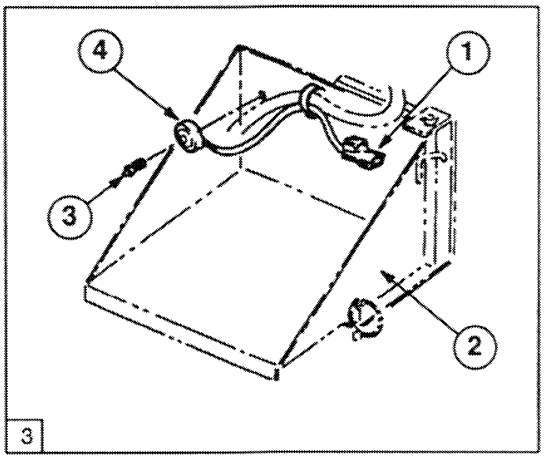
55 Amp Alternator

1. Output Connection (B+ Terminal)
2. Battery Temperature Sensor Connection
3. Engine Speed Sensor Connection (W Terminal)
4. Earth (Ground) Connection
5. Protective Terminal Sleeve
6. Warning Lamp (D+ terminal)

Printed In U.K. 12/92

the charge indicator light will remain on to indicate failure.

Battery Temperature Compensation



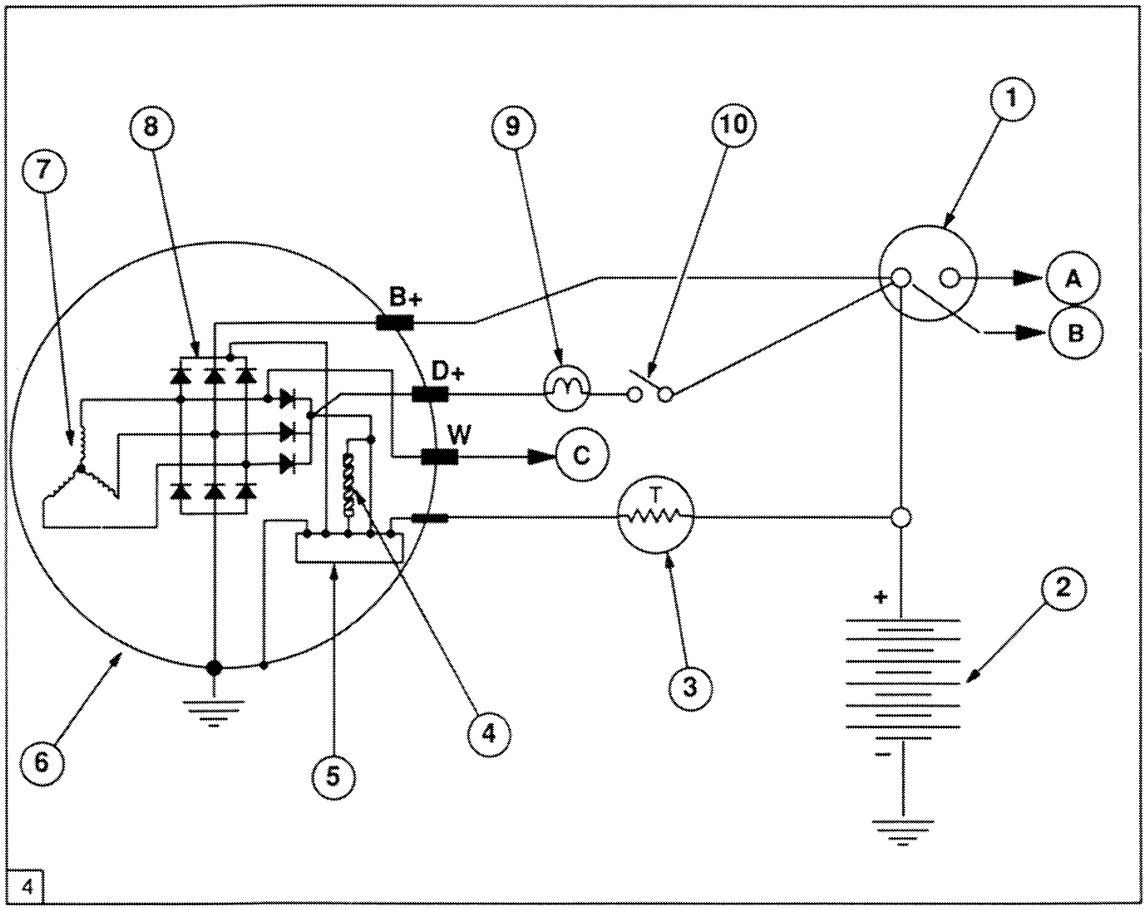
Battery Temperature Sensor

1. Sensor Connector
2. Battery Tray
3. Securing Bolt
4. Temperature Sensor

Because charging systems are directly affected by changes in battery temperature and loading, the alternator charging system features combined battery temperature and system voltage sensing.

A circular temperature sensing pad is located in the battery tray which is in contact with the battery, Figure 3.

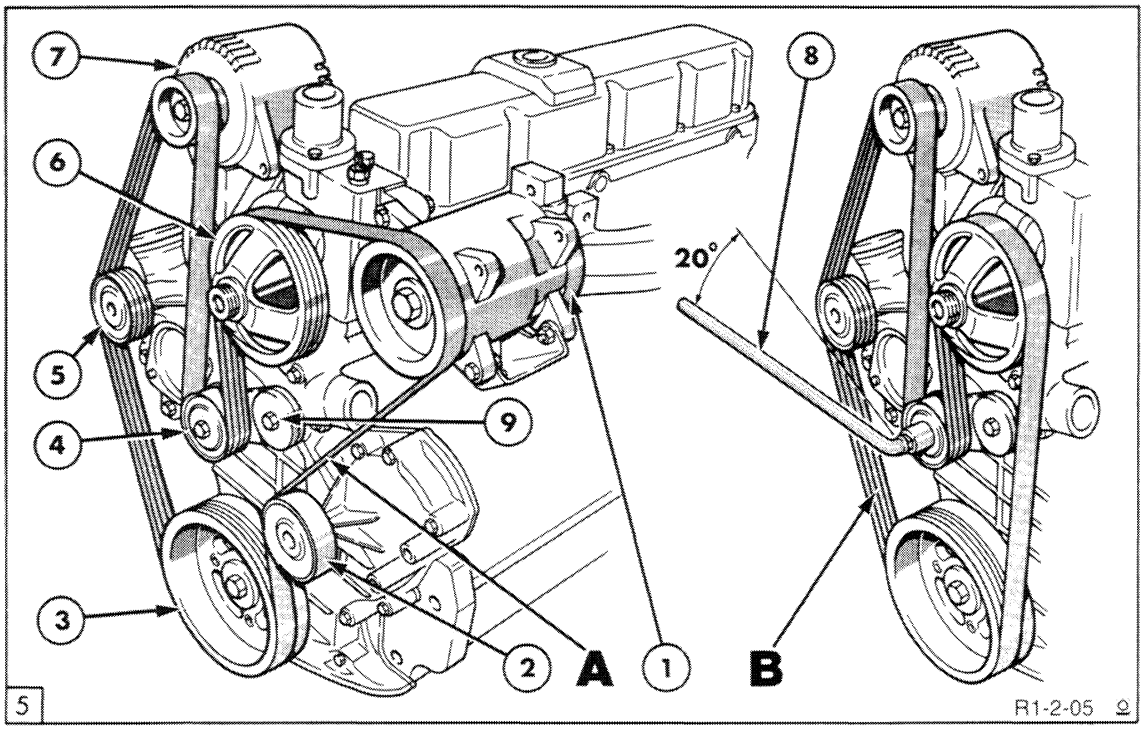
The sensor detects any changes in battery temperature and relays this information to the voltage regulator which adjusts the charge rate accordingly.



Alternator Charging Circuit
(With Battery Temperature Compensation)

A To Starter Motor
B To Starter Relay
C Speed Sensor Terminal to, Diagnostic Plug, ETC Module Terminal 19, PTO Module and Instrument Panel

1. Starter Solenoid
2. Battery
3. Temperature Sensor
4. Rotor Field Winding
5. Regulator
6. Alternator Frame
7. Stator Output Windings (55 Amp Alternator)
8. Rectifier Pack
9. Charge Indicator Lamp
10. Key Start Switch



Fan Belt Tensioner

A. Fan Belt with Air Conditioning

1. Air Conditioning Compressor (optional)
2. Idler Pulley only with (Air Conditioning)
3. Crankshaft Pulley
4. Tensioner Assembly
5. Idler Pulley

B. Fan Belt Less Air Conditioning

6. Water Pump Pulley
7. Alternator
8. Torque Wrench
9. Tensioner Attaching Bolt

B. SYSTEM TESTING AND FAULT FINDING

Service Precautions

To avoid damage to the components of the alternator charging system, service precautions must be observed as follows:

- **NEVER** make or break any of the charging circuit connections, including the battery, when the engine is running.
- **NEVER** short any of the charging components to ground.
- **ALWAYS** disconnect the battery ground cable (negative) when charging the battery on the tractor using a battery charger.
- **ALWAYS** observe correct polarity when installing the battery or using a slave battery to start the engine.

CONNECT POSITIVE TO POSITIVE AND NEGATIVE TO NEGATIVE

Preliminary Checks

Prior to electrical testing thoroughly inspect the charging and electrical system.

Check all leads and connections for continuity and tightness.

1. Check the battery

Using a hydrometer check the individual battery cells. The battery should be at least 70% charged and in good condition.

2. Check the drive belt

Inspect the alternator drive belt and pulley, ensuring that both are clean, free from oil and grease and in good condition.

The alternator drive belt is automatically tensioned by a spring tensioner mounted at the front of the engine, shown in Figure 5. If the the belt tension is suspect, check the tensioner assembly as follows:

Fan Belt Tensioner Removal

1. The fan belt should be removed in the following manner. Place a lever with socket attachment, onto the tensioner retaining bolt and gently lever the tensioner up, Figure 5. Remove the fan belt from the pulley, and allow the tensioner to return to its untensioned position once the belt has been removed,

2. Remove the tensioner from the pump by loosening, and removing the centre attaching bolt.

Inspection and Repair

1. Checking of the tensioner assembly operation should be carried out, with the tensioner assembly still attached to the water pump. To check the spring load, place a "break back" torque bar pre–set to, 52 – 63 lbf. ft (70 – 85 Nm) (7.1 – 8.7 kgf.m), on to the pulley attaching bolt. Raise the lever up through an arc of 20° maximum. If the torque bar does not "break" within the range a new tensioner assembly is required.

2. Ensure the tensioner pulley rotates freely by hand. If not replace with new parts.

Re–Assembly

1. Fit a new pulley to the assembly if required, and torque the attaching bolt to, 34.5 – 44 lbf.ft (46.5 – 60 Nm), (4.7 – 6.1 kgf.m)

2. To re–assemble the arm assembly, position the tensioner on to the water pump, fit the mounting bolt through the assembly, and torque the bolt to, 34.5 – 44 lbf.ft (46.5 – 60 Nm), (4.7 – 6.1 kgf.m).

3. Refitment of the fan belt is the reverse of the removal procedure, but ensure the "Poly V" belt, is positioned correctly onto all of the pulleys.

3. Check the Warning Lamp

Turn on the key start switch and check that the warning lamp is fully illuminated.

If the warning lamp is not fully illuminated check the bulb. If the bulb is not the cause of the fault carry out the Alternator wiring connections test as detailed under 'initial tests' in this section.

If the warning lamp is illuminated start the engine and run above idling speed. The lamp should go out.

If the lamp does not go out, stop the engine and remove the wire from the D+ terminal. If the lamp now goes out a faulty temperature sensor or alternator component is indicated. Conduct the 'Battery temperature sensor circuit test' and 'Alternator components tests' as detailed in this section.

If the warning lamp remains illuminated, check for a short circuit to earth (ground) between the 'D+' cable end and the warning lamp.

INITIAL TESTS

The initial tests may be performed without removing any of the charging circuit components from the tractor and enable the following items to be checked:

- Alternator wire connections
- Battery temperature sensor circuit
- Alternator charging current and controlled voltage
- Alternator charging circuit volt drops
- Alternator maximum output performance

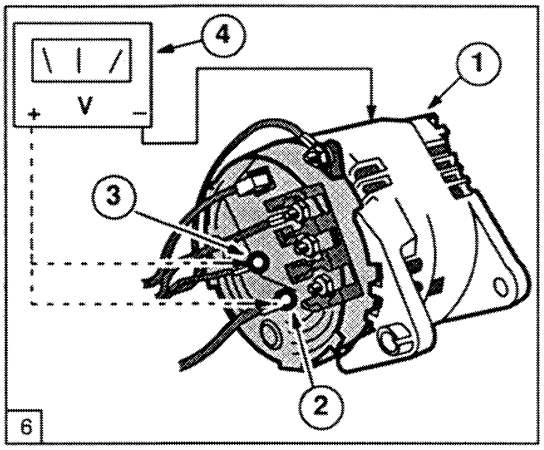
Test equipment required:

- Voltmeter (0–30 volts moving coil type
- Millivoltmeter (0–1 volt)
- Ammeter (0–110 Amperes moving coil type)
- 1.5 Ohm 110 Amperes variable load resistor

NOTE: *Most commercial test equipment incorporates several testing devices within a single unit . Use such equipment in accordance with the manufacturers instructions.*

1. Alternator Wiring Connections Test

With reference to Figure 6.



Alternator Wire Connections

1. Alternator Frame
2. B+ terminal
3. D+ Terminal
4. Voltmeter

1. Disconnect the battery

2. Disconnect the B+ and D+ terminals from the alternator.

3. Reconnect the battery and turn the key start on but do not start the engine. Connect a voltmeter between each terminal and earth (ground). Battery voltage should be registered.

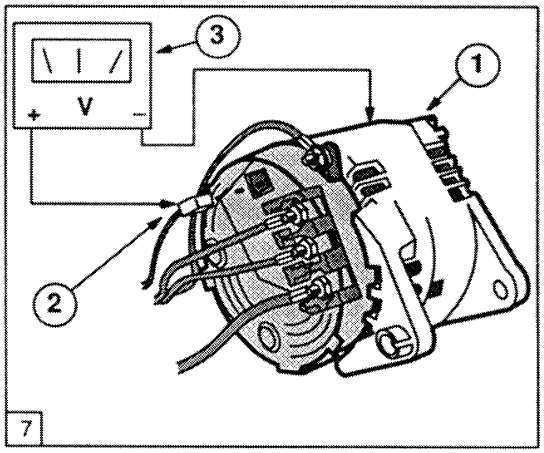
If battery voltage is not registered a continuity fault in the external cable circuitry must be traced and remedied, refer to the circuit diagram shown in Figure 4.

4. Connect the D+ terminal, warning lamp (brown/yellow) wire, to earth (ground). The warning lamp should illuminate.

5. Disconnect the battery and reconnect the removed alternator cable connections to the alternator.

NOTE: *If the warning lamp fails to illuminate when the cable is reconnected to the alternator, a fault is indicated in the alternator regulator or rotor circuits. Ensure that the D+ terminal is clean and then conduct the alternator component tests as detailed in this section.*

2. Battery Temperature Sensor Circuit Test



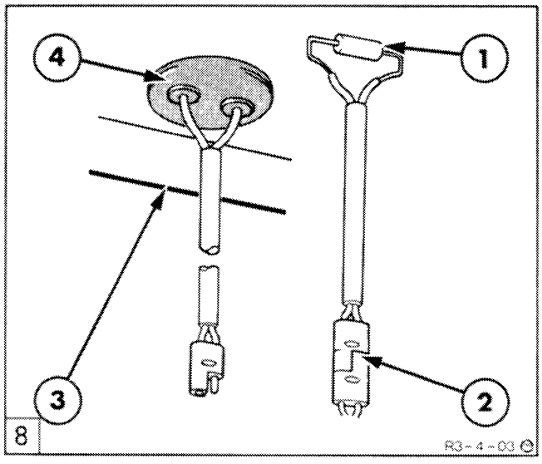
Battery Temperature Sensor Circuit Test

1. Alternator Frame
2. Sensor Lead
3. Voltmeter

1. Disconnect the battery temperature sensor connector. Connect a volt meter between the sensor lead and earth (ground). Battery voltage should be registered.

If battery voltage is not registered, disconnect the harness to sensor plug and connect a 205 ohm resistor (55 amp alternator) or an 11000 ohm resistor (100 amp alternator) across the plug terminal, Figure 8.

NOTE: *it is recommended that a permanent test piece be made by removing the plug and leads from an old sensor unit and connecting the appropriate resistor as shown in Figure 8.*



Connection of Test Resistor

1. Resistor
2. Harness to Sensor Plug
3. Battery Tray
4. Temperature Sensor

If battery voltage is now registered the sensor unit is faulty (open circuit) and must be replaced.

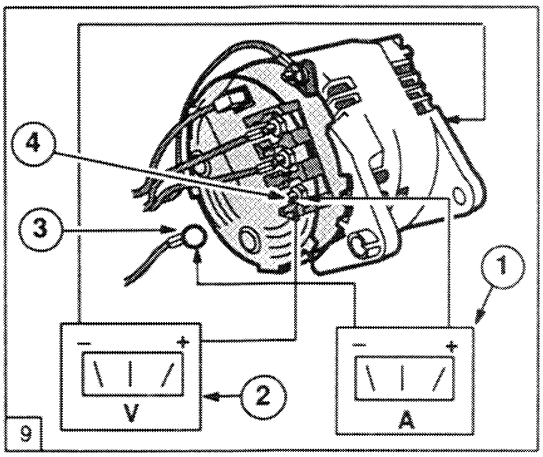
If battery voltage is not registered a continuity fault in the external circuitry must be traced

and rectified. Reconnect the sensor and confirm battery voltage is registered

NOTE: *It is very difficult to test prove the effective resistance of a temperature sensor. If such a unit is suspected of being faulty it should be substituted and proved in Service.*

3. Charging Current And Controlled Voltage Tests

With reference to Figure 9.



Charging Current and Controlled Voltage Tests

1. Ammeter
2. Voltmeter
3. B+ Wire
4. B+ Terminal

1. Ensure all tractor electrical components are switched off and the key start switch is in the 'off' position.

2. Disconnect the battery negative terminal and disconnect the B+ terminal of the alternator.

3. Connect an ammeter between the removed (brown) cable and the B+ alternator terminal.

4. Connect a voltmeter between the alternator B+ terminal and earth (ground)

5. Reconnect the battery. Start and run the engine at 2000 rev/min. and observe the ammeter and voltmeter readings.

If the ammeter registers a charging current stop the engine.

If the ammeter registers zero amperes a faulty alternator component is indicated. Turn off the engine and conduct the 'alternator component tests' as detailed in this chapter.

6. Disconnect the temperature sensor plug and connect the appropriate resistor across the plug terminals, Figure 8.

7. Restart the engine and increase the engine speed to 2000 rev/min. Observe the ammeter and voltmeter readings.

The voltmeter should register in excess of battery voltage and when the ammeter reading falls below 10 Amperes the voltmeter reading should stabilise at 13.6–14.4 volts.

If the voltmeter reading exceeds 14.4 volts the alternator regulator must be replaced as described in this section. (when a new regulator has been installed conduct tests 4 and 5).

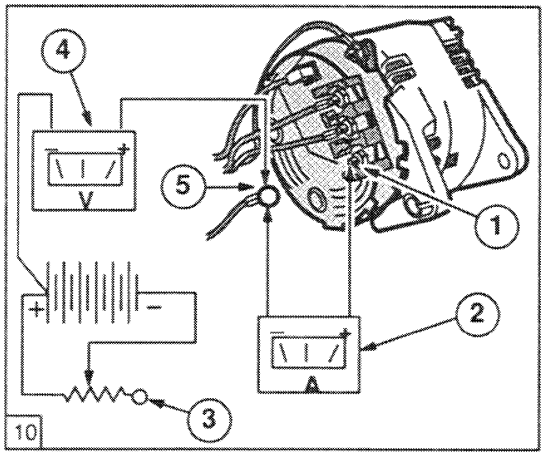
If the voltmeter reading is below 13.6 volts a faulty alternator component or a high resistance fault in the external connections of the charging system is indicated.

8. Stop the engine.

4. Charging Circuit Volt Drop Tests

(a) Insulated–Side Volt Drop Tests

With reference to Figure 10.



Insulated Side – Volt Drop Test

1. B+ Terminal
2. Ammeter
3. Variable Load Resistor
4. Milli–Voltmeter
5. B+ Wire

Ensure the key start switch is in the 'off' position.

1. Disconnect the battery negative cable and disconnect the B+ cable from the alternator

2. Connect a millivoltmeter between the battery positive terminal and the B+ cable. (Positive side to cable).

3. Securely connect an ammeter between the B+ terminal of the alternator and the B+ cable (negative side to cable)

4. Reconnect the battery negative cable and connect a variable load resistor, with the slider in the minimum current draw position (maximum resistance), across the battery terminals.

5. Start the engine and increase the speed to 2000 rev/min.

6. Slowly increase the current loading of the resistor (decrease resistance) until the ammeter registers 55 or 100 Amperes depending on alternator type.

7. Observe the millivoltmeter reading which should not exceed 400 millivolts.

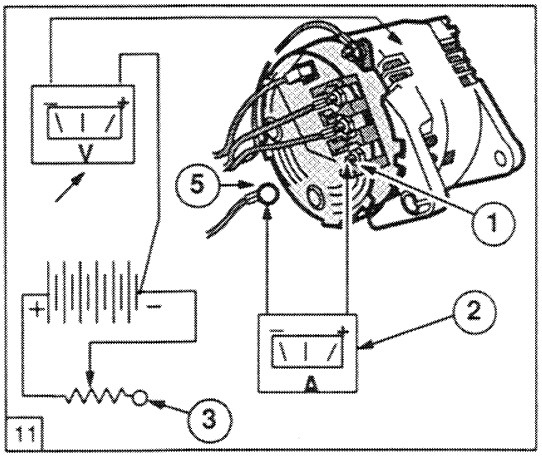
If the reading is in excess of 400 millivolts, a high resistance fault is indicated in the external circuitry.

If the required alternator output cannot be achieved and the millivoltmeter reading is less than 400 millivolts, then a faulty alternator component is indicated. Conduct the' alternator component tests' as detailed in this section.

8. Stop the engine.

(b) Ground–Side Volt Drop Test

With reference to Figure 11.



Ground Side – Volt Drop test

1. B+ Terminal
2. Ammeter
3. Variable Load
4. Milli–Voltmeter
5. B+ Wire

1. Ensure the key start switch is in the 'off' position.

2. The circuit is the same as that used in the previous test except for the millivoltmeter which is now connected between the battery negative terminal and the alternator frame (negative side to frame).

NOTE: *Ensure the variable load resistor is in the minimum current draw position (maximum resistance).*

3. Start the engine and increase the speed to 2000rev/min.

4. Slowly increase the current loading of the resistor (decrease resistance) until the ammeter registers 55 or 100 Amperes depending on alternator type.

5. Observe the voltmeter reading which should not exceed 200 millivolts.

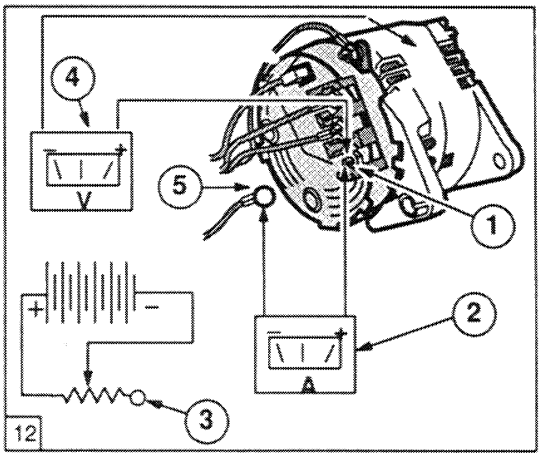
If the reading is in excess of 200 millivolts a high resistance fault is indicated in the external circuitry.

If the required alternator output cannot be achieved and the millivoltmeter reading is less than 200 millivolts then a faulty alternator component is indicated. Conduct the alternator component tests as detailed in this section.

6. Stop the engine.

5. Alternator Maximum Output Performance Test

With reference to Figure 12



Maximum Output Performance Test

1. B+ Terminal
2. Ammeter
3. Variable Load
4. Milli–Voltmeter
5. B+ Wire

1. Ensure the key start switch is in the 'off' position.

2. Disconnect the battery negative cable and disconnect the B+ cable from the alternator.

3. Securely connect an ammeter between the B+ terminal of the alternator and the B+ cable (negative side to cable).

4. Connect a voltmeter between the alternator B+ terminal and earth (ground)

5. Disconnect the harness to battery sensor plug and connect the appropriate resistor across the plug terminals. Refer to Figure 8.

6. Reconnect the battery, start and increase the engine speed to 2000 rev/min.

7. Slowly increase the the current loading of the resistor (decrease resistance) until the ammeter registers either 55 or 100 Amperes depending on alternator type.

8. Observe the voltmeter reading which should not fall below 13.6 volts

If the reading falls below 13.6 volts a faulty alternator component is indicated. Conduct the 'alternator component tests' as detailed in this section.

ALTERNATOR COMPONENT TESTS

The component tests which should only be conducted if the INITIAL TESTS have indicated a faulty alternator component, will enable the the following items to be checked:

- Regulator
- Rotor Field Winding Continuity
- Brushes and Springs and Rotor Slip Rings

NOTE: *The component tests detailed previously may be performed with the alternator installed on the tractor. Testing of the other alternator components will necessitate removal of the alternator from the tractor. Refer to the 'Overhaul' section of this Chapter.*

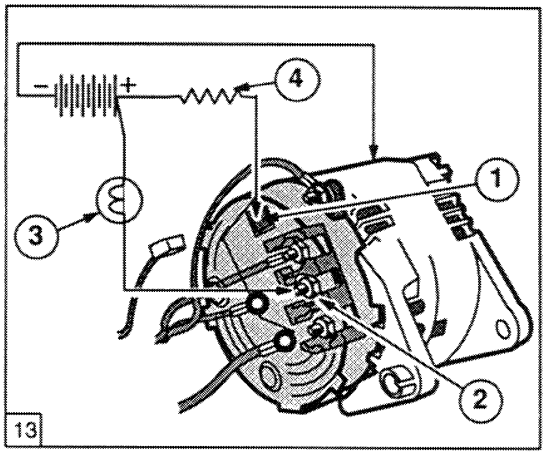
IMPORTANT: *Prior to removal of the alternator cables from the alternator ensure that the key start switch is in the 'off' position and the battery negative cable is disconnected.*

Test equipment required:

- 12 volt battery
- Multimeter
- 2.2 Watt Test Lamp

1. Regulator and Rotor Field Circuit Test

With reference to Figure 13



Regulator and Rotor Field Circuit Test

1. Battery Sensor Terminal
2. D+ terminal
3. 2.2 Watt Test Lamp
4. 205 Ohm Resistor

1. Disconnect all of the alternator cables.

2. Connect a 12 volt battery and a 2.2 Watt test lamp in series between the D+ and the alternator frame (negative side to frame).

3. Connect a 205 ohm resistor between the positive side of the battery and the sensor terminal.

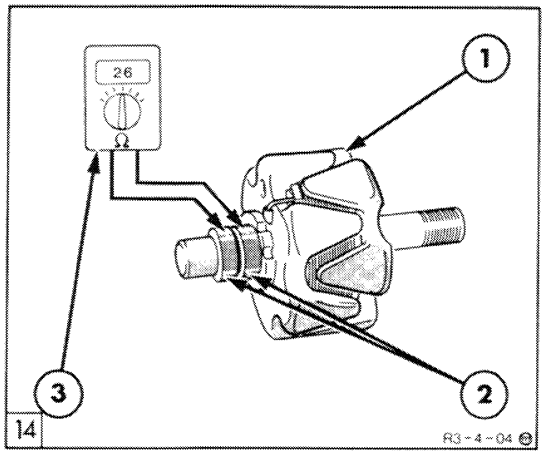
4. The test lamp should illuminate.

If the test lamp is not illuminated a fault is indicated in the rotor circuit. Check brushes, slip rings and continuity of rotor field windings.

If examination indicates these parts to be satisfactory the regulator may be suspect.

2. Rotor Field Winding Continuity Test

with reference to Figure 14



Rotor Field Winding Continuity Test

1. Rotor
2. Slip Rings
3. Ohmmeter

2. Ensure the brushes and slip rings are clean and check for freedom of movement of the brushes in the brushbox moulding.

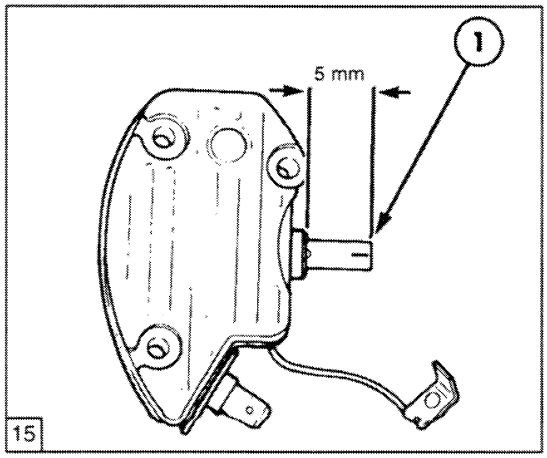
3. Check the brush spring pressure with a push type spring gauge and record the spring pressure when the brush end face is flush with the moulding. Install a new regulator and brushbox assembly if the pressure is less than specified.

If the visible length of the brushes in the free position is less than 0.25 in. (5mm) this is a probable cause of open circuit in the field circuit and the regulator and brushbox assembly should be renewed, Figure 15.

1. Remove the regulator and brushbox assembly as described in this chapter.

2. Connect an ohmmeter between the two slip rings. The resistance should read 2.6 ohms at 20°C.

If the resistance is outside of the specification renew the rotor as detailed in the following overhaul section.



Regulator and Brushbox Assembly
(55 Amp Shown, 100 Amp Similar)

1. Brushes

3. Brushes–and–Springs and Rotor Slip Rings

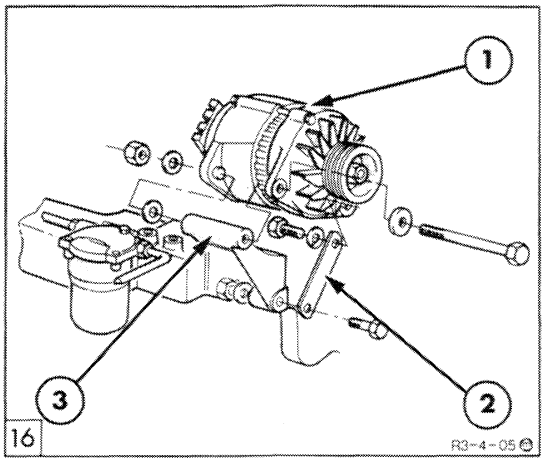
1. Remove the regulator and brushbox assembly as described in this Chapter.

NOTE: *The brushes are an integral part of the regulator and brushbox assembly and cannot be replaced as individual items.*

C. ALTERNATOR OVERHAUL AND COMPONENT TESTING

Alternator Removal

With reference to Figure 16



Alternator Installation
(Same Installation for 100 Amp and 55 Amp Alternators)

1. Alternator Assembly
2. Arm
3. Engine Bracket

1. Disconnect the battery negative cable.

2. Disconnect the five cables from the rear of the alternator.

3. Remove the alternator drive belt in the following manner. Place a lever with socket attachment, onto the tensioner retaining bolt and gently lever the tensioner up, Figure 5. Remove the fan belt from the pulley, and allow the tensioner to return to its untensioned position once the belt has been removed.

4. Remove the alternator arm and the lower mounting through bolts and remove the alternator from the tractor.

Disassembly – 100 Amp Alternator

With reference to Figure 17

1. Remove the three nuts securing the plastic end cover.

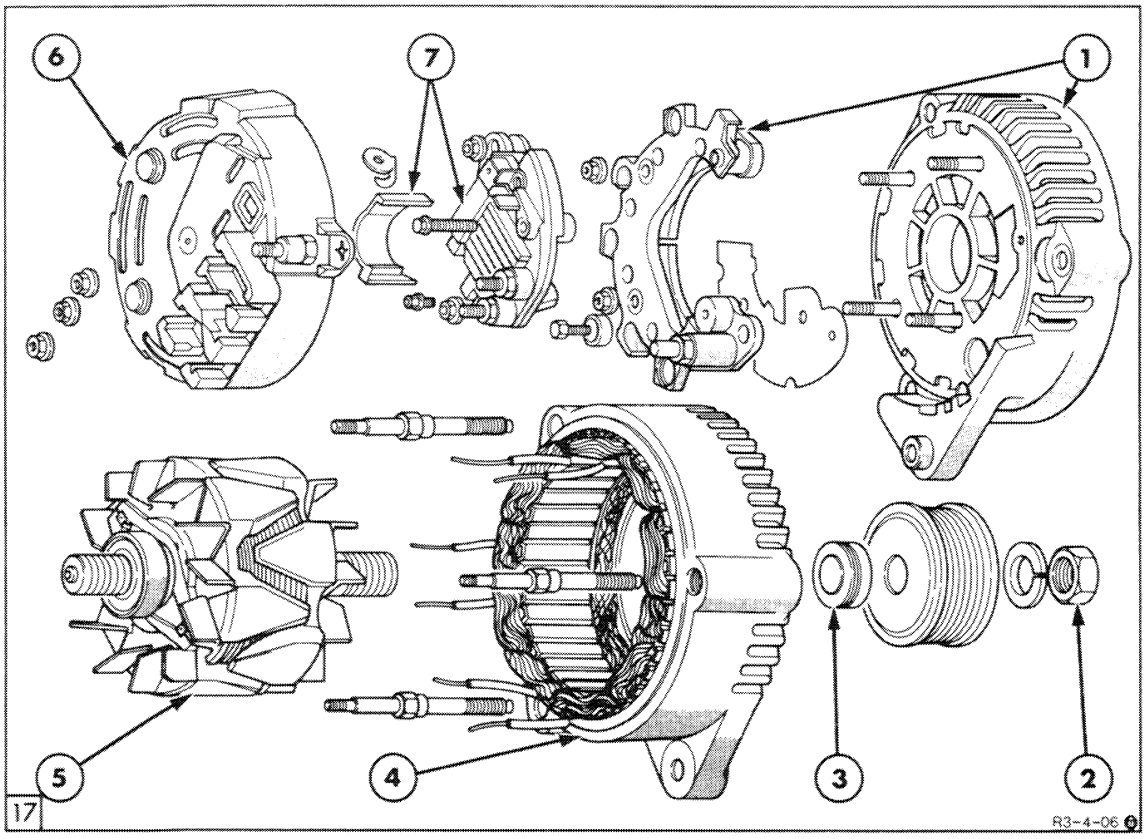
2. Remove the nut securing the blue wire to the warning lamp terminal and disconnect the wire. Remove the two bolts and two nuts securing the regulator and brushbox assembly, withdraw the assembly from the alternator.

3. Using a suitable soldering iron, unsolder the six wires from the stator to rectifier.

4. Remove the three nuts securing the two halves of the outer casing. Mark each half of the casing to aid reassembly and carefully pull the casing apart, it may be necessary to gently tap the casing on the mounting lugs.

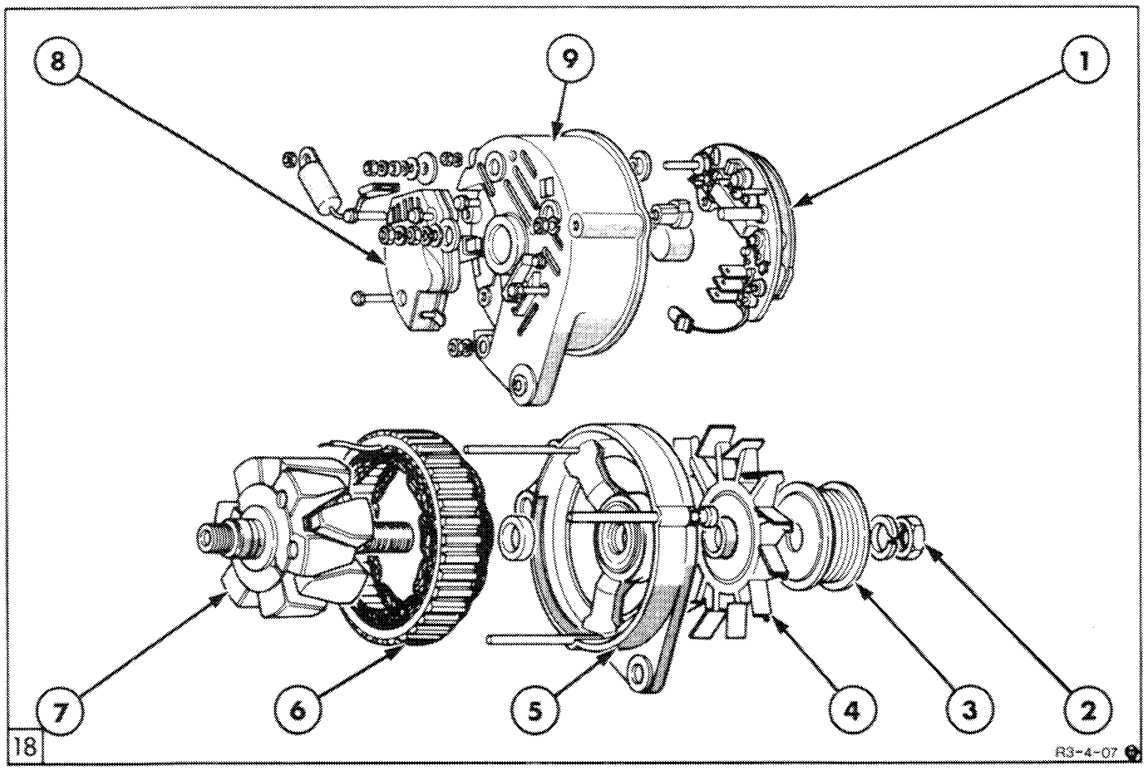
5. Remove the nut securing the pulley to the rotor shaft and withdraw the rotor from the casing.

6. It is not necessary to remove the rectifier from the casing as these are serviced as one unit.



100 Amp Alternator Components

1. Rectifier and Housing Assembly
2. Pulley Retaining Nut
3. Spacer
4. Stator and Housing Assembly
5. Rotor Assembly
6. End Cover
7. Regulator and Brushbox Assembly



55 Amp Alternator Components

1. Rectifier assembly
2. Pulley Retaining Nut
3. pulley
4. Cooling Fan
5. Front End Housing
6. Stator
7. Rotor
8. Regulator and Brushbox assembly
9. Rear End Housing

Disassembly – 55 Amp Alternator

With reference to Figure 18.

1. Remove the four nuts securing the terminal block to the alternator.

2. Remove the nut from the temperature sensor terminal block.

3. Remove the three securing bolts and withdraw the regulator/brushbox assembly.

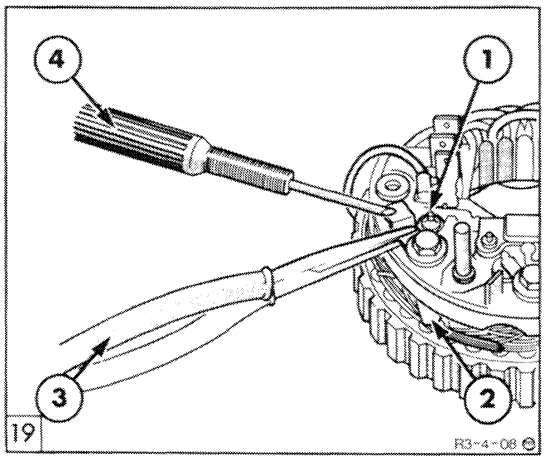
4. Unscrew and remove the remaining three nuts from the alternator through bolts. With a soft mallet tap the threaded end of the through bolts to release the spline at the hexagon head end.

5. Mark the alternator front end bracket, stator and rear end bracket to ensure correct alignment on reassembly.

6. Gently tap the rear face of the alternator front end bracket to separate the front end bracket and rotor assembly from the rear end bracket, stator and rectifier assembly.

7. Remove the nuts, washers and insulators from the stud terminals on the alternator rear end bracket and the two rectifier retaining screws. Remove the stator and rectifier from the rear end bracket.

8. Unsolder the stator leads from the tags on the rectifier, using a pair of pliers as a heat sink to prevent the diodes from overheating. See Figure 19.



Diode Soldering – 55 Amp Alternator

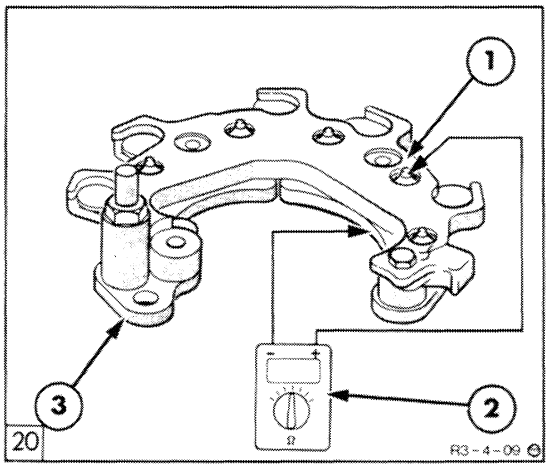
1. Diode
2. Stator Output Wire
3. Pliers Between Diode and Solder Point
4. Soldering Iron

9. Remove the nut, washer, pulley, fan and spacer from the rotor shaft.

10. Press the rotor shaft out of the front end bracket bearing.

COMPONENT TEST

Rectifier Assembly – Diode Testing 100 Amp Alternator



Diode Testing – 100 Amp Alternator

1. Diode Pin
2. Multimeter
3. Lower Plate, two halves

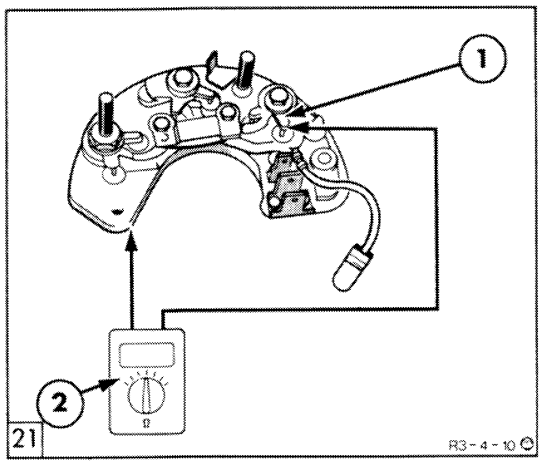
With reference to Figure 20.

1. Test each of the nine diodes separately, using a multimeter with a diode check facility or a multimeter set on the resistance scale.

2. Connect one test lead onto the lower plate and the other to the diode pin. On a multimeter with the diode check facility, note if a reading of 0.49 (volts) is shown. Reverse the test lead connections. The meter should indicate 0.49 (volts) during one half of the test and 0 volts with the leads reversed. Repeat this test on all nine diodes. If any one diode fails this test it will be necessary to replace the rectifier and housing assembly.

3. Where only an ohmmeter is available repeat the above test observing the following results, 0 ohms with leads in one direction and when the test leads are reversed a reading of between 900–1000KΩ, again if any one diode fails this test it will be necessary to replace the rectifier and housing assembly.

Rectifier Assembly – Positive / Negative Diode Testing 55 Amp Alternator



Output Diode Test

1. Diode Connecting Pin
2. Multimeter

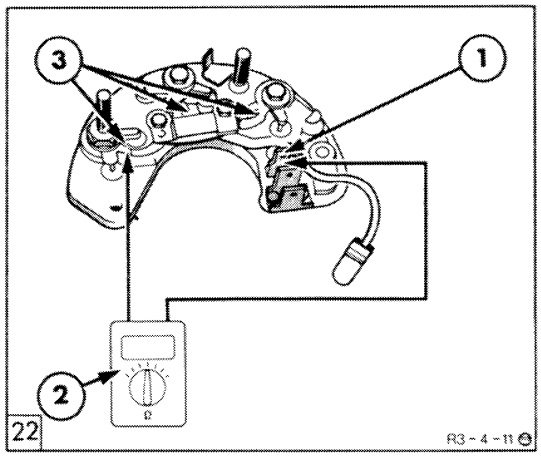
With reference to Figure 21. Test each of the six diodes separately as follows:

1. Connect a multimeter in series with one of the diodes. One test lead is applied to the diode connecting pin and the other lead to the plate into which the diode is mounted.

2. Note the resistance shown on the multimeter. Reverse the test lead connections.

3. The multimeter should indicate an open circuit (infinity ohms) during one half of the test only. If any one diode fails this test the complete rectifier will need replacing.

Rectifier Assembly – Field Diode Testing 55 Amp Alternator



Field Diode Test

1. D+ Terminal Connection
2. Multimeter
3. Field Diode Connections

With reference to Figure 22. Test each field diode separately as follows:

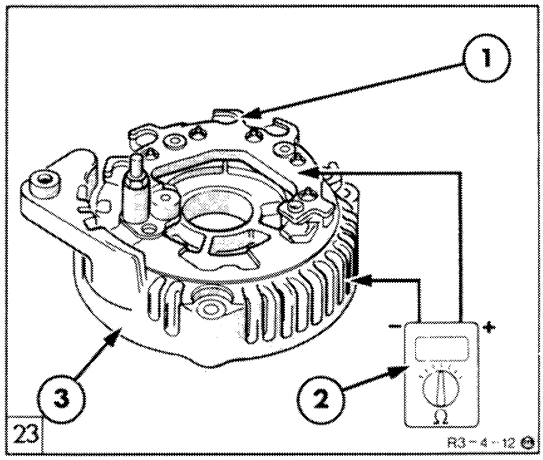
1. Connect a multimeter in series with the field diode module. Apply the negative test lead to the D+ terminal connection and the other lead in turn to each of the field diode connections.

2. Note the resistance shown on the multimeter. Reverse the test lead connections.

3. The multimeter should indicate an open circuit (infinity ohms) during one half of the test only. If any one diode fails this test the complete rectifier will need replacing.

Rectifier Insulation 100 Amp Alternator

With reference to Figure 23.



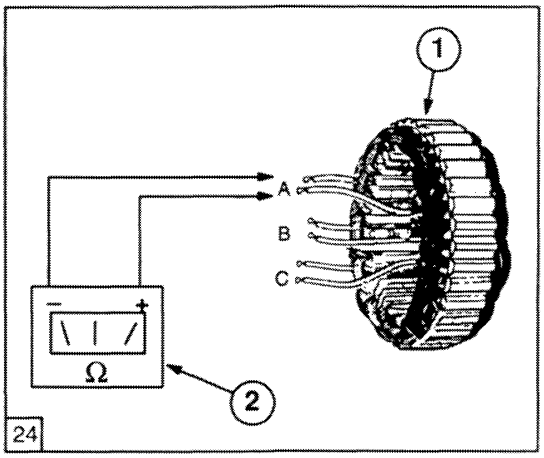
Insulation Testing 100 Amp Alternator

1. Rectifier
2. Multimeter
3. End Housing

1. Check the insulation of the rectifier to the casing. With an ohmmeter, connect the test leads between the alternator casing and the positive plate of the diodes. An infinity reading should be displayed, therefore indicating an open circuit. If a resistance of any kind is indicated, i.e, a short circuit, the rectifier and housing assembly should be replaced.

Stator Test – Winding Continuity 100 Amp Alternator

With reference to Figure 24.

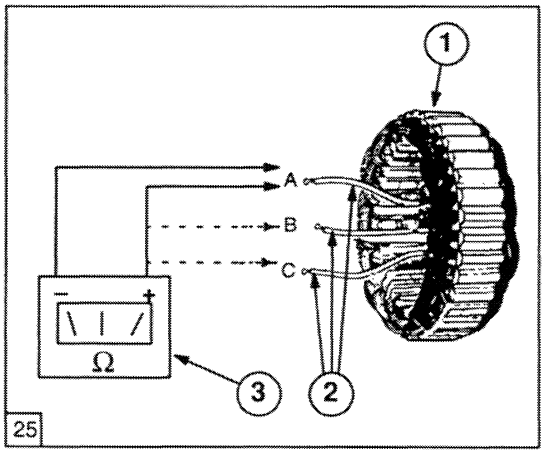


Stator Winding Continuity 100 Amp Alternator

1. Stator Assembly
2. Ohmmeter

1. Connect the ohmmeter test leads between the pairs of wires, A, B and C. There should be a small resistance of 0.1Ω, between each pair of wires. If a resistance higher than this is registered it will indicate a possible break within the winding, i.e, an open circuit. A lower reading, for example 0.0Ω will indicate a short circuit within the winding. If any one of the three pairs of wires fail the test a new stator and housing assembly will be required.

Stator Test – Winding Continuity 55 Amp Alternator



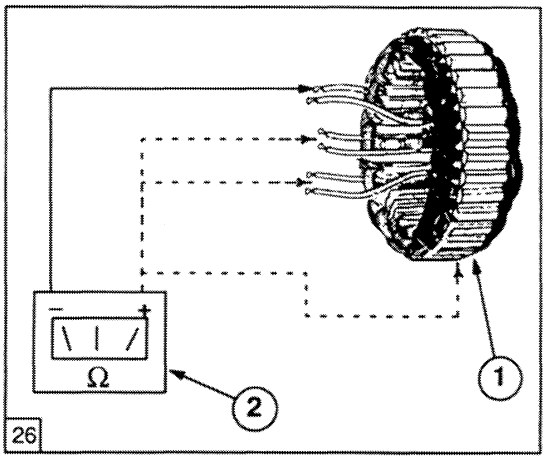
Stator Winding Continuity 55 Amp Alternator

1. Stator Assembly
2. Stator Output Wires
3. Multimeter

1. Connect the ohmmeter test leads between the A, B and C wires. There should be a small resistance of 0.1Ω, between each of the wires. If a resistance higher than this is registered it will indicate a possible break within the winding, i.e, an open circuit. A lower reading, for example 0.0Ω will indicate a short circuit within the winding. If the test proves unsatisfactory a new stator and housing assembly will be required.

Stator Test – Insulation 100 Amp Alternator

With reference to Figure 26.



Stator Insulation Testing 100 Amp Alternator

1. Stator Assembly
2. Ohmmeter