INDICATOR LIGHTS, GAUGES, HOURMETER, AND LIGHTS CIRCUIT OPERATION—445 (S.N. 070001—)

Function:

ENGINE OIL PRESSURE LIGHT:
To alert operator of low engine oil pressure by illuminating a lamp.

FUEL GAUGE:
To inform the operator of the fuel level in the tank.

COOLANT TEMPERATURE GAUGE:
To inform the operator of the engine coolant temperature.

HOURMETER:
To record the number of hours the engine is running.

LIGHTS:
To provide power to the head lights, tail lights, and instrument panel lights for illumination if desired by the operator.

Operating Conditions:

The key switch must be in the run position and the lights switch must be in the on position.

System Operation:

Current (A) flows from the battery (G1) to the starting motor (M1), fusible link (F2), and B terminal of the key switch (S1). With the key switch in the run position, current flows through the switch to the light and power fuses (F4 and F5), fuel gauge, engine oil pressure light (H1), coolant temperature gauge (P3), hourmeter (P2), dash lights (H5), and lights switch (S6).

ENGINE OIL PRESSURE LIGHT:

When the engine oil pressure switch (B2) is closed, a path to ground (D) is made which turns on the indicator light. The oil pressure switch will be closed if the engine is not running or the engine oil pressure is below 28 kPa (4 psi). With the key switch in the run position, the engine oil pressure light will be on. This is to inform the operator that the light is functioning. The engine oil pressure light will go out after normal engine start-up.

FUEL GAUGE:

Current (C) flows from the fuel gauge to the fuel gauge sensor (B7). Current flow through the sensor is controlled by a variable resistor. As the sensor float moves to agree with the fuel level, the amount of resistance increases or decreases accordingly. The gauge senses the change in resistance and moves the gauge needle to indicate the fuel level.

COOLANT TEMPERATURE GAUGE:

Current (E) flows from the coolant temperature gauge to the coolant temperature sensor (B1). Current flow through the sensor is controlled by a temperature sensitive variable resistor. As the coolant temperature increases or decreases, the amount of resistance in the sensor increases or decreases accordingly. The gauge senses the change in resistance and moves the gauge needle to indicate the coolant temperature.

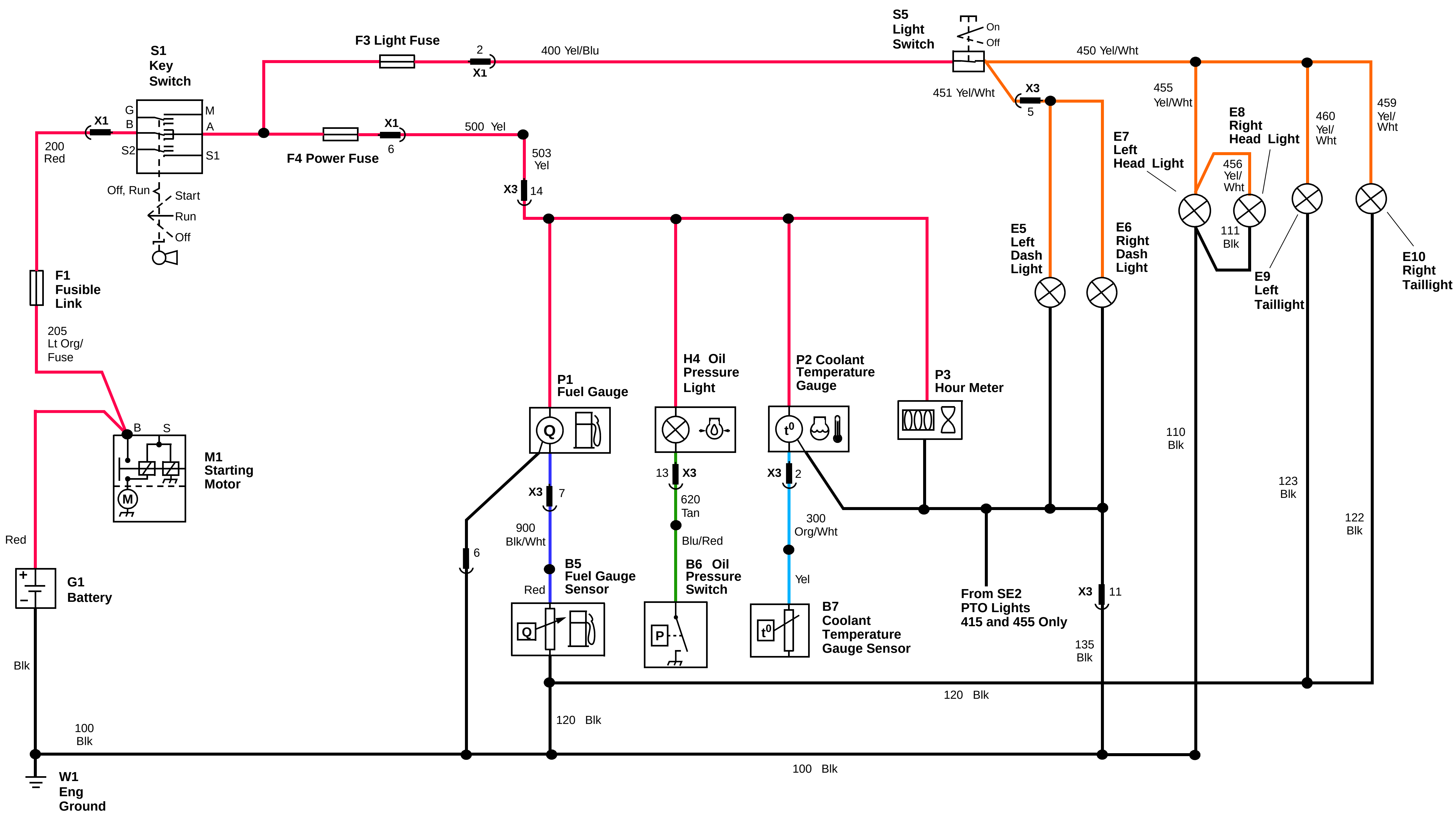
HOURMETER:

Power for the hourmeter (P2) comes from the key switch (S3). When the key switch is in the run position, the hourmeter will be operating.

LIGHTS:

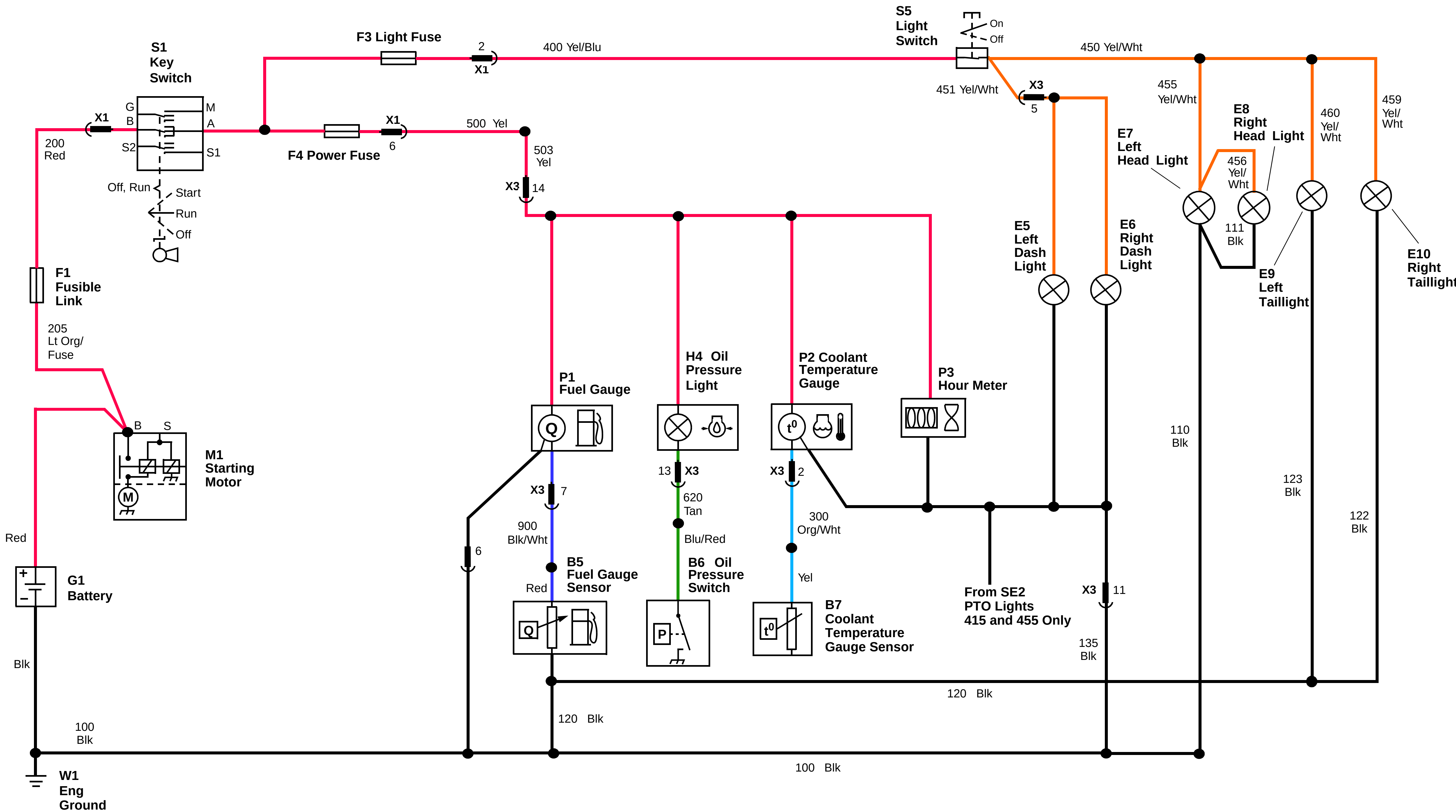
With the lights switch (S6) in the on position (switch closed), current flows to the head lights (E5 and E6), tail lights (E7 and E8), and dash lights (H5) in the instrument panel (A4) to turn on each light. The circuit is protected by F4 fuse - 15A in the control/fuse module (A2).

INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—445 (S.N. —070000)



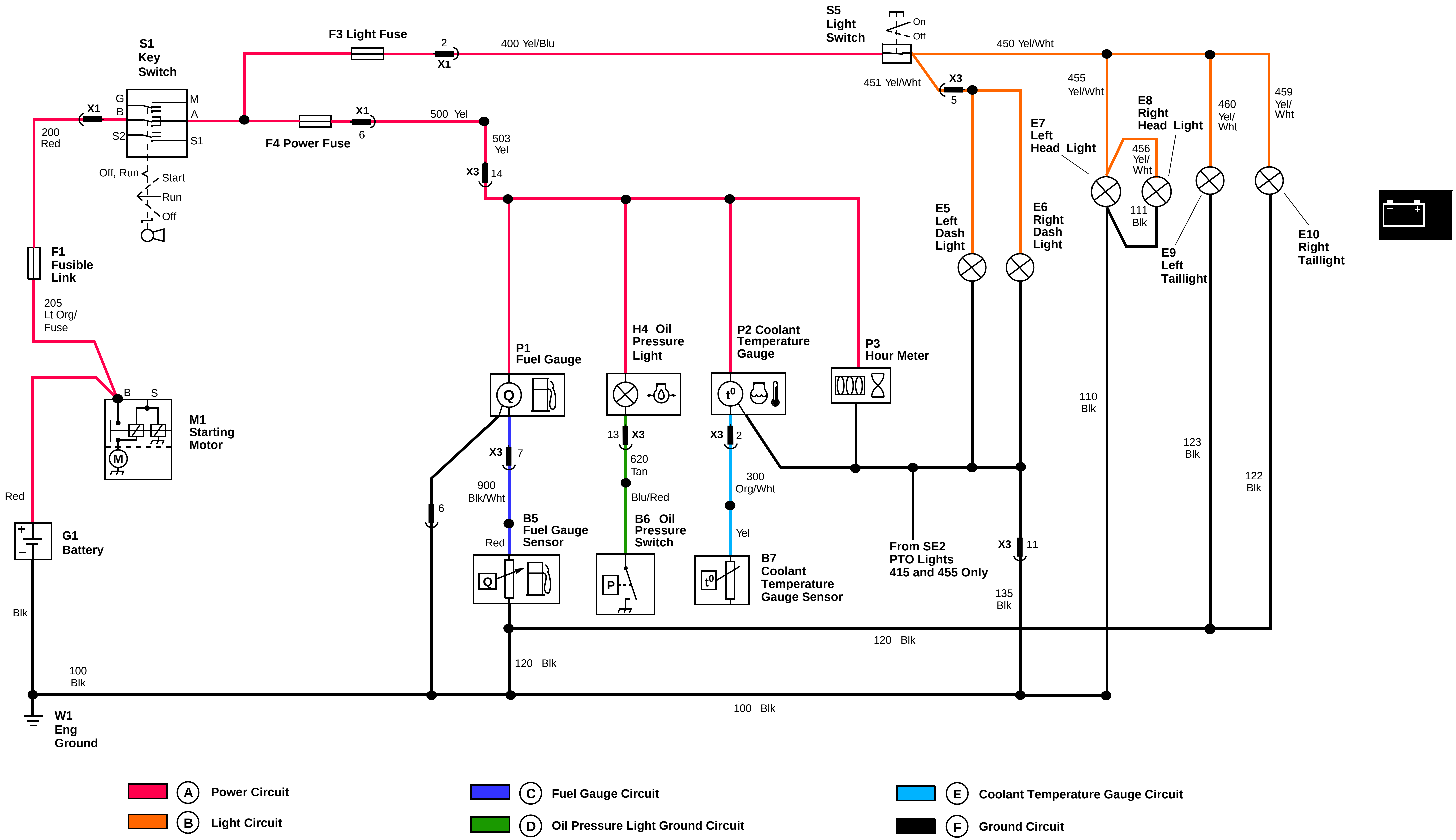
(A) Power Circuit
(B) Light Circuit
(C) Fuel Gauge Circuit
(D) Oil Pressure Light Ground Circuit
(E) Coolant Temperature Gauge Circuit
(F) Ground Circuit

INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—445 (S.N. —070000)

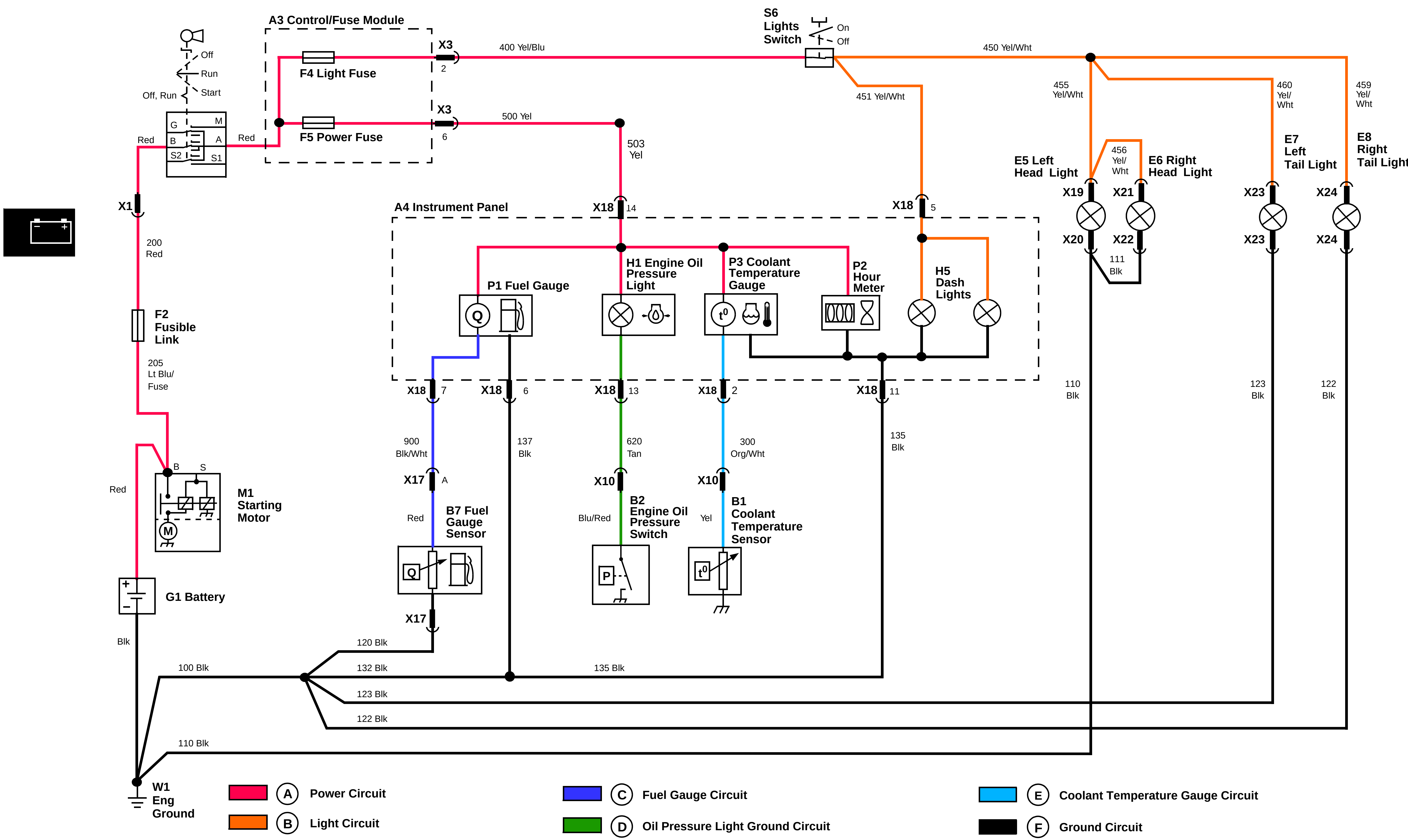


A	Power Circuit	
B	Light Circuit	
C	Fuel Gauge Circuit	
D	Oil Pressure Light Ground Circuit	
E	Coolant Temperature Gauge Circuit	
F	Ground Circuit	

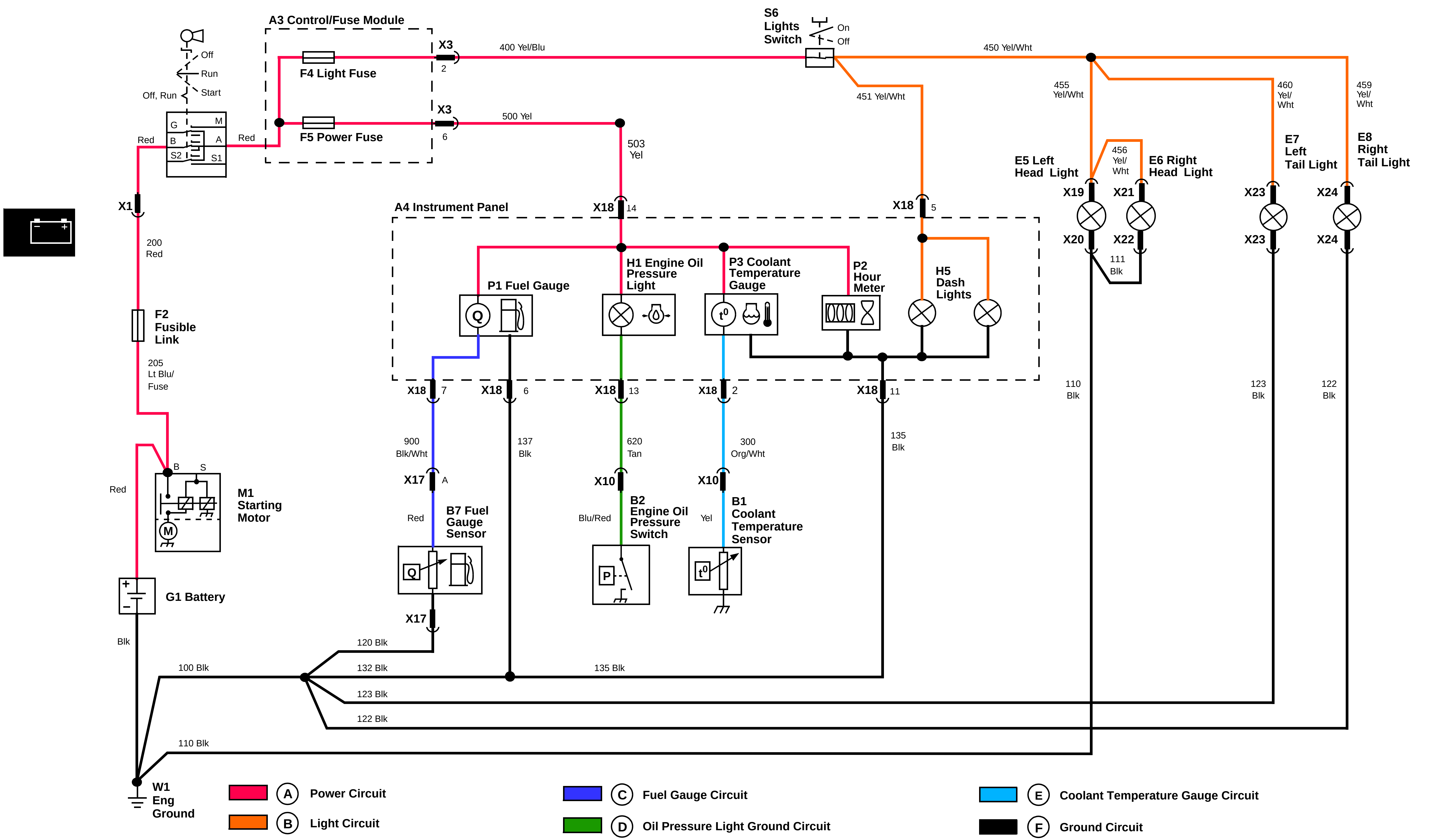
INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—445 (S.N. —070000)



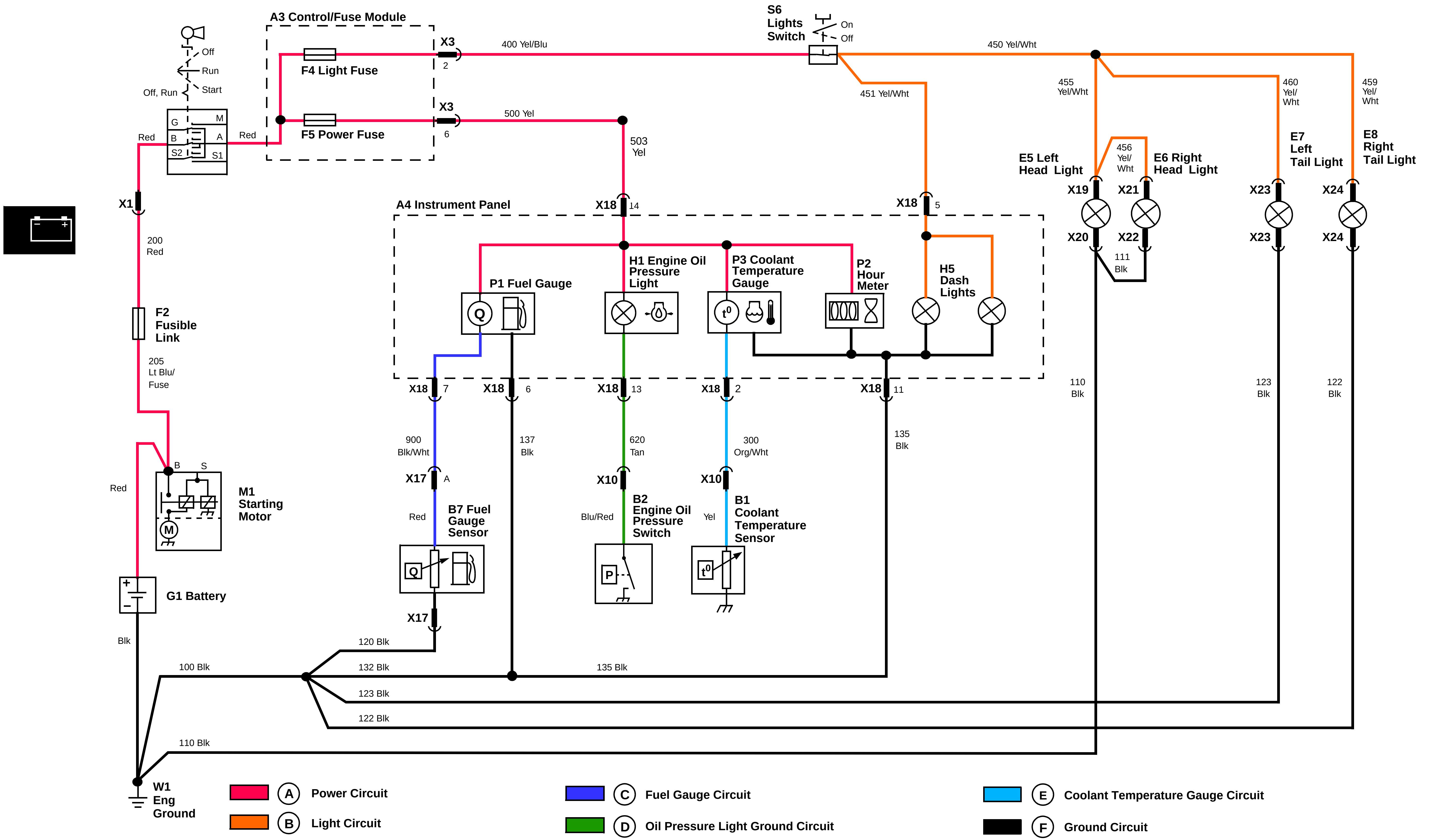
INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—445 (S.N. 070001—)



INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—445 (S.N. 070001—)



INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—445 (S.N. 070001—)



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OIL PRESSURE LIGHT AND HOURMETER CIRCUIT DIAGNOSIS —445 (S.N. —070000)

Test Conditions:

- PTO switch off position.
- Park brake engaged.
- Oil pressure sensor lead (A) disconnected.
- Key switch run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

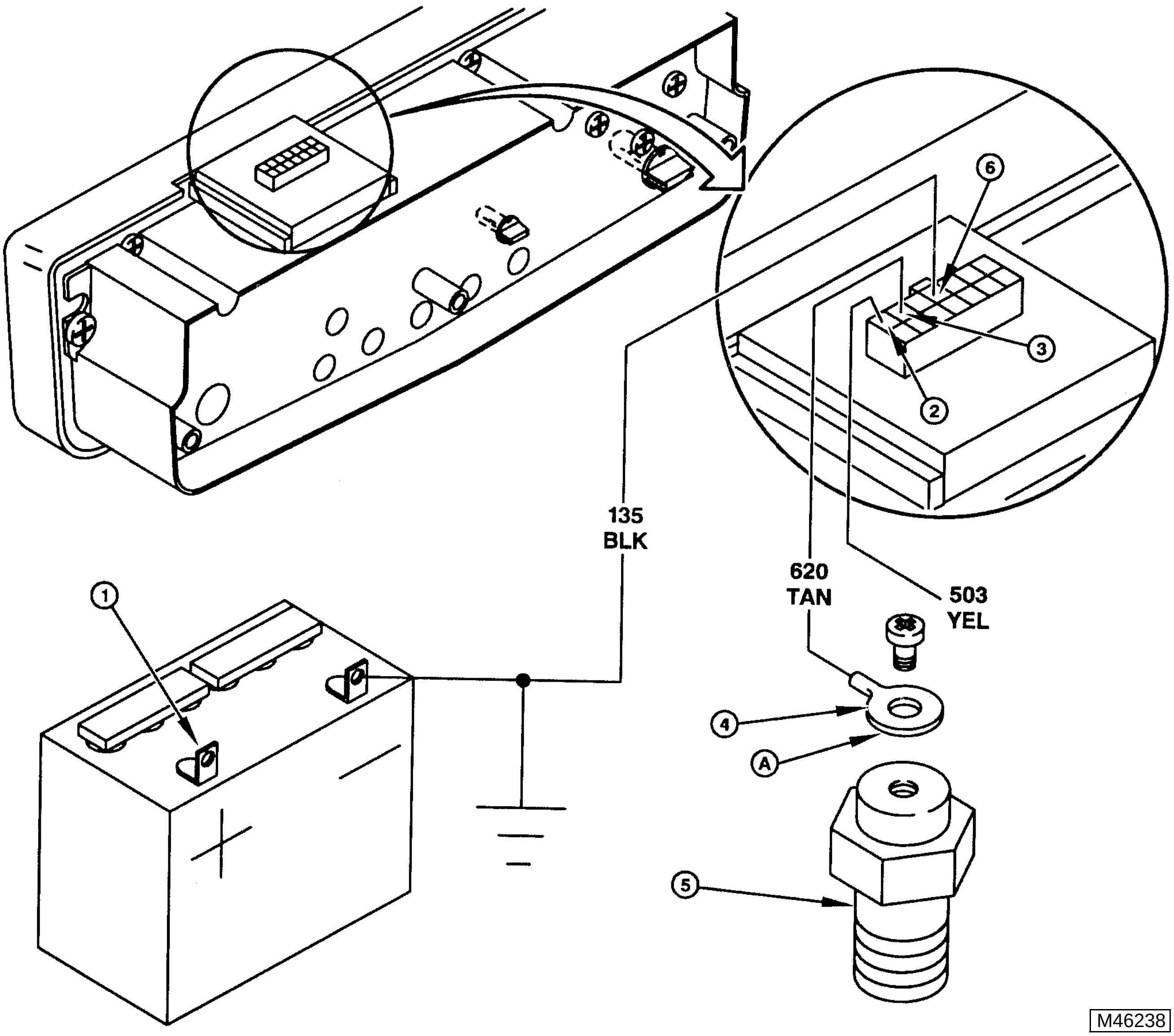
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Dash panel module terminal 14.	Battery voltage.	Check power circuit test points.
3. Dash panel module terminal 13.	Battery voltage.	Replace oil pressure light bulb.
4. Oil pressure sensor lead.	Battery voltage.	Check 620 tan wire and blu/red wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
5. Oil pressure sensor.	Continuity to ground Maximum 0.1 ohms resistance.	Check engine ground, if ok replace oil pressure sensor.
6. Dash panel module terminal 11—Hourmeter check.	Maximum 0.1 ohms resistance.	Check engine ground connection, 100 and 135 blk wires, if ok replace dash panel module.

OIL PRESSURE LIGHT AND HOURMETER CIRCUIT TEST POINTS—445 (S.N. —070000)



OIL PRESSURE LIGHT AND HOURMETER CIRCUIT DIAGNOSIS —445 (S.N. 070001—)

Test Conditions:

- PTO switch in off position.
- Prak brake engaged.
- Oil pressure sensor lead (A) disconnected.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and lose terminals when testing.

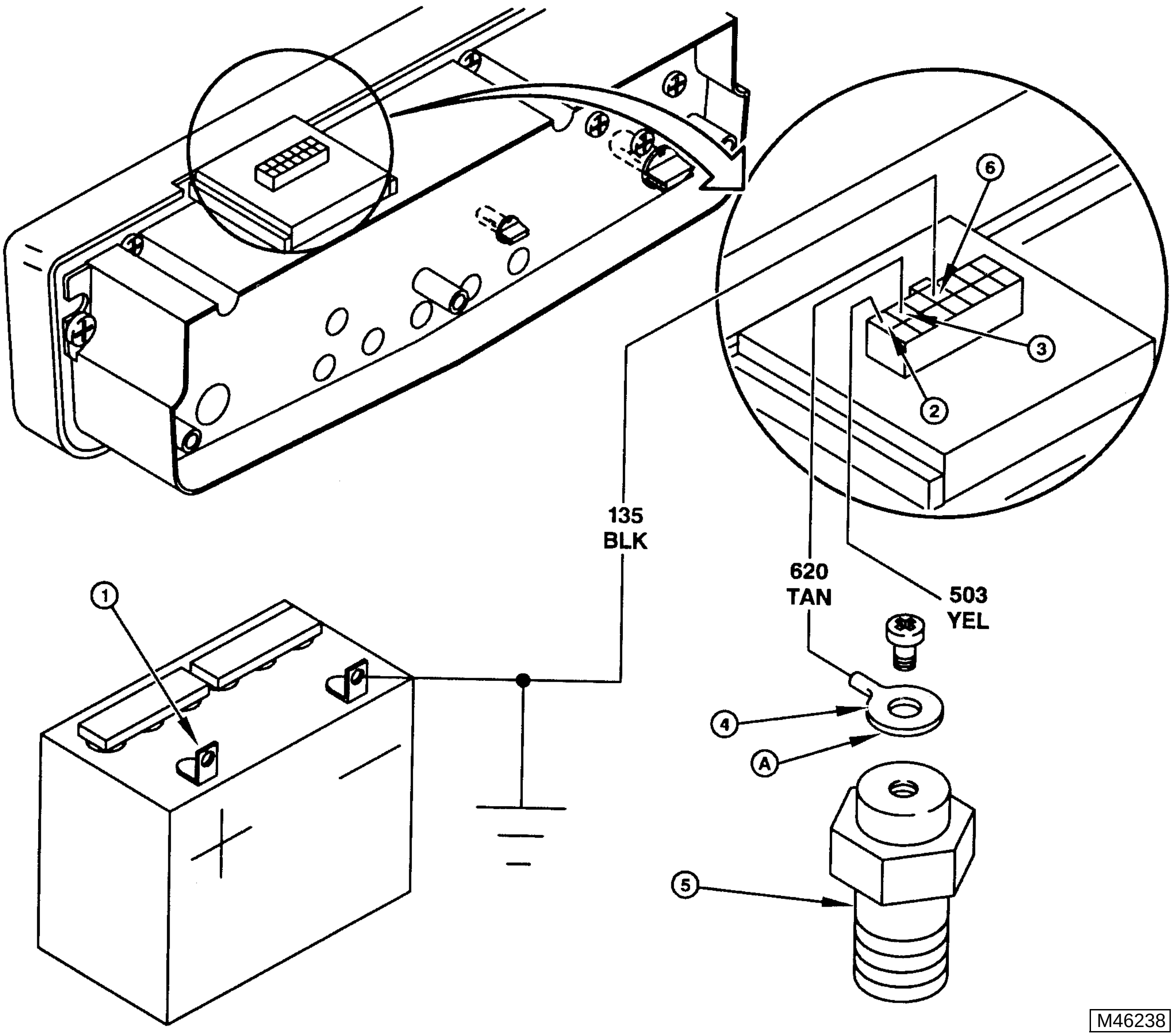
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Instrument panel connector terminal 14.	Battery voltage.	Check power circuit test points.
3. Instrument panel connector terminal 13.	Battery voltage.	Replace oil pressure light bulb.
4. Oil pressure switch lead.	Battery voltage.	Check 620 tan wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
5. Oil pressure sensor.	Continuity to ground. Maximum 0.1 ohms resistance.	Check engine ground, if ok replace oil pressure sensor.
6. Instrument panel connector terminal 11—Hourmeter check.	Maximum 0.1 ohms resistance.	Check engine ground connection. 100 and 135 blk wires, if ok replace instrument panel.

OIL PRESSURE LIGHT AND HOURMETER CIRCUIT TEST POINTS—445 (S.N. 070001—)



COOLANT TEMPERATURE GAUGE CIRCUIT DIAGNOSIS—445 (S.N. —070000)

Test Conditions:

- PTO switch off position.
- Park brake engaged.
- Coolant temperature sensor lead (A) disconnected.
- Key switch run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Dash panel module terminal 14. 445 only—Dash panel module terminal 14, 503 yel wire.	Battery voltage.	Check power circuit diagnosis.
3. Dash panel module terminal 2.	Battery voltage.	Replace dash panel module.
4. Coolant temperature sensor.	Battery voltage.	Check 300 org/wht wire and yel wire lead.

Test Conditions:

Key switch in off position.

Test/Check Point	Normal	If Not Normal
5. Dash panel module terminal 11.	Maximum 0.1 ohms resistance.	Check battery negative cable, engine ground connection, 100 and 135 blk wires.

Test Conditions:

- Key switch in run position.
- Check coolant temperature gauge needle position with coolant temperature sensor lead disconnected and then grounded.

Test/Check Point	Normal	If Not Normal
6. Coolant temperature gauge.	Needle at cold position with lead disconnected and hot position with lead grounded.	Replace dash panel module.

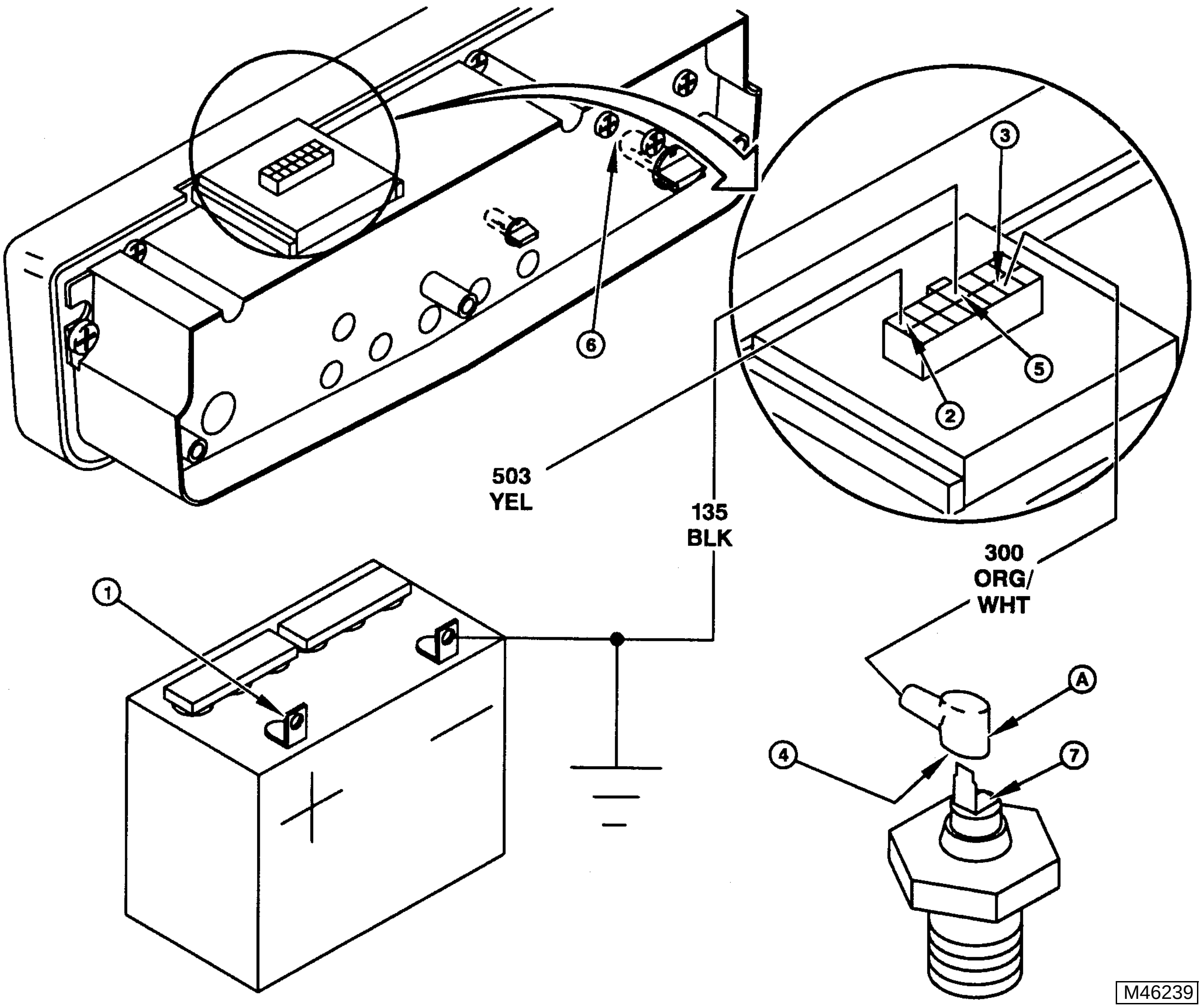
COOLANT TEMPERATURE GAUGE CIRCUIT DIAGNOSIS—445 (S.N. —070000) (continued)

Test Conditions:

- Key switch in off position.
- Coolant temperature sensor lead disconnected.

Test/Check Point	Normal	If Not Normal
7. Coolant temperature sensor.	Continuity to ground—resistance depends on engine temperature. Sensor threads not corroded.	Replace coolant temperature sensor.

COOLANT TEMPERATURE GAUGE CIRCUIT TEST POINTS—445 (S.N. —070000)



COOLANT TEMPERATURE GAUGE CIRCUIT DIAGNOSIS—445 (S.N. 070001—)

Test Conditions:

- PTO switch in off position.
- Park brake engaged.
- Coolant temperature sensor lead (A) disconnected.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Instrument panel connector terminal 14.	Battery voltage.	Check power circuit diagnosis.
3. Instrument panel connector terminal 2.	Battery voltage.	Replace instrument panel
4. Coolant temperature sensor.	Battery voltage.	Check 300 org/wht wire and yel wire lead.

Test Conditions:

Key switch in off position.

Test/Check Point	Normal	If Not Normal
5. Instrument panel connector terminal 11.	Maximum 0.1 ohms resistance.	Check battery negative cable, engine ground connection, 100 and 135 blk wires.

Test Conditions:

- Key switch in run position.
- Check coolant temperature gauge needle position with coolant temperature sensor lead disconnected and then grounded.

Test/Check Point	Normal	If Not Normal
6. Coolant temperature gauge.	Needle at cold position with lead disconnected and hot position with lead grounded.	Replace instrument panel.

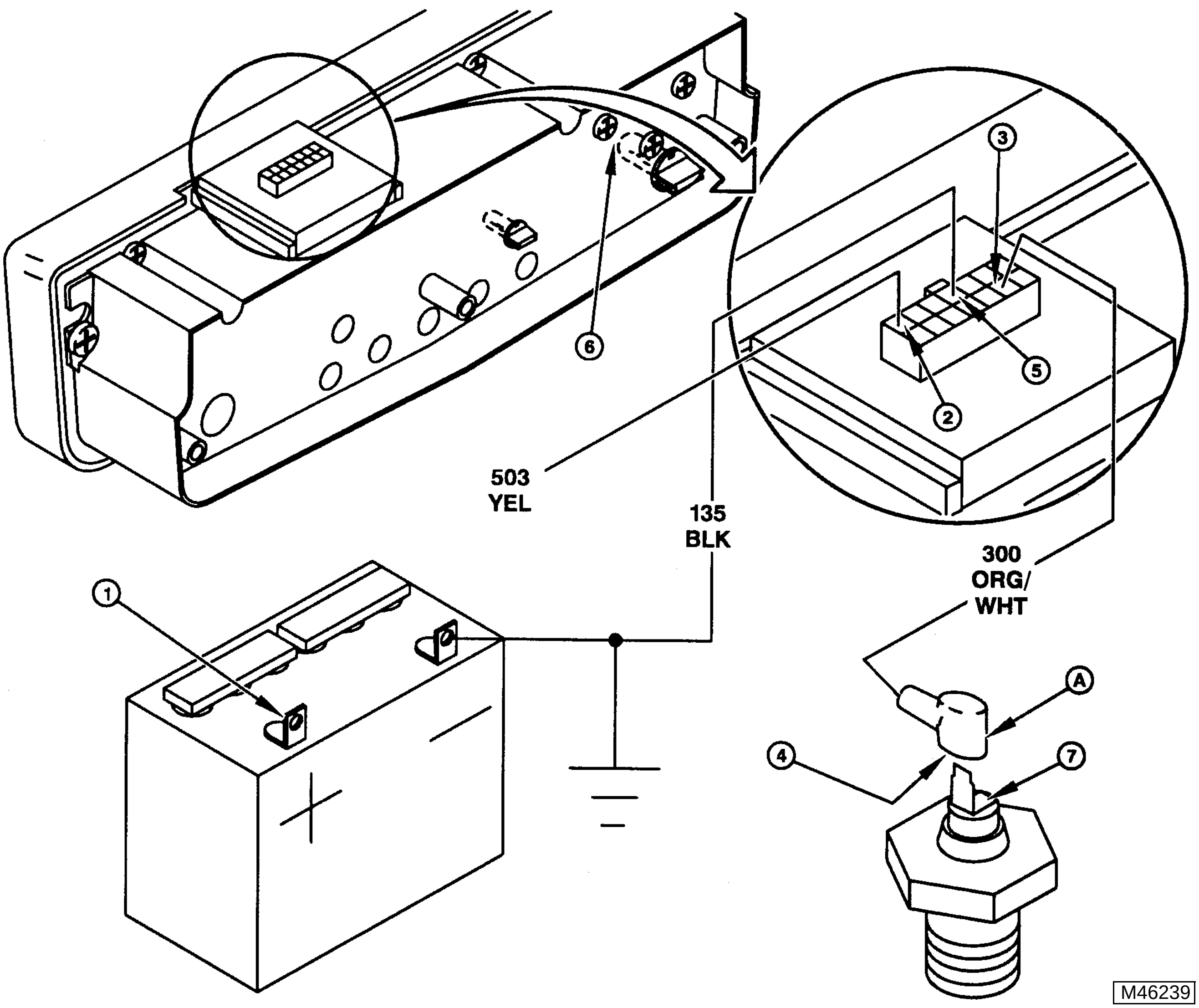
COOLANT TEMPERATURE GAUGE CIRCUIT DIAGNOSIS—445 (S.N. 070001—) (continued)

Test Conditions:

- Key switch in off position.
- Coolant temperature sensor lead disconnected.

Test/Check Point	Normal	If Not Normal
7. Coolant temperature sensor.	Continuity to ground—resistance depends on engine temperature. Sensor threads not corroded.	Replace coolant temperature sensor.

COOLANT TEMPERATURE GAUGE CIRCUIT TEST POINTS—445 (S.N. 070001—)



FUEL GAUGE CIRCUIT DIAGNOSIS—445 (S.N. —070000)

Test Conditions:

- PTO switch off position.
- Park brake engaged.
- Fuel gauge sensor connector (A) disconnected.
- Key switch run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Dash panel module terminal 14.	Battery voltage.	Check power circuit diagnosis.
3. Dash panel module terminal 7.	0.69—4.5 volts.	Replace dash panel module.
4. Fuel gauge sensor lead.	0.69—4.5 volts.	Check 900 blk/wht wire and red wires.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
5. Fuel gauge sensor ground lead.	Maximum 0.1 ohms resistance.	Check battery negative cable, engine ground connection, 100 and 120 blk wires.
6. Dash panel module terminal 6.	Maximum 0.1 ohms resistance.	Check 137 blk wire.

Test Conditions:

- Key switch in run position.
- Check fuel gauge needle position with fuel gauge.
- Sensor lead (blk/wht wire) disconnected and then grounded.

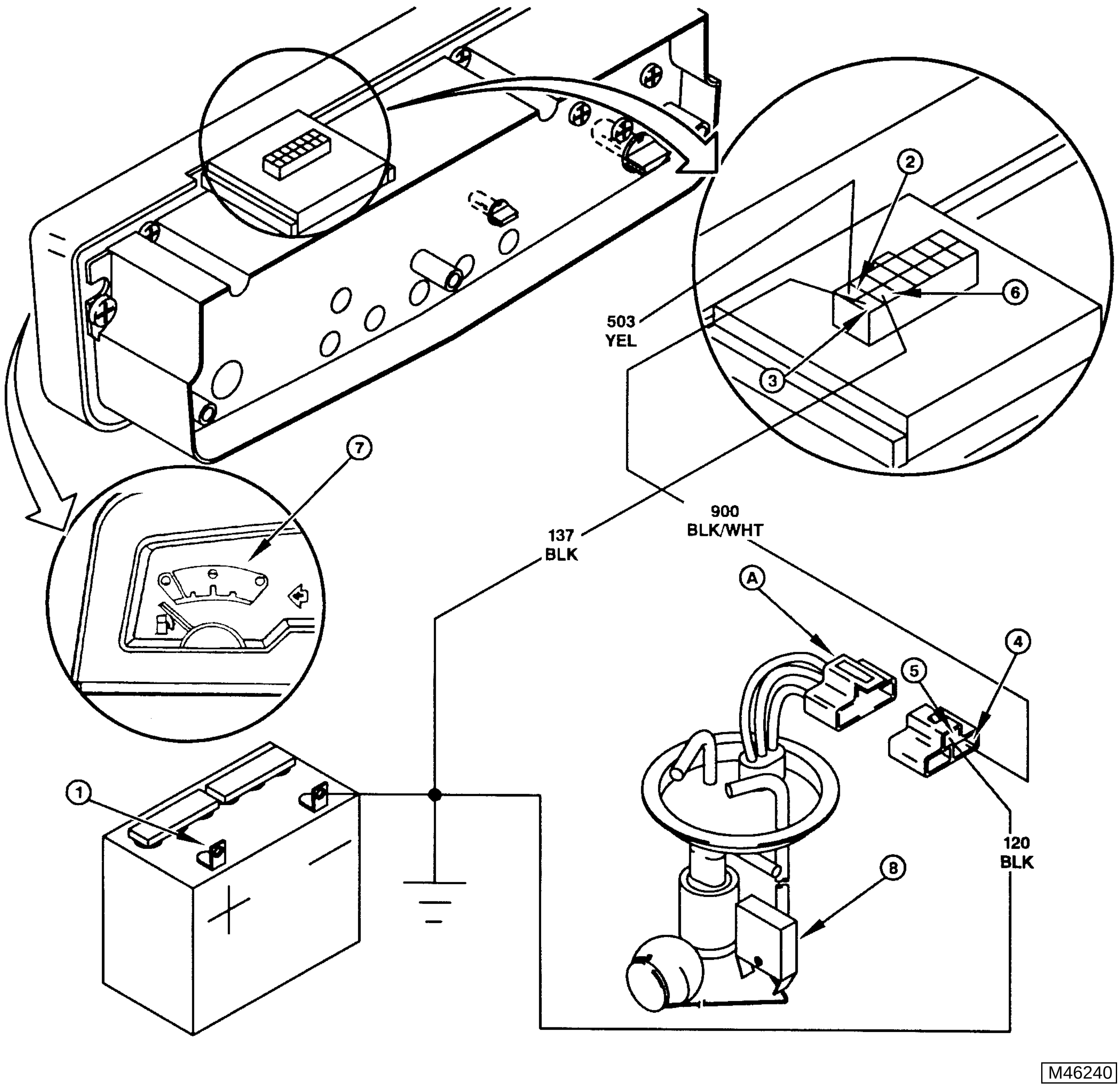
Test/Check Point	Normal	If Not Normal
7. Fuel gauge.	Full position with lead disconnected and “empty” position with lead grounded.	Replace dash panel module.

Test Conditions:

- Key switch in off position.
- Disconnect fuel gauge sensor connector.
- Remove fuel gauge sensor from tank so float can be raised and lowered.

Test/Check Point	Normal	If Not Normal
8. Fuel gauge sensor float (check between red and blk wires on sensor side).	Resistance increases as float is raised and decreases as float is lowered. Resistance about 6—200 ohms.	Replace fuel gauge sensor.

FUEL GAUGE CIRCUIT TEST POINTS—445 (S.N. —070000)



FUEL GAUGE CIRCUIT DIAGNOSIS—445 (S.N. 070001—)

Test Conditions:

- PTO switch in off position.
- Park brake engaged.
- Fuel gauge sensor connector (A) disconnected.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Instrument panel connector terminal 14.	Battery voltage.	Check power circuit diagnosis.
3. Instrument panel connector terminal 7.	0.69—4.5 volts.	Replace instrument panel.
4. Fuel gauge sensor lead.	0.69—4.5 volts.	Check 900 blk/wht wire and red wires.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
5. Fuel gauge sensor ground lead.	Maximum 0.1 ohms resistance.	Check battery negative cable, engine ground connection, 100 and 120 blk wires.
6. Instrument panel connector terminal 6.	Maximum 0.1 ohms resistance.	Check 137 blk wire.

Test Conditions:

- Key switch in run position.
- Check fuel gauge needle position with fuel gauge sensor lead (blk/wht wire) disconnected and then grounded.

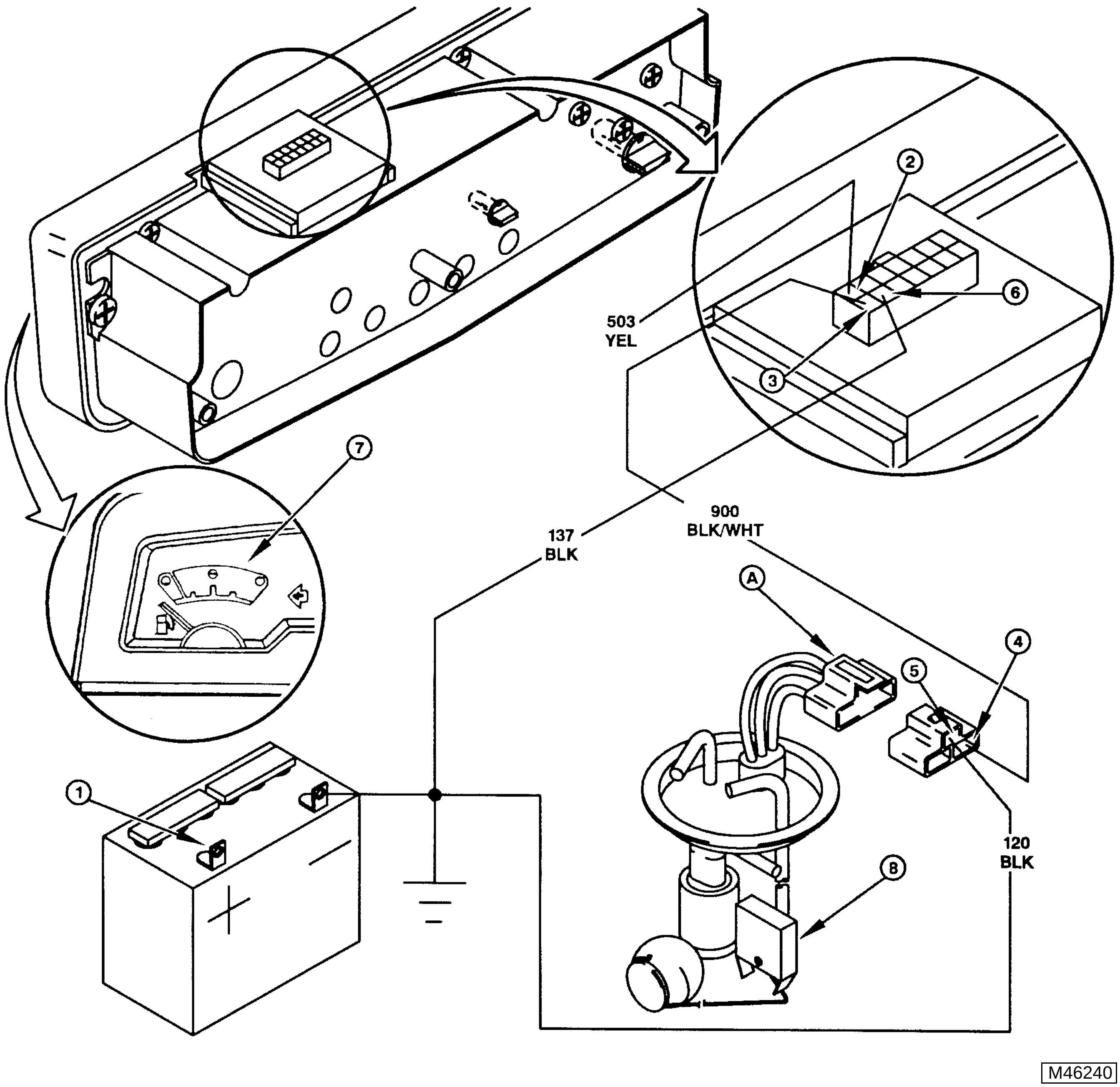
Test/Check Point	Normal	If Not Normal
7. Fuel gauge.	Full position with lead disconnected and “empty” position with lead grounded.	Replace instrument panel.

Test Conditions:

- Key switch in off position.
- Disconnect fuel gauge sensor connector.
- Remove fuel gauge sensor from tank so float can be raised and lowered.

Test/Check Point	Normal	If Not Normal
8. Fuel gauge sensor float (check between red and blk wires on sensor side).	Resistance increases as float is raised and decreases as float is lowered. Resistance about 6—200 ohms.	Replace fuel gauge sensor.

FUEL GAUGE CIRCUIT TEST POINTS—445 (S.N. 070001—)



LIGHTS CIRCUIT DIAGNOSIS—445 (S.N. —070000)

Test Conditions:

- Light bulb continuity is ok or light bulb replaced.
- PTO switch in off position.
- Park brake engaged.
- Key switch in run position.
- Lights switch in on position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

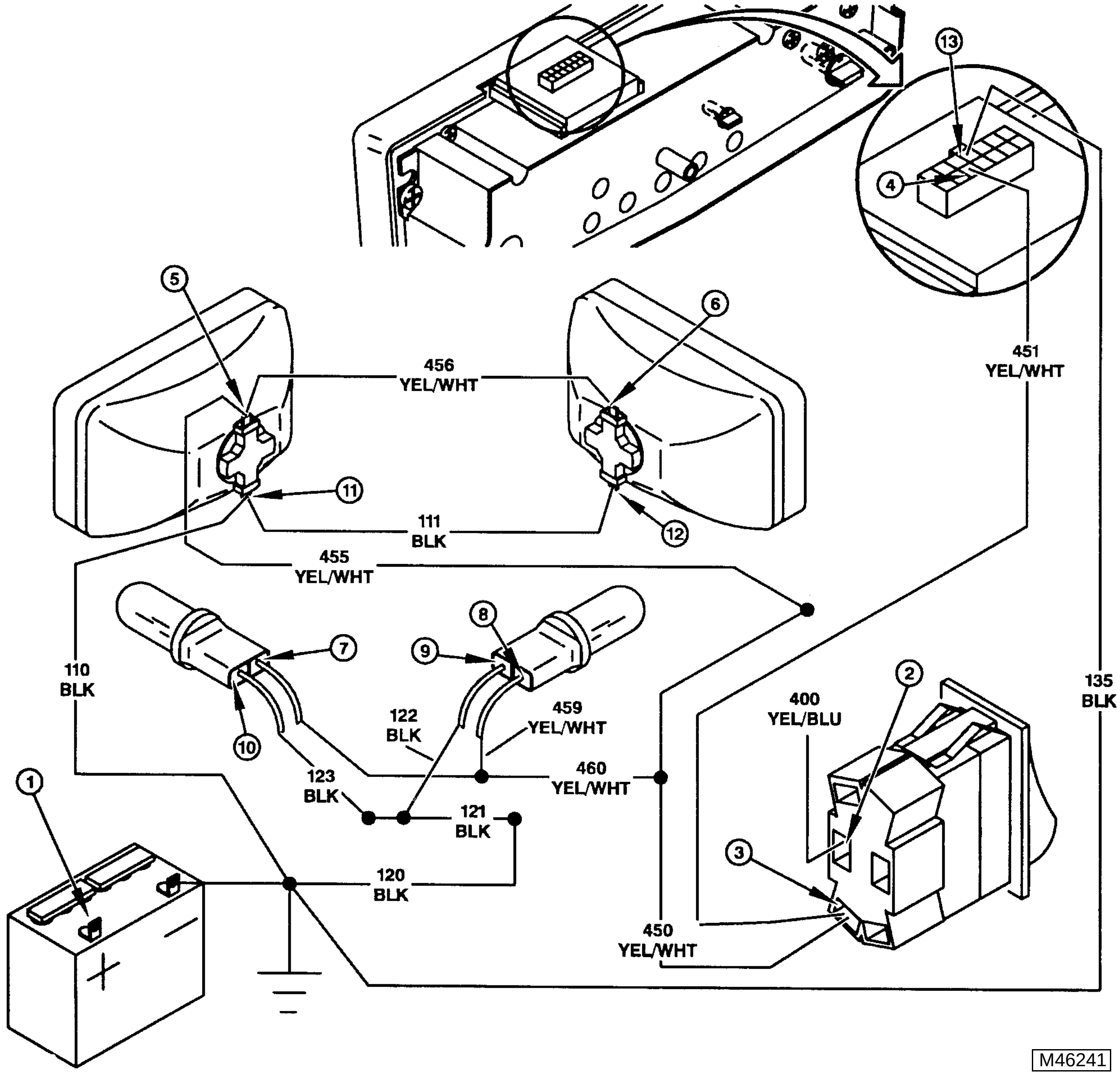
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Lights switch.	Battery voltage.	Check power circuit test points.
3. Lights switch.	Battery voltage.	Test lights switch.
4. Instrument panel connector terminal 5.	Battery voltage.	Check 451 yel/wht wire.
5. Left head light.	Battery voltage.	Check 455 yel/wht wire.
6. Right head light.	Battery voltage.	Check 456 yel/wht wire.
7. Left tail light.	Battery voltage.	Check 460 yel/wht wire.
8. Right tail light.	Battery voltage.	Check 459 yel/wht wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
9. Right tail light.	Maximum 0.1 ohms resistance.	Check battery negative cable, engine ground connection, 100, 120, 121 and 122 blk wires
10. Left tail light.	Maximum 0.1 ohms resistance.	Check 123 blk wire.
11. Left head light.	Maximum 0.1 ohms resistance.	Check 110 blk wire.
12. Right head light.	Maximum 0.1 ohms resistance.	Check 111 blk wire.
13. Instrument panel connector terminal 11.	Maximum 0.1 ohms resistance.	Check 135 blk wire, if ok replace instrument panel.

LIGHTS CIRCUIT TEST POINTS—445 (S.N. —070000)



LIGHTS CIRCUIT DIAGNOSIS—445 (S.N. 070001—)

Test Conditions:

- Light bulb continuity is ok or light bulb replaced.
- PTO switch in off position.
- Park brake engaged.
- Key switch in run position.
- Lights switch in on position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

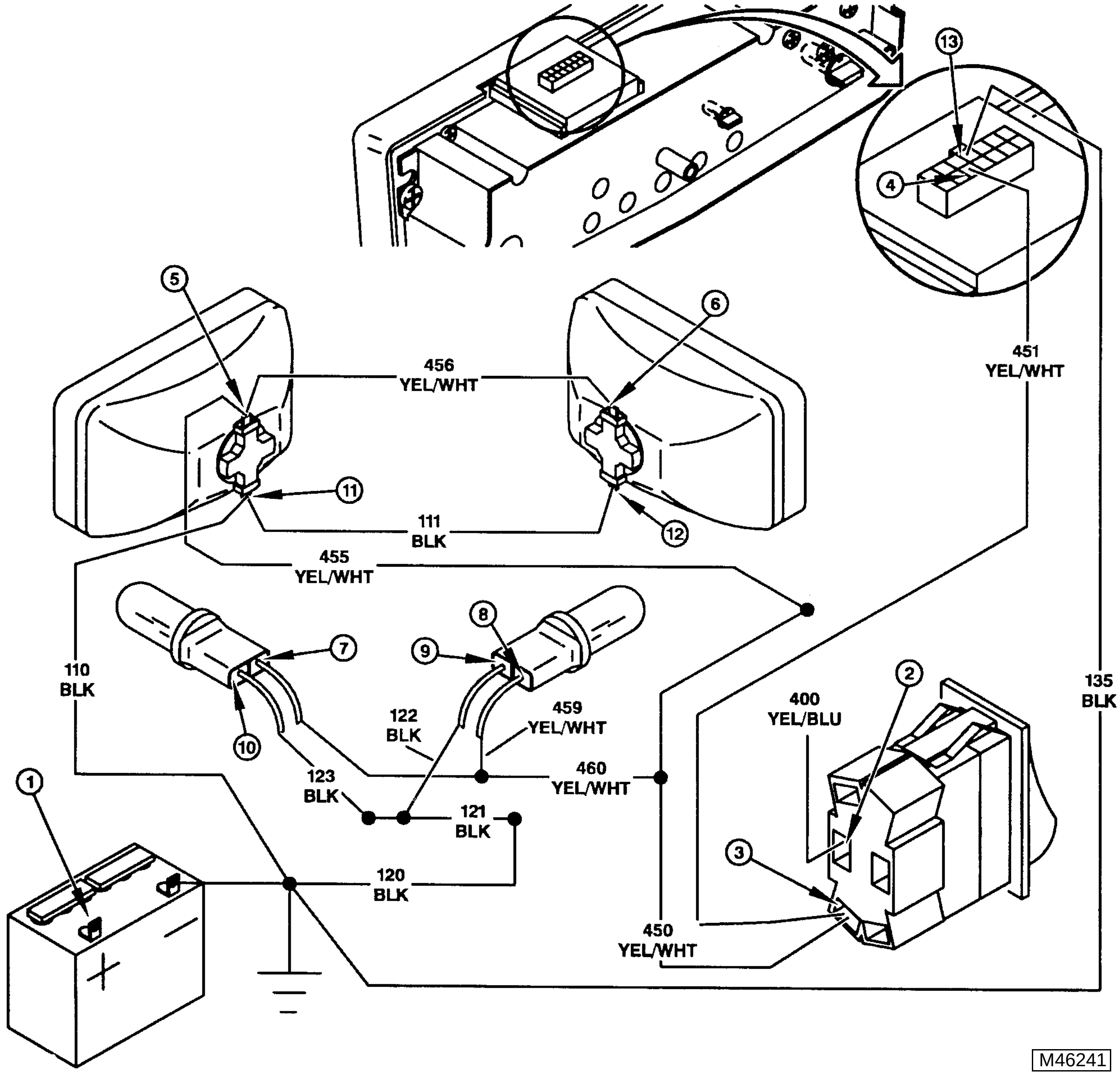
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Lights switch.	Battery voltage.	Check power circuit test points.
3. Lights switch.	Battery voltage.	Test lights switch.
4. Instrument panel connector terminal 5.	Battery voltage.	Check 451 yel/wht wire.
5. Left head light.	Battery voltage.	Check 455 yel/wht wire.
6. Right head light.	Battery voltage.	Check 456 yel/wht wire.
7. Left tail light.	Battery voltage.	Check 460 yel/wht wire.
8. Right tail light.	Battery voltage.	Check 459 yel/wht wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
9. Right tail light.	Maximum 0.1 ohms resistance.	Check battery negative cable, engine ground connection, 100, 120, 121 and 122 blk wires
10. Left tail light.	Maximum 0.1 ohms resistance.	Check 123 blk wire.
11. Left head light.	Maximum 0.1 ohms resistance.	Check 110 blk wire.
12. Right head light.	Maximum 0.1 ohms resistance.	Check 111 blk wire.
13. Instrument panel connector terminal 11.	Maximum 0.1 ohms resistance.	Check 135 blk wire, if ok replace instrument panel.

LIGHTS CIRCUIT TEST POINTS—445 (S.N. 070001—)



FUEL INJECTOR AND FUEL PUMP CIRCUIT OPERATION— 445 (S.N. —70000)

Function:

The fuel pump provides pressurized fuel to the fuel injector. The fuel injector injects pressurized fuel into the throttle body at the correct time and duration for the current engine operating conditions.

Operating Conditions:

To energize the fuel pump and injector, the key switch must be in the run or start position, and the operator must be on the seat (seat switch closed) or with the operator off the seat, the brake pedal must be depressed (brake switch closed) and the PTO switch must be off (PTO switch closed).

System Operation:

The fuel pump and injector are controlled by the fuel injection module. The fuel injection module energizes or de-energizes the fuel injector and fuel pump relay based on input received from the engine sensors (pulser coil (B4), key switch (S1), air temperature sensor (B1), coolant temperature sensor (B2), and air pressure sensor (B3)). The engine sensors send signals that show environmental and engine operating conditions to a computer in the fuel injection module. The fuel injection module computer processes the engine, sensor signals and calculates the quantity of fuel to be injected, ignition timing, and duration of fuel pump operation for the current engine operating conditions. The fuel injection module computer has the following fuel injection correction conditions:

- Cold start enrichment—When the engine is cold and when the starting motor is cranking.
- After start enrichment—When the engine is cold and when the key switch is turned from start to run position.
- Warm up enrichment—When the engine is cold and when the engine is running.
- Fuel shut-off—When the engine speed exceeds the preset rpm or the operator gets off the seat withthe PTO engaged or the brake pedal released.

The engine is shut off by de-energizing the ignition and safety relay which breaks the path to ground for the fuel injection module. Current (A) flows from the battery (G1) to the starting motor (M1), fusible links (F1, F2), key switch terminal B (S1), fuel injection fuse (F5), and the fuel injection relay terminal 87 (K5). Current from the fuel injection relay cannot flow to the fuel injection module (A1) until the relay is energized. With the operator off the seat and the key switch in the run position, current flows from key switch terminal B to terminal A, power fuse (F4), ignition relay terminal 87, brake switch (S3) (brake pedal depressed), PTO switch (S4) (PTO disengaged), ignition relay coil terminal 85, ignition LED (E1), and fuel injection relay coil terminal 85 (K5). The ignition LED indicates that power is available to the ignition relay coil. With the fuel injection relay energized, current (E) flows to the fuel injection module, fuel injector, and fuel pump relay terminals 87 and 85. Current from the fuel pump relay cannot flow to the fuel pump until the relay is energized. The fuel injector and fuel pump relay cannot be energized until a ground path is provided through the fuel injection module. With the ignition relay energized, current (C) flows to the PTO switch and safety relay terminal 86, energizing the relay. When the relay is energized a path to ground is provided for the fuel injection module.An alternate current path is provided to keep the ignition and the safety relay energized when the PTO is engaged or the brake pedal is released. With the operator on the seat (seat switch (S2) closed), current (D) flows to the ignition relay coil, keeping the relay energized. If the operator leaves the seat with the PTO engaged or the brake pedal released, current to the ignition relay coil is stopped. The ignition and safety relays open, which opens the fuel injection module ground and de-energizes the fuel injector stopping the fuel. A delay capacitor in the ignition module provides current for 1/2 second to keep the ignition relay coil energized if the operator bounces on the seat. The fuel injection module creates a path to ground and energizes the fuel injector and fuel pump relay. The fuel injector opens and fuel is injected into the throttle body. Current from the fuel pump relay flows to the fuel pump motor causing it to turn and pressurize the fuel. The fuel injection module computer allows the fuel pump to operate only when one of the following conditions exist:

- For about 2 seconds after the key switch is turned to the run position.
- When the starting motor is cranking.
- When the engine is running.

When the fuel conditions are satisfied, the fuel injection module breaks the path to ground which de-energizes the fuel injector and fuel pump relay.

FUEL INJECTOR AND FUEL PUMP CIRCUIT OPERATION— 445 (S.N. 070001—)

Function:

The fuel pump provides pressurized fuel to the fuel injector. The fuel injector injects pressurized fuel into the throttle body at the correct time and duration for the current engine operating conditions.

Operating Conditions:

To energize the fuel pump and injector, the key switch must be in the run or start position, and the operator must be on the seat (seat switch closed) or with the operator off the seat, the brake pedal must be depressed (brake switch closed) and the PTO switch must be off (PTO switch closed).

System Operation:

The fuel pump and injector are controlled by the fuel injection module. The fuel injection module energizes or de-energizes the fuel injector and fuel pump relay based on input received from the engine sensors (pulser coil (B6), key switch (S1), air temperature sensor (B4), coolant temperature sensor (B3), and air pressure sensor (B5)). The engine sensors send signals that show environmental and engine operating conditions to a computer in the fuel injection module. The fuel injection module computer processes the engine sensor signals and calculates the quantity of fuel to be injected, ignition timing, and duration of fuel pump operation for the current engine operating conditions. The fuel injection module computer has the following fuel injection correction conditions:

- Cold start enrichment—When the engine is cold and when the starting motor is cranking.
- After start enrichment—When the engine is cold and when the key switch is turned from start to run position.
- Warm up enrichment—When the engine is cold and when the engine is running.
- Fuel shut-off—When the engine speed exceeds the preset rpm or the operator gets off the seat with the PTO engaged or the brake pedal released.

The engine is shut off by de-energizing the ignition and safety signal relay which breaks the path to ground for the fuel injection module. Current (A) flows from the battery (G1) to the starting motor (M1), fusible link (F1), terminal B of key switch (S1), fuel pump fuse (F3), and terminal 87 of the fuel injection relay (K6). Current from the fuel injection relay cannot flow to the fuel injection module (A1) until the relay is energized. With the operator off the seat and the key switch in the run position, current flows from key switch terminal B to terminal A, power fuse (F5), ignition relay terminal 87, brake switch (S5) (brake pedal depressed), PTO switch (S2) (PTO disengaged), ignition relay coil terminal 85, ignition LED (E1), and coil terminal 85 of the fuel injection relay (K6). The ignition LED indicates that power is available to the ignition relay coil. With the fuel injection relay energized, current (E) flows to the fuel injection module, fuel injector, and terminals 87 and 85 of the fuel pump relay. Current from the fuel pump relay cannot flow to the fuel pump until the relay is energized. The fuel injector and fuel pump relay cannot be energized until a ground path is provided through the fuel injection module. With the ignition relay energized, current (C) flows to the PTO switch and terminal 86 of the safety signal relay (K7), energizing the relay. When the relay is energized a path to ground is provided for the fuel injection module. An alternate current path is provided to keep the ignition and the safety signal relay energized when the PTO is engaged or the brake pedal is released. With the operator on the seat (seat switch (S3) closed), current (D) flows to the ignition relay coil, keeping the relay energized. If the operator leaves the seat with the PTO engaged or the brake pedal released, current to the ignition relay coil is stopped. The ignition and safety signal relays open, which opens the fuel injection module ground and de-energizes the fuel injector, stopping the fuel. A delay capacitor in the ignition module provides current for 1/2 second to keep the ignition relay coil energized if the operator bounces on the seat. The fuel injection module creates a path to ground and energizes the fuel injector and fuel pump relay (K8). The fuel injector opens and fuel is injected into the throttle body. Current from the fuel pump relay flows to the fuel pump motor causing it to turn and pressurize the fuel. The fuel injection module computer allows the fuel pump to operate only when one of the following conditions exist:

- For about 2 seconds after the key switch is turned to the run position.
- When the starting motor is cranking.
- When the engine is running.

When the fuel conditions are satisfied, the fuel injection module breaks the path to ground which de-energizes the fuel injector and fuel pump relay.

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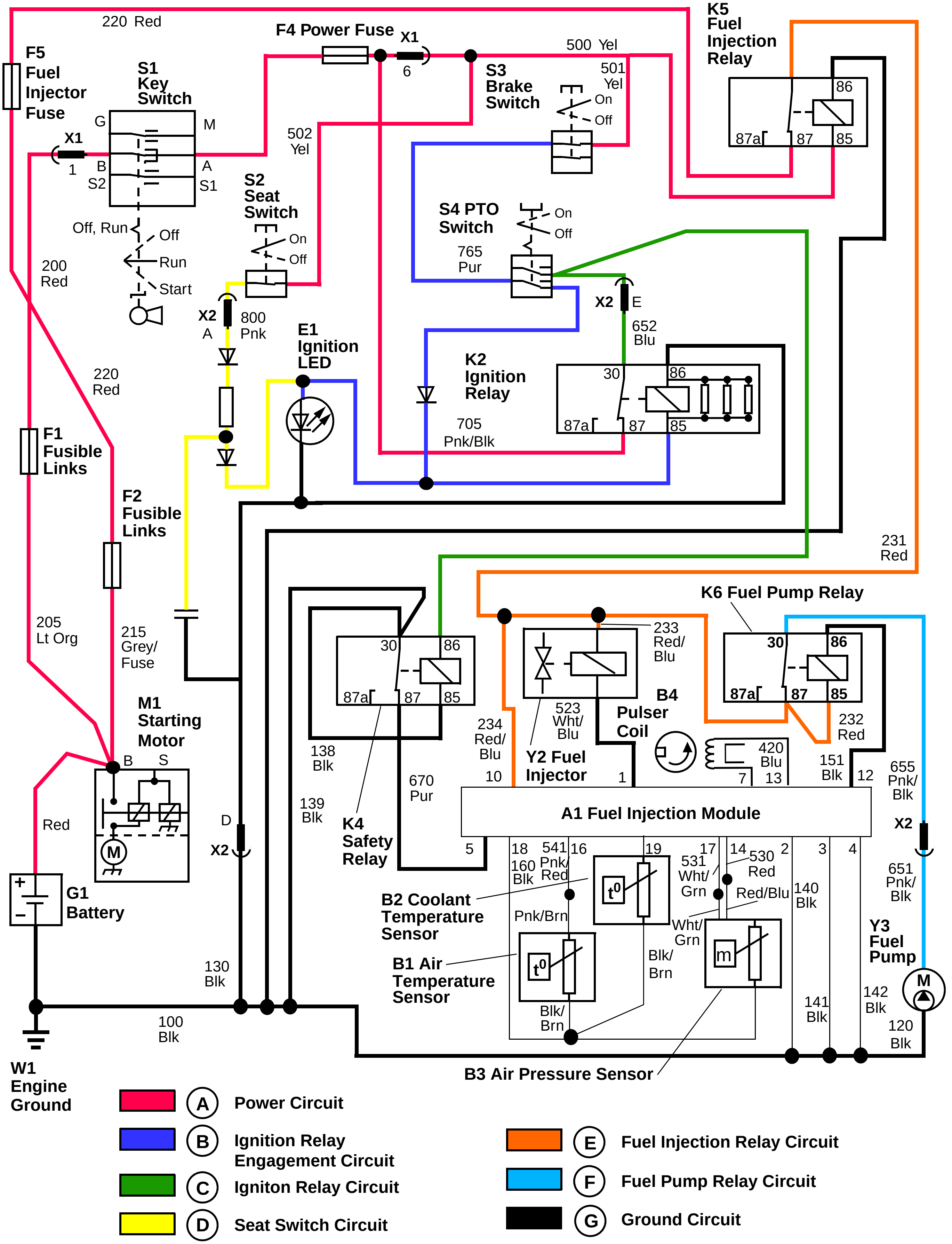
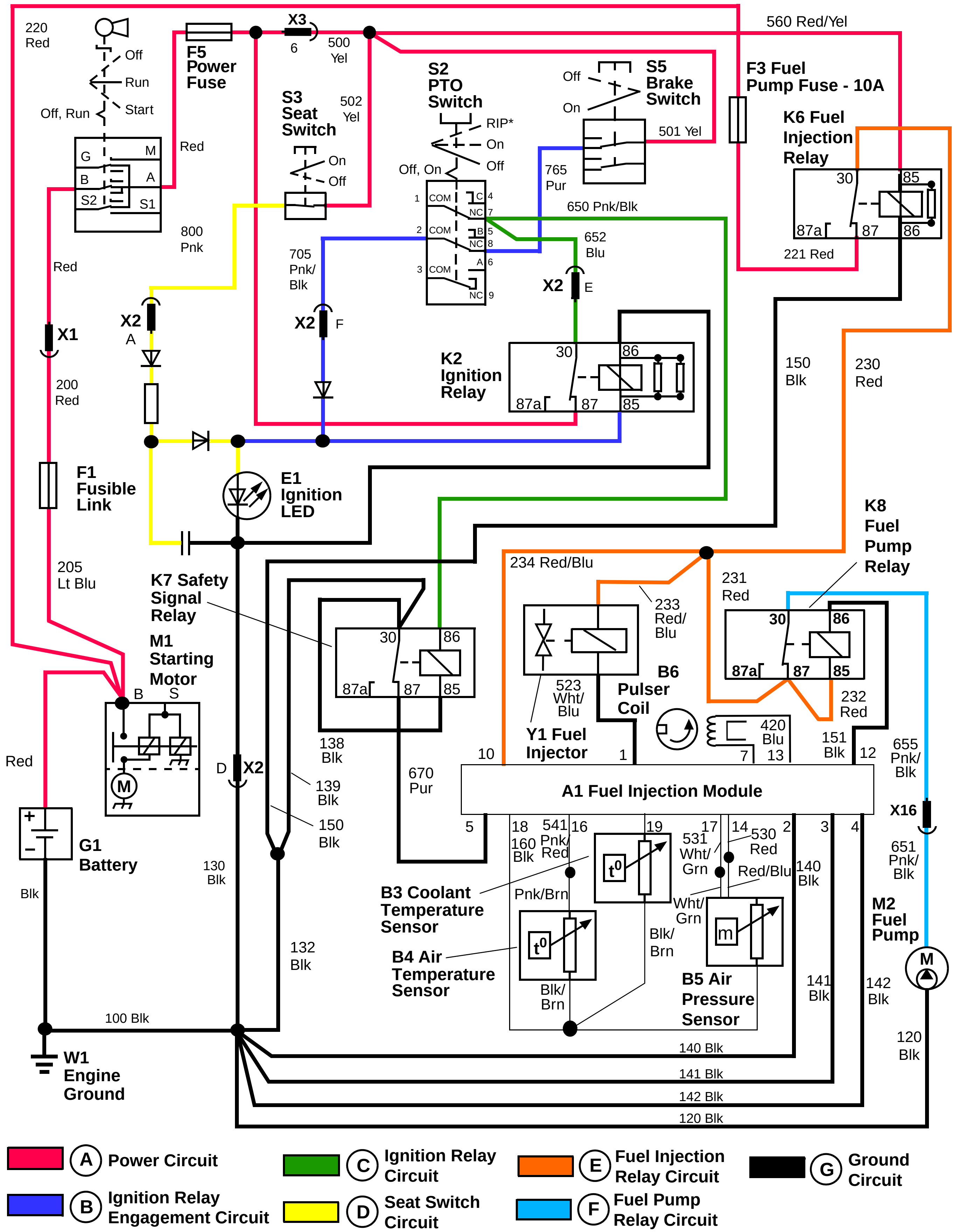
FUEL INJECTOR AND FUEL PUMP CIRCUIT SCHEMATIC—445 (S.N. —070000)



FUEL INJECTOR AND FUEL PUMP CIRCUIT SCHEMATIC—445 (S.N. 070001—)



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FUEL INJECTOR AND PUMP CIRCUIT DIAGNOSIS—445 (S.N. —070000)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Seat switch depressed or jumper wire installed in connector.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

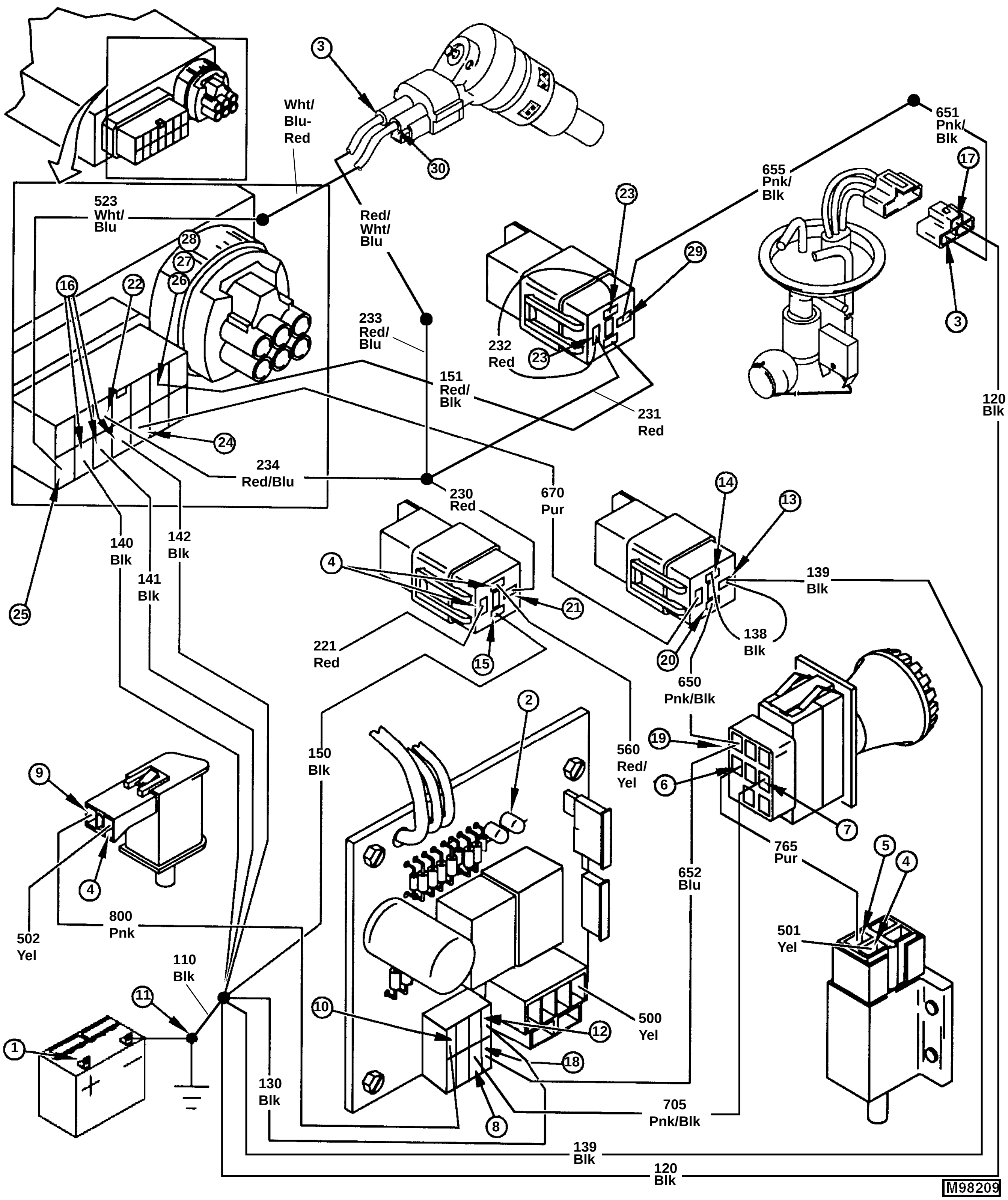
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Ignition LED.	Light on.	Check ignition relay engagement circuit, go to step 5.
3. Fuel injector if testing fuel injector circuits or fuel pump if testing fuel pump circuits.	Battery voltage at fuel injector. Battery voltage at fuel pump for 2 seconds after moving key switch to run.	No voltage—go to step 4. Voltage—Go to step 11.
4. Brake switch, seat switch, and terminals 87 and 85 of fuel injection relay.	Battery voltage.	Check power circuit test points.
5. Brake switch.	Battery voltage.	Test brake switch.
6. PTO switch.	Battery voltage.	Check 765 pur wire.
7. PTO switch.	Battery voltage.	Test PTO switch.
8. Control/fuse module terminal F.	Battery voltage.	Check 705 pnk/blk wire.
9. Seat switch.	Battery voltage.	Test seat switch.
10. Control/fuse module terminal A.	Battery voltage.	Check 800 pnk wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
11. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative cable and engine ground connection.
12. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check 100 and 130 blk wires and harness to engine ground connection.
13. Safety relay terminal 30.	Maximum 0.1 ohms resistance.	Check 139 blk wire.
14. Safety relay terminal 85.	Maximum 0.1 ohms resistance.	Check 138 blk wire.
15. Fuel injection relay terminal 86.	Maximum 0.1 ohms resistance.	Check 150 blk wire terminal 86.

FUEL INJECTOR AND PUMP CIRCUIT TEST POINTS—445 (S.N. —070000)



FUEL INJECTOR AND PUMP CIRCUIT DIAGNOSIS—445 (S.N. —070000) (continued)

Test Conditions:

- Key switch in run position.

Test/Check Point	Normal	If Not Normal
16. Fuel injection module terminal 2, 3, and 4.	Maximum 0.1 ohms resistance.	Check 140, 141, and 142 blk wires.
17. Fuel pump.	Maximum 0.1 ohms resistance.	Check 120 blk wire.
18. Control/fuse module terminal E.	Battery voltage.	Replace control/fuse module.
19. PTO switch.	Battery voltage.	Check 652 blu wire.
20. Safety relay terminal 86.	Battery voltage.	Check 650 pnk/blk wire.
21. Fuel injection relay terminal 30.	Battery voltage.	Test fuel injection relay.
22. Fuel injection module terminal 10.	Battery voltage.	Check 234 red/blu wire.
23. Test only if checking fuel pump circuit. Fuel pump relay terminals 87 and 85.	Battery voltage.	Check 231 and 232 red wires.
24. Fuel injection module terminal 5.	0.0—0.2 volts.	Greater than 0.2 volts—Check 670 pur wire and safety relay. 0.0 volts—replace fuel injection module.
25. Test only if checking fuel injector circuit. Fuel injection module terminal 1.	Battery voltage.	Check 523 wht/blu and wht/blu/brn wires and test fuel injector.
26. Test only if checking fuel pump circuit. Fuel injection module terminal 12.	Battery voltage.	Check 151 red/blk wire and test fuel pump relay.

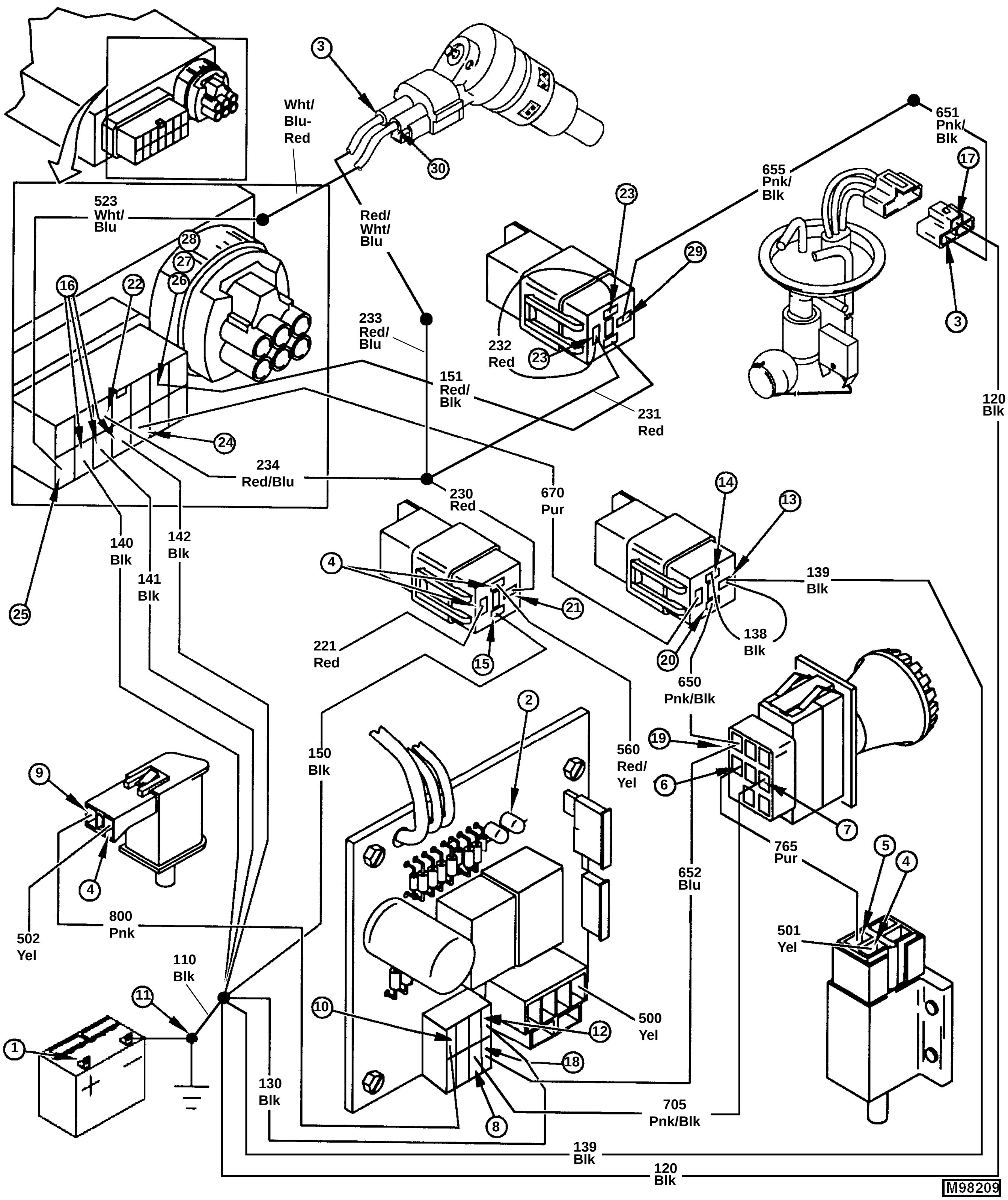
NOTE: Complete steps 27—29 only if testing fuel pump circuits.

Test Conditions:

- Turn key switch to off then run position and measure voltage within 2 seconds.

Test/Check Point	Normal	If Not Normal
27. Fuel injection module terminal 12.	0.0—0.2 volts for 2 seconds.	Greater than 0.2 volts—replace fuel injection module.

FUEL INJECTOR AND PUMP CIRCUIT TEST POINTS—445 (S.N. —070000)



FUEL INJECTOR AND PUMP CIRCUIT DIAGNOSIS—445 (S.N. —070000) (continued)

Test Conditions:

- Turn key switch to start and hold while measuring voltage.

Test/Check Point	Normal	If Not Normal
28. Fuel injection module terminal 12.	0.0—0.2 volts.	Greater than 0.2 volts—replace fuel injection module.

Test Conditions:

- Turn key switch to off then run position and measure voltage within 2 seconds.

Test/Check Point	Normal	If Not Normal
29. Fuel pump relay terminal 30.	Battery voltage for 2 seconds.	No voltage—Test fuel pump relay. Voltage—check 655 and 651 pnk/blk wires, if ok, replace fuel pump.

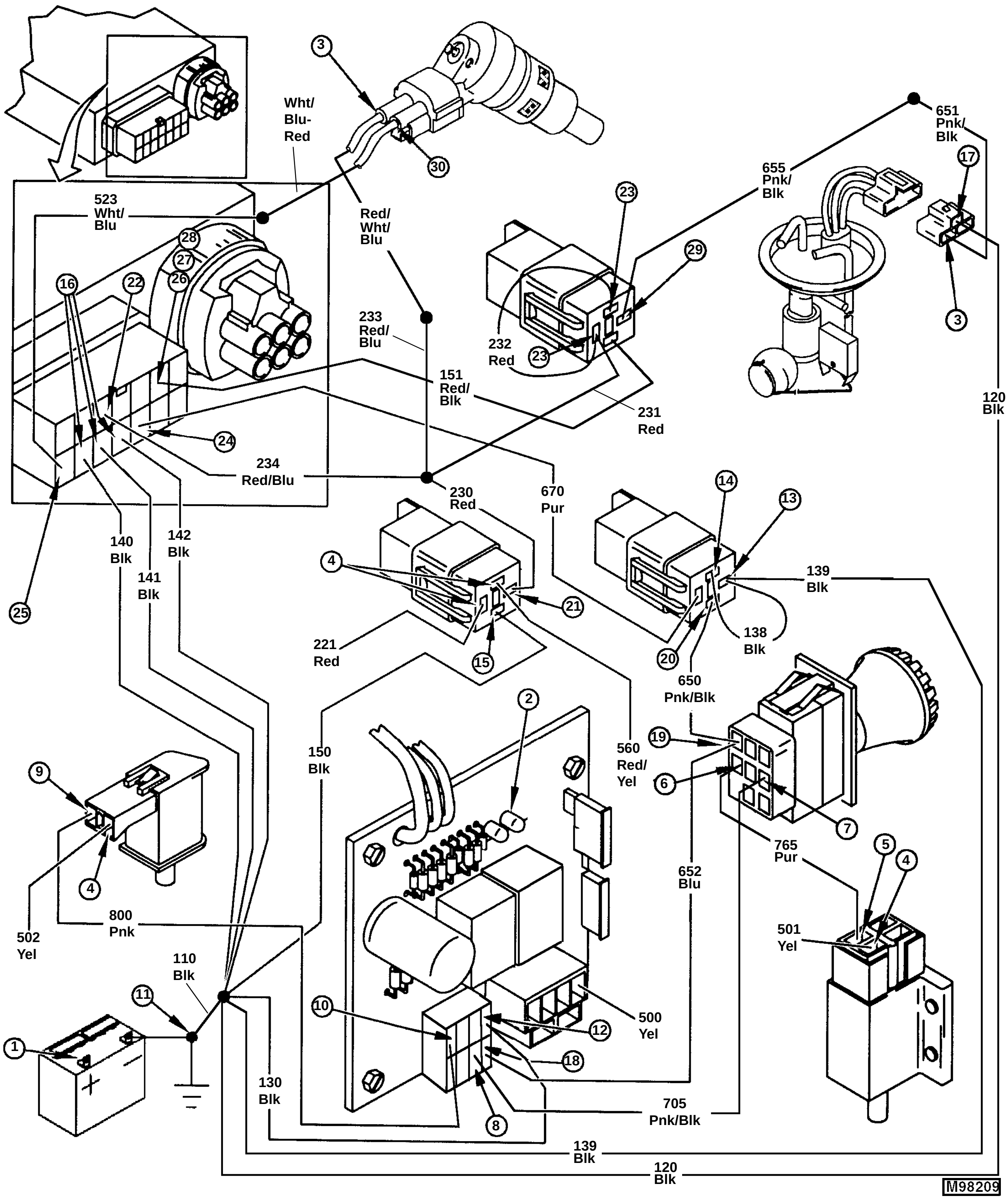
NOTE: Complete step 30 only if testing fuel injection circuits.

Test Conditions:

- Key switch in start position.
- Voltage test light connected to battery negative terminal (checking for current pulses).

Test/Check Point	Normal	If Not Normal
30. Fuel injector negative terminal.	Rapidly flashing light, not steady glow.	Light steady glow—replace fuel injection module.

FUEL INJECTOR AND PUMP CIRCUIT TEST POINTS—445 (S.N. —070000) (continued)



FUEL INJECTOR AND PUMP CIRCUIT DIAGNOSIS—445 (S.N. 070001—)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Seat switch depressed or jumper wire installed in connector.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

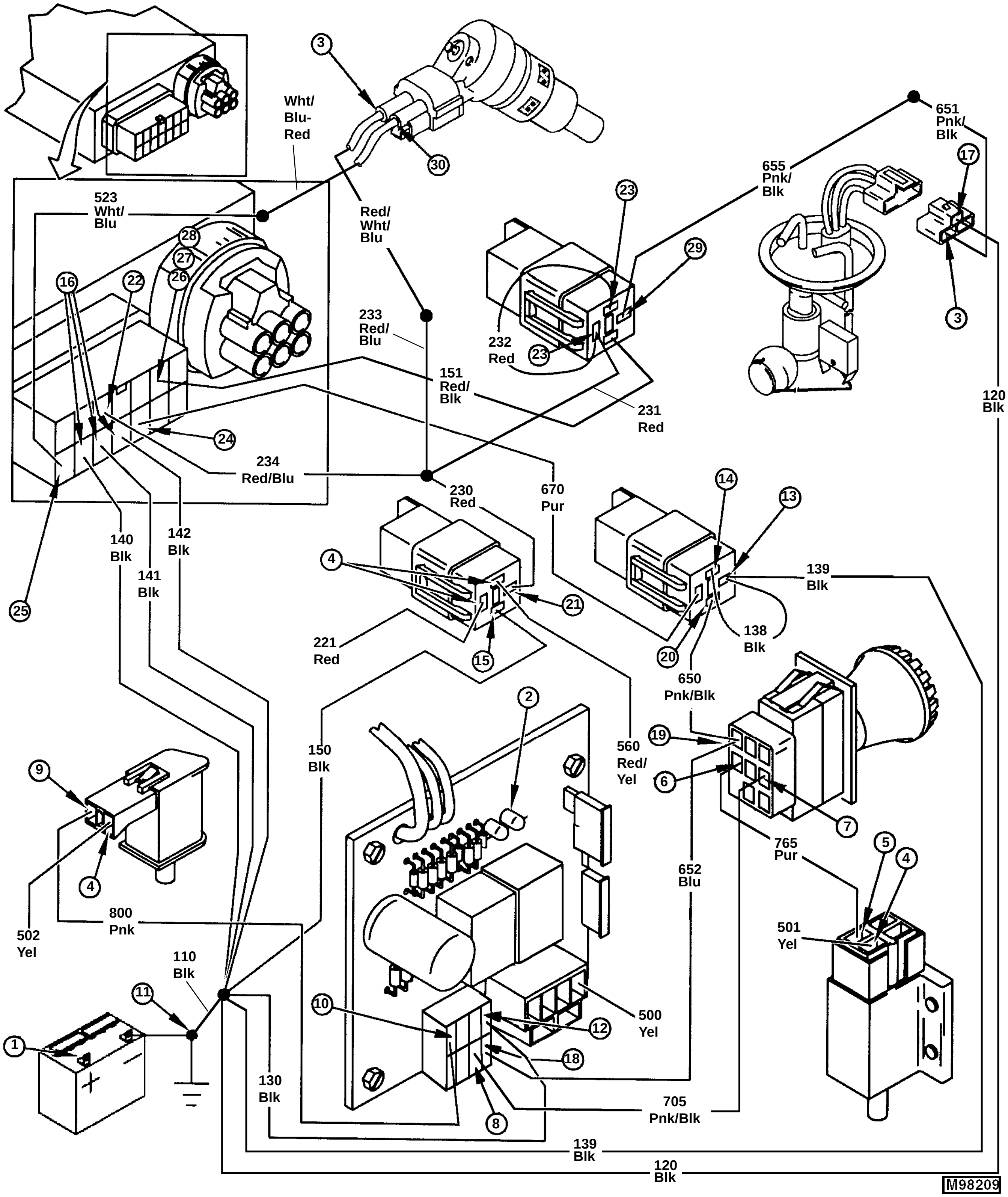
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Ignition LED.	Light on.	Check ignition relay engagement circuit, go to step 5.
3. Fuel injector if testing fuel injector circuits or fuel pump if testing fuel pump circuits.	Battery voltage at fuel injector. Battery voltage at fuel pump for 2 seconds after moving key switch to run.	No voltage—go to step 4. Voltage—Go to step 11.
4. Brake switch, seat switch, and terminals 87 and 85 of fuel injection relay.	Battery voltage.	Check power circuit test points.
5. Brake switch.	Battery voltage.	Test brake switch.
6. PTO switch.	Battery voltage.	Check 765 pur wire.
7. PTO switch.	Battery voltage.	Test PTO switch.
8. Control/fuse module terminal F.	Battery voltage.	Check 705 pnk/blk wire.
9. Seat switch.	Battery voltage.	Test seat switch.
10. Control/fuse module terminal A.	Battery voltage.	Check 800 pnk wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
11. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative cable and engine ground connection.
12. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check 100 and 130 blk wires and harness to engine ground connection.
13. Safety relay terminal 30.	Maximum 0.1 ohms resistance.	Check 139 blk wire.
14. Safety relay terminal 85.	Maximum 0.1 ohms resistance.	Check 138 blk wire.
15. Fuel injection relay terminal 86.	Maximum 0.1 ohms resistance.	Check 150 blk wire terminal 86.

FUEL INJECTOR AND PUMP CIRCUIT TEST POINTS—445 (S.N. 070001—)



FUEL INJECTOR AND PUMP CIRCUIT DIAGNOSIS—445 (S.N. 070001—) (continued)

Test Conditions:

• Key switch in run position.

Test/Check Point	Normal	If Not Normal
16. Fuel injection module terminal 2, 3, and 4.	Maximum 0.1 ohms resistance.	Check 140, 141, and 142 blk wires.
17. Fuel pump.	Maximum 0.1 ohms resistance.	Check 120 blk wire.
18. Control/fuse module terminal E.	Battery voltage.	Replace control/fuse module.
19. PTO switch.	Battery voltage.	Check 652 blu wire.
20. Safety relay terminal 86.	Battery voltage.	Check 650 pnk/blk wire.
21. Fuel injection relay terminal 30.	Battery voltage.	Test fuel injection relay.
22. Fuel injection module terminal 10.	Battery voltage.	Check 234 red/blu wire.
23. Test only if checking fuel pump circuit. Fuel pump relay terminals 87 and 85.	Battery voltage.	Check 231 and 232 red wires.
24. Fuel injection module terminal 5.	0.0—0.2 volts.	Greater than 0.2 volts—Check 670 pur wire and safety relay. 0.0 volts—replace fuel injection module.
25. Test only if checking fuel injector circuit. Fuel injection module terminal 1.	Battery voltage.	Check 523 wht/blu and wht/blu/brn wires and test fuel injector.
26. Test only if checking fuel pump circuit. Fuel injection module terminal 12.	Battery voltage.	Check 151 red/blk wire and test fuel pump relay.

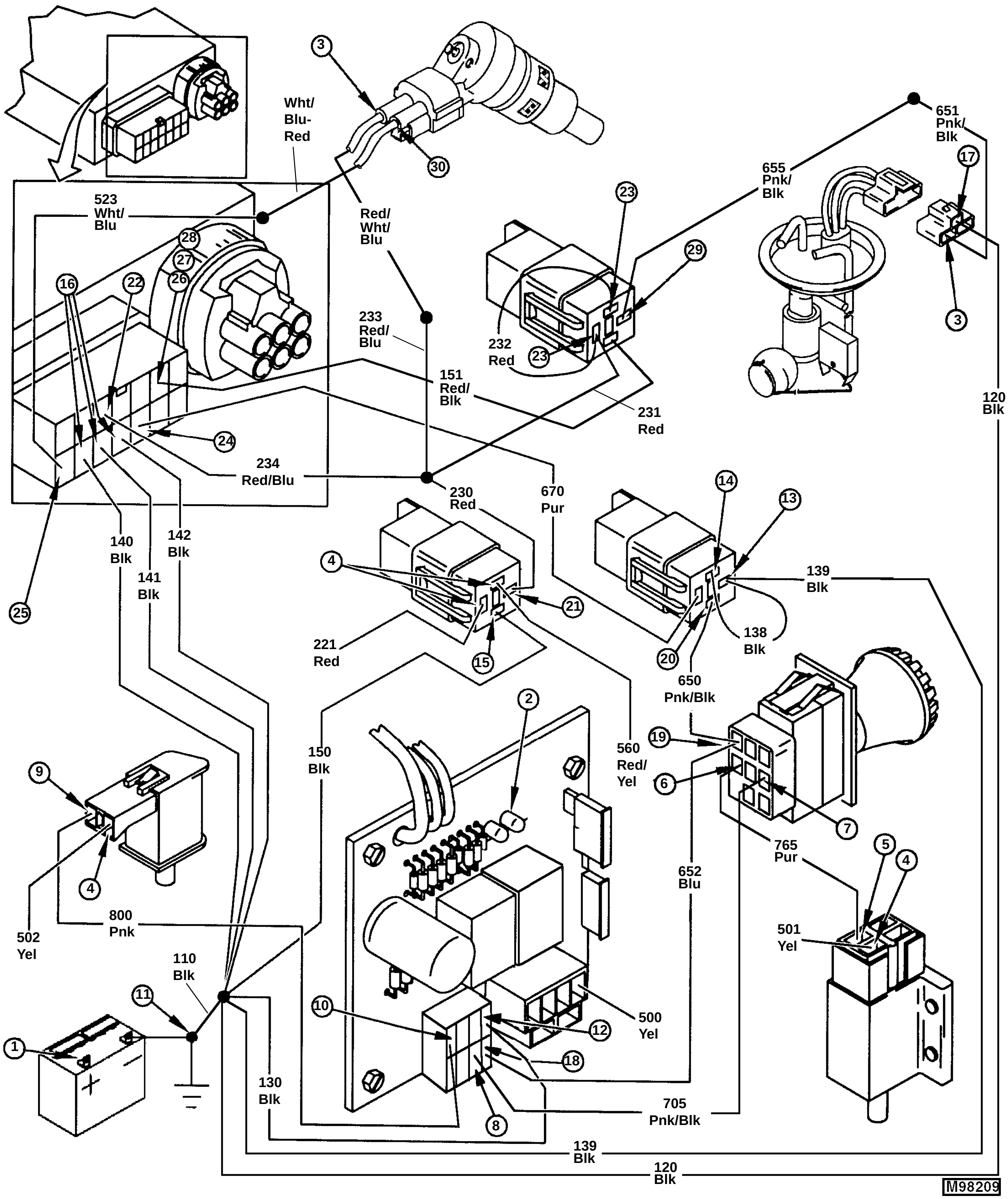
NOTE: *Complete steps 27—29 only if testing fuel pump circuits.*

Test Conditions:

• Turn key switch to off then run position and measure voltage within 2 seconds.

Test/Check Point	Normal	If Not Normal
27. Fuel injection module terminal 12.	0.0—0.2 volts for 2 seconds.	Greater than 0.2 volts—replace fuel injection module.

FUEL INJECTOR AND PUMP CIRCUIT TEST POINTS—445 (S.N. 070001—) (continued)



FUEL INJECTOR AND PUMP CIRCUIT DIAGNOSIS—445 (S.N. 070001—) (continued)

Test Conditions:

- Turn key switch to start and hold while measuring voltage.

Test/Check Point	Normal	If Not Normal
28. Fuel injection module terminal 12.	0.0—0.2 volts.	Greater than 0.2 volts—replace fuel injection module.

Test Conditions:

- Turn key switch to off then run position and measure voltage within 2 seconds.

Test/Check Point	Normal	If Not Normal
29. Fuel pump relay terminal 30.	Battery voltage for 2 seconds.	No voltage—Test fuel pump relay. Voltage—check 655 and 651 pnk/blk wires, if ok, replace fuel pump.

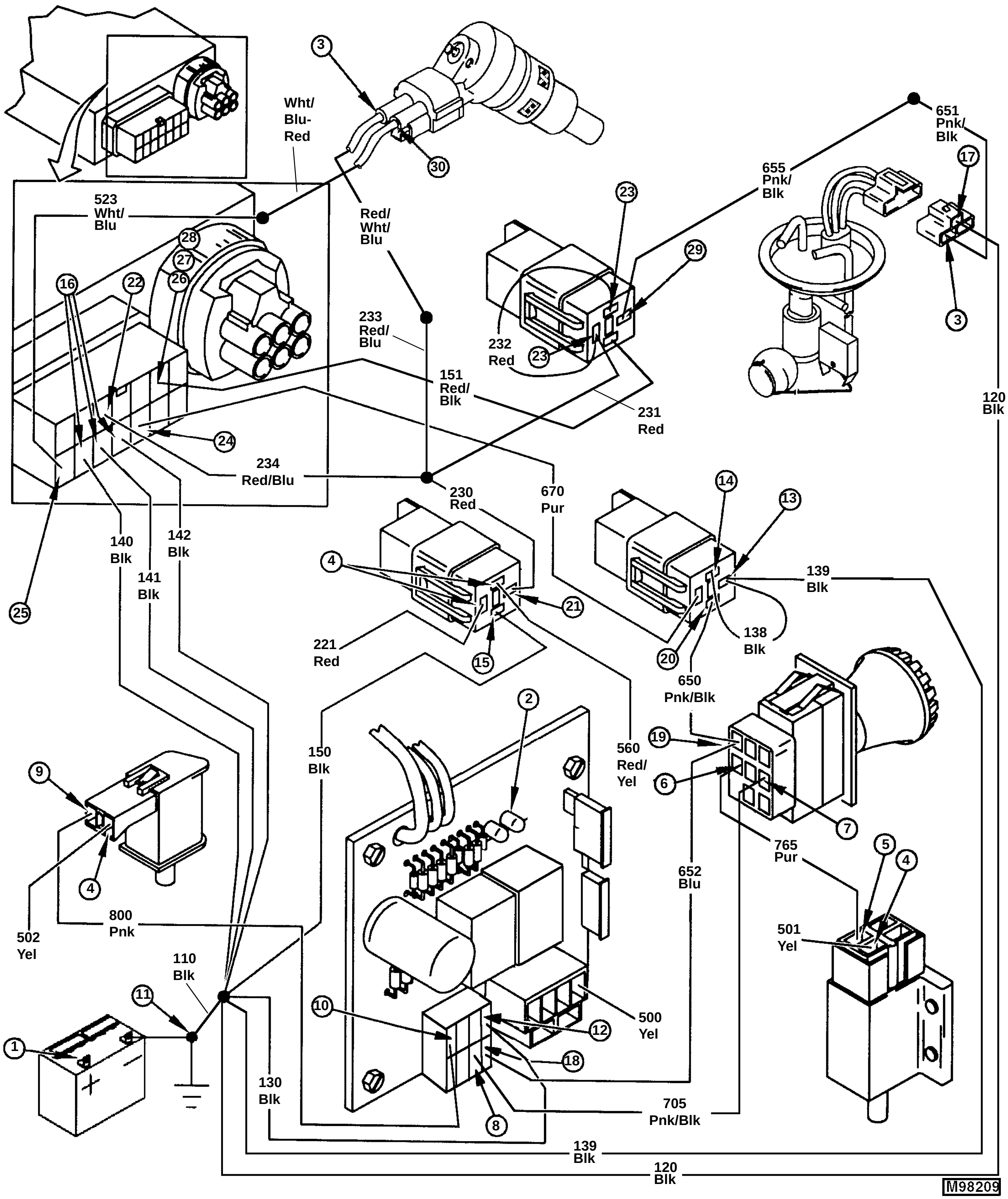
NOTE: Complete step 30 only if testing fuel injection circuits.

Test Conditions:

- Key switch in start position.
- Voltage test light connected to battery negative terminal (checking for current pulses).

Test/Check Point	Normal	If Not Normal
30. Fuel injector negative terminal.	Rapidly flashing light, not steady glow.	Light steady glow—replace fuel injection module.

FUEL INJECTOR AND PUMP CIRCUIT TEST POINTS—445 (S.N. 070001—) (continued)



FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT OPERATION—445 (S.N. —070000)

Function:

The engine sensors send signals that show environmental and engine operating conditions to a computer in the fuel injection module.The injection system failure light warns the operator that either the air temperature, coolant temperature or air pressure sensors are not operating correctly.

Operating Conditions:

For the engine sensors to operate, the key switch must be in the run or start position, and the operator must be on the seat (seat switch closed) or with the operator off the seat, the brake pedal must be depressed (brake switch closed) end the PTO switch must be off (PTO switch closed).

System Operation:

The fuel injection module (A1) monitors input voltage to the air and coolant temperature sensors (B1 and B2) and output voltage from the air pressure sensor (B3), and pulser coil (B4). The engine sensors vary the voltage, based on the environmental and engine operating conditions, to a computer in the fuel injection module. The fuel injection module computer processes the engine sensor voltage and calculates the quantity of fuel to be injected, ignition timing, and duration of fuel pump operation for the current engine operating conditions.

Current (A) flows from the battery (G1) to the starting motor (M1), fusible links (F1), key switch terminal B (S1), fuel injection fuse (F2), and the fuel injection relay terminal 87 (K5). Current from the fuel injection relay cannot flow to the fuel injection module (A1) until the relay is energized.

With the operator off the seat and the key switch in the run position, current flows from key switch terminal B to terminal A, power fuse (F4), ignition relay terminal 87 (K2), brake switch (S3) (brake pedal depressed), PTO switch (S4) (PTO disengaged), ignition relay coil terminal 85, ignition LED (E1), and fuel injection relay coil terminal 85 (K5). The ignition LED indicates that power is available to the ignition relay coil.

With the fuel injection relay energized, current flows to the fuel injection module. With the ignition relay energized, current flows to the PTO switch and safety relay terminal 86 (K4), energizing the relay. When the relay is energized a path to ground is provided for the fuel injection module.

An alternate current path is provided to keep the ignition and the safety relay energized when the PTO is engaged or the brake pedal is released. With the operator on the seat (seat switch (S2) closed), current flows to the ignition relay coil, keeping the relay energized. If the operator leaves the seat with the PTO engaged or the brake pedal released, current to the ignition relay coil is stopped. The ignition and safety relays open, which opens the fuel injection module ground and the engine stops. A delay capacitor in the control/fuse module provides current for 1/2 second to keep the ignition relay coil energized if the operator bounces on the seat.

A circuit in the fuel injection module converts varying battery voltage to a constant 5-volt current, which is used in the sensor circuits. The sensor input voltage must be a constant 5-volt current for the computer to process the sensor signals correctly. Current from the fuel injection module flows to the sensors. The sensor resistance, depending on temperature and air pressure, varies the current flow through the sensors. The fuel injection module computer monitors current flow through the sensors to calculate engine temperature and air pressure.

The air and coolant temperature sensors (B1 and B2) are thermistors, which are temperature sensitive variable resistors. The resistance of the thermistor decreases as the temperature increases.

The air pressure sensor (B3) uses a piezoelectric element to measure the atmospheric pressure inside the throttle body. The element converts the input voltage from the fuel injection module to a specific output voltage depending on air pressure. The output voltage increases as the air pressure increases.

As the flywheel turns, four tabs on the flywheel travel past the pulser coil (B4) and produce current in the pulser coil by electromagnetic induction. Four current pulses per one crankshaft revolution flow from the pulser coil to the fuel injection module providing piston position (top dead center) and engine speed information.

If the air temperature, coolant temperature, or air pressure sensors fail, the fuel injection module creates a path to ground for the fuel injection diagnostic light (H5). The light blinks in a code to warn the operator which sensor may require service. When the light is blinking a code, the fuel injection module computer operates in a default mode for fuel injection to allow the engine to run until the unit can be serviced. The diagnostic light code is as follows:

- Long, short, short—air temperature sensor.
- Long, short, short, short—coolant temperature sensor.
- Long, long, short—air pressure sensor.
- Long, long, short, short—key switch turned to start position before light was off, or air pressure sensor.
- Short, long continuously—more than one sensor may require service.

FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT OPERATION—445 (S.N. 070001—)

Function:

The engine sensors send signals that show environmental and engine operating conditions to a computer in the fuel injection module. The fuel injection diagnostic light warns the operator that either the air temperature, coolant temperature or air pressure sensors are not operating correctly.

Operating Conditions:

For the engine sensors to operate, the key switch must be in the run or start position, and the operator must be on the seat (seat switch closed) or with the operator off the seat, the brake pedal must be depressed (brake switch closed) end the PTO switch must be off (PTO switch closed).

System Operation:

The fuel injection module (A1) monitors input voltage to the coolant and air temperature sensors (B3 and B4) and output voltage from the air pressure sensor (B5), and pulser coil (B6). The engine sensors vary the voltage, based on the environmental and engine operating conditions, to a computer in the fuel injection module. The fuel injection module computer processes the engine sensor voltage and calculates the quantity of fuel to be injected, ignition timing, and duration of fuel pump operation for the current engine operating conditions.

Current (A) flows from the battery (G1) to the starting motor (M1), fusible links (F1 and F2), terminal B of key switch (S1), fuel pump fuse (F3), and terminal 87 of fuel injection relay (K6). Current from the fuel injection relay cannot flow to the fuel injection module (A1) until the relay is energized.

With the operator off the seat and the key switch in the run position, current flows from key switch terminal B to terminal A, power fuse (F5), ignition relay terminal 87 (K2), brake switch (S5) (brake pedal depressed), PTO switch (S2) (PTO disengaged), ignition relay coil terminal 85, ignition LED (E1), and fuel injection relay coil terminal 85 (K6). The ignition LED indicates that power is available to the ignition relay coil.

With the fuel injection relay energized, current flows to the fuel injection module. With the ignition relay energized, current flows to the PTO switch and terminal 86 of safety signal relay (K7), energizing the relay. When the relay is energized a path to ground is provided for the fuel injection module.

An alternate current path is provided to keep the ignition and the safety relay energized when the PTO is engaged or the brake pedal is released. With the operator on the seat (seat switch (S3) closed), current flows to the ignition relay coil, keeping the relay energized. If the operator leaves the seat with the PTO engaged or the brake pedal released, current to the ignition relay coil is stopped. The ignition and safety relays open, which opens the fuel injection module ground and the engine stops. A delay capacitor in the control/fuse module provides current for 1/2 second to keep the ignition relay coil energized if the operator bounces on the seat.

A circuit in the fuel injection module converts varying battery voltage to a constant 5-volt current, which is used in the sensor circuits. The sensor input voltage must be a constant 5-volt current for the computer to process the sensor signals correctly. Current from the fuel injection module flows to the sensors. The sensor resistance, depending on temperature and air pressure, varies the current flow through the sensors. The fuel injection module computer monitors current flow through the sensors to calculate engine temperature and air pressure.

The coolant and air temperature sensors (B3 and B4) are thermistors, which are temperature sensitive variable resistors. The resistance of the thermistor decreases as the temperature increases.

The air pressure sensor (B5) uses a piezoelectric element to measure the atmospheric pressure inside the throttle body. The element converts the input voltage from the fuel injection module to a specific output voltage depending on air pressure. The output voltage increases as the air pressure increases.

As the flywheel turns, four tabs on the flywheel travel past the pulser coil (B6) and produce current in the pulser coil by electromagnetic induction. Four current pulses per one crankshaft revolution flow from the pulser coil to the fuel injection module providing piston position (top dead center) and engine speed information.

If the air temperature, coolant temperature, or air pressure sensors fail, the fuel injection module creates a path to ground for the fuel injection diagnostic light (H6). The light blinks a code to warn the operator which sensor may require service. When the light is blinking a code, the fuel injection module computer operates in a default mode for fuel injection to allow the engine to run until the unit can be serviced. The diagnostic light codes are as follows:

- Long, short, short—air temperature sensor.
- Long, short, short, short—coolant temperature sensor.
- Long, long, short—air pressure sensor.
- Long, long, short, short—key switch turned to start position before light was off, or air pressure sensor.
- Short, long continuously—more than one sensor may require service.

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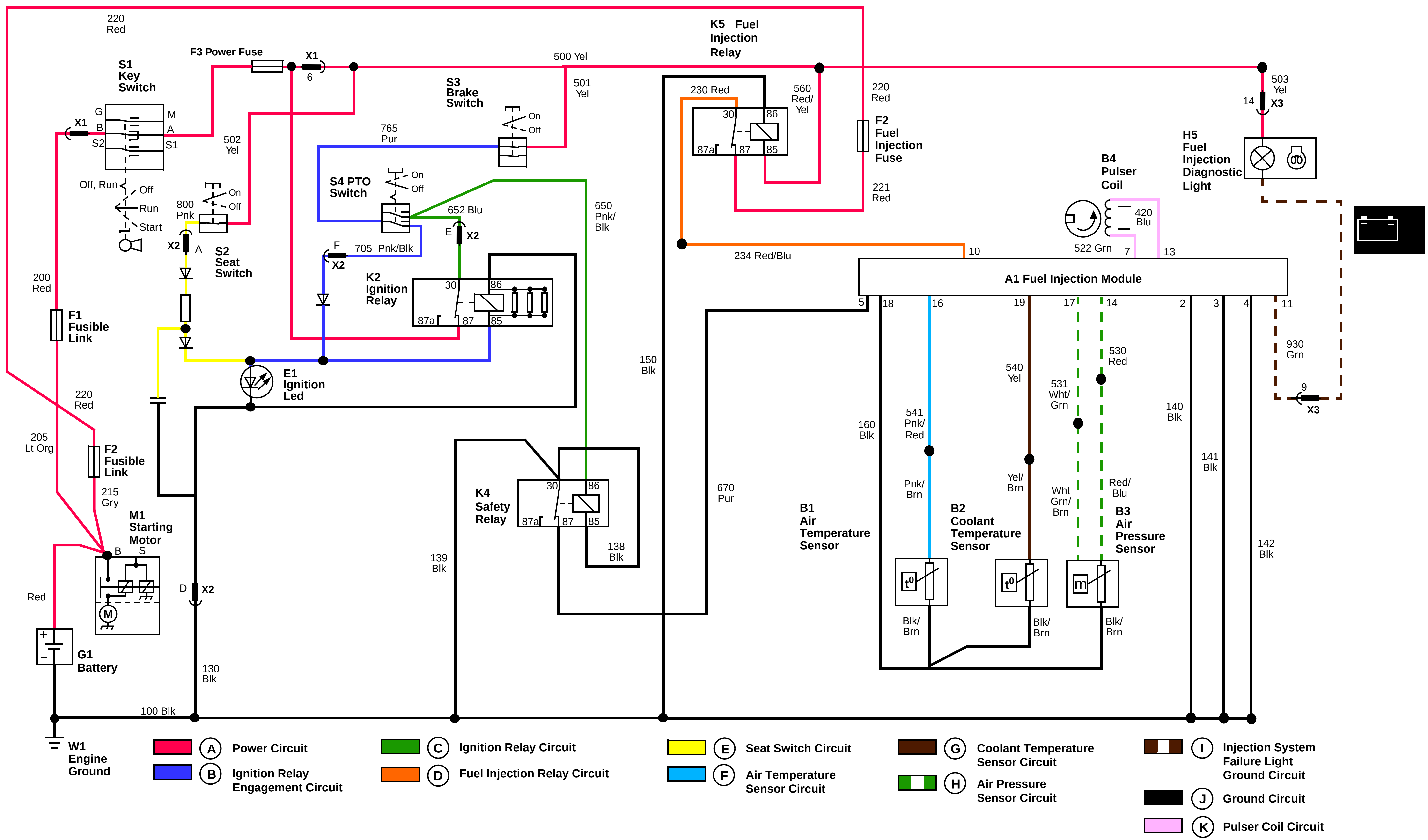
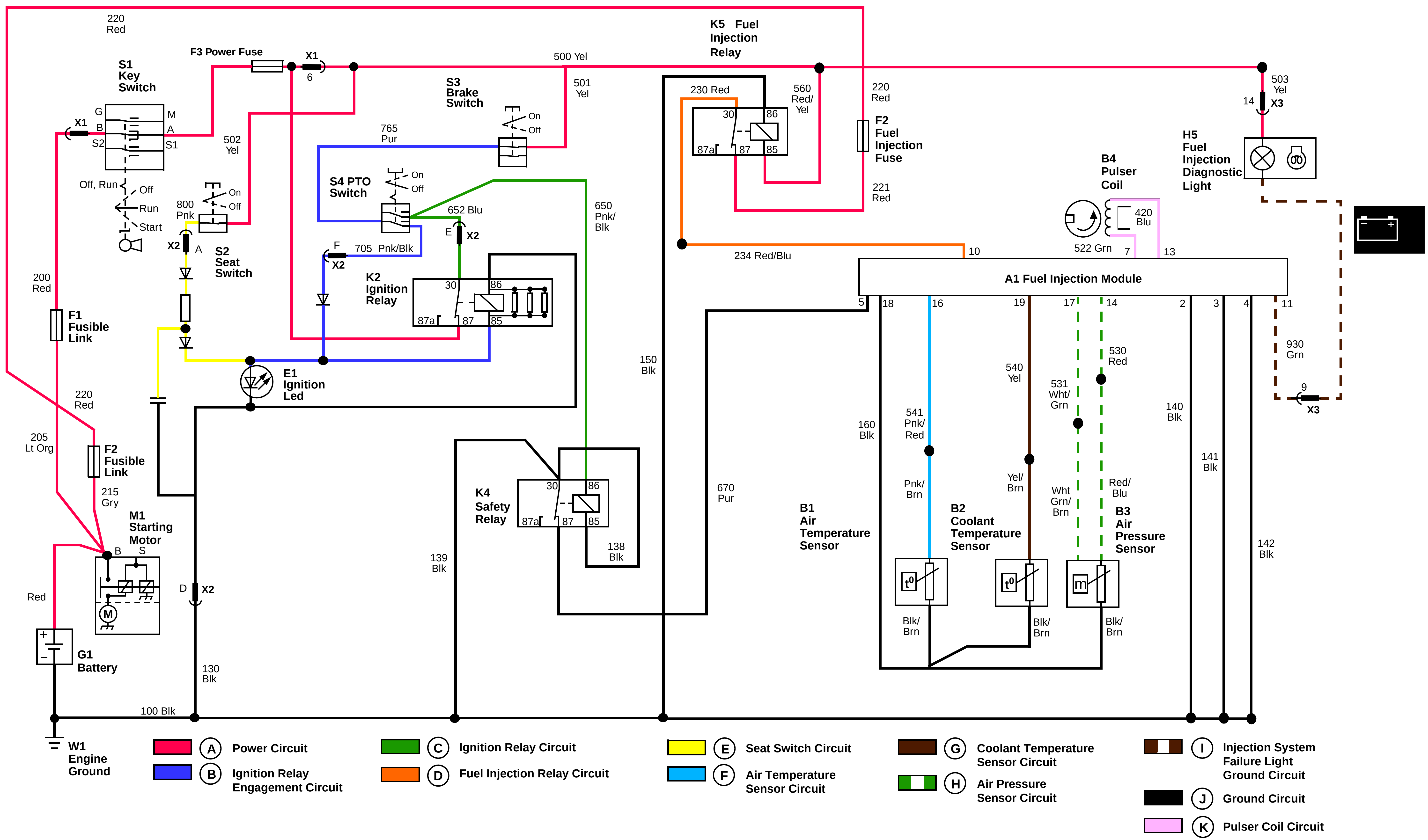
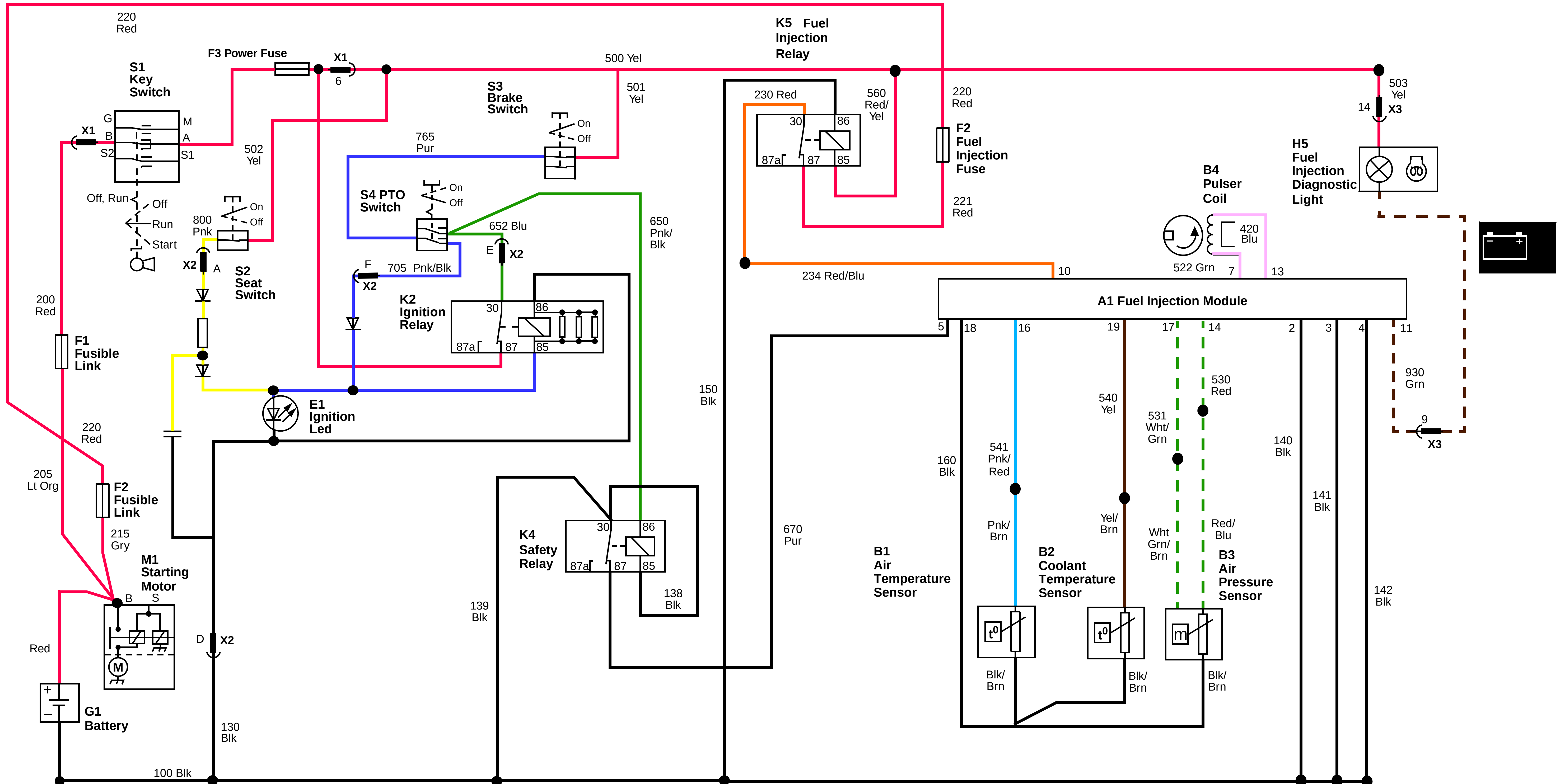
FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT SCHEMATIC—445 (S.N. —070000)



FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT SCHEMATIC—445 (S.N. —070000)

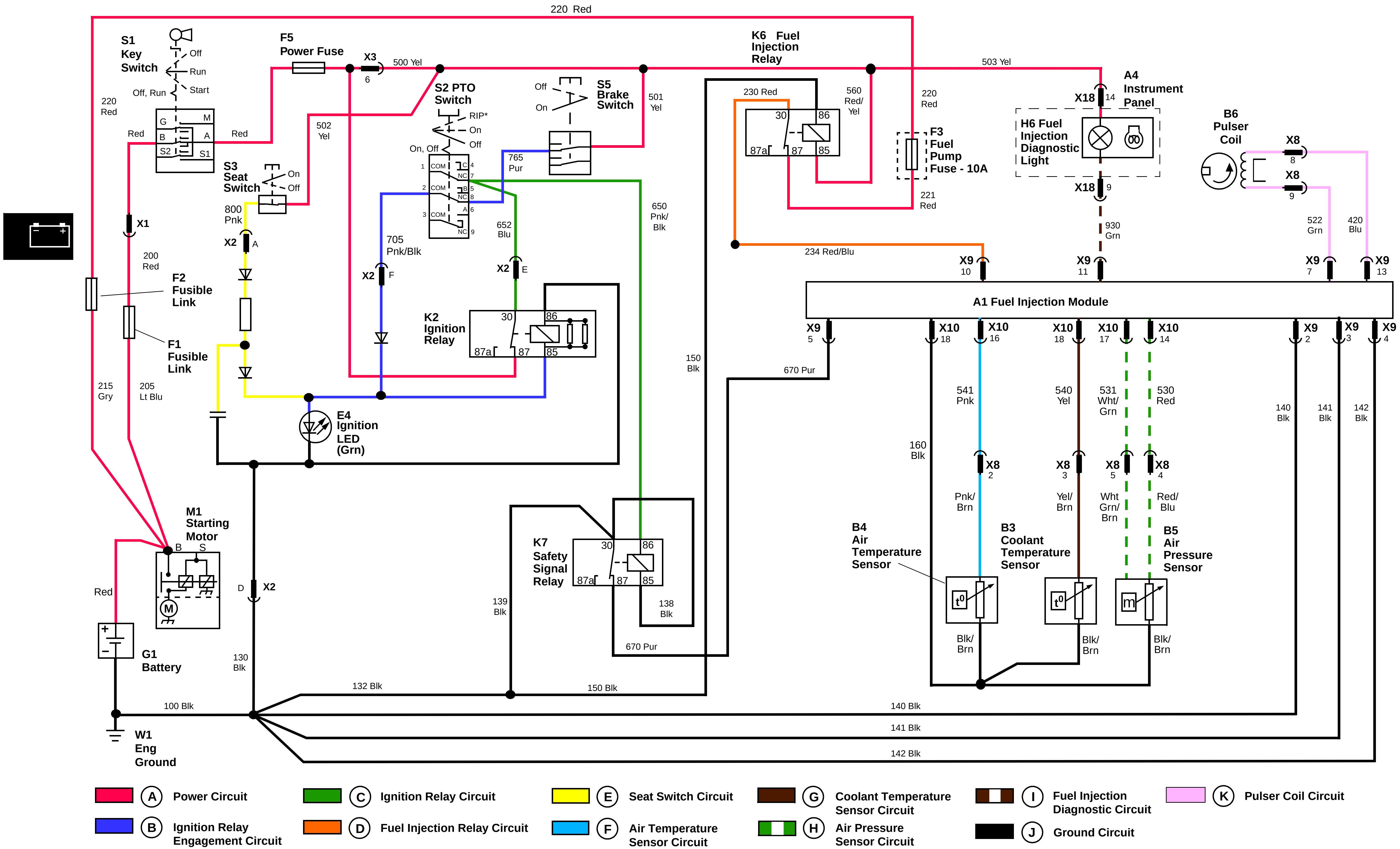


FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT SCHEMATIC—445 (S.N. —070000)

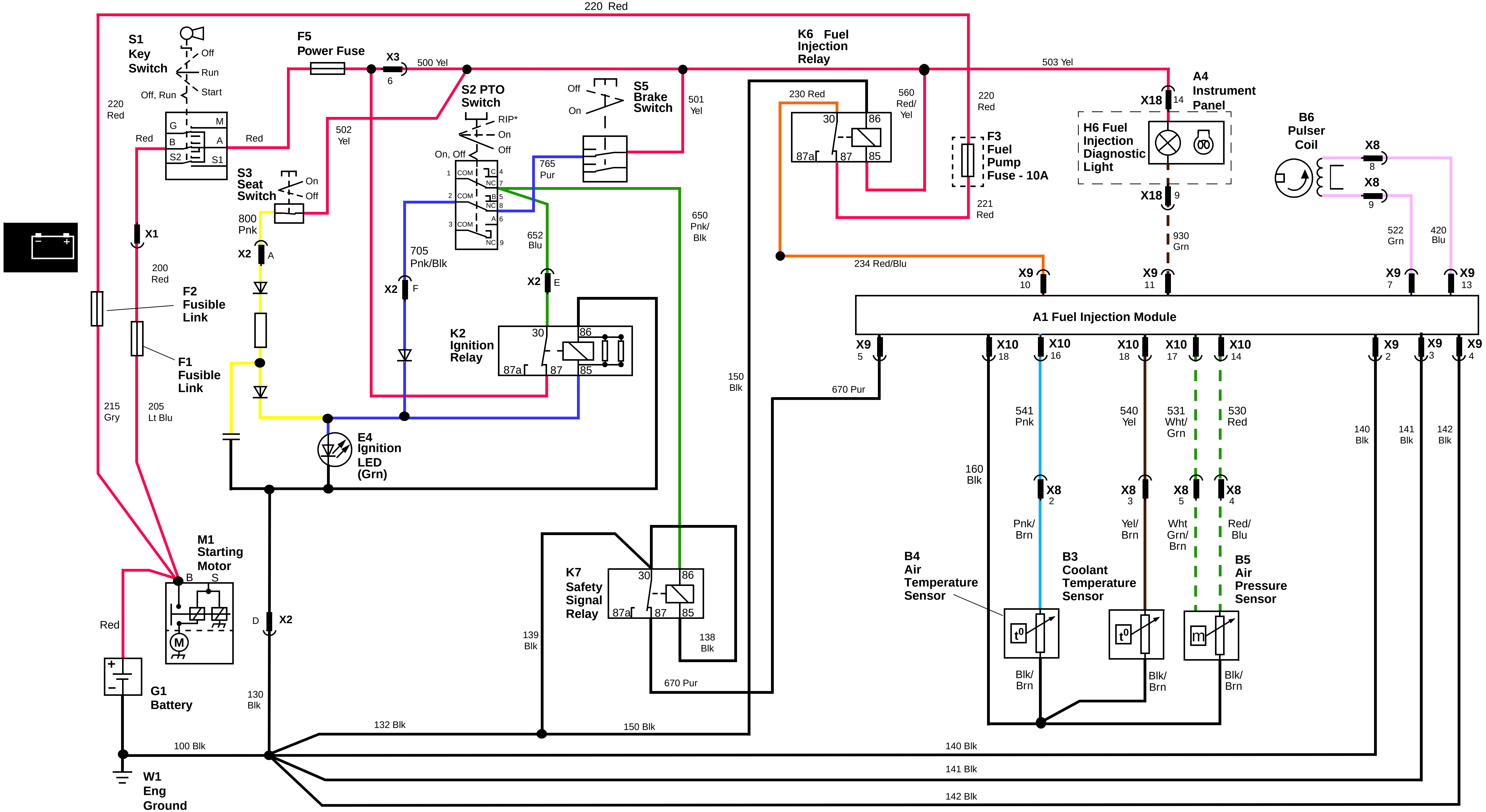


- (A) Power Circuit
- (B) Ignition Relay Engagement Circuit
- (C) Ignition Relay Circuit
- (D) Fuel Injection Relay Circuit
- (E) Seat Switch Circuit
- (F) Air Temperature Sensor Circuit
- (G) Coolant Temperature Sensor Circuit
- (H) Air Pressure Sensor Circuit
- (I) Injection System Failure Light Ground Circuit
- (J) Ground Circuit
- (K) Pulser Coil Circuit

FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT SCHEMATIC—445 (S.N. 070001—)

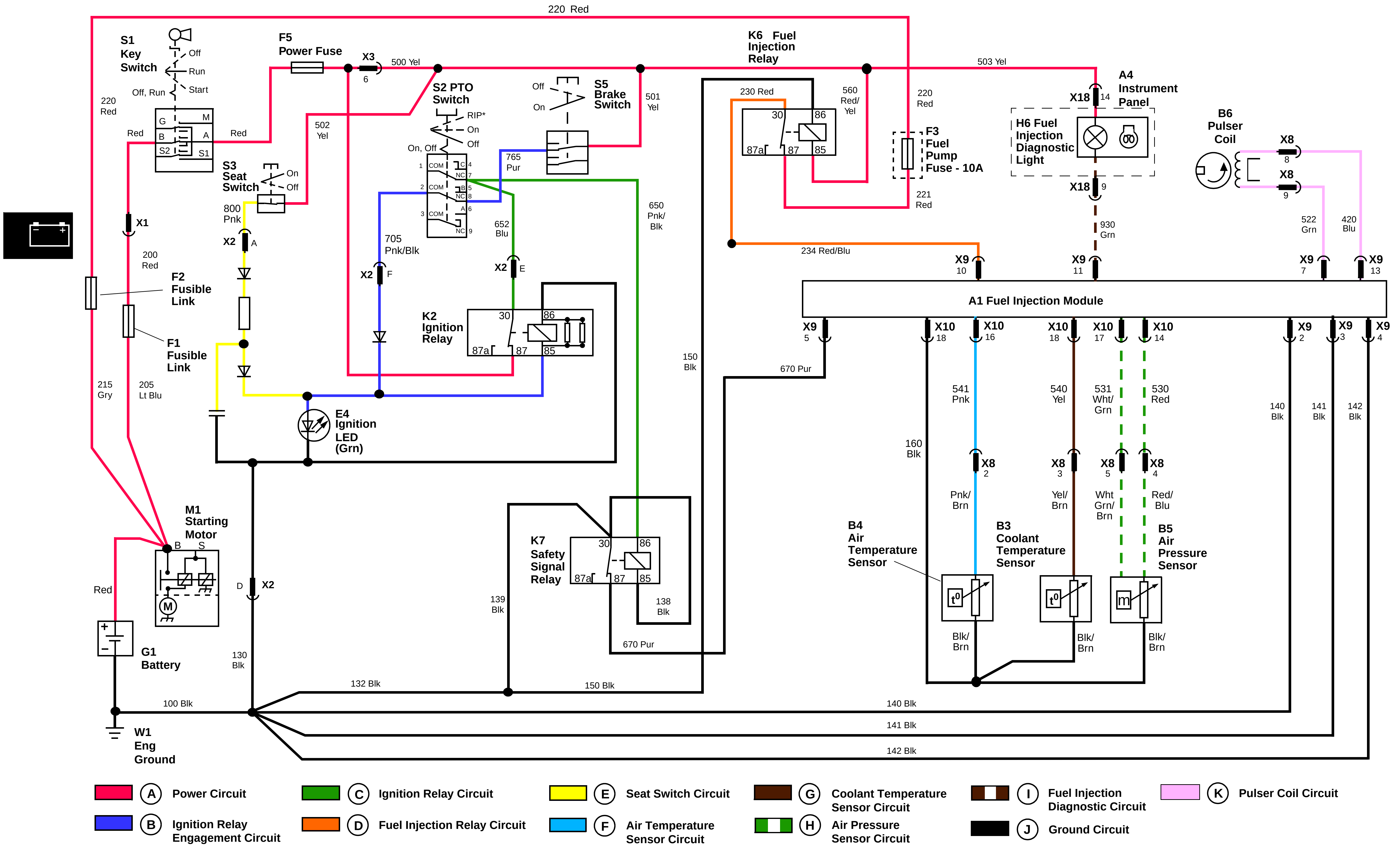


FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT SCHEMATIC—445 (S.N. 070001—)



- (A) Power Circuit
- (B) Ignition Relay Engagement Circuit
- (C) Ignition Relay Circuit
- (D) Fuel Injection Relay Circuit
- (E) Seat Switch Circuit
- (F) Air Temperature Sensor Circuit
- (G) Coolant Temperature Sensor Circuit
- (H) Air Pressure Sensor Circuit
- (I) Fuel Injection Diagnostic Circuit
- (J) Ground Circuit
- (K) Pulser Coil Circuit

FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT SCHEMATIC—445 (S.N. 070001—)



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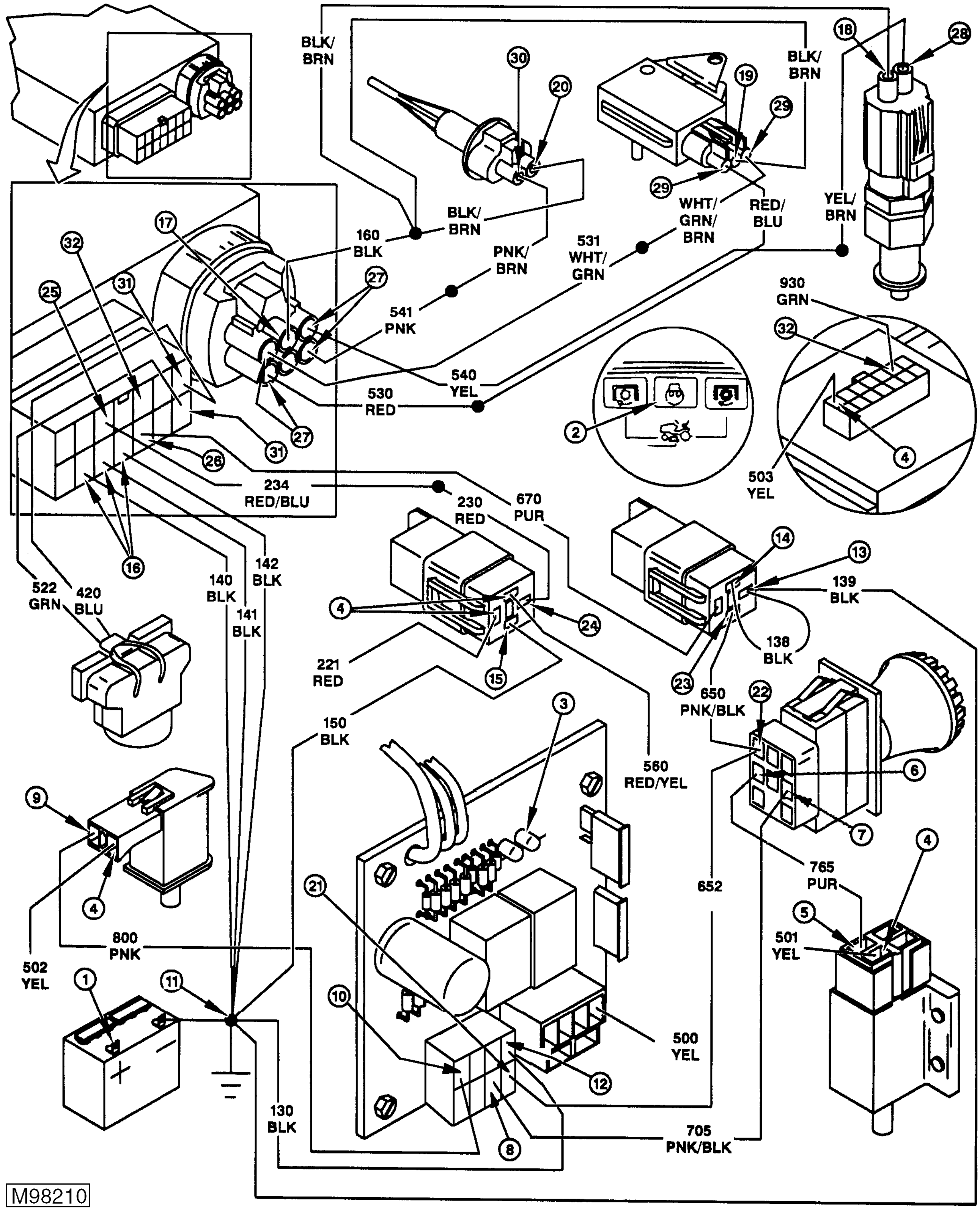
FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT DIAGNOSIS—445 (S.N. —070000)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Seat switch depressed or jumper wire installed in connector.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Fuel injection diagnostic light.	Light on for about 2 seconds and then goes out. Light does not blink injection sensor diagnostic codes.	Check fuel injection diagnostic light bulb continuity, if ok go to step 3. Lights blinks following diagnostic codes: Long, short, short—check air temperature sensor circuit Long, short, short, short—coolant temperature sensor circuit Long, long, short—check air pressure sensor circuit. Long, long, short, short—key switch turned to start position before light was off, turn key off, then on, wait for light to go off— if light still blinks, check air pressure sensor circuit. Short, long continuously—several sensors have failed at same time, check air temperature, coolant temperature, and air pressure sensor circuits.
3. Ignition LED.	Light on.	Light off—check ignition relay engagement circuit, go to step 4. Light on—go to step 11.
4. Brake switch, seat switch, and fuel injection relay terminals 87 and 85, and insturment panel terminal 14.	Battery voltage.	Check power circuit test points.
5. Brake switch.	Battery voltage.	Test brake switch.
6. PTO switch.	Battery voltage.	Check 765 pur wire.
7. PTO switch.	Battery voltage.	Test PTO switch.
8. Control/fuse module terminal F.	Battery voltage.	Check 705 pnk/blk wire.
9. Seat switch.	Battery voltage.	Test seat switch.
10. Control/fuse module terminal A.	Battery voltage.	Check 800 pnk wire.

FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT TEST POINTS—445 (S.N. —070000)



FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT DIAGNOSIS—445 (S.N. —070000) (continued)

Test Conditions:

- Key switch in off position.

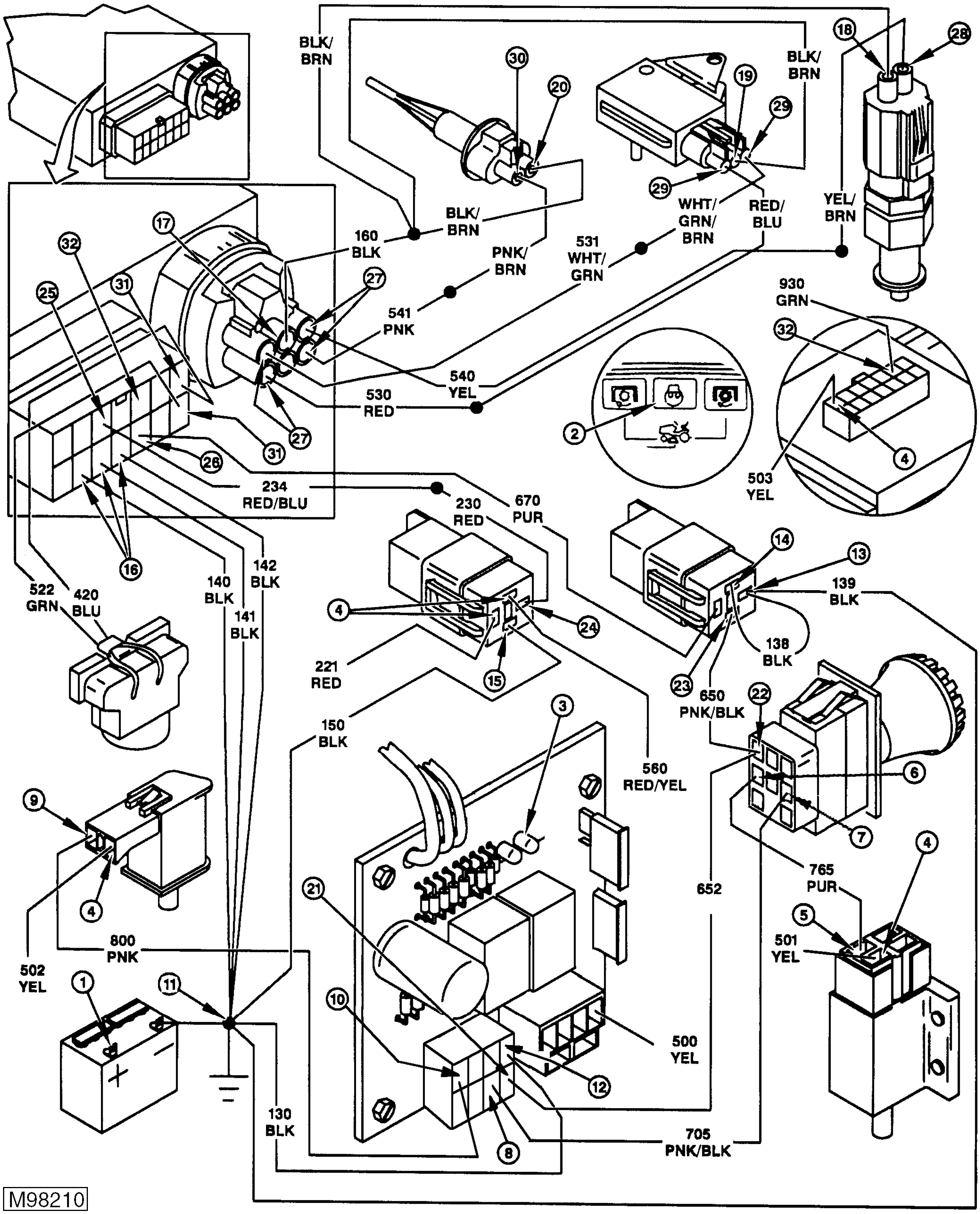
Test/Check Point	Normal	If Not Normal
11. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative cable and engine ground connection.
12. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check 100 and 130 blk wires and harness to engine ground connection.
13. Safety relay terminal 30.	Maximum 0.1 ohms resistance.	Check 139 blk wire.
14. Safety relay terminal 85.	Maximum 0.1 ohms resistance.	Check 138 blk wire.
15. Fuel injection relay terminal 86.	Maximum 0.1 ohms resistance.	Check 150 blk wire.
16. Fuel injection module terminals 2, 3, and 4.	Maximum 0.1 ohms resistance.	Check 140, 141, and 142 blk wire.
17. Fuel injection module terminal 18.	Maximum 0.1 ohms resistance.	Replace fuel injection module.
18. Coolant temperature sensor.	Maximum 0.1 ohms resistance	Check coolant temperature sensor ground blk/brn wire and 160 blk wire.
19. Air pressure sensor.	Maximum 0.1 ohms resistance.	Check air pressure sensor ground blk/brn wire.
20. Air temperature sensor.	Maximum 0.1 ohms resistance.	Check air temperature sensor ground blk/brn wire.

Test Conditions:

- Key switch in run position.

Test/Check Point	Normal	If Not Normal
21. Control/fuse module terminal E.	Battery voltage.	Replace control/fuse module.
22. PTO switch.	Battery voltage.	Check 652 blu wire.
23. Safety relay terminal 86.	Battery voltage.	Check 650 pnk/blk wire.
24. Fuel injection relay terminal 30.	Battery voltage.	Test fuel injection relay.
25. Fuel injection module terminal 10.	Battery voltage.	Check 234 red/blu and 230 red wire.
26. Fuel injection module terminal 5.	0.0—0.2 volts.	Greater than 0.2 volts—Check 670 pur wire and safety relay. 0.0 volts—replace fuel injection module.

FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT TEST POINTS—445 (S.N. —070000) (continued)



FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT DIAGNOSIS—445 (S.N. —070000) (continued)

Test/Check Point	Normal	If Not Normal
27. Fuel injection module terminals 14,16,17,and 19.	0.2—5.0 volts.	Replace fuel injection module.
28. Coolant temperature sensor.	0.2—5.0 volts.	Check 540 yel and yel/brn wires, if OK test coolant temperature sensor.
29. Air pressure sensor.	0.2—5.0 volts.	Check 531 wht/grn, wht/grn/brn, 530 red, and red/blu wires, if ok, test air pressure sensor.
30. Air temperature sensor.	0.2—5.0 volts.	Check 541 pnk and pnk/brn wires, if ok, test air temperature sensor.

Test Conditions:

- Meter set for AC voltage.
- Key switch in start position.
- Test light connected to battery negative terminal.

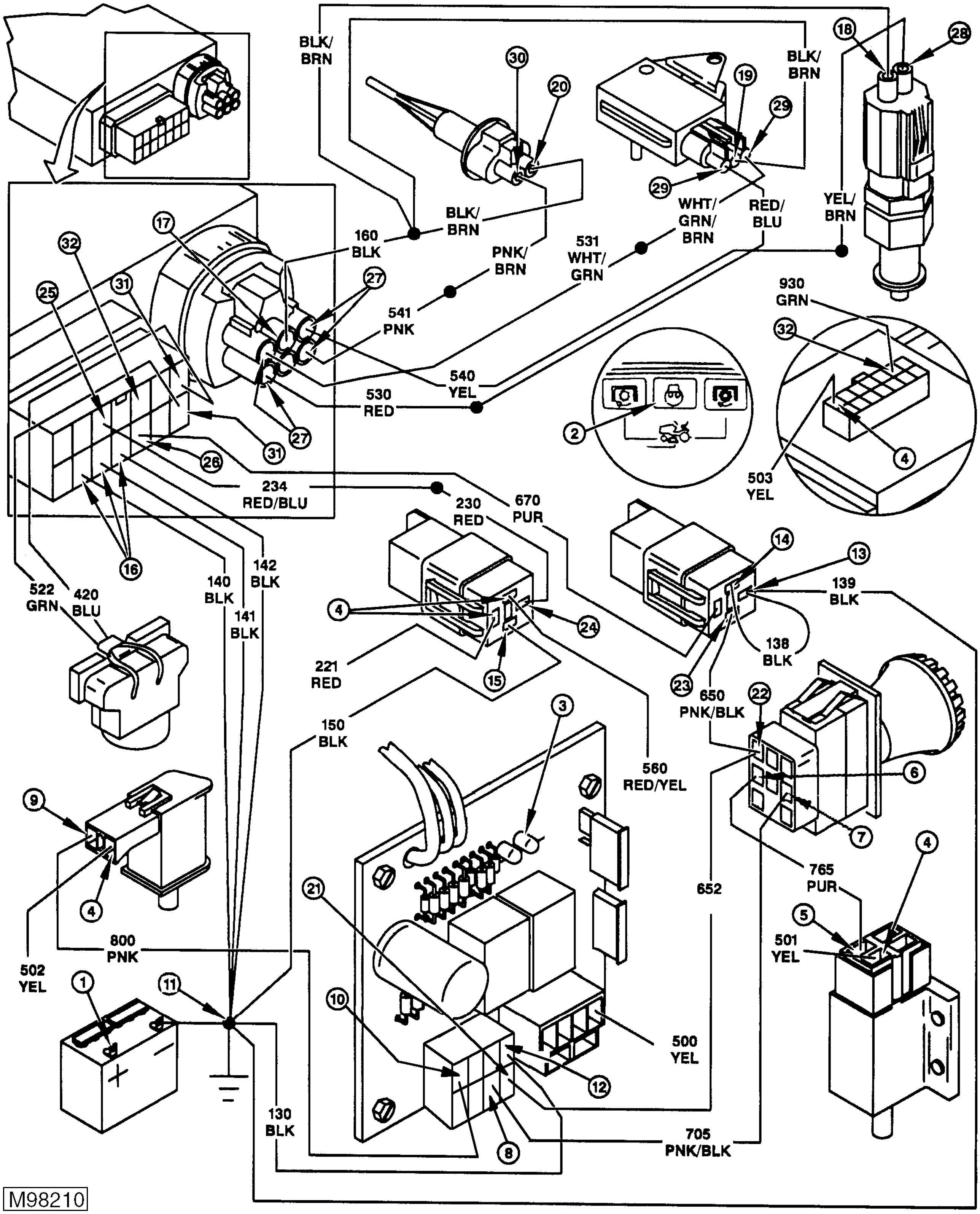
Test/Check Point	Normal	If Not Normal
31. Fuel injection module terminals 7 and 13.	0.1—1.0 VAC or rapidly flashing light, not steady glow.	Check 522 grn and 420 blu wires, and test pulser coil resistance.

Test Conditions:

- Key switch in run position.

Test/Check Point	Normal	If Not Normal
32. Fuel injection module terminal 11.	0.0—0.2 volts for about 2 seconds and “battery voltage” after 2 seconds.	Greater than 0.2 volts—replace fuel injection module. 0.0 volts—Check 930 grn wire, if ok replace dash panel module.

FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT TEST POINTS—445 (S.N. —070000) (continued)



M98210

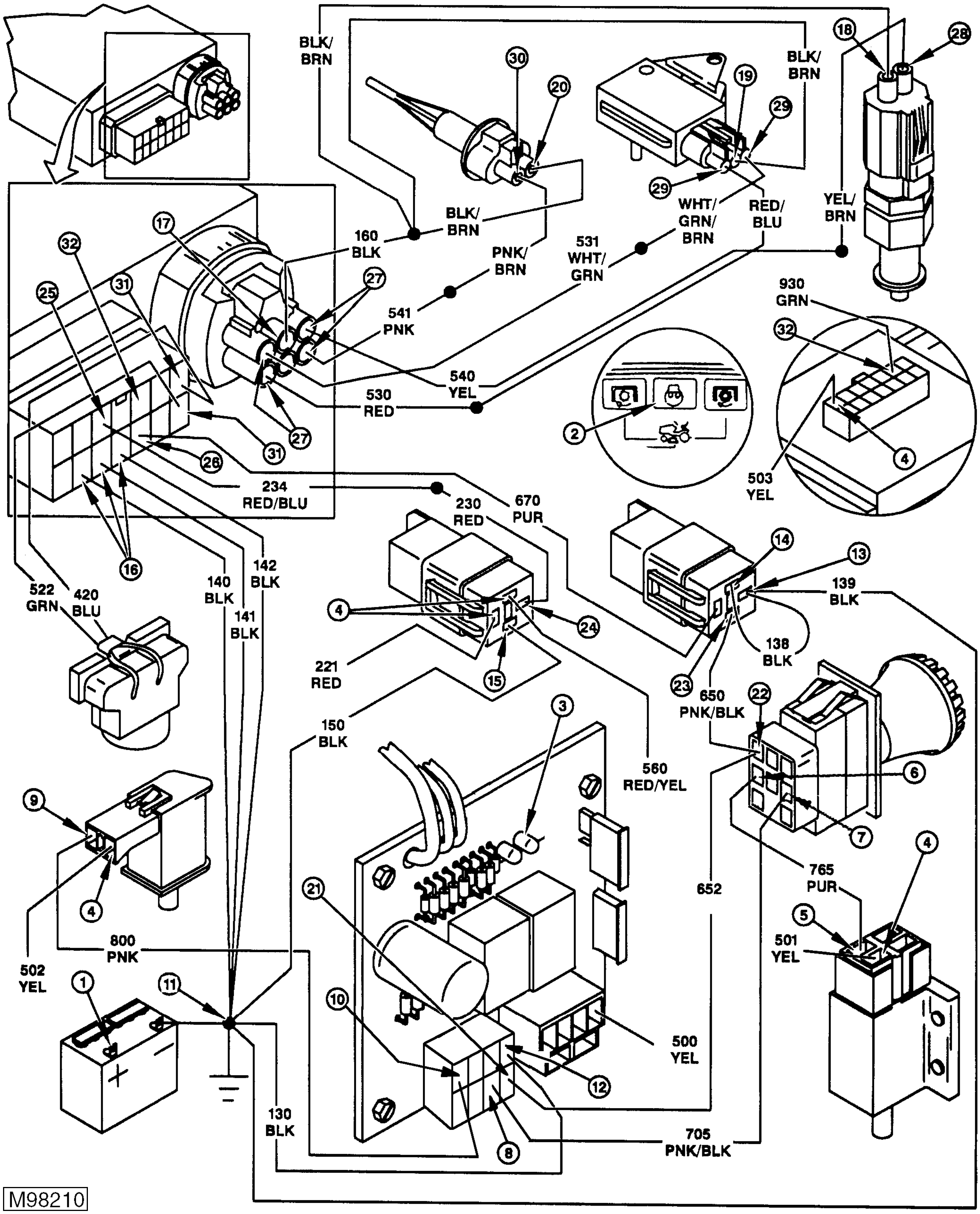
FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT DIAGNOSIS—445 (S.N. 070001—)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Seat switch depressed or jumper wire installed in connector.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Fuel injection diagnostic light.	Light on for about 2 seconds and then goes out. Light does not blink injection sensor diagnostic codes.	Check fuel injection diagnostic light bulb continuity, if ok go to step 3. Lights blinks following diagnostic codes: Long, short, short—check air temperature sensor circuit Long, short, short, short—coolant temperature sensor circuit Long, long, short—check air pressure sensor circuit. Long, long, short, short—key switch turned to start position before light was off, turn key off, then on, wait for light to go off— if light still blinks, check air pressure sensor circuit. Short, long continuously—several sensors have failed at same time, check air temperature, coolant temperature, and air pressure sensor circuits.
3. Ignition LED.	Light on.	Light off—check ignition relay engagement circuit, go to step 4. Light on—go to step 11.
4. Brake switch, seat switch, and fuel injection relay terminals 87 and 85, and insturment panel terminal 14.	Battery voltage.	Check power circuit test points.
5. Brake switch.	Battery voltage.	Test brake switch.
6. PTO switch.	Battery voltage.	Check 765 pur wire.
7. PTO switch.	Battery voltage.	Test PTO switch.
8. Control/fuse module terminal F.	Battery voltage.	Check 705 pnk/blk wire.
9. Seat switch.	Battery voltage.	Test seat switch.
10. Control/fuse module terminal A.	Battery voltage.	Check 800 pnk wire.

FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT TEST POINTS—445 S.N. 070001—)



M98210

FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT DIAGNOSIS—445 (S.N. 070001—) (continued)

Test Conditions:

- Key switch in off position.

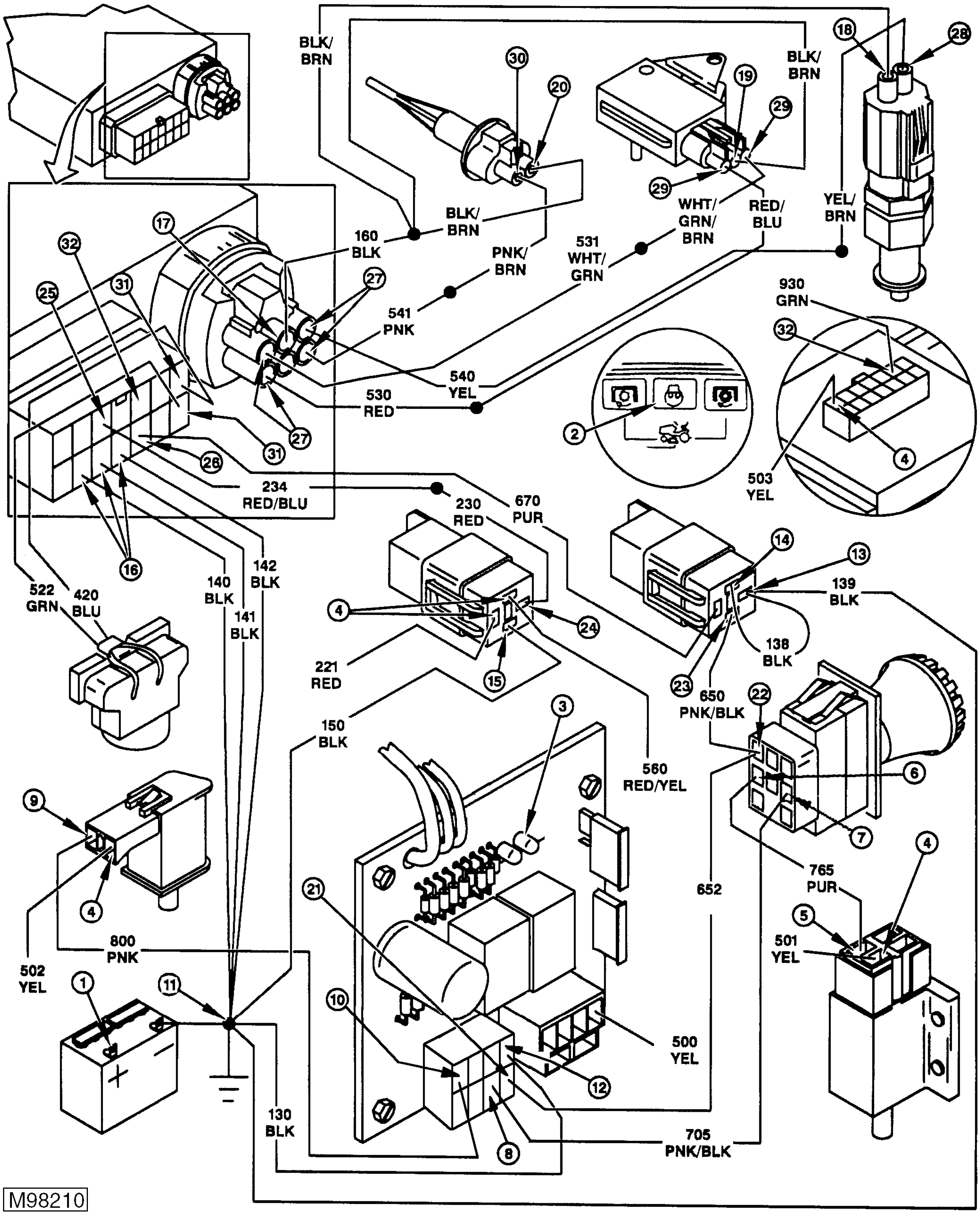
Test/Check Point	Normal	If Not Normal
11. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative cable and engine ground connection.
12. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check 100 and 130 blk wires and harness to engine ground connection.
13. Safety relay terminal 30.	Maximum 0.1 ohms resistance.	Check 139 blk wire.
14. Safety relay terminal 85.	Maximum 0.1 ohms resistance.	Check 138 blk wire.
15. Fuel injection relay terminal 86.	Maximum 0.1 ohms resistance.	Check 150 blk wire.
16. Fuel injection module terminals 2, 3, and 4.	Maximum 0.1 ohms resistance.	Check 140, 141, and 142 blk wire.
17. Fuel injection module terminal 18.	Maximum 0.1 ohms resistance.	Replace fuel injection module.
18. Coolant temperature sensor.	Maximum 0.1 ohms resistance	Check coolant temperature sensor ground blk/brn wire and 160 blk wire.
19. Air pressure sensor.	Maximum 0.1 ohms resistance.	Check air pressure sensor ground blk/brn wire.
20. Air temperature sensor.	Maximum 0.1 ohms resistance.	Check air temperature sensor ground blk/brn wire.

Test Conditions:

- Key switch in run position.

Test/Check Point	Normal	If Not Normal
21. Control/fuse module terminal E.	Battery voltage.	Replace control/fuse module.
22. PTO switch.	Battery voltage.	Check 652 blu wire.
23. Safety relay terminal 86.	Battery voltage.	Check 650 pnk/blk wire.
24. Fuel injection relay terminal 30.	Battery voltage.	Test fuel injection relay.
25. Fuel injection module terminal 10.	Battery voltage.	Check 234 red/blu and 230 red wire.
26. Fuel injection module terminal 5.	0.0—0.2 volts.	Greater than 0.2 volts—Check 670 pur wire and safety relay. 0.0 volts—replace fuel injection module.

FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT TEST POINTS—445 (S.N. 070001—) (continued)



FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT DIAGNOSIS—445 (S.N. 070001—) (continued)

Test/Check Point	Normal	If Not Normal
27. Fuel injection module terminals 14,16,17,and 19.	0.2—5.0 volts.	Replace fuel injection module.
28. Coolant temperature sensor.	0.2—5.0 volts.	Check 540 yel and yel/brn wires, if OK test coolant temperature sensor.
29. Air pressure sensor.	0.2—5.0 volts.	Check 531 wht/grn, wht/grn/brn, 530 red, and red/blu wires, if ok, test air pressure sensor.
30. Air temperature sensor.	0.2—5.0 volts.	Check 541 pnk and pnk/brn wires, if ok, test air temperature sensor.

Test Conditions:

- Meter set for AC voltage.
- Key switch in start position.
- Test light connected to battery negative terminal.

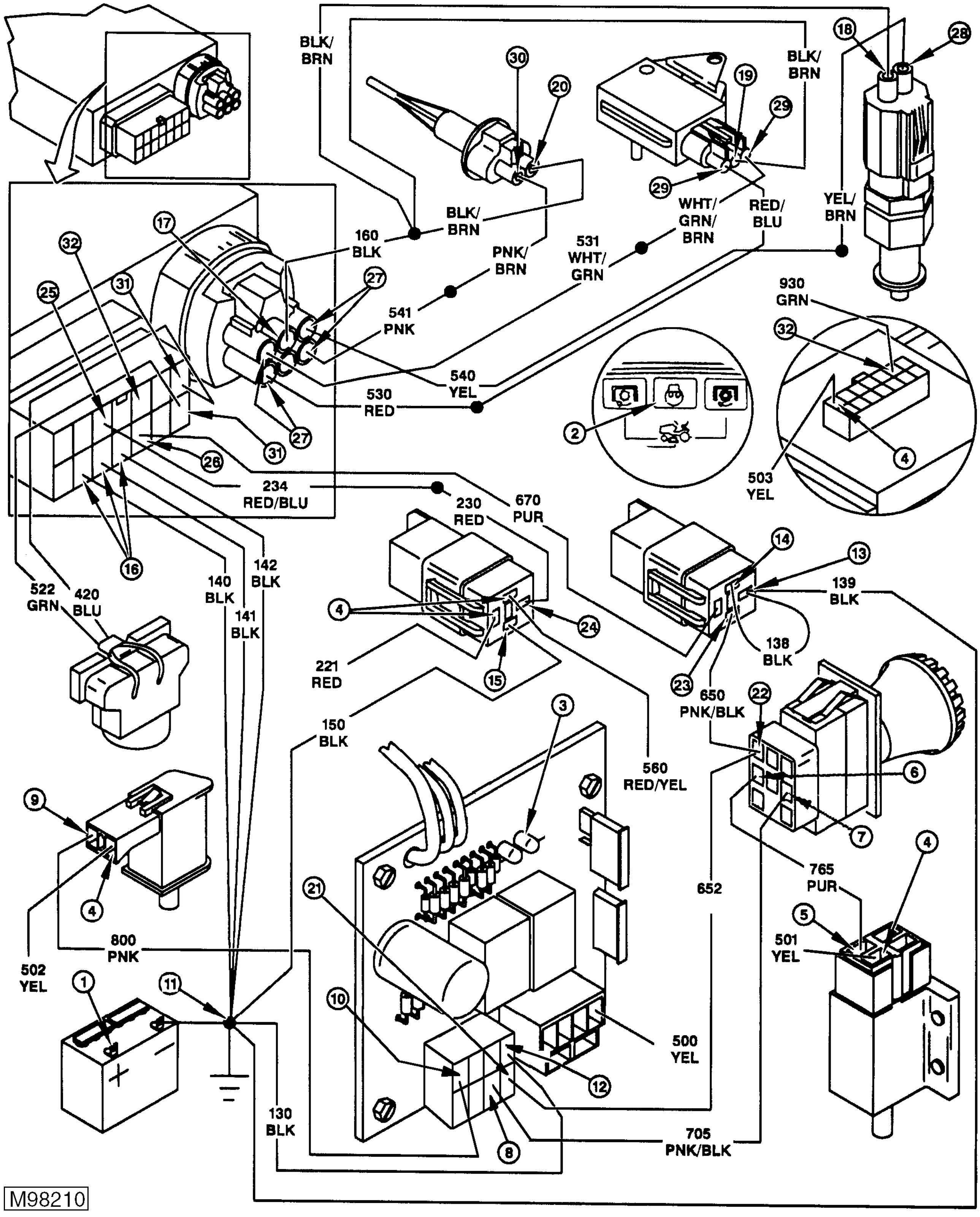
Test/Check Point	Normal	If Not Normal
31. Fuel injection module terminals 7 and 13.	0.1—1.0 VAC or rapidly flashing light, not steady glow.	Check 522 grn and 420 blu wires, and test pulser coil resistance.

Test Conditions:

- Key switch in run position.

Test/Check Point	Normal	If Not Normal
32. Fuel injection module terminal 11.	0.0—0.2 volts for about 2 seconds and “battery voltage” after 2 seconds.	Greater than 0.2 volts—replace fuel injection module. 0.0 volts—Check 930 grn wire, if ok replace dash panel module.

FUEL INJECTION SENSOR AND DIAGNOSTIC LIGHT CIRCUIT TEST POINTS—445 (S.N. 070001—) (continued)



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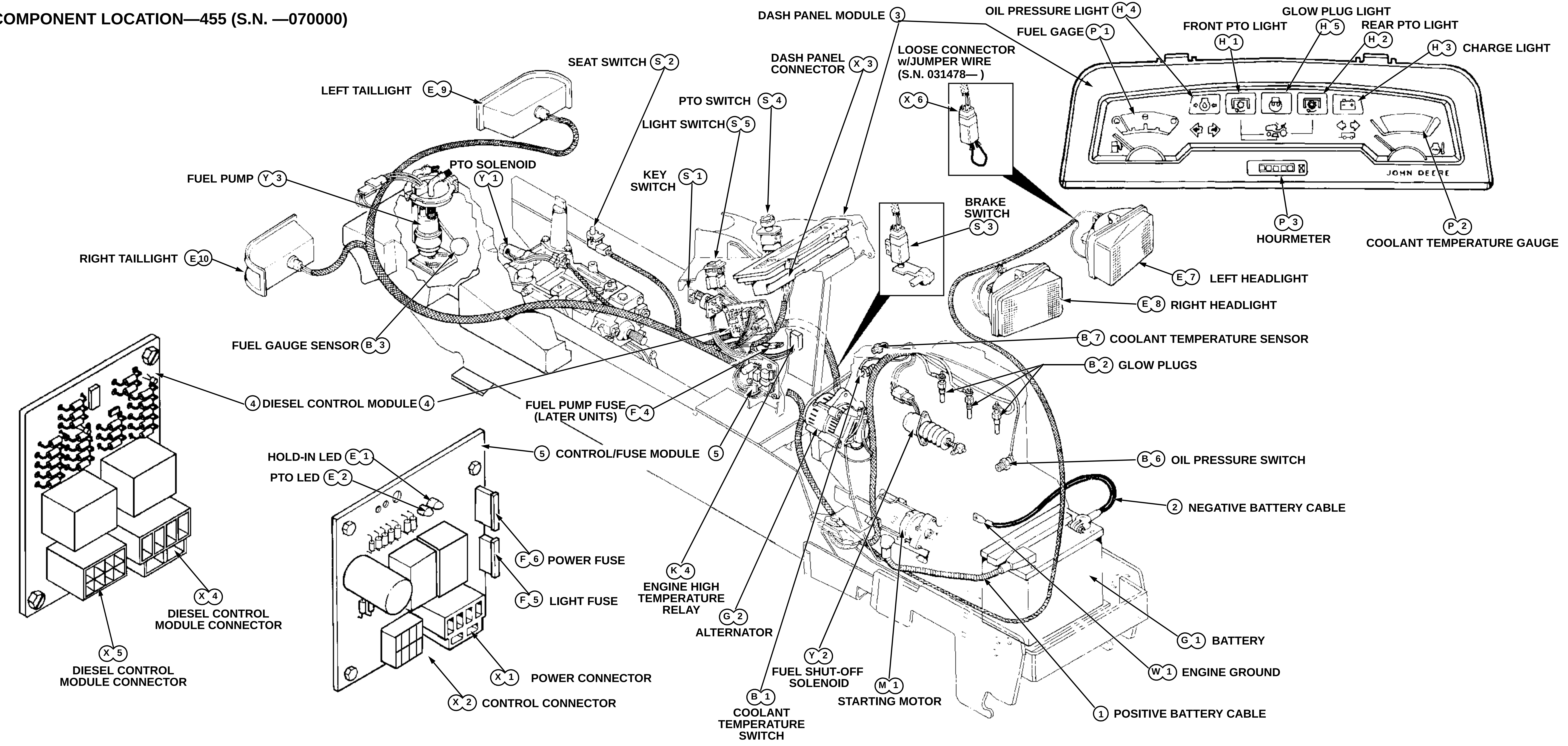
COMPONENT LOCATION—455

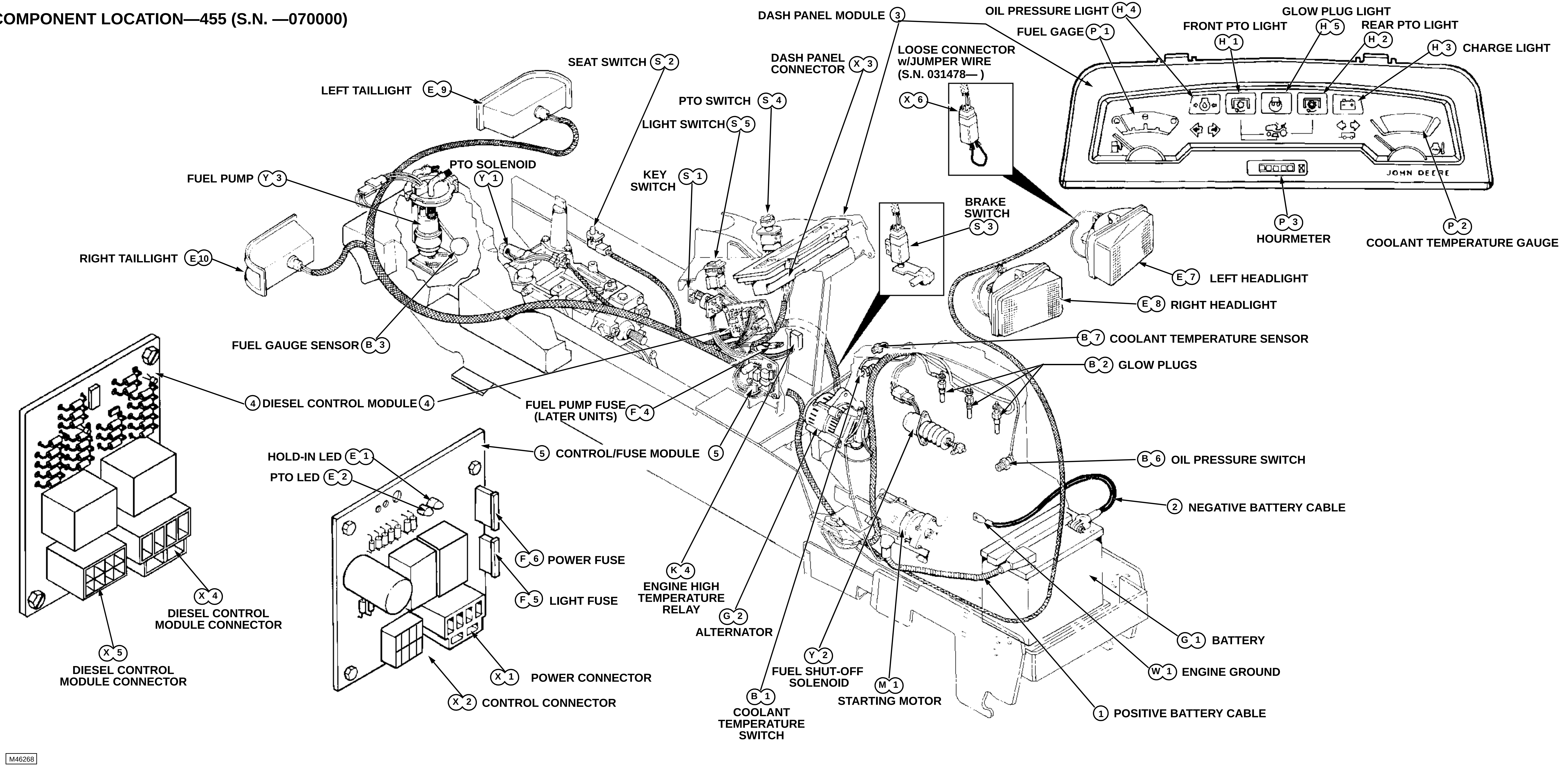
COMPONENT LOCATION—455 (S.N. —070000)



M46268

COMPONENT LOCATION—455

COMPONENT LOCATION—455 (S.N. —070000)



COMPONENT LOCATION—455

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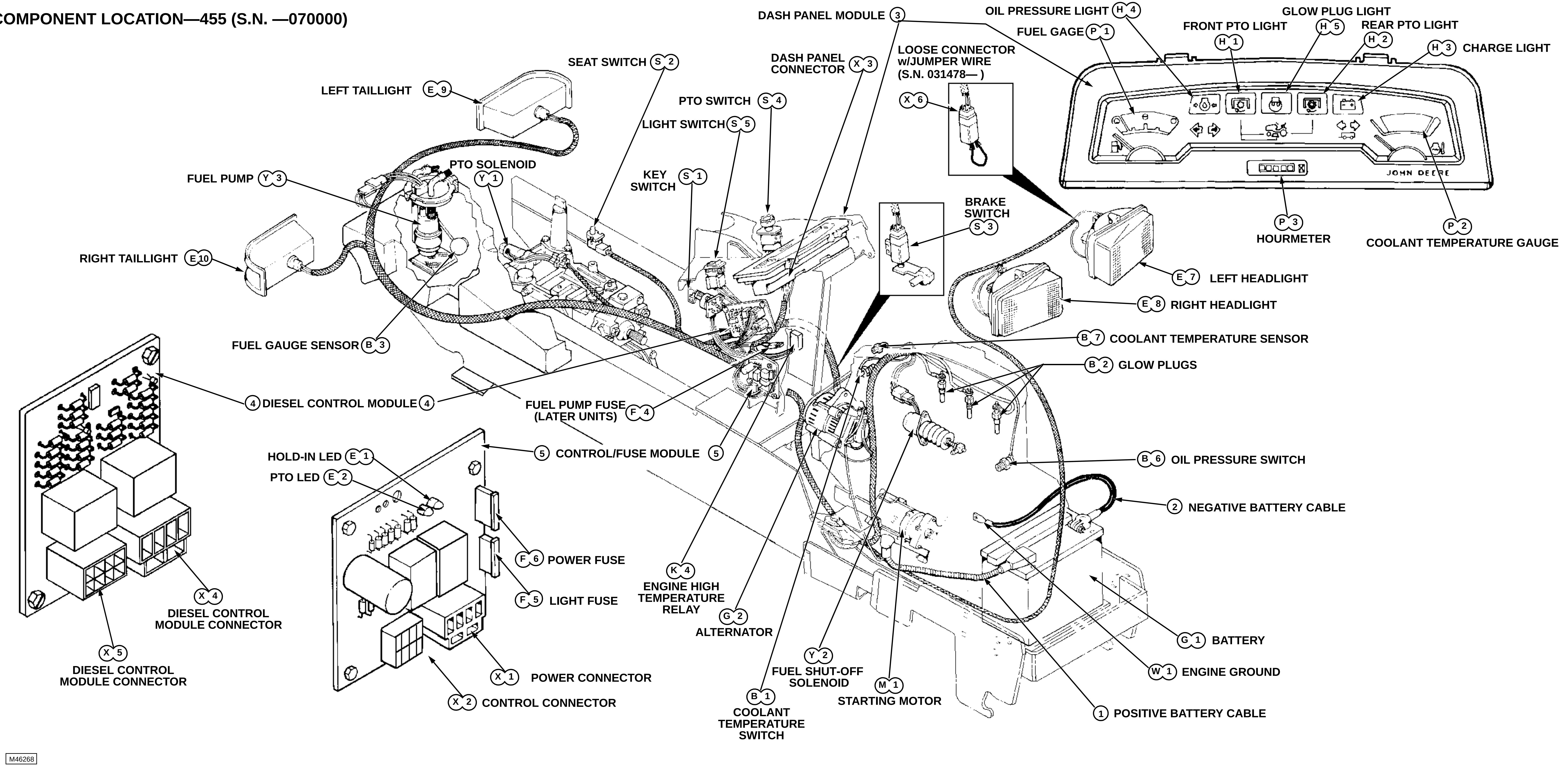

COMPONENT LOCATION—455

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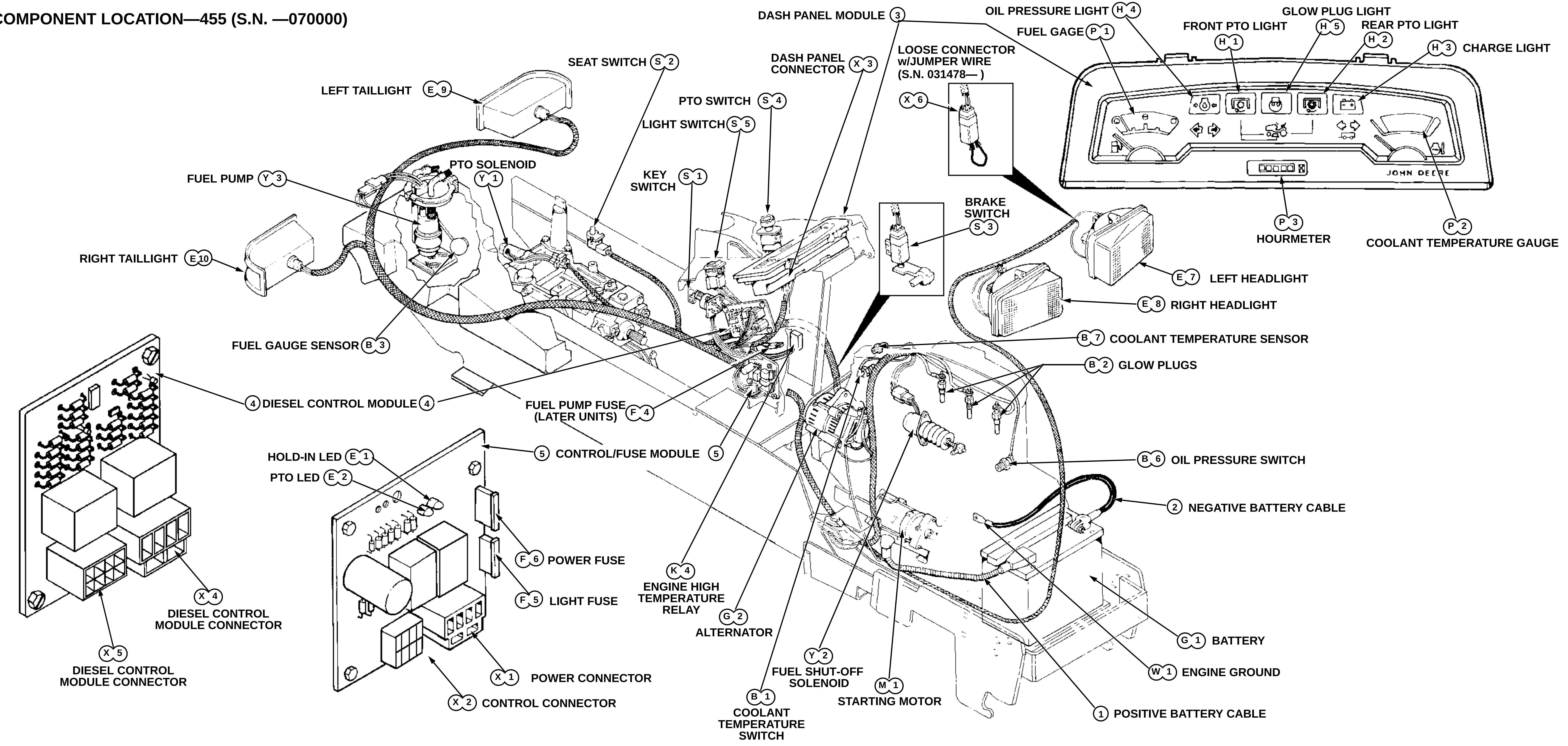
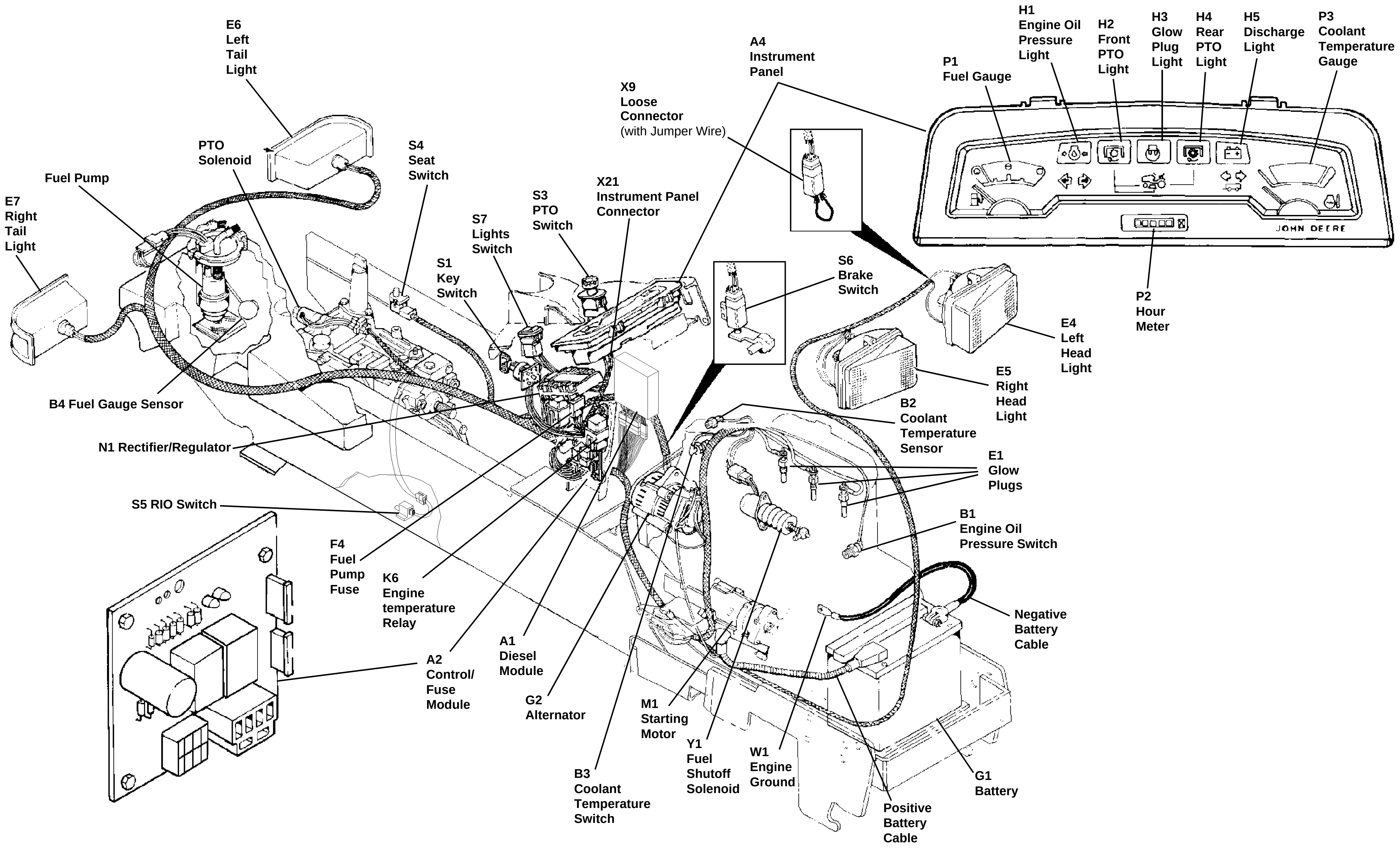


M46268

COMPONENT LOCATION—455 (S.N. 070001—)



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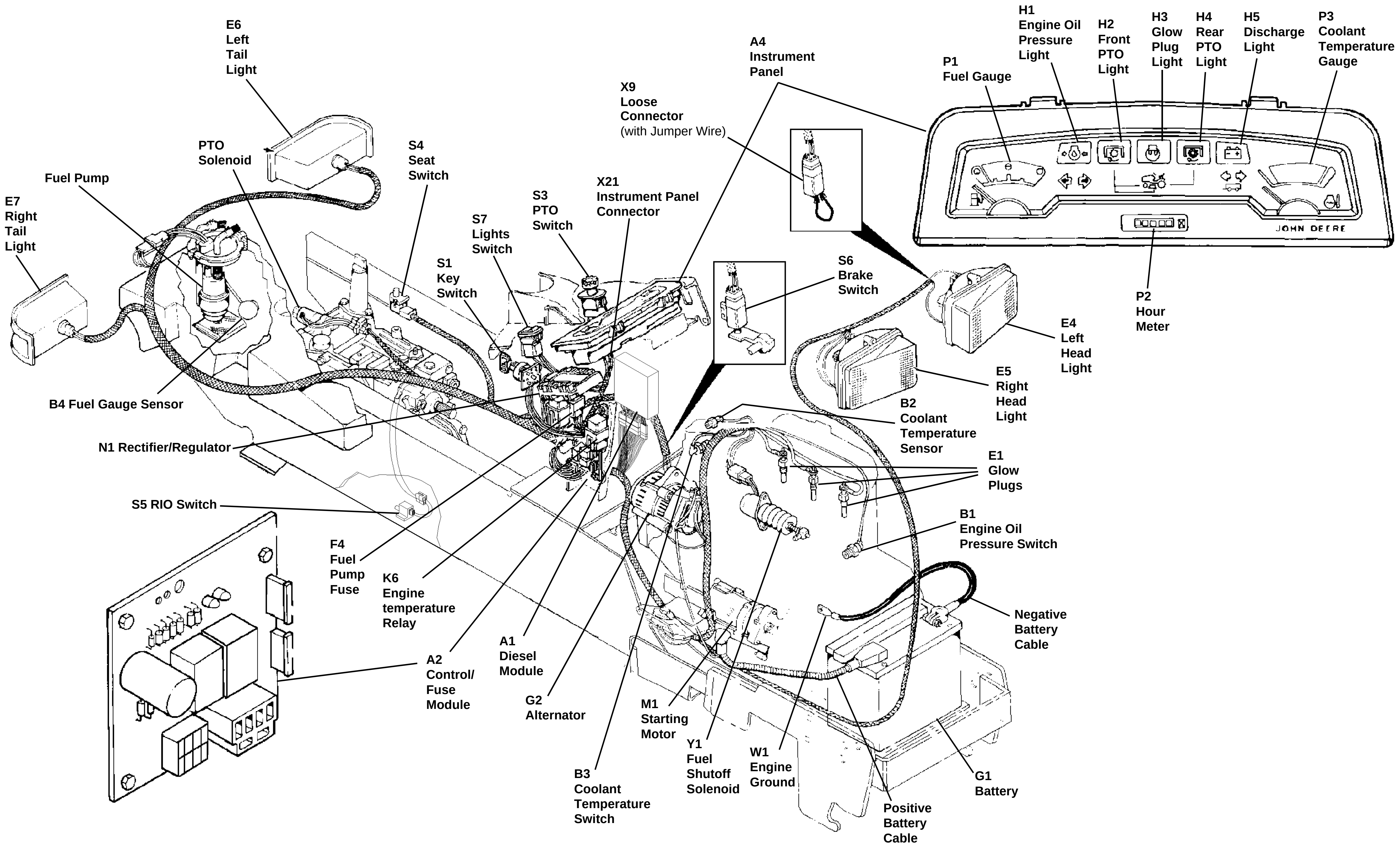

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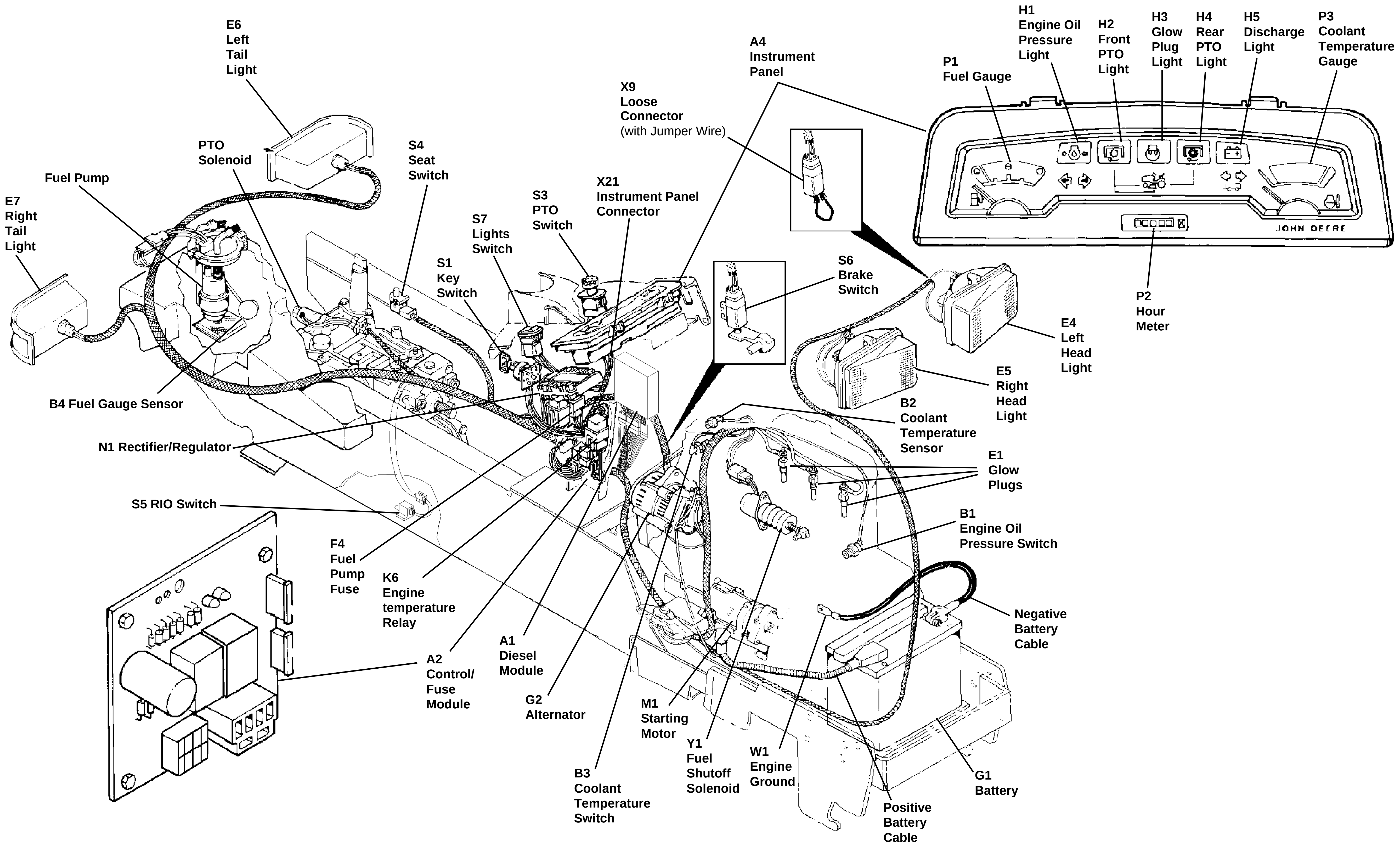

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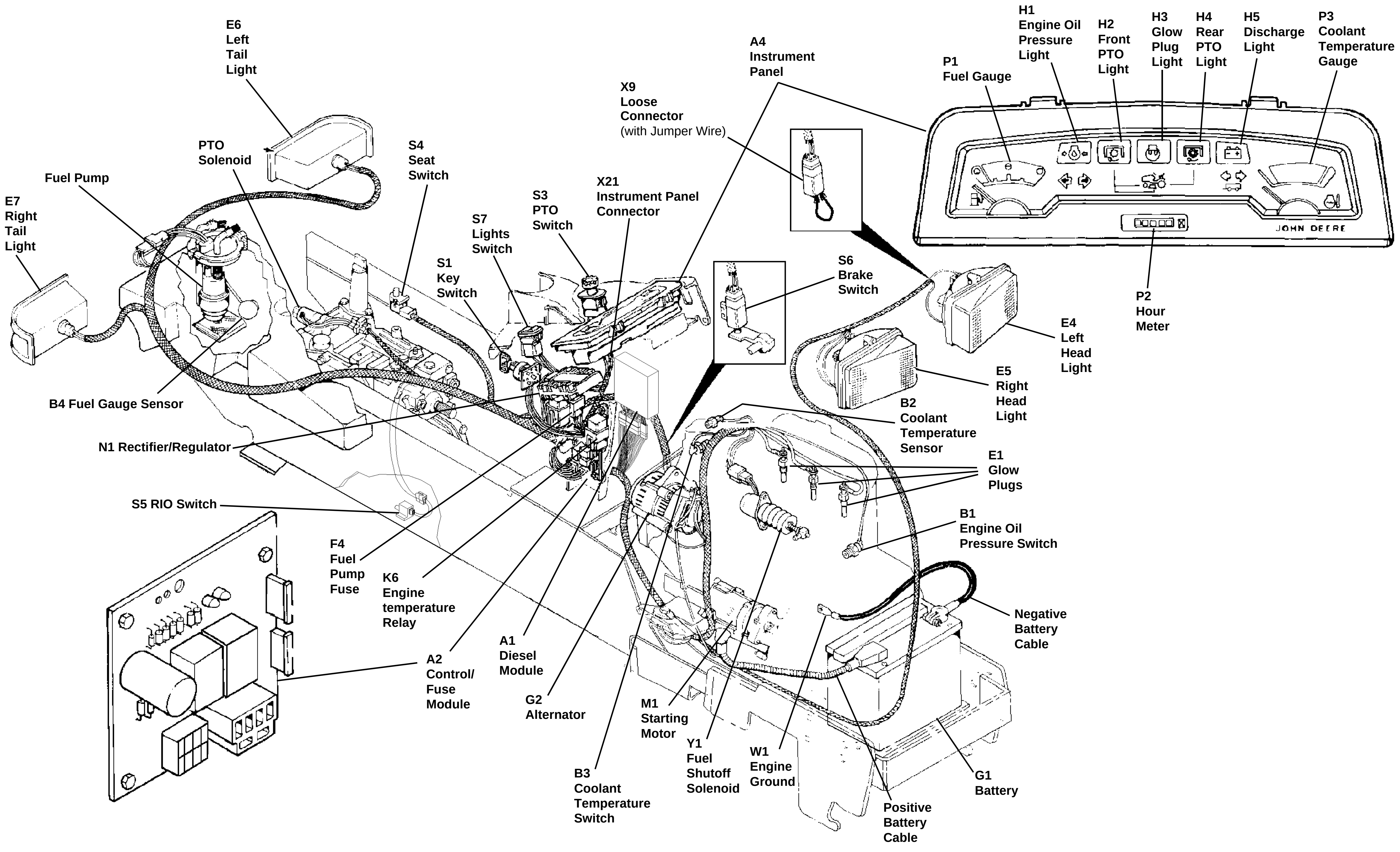


LEGENDS FOR ELECTRICAL COMPONENTS—455

LEGEND FOR ELECTRICAL COMPONENTS—455 (S.N. —070000)

A1—Diesel Module
A2—Control/Fuse Module
B1—Coolant Temperature Switch (SE3)
B2—Glow Plugs (SE3)
B3—Fuel Gauge Sensor (SE5, W1)
B4—Oil Pressure Switch (SE5)
B5—Coolant Temperature Sensor (SE6)
E1—Hold-In LED (SE2)
E2—PTO LED (SE3)
E3—Left Dash Light (SE6)
E4—Right Dash Light (SE6)
E5—Left Head Light (SE7, W1)
E6—Right Head Light (SE7, W1)
E7—Left Tail Light (SE7, W1)
E8—Right Tail Light (SE7, W1)
F1—Fusible Link (SE1, W1)
F2—Fusible Link (SE1, W1)
F3—Fusible Link (SE1, W1)
F4—Fuel Pump Fuse (SE2, W1)
F5—Light Fuse (SE2)
F6—Power Fuse (SE2)
G1—Battery (SE1)
G2—Alternator (SE4, W1)
H1—Front PTO Light (SE2)
H2—Rear PTO Light (SE2)
H3—Discharge Light (SE4)
H4—Oil Pressure Light (SE4)
H5—Glow Plug Light (SE5)
K1—Start Relay (SE1)
K2—Hold-In Relay (SE2)
K3—PTO Relay (SE3)
K4—Engine High Temperature Relay (SE3, W1)
K5—Pull-In Relay (SE3)
K6—Glow Plug Relay (SE3)
M1—Starting Motor (SE1, W1)
M2—Fuel Pump (SE4, W1)
P1—Fuel Gauge (SE5, W1)
P2—Coolant Temperature Gauge (SE6)
P3—Hourmeter (SE6)
S1—Key Switch (SE1)
S2—Seat Switch (SE2, W1)
S3—Brake Switch (SE2, W1)
S4—PTO Switch (SE2, W1)
S5—Light Switch (SE6, W1)
W1—Main Wiring Harness
W2—Rear PTO Wiring Harness
X1—Power Connector (SE1, SE2, SE3, W1)
X2—Control Connector (SE1, SE2, SE3, W1)
X3—Dash Panel Connector (SE2, SE4, SE5, SE6, W1)
X4—Diesel Module Power In (SE3, W1)
X5—Diesel Module Power Outputs (SE2, SE3, SE4, W1)
X6—Front PTO Light Connector (SE2, W1)
X7—Rear PTO Connector (SE1, SE2, W1)
X8—Rear PTO Connector (SE1, W1)
X9—Rear PTO Connector (SE1, W1)

LEGEND FOR ELECTRICAL COMPONENTS—455 (S.N. 070001—)

A1—Diesel Module (SE1)
A2—Control/Fuse Module (SE1)
B1—Engine Oil Pressure Switch (SE1)
B2—Coolant Temperature Sensor (SE1)
B3—Coolant Temperature Switch (SE1)
B4—Fuel Gauge Sensor (SE3, W1)
E1—Glow Plugs (SE1)
E2—PTO LED (SE1)
E3—Ignition LED (SE1)
E4—Left Head Light (SE3, W1)
E5—Right Head Light (SE3, W1)
E6—Left Tail Light (SE3, W1)
E7—Right Tail Light (SE3, W1)
E8—Dash Light (SE3)
E9—Dash Light (SE3)
F1—Fusible Link (SE1, W1)
F2—Fusible Link (SE1, W1)
F3—Fusible Link (SE1, W1)
F4—Fuel Pump Fuse (SE2, W1)
F5—Fuse-15A (SE2)
F6—Fuse-15A (SE2)
G1—Battery (SE1)
G2—Alternator (SE1, W1)
H1—Engine Oil Pressure Light (SE3)
H2—Front PTO Light (SE3)
H3—Glow Plug Light (SE3)
H4—Rear PTO Light (Option)
H5—Discharge Light (SE3)
K1—Start Relay (SE1)
K2—Ignition relay (SE1)
K3—PTO Relay (SE2)
K4—RIO Latch Relay (SE1)
K5—RIO Unlatch Relay (SE1)
K6—Engine Temperature Relay (SE2, W1)
M1—Starting Motor (SE1, W1)
M2—Fuel Pump (SE3,W1)
N1—Rectifier/Regulator (SE1, W1)
P1—Fuel Gauge (SE3)
P2—Hourmeter (SE3)
P3—Coolant Temperature Gauge (SE3)
S1—Key Switch (SE1)
S2—Not Used
S3—PTO Switch (SE2, W1)
S4—Seat Switch (SE2, W1)
S5—RIO Switch (SE2, W1)
S6—Brake Switch (SE3, W1)
S7—Light Switch (SE3, W1)
W1—Main wiring Harness
W2—Rear PTO Wiring Harness
X1—Key Switch Power Connector (SE1, W1)
X2—Control/Fuse Module Connector (SE1, SE2, W1)
X3—Control/Fuse Module Connector (SE1, SE2, W1)
X4—Not Used
X5—Not Used
X6—Not Used
X7—Fuel Shut-Off Solenoid Connector (SE1, W1)
X8—Starter Solenoid Connector (SE1, W1)
X9—Loose Connector With Jumper Wire (SE1, W1)
X10—Alternator Connector (SE1, W1)
X11—Diesel Module Connector (SE1, W1)
X12—Diesel Module Connector (SE1, W1)
X13—Diesel Module Connector (SE1, W1)
X14—Rear PTO Connector (SE2, W1)
X15—Rear PTO Connector (SE2, W1)
X16—Rear PTO Connector (SE2, W1)
X17—Rear PTO Connector (SE2, W1)
X18—Front PTO Light Connector (SE2, W1)
X19—PTO Solenoid Connector (SE2, W1)
X20—Fuel Pump and Fuel Gauge Sensor Connector (SE3, W1)
X21—Instrument Panel Connector (SE3, W1)
X22—Left Head Light Connector (SE3, W1)
X23—Right Head Light Connector ((SE3, W1)
X24—Left Tail Light Connector (SE3, W1)
X25—Right Tail Light Connector (SE3, W1

LEGENDS FOR ELECTRICAL COMPONENTS—455

LEGEND FOR ELECTRICAL COMPONENTS—455 (S.N. —070000)

A1—Diesel Module
A2—Control/Fuse Module
B1—Coolant Temperature Switch (SE3)
B2—Glow Plugs (SE3)
B3—Fuel Gauge Sensor (SE5, W1)
B4—Oil Pressure Switch (SE5)
B5—Coolant Temperature Sensor (SE6)
E1—Hold-In LED (SE2)
E2—PTO LED (SE3)
E3—Left Dash Light (SE6)
E4—Right Dash Light (SE6)
E5—Left Head Light (SE7, W1)
E6—Right Head Light (SE7, W1)
E7—Left Tail Light (SE7, W1)
E8—Right Tail Light (SE7, W1)
F1—Fusible Link (SE1, W1)
F2—Fusible Link (SE1, W1)
F3—Fusible Link (SE1, W1)
F4—Fuel Pump Fuse (SE2, W1)
F5—Light Fuse (SE2)
F6—Power Fuse (SE2)
G1—Battery (SE1)
G2—Alternator (SE4, W1)
H1—Front PTO Light (SE2)
H2—Rear PTO Light (SE2)
H3—Discharge Light (SE4)
H4—Oil Pressure Light (SE4)
H5—Glow Plug Light (SE5)
K1—Start Relay (SE1)
K2—Hold-In Relay (SE2)
K3—PTO Relay (SE3)
K4—Engine High Temperature Relay (SE3, W1)
K5—Pull-In Relay (SE3)
K6—Glow Plug Relay (SE3)
M1—Starting Motor (SE1, W1)
M2—Fuel Pump (SE4, W1)
P1—Fuel Gauge (SE5, W1)
P2—Coolant Temperature Gauge (SE6)
P3—Hourmeter (SE6)
S1—Key Switch (SE1)
S2—Seat Switch (SE2, W1)
S3—Brake Switch (SE2, W1)
S4—PTO Switch (SE2, W1)
S5—Light Switch (SE6, W1)
W1—Main Wiring Harness
W2—Rear PTO Wiring Harness
X1—Power Connector (SE1, SE2, SE3, W1)
X2—Control Connector (SE1, SE2, SE3, W1)
X3—Dash Panel Connector (SE2, SE4, SE5, SE6, W1)
X4—Diesel Module Power In (SE3, W1)
X5—Diesel Module Power Outputs (SE2, SE3, SE4, W1)
X6—Front PTO Light Connector (SE2, W1)
X7—Rear PTO Connector (SE1, SE2, W1)
X8—Rear PTO Connector (SE1, W1)
X9—Rear PTO Connector (SE1, W1)

LEGEND FOR ELECTRICAL COMPONENTS—455 (S.N. 070001—)

A1—Diesel Module (SE1)
A2—Control/Fuse Module (SE1)
B1—Engine Oil Pressure Switch (SE1)
B2—Coolant Temperature Sensor (SE1)
B3—Coolant Temperature Switch (SE1)
B4—Fuel Gauge Sensor (SE3, W1)
E1—Glow Plugs (SE1)
E2—PTO LED (SE1)
E3—Ignition LED (SE1)
E4—Left Head Light (SE3, W1)
E5—Right Head Light (SE3, W1)
E6—Left Tail Light (SE3, W1)
E7—Right Tail Light (SE3, W1)
E8—Dash Light (SE3)
E9—Dash Light (SE3)
F1—Fusible Link (SE1, W1)
F2—Fusible Link (SE1, W1)
F3—Fusible Link (SE1, W1)
F4—Fuel Pump Fuse (SE2, W1)
F5—Fuse-15A (SE2)
F6—Fuse-15A (SE2)
G1—Battery (SE1)
G2—Alternator (SE1, W1)
H1—Engine Oil Pressure Light (SE3)
H2—Front PTO Light (SE3)
H3—Glow Plug Light (SE3)
H4—Rear PTO Light (Option)
H5—Discharge Light (SE3)
K1—Start Relay (SE1)
K2—Ignition relay (SE1)
K3—PTO Relay (SE2)
K4—RIO Latch Relay (SE1)
K5—RIO Unlatch Relay (SE1)
K6—Engine Temperature Relay (SE2, W1)
M1—Starting Motor (SE1, W1)
M2—Fuel Pump (SE3,W1)
N1—Rectifier/Regulator (SE1, W1)
P1—Fuel Gauge (SE3)
P2—Hourmeter (SE3)
P3—Coolant Temperature Gauge (SE3)
S1—Key Switch (SE1)
S2—Not Used
S3—PTO Switch (SE2, W1)
S4—Seat Switch (SE2, W1)
S5—RIO Switch (SE2, W1)
S6—Brake Switch (SE3, W1)
S7—Light Switch (SE3, W1)
W1—Main wiring Harness
W2—Rear PTO Wiring Harness
X1—Key Switch Power Connector (SE1, W1)
X2—Control/Fuse Module Connector (SE1, SE2, W1)
X3—Control/Fuse Module Connector (SE1, SE2, W1)
X4—Not Used
X5—Not Used
X6—Not Used
X7—Fuel Shut-Off Solenoid Connector (SE1, W1)
X8—Starter Solenoid Connector (SE1, W1)
X9—Loose Connector With Jumper Wire (SE1, W1)
X10—Alternator Connector (SE1, W1)
X11—Diesel Module Connector (SE1, W1)
X12—Diesel Module Connector (SE1, W1)
X13—Diesel Module Connector (SE1, W1)
X14—Rear PTO Connector (SE2, W1)
X15—Rear PTO Connector (SE2, W1)
X16—Rear PTO Connector (SE2, W1)
X17—Rear PTO Connector (SE2, W1)
X18—Front PTO Light Connector (SE2, W1)
X19—PTO Solenoid Connector (SE2, W1)
X20—Fuel Pump and Fuel Gauge Sensor Connector (SE3, W1)
X21—Instrument Panel Connector (SE3, W1)
X22—Left Head Light Connector (SE3, W1)
X23—Right Head Light Connector ((SE3, W1)
X24—Left Tail Light Connector (SE3, W1)
X25—Right Tail Light Connector (SE3, W1

LEGENDS FOR ELECTRICAL COMPONENTS—455

LEGEND FOR ELECTRICAL COMPONENTS—455 (S.N. —070000)

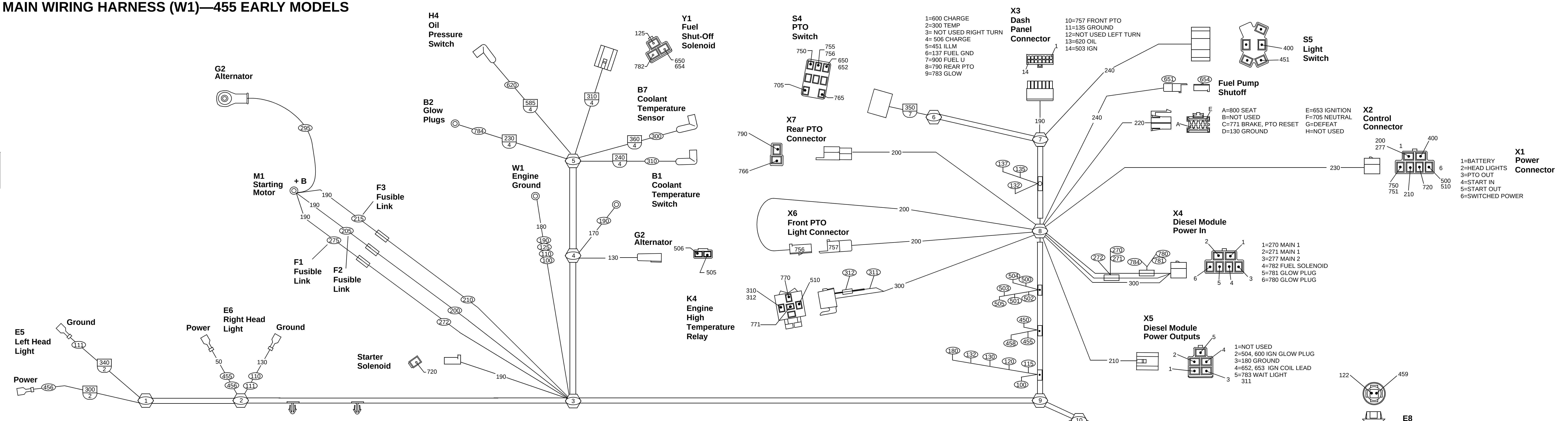
A1—Diesel Module
A2—Control/Fuse Module
B1—Coolant Temperature Switch (SE3)
B2—Glow Plugs (SE3)
B3—Fuel Gauge Sensor (SE5, W1)
B4—Oil Pressure Switch (SE5)
B5—Coolant Temperature Sensor (SE6)
E1—Hold-In LED (SE2)
E2—PTO LED (SE3)
E3—Left Dash Light (SE6)
E4—Right Dash Light (SE6)
E5—Left Head Light (SE7, W1)
E6—Right Head Light (SE7, W1)
E7—Left Tail Light (SE7, W1)
E8—Right Tail Light (SE7, W1)
F1—Fusible Link (SE1, W1)
F2—Fusible Link (SE1, W1)
F3—Fusible Link (SE1, W1)
F4—Fuel Pump Fuse (SE2, W1)
F5—Light Fuse (SE2)
F6—Power Fuse (SE2)
G1—Battery (SE1)
G2—Alternator (SE4, W1)
H1—Front PTO Light (SE2)
H2—Rear PTO Light (SE2)
H3—Discharge Light (SE4)
H4—Oil Pressure Light (SE4)
H5—Glow Plug Light (SE5)
K1—Start Relay (SE1)
K2—Hold-In Relay (SE2)
K3—PTO Relay (SE3)
K4—Engine High Temperature Relay (SE3, W1)
K5—Pull-In Relay (SE3)
K6—Glow Plug Relay (SE3)
M1—Starting Motor (SE1, W1)
M2—Fuel Pump (SE4, W1)
P1—Fuel Gauge (SE5, W1)
P2—Coolant Temperature Gauge (SE6)
P3—Hourmeter (SE6)
S1—Key Switch (SE1)
S2—Seat Switch (SE2, W1)
S3—Brake Switch (SE2, W1)
S4—PTO Switch (SE2, W1)
S5—Light Switch (SE6, W1)
W1—Main Wiring Harness
W2—Rear PTO Wiring Harness
X1—Power Connector (SE1, SE2, SE3, W1)
X2—Control Connector (SE1, SE2, SE3, W1)
X3—Dash Panel Connector (SE2, SE4, SE5, SE6, W1)
X4—Diesel Module Power In (SE3, W1)
X5—Diesel Module Power Outputs (SE2, SE3, SE4, W1)
X6—Front PTO Light Connector (SE2, W1)
X7—Rear PTO Connector (SE1, SE2, W1)
X8—Rear PTO Connector (SE1, W1)
X9—Rear PTO Connector (SE1, W1)

LEGEND FOR ELECTRICAL COMPONENTS—455 (S.N. 070001—)

A1—Diesel Module (SE1)
A2—Control/Fuse Module (SE1)
B1—Engine Oil Pressure Switch (SE1)
B2—Coolant Temperature Sensor (SE1)
B3—Coolant Temperature Switch (SE1)
B4—Fuel Gauge Sensor (SE3, W1)
E1—Glow Plugs (SE1)
E2—PTO LED (SE1)
E3—Ignition LED (SE1)
E4—Left Head Light (SE3, W1)
E5—Right Head Light (SE3, W1)
E6—Left Tail Light (SE3, W1)
E7—Right Tail Light (SE3, W1)
E8—Dash Light (SE3)
E9—Dash Light (SE3)
F1—Fusible Link (SE1, W1)
F2—Fusible Link (SE1, W1)
F3—Fusible Link (SE1, W1)
F4—Fuel Pump Fuse (SE2, W1)
F5—Fuse-15A (SE2)
F6—Fuse-15A (SE2)
G1—Battery (SE1)
G2—Alternator (SE1, W1)
H1—Engine Oil Pressure Light (SE3)
H2—Front PTO Light (SE3)
H3—Glow Plug Light (SE3)
H4—Rear PTO Light (Option)
H5—Discharge Light (SE3)
K1—Start Relay (SE1)
K2—Ignition relay (SE1)
K3—PTO Relay (SE2)
K4—RIO Latch Relay (SE1)
K5—RIO Unlatch Relay (SE1)
K6—Engine Temperature Relay (SE2, W1)
M1—Starting Motor (SE1, W1)
M2—Fuel Pump (SE3,W1)
N1—Rectifier/Regulator (SE1, W1)
P1—Fuel Gauge (SE3)
P2—Hourmeter (SE3)
P3—Coolant Temperature Gauge (SE3)
S1—Key Switch (SE1)
S2—Not Used
S3—PTO Switch (SE2, W1)
S4—Seat Switch (SE2, W1)
S5—RIO Switch (SE2, W1)
S6—Brake Switch (SE3, W1)
S7—Light Switch (SE3, W1)
W1—Main wiring Harness
W2—Rear PTO Wiring Harness
X1—Key Switch Power Connector (SE1, W1)
X2—Control/Fuse Module Connector (SE1, SE2, W1)
X3—Control/Fuse Module Connector (SE1, SE2, W1)
X4—Not Used
X5—Not Used
X6—Not Used
X7—Fuel Shut-Off Solenoid Connector (SE1, W1)
X8—Starter Solenoid Connector (SE1, W1)
X9—Loose Connector With Jumper Wire (SE1, W1)
X10—Alternator Connector (SE1, W1)
X11—Diesel Module Connector (SE1, W1)
X12—Diesel Module Connector (SE1, W1)
X13—Diesel Module Connector (SE1, W1)
X14—Rear PTO Connector (SE2, W1)
X15—Rear PTO Connector (SE2, W1)
X16—Rear PTO Connector (SE2, W1)
X17—Rear PTO Connector (SE2, W1)
X18—Front PTO Light Connector (SE2, W1)
X19—PTO Solenoid Connector (SE2, W1)
X20—Fuel Pump and Fuel Gauge Sensor Connector (SE3, W1)
X21—Instrument Panel Connector (SE3, W1)
X22—Left Head Light Connector (SE3, W1)
X23—Right Head Light Connector ((SE3, W1)
X24—Left Tail Light Connector (SE3, W1)
X25—Right Tail Light Connector (SE3, W1

ELECTRICAL WIRING HARNESSES—455

MAIN WIRING HARNESS (W1)—455 EARLY MODELS

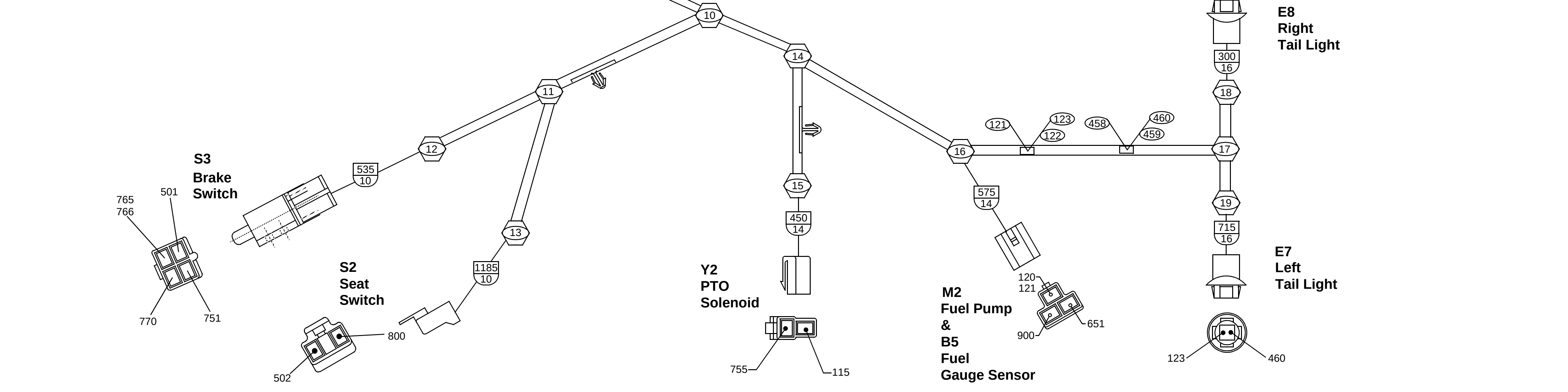


Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk, Y3
121	0.8	Blk	120, 122, 123 Blk, Y3
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk
137	0.5	Blk	X3-6, 100 Blk
180	0.8	Blk	X5-3, 100 Blk
190	1.0	Blk	N1,100 Blk
195	0.5	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red

Circuit Number	Wire Size	Color	Termination Points
210	1.0	Red	215 Lt Org, N1
215	1.0	Lt Org	M1, 210 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/Wht
451	0.5	Yel/Wht	X3-5, 450 Yel/Wht
455	1.0	Yel/Wht	S5, 456 Yel/Wht

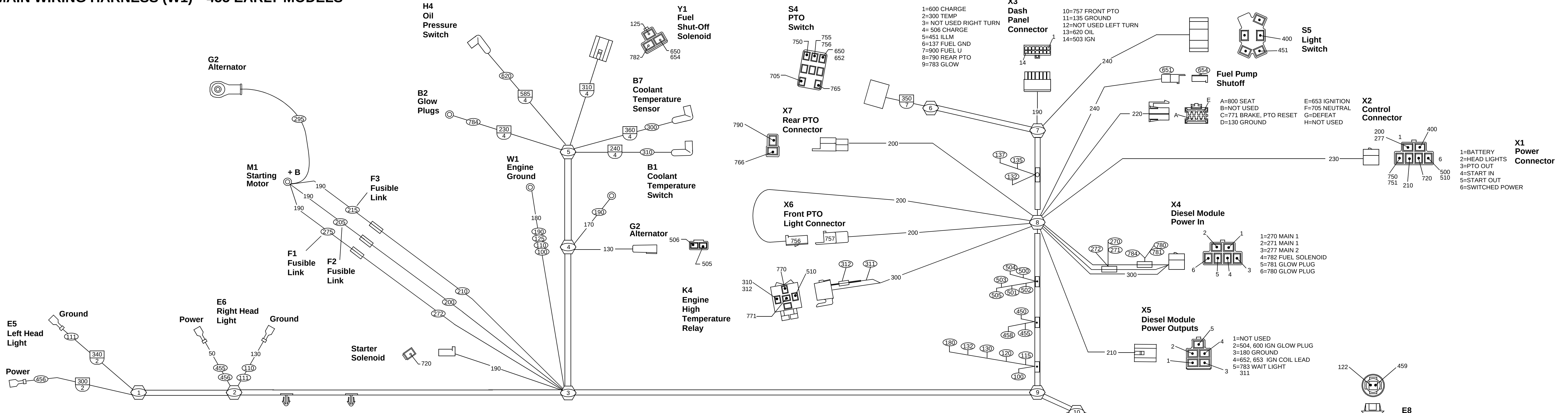
Circuit Number	Wire Size	Color	Termination Points
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
600	0.5	Brn	N1,X3-1
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blk	Y1, 652 Pnk/Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Blu/Blk	655, 650 Pnk/Blu
653	1.0	Blu	S4, 655 Pnk/Blu
654	0.8	Pnk/Blk	Y3, Fuse
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
766	0.8	Pur	S3, X7
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
900	0.5	Blk/Wht	X3-7, Y3



ELECTRICAL WIRING HARNESSES—455

MAIN WIRING HARNESS (W1)—455 EARLY MODELS

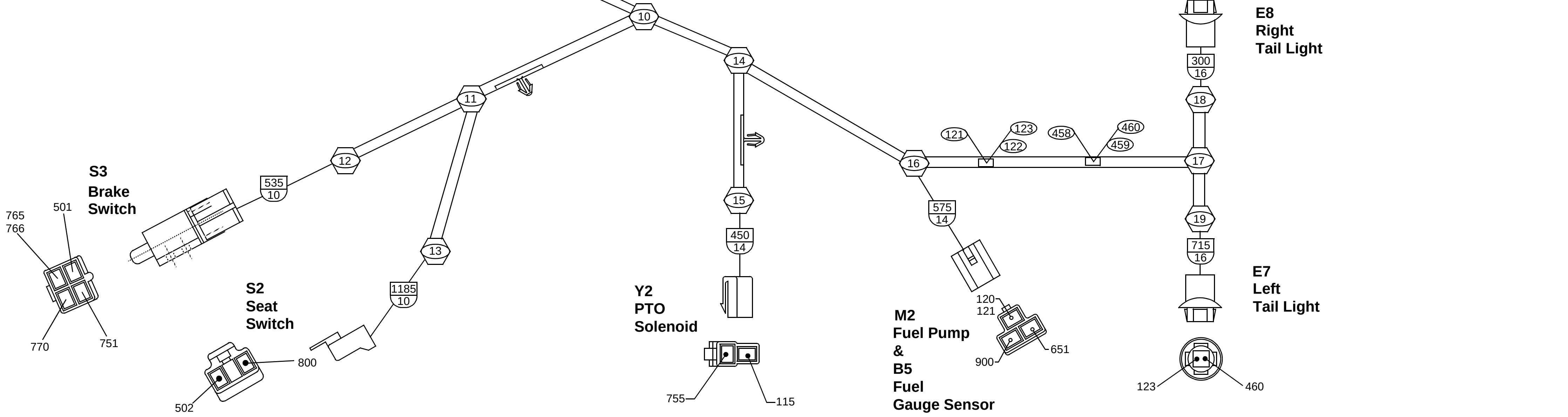


Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk, Y3
121	0.8	Blk	120, 122, 123 Blk, Y3
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk
137	0.5	Blk	X3-6, 100 Blk
180	0.8	Blk	X5-3, 100 Blk
190	1.0	Blk	N1,100 Blk
195	0.5	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red

Circuit Number	Wire Size	Color	Termination Points
210	1.0	Red	215 Lt Org, N1
215	1.0	Lt Org	M1, 210 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/Wht
451	0.5	Yel/Wht	X3-5, 450 Yel/Wht
455	1.0	Yel/Wht	S5, 456 Yel/Wht

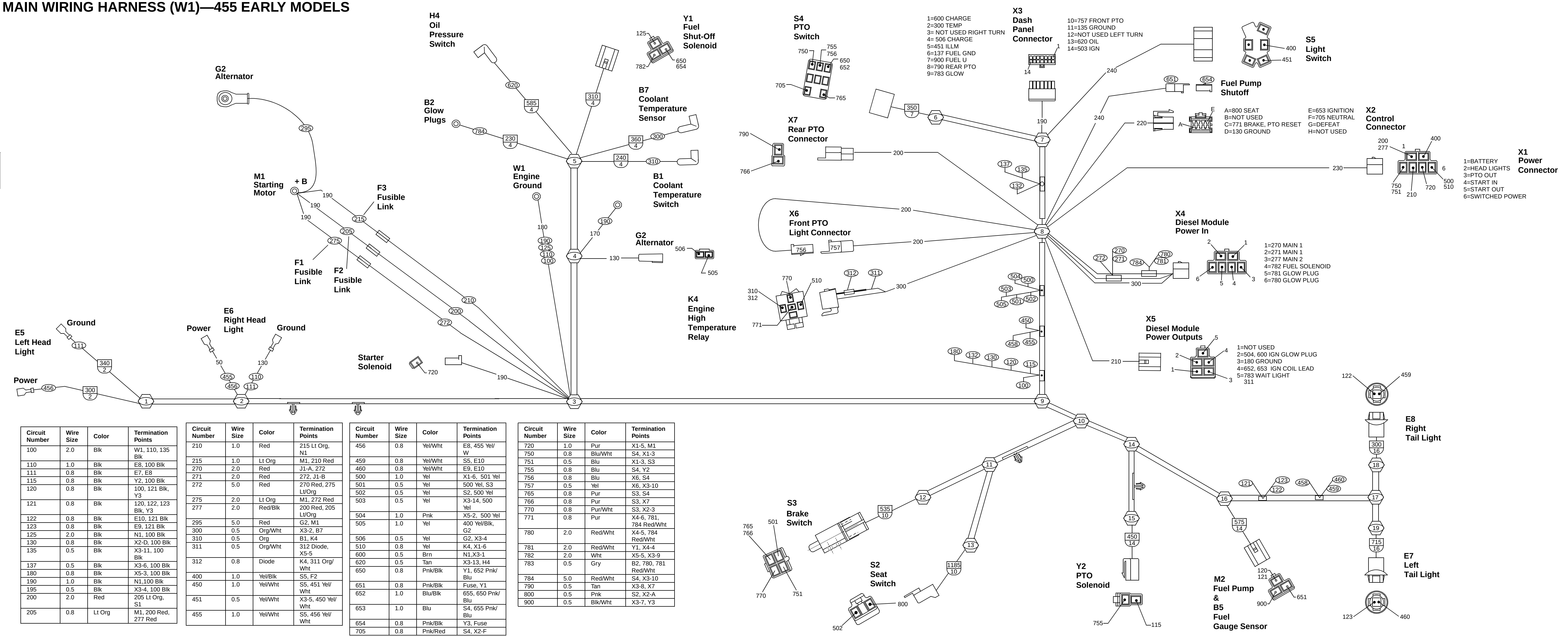
Circuit Number	Wire Size	Color	Termination Points
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
600	0.5	Brn	N1,X3-1
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blk	Y1, 652 Pnk/Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Blu/Blk	655, 650 Pnk/Blu
653	1.0	Blu	S4, 655 Pnk/Blu
654	0.8	Pnk/Blk	Y3, Fuse
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
766	0.8	Pur	S3, X7
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
900	0.5	Blk/Wht	X3-7, Y3



ELECTRICAL WIRING HARNESSES—455

MAIN WIRING HARNESS (W1)—455 EARLY MODELS



Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk, Y3
121	0.8	Blk	120, 122, 123 Blk, Y3
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk
137	0.5	Blk	X3-6, 100 Blk
180	0.8	Blk	X5-3, 100 Blk
190	1.0	Blk	N1,100 Blk
195	0.5	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red

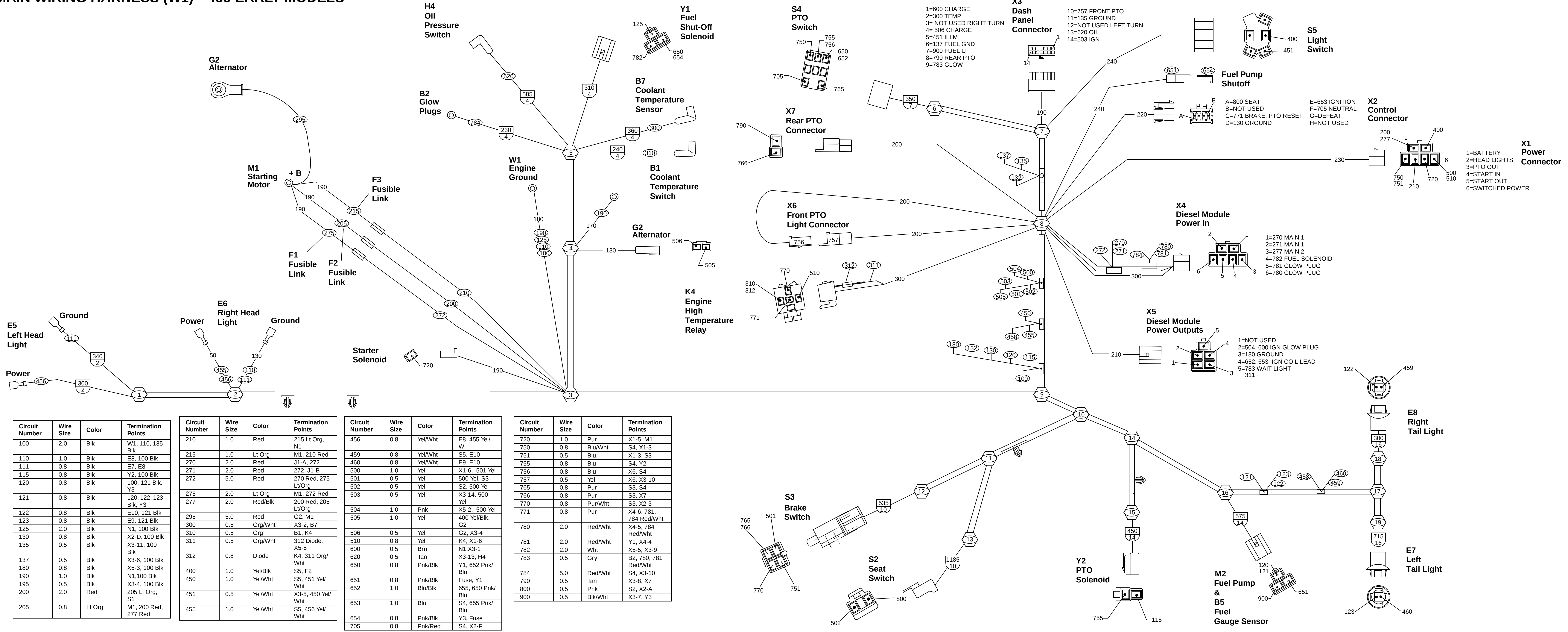
Circuit Number	Wire Size	Color	Termination Points
210	1.0	Red	215 Lt Org, N1
215	1.0	Lt Org	M1, 210 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/Wht
451	0.5	Yel/Wht	X3-5, 450 Yel/Wht
455	1.0	Yel/Wht	S5, 456 Yel/Wht

Circuit Number	Wire Size	Color	Termination Points
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
600	0.5	Brn	N1,X3-1
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blk	Y1, 652 Pnk/Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Blu/Blk	655, 650 Pnk/Blu
653	1.0	Blu	S4, 655 Pnk/Blu
654	0.8	Pnk/Blk	Y3, Fuse
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
766	0.8	Pur	S3, X7
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
900	0.5	Blk/Wht	X3-7, Y3

ELECTRICAL WIRING HARNESSES—455

MAIN WIRING HARNESS (W1)—455 EARLY MODELS



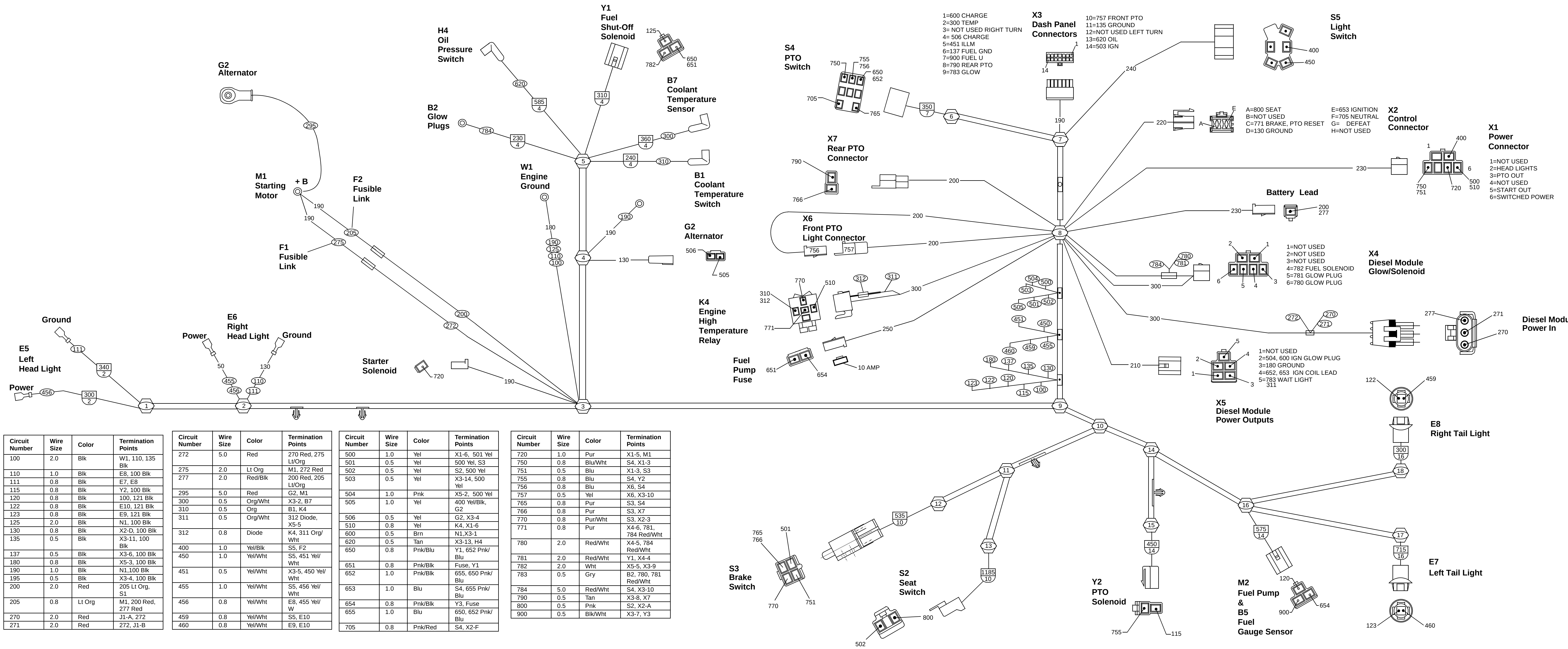
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk, Y3
121	0.8	Blk	120, 122, 123 Blk, Y3
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk
137	0.5	Blk	X3-6, 100 Blk
180	0.8	Blk	X5-3, 100 Blk
190	1.0	Blk	N1,100 Blk
195	0.5	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red

Circuit Number	Wire Size	Color	Termination Points
210	1.0	Red	215 Lt Org, N1
215	1.0	Lt Org	M1, 210 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/ Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/ Wht
451	0.5	Yel/Wht	X3-5, 450 Yel/ Wht
455	1.0	Yel/Wht	S5, 456 Yel/ Wht

Circuit Number	Wire Size	Color	Termination Points
456	0.8	Yel/Wht	E8, 455 Yel/ W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
600	0.5	Brn	N1,X3-1
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blk	Y1, 652 Pnk/ Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Blu/Blk	655, 650 Pnk/ Blu
653	1.0	Blu	S4, 655 Pnk/ Blu
654	0.8	Pnk/Blk	Y3, Fuse
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
766	0.8	Pur	S3, X7
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
900	0.5	Blk/Wht	X3-7, Y3

MAIN WIRING HARNESS (W1)—455 LATE MODELS (S.N. —031477)



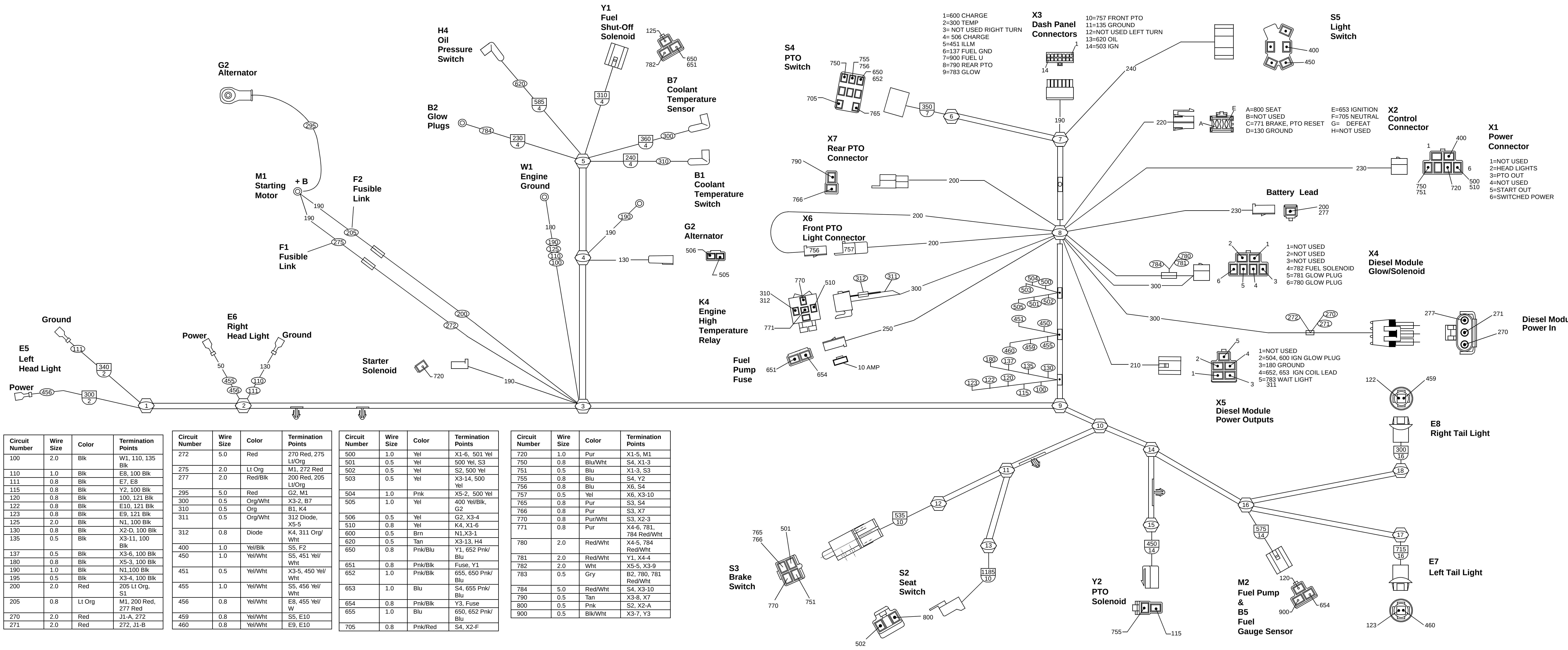
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk
137	0.5	Blk	X3-6, 100 Blk
180	0.8	Blk	X5-3, 100 Blk
190	1.0	Blk	N1,100 Blk
195	0.5	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B

Circuit Number	Wire Size	Color	Termination Points
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/Wht
451	0.5	Yel/Wht	X3-5, 450 Yel/Wht
455	1.0	Yel/Wht	S5, 456 Yel/Wht
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10

Circuit Number	Wire Size	Color	Termination Points
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
600	0.5	Brn	N1,X3-1
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blu	Y1, 652 Pnk/Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Pnk/Blk	655, 650 Pnk/Blu
653	1.0	Blu	S4, 655 Pnk/Blu
654	0.8	Pnk/Blk	Y3, Fuse
655	1.0	Blu	650, 652 Pnk/Blu
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
766	0.8	Pur	S3, X7
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
900	0.5	Blk/Wht	X3-7, Y3

MAIN WIRING HARNESS (W1)—455 LATE MODELS (S.N. —031477)



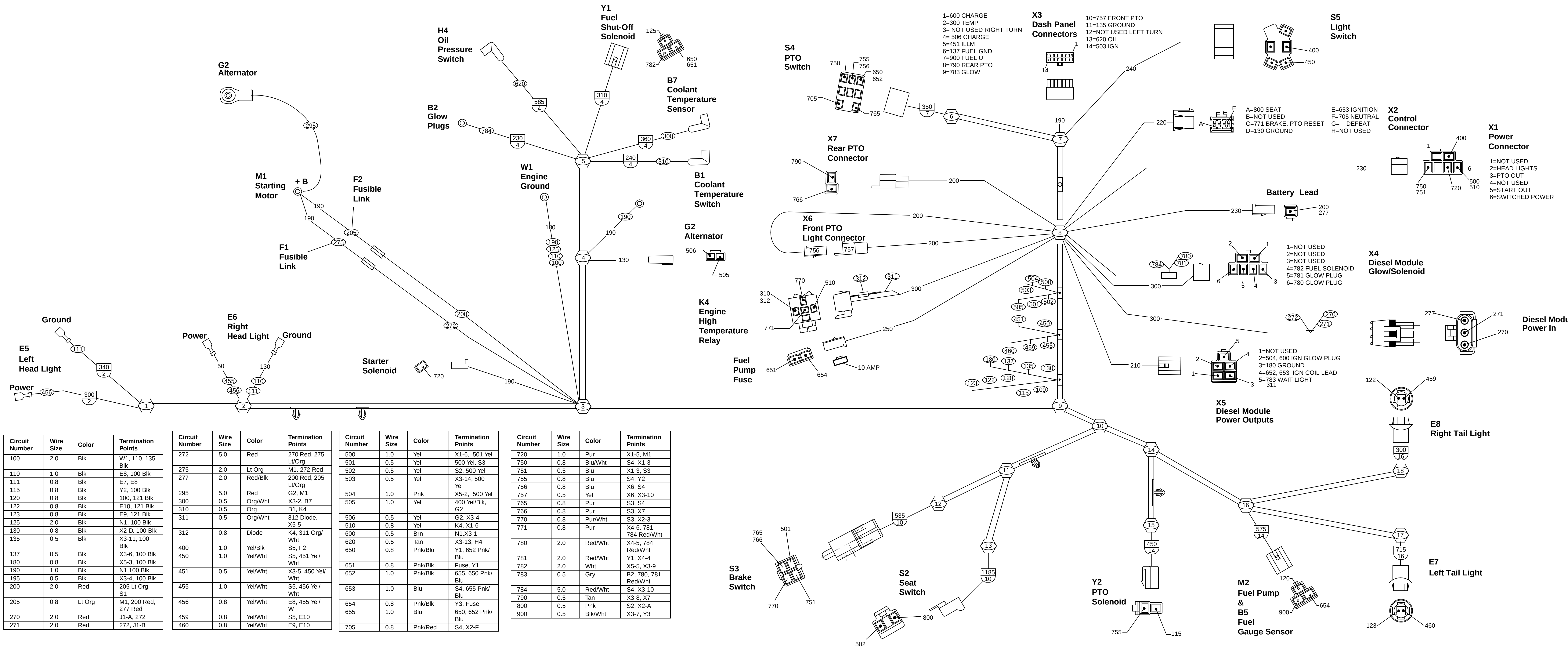
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk
137	0.5	Blk	X3-6, 100 Blk
180	0.8	Blk	X5-3, 100 Blk
190	1.0	Blk	N1,100 Blk
195	0.5	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B

Circuit Number	Wire Size	Color	Termination Points
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/Wht
451	0.5	Yel/Wht	X3-5, 450 Yel/Wht
455	1.0	Yel/Wht	S5, 456 Yel/Wht
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10

Circuit Number	Wire Size	Color	Termination Points
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
600	0.5	Brn	N1,X3-1
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blu	Y1, 652 Pnk/Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Pnk/Blk	655, 650 Pnk/Blu
653	1.0	Blu	S4, 655 Pnk/Blu
654	0.8	Pnk/Blk	Y3, Fuse
655	1.0	Blu	650, 652 Pnk/Blu
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
766	0.8	Pur	S3, X7
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
900	0.5	Blk/Wht	X3-7, Y3

MAIN WIRING HARNESS (W1)—455 LATE MODELS (S.N. —031477)



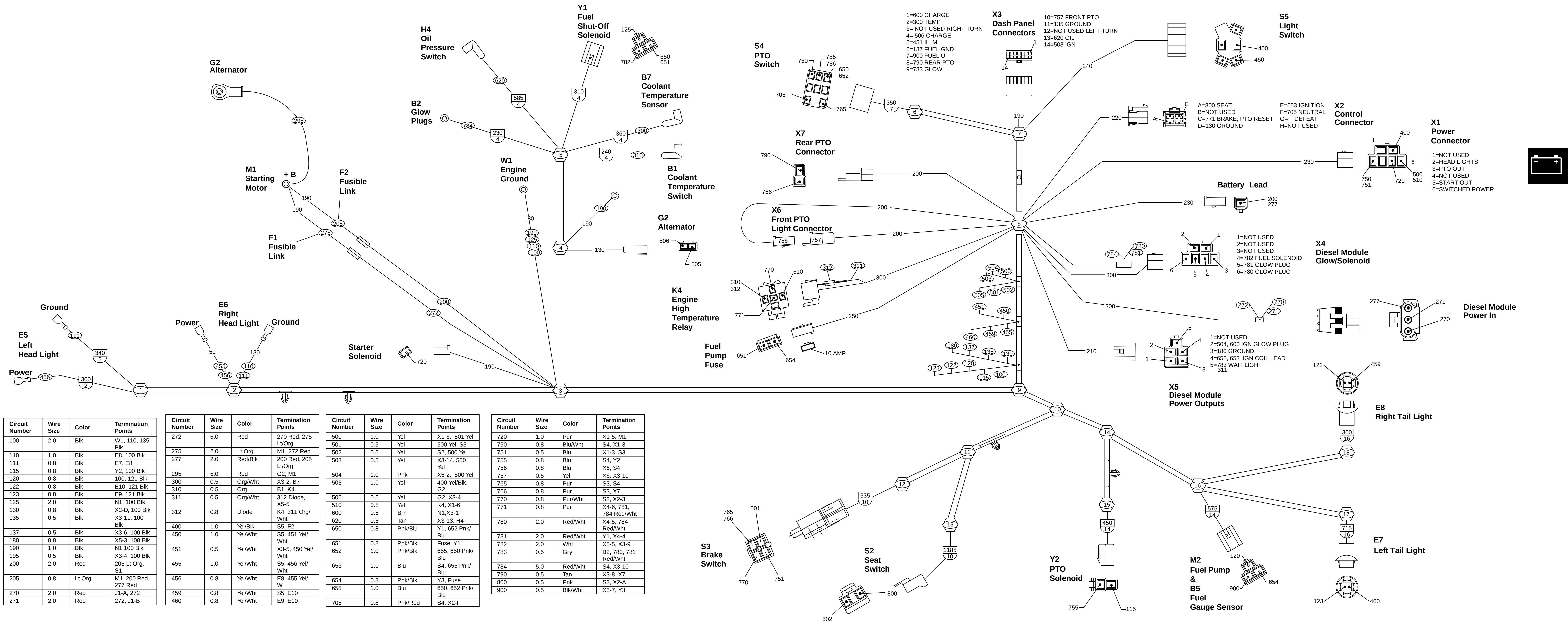
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk
137	0.5	Blk	X3-6, 100 Blk
180	0.8	Blk	X5-3, 100 Blk
190	1.0	Blk	N1,100 Blk
195	0.5	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B

Circuit Number	Wire Size	Color	Termination Points
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/Wht
451	0.5	Yel/Wht	X3-5, 450 Yel/Wht
455	1.0	Yel/Wht	S5, 456 Yel/Wht
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10

Circuit Number	Wire Size	Color	Termination Points
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
600	0.5	Brn	N1,X3-1
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blu	Y1, 652 Pnk/Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Pnk/Blk	655, 650 Pnk/Blu
653	1.0	Blu	S4, 655 Pnk/Blu
654	0.8	Pnk/Blk	Y3, Fuse
655	1.0	Blu	650, 652 Pnk/Blu
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
766	0.8	Pur	S3, X7
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
900	0.5	Blk/Wht	X3-7, Y3

MAIN WIRING HARNESS (W1)—455 LATE MODELS (S.N. —031477)



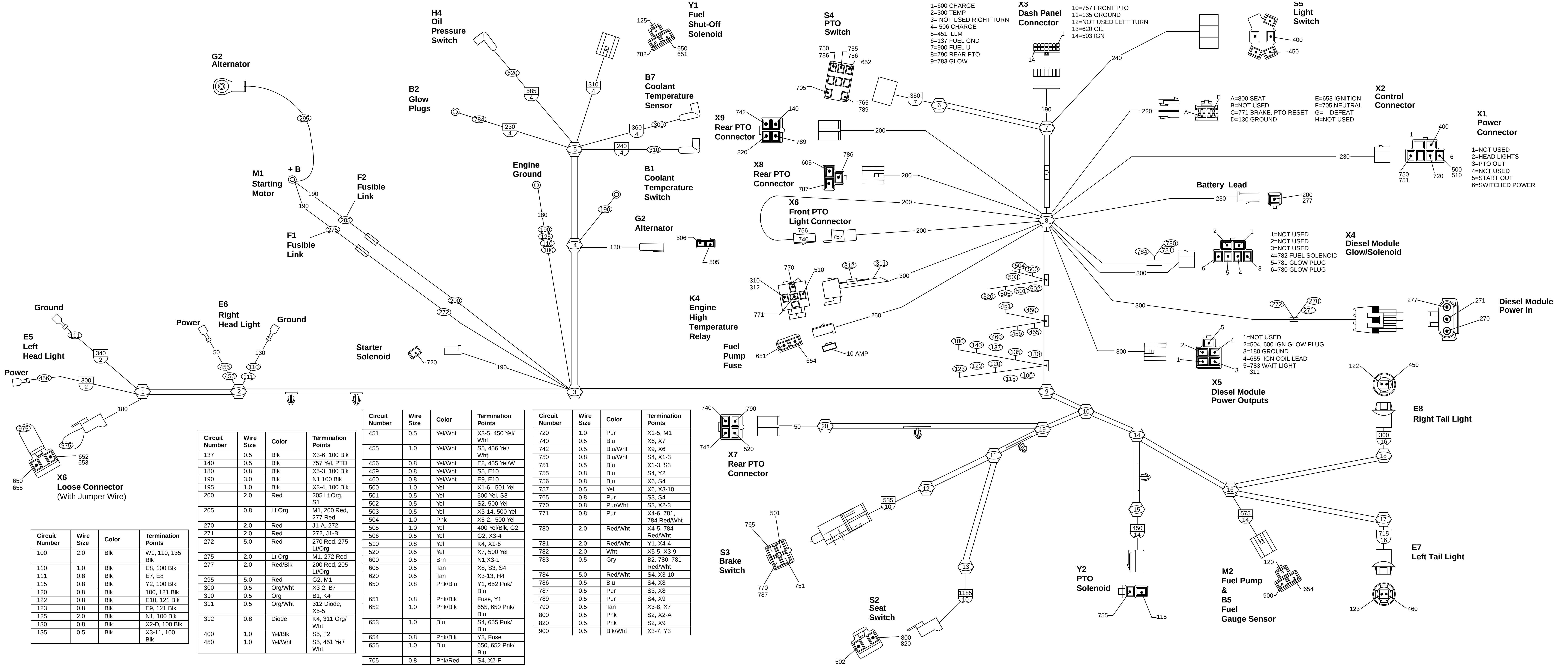
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk
137	0.5	Blk	X3-6, 100 Blk
180	0.8	Blk	X5-3, 100 Blk
190	1.0	Blk	N1,100 Blk
195	0.5	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B

Circuit Number	Wire Size	Color	Termination Points
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/Wht
451	0.5	Yel/Wht	X3-5, 450 Yel/Wht
455	1.0	Yel/Wht	S5, 456 Yel/Wht
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10

Circuit Number	Wire Size	Color	Termination Points
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
600	0.5	Brn	N1,X3-1
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blu	Y1, 652 Pnk/Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Pnk/Blk	655, 650 Pnk/Blu
653	1.0	Blu	S4, 655 Pnk/Blu
654	0.8	Pnk/Blk	Y3, Fuse
655	1.0	Blu	650, 652 Pnk/Blu
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
766	0.8	Pur	S3, X7
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
900	0.5	Blk/Wht	X3-7, Y3

MAIN WIRING HARNESS (W1)—455 (S.N. 031478—070000)



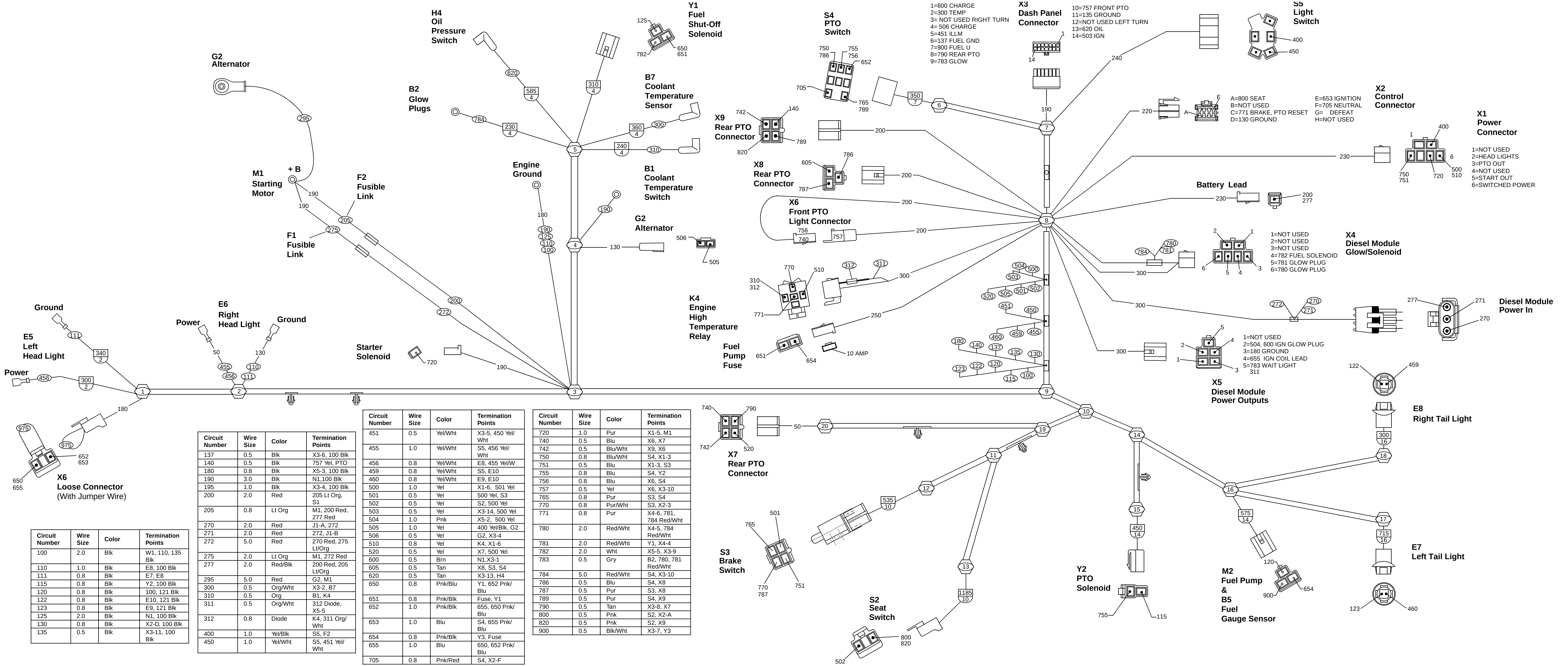
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk

Circuit Number	Wire Size	Color	Termination Points
137	0.5	Blk	X3-6, 100 Blk
140	0.5	Blk	757 Yel, PTO
180	0.8	Blk	X5-3, 100 Blk
190	3.0	Blk	N1,100 Blk
195	1.0	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/ Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/ Wht

Circuit Number	Wire Size	Color	Termination Points
451	0.5	Yel/Wht	X3-5, 450 Yel/ Wht
455	1.0	Yel/Wht	S5, 456 Yel/ Wht
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
520	0.5	Yel	X7, 500 Yel
600	0.5	Brn	N1,X3-1
605	0.5	Tan	X8, S3, S4
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blu	Y1, 652 Pnk/ Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Pnk/Blk	655, 650 Pnk/ Blu
653	1.0	Blu	S4, 655 Pnk/ Blu
654	0.8	Pnk/Blk	Y3, Fuse
655	1.0	Blu	650, 652 Pnk/ Blu
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
740	0.5	Blu	X6, X7
742	0.5	Blu/Wht	X9, X6
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
786	0.5	Blu	S4, X8
787	0.5	Pur	S3, X8
789	0.5	Pur	S4, X9
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
820	0.5	Pnk	S2, X9
900	0.5	Blk/Wht	X3-7, Y3

MAIN WIRING HARNESS (W1)—455 (S.N. 031478—070000)



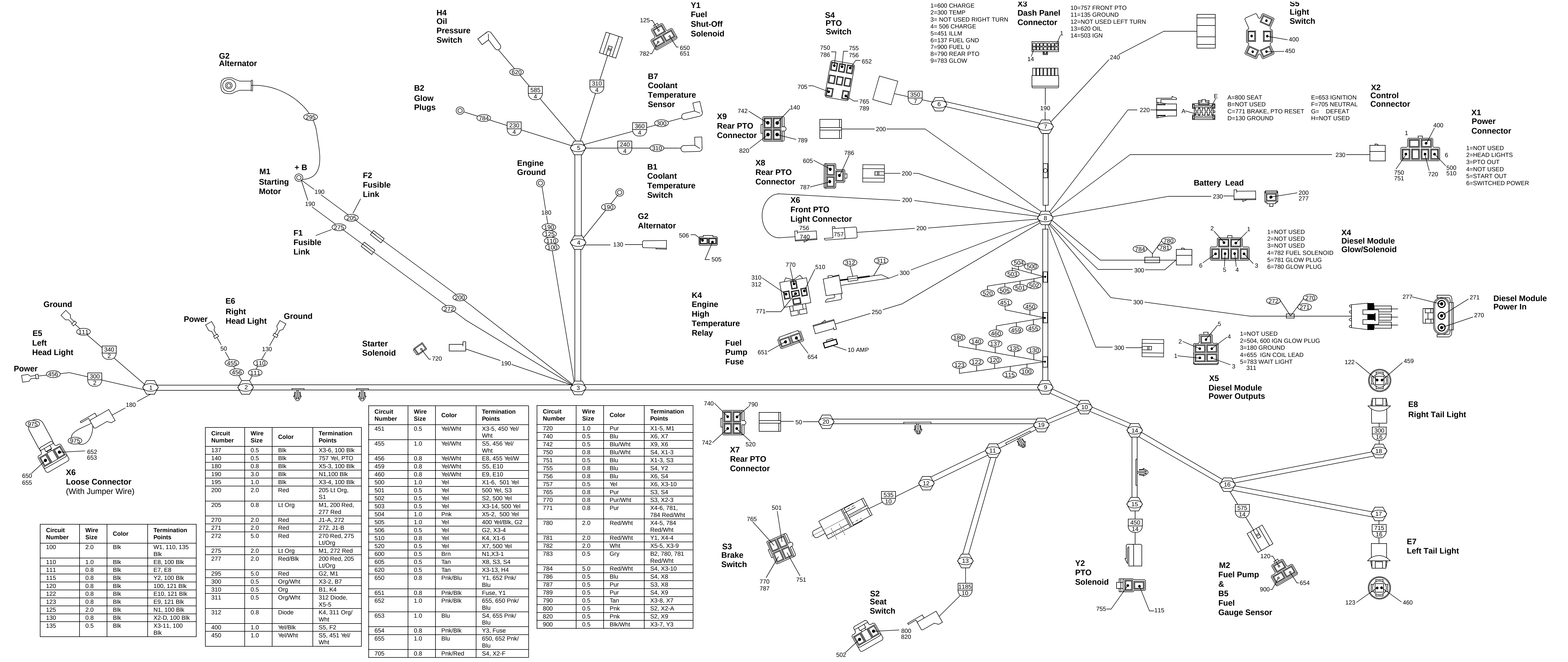
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk

Circuit Number	Wire Size	Color	Termination Points
137	0.5	Blk	X3-6, 100 Blk
140	0.5	Blk	757 Yel, PTO
180	0.8	Blk	X5-3, 100 Blk
190	3.0	Blk	N1,100 Blk
195	1.0	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/ Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/ Wht

Circuit Number	Wire Size	Color	Termination Points
451	0.5	Yel/Wht	X3-5, 450 Yel/ Wht
455	1.0	Yel/Wht	S5, 456 Yel/ Wht
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
520	0.5	Yel	X7, 500 Yel
600	0.5	Brn	N1,X3-1
605	0.5	Tan	X8, S3, S4
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blu	Y1, 652 Pnk/ Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Pnk/Blk	655, 650 Pnk/ Blu
653	1.0	Blu	S4, 655 Pnk/ Blu
654	0.8	Pnk/Blk	Y3, Fuse
655	1.0	Blu	650, 652 Pnk/ Blu
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
740	0.5	Blu	X6, X7
742	0.5	Blu/Wht	X9, X6
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
786	0.5	Blu	S4, X8
787	0.5	Pur	S3, X8
789	0.5	Pur	S4, X9
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
820	0.5	Pnk	S2, X9
900	0.5	Blk/Wht	X3-7, Y3

MAIN WIRING HARNESS (W1)—455 (S.N. 031478—070000)



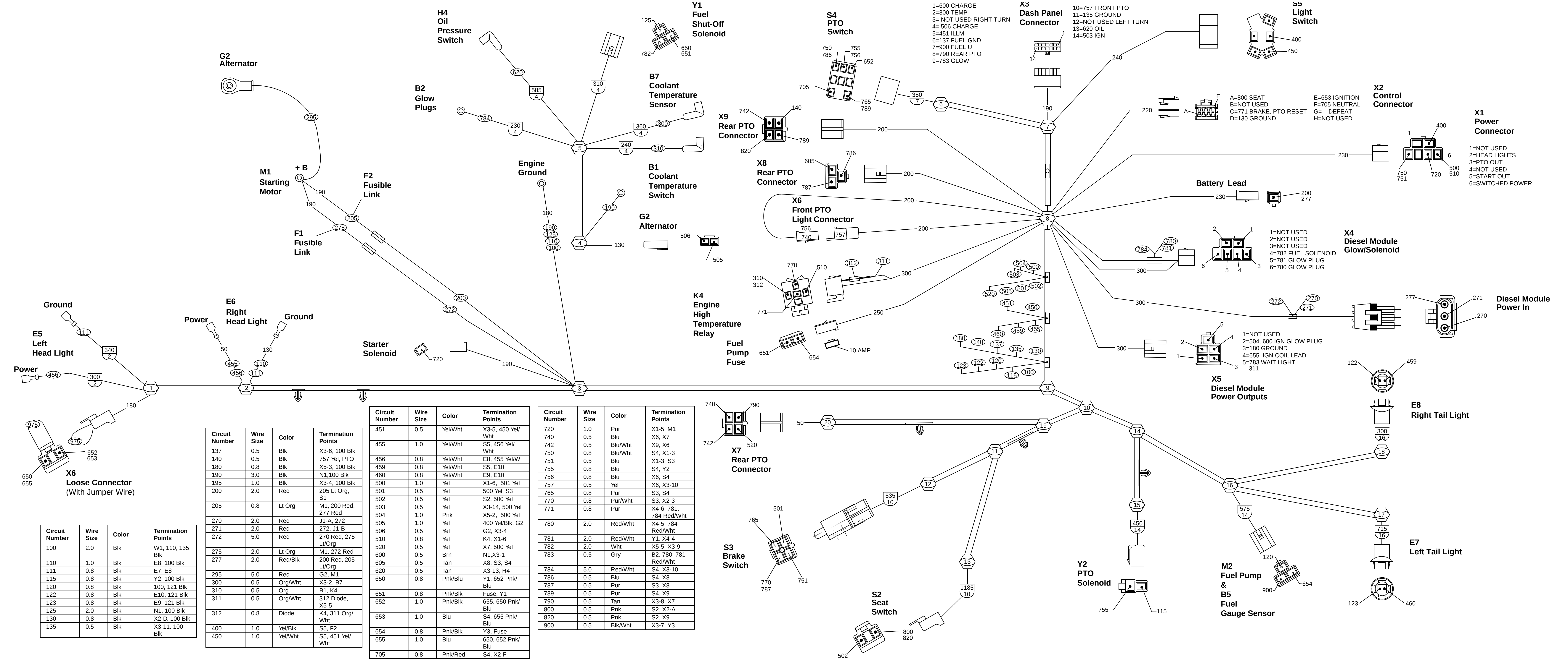
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk

Circuit Number	Wire Size	Color	Termination Points
137	0.5	Blk	X3-6, 100 Blk
140	0.5	Blk	757 Yel, PTO
180	0.8	Blk	X5-3, 100 Blk
190	3.0	Blk	N1,100 Blk
195	1.0	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/Wht

Circuit Number	Wire Size	Color	Termination Points
451	0.5	Yel/Wht	X3-5, 450 Yel/Wht
455	1.0	Yel/Wht	S5, 456 Yel/Wht
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
520	0.5	Yel	X7, 500 Yel
600	0.5	Brn	N1,X3-1
605	0.5	Tan	X8, S3, S4
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blu	Y1, 652 Pnk/Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Pnk/Blk	655, 650 Pnk/Blu
653	1.0	Blu	S4, 655 Pnk/Blu
654	0.8	Pnk/Blk	Y3, Fuse
655	1.0	Blu	650, 652 Pnk/Blu
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
740	0.5	Blu	X6, X7
742	0.5	Blu/Wht	X9, X6
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
786	0.5	Blu	S4, X8
787	0.5	Pur	S3, X8
789	0.5	Pur	S4, X9
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
820	0.5	Pnk	S2, X9
900	0.5	Blk/Wht	X3-7, Y3

MAIN WIRING HARNESS (W1)—455 (S.N. 031478—070000)



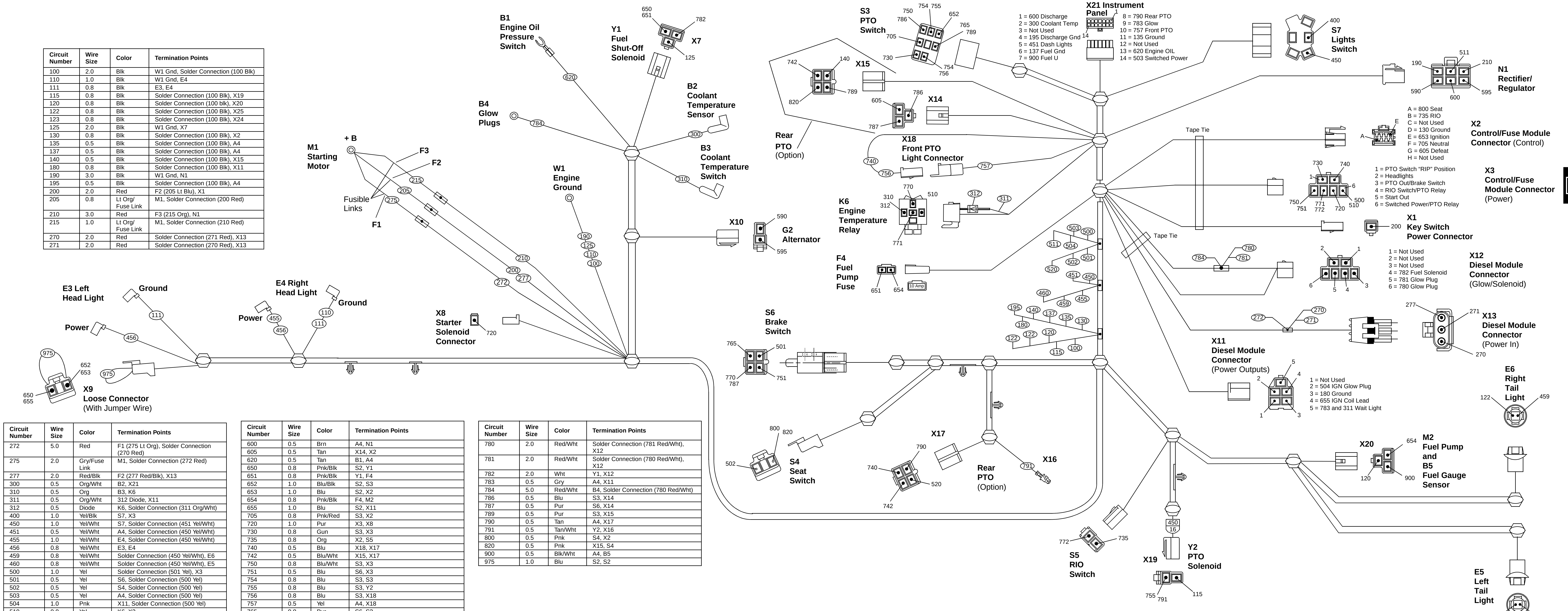
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1, 110, 135 Blk
110	1.0	Blk	E8, 100 Blk
111	0.8	Blk	E7, E8
115	0.8	Blk	Y2, 100 Blk
120	0.8	Blk	100, 121 Blk
122	0.8	Blk	E10, 121 Blk
123	0.8	Blk	E9, 121 Blk
125	2.0	Blk	N1, 100 Blk
130	0.8	Blk	X2-D, 100 Blk
135	0.5	Blk	X3-11, 100 Blk

Circuit Number	Wire Size	Color	Termination Points
137	0.5	Blk	X3-6, 100 Blk
140	0.5	Blk	757 Yel, PTO
180	0.8	Blk	X5-3, 100 Blk
190	3.0	Blk	N1,100 Blk
195	1.0	Blk	X3-4, 100 Blk
200	2.0	Red	205 Lt Org, S1
205	0.8	Lt Org	M1, 200 Red, 277 Red
270	2.0	Red	J1-A, 272
271	2.0	Red	272, J1-B
272	5.0	Red	270 Red, 275 Lt/Org
275	2.0	Lt Org	M1, 272 Red
277	2.0	Red/Blk	200 Red, 205 Lt/Org
295	5.0	Red	G2, M1
300	0.5	Org/Wht	X3-2, B7
310	0.5	Org	B1, K4
311	0.5	Org/Wht	312 Diode, X5-5
312	0.8	Diode	K4, 311 Org/Wht
400	1.0	Yel/Blk	S5, F2
450	1.0	Yel/Wht	S5, 451 Yel/Wht

Circuit Number	Wire Size	Color	Termination Points
451	0.5	Yel/Wht	X3-5, 450 Yel/Wht
455	1.0	Yel/Wht	S5, 456 Yel/Wht
456	0.8	Yel/Wht	E8, 455 Yel/W
459	0.8	Yel/Wht	S5, E10
460	0.8	Yel/Wht	E9, E10
500	1.0	Yel	X1-6, 501 Yel
501	0.5	Yel	500 Yel, S3
502	0.5	Yel	S2, 500 Yel
503	0.5	Yel	X3-14, 500 Yel
504	1.0	Pnk	X5-2, 500 Yel
505	1.0	Yel	400 Yel/Blk, G2
506	0.5	Yel	G2, X3-4
510	0.8	Yel	K4, X1-6
520	0.5	Yel	X7, 500 Yel
600	0.5	Brn	N1,X3-1
605	0.5	Tan	X8, S3, S4
620	0.5	Tan	X3-13, H4
650	0.8	Pnk/Blu	Y1, 652 Pnk/Blu
651	0.8	Pnk/Blk	Fuse, Y1
652	1.0	Pnk/Blk	655, 650 Pnk/Blu
653	1.0	Blu	S4, 655 Pnk/Blu
654	0.8	Pnk/Blk	Y3, Fuse
655	1.0	Blu	650, 652 Pnk/Blu
705	0.8	Pnk/Red	S4, X2-F

Circuit Number	Wire Size	Color	Termination Points
720	1.0	Pur	X1-5, M1
740	0.5	Blu	X6, X7
742	0.5	Blu/Wht	X9, X6
750	0.8	Blu/Wht	S4, X1-3
751	0.5	Blu	X1-3, S3
755	0.8	Blu	S4, Y2
756	0.8	Blu	X6, S4
757	0.5	Yel	X6, X3-10
765	0.8	Pur	S3, S4
770	0.8	Pur/Wht	S3, X2-3
771	0.8	Pur	X4-6, 781, 784 Red/Wht
780	2.0	Red/Wht	X4-5, 784 Red/Wht
781	2.0	Red/Wht	Y1, X4-4
782	2.0	Wht	X5-5, X3-9
783	0.5	Gry	B2, 780, 781 Red/Wht
784	5.0	Red/Wht	S4, X3-10
786	0.5	Blu	S4, X8
787	0.5	Pur	S3, X8
789	0.5	Pur	S4, X9
790	0.5	Tan	X3-8, X7
800	0.5	Pnk	S2, X2-A
820	0.5	Pnk	S2, X9
900	0.5	Blk/Wht	X3-7, Y3

MAIN WIRING HARNESS (W1)—455 (S.N. 070001—)



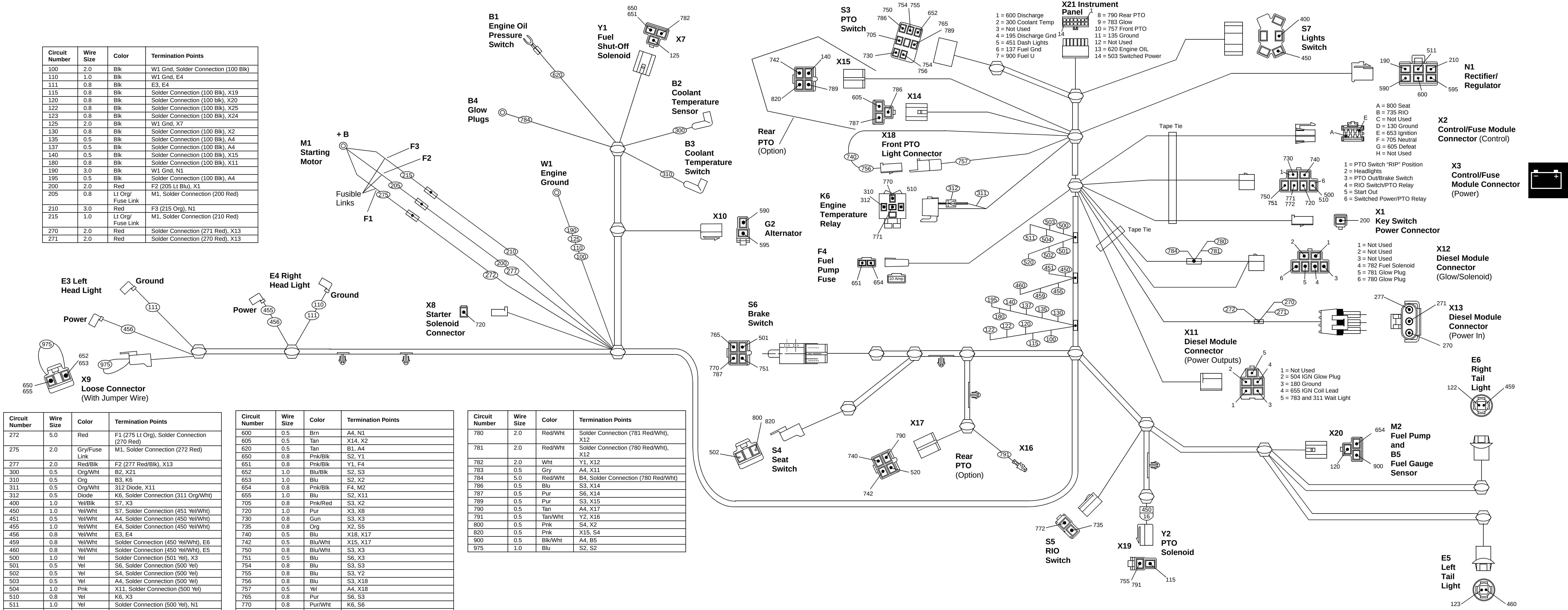
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1 Gnd, Solder Connection (100 Blk)
110	1.0	Blk	W1 Gnd, E4
111	0.8	Blk	E3, E4
115	0.8	Blk	Solder Connection (100 Blk), X19
120	0.8	Blk	Solder Connection (100 blk), X20
122	0.8	Blk	Solder Connection (100 Blk), X25
123	0.8	Blk	Solder Connection (100 Blk), X24
125	2.0	Blk	W1 Gnd, X7
130	0.8	Blk	Solder Connection (100 Blk), X2
135	0.5	Blk	Solder Connection (100 Blk), A4
137	0.5	Blk	Solder Connection (100 Blk), A4
140	0.5	Blk	Solder Connection (100 Blk), X15
180	0.8	Blk	Solder Connection (100 Blk), X11
190	3.0	Blk	W1 Gnd, N1
195	0.5	Blk	Solder Connection (100 Blk), A4
200	2.0	Red	F2 (205 Lt Blu), X1
205	0.8	Lt Org/ Fuse Link	M1, Solder Connection (200 Red)
210	3.0	Red	F3 (215 Org), N1
215	1.0	Lt Org/ Fuse Link	M1, Solder Connection (210 Red)
270	2.0	Red	Solder Connection (271 Red), X13
271	2.0	Red	Solder Connection (270 Red), X13

Circuit Number	Wire Size	Color	Termination Points
272	5.0	Red	F1 (275 Lt Org), Solder Connection (270 Red)
275	2.0	Gry/Fuse Link	M1, Solder Connection (272 Red)
277	2.0	Red/Blk	F2 (277 Red/Blk), X13
300	0.5	Org/Wht	B2, X21
310	0.5	Org	B3, K6
311	0.5	Org/Wht	312 Diode, X11
312	0.5	Diode	K6, Solder Connection (311 Org/Wht)
400	1.0	Yel/Blk	S7, X3
450	1.0	Yel/Wht	S7, Solder Connection (451 Yel/Wht)
451	0.5	Yel/Wht	A4, Solder Connection (450 Yel/Wht)
455	1.0	Yel/Wht	E4, Solder Connection (450 Yel/Wht)
456	0.8	Yel/Wht	E3, E4
459	0.8	Yel/Wht	Solder Connection (450 Yel/Wht), E6
460	0.8	Yel/Wht	Solder Connection (450 Yel/Wht), E5
500	1.0	Yel	Solder Connection (501 Yel), X3
501	0.5	Yel	S6, Solder Connection (500 Yel)
502	0.5	Yel	S4, Solder Connection (500 Yel)
503	0.5	Yel	A4, Solder Connection (500 Yel)
504	1.0	Pnk	X11, Solder Connection (500 Yel)
510	0.8	Yel	K6, X3
511	1.0	Yel	Solder Connection (500 Yel), N1
520	0.5	Yel	Solder Connection (500 Yel), X17
590	2.0	Brn/Yel	G2, N1
595	2.0	Brn/Wht	G2, N1

Circuit Number	Wire Size	Color	Termination Points
600	0.5	Brn	A4, N1
605	0.5	Tan	X14, X2
620	0.5	Tan	B1, A4
650	0.8	Pnk/Blk	S2, Y1
651	0.8	Pnk/Blk	Y1, F4
652	1.0	Blu/Blk	S2, S3
653	1.0	Blu	S2, X2
654	0.8	Pnk/Blk	F4, M2
655	1.0	Blu	S2, X11
705	0.8	Pnk/Red	S3, X2
720	1.0	Pur	X3, X8
730	0.8	Gun	S3, X3
735	0.8	Org	X2, S5
740	0.5	Blu	X18, X17
742	0.5	Blu/Wht	X15, X17
750	0.8	Blu/Wht	S3, X3
751	0.5	Blu	S6, X3
754	0.8	Blu	S3, S3
755	0.8	Blu	S3, Y2
756	0.8	Blu	S3, X18
757	0.5	Yel	A4, X18
765	0.8	Pur	S6, S3
770	0.8	Pur/Wht	K6, S6
771	0.8	Pur	K6, X3
772	0.8	Blu	X3, S5

Circuit Number	Wire Size	Color	Termination Points
780	2.0	Red/Wht	Solder Connection (781 Red/Wht), X12
781	2.0	Red/Wht	Solder Connection (780 Red/Wht), X12
782	2.0	Wht	Y1, X12
783	0.5	Gry	A4, X11
784	5.0	Red/Wht	B4, Solder Connection (780 Red/Wht)
786	0.5	Blu	S3, X14
787	0.5	Pur	S6, X14
789	0.5	Pur	S3, X15
790	0.5	Tan	A4, X17
791	0.5	Tan/Wht	Y2, X16
800	0.5	Pnk	S4, X2
820	0.5	Pnk	X15, S4
900	0.5	Blk/Wht	A4, B5
975	1.0	Blu	S2, S2

MAIN WIRING HARNESS (W1)—455 (S.N. 070001—)



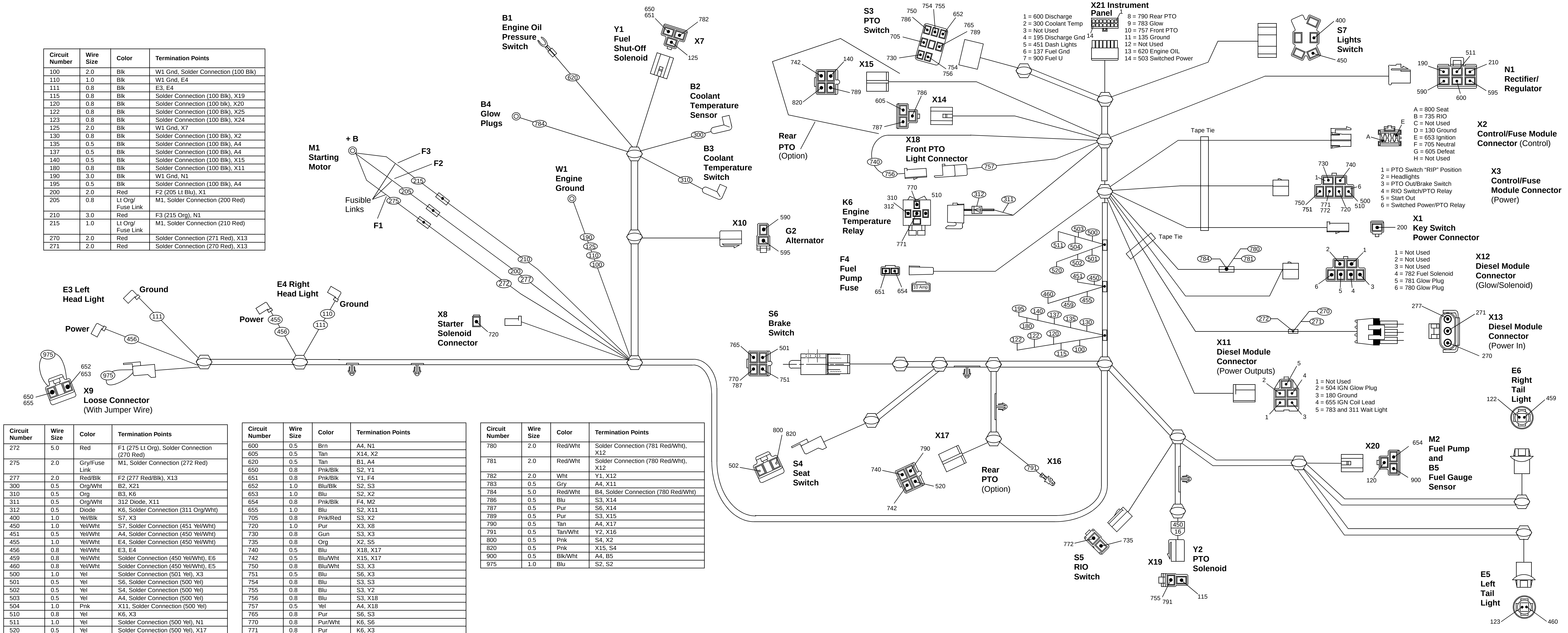
Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1 Gnd, Solder Connection (100 Blk)
110	1.0	Blk	W1 Gnd, E4
111	0.8	Blk	E3, E4
115	0.8	Blk	Solder Connection (100 Blk), X19
120	0.8	Blk	Solder Connection (100 blk), X20
122	0.8	Blk	Solder Connection (100 Blk), X25
123	0.8	Blk	Solder Connection (100 Blk), X24
125	2.0	Blk	W1 Gnd, X7
130	0.8	Blk	Solder Connection (100 Blk), X2
135	0.5	Blk	Solder Connection (100 Blk), A4
137	0.5	Blk	Solder Connection (100 Blk), A4
140	0.5	Blk	Solder Connection (100 Blk), X15
180	0.8	Blk	Solder Connection (100 Blk), X11
190	3.0	Blk	W1 Gnd, N1
195	0.5	Blk	Solder Connection (100 Blk), A4
200	2.0	Red	F2 (205 Lt Blu), X1
205	0.8	Lt Org/ Fuse Link	M1, Solder Connection (200 Red)
210	3.0	Red	F3 (215 Org), N1
215	1.0	Lt Org/ Fuse Link	M1, Solder Connection (210 Red)
270	2.0	Red	Solder Connection (271 Red), X13
271	2.0	Red	Solder Connection (270 Red), X13

Circuit Number	Wire Size	Color	Termination Points
272	5.0	Red	F1 (275 Lt Org), Solder Connection (270 Red)
275	2.0	Gry/Fuse Link	M1, Solder Connection (272 Red)
277	2.0	Red/Blk	F2 (277 Red/Blk), X13
300	0.5	Org/Wht	B2, X21
310	0.5	Org	B3, K6
311	0.5	Org/Wht	312 Diode, X11
312	0.5	Diode	K6, Solder Connection (311 Org/Wht)
400	1.0	Yel/Blk	S7, X3
450	1.0	Yel/Wht	S7, Solder Connection (451 Yel/Wht)
451	0.5	Yel/Wht	A4, Solder Connection (450 Yel/Wht)
455	1.0	Yel/Wht	E4, Solder Connection (450 Yel/Wht)
456	0.8	Yel/Wht	E3, E4
459	0.8	Yel/Wht	Solder Connection (450 Yel/Wht), E6
460	0.8	Yel/Wht	Solder Connection (450 Yel/Wht), E5
500	1.0	Yel	Solder Connection (501 Yel), X3
501	0.5	Yel	S6, Solder Connection (500 Yel)
502	0.5	Yel	S4, Solder Connection (500 Yel)
503	0.5	Yel	A4, Solder Connection (500 Yel)
504	1.0	Pnk	X11, Solder Connection (500 Yel)
510	0.8	Yel	K6, X3
511	1.0	Yel	Solder Connection (500 Yel), N1
520	0.5	Yel	Solder Connection (500 Yel), X17
590	2.0	Brn/Yel	G2, N1
595	2.0	Brn/Wht	G2, N1

Circuit Number	Wire Size	Color	Termination Points
600	0.5	Brn	A4, N1
605	0.5	Tan	X14, X2
620	0.5	Tan	B1, A4
650	0.8	Pnk/Blk	S2, Y1
651	0.8	Pnk/Blk	Y1, F4
652	1.0	Blu/Blk	S2, S3
653	1.0	Blu	S2, X2
654	0.8	Pnk/Blk	F4, M2
655	1.0	Blu	S2, X11
705	0.8	Pnk/Red	S3, X2
720	1.0	Pur	X3, X8
730	0.8	Gun	S3, X3
735	0.8	Org	X2, S5
740	0.5	Blu	X18, X17
742	0.5	Blu/Wht	X15, X17
750	0.8	Blu/Wht	S3, X3
751	0.5	Blu	S6, X3
754	0.8	Blu	S3, S3
755	0.8	Blu	S3, Y2
756	0.8	Blu	S3, X18
757	0.5	Yel	A4, X18
765	0.8	Pur	S6, S3
770	0.8	Pur/Wht	K6, S6
771	0.8	Pur	K6, X3
772	0.8	Blu	X3, S5

Circuit Number	Wire Size	Color	Termination Points
780	2.0	Red/Wht	Solder Connection (781 Red/Wht), X12
781	2.0	Red/Wht	Solder Connection (780 Red/Wht), X12
782	2.0	Wht	Y1, X12
783	0.5	Gry	A4, X11
784	5.0	Red/Wht	B4, Solder Connection (780 Red/Wht)
786	0.5	Blu	S3, X14
787	0.5	Pur	S6, X14
789	0.5	Pur	S3, X15
790	0.5	Tan	A4, X17
791	0.5	Tan/Wht	Y2, X16
800	0.5	Pnk	S4, X2
820	0.5	Pnk	X15, S4
900	0.5	Blk/Wht	A4, B5
975	1.0	Blu	S2, S2

MAIN WIRING HARNESS (W1)—455 (S.N. 070001—)



Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1 Gnd, Solder Connection (100 Blk)
110	1.0	Blk	W1 Gnd, E4
111	0.8	Blk	E3, E4
115	0.8	Blk	Solder Connection (100 Blk), X19
120	0.8	Blk	Solder Connection (100 blk), X20
122	0.8	Blk	Solder Connection (100 Blk), X25
123	0.8	Blk	Solder Connection (100 Blk), X24
125	2.0	Blk	W1 Gnd, X7
130	0.8	Blk	Solder Connection (100 Blk), X2
135	0.5	Blk	Solder Connection (100 Blk), A4
137	0.5	Blk	Solder Connection (100 Blk), A4
140	0.5	Blk	Solder Connection (100 Blk), X15
180	0.8	Blk	Solder Connection (100 Blk), X11
190	3.0	Blk	W1 Gnd, N1
195	0.5	Blk	Solder Connection (100 Blk), A4
200	2.0	Red	F2 (205 Lt Blu), X1
205	0.8	Lt Org/ Fuse Link	M1, Solder Connection (200 Red)
210	3.0	Red	F3 (215 Org), N1
215	1.0	Lt Org/ Fuse Link	M1, Solder Connection (210 Red)
270	2.0	Red	Solder Connection (271 Red), X13
271	2.0	Red	Solder Connection (270 Red), X13

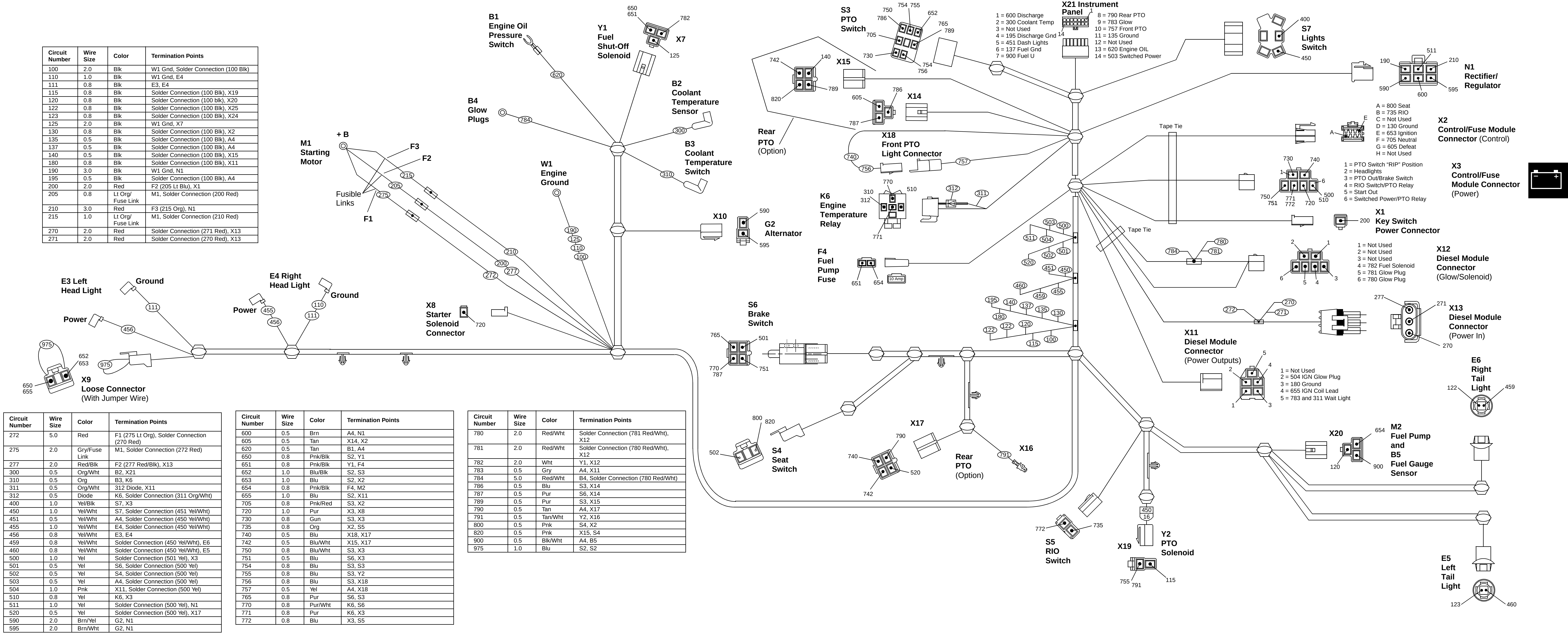
Circuit Number	Wire Size	Color	Termination Points
272	5.0	Red	F1 (275 Lt Org), Solder Connection (270 Red)
275	2.0	Gry/Fuse Link	M1, Solder Connection (272 Red)
277	2.0	Red/Blk	F2 (277 Red/Blk), X13
300	0.5	Org/Wht	B2, X21
310	0.5	Org	B3, K6
311	0.5	Org/Wht	312 Diode, X11
312	0.5	Diode	K6, Solder Connection (311 Org/Wht)
400	1.0	Yel/Blk	S7, X3
450	1.0	Yel/Wht	S7, Solder Connection (451 Yel/Wht)
451	0.5	Yel/Wht	A4, Solder Connection (450 Yel/Wht)
455	1.0	Yel/Wht	E4, Solder Connection (450 Yel/Wht)
456	0.8	Yel/Wht	E3, E4
459	0.8	Yel/Wht	Solder Connection (450 Yel/Wht), E6
460	0.8	Yel/Wht	Solder Connection (450 Yel/Wht), E5
500	1.0	Yel	Solder Connection (501 Yel), X3
501	0.5	Yel	S6, Solder Connection (500 Yel)
502	0.5	Yel	S4, Solder Connection (500 Yel)
503	0.5	Yel	A4, Solder Connection (500 Yel)
504	1.0	Pnk	X11, Solder Connection (500 Yel)
510	0.8	Yel	K6, X3
511	1.0	Yel	Solder Connection (500 Yel), N1
520	0.5	Yel	Solder Connection (500 Yel), X17
590	2.0	Brn/Yel	G2, N1
595	2.0	Brn/Wht	G2, N1

Circuit Number	Wire Size	Color	Termination Points
600	0.5	Brn	A4, N1
605	0.5	Tan	X14, X2
620	0.5	Tan	B1, A4
650	0.8	Pnk/Blk	S2, Y1
651	0.8	Pnk/Blk	Y1, F4
652	1.0	Blu/Blk	S2, S3
653	1.0	Blu	S2, X2
654	0.8	Pnk/Blk	F4, M2
655	1.0	Blu	S2, X11
705	0.8	Pnk/Red	S3, X2
720	1.0	Pur	X3, X8
730	0.8	Gun	S3, X3
735	0.8	Org	X2, S5
740	0.5	Blu	X18, X17
742	0.5	Blu/Wht	X15, X17
750	0.8	Blu/Wht	S3, X3
751	0.5	Blu	S6, X3
754	0.8	Blu	S3, S3
755	0.8	Blu	S3, Y2
756	0.8	Blu	S3, X18
757	0.5	Yel	A4, X18
765	0.8	Pur	S6, S3
770	0.8	Pur/Wht	K6, S6
771	0.8	Pur	K6, X3
772	0.8	Blu	X3, S5

Circuit Number	Wire Size	Color	Termination Points
780	2.0	Red/Wht	Solder Connection (781 Red/Wht), X12
781	2.0	Red/Wht	Solder Connection (780 Red/Wht), X12
782	2.0	Wht	Y1, X12
783	0.5	Gry	A4, X11
784	5.0	Red/Wht	B4, Solder Connection (780 Red/Wht)
786	0.5	Blu	S3, X14
787	0.5	Pur	S6, X14
789	0.5	Pur	S3, X15
790	0.5	Tan	A4, X17
791	0.5	Tan/Wht	Y2, X16
800	0.5	Pnk	S4, X2
820	0.5	Pnk	X15, S4
900	0.5	Blk/Wht	A4, B5
975	1.0	Blu	S2, S2

MAIN WIRING HARNESS (W1)—455 (S.N. 070001—)

Circuit Number	Wire Size	Color	Termination Points
100	2.0	Blk	W1 Gnd, Solder Connection (100 Blk)
110	1.0	Blk	W1 Gnd, E4
111	0.8	Blk	E3, E4
115	0.8	Blk	Solder Connection (100 Blk), X19
120	0.8	Blk	Solder Connection (100 blk), X20
122	0.8	Blk	Solder Connection (100 Blk), X25
123	0.8	Blk	Solder Connection (100 Blk), X24
125	2.0	Blk	W1 Gnd, X7
130	0.8	Blk	Solder Connection (100 Blk), X2
135	0.5	Blk	Solder Connection (100 Blk), A4
137	0.5	Blk	Solder Connection (100 Blk), A4
140	0.5	Blk	Solder Connection (100 Blk), X15
180	0.8	Blk	Solder Connection (100 Blk), X11
190	3.0	Blk	W1 Gnd, N1
195	0.5	Blk	Solder Connection (100 Blk), A4
200	2.0	Red	F2 (205 Lt Blu), X1
205	0.8	Lt Org/ Fuse Link	M1, Solder Connection (200 Red)
210	3.0	Red	F3 (215 Org), N1
215	1.0	Lt Org/ Fuse Link	M1, Solder Connection (210 Red)
270	2.0	Red	Solder Connection (271 Red), X13
271	2.0	Red	Solder Connection (270 Red), X13

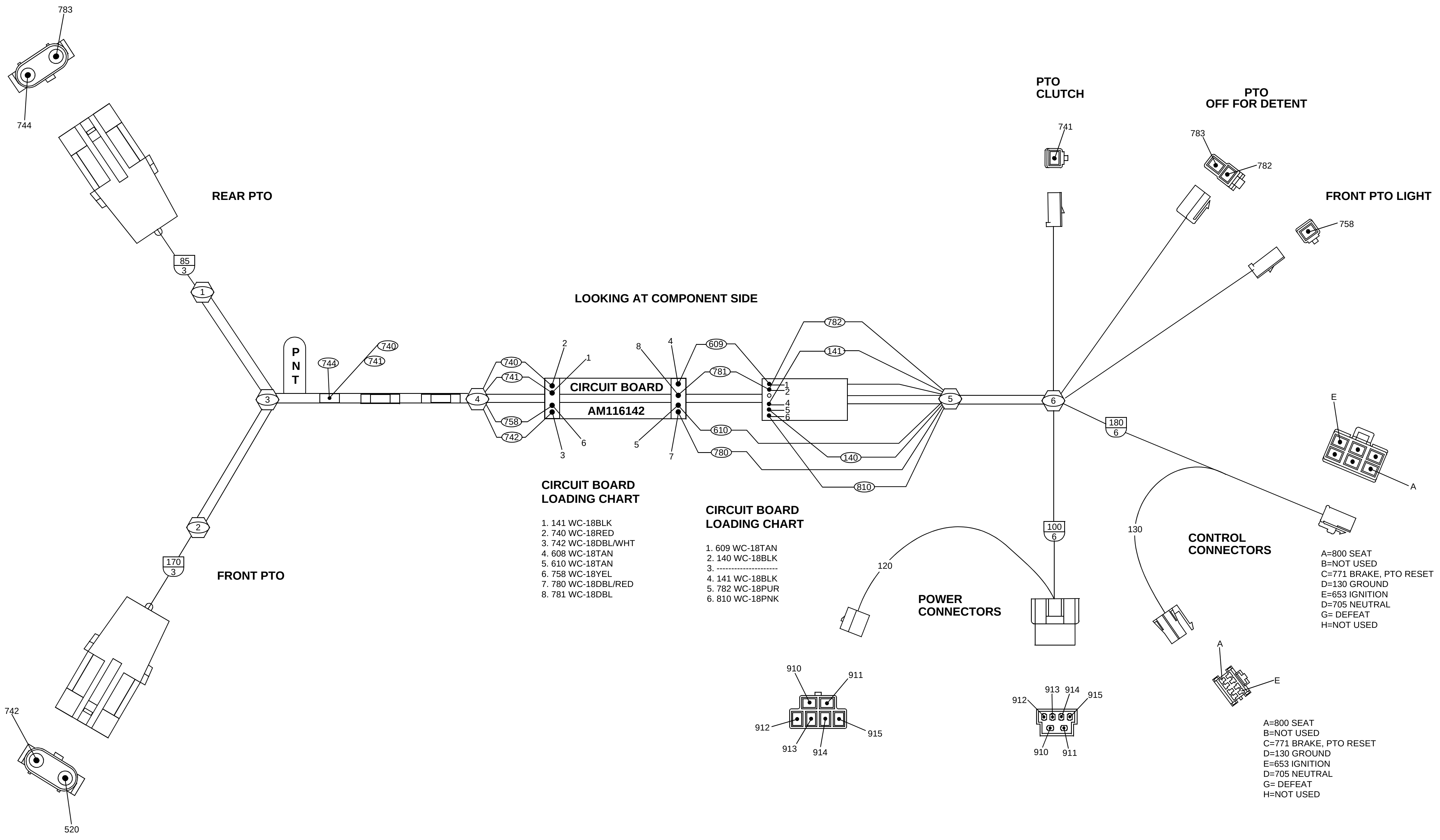


Circuit Number	Wire Size	Color	Termination Points
272	5.0	Red	F1 (275 Lt Org), Solder Connection (270 Red)
275	2.0	Gry/Fuse Link	M1, Solder Connection (272 Red)
277	2.0	Red/Blk	F2 (277 Red/Blk), X13
300	0.5	Org/Wht	B2, X21
310	0.5	Org	B3, K6
311	0.5	Org/Wht	312 Diode, X11
312	0.5	Diode	K6, Solder Connection (311 Org/Wht)
400	1.0	Yel/Blk	S7, X3
450	1.0	Yel/Wht	S7, Solder Connection (451 Yel/Wht)
451	0.5	Yel/Wht	A4, Solder Connection (450 Yel/Wht)
455	1.0	Yel/Wht	E4, Solder Connection (450 Yel/Wht)
456	0.8	Yel/Wht	E3, E4
459	0.8	Yel/Wht	Solder Connection (450 Yel/Wht), E6
460	0.8	Yel/Wht	Solder Connection (450 Yel/Wht), E5
500	1.0	Yel	Solder Connection (501 Yel), X3
501	0.5	Yel	S6, Solder Connection (500 Yel)
502	0.5	Yel	S4, Solder Connection (500 Yel)
503	0.5	Yel	A4, Solder Connection (500 Yel)
504	1.0	Pnk	X11, Solder Connection (500 Yel)
510	0.8	Yel	K6, X3
511	1.0	Yel	Solder Connection (500 Yel), N1
520	0.5	Yel	Solder Connection (500 Yel), X17
590	2.0	Brn/Yel	G2, N1
595	2.0	Brn/Wht	G2, N1

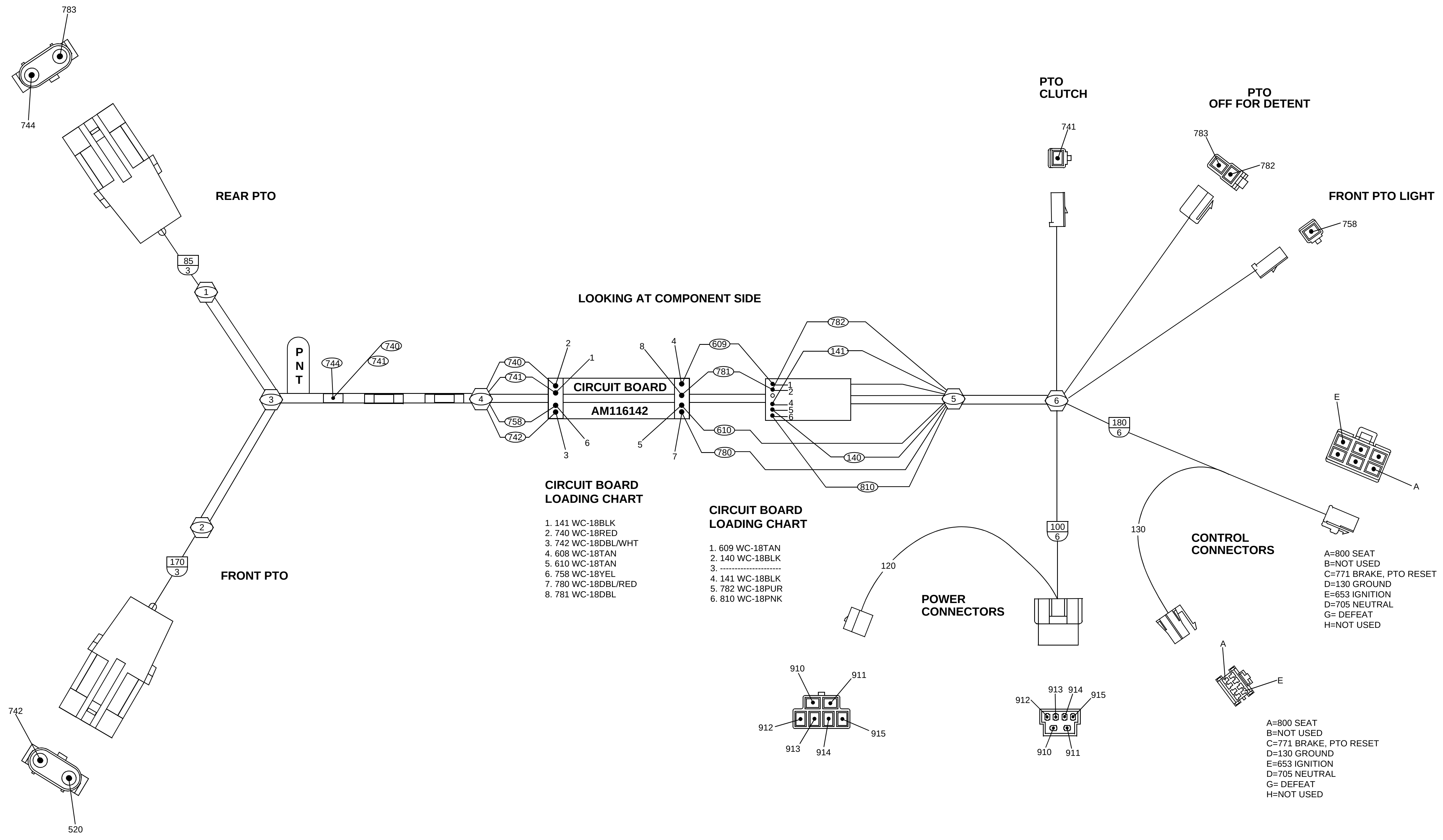
Circuit Number	Wire Size	Color	Termination Points
600	0.5	Brn	A4, N1
605	0.5	Tan	X14, X2
620	0.5	Tan	B1, A4
650	0.8	Pnk/Blk	S2, Y1
651	0.8	Pnk/Blk	Y1, F4
652	1.0	Blu/Blk	S2, S3
653	1.0	Blu	S2, X2
654	0.8	Pnk/Blk	F4, M2
655	1.0	Blu	S2, X11
705	0.8	Pnk/Red	S3, X2
720	1.0	Pur	X3, X8
730	0.8	Gun	S3, X3
735	0.8	Org	X2, S5
740	0.5	Blu	X18, X17
742	0.5	Blu/Wht	X15, X17
750	0.8	Blu/Wht	S3, X3
751	0.5	Blu	S6, X3
754	0.8	Blu	S3, S3
755	0.8	Blu	S3, Y2
756	0.8	Blu	S3, X18
757	0.5	Yel	A4, X18
765	0.8	Pur	S6, S3
770	0.8	Pur/Wht	K6, S6
771	0.8	Pur	K6, X3
772	0.8	Blu	X3, S5

Circuit Number	Wire Size	Color	Termination Points
780	2.0	Red/Wht	Solder Connection (781 Red/Wht), X12
781	2.0	Red/Wht	Solder Connection (780 Red/Wht), X12
782	2.0	Wht	Y1, X12
783	0.5	Gry	A4, X11
784	5.0	Red/Wht	B4, Solder Connection (780 Red/Wht)
786	0.5	Blu	S3, X14
787	0.5	Pur	S6, X14
789	0.5	Pur	S3, X15
790	0.5	Tan	A4, X17
791	0.5	Tan/Wht	Y2, X16
800	0.5	Pnk	S4, X2
820	0.5	Pnk	X15, S4
900	0.5	Blk/Wht	A4, B5
975	1.0	Blu	S2, S2

REAR PTO WIRING HARNESS (W2)—455 EARLY MODELS



REAR PTO WIRING HARNESS (W2)—455 EARLY MODELS



CIRCUIT BOARD
LOADING CHART

1. 141 WC-18BLK
2. 740 WC-18RED
3. 742 WC-18DBL/WHT
4. 608 WC-18TAN
5. 610 WC-18TAN
6. 758 WC-18YEL
7. 780 WC-18DBL/RED
8. 781 WC-18DBL

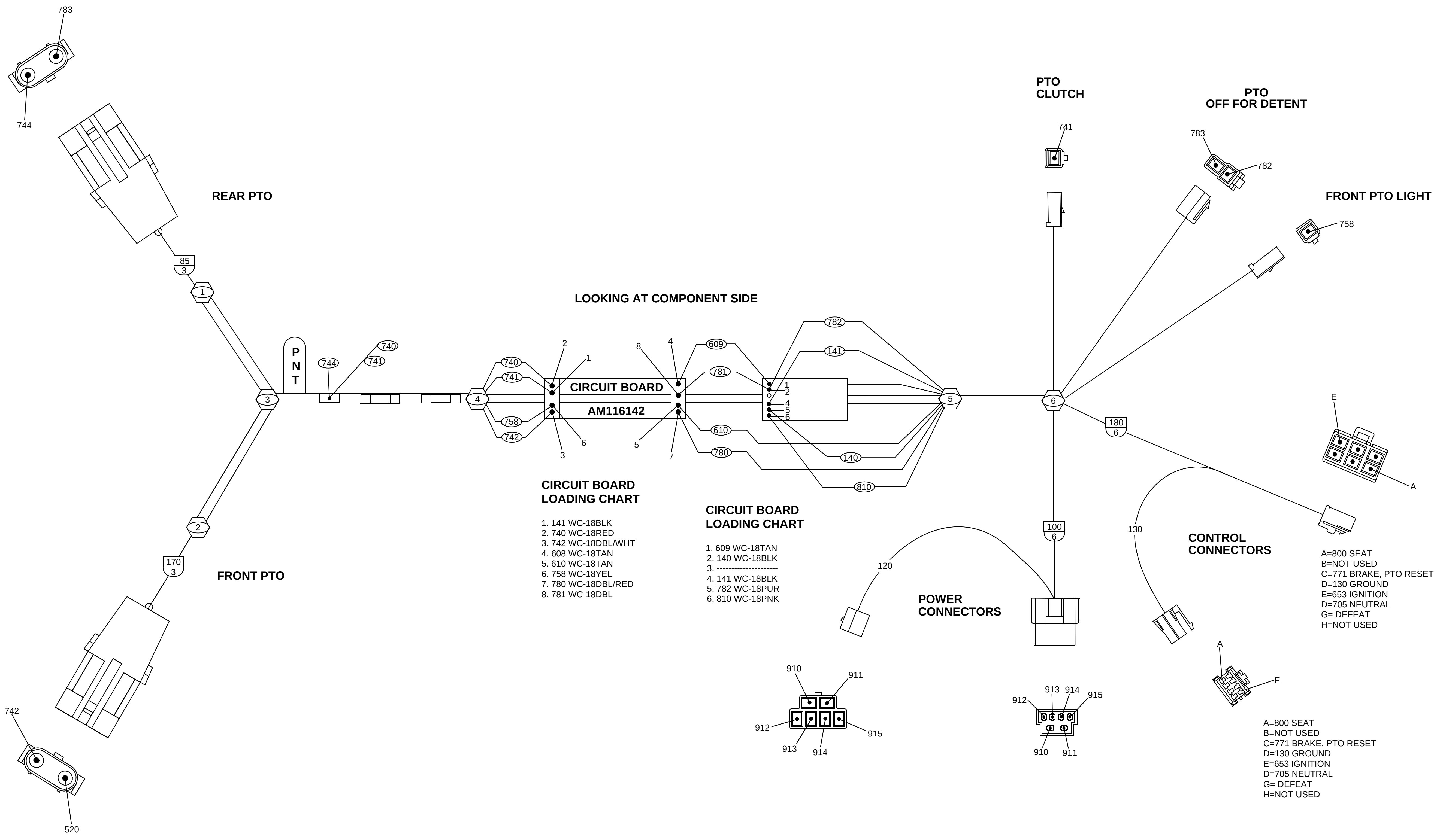
CIRCUIT BOARD
LOADING CHART

1. 609 WC-18TAN
2. 140 WC-18BLK
3. --------------------
4. 141 WC-18BLK
5. 782 WC-18PUR
6. 810 WC-18PNK

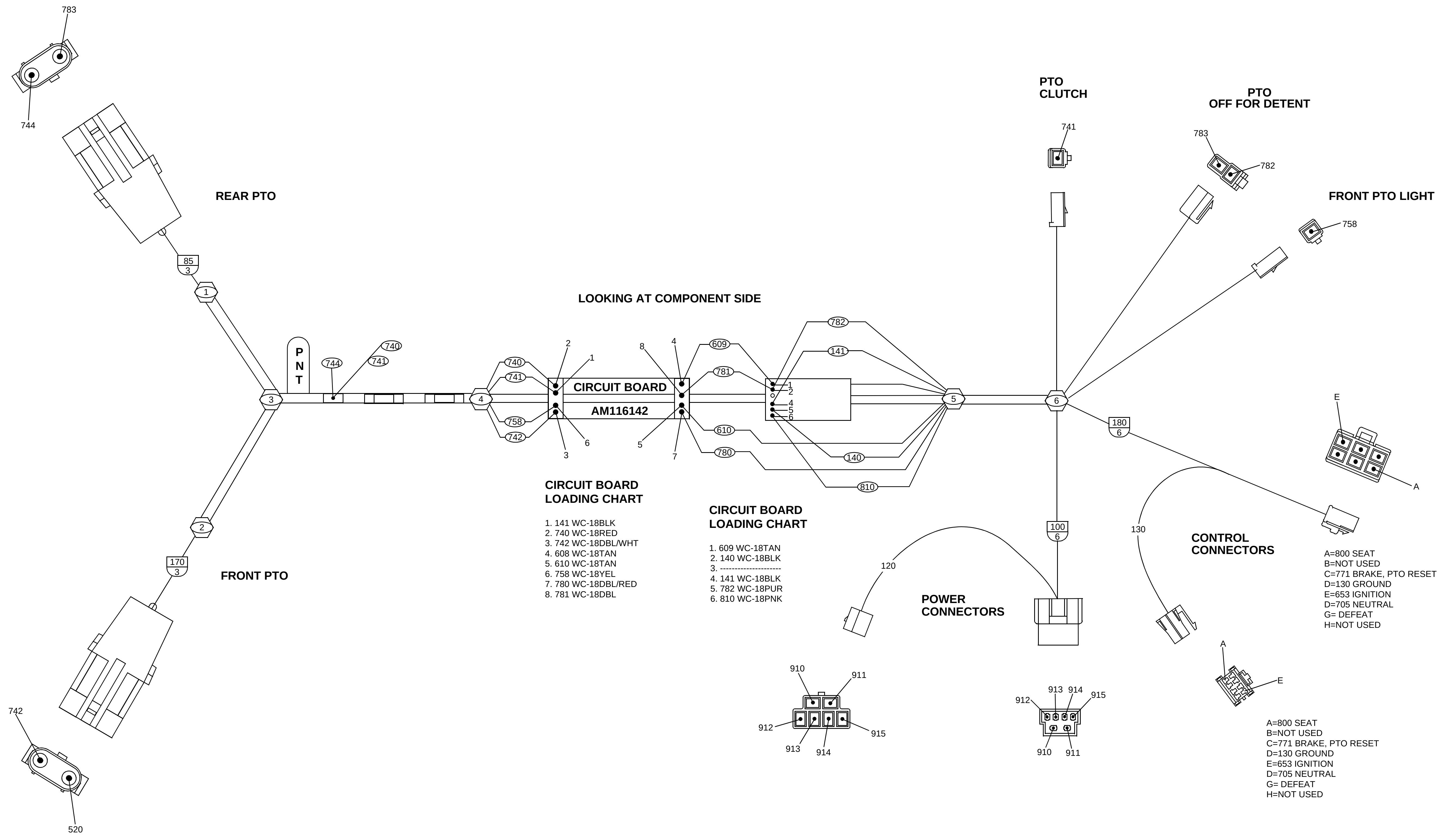
A=800 SEAT
B=NOT USED
C=771 BRAKE, PTO RESET
D=130 GROUND
E=653 IGNITION
D=705 NEUTRAL
G= DEFEAT
H=NOT USED

A=800 SEAT
B=NOT USED
C=771 BRAKE, PTO RESET
D=130 GROUND
E=653 IGNITION
D=705 NEUTRAL
G= DEFEAT
H=NOT USED

REAR PTO WIRING HARNESS (W2)—455 EARLY MODELS



REAR PTO WIRING HARNESS (W2)—455 EARLY MODELS



CIRCUIT BOARD LOADING CHART

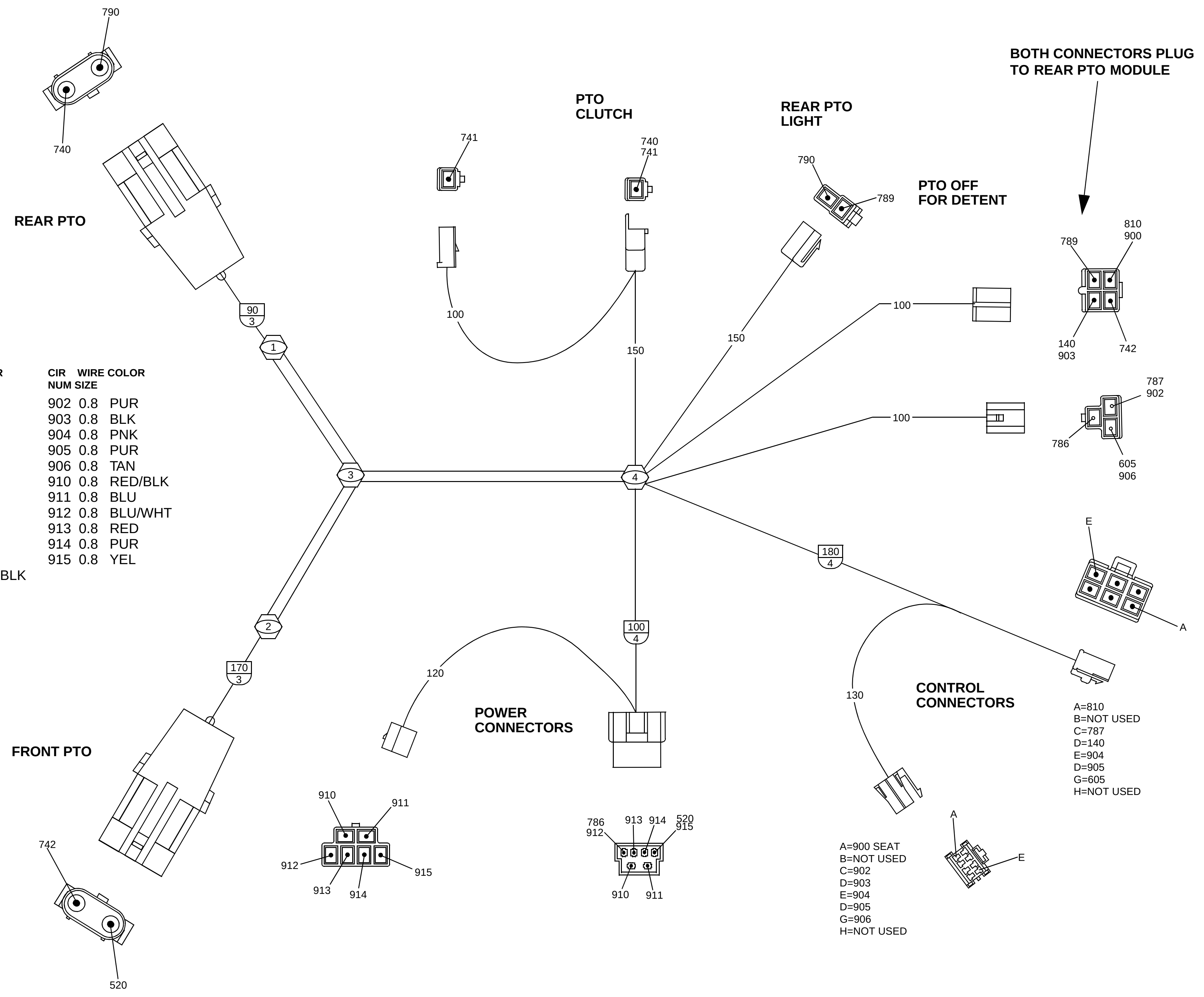
1. 141 WC-18BLK
2. 740 WC-18RED
3. 742 WC-18DBL/WHT
4. 608 WC-18TAN
5. 610 WC-18TAN
6. 758 WC-18YEL
7. 780 WC-18DBL/RED
8. 781 WC-18DBL

CIRCUIT BOARD LOADING CHART

1. 609 WC-18TAN
2. 140 WC-18BLK
3. --------------------
4. 141 WC-18BLK
5. 782 WC-18PUR
6. 810 WC-18PNK

REAR PTO WIRING HARNESS (W2)—455 LATER MODELS

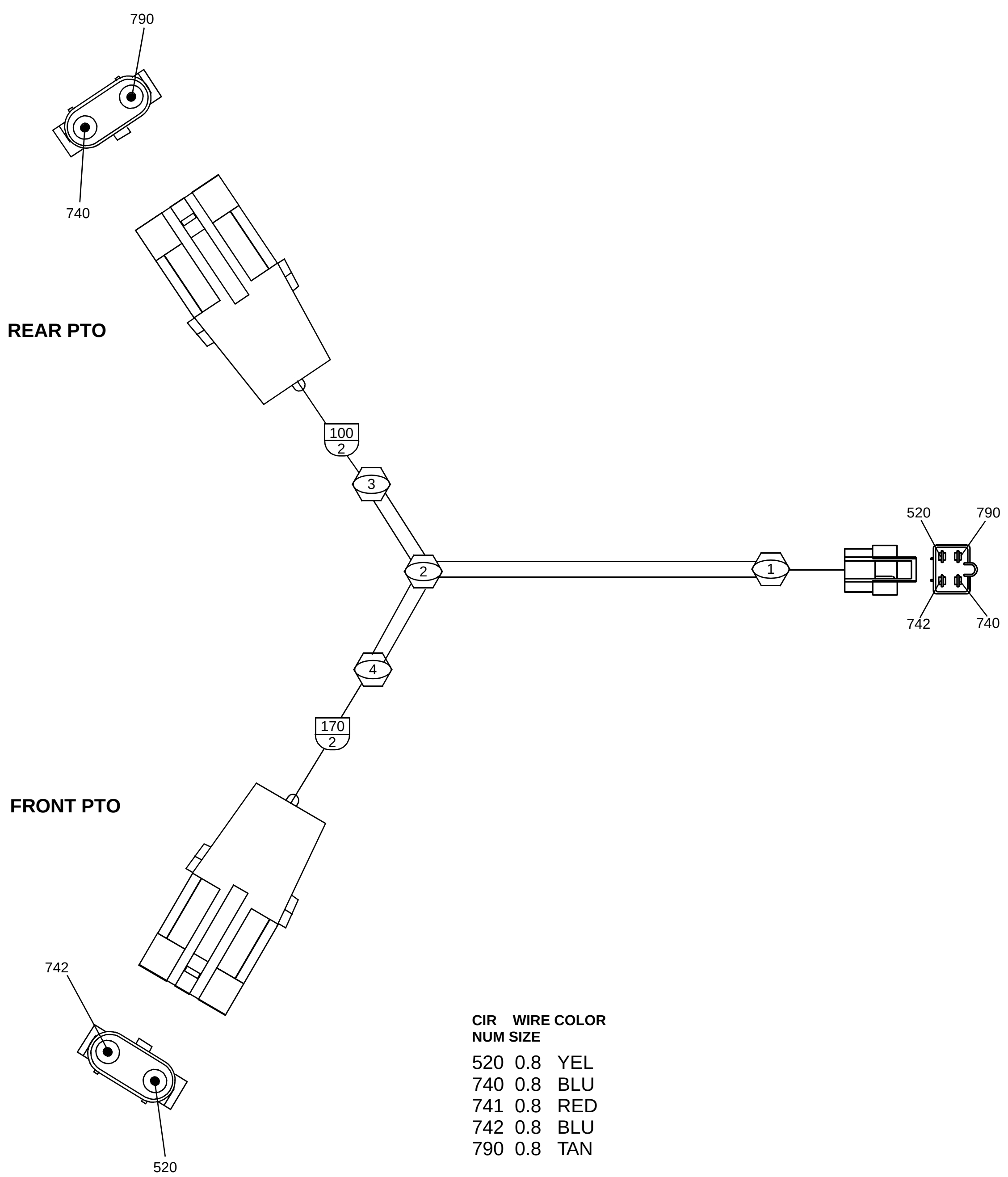
TWO-WHEEL STEER (S.N. —031477)
ALL-WHEEL STEER (S.N. —030384)



CIR NUM	WIRE SIZE	COLOR
140	0.8	BLK
520	0.8	YEL
605	0.8	TAN
740	0.8	BLU
741	0.8	RED
742	0.8	BLU
786	0.8	BLU
787	0.8	PUR
789	0.8	PUR
790	0.8	TAN
810	0.8	PNK
900	0.8	PNK/BLK

CIR NUM	WIRE SIZE	COLOR
902	0.8	PUR
903	0.8	BLK
904	0.8	PNK
905	0.8	PUR
906	0.8	TAN
910	0.8	RED/BLK
911	0.8	BLU
912	0.8	BLU/WHT
913	0.8	RED
914	0.8	PUR
915	0.8	YEL

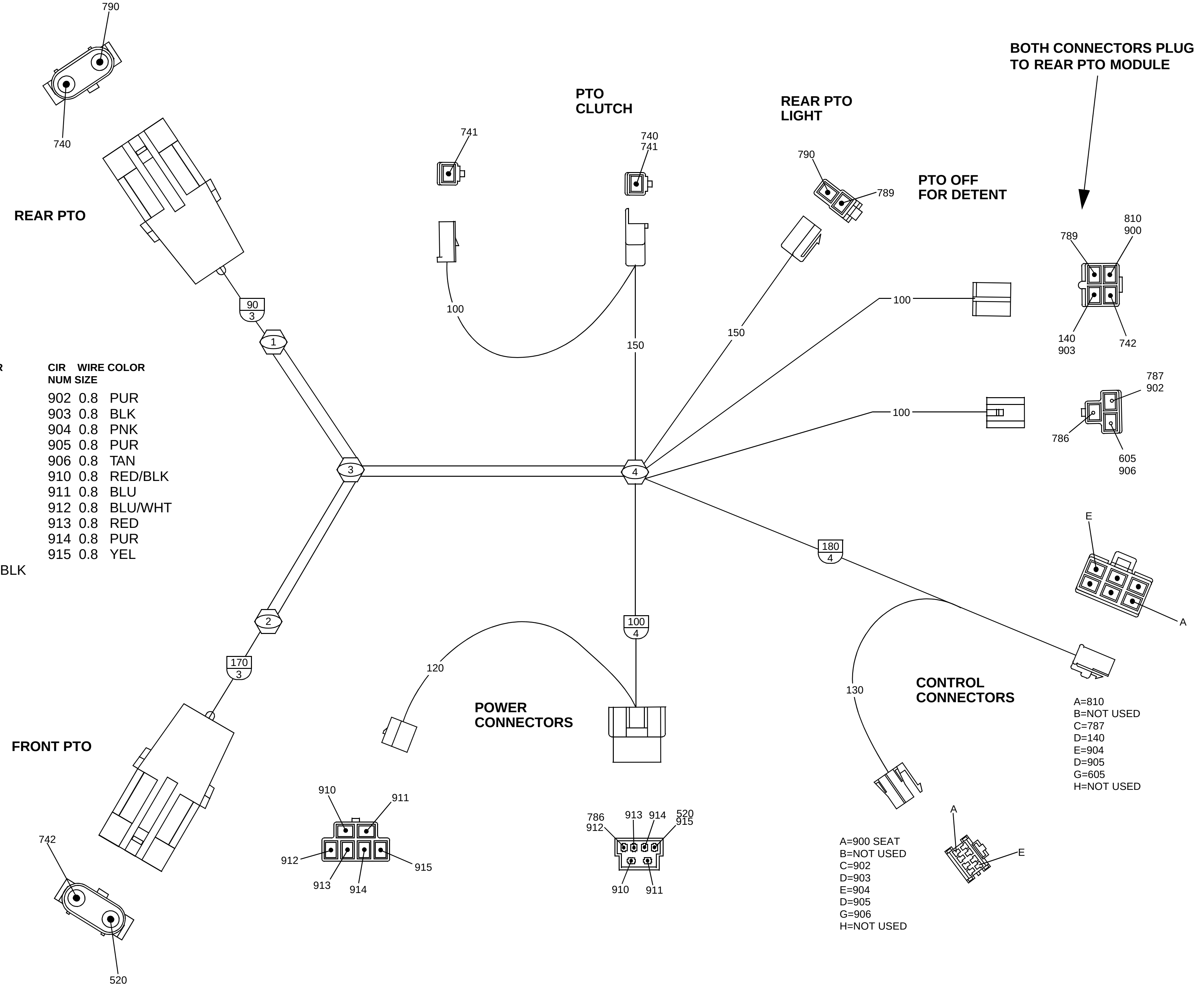
TWO-WHEEL STEER (S.N. 031478—)
ALL-WHEEL STEER (S.N. 030385—)



CIR NUM	WIRE SIZE	COLOR
520	0.8	YEL
740	0.8	BLU
741	0.8	RED
742	0.8	BLU
790	0.8	TAN

REAR PTO WIRING HARNESS (W2)—455 LATER MODELS

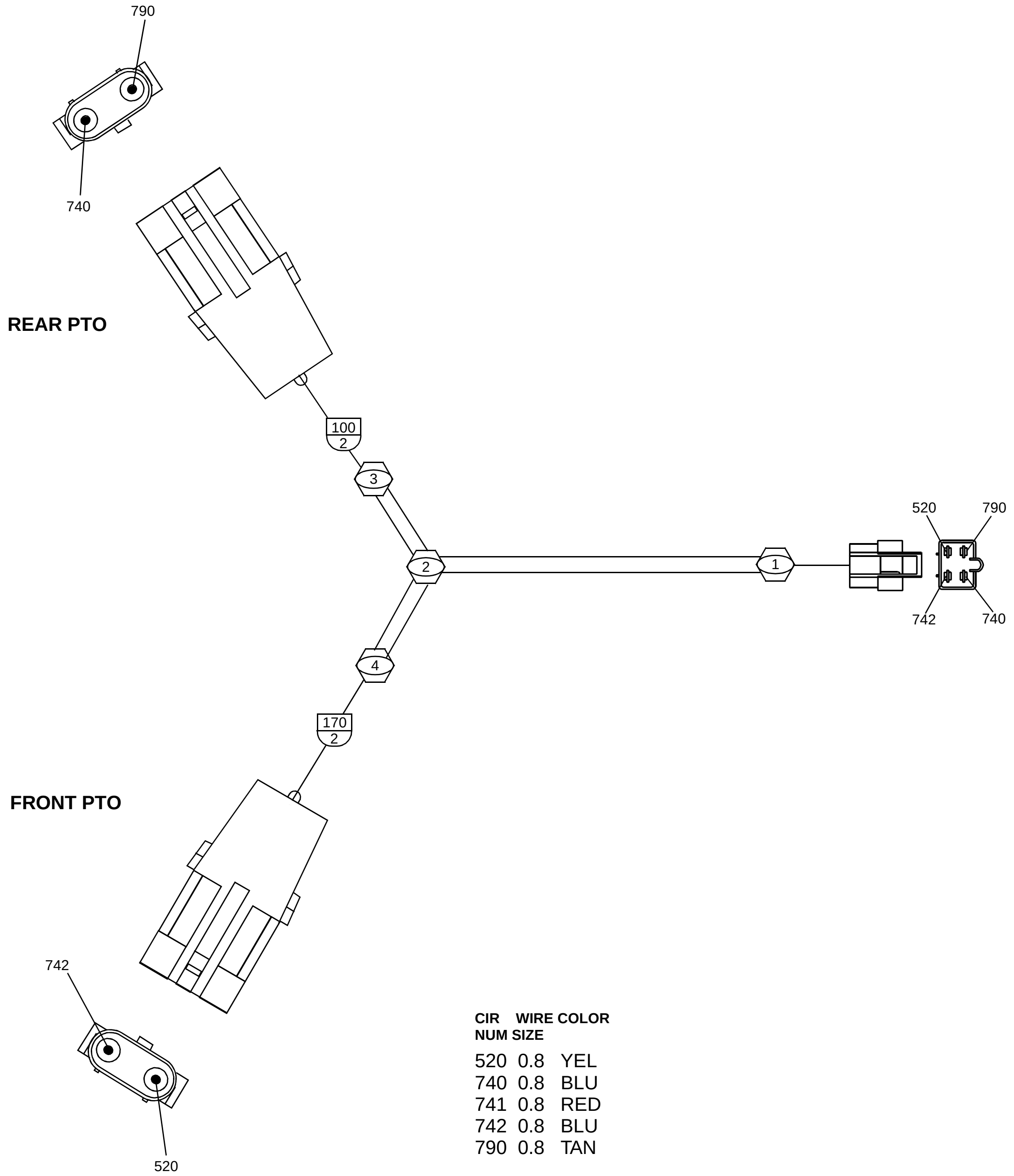
TWO-WHEEL STEER (S.N. —031477)
ALL-WHEEL STEER (S.N. —030384)



CIR NUM	WIRE SIZE	COLOR
140	0.8	BLK
520	0.8	YEL
605	0.8	TAN
740	0.8	BLU
741	0.8	RED
742	0.8	BLU
786	0.8	BLU
787	0.8	PUR
789	0.8	PUR
790	0.8	TAN
810	0.8	PNK
900	0.8	PNK/BLK

CIR NUM	WIRE SIZE	COLOR
902	0.8	PUR
903	0.8	BLK
904	0.8	PNK
905	0.8	PUR
906	0.8	TAN
910	0.8	RED/BLK
911	0.8	BLU
912	0.8	BLU/WHT
913	0.8	RED
914	0.8	PUR
915	0.8	YEL

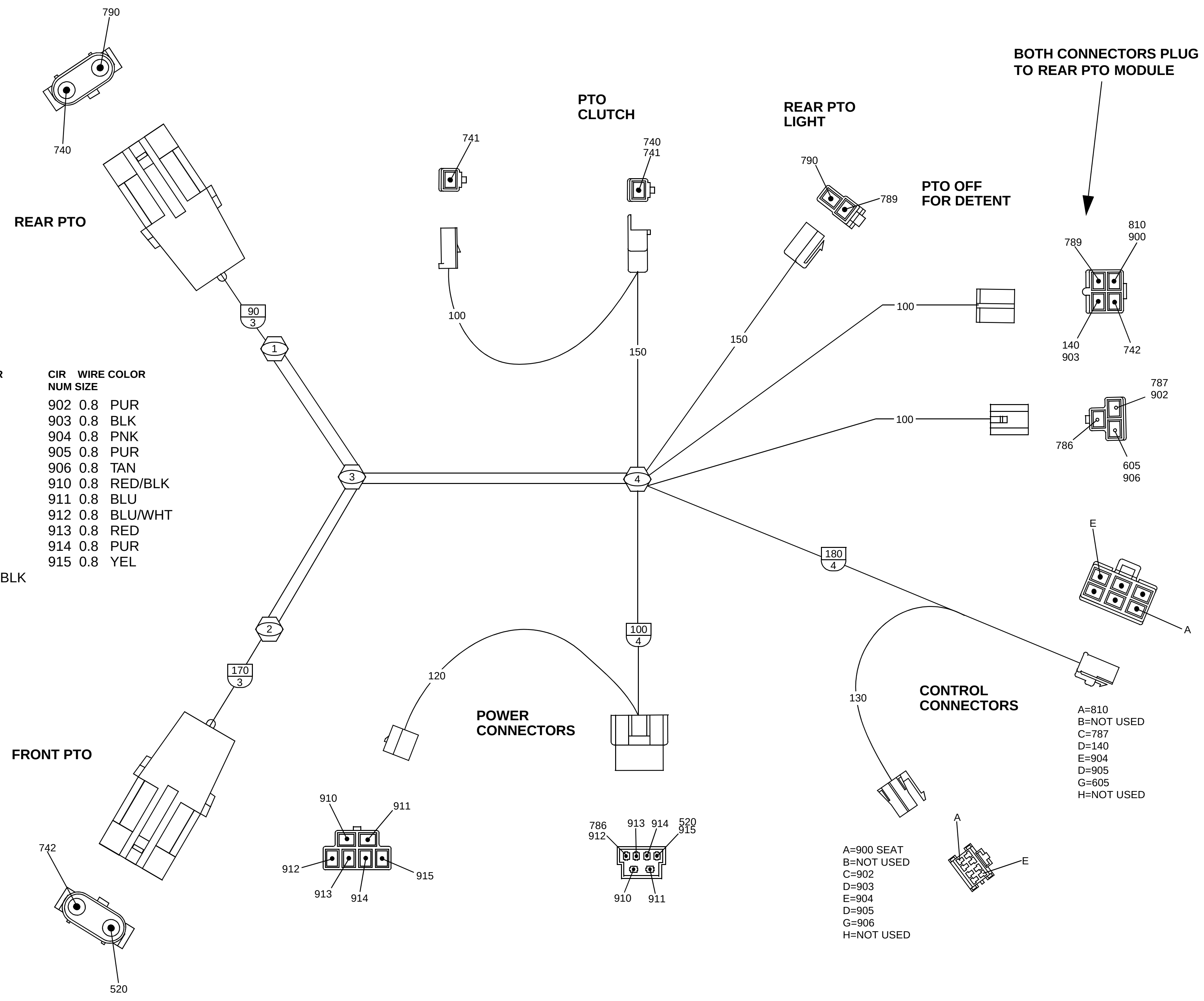
TWO-WHEEL STEER (S.N. 031478—)
ALL-WHEEL STEER (S.N. 030385—)



CIR NUM	WIRE SIZE	COLOR
520	0.8	YEL
740	0.8	BLU
741	0.8	RED
742	0.8	BLU
790	0.8	TAN

REAR PTO WIRING HARNESS (W2)—455 LATER MODELS

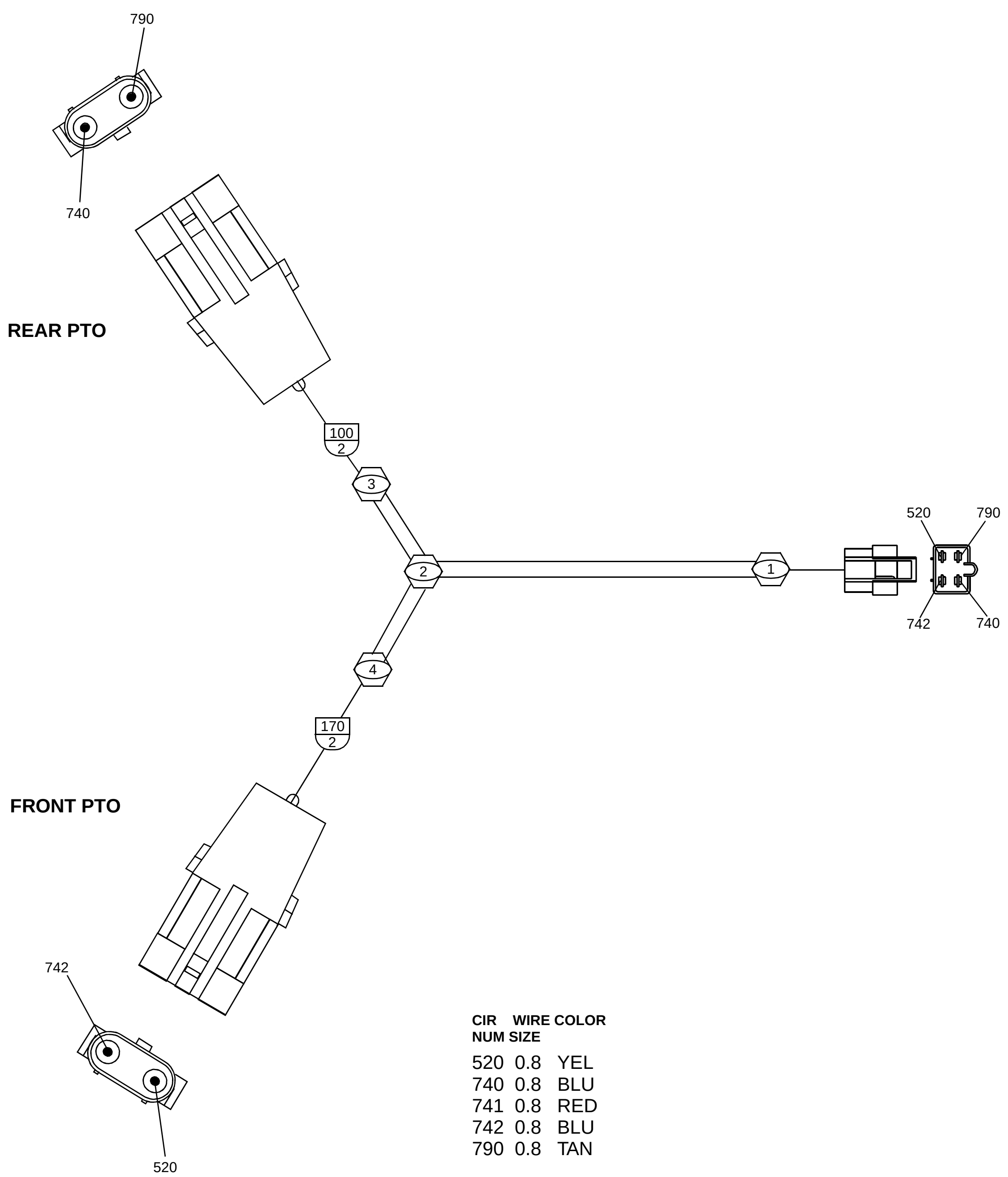
TWO-WHEEL STEER (S.N. —031477)
ALL-WHEEL STEER (S.N. —030384)



CIR NUM	WIRE SIZE	COLOR
140	0.8	BLK
520	0.8	YEL
605	0.8	TAN
740	0.8	BLU
741	0.8	RED
742	0.8	BLU
786	0.8	BLU
787	0.8	PUR
789	0.8	PUR
790	0.8	TAN
810	0.8	PNK
900	0.8	PNK/BLK

CIR NUM	WIRE SIZE	COLOR
902	0.8	PUR
903	0.8	BLK
904	0.8	PNK
905	0.8	PUR
906	0.8	TAN
910	0.8	RED/BLK
911	0.8	BLU
912	0.8	BLU/WHT
913	0.8	RED
914	0.8	PUR
915	0.8	YEL

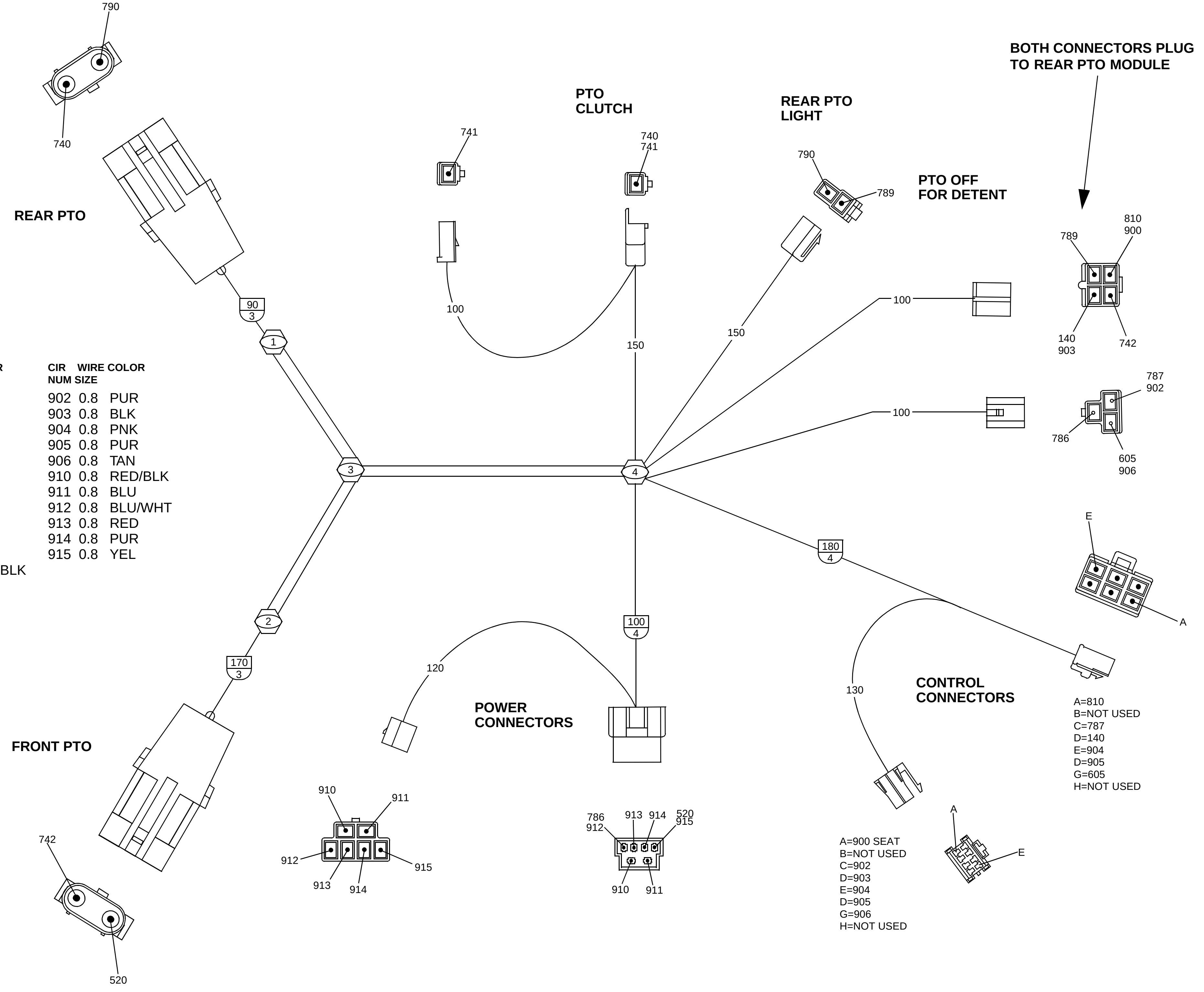
TWO-WHEEL STEER (S.N. 031478—)
ALL-WHEEL STEER (S.N. 030385—)



CIR NUM	WIRE SIZE	COLOR
520	0.8	YEL
740	0.8	BLU
741	0.8	RED
742	0.8	BLU
790	0.8	TAN

REAR PTO WIRING HARNESS (W2)—455 LATER MODELS

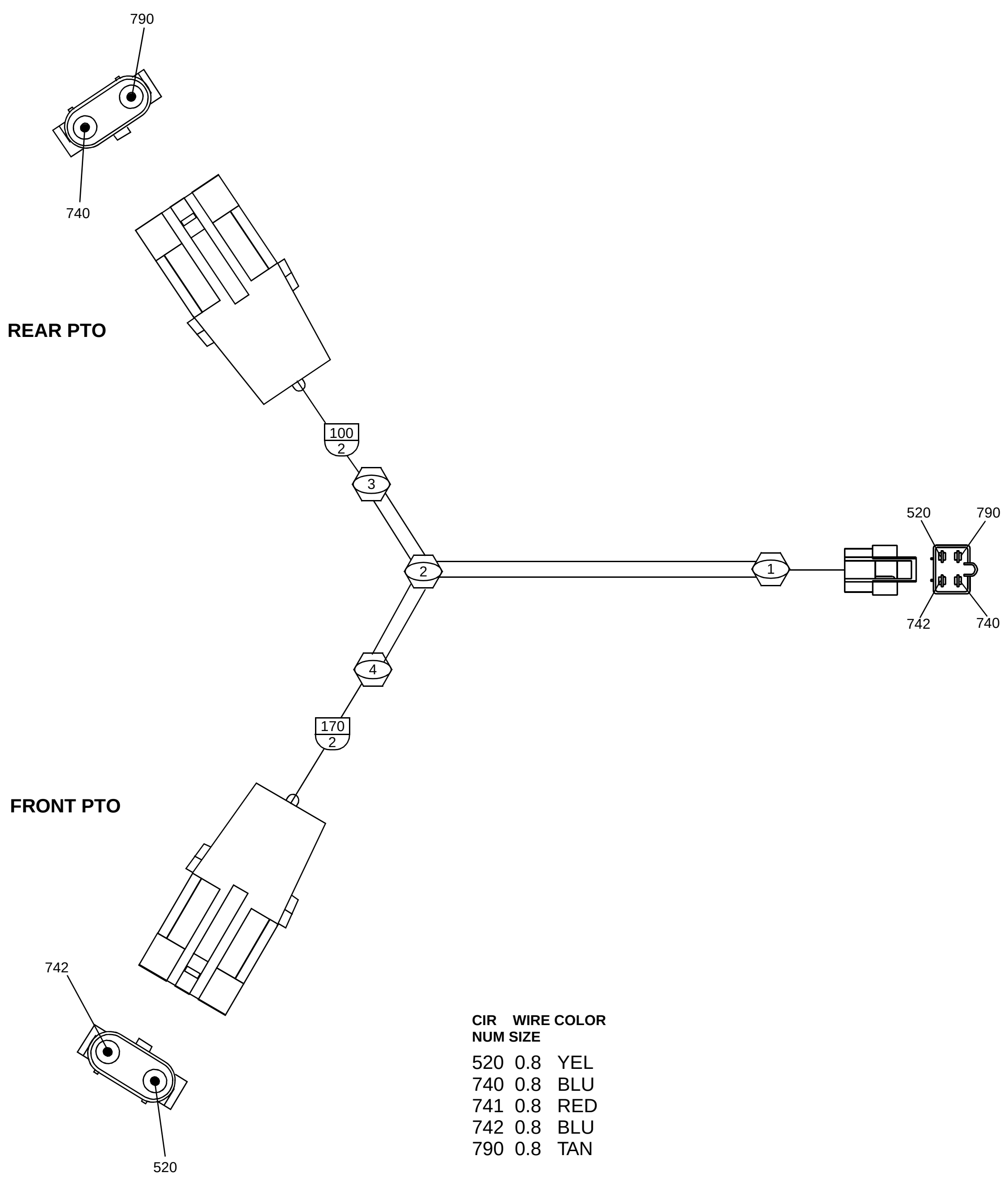
TWO-WHEEL STEER (S.N. —031477)
ALL-WHEEL STEER (S.N. —030384)



CIR NUM	WIRE SIZE	COLOR
140	0.8	BLK
520	0.8	YEL
605	0.8	TAN
740	0.8	BLU
741	0.8	RED
742	0.8	BLU
786	0.8	BLU
787	0.8	PUR
789	0.8	PUR
790	0.8	TAN
810	0.8	PNK
900	0.8	PNK/BLK

CIR NUM	WIRE SIZE	COLOR
902	0.8	PUR
903	0.8	BLK
904	0.8	PNK
905	0.8	PUR
906	0.8	TAN
910	0.8	RED/BLK
911	0.8	BLU
912	0.8	BLU/WHT
913	0.8	RED
914	0.8	PUR
915	0.8	YEL

TWO-WHEEL STEER (S.N. 031478—)
ALL-WHEEL STEER (S.N. 030385—)



CIR NUM	WIRE SIZE	COLOR
520	0.8	YEL
740	0.8	BLU
741	0.8	RED
742	0.8	BLU
790	0.8	TAN

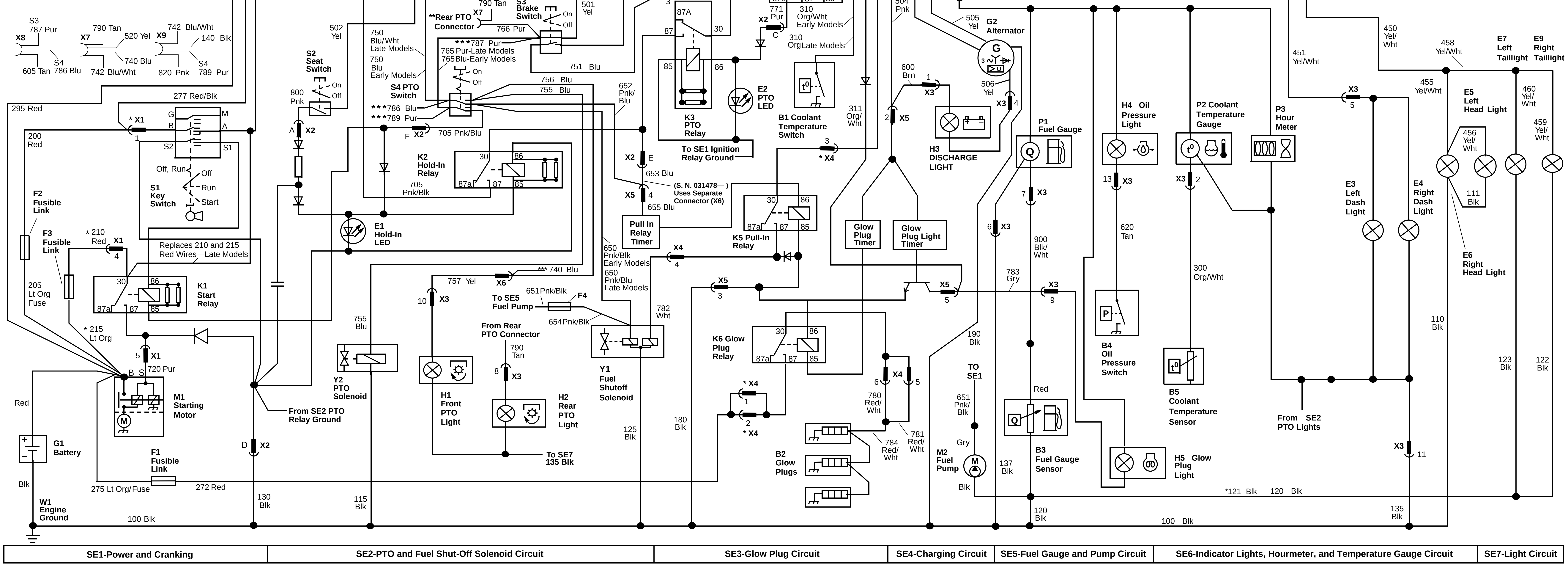
ELECTRICAL SCHEMATICS—455

MAIN SCHEMATIC—455 (S.N. —070000)

*NOTE: Late model wiring harnesses do not have 210, 215 red and 121 blk wires. 200, 270, 271 red and 277 red/blk wires use separate connectors (not connectors X1-1, X4-1, -2, -3)

**Early models and (S.N. —031477) only.

*** (S.N. 031478—) have the following rear PTO connections instead.



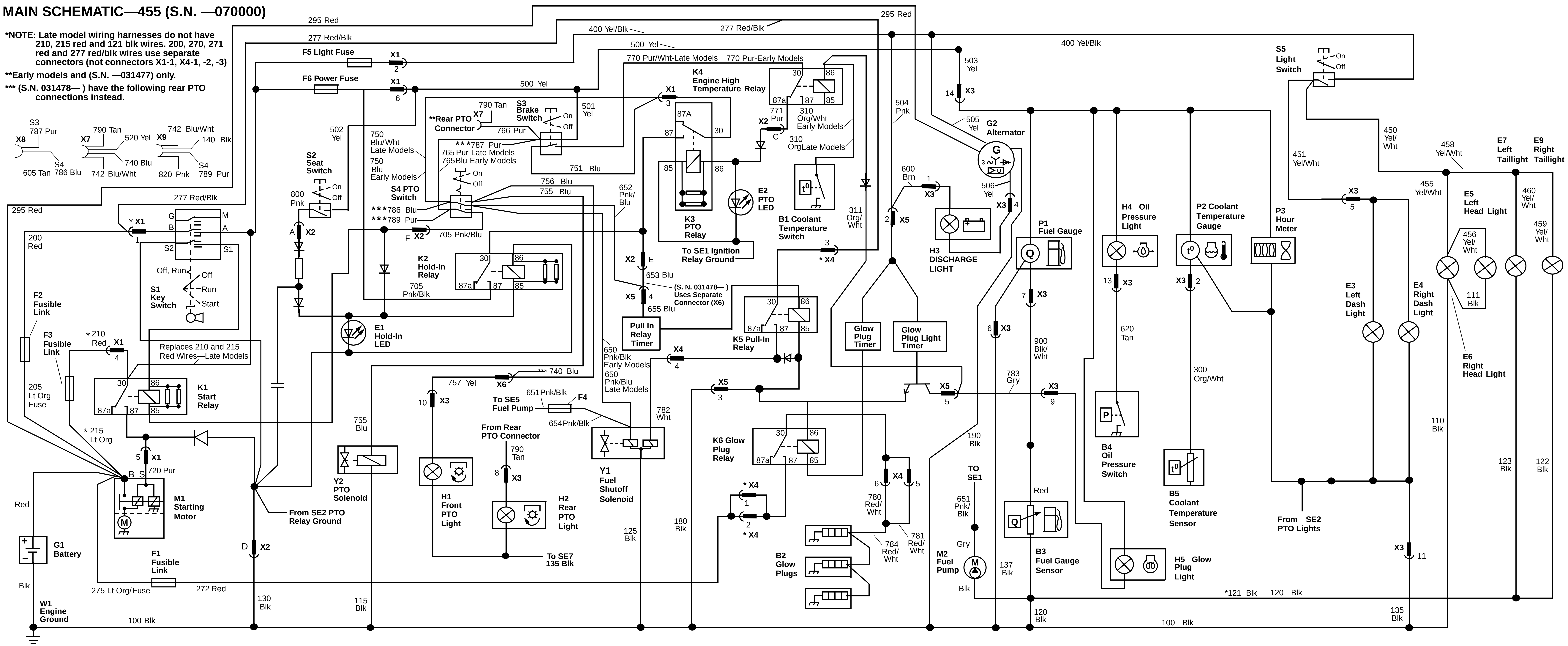
ELECTRICAL SCHEMATICS—455

MAIN SCHEMATIC—455 (S.N. —070000)

*NOTE: Late model wiring harnesses do not have 210, 215 red and 121 blk wires. 200, 270, 271 red and 277 red/blk wires use separate connectors (not connectors X1-1, X4-1, -2, -3)

**Early models and (S.N. —031477) only.

*** (S.N. 031478—) have the following rear PTO connections instead.



SE1-Power and Cranking	SE2-PTO and Fuel Shut-Off Solenoid Circuit	SE3-Glow Plug Circuit	SE4-Charging Circuit	SE5-Fuel Gauge and Pump Circuit	SE6-Indicator Lights, Hourmeter, and Temperature Gauge Circuit	SE7-Light Circuit

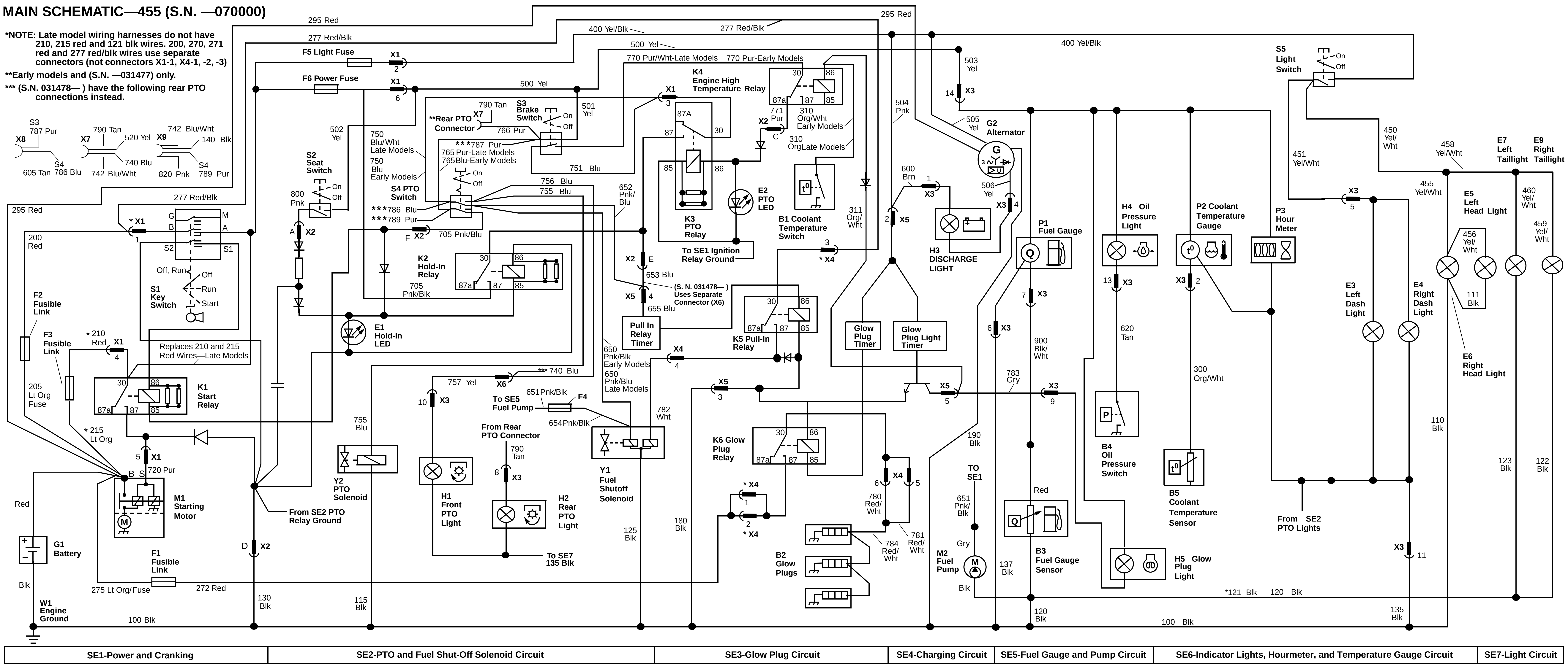
ELECTRICAL SCHEMATICS—455

MAIN SCHEMATIC—455 (S.N. —070000)

*NOTE: Late model wiring harnesses do not have 210, 215 red and 121 blk wires. 200, 270, 271 red and 277 red/blk wires use separate connectors (not connectors X1-1, X4-1, -2, -3)

**Early models and (S.N. —031477) only.

*** (S.N. 031478—) have the following rear PTO connections instead.



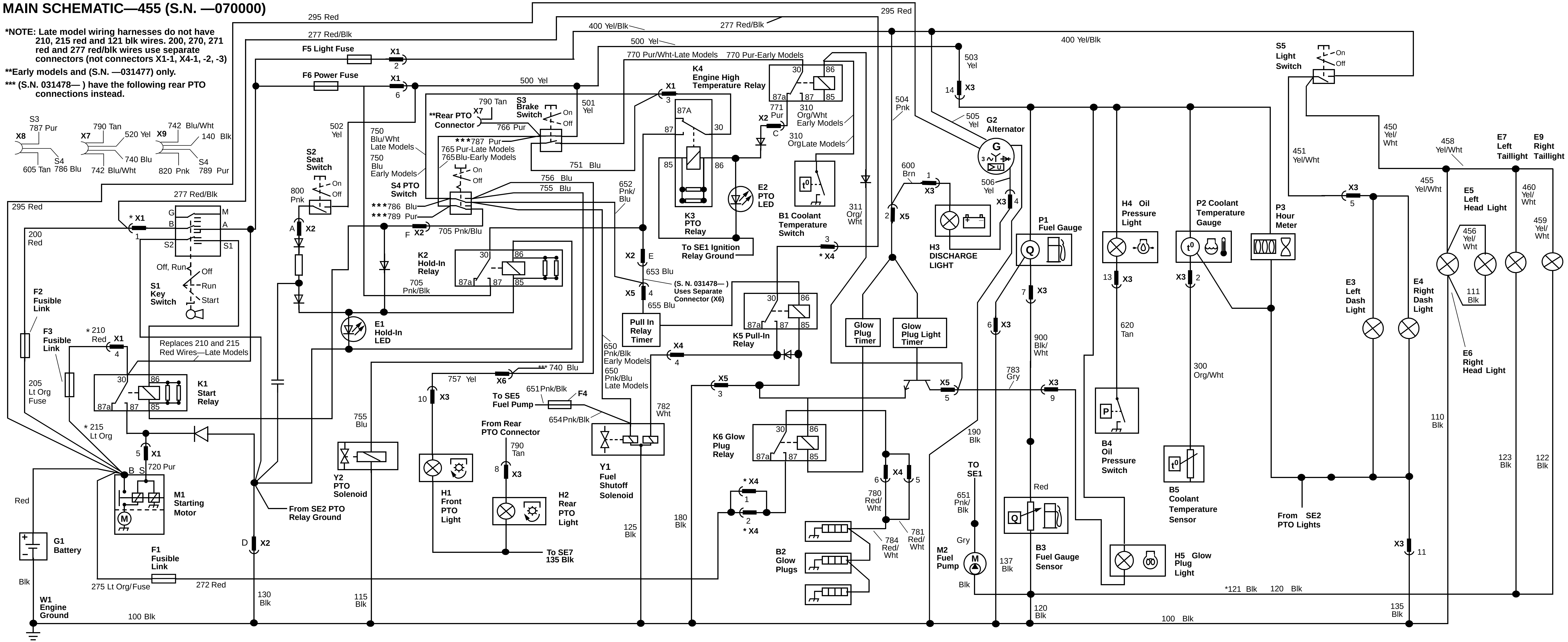
ELECTRICAL SCHEMATICS—455

MAIN SCHEMATIC—455 (S.N. —070000)

*NOTE: Late model wiring harnesses do not have 210, 215 red and 121 blk wires. 200, 270, 271 red and 277 red/blk wires use separate connectors (not connectors X1-1, X4-1, -2, -3)

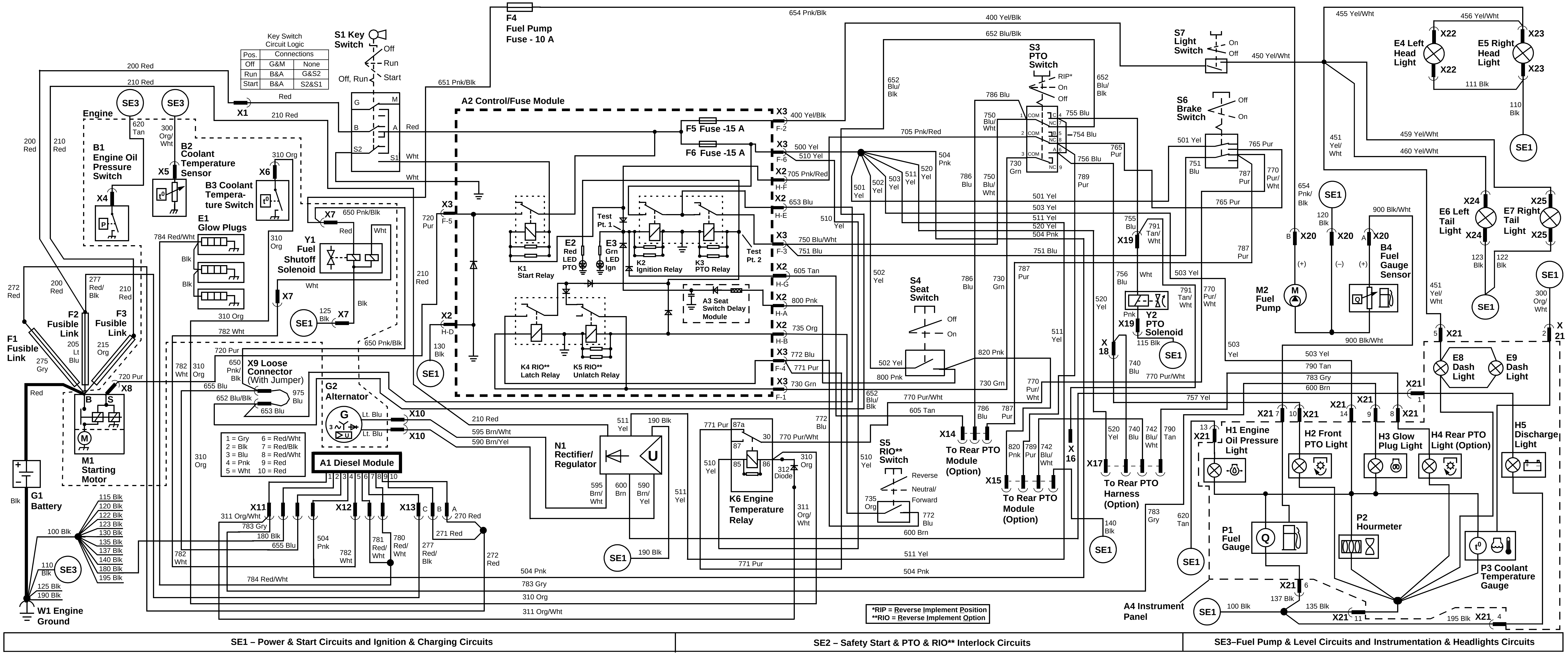
**Early models and (S.N. —031477) only.

*** (S.N. 031478—) have the following rear PTO connections instead.

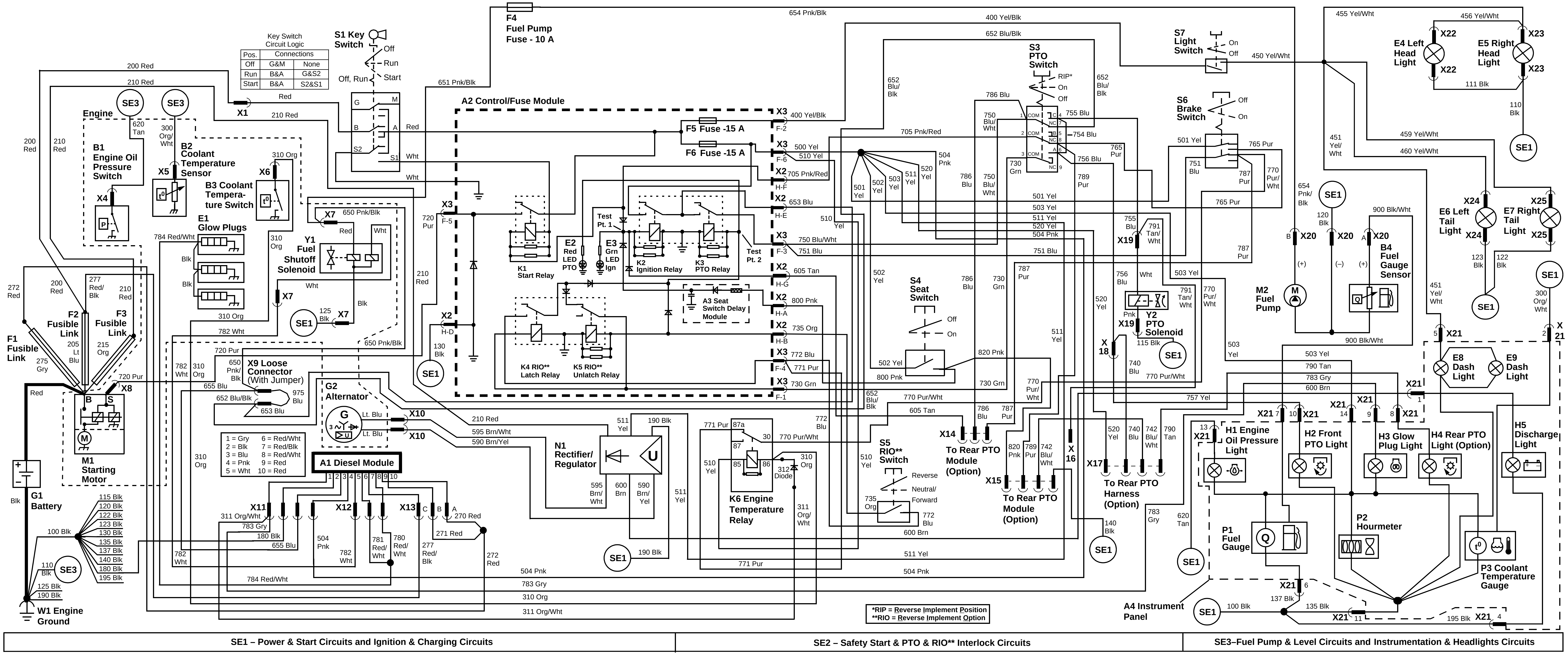


SE1-Power and Cranking	SE2-PTO and Fuel Shut-Off Solenoid Circuit	SE3-Glow Plug Circuit	SE4-Charging Circuit	SE5-Fuel Gauge and Pump Circuit	SE6-Indicator Lights, Hourmeter, and Temperature Gauge Circuit	SE7-Light Circuit

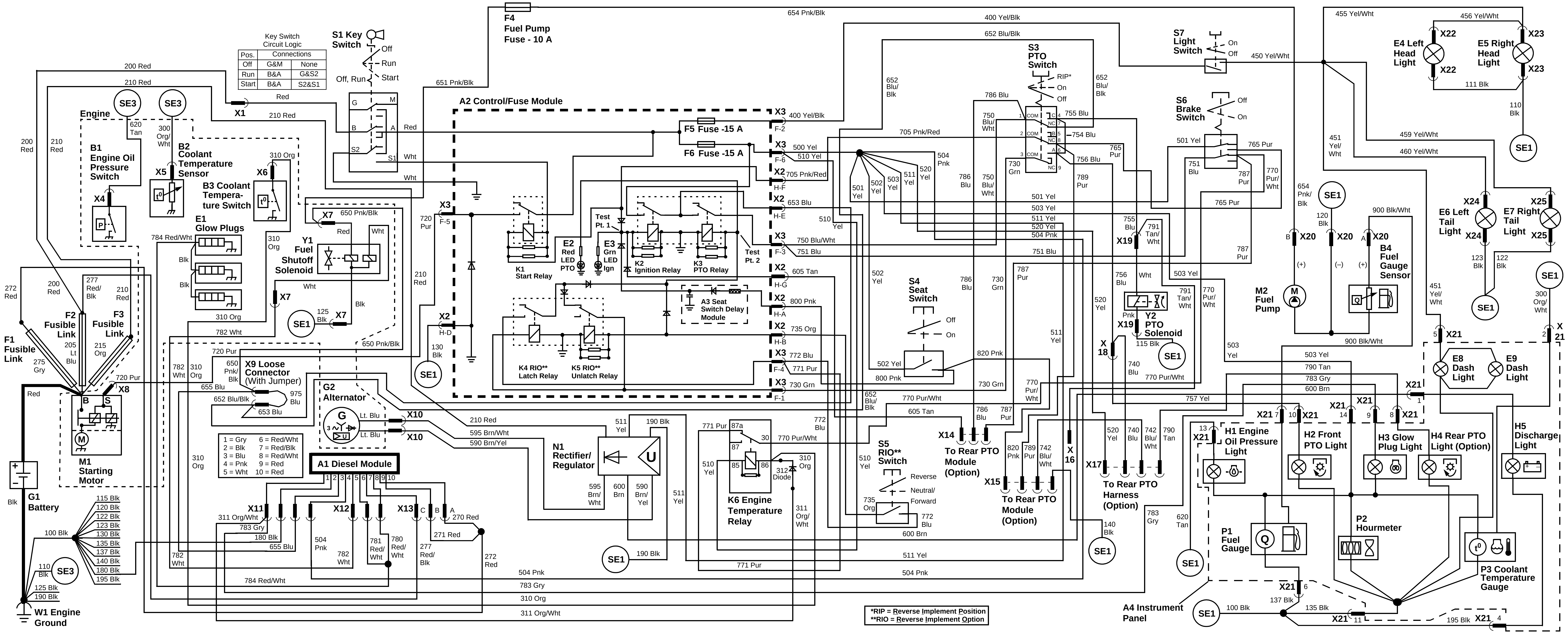
MAIN SCHEMATIC—455 (S.N. 070001—)



MAIN SCHEMATIC—455 (S.N. 070001—)

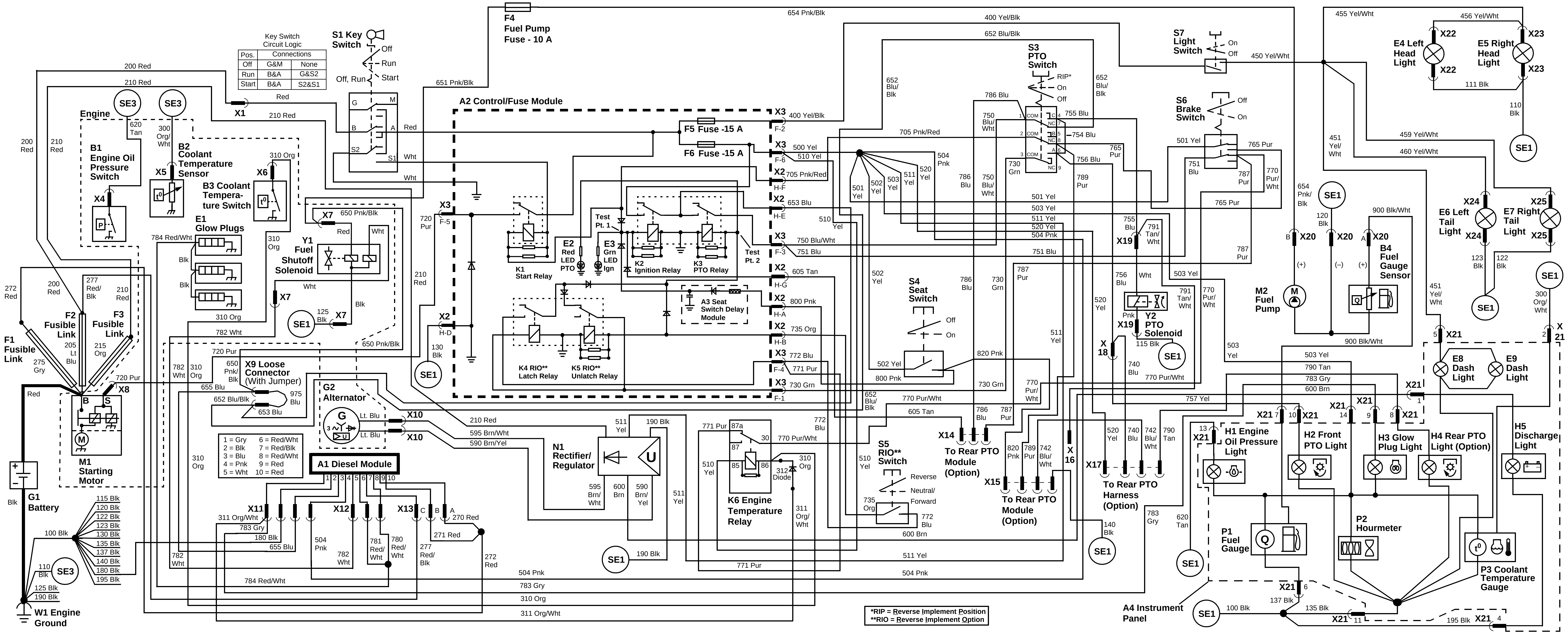


MAIN SCHEMATIC—455 (S.N. 070001—)



SE1 – Power & Start Circuits and Ignition & Charging Circuits | SE2 – Safety Start & PTO & RIO** Interlock Circuits | SE3–Fuel Pump & Level Circuits and Instrumentation & Headlights Circuits

MAIN SCHEMATIC—455 (S.N. 070001—)



SE1 – Power & Start Circuits and Ignition & Charging Circuits	SE2 – Safety Start & PTO & RIO** Interlock Circuits	SE3–Fuel Pump & Level Circuits and Instrumentation & Headlights Circuits

TROUBLESHOOTING—455

ELECTRICAL SYSTEM QUICK TEST—455

Test Conditions:

- Transmission in neutral.
- PTO switch in off position.
- Park brake engaged.
- Seat switch depressed or jumper wire installed in connector.
- Key switch off position.
- Check connections for corrosion and loose terminals.
- Battery fully charged and in good condition.
- Fuel tank full of fresh clean fuel.

Test/Check Point	Normal	If Not Normal
1. Battery.	Electrolyte level—ok. Cables clean and tight at battery, starter, and engine ground. Case clamped down tight, not cracked, dirty, or wet.	Add electrolyte. Clean, tighten, or replace cables. Clamp down tight, clean, or replace battery.
2. Engine, frame, and wiring harness ground connections.	Connections clean and tight.	Clean, tighten, or replace.
3. Wiring harness.	Wire insulation not worn or burned. Conduit and wrap not worn/missing. Connections not corroded. Terminals or crimp not loose. Wires or components not hot.	Replace harness.
4. Fuses and fusible links.	Not open, connections tight.	Replace fuses or fusible links.
5. Alternator.	Connections clean and tight. Belt not glazed or worn. Belt deflection 10—15 mm (0.400—0.600 in.) with 98 N (22 lb force).	Clean, tighten, or replace. Replace belt. Adjust tension.

Test Conditions:

- Key switch in run position.

Test/Check Point	Normal	If Not Normal
6. Dash panel.	Oil pressure and charge light on, fuel and temperature gauge needle movement indicates fuel level and engine temperature. Glow plug light on for 20 seconds or less if ambient air temperature is below 40°C (104°F).	See troubleshooting chart and check problem circuit.
7. Fuel shutoff solenoid.	Fuel shutoff solenoid must click and pull lever on injection pump.	See fuel shutoff solenoid circuit test points.
8. Fuel pump—turn key switch to off and then to on position—listen for fuel pump operation.	Fuel pump must run, listen for humming or ticking noise near fuel injection pump.	Check fuel pump circuit test points.

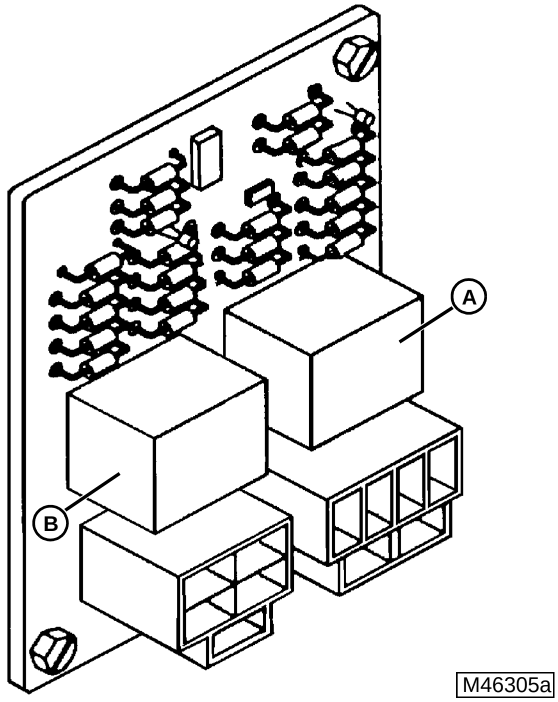
ELECTRICAL SYSTEM TROUBLESHOOTING CHART

Problem or Symptom / Check or Solution	Engine will not crank	Engine cranks but will not start	Fuel shut-off solenoid will not pull-in, hold-in, or release	Charge light stays on, will not come on, battery over-charges or discharges	Glow plug light does not go on or off; glow plugs do not operate	PTO will not engage, PTO light not on	PTO will not disengage	Fuel gauge does not show correct level
See power circuit diagnosis	●	●	●	●	●	●		●
See charging circuit diagnosis	●		●	●	●			
See PTO circuit diagnosis						●	●	
See cranking circuit diagnosis	●							
See fuel gauge circuit diagnosis								●
See glow plug circuit diagnosis		●			●			
See fuel pump circuit diagnosis		●						
See ignition circuit diagnosis		●						
Check ground circuit	●	●		●		●		●
Check for shorted circuit	●	●		●		●		●
See power circuit diagnosis	●		●	●	●	●	●	●
See charging circuit diagnosis						●		●
See PTO circuit diagnosis					●	●	●	

ELECTRICAL SYSTEM TROUBLESHOOTING CHART—(continued)

Problem or Symptom / Check or Solution	Coolant temperature gauge problem	Oil pressure light stays on, or will not come on	Hourmeter does not run	Head lights, tail lights, or dash lights do not come on	Engine stops when PTO is engaged or when brake pedal is released	No indicator lights come on	PTO LED light not on	No components operate	Fuel pump does not run
See power circuit diagnosis	●		●	●	●	●	●	●	●
See fuel shut-off solenoid circuit test diagnosis					●	●	●		●
See charging circuit diagnosis						●		●	
See PTO circuit diagnosis					●	●	●		
See coolant temperature gauge circuit diagnosis	●								
See oil pressure light circuit diagnosis		●				●			
See hourmeter circuit diagnosis			●						
See lights circuit diagnosis				●					
See fuel pump circuit diagnosis									

DIESEL MODULE—455



The glow plug relay (A) coil receives power for up to 45 seconds through the glow plug controller of the diesel module.

The pull-in relay (B) coil receives power for 1 second through the following circuits:

- Fuel solenoid pull-in controller of the diesel module. Key switch on, operator on seat, hold-in relay energized, and fuel shut-off solenoid relay energized (operation circuit).
- Key switch on, PTO turned off, park brake engaged, hold-in relay energized, and fuel shut-off solenoid relay energized (neutral start circuit).

The glow plug relay (A) and the pull-in relay (B) are mounted in a printed circuit board. The components are solid state and are not serviced separately. As a quick check for the relays, hold the relays and energize the circuits. The relays should click.

CIRCUIT OPERATION AND DIAGNOSIS—455

POWER CIRCUIT OPERATION—455 (S.N. —070000)

Function:

To provide battery power to the primary machine components through main current paths.

Operating Conditions:

Voltage must be present at the following components for the other circuits to operate:

- B Terminal of Starting Motor
- Fusible Links
- B Terminal of Key Switch
- Control/fuse Module
- Control/fuse Module Fuses
- Ignition Delay Module

System Operation:

With the key switch (S1) in the off position, unswitched current (A) from the battery positive terminal flows to the starter solenoid battery terminal (M1), fusible links (F1, F2, and F3), key switch battery terminal, start relay (K1), pull-in relay (K5), glow plug relay (K6), and alternator (G2). With the key switch in the run position, current flows from key switch B to A terminal, control/fuse module fuses (F5, F6), hold-in relay (K2), seat switch (S2), brake switch (S3), engine high temperature relay (K4), diesel module, alternator (G2), discharge light (H3), fuel gauge (P1), oil pressure light (H4), coolant temperature gauge (P2), hourmeter (P3), glow plug light (H5), and light switch (S5).

POWER CIRCUIT OPERATION—455 (S.N. 070001—)

Function:

To provide battery power to the primary machine components through main current paths.

Operating Conditions:

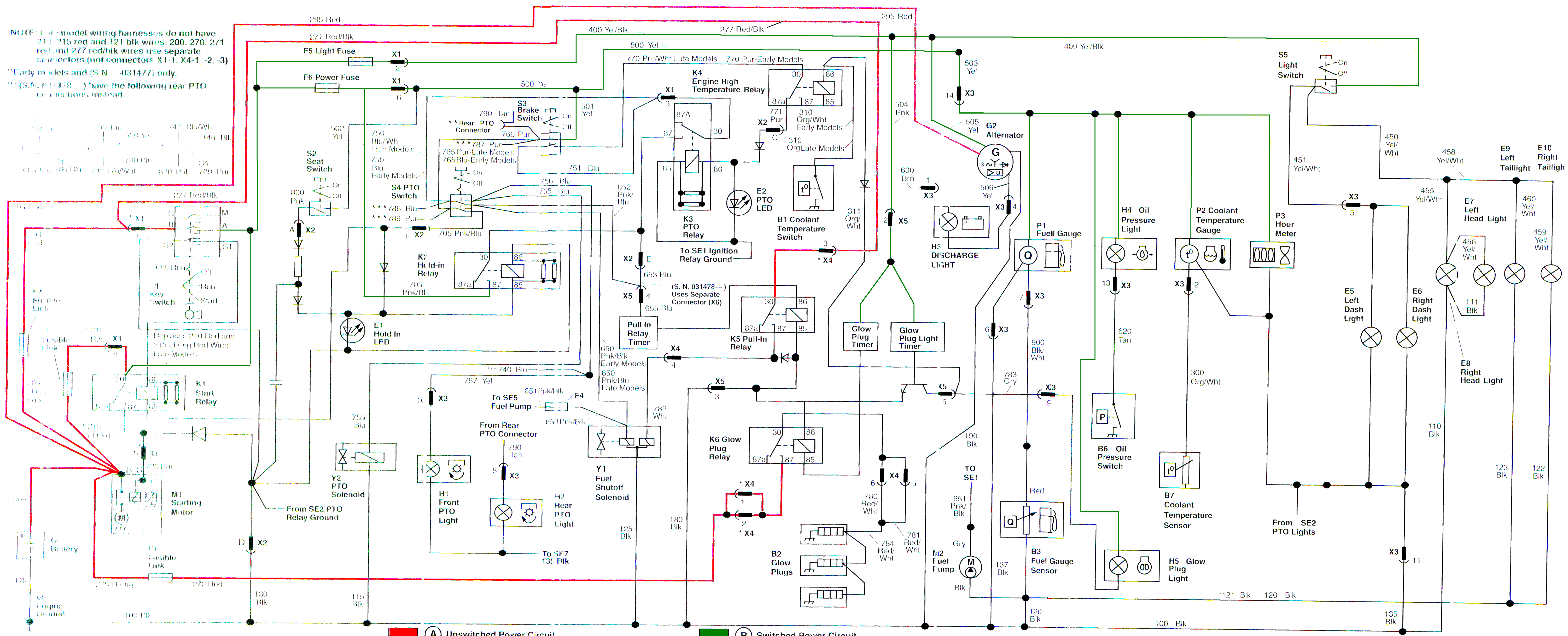
Voltage must be present at the following components for the other circuits to operate:

- B Terminal of Starting Motor
- Fusible Links
- B Terminal of Key Switch
- Control/fuse Module
- Control/fuse Module Fuses
- Ignition Delay Module

System Operation:

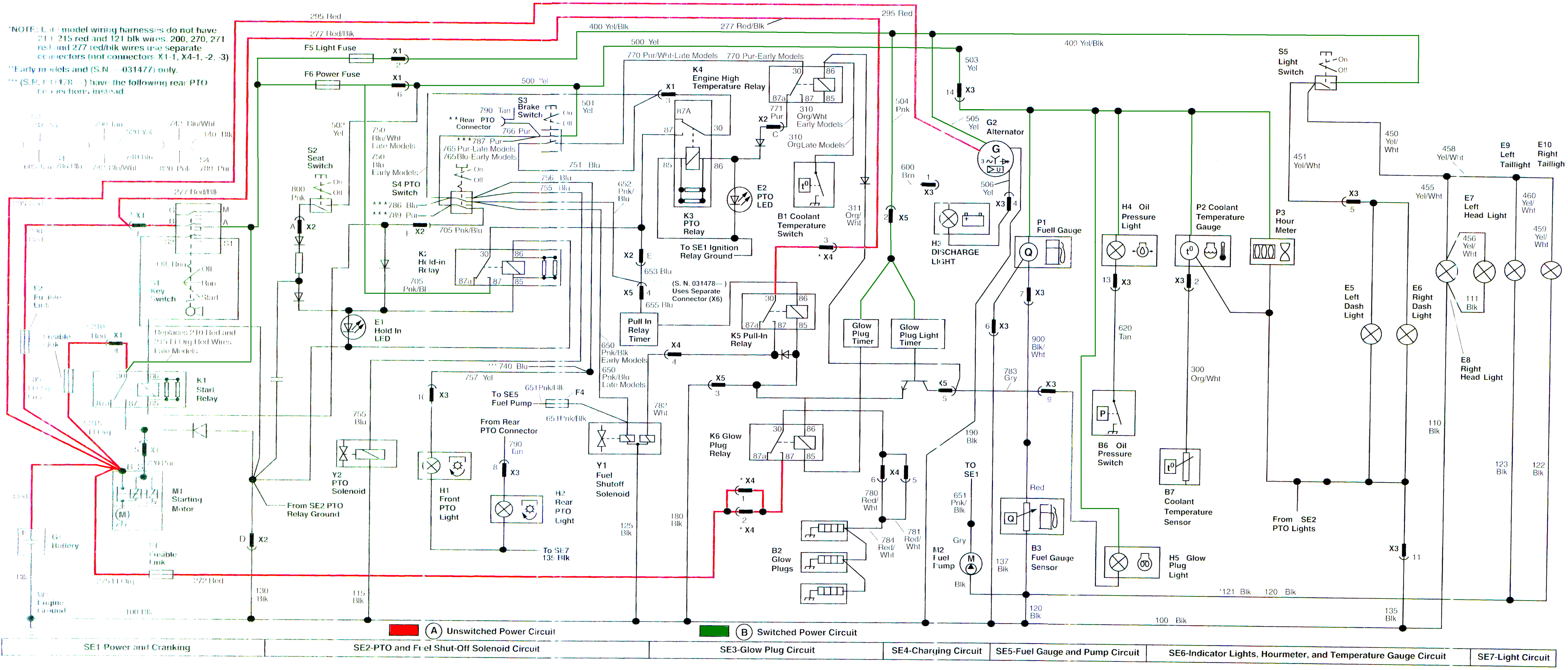
With the key switch (S1) in the off position, unswitched current from the battery positive terminal flows to the battery terminal (B) of starting motor (M1), fusible links (F1, F2 and F3). From F1 and F2, current flows to diesel module (A1). From F2, current flows also to the battery terminal on key switch (S1). With the key switch in the run position, current flows from terminal B to terminal A of the key switch and then to fuses (F5, F6), lights switch (S7), engine temperature relay (K6), brake switch (S6), seat switch (S4), instrument panel (A4), rear PTO harness connector (X15), diesel module (A1), and rectifier/regulator (N1). From fuse (F3), current flows to rectifier/regulator (N1).

POWER CIRCUIT SCHEMATIC—455 (S.N. —070000)

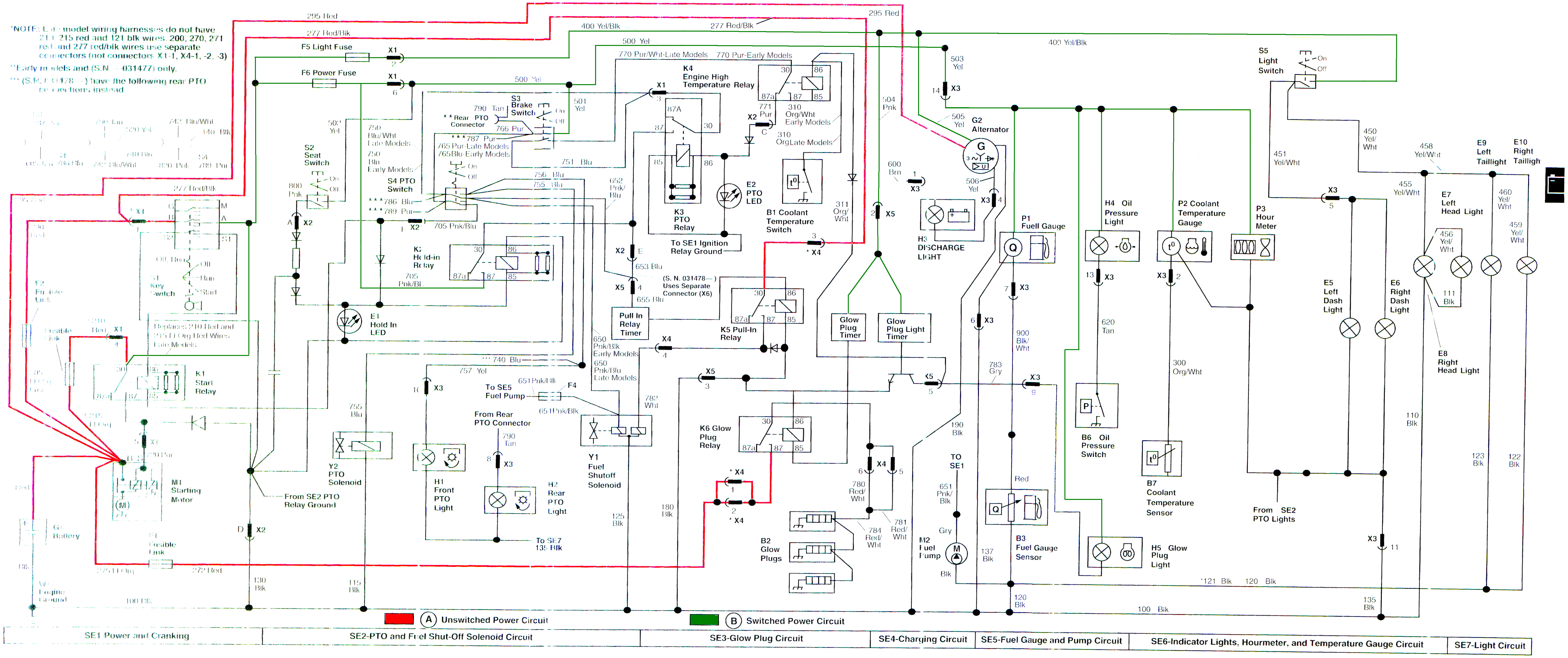


SE1 Power and Cranking	SE2-PTO and Fuel Shut-Off Solenoid Circuit	SE3-Glow Plug Circuit	SE4-Charging Circuit	SE5-Fuel Gauge and Pump Circuit	SE6-Indicator Lights, Hourmeter, and Temperature Gauge Circuit	SE7-Light Circuit

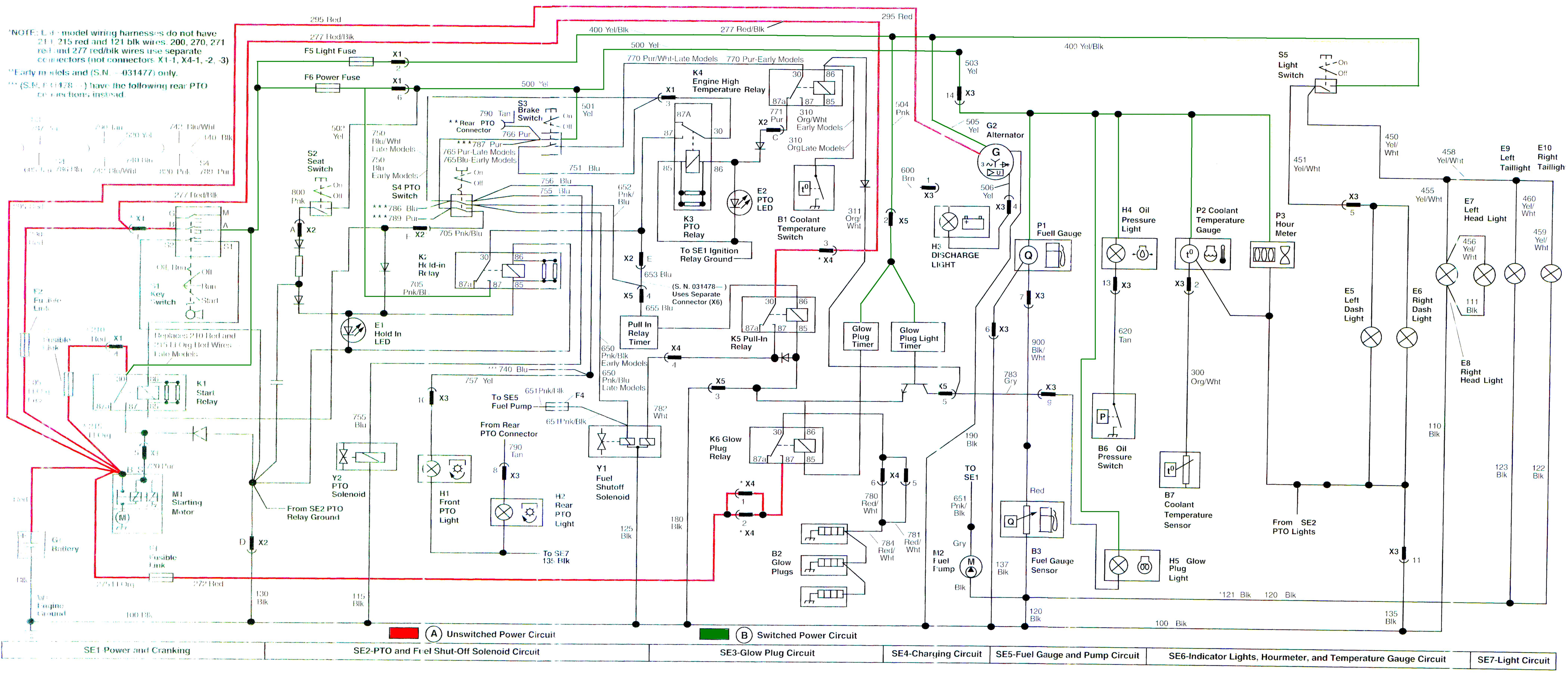
POWER CIRCUIT SCHEMATIC—455 (S.N. —070000)



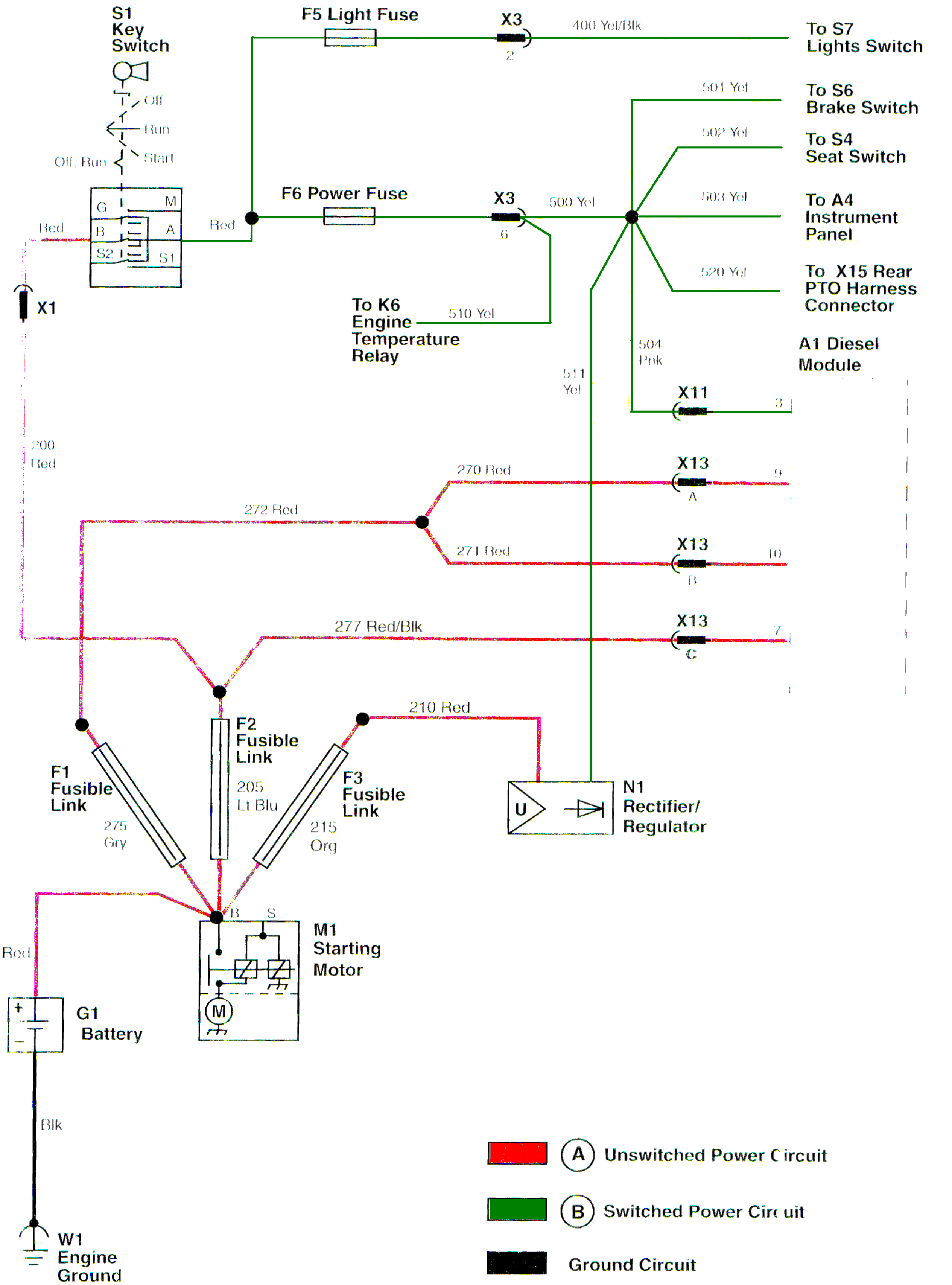
POWER CIRCUIT SCHEMATIC—455 (S.N. —070000)



POWER CIRCUIT SCHEMATIC—455 (S.N. —070000)



POWER CIRCUIT SCHEMATIC—455 (S.N. 070001—)



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POWER CIRCUIT DIAGNOSIS—455 (S.N. —070000)

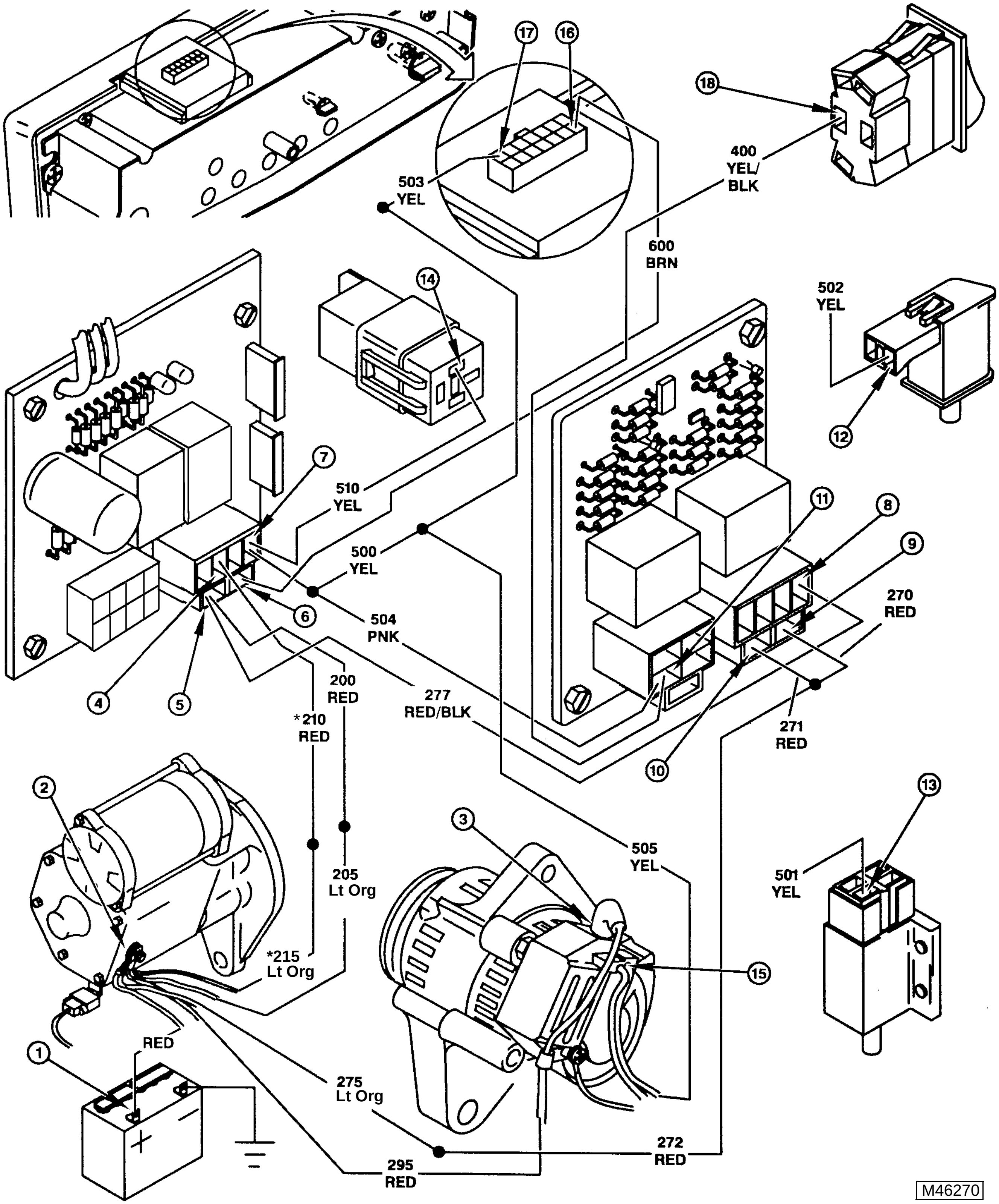
Test Conditions:

- Park brake engaged.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

NOTE: 455 Early models have 210 red and 215 lt org wires.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Starter solenoid terminal B.	Battery voltage.	Check battery cable and connection.
3. Alternator terminal B.	Battery voltage.	Check 295 red wire.
4. Control/fuse module terminal 1.	Battery voltage.	Check 205 lt org fusible link, 200 red wire.
5. Control/fuse module terminal 4. See *NOTE.*	Battery voltage.	Check 215 lt org (fusible link) and 210 red wires.
6. Control/fuse module terminal 2.	Battery voltage.	Check light fuse, if ok replace module.
7. Control/fuse module terminal 6.	Battery voltage.	Check power fuse, if ok replace module.
8. Diesel module terminal 3.	Battery voltage.	Check 277 red/blk wire.
9. Diesel module terminal 1.	Battery voltage.	Check 275 lt org (fusible link), 272 and 270 red wires.
10. Diesel module terminal 2.	Battery voltage.	Check 271 red wire.
11. Diesel module terminal 2.	Battery voltage.	Check 504 pnk wire.
12. Brake switch	Battery voltage.	Check 501 yel wire.
13. Seat switch.	Battery voltage.	Check 502 yel wire.
14. Engine high temperature relay terminal 85.	Battery voltage.	Check 510 yel wire.
15. Alternator.	Battery voltage.	Check 505 yel wire.
16. Dash panel connector terminal 1.	Battery voltage.	Check 600 brn wire.
17. Dash panel connector terminal 14.	Battery voltage.	Check 503 yel wire.
18. Light switch.	Battery voltage.	Check 400 yel/blk wire.

POWER CIRCUIT TEST POINTS—455 (S.N. —070000)



***Early models only, late models do not have 210 red and 215 lt org wires.**

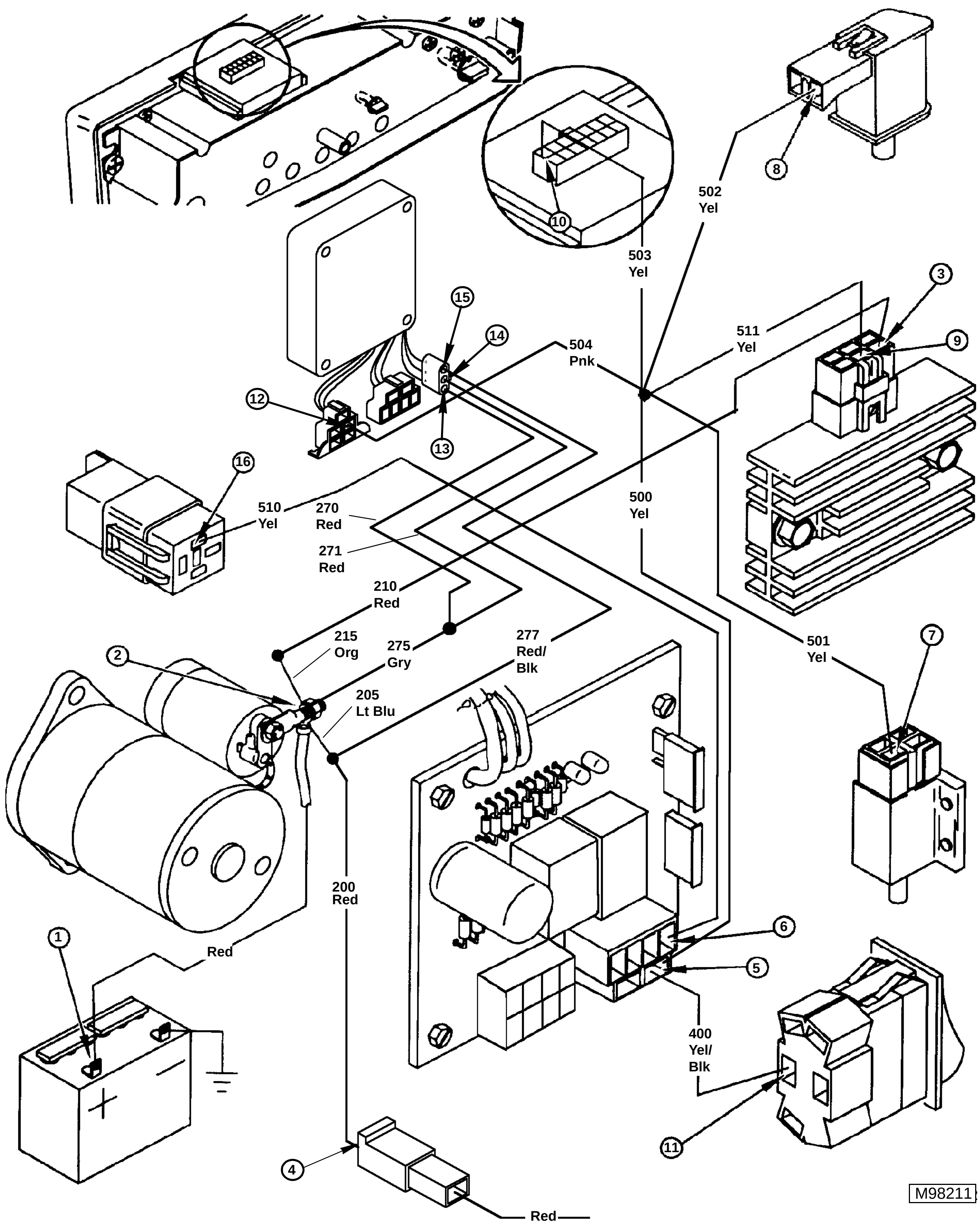
POWER CIRCUIT DIAGNOSIS—455 (S.N. 070001—)

Test Conditions:

- Park brake engaged.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Starter solenoid terminal B.	Battery voltage.	Check battery cable and connection.
3. Rectifier/regulator.	Battery voltage.	Check 210 red wire, and 215 org wire (fusible link).
4. Key switch power connector.	Battery voltage.	Check 200 red wire.
5. Control/fuse module terminal 2.	Battery voltage.	Check light fuse (F4), if ok replace control/fuse module.
6. Control/fuse module terminal 6.	Battery voltage.	Check power fuse (F5), if ok replace control/fuse module.
7. Brake switch.	Battery voltage.	Check 500 and 501 yel wire.
8. Seat switch.	Battery voltage.	Check 502 yel wire.
9. Rectifier/regulator.	Battery voltage.	Check 511 yel wire.
10. Instrument panel connector terminal 14.	Battery voltage.	Check 503 yel wire.
11. Lights switch.	Battery voltage.	Check 400 yel/blu wire.
12. Diesel module.	Battery voltage.	Check 504 pnk wire.
13. Diesel module.	Battery voltage.	Check 270 and 272 red and 275 gry (fusible link) wires.
14. Diesel module.	Battery voltage.	Check 271 red wire.
15. Diesel module.	Battery voltage.	Check 277 red/blk wire.
16. Engine temperature relay.	Battery voltage.	Check 510 yel wire.

POWER CIRCUIT TEST POINTS—455 (S.N. 070001—)



CRANKING CIRCUIT OPERATION—455 (S.N. —070000)

Function:

To energize the starter solenoid and engage starting motor to crank engine.

Operation Conditions:

To crank the engine, the key switch must be in the start position, with the PTO switch off (PTO switch closed), and the park brake engaged (brake switch closed).

System Operation:

Current (A) flows from the battery (G1) to the starting motor (M1), fusible links (F1 and F2), key switch terminal B (S1), and start relay (K1). Current from the start relay cannot flow to the starter solenoid until the relay is energized. The start relay receives the energizing current from the neutral start circuit.The neutral start circuit prevents the engine from cranking if the PTO is engaged, or the park brake is not engaged.

With the key switch in the start position, current flows from terminal B to terminal A, 15-amp fuse (F6), park brake switch (S3) (park brake pedal engaged), PTO switch (S4) (PTO disengaged), and start relay coil terminal (K1).

A ground circuit for the start relay coil must be provided for the relay to energize. With the key switch in the start position, current flows to ground through the key switch terminals S1 and S2, energizing the start relay coil which closes the relay.

With the relay closed, current flows to the starter solenoid, engaging the solenoid. The solenoid is engaged by current flowing through both the pull-in and hold-in windings, pulling the plunger inward. The plunger closes the solenoid main contacts. When the main contacts are closed, both ends of the pull-in windings have the same voltage so current through the pull-in winding stops. Current continues through the hold-in windings, keeping the solenoid engaged.

With the solenoid main contacts closed, high current from the battery flows across the main contacts to the starting motor (M1) causing it to turn.

CRANKING CIRCUIT OPERATION—455 (S.N. 070001—)

Function:

To energize the starter solenoid and engage starting motor to crank engine.

Operation Conditions:

To crank the engine, the key switch must be in the start position, with the PTO switch off (PTO switch closed), and the park brake engaged (brake switch closed).

System Operation:

Current (A) flows from the battery (G1) to the starting motor (M1), fusible link (F2), and terminal B of key switch (S1). The contacts of start relay (K1) receive power from terminal A of the key switch when the switch is in the run or start positions. Current from the start relay cannot flow to the starter solenoid until the relay is energized. The start relay receives the energizing current from the neutral start circuit. The neutral start circuit prevents the engine from cranking if the PTO is engaged, or the park brake is not engaged.

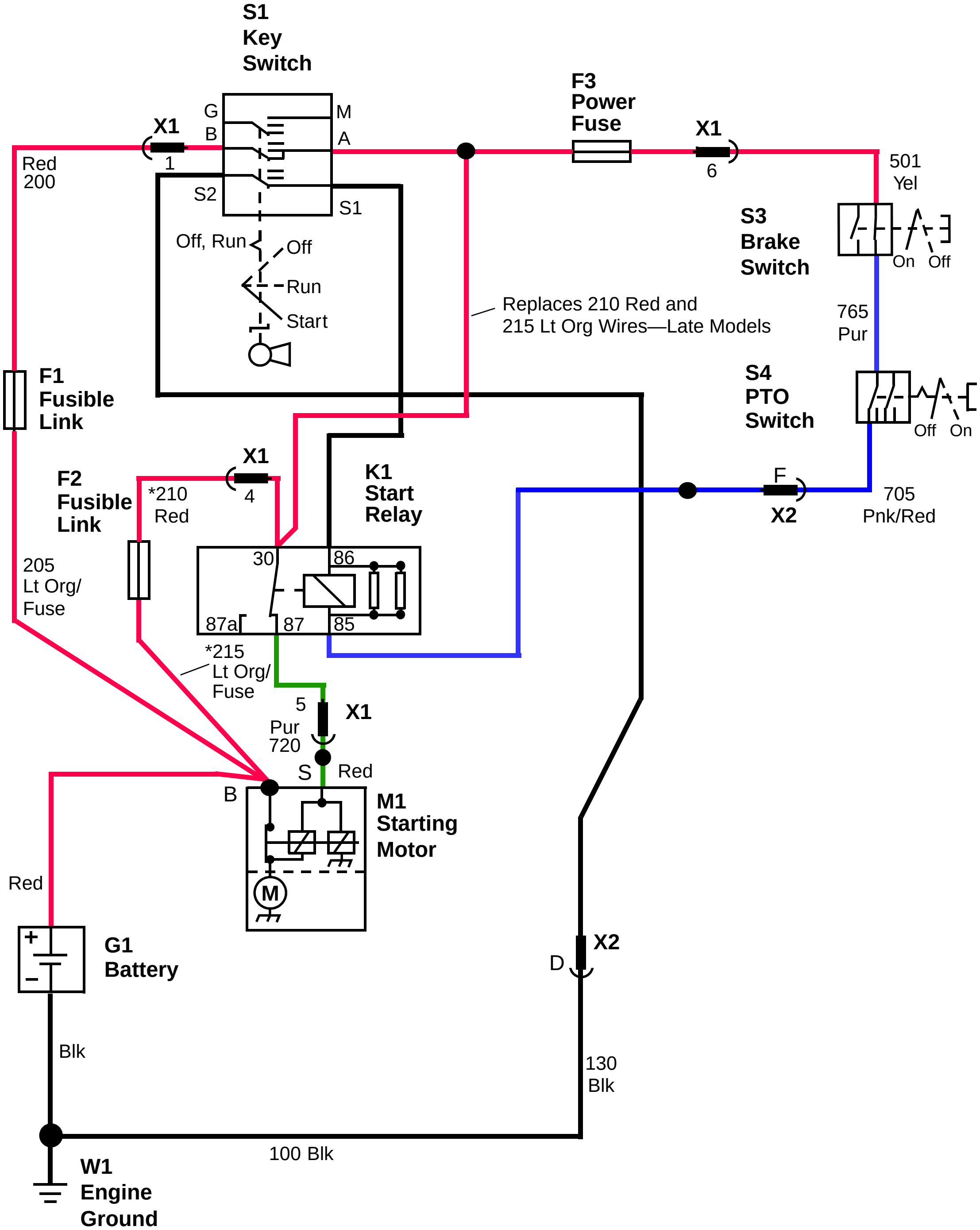
With the key switch in the start position, current flows from terminal B to terminal A, 15-amp fuse (F4), brake switch (S6) (brake pedal engaged), PTO switch (S3) (PTO disengaged), and coil of start relay (K1).

A ground circuit for the start relay coil must be provided for the relay to energize. With the key switch in the start position, current flows to ground through the key switch terminals S1 and S2, energizing the start relay coil which closes the relay.

With the relay closed, current flows to the starter solenoid, engaging the solenoid. The solenoid is engaged by current flowing through both the pull-in and hold-in windings, pulling the plunger inward. The plunger closes the solenoid main contacts. When the main contacts are closed, both ends of the pull-in windings have the same voltage so current through the pull-in winding stops. Current continues through the hold-in windings, keeping the solenoid engaged.

With the solenoid main contacts closed, high current from the battery flows across the main contacts to the starting motor (M1) causing it to turn.

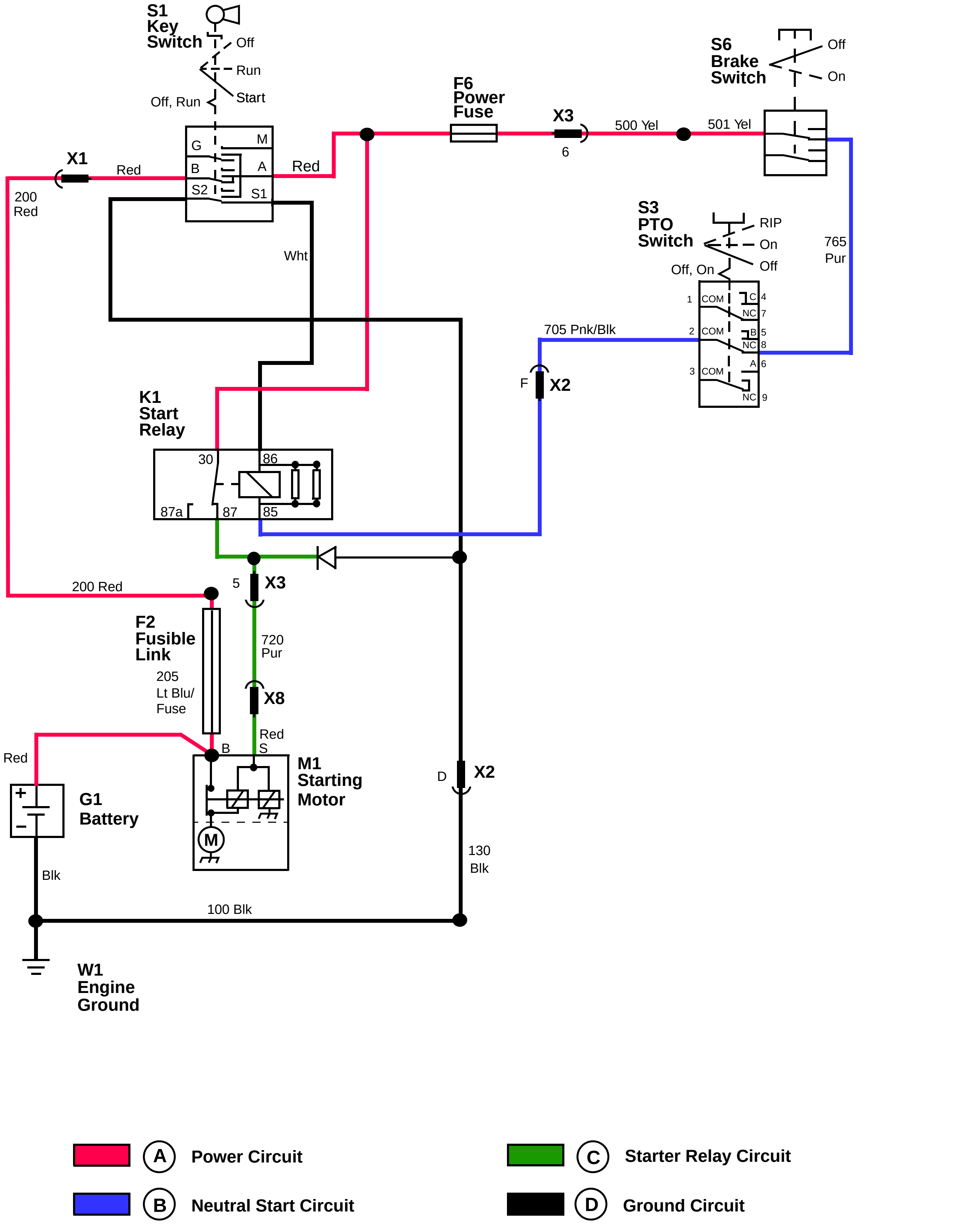
CRANKING CIRCUIT SCHEMATIC—455 (S.N. —070000)



* 210 Red and 215 Lt Org Wires Are On Early Models Only.

(red)	A	Power Circuit
(blue)	B	Neutral Start Circuit
(green)	C	Start Relay Circuit
(black)	D	Ground Circuit

CRANKING CIRCUIT SCHEMATIC—455 (S.N. 070001—)



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CRANKING CIRCUIT DIAGNOSIS—455 (S.N. —070000)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Key switch run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Ignition LED.	Light on.	Check neutral start circuit—go to step 5.

Test Conditions:

- Key switch in start position.

Test/Check Point	Normal	If Not Normal
3. Starter solenoid terminal S.	Minimum 10 volts.	No voltage—go to step 4. Low voltage—check neutral start circuit for voltage drop—go to step 5. Voltage ok—test starter solenoid and motor.

Test Conditions:

- Disconnect starter solenoid connector (A).
- Turn key switch from on to start repeatedly while holding relay.

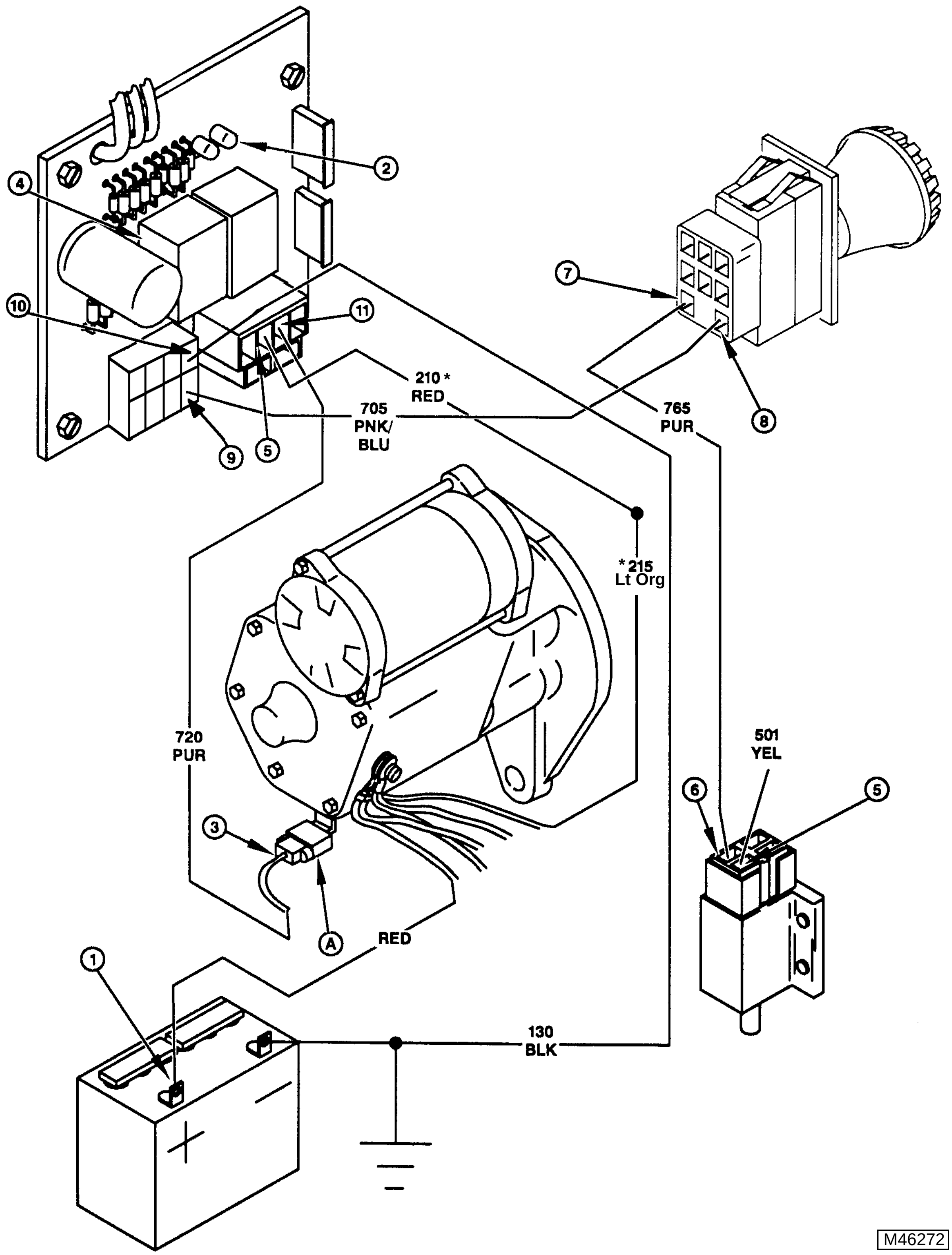
Test/Check Point	Normal	If Not Normal
4. Start relay.	Relay clicks.	Relay does not click or cannot feel, go step 5. Relay clicks, go to step 11.

Test Conditions:

- Connect starter solenoid connector (A).
- Key switch in run position.

Test/Check Point	Normal	If Not Normal
5. Brake switch and control/fuse switch module terminal 4.	Battery voltage.	Check power circuit test points from battery to brake and control/fuse module terminal 4.
6. Brake switch.	Battery voltage.	Test brake switch.
7. PTO switch.	Battery voltage.	Test 765 pur wire.
8. PTO switch.	Battery voltage.	Test PTO switch.
9. Control/fuse module terminal F.	Battery voltage.	Test 705 pnk/red wire.

CRANKING CIRCUIT TEST POINTS—455 (S.N. —070000)



*Early models only, late models do not have 210 red and 215 lt org wires.

CRANKING CIRCUIT DIAGNOSIS— 455 (S.N. —070000) (continued)

Test Conditions:

- Control/fuse module fuses removed.
- Key switch start position.

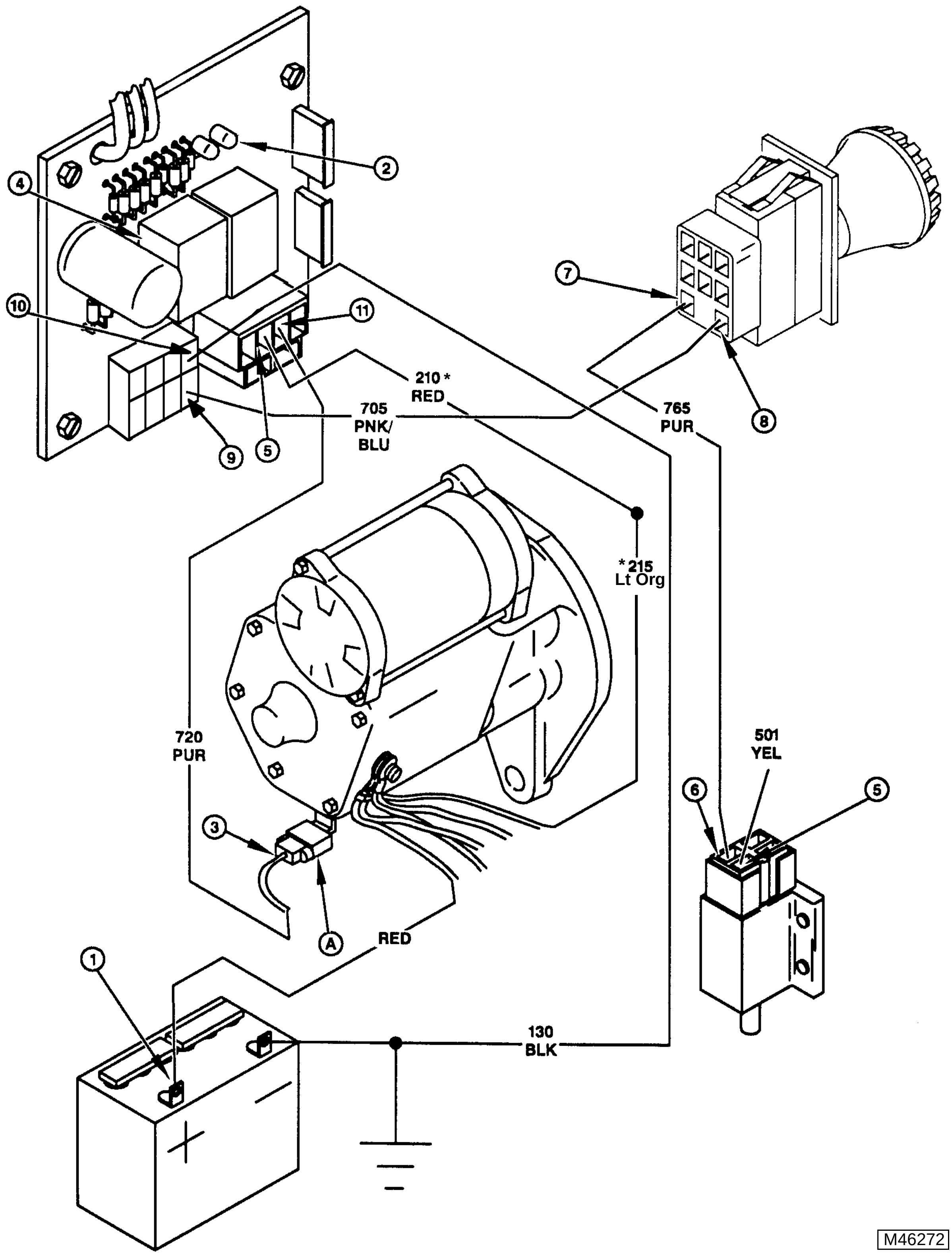
Test/Check Point	Normal	If Not Normal
10. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check control/fuse module ground circuit-130 and 100 blk wires.

Test Conditions:

- Control/fuse module fuses installed.
- Key switch in run position.

Test/Check Point	Normal	If Not Normal
11. Control/fuse module terminal 5.	Battery voltage.	No voltage-replace control/fuse module. Voltage-check 720 pur and red wires.

CRANKING CIRCUIT TEST POINTS—455 (S.N. —070000) (continued)



*Early models only, late models do not have 210 red and 215 lt org wires.

CRANKING CIRCUIT DIAGNOSIS—455 (S.N. 070001—)

Test Conditions:

- Transmission in neutral.
- PTO switch in off position.
- Park brake engaged.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Ignition LED.	Light on.	Check neutral start circuit, go to step 5.

Test Conditions:

- Key switch in start position.

Test/Check Point	Normal	If Not Normal
3. Starter solenoid terminal S.	Minimum 10 volts.	No voltage—go to step 4. Low voltage—check neutral start circuit for voltage drop, go to step 5. Voltage ok—test starter solenoid and motor.

Test Conditions:

- Disconnect starter solenoid connector (A).
- Turn key switch from on to start repeatedly while holding relay.

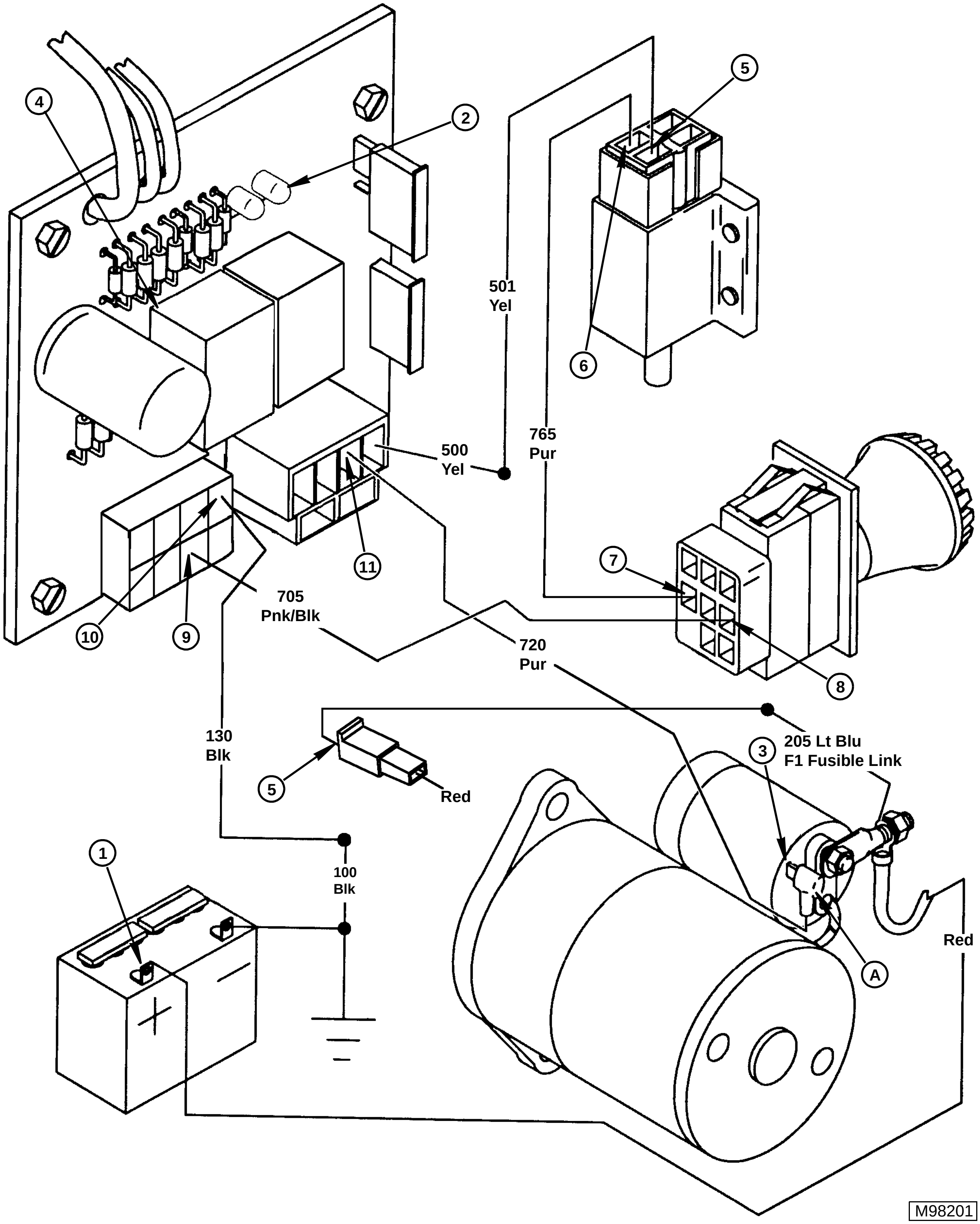
Test/Check Point	Normal	If Not Normal
4. Start relay.	Relay clicks.	Relay does not click or cannot feel, go to step 5. Relay clicks, go to step 11.

Test Conditions:

- Connect starter solenoid connector (A).
- Key switch in run position.

Test/Check Point	Normal	If Not Normal
5. Key switch power connector and control/fuse switch module terminal 4.	Battery voltage.	Check power circuit test points from battery to key switch power connector and control/fuse module terminal 4.
6. Brake switch.	Battery voltage.	Test brake switch.
7. PTO switch.	Battery voltage.	Test 765 pur wire.

CRANKING CIRCUIT TEST POINTS—455 (S.N. 070001—)



CRANKING CIRCUIT DIAGNOSIS— 455 (S.N. 070001—) (continued)

Test/Check Point	Normal	If Not Normal
8. PTO switch.	Battery voltage.	Test PTO switch.
9. Control/fuse module terminal F.	Battery voltage.	Test 705 pnk/red wire.

Test Conditions:

- Control/fuse module fuses removed.
- Key switch in start position.

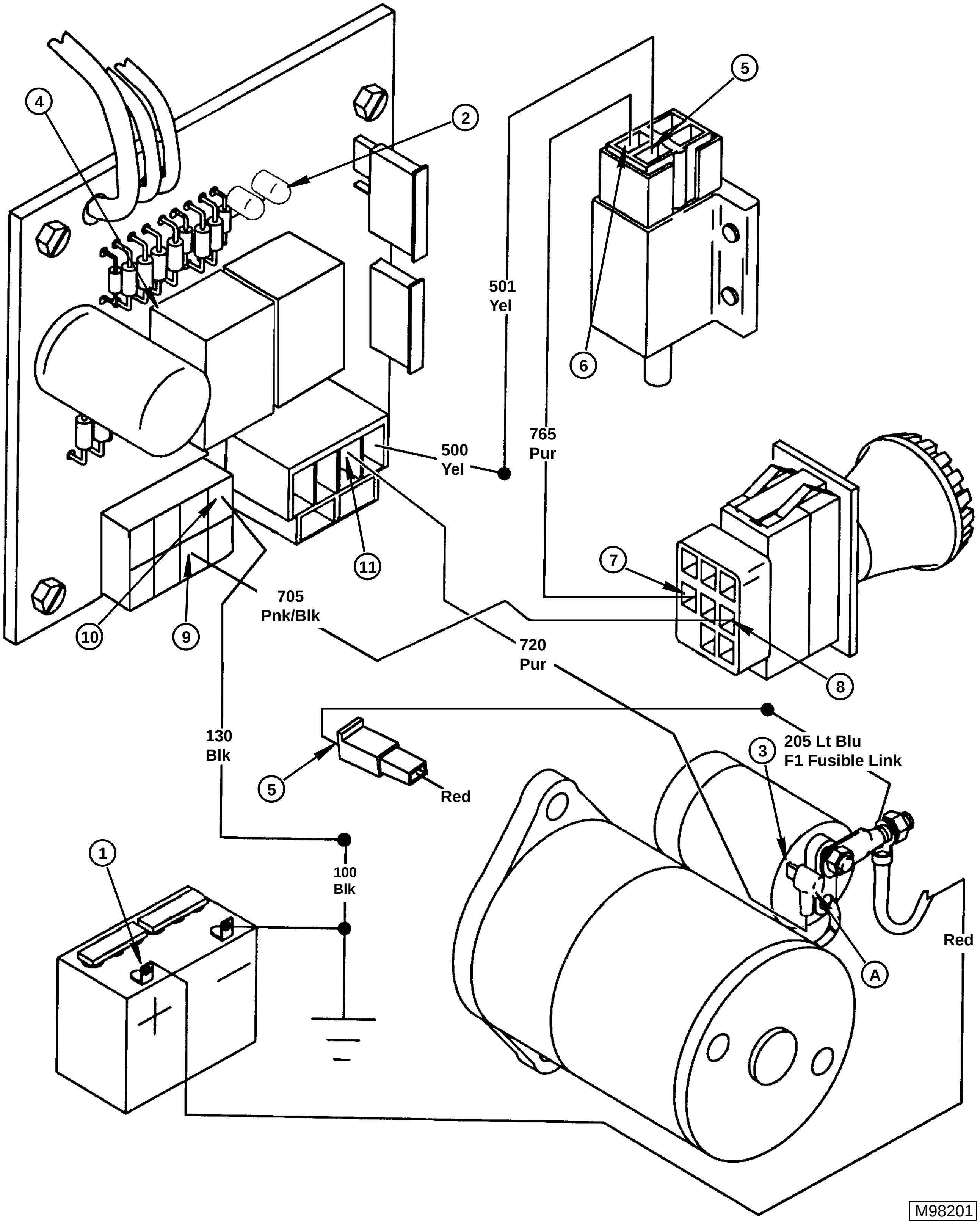
Test/Check Point	Normal	If Not Normal
10. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check control/fuse module ground circuit, 130 and 100 blk wires.

Test Conditions:

- Control/fuse module fuses installed.
- Key switch in run position.

Test/Check Point	Normal	If Not Normal
11. Control/fuse module terminal 5.	Battery voltage.	No voltage—replace control/fuse module. Voltage—check 720 pur and red wires.

CRANKING CIRCUIT TEST POINTS—455 (S.N. 070001—) (continued)



CHARGING CIRCUIT OPERATION—455 (S.N. —070000)

Function:

To maintain proper battery charge at approximately 11.8—13.2 volts.

Operating Conditions:

The key switch must be in the run position with the engine running.

System Operation:

Current (A) flows from the battery (G1) to the starter (M1), fusible link (F2), key switch B terminal (S1), and alternator battery terminal (G2). With the key switch in the run position, current flows through the switch to the 15 amp fuse (F3), charge light (H3), and the alternator voltage regulator. When the alternator has no output, an internal ground closes in the regulator to complete a path to ground and lights the charge lamp.

The voltage regulator monitors battery voltage and increases alternator output to maintain proper running voltage and battery charge. Alternator output is determined by the intensity of magnetism at the field coil. As the battery voltage fluctuates the regulator adjusts voltage to the field coil which in turn intensifies the magnetic field at the field coil to increase alternator output.

The alternator produces alternating current (AC) which is then rectified to direct current (DC) in the rectifier.

Current (B) flows from the alternator to the common tie point on the starter and then to the positive terminal of the battery for storage.

Ground circuit (C) provides a path to ground for the alternator regulator, and discharge light (H3).

CHARGING CIRCUIT OPERATION—455 (S.N. 070001—)

Function:

To maintain battery voltage between 11.8 and 13.2 volts.

Operating Conditions:

The key switch must be in the run position with the engine running for the charging system to operate.

System Operation:

The charging system is a permanent magnet and stator design. Charging output is controlled by a rectifier/regulator. A discharge light warns the operator if the stator stops charging. The discharge light circuit monitors stator output, not battery voltage.

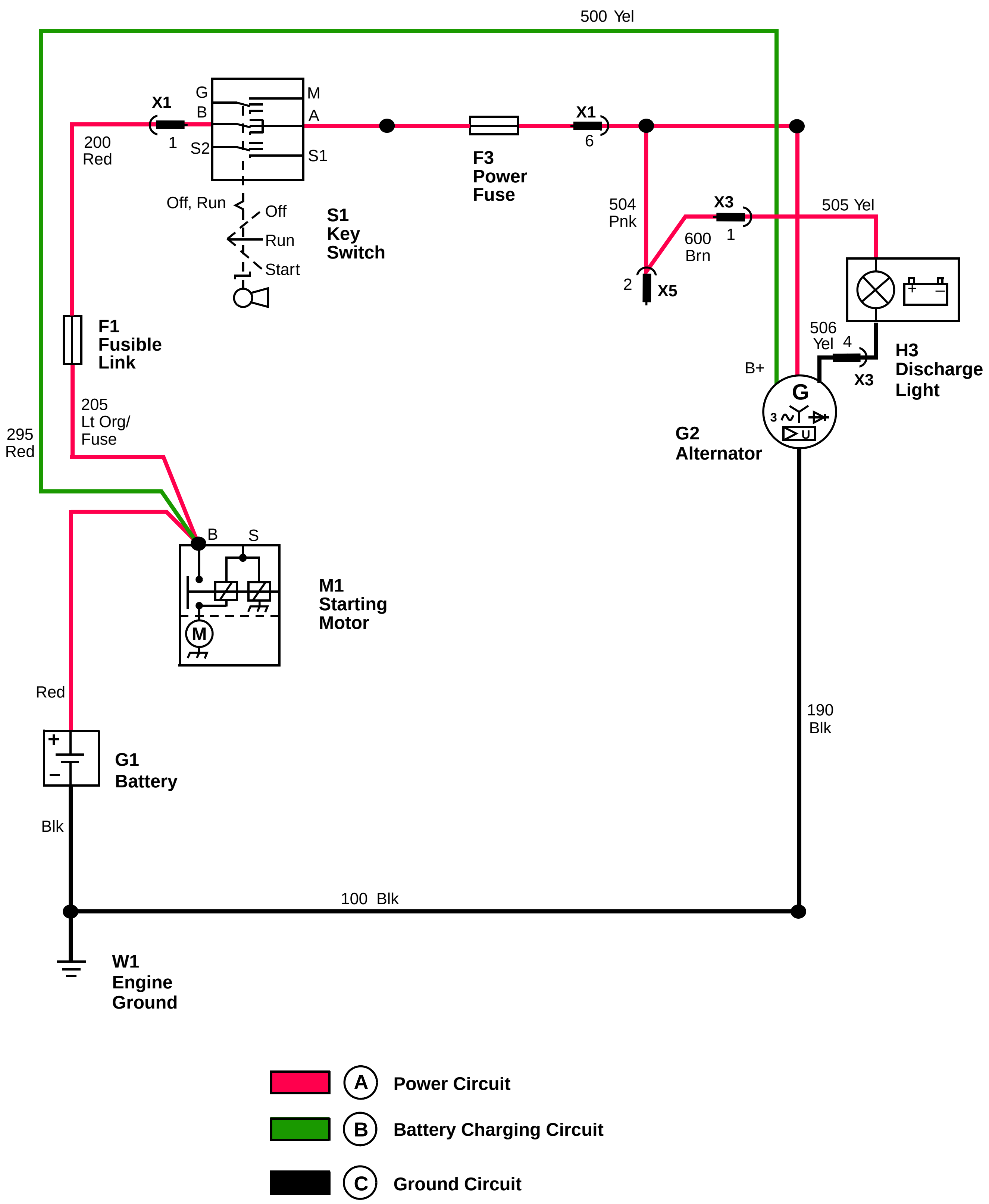
The power circuit (A) provides current to the key switch (S1) battery terminal and protects the charging circuit with a fusible link (F2). With the key switch in the run position, current flows from battery (G1) positive terminal to fusible link, key switch, power fuse (F6), and rectifier/regulator (N1). The voltage sensing circuit allows the rectifier/regulator to monitor battery voltage.

As the flywheel turns, a permanent magnet located in the flywheel induces AC current in the stator (G2) windings. The AC current flows to the rectifier/regulator. The rectifier/regulator converts AC current to DC current needed to charge the battery. If battery voltage is low, the rectifier/regulator allows DC current to flow to the battery to charge it through the battery charging circuit (B). When the battery is fully charged, the rectifier/regulator stops current flow to the battery.

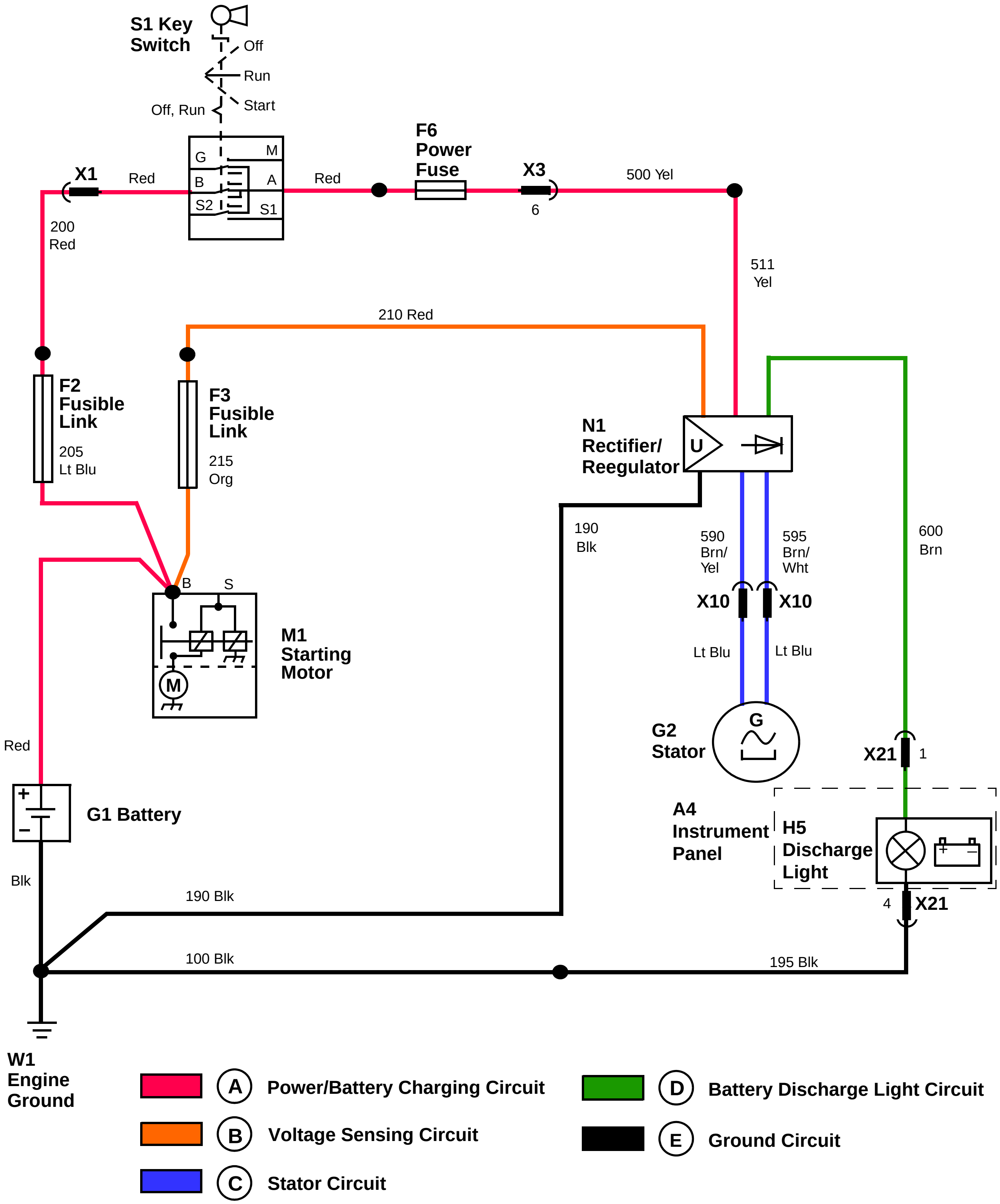
If stator output current to the rectifier/regulator stops, the rectifier/regulator provides current to the discharge light (H5) to light the lamp.

The ground circuit (E) provides a path to ground for the rectifier/regulator.

CHARGING CIRCUIT SCHEMATIC—455 (S.N. —070000)



CHARGING CIRCUIT SCHEMATIC—455 (S.N. 070001—)



CHARGING CIRCUIT DIAGNOSIS—455 (S.N. —070000)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Key switch off position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Alternator ground terminal.	Maximum 0.1 ohms resistance.	Check battery negative cable and harness connection, and 100 and 190 blk wires.

Test Conditions:

- Key switch in run position.

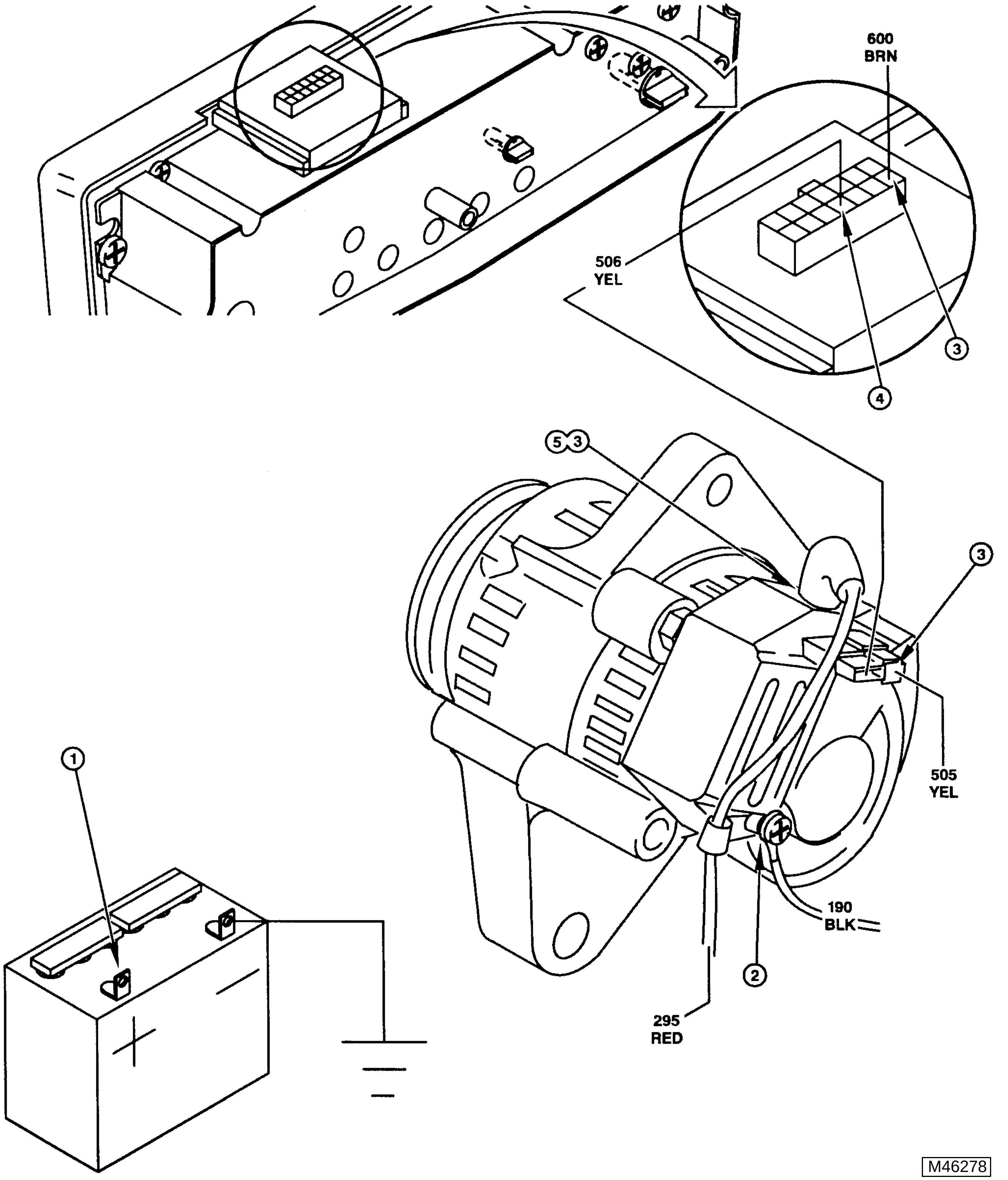
Test/Check Point	Normal	If Not Normal
3. Dash panel module terminal 1, alternator terminal B, and regulator terminal.	Battery voltage.	Check power circuit test points.
4. Dash panel module terminal 4.	0.0—0.2 volts.	Greater than 0.2 volts—check charge lamp ground circuit—506 yel wire. 0.0 volts—check bulb, if ok, replace dash panel module.

Test Conditions:

- Disconnect fuel shut-off solenoid connector.
- Crank engine for 15 seconds to discharge battery.
- Connect fuel shut-off solenoid connector.
- Start and run engine at fast idle.

Test/Check Point	Normal	If Not Normal
5. Alternator red wire.	Voltage increases—between 12.2—14.7 volts. Voltage must not exceed 14.7.	Voltage does not increase—test unregulated amperage to determine if alternator or regulator is defective. Voltage exceeds 14.7—replace regulator

CHARGING CIRCUIT TEST POINTS—455 (S.N. —070000)



CHARGING CIRCUIT DIAGNOSIS—455 (S.N. 070001—)

Test Conditions:

- Park brake engaged.
- Transaxle/Transmission in neutral.
- Rectifier/regulator connector disconnected.
- Key switch in run position.
- Engine running at fast idle.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Rectifier/regulator connector.	Minimum unregulated voltage output—26 VAC.	Test stator, check flywheel magnets, 595 brn/wht and 590 brn/yel wires.

Test Conditions:

- Regulator/rectifier connector connected.

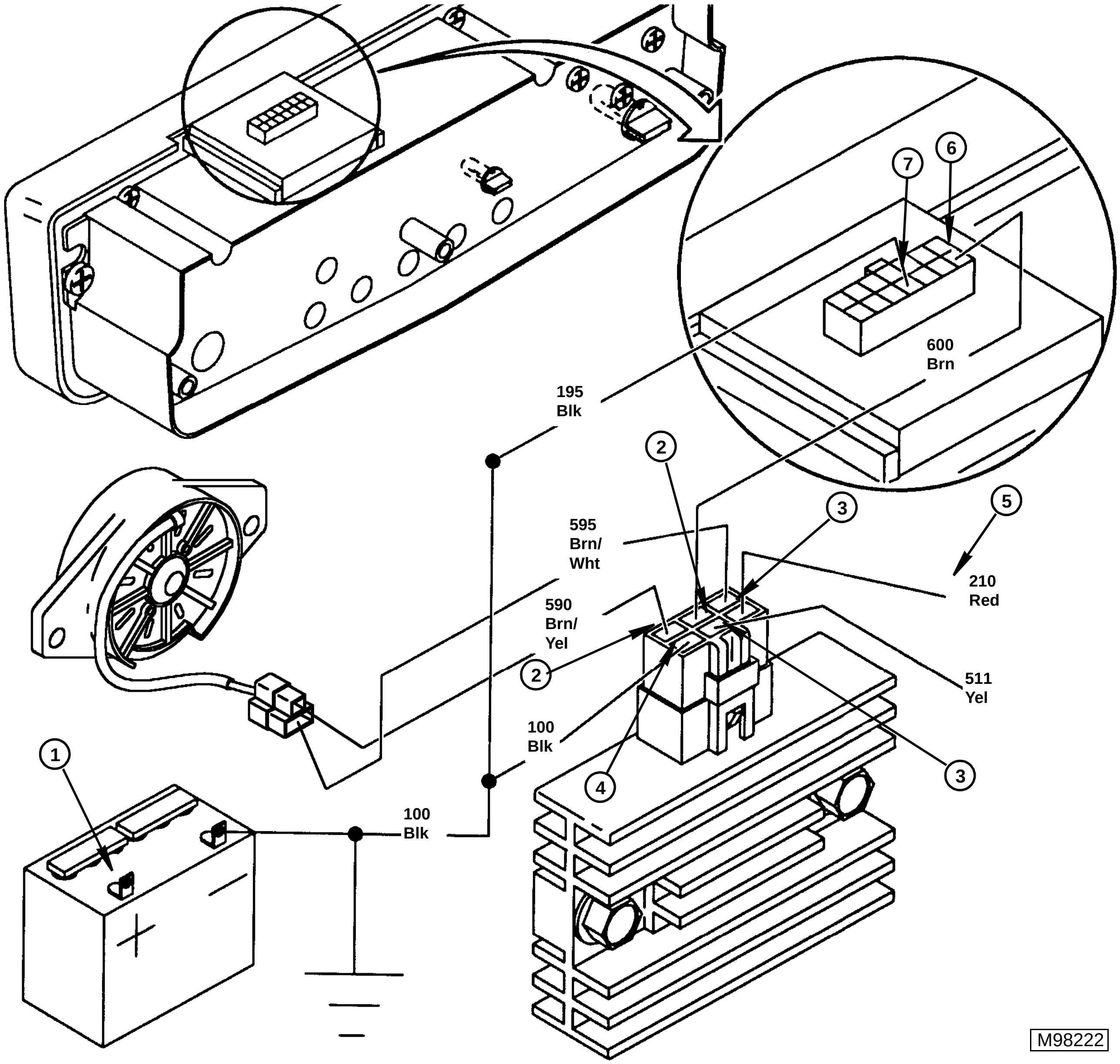
Test/Check Point	Normal	If Not Normal
3. Rectifier/regulator.	Battery voltage.	Check power circuit.
4. Rectifier/regulator.	0.0—0.2 volts.	Greater than 0.2 volts—test rectifier/regulator ground circuit (190 and 100 blk wires). 0.0 volts—Replace rectifier/ regulator.
5. Rectifier/regulator wire.	Minimum regulated output—13 amps.	Replace rectifier/regulator.

Test Conditions:

- Engine off.
- Key switch in run position.

Test/Check Point	Normal	If Not Normal
6. Charge light.	Battery voltage.	Check 600 brn wire then replace rectifier/regulator.
7. Charge light.	0.0—0.2 volts.	Greater than 0.2 volts —test charge light ground circuit—136 blk wire. 0 volts —replace bulb.

CHARGING CIRCUIT TEST POINTS—455 (S.N. 070001—)



PTO CIRCUIT OPERATION—455 (S.N. —070000)

Function:

To provide power to energize or de-energize the PTO solenoid when desired by the operator.

Operating Conditions:

The key switch must be in the run position, with the brake pedal released (brake switch closed), the PTO switch off, engine temperature normal (green area on coolant temperature gauge), and the operator on the seat to initially provide power to the PTO switch for PTO solenoid operation.

System Operation:

The PTO circuit uses the seat switch (S2), hold-in relay (K2), and PTO relay (K3) to stop current flow to the PTO solenoid (Y1) if the operator gets off the seat with the PTO engaged. Also, the PTO will be disengaged if the brake pedal is depressed with the PTO switch on or if the engine temperature gets too hot.

Current (A) flows from the battery (G1) to the starting motor (M1), fusible link (F2), and key switch terminal B (S1). With the key switch in the run position, current flows from key switch terminal B to terminal A, power fuse (F3), hold-in relay terminal 87, engine high temperature relay terminal 85 (K4), seat switch, and the glow plug light (H5). Current cannot flow to the PTO relay until the hold-in relay is energized. Energizing current for the hold-in relay must come from the seat switch circuit (B). With the seat switch closed (operator on seat), current flows to the hold-in relay coil terminal, and the hold-in relay LED (E1). The hold-in relay LED indicates that power is available to the hold-in relay coil.

With the hold-in relay energized, current (C) flows to the PTO relay terminal 87. Current cannot flow to the PTO solenoid until the PTO relay is energized. Energizing current for the PTO relay must come from the PTO switch, the brake switch (S3), and the engine high temperature relay (K4). With the PTO switch off, current flows to the PTO relay terminal 30, brake switch (brake pedal released), engine high temperature relay terminals 30 and 87A (relay de-energized), PTO LED (E2), PTO relay coil and energizes the coil, closing the relay. PTO relay circuit current (E) is available to operate the PTO solenoid (Y1) and light (H1) when the PTO switch is turned on. The PTO relay LED indicates that power is available to the PTO relay coil.

If the operator leaves the seat, or depresses the brake pedal with the PTO engaged, current to the hold-in and PTO relay coil is stopped. If the engine temperature rises above 110°C (230°F), the coolant temperature switch (B1) closes and provides a path to ground for the engine high temperature relay coil and the glow plug light. With the engine high temperature relay energized, current flow to PTO relay coil is stopped. Also the glow plug light comes on to alert the operator of high engine temperature. When any one of the hold-in, PTO, or engine high temperature relays open, current flow to the PTO solenoid stops, disengaging the PTO clutch and turning off the PTO light. The operator must return to the seat, release the brake pedal, or allow the engine to cool down and turn the PTO switch off before the PTO relay will energize again. A delay capacitor in the control/fuse module provides current for 1/2 second to keep the hold-in relay coil energized if the operator bounces on the seat.

When the PTO switch is moved to the on position, current flows to the PTO solenoid and energizes the solenoid to engage the clutch. At the same time, current also flows to the PTO light. An alternate path for PTO relay coil energizing current must be provided when the PTO switch is on. With the brake pedal released, PTO relay circuit current (E) from terminal 30 flows to the brake switch, engine high temperature relay, and PTO relay coil, keeping the relay energized.

PTO CIRCUIT OPERATION—455 (S.N. 070001—)

Function:

To provide power to energize or de-energize the PTO solenoid when desired by the operator.

Operating Conditions:

The key switch must be in the run position, with the brake pedal released (brake switch closed), the PTO switch off, and the operator on the seat to initially provide power to the PTO switch for PTO solenoid operation.

System Operation:

The PTO circuit uses the seat switch (S4), ignition relay (K2), and PTO relay (K3) to stop current flow to the PTO solenoid (Y2) if the operator gets off the seat with the PTO engaged. The PTO will be disengaged if the brake pedal is depressed with the PTO switch on. Also, the PTO will be disengaged if the engine coolant temperature becomes too hot.

Current (A) flows from the battery (G1) to the starting motor (M1), fusible link (F2), and terminal B of key switch (S1). With the key switch in the run position, current flows from terminal B to terminal A of key switch (S1) and then to power fuse (F6), terminal 87 of ignition relay (K2), and seat switch (S4). Current cannot flow to the PTO relay until the ignition relay is energized. Energizing current for the ignition relay comes from the seat switch circuit (B). With the seat switch closed, current flows to the ignition relay coil terminal, and the ignition LED (E2). The ignition LED indicates that power is available to the ignition relay coil.

With the ignition relay energized, current (A) flows to the PTO relay terminal 87. Current (D) cannot flow to the PTO switch (S3) until the PTO relay is energized. To energize the PTO relay, current flows from the PTO switch to brake switch (S6), engine temperature relay (K6), RIO switch (S5) and coil of PTO relay (K3).

When the PTO switch is moved to the ON position, current flows to the PTO solenoid and energizes the solenoid to engage the clutch. At the same time, current also flows to the front PTO light.

The PTO safety circuit is used to prevent the PTO relay from energizing if the brake pedal is depressed. With the PTO switch off, current flows to the PTO relay terminal 30, brake switch (brake pedal released), engine temperature relay, RIO switch, PTO LED (E1), PTO relay coil and energizes the coil, closing the relay which supplies current to the PTO switch. The PTO LED indicates that power is available to the PTO relay coil. When the PTO switch is turned on, PTO relay circuit current (C) is available to operate the PTO solenoid (Y2) and front PTO light.

If the operator leaves the seat or depresses the brake pedal with the PTO engaged, current to the ignition and PTO relay coil is stopped. The relays open and current flow to the PTO solenoid stops, disengaging the PTO clutch. The operator must return to the seat, release the brake pedal, and turn the PTO switch to OFF before the PTO relay will energize again. A delay capacitor in the control/fuse module provides current for 1/2 second to keep the ignition relay coil energized if the operator bounces on the seat.

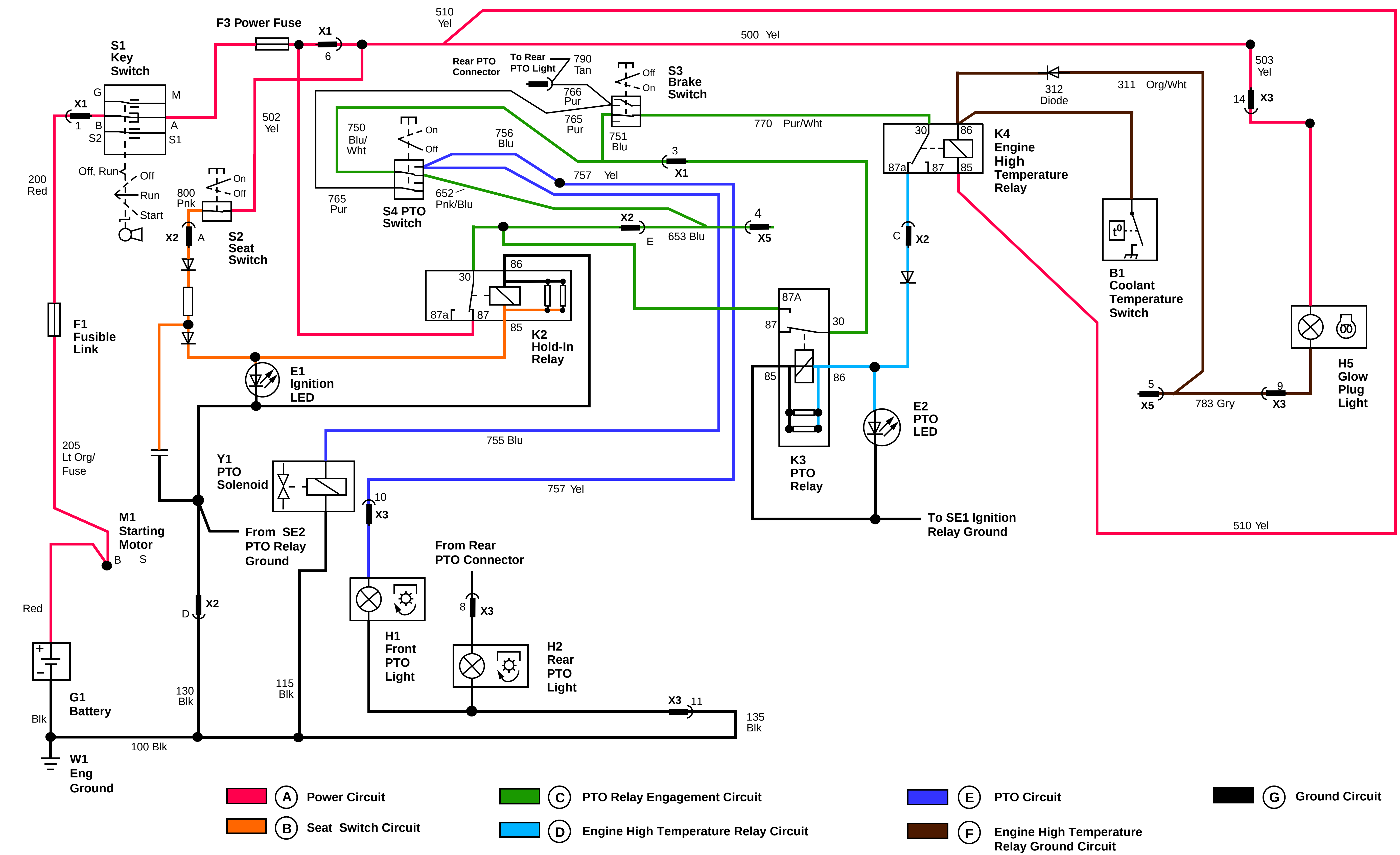
When the PTO is engaged and the operator changes to reverse, current flow to the PTO relay coil is stopped by RIO switch (S5), de-energizing the relay. With the PTO relay de-energized, current flow to the PTO switch and PTO solenoid is also stopped, preventing the PTO solenoid from energizing and the PTO is disengaged.

If the PTO switch is placed in the RIP position before changing to reverse, current will flow to the RIO latch relay coil. The RIO latch relay allows current to flow to the PTO relay. Once reverse motion has begun the RIO switch is open, current to the RIO latch relay must come from the brake switch and engine temperature relay (K6) and is routed through the RIO latch relay contacts and RIO unlatch relay contacts back to the RIO latch relay coil to keep it latched.

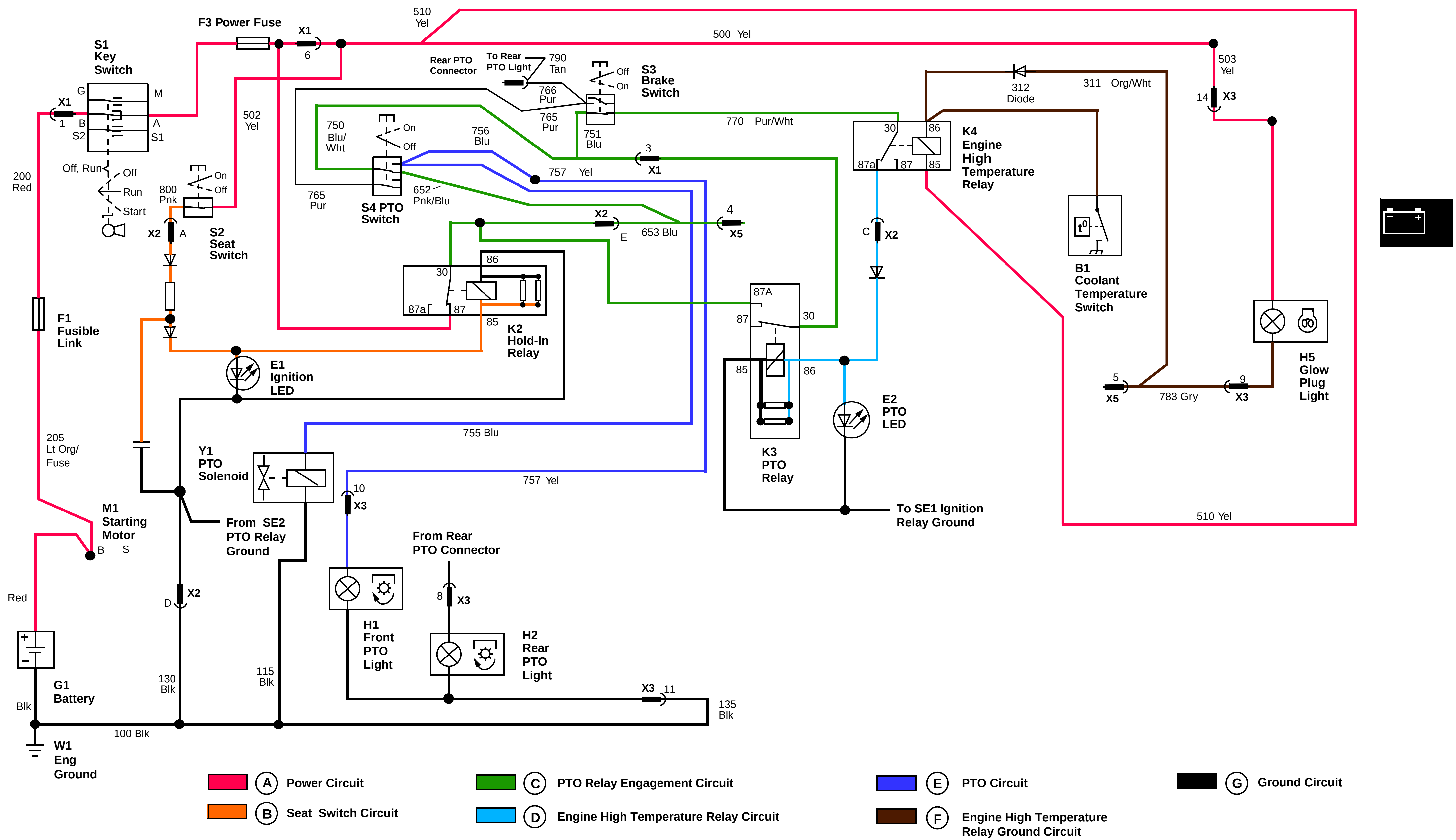
When forward or neutral is resumed, the RIO switch closes and current flows to the RIO unlatch relay coil and energizes the relay, stopping current flow to the RIO latch coil and de-energizes it and stops current flow to the PTO relay, PTO switch, and PTO solenoid. After the PTO relay is de-energized by changing to reverse, it cannot be energized again until the PTO switch is returned to the OFF position.

When the engine coolant temperature rises above 110°C (230°F), the coolant temperature switch (B3) closes and provides a path to ground for the engine temperature relay (K6) and glow plug light (H4). The glow plug light comes on to alert the operator of high engine temperature. With the relay energized, current to the RIO switch (S5) is stopped and no current is supplied to the PTO relay. The PTO is disengaged and the glow plug light remains on until the engine coolant returns to normal operating temperature.

PTO CIRCUIT SCHEMATIC—455 (S.N. —031477)



PTO CIRCUIT SCHEMATIC—455 (S.N. —031477)



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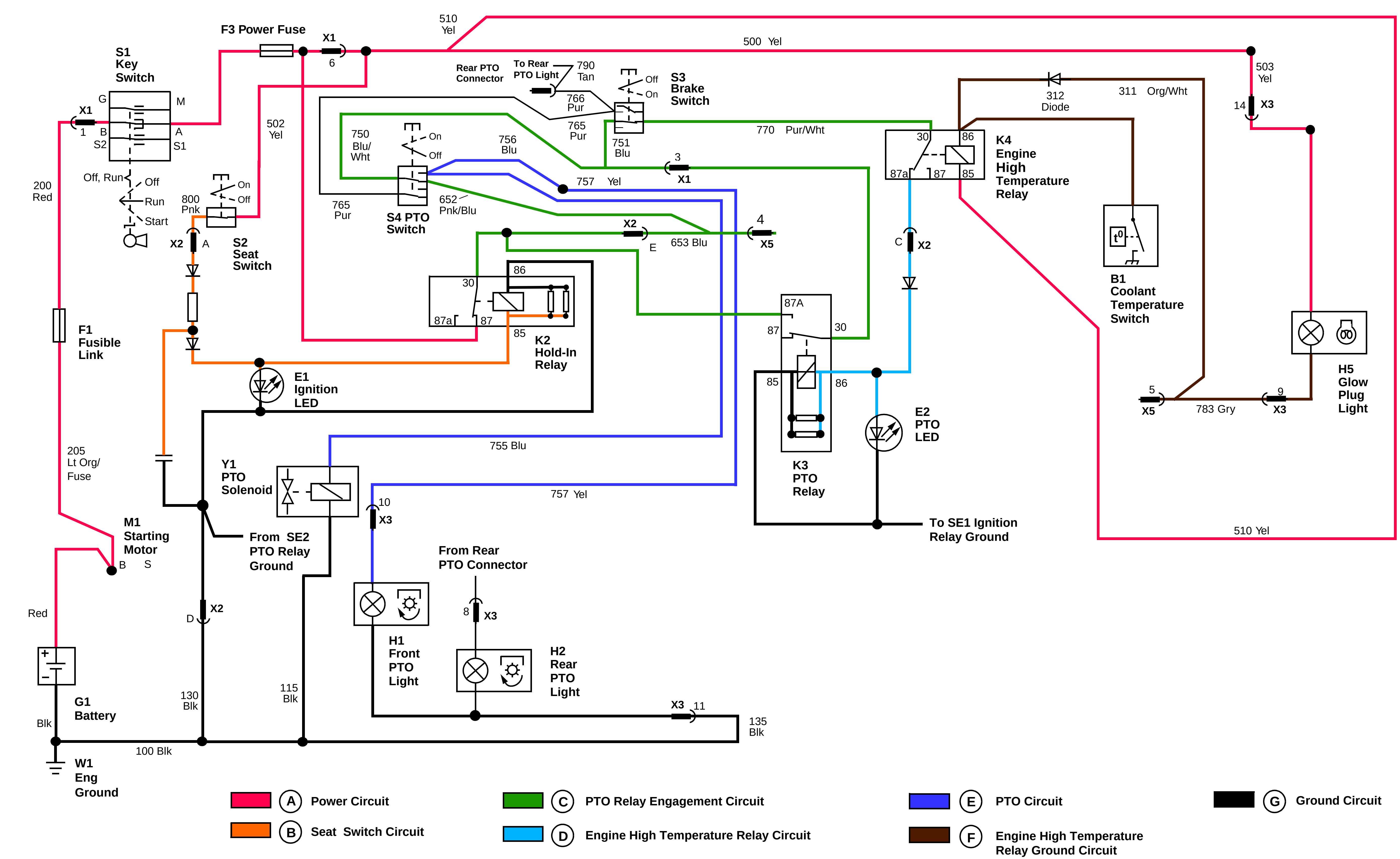
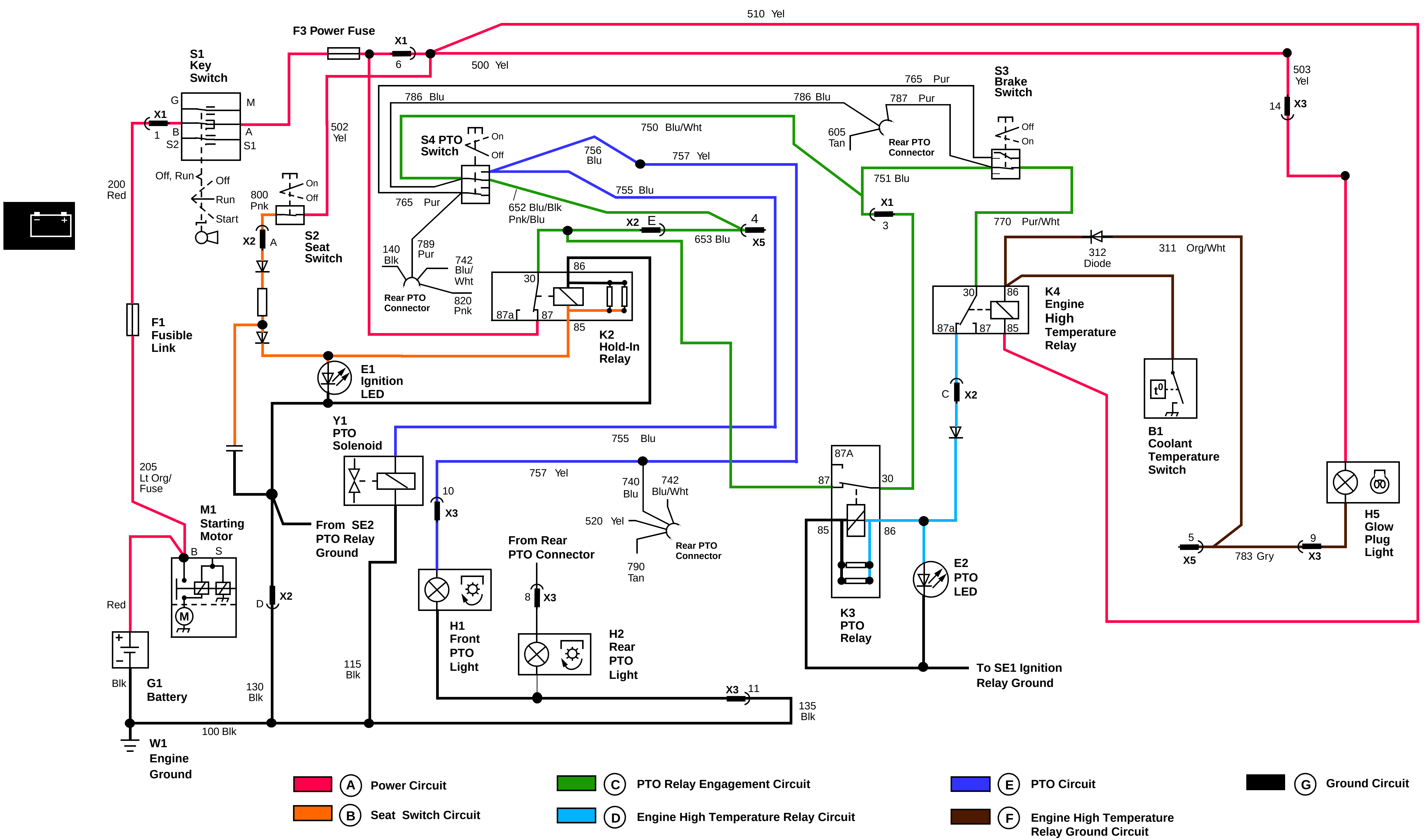


PTO CIRCUIT SCHEMATIC—455 (S.N. 031478—070000)



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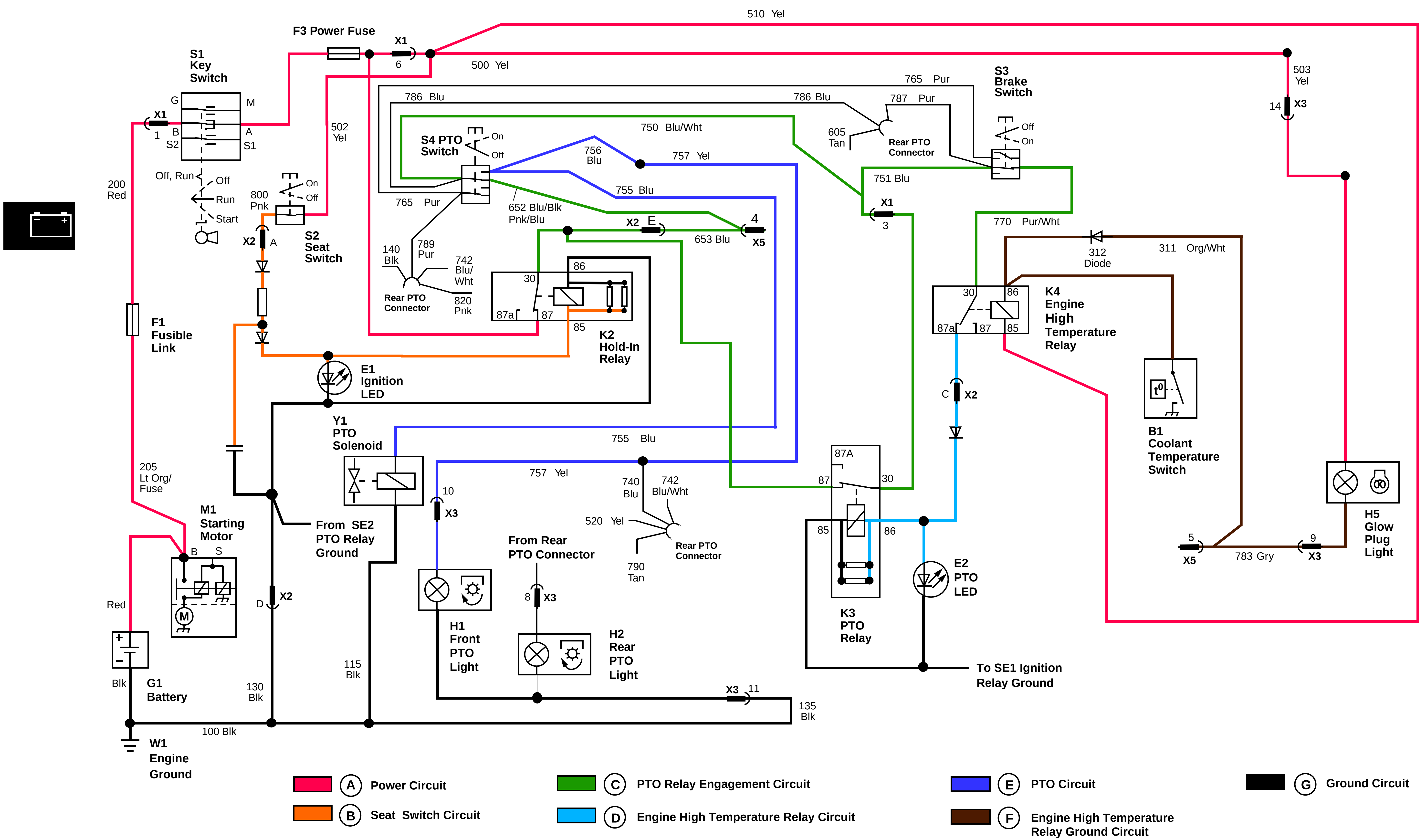

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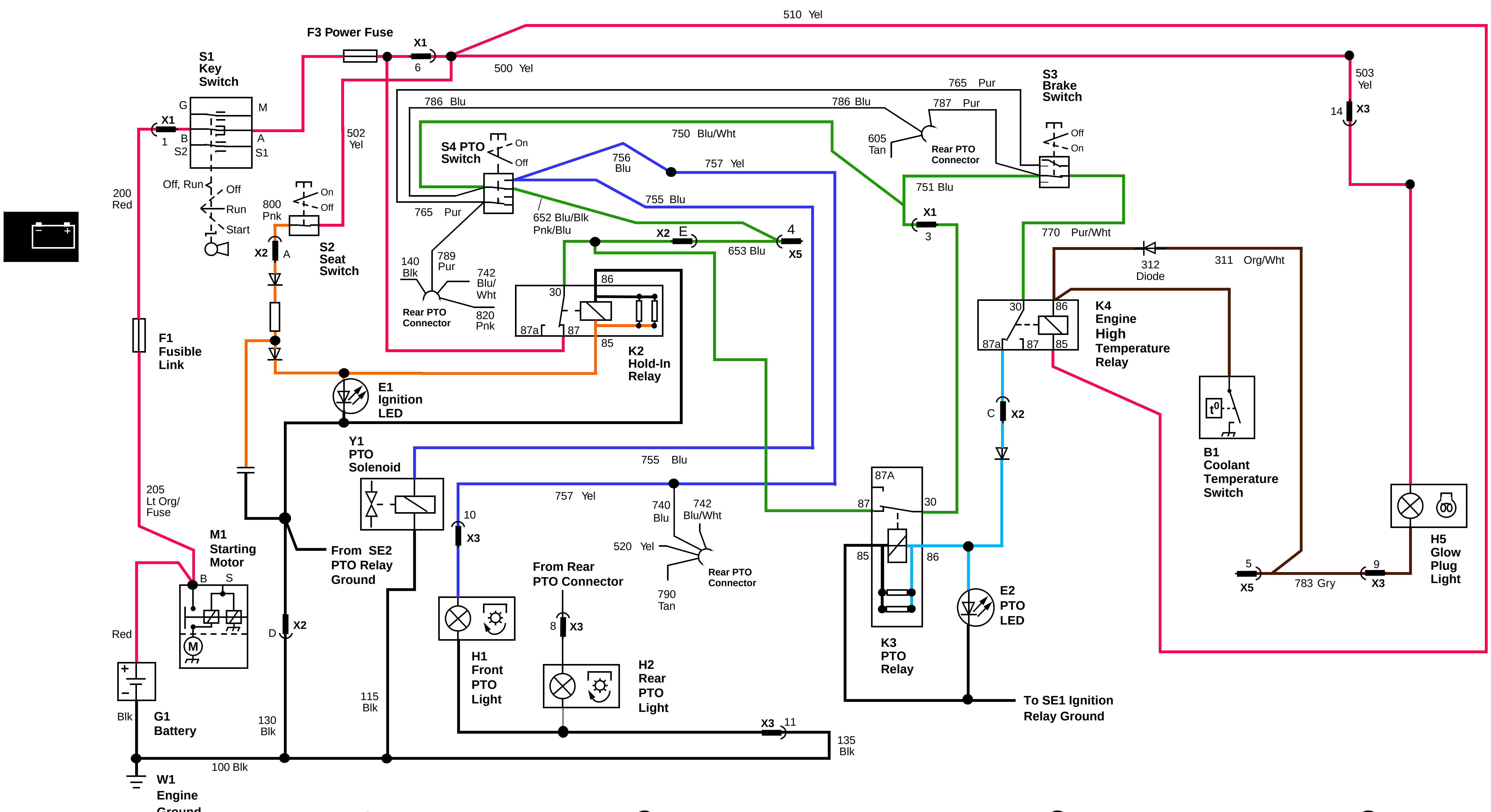


A Power Circuit

B Seat Switch Circuit

C PTO Relay Engagement Circuit

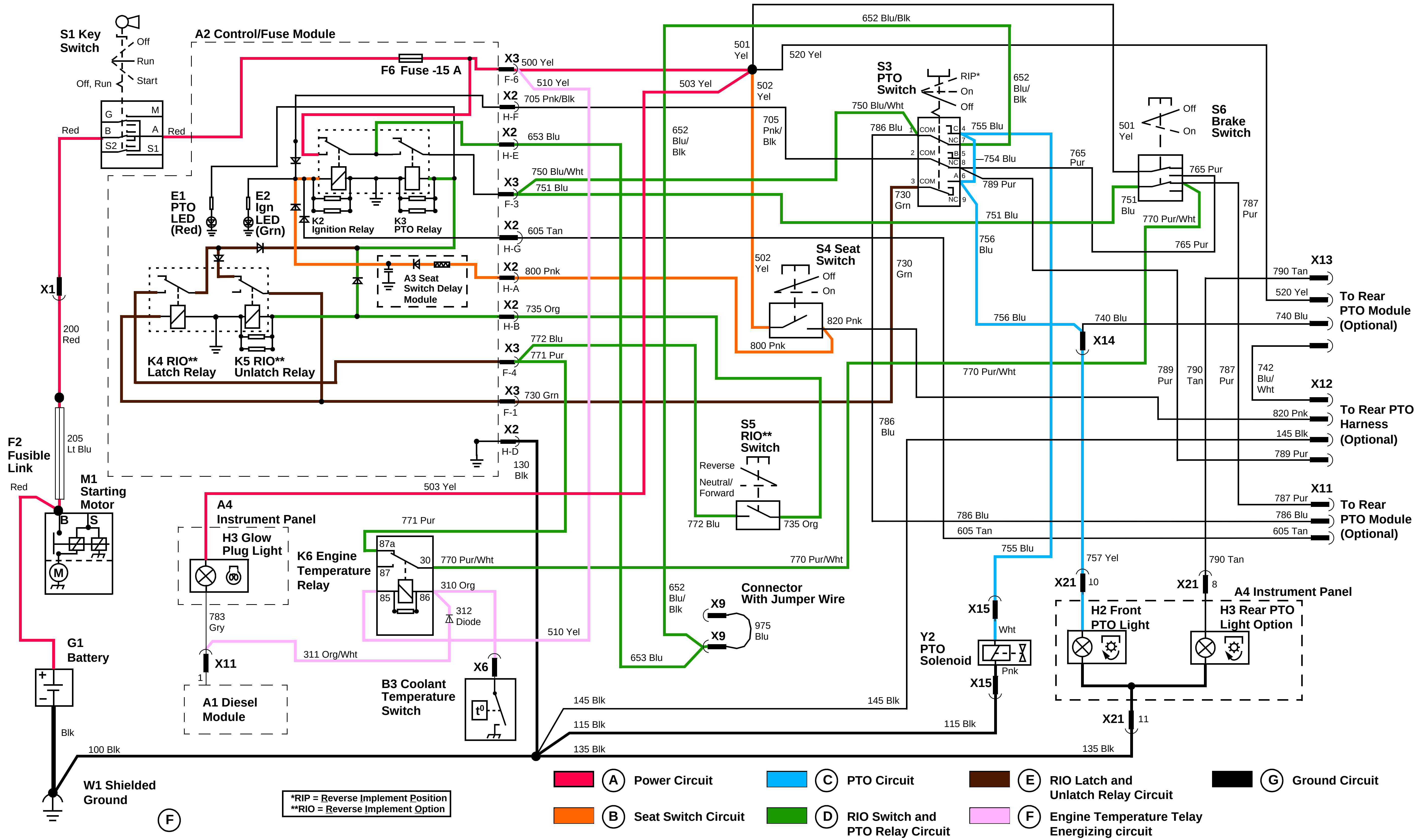
D Engine High Temperature Relay Circuit

E PTO Circuit

F Engine High Temperature Relay Ground Circuit

G Ground Circuit

PTO CIRCUIT SCHEMATIC—455 (S.N. 070001—)



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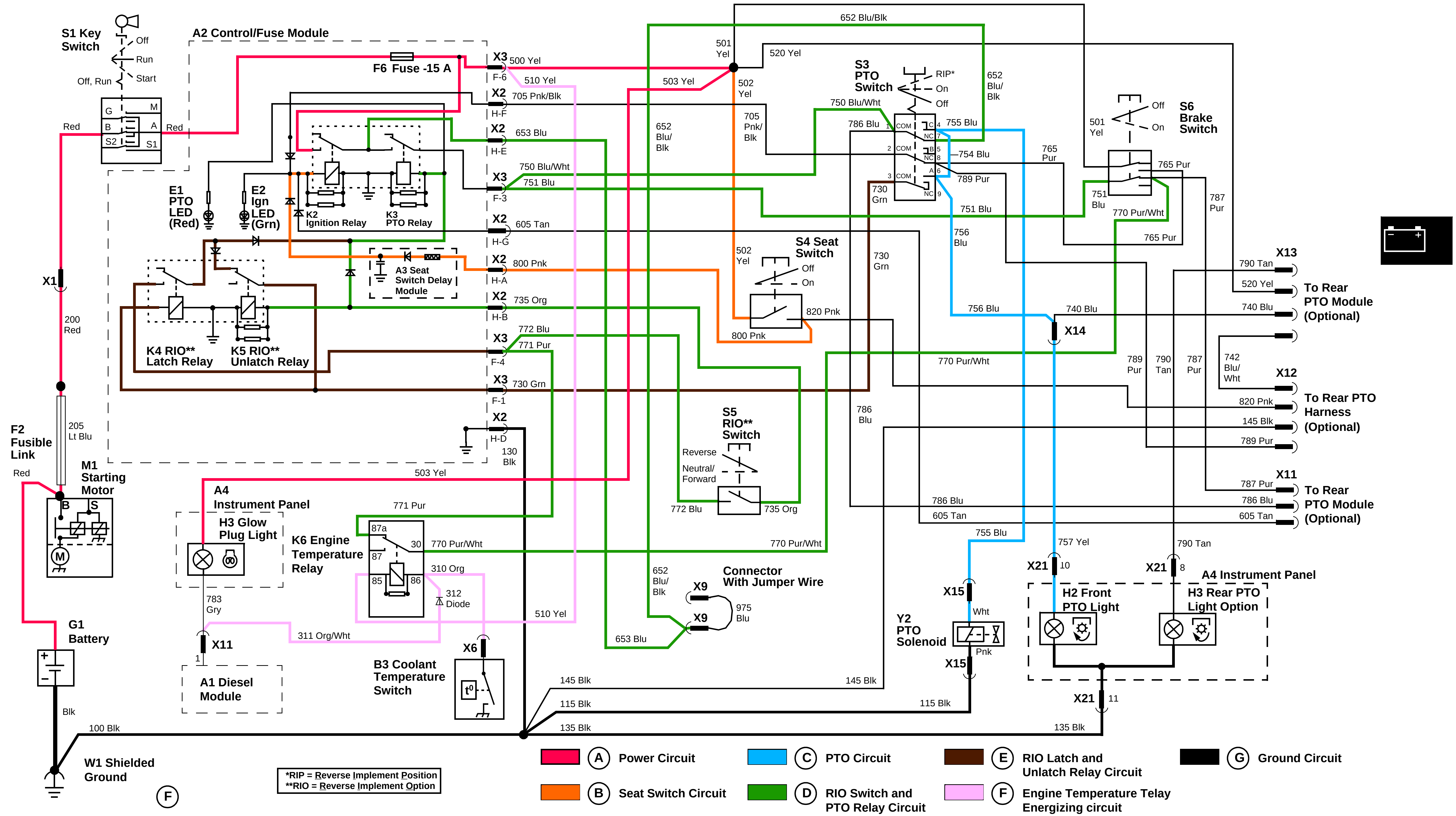

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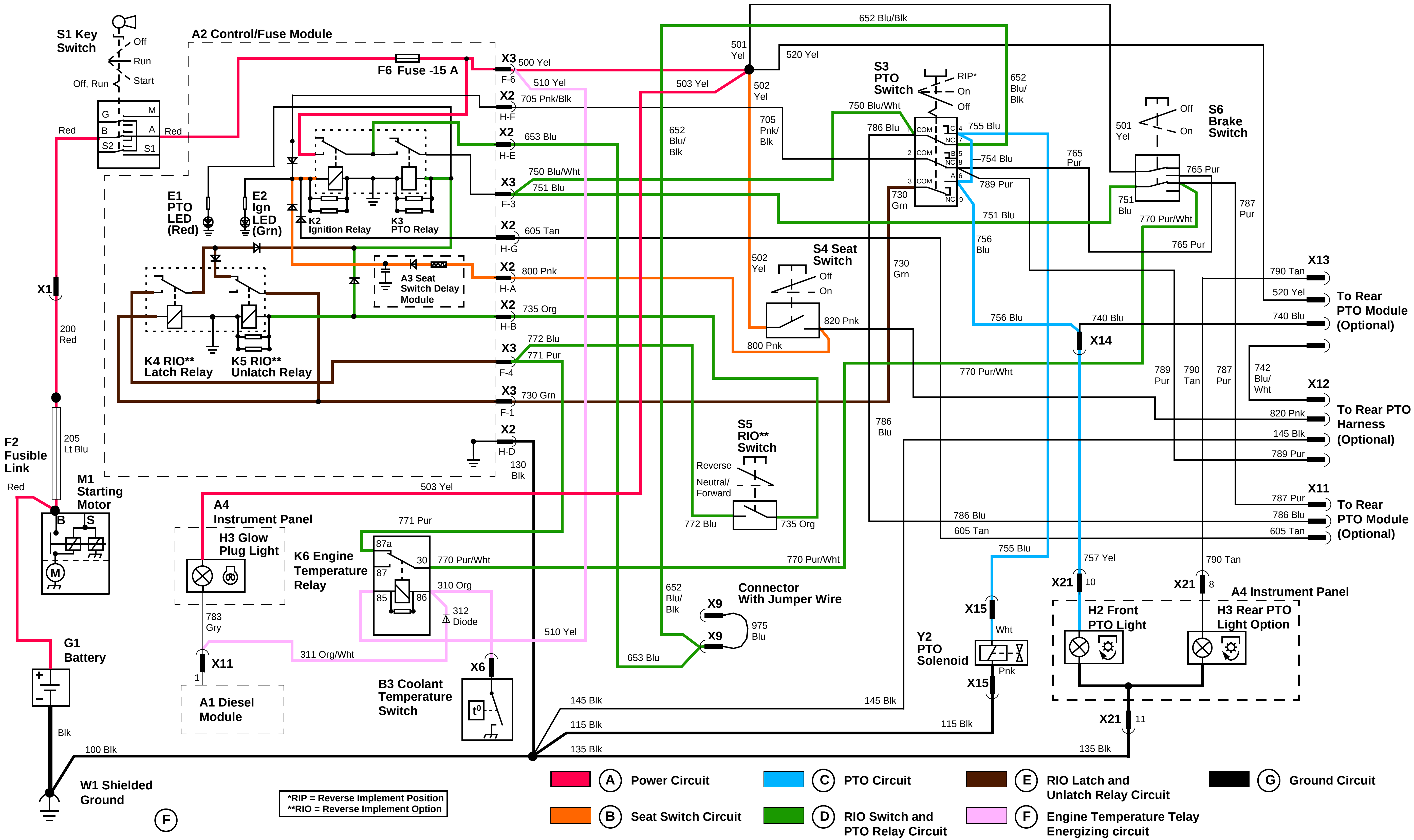


PTO CIRCUIT DIAGNOSIS—455 (S.N. —070000)

Test Conditions:

- PTO switch off position.
- Brake pedal released.
- Seat switch depressed or jumper wire installed in connector.
- Key switch run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

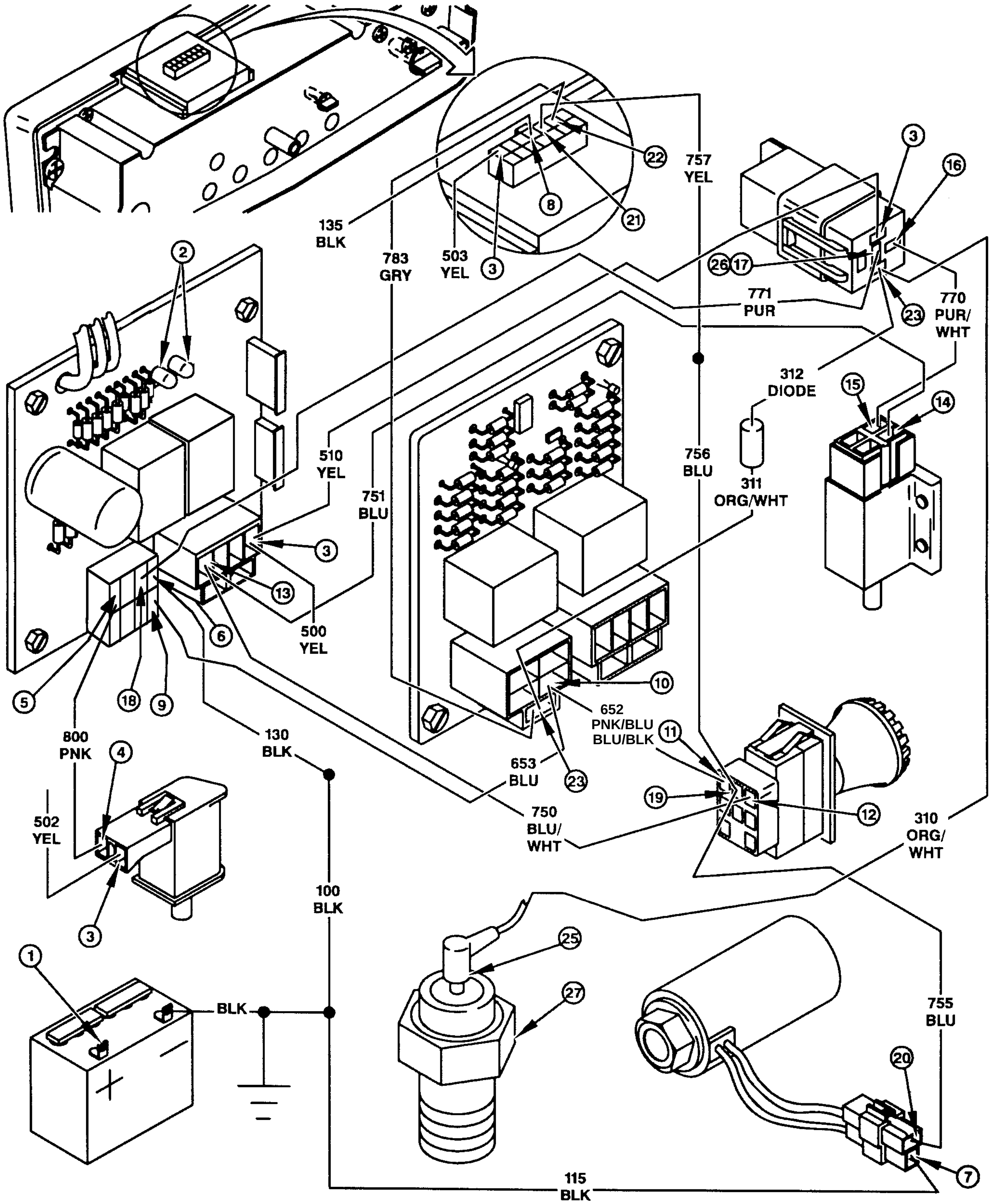
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Hold-in and PTO LED.	Lights on.	Lights off—check relay engagement circuit—go to step 3. Lights on—go to step 7.
3. Seat switch and control/fuse module terminal 6, engine high temperature relay terminal 85, and dash panel module terminal 14.	Battery voltage.	Check power circuit test points from battery to dash panel module.
4. Seat switch.	Battery voltage.	Test seat switch.
5. Control/fuse module terminal A.	Battery voltage.	Check 800 pnk wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
6. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check battery negative cable and harness ground connection, 100 and 130 blk wires.
7. PTO solenoid.	Maximum 0.1 ohms resistance.	Check 115 blk wire.
8. Dash panel.	Maximum 0.1 ohms resistance.	Check 135 blk wire.

PTO CIRCUIT TEST POINTS—455 (S.N. —070000)



PTO CIRCUIT DIAGNOSIS—455 (S.N. —070000) (continued)

Test Conditions:

• Key switch in run position.

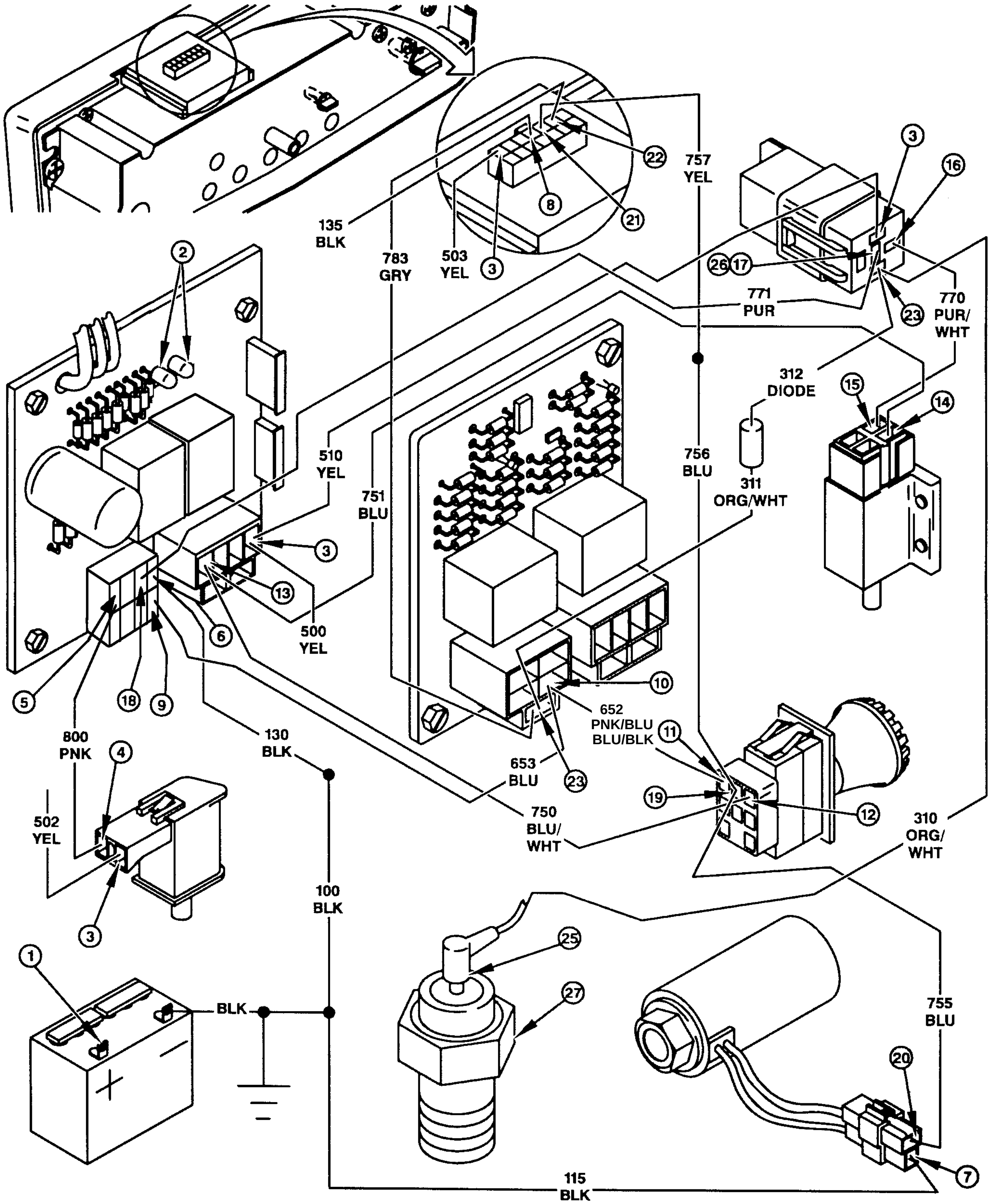
Test/Check Point	Normal	If Not Normal
8. Control/fuse module terminal E.	Battery voltage.	Replace control/fuse module.
9. Diesel module terminal 4.	Battery voltage.	Check 653 blu wire.
10. PTO switch.	Battery voltage.	Check 652 pnk/blu (blu/blk) wire.
11. PTO switch.	Battery voltage.	Test PTO switch.
12. Control/fuse module terminal 3.	Battery voltage.	Check 750 blu wire.
13. Brake switch.	Battery voltage.	Check 751 blu wire.
14. Brake switch.	Battery voltage.	Test brake switch.
15. Engine high temperature relay terminal 30.	Battery voltage.	Check 770 pur/wht wire.
16. Engine high temperature relay terminal 87A.	Battery voltage.	Test engine high temperature relay.
17. Control/fuse module terminal C.	Battery voltage.	Check 770 pur wire.

Test Conditions:

• PTO switch on.

Test/Check Point	Normal	If Not Normal
18. PTO switch.	Battery voltage.	Replace control/fuse module.
19. PTO solenoid.	Battery voltage.	Check 755 blu wire, if ok replace PTO solenoid.
20. Dash panel.	Battery voltage.	Check 756 blu, 757 yel wire, and PTO light, if ok replace dash panel module.

PTO CIRCUIT TEST POINTS—455 (S.N. —070000) (continued)



PTO CIRCUIT DIAGNOSIS—455 (S.N. —070000) (continued)

Test Conditions:

- PTO switch on.

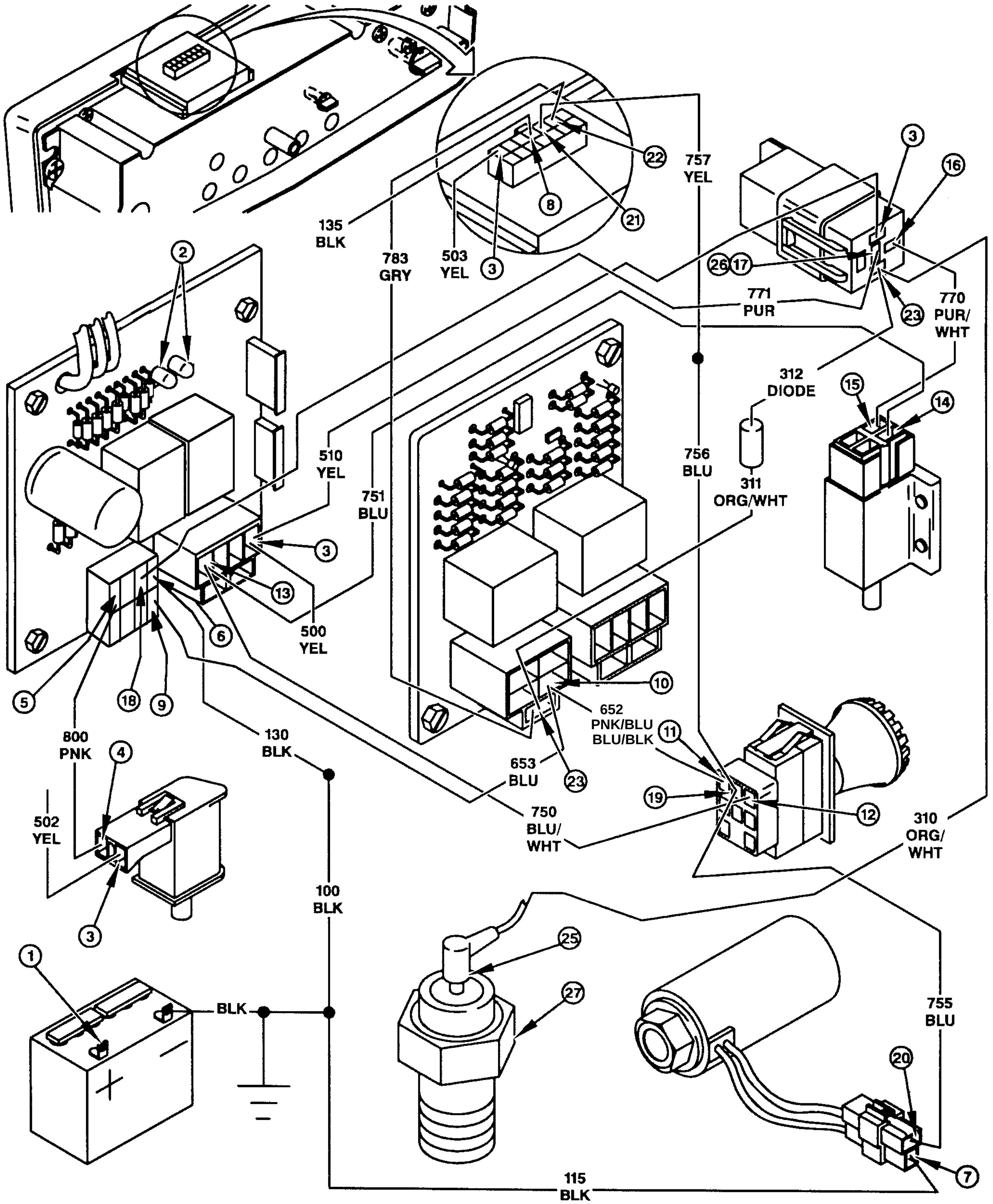
Test/Check Point	Normal	If Not Normal
19. PTO switch.	Battery voltage.	Replace control/fuse module.
20. PTO solenoid.	Battery voltage.	Check 755 blu wire, if ok replace PTO solenoid.
21. Dash panel module terminal 10.	Battery voltage.	Check 756 blu, 757 yel wire, and PTO light, if ok replace dash panel module.
22. Dash panel module terminal 9.	Battery voltage.	Check glow plug light, if ok, replace dash panel module.
23. Dash panel module terminal 5.	Battery voltage.	Check 783 gry wire.
24. Engine high temperature relay terminal 86.	Battery voltage.	Check 311 org/wht wire and 312 diode.
25. Coolant temperature switch (Right side of thermostat housing).	Battery voltage.	Check 310 org/wht wire.

Test Conditions:

- Disconnect and ground coolant temperature switch lead.

Test/Check Point	Normal	If Not Normal
26. Engine high temperature relay terminal 87A.	No voltage.	Replace engine high temperature relay.
27. Coolant temperature switch.	No continuity to ground with engine coolant temperature below 110° C (230° F).	Replace coolant temperature switch.

PTO CIRCUIT TEST POINTS—455 (S.N. —070000) (continued)



PTO CIRCUIT DIAGNOSIS—455 (S.N. 070001—)

Test Conditions:

- PTO switch in off position.
- Brake pedal released.
- Seat switch depressed or jumper wire installed in connector.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

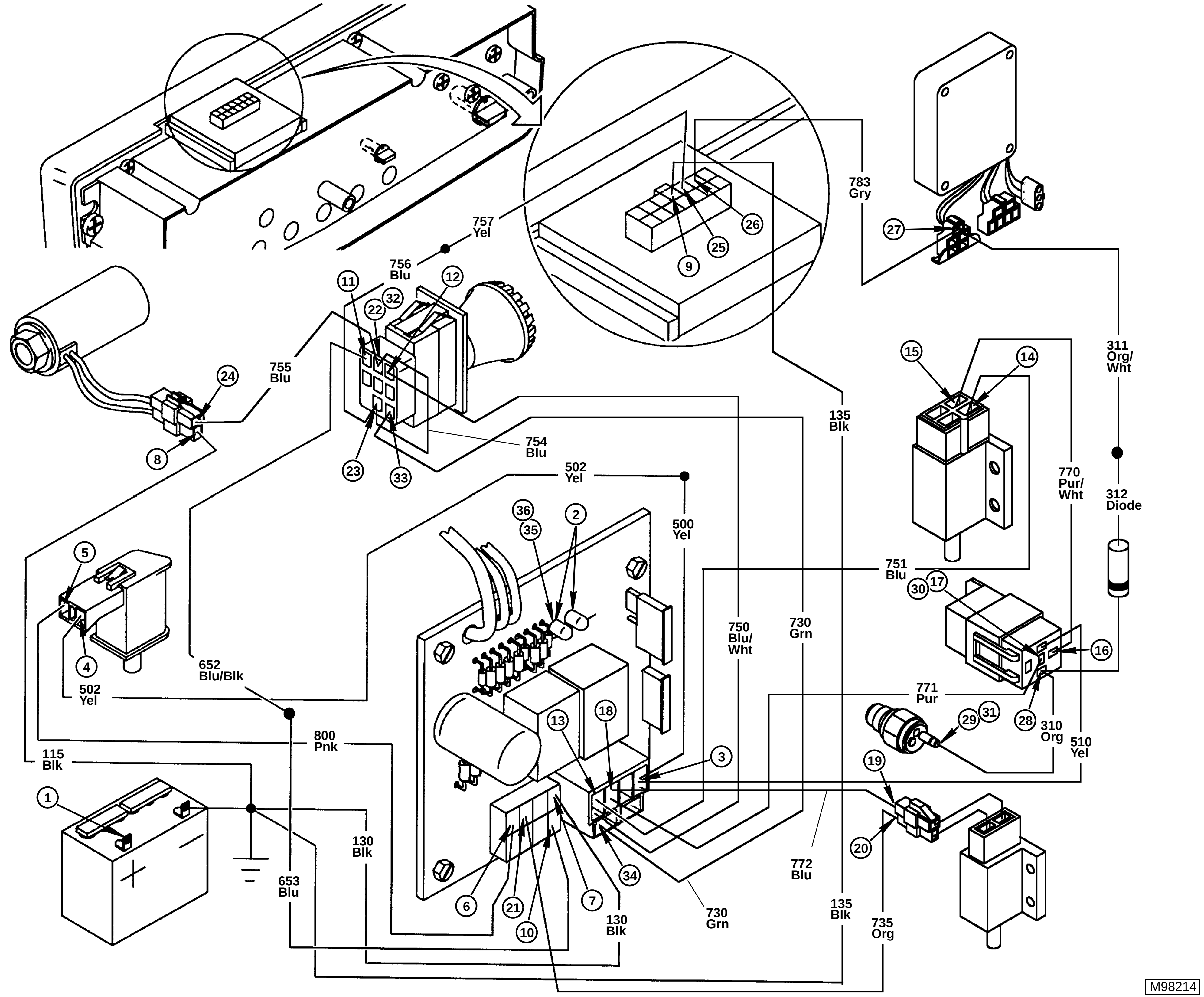
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Ignition and PTO LED.	Lights on.	Lights off—check relay engagement circuit—go to step 3. Lights on—go to step 7.
3. Control/fuse module terminal 6.	Battery voltage.	Check power circuit test points from battery to control/fuse module.
4. Seat switch.	Battery voltage.	Check 502 yel wire.
5. Seat switch.	Battery voltage.	Test seat switch.
6. Control/fuse module terminal A.	Battery voltage.	Check 800 pnk wire.

Test Conditions:

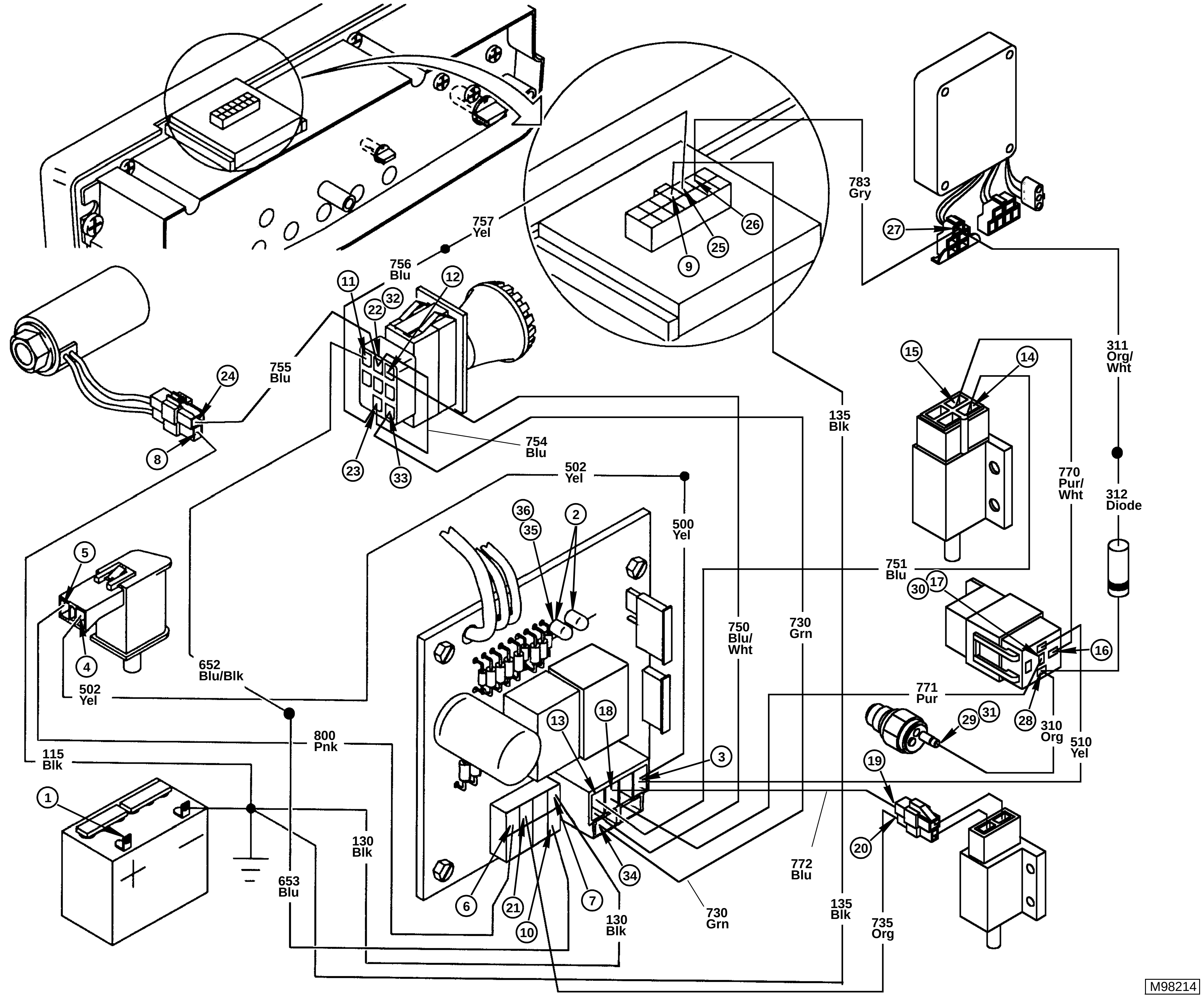
- Key switch in off position.

Test/Check Point	Normal	If Not Normal
7. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check battery negative cable and harness ground connection, 100 and 130 blk wires.
8. PTO solenoid.	Maximum 0.1 ohms resistance.	Check 115 blk wire.
9. Instrument panel.	Maximum 0.1 ohms resistance.	Check 135 blk wire.

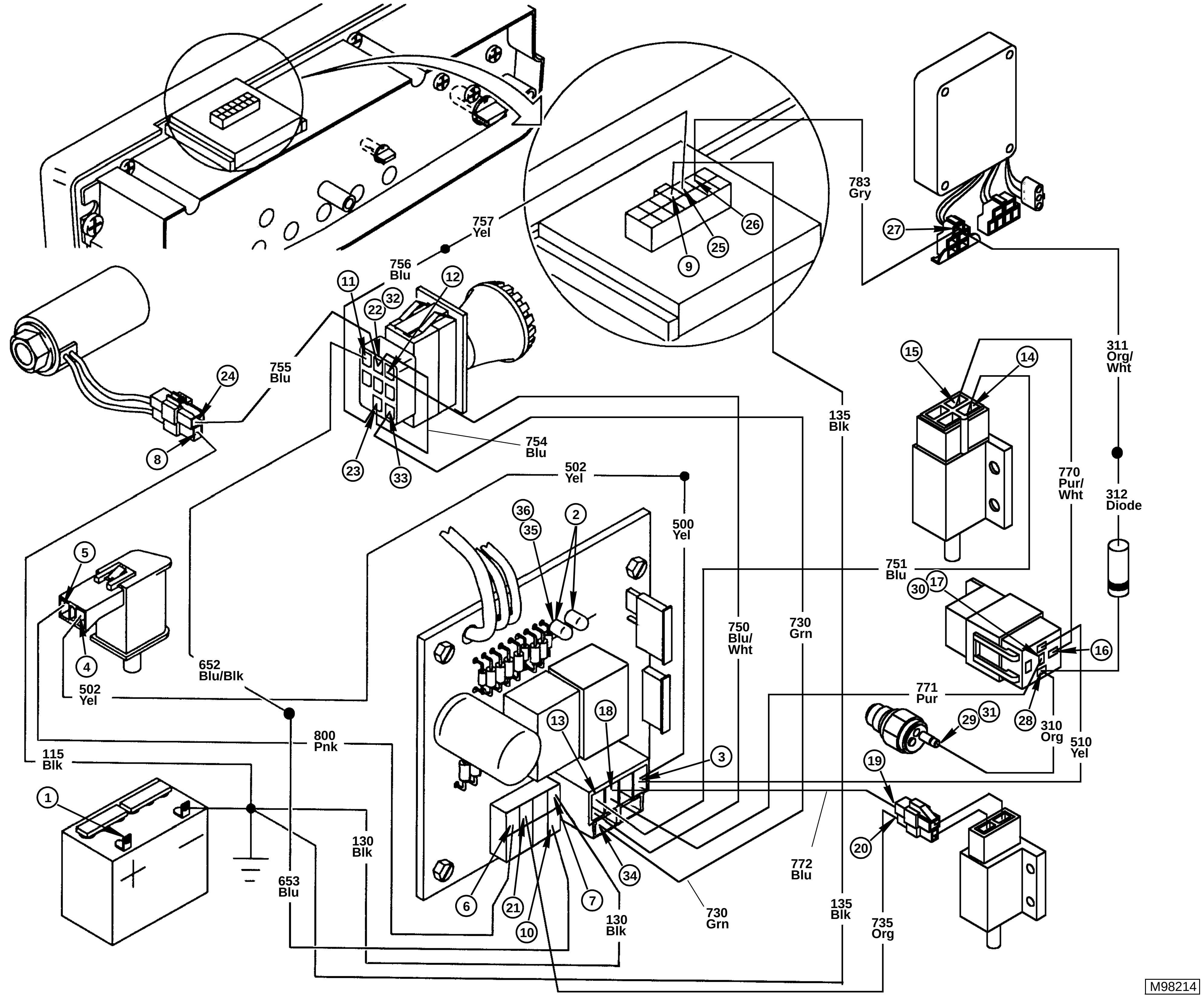
PTO CIRCUIT TEST POINTS—455 (S.N. 070001—)



PTO CIRCUIT TEST POINTS—455 (S.N. 070001—)



PTO CIRCUIT TEST POINTS—455 (S.N. 070001—)



PTO CIRCUIT DIAGNOSIS—455 (S.N. 070001—) (continued)

Test Conditions:

• Key switch in run position.

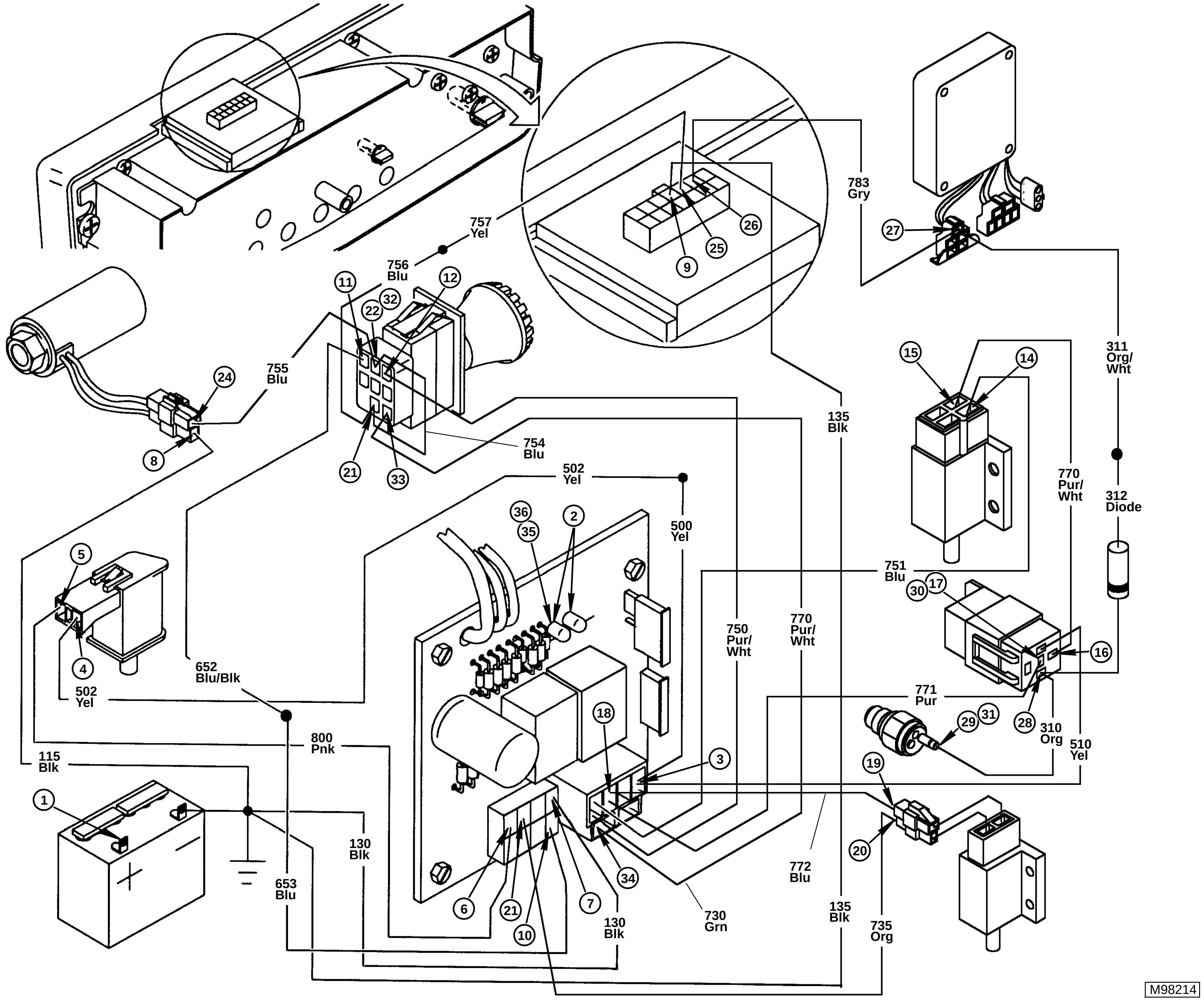
Test/Check Point	Normal	If Not Normal
10. Control/fuse module terminal E.	Battery voltage.	Replace control/fuse module.
11. PTO switch.	Battery voltage.	Check 652 blu, 653 blu/blk wires.
12. PTO switch.	Battery voltage.	Test PTO switch.
13. Control/fuse module terminal 3.	Battery voltage.	Check 750 blu/wht wire.
14. Brake switch.	Battery voltage.	Check 751 blu wire.
15. Brake switch.	Battery voltage.	Test brake switch.
16. Engine high temperature relay terminal 30.	Battery voltage.	Check 770 pur/wht wire.
17. Engine high temperature relay teminal 87a.	Battery voltage.	Test engine high temperature relay.
18. Control/fuse module terminal 4.	Battery voltage.	Check 770 pur wire.

Test Conditions:

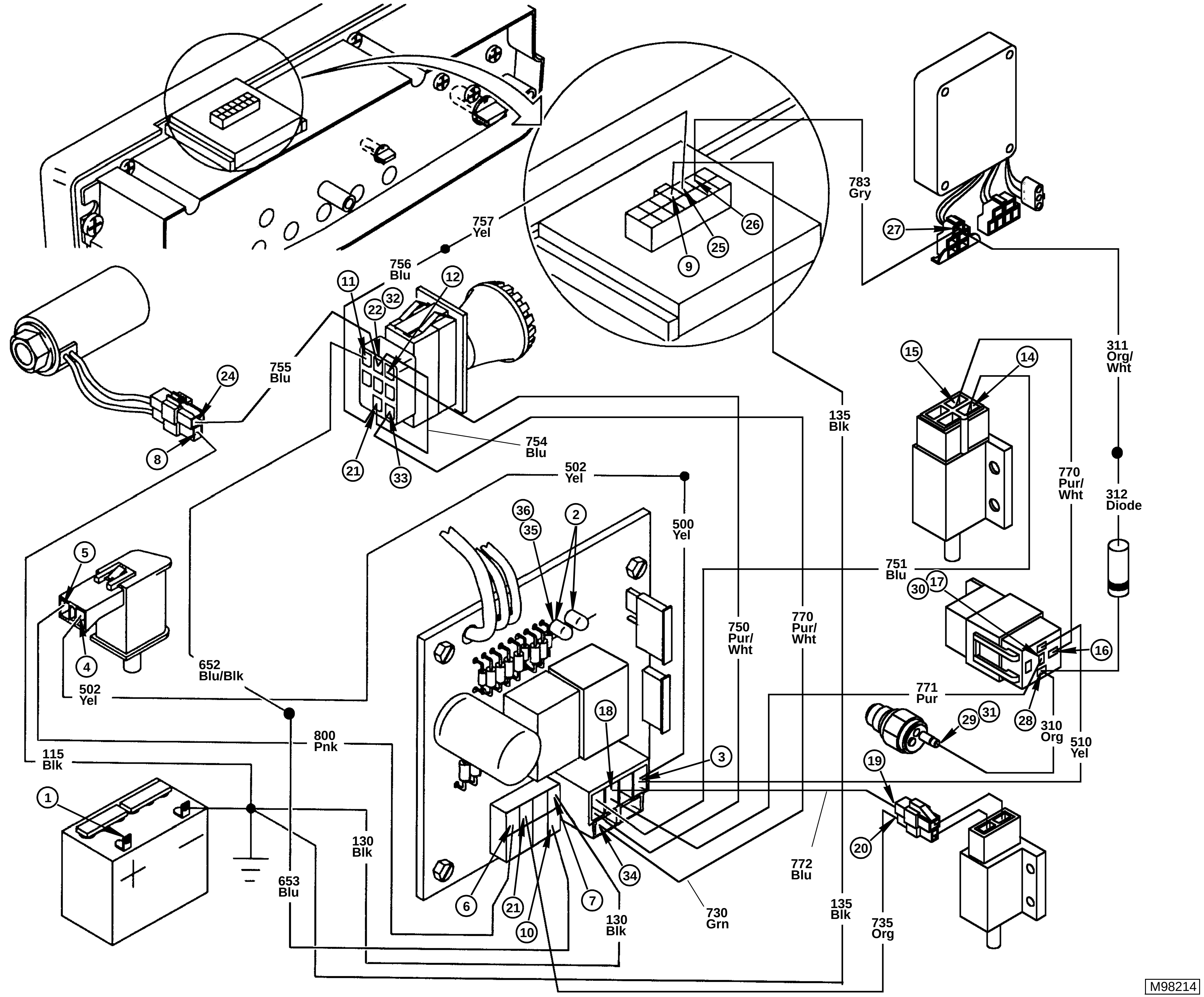
• PTO switch in on position.

Test/Check Point	Normal	If Not Normal
19. RIO switch.	Battery voltage.	Check 772 blu wire.
20. RIO switch.	Battery voltage.	Test RIO switch.
21. Control/fuse module terminal B.	Battery voltage.	Check 735 org wire.
22. PTO switch.	Battery voltage.	Replace control/fuse module.
23. PTO switch.	Battery voltage.	Check 754 blu wire.
24. PTO solenoid.	Battery voltage.	Check 755 blu wire, if ok replace PTO solenoid.
25. Instrument panel connector terminal 10.	Battery voltage.	Check 756 blu, 757 yel wires, and PTO light, if ok replace instrument panel.
26. Dash panel module terminal 9.	Battery voltage.	Check glow plug light, if ok, replace dash panel module.
27. Diesel module connector terminal 5.	Battery voltage.	Check 783 gry wire.

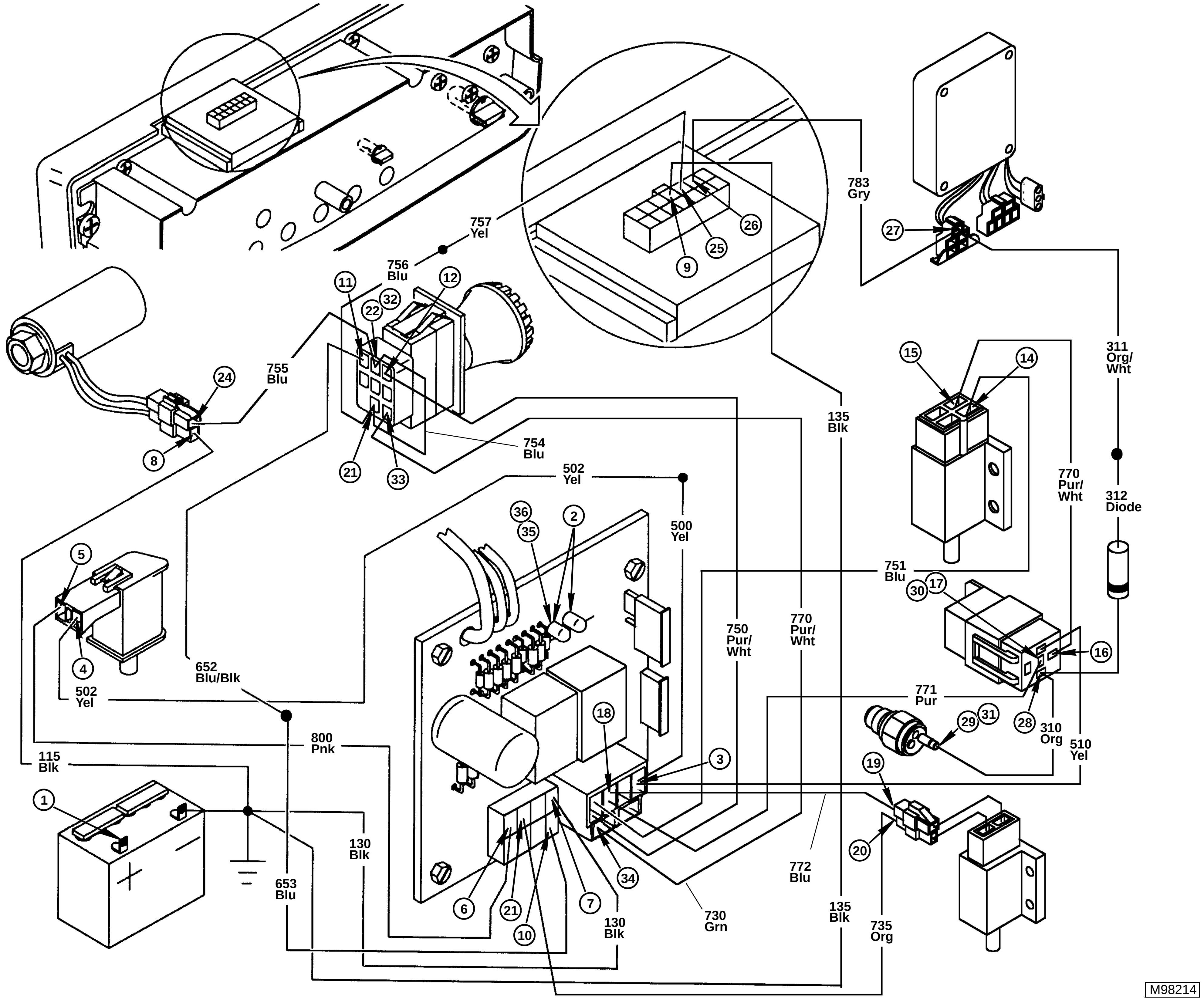
PTO CIRCUIT TEST POINTS—455 (S.N. 070001—) (continued)



PTO CIRCUIT TEST POINTS—455 (S.N. 070001—) (continued)



PTO CIRCUIT TEST POINTS—455 (S.N. 070001—) (continued)



PTO CIRCUIT DIAGNOSIS—455 (S.N. 070001—) (continued)

Test/Check Point	Normal	If Not Normal
28. Engine high temperature relay teminal 86.	Battery voltage.	Check 311 org/wht wire.
29. Coolant temperature switch (right side of thermostat housing).	Battery voltage.	Check 310 org wire.

Test Conditions:

- Disconnect and ground coolant temperature switch lead.

Test/Check Point	Normal	If Not Normal
30. Engine high temperature relay teminal 87a.	No voltage.	Replace engine high temperature relay.
31. Coolant temperature switch.	No continuity to ground with engine coolant temperature below 110°C (230°F).	Replace coolant temperature switch.

Test Conditions:

- PTO switch in RIP position.
- Forward/reverse pedal in reverse.

Test/Check Point	Normal	If Not Normal
32. PTO switch.	Battery voltage.	Test PTO switch.
33. PTO switch.	Battery voltage.	Test PTO switch.
34. Control/fulse module terminal 1.	Battery voltage.	Check 730 grn wire.

Test Conditions:

- Release the PTO switch to on.

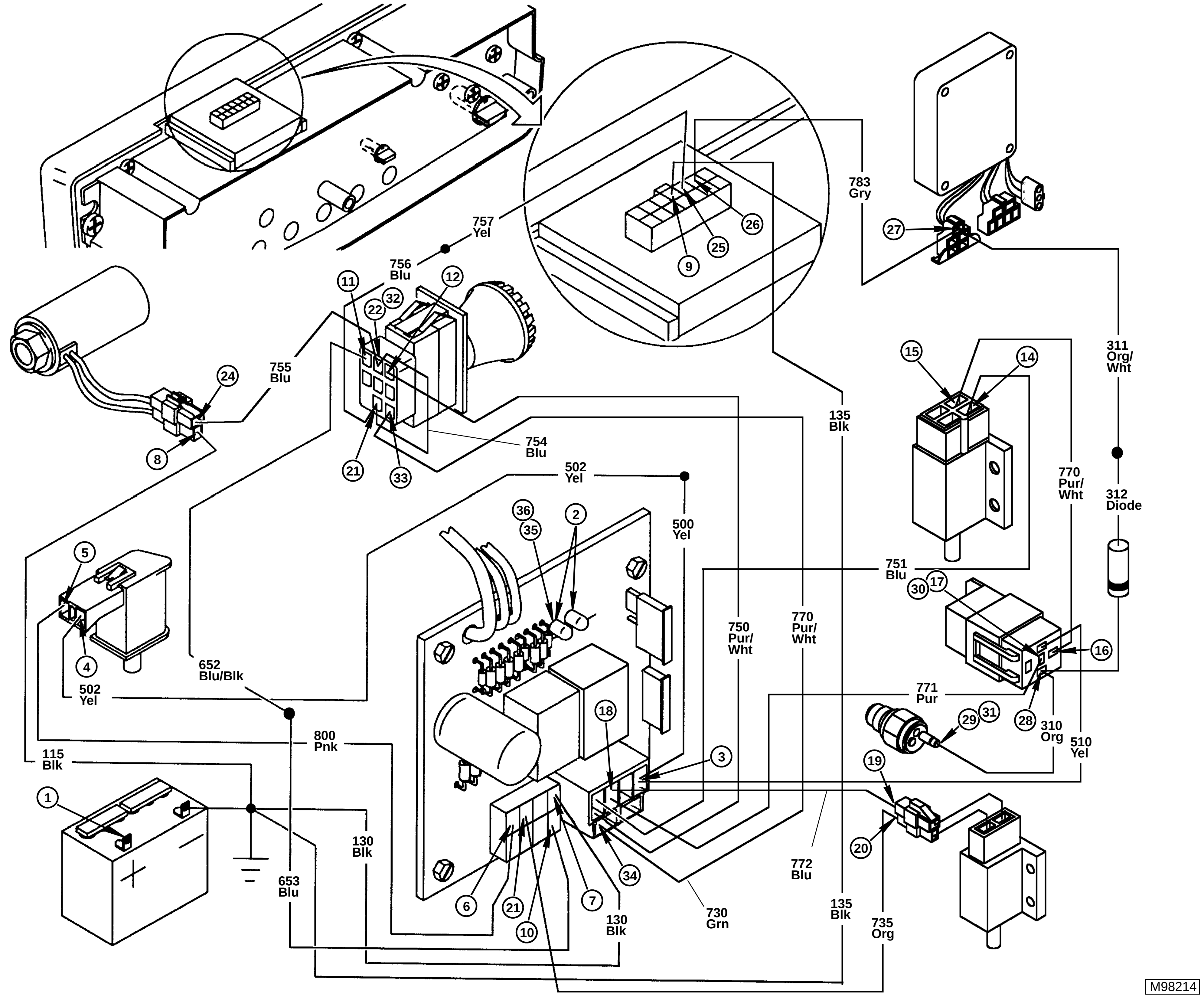
Test/Check Point	Normal	If Not Normal
35. PTO LED.	Light on.	Test RIO latch relay.

Test Conditions:

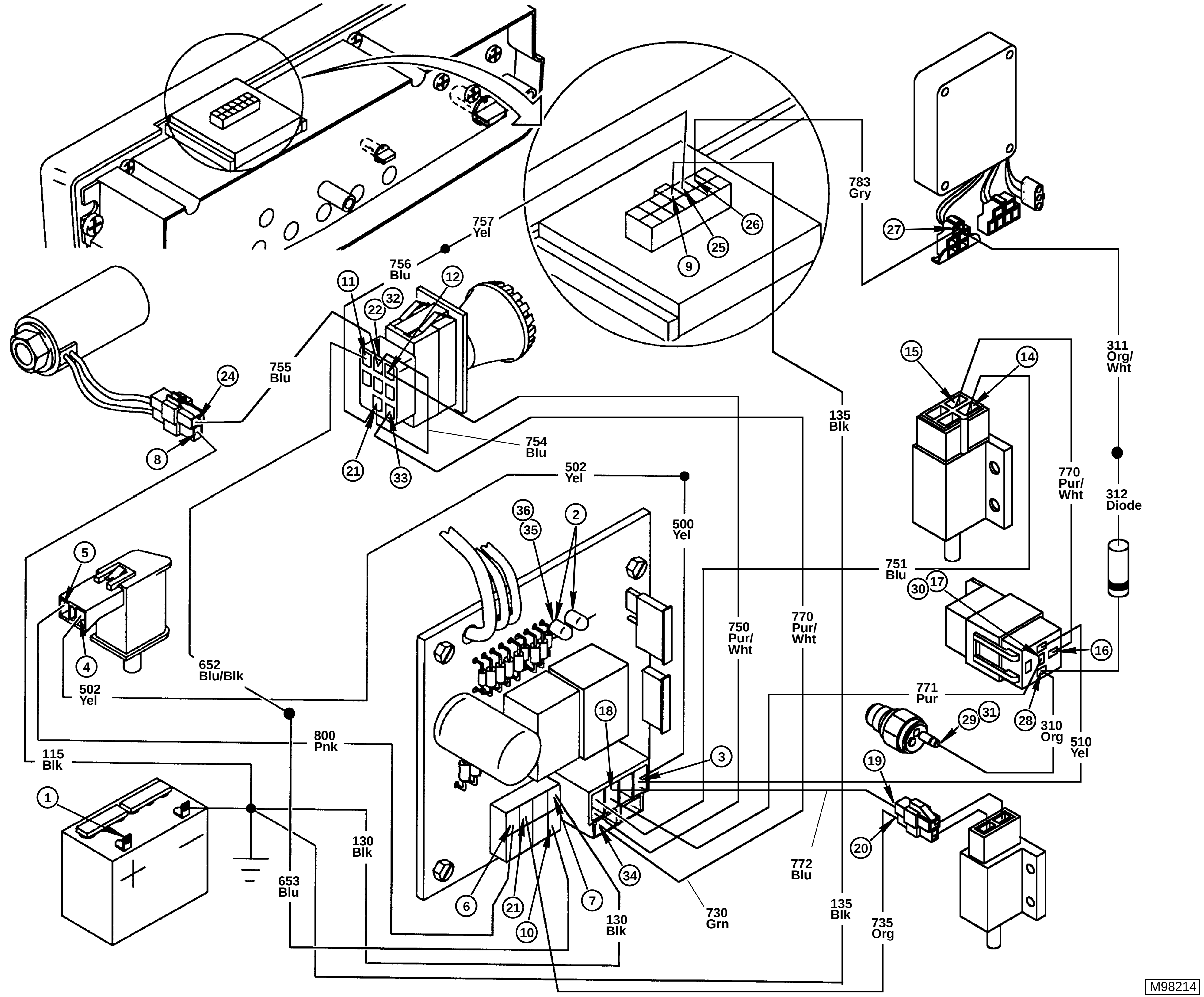
- Forward/reverse pedal in forward.

Test/Check Point	Normal	If Not Normal
36. PTO LED.	Light off.	Test RIO unlatch relay.

PTO CIRCUIT TEST POINTS—455 (S.N. 070001—) (continued)



PTO CIRCUIT TEST POINTS—455 (S.N. 070001—) (continued)



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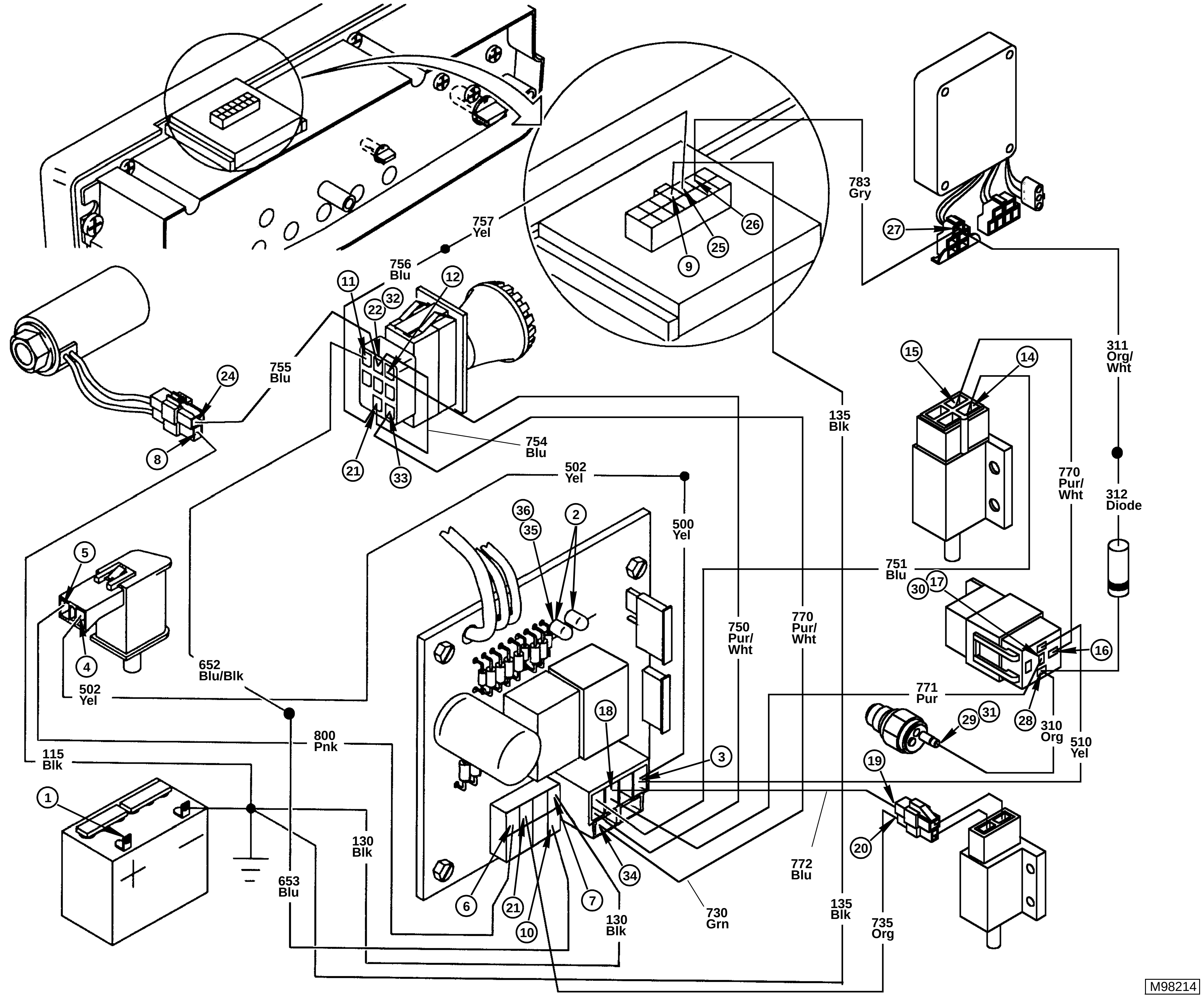

INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT—455 (S.N. —070000)

Function:

OIL PRESSURE LIGHT:

To alert operator of low engine oil pressure by illuminating a lamp.

FUEL GAUGE:

To inform the operator of the fuel level in the tank.

COOLANT TEMPERATURE GAUGE:

To inform the operator of the engine coolant temperature.

HOURMETER:

To record the number of hours the engine is running.

HEADLIGHTS:

To provide power to the headlights, taillights, and dash panel lights for illumination if desired by the operator.

Operating Conditions:

The key switch must be in the run position; and the oil pressure switch, or light switch closed.

System Operation:

Current (A) flows from the battery (G1) to the starting motor (M1), fusible link (F2), and key switch B terminal (S2). With the key switch in the run position, current flows through the switch to the light and power fuses (F5 and F6), fuel gauge (P1), oil pressure light (H4), coolant temperature gauge (P2), hourmeter (P3), and light switch (S5).

OIL PRESSURE LIGHT:

When the oil pressure switch (B6) is closed a path to ground (D) is made which illuminates the indicator light. The oil pressure switch will be closed if the engine is not running or the oil pressure is below 28 kPa (4 psi). With the key switch in the run position, the oil pressure light will be on. This is to inform the operator that the light is functioning. The warning light will go out after a normal engine start-up.

FUEL GAUGE:

Current (C) flows from the fuel gauge (P1) to the fuel gauge sensor (B5). Current flow through the sensor is controlled by a variable resistor. As the sensor float moves to agree with the fuel level, the amount of resistance increases/decreases accordingly. This change in resistance is sensed back at the gauge needle which moves to indicate fuel level.

COOLANT TEMPERATURE GAUGE:

Current (E) flows from the gauge (P2) to the coolant temperature sensor (B7). Current flow through the sensor is controlled by a temperature sensitive variable resistor. As the coolant temperature increases or decreases, the amount of resistance in the sensor increases/decreases accordingly. This change in resistance is sensed back at the gauge needle which moves to indicate coolant temperature.

HOURMETER:

Power for the hourmeter (P3) comes from the key switch (S3). When the key switch is in the run position, the hourmeter will be operating.

HEADLIGHTS:

With the light switch (S5) on (switch closed), current flows to the headlights (E5 and E6), taillights (E9 and 10), and dash lights (E3 and E4) and illuminates the lamps. The circuit is protected by a 15-amp fuse in the control/fuse module.

INDICATOR LIGHTS, GAUGES, HOURMETER, AND LIGHTS CIRCUIT OPERATION—455 (S.N. 070001—)

Function:

OIL PRESSURE LIGHT:
To alert operator of low engine oil pressure by illuminating a lamp.

FUEL GAUGE:
To inform the operator of the fuel level in the tank.

COOLANT TEMPERATURE GAUGE:
To inform the operator of the engine coolant temperature.

HOURMETER:
To record the number of hours the engine is running.

HEAD LIGHTS:
To provide power to the head lights, tail lights, and instrument panel lights for illumination if desired by the operator.

Operating Conditions:

The key switch must be in the run position and the light switch must be in the on position.

System Operation:

Current (A) flows from the battery (G1) to the starting motor (M1), fusible link (F2), and B terminal of the key switch (S1). With the key switch in the run position, current flows through the switch to the light and power fuses (F5 and F6), fuel gauge (P1), engine oil pressure light (H1), coolant temperature gauge (P3), hourmeter (P2), dash lights (E8), and light switch (S7).

ENGINE OIL PRESSURE LIGHT:

When the engine oil pressure switch (B1) is closed, a path to ground (D) is made which turns on the indicator light. The oil pressure switch will be closed if the engine is not running or the engine oil pressure is below 28 kPa (4 psi). With the key switch in the run position, the oil pressure light will be on. This is to inform the operator that the light is functioning. The engine oil pressure light will go out after normal engine start-up.

FUEL GAUGE:

Current (C) flows from the fuel gauge to the fuel gauge sensor (B4). Current flow through the sensor is controlled by a variable resistor. As the sensor float moves to agree with the fuel level, the amount of resistance increases or decreases accordingly. The gauge senses the change in resistance and moves the gauge needle to indicate the fuel level.

COOLANT TEMPERATURE GAUGE:

Current (E) flows from the coolant temperature gauge to the coolant temperature sensor (B2). Current flow through the sensor is controlled by a temperature sensitive variable resistor. As the coolant temperature increases or decreases, the amount of resistance in the sensor increases or decreases accordingly. The gauge senses the change in resistance and moves the gauge needle to indicate the coolant temperature.

HOURMETER:

Power for the hourmeter comes from the key switch (S1). When the key switch is in the run position, the hourmeter will be operating.

HEAD LIGHTS:

With the light switch (S7) in the on position (switch closed), current flows to the head lights (E4 and E5), tail lights (E6 and E7), and dash lights (E8 and E9) in the instrument panel (A4) to turn on each light. The circuit is protected by light fuse (F5) in the control/fuse module (A2).

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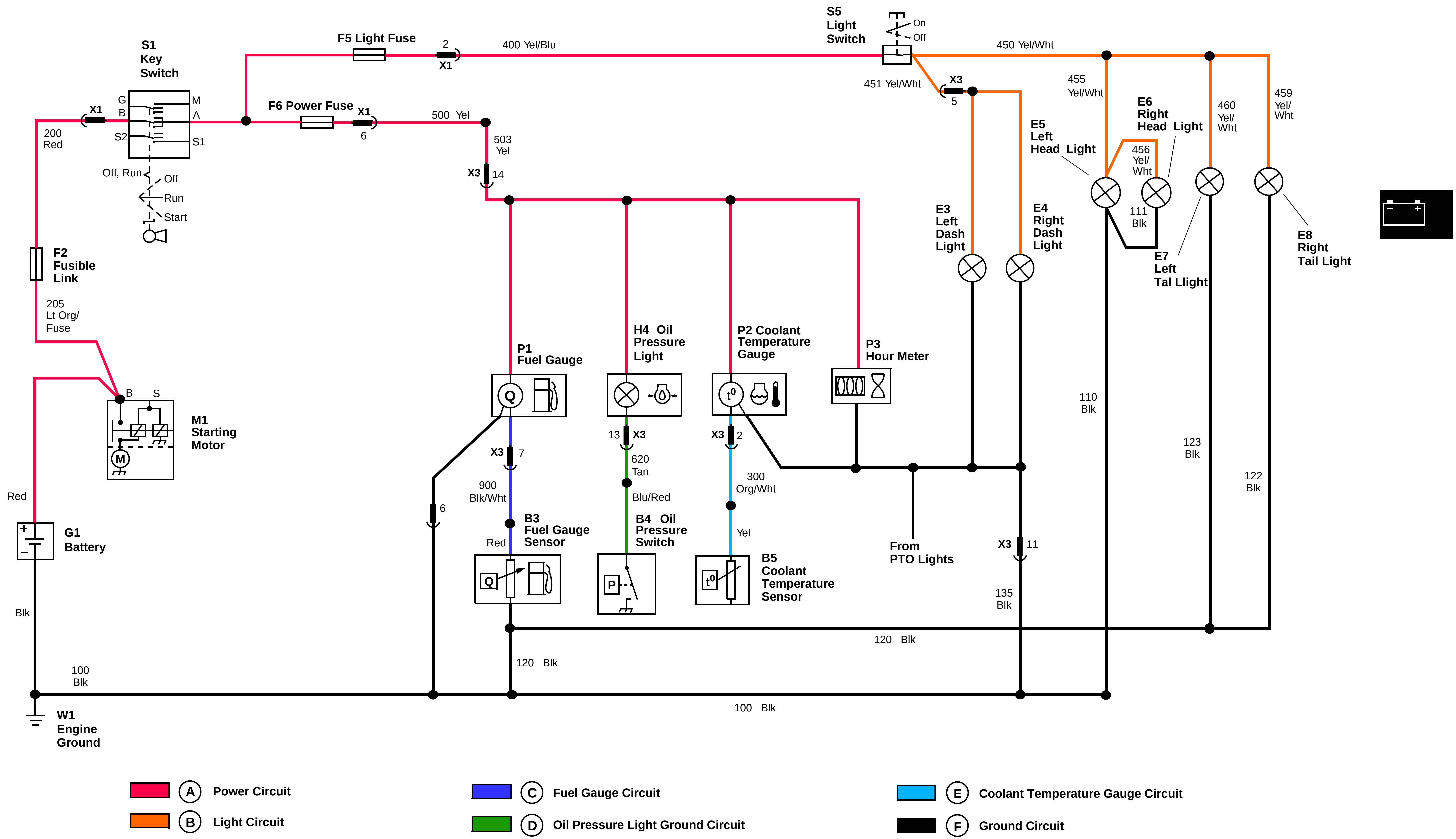
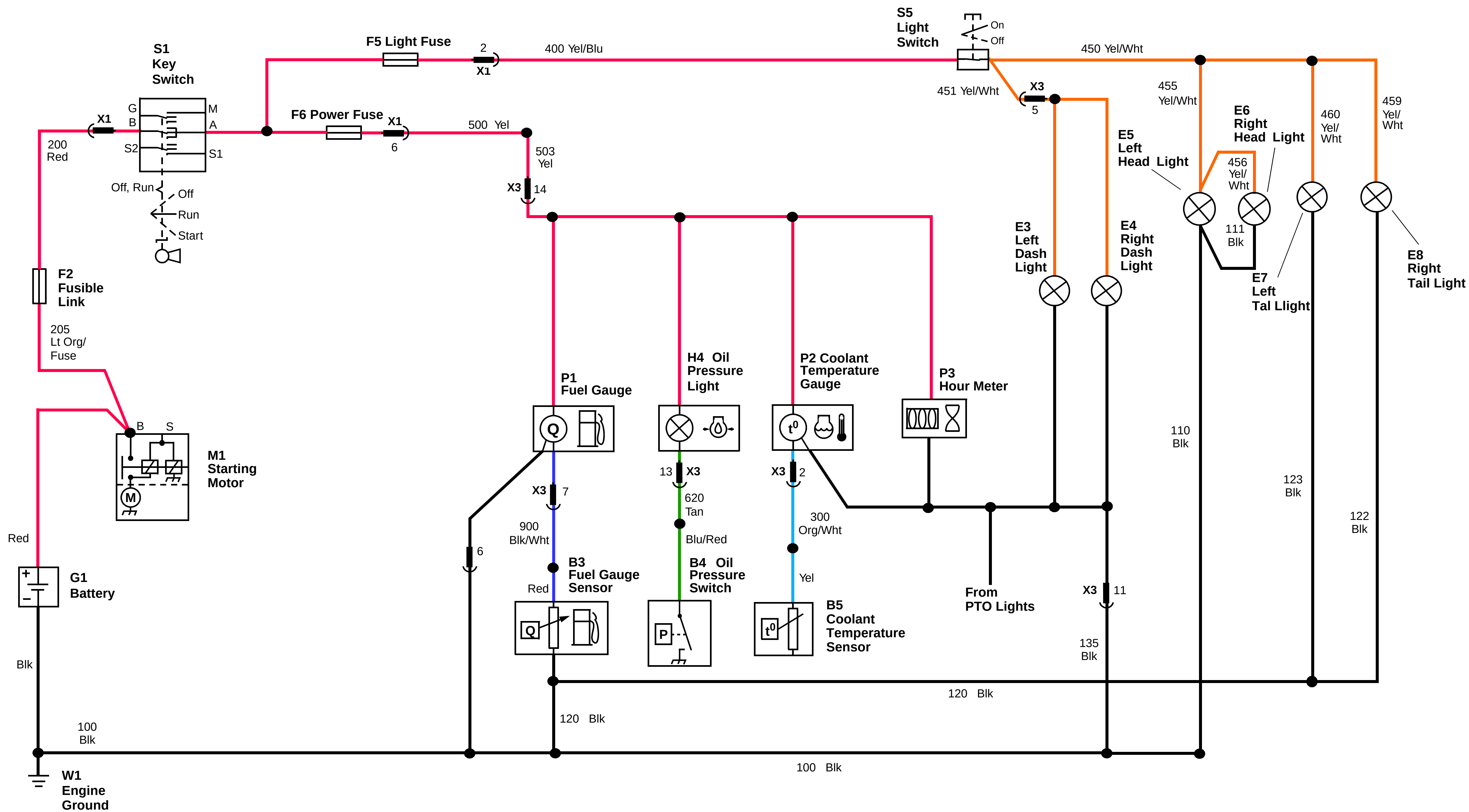
INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—455 (S.N. —070000)

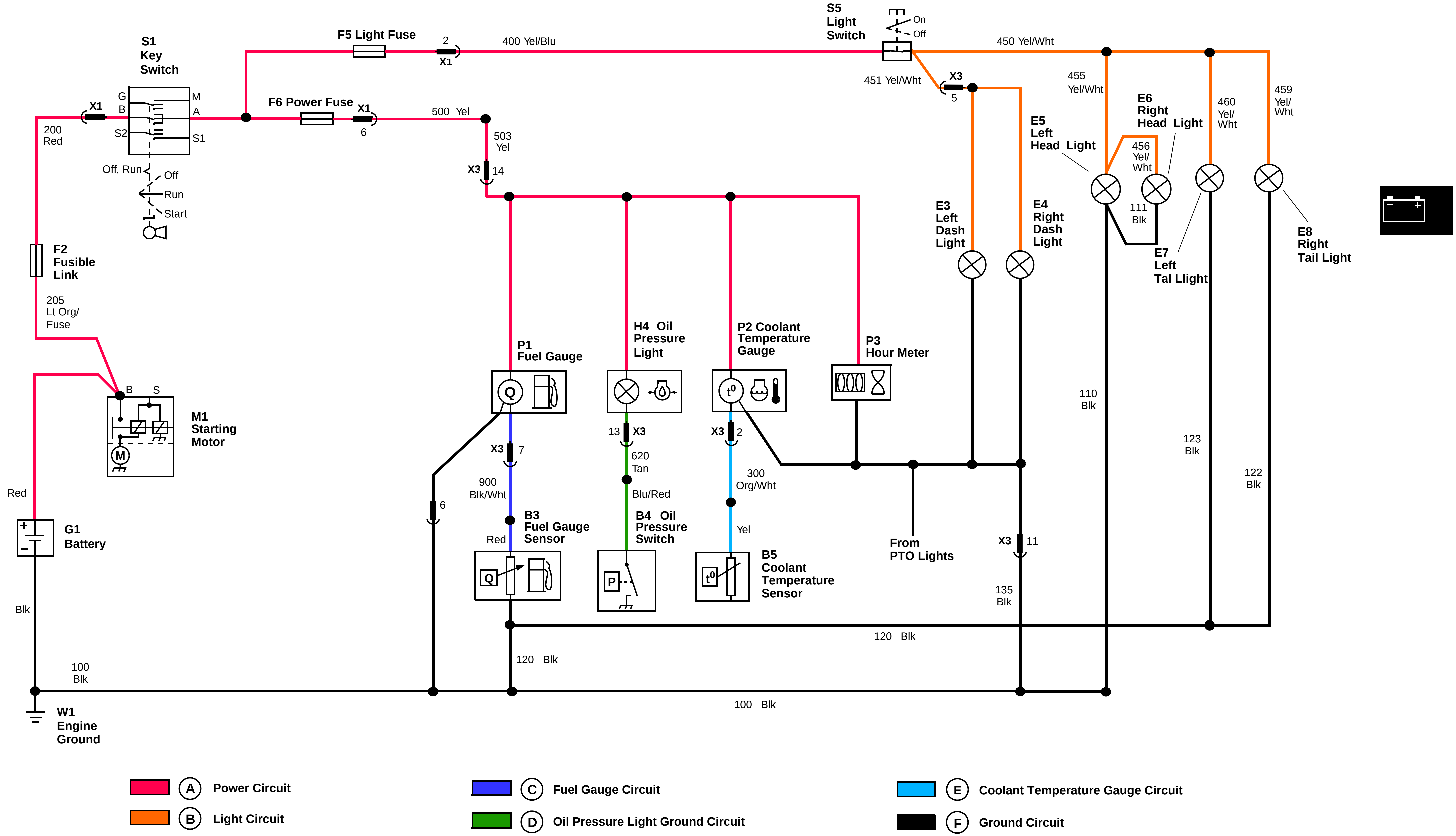


INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—455 (S.N. —070000)

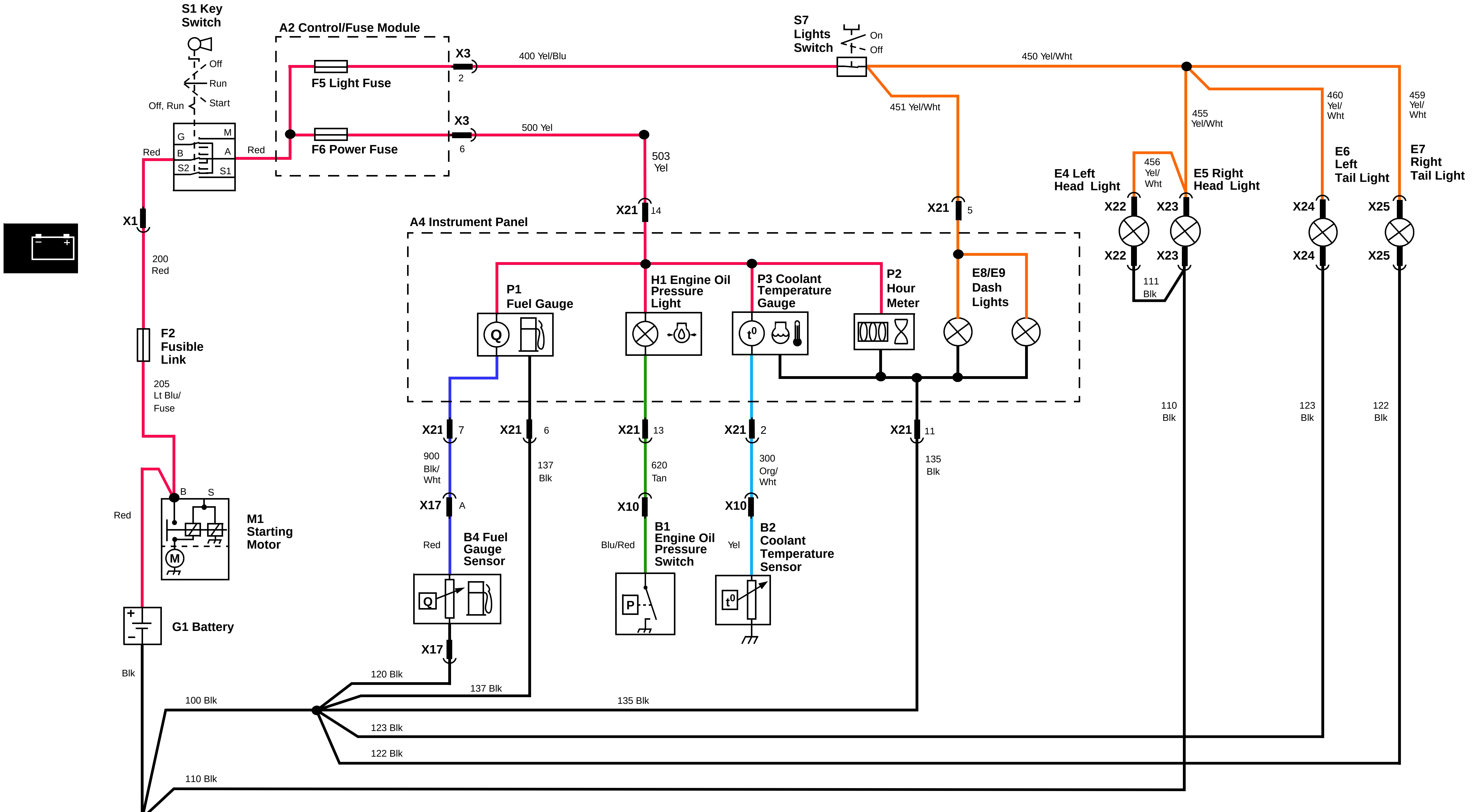


A	Power Circuit	Red
B	Light Circuit	Orange
C	Fuel Gauge Circuit	Blue
D	Oil Pressure Light Ground Circuit	Green
E	Coolant Temperature Gauge Circuit	Light blue
F	Ground Circuit	Black

INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—455 (S.N. —070000)

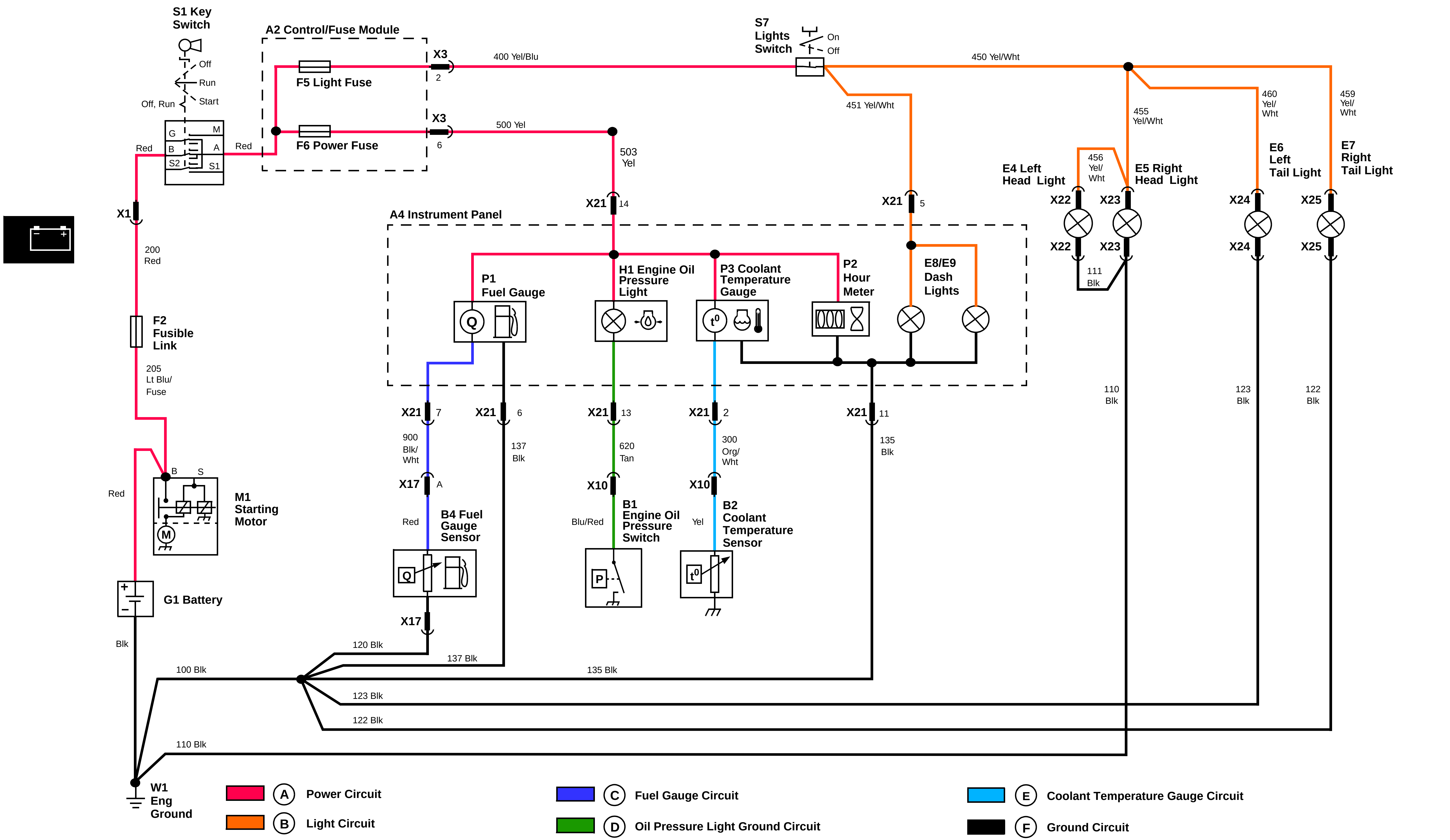


INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—455 (S.N. 070001—)

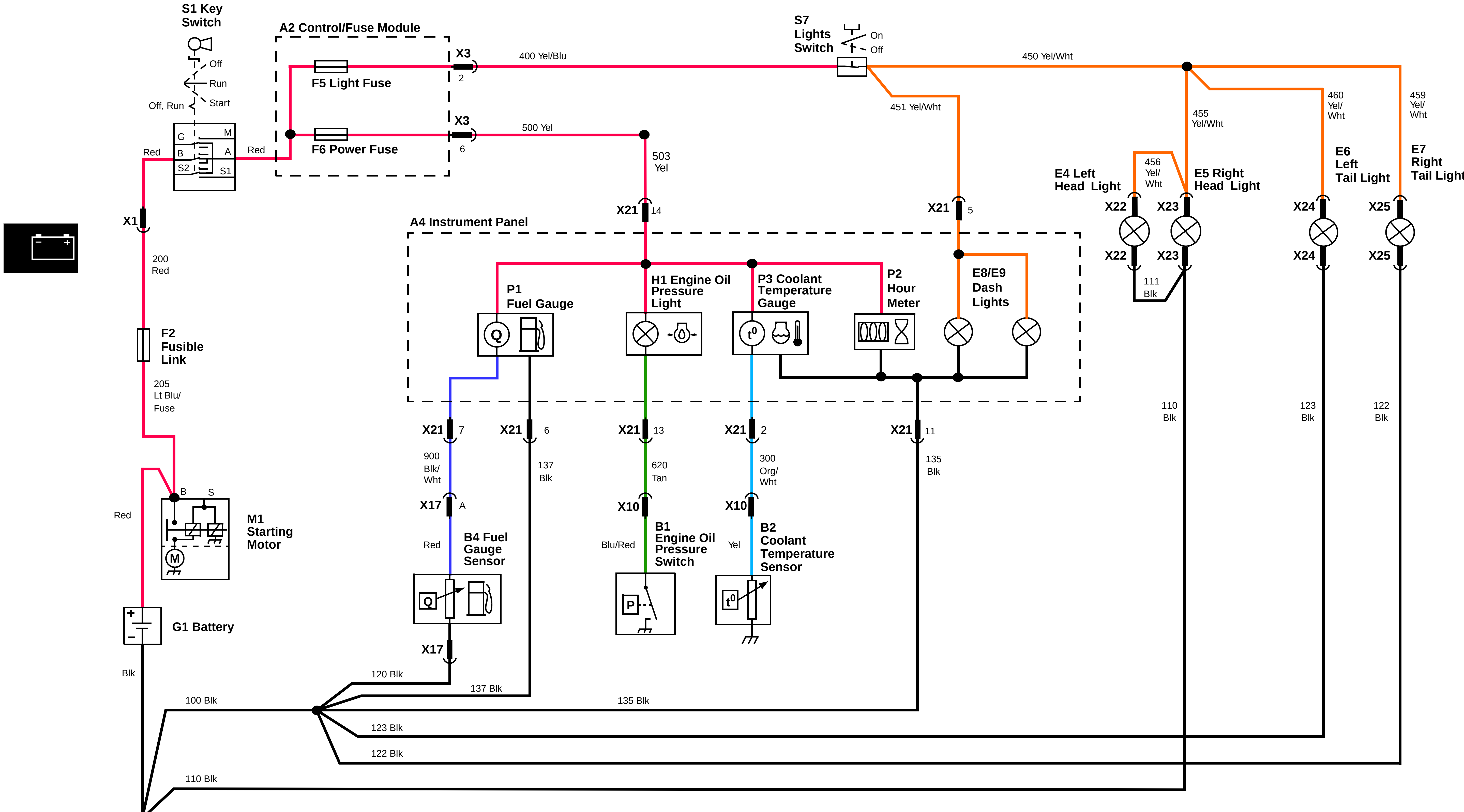


Ⓐ Power Circuit
Ⓑ Light Circuit
Ⓒ Fuel Gauge Circuit
Ⓓ Oil Pressure Light Ground Circuit
Ⓔ Coolant Temperature Gauge Circuit
Ⓕ Ground Circuit

INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—455 (S.N. 070001—)



INDICATOR LIGHTS, GAUGES, HOUR METER, AND LIGHT CIRCUIT SCHEMATIC—455 (S.N. 070001—)



A	Power Circuit	C	Fuel Gauge Circuit
B	Light Circuit	D	Oil Pressure Light Ground Circuit
E	Coolant Temperature Gauge Circuit	F	Ground Circuit

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OIL PRESSURE LIGHT AND HOURMETER CIRCUIT DIAGNOSIS—455

Test Conditions:

- PTO switch in off position.
- Prak brake engaged.
- Oil pressure sensor lead (A) disconnected.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and lose terminals when testing.

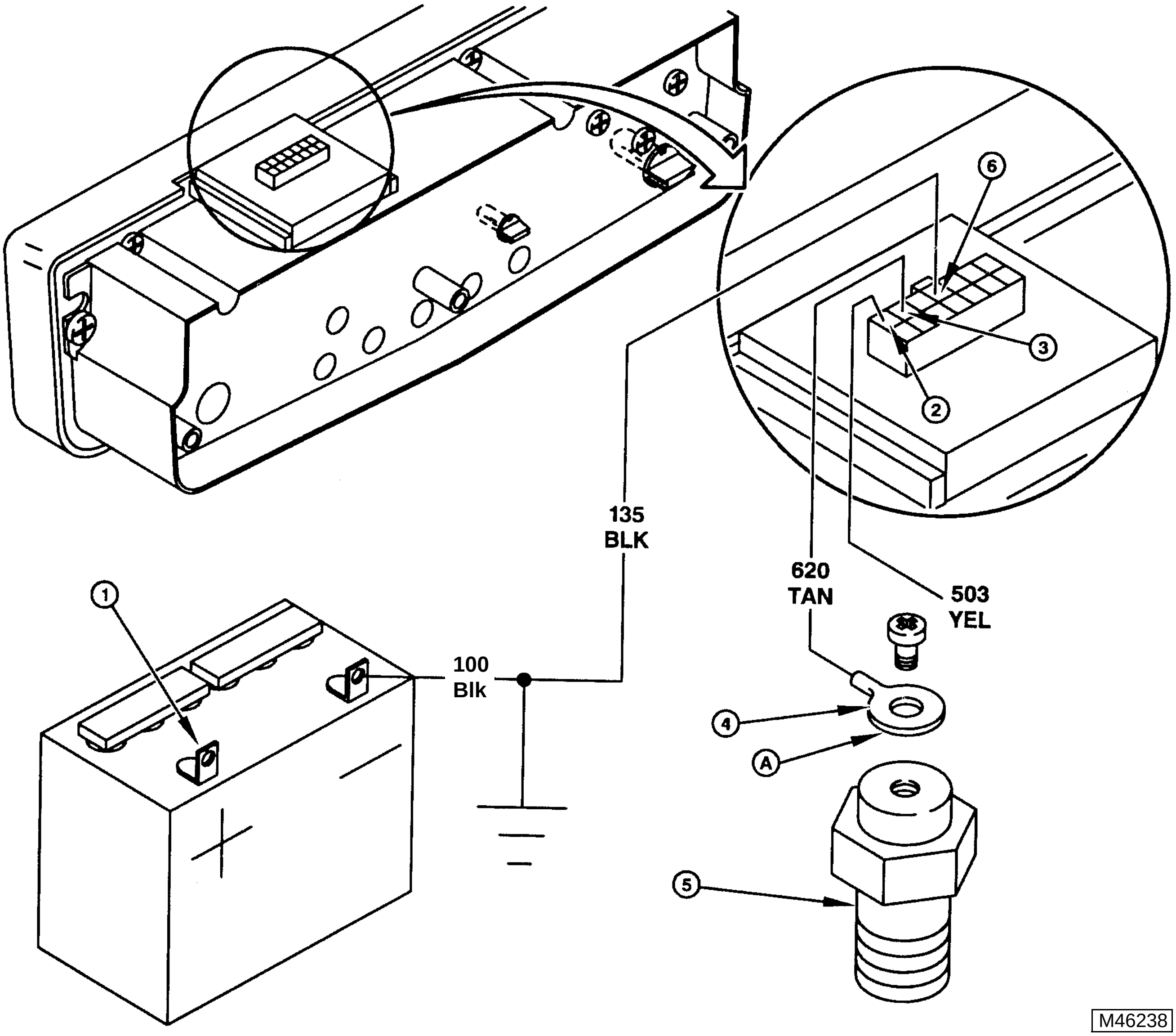
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Instrument panel connector terminal 14.	Battery voltage.	Check power circuit test points.
3. Instrument panel connector terminal 13.	Battery voltage.	Replace oil pressure light bulb.
4. Oil pressure switch lead.	Battery voltage.	Check 620 tan wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
5. Oil pressure switch.	Continuity to ground. Maximum 0.1 ohms resistance.	Check engine ground, if ok replace oil pressure sensor.
6. Instrument panel connector terminal 11—Hourmeter check.	Maximum 0.1 ohms resistance.	Check engine ground connection. 100 and 135 blk wires, if ok replace instrument panel.

OIL PRESSURE LIGHT AND HOURMETER CIRCUIT TEST POINTS—455



COOLANT TEMPERATURE GAUGE CIRCUIT DIAGNOSIS—455

Test Conditions:

- PTO switch in off position.
- Park brake engaged.
- Coolant temperature sensor lead (A) disconnected.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Instrument panel connector terminal 14.	Battery voltage.	Check power circuit diagnosis.
3. Instrument panel connector terminal 2.	Battery voltage.	Replace instrument panel
4. Coolant temperature sensor.	Battery voltage.	Check 300 org/wht wire and yel wire lead.

Test Conditions:

Key switch in off position.

Test/Check Point	Normal	If Not Normal
5. Instrument panel connector terminal 11.	Maximum 0.1 ohms resistance.	Check battery negative cable, engine ground connection, 100 and 135 blk wires.

Test Conditions:

- Key switch in run position.
- Check coolant temperature gauge needle position with coolant temperature sensor lead disconnected and then check again with the lead grounded.

Test/Check Point	Normal	If Not Normal
6. Coolant temperature gauge.	Needle at cold position with lead disconnected and hot position with lead grounded.	Replace instrument panel.

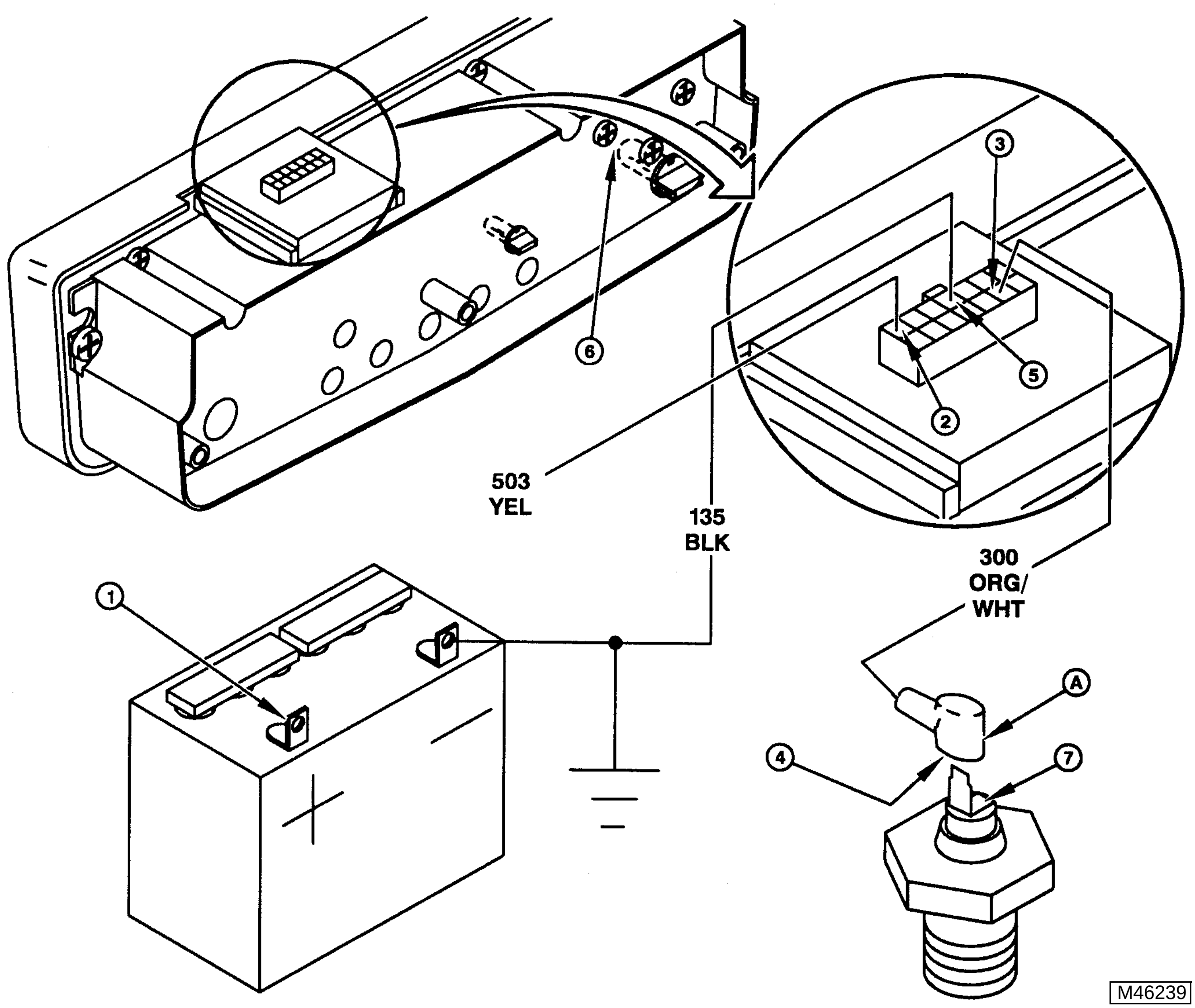
COOLANT TEMPERATURE GAUGE CIRCUIT DIAGNOSIS—455 (continued)

Test Conditions:

- Key switch in off position.
- Coolant temperature sensor lead disconnected.

Test/Check Point	Normal	If Not Normal
7. Coolant temperature sensor.	Continuity to ground—resistance depends on engine temperature. Sensor threads not corroded.	Replace coolant temperature sensor.

COOLANT TEMPERATURE GAUGE CIRCUIT TEST POINTS—455



FUEL GAUGE CIRCUIT DIAGNOSIS—455

Test Conditions:

- PTO switch in off position.
- Park brake engaged.
- Fuel gauge sensor connector (A) disconnected.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Instrument panel connector terminal 14.	Battery voltage.	Check power circuit diagnosis.
3. Instrument panel connector terminal 7.	0.69—4.5 volts.	Replace instrument panel.
4. Fuel gauge sensor lead.	0.69—4.5 volts.	Check 900 blk/wht wire and red wires.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
5. Fuel gauge sensor ground lead.	Maximum 0.1 ohms resistance.	Check battery negative cable, engine ground connection, 100 and 120 blk wires.
6. Instrument panel connector terminal 6.	Maximum 0.1 ohms resistance.	Check 137 blk wire.

Test Conditions:

- Key switch in run position.
- Check fuel gauge needle position with fuel gauge sensor lead (blk/wht wire) disconnected and then grounded.

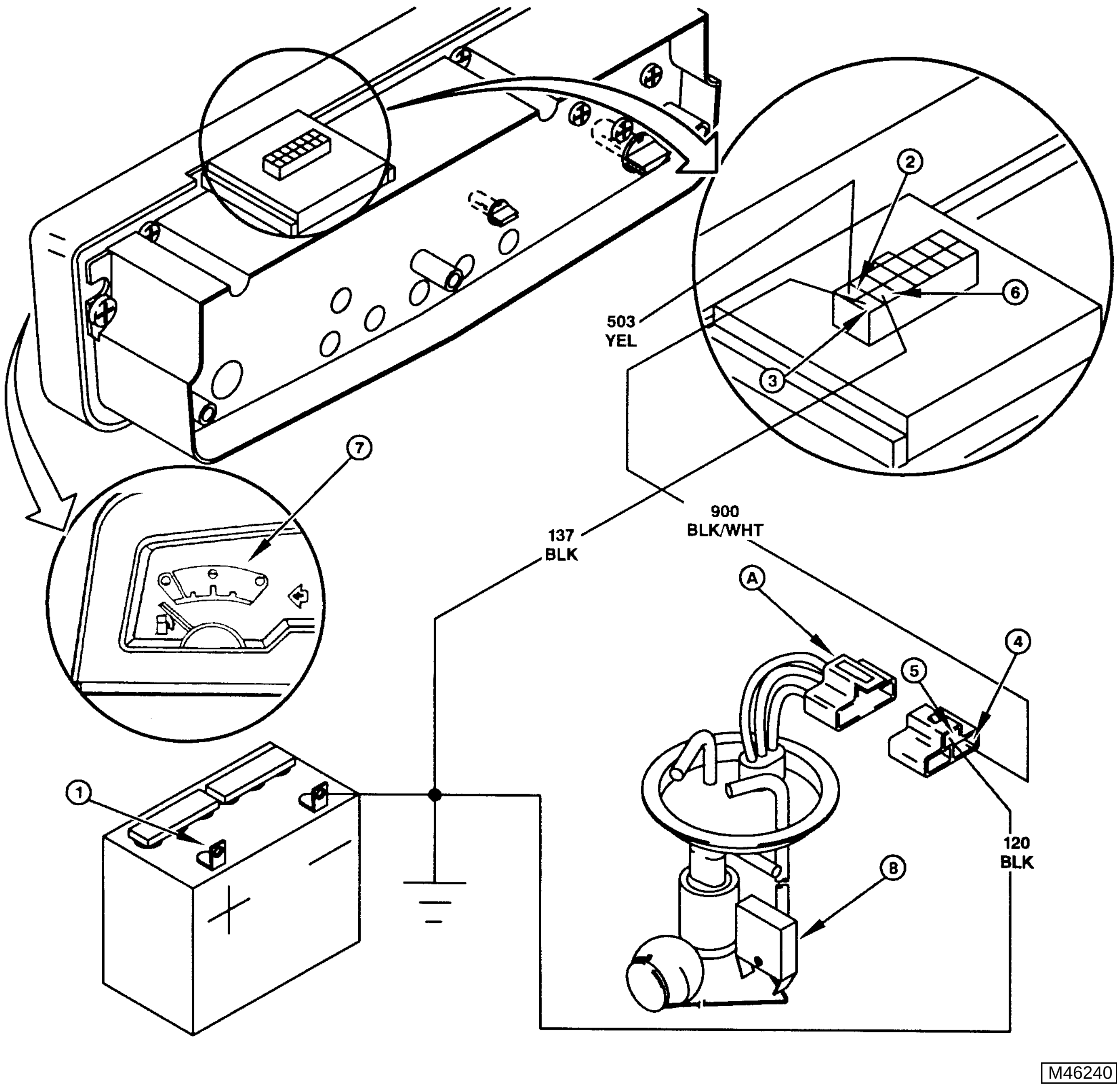
Test/Check Point	Normal	If Not Normal
7. Fuel gauge.	Full position with lead disconnected and “empty” position with lead grounded.	Replace instrument panel.

Test Conditions:

- Key switch in off position.
- Disconnect fuel gauge sensor connector.
- Remove fuel gauge sensor from tank so float can be raised and lowered.

Test/Check Point	Normal	If Not Normal
8. Fuel gauge sensor float (check between red and blk wires on sensor side).	Resistance increases as float is raised and decreases as float is lowered. Resistance about 6—200 ohms.	Replace fuel gauge sensor.

FUEL GAUGE CIRCUIT TEST POINTS—455



LIGHTS CIRCUIT DIAGNOSIS—455

Test Conditions:

- Light bulb continuity is ok or light bulb replaced.
- PTO switch in off position.
- Park brake engaged.
- Key switch in run position.
- Light switch in on position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

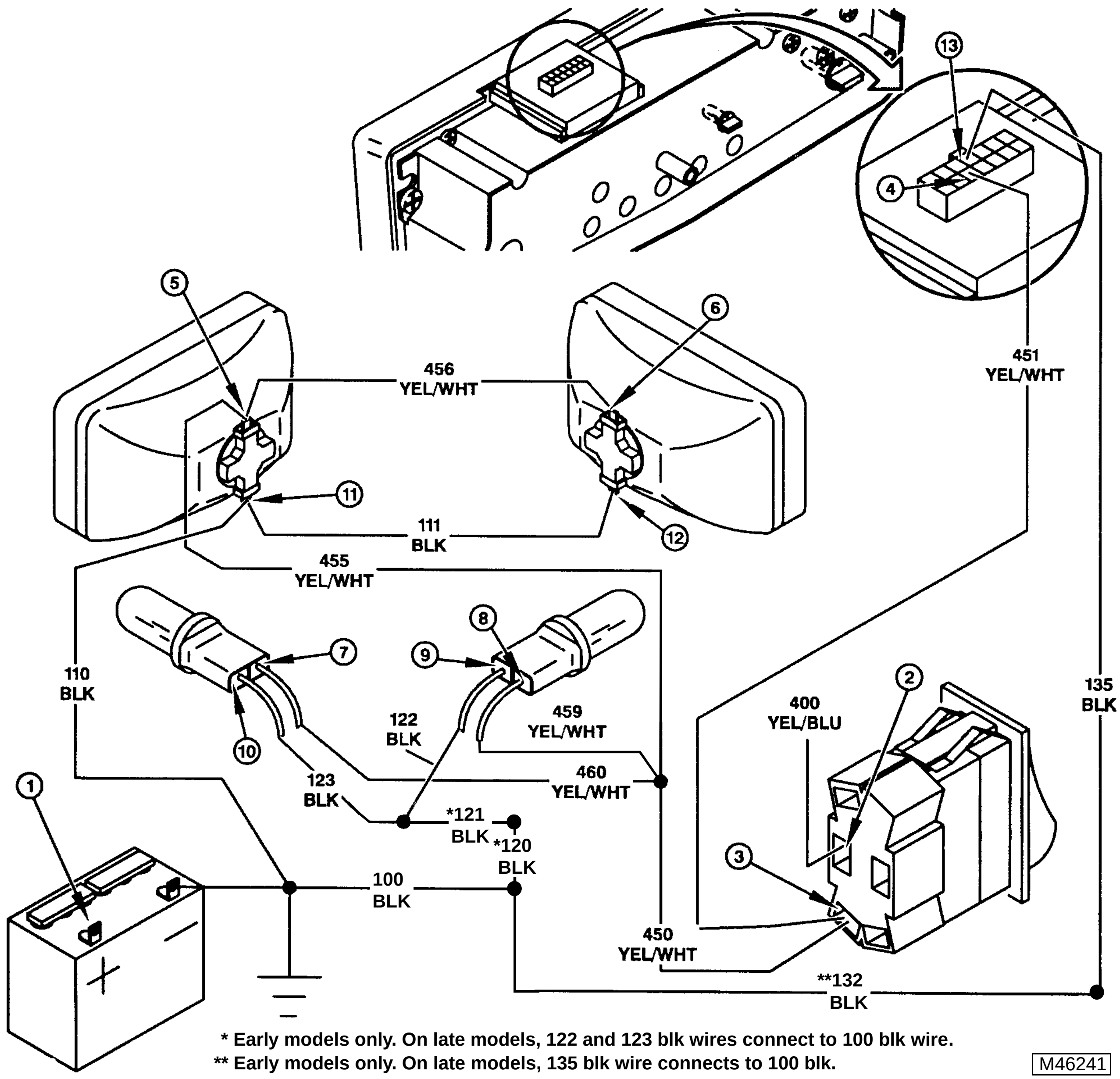
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Light switch.	Battery voltage.	Check power circuit test points.
3. Light switch.	Battery voltage.	Test light switch.
4. Instrument panel connector terminal 5.	Battery voltage.	Check 451 yel/wht wire.
5. Right head light.	Battery voltage.	Check 455 yel/wht wire.
6. Left head light.	Battery voltage.	Check 456 yel/wht wire.
7. Left tail light.	Battery voltage.	Check 460 yel/wht wire.
8. Right tail light.	Battery voltage.	Check 459 yel/wht wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
9. Right tail light.	Maximum 0.1 ohms resistance.	Check battery negative cable, engine ground connection, 100 and 122 blk wires. On early models, also check 120 and 121 blk wires.
10. Left tail light.	Maximum 0.1 ohms resistance.	Check 123 blk wire.
11. Right head light.	Maximum 0.1 ohms resistance.	Check 110 blk wire.
12. Left head light.	Maximum 0.1 ohms resistance.	Check 111 blk wire.
13. Instrument panel connector terminal 11.	Maximum 0.1 ohms resistance.	Check 135 blk wire, if ok replace instrument panel. On early models, also check 132 blk wire.

LIGHTS CIRCUIT TEST POINTS—455



* Early models only. On late models, 122 and 123 blk wires connect to 100 blk wire.

** Early models only. On late models, 135 blk wire connects to 100 blk.

FUEL PUMP CIRCUIT OPERATION—455 (S.N. —070000)

Function:

To provide pressurized fuel to the fuel injection pump.

Operation Conditions:

The key switch must be in the run or start position, and the operator must be on the seat (seat switch closed) or with the operator off the seat, the brake pedal must be depressed and the PTO switch must be off.

System Operation:

Current (A) flows from the battery (G1) to the starting motor (M1), fusible link (F2), and key switch terminal B (S1). Current cannot flow to the fuel pump until the hold-in relay (K2) is energized. With the operator OFF the seat and the key switch in the run position, current flows from key switch terminal B to terminal A, power fuse (F6), hold-in relay terminal 87, brake switch (S3) (brake pedal depressed), PTO switch (S4) (PTO disengaged), hold-in relay coil terminal 85, and hold-in LED (E1). The hold-in LED indicates that power is available to the hold-in relay coil. With the hold-in relay energized, current (C) flows to the diesel module, PTO switch, fuel shut-off solenoid (Y2), fuel pump fuse (F4) (later models only), and fuel pump, energizing the pump. The fuel pump fuse protects the fuel pump from damage due to lack of fuel lubrication, if the fuel becomes thick during cold weather operation.

An alternate current path is provided to keep the hold-in relay energized when the PTO is engaged or the brake pedal is released. With the operator on the seat (seat switch (S2) closed), current (D) flows to the hold-in relay coil, keeping the relay energized. If the operator leaves the seat with the PTO engaged or the brake pedal released, current to the hold-in relay coil is stopped. The hold-in relay opens, which stops current flow to the fuel shut-off solenoid and fuel pump, stopping the engine. A delay capacitor in the control/fuse module provides current for 1/2 second to keep the hold-in relay coil energized if the operator bounces on the seat

FUEL PUMP CIRCUIT OPERATION—455 (S.N. 070001—)

Function:

To provide pressurized fuel to the fuel injection pump.

Operating Conditions:

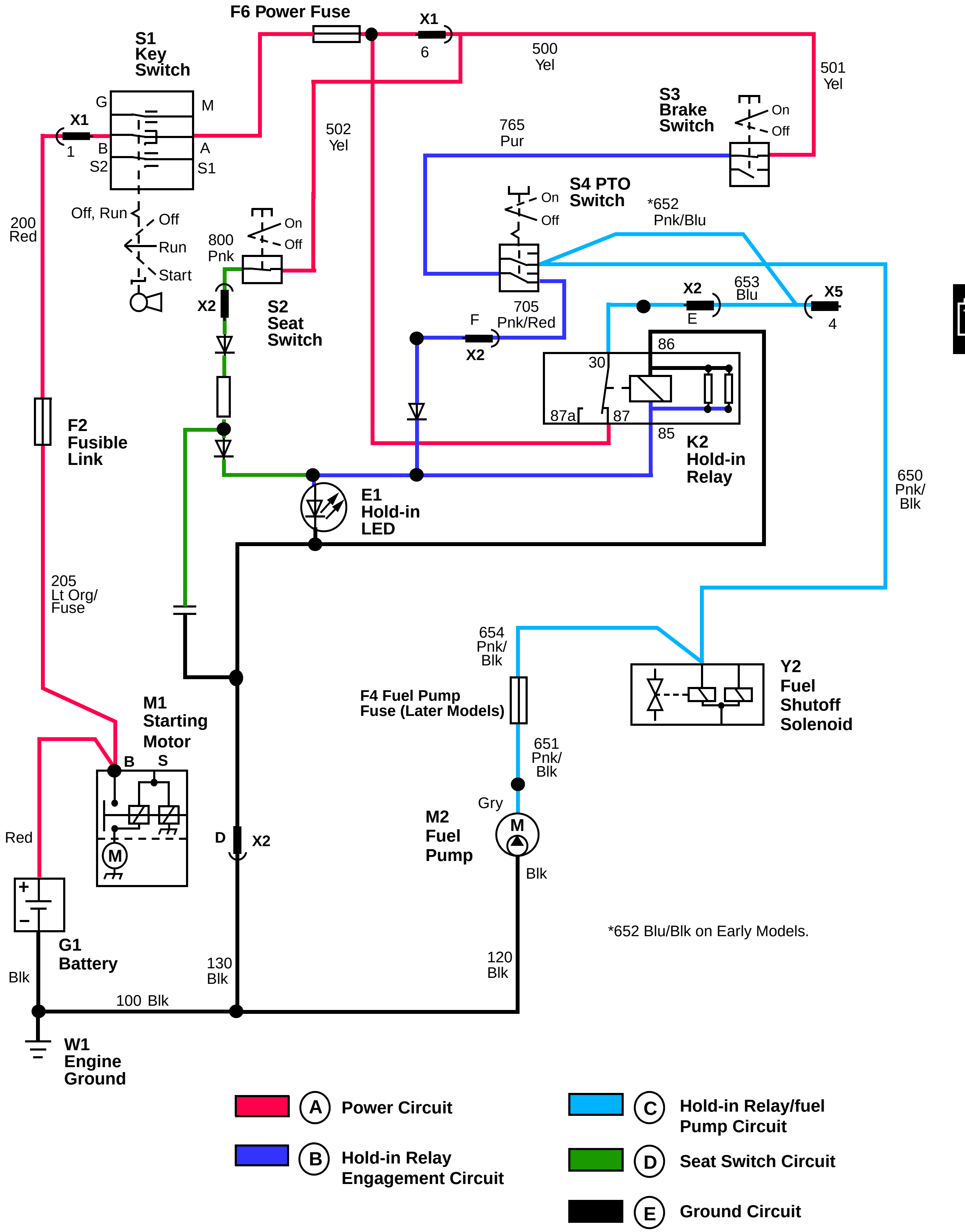
The key switch must be in the run or start position, and the operator must be on the seat (seat switch closed).

System Operation:

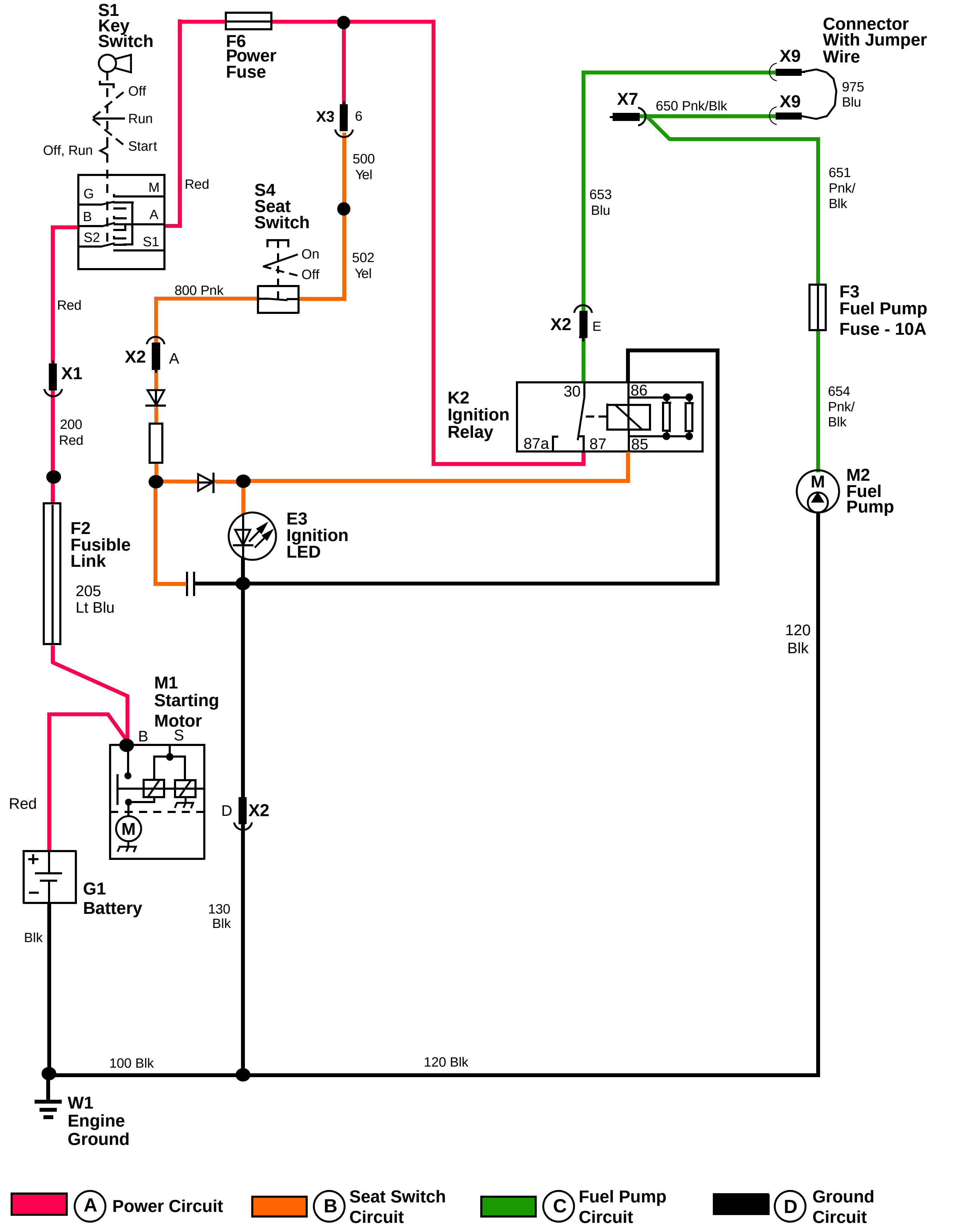
Current (A) flows from the battery (G1) to starting motor (M1), fusible link (F2), and terminal B of key switch (S1). With the key switch in the run or start position, current flows from terminal B to terminal A of the key switch and then to power fuse (F6), seat switch (S3) and terminal 87 of ignition relay (K2). With the operator on the seat (seat switch closed), current (B) flows to ignition LED (E3) and the coil (terminal 85) of the ignition relay, energizing the relay. With the relay energized, current (C) flows to the hood switch option (S2), fuel pump fuse (F3), and fuel pump (M2), energizing the pump. The fuel pump fuse protects the fuel pump from damage due to lack of fuel lubrication, if the fuel becomes thick during cold weather operation.

If the operator leaves the seat, current to the ignition relay coil is stopped and the ignition relay opens which stops current to the fuel pump. A delay capacitor in the control/fuse module (A2) provides current for 1/2 second to keep the ignition relay coil energized if the operator bounces on the seat.

FUEL PUMP CIRCUIT SCHEMATIC—455 (S.N. —070000)



FUEL PUMP CIRCUIT SCHEMATIC—455 (S.N. 070001—)



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FUEL PUMP CIRCUIT DIAGNOSIS—455 (S.N. —070000)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Seat switch depressed or jumper wire installed in connector.
- Key switch run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

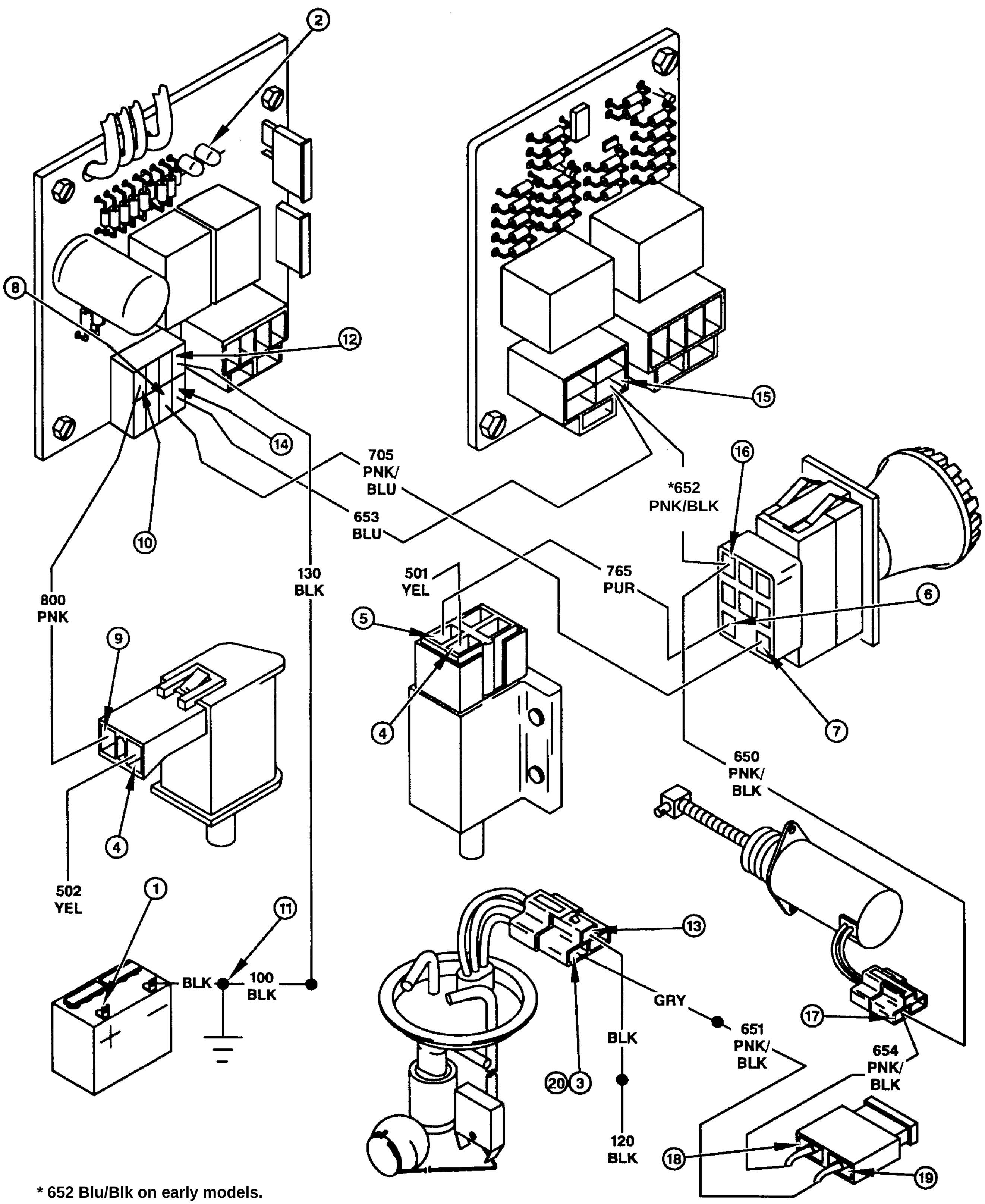
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Hold-in LED.	Light on.	Check hold-in relay engagement circuit, go to step 4.
3. Fuel pump.	Battery voltage.	No voltage—check hold-in relay engagement circuit, go to step 4. Voltage—check fuel pump ground circuit, go to step 11.
4. Brake switch, seat switch.	Battery voltage.	Check power circuit diagnosis.
5. Brake switch.	Battery voltage.	Test brake switch.
6. PTO switch.	Battery voltage.	Check 765 pur wire.
7. PTO switch.	Battery voltage.	Test PTO switch.
8. Control/fuse module terminal F.	Battery voltage.	Check 705 pnk/blk wire.
9. Seat switch.	Battery voltage.	Test seat switch.
10. Control/fuse module terminal A.	Battery voltage.	Check 800 pnk wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
11. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative cable and engine ground connection.
12. Control/fuse module resistance terminal D.	Maximum 0.1 ohms resistance.	Check 100 and 130 blk wires and harness to engine ground connection.
13. Fuel pump.	Maximum 0.1 ohms resistance.	Check fuel pump blk wire, 120 and 100 blk wires.

FUEL PUMP CIRCUIT TEST POINTS—455 (S.N. —070000)



* 652 Blu/Blk on early models.

M46286

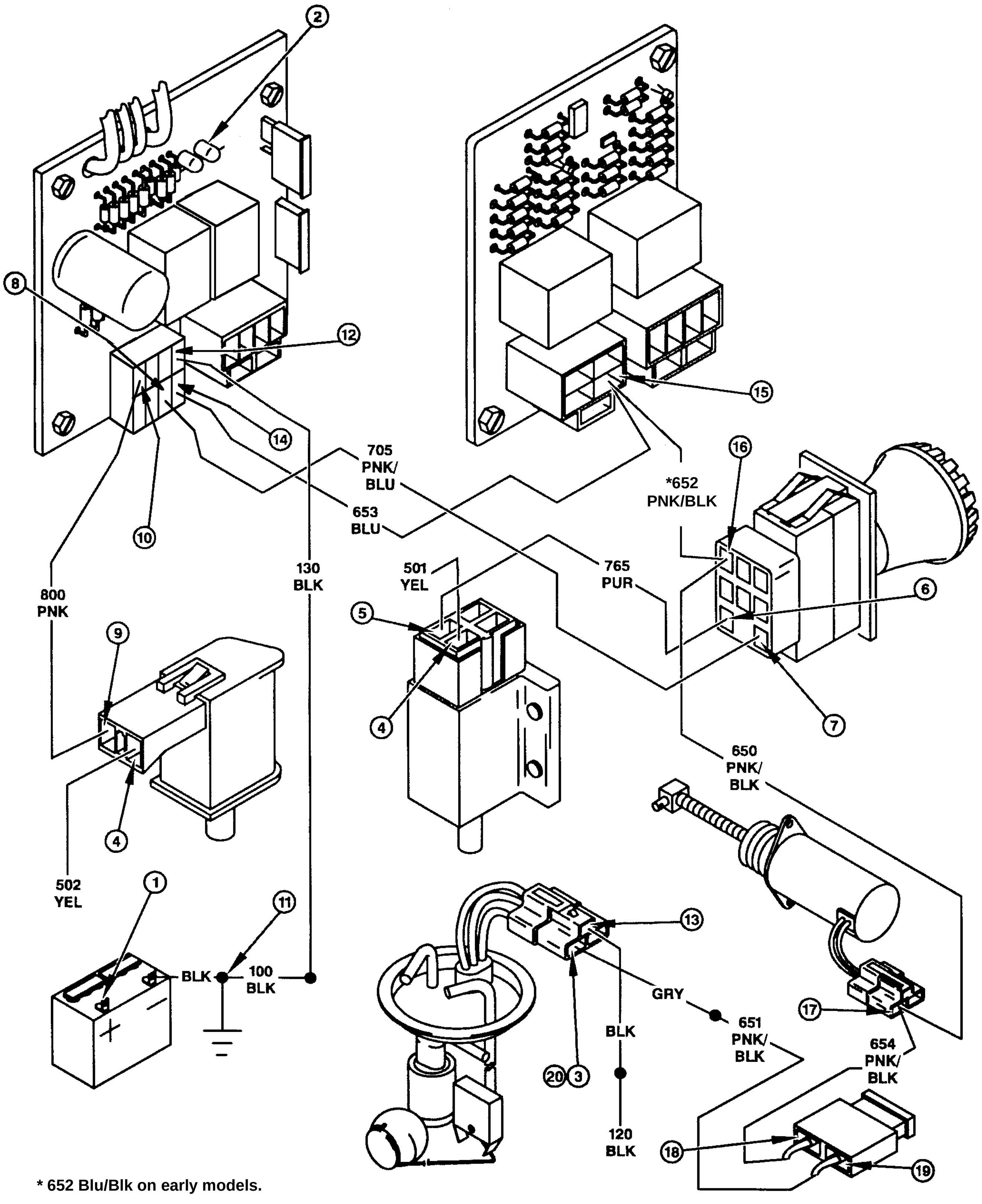
FUEL PUMP CIRCUIT DIAGNOSIS—455 (S.N. —070000) (continued)

Test Conditions:

• Key switch in run position.

Test/Check Point	Normal	If Not Normal
14. Control/fuse module terminal E.	Battery voltage.	Replace control/fuse module.
15. Diesel module terminal 4.	Battery voltage.	Check 653 blu wire.
16. PTO switch.	Battery voltage.	Check 652 pnk/blu (blu/blk on early models) wire.
17. Fuel shut-off solenoid.	Battery voltage.	Check 650 pnk/blu wire.
18. Fuel pump fuse (later models only).	Battery voltage.	Check 654 pnk/blk wire.
19. Fuel pump fuse (later models only).	Battery voltage.	Replace 10-amp fuse.
20. Fuel pump.	Battery voltage.	Check 651 pnk/blk wire, gry wire and terminal connections, if OK, replace fuel pump.

FUEL PUMP CIRCUIT TEST POINTS—455 (S.N. —070000) (continued)



* 652 Blu/Blk on early models.

M46286

FUEL PUMP CIRCUIT DIAGNOSIS—455 (S.N. 070001—)

Test Conditions:

- Seat switch depressed or jumper wire installed in connector.
- Key switch in run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

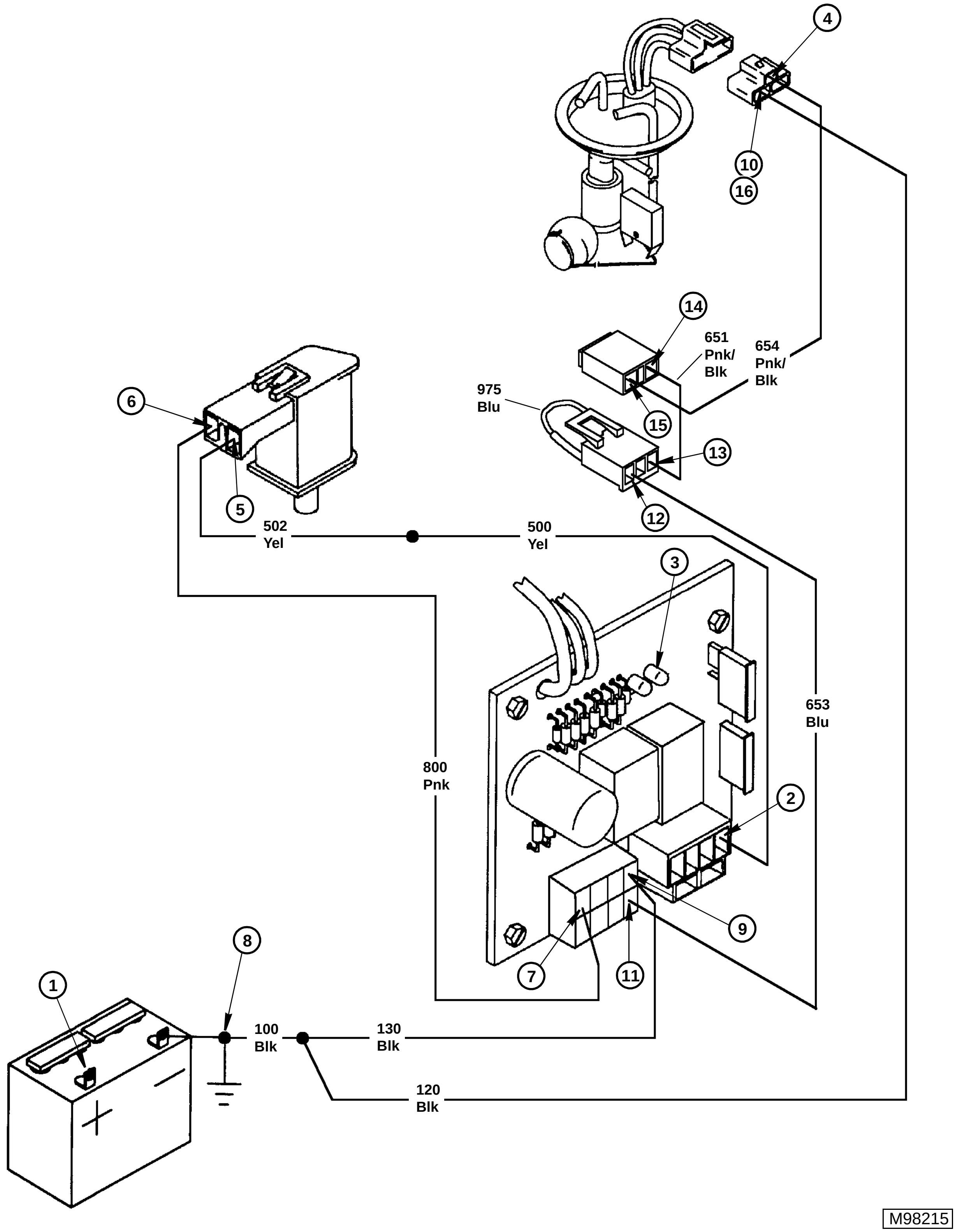
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Control/fuse module terminal 6.	Battery voltage.	Check power circuit test points and F6 power fuse. If power circuit and fuse ok, replace control/fuse module.
3. Ignition LED.	Light on.	Check ignition relay engagement circuit, go to step 4.
4. Fuel pump.	Battery voltage.	No voltage—go to step 5. Voltage—Go to step 8.
5. Seat switch.	Battery voltage.	Check power circuit test points.
6. Seat switch.	Battery voltage.	Test seat switch.
7. Control/fuse module terminal A.	Battery voltage.	Check 800 pnk wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
8. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative cable and engine ground connection.
9. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check 100 and 130 blk wires and harness to engine ground connection.
10. Fuel pump.	Maximum 0.1 ohms resistance.	Check 120 blk wire.

FUEL PUMP CIRCUIT TEST POINTS—455 (S.N. 070001—)



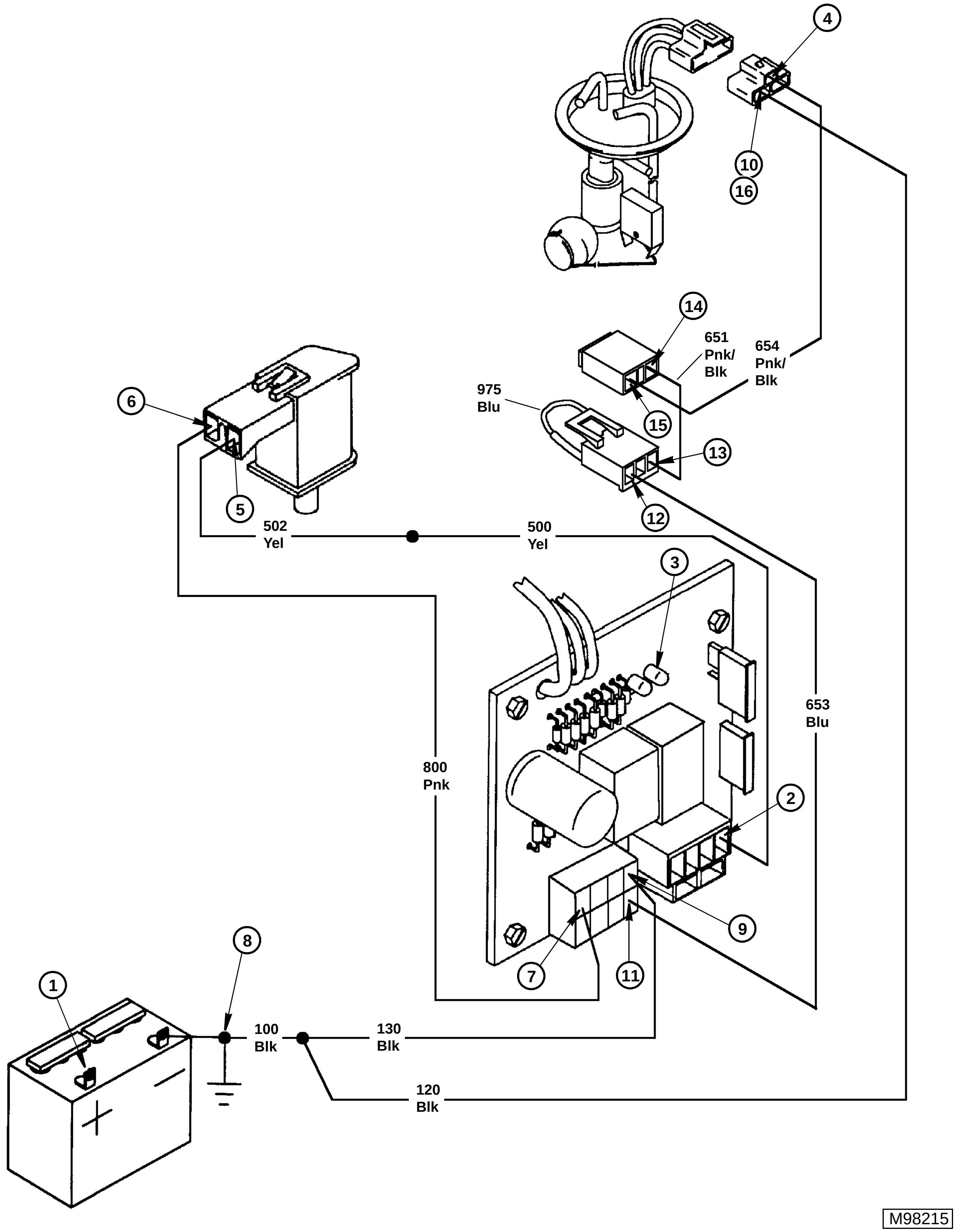
FUEL PUMP CIRCUIT DIAGNOSIS—455 (S.N. 070001—) (continued)

Test Conditions:

- Key switch in run position.

Test/Check Point	Normal	If Not Normal
11. Control/fuse module terminal E.	Battery voltage.	Replace control/fuse module.
12. Hood switch option connector.	Battery voltage.	Check 653 blu wire.
13. Hood switch option connector.	Battery voltage.	Check 975 blu wire.
14. Fuel pump fuse.	Battery voltage.	Check 651 pnk/blk wire.
15. Fuel pump fuse.	Battery voltage.	Check fuse and make sure it is fully inserted.
16. Fuel pump.	Battery voltage. If OK, replace fuel pump.	Check 654 pnk/blk wire and terminal connections.

FUEL PUMP CIRCUIT TEST POINTS—455 (S.N. 070001—) (continued)



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FUEL SHUT-OFF SOLENOID CIRCUIT OPERATION—455 (S.N. —070000)

Function:

To energize the fuel shut-off solenoid which controls fuel flow by mechanically moving the fuel injection pump linkage.

Operating Conditions:

To energize the fuel shut-off solenoid, the key switch must be in the run position, and the operator must be on the seat (seat switch closed) or with the operator off the seat, the brake pedal must be depressed and the PTO switch must be off.

System Operation:

Current (A) flows from the battery (G1) to the starting motor (M1), fusible link (F2), key switch terminal B (S1), and pull-in relay (K5). Current from the pull-in relay cannot flow to the fuel shut-off solenoid (Y2) until the relay is energized. The pull-in relay receives the energizing current from the hold-in relay circuit (C). The hold-in relay circuit stops the engine if the PTO is engaged, or the brake pedal is released with the operator OFF the seat.

With the operator off the seat and the key switch in the run position, current flows from key switch terminal B to terminal A, 15-amp fuse (F6), hold-in relay terminal 87 (K2), brake switch (S3) (brake pedal depressed), PTO switch (S4) (PTO disengaged), hold-in relay coil terminal 85, and the hold-in relay LED (E1). The hold-in relay LED indicates that power is available to the hold-in relay coil. With the hold-in relay energized, current (C) flows to the pull-in relay timer of the diesel module, PTO switch, and fuel shut-off solenoid (Y2) hold-in winding (H). The pull-in relay timer energizes the pull-in relay coil (K5) and closes the relay for approximately 1 second. Closing the relay provides direct battery current (E) to energize the pull-in winding (I) of the fuel shut-off solenoid. This pulls the fuel injection pump linkage from the shut-off to fuel position. After one second, the pull-in relay timer stops current flow to the pull-in relay coil. The pull-in relay opens and current flow to the fuel shut-off solenoid pull-in winding stops. Once the fuel shut-off solenoid has been pulled in, the hold-in winding (H) maintains the fuel injection pump linkage in the engaged position.

An alternate current path is provided to keep the hold-in relay energized when the PTO is engaged or the brake pedal is released. With the operator on the seat (seat switch (S2) closed), current (D) flows to the hold-in relay coil, keeping the relay energized. If the operator leaves the seat with the PTO engaged or the brake pedal released, current to the hold-in relay coil is stopped. The hold-in relay opens and current flow to the fuel shut-off solenoid hold-in winding stops. Spring pressure moves the fuel shut-off solenoid linkage to the no fuel position and the engine stops. A delay capacitor in the control/fuse module provides current for 1/2 second to keep the hold-in relay coil energized if the operator bounces on the seat.

FUEL SHUT-OFF SOLENOID CIRCUIT OPERATION—455 (S.N. 070001—)

Function:

To energize the fuel shut-off solenoid which controls fuel flow by mechanically moving the fuel injection pump linkage.

Operating Conditions:

To energize the fuel shut-off solenoid, the key switch must be in the run position, and the operator must be on the seat (seat switch closed) or with the operator off the seat, the brake pedal must be depressed and the PTO switch must be off.

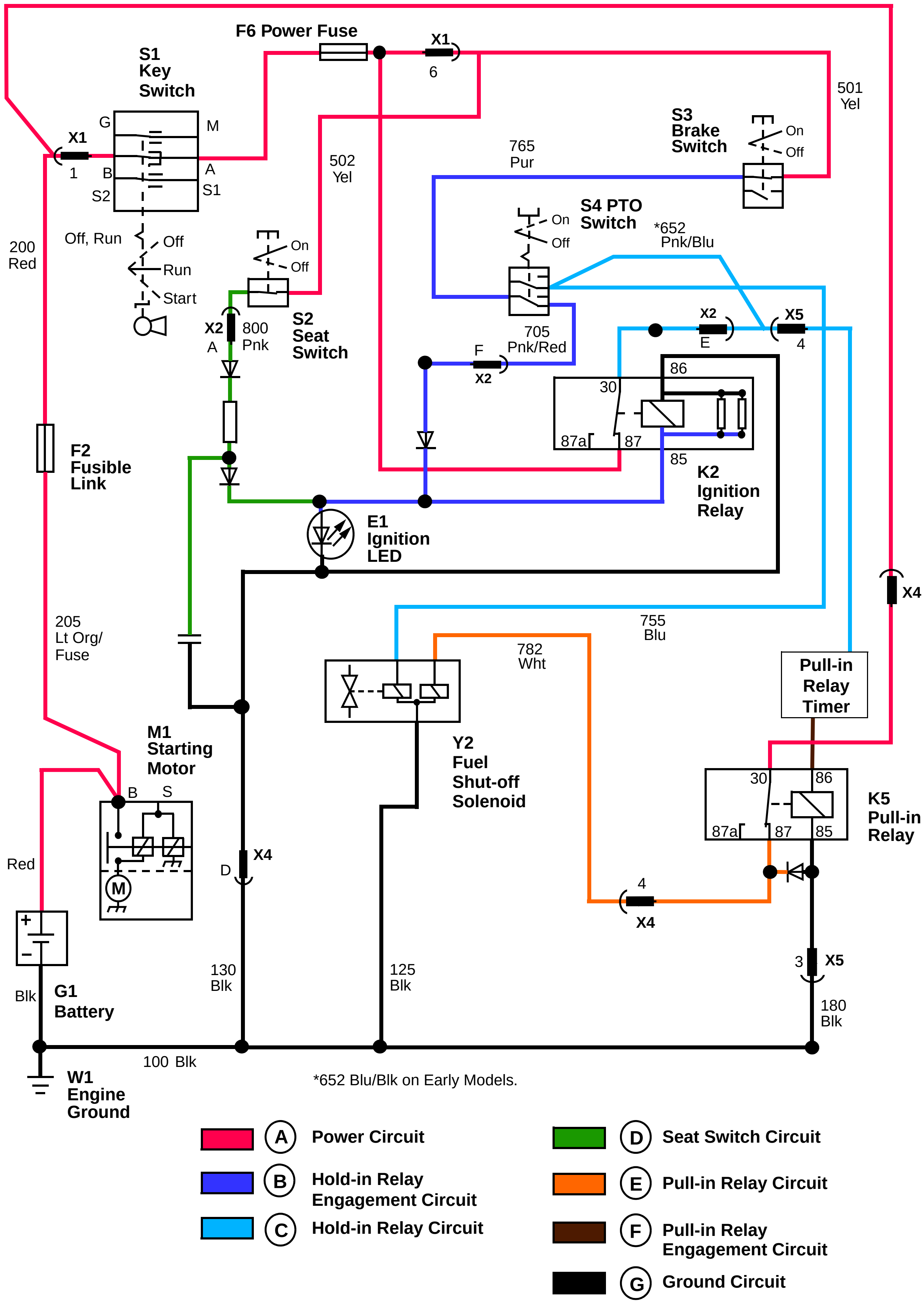
System Operation:

Current (A) flows from the battery (G1) to the starting motor (M1), fusible links (F1 and F2), terminal B of key switch (S1), terminal 87 of ignition relay (K2), and diesel module (A1). When the operator is on the seat (seat switch closed), current (B) flows to the ignition LED (E3), and terminal 85 of the ignition relay, energizing the relay. The ignition LED indicates that power is available to the ignition relay coil. With the ignition relay energized, current (E) flows from the ignition relay to the hood switch (S2) (optional) and then to the diesel module and the hold-in coil of the fuel shut-off solenoid. Because current (E) flows to the diesel module, current (C) flows from the diesel module to the pull-in coil on the fuel shut-off solenoid (Y2). This pulls the fuel injection pump linkage from the shut-off to fuel position. After one second, the diesel module stops current flow to the pull-in coil on the fuel shut-off solenoid. The fuel shut-off solenoid moves the fuel shut-off linkage from the shut-off position to the engaged position, supplying fuel to the engine. Once the fuel shut-off solenoid has been pulled in, the hold-in winding maintains the fuel injection pump linkage in the engaged position.

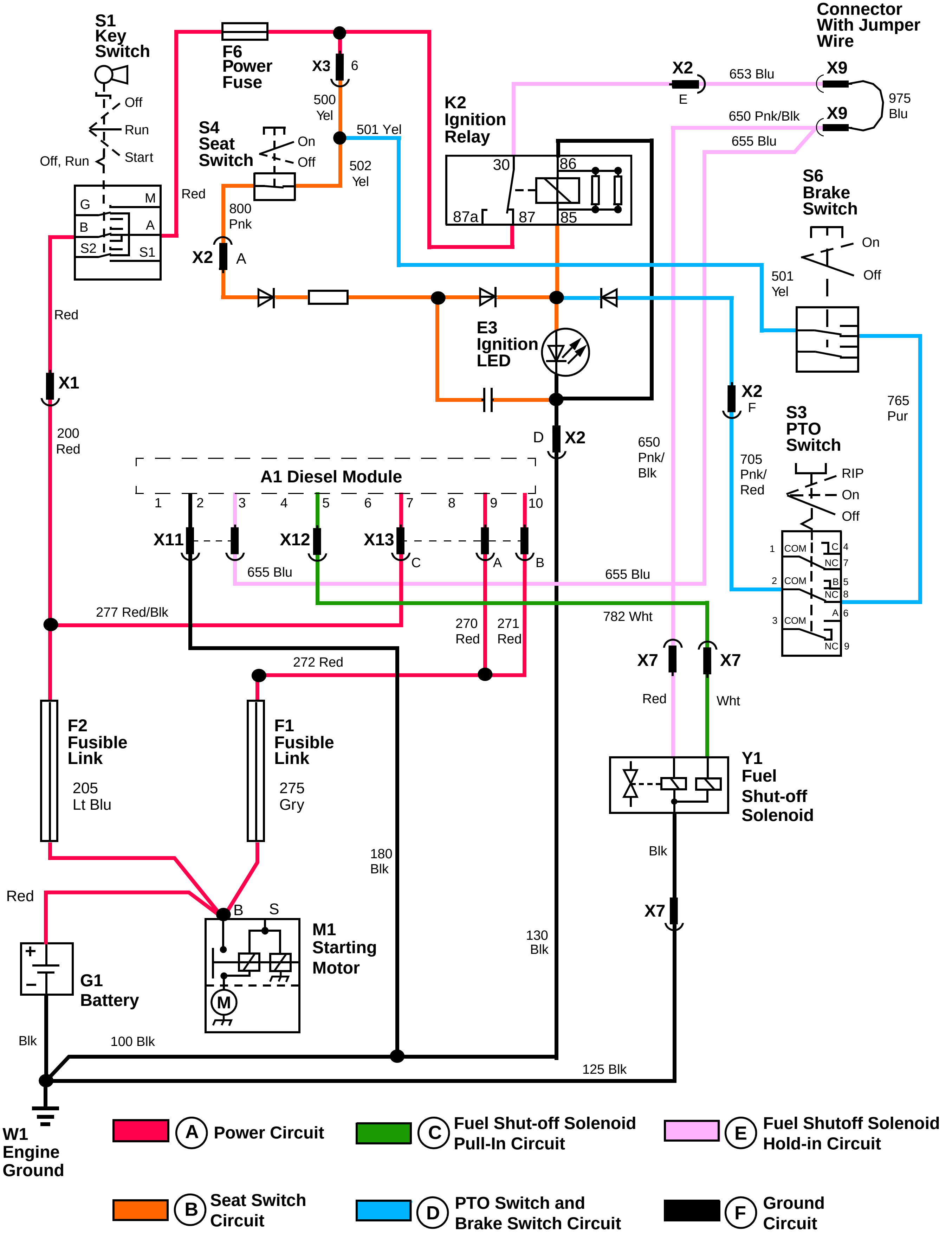
If the operator leaves the seat with the PTO engaged or the brake pedal released, current to the ignition relay coil is stopped, de-energizing the relay. With the ignition relay de-energized, current (C) to the hold-in coil of the fuel shut-off solenoid and diesel module is stopped. Spring pressure moves the fuel shut-off solenoid linkage to the shut-off position and the engine stops. A delay capacitor in the control/fuse module provides current for 1/2 second to keep the ignition relay coil energized if the operator bounces on the seat.

With the operator off the seat and the key switch in the run position, current flows from terminal B to terminal A of the key switch, 15-amp fuse (F6), brake switch (S6) (brake pedal depressed), PTO switch (S3) (PTO disengaged), terminal 85 of the ignition relay, and the ignition LED (E3). The ignition LED indicates that power is available to the ignition relay coil. With the ignition relay energized, current (C) flows to the hold-in coil of the fuel shut-off solenoid (Y2) and to the diesel module.

FUEL SHUTOFF SOLENOID CIRCUIT SCHEMATIC—455 (S.N. —070000)



FUEL SHUTOFF SOLENOID CIRCUIT SCHEMATIC—455 (S.N. 070001—)



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FUEL SHUT-OFF SOLENOID CIRCUIT DIAGNOSIS—455 (S.N. —070000)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Seat switch depressed or jumper wire installed in connector.
- Key switch run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

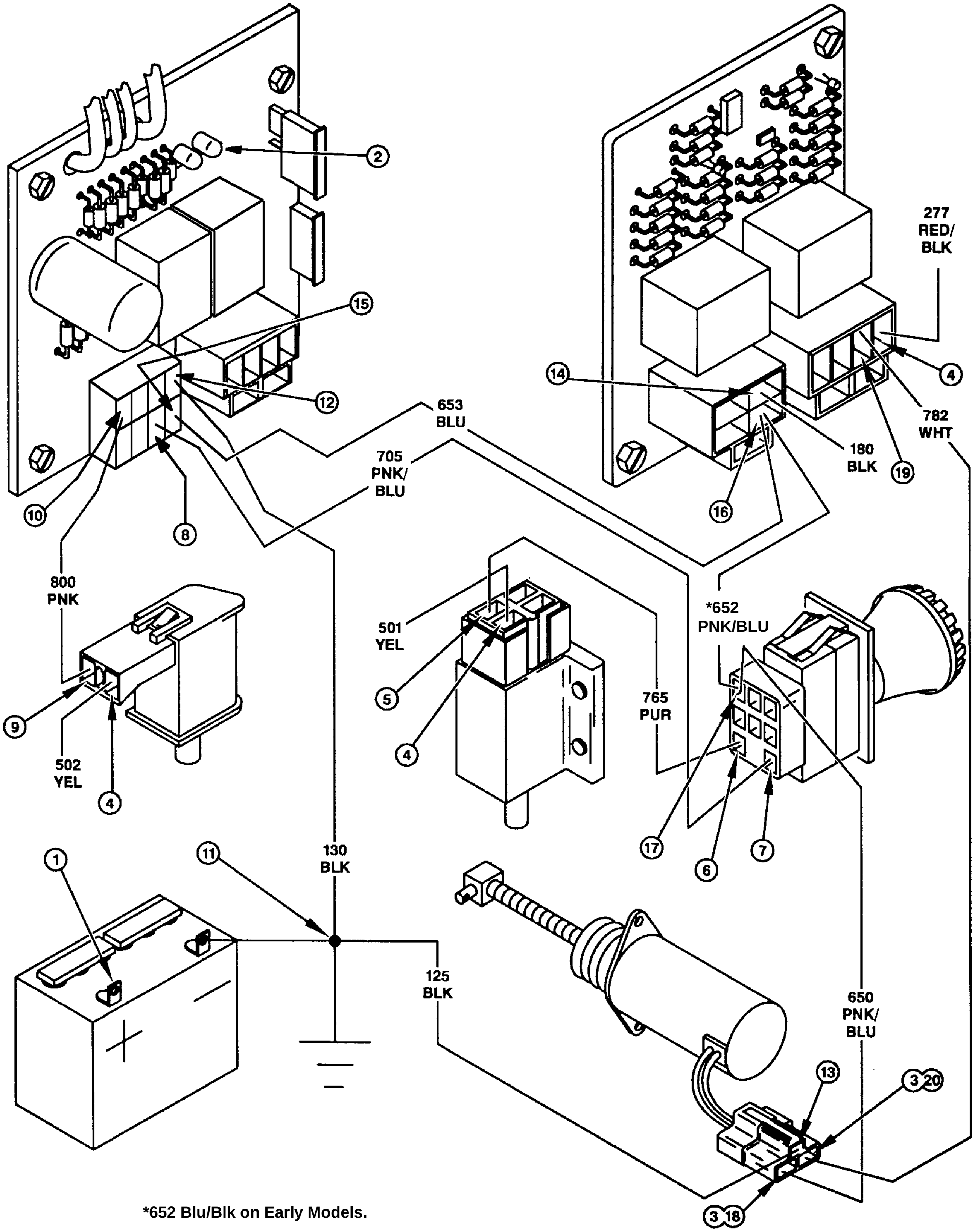
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Ignition LED.	Light on.	Check ignition relay engagement circuit, go to step 4.

Test Conditions:

- Turn key switch off then on while checking voltage within 1 second.

Test/Check Point	Normal	If Not Normal
3. Fuel shut-off solenoid. Check not binding.	Battery voltage for 1 second on wht wire. Battery voltage continuous on pnk/blk wire. Fuel shut-off solenoid winding 1—3 ohms	No voltage—check power circuit—go to step 4. Voltage—check solenoid ground circuit—go to step 11. Repair or replace.
4. Brake switch, seat switch, and diesel module terminals 3.	Battery voltage.	Check power circuit test points.
5. Brake switch.	Battery voltage.	Test brake switch.
6. PTO switch.	Battery voltage.	Check 765 pur wire.
7. PTO switch.	Battery voltage.	Test PTO switch.
8. Control/fuse module terminal F.	Battery voltage.	Check 705 pnk/blk wire.
9. Seat switch.	Battery voltage.	Test seat switch.
10. Control/fuse module terminal A.	Battery voltage.	Check 800 pnk wire.

FUEL SHUT-OFF SOLENOID CIRCUIT TEST POINTS—455 (S.N. —070000)



*652 Blu/Blk on Early Models.

FUEL SHUT-OFF SOLENOID CIRCUIT DIAGNOSIS—455 (S.N. —070000) (continued)

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
11. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative cable and harness ground connection.
12. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check 130 blk wire.
13. Fuel shut-off solenoid.	Maximum 0.1 ohms resistance.	Check 125 blk wire.
14. Diesel module terminal 3.	Maximum 0.1 ohms resistance.	Check 180 blk wire.

Test Conditions:

- Key switch in run position.

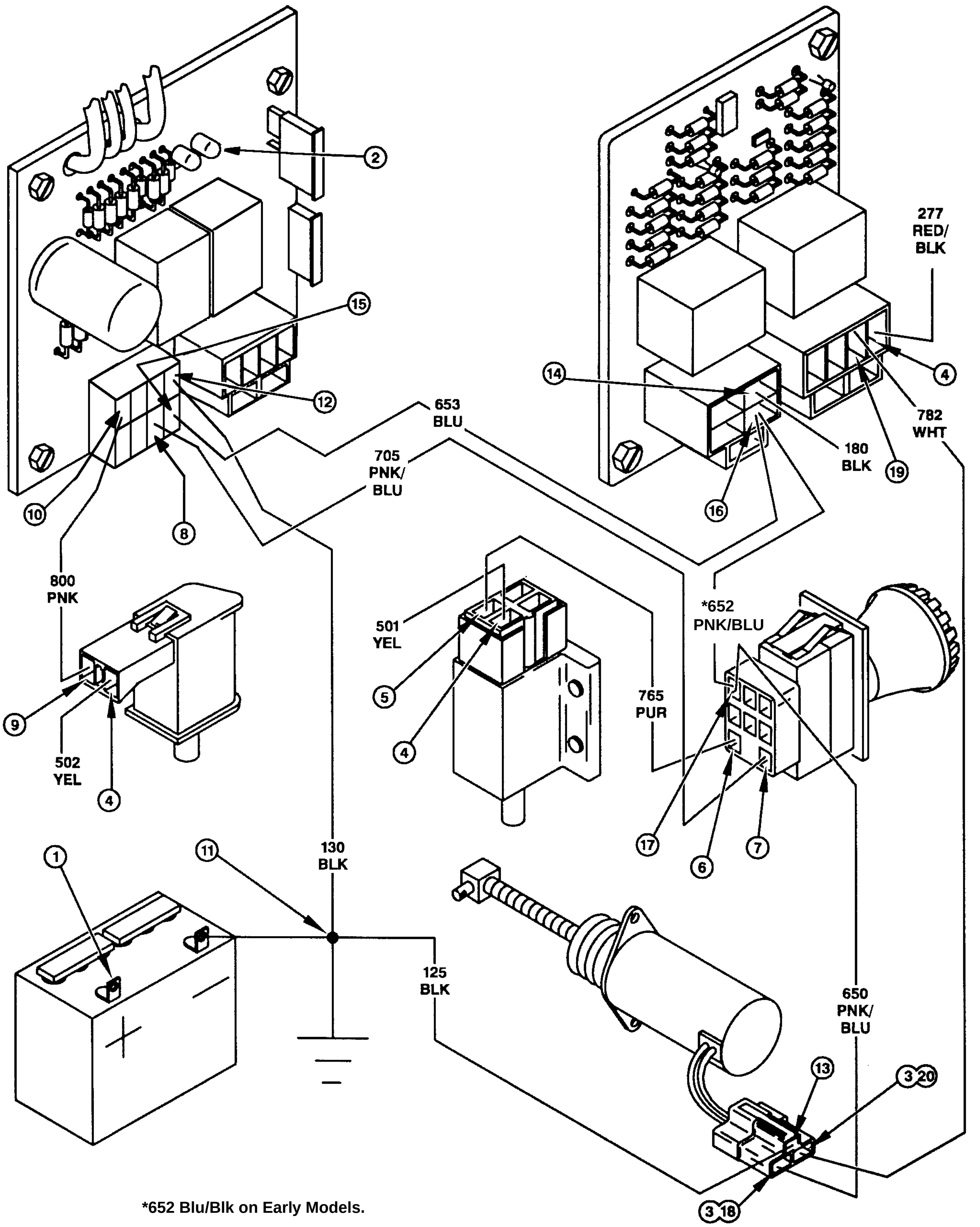
Test/Check Point	Normal	If Not Normal
15. Control/fuse module terminal E.	Battery voltage.	Replace control/fuse module.
16. Diesel module terminal 4.	Battery voltage.	Check 653 blu wire.
17. PTO switch.	Battery voltage.	Check 652 pnk/blu (blu/blk on early models) wire.
18. Fuel shut-off solenoid.	Battery voltage.	Check 650 pnk/blu wire connector.

Test Conditions:

- Turn key switch off then on when checking steps 19 and 20.

Test/Check Point	Normal	If Not Normal
19. Diesel module terminal 4.	Battery voltage for 1 second.	Replace diesel module.
20. Fuel shut-off solenoid connector.	Battery voltage for 1 second.	No voltage—check 782 wht wire. Voltage—test or replace fuel shut-off solenoid.

FUEL SHUT-OFF SOLENOID CIRCUIT TEST POINTS—455 (S.N. —070000) (continued)



*652 Blu/Blk on Early Models.

FUEL SHUT-OFF SOLENOID CIRCUIT DIAGNOSIS—455 (S.N. 070001—)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Seat switch depressed or jumper wire installed in connector.
- Key switch run position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

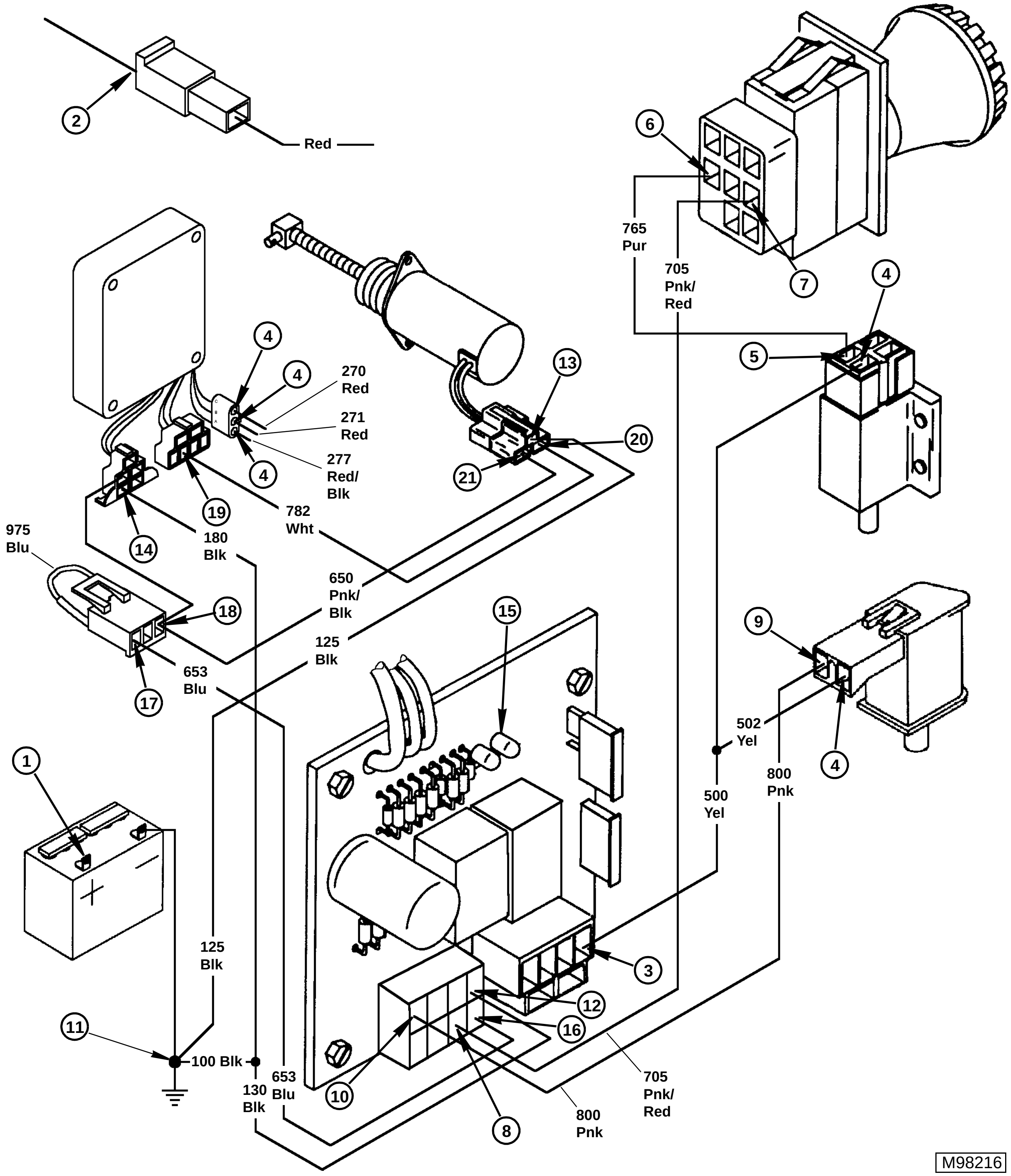
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Key switch power connector.	Battery voltage.	Check power circuit test points.
3. Control/fuse module terminal 6.	Battery voltage.	Check F6 power fuse. If fuse ok, replace control/fuse module.
4. Brake switch, seat switch, and diesel module connector X13.	Battery voltage.	Check power circuit test points.
5. Brake switch.	Battery voltage.	Test brake switch.
6. PTO switch.	Battery voltage.	Check 765 pur wire.
7. PTO switch.	Battery voltage.	Test PTO switch.
8. Control/fuse module terminal F.	Battery voltage.	Check 705 pnk/blk wire.
9. Seat switch.	Battery voltage.	Test seat switch.
10. Control/fuse module terminal A.	Battery voltage.	Check 800 pnk wire.

Test Conditions:

- Key switch in off position.

Test/Check Point	Normal	If Not Normal
11. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative cable and engine ground connection.
12. Control/fuse module terminal D.	Maximum 0.1 ohms resistance.	Check 100 and 130 blk wires and harness to engine ground connection.
13. Fuel shut-off solenoid.	Maximum 0.1 ohms resistance.	Check 125 blk wire.
14. Diesel module connector X11.	Maximum 0.1 ohms resistance.	Check 180 and 100 blk wire.

FUEL SHUT-OFF SOLENOID CIRCUIT TEST POINTS—455 (S.N. 070001—)



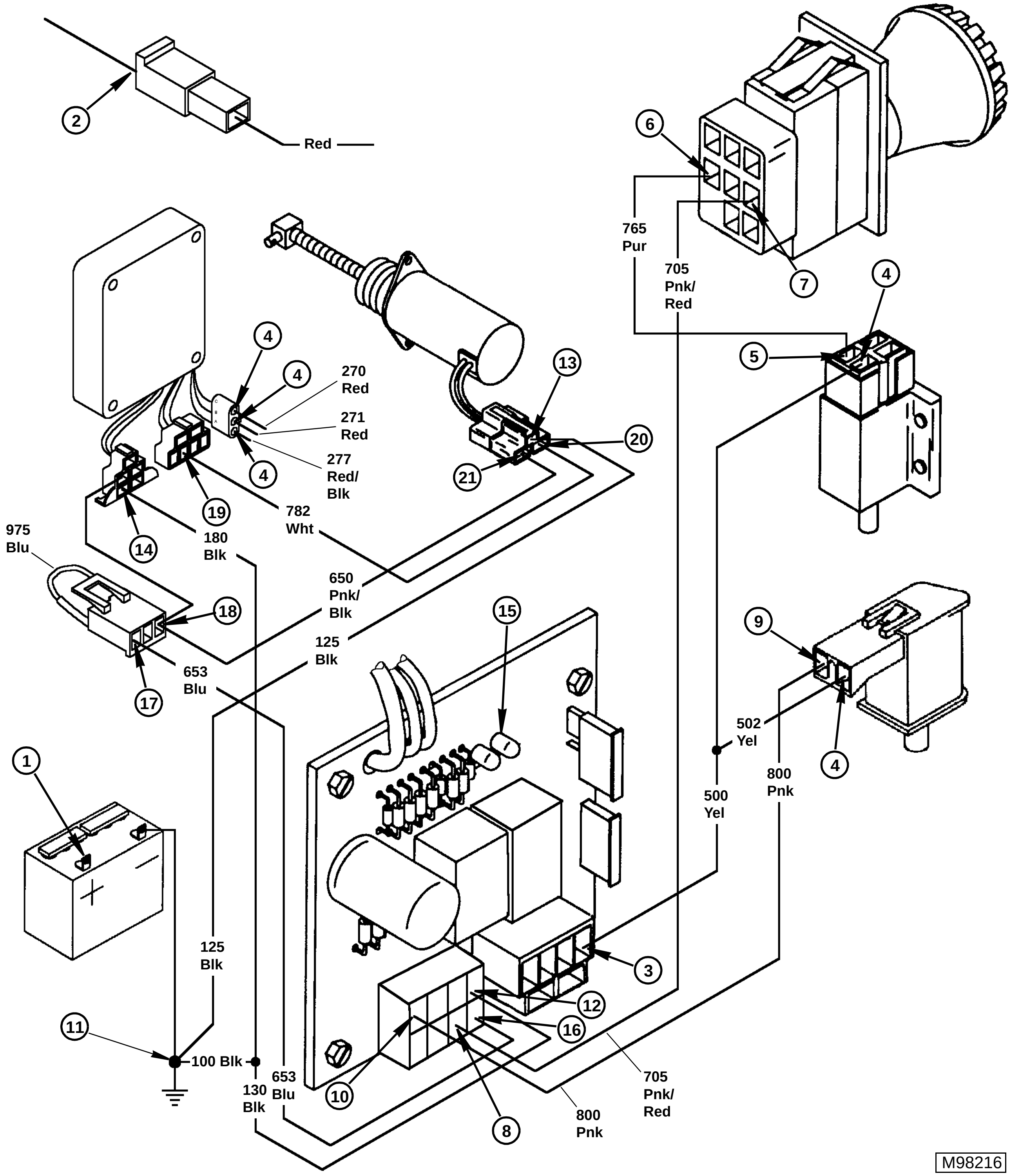
FUEL SHUT-OFF SOLENOID CIRCUIT DIAGNOSIS—455 (S.N. 070001—) (continued)

Test Conditions:

- Key switch in run position.

Test/Check Point	Normal	If Not Normal
15. Ignition LED.	Light on.	Check ignition relay engagement circuit.
16. Control/fuse module terminal E.	Battery voltage.	Replace control/fuse module.
17. Hood switch option connector.	Battery voltage.	Check 653 blu wire.
18. Hood switch option connector.	Battery voltage.	Check 975 blu wire.
19. Diesel module connector X12.	Battery voltage for 1 second after moving the key switch from off to run.	Replace diesel module.
20. Fuel shut-off solenoid.	Battery voltage for 1 second after moving the key switch from off to run.	Check 782 wht wire. If wire is ok and fuel shut-off solenoid does not operate, replace fuel shut-off solenoid.
21. Fuel shut-off solenoid.	Battery voltage.	Check 650 pnk/blk wire. If wire is ok and fuel shut-off solenoid does not hold in the fuel-on position, replace fuel shut-off solenoid.

FUEL SHUT-OFF SOLENOID CIRCUIT TEST POINTS—455 (S.N. 070001—) (continued)



GLOW PLUG AND LIGHT CIRCUIT OPERATION—455 (S.N. —070000)

Function:

To provide current to the glow plugs to preheat the engine for better starting performance.

Operating Conditions:

The key switch must be in the run or start position and the air temperature at the diesel module must be below 40°C (104°F).

System Operation:

Current (A) flows from the battery (G1) to the starting motor (M1), fusible links (F1), key switch B terminal (S1), and glow plug relay (K6). With the key switch in the start or run position, current flows through the switch to the 15-amp fuse (F3), glow plug timer and glow plug light timer of the diesel module, and the glow plug light (H5).

The glow plug timer and glow plug light timer of the diesel module sense ambient air temperature at the diesel module. When the air temperature is below 40°C (104°F), the diesel module energizes the glow plugs and lights the glow plug lamp.

The glow plug timer energizes the glow plug relay coil and closes the glow plug relay for an approximate amount of time depending on ambient air temperature. Closing the relay provides direct battery current (D) to the glow plugs (B2). The resistance of the glow plugs produce heat to warm the cylinder head and cylinder chambers. After an approximate amount of time, the glow plug timer stops current flow to the glow plug relay coil. The glow plug relay opens and current flow to the glow plugs stops. The glow plug timer will function up to 45 seconds if the air temperature is very cold.

The glow plug light timer energizes a transistor, which completes a path to ground for the glow plug light current and lights the lamp. The transistor remains energized for an approximate amount of time depending on ambient air temperature. The glow plug light will function for up to 20 seconds to inform operator that the engine requires preheating before starting. After an approximate amount of time, the glow plug light timer stops current flow to the transistor. The transistor opens and the path to ground for the glow plug light is eliminated. The lamp goes out indicating that the engine can be started.

The glow plug light also illuminates when the engine high temperature relay and coolant temperature switch have disengaged the PTO (See PTO CIRCUIT OPERATION).

GLOW PLUG AND LIGHT CIRCUIT OPERATION—455 (S.N. 070001—)

Function:

To provide current to the glow plugs to preheat the engine for better starting performance.

Operating Conditions:

The key switch must be in the run or start position and the air temperature at the diesel module must be below 40°C (104°F).

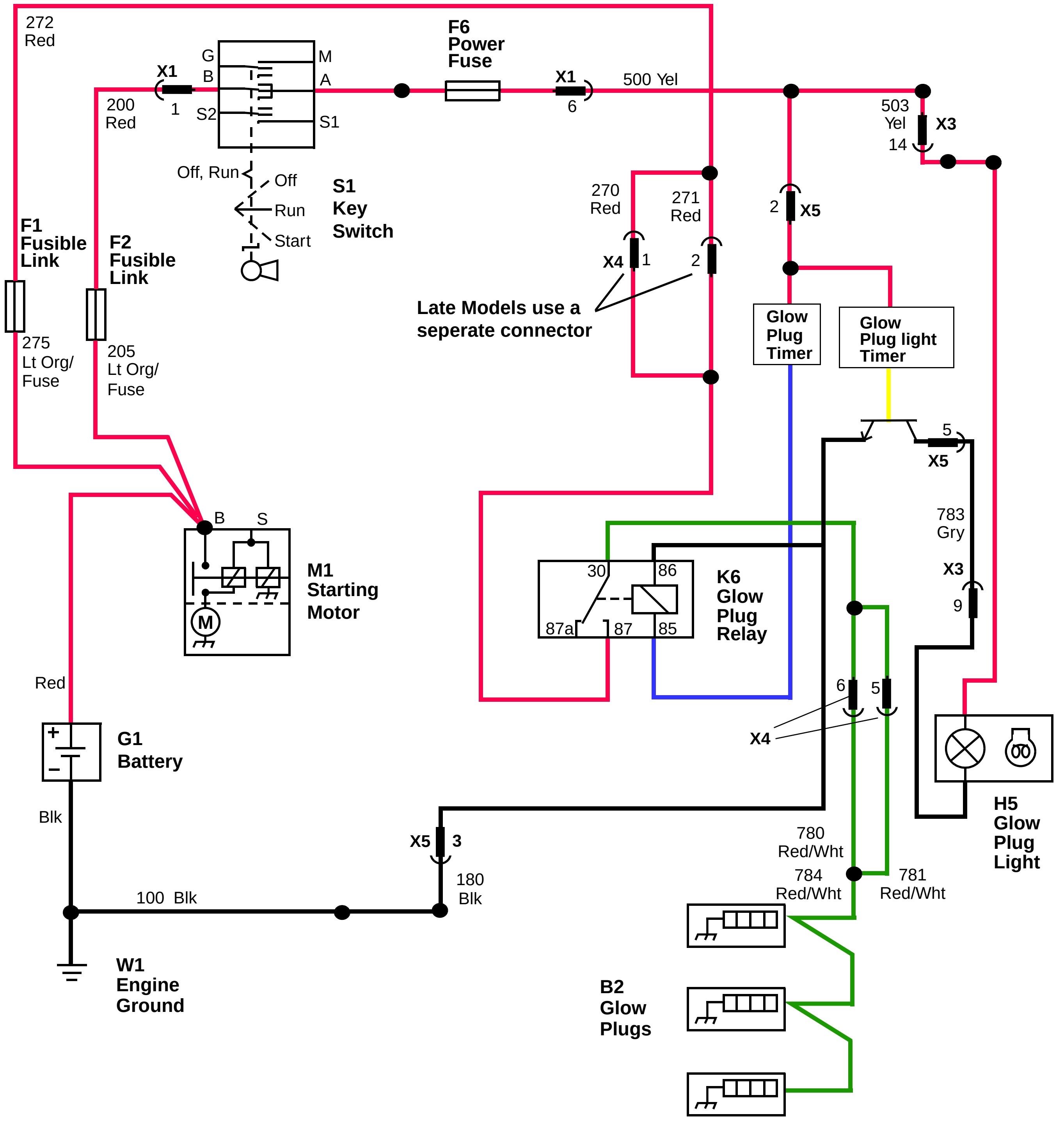
System Operation:

With the key switch in the run or start position, current (A) flows from the battery (G1) to the starting motor (M1), fusible links (F1 and F2), terminal B of key switch (S1), glow plug light (H3), and diesel module (A1).

The diesel module senses ambient air temperature. When the air temperature is below 40°C (104°F), the diesel module supplies current (C) to energize the glow plugs and supplies a path to ground (B) to turn on the glow plug light. The resistance of the glow plugs produces heat to warm the cylinder head and cylinder chambers. After a while (up to 45 seconds when the air is very cold) the diesel module stops the current to the glow plugs and interrupts the ground circuit to the glow plug light. When the glow plug light goes out, the engine is ready to start.

The glow plug light also comes on when the engine high temperature relay and coolant temperature switch have disengaged the PTO. (See PTO CIRCUIT OPERATION.)

G OW PLUG AND LIGHT CIRCUIT SCHEMATIC—455 (S.N. —070000)



A Power Circuit

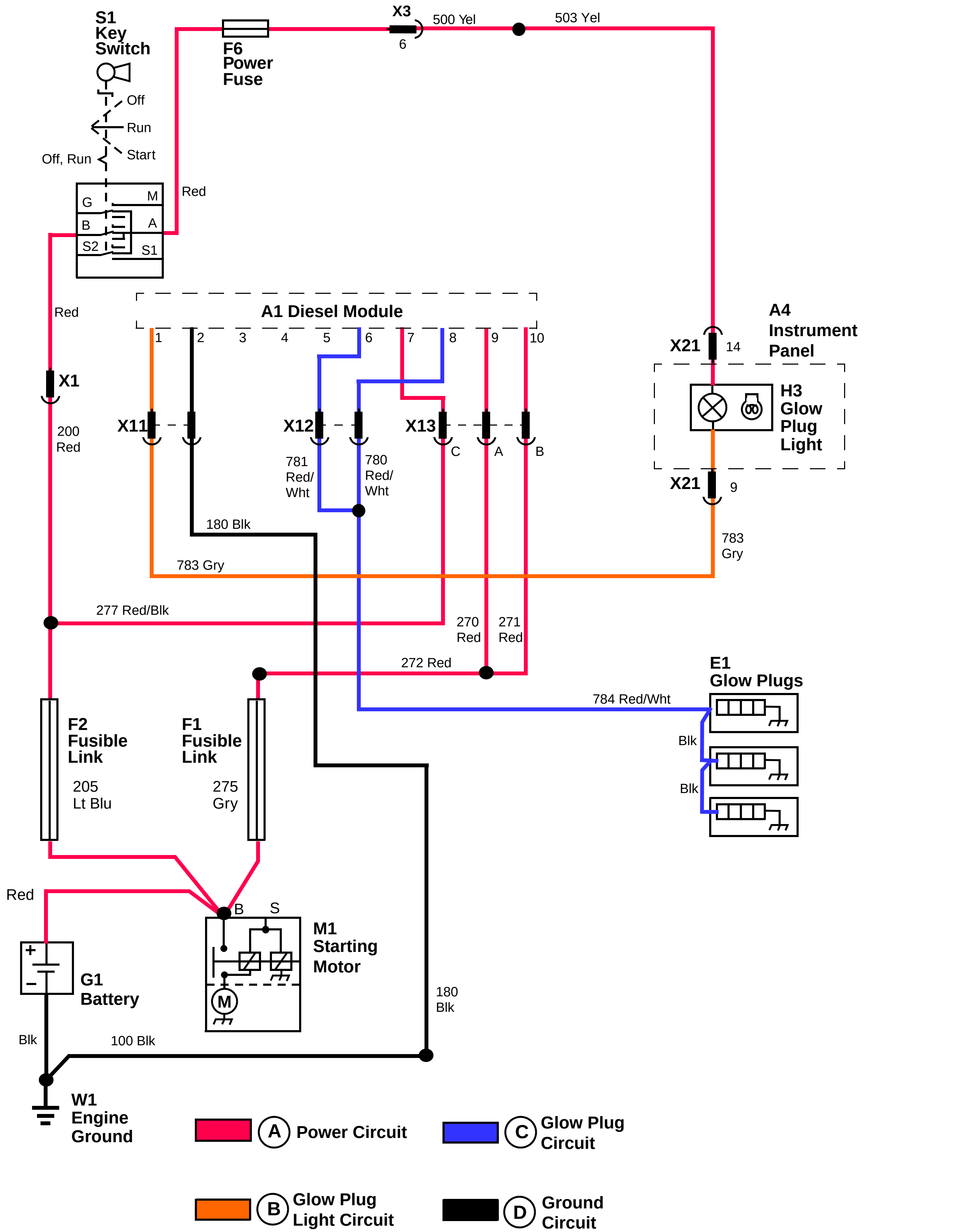
B Glow Plug Timer Circuit

C Glow Plug Light Timer Circuit

D Glow Plug Relay Circuit

E Ground Circuit

GLOW PLUG AND LIGHT CIRCUIT SCHEMATIC—455 (S.N. 070001—)



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GLOW PLUG AND LIGHT CIRCUIT DIAGNOSIS—455 (S.N. —070000)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Key switch off position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

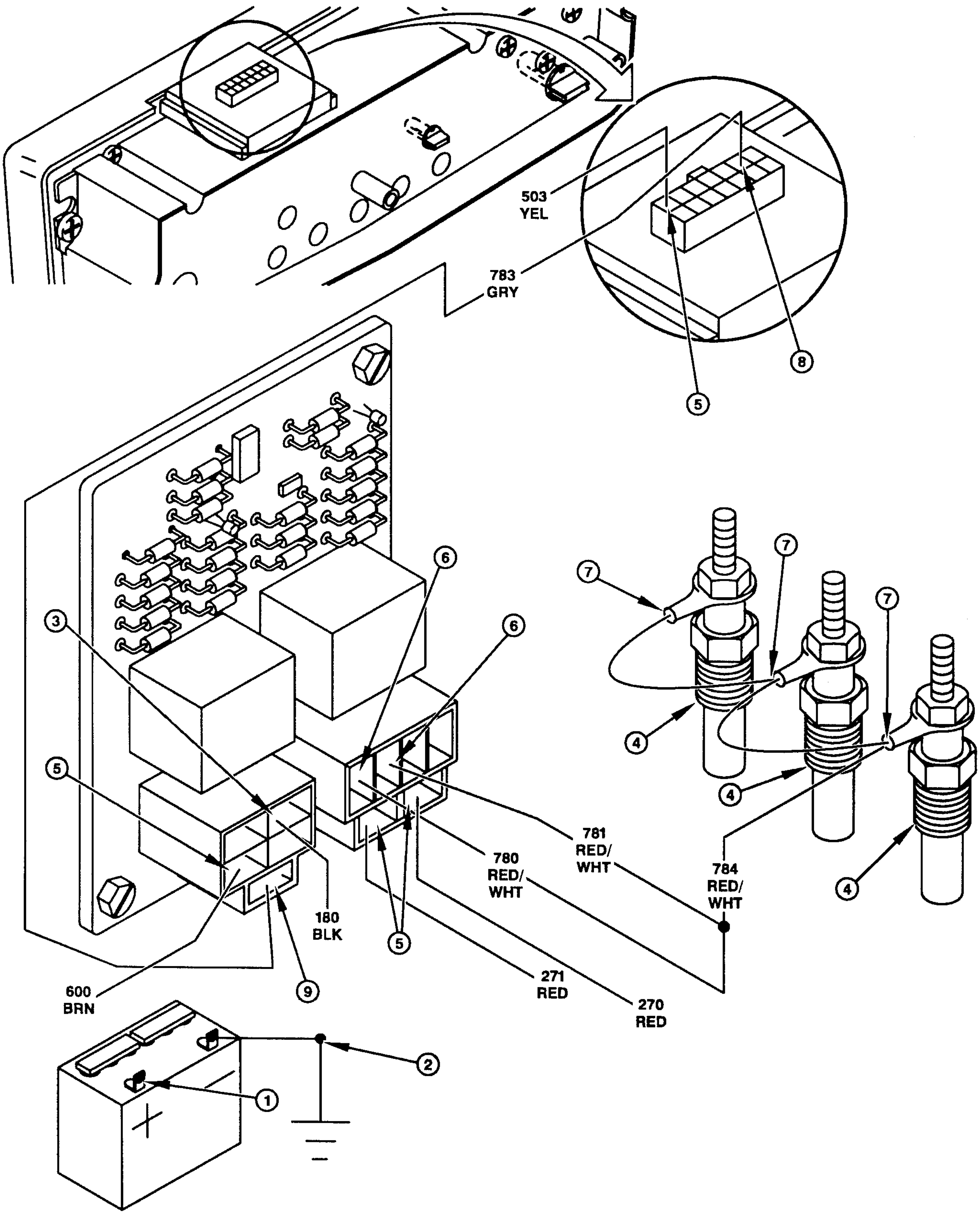
Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative cable and engine ground connection.
3. Control/fuse module resistance terminal 3	Maximum 0.1 ohms resistance.	Check 180 and 100 blk wires.
4. Glow plugs.	Maximum 0.1 ohms resistance.	Check glow plug ground surface.

Test Conditions:

- Key switch in run position.
- Glow plug and light timer in the diesel control module are activated when the air temperature is below 40°C (104°F). If necessary, refrigerate module to reduce temperature before testing.

Test/Check Point	Normal	If Not Normal
5. Diesel module terminals 1, 2, and dash panel module terminal 14.	Battery voltage.	Check power circuit diagnosis.
6. Diesel module to terminals 5 and 6.	Battery voltage for up to 45 seconds.	Replace diesel module.
7. Glow plugs.	Battery voltage for up to 45 seconds.	Check 780, 781, and 784 red/wht wires, if ok, test glow plugs.
8. Dash panel module.	0.0—0.2 volts for up to 20 seconds, battery voltage after timer de-energizes.	Greater than 0.2 volts—check 783 grey terminal 9 wire, if ok replace diesel module. 0.0 volts—check glow plug lamp.

GLOW PLUG AND LIGHT CIRCUIT TEST POINTS—455 (S.N. —070000)



GLOW PLUG AND LIGHT CIRCUIT DIAGNOSIS—455 (S.N. 070001—)

Test Conditions:

- Transmission in neutral.
- PTO switch off position.
- Park brake engaged.
- Key switch in off position.
- Meter negative (–) lead on battery negative (–) terminal.
- Meter positive (+) lead on numbered test point.
- Check connection for corrosion and loose terminals when testing.

Test/Check Point	Normal	If Not Normal
1. Battery positive terminal.	11.8—13.2 volts.	Test battery.
2. Key switch power connector.	Battery voltage.	Check power circuit test points.
3. Control/fuse module terminal 6.	Battery voltage.	Check F6 power fuse. If fuse ok, replace control/fuse module.
4. Diesel module connector X13.	Battery voltage.	Check power circuit test points.
5. Instrument panel terminal 14.	Battery voltage.	Check 503 yel wire.

Test Conditions:

- Key switch in off position.

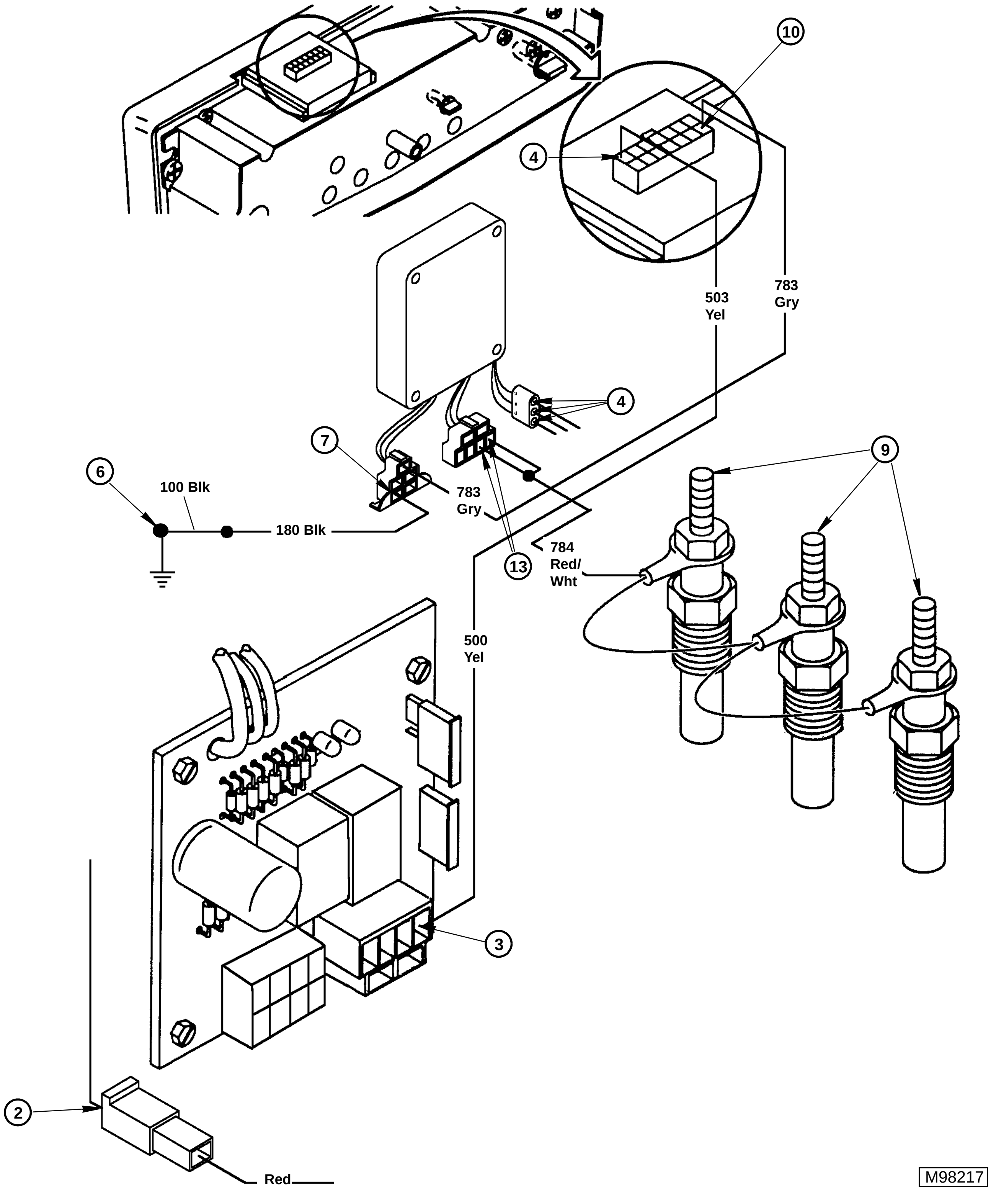
Test/Check Point	Normal	If Not Normal
6. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative cable and engine ground connection.
7. Diesel module connector X11.	Maximum 0.1 ohms resistance.	Check 180 and 100 blk wire.

Test Conditions:

- Key switch in run position.
- Glow plug and light timer in the diesel module are activated when the air temperature is below 40°C (104°F). If necessary, refrigerate module to reduce temperature before testing.

Test/Check Point	Normal	If Not Normal
8. Diesel module connector X12.	Battery voltage for up to 45 seconds.	Replace diesel module.
9. Glow plugs.	Battery voltage for up to 45 seconds.	Check 780, 781, and 784 red/wht wires. If wires are ok and glow plugs do not operate, replace glow plugs.
10. Instrument panel.	0.0—0.2 volts for up to 20 seconds, battery voltage after timer de-energizes.	Greater than 0.2 volts—Check 783 gry wire. If wire is OK, replace diesel module. 0.0 volts—check glow plug lamp.

GLOW PLUG AND LIGHT CIRCUIT TEST POINTS—455 (S.N. 070001—)



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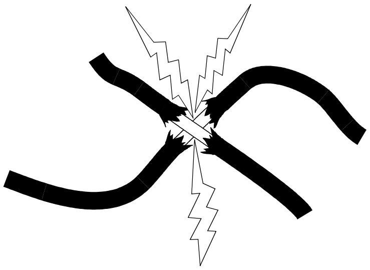
TESTS AND ADJUSTMENTS

COMMON CIRCUIT TESTS

Shorted Circuit:

A shorted circuit may result in the wrong component operating (i.e. improper wire-to-wire contact). To test for a shorted or improperly wired circuit:

1. Turn component switch ON.
2. Start at the controlling switch of the component that should not be operating.
3. Follow the circuit and disconnect wires at connectors until component stops operating.
4. Shorted or improper connections will be the last two wires disconnected.

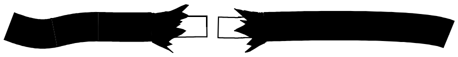


M85600

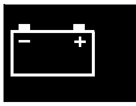
High Resistance or Open Circuit:

High resistance or open circuits usually result in slow, dim or no component operation (i.e. poor, corroded, or disconnected connections). Voltage at the component will be low when the component is in operation. To test for high resistance and open circuits:

1. Check all terminals and grounds of the circuit for corrosion.
2. If terminals are not corroded or loose, the problem is in the component or wiring.

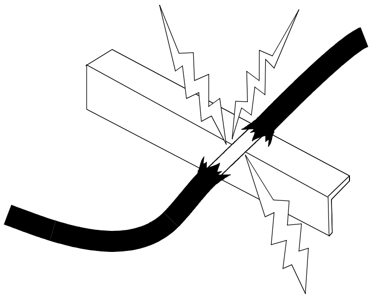


M85601



Grounded Circuit:

Grounded circuits usually result in no component operation or a blown fuse.



M85602

AIR PRESSURE SENSOR TEST—445

Reason:

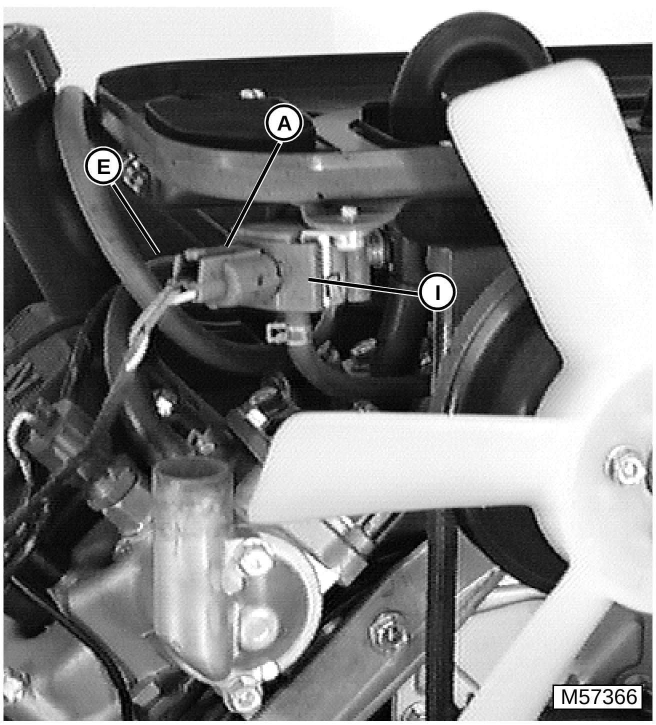
To verify air pressure sensor continuity and operation.

Equipment:

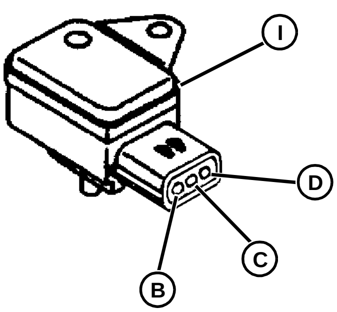
- Ohmmeter
- Voltmeter

Procedure:

1. Turn key switch to off position.

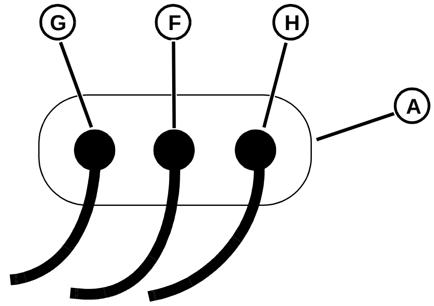


2. Disconnect air pressure sensor connector (A).



M57366a

3. Measure resistance between left (B), center (C), and right (D) terminals on (I) connector.
4. Connect air pressure sensor connector.
5. Disconnect air pressure sensor hose (E).
6. Turn key switch to on position.



7. Connect voltmeter negative lead to air pressure sensor (A) black wire terminal (F). Connect meter positive lead to red/blu wire terminal (G). Measure input voltage. Voltage should be about 5 volts.
8. Connect meter positive lead to wht/brn wire terminal (H). Measure output voltage. Voltage should be something less than 5 volts depending on air pressure.
9. Apply slight air pressure to sensor hose. Voltage should increase. Apply slight vacuum to hose and voltage should decrease.

Specifications:

Terminal resistance (Approximation):	
Left (B) and center (C)	**2986—3034 ohms**
Left (B) and right (D)	**773—787 ohms**
Center (C) and right (D)	**3774—3798 ohms**
Input voltage (G)	**about 5 volts**
Output voltage (H)	**0.5—4.9 volts depending on air pressure**

Results:

- If resistance does not meet specifications, check output voltage before replacing the air pressure sensor. The tested resistance values may vary from the specifications due to type of meter used or temperature.
- If the output voltage does not increase or decrease, replace the air pressure sensor.

AIR TEMPERATURE SENSOR TEST—445

Reason:

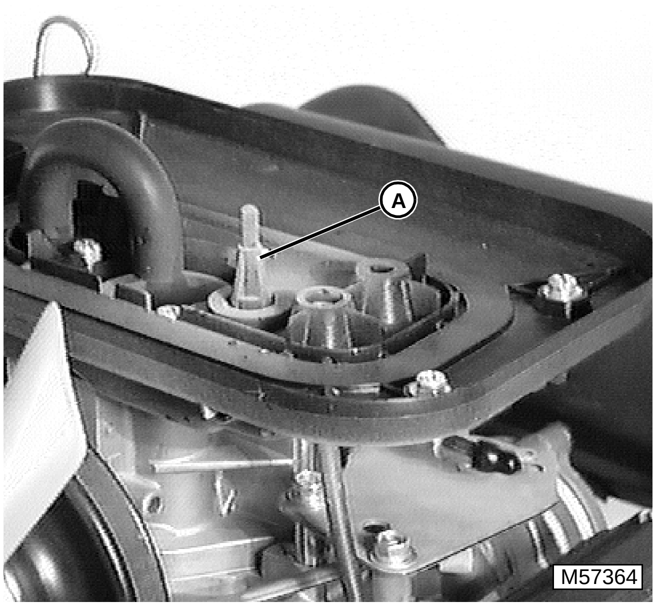
To verify air temperature sensor continuity.

Equipment:

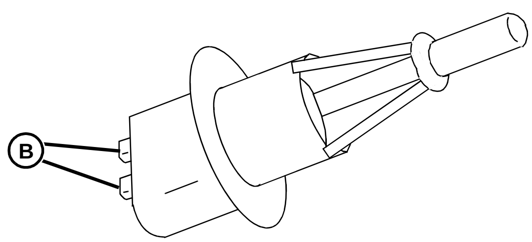
- Ohmmeter

Procedure:

1. Turn key switch to off position.



2. Disconnect air temperature sensor connector (A).



3. Measure resistance across air temperature sensor terminals (B).

Specifications:

Resistance at 20°C (68°F) . . . . . .2.21—2.69 k-ohms
Resistance at 0-30°C (32-86°F) . . 5.88—1.65 k-ohms

Results:

- If resistance does not meet specifications, replace the air temperature sensor. The tested resistance values may vary from the specifications due to type of meter used or temperature.

BATTERY TEST

CAUTION

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into the eyes.
Avoid the hazard by:

1. **Filling batteries in a well-ventilated area.**
2. **Wearing eye protection and rubber gloves.**
3. **Avoiding breathing fumes when electrolyte is added.**
4. **Avoid spilling or dripping electrolyte.**
5. **Use proper jumpstart procedure.**

If you spill acid on yourself:

1. **Flush your skin with water.**
2. **Apply baking soda or lime to help neutralize the acid.**
3. **Flush your eyes with water for 10—15 minutes. Get medical attention immediately.**

If acid is swallowed:

1. **Drink large amounts of water or milk.**
2. **Then drink milk of magnesia, beaten eggs, or vegetable oil.**
3. **Get medical attention immediately.**

Reason:

To check condition of battery and determine battery voltage.

Equipment:

- Hydrometer
- Voltmeter or JTO5685 Battery Tester

Procedure:

1. Park machine on level surface.
2. Turn key switch off.
3. Engage parking brake.
4. Clean cable ends, battery terminals and top of battery.
5. Remove battery to workbench.
6. Inspect battery terminals and case for breakage or cracks.
7. Check electrolyte level in each battery cell. Add clean, soft water as needed. If water was added, charge battery for **20 minutes at 10 amps**.

8. Remove surface charge by placing a small load on the battery for 15 seconds.
9. Check specific gravity of each cell with a hydrometer.
10. Check battery voltage with voltmeter or JTO5685 Battery Tester.

Specifications:

Minimum specific gravity . . . . 1.225 with less than 50 point variation
Minimum battery voltage . . . . 12.4 volts

Results:

- Battery voltage less than 12.4 VDC, charge battery.
- Battery voltage more than 12.4 VDC, test specific gravity.
- All cells less than 1.175, charge battery at 10 amp rate.
- All cells less than 1.225 with less than 50 point variation, charge battery at 10 amp rate.
- All cells more than 1.225 with less than 50 point variation, load test battery.
- More than 50 point variation: replace battery.

BATTERY CHARGING

Reason:

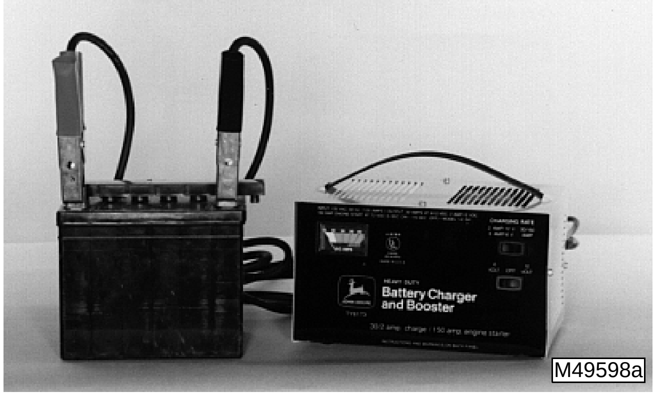
To increase battery charge after battery has been discharged.

Equipment:

Battery charger (variable rate)

Procedure:

NOTE: *See BATTERY TEST in this section before charging battery.*



1. Connect variable rate charger to battery.

NOTE: *Maximum charge time at boost setting is 10 minutes. Allow additional 5 minutes for each 10 degrees below 70 degrees F.*

2. Start charger at slow rate. Increase charge rate one setting at a time.
3. Check charger ammeter after 1 minute at each setting. Maintain 10 amp charge rate. Use boost setting as necessary.
4. Check if battery is accepting a 10 amp charge after 10 minutes at boost setting.
   - Battery will not accept 10 amp charge after 10 minutes at boost setting: replace battery.
   - Battery is accepting 10 amp charge after 10 minutes at boost setting, and battery did not need water: go to steps 6 and 7.
   - Battery is accepting 10 amp charge after 10 minutes at boost setting, but battery did need water or all cells were below 1.175: go to steps 4 and 5.
5. Set charger at 15—25 amps.

IMPORTANT: Decrease charge rate if battery gases or bubbles excessively or becomes too warm to touch.

6. Check specific gravity after 30 minutes (60 minutes for maintenance-free battery).
   - More than 50 point variation between cells: replace battery.
   - Less than 50 point variation between cells: go to steps 6 and 7.

NOTE: *If battery was discharged at slow or unknown rate, charge at 10—15 amps for 6—12 hours. (Maintenance-free battery: 12—24 hours.) If battery was discharged at fast rate, charge at 20—25 amps for 2—4 hours. (Maintenance-free battery: 4—8 hours.)*

7. Continue charging battery until specific gravity is 1.230—1.265 points.
8. Load test battery.

BATTERY LOAD TEST

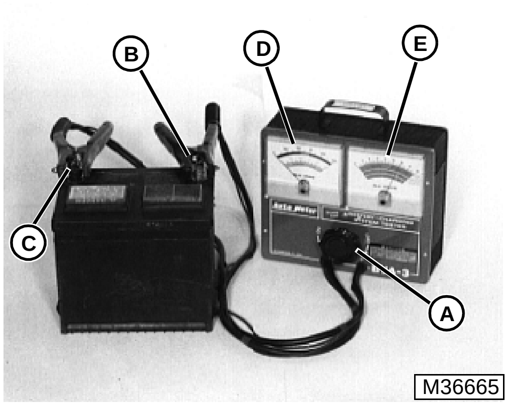
Reason:

To check condition of battery under load.

Equipment:

- JTO5685 Battery Tester

Connections:



1. Turn load knob (A) of tester counter-clockwise to off.
2. Connect tester positive cable (B) to battery positive terminal.
3. Connect tester negative cable (C) to battery negative terminal.

Procedure:

1. Turn load knob of tester clockwise until amperage reading (D) is equal to:

   A. Cold cranking amperage rating (use blue scale).

   OR

   B. Three times ampere-hour rating (use black scale).
2. Hold for 15 seconds and turn load knob of tester off.
3. Repeat procedure steps 1 and 2 from above and read condition of battery at DC volts scale (E).

Results:

If the battery does not pass the test and has not been charged, charge battery and retest. (See CHARGE BATTERY.) If the battery does not pass the test and has been charged, replace the battery.

BRAKE SWITCH TEST AND ADJUSTMENT

Reason:

To make sure the brake switch has continuity when the brake pedal is depressed.

Equipment:

- Ohmmeter

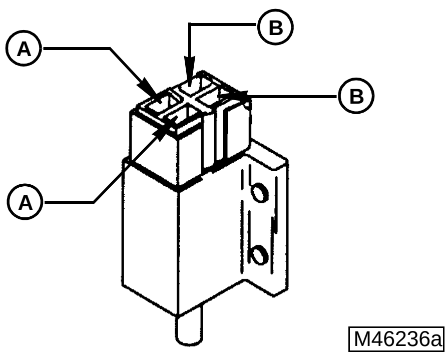
Connections:

1. Turn key switch off.
2. Depress brake pedal and engage park brake lock.

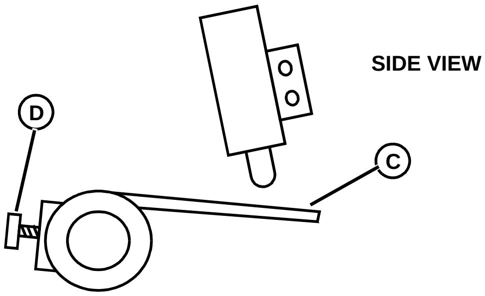
NOTE: *Brake switch is located on left side of frame under footrest.*

3. Remove footrest.
4. Disconnect brake switch connector.

Procedure:



1. Check continuity across terminals (A). Check continuity across terminals (B).



NOTE: *Be sure actuator (C) contacts switch plunger (plunger depressed) and not switch body.*

2. Release park brake pedal.
3. Check continuity across terminals. Be sure actuator does not contact switch plunger (plunger released).

Specifications:

Brake pedal depressed
(plunger depressed)
continuity between terminals . . . . (A) only
Brake pedal released
(plunger released)
continuity bebetween terminals . . . . (B) only

Results:

- If continuity is not correct, replace switch.
- If actuator position is not correct, loosen cap screw (D). Depress brake pedal and engage park brake lock. Rotate actuator (C) until the switch plunger is depressed, but not bottomed out. The actuator must not contact the switch body. Hold actuator in position and tighten cap screw.

COOLANT TEMPERATURE SENSOR TEST—445

Reason:

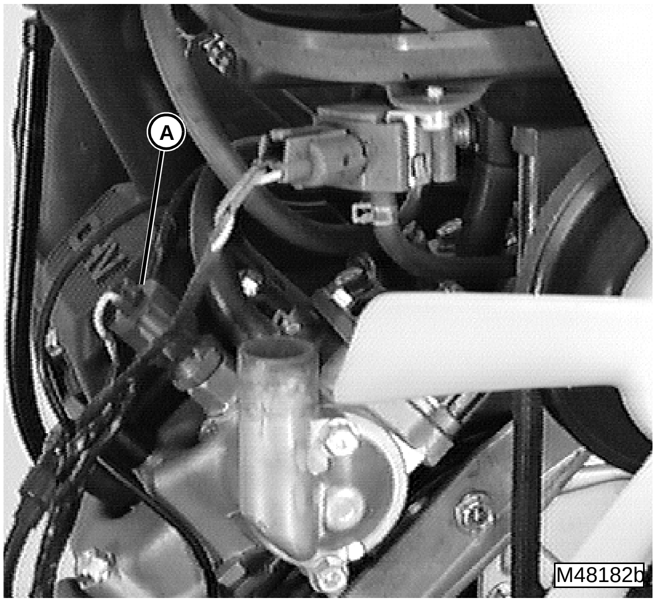
To verify coolant temperature sensor continuity.

Equipment:

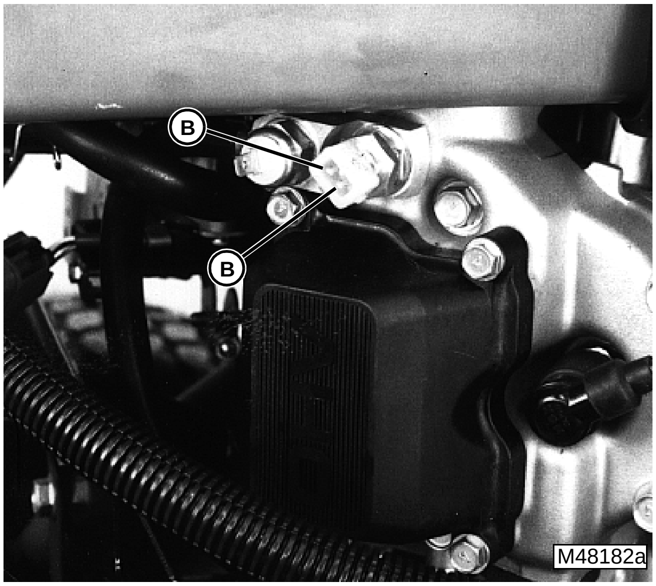
- Ohmmeter

Procedure:

1. Turn key switch to off position.



2. Disconnect coolant temperature sensor connector (A).



3. Measure resistance across coolant temperature sensor terminals (B).

Specifications:

Resistance at 20°C (68°F) . . . . . . 2.21—2.69 k-ohms
Resistance at 0-30°C (32-86°F) . . 5.88—1.65 k-ohms

Results:

- If resistance does not meet specifications, replace the coolant temperature sensor. The tested resistance values may vary from the specifications due to type of meter used or temperature.

CONTROL/FUSE MODULE TEST (S.N. —070000)

Reason:

To make sure the control/fuse module has input and output voltage at the correct terminals for proper operation. This test determines if the control/fuse module is defective or the input circuit is defective.

Equipment:

- Voltmeter
- Ohmmeter

Connections:

1. Put transmission in neutral. Engage park brake. Put PTO in off position.
2. Seat switch depressed or jumper wire installed in harness connector.
3. Put key switch in off position.
4. Connect meter negative (black) lead to battery negative terminal.

Procedure:

1. Check battery voltage.
2. Check fuses (A) to be sure they are not open.
3. Put meter positive (red) lead at terminals as indicated in the test table on the next page.
4. Check the terminals for input and output battery voltage or good ground.

Results:

- If terminal does not have input voltage or voltage is low, check proper circuit before the control/fuse module.
- If terminal does not have output voltage, replace the control/fuse module.

CONTROL/FUSE MODULE TEST TABLE (S.N. —070000)

Test/Check Point	Normal	If Not Normal
1. Terminal D—130 blk wire.	Maximum 0.1 ohms resistance.	Check battery negative cable and harness ground connection, and 100, 130 blk wires.

Test Conditions:

• Key switch in on position.

Test/Check Point	Normal	If Not Normal
2. Terminal 4—210 red wire	Battery voltage—input.	Check 215 red wire power circuit. 445—215 wire (grey) 455—215 wire (lt org)
3. Terminal 1—200 red wire, 277 red/blk (455 only).	Battery voltage—input.	Check 205 lt org wire power circuit.
4. Terminal 6—500 yel wire, 510 yel wire (455 only).	Battery voltage—output.	Check fuses, if ok, replace control/ fuse module.
5. Terminal F—705 pnk/blk wire.	Battery voltage—input.	Check neutral start circuit.
6. Terminal A—800 pnk wire.	Battery voltage—input.	Check seat switch circuit.
7. Terminal E—652 425—pnk/blk or blu wire. 445—blu 455—pnk/blu 455 (late models) —blu/blk	Battery voltage—output.	Replace control/fuse module.
8. Terminal 2—400 yel/blu wire.	Battery voltage—output.	Replace control/fuse module.

Test Conditions:

• Park brake disengaged.

Test/Check Point	Normal	If Not Normal
9. Terminal C—770 pur wire, 771 pur wire (455 only).	Battery voltage—input.	Check PTO relay engagement circuit.
10. Terminal 3—750, 751 blu wires.	Battery voltage—output.	Replace control/fuse module.

Test Conditions:

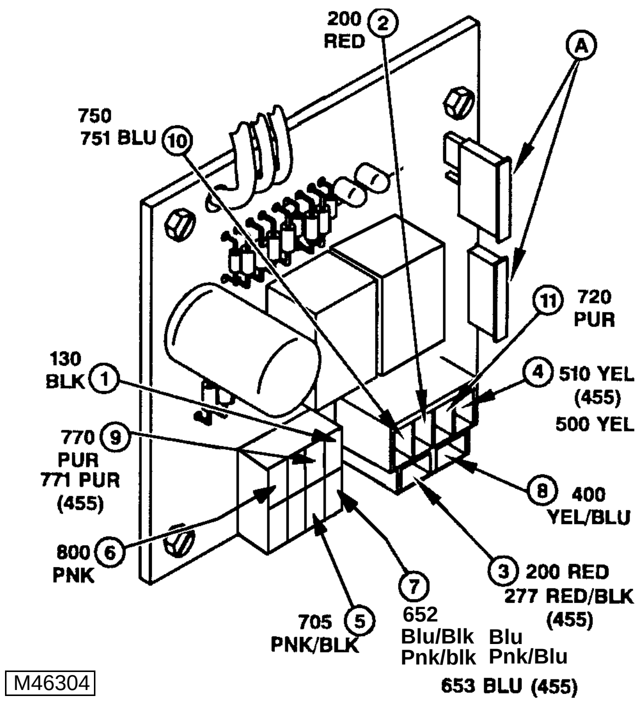
• Park brake engaged.

• Starting motor solenoid wire disconnected.

• Key switch in start position.

Test/Check Point	Normal	If Not Normal
11. Terminal 5—720 pur wire.	Battery voltage—output.	Replace control/fuse module.

CONTROL/FUSE MODULE TEST POINTS (S.N. —070000)



CONTROL/FUSE MODULE TEST (S.N. 070001—)

Reason:

To make sure the control/fuse module has input and output voltage at the correct terminals for proper operation. This test determines if the control/fuse module is defective or the input circuit is defective.

Equipment:

- Voltmeter
- Ohmmeter

Connections:

1. Put transmission in neutral. Engage park brake. Put PTO in off position.
2. Seat switch depressed or jumper wire installed in harness connector.
3. Put key switch in off position.
4. Connect meter negative (black) lead to battery negative terminal.

Procedure:

1. Check battery voltage.
2. Check fuses to be sure they are not open.
3. Put meter positive (red) lead at terminals as indicated in the test table.
4. Check the terminals for input and output battery voltage or good ground.

Results:

- If terminal does not have input voltage or voltage is low, check proper circuit before the control/fuse module.
- If terminal does not have output voltage, replace the control/fuse module.

CONTROL/FUSE MODULE TEST TABLE (S.N. 070001—)

Test Conditions:

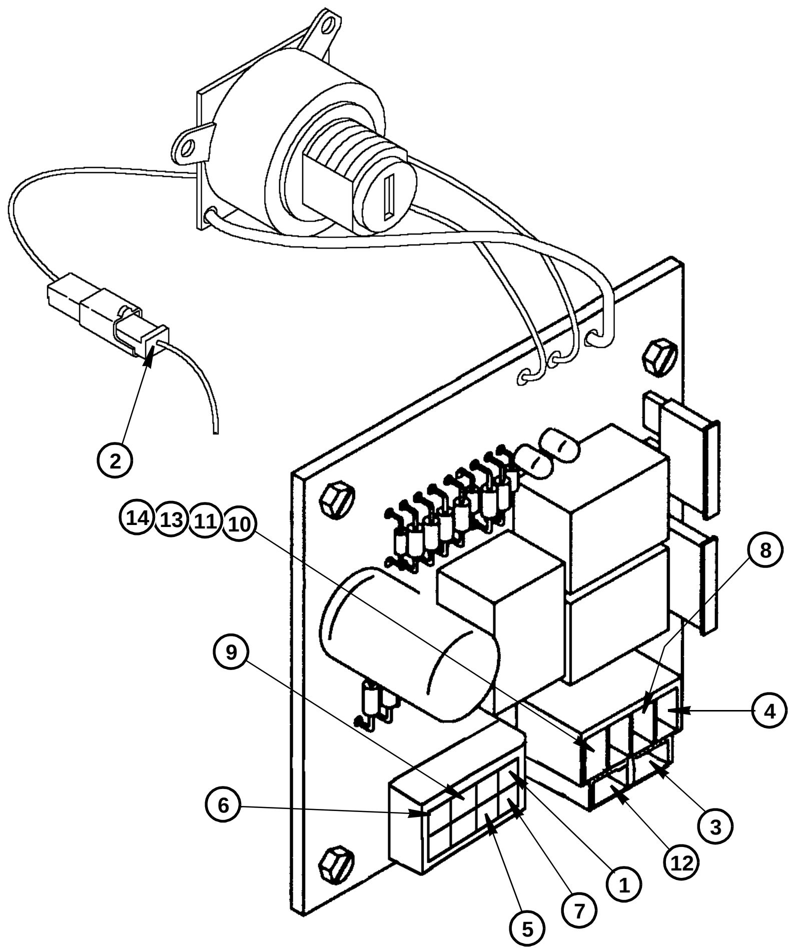
Test/Check Point	Normal	If Not Normal
1. Terminal D.	Maximum 0.1 ohms resistance.	Check battery negative cable and harness ground connection, and 100, 130 blk wires.

Test Conditions:

- Key switch in run position.

Test/Check Point	Normal	If Not Normal
2. Key switch power connector.	Battery voltage—input.	Check 200 red and 205 lt blu wires.
3. Terminal 2.	Battery voltage—output.	Check fuses, if ok, replace control/ fuse module.
4. Terminal 6.	Battery voltage—output.	Check fuses, if ok, replace control/ fuse module.
5. Terminal F.	Battery voltage—input.	Check cranking circuit test points.
6. Terminal A.	Battery voltage—input.	Check seat switch, 800 pnk, 502 yel and 500 yel wires.
7. Terminal E.	Battery voltage—output.	Replace control/fuse module.

CONTROL/FUSE MODULE TEST POINTS (S.N. 070001—)



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CONTROL/FUSE MODULE TEST TABLE (S.N. 070001—) (continued)

Test Conditions:

- Park brake disengaged.

Test/Check Point	Normal	If Not Normal
8. Terminal 4.	Battery voltage—input.	Check PTO circuit test points.
9. Terminal B.	Battery voltage—input.	Check RIO switch, 735 org and 772 blu wires.
10. Terminal 3.	Battery voltage—output.	Replace control/fuse module.

Test Conditions:

- PTO switch in ON position then put machine in reverse.

Test/Check Point	Normal	If Not Normal
11. Terminal 3.	0.0 volts—output.	Check PTO switch and RIO switch. If switches and wires are good, replace control/fuse module.

Test Conditions:

- Machine in forward then cycle the PTO switch to off and then to the RIP position.

Test/Check Point	Normal	If Not Normal
12. Terminal 1.	Battery voltage—input.	Check PTO switch, 730 grn and 754 blu wires.

Test Conditions:

- While holding PTO switch in RIP position, place machine in reverse then release PTO switch to the on position.

Test/Check Point	Normal	If Not Normal
13. Terminal 3.	Battery voltage—output.	Check PTO switch, 730 grn and 754 blu wires. If PTO switch and wires are good, replace control/fuse module.

CONTROL/FUSE MODULE TEST TABLE (S.N. 070001—) (continued)

Test Conditions:

- Place machine in forward and back to reverse.

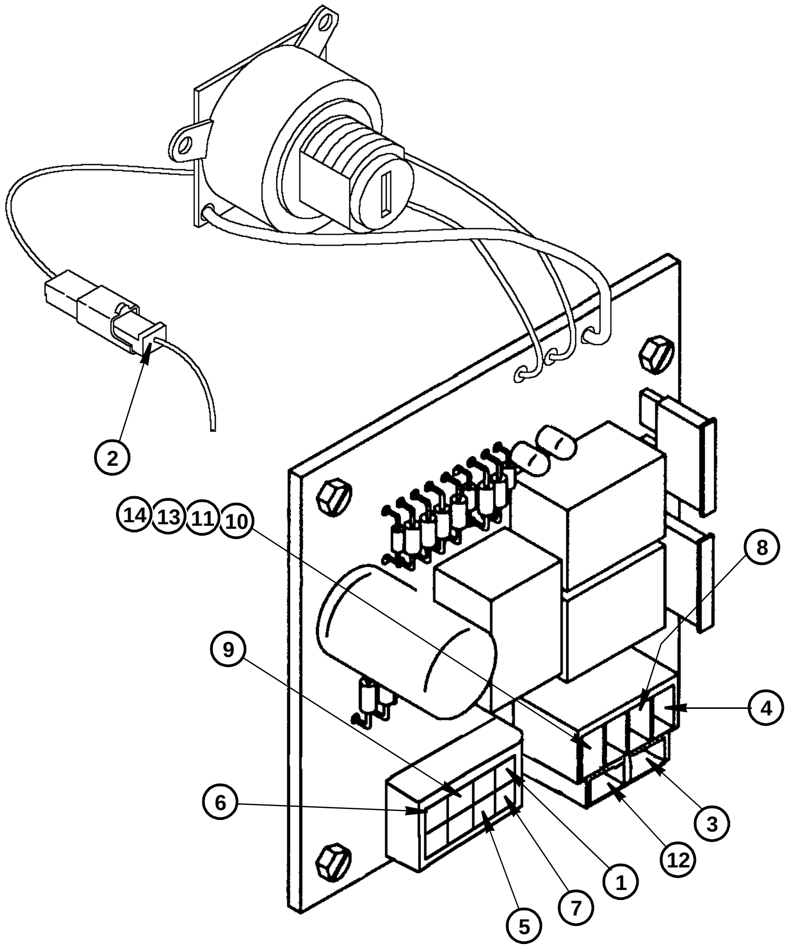
Test/Check Point	Normal	If Not Normal
14. Terminal 3.	0.0 volts—output.	Replace control/fuse module.

Test Conditions:

- Park brake engaged.
- PTO switch in off position.
- Starting motor solenoid wire disconnected.
- Key switch in start position.

Test/Check Point	Normal	If Not Normal
15. Terminal 5.	Battery voltage—output.	Replace control/fuse module.

CONTROL/FUSE MODULE TEST POINTS (S.N. 070001—)(continued)



M98233

DIESEL CONTROL MODULE TEST—455

Reason:

To make sure the diesel control module has input and output voltage at the correct terminals for proper operation. This test determines if the diesel control module is defective or the input circuit is defective.

Equipment:

- Voltmeter
- Ohmmeter

Connections:

1. Put transmission in neutral. Engage park brake. Put PTO in off position.
2. Seat switch depressed or jumper wire installed in harness connector.
3. Put key switch in off position.
4. Connect meter negative (black) lead to battery negative terminal.

Procedure:

1. Check battery voltage.
2. Check control/fuse module fuses to be sure they are not open.
3. Put meter positive (red) lead at terminals as indicated in the test table.
4. Check the terminals for input and output battery voltage or good ground.

Specifications:

Terminals must have input and output battery voltage or good ground as indicated.

Results:

- If terminal does not have input voltage or voltage is low, check proper circuit before the diesel control module.
- If terminal does not have output voltage, replace the diesel control module.

DIESEL CONTROL MODULE TEST TABLE

Test/Check Point	Normal	If Not Normal
1. Terminal 3—180 blk wire	Maximum 0.1 ohms resistance	Check battery negative cable and harness ground connection, 180, 100 blk wires.

Test Conditions:

• Key switch in on position

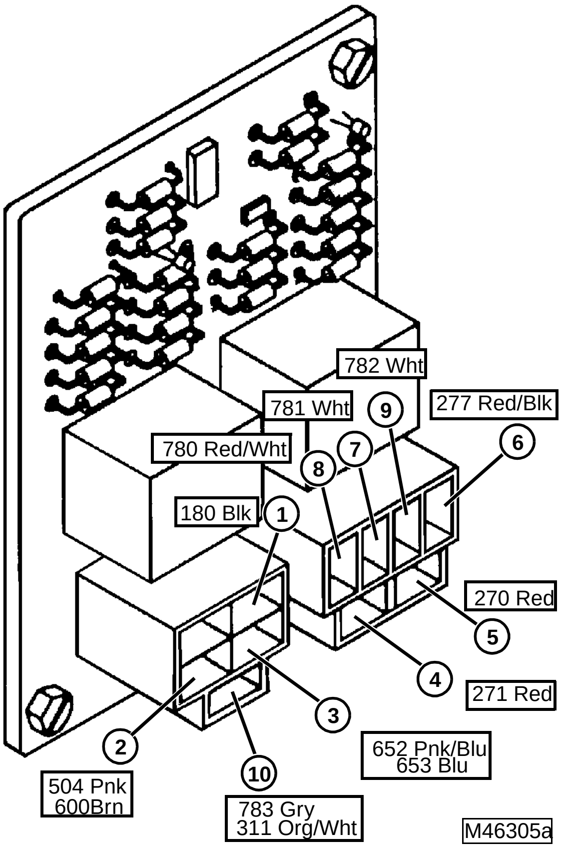
Test/Check Point	Normal	If Not Normal
2. Terminal 2—504 pnk wire, 600 brn wire.	Battery voltage—input.	Check control/fuse module power circuit.
3. Terminal 4 455—pnk/blu 455 (late models) —blu/blk 653 blu wire	Battery voltage—input.	Check fuel shutoff solenoid relay hold-in circuit.
4. Terminal 1—271 red wire.	Battery voltage—input.	Check 272 red wire power circuit.
5. Terminal 2—270 red wire.	Battery voltage—input.	Check 272 red wire power circuit.
6. Terminal 3—277 red wire.	Battery voltage—input.	Check 200, 205 lt org wire power circuit.

Test Conditions:

• Turn key switch off, then on repeatedly when testing steps 7-10.

Test/Check Point	Normal	If Not Normal
7. Terminal 5—781 red/wht wire.	Battery voltage for up to 45 seconds—output.	Replace diesel control module.
8. Terminal 6—780 red/wht wire.	Battery voltage for up to 45 seconds—output.	Replace diesel control module.
9. Terminal 4—782 wht wire.	Battery voltage for 1 second—output.	Replace diesel control module.
10. Terminal 5—783 gry 311 wire, org/wht wire.	Voltage greater than 0 but less than 1 volt for up to 20 seconds-input.	Greater than 1 volt-replace diesel control module.

DIESEL CONTROL MODULE TEST POINTS



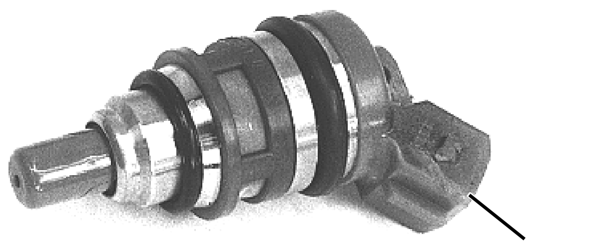
FUEL INJECTOR TEST—445

Reason:

To verify fuel injector continuity and operation.

Equipment:

- Ohmmeter



M48181

Procedure:

1. Turn key switch to off position.
2. Disconnect fuel injector connector.
3. Measure resistance across fuel injector terminals.
4. Connect a jumper wire from battery negative terminal to fuel injector terminal. Briefly and repeatedly connect a jumper wire from battery positive terminal to the other fuel injector terminal. The fuel injector must click each time the jumper wire contacts the terminal.

Specifications:

Resistance at 20° C(68° F). . . . . 13.8 ohms

Results:

- If resistance does not meet specifications, check fuel injector operation before replacing the fuel injector. The tested resistance values may vary from the specifications due to type of meter used or temperature.
- If the fuel injector does not click, replace the fuel injector.

FUEL INJECTION MODULE TEST—445

Reason:

To determine if fuel injection module is defective.

Procedure:

The fuel injection module (A) is very sensitive to the type of meter used to check resistance. Due to variations in the meters, the best way to determine if the fuel injection module is good is to replace the questionable fuel injection module with a known good module.

M57157

Results:

- If the new fuel injection module does not solve the problem, check the other fuel injection components.

FUEL SHUT-OFF SOLENOID AMPERAGE TEST—455

Reason:

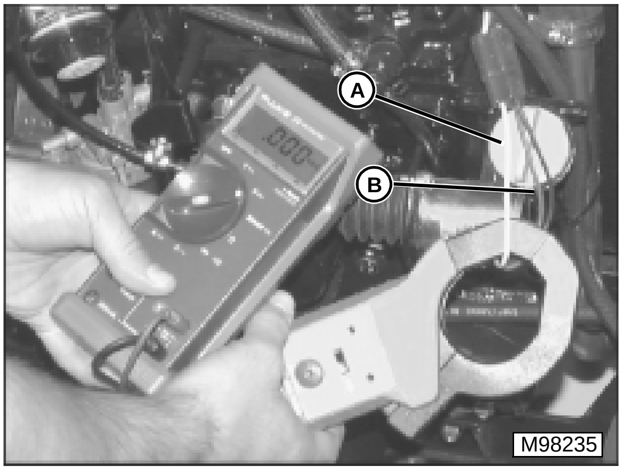
To test condition of fuel shut-off solenoid windings and check for fuel pump linkage binding creating excessive current draw.

Equipment:

- JT05712 Current Gun

Connections:

1. Put transmission in neutral. Engage park brake. Put key switch in off position. Put PTO switch in off position.
2. Test system ground connections and battery.
3. Perform circuit tests to ensure voltage at solenoid.



4. Attach current gun to pull-in (white) wire (A) of fuel shutoff solenoid.
5. Set current gun for DC current.

Procedure:

1. Turn key switch on and measure pull-in amperage.
2. Move current gun to hold-in (red) wire (B) and measure amperage.

Specification:

Pull-In Amperage . . . 50 amps (max) for 1/2 second
Hold-In Amperage . . . . 1 amp (max) continuous

Results:

- If readings do not meet specifications check for binding linkage and adjust as needed or replace solenoid.

FUEL TANK SENSOR TEST

Reason:

To make sure the fuel tank sensor resistance changes as the float is raised or lowered.

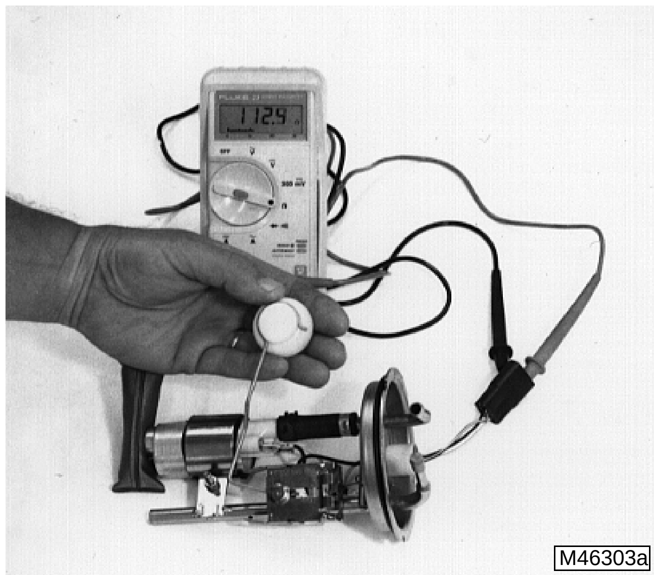
Equipment:

- Ohmmeter

Connections:

1. Engage park brake.
2. Put key switch in the off position.
3. Remove fender deck.
4. Disconnect fuel tank sensor connector.
5. Remove fuel tank sensor.

Procedure:



1. Measure resistance across fuel tank sensor terminals with black and black/white wires (A).
2. Move sensor float arm up and down.
3. Meter must show resistance increase and decrease as float moves up and down. Resistance is the lowest when the float is in the lowest (empty) position.

Specifications:

Fuel tank sensor resistance . . . . 6—200 ohms

Results:

If the resistance does not change or does not meet the specifications, replace the fuel tank sensor.

TESTS AND ADJUSTMENTS

GLOW PLUGS TEST—455

Reason:

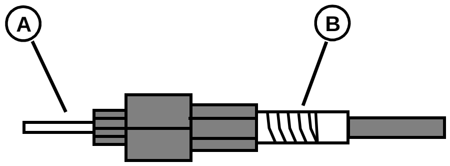
To test operation of glow plugs.

Equipment:

• Ohmmeter

Procedure:

1. Put key switch in off position. Engage park brake.
2. Disconnect glow plug lead. Remove glow plug.



3. Check continuity across terminal (A) and glow plug body (B).

Specification:

Glow plug resistance . . . . 0.70—1.65 ohms

Results:

- If glow plug does not have proper resistance, replace glow plug.

GROUND CIRCUIT TEST—425 and 445

Reason:

To check for opens, loose terminal wire crimps, poor connections, or corrosion in the ground circuit. The voltmeter method checks ground connections under load.

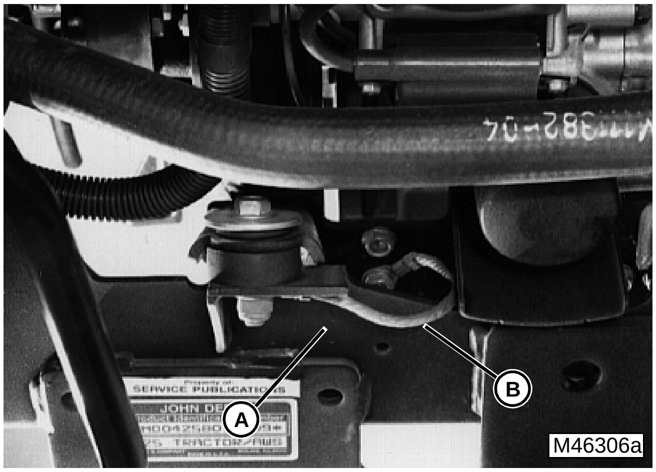
Equipment:

• Ohmmeter or voltmeter

IMPORTANT: Negative ground cable to tractor frame must not be corroded or loose.

Procedure:

OHMMETER METHOD:

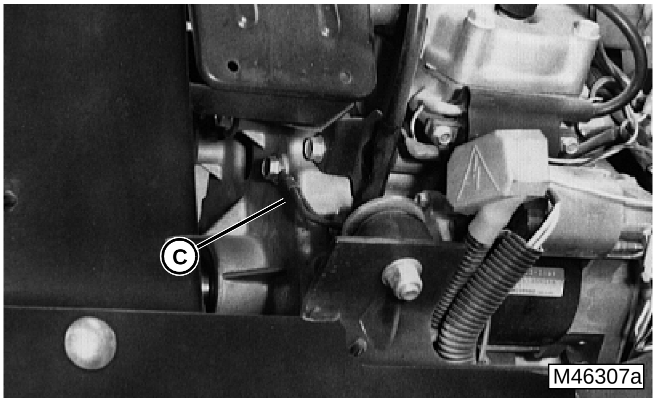


(A)—Battery negative terminal to engine ground.

(B)—Engine to frame ground.

1. Turn key switch to off position. Engage park brake.
2. Connect ohmmeter negative (black) lead to negative terminal of battery. Put meter positive (red) lead on negative terminal of battery and record reading.
3. Put meter red lead on ground terminal of circuit or component to be tested that is closest to the battery negative terminal. Resistance reading must be very close to or the same as the battery negative terminal reading. Work backwards from the battery on the ground side of the problem circuit until the resistance reading increases above 0.1 ohms. The problem is between the last two test points. If a problem is indicated, disconnect the wiring harness connector to isolate the wire or component and check resistance again. Maximum allowable resistance in the circuit is 0.1 ohms. Check both sides of connectors closely as disconnecting and connecting may temporarily solve problem.

VOLTMETER METHOD:



(C)—Wiring harness to engine ground.

1. Put transmission in neutral. Engage park brake. Put PTO switch in off position. Turn key switch to on position.
2. Connect voltmeter negative (black) lead to negative terminal of battery.
3. Put meter positive (red) lead on ground terminal of component to be tested. Be sure the component circuit is activated (key on, switches closed) so voltage will be present at the component. Record voltage. Voltage must be greater than 0 but less than 1 volt. Some components will have a very small voltage reading on the ground side and still be operating correctly.

Results:

- If resistance is above 0.1 ohms, check for open wiring, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.
- If voltage is 0.0, the component is open.
- If voltage is greater than 1.0 volt, the ground circuit is bad. Check for open wiring, loose terminal wire crimps, poor connections, and corrosion in the ground circuit.

GROUND CIRCUIT TEST—455

Reason:

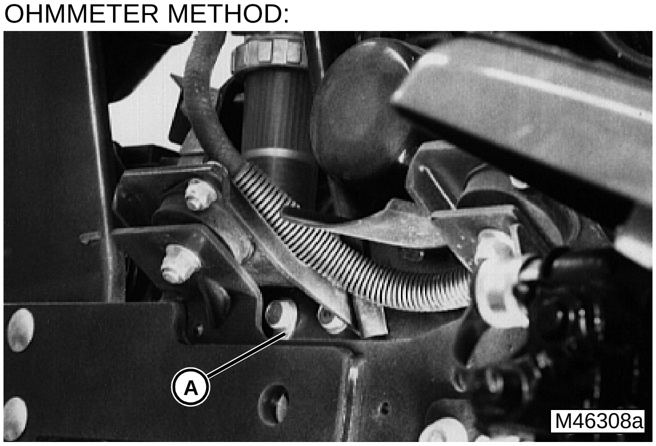
To check for opens, loose terminal wire crimps, poor connections, or corrosion in the ground circuit. The voltmeter method checks ground connections under load.

Equipment:

- Ohmmeter or voltmeter

Procedure:

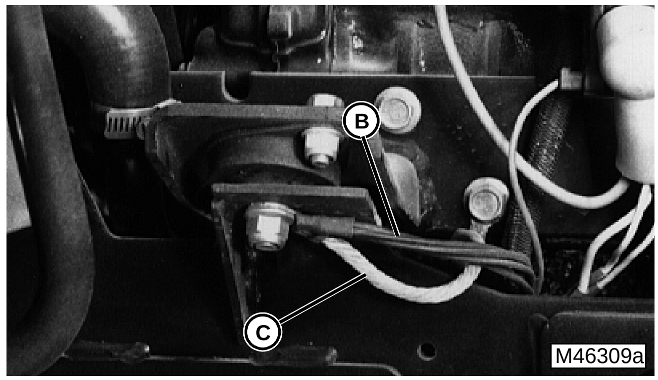
OHMMETER METHOD:



(A)—Battery negative terminal to engine ground.

1. Turn key switch to off position. Engage park brake.
2. Connect ohmmeter negative (black) lead to negative terminal of battery. Put meter positive (red) lead on negative terminal of battery and record reading.
3. Put meter red lead on ground terminal of circuit or component to be tested that is closest to the battery negative terminal. Resistance reading must be very close to or the same as the battery negative terminal reading. Work backwards from the battery on the ground side of the problem circuit until the resistance reading increases above 0.1 ohms. The problem is between the last two test points. If a problem is indicated, disconnect the wiring harness connector to isolate the wire or component and check resistance again. Maximum allowable resistance in the circuit is 0.1 ohms. Check both sides of connectors closely, as disconnecting and connecting may temporarily solve the problem.

VOLTMETER METHOD:



(B)—Wiring harness to frame ground.

(C)—Engine to frame ground.

1. Put transmission in neutral. Engage park brake. Put PTO switch in off position. Turn key switch to on position.
2. Connect voltmeter negative (black) lead to negative terminal of battery.
3. Put meter positive (red) lead on ground terminal of component to be tested. Be sure the component circuit is activated (key on, switches closed) so voltage will be present at the component. Record voltage. Voltage must be greater than 0 but less than 1 volt. Some components will have a very small voltage reading on the ground side and still be operating correctly.

Results:

- If resistance is above 0.1 ohms, check for open wiring, loose terminal wire crimps, poor connections, and corrosion in the ground circuit.
- If voltage is 0.0, the component is open.
- If voltage is greater than 1 volt, the ground circuit is bad. Check for open wiring, loose terminal wire crimps, poor connections, or corrosion in the ground circuit. Battery cable grounding bolt should be tightened to **61—81 N•m (45—60 lb-ft)**. Do not use a star washer or float washer under grounding cable. Neither will give good contact to block surface over a long period of time due to corrosion from minerals in water from washing and electrical contact corrosion.

LIGHTS SWITCH TEST

Reason:

To make sure the lights switch terminals have continuity when the lights switch is on.

Equipment:

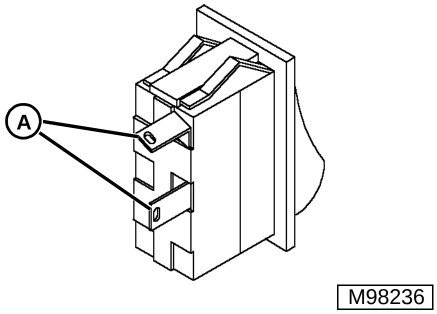
• Ohmmeter or continuity tester

Connections:

1. Put transmission in neutral. Engage park brake.
2. Put key switch in off position.
3. Disconnect lights switch connector.

Procedure:

1. Move lights switch to the on position.



2. Check continuity across switch terminals (A). Terminals should have continuity.
3. Move lights switch to the off position. Terminals should not have/continuity.

Specifications:

Terminals should have continuity only when the switch is on.

Results:

• If continuity is not correct, replace lights switch.

IGNITION COIL TEST

Reason:

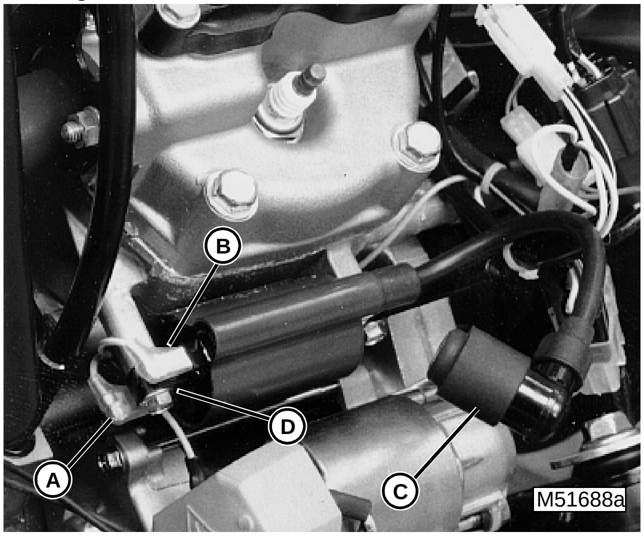
To determine condition of ignition coil windings.

Equipment:

• Ohmmeter

Procedure:

1. Put transmission in neutral. Put key switch in off position.
2. Remove spark plug cap from spark plug wire.
3. Disconnect wires from ignition coil positive and negative terminals.



4. Measure primary coil resistance between positive (wide) terminal (A) and negative (narrow) terminal (B).
5. Measure secondary coil resistance between positive terminal (A) and spark plug wire (C).
6. Remove coating from core at meter probe test point. Measure core insulation resistance between positive terminal (A) and core (D) and also between spark plug wire (C) and core (D).

Specifications:

Primary coil resistance . . . . 3.4—4.6 ohms
Secondary coil resistance. . . . . . 10.4—15.5 k-ohms
Core insulation resistance . . infinite (no continuity)

Results:

• If resistance does not meet specifications, replace the ignition coil.

OIL PRESSURE SENSOR SWITCH TEST

Reason:

Determine the proper operation of the oil pressure sensor switch.

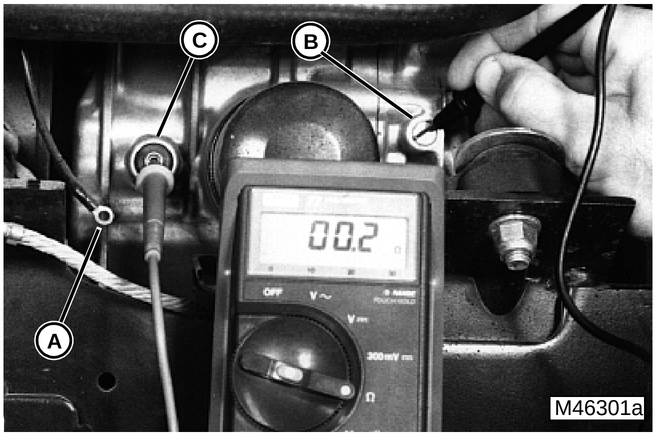
Equipment:

• Ohmmeter

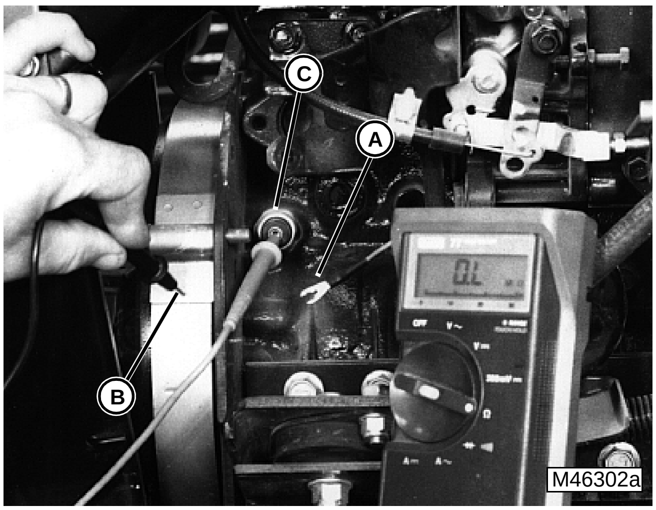
Connections:

NOTE: On 3TNA72UJ Engine, fuel filter removed for clarity of photo.

1. Set ohmmeter for 1x ohms scale.



FD620D Engine



3TNA72UJ Engine

2. Remove wire (A) from sensor switch.

IMPORTANT: Do not allow connector of wire to contact the engine or frame as there will be voltage at it during the test.

3. Connect black lead of meter to engine block (B).
4. Connect red lead of meter to terminal (C) of sensor switch.

Procedure:

1. Read meter.
2. Start and run engine.
3. Read meter.

Specifications:

With engine NOT running . . . . continuity to ground
With engine running . . . . . no continuity to ground

Results:

- If the switch does not have continuity to ground when the engine is not running, replace the switch.
- If the switch does have continuity to ground with the engine running, check engine oil pressure (see Oil Pressure Test). If the oil pressure is to specifications, replace the switch.

PTO SWITCH TEST (S.N. —070000)

Reason:

To make sure terminal continuity is correct in the on and off positions.

Equipment:

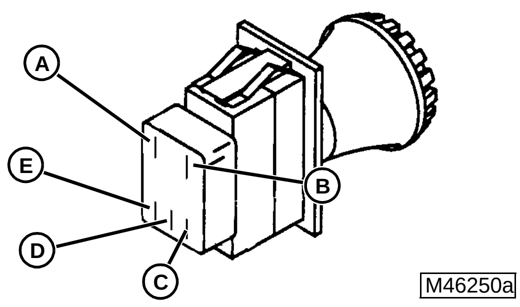
- Ohmmeter

Connections:

1. Put transmission in neutral.
2. Engage park brake.
3. Put key switch in off position.
4. Disconnect PTO switch connector.

Procedure:

1. Put PTO switch in the off position.



2. Check continuity between terminals (A and B) and (C and E). Check continuity between terminals (D and E).
3. Move PTO switch to the on position. Check continuity between terminals (A and B) and (C and E). Check continuity between terminals (D and E).

Specifications, PTO switch OFF:

Continuity between terminals . . . . (A and B) and (C and E) only

Specifications, PTO switch ON

Continuity between terminals . . . . . . (D and E) only

Results:

If continuity is not correct, replace PTO switch.

PTO SWITCH TEST (S.N. 070001—)

Reason:

To make sure terminal continuity is correct in the on, off and RIP positions.

Equipment:

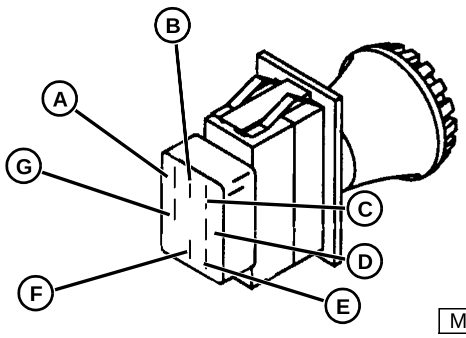
- Ohmmeter

Connections:

1. Put transmission in neutral.
2. Engage park brake.
3. Put key switch in off position.
4. Disconnect PTO switch connector.

Procedure:

1. Put PTO switch in the off position.



M98234

2. Check continuity between terminals (A and C) and (B and C).
3. Check continuity between terminals (D and G).
4. Check continuity between terminals (E and F).

Specifications, PTO Switch Off:

Continuity between terminals . . . . (A and C) (D and G)
No continuity between terminals . . . . (A and B) (E and F)

5. Move PTO switch to the on position.
6. Check continuity between terminals (A and C) and (B and C).
7. Check continuity between terminals (D and G).
8. Check continuity between terminals (E and F).

Specifications, PTO Switch On:

Continuity between terminals . . . . . . (B and C) only
No continuity between terminals . . . . (A and C) (D and G) (E and F)

9. Move PTO switch to the RIP position.
10. Check continuity between terminals (A and C) and (B and C).
11. Check continuity between terminals (D and G).
12. Check continuity between terminals (E and F).

Specifications, PTO Switch RIP:

Continuity between terminals . . . . (B and C) . . . . (E and F)
No Continuity between terminals . . . . (A and C) . . . . (D and G)

Results:

If continuity is not correct, replace PTO switch.

PULSER COIL TEST

Reason:

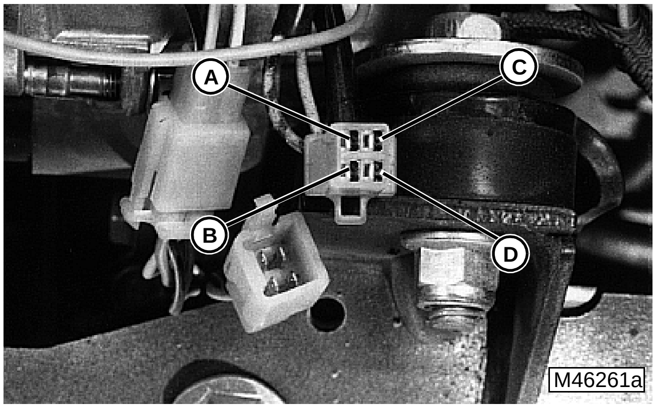
To determine condition of pulser coil windings and verify pulser coil wire continuity.

Equipment:

- Ohmmeter

Procedure: 425—only

1. Turn key switch to off position.



M46261a

2. Disconnect 4-pin pulser connector.
3. Measure resistance between white/blue wire (A) and pink wire (B), then green/white wire (C) and yellow wire (D) at pulser side of connector.

Specifications:

Pulser coil resistance . . . . 85—270 ohms

Results:

If resistance does not meet specifications, replace the pulser coil.

445—only

1. Turn key switch to off position.
2. Disconnect 2-pin pulser connector (not depicted).
3. Measure resistance between green wire and blue wire at pulser side of connector.

Specifications:

Pulser coil resistance . . . . 190—290 ohms

Results:

If resistance does not meet specifications, check pulser coil for voltage output before replacing the pulser coil (see Ignition Circuit Test Points). The tested resistance values may vary from the specifications due to type of meter used or temperature.

REGULATED AMPERAGE TEST—455

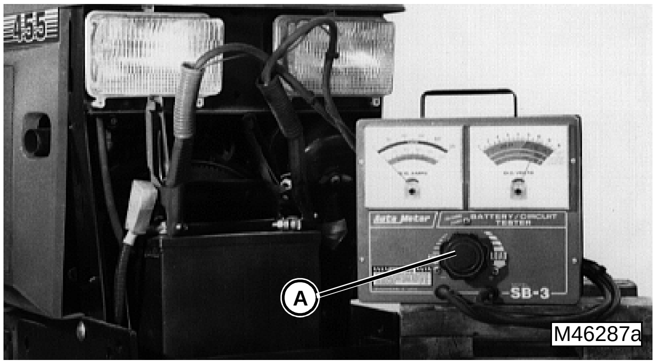
Reason:

To determine regulated charging output of alternator.

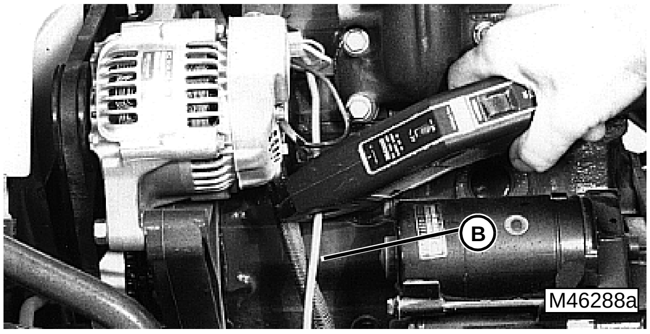
Equipment:

- JTO5712 Current Gun
- JTO5685 Battery Tester

Procedure:



1. Turn load knob (A) of JTO5685 Battery Tester fully out (counterclockwise) before connecting to battery. Connect Battery Tester to battery.



2. Put JTO5712 Current Gun over alternator red wire (B). Set Current Gun for DC current.

IMPORTANT: Perform this test quickly to prevent damage to battery tester. DO NOT apply full load to battery for more than 10 seconds.

3. Start and run engine at full throttle.
4. Turn load knob in until voltage scale is 11 volts and read amperage on current gun.

Specifications:

Minimum regulated amperage . . . . 35 amps
Engine speed . . . . .3350 rpm

Results:

- If reading does not meet specifications, verify voltage at the alternator regulator terminal and good alternator ground. If voltage and ground are ok, test unregulated amperage output in this section to determine if alternator or voltage regulator is defective.

REGULATED VOLTAGE TEST—455

Reason:

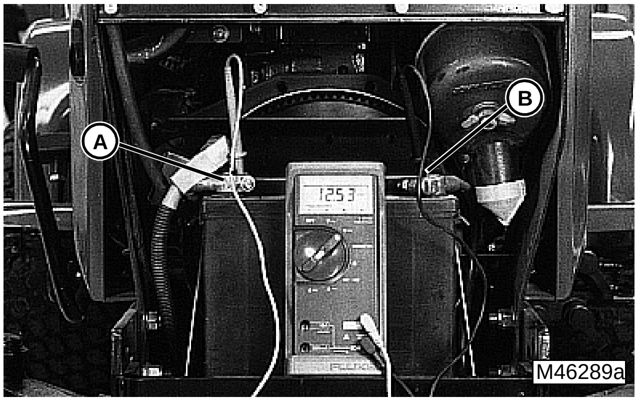
To determine regulated voltage output of the alternator regulator.

Equipment:

- Voltmeter

Connections:

1. Remove surface charge from battery by placing a small load on the battery for 15 seconds.
2. Set voltmeter to DC volts scale.



3. Connect meter red lead (A) to positive battery terminal.
4. Connect meter black lead (B) to negative battery terminal.

Procedure:

1. Start and run engine at 3350 rpm.
2. Read meter several times during 5 minutes of running time.

IMPORTANT: Do not allow the battery voltage to exceed 15.5 volts or the battery and charging system will be damaged.

Specifications:

Regulated voltage . . . . 12.2—14.7 VDC at 3350 rpm

Results:

- If the DC voltage stays below the minimum specification, verify voltage at the alternator regulator terminal and good alternator ground. If voltage and ground are ok, test Unregulated Amperage Output in this section to determine if alternator or voltage regulator is defective. If the DC voltage goes above the maximum specification, replace the regulator.

UNREGULATED AMPERAGE TEST—455

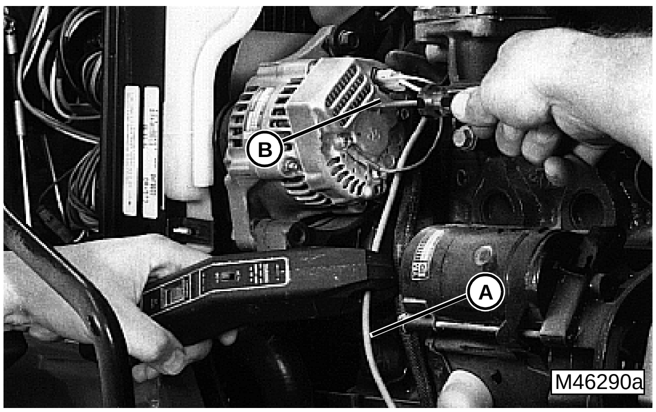
Reason:

To determine charging output of the alternator stator.

Equipment:

- JTO5712 Current Gun

Connections:



1. Put JTO5712 Current Gun over alternator red wire (A). Set Current Gun for DC current.

IMPORTANT: Perform this test quickly to prevent damage to battery. DO NOT apply full load to battery for more than 10 seconds.

1. Start and run engine at full throttle.
2. Insert a Phillips screwdriver through hole (B) in rear cover of alternator to ground the regulator to the rear cover. Read amperage on current gun.

Specifications:

Minimum unregulated amperage . . . . 35 amps
Engine speed . . . . .3350 rpm

Results:

- If reading does not meet specifications, verify voltage at the alternator regulator terminal and good alternator ground. If voltage and ground are ok, replace the alternator. If reading meets the specification, replace the regulator.

RELAY TEST

Reason:

To check relay terminal continuity in the energized and de-energized condition.

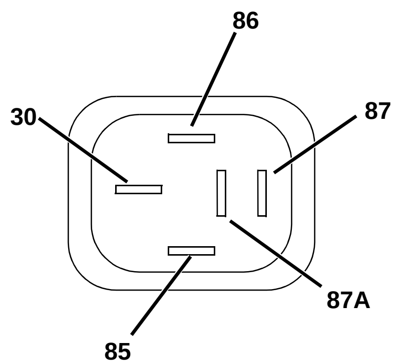
Equipment:

- Ohmmeter

Connections:

1. Put transmission in neutral. Engage park brake.
2. Turn key switch to off position.
3. Disconnect relay connector.

Procedure:



1. There should be continuity between terminals 87A and 30, and 85 and 86.
2. There should not be continuity between terminals 87 and 30.
3. Connect a jumper wire from battery positive (+) terminal to relay terminal 85. Connect a jumper wire from relay terminal 86 to ground (–).
4. There should be continuity between terminals 87 and 30.

Results:

- If continuity is not correct, replace relay.

SEAT SWITCH TEST

Reason:

To make sure the seat switch terminals have continuity when the operator is on the seat (plunger depressed).

Equipment:

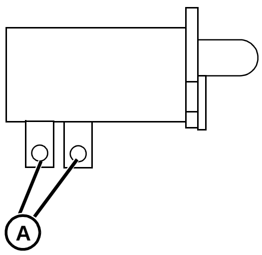
- Ohmmeter

Connections:

1. Put transmission in neutral. Engage park brake.
2. Put key switch in the off position.
3. Disconnect seat switch connector.

Procedure:

1. Depress the seat switch plunger.



2. Check continuity across seat switch connector terminals (A). There should be continuity.
3. Release the seat switch plunger.
4. Check continuity across connector terminals. There should not be continuity.

Specifications:

Seat switch plunger depressed . . . . continuity
Seat switch plunger released . . . . no continuity

Results:

- If the seat switch does not have continuity with the operator on the seat, check the seat switch bracket and spring for damage.
- If the seat switch does not have continuity with the plunger depressed, replace the switch.

STARTING MOTOR SYSTEM TEST

Test Conditions

• Known good battery.

Test/Check Point	Normal	If Not Normal
1. Starter solenoid (Solenoid does not click).	Solenoid clicks when key is in start position.	See cranking and neutral start circuits. Check wire connections at battery, solenoid switch terminals of solenoid and ground circuit (see ground circuit test). Check solenoid, starting motor and engine to battery ground. Faulty solenoid—test and replace.
2. Starter (Solenoid clicks but starter does not rotate).	Starter motor should crank engine.	Disconnect all external drives. Rotate engine by hand to check for seized engine. Check starter solenoid to starting motor connection. Remove and test starter motor.
3. Starting motor (Starting motor rotates but engine does not crank).	Engine cranking.	Worn pinion or ring gear. Replace Incorrect starting motor alignment or starting motor drive cover broken. Faulty starting motor drive clutch. Replace.

Test Conditions

• Engine will not crank.

Test/Check Point	Normal	If Not Normal
4. Starting motor (Solenoid clicks but starting motor does not rotate).	Starting motor should crank engine.	Disconnect all external drives. Rotate engine by hand to check for seized engine. Check starter solenoid to starter motor connection. Remove and test starter motor.
5. Starting motor (Starter rotates but engine does not crank).	Engine cranking.	Worn pinion or ring gear. Replace Incorrect starting motor alignment or starting motor drive cover broken. Faulty starting motor drive clutch. Replace.

Test Conditions

• Engine cranks slow.

Test/Check Point	Normal	If Not Normal
6. Starting motor.	Engine cranking at a minimum of 250 rpm.	Check solenoid to motor connection. Test or repair starting motor. Engine seizing. Repair engine.

Test Conditions

- Starter does not disengage.

Test/Check Point	Normal	If Not Normal
7. Starting motor drive (starting motor continues to run).	Disengages when key is returned to run.	Faulty ignition switch. Replace faulty solenoid.
8. Starting motor drive (starting motor disengages).	Retracts when motor disengages.	Faulty pinion and ring gear. Starter shift fork binding.
9. Engine cranking speed good but will not start.	Starts and runs with no performance complaints.	Continue testing.

STARTING MOTOR CONDITION

1. The starting motor overheats because of:
- Long cranking.
- Armature binding.
2. The starting motor operates poorly because of:
- Armature binding.
- Dirty or damaged starter drive.
- Badly worn brushes or weak brush springs.
- Excessive voltage drop in cranking system.
- Battery or wiring defective.
- Shorts, opens, or grounds in armature.

NOTE: Starting motor repair is limited to brushes, end caps, and starter drive. Fields in starting motor are permanent magnets and are not serviceable. If housing or armature is damaged, replace starting motor.

STARTER SOLENOID TEST

Reason:

To determine if starter solenoid or starting motor is defective.

Equipment:

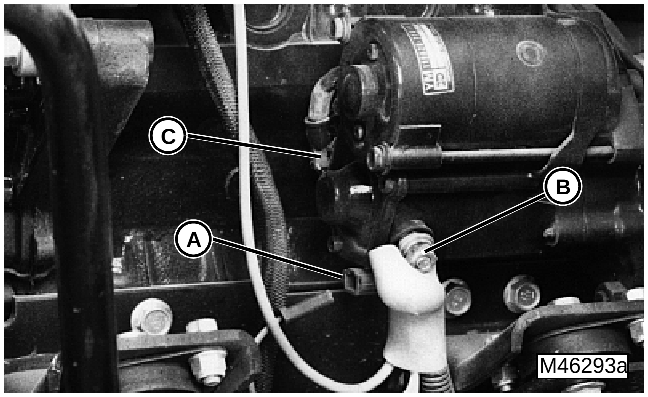
- Jumper wire

Connections:

425 and 445—

1. Put transmission in neutral. Engage park brake. Move key switch to off position.
2. Disconnect and ground spark plug leads.
3. Disconnect red wire from starter solenoid lead.

455—



1. Put transmission in neutral. Engage park brake. Move key switch to off position. Put PTO switch in off position.
2. Disconnect fuel shutoff solenoid connector.
3. Disconnect purple wire from starter solenoid lead.

Procedure:

1. Connect jumper wire to positive battery terminal and briefly jump to starter solenoid terminal (A).
- Starting motor runs: solenoid is good, check circuit wiring. (See CRANKING CIRCUIT DIAGNOSIS.)
- Starting motor does not run: go to step 2.
2. Remove red and black rubber boots from starter solenoid terminals (B and C).
3. Connect jumper wire between starter solenoid large terminals (B and C).
- Starter runs: Replace solenoid.
- Starting motor does not run: Check battery cables then replace starting motor.

STARTING MOTOR AMP DRAW TEST

Reason:

To determine the amperage required to crank the engine and check starter motor operation under load.

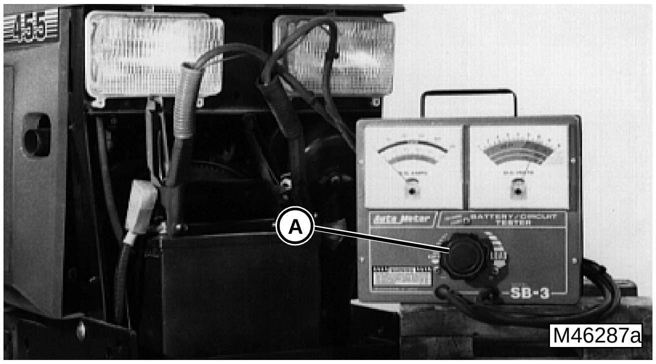
Equipment:

- JTO5685 Battery Tester

Connections:

1. Put transmission in neutral. Engage park brake. Put key switch in off position. Put PTO switch in off position.
2. Test system ground connections and battery.
3. 425 and 445—Disconnect and ground spark plug leads.
   455—Disconnect fuel shutoff solenoid connector.

IMPORTANT: Turn load knob (A) fully counterclockwise before making any test connections.



4. Connect JTO5685 Battery Tester to battery.

Procedure:

1. Crank engine and read voltage.
2. Turn key switch to off position. Adjust load knob until battery voltage reads the same as when cranking.
3. Read amperage on meter.
4. Turn load knob fully counterclockwise.

Specifications:—425 and 445

Maximum starter amp draw. . . . . 72 amps

Specifications:—455

Maximum starter amp draw. . . . . 230 amps

Results:

- If amperage is above specification, see STARTING MOTOR NO-LOAD AMPERAGE AND RPM TEST to determine if starting motor is binding or damaged.
- If starting motor is good, check internal engine components for binding or damage.

STARTING MOTOR NO-LOAD AMPERAGE AND RPM TEST

Reason:

To determine if starting motor is binding or has excessive amperage draw under no-load.

Equipment:

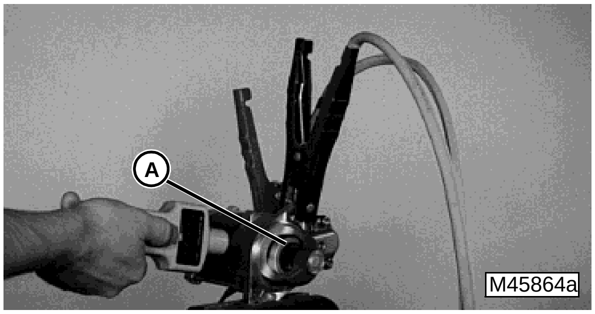
- JTO5712 Current Gun
- JTO5719 Photo Tachometer

Connections:

1. Remove starter from engine.

NOTE: Check that battery is fully charged and of proper size to ensure accuracy of test.

2. Connect jumper cables to battery.



3. 425 and 445—Put screwdriver between gear and bendix drum (A) and pull outward. Install reflective tape on drum.
4. Connect negative cable to starter body.
5. Connect positive cable to solenoid battery terminal.
6. Attach current gun to positive jumper cable.

Procedure:

IMPORTANT: Complete this test in 20 seconds or less to prevent starter damage.

1. Use jumper wire to briefly connect solenoid battery terminal and solenoid engagement terminal.
2. Measure starter amperage and rpm.

Specifications:—425 and 445

Maximum starter amperage . . 50 amps at 6000 rpm
Minimum starter rpm 6000

Specifications:—455

Maximum starter amperage . . 90 amps at 3000 rpm
Minimum starter rpm 3000

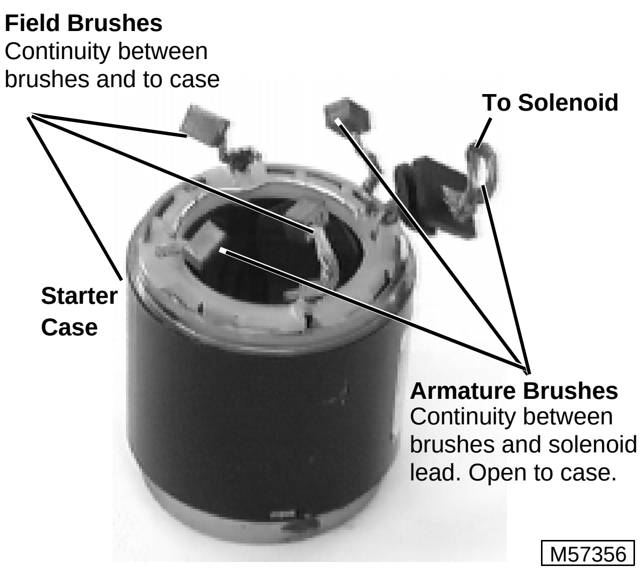
Results:

- If amperage or rpm is out of specification, check for binding or seizing bearings, sticking brushes, dirty or worn commutator. Repair or replace starter.

TEST FIELD WINDINGS

NOTE: Field winding case is a tie point for many separate field coils.
It may be difficult to detect one bad coil.
If rpm was slow and armature tests are normal, replace field coil assembly.

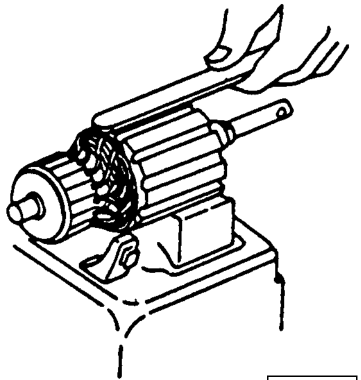
Replace field coil if not according to specifications.



M57356

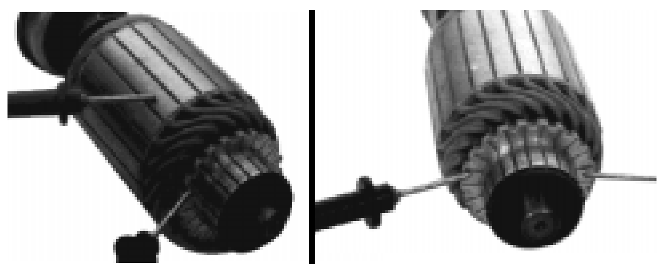
TEST STARTER ARMATURE

IMPORTANT: Do not clean armature with solvent. Solvent can damage insulation on windings. Use only mineral spirits and a brush.



M24861

1. Locate short circuits by rotating armature on a growler while holding a hacksaw blade or steel strip on armature. The hacksaw blade will vibrate in area of short circuit.
2. Shorts between bars are sometimes caused by dirt or copper between bars. Inspect for this condition.
3. If test indicates short circuited windings, clean the commutator of dust and fillings. Check armature again. If test still indicates short circuit, replace armature.



Test For Grounds **Test For Open**

M50112, M50113

4. Using an ohmmeter, test each individual armature windings for grounded or open circuits.

Armature windings are connected in parallel, so each commutator bar needs to be checked.

- If test either test fails, armature must be replaced.

SPARK PLUG CAP TEST

Spark plugs should not be burned, blistered, or have cracked insulator tips or badly eroded electrode.

Make sure the plug is correctly gapped.

Specifications:

425—Spark Plug (AM101194) . . . . gapped at 0.64 mm (0.025-in.)
445—Spark Plug (M71939) . . . . gapped at 0.64 mm (0.025-in.)

NOTE: Bending center wire or hitting plug with gapping tool can break insulator.

John Deere recommended plug is the best heat range for the engine application.

If hotter plug is used, go no more than (1) one range hotter.

- For NGK plugs: the lower the number the hotter the plug.
- For Champion Plugs: The higher the number the hotter the plug.

If spark plugs are burning improperly.

- Use known good grade and source of fuel.
- Test fuel for alcohol content. Tester is available at an auto parts stores. Alcohol content should be a maximum of 10%. This rating should be listed on service station pumps.
- Try a different grade (octane) fuel, or a different fuel manufacturer.
- With electronic ignition, check ground connections, ignition components, and a possible sheared flywheel key (unlikely).

Reason:

To determine if spark plug cap is defective.

Equipment:

- Ohmmeter

Procedure:

1. Turn key switch off. Put transmission in neutral.
2. Disconnect spark plug cap

M48364

3. Measure resistance across spark plug cap terminals. Resistance should be about the same as marked on the spark plug cap.

Specifications:

Spark plug cap resistance. . . . . marked on cap

Results:

- If resistance does not meet specification, replace spark plug cap.

SPARK PLUG GAP ADJUSTMENT

Reason:

To maintain the correct gap between the center electrode and the tab needed to produce a good spark.

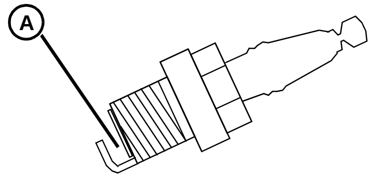
Equipment:

- 0.64 mm (0.025 in.) feeler gauge

Procedure:

IMPORTANT: Do not clean spark plug with sand paper or abrasives. Engine scoring can result.

1. Scrape or wire brush deposits from spark plug.
2. Inspect spark plug for:
- Cracked porcelain.
- Pitted or damaged electrodes.



3. Check spark plug gap (A) using a feeler gauge. Set gap to specifications.
4. Install and tighten spark plug to specifications.

Specifications:

Spark plug gap . . . . 0.64 mm (0.025 in.)
Spark plug torque . . . . 25 N•m (221 lb-in.)

SPARK TEST

Reason:

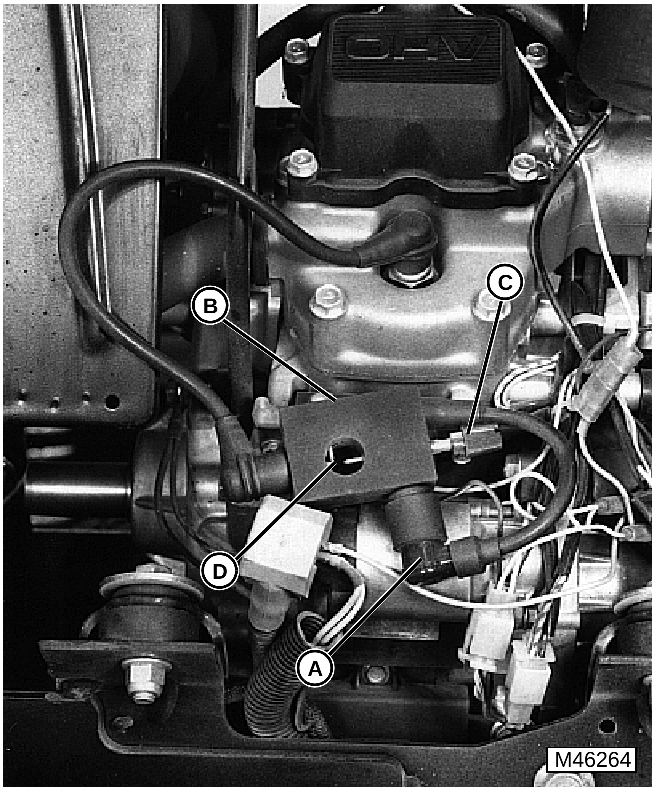
Check overall condition of ignition system.

Equipment:

• D-05351ST Spark Tester

Connections:

1. Park brake engaged. PTO disengaged.



2. Remove high tension lead (A) from spark plug and connect to spark tester (B).
3. Connect spark tester to spark plug.
4. Adjust spark tester gap to 4.2 mm (0.166 in.) with screw (C).

NOTE: Do not adjust spark tester gap beyond 5.0 mm (0.200 in.) as damage to ignition system components could occur.

Procedure:

1. Turn key switch to start position and watch spark (D) at spark tester. If engine will start, watch spark with engine running.

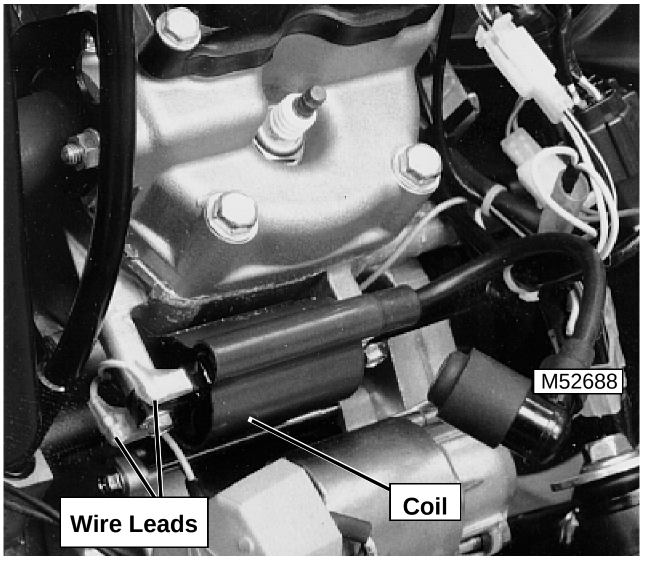
Specifications:

• Steady, strong, blue spark.

Results:

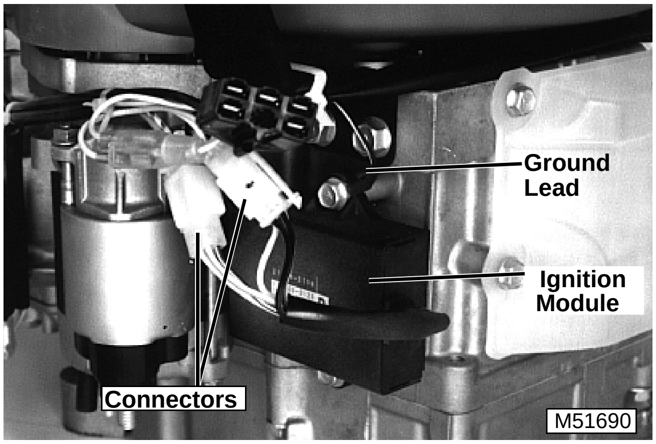
• If spark is weak, or if no spark, install a new spark plug and test again.
• If spark is still weak, or still no spark, run tests on individual components to find cause of malfunction.

REPLACE IGNITION COILS—425 and 445



1. Disconnect plug wire from spark plug lead and primary wire leads from coil.
2. Remove ignition coil.
3. Install ignition coil and connect wiring leads.

REPLACE IGNITION MODULE—425 and 445



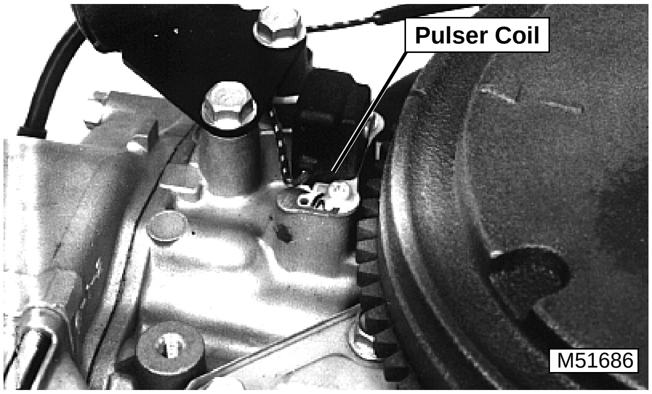
NOTE: Module may not be mounted on engine on some applications.

Note position of ground wire. Module must be grounded.

1. Disconnect connectors and remove ignition module.
2. When installing ignition, put wire lead under cap screw.
3. Install ignition module and connect plugs.

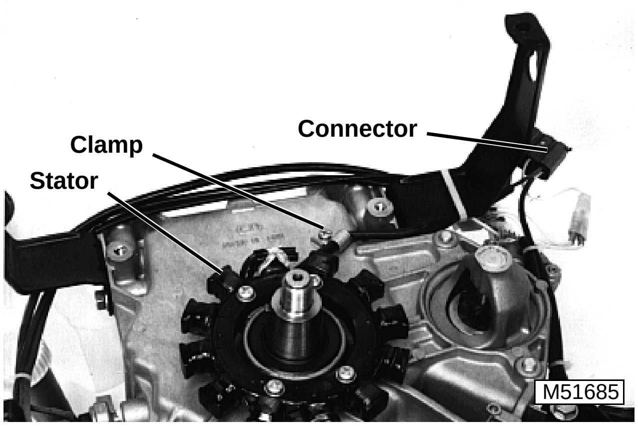
REPLACE PULSER COILS—425 and 445

NOTE: Pulser coils are mounted in a fixed position.Some application only use one pulser coil.



1. Remove cooling air duct or flywheel guard, fan bracket.
2. Remove pulser coil(s) wire ties from wiring harness.
3. Disconnect wiring harness from ignitor.
4. Install coils.
5. Install fan or radiator brackets.
6. Connect plug to ignitor.
7. Install new wire ties where needed.

REPLACE STATOR—425 and 445



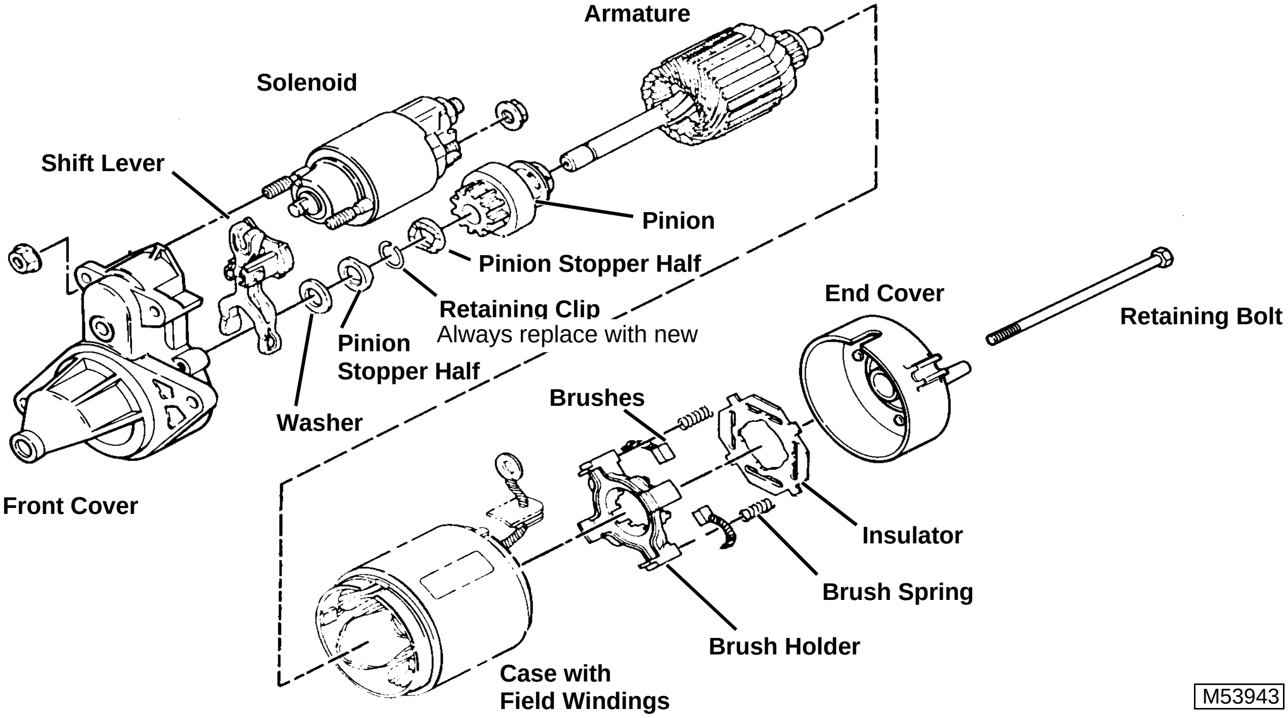
NOTE: The charging system is a permanent magnet and stator design. As the flywheel rotates, a permanent magnet in the flywheel induces AC current in the stator windings. This current flows to the regulator-rectifier where it is converted to DC current needed to charge the battery. Component may differ from illustration.

1. Remove flywheel, wire clamp(s) stator wiring lead pins from connector.
2. Cut wire tie from wiring harness and remove stator.
3. Install stator and connect wiring leads to plug.

REPAIR

STARTING MOTOR—425 and 445

NOTE: Mark body and end cover to aid reassembly.



1. Separate pinion stopper halves to remove retaining clip to remove armature from pinion.
2. Test and inspect parts for wear or damage.
3. Replace brushes as a set if length of any one is less than **6 mm (0.240 in.)**. Brushes must be soldered to field windings
4. Apply very light coat of multipurpose grease to:
   - sliding surfaces of armature and solenoid shift lever pivots.
   - armature shaft spline.
   - points where shaft contacts cover.
5. Assemble starting motor. Hook solenoid plunger over shift fork.

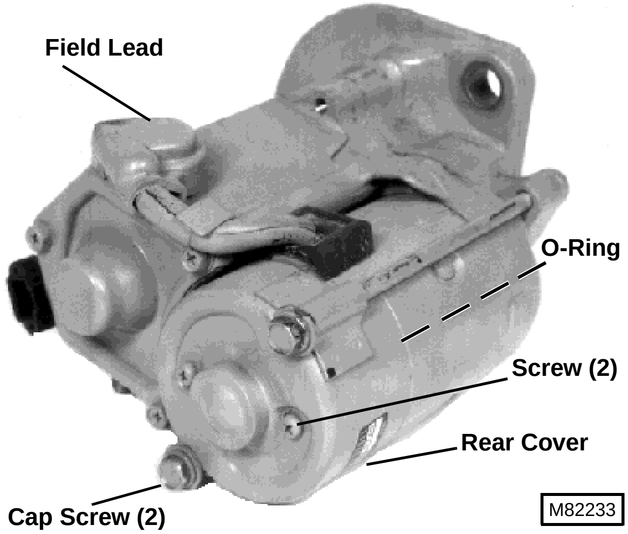
Brush Assembly Tips:

- With front cover facing down in vise, assemble front cover, armature and body.
- Assemble brush holder over armature.
- Install brushes against armature.
- Squeeze springs into place.
- install insulator and cover.

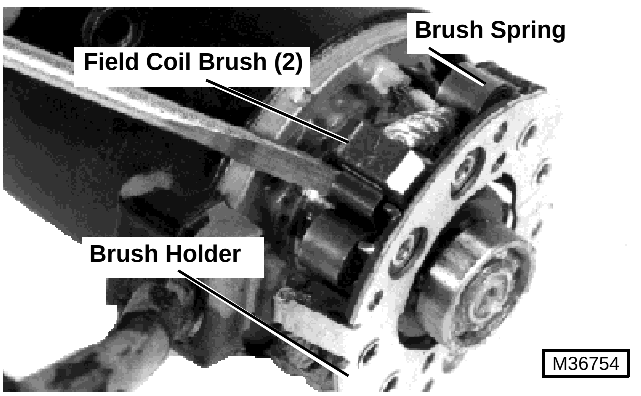
STARTING MOTOR—455

DISASSEMBLY

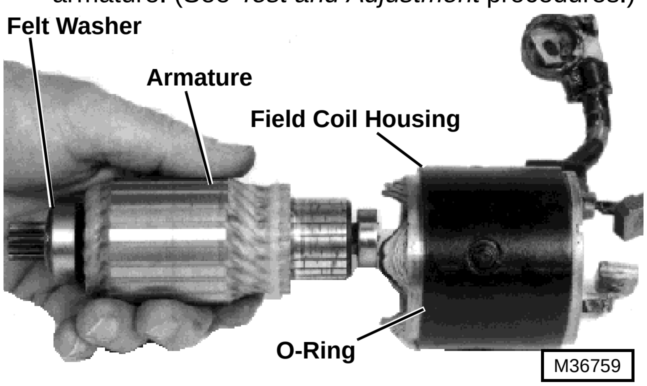
1. Disconnect field lead.
2. Remove two cap screws and two screws.
3. Remove rear cover and o-ring, if equipped.



4. Remove field coil brushes from brush holder.
5. Pry brush springs away and pull negative brushes up enough to allow spring to hold brush in place.
6. Remove brush holder.



7. Remove armature from field coil housing.
8. Remove felt washer and o-ring, if equipped.
9. Inspect and test brushes, holder, field coil and armature. (See *Test and Adjustment* procedures.)



ASSEMBLY

Assembly is done in the reverse order of disassembly.

- Apply multipurpose grease to bearing cup inside rear cover and felt washer, if equipped.

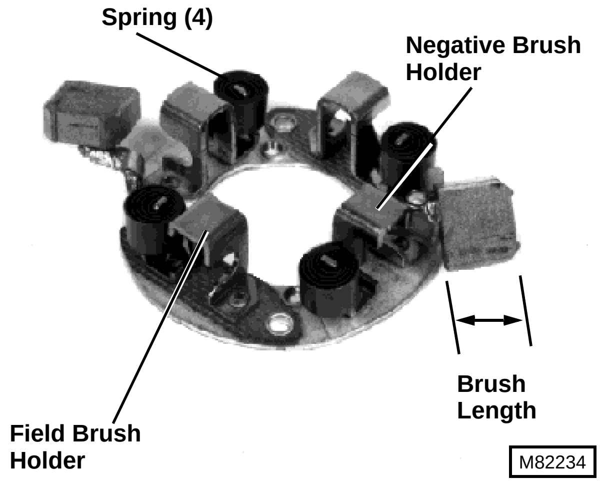
IMPORTANT: When installing rear cover, be sure field coil brush wires do not touch cover. Turn brush holder slightly to take up slack in brush wires. Press wires inward to clear rear cover.

INSPECTION/TEST/REPLACEMENT

1. Measure holder and field coil brush lengths. Minimum brush length is **8.5 mm (0.335 in.)**. Replace brush holder or field coil if brush length is below minimum.

NOTE: Test brush holder using an ohmmeter or test light.

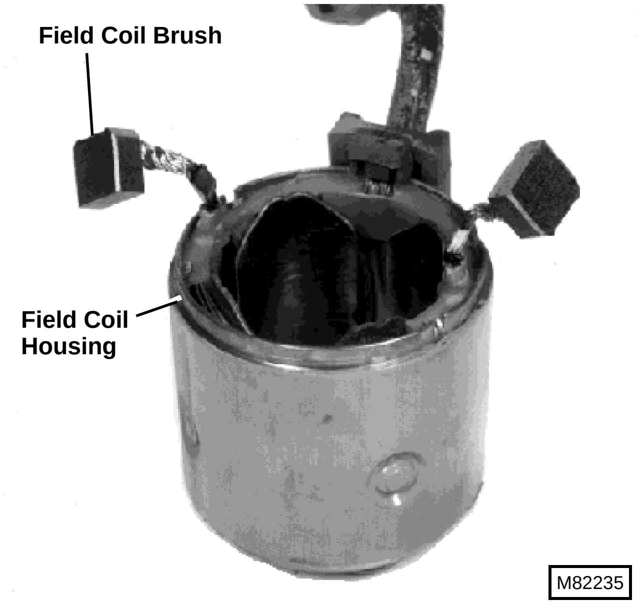
2. Test brush holder—Touch one probe of tester to negative brush holder and other probe to field brush holder. If there is continuity, replace the brush holder.
3. Inspect springs for wear or damage. Replace if necessary.



NOTE: Test field coil using an ohmmeter or test light.

4. Test for grounded field winding:

   Touch one probe of tester to field coil brush and other probe to field coil housing. Be sure the brush lead is not touching the frame. If there is continuity, the coil is grounded and the field coil housing assembly must be replaced.
5. Test for open field coil:
6. Touch one probe of tester to each field coil brush. If there is no continuity, the field coil is open and the field coil housing assembly must be replaced.



M82235

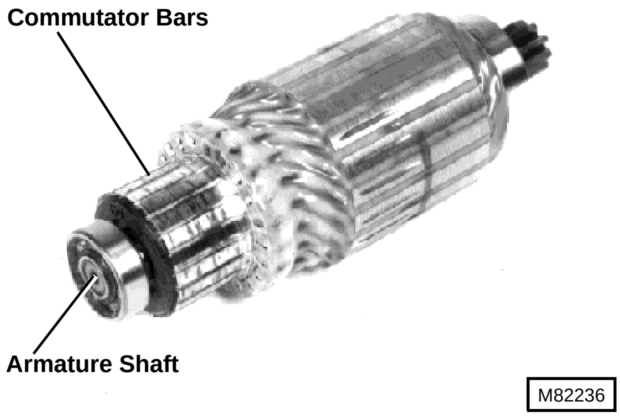
IMPORTANT: Do not clean armature with solvent. Solvent can damage insulation on windings. Use only mineral spirits and a brush.

7. Inspect armature. Look for signs of dragging against pole shoes.
8. Inspect commutator. Look for roughness, burned bars, or any material which might cause short circuits between bars. If necessary, clean and touch up with 400 sandpaper. NEVER use emery cloth. Clean all dust from armature when finished.

NOTE: Test armature windings using an ohmmeter or test light.

9. Test for grounded windings:
   - Touch probes on one commutator bar and armature shaft. Armature windings are connected in series, so only one commutator bar needs to be checked.
   - If test shows continuity, a winding is grounded and the armature must be replaced.
10. Test for open circuited windings:

    Touch probes on two different commutator bars. If test shows no continuity, there is an open circuit and the armature must be replaced.



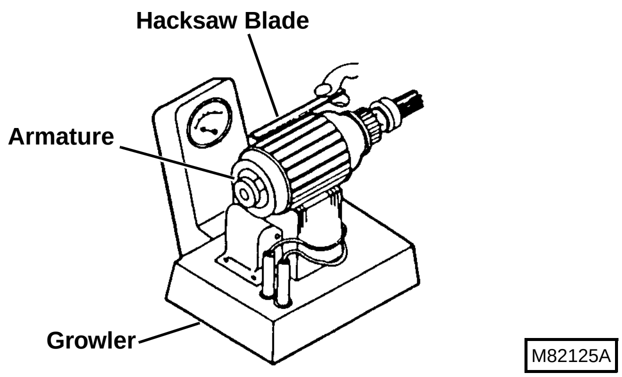
M82236

11. Test for short circuited windings using a growler. Put armature in a growler and hold a hacksaw blade above each slot while slowly rotating armature.

    If coil is shorted, the blade will vibrate on the slot.

NOTE: A short circuit most often occurs because of copper dust or filings between two commutator segments.

12. If test indicates short circuited windings, clean the commutator of dust and filings. Check the armature again. If the test still indicates a short circuit, replace the armature.



M82125A

13. Inspect armature cover and housing bearings for wear or damage. Replace if necessary.

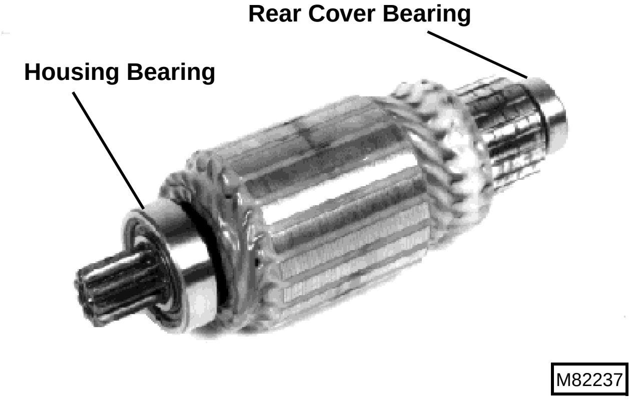
To replace bearings:

Bearings are press fit. Remove bearings using a knife-edge puller set.

IMPORTANT: Install both bearings with sealed side toward armature.

Install new housing bearing tight against shoulder of shaft using a piece of pipe.

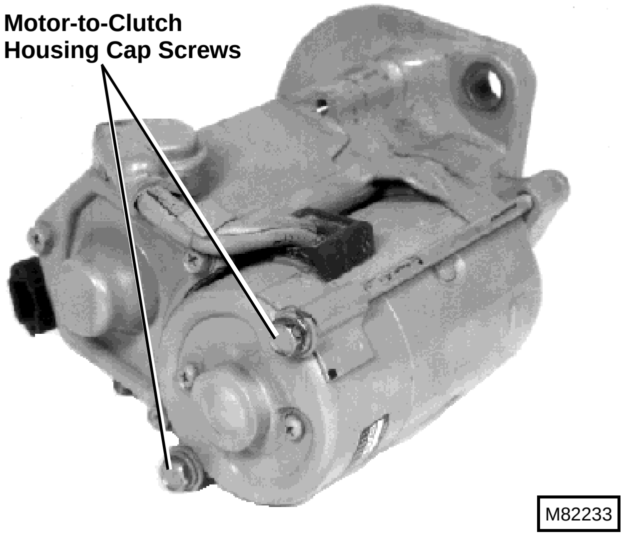
Install new rear cover bearing tight against shoulder of shaft using a driver set.

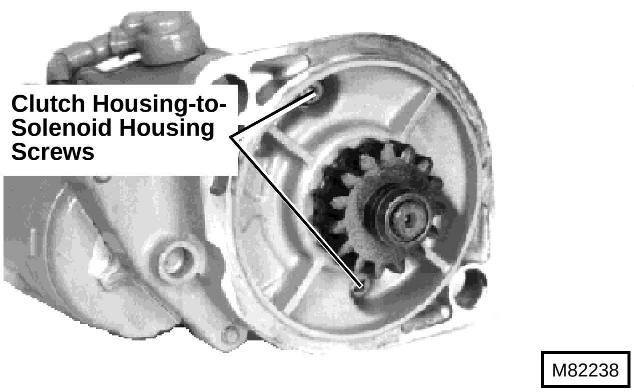


STARTING MOTOR GEAR TRAIN AND OVERRUNNING CLUTCH—455

DISASSEMBLY/INSPECTION

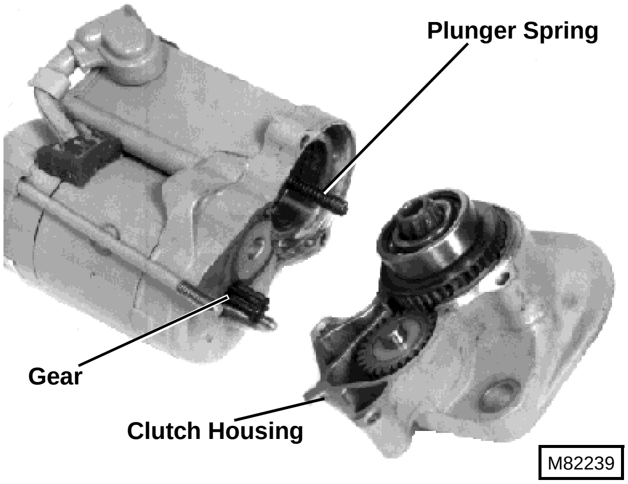
1. Remove two motor-to-clutch housing cap screws and two clutch housing-to-solenoid housing screws.





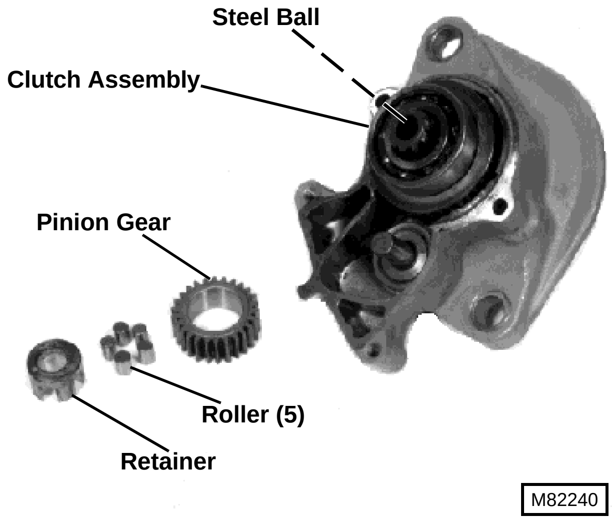
2. Separate clutch housing from solenoid/motor assembly.

3. Remove plunger spring and gear, if equipped.

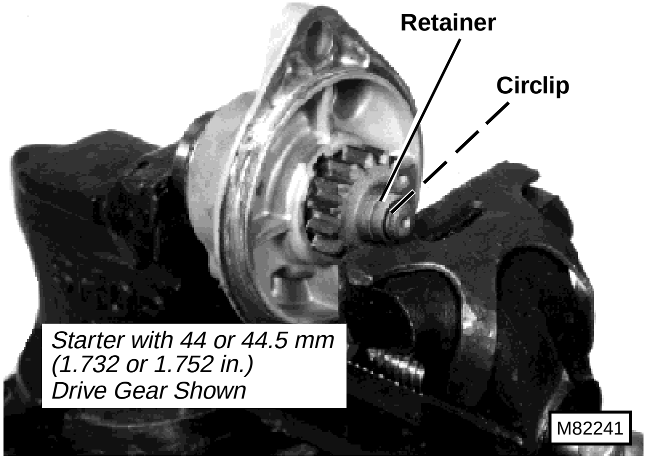


NOTE: *Starter is equipped with either a 33 mm (1.299 in.), 44 mm (1.732 in.) or 44.5 mm (1.752 in.) drive gear on end of clutch shaft. Disassembly procedures are slightly different.*

4. Starter with 33 mm (1.299 in.) drive gear: Remove clutch assembly from housing.
5. Remove retainer, five rollers and pinion gear.
6. Remove steel ball.



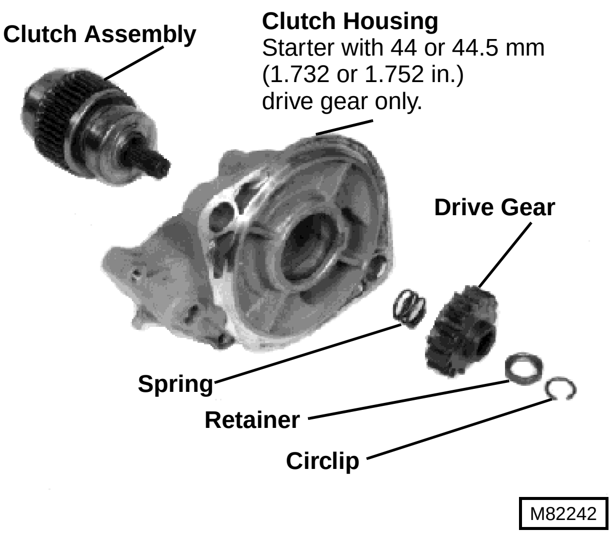
7. Put clutch (housing) assembly into a soft-jawed vice, as shown.
8. Tighten vise slowly, until drive gear compresses.
9. Remove retainer and circlip.



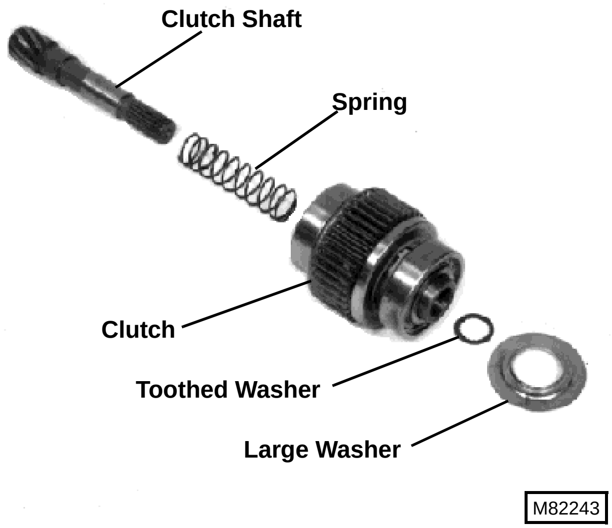
⚠ CAUTION

Shaft could be propelled from clutch unit with considerable force if spring is not allowed to extend fully while in vise.

10. While holding clutch assembly, slowly open vise until all spring compression is relieved.
11. Starter with 33 mm (1.299 in.) drive gear: Remove drive gear and spring from clutch assembly. Starter with 44 mm (1.732 in.) or 44.5 mm (1.752 in.) drive gear: Remove drive gear, spring and clutch assembly from housing.



12. Remove washer, toothed washer, spring and clutch shaft.
13. Inspect all parts for wear or damage. Replace as necessary.



ASSEMBLY

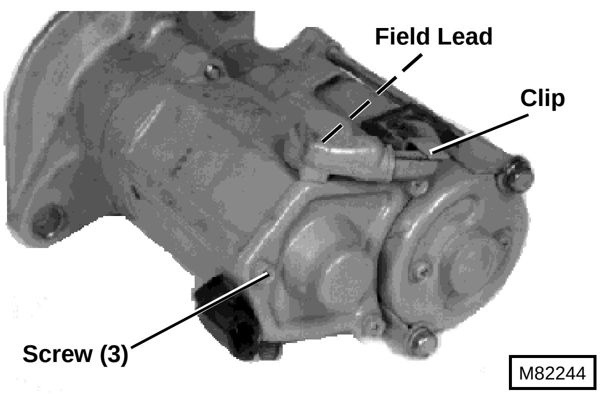
Assembly is done in the reverse order of disassembly.

- Apply multipurpose grease to bearings, clutch shaft, springs, pinion gears, retainer, rollers and steel ball.
- Install large washer with flat side toward clutch assembly.
- Install retainer with cupped side away from clutch assembly.

STARTER SOLENOID—455

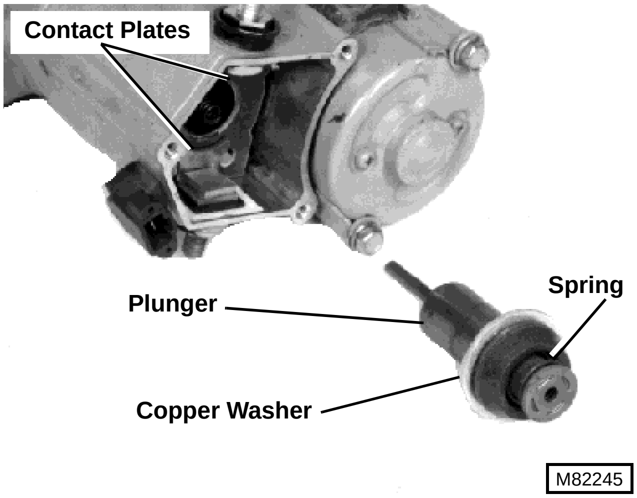
Disassembly/Inspection

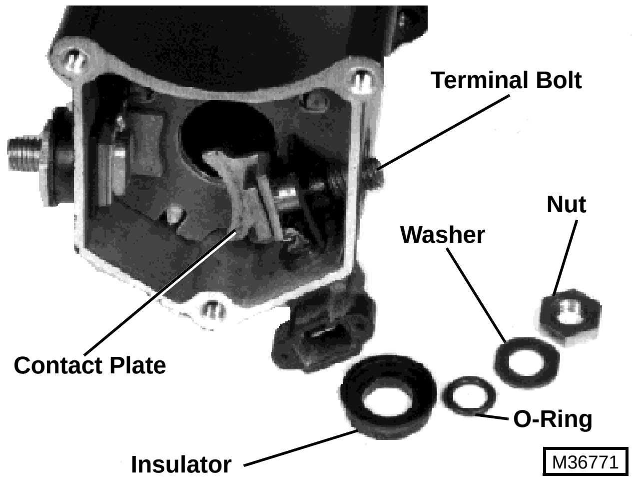
1. Disconnect field lead.
2. Remove three screws and clip.
3. Remove cover and gasket.



4. Remove plunger.
5. Disassemble terminals. Remove parts from each terminal in order shown.

6. Inspect copper washer and contact plates for excessive burning or pitting. Clean burnt areas to improve electrical contact. Replace contacts or plunger if necessary. The solenoid is not serviceable. If defective, replace solenoid housing assembly.

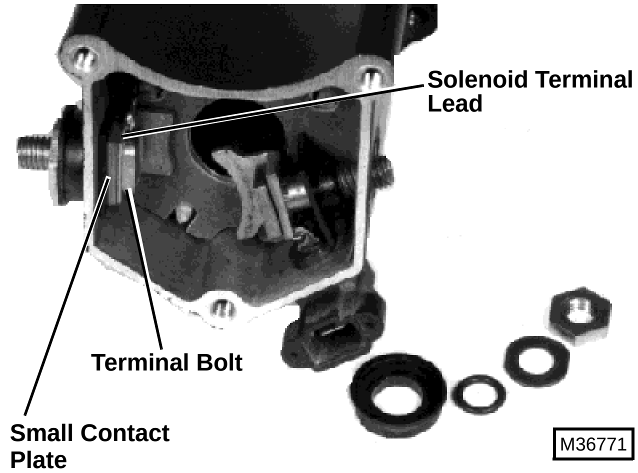




ASSEMBLY

Assembly is done in the reverse order of disassembly.

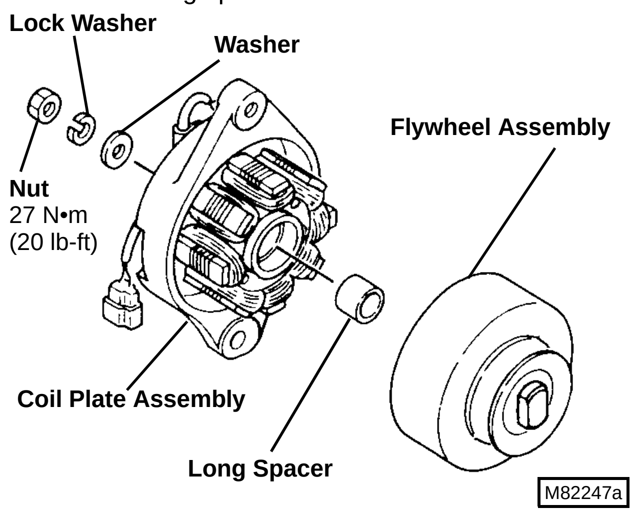
NOTE: The assembly sequence of the left and right terminals is similar. Be sure solenoid terminal lead is installed between terminal bolt and contact plate. Also, be sure smaller contact plate is on the left side



ALTERNATOR—455 (20-AMP)

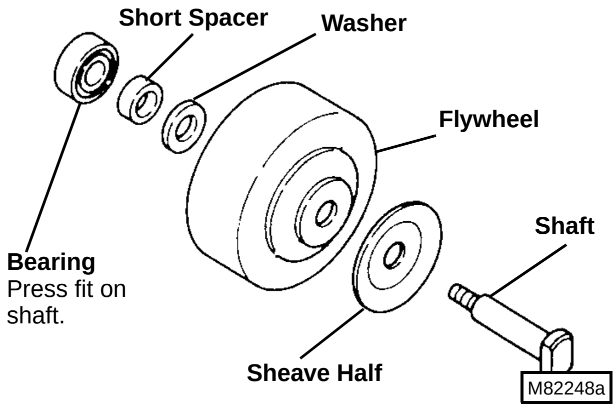
DISASSEMBLY/INSPECTION

1. Remove nut and washers.
2. Tap on end of shaft with a soft-faced hammer to separate flywheel assembly from coil plate assembly.
3. Remove long spacer.



NOTE: Bearing and flywheel are press fit on shaft.

4. Remove shaft from bearing, short spacer, washer, flywheel and sheave half, using a press.
5. Inspect all parts for wear or damage. Replace as necessary.

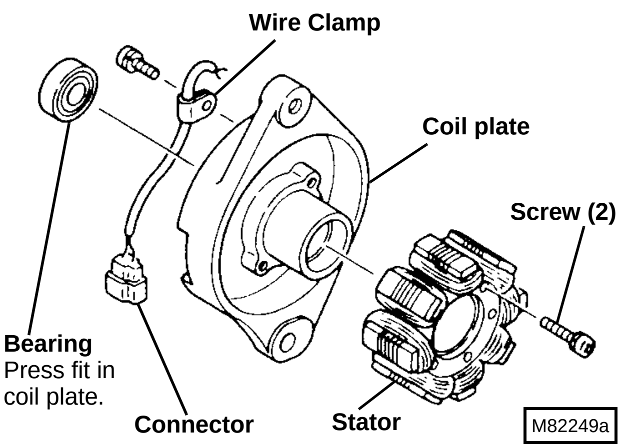


NOTE: Remove bearing only if replacement is necessary.

6. Inspect bearing in coil plate for wear or damage. Replace if necessary.

To replace bearing:
Remove bearing using a spark plug socket and a press. Install bearing into coil plate until it bottoms in bore using a 1 in. socket.

7. Remove wire clamp.
8. Remove connector from harness leads.
9. Remove two screws and stator.
10. Inspect all parts for wear or damage. Replace as necessary.



ASSEMBLY

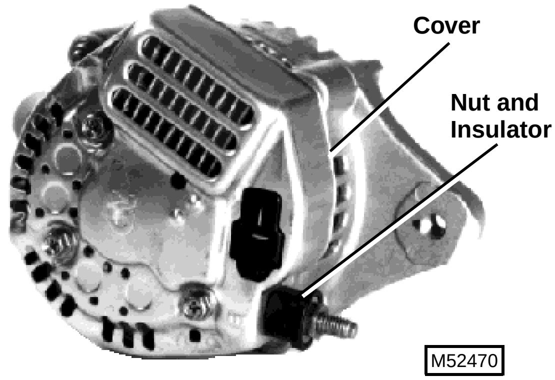
Assembly is done in the reverse order of disassembly.

- With sheave half on shaft, press shaft into flywheel until sheave half bottoms on flywheel face.
- With washer and short spacer installed, press new bearing onto shaft until it bottoms on spacer.

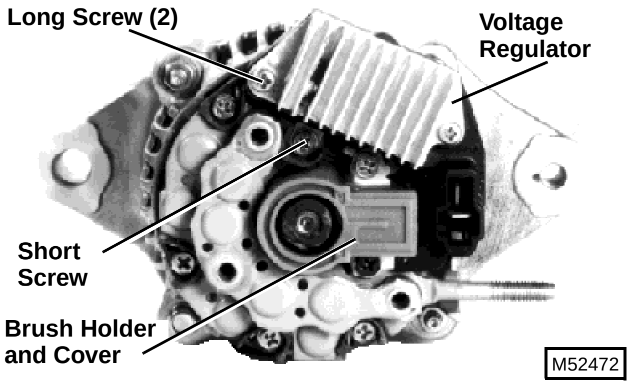
VOLTAGE REGULATOR—455 (40 Amp)

REPLACEMENT

1. Remove nut and insulator.
2. Remove three screws and cover.



3. Remove two screws, brush holder and cover.
4. Remove three screws. Replace voltage regulator.



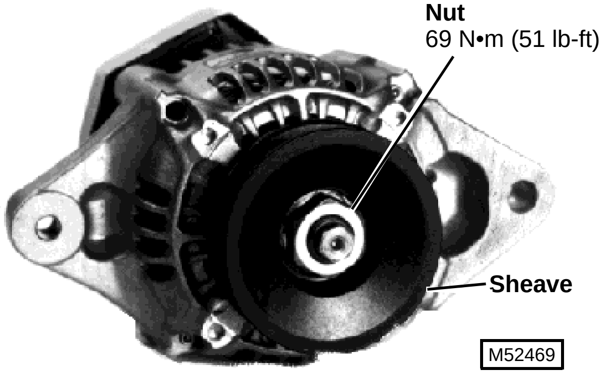
Installation is done in the reverse order of removal.

IMPORTANT: Make sure to install short screw at location shown. Longer screw will contact frame and cause damage to the charging system.

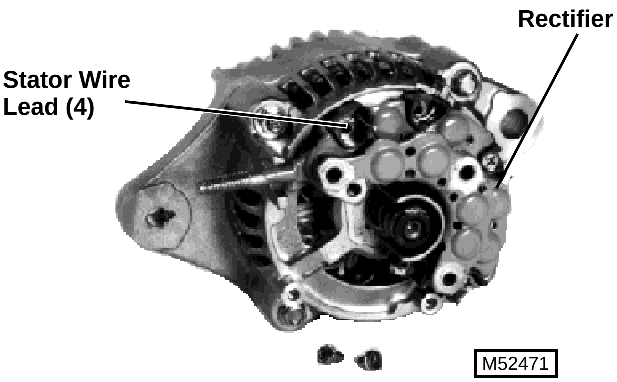
ALTERNATOR—455 (40-AMP)

DISASSEMBLY

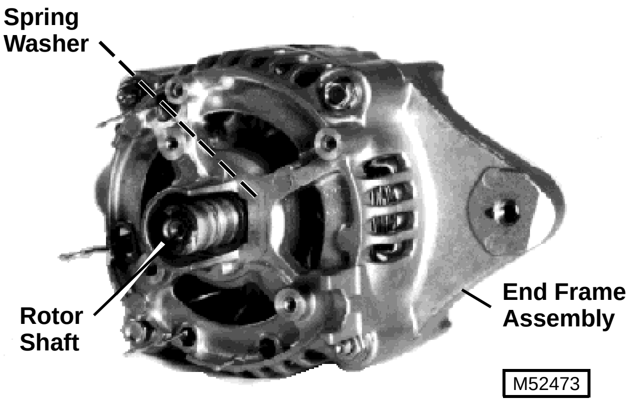
1. Remove voltage regulator.Remove nut.
2. Remove sheave using a puller set.



3. Remove four screws and straighten stator wire leads.
4. Remove rectifier.



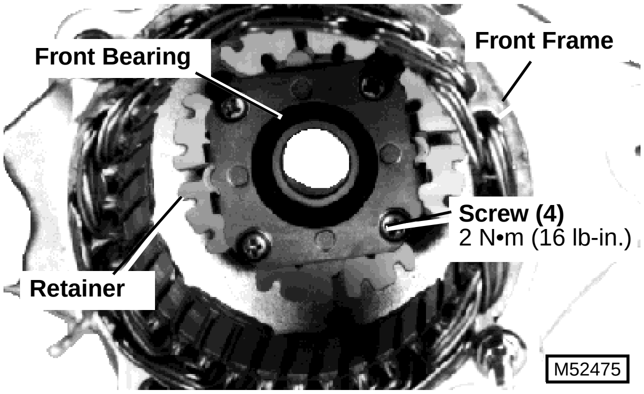
5. Remove two nuts, two screws and end frame assembly.
6. Press rotor shaft from end frame.
7. Remove spring washer.



8. Remove four screws and retainer.

NOTE: Front bearing is press fit in front frame. Remove bearing only if replacement is necessary.

9. Inspect bearing in front frame for wear or damage. Replace if necessary. Replace bearing using a driver set and a press.



10. Inspect and test brushes, stator and rectifier. (See *Inspection/Test* in this group.)

ASSEMBLY

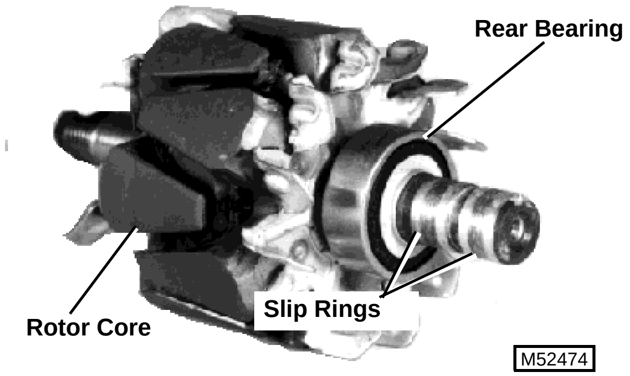
1. Assembly is done in the reverse order of disassembly.
2. After installing rectifier, form a loop in stator wire leads, insert screws through loop and secure rectifier and wire leads.

INSPECTION/TEST

Rotor:

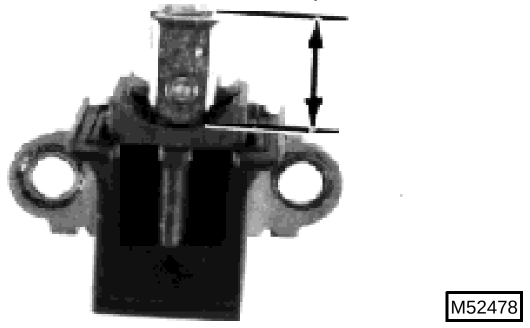
NOTE: Rear bearing and rotor assembly are not serviced separately. Damaged parts require that rotor assembly and bearing be replaced as a unit.

1. Inspect bearing for wear or damage. Replace complete rotor if necessary.
2. Inspect slip rings for dirt build-up, rough spots or out-of-roundness. If necessary, polish the surface of the slip rings using No. 00 sandpaper or 400-grit silicone carbide paper. Measure outer diameter of slip rings. Replace rotor if less than **14 mm (0.550 in.)**.
3. Touch the probes of an ohmmeter to slip rings. Replace rotor if test indicates no continuity (no needle movement).
4. Touch probes of ohmmeter to the rotor core and one of the slip rings. Repeat for other slip ring. Replace rotor if test shows continuity (needle movement).



Brushes:

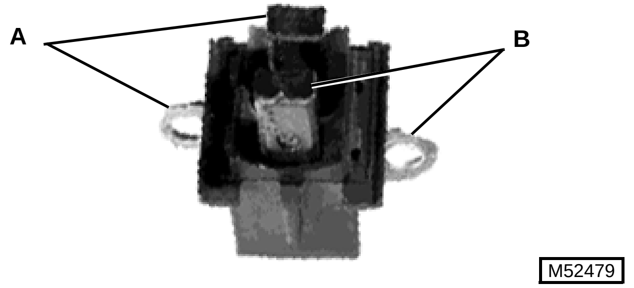
1. Inspect brush holder, brushes and springs for damage. Brushes must slide freely and springs must hold brushes firmly against the slip rings of the rotor.
2. Measure length of brush protruding from holder. If length is less than wear limit, replace brushes.



Brush Length Specifications

New . . . . 10.50 mm (0.410 in.)
Wear Limit. . . . . 4.50 mm (0.170 in.)

3. Check continuity between brush and terminal “A”.
4. Check continuity between brush and terminal “B”.
5. There should be continuity only at these points.



Stator:

1. Inspect stator for defective insulation, discoloration or a burned odor. If any of these defects are found, replace stator.

NOTE: Use an ohmmeter that is sensitive to resistance of 0—1 ohm.

CONTENTS

HYDROSTATIC POWER TRAIN

SPECIFICATIONS

GENERAL SPECIFICATIONS

Transaxle:

Hydraulic Oil . . . . J20D Low Viscosity HY-GARD

Capacity:

Two-Wheel Steer . . . . 6.6 L (7.0 qt)
All-Wheel Steer . . . . 5.7 L (6.0 qt)

TEST AND ADJUSTMENT SPECIFICATIONS

Hydrostatic Transmission:

Pump and Motor Displacement. . . . . 18 cc (1.1 cu.in.)/rev
Lube Reduction Valve . . . . 490—586 kPa (71—85 psi)

Charge Pump:

Displacement . . . . 6 cc (0.37 cu.in.)/rev
Charge Pressure Control Valve . . . . 1965—2255 kPa (285—327 psi)
Implement Relief Valve Pressure . . . . 6371—7350 kPa (924—1066 psi)
Charge Pump Flow . . . . 17 L/m (4.5 gpm)
Minimum Flow . . . . 13 L/m (3.5 gpm)

PTO:

PTO Pressure Control Valve . . . . 1420—1517 kPa (206—220 psi)
PTO Circuit Flow . . . . 1.5 L/m (0.42 gpm)

REPAIR SPECIFICATIONS

Control Arm Cap Screw Torque . . . . 73 N•m (54 lb-ft)
PTO Solenoid Armature Torque . . . . 22 N•m (195 lb-in.)
PTO Solenoid Nut Torque . . . . 4.9 N•m (43 lb-in.)
Transaxle Cover Cap Screws
Used Transaxle Case Torque . . . . 25 N•m (18 lb-ft)
New Transaxle Case Torque . . . . 30 N•m (22 lb-ft)
PTO Output Shaft Retaining Cap Screws Torque . . . . 27 N•m (20 lb-ft)
PTO Shifter Shaft Cap Screw Torque . . . . 25 N•m (18 lb-ft)
PTO Ball Switches Torque . . . . 34 N•m (25 lb-ft)
PTO Clutch Pack Wear
Clearance Between Plate and Bottom
of Gear/Hub Groove . . . . 2.7 mm (0.106 in.) maximum
Charge Pump Cap Screws
Short Cap Screws Torque. . . . . 25 N•m (18 lb-ft)
Long Cap Screw Torque . . . . 39 N•m (29 lb-ft)
Hydrostatic Motor Seal Cap Depth below Housing . . . . 4 mm (5/32 in.)

Hydrostatic Center Valve Block	
Directional Control Valves Torque	35 N•m (26 lb-ft)
Bottom Suction Plug Torque	50 N•m (37 lb-ft)
Implement Relief Valve Plug Torque	25 N•m (18 lb-ft)
Mounting Cap Screws Torque	39 N•m (29 lb-ft)
Axle Housing Cap Screws Torque	54 N•m (40 lb-ft)
King Pin Cap Screws Torque	54 N•m (40 lb-ft)
Transaxle to Frame Mounting Cap Screws	88 N•m (65 lb-ft)
Differential Cap Screws Torque	88 N•m (65 lb-ft)
Drive Shaft Cap Screws Torque	40 N•m (30 lb-ft)

OTHER MATERIALS

Number	Name	Use
TY15130	John Deere Form-in-Place Gasket	Seal mating surfaces of transaxle
TY6305/TY9485/#764	Cure Primer	Clean threads and sealing surfaces.
TY9370/TY9477/#242	Thread Lock and Sealer (Medium Strength)	Retain cap screws

SPECIAL OR ESSENTIAL TOOLS

NOTE: Order tools according to information given in the U.S. SERVICEGARD® Catalog or in the European Microfiche Tool Catalog (MTC).

JDG282 Temperature Gauge
Used to test the hydraulic oil temperature.

JDG757A—Solenoid Valve Socket
Used to install solenoid armature.

JDT39—Transmission Gear Spacer
Used to separate transmission gear sets in compact utility tractors. Used to disassemble and assemble PTO clutch assembly in lawn and garden tractors.

SERVICE EQUIPMENT AND TOOLS

Bushing, Bearing and Seal Driver Set
Used to service bearings and seals.

Press
Used to remove and install axle shaft and bearings.

Snap Ring Pliers Set
Used to remove snap rings.

Knife-Edge Puller
Used to remove bearings.

Jack Stands
Used to support tractor.

Lift Brackets or 8 mm Eyebolts
Used to remove and install transaxle.

Hoist
Used to remove and install transaxle.

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NOTES

THEORY OF OPERATION

NOTE: Hydrostatic theory is not covered. See FOS Series Manuals.

CENTER SECTION AND DIRECTIONAL CONTROL VALVES—REVERSE SYSTEM OPERATION

Function:

The center section contains the closed loop passages between the variable displacement pump and the bi-directional, fixed displacement motor. It also contains the directional control valves. These valves control the flow of charge oil into the closed loop and block closed loop pressure from the charge circuit oil.

System Operation:

Charge oil from the charge pump enters the center section at port (A). Charge oil will open the closed loop check valve and enter the forward side of the closed loop when the reverse side has been pressurized by the hydrostatic pump. When the direction is reversed to provide forward direction, charge oil will then pressurize the reverse side of the closed loop.

The variable displacement hydrostatic pump pressurizes the reverse side loop, causing the fixed displacement motor to rotate. The reverse directional check valve blocks the closed loop pressure oil from entering the charge circuit.

The reverse directional check valve cartridge has a leak-off orifice. This orifice bleeds off a small amount of high pressure oil from the reserve closed loop back into the charge circuit. This provides for a wider neutral band to help prevent creep. This small leakage does not slow down reverse.

Free-Wheeling:

When the free-wheeling push pins are pushed down, the pins unseat the closed loop check valves, allowing oil flow created by the motor to escape into the charge circuit. This prevents oil pressure from building between the pump and motor, allowing the unit to be pushed.

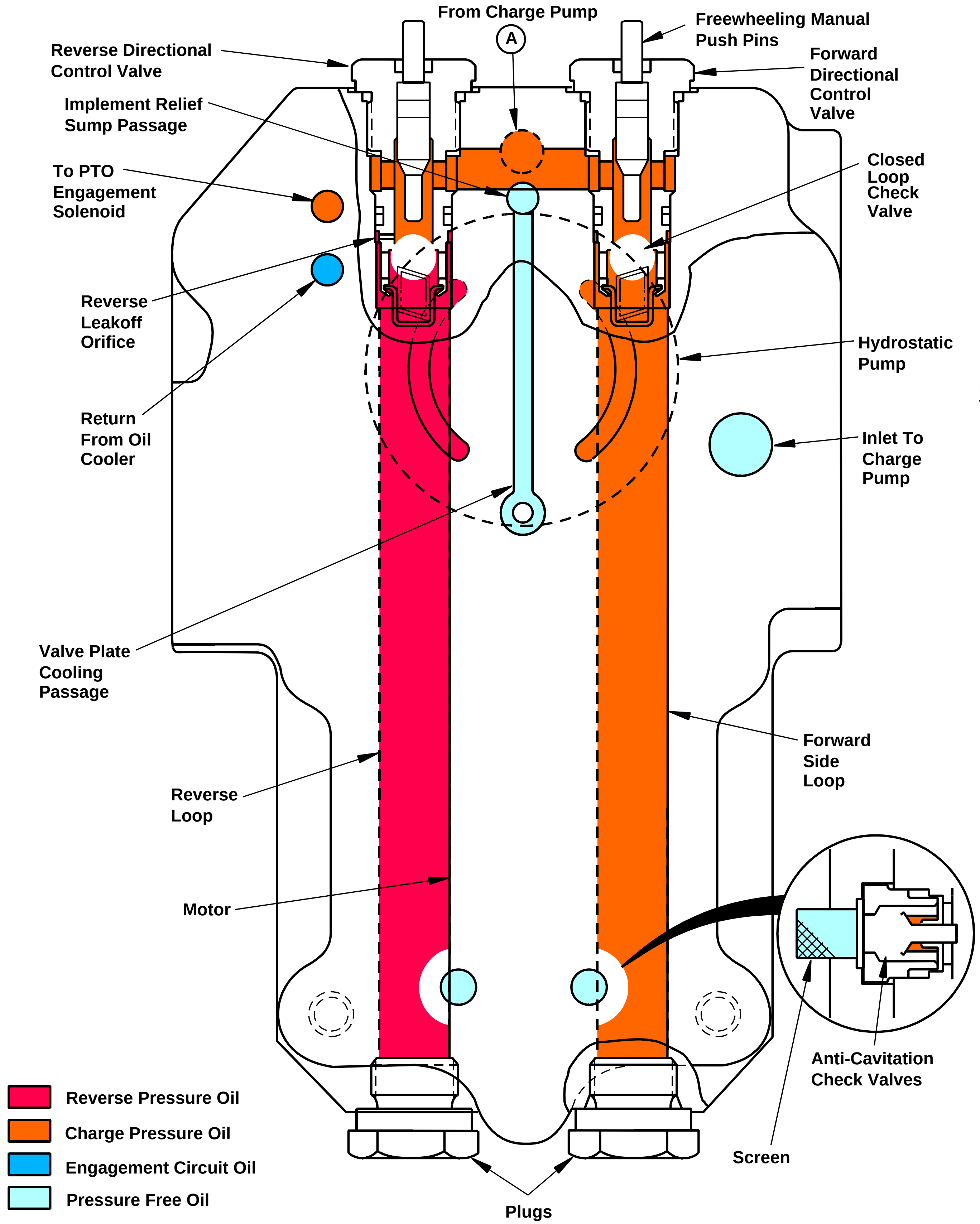
Anti-Cavitation Valves:

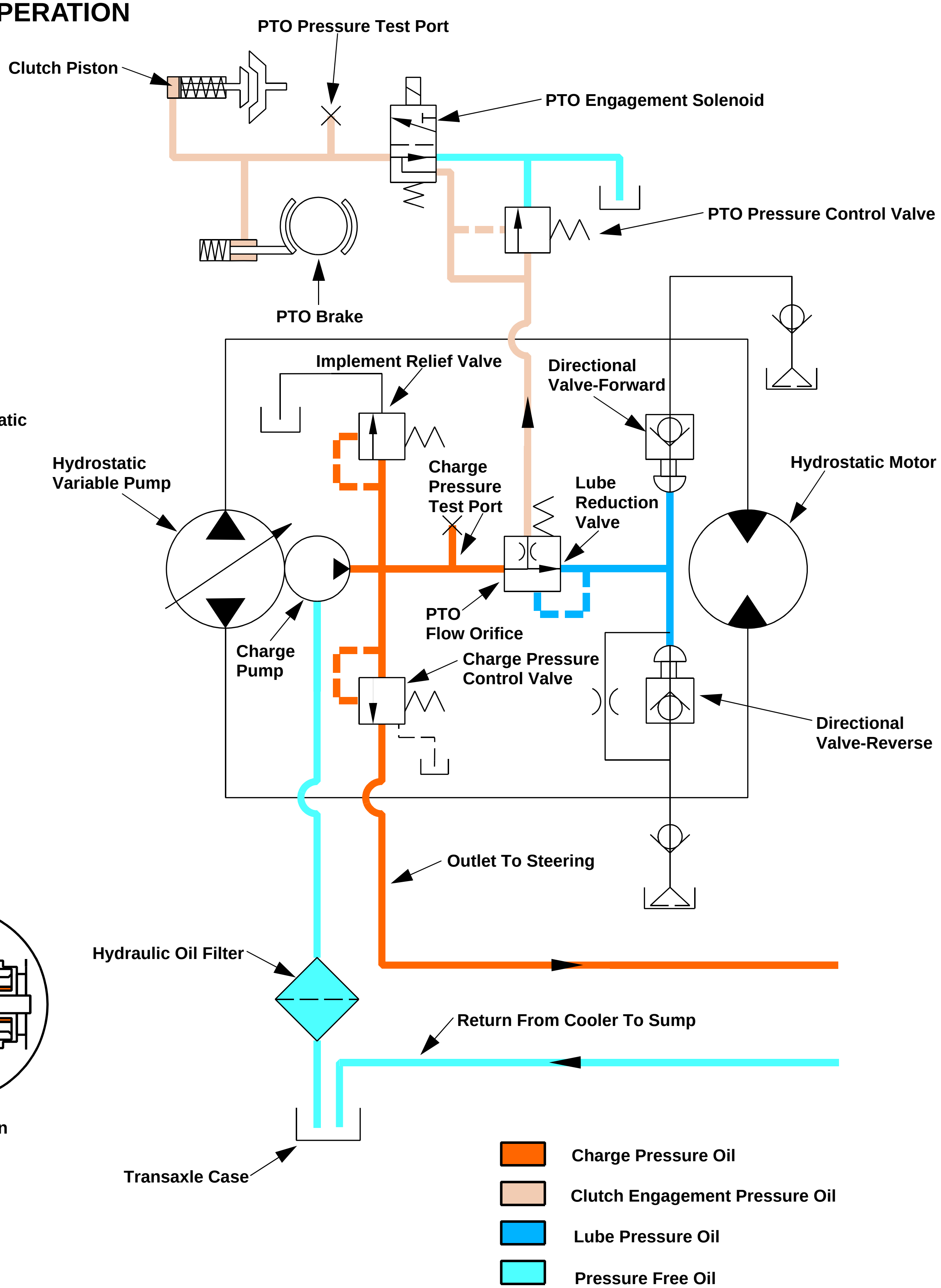
These valves prevent cavitating of the motor during free-wheeling or when the motor overruns the pump (vehicle going down hill).

During free-wheeling, the free-wheeling valves are depressed and the engine is not turning the charge pump that supplies the charge oil. The hydrostatic motor pumps the closed loop oil out into the charge circuit; the anti-cavitation valves open, letting oil from the transaxle sump into the closed loop, preventing motor cavitation.

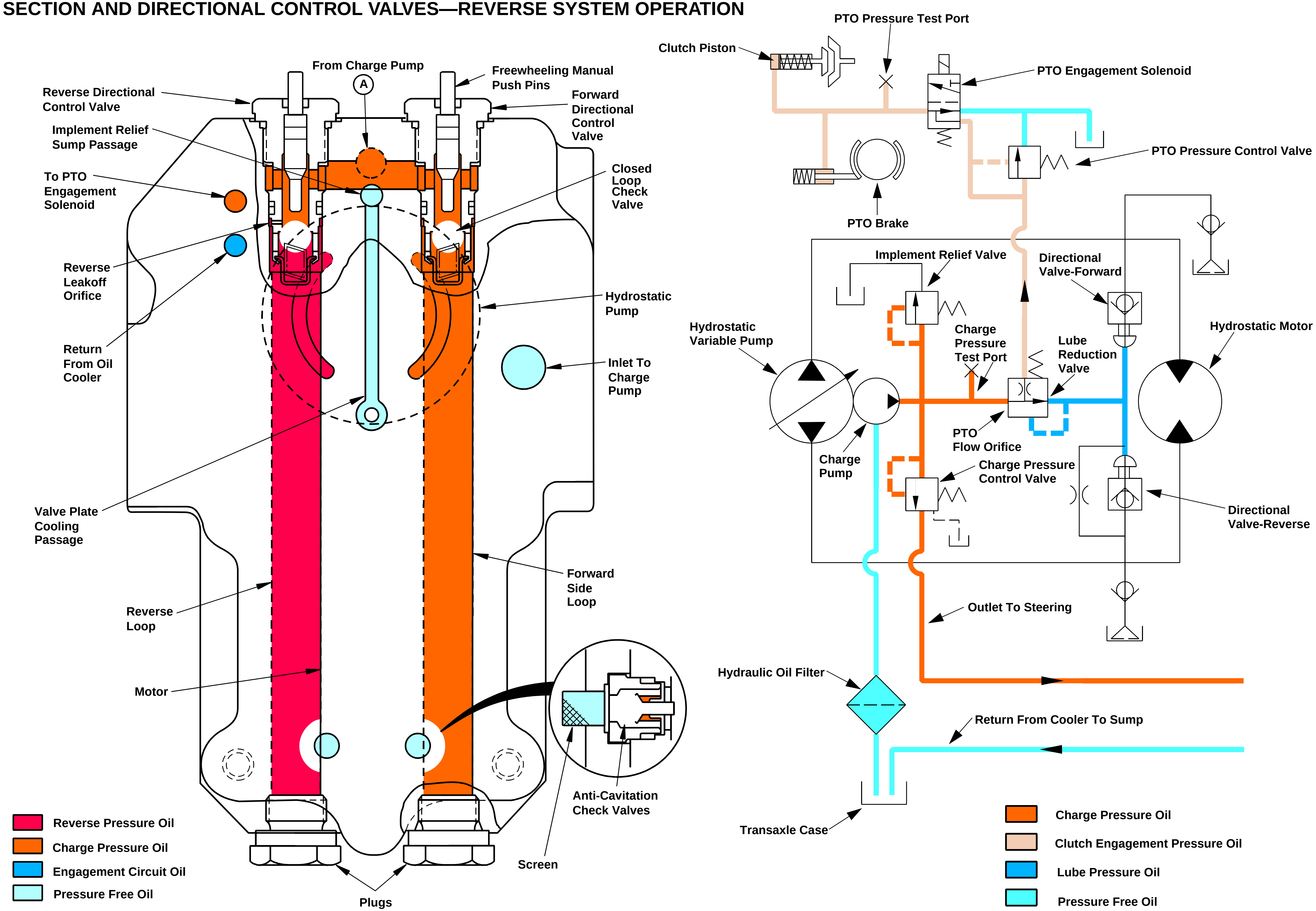
When the vehicle goes down a hill, the motor becomes the pump, going into a braking mode, and tries to overrun the pump. Closed loop pressure increases higher than the charge pressure, closing off the charge oil. Anti-cavitation valve then opens to make up oil lost through the pump, preventing pump cavitation.

CENTER SECTION AND DIRECTIONAL CONTROL VALVES—REVERSE SYSTEM OPERATION

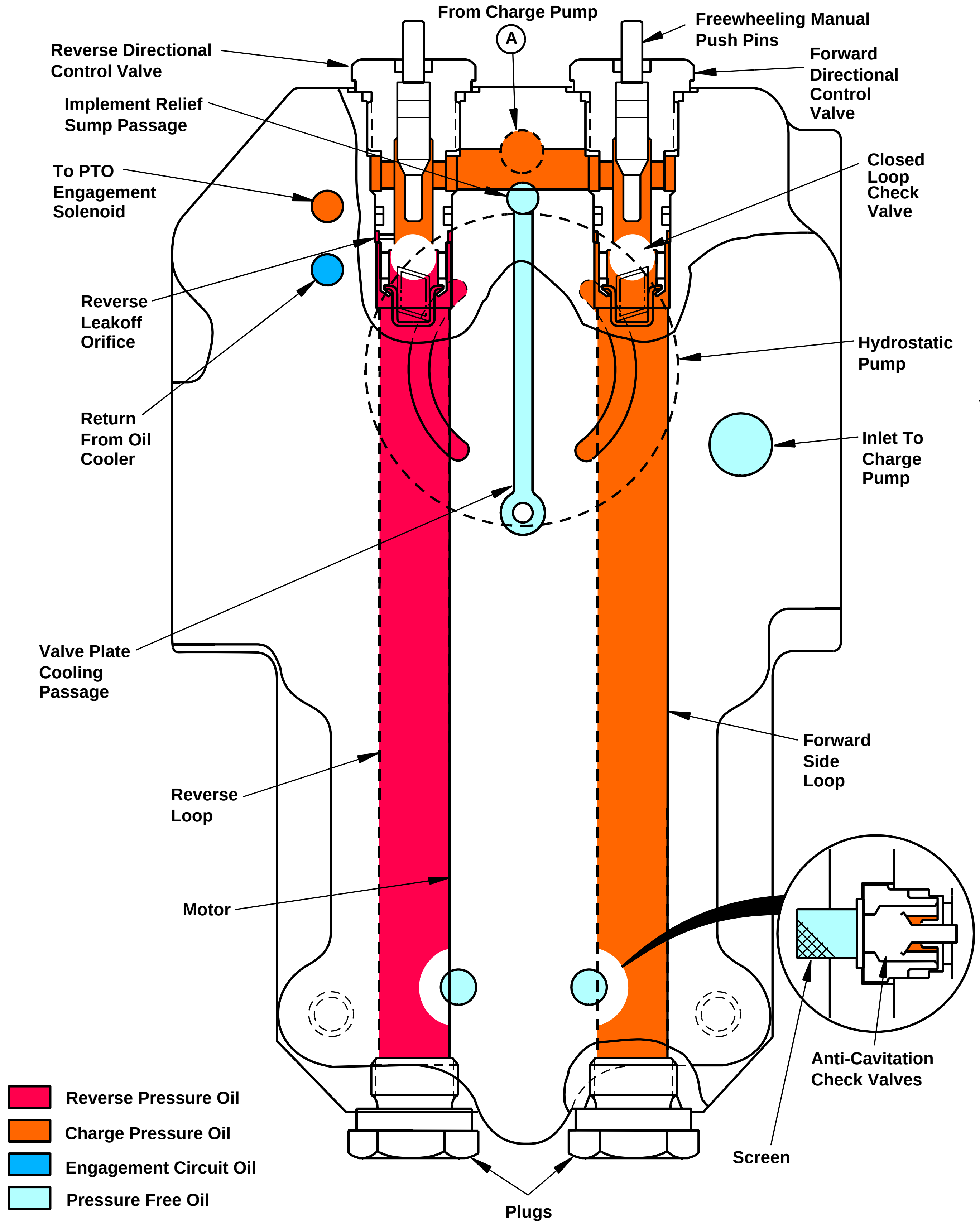


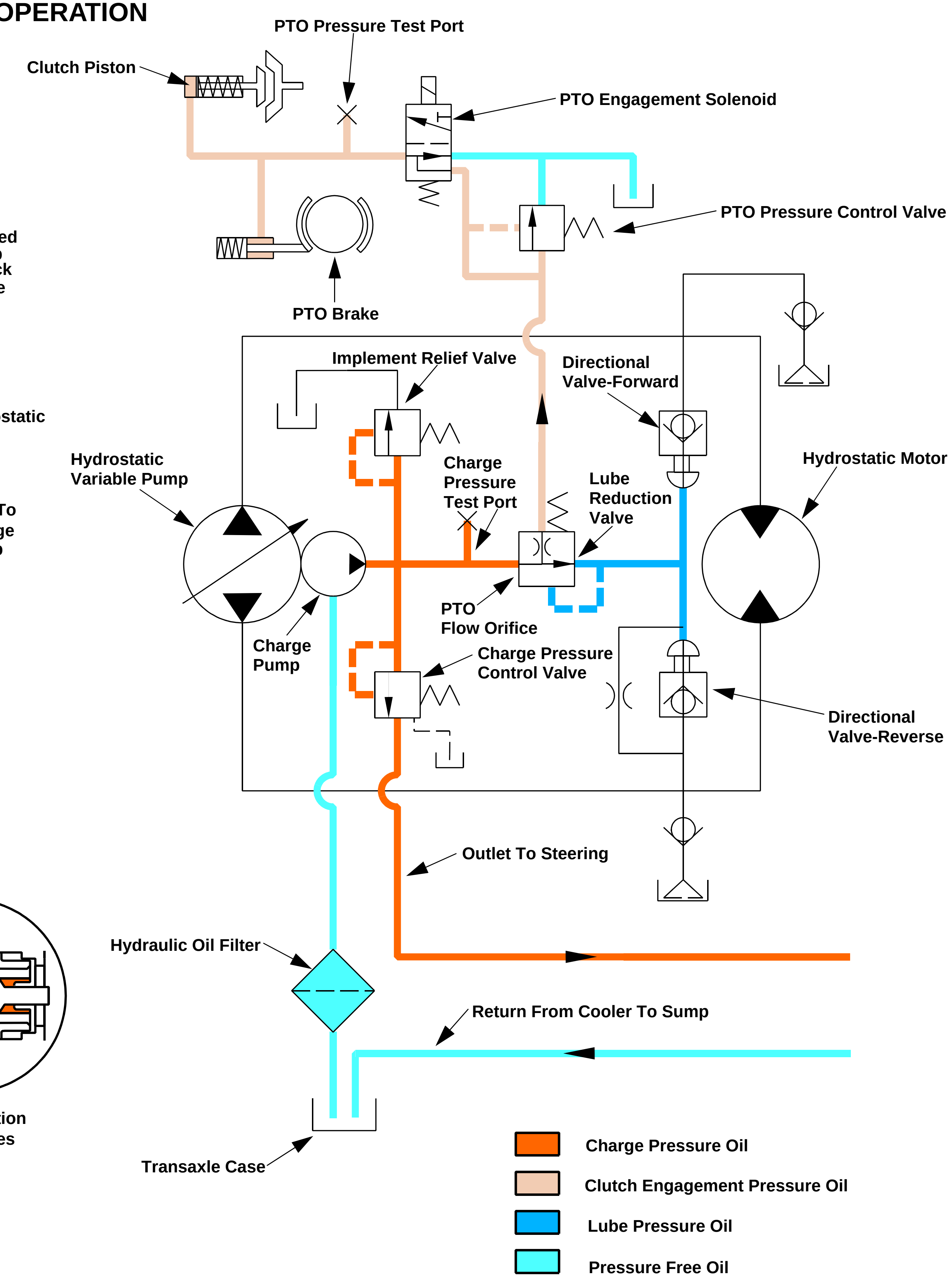


CENTER SECTION AND DIRECTIONAL CONTROL VALVES—REVERSE SYSTEM OPERATION

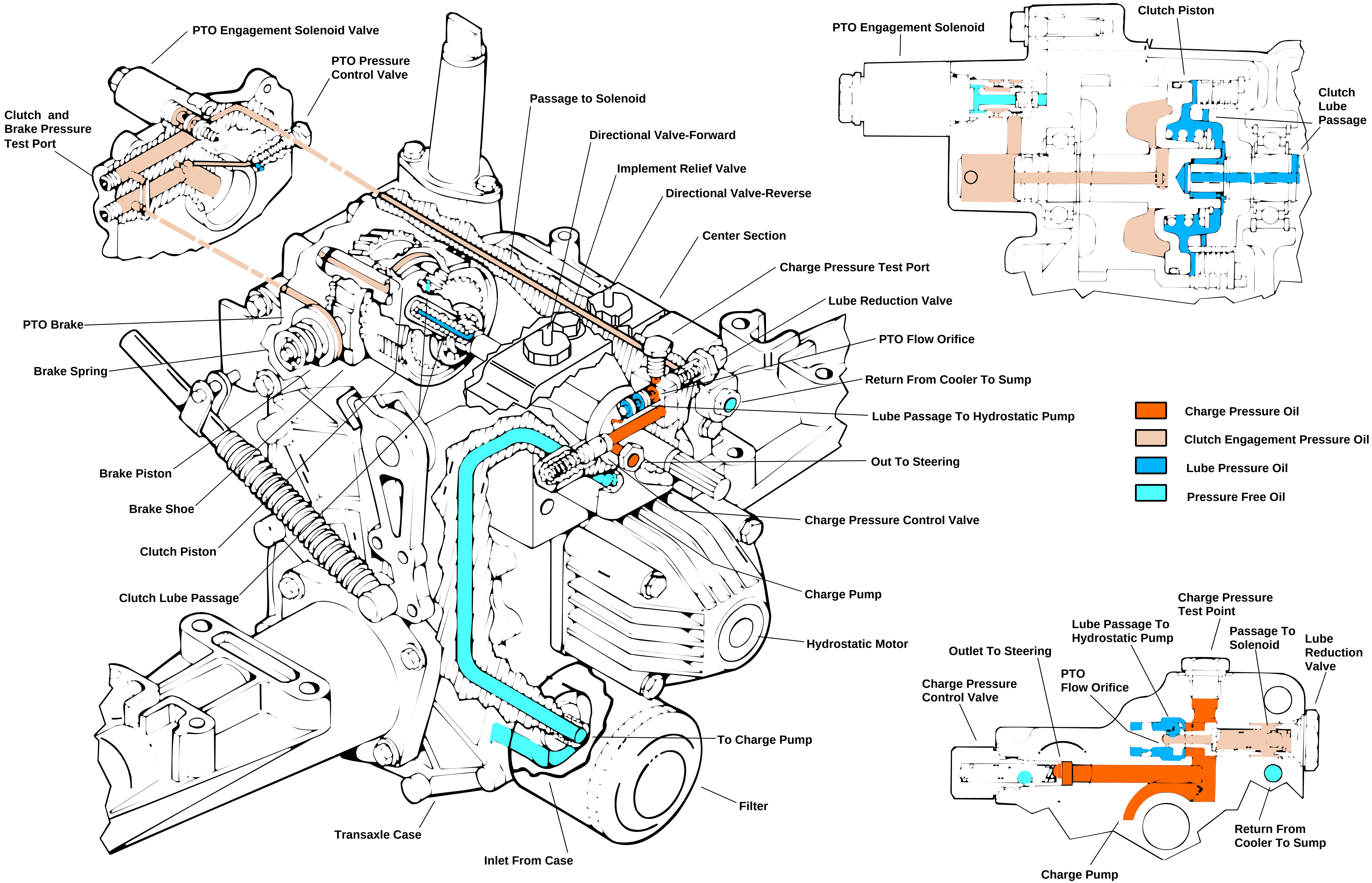


CENTER SECTION AND DIRECTIONAL CONTROL VALVES—REVERSE SYSTEM OPERATION

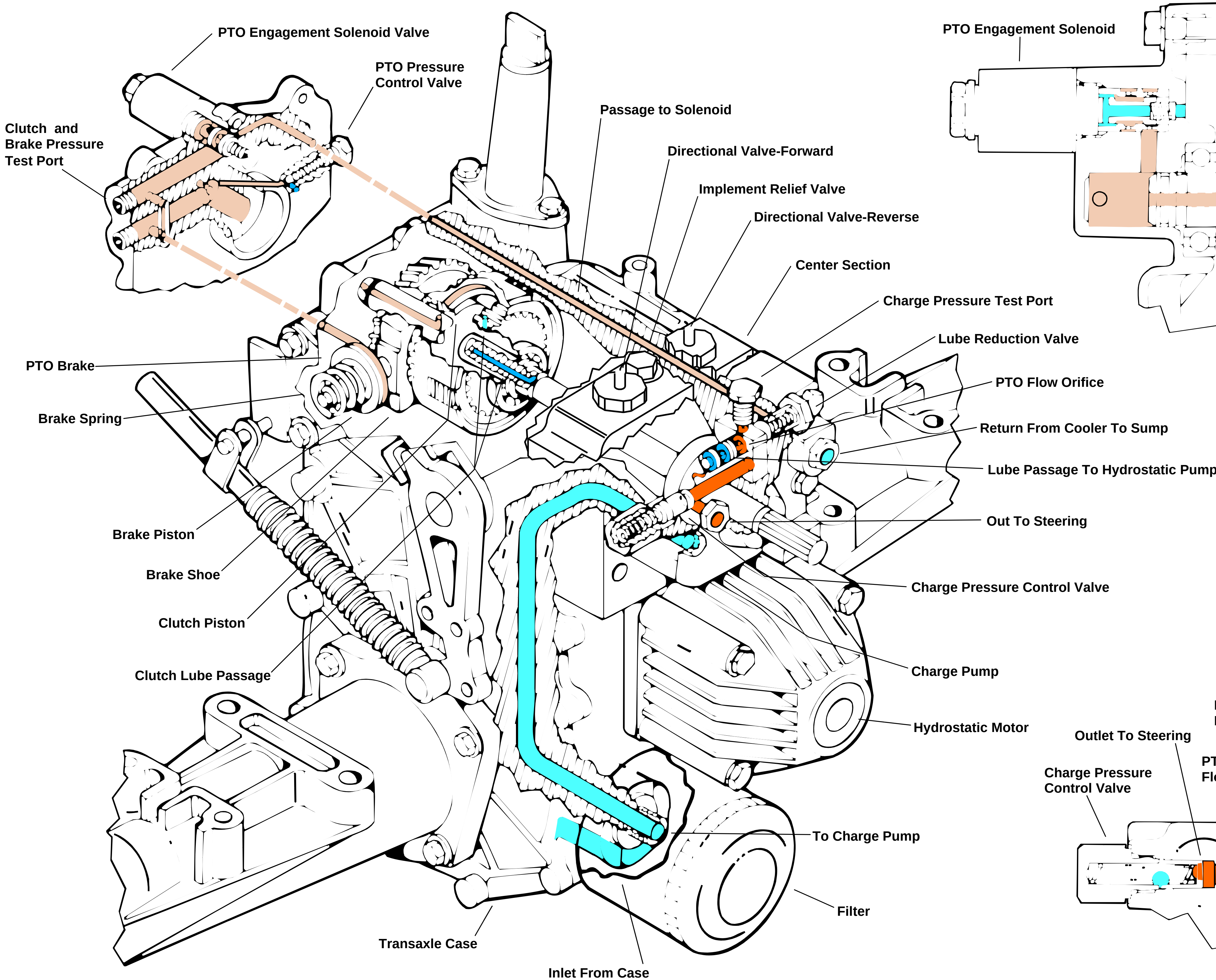


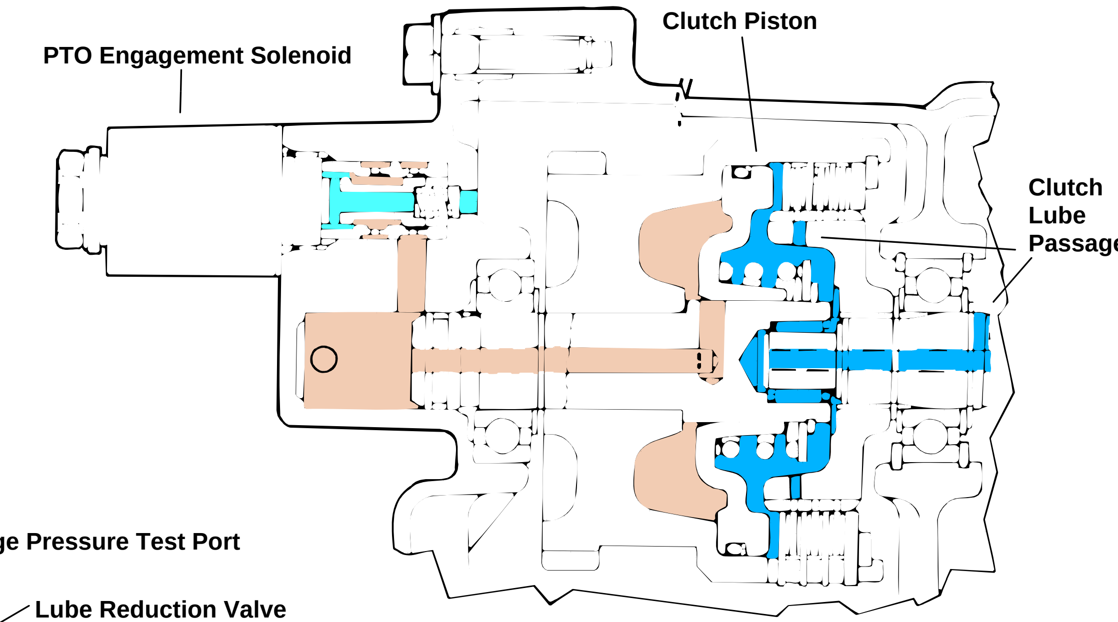


TRANSAXLE OIL FLOW



TRANSAXLE OIL FLOW



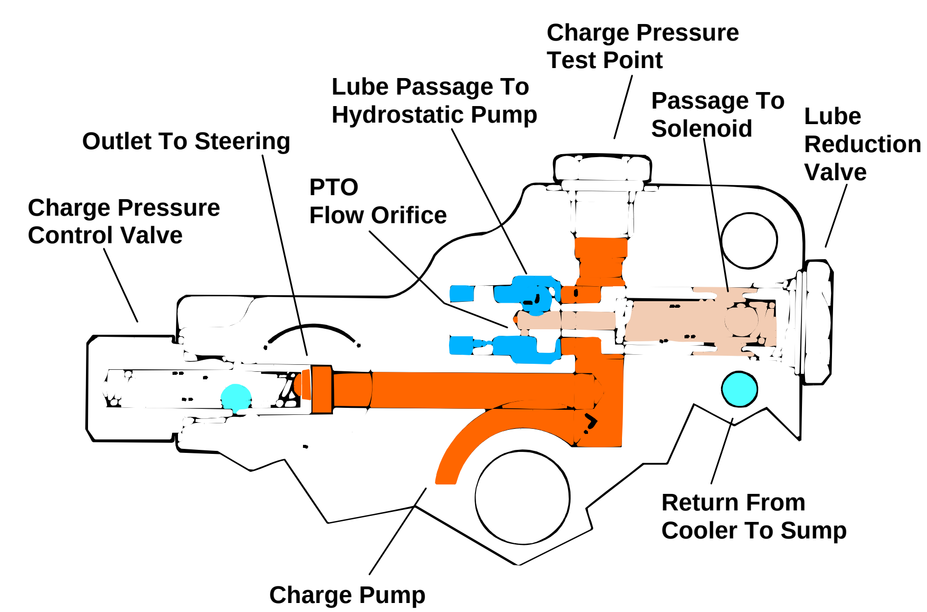


Charge Pressure Oil

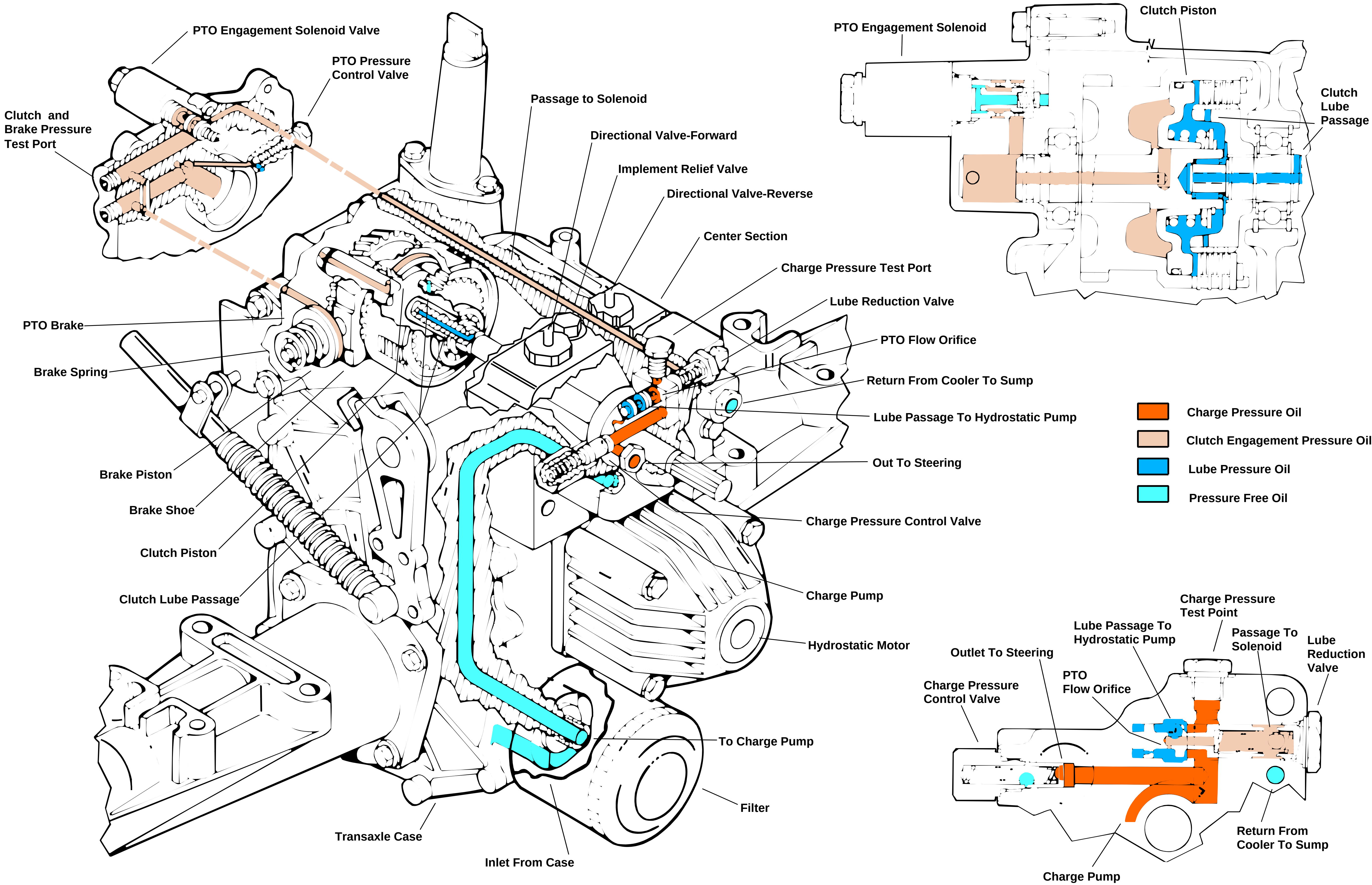
Clutch Engagement Pressure Oil

Lube Pressure Oil

Pressure Free Oil



TRANSAXLE OIL FLOW



TRANSAXLE OIL FLOW SYSTEM OPERATION

Function:

Provide pressure oil to charge and lubricate the hydrostatic transmission, operate the hydraulic system and engage the PTO clutch and brake.

System Operation:

The charge pump draws oil from the transaxle case, through the filter and provides pressure oil to outlet galley of the pump. Three valves control the flow and pressure from the pump.

Charge Pressure Control Valve:

If charge pressure is below 1965 kPa (285 psi), the charge pressure control valve will block oil flow from leaving the "OUT" port to the steering valve. This will insure priority oil flow to the lube reduction valve for transmission lubrication.

When charge pressure is at 1965—2255 kPa (285—327 psi), it will allow oil flow out the "OUT" port to steering and hydraulic control valve.

Implement Relief Valve:

Implement relief valve protects the hydraulic system and charge pump from excessive pressure. High pressure in the hydraulic circuit can be caused by an excessive load on the hydraulic outlets, or with nothing connected to the outlets when the control lever is moved.

Lube Reduction Valve:

The lube reduction valve has two functions:

1. If pressure in the lube and charge port exceeds 586 kPa (85 psi), it will close off the flow to the port, reducing lube and charge pressure.
2. This valve also has a small orifice that allows a small flow of oil to the engagement solenoid. Oil is available for clutch and brake engagement when PTO is engaged.

EXTERNAL POWER TRAIN SYSTEM OPERATION

System Operation:

The transaxle is a combination of a hydrostatic transmission, differential and axle assemblies. It also contains a hydraulic operated PTO clutch and brake with all associated drive train gears.

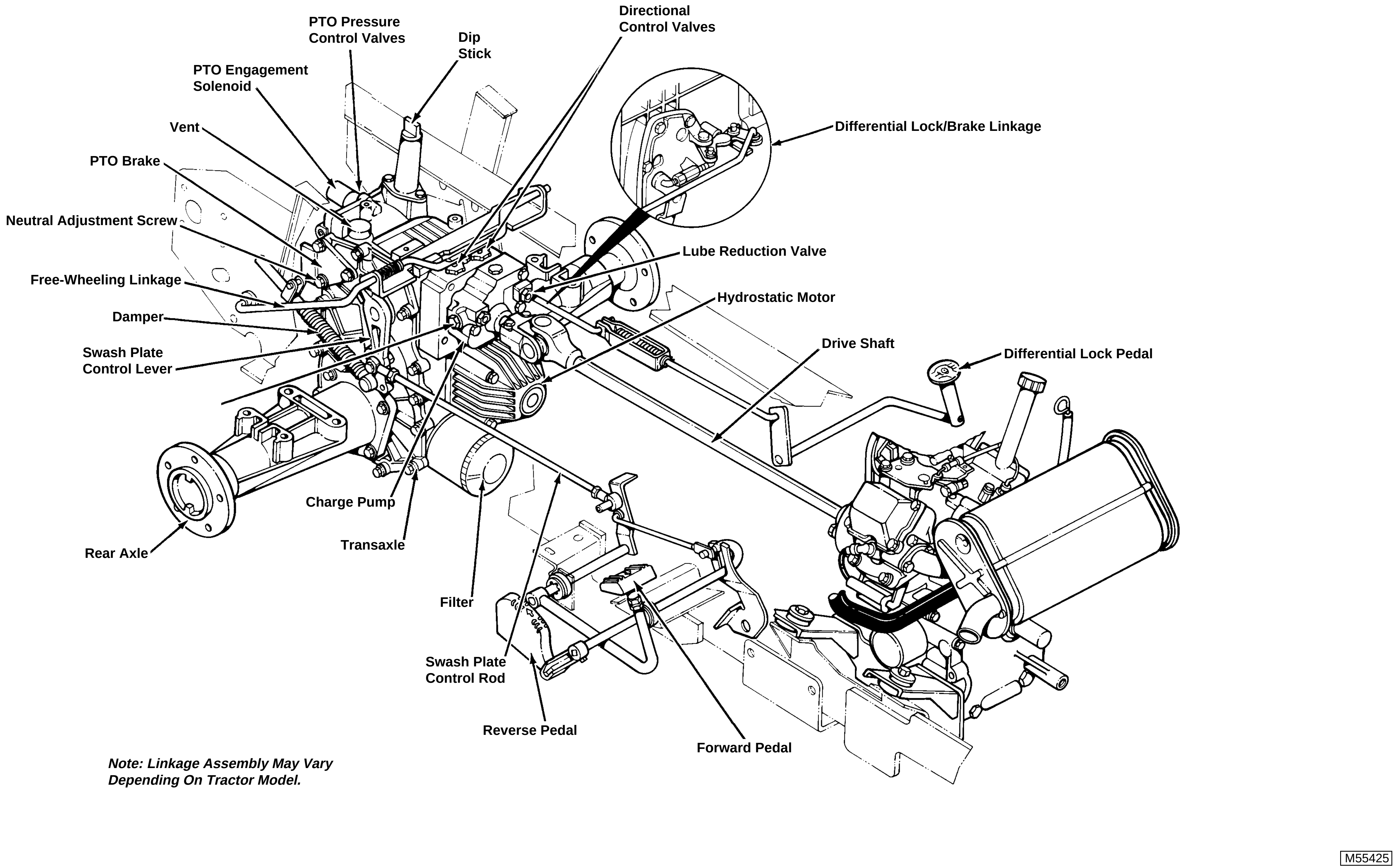
The drive shaft connects the engine to the input shaft of the transaxle. The input shaft rotates the charge pump, hydrostatic pump and PTO clutch drive hub. These components provide the power to operate the transaxle.

The transaxle is controlled by foot operated forward and reverse pedals. The pedal linkage is connected to the swash plate control lever that operates the internal swash plate shaft, controlling the direction and amount of output of the hydrostatic pump to the hydrostatic motor. The damper (shock absorber) provides for a smooth operation of the control linkage and also provides the pedal "feel".

The differential lock pedal and linkage are located on the left-hand side of the transaxle. When the pedal is depressed, the linkage holds the internal differential lock lever, collar and pins under spring tension. This is done because if the lock pins do not line up with the holes in the differential, the lock will not engage. When the holes do line up with the pins, the spring will force the pins to engage.

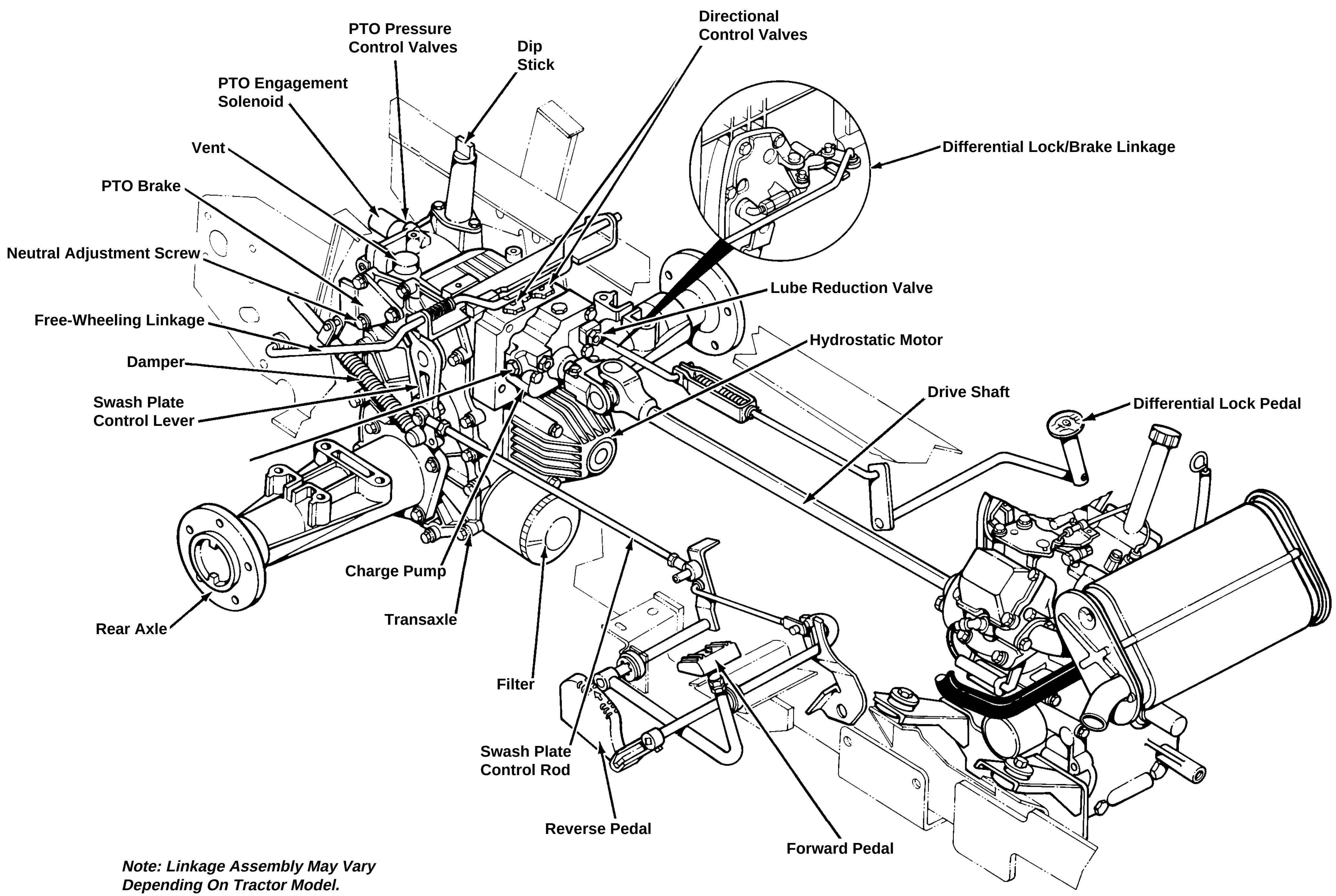
The free-wheeling linkage is accessible from the right rear of the tractor. When the linkage is moved up, the directional control valves are depressed, allowing the closed loop circuit to by-pass, allowing the tractor to be pushed.

EXTERNAL POWER TRAIN SYSTEM OPERATION



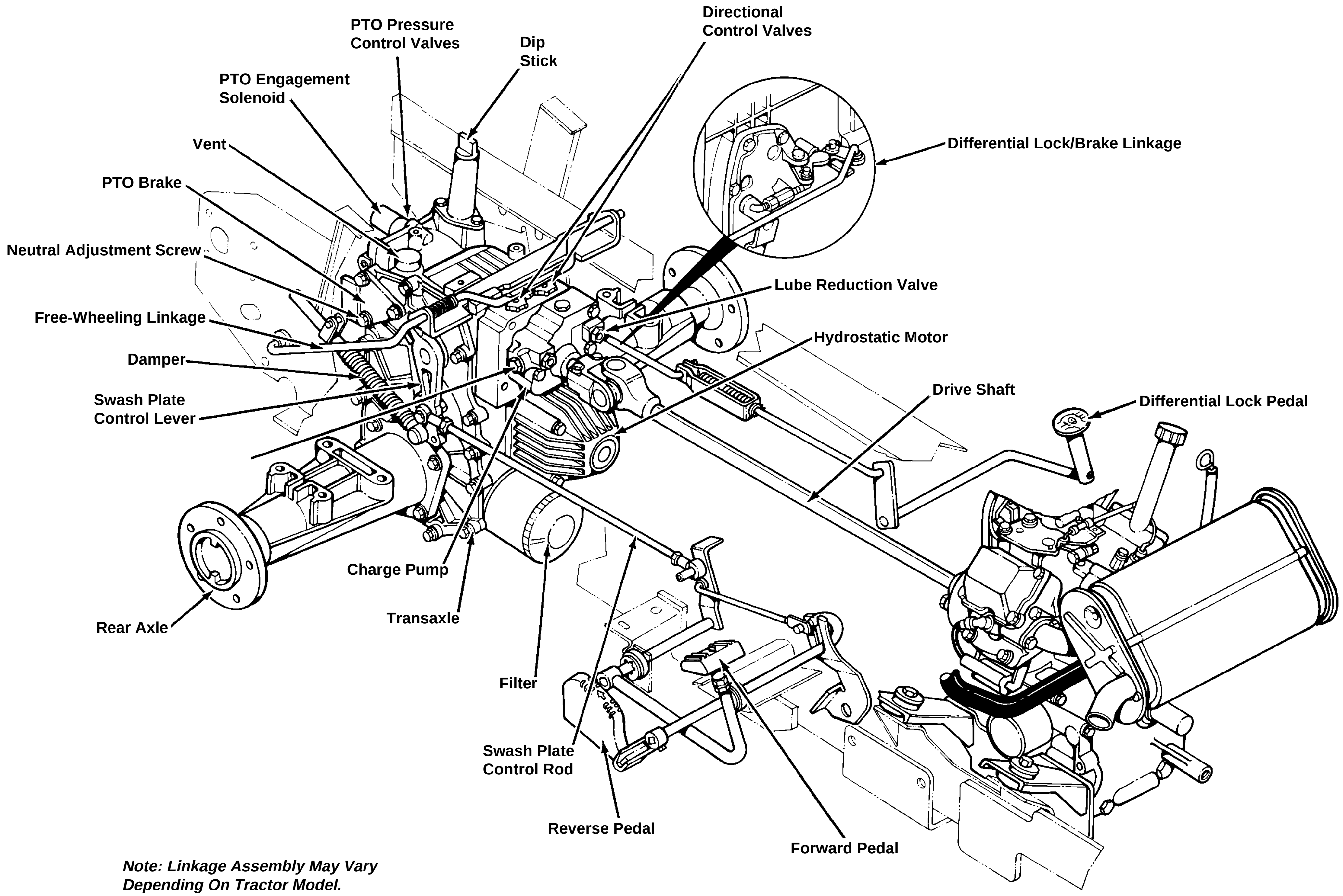
Note: Linkage Assembly May Vary Depending On Tractor Model.

EXTERNAL POWER TRAIN SYSTEM OPERATION



Note: Linkage Assembly May Vary Depending On Tractor Model.

EXTERNAL POWER TRAIN SYSTEM OPERATION



Note: Linkage Assembly May Vary Depending On Tractor Model.

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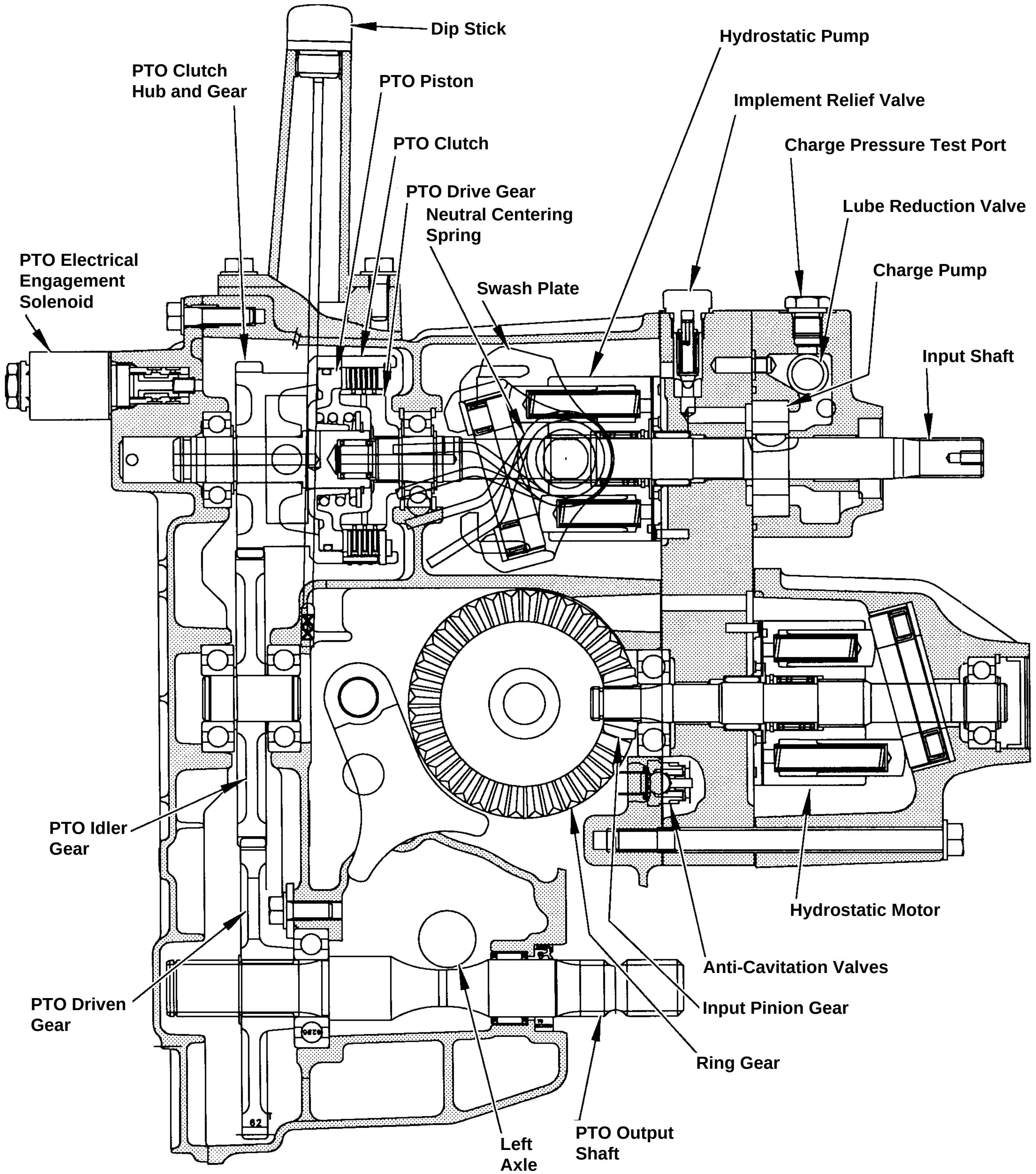
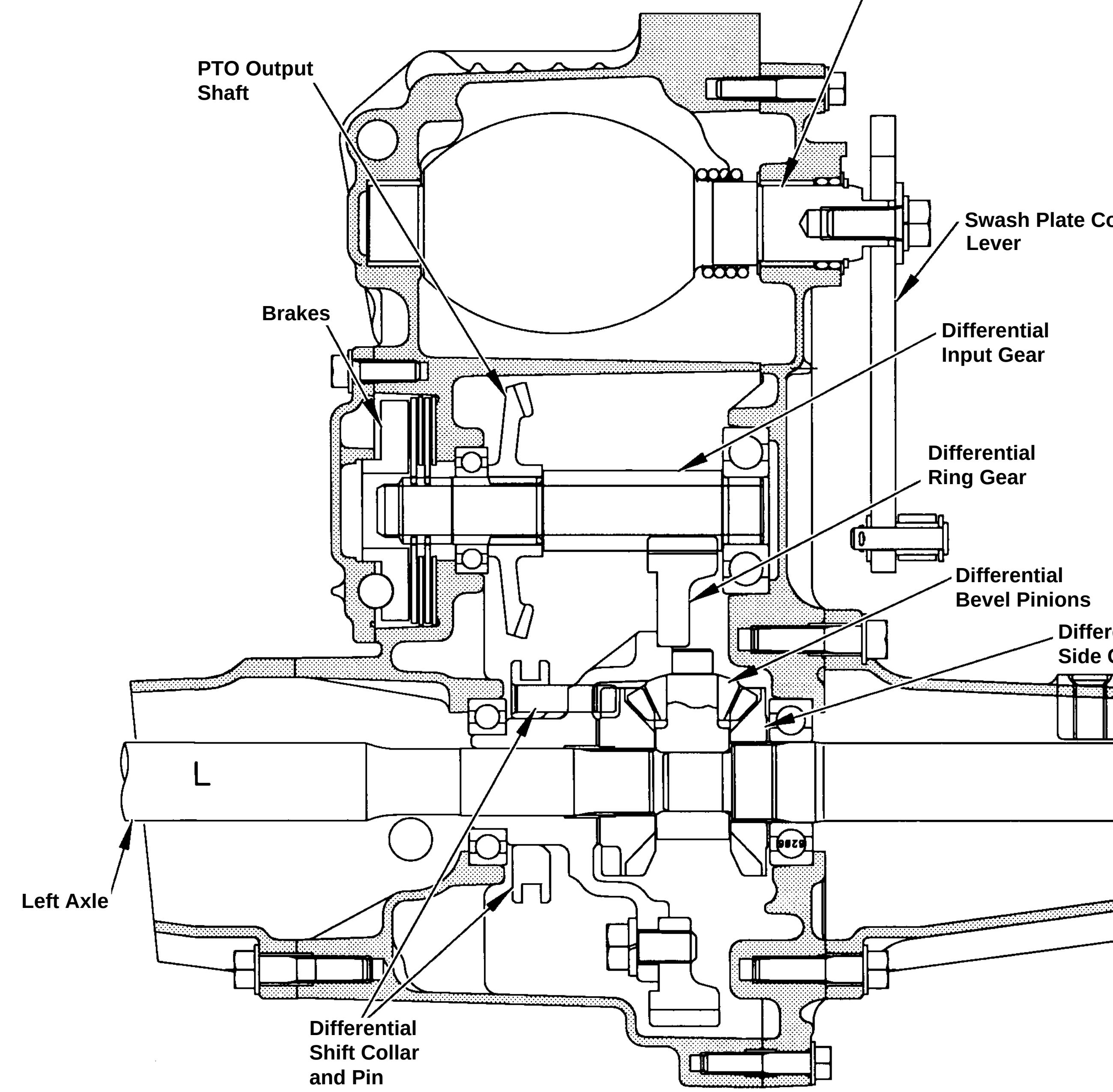
TRANSAXLE INTERNAL SYSTEM OPERATION

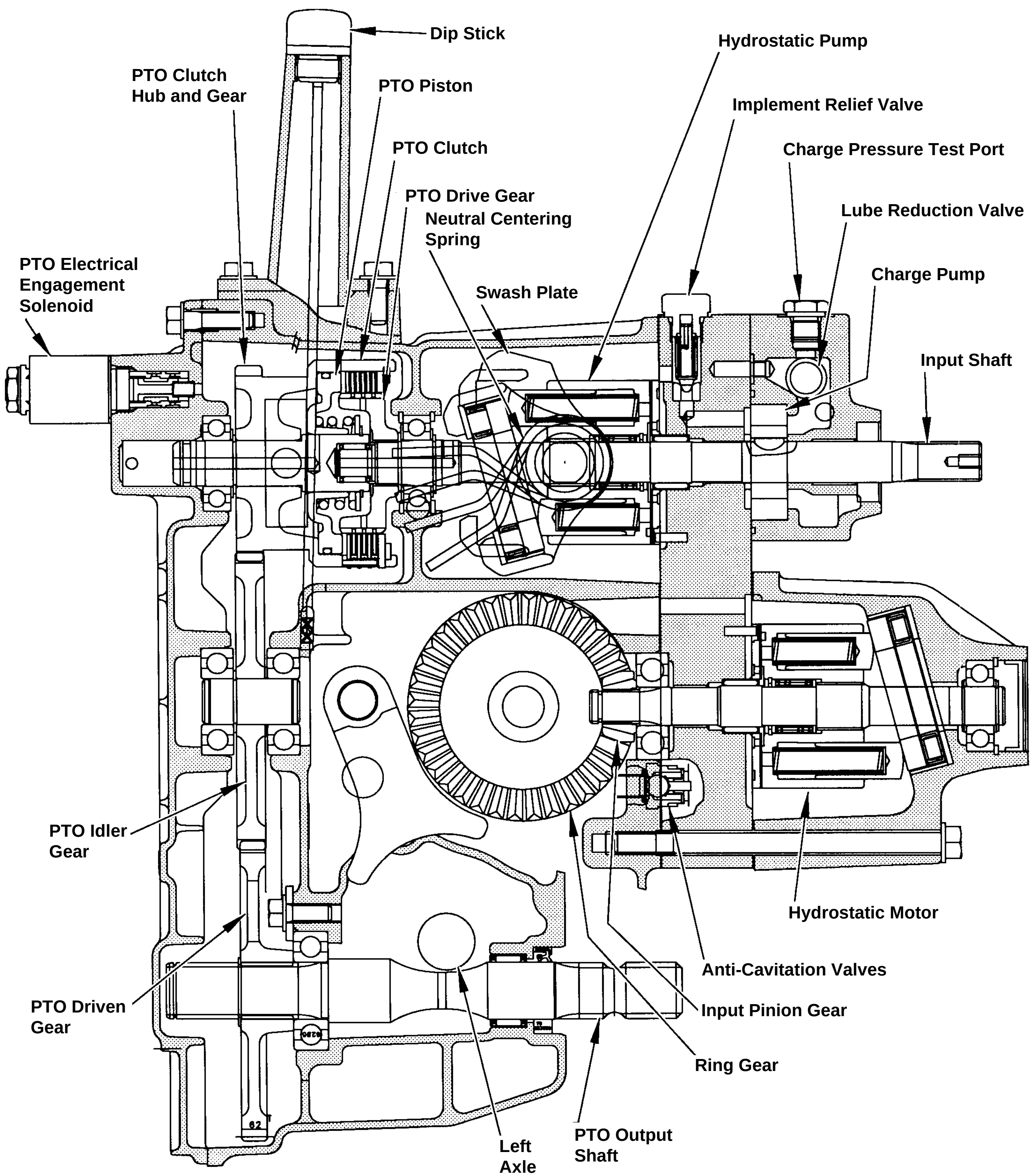
Side View

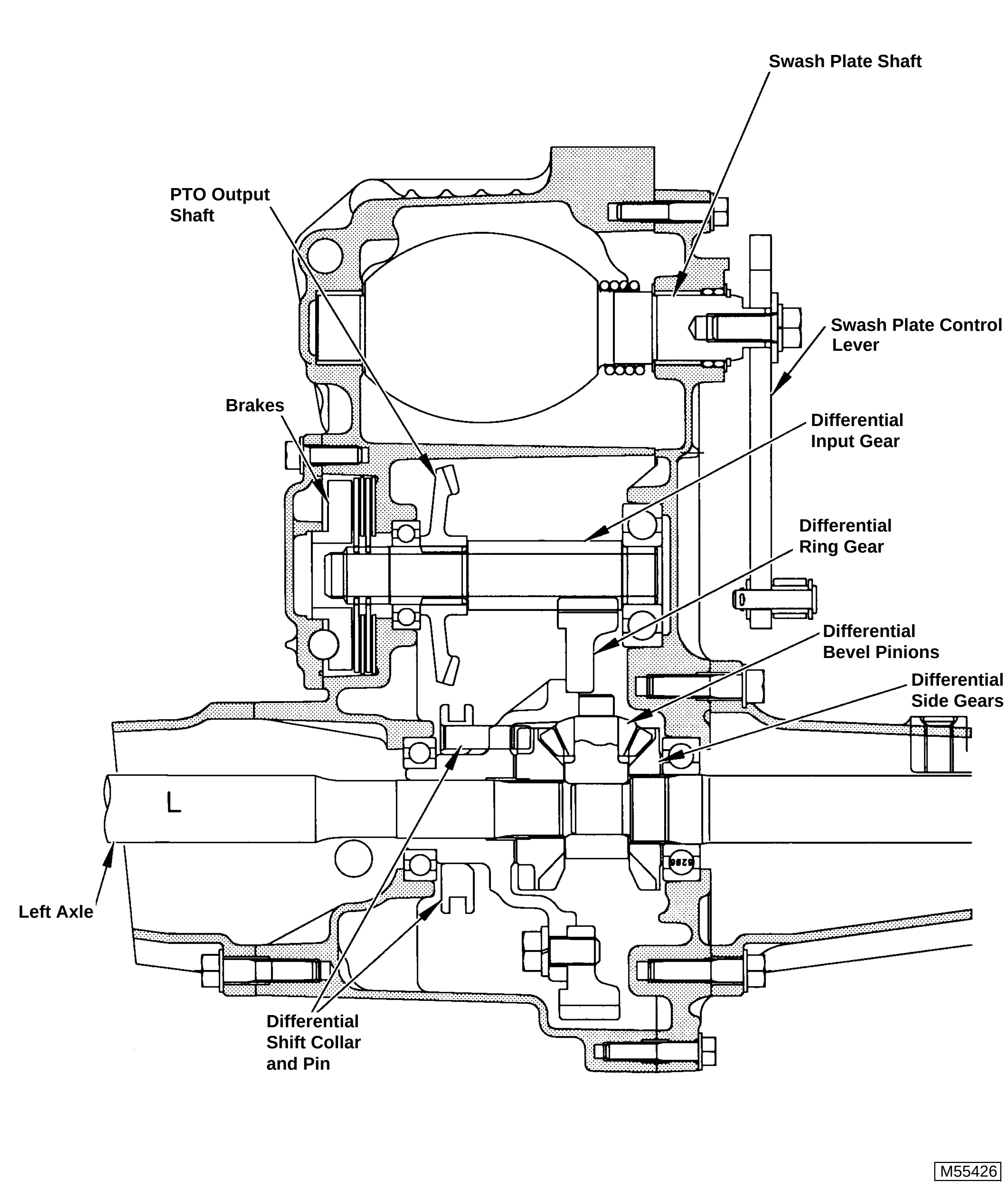


Rear View



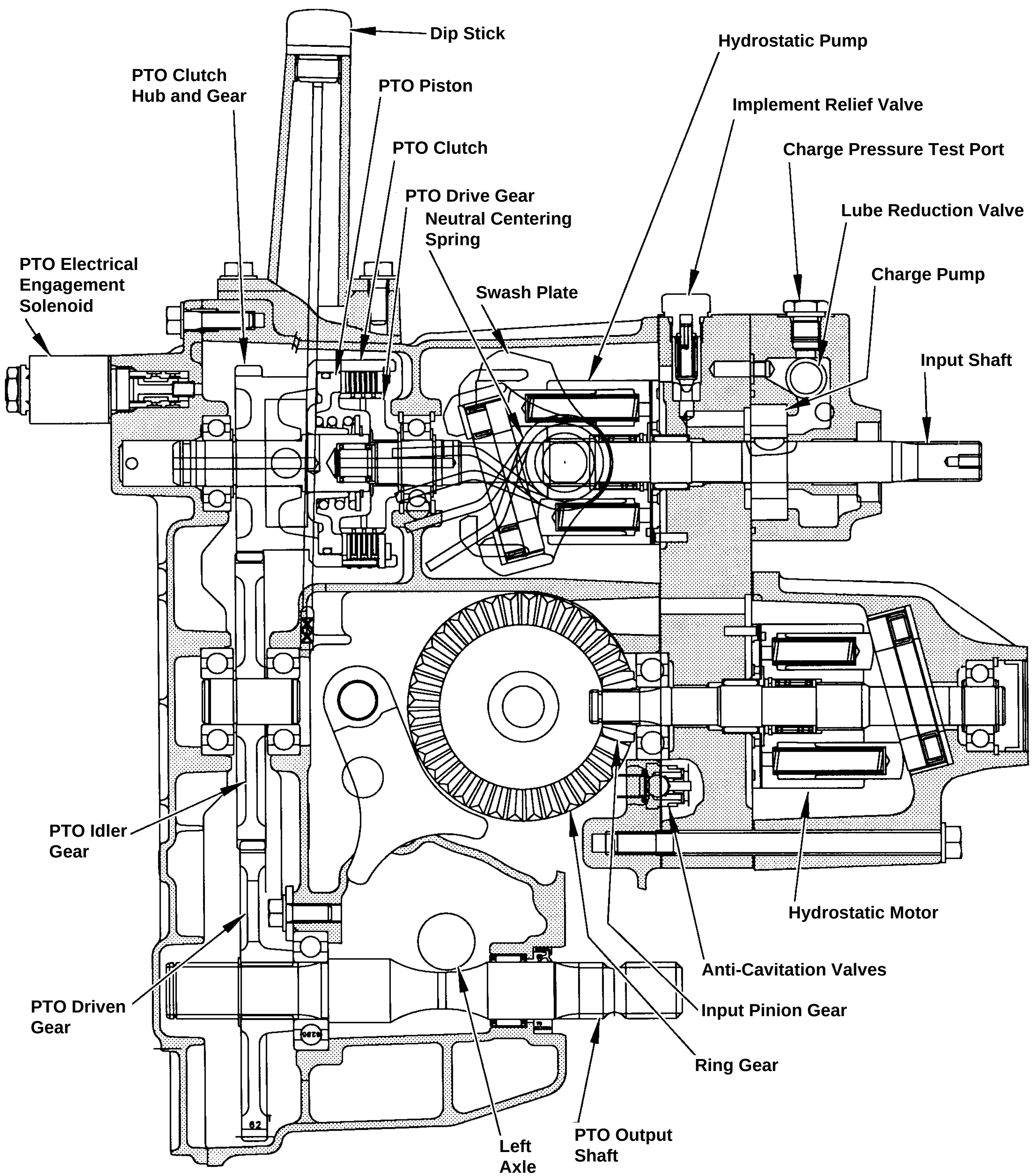
TRANSAXLE INTERNAL SYSTEM OPERATION



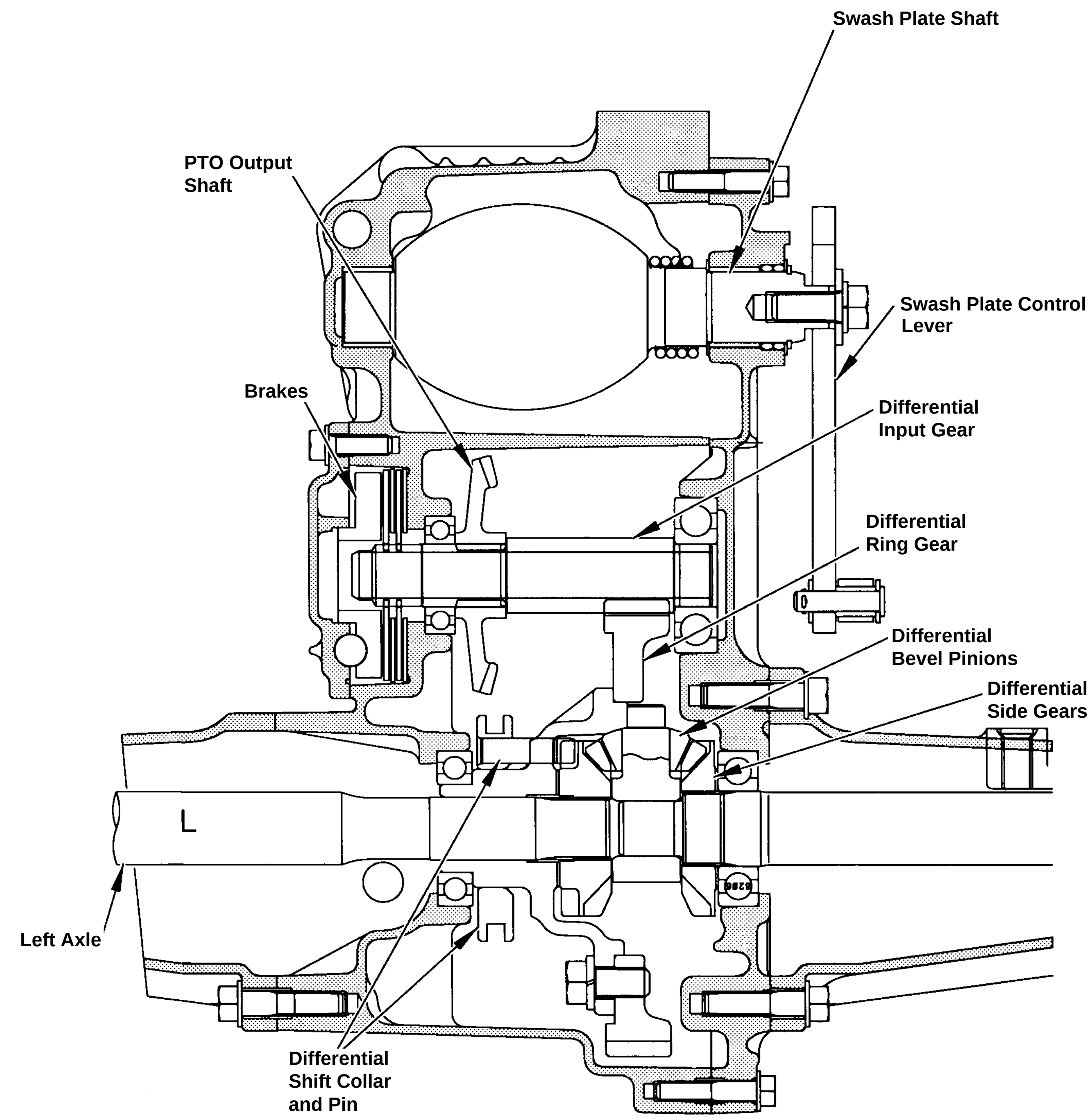


TRANSAXLE INTERNAL SYSTEM OPERATION

Side View



Rear View



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TRANSAXLE INTERNAL SYSTEM OPERATION

Transaxle Operation:

The transaxle consists of an internal hydrostatic pump and external hydrostatic motor, differential assembly and a hydraulic PTO clutch and gearing to the PTO output shaft.

Whenever the engine is running, the drive shaft is turning the input shaft, charge pump and PTO drive gear.

The charge pump provides charge and lubrication oil for the hydrostatic pump, motor and PTO clutch lube. It also provides pressure oil to operate the PTO clutch and supply oil for the steering valve and hydraulic control valve. (See STEERING HYDRAULICS sections.)

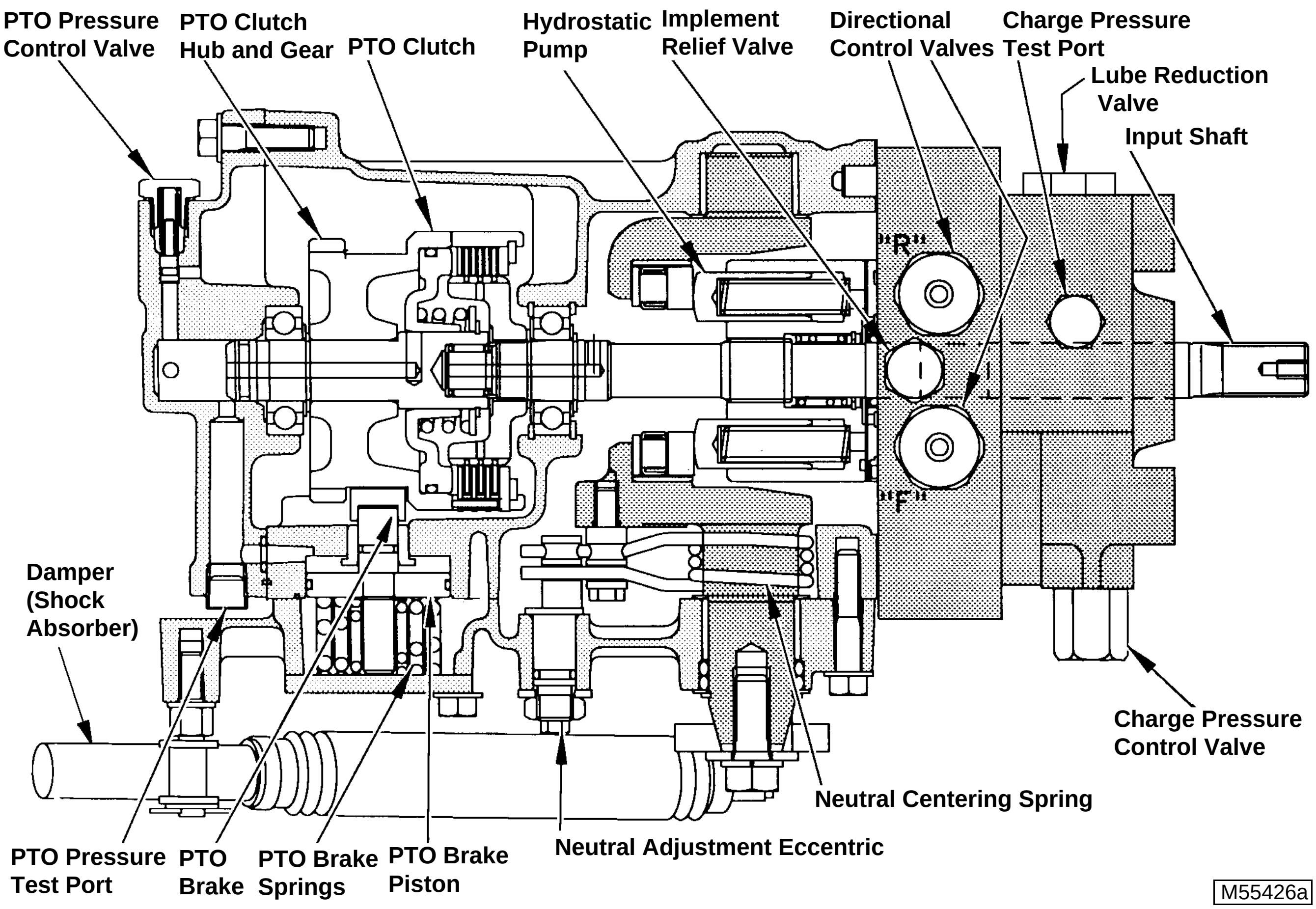
The hydrostatic pump, controlled by the foot control linkage and swash plate, provides direction and speed of the closed loop pressure oil to the hydrostatic motor. The motor drives the input pinion gear. Power is then transmitted through the ring gear, differential input gear and differential ring gear. Differential action to the rear axles and wheels is provided through the bevel pinions and side gears.

When the differential lock is engaged, the differential collar and pins lock the left-hand axle and side gear to the differential carrier, turning both axles at the same rate.

PTO Operation:

When the PTO is engaged, the electrical engagement solenoid allows pressure oil, supplied by the charge pump, to engage the PTO clutch and release the PTO brake. The PTO clutch is applied when pressure oil moves the PTO piston, squeezing the clutch disk together. With the disks locked together, power is then transmitted by the PTO clutch hub and gear, through the idler gear and driven gear and out the case through the output shaft.

The PTO brake is released at the same time the clutch is applied. Pressure oil moves the brake piston out against brake spring pressure, releasing the brake. When the PTO is shut off, the engagement solenoid blocks the pressure oil and the brake springs push the piston and brake shoe against the PTO clutch hub and gear. Frictional force stops the rotation of the PTO drive train. (See TRANSAXLE OIL FLOW SYSTEM OPERATION.)



REAR PTO COMPONENT LOCATION AND OPERATION—OPTIONAL

Function:

To provide 540 rear PTO drive.

Theory of Operation:

The mid-PTO and the rear PTO kits, use a common power flow up to the shift collar. To have power to either or both PTO's the operator must be on the seat and PTO clutch must be engaged. Power is then transmitted from the input shaft through the clutch disks and out the clutch hub and gear, idler gear, PTO drive gear and into shift collar. The shift collar has three detented positions. It is moved by the shift fork that is controlled by the external shift lever.

Rear PTO:

When the shift collar is positioned in the rear detent (shift lever up), the collar connects and drives only the rear PTO drive gear. Power then flow through the reduction gear set and PTO output gear, out the rear coupler. A boss on the shift fork depresses the mid-PTO switch, turning off the mid-PTO indicator light on the dash.

Mid- and Rear PTO:

When the shift collar is in the middle detent position, the shift collar picks up both the rear and mid-PTO drive gears. Both PTO output shafts are powered. The shift fork boss is not depressing either of the PTO switches, leaving both PTO indicator lights on.

Mid-PTO:

When the collar is positioned in forward detent (shift lever down) the collar connects and drives only the mid-PTO shaft. A boss on the shift fork depresses the rear PTO switch and turns the indicator light on the dash off.

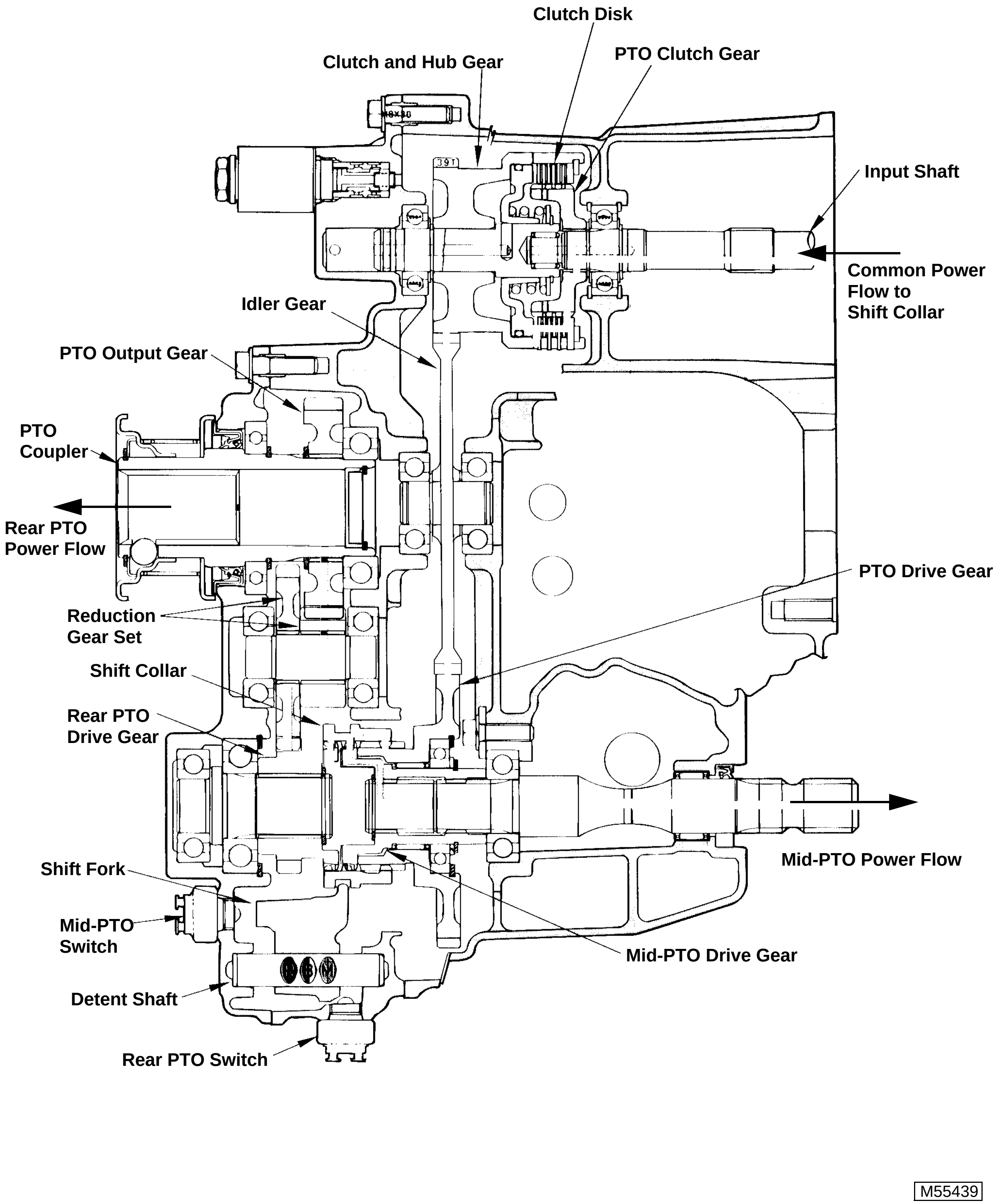
Stationary PTO Operation:

For the rear PTO to operate with operator off seat, a start-up sequence must be followed:

1. Engine off. PTO switch off. PTO drive line connected and shields in place.
2. Park brake set.
3. Rear PTO lever positioned up for rear PTO operation.
4. Engine can be started with operator on or off seat.
5. Operator off seat. Pull PTO switch on.

NOTE: If seat switch is activated by touching or sitting on seat, PTO will disengage. Repeat procedure to engage PTO.

540 REAR PTO


Clutch Disk
Clutch and Hub Gear
PTO Clutch Gear
Input Shaft
Common Power Flow to Shift Collar
Idler Gear
PTO Output Gear
PTO Coupler
Rear PTO Power Flow
PTO Drive Gear
Reduction Gear Set
Shift Collar
Rear PTO Drive Gear
Mid-PTO Power Flow
Shift Fork
Mid-PTO Switch
Mid-PTO Drive Gear
Detent Shaft
Rear PTO Switch
M55439

TROUBLESHOOTING

HYDROSTATIC TRANSMISSION

Problem or Symptom / Check or Solution	Unit will not move on its own power.	Will not move in one direction.	Too aggressive in reverse.	Slow forward under load or speed drops when load is applied.	Erratic speed.	Hydraulic noise.	Transmission operating hot.	Gear noise, dependent on speed, direction of travel or during turn.	Unit will not stop.
Free-wheeling linkage set for push or partially set.	●	●	●	●	●	●	●		●
Drive shaft not turning pump input shaft or charge pump key sheared.	●			●	●	●		●	
Directional control valves leaking or stuck down.	●	●		●	●	●	●		
Anti-cavitation valves leaking or stuck open.	●	●		●	●	●	●		●
Directional valve in wrong location.		●	●	●					
Charge pump scored or worn. See CHARGE PUMP FLOW AND PRESSURE TEST.	●			●	●	●	●	●	
Pump or motor valve plates scored or worn.	●	●	●	●	●	●	●	●	
Filter plugged or suction side air leak. Check filter, charge pump or case seal.	●			●	●	●		●	
Implement relief valve leaking. Seat valve or spring damaged.	●				●	●	●		
Control pedal linkage bent, binding or disconnected.	●	●		●	●				●

Problem or Symptom / Check or Solution	Unit will not move Wheels locked up Can not be pushed.	Unit will not move on its own power.	Will not move in one direction.	Too aggressive in reverse.	Slow forward under load or speed drops when load is applied.	Erratic speed.	Hydraulic noise.	Transmission operating hot.	Gear noise, dependant on speed, direction of travel or during turn.	Unit will not stop.	PTO problem or complaint.	Transaxle or differential lock problem or complaint.
Engine performance is poor or not operating or set at correct operating speeds. See ENGINE DIAGNOSIS.					●	●						
See TRANSAXLE DIAGNOSIS.	●	●	●					●	●			●
For mid- or rear PTO problems or complaints. See MID- OR REAR PTO DIAGNOSIS.							●	●	●		●	
Brakes set or not releasing. See BRAKES section.	●	●				●	●	●	●	●		
Swash plate control shaft or bushing worn.						●	●			●		
Neutral adjustment not correct. See TRANSMISSION NEUTRAL ADJUSTMENT.							●	●		●		
Linkage damper (shock absorber) failed.				●		●						

MID-PTO SYSTEM

Problem or Symptom / Check or Solution	PTO will not engage.	Engine stalls when PTO is engaged.	PTO will not stay engaged.	PTO shaft slows down.	PTO shaft will not stop, or slow to stop.	Gear or bearing noise with PTO engaged.
Check engagement solenoid circuit. See ELECTRICAL section.	●		●		●	
Engagement valve installed incorrectly.	●		●		●	
Use higher engine rpm. Check engine performance.		●		●		
Hydraulic circuit in relief. Remove restriction or load.		●				
PTO brake not releasing. Check brake piston, O-rings.		●			●	●
Excessive load on PTO output. Remove load.		●		●	●	
PTO clutch piston leaking, input shaft seal leaking or clutch disk worn.	●		●	●		
PTO lube reduction valve orifice plugged.	●		●	●		
Low charge pump output. Perform CHARGE PUMP FLOW AND PRESSURE TEST.	●		●	●		
PTO shaft, gear or bearing failure.	●	●				
PTO pressure control valve faulty.	●		●	●		
PTO brake springs faulty.					●	●

TRANSAXLE

Problem or Symptom / Check or Solution	Rear drive wheels are locked up Will not move Directional pins down.	Ratcheting noise as tractor moves.	Ratcheting noise as tractor turns.	Rear wheels free-wheel No Transaxle Drive Hydraulic control valve pins are up.	Differential lock will not engage.	Differential lock will not disengage.	PTO complaint.	Hydrostatic transmission complaint.
Brakes are applied or misadjusted. See BRAKES section.	●	●				●		●
Differential lock linkage is misadjusted. See BRAKE/ DIFFERENTIAL LOCK ADJUSTMENT.		●	●		●	●		
Differential is engaged. Check adjustment. Adjustment ok, repair differential lock.		●	●			●		
Check axle or differential gear failure. See AXLE OR DIFFERENTIAL REPAIR.	●	●	●	●				
See DIFFERENTIAL LOCK LINKAGE REPAIR.		●	●		●	●		
See TRANSAXLE REPAIR.	●	●	●	●	●	●	●	
See HYDROSTATIC TRANSMISSION DIAGNOSIS.	●			●				●
See MID-PTO OR REAR PTO DIAGNOSIS.							●	
Differential lock collar, pin or differential carrier failure. See TRANSAXLE REPAIR.	●	●	●	●	●	●		

DIAGNOSIS

HYDROSTATIC TRANSMISSION

Test Conditions:

- Park brake disengaged.
- Engine not running.
- Machine on hard level surface.

Test/Check Point	Normal	If Not Normal
1. Transmission dipstick.	Correct type, viscosity of oil, and oil level. No signs of leaks from transaxle.	Add or change hydraulic oil. Repair all external leaks.
2. Oil cooler/radiator. (Not shown.)	Intake screen and cooler fins free of debris and clean. Fins not bent.	Clean as required.
3. Hydraulic control levers. (Not shown.)	Have returned to neutral position.	Hydraulic control levers not in neutral, hydraulic system could be in relief, heating the hydraulic oil. See HYDRAULICS section and check linkage for binding.
4. Free-wheeling lever disengaged (down). Directional control valve pins.	Directional control valve pins not depressed (up).Tractor will push slowly forward but not backward.	Free-wheels in both directions, check for the following: —Free-wheeling linkage not releasing directional control valve pins. —Directional control pins stuck down.
	Brakes are not applied.	Free-wheels with brakes applied: —Adjust brakes. (See BRAKES section.) If brakes do not stop tractor, check for the following: *(Note: Push tractor until differential lock engages.)* —Failed brake shaft or bearing. —Failed differential input gear or differential carrier. —Differential bevel gears. Tractor stops after differential lock engages, check for the following: —Differential bevel gears or axles will not push in either direction. —Brakes are on or dragging. —Reverse orifice is plugged. Pushes in reverse but not forward: —Directional control valves are installed in wrong ports. Switch valves around. —Forward valve is leaking. Replace forward valve.

Test/Check Point	Normal	If Not Normal
5. Free-wheeling lever engaged (up). Directional control valve pins. (Push lever down after test.)	Directional control pins depressed. Tractor pushes easily forward and backward.	Free-wheel lever is bent, or disconnected from L.H. bracket not pushing directional control valve pins. Repair linkage. Check directional control valve pins for dirt or corrosion that would bind pins. —Check brakes for dragging.
6. Transmission control pedals and linkage. Brakes disengaged.	Pedals move smoothly with slight resistance to movement. Return to neutral position. No free-play in linkage between pedals and swash plate shaft. *NOTE: Linkage will return slower at colder temperatures.*	Inspect linkage for bent, binding or looseness. If pedals do not return to neutral, disconnect damper (shock). Pedals should return sharply. Disconnect control rod from swash plate arm. Check linkage for binding and repair. Linkage not binding, check swash plate shaft for binding or internal return/centering spring or swash plate bushing binding.
7. Transmission control pedals and linkage. Brake pedal engaged.	With brake pedal pushed in, forward and reverse pedal should be locked in neutral. Brake set and locked. Tractor should not move. Engage free-wheeling lever and push tractor to verify.	Pedals not locked in neutral. See TRANSMISSION CONTROL LINKAGE ADJUSTMENT. Brakes not holding tractor, see BRAKES section and adjust.
8. Cruise control lever and linkage (If equipped). Brake pedal released.	Push forward pedal slightly and set cruise. Cruise releases when: —Forward pedal is pressed and released. —Brake pedal is depressed.	Check linkage for bent, binding or disconnected links. Check cam teeth for wear if cruise will not stay engaged.

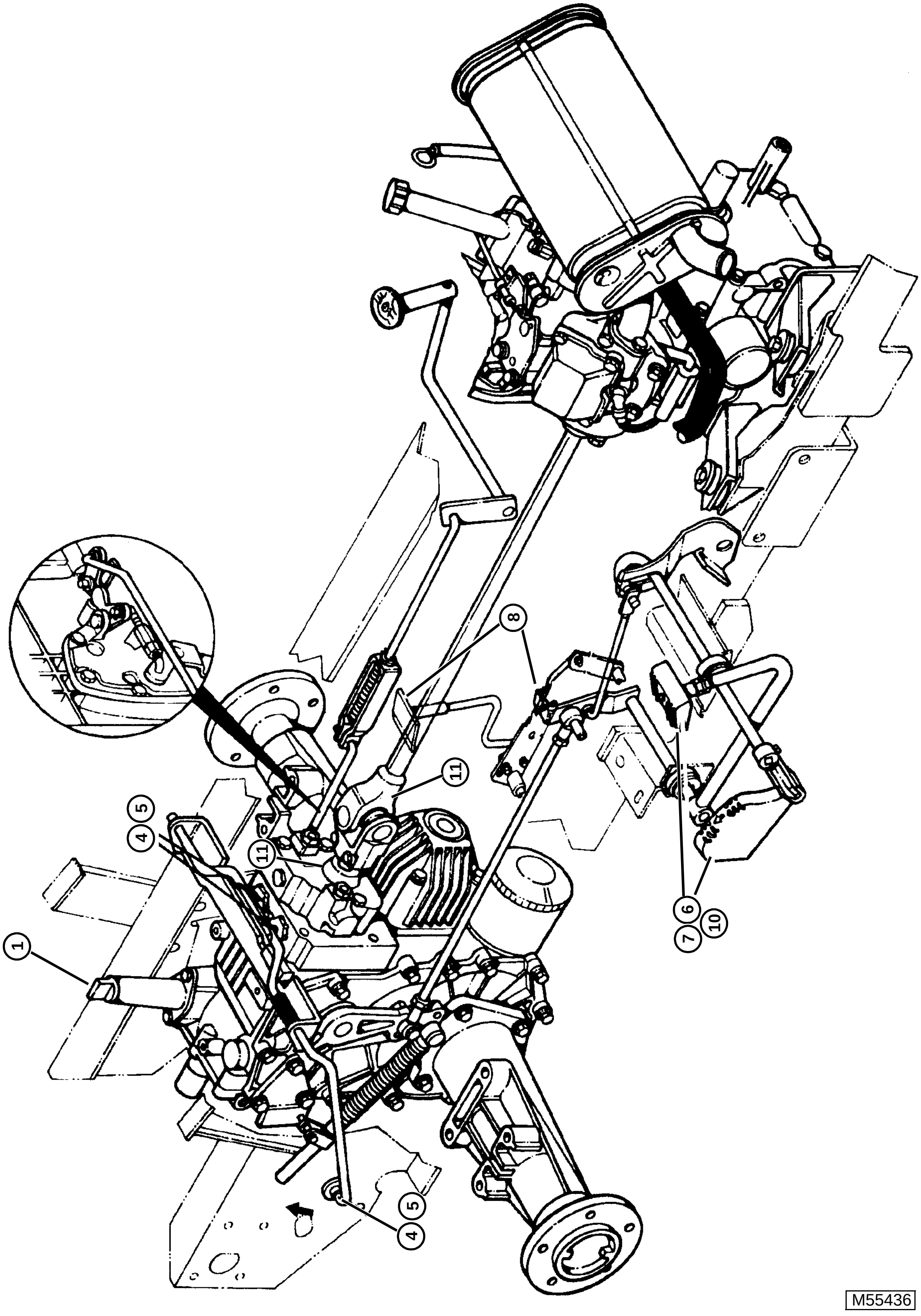
Test Conditions

- Start engine.
- Release park brake.
- Move machine to open area for driving test.

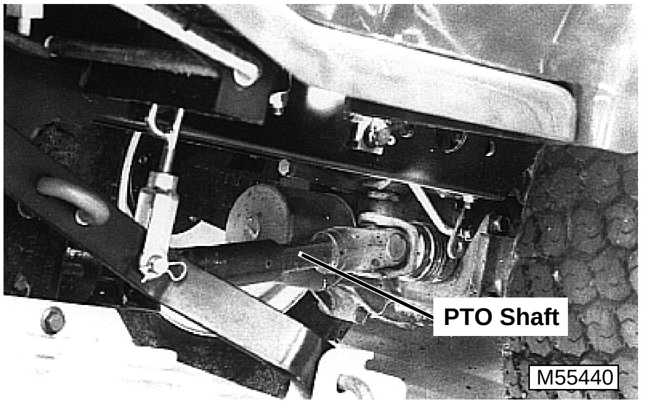
Test/Check Point	Normal	If Not Normal
9. Park brake applied.	Tractor should not have excessive noise when operated.	Excessive noise from transmission: —Transmission neutral return linkage bolt is out of adjustment.
10. Forward and reverse pedals. Drive tractor forward, then stop. Reverse and stop.	Tractor should respond to pedal movement. Gradual increase in speed forward up to 12.1 km/h (7.5 mph). Should stop within 2.2—4 m (7—10 ft) without using brake. Gradual speed increase; speed in reverse to 8.1 km/h (5 mph). Should stop within 1.2—1.8 m (4—8 ft).	Check free-wheeling linkage if tractor will not move or if hydrostatic is jerky. If tractor still will not move, continue testing sequence. If tractor does not stop within distance, check linkage for binding, replace dampener and retest. Check swash plate shaft for binding or neutral return spring, weak or broken.
11. Drive shaft.	Cap screws tight. No wear or damage to splines. Drive shaft turning input shaft.	Tighten cap screws. Repair or replace as necessary.

Test/Check Point	Normal	If Not Normal
12. Charge pump pressure port.	Charge pressure within specification.	No charge pressure, check the following: —Hydraulic oil level. —Replace hydraulic filter. —Check vent for plugging. —Check charge pump seal. —Check for sheared pump drive key. —Check implement relief valve for broken spring or debris. Charge pressure but no drive: —Replace directional control valves. —Lube reduction valve stuck. —Inspect pump and motor for wear. —See TRANSAXLE DIAGNOSIS. —Anti-cavitation valve stuck open. —See CHARGE PUMP FLOW AND PRESSURE TEST. —Extreme wear of valve plates or rotating groups.

HYDROSTATIC TRANSMISSION TEST POINTS



MID-PTO SYSTEM



Test Conditions:

- Park brake disengaged.
- Engine running approximately half throttle.
- Deck or PTO driven implement installed.
- PTO switch off.

Test/Check Point	Normal	If Not Normal
1. PTO shaft.	PTO shaft must not be turning.	Perform PTO BRAKE TEST. Check brake springs, brake shoes, solenoid valve and clutch return spring
2. PTO switch on. Brake off. On seat.	PTO must engage. *(NOTE: Engagement is not modulated. Some pressure hesitation can be seen on the pressure gauge as brake piston fills). Engagement pressure must be within specification.*	Perform PTO engagement pressure test. (See MID PTO ENGAGEMENT PRESSURE AND BRAKE TEST.) No engagement, no engagement pressure: —See ELECTRICAL section, check electrical solenoid. —PTO pressure control valve leaking to sump. —Lube reduction valve orifice plugged. —No charge pressure. Perform CHARGE PUMP FLOW AND PRESSURE TEST. —Clutch or brake packing leaking. —Packing on end of clutch hub shaft missing or leaking.
3. Observe PTO Shaft. Engine at full rpm PTO on, then off.	PTO shaft and implement must stop within four seconds.	Check brake springs and brake facing. Repair PTO inertia brake.
4. PTO Shaft. Engine at full rpm PTO on.	PTO driving implement satisfactory under load. PTO clutch not slipping. No vibration.	PTO pressure low, adjust pressure control valve. Pressure in spec.: —Check clutch disk for wear. *(NOTE: Check lube passage in input shaft and in clutch input gear for blockage.)* Vibration: Disconnect implement drive shaft and operate PTO. Check shaft U-joints or implement for vibration.

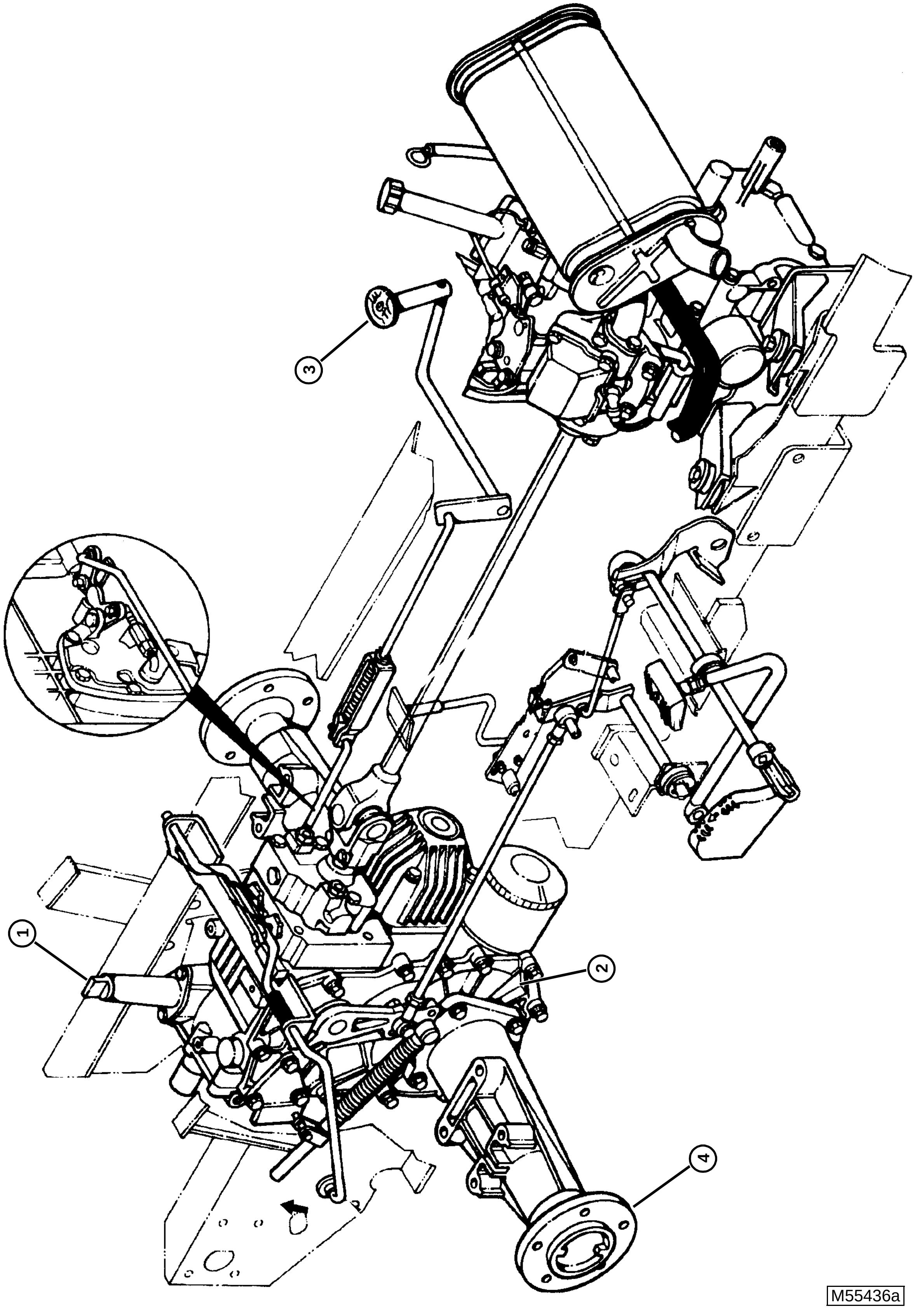
TRANSAXLE

Test Conditions:

- Park brake engaged.
- Engine not running.

Test/Check Point	Normal	If Not Normal
1. Dipstick.	Proper level and viscosity.	Add or change hydraulic oil and filter.
2. Transaxle. Drive machine.	No leaks. Transaxle engages in 0.5—1.0 seconds (abruptly).	Replace leaking and worn seals.
3. Differential lock pedal.	Differential lock engages within a short distance when pedal is depressed. Vehicle wants to continue in a straight line. Differential lock will disengage with equal traction of wheels.	Check linkage springs and all linkage connections. Inspect differential and lock collar and pins. Check for broken differential shift fork return spring.
4. Differential and axles. Jack one wheel off ground.	During a turn, no noise from axles or differential. AWS wheel hubs in knuckle housing should have movement (wobble).	Noise in the turn. Check axle bearings then differential side gears and bevel pinions.
5. Brake pedals. (Not shown.)	No noise in differential when brakes are released and rear wheels are rotated.	Ratcheting noise: see BRAKE / DIFFERENTIAL LINKAGE ADJUSTMENT in the BRAKES section. Brakes adjusted properly, disassemble and repair transaxle.

TRANSAXLE TEST POINTS



TESTS AND ADJUSTMENTS

CHARGE PUMP FLOW AND PRESSURE TEST—AT CHARGE PUMP

Reason:

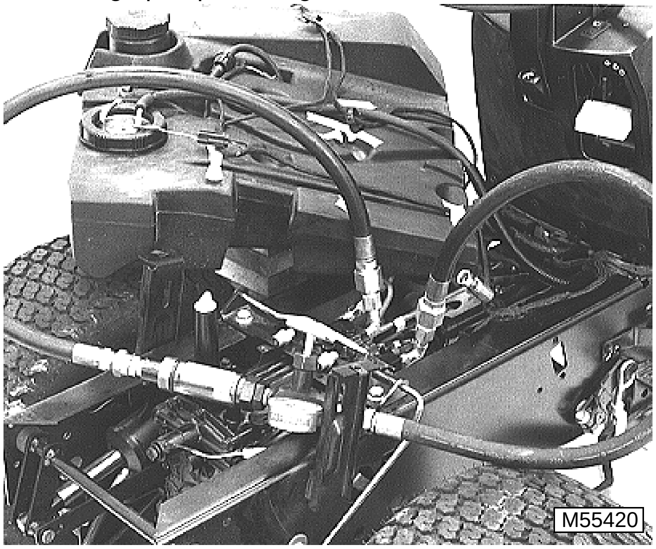
To check condition of charge pump and setting of the charge pump relief valve.

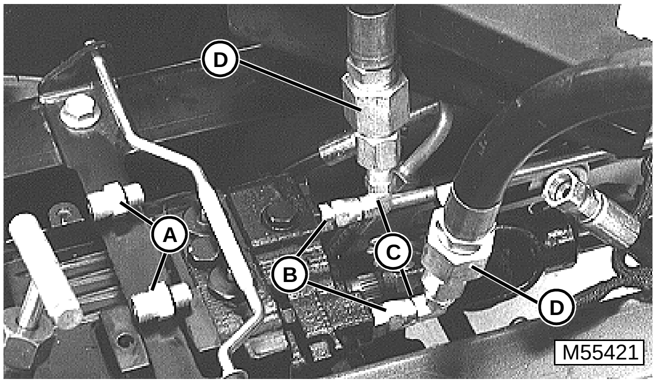
Test Equipment:

- JT01765 Consumer Products Hydraulic Fitting Kit
- JT05469 Flowcharter Kit
- JT03216 Connector, 9/16-18 M 37° x 9/16-18 M ORB
- JT03341 Elbow, 90° 9/16-18 M 37° x 9/16-18 F 37°
- JTO3342 Coupler, 3/4" F NPT x 9/16-18 F 37°

Procedure:

1. Remove fender deck. Support fuel tank to one side.
2. Disconnect the pressure and return line from the charge pump housing.





3. Remove the ORB fittings and install JT03216 and JT03341.

A—ORB Connectors (removed from charge pump)

B—JT03216 Connector, 9/16-18 M 37° x 9/16-18 M ORB

C—JT03341 Elbow, 90° 9/16-18 M 37° x 9/16-18 F 37°

D—JT03342 Coupler, 3/4" F NPT x 9/16-18 F 37°

IMPORTANT: After connecting flowmeter, keep disconnected lines away from drive shaft.

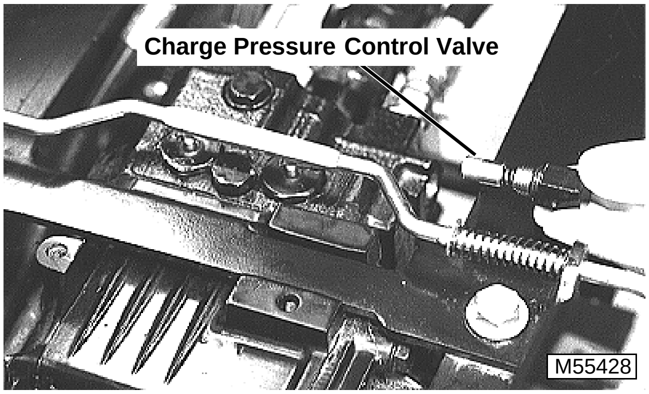
4. Connect flowmeter inlet hose to pump outlet (right-hand side).
5. Connect return hose of flowmeter to return port (left-hand side).

Flow Test Procedure:

1. Open flowmeter control valve.
2. Start engine and run at wide open throttle. Oil must be at normal operating temperature.
3. Observe flowmeter reading.

Results:

- If pump flow is above **13.0 L/m (3.5 gpm)**, pump is in good condition.



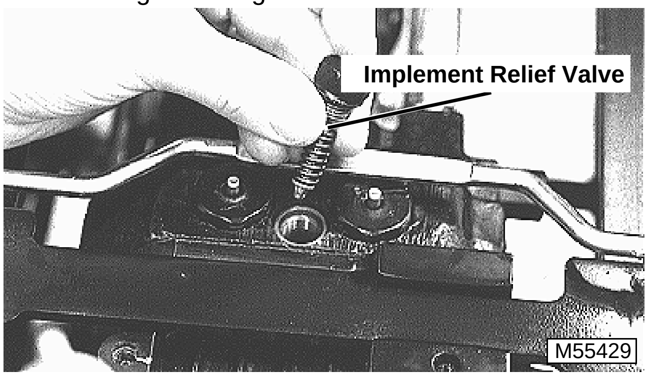
- If there is no pump flow, check:

—drive shaft not turning input shaft,

—sheared charge pump drive key,
—charge pressure control valve stuck closed, or
—lube reduction valve modulation orifice plugged.

- If pump flow is below **13.0 L/m (3.5 gpm)**, foamy or erratic, check:

—hydraulic oil level, replace filter and repeat test.
—transaxle vent not plugged, filter seal for leaks.
—oil ring at inlet of charge pump for leak in case passage between filter and charge pump.
—if dipstick is loose.
—if O-ring is damaged.



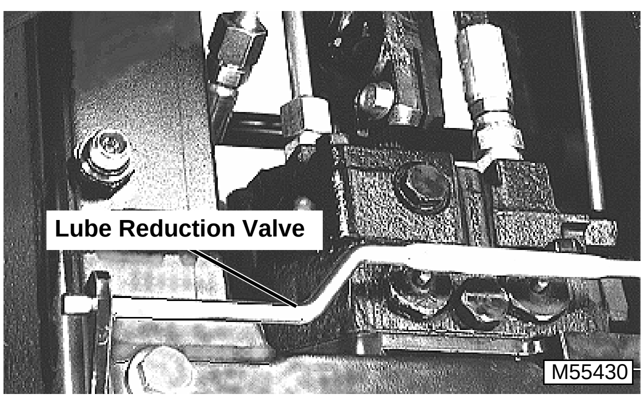
- If pump flow is still below **13.0 L/m (3.5 gpm)**, check implement relief valve for damage or debris that could be holding valve open.
- Replace pump and repeat test.

Pressure Test Procedure:

1. Flowmeter still connected as in flow test.
2. Start engine and run at wide open throttle.
3. Close flowmeter valve. Observe pressure reading.

Results:

- If pressure is within **6371—7350 kPa (924—1066 psi)**, pump and valve are in good condition.
- If pressure is below **6371—7350 kPa (924—1066 psi)**, shim implement relief pressure spring. If pressure cannot be increased, check charge pump for damage.



- If pump seems in good condition, check condition of lube reduction valve modulation orifice for plugging.
- Replace charge pump and repeat test.

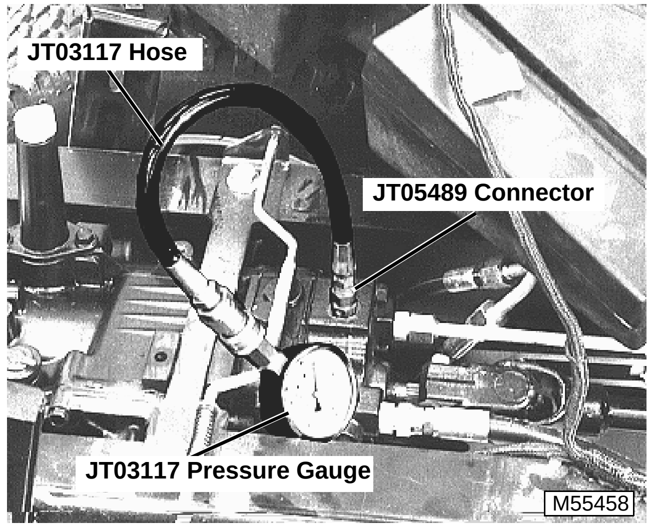
CHARGE PRESSURE TEST—USING PRESSURE GAUGE (OPTIONAL)

Test Equipment:

- JT05489 Connector, 7/16-20 x M 37° 1/2-20 M ORB
- JT03017 Hose
- JT03117 13,790 kPa (2000 psi) Pressure Gauge

Procedure:

1. Remove plug from top of charge pump housing.



2. Install JT05489 Connector.
3. Connect JTO3017 Hose with JT03117 Pressure Gauge.
4. Run engine at wide open throttle.
5. Move hydraulic control lever to raise or lower position. Hold until pump pressure is in relief.
6. Observe gauge reading.

Specification:

Implement Relief Pressure . . . . 6371—7350 kPa (924—1066 psi)
Charge Pressure. . . . . 1965—2255 kPa (285—327 psi)

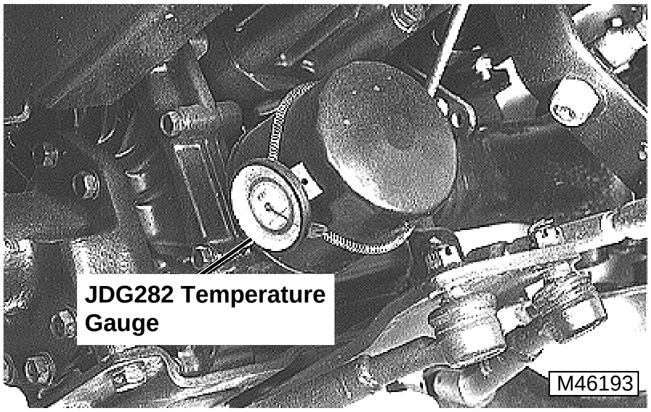
HYDRAULIC OIL WARM-UP PROCEDURE

Reason:

When making hydraulic tests the oil must be heated to normal operating temperature for the tests to be accurate.

Test Equipment:

- JDG282 Temperature Gauge



Procedure:

1. Install JDG282 Temperature Gauge on transmission oil filter.

IMPORTANT: DO NOT overheat engine.

2. Apply park brake. Start engine and run at full throttle.
3. Move and hold hydraulic lever in implement raise position.
4. Periodically cycle all hydraulic functions to distribute heated oil.
5. Heat oil to operating temperature to perform test.

MID-PTO ENGAGEMENT PRESSURE AND BRAKE TEST

PTO Engagement Pressure Test

Reason:

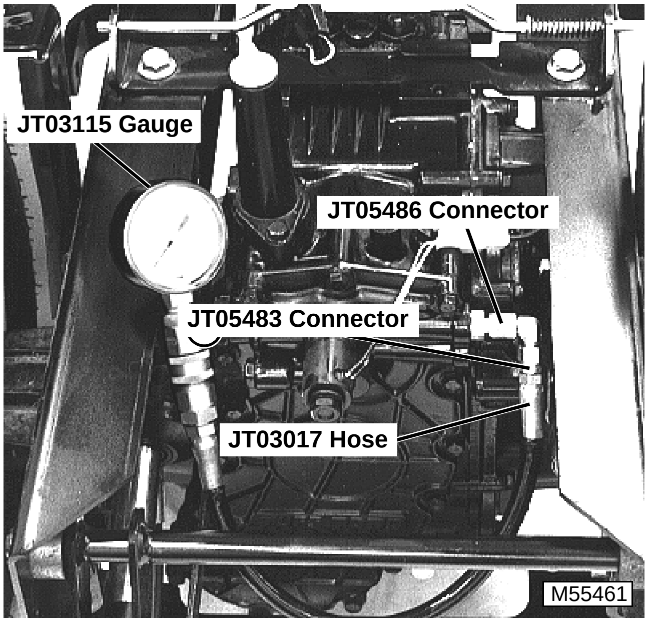
To check for adequate clutch engagement pressure and brake release pressure.

Test Equipment:

- JT05486 Connector, 1/4 M NPT x 7/16-20 M 37°
- JTO5483 Connector, 90° elbow, 7/16-20 M 37°, 7/16-20 F 37° Swivel
- JTO3017 Hose
- JTO3115 2758 kPa (400 psi) Pressure Gauge

Procedure:

1. Remove hex-plug upper right-hand port on rear transmission case.

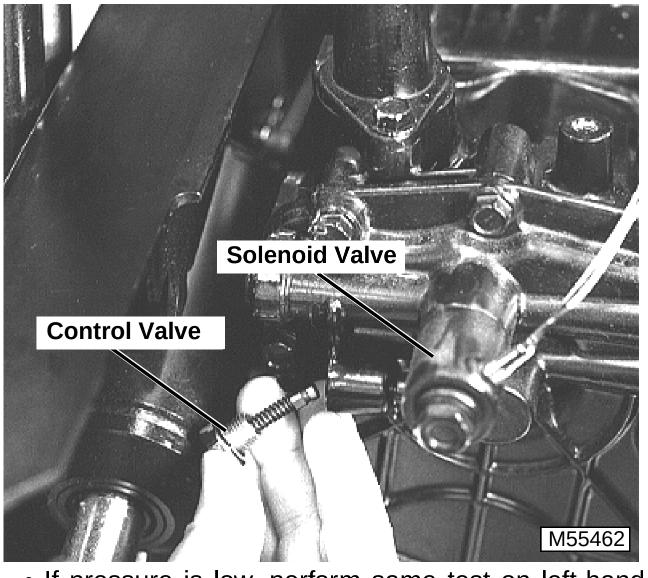


IMPORTANT: Do not overtighten fittings.

2. Install JT05486 and JT05483 Connectors.
3. Install JT03017 Hose with JT03115, 2758 kPa (400 psi) Pressure Gauge.
4. Run engine at wide open throttle.
5. With brake pedal released and operator on seat, engage PTO switch.
6. Observe pressure gauge.

Results:

- If pressure is at or above **1420—1517 kPa (206—220 psi)** engagement valve is operating and engagement pressure is OK. If there is a PTO engagement complaint, inspect clutch disk for wear.
- If there is no pressure on gauge, see Electrical Section to check engagement solenoid and circuit. Inspect PTO engagement valve for proper installation, scoring, or damage to solenoid shaft. If solenoid is operating, check lube reduction valve orifice for plugging. Perform CHARGE PUMP FLOW AND PRESSURE TEST.



- If pressure is low, perform same test on left-hand port opposite test port checked above and compare pressure differential. If different, check solenoid valve for sticking or shim missing, or solenoid not functioning. If both pressures are low, check PTO pressure control valve.
- If pressure is low, inspect PTO pressure control valve spring or seat for damage and valve for scoring. Add shims to increase pressure. If shims will not increase pressure, check lube reduction valve orifice. Perform CHARGE FLOW AND PRESSURE TEST.

MID-PTO BRAKE TEST

Reason:

PTO brake is not stopping implement within five seconds. Also, insure PTO shaft does not rotate when PTO is off.

Procedure:

1. With implement installed, PTO on and engine at wide open throttle.
2. Shut PTO off.
3. Observe the time it takes for implement to come to complete stop.

Results:

- Implement stops within five seconds and stays stopped, PTO brake is OK.
- Implement takes longer than specified time to stop or continues to run, check the following:

—Size of the implement may be too large or requires its own brake.

—Weak or broken brake springs.

—Worn brake shoe or scored PTO clutch hub and gear assembly.

—Weak or broken clutch piston return spring.

—Engagement solenoid valve not releasing pressure, keeping clutch engaged.

TRANSMISSION NEUTRAL ADJUSTMENT

Reason:

To ensure that machine does not creep when pedals are in neutral.

Test Equipment:

- Hoist
- Jackstands (2)

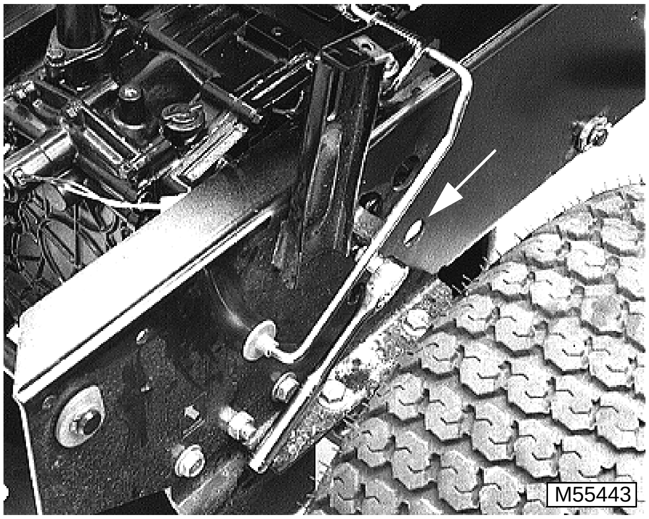
NOTE: If creep is intermittent, inspect transmission control linkage for binding or damage. Repair linkage before adjusting transmission neutral.

Procedure:

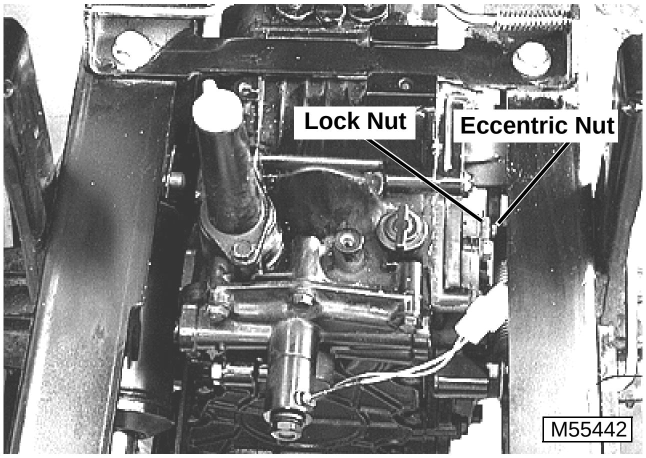
CAUTION

Rear wheels will rotate during adjustment or if transaxle is out of adjustment. Always support rear wheels with jackstands. Be cautious of rotating wheels.

1. Lift machine with a hoist and support rear wheels off the ground.
2. Support rear axle with jackstands.



NOTE: Fender deck was removed to illustrate adjustment location. Adjustment can be made through right-hand side frame cutout.



3. Loosen lock nut.

CAUTION

Use extreme caution when doing this adjustment. Drive wheels are free to rotate.

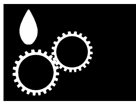
4. Have someone activate seat safety switch, or use a jumper wire to bypass the seat switch.
5. Start engine and run at low idle.
6. With brakes disengaged, turn eccentric nut forward and backward until rear wheels stop turning.
7. Tighten lock nut. Make sure adjustment did not change. If adjustment changes, use wrench from rear of tractor to tighten lock nut.
8. Depress both forward and reverse speed pedals then release to verify adjustment. Repeat adjustment as necessary.
9. Lower machine to the ground. Remove seat switch jumper wire if used.

Results:

- If neutral will not hold, turn eccentric 180° and repeat adjustment.
- If drive wheels continue to rotate, check for worn or binding control linkage. Disconnect linkage and repeat adjustment.
- Wheels rotate after adjustment with control linkage disconnected. Check swash plate shaft bushing for binding or wear. Check neutral return spring, pump and motor valve plate wear.

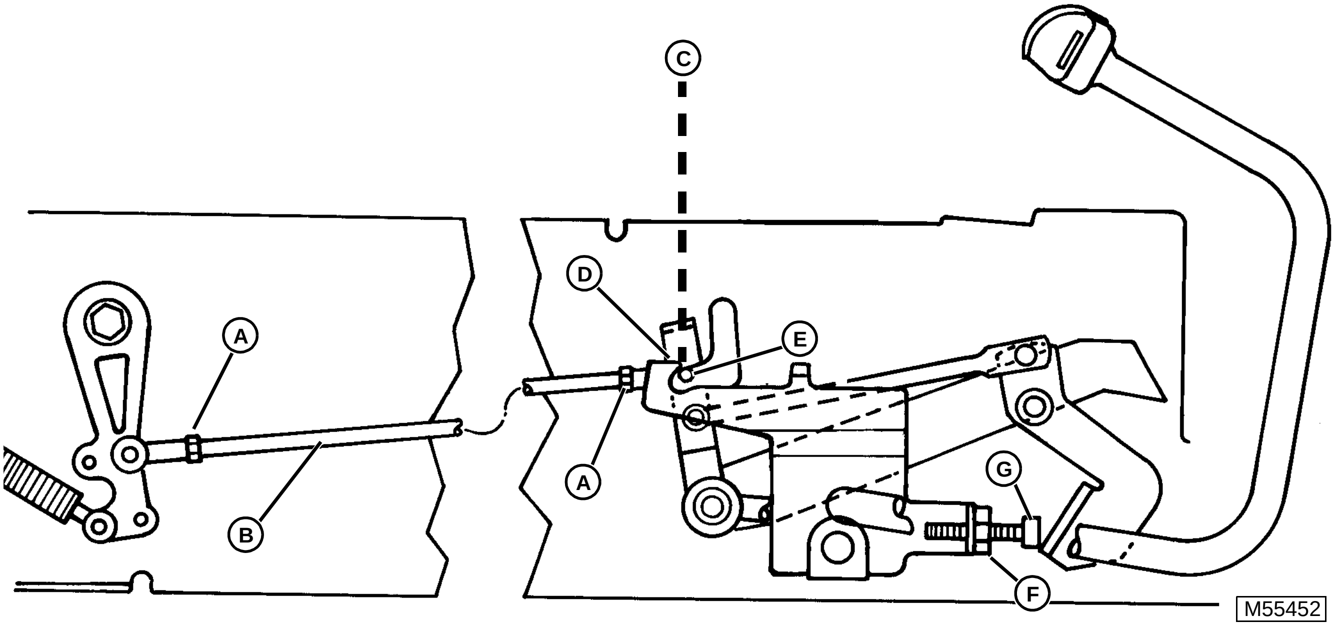
CAUTION

Remove jumper wire from seat switch if installed.



TRANSMISSION CONTROL LINKAGE ADJUSTMENT

NOTE: The transmission shock absorber on the following tractors could result in "jerky" traction controls. Replace if affected.
425A *(033735, 033789, 033792—033827, 033829, 033831—033834, 033836—033905, 033907—034001, 034016, 034025—034044);* ***425B*** *(031844, 031954, 031976, 031978, 032007—032008, 032043, 032046—032050, 032055—032056, 032058, 032074—032076, 032078—032086, 032088—032092, 032095, 032097);* ***455A*** *(030039, 030042—030049)* ***455B*** *(030121—030126);* ***455C*** *(031916—031927, 031929—031932, 031937—031959, 031964—031968, 031970—031972, 031974—032001);* ***455D*** *030562, 030565—030568, 030574—030576, 030584, 030585).*

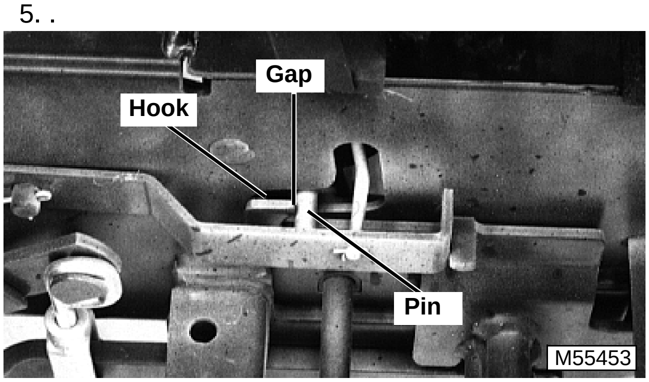


Reason:

To insure transmission returns to neutral and control pedals are locked in neutral when brake is set.

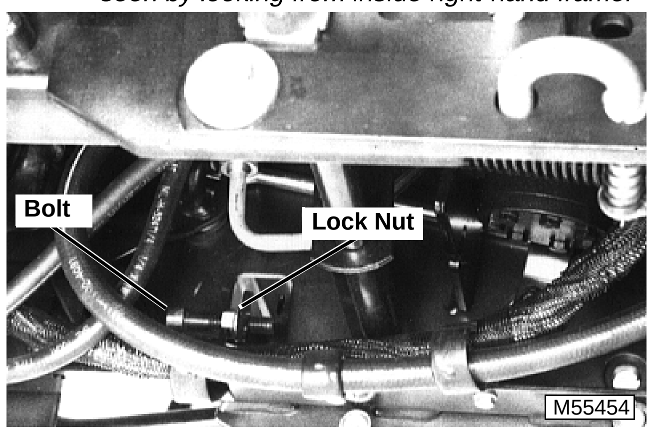
Procedure:

1. Check transmission neutral adjustment and readjust if not correct. Engine is off.
2. Loosen lock nut (F) and turn bolt (G) to prevent contact from neutral return linkage.
3. Loosen lock nuts (A) on swash plate control rod (B).
4. Have someone push brake pedal completely down.
5. .



6. Turn control rod (B) to obtain 1—2 mm (0.04—0.08 in.) gap between hook and pin.

NOTE: Adjustment can be made from under tractor without removing fender deck. Gap can be seen by looking from inside right-hand frame.



7. With brake still down, loosen lock nut and adjust bolt out until it contacts ramp of neutral return linkage. Tighten lock nut.
8. Tighten lock nuts on control rod.

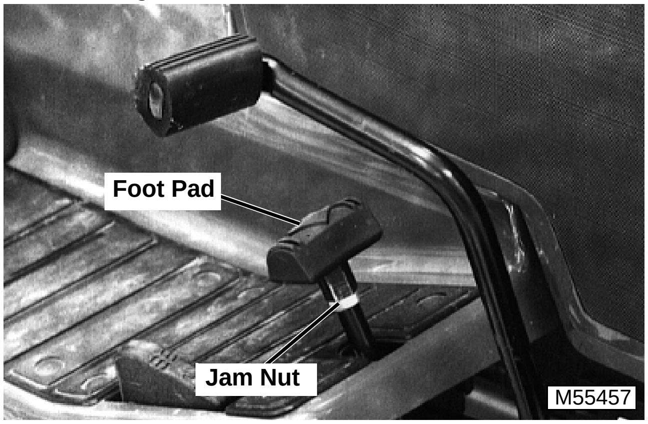
TRANSMISSION LINKAGE FULL FORWARD ADJUSTMENT

Reason:

To set forward pedal height to insure maximum forward speed.

Procedure:

1. Turn engine off.



2. Loosen jam nut under forward foot pad.
3. Turn foot pad off several turns.
4. Hold forward foot control rod down. Thread foot pad down until it contacts foot rest. Tighten one additional turn (arrow on foot pad should point forward) and tighten lock nut to hold pedal in correct alignment.

Results:

- If speed is still slow, see HYDROSTATIC TRANSMISSION DIAGNOSIS.

CRUISE CONTROL LINKAGE CHECK AND ADJUSTMENT

Reason:

To ensure that cruise control will engage and disengage properly.

First Procedure:

1. Put service-park brake in disengaged position, transaxle in neutral.

.

2. With engine not running, push down forward drive pedal and engage cruise control in several locations and with forward pedal all the way down.

Results:

- Drive pedal should remain in down position.
- If pedal will not stay engaged, check condition of teeth on toothed lever. Replace if worn.
- If speed control will not engage at full forward position, linkage is bent. Bend engagement rod to get full engagement or replace rod.

Second Procedure:

1. Reset cruise control.
2. Engage service-park brake.

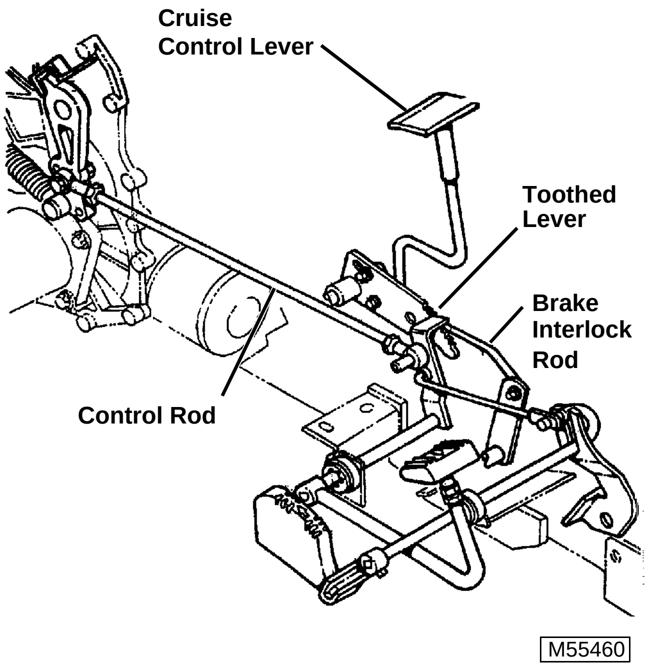
Results:

- Forward drive pedal should disengage.
- If cruise control does not disengage, check hydrostatic control linkage adjustment or for a disconnected brake rod link.

Third Procedure:

1. Reset cruise control.
2. Tap forward pedal down and release.

Results:

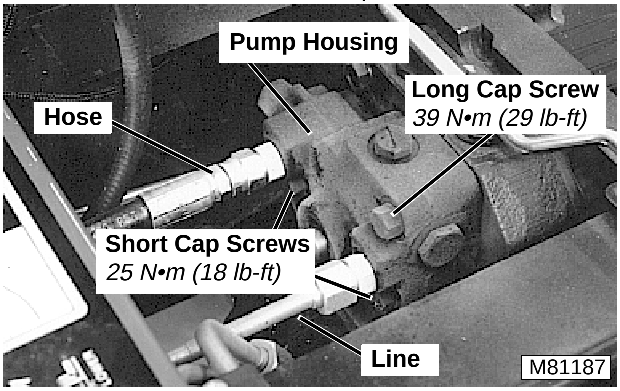


- Cruise should disengage.
- If cruise does not disengage check for binding pivots. Inspect linkage component for wear or damaged conditions. Replace as necessary.

CHARGE PUMP—REMOVAL/ INSTALLATION

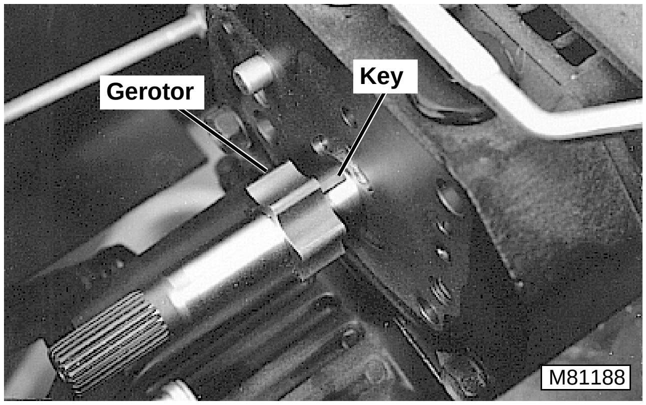
NOTE: Approximate capacity of hydrostatic powertrain is 6.6L (7.0 qt.) for two-wheel steering and 5.7L (6.0 qt.) for all-wheel steering.

1. Remove drain plug to drain oil from transaxle.
2. Remove drive shaft. (See DRIVE SHAFT—REMOVAL/INSTALLATION.)



3. Disconnect hose and line.
4. Remove all cap screws.

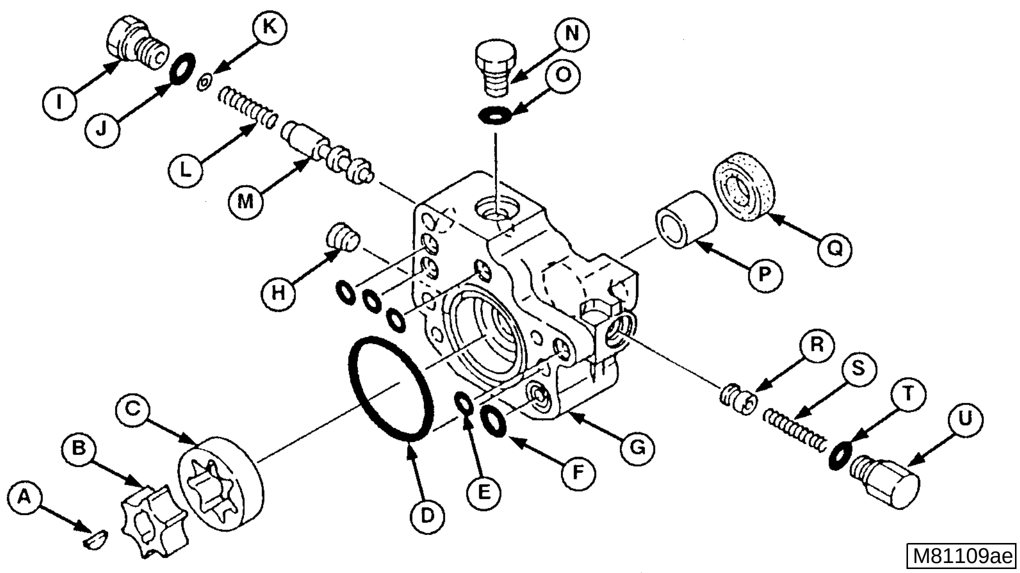
IMPORTANT: Do not drop pump gerotor. Damage to machined surfaces will cause poor performance and premature failure.



Installation is done in the reverse order of removal.

- Tighten short cap screws to **25 N•m (18 lb-ft)**.
- Tighten long cap screws to **39 N•m (29 lb-ft)**.

CHARGE PUMP—DISASSEMBLY/ASSEMBLY



NOTE: Charge pressure control valve and pressure reducing valve can be removed when the charge pump is in the tractor. To inspect valve seats and bores, the pump must be removed.

1. Disassemble all parts of charge pump (G).
2. Inspect O-rings (D, E, F, and O) for cuts or damage. Replace as necessary.

NOTE: Pump gerotor, ring, body, and pressure reducing valve parts must be replaced as a set.

3. Inspect gerotor charge pump parts (A—C). Replace parts if worn, chipped, scored or damaged.
4. Remove plug (I) to remove pressure reducing valve parts (J—M).
5. Inspect parts for scoring, wear or damage.
6. Check small orifice in reducing valve spool (M) for obstruction.
7. Replace parts if necessary.
8. Remove plug (U) to remove charge pressure relief valve parts (R—T).
9. Inspect parts for scoring, wear or damage.

10. Replace parts if necessary.
11. Inspect seal (Q) and bushing (P) for wear or damage.
12. If bushing is removed, apply clean hydraulic oil to bushing and use a disk driver to install bushing to bottom of bore.
13. If seal is replaced, apply clean hydraulic oil to new seal. Install seal with open side into pump body. Push seal to bottom of bore.
14. Apply clean hydraulic oil to all machined surfaces before assembly.

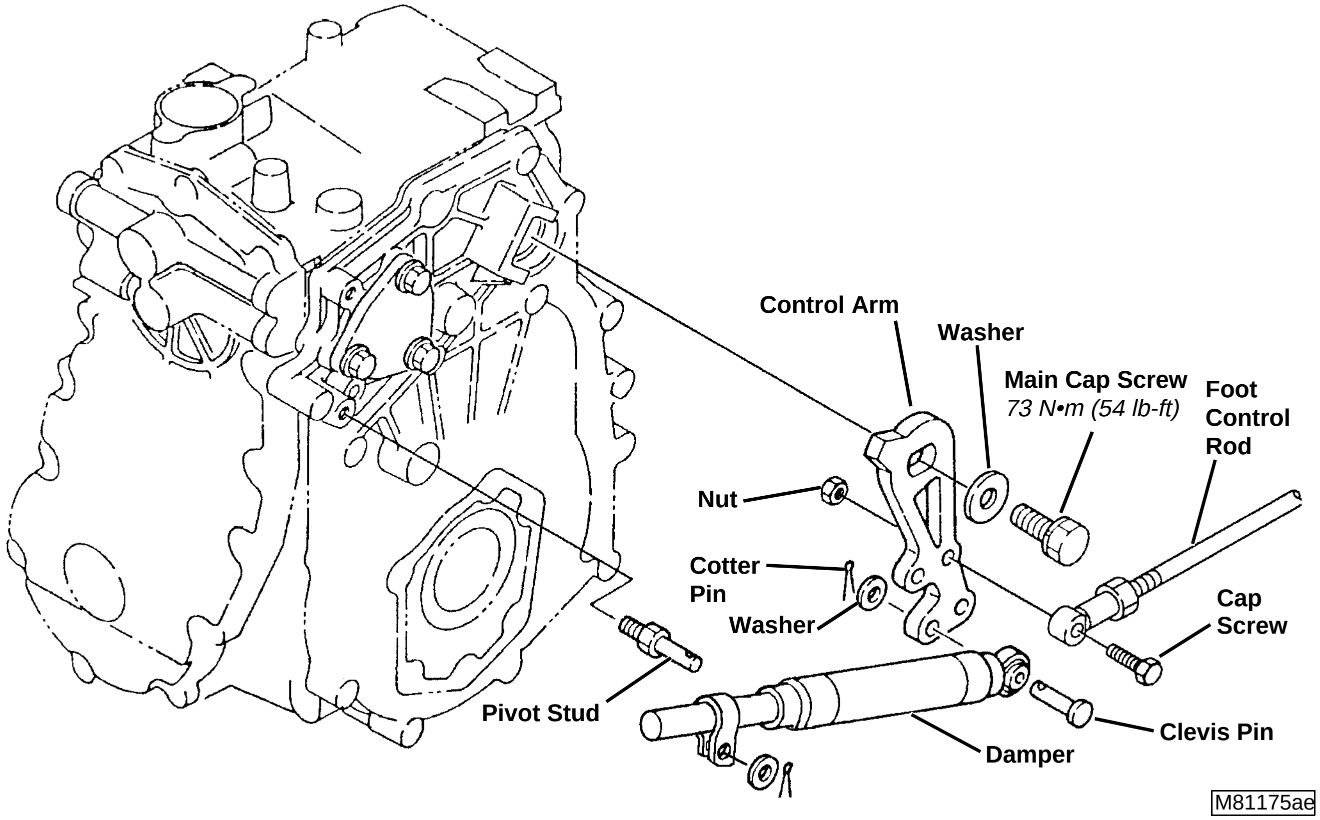
CONTROL ARM DAMPER—REMOVAL/INSTALLATION

NOTE: Fuel tank can be removed for easier access to control arm and damper.

NOTE: Access to cap screws is through holes in right frame.

1. Remove two cap screws from control arm damper.
2. Remove control arm damper.

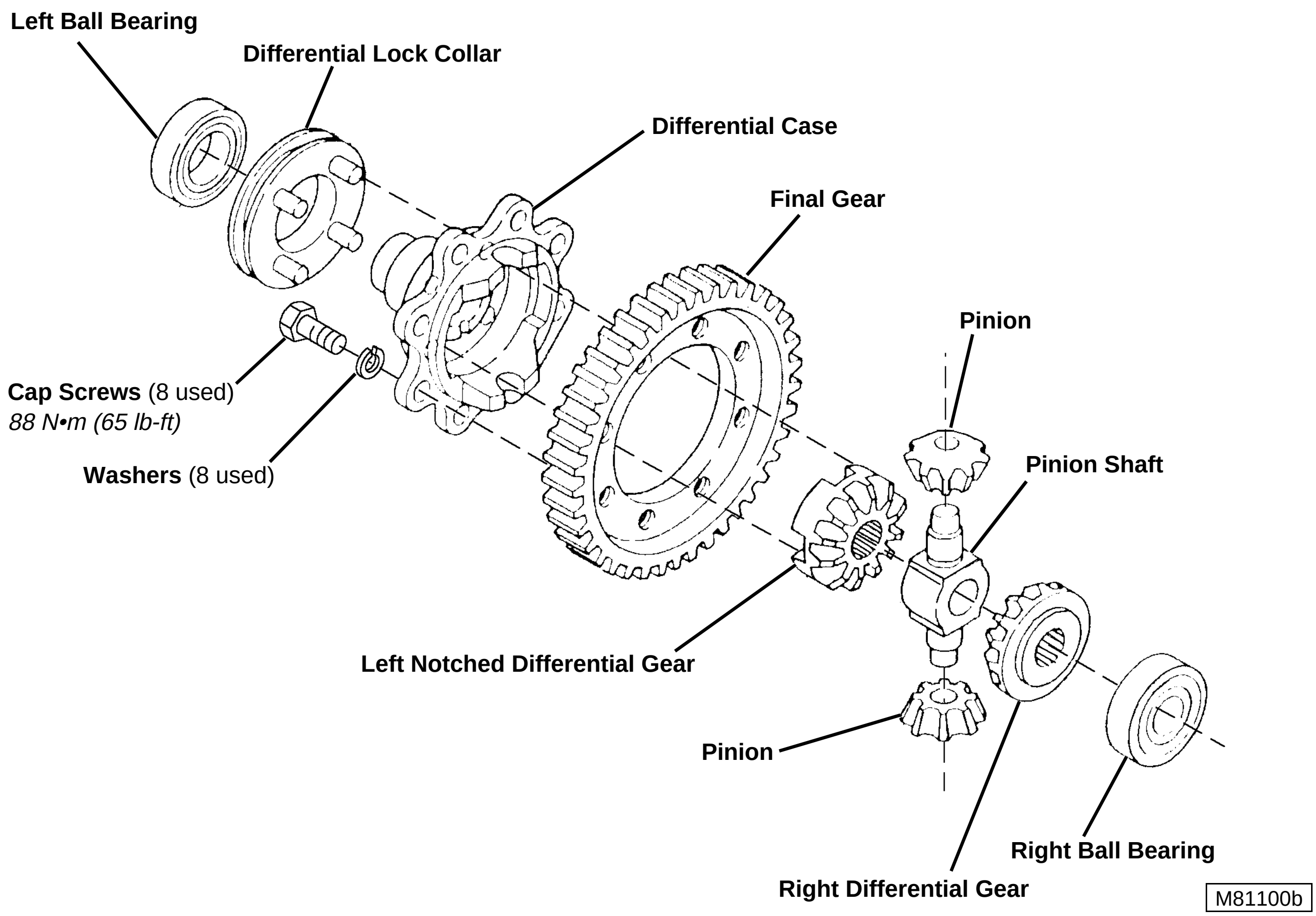
CONTROL ARM DAMPER—DISASSEMBLY/ASSEMBLY



1. Disconnect foot control rod from control arm.
2. Remove control arm and damper as an assembly.
3. Install damper with open end of clamp facing down.
4. Install cap screws. Tighten main cap screw to **73 N•m (54 lb-ft)**.

NOTE: Use medium strength thread lock and sealer on pivot stud.

DIFFERENTIAL (S.N. —080000)—DISASSEMBLY/ASSEMBLY



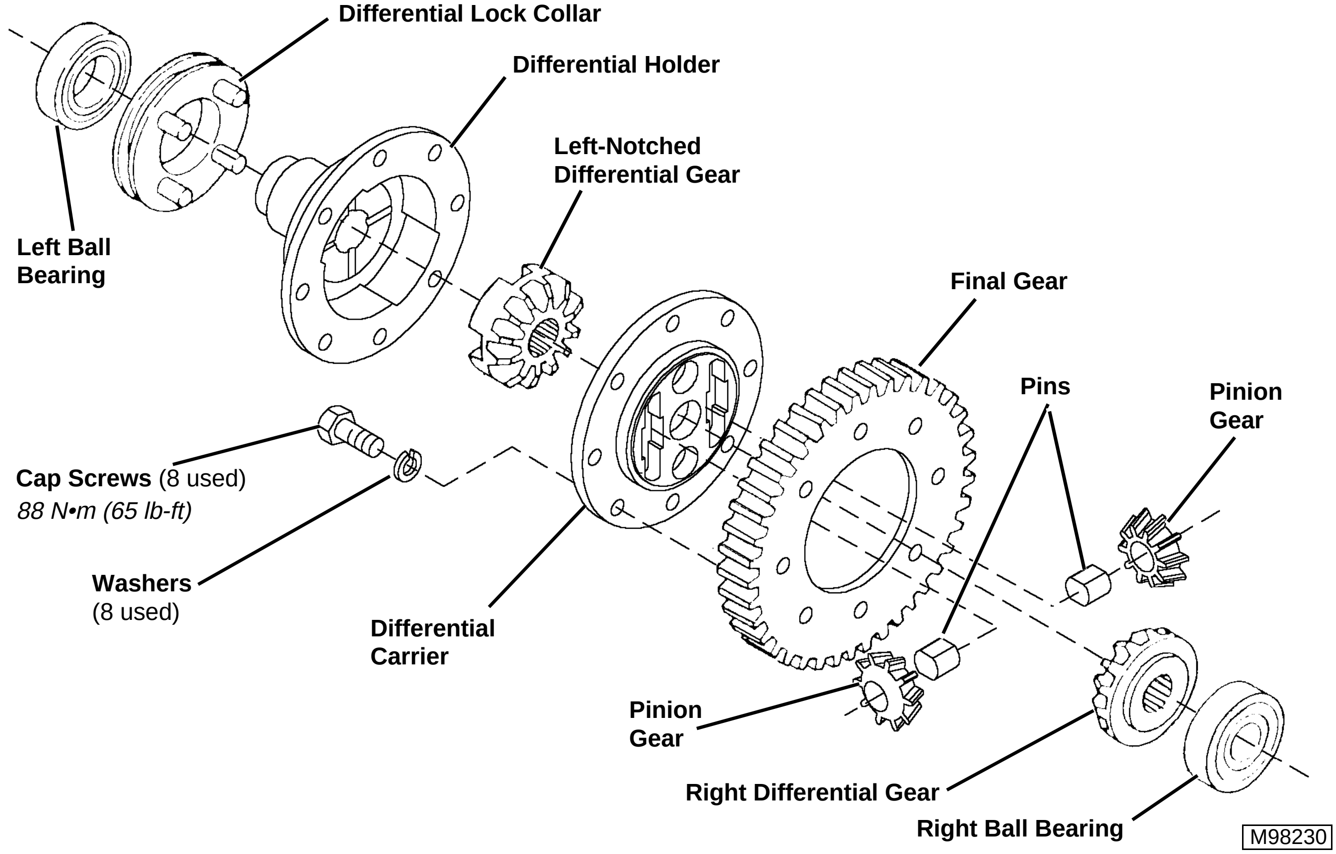
1. Use a puller to remove left ball bearing from differential case.
2. Inspect differential components.
3. Bearings must rotate free and smoothly. Replace as necessary.
4. Check differential components for wear or damage. If replacement is necessary, all parts must be replaced as set.
5. Inspect differential lock collar for wear or loose or sheared off pins.
6. Check differential case for wear, cracks or damage.
7. Inspect final gear for worn or damaged teeth.

NOTE: Final gear and final pinion shaft must be replaced as a set.

8. Install final gear on differential case with the deeper offset of gear center away from the case. Tighten differential cap screws to **88 N•m (65 lb-ft)**.
9. Install differential lock collar and left bearing. Push bearing tight against shoulder of differential case.
10. Install remaining components.

NOTE: Use medium strength thread lock and sealer.

DIFFERENTIAL (S.N. 080001—)—DISASSEMBLY/ASSEMBLY



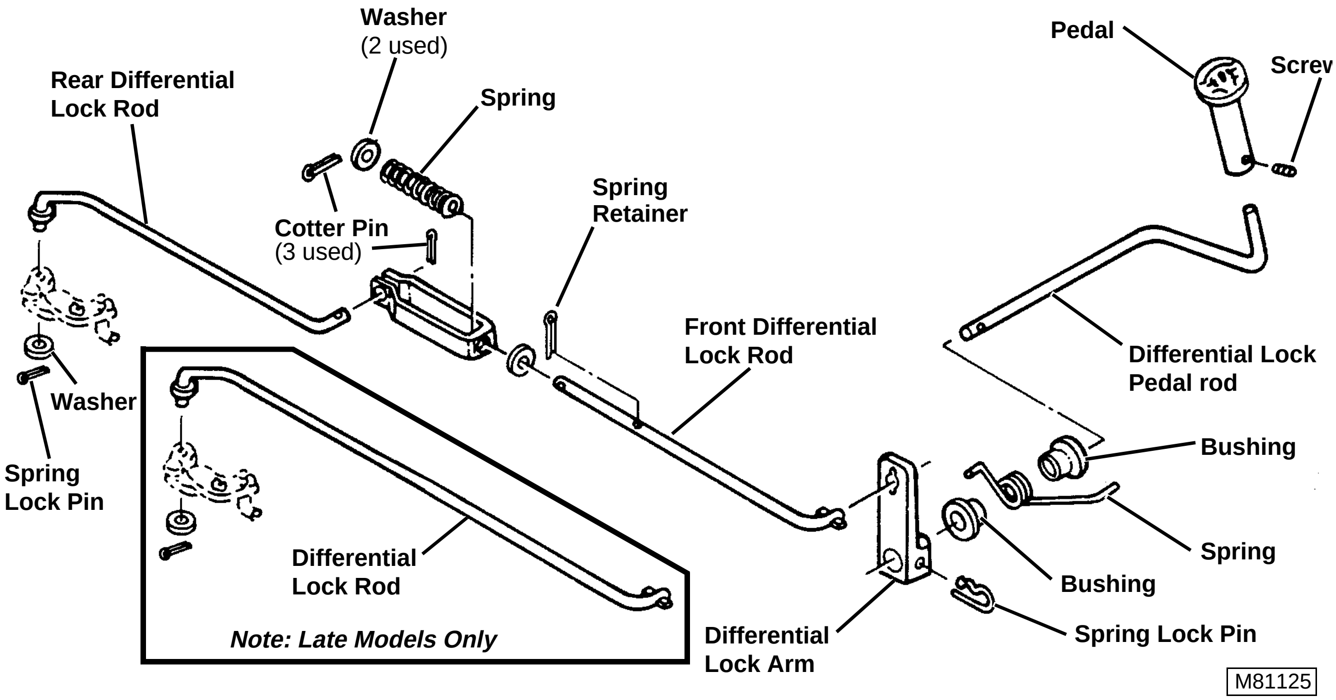
1. Use a puller to remove left ball bearing from differential holder.
2. Inspect differential components.
3. Bearings must rotate free and smoothly. Replace as necessary.
4. Check differential components for wear or damage. If replacement is necessary, all parts must be replaced as set.
5. Inspect differential lock collar for wear or loose or sheared off pins.
6. Check differential holder and carrier for wear, cracks or damage.
7. Inspect final gear for worn or damaged teeth.

NOTE: Pinion gears (2 used) and pins (2 used) must be replaced as a set.

8. Install final gear on differential holder and carrier with the deeper offset of gear center away from the holder. Tighten differential cap screws to **88 N•m (65 lb-ft)**.
9. Install differential lock collar and left bearing. Push bearing tight against shoulder of differential holder.
10. Install remaining components.

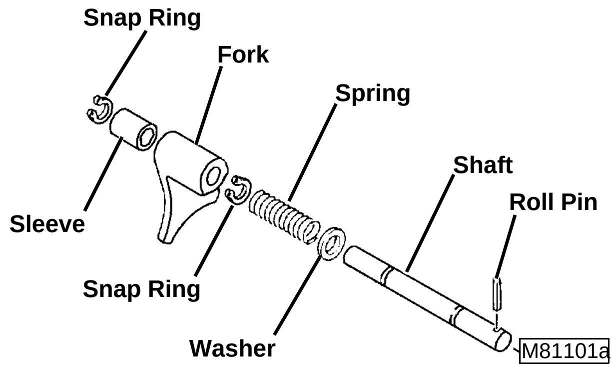
NOTE: Use medium strength thread lock and sealer.

DIFFERENTIAL LOCK LINKAGE—INSPECTION



1. Disassemble parts from differential lock linkage.
2. Inspect linkage components for wear or damaged conditions. Replace as necessary.
3. Install short leg of spring to the rear of arm.

DIFFERENTIAL LOCK SHAFT DISASSEMBLY/ASSEMBLY

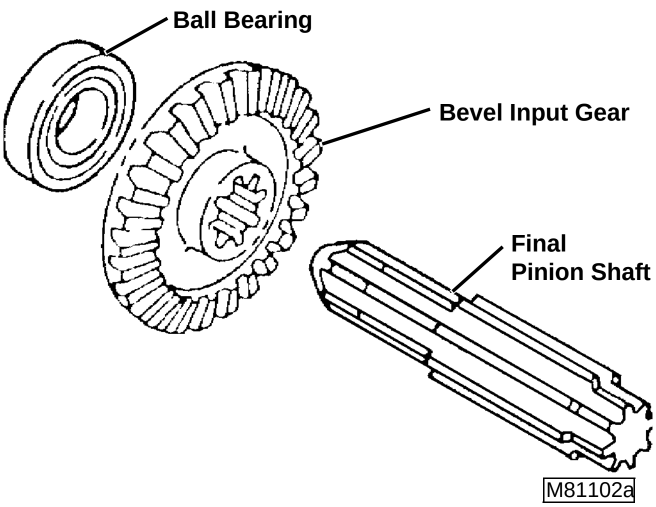


CAUTION

Spring is under compression. Carefully remove roll pin and release spring force slowly to prevent personal injury.

1. Remove roll pin, washer, and spring.
2. Remove snap rings, sleeve and fork.
3. Inspect shaft and fork for wear or damage. Replace parts as necessary.
4. Install sleeve, fork and snap rings on shaft.
5. Install long hub of fork towards spring end of shaft.

DIFFERENTIAL (FINAL PINION SHAFT)—INSPECTION

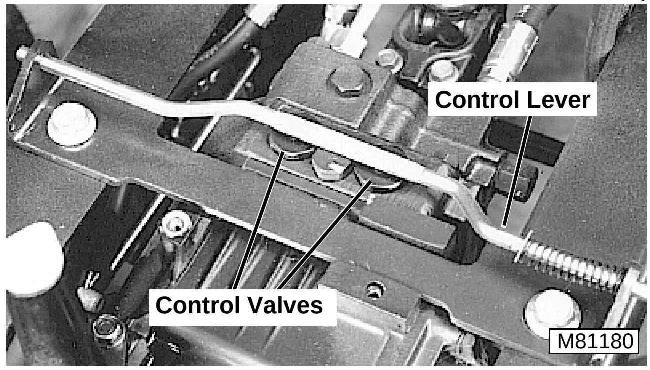


1. Inspect ball bearing for smooth rotation.
2. Check bevel input gear and final pinion shaft for worn or damaged condition. Replace parts as necessary.

NOTE: Final pinion shaft and final gear must be replaced as a set. Bevel input gear and bevel input pinion must be replaced as a set.

DIRECTIONAL CONTROL VALVES—REMOVAL/INSTALLATION

1. Remove fuel tank. (See FUEL TANK—REMOVAL/ INSTALLATION in the MISCELLANEOUS section.)

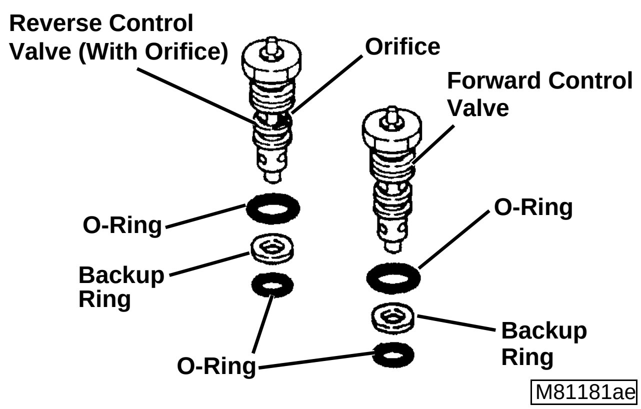


2. Remove free-wheeling control lever.
3. Remove directional control valves.

Installation is done in the reverse order of removal.

- Tighten directional control valves to **35 N•m (26 lb-ft)**.

DIRECTIONAL CONTROL VALVES—DISASSEMBLY/INSPECTION AND ASSEMBLY

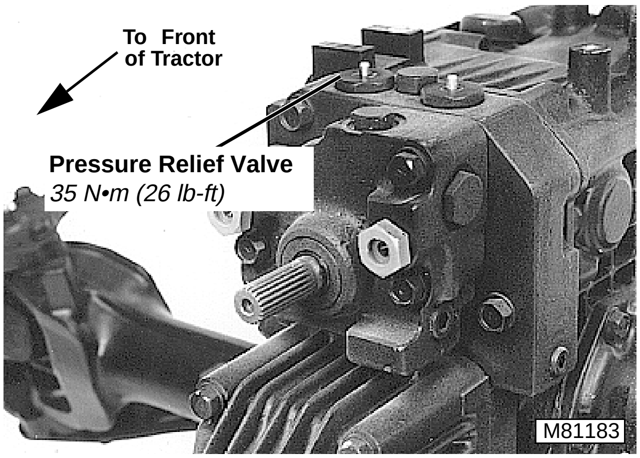


1. Disassemble parts from directional control valves.
2. Inspect O-rings and backup rings for damage.
3. Plunger pin must move freely.
4. Internal valve must move freely when valve is shaken.
5. Make sure orifice and all passages are free of any obstruction.
6. Assemble parts.

IMPORTANT: The reverse control valve must be installed in the left port. The control valve can be identified by a small orifice drilled into a land between the two sets of valve passageways.

HYDROSTATIC PRESSURE RELIEF VALVE (40 LOADER)—INSTALLATION

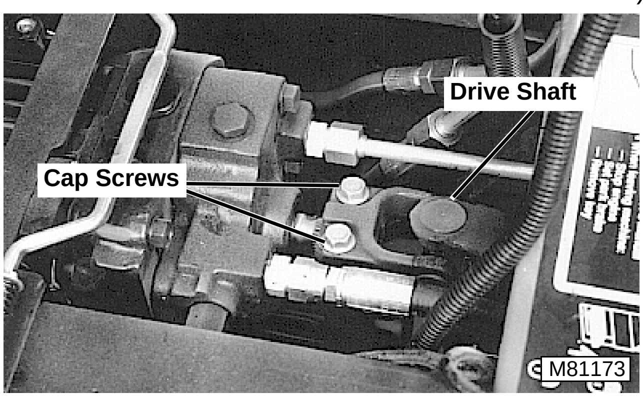
IMPORTANT: The 40 loader is shipped complete with a hydrostatic pressure relief valve which must be installed in place of the tractor transaxle forward control valve. The relief valve limits the peak hydrostatic pressures in the transaxle. This protects the transaxle from unnecessary stress for longer life. Operation of a front end loader on a tractor without the transaxle hydrostatic pressure relief valve will void the tractor warranty. If a 40 loader is taken off one tractor and used on another, or another brand of loader is used, it is important that the loader tractor be equipped with the transaxle relief valve.



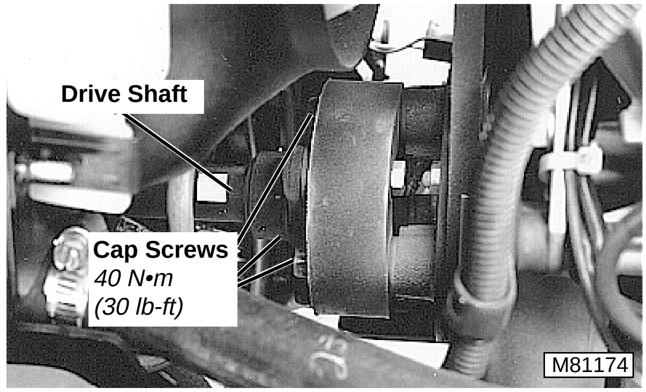
1. Remove forward control valve and replace with hydrostatic pressure relief valve.
2. Tighten valve to **35 N•m (26 lb-ft)**.

DRIVE SHAFT—REMOVAL/ INSTALLATION

1. Remove fuel tank. (See FUEL TANK—REMOVAL/ INSTALLATION in the MISCELLANEOUS section.)

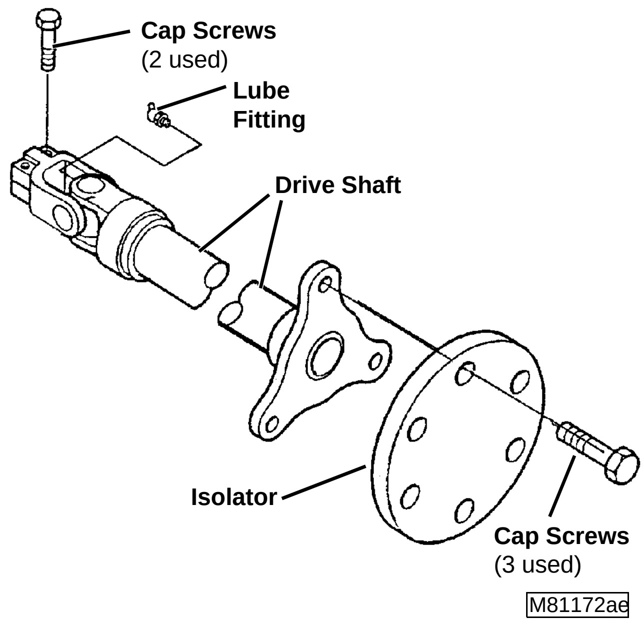


2. Loosen cap screws.



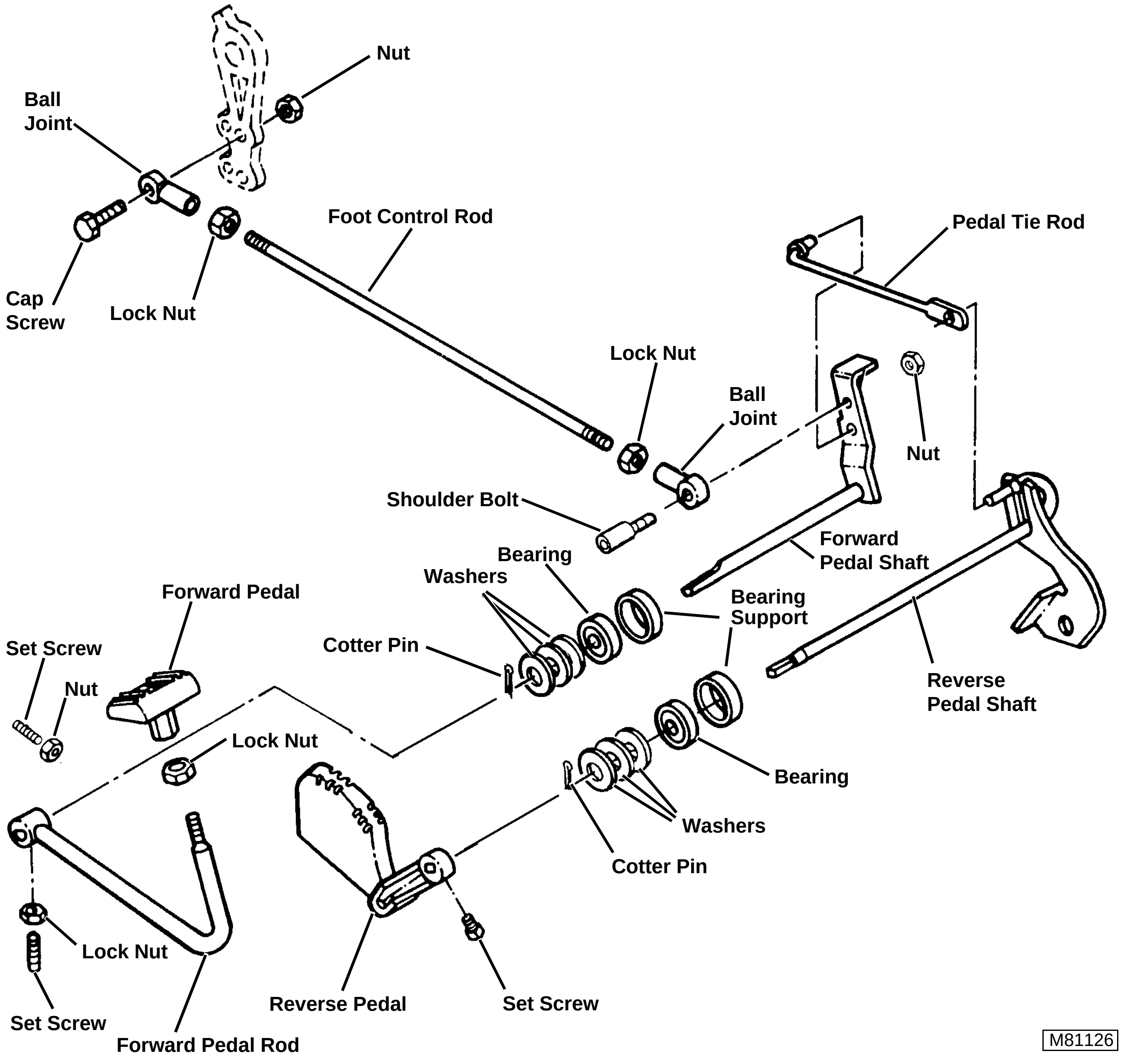
3. Remove cap screws to remove drive shaft.
4. Install drive shaft and tighten cap screws to **40 N•m (30 lb-ft)**.

DRIVE SHAFT—DISASSEMBLY/ INSPECTION AND ASSEMBLY



1. Disassemble drive shaft.
2. Inspect U-joint for wear.
3. Inspect isolator for cracks or wear.
4. Install isolator with bosses toward drive shaft.
5. Assemble drive shaft.

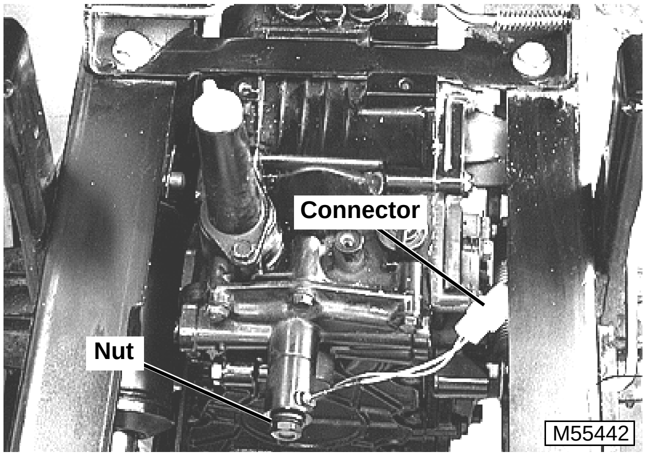
FOOT CONTROL LINKAGE—DISASSEMBLY/ASSEMBLY



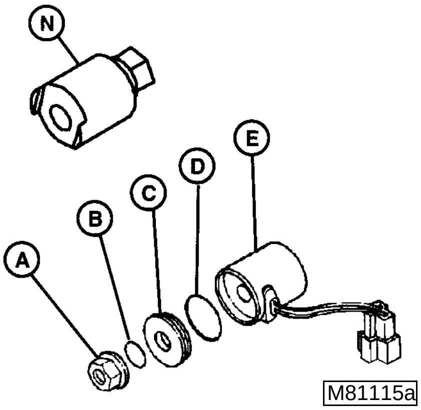
1. Disassemble foot control linkage. If equipped, remove cruise control linkage first.
2. If ball joints were removed, adjust length of foot control rod until mounting holes of ball joints are approximately 545 mm (21.5 in.) between centers.
3. Adjust foot control linkage after assembly.

PTO SOLENOID VALVE—REMOVAL/ INSTALLATION

IMPORTANT: Do not bend, twist or damage solenoid armature. Do not damage machined surfaces or sharp edges of spool or sleeve. PTO will not function or will function erratically if spool, sleeve or armature is damaged.



1. Disconnect solenoid connector from wiring harness.
2. Remove nut and O-ring.



NOTE: Nut (A) and O-ring (B) were already removed in step 2.

3. Remove solenoid cover (C), O-ring (D), and solenoid coil (E). Note order and direction of valve components for reassembly.
4. Remove solenoid armature assembly using JDG757A Solenoid Valve Socket (N).
5. Carefully remove valve components from PTO cover.

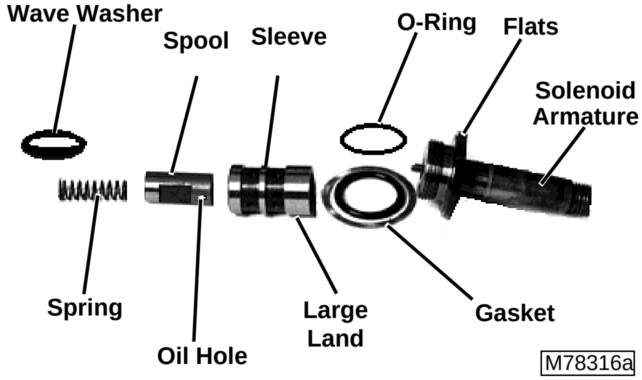
NOTE: Check bottom of bore for "wave" washer.

6. Clean and inspect parts for damage. Replace if necessary.
7. Place wave washer in case cover.

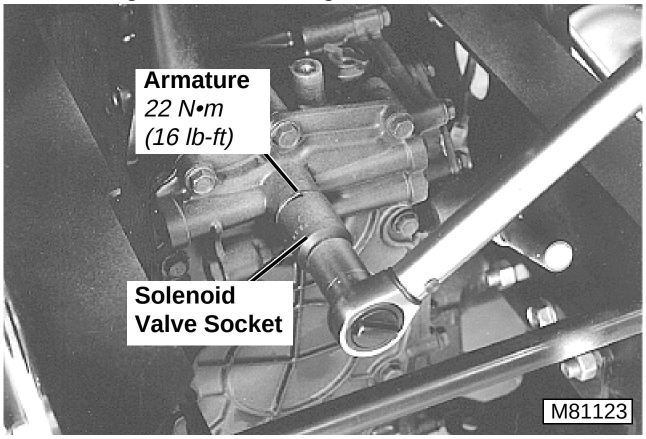
PTO SOLENOID VALVE—DISASSEMBLY/INSPECTION/ ASSEMBLY

NOTE: Sleeve and spool must be replaced as a set.

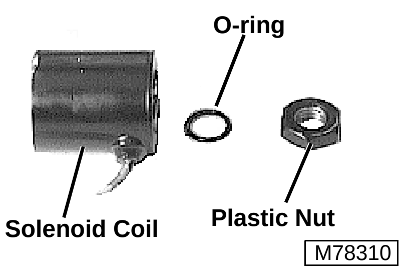
IMPORTANT: Be sure large land on sleeve and oil hole in spool are facing away from PTO case cover.



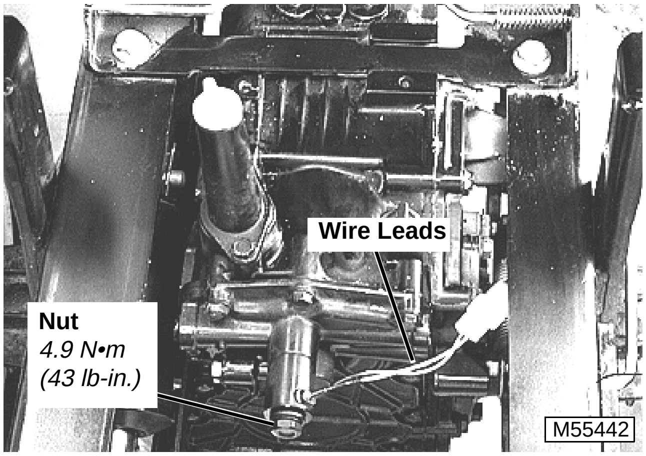
1. Disassemble PTO solenoid valve.
2. Inspect parts for wear or damage.
3. Install spool into sleeve so the end with the oil hole is toward the large land on the sleeve.
4. Place spring into recess in end of spool.
5. Install sleeve assembly so smaller lands go into the PTO cover first.
6. Install gasket and O-ring.



7. Use JDG757A Solenoid Valve Socket to tighten solenoid armature to **22 N•m (195 lb-in.)**.



8. Slide solenoid coil onto solenoid armature. Install O-ring and plastic nut **(do not tighten plastic nut at this time.)**

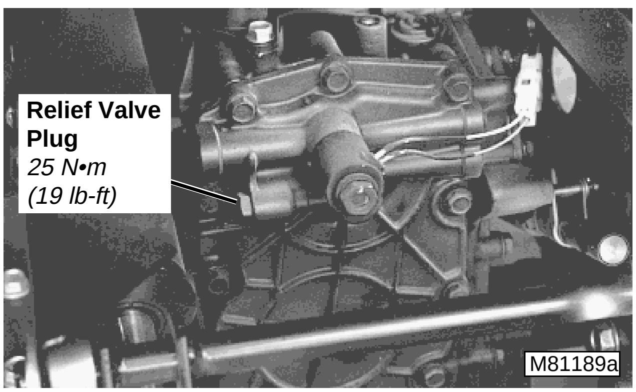


9. Position solenoid coil wire leads to the right and approximately 45° above horizontal.

IMPORTANT: When tightening plastic nut be sure to tighten nut to exact specifications. Nut has a very low torque. Any overtightening will damage the armature coil.

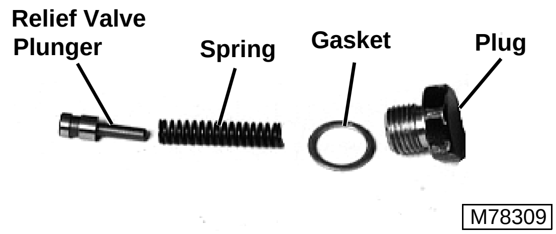
10. Tighten plastic nut to **4.9 N•m (43 lb-in)**.

PTO RELIEF VALVE—REMOVAL/ INSTALLATION



1. Remove relief valve plug.
2. Install relief valve plug and tighten to **25 N•m (19 lb-ft)**.

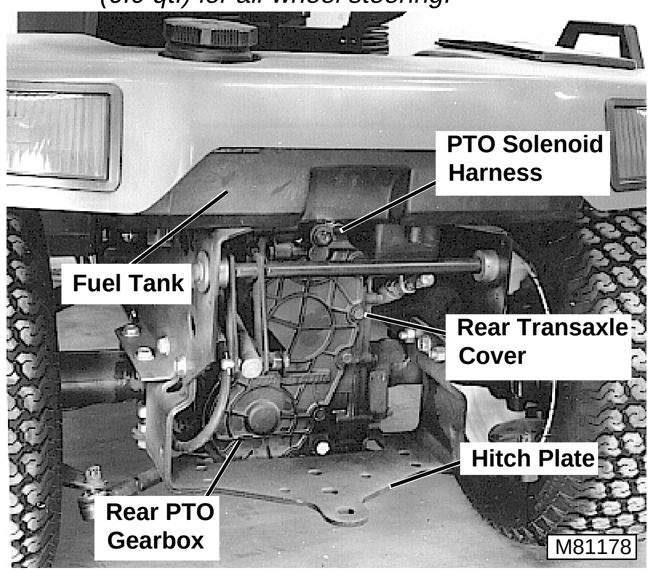
PTO RELIEF VALVE—DISASSEMBLY/INSPECTION AND ASSEMBLY



1. Disassemble PTO relief valve.
2. Check relief valve plunger and bore for scoring, nicks or burrs. Replace if necessary.
3. Install spring, gasket, relief valve plunger, and plug in PTO cover.

PTO BRAKE—REMOVAL/ INSTALLATION

NOTE: Approximate capacity of hydrostatic powertrain is 6.6L (7.0 qt.) for two-wheel steering and 5.7L (6.0 qt.) for all-wheel steering.

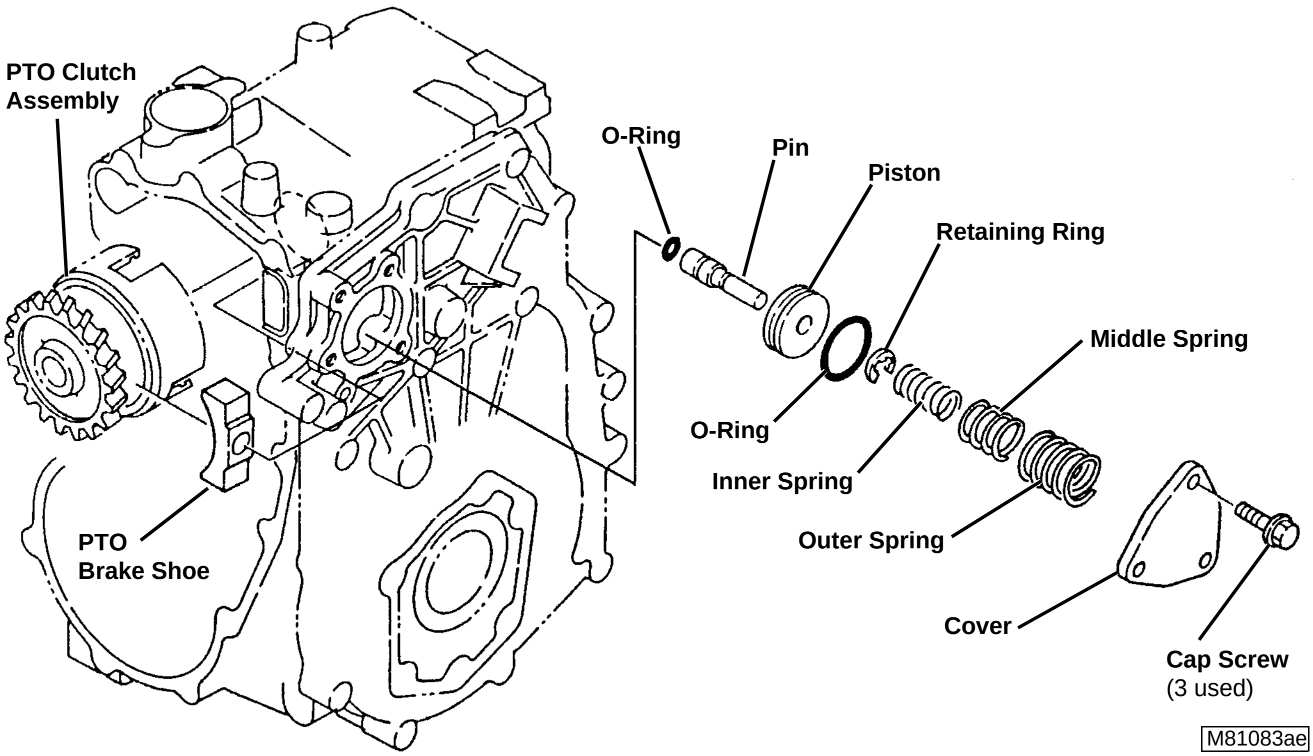


1. Remove plug to drain oil from transaxle.
2. Remove fuel tank. (See FUEL TANK—REMOVAL/ INSTALLATION in the MISCELLANEOUS section.)
3. Remove hitch plate.
4. Remove rear transaxle cover or rear PTO gearbox and cap screws (14 used). (See PTO DRIVE TRAIN—REMOVAL/INSTALLATION.)

CAUTION

PTO brake cover is spring loaded. Remove cap screws evenly to release spring force.

PTO BRAKE—DISASSEMBLY/INSPECTION AND ASSEMBLY



1. Carefully pull piston assembly from case using a pliers. Do not damage pin.
2. Remove PTO clutch assembly and brake shoe together.

IMPORTANT: Use care not to lose needle bearing and washer located between PTO clutch assembly and input shaft.

NOTE: PTO brake pin, piston and springs must be replaced as a set.

3. Check pin and piston for burrs, scoring or wear.
4. Replace brake shoe if grooves in shoe contact surface are not visible.
5. Inspect O-rings for cuts or damage.
6. Inspect springs for cracks or damage.
7. Apply petroleum jelly to O-rings and seal on end of PTO clutch shaft.
8. Install piston assembly and clutch assembly.
9. Clean mating surface of cover and case. Be sure threaded holes are clean.
10. Apply a bead of John Deere Form-in-Place Gasket to cover mating surface.

IMPORTANT: Be sure cover is aligned with transaxle case and installed within 3 mm (1/8 in.) of case before tightening cap screws. Major damage can occur to cover and/or case if cover is not installed properly before tightening cap screws.

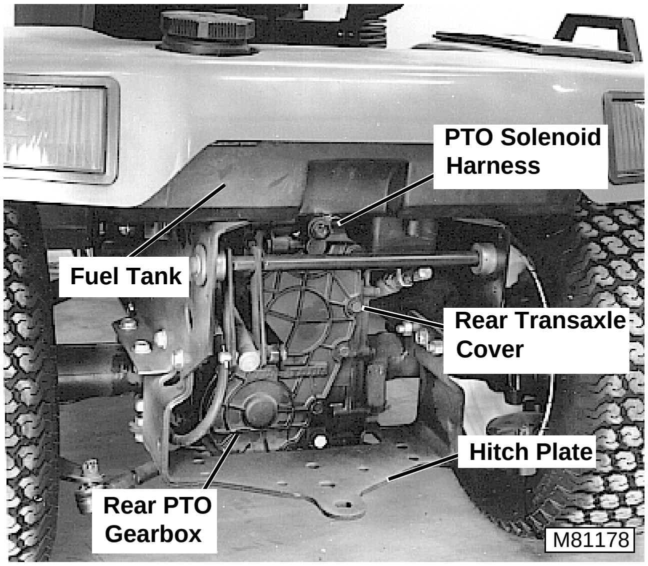
Transaxle Cover Cap Screw Torque Specifications:

Used Transaxle Case . . . . 25 N•m (18 lb-ft)
New Transaxle Case. . . . . 30 N•m (22 lb-ft)

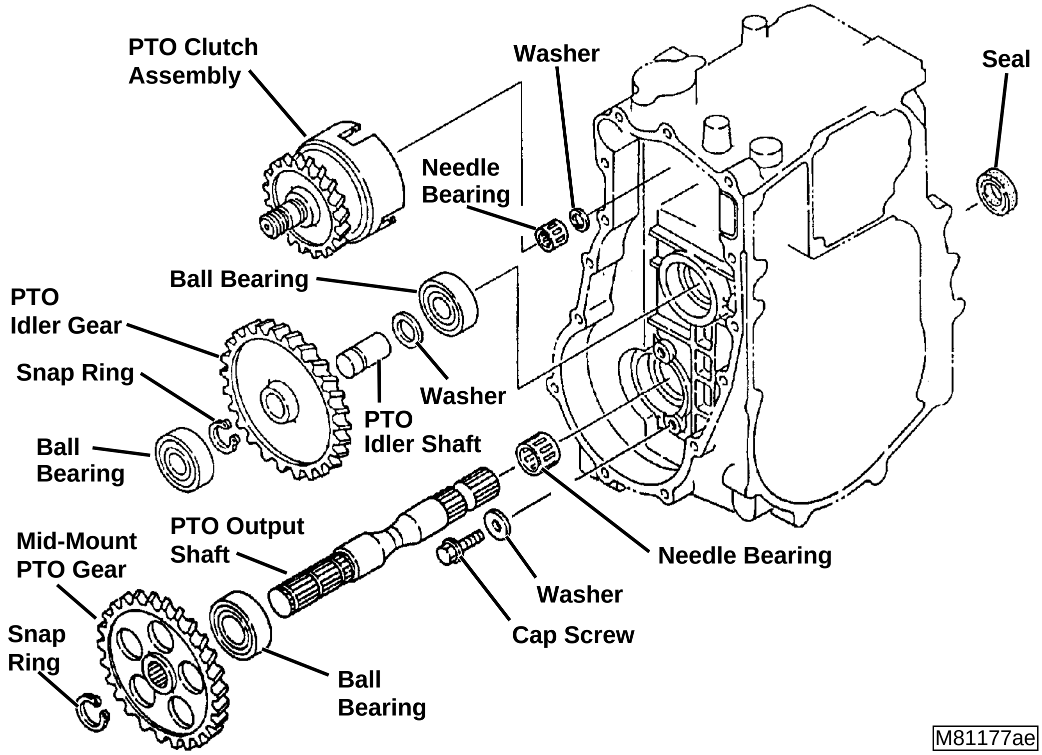
PTO DRIVE TRAIN (MID-PTO)—REMOVAL/INSTALLATION

NOTE: Approximate capacity of hydrostatic powertrain is 6.6L (7.0 qt.) for two-wheel steering and 5.7L (6.0 qt.) for all-wheel steering.

1. Remove plug to drain oil from transaxle.



2. Remove fuel tank.
3. Remove hitch plate.
4. Disconnect PTO solenoid harness.
5. Remove rear transaxle cover. (See TRANSAXLE—DISASSEMBLY and TRANSAXLE—ASSEMBLY.)
6. Remove PTO clutch assembly.



IMPORTANT: Be sure not to lose needle bearing or washer.

7. Remove PTO idler gear assembly.
8. Remove PTO gear.
9. Left axle must be removed to remove PTO output shaft assembly. (See REAR AXLE ASSEMBLY—REMOVAL/INSTALLATION.)
10. Inspect ball bearings and needle bearing for smooth rotation.
11. Inspect gears and splines for missing or chipped teeth, wear or damage. Replace parts if necessary.

NOTE: Idler gear and shaft must be replaced as a set.

12. If replaced, install new needle bearing from inside case with bearing identification marks toward the inside of the case. Push bearing tight against shoulder in bore.
13. Install new seal with the open, spring side towards the inside of the case.
14. Push seal against shoulder in bore.
15. Install mid-mount PTO gear so side with the longer center hub is towards bearing.
16. Clean mating surfaces of rear cover and case. Be sure threaded holes are clean and two O-rings are in position in rear cover.
17. Apply petroleum jelly to seal on shaft of PTO clutch assembly.
18. Apply a bead of John Deere Form-in-Place Gasket to cover mating surface.

IMPORTANT: Be sure cover is aligned with transaxle case and installed within 3 mm (1/8 in.) of case before tightening cap screws. Major damage can occur to cover and/or case if cover is not installed properly before tightening cap screws.

Rear Cover Cap Screw Torque Specifications:

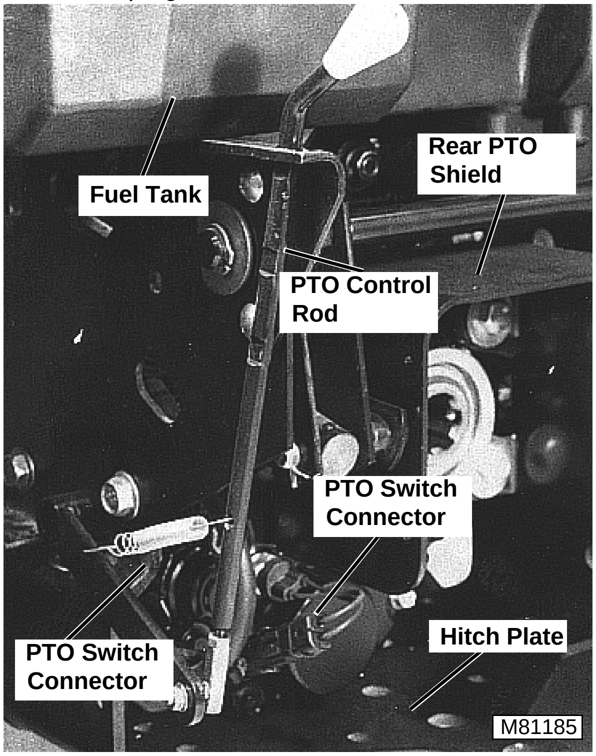
Used Transaxle Case . . . . 25 N•m (18 lb-ft)
New Transaxle Case . . . . 30 N•m (22 lb-ft)
Internal Cap Screw. . . . . 27 N•m (20 lb-ft)

19. Fill transaxle with proper oil.

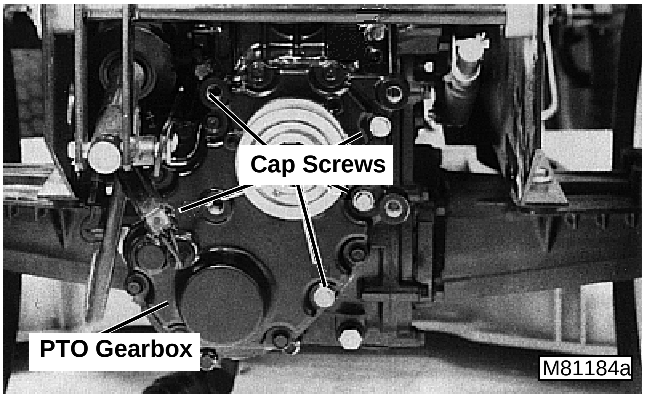
PTO DRIVE TRAIN (MID- AND REAR PTO)—REMOVAL

NOTE: Approximate capacity of hydrostatic powertrain is 6.6L (7.0 qt.) for two-wheel steering and 5.7L (6.0 qt.) for all-wheel steering.

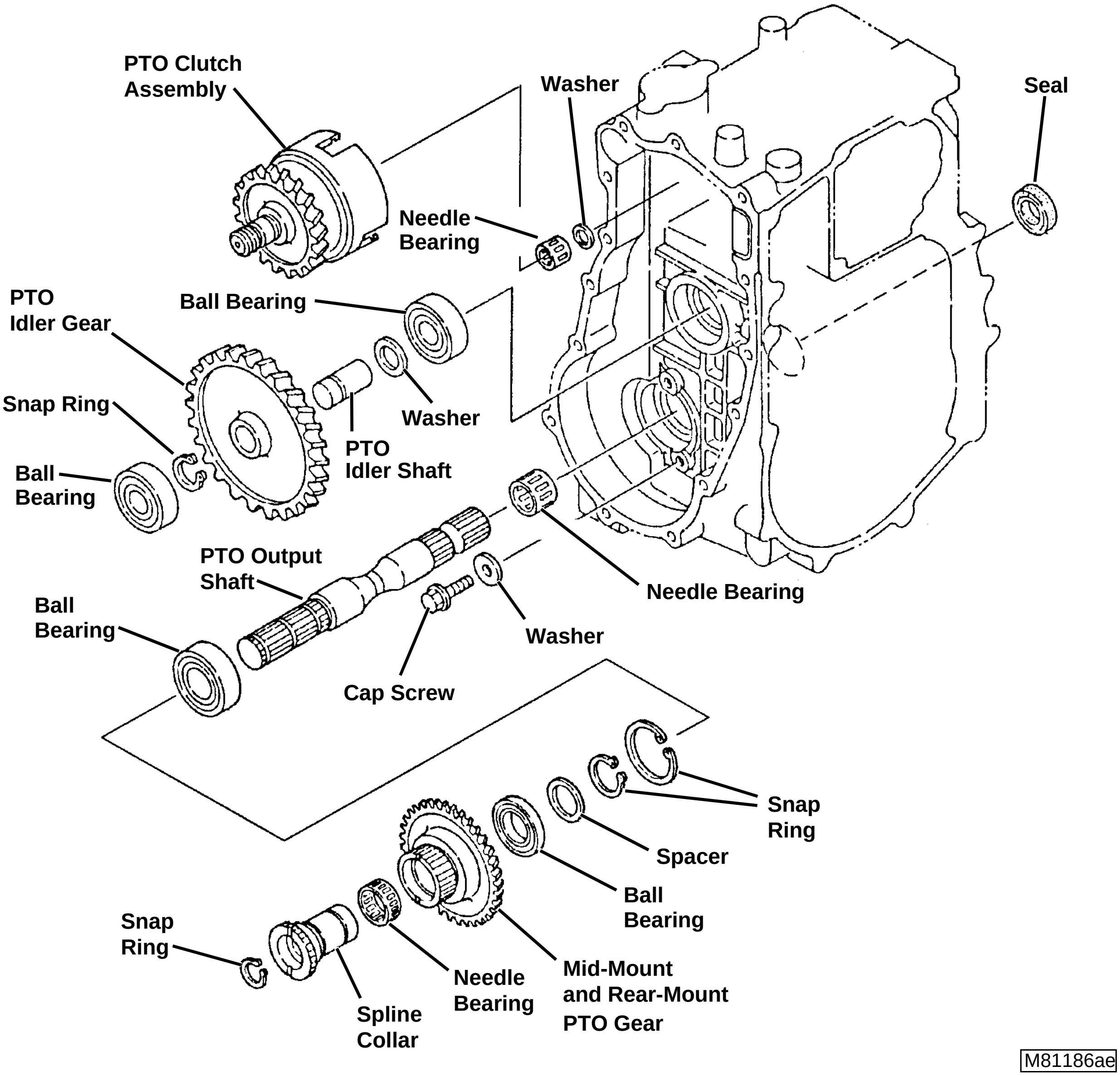
1. Remove plug to drain oil from transaxle.



2. Remove fuel tank.
3. Disconnect rear PTO control rod.
4. Remove rear PTO shield.
5. Remove hitch plate.
6. Disconnect two PTO switch connectors.



7. Remove cap screws (14 used) to remove rear PTO gearbox. Remove gearbox.

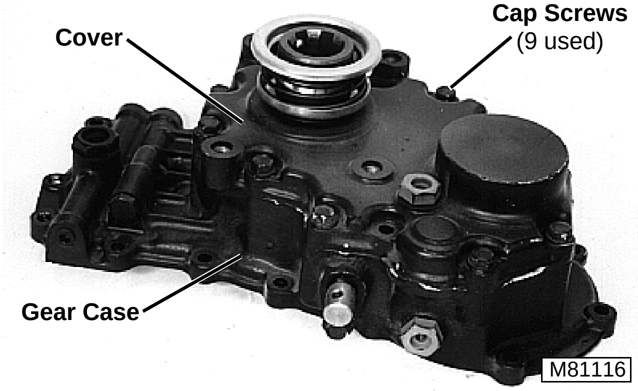


8. Remove PTO clutch assembly.

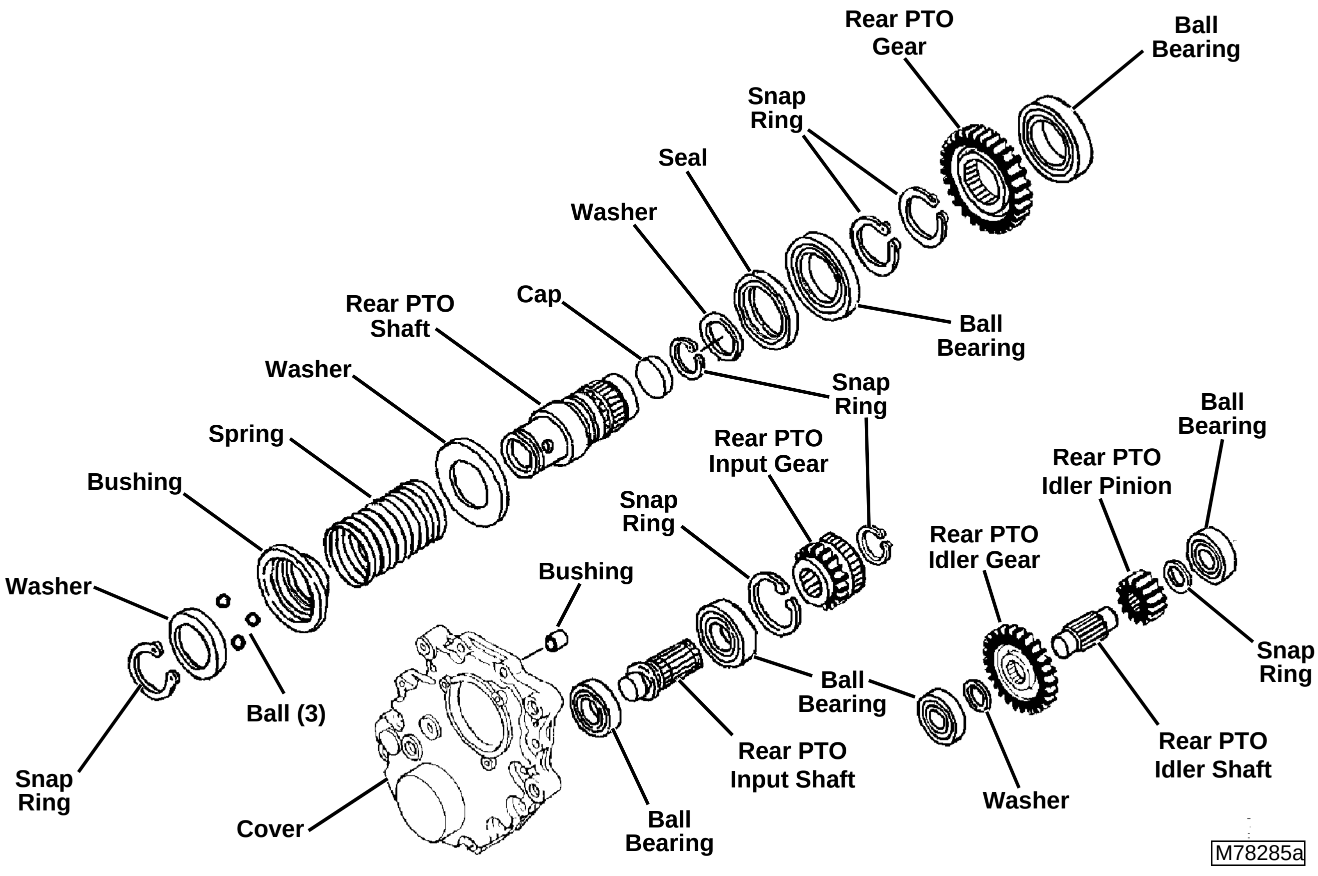
IMPORTANT: Be sure not to lose needle bearings or washers.

9. Remove PTO idler gear assembly.
10. Remove mid-mount and rear-mount PTO gear assembly.
11. Left axle must be removed to remove PTO output shaft assembly. Inspect ball bearings and needle bearings for smooth rotation.
12. Inspect gears and splines for missing or chipped teeth, wear or damage. Replace parts if necessary.

REAR PTO GEAR CASE—REMOVAL/INSTALLATION

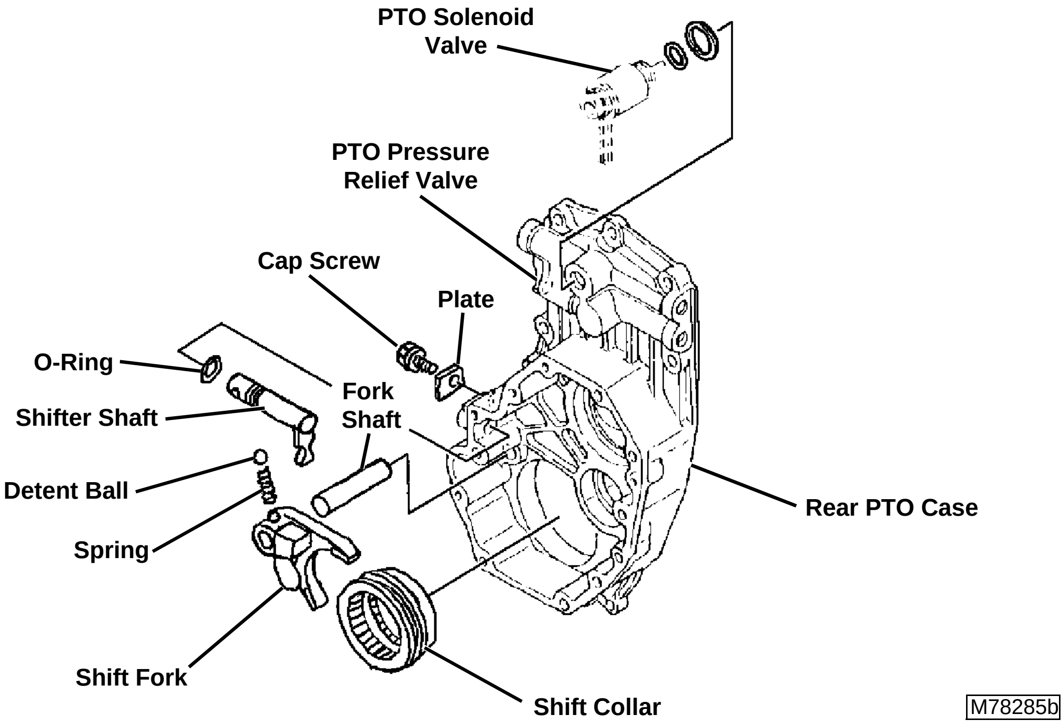


1. Remove gear case cover and cap screws.



NOTE: If rear PTO input gear replacement is necessary, the shift collar (in the rear PTO case) and rear PTO idler gear must be replaced also. The three gears are available as a set. Rear PTO gear and rear PTO idler pinion must be replaced as a set.

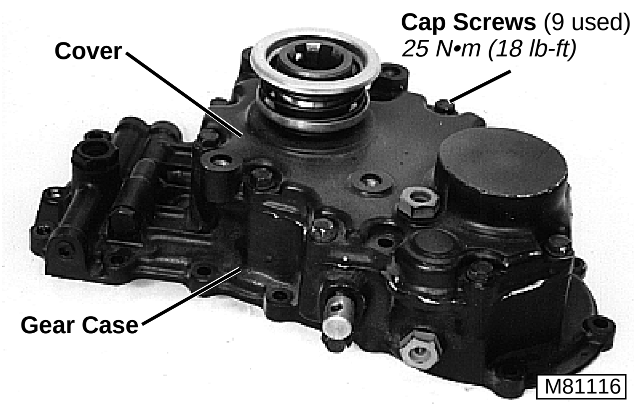
2. Inspect rear PTO cover components. Replace if necessary.
3. Install new seal into cover with the closed side of the seal into the bore first. Use a disk driver to push seal to bottom of bore.
4. Install bearings on rear PTO input shaft tight against shoulder.
5. Install rear PTO gear with longer center hub towards bearing.



6. Remove shift collar and shifter fork assembly together.
7. Remove PTO pressure relief valve and solenoid valve if necessary. (See PTO RELIEF VALVE—REMOVAL/INSTALLATION and PTO SOLENOID VALVE—REMOVAL/INSTALLATION.)

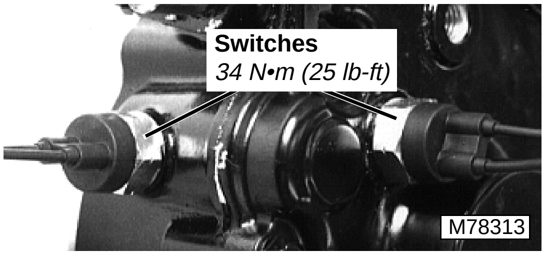
NOTE: *If shift collar replacement is necessary, the rear PTO idler gear and rear PTO input gear (in the rear PTO cover) must be replaced also. The three gears are available as a set.*

8. Inspect rear PTO case components. Replace as necessary.
9. Apply clean hydraulic oil to O-ring before installation.
10. If shifter fork was disassembled, install spring and ball in fork. While compressing ball and spring, install fork shaft. Be sure ball fits into grooves of shaft.
11. With fork groove of shift collar away from case, install shifter fork and collar. Be sure arm of shifter shaft fits into slot of shifter fork.



12. Clean mating surface of cover and case. Be sure threaded holes are clean.
13. Apply a bead of John Deere Form-in-Place Gasket to cover mating surface.

IMPORTANT: Carefully lower cover assembly onto case, making sure bearings fit into bores and gears mesh properly. Be sure cover is installed within 3 mm (1/8 in.) of case before tightening cap screws to 25 N•m (18 lb-ft). Major damage can occur to cover and/or case if cover is not installed properly before tightening cap screws.

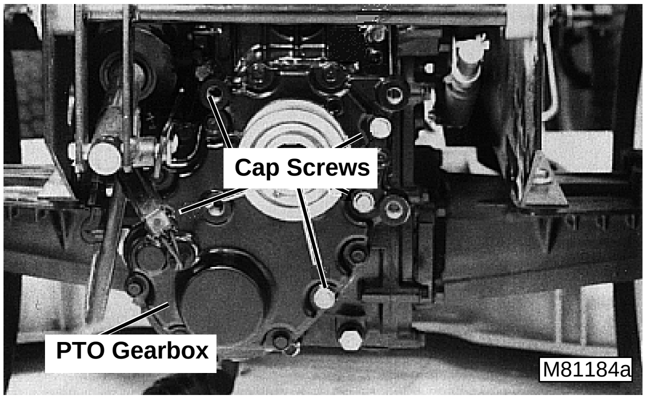


14. If removed, install O-rings and switches. DO NOT overtighten. Tighten to **34 N•m (25 lb-ft)**.

PTO DRIVE TRAIN (MID- AND REAR-MOUNT PTO)—INSTALLATION

IMPORTANT: Be careful not to get too much sealant in area of upper O-rings. Sealant should be applied outside of the grooves surrounding each O-ring. DO NOT fill groove with sealant. Purpose of groove is to stop excess sealant from moving O-ring during reassembly.

1. Clean mating surfaces of rear PTO gear case and transaxle case. Be sure threaded holes are clean and two O-rings are in position in gear case.
2. Apply petroleum jelly to seal on shaft of PTO clutch assembly.
3. Apply a bead of John Deere Form-in-Place Gasket to gear case mating surface.
4. Shift PTO lever to the middle position.



5. Carefully position the PTO on the transaxle and onto the lower dowel pin. Use a pry bar between the PTO and frame to carefully move the PTO approximately 1.5 mm (1/16-in.) to the right to align the top of the PTO with the upper dowel pin.

IMPORTANT: Be sure cover is aligned with transaxle case and installed within 4 mm (1/8 in.) of case before tightening cap screws. Major damage can occur to cover and/or case if cover is not installed properly before tightening cap screws.

6. Secure PTO to transaxle with cap screws.

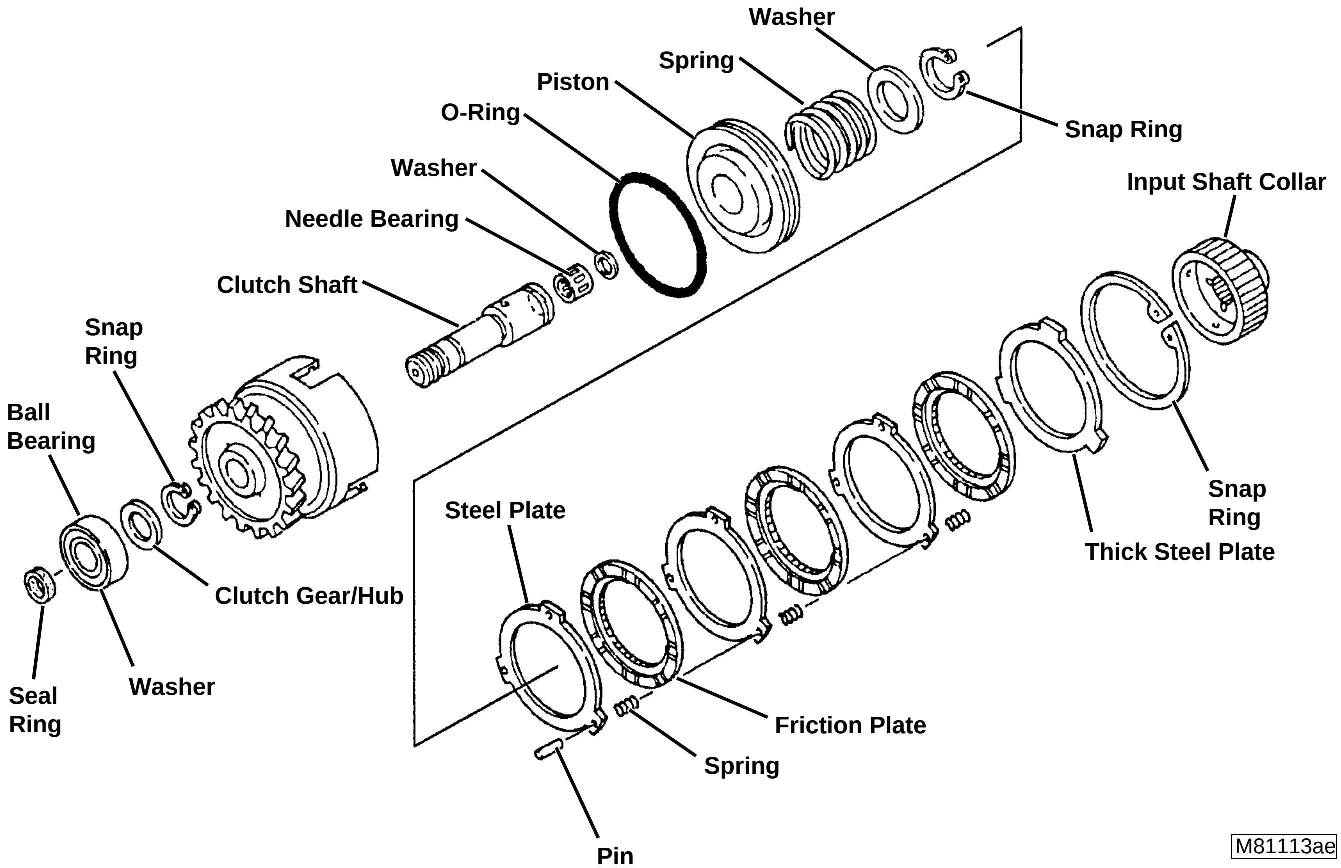
Rear PTO Gear Case Cap Screw Torque Specifications:

Used Transaxle Case . . . . 25 N•m (18 lb-ft)
New Transaxle Case. . . . . 30 N•m (22 lb-ft)

7. Install shifter, PTO shield, and hitch plate.
8. Connect solenoid lead and ball switch leads.
9. Install transaxle drain plug. Refill transaxle with approximately 7.5L (8 qts) JOHN DEERE LOW VISCOSITY HY-GARD™ (J20D as required) to cross-hatched area of dipstick.
10. Install any additional items removed prior to PTO.

PTO CLUTCH—DISASSEMBLY/INSPECTION/ASSEMBLY

1. Remove PTO clutch assembly. (See PTO BRAKE—REMOVAL/INSTALLATION.)



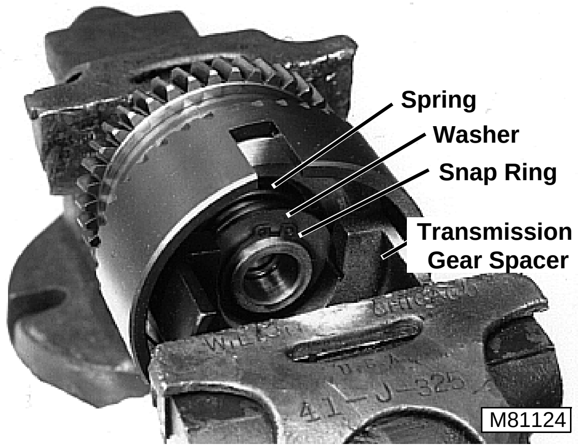
2. Remove large snap ring and thick steel plate.
3. Remove parts.

NOTE: Friction plates, springs, steel plates and pins must be replaced as a set.

4. Replace clutch gear/hub if brake surface is badly scored or teeth are chipped or damaged.

CAUTION

Piston is under spring force. Use care during disassembly.



5. Remove piston from clutch gear/hub. Use JDT39 Transmission Gear Spacer to compress spring and washer in a vise. Remove snap ring and slowly release force of spring.
6. Remove remaining clutch parts.
7. Check bearings for smooth rotation.
8. Inspect clutch gear for worn or damaged teeth.
9. Check inner piston bore for scoring or wear.
10. Check steel plates for scoring, discoloration, warping or wear.
11. Replace worn or damaged springs.
12. Check input shaft collar for burrs, wear or damaged teeth or splines.
13. Check clutch pack wear. Assemble parts.

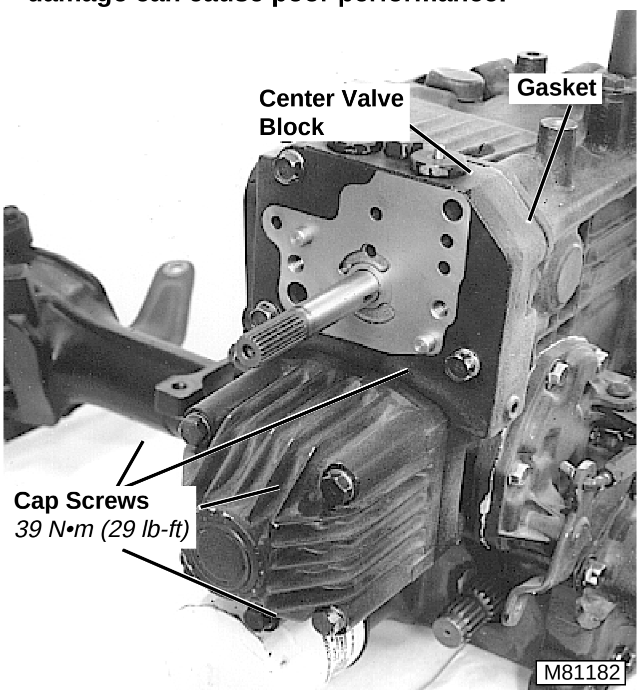
14. Put clutch gear/hub on bench so steel and friction plates are against snap ring. Measure clearance between inner steel plate and bottom of clutch gear/hub.
15. If clearance measures **2.7 mm (0.106 in.)** or more, replace PTO clutch plates.
16. Apply clean hydraulic oil to all parts.

Installation is done in the reverse order of removal.

HYDROSTATIC TRANSMISSION—REMOVAL

1. Remove transaxle. (See TRANSAXLE—REMOVAL/INSTALLATION.)
2. Remove charge pump. (See CHARGE PUMP—REMOVAL/INSTALLATION.)

IMPORTANT: Do not drop or damage pump valve plate when removing center valve block assembly. Do not nick or scratch lapped or machined surfaces of the valve plates or cylinder block components. The slightest damage can cause poor performance.

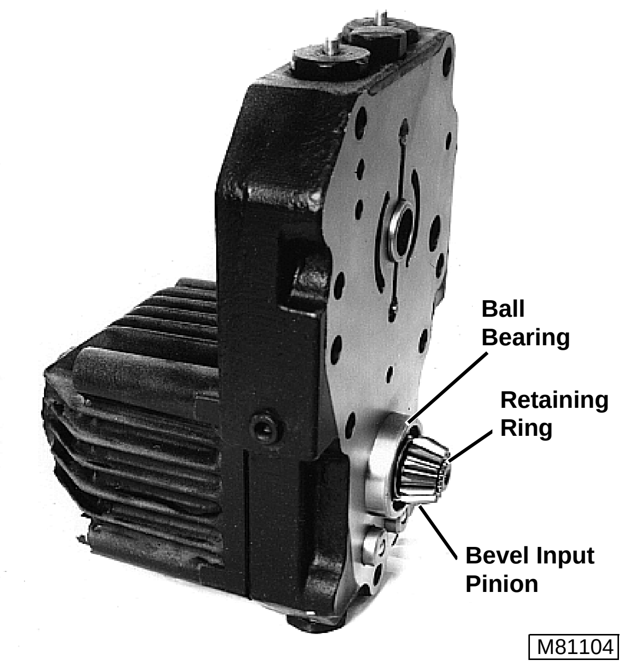


3. Remove cap screws and carefully remove center valve block and motor assembly from transaxle.
4. Replace gasket if torn or damaged.

Installation is done in the reverse order of removal.

- Tighten cap screws to **39 N•m (29 lb-ft)**.

HYDROSTATIC TRANSMISSION MOTOR—REMOVAL

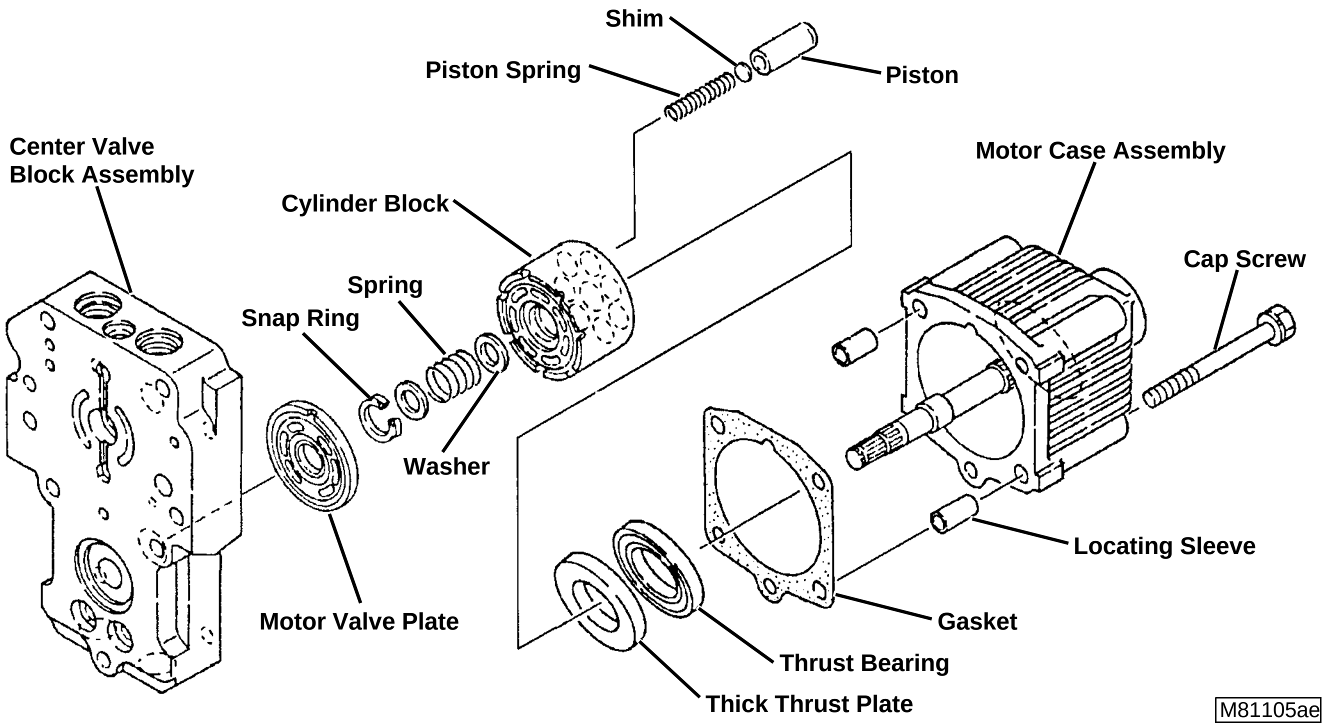


1. Remove retaining ring, bevel input pinion, and ball bearing.
2. Inspect bearing for smooth rotation.

NOTE: Bevel input pinion and bevel input gear must be replaced as a set.

3. Check pinion for wear or damage.
4. Replace retaining ring if ring is distorted during removal.

HYDROSTATIC MOTOR—DISASSEMBLY



1. Remove two cap screws.

IMPORTANT: Do not drop or damage motor valve plate when removing motor assembly. Do not nick or scratch lapped or machined surfaces of the valve plate or cylinder block components. The slightest damage can cause poor performance.

IMPORTANT: Keep pistons matched with bore of cylinder block. Do not interchange motor pistons and valve plate with pump pistons and valve plate. Pistons and cylinder blocks are a matched set.

2. Remove cylinder block assembly.

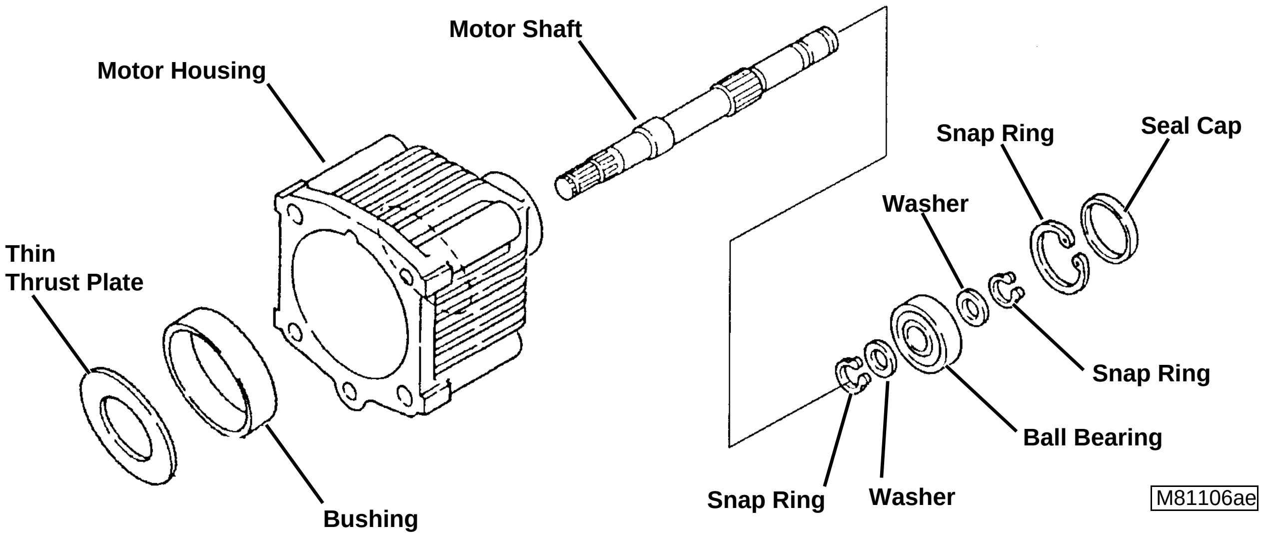
NOTE: Motor rotating components must be replaced as a set.

3. Inspect rotating components:

NOTE: Scoring is fine scratches or grooves cut into the highly machined surface. When the scratches can be detected by feel using a lead pencil or fingernail, the part must be replaced.

4. Check valve plate and cylinder block for grooves, scoring, discoloration or pitting.
5. Check for free movement of pistons in cylinder bore.
6. Check pistons for flat areas, scoring or discoloration.
7. Thrust bearing must rotate freely.

MOTOR CASE ASSEMBLY—DISASSEMBLY/INSPECTION/ASSEMBLY



NOTE: Thin thrust washer, bushing and motor housing must be replaced as a set.

1. Inspect thin thrust washer for wear or damage. Replace as necessary.

IMPORTANT: Do not damage ball bearing when removing seal cap.

2. Remove seal cap and snap ring to remove shaft assembly components.
3. Inspect bushing, bearing and shaft for wear or damage. Replace if necessary.
4. Assemble parts.
5. Apply John Deere Form-in-Place Gasket to outer edge of new seal cap. Install seal cap until cap is approximately 4 mm (5/32 in.) below surface of motor case.

IMPORTANT: Apply clean hydraulic oil to all mating surfaces.

HYDROSTATIC TRANSMISSION MOTOR—ASSEMBLY

1. Install components in motor case assembly. (See MOTOR CASE ASSEMBLY—DISASSEMBLY/ INSPECTION/ASSEMBLY.)

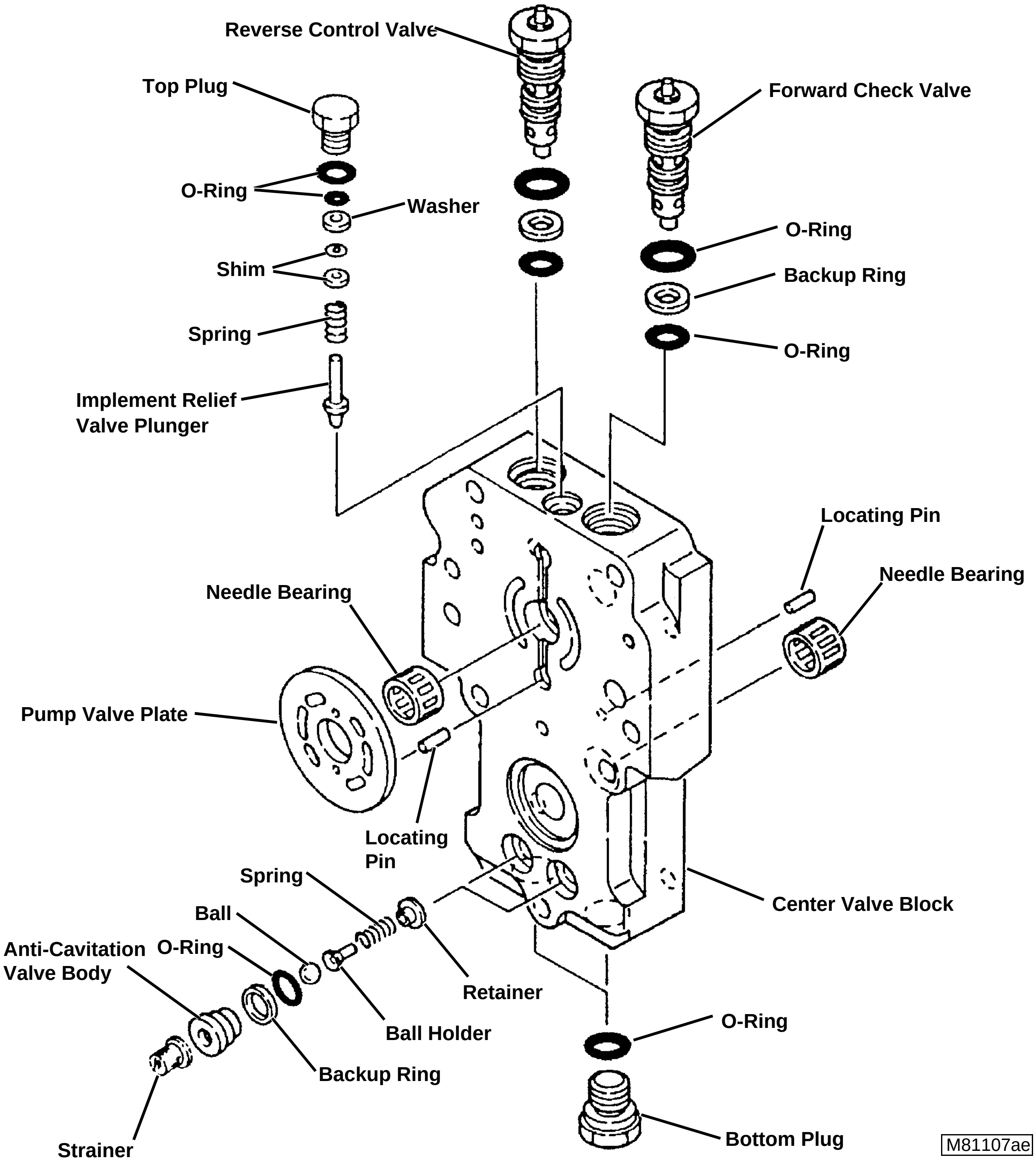
NOTE: Use petroleum jelly to hold valve plate in position.

IMPORTANT: Pump and motor valve plates are not interchangeable. The pump valve plate has two leading grooves into two of the slotted ports. The motor valve plate has no leading grooves.

2. Put motor valve plate on center valve block. Make sure bronze surface is away from valve block and notch in valve plate fits on locating pin of valve block.

NOTE: Motor case will seem springy because the springs inside the cylinder block are being compressed.

CENTER VALVE BLOCK—DISASSEMBLY/ASSEMBLY



NOTE: Remove motor assembly if necessary to inspect needle bearing. (See HYDROSTATIC TRANSMISSION MOTOR—REMOVAL.)

1. Remove and inspect directional check valves.

IMPORTANT: The reverse check valve must be installed in the left port. The check valve can be identified by a small orifice drilled into a land between the two sets of valve passageways.

2. Replace locator pins if missing or damaged.
3. Inspect needle bearings for wear or damage. If bearings are replaced, install new bearings with the stamped end away from center valve block.
4. Push bearings into bore until end of bearing is approximately 3 mm (7/64 in.) above the surface of the valve block.
5. Inspect anti-cavitation valve assemblies.

NOTE: Screens may be located in bores of transaxle case.

6. Check suction screens for blockage.
7. Carefully pull anti-cavitation valve body from center valve block so as not to lose parts.
8. Replace parts as necessary.
9. Apply oil to O-rings and push assembly to bottom of bore.
10. Inspect center valve block where charge pump contacts block for scoring.
11. Replace center valve block if necessary.

NOTE: Scoring is fine scratches or grooves cut into the highly machined surface. When the scratches can be detected by feel using a lead pencil or fingernail, the part must be replaced.

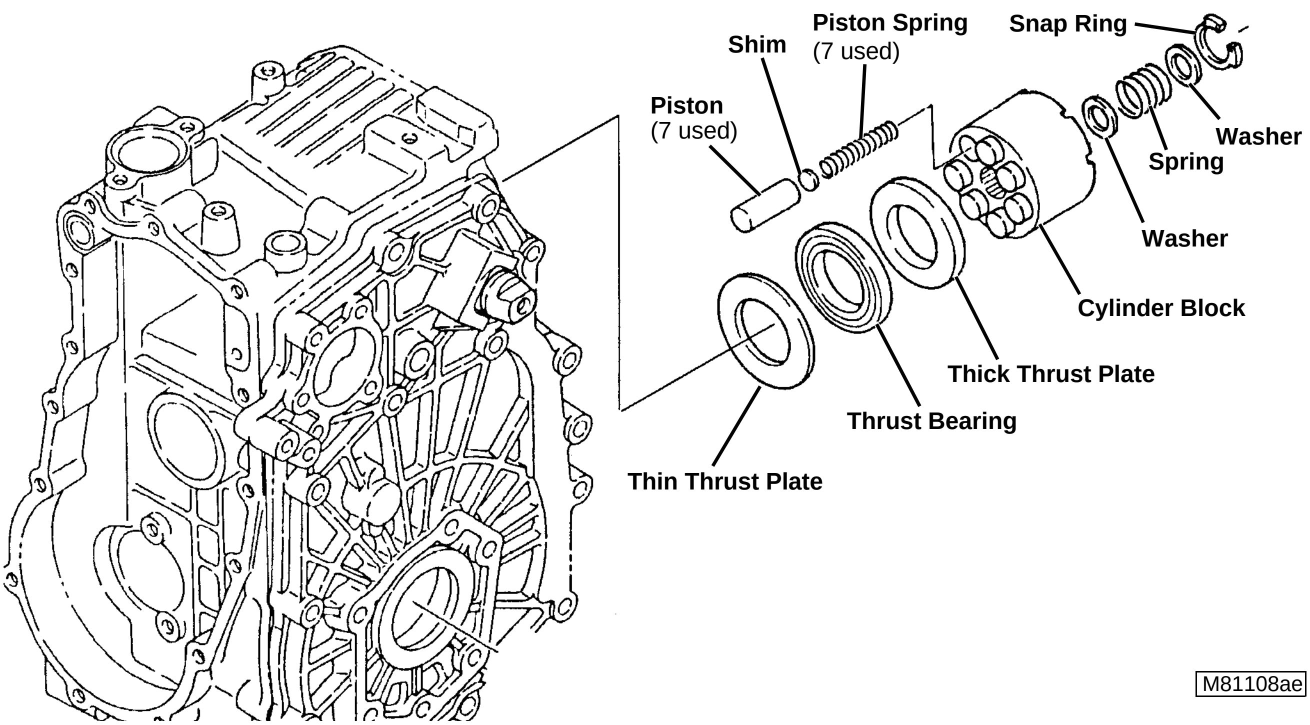
12. Inspect valve plate for grooves, scoring, discoloration or pitting.

IMPORTANT: Pump and motor valve plates are not interchangeable. The pump valve plate has two leading grooves into two of the slotted ports. The motor valve plate has no leading grooves.

NOTE: Use petroleum jelly to hold valve plate in position.

13. Put pump valve plate on center valve block. Make sure bronze surface is away from valve block and notch in valve plate fits on locating pin of valve block.
14. Remove plug to inspect implement pressure relief valve parts.
15. Check plunger for nicks, wear or damage.
16. Inspect plunger seat in center valve block. Remove any obstructions and replace center valve block if seat is worn or damaged.

HYDROSTATIC PUMP—INSPECTION



IMPORTANT: Keep pistons matched with bore of cylinder block. Do not interchange motor pistons and valve plate with pump pistons and valve plate. Pistons and cylinder blocks are a matched set.

1. Spring is compressed. Apply an external force to compress spring farther before removing snap ring. Then slowly remove external force.
2. Remove parts from transaxle as necessary.

NOTE: Pump rotating components must be replaced as a set. Thin thrust plate must be replaced as a set with the pump swash plate and bushing.

NOTE: Scoring is fine scratches or grooves cut into the highly machined surface. When the scratches can be detected by feel using a lead pencil or fingernail, the part must be replaced.

3. Check cylinder block for grooves, scoring, discoloration or pitting.
4. Check for free movement of pistons in cylinder bores.
5. Check pistons for flat areas, scoring or discoloration. Thrust bearing must rotate freely.

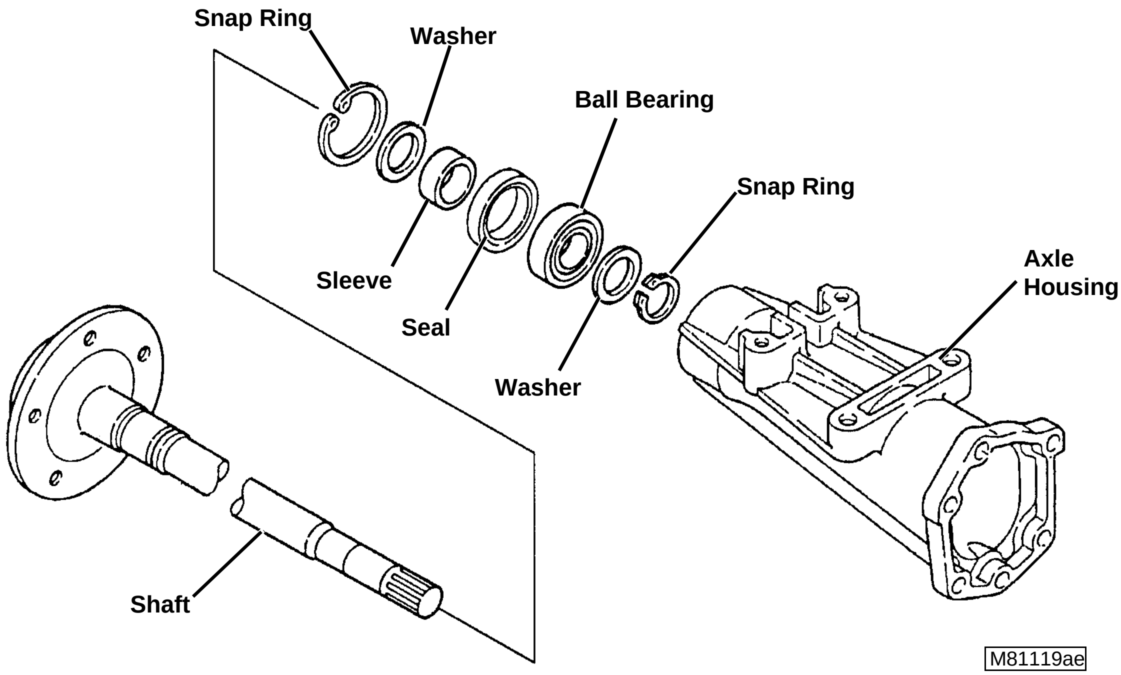
For inspection of pump valve plate, refer to CENTER VALVE BLOCK—DISASSEMBLY/ASSEMBLY.

REAR AXLE ASSEMBLY—REMOVAL/INSTALLATION

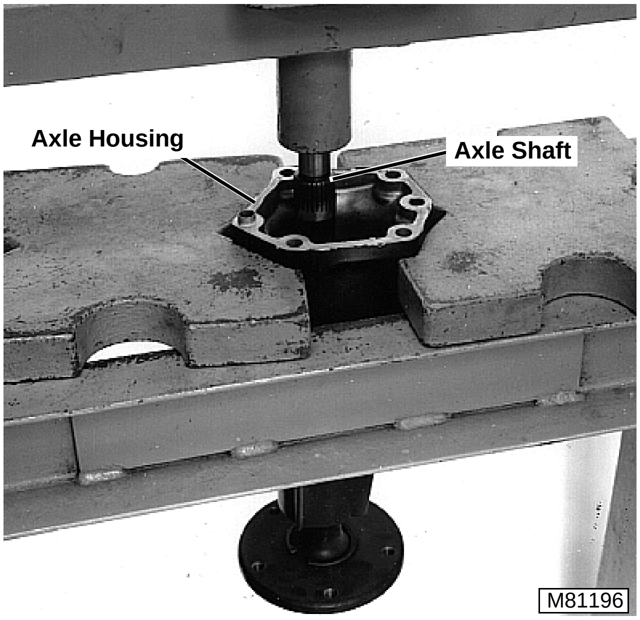
1. Remove transaxle. (See TRANSAXLE—REMOVAL/INSTALLATION.)
2. For AWS models, remove rear steering linkage. (See REAR STEERING LINKAGE—REMOVAL in the STEERING section.)
3. Remove rear axle assembly.
4. Clean axle housing and transaxle mating surfaces. Apply a bead of John Deere Form-in-Place Gasket to mating surface.

NOTE: For AWS models, longer caps screws are installed in the bottom three holes.

5. Repeat for other side if necessary.



REAR AXLE ASSEMBLY (TWO WHEEL STEER MODELS)—DISASSEMBLY/ASSEMBLY

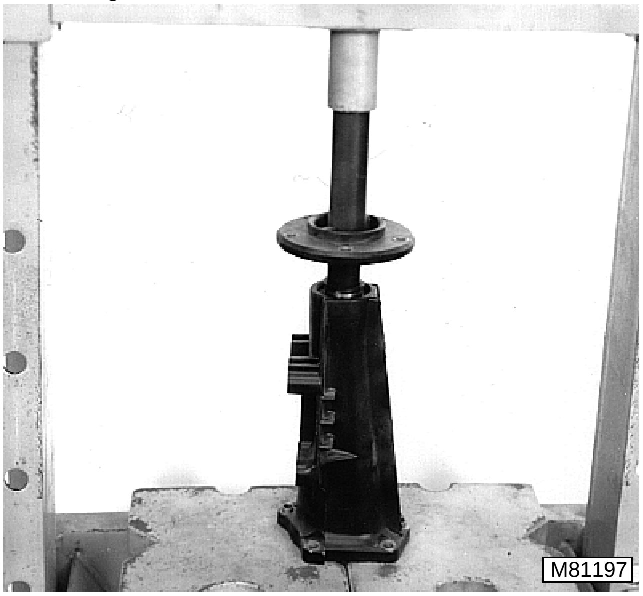


1. Remove snap ring from groove of axle housing.
2. Use a press to remove axle shaft from axle housing.
3. Remove remaining snap ring to remove axle shaft components.
4. Inspect axle shaft and housing for wear or damage. Replace parts as necessary.
5. Inspect bearing for smooth rotation. Replace if necessary.

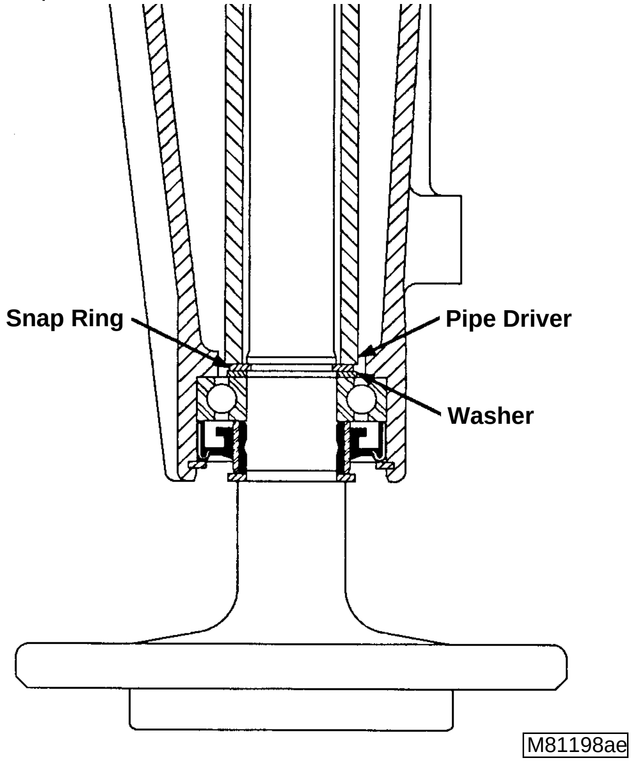
NOTE: Ball bearing is not pressed into housing. When placed in axle housing it may be loose. A clearance up to 0.38 mm (0.015 in.) is normal.

6. Install bearing, seal and snap ring into axle housing. Put spring-side of seal into housing first.
7. Apply petroleum jelly to lips of seal and inner diameter of sleeve.
8. Install snap ring, washer and sleeve on axle shaft. Use a piece of pipe with a minimum inside diameter of 31 mm (1-3/16 in.) to push sleeve and washer tight against shoulder of shaft.

IMPORTANT: Do not use excessive force to install axle shaft. Axle housing may be cracked or damaged if too much force is used.

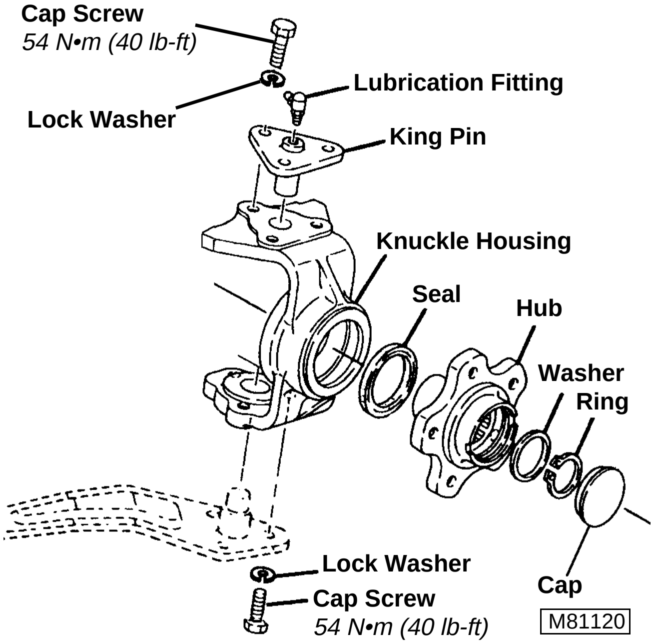


9. Install axle shaft assembly into axle housing using a press. Press shaft only until a rapid increase in pressure is noticed.



10. Install washer and snap ring on axle shaft.
11. Use a piece of pipe with a minimum inside diameter of 31 mm (1-3/16 in.), maximum outer diameter of 43 mm (1-11/16 in.) and approximately 330 mm (13 in.) long to install snap ring.

REAR AXLE ASSEMBLY (ALL WHEEL STEER)—DISASSEMBLY/ ASSEMBLY

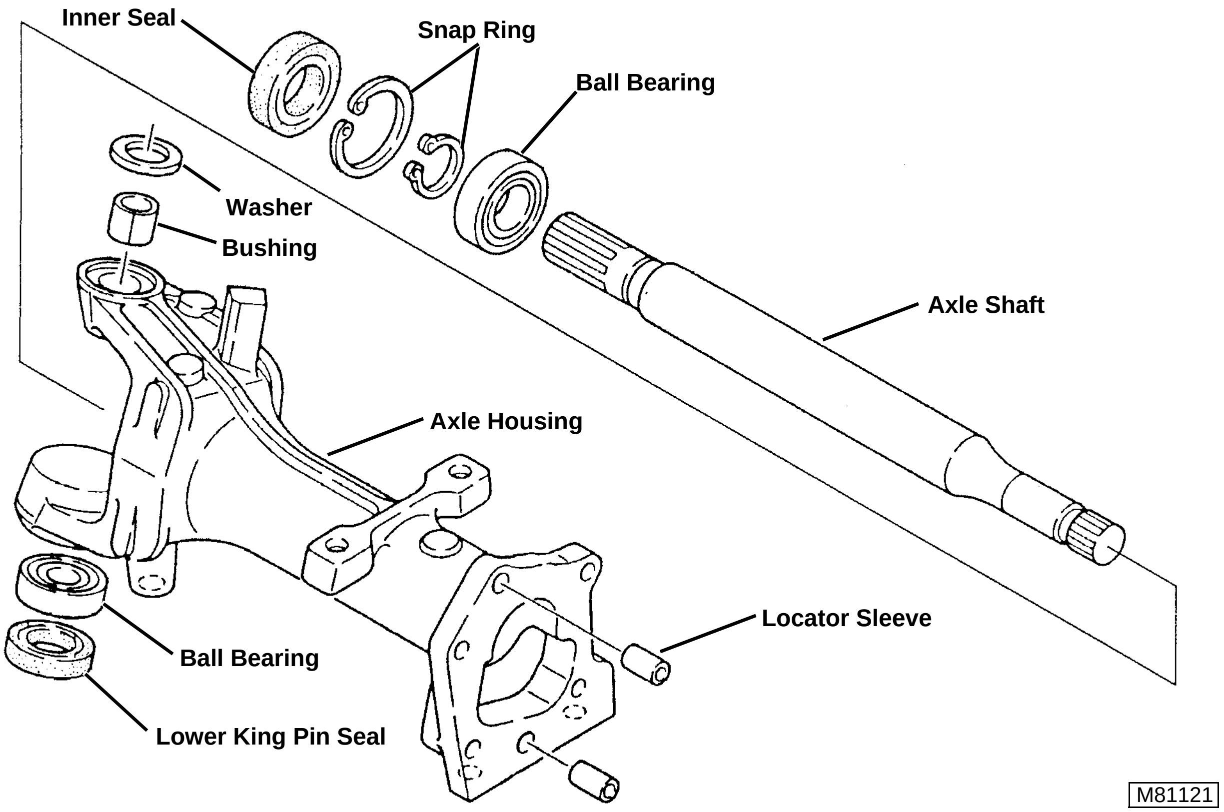


1. Remove upper and lower king pins.
2. Pull knuckle housing from axle housing.

Installation is done in the reverse order of removal.

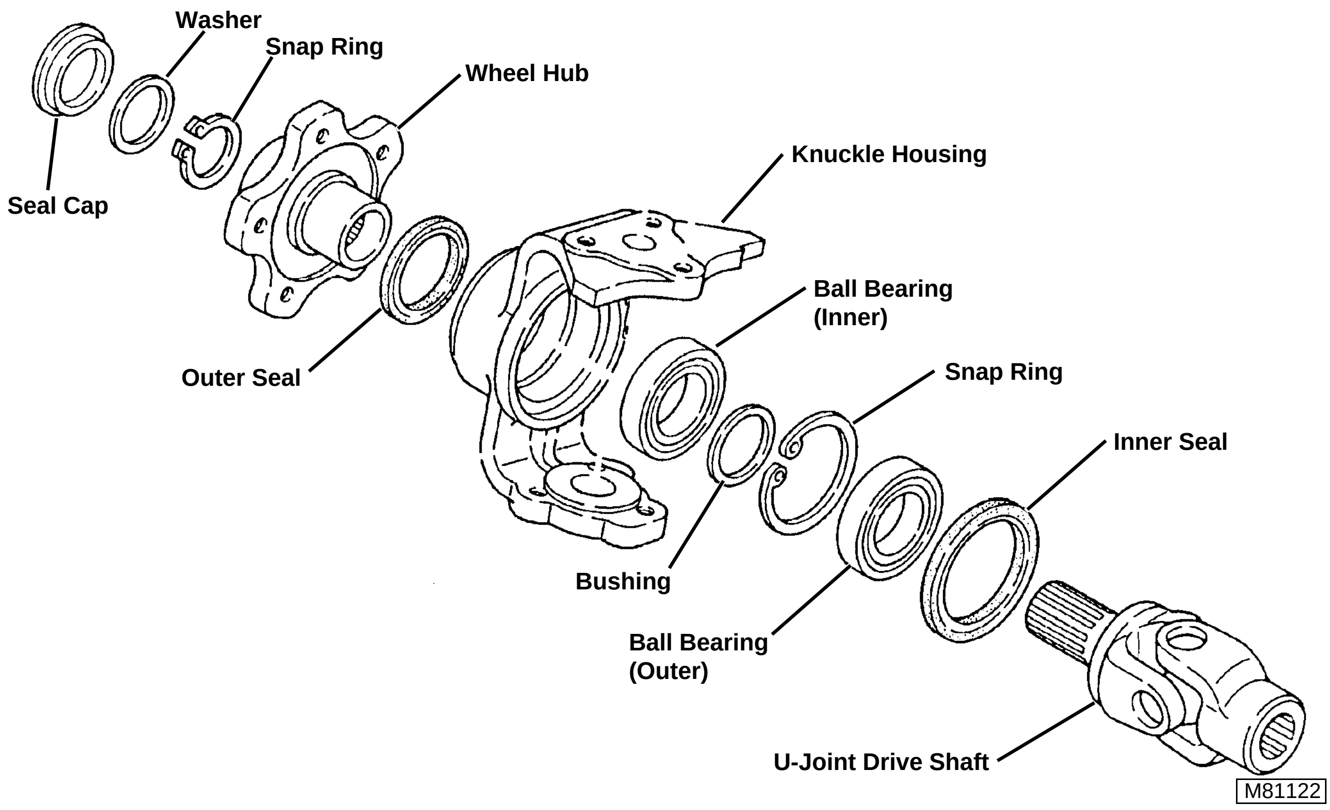
- Apply medium strength thread lock and sealer to threads of cap screws and washers.
- Tighten cap screws to **54 N•m (40 lb-ft)**.
- Apply multi-purpose grease to lube fitting until grease begins to appear at upper joint.

REAR AXLE ASSEMBLY (ALL WHEEL STEER)—DISASSEMBLY/ASSEMBLY



1. Remove inner seal.
2. Remove large snap ring to remove axle shaft with bearing and snap ring. Remove snap ring if bearing or shaft must be replaced.
3. Inspect axle components for cracks, wear or damage. Replace if necessary.
4. If bushing was replaced, use a disk driver to install bushing until end of bushing is even with machined surface of axle housing. Apply multipurpose grease to inside diameter of bushing.
5. If ball bearing was replaced, push bearing to bottom of bore.
6. Install new lower king pin seal with open side of seal away from bearing. Use a disk driver to push seal into bore until even with surface of axle housing. Apply multi-purpose grease to seal lips.
7. Install axle shaft with bearing and snap ring in axle housing.
8. Install large snap ring.
9. Apply multi-purpose grease to lips of seal. Install seal so open, spring side of seal is towards bearing. Push seal against snap ring using a tube type driver.

KNUCKLE HOUSING—DISASSEMBLY/ASSEMBLY



1. Remove seal cap, washer, snap ring and U-joint drive shaft.
2. Remove wheel hub to disassemble remaining components.
3. Inspect knuckle housing components for cracks, wear or damage. Replace as necessary.

NOTE: Inner bearing is not press fit.

4. If inner bearing was replaced, push new bearing to bottom of bore. Fill bearing and cavity with multipurpose grease.
5. Install snap ring.
6. Install bushing against inner bearing.
7. Push outer bearing tight against bushing.

IMPORTANT: Open lip side of seal must face outward to prevent dust and moisture from getting into bearings. Push only on outer surface of seal.

8. Use a disk driver to push outer seal (lip facing outward) into bore until even with the surface of knuckle housing.

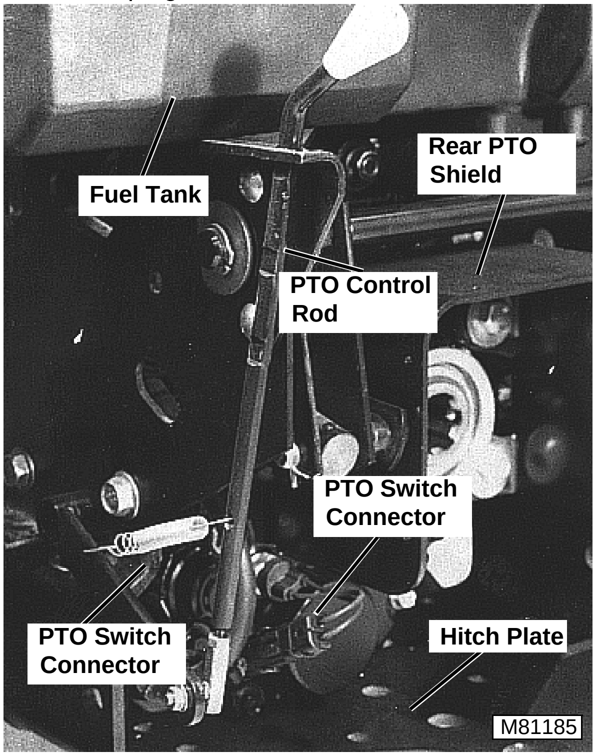
IMPORTANT: Lip on seal must not be damaged or rolled over.

9. Use a disk driver to push inner seal (seal lip facing outward) to bottom of bore.
10. Apply multi-purpose grease to seal lips.
11. Rotate wheel hub while installing into knuckle housing. Check while installing that seal lip is not rolled over.
12. Apply Dubois MPG-2 (M79292) grease (water repellent) to splines of U-joint drive shaft and slide into knuckle housing assembly.
13. Install remaining components.
14. Clean all threads of knuckle housing and cap screws with clean and cure primer.

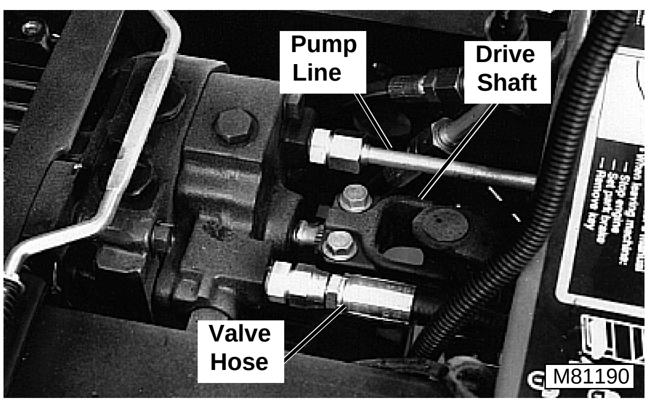
TRANSAXLE—REMOVAL/ INSTALLATION

NOTE: Approximate capacity of hydrostatic powertrain is 6.6L (7.0 qt.) for two-wheel steering and 5.7L (6.0 qt.) for all-wheel steering.

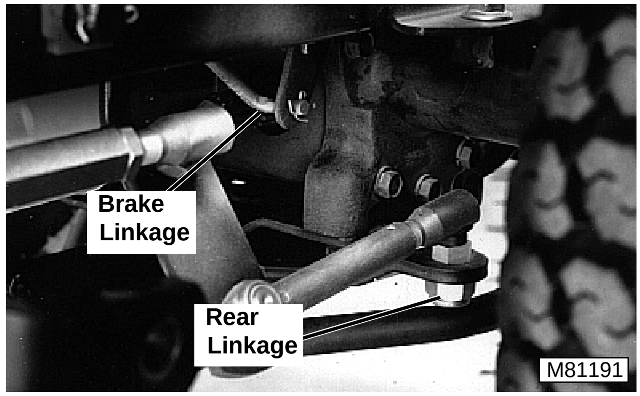
1. Remove plug to drain oil from transaxle.



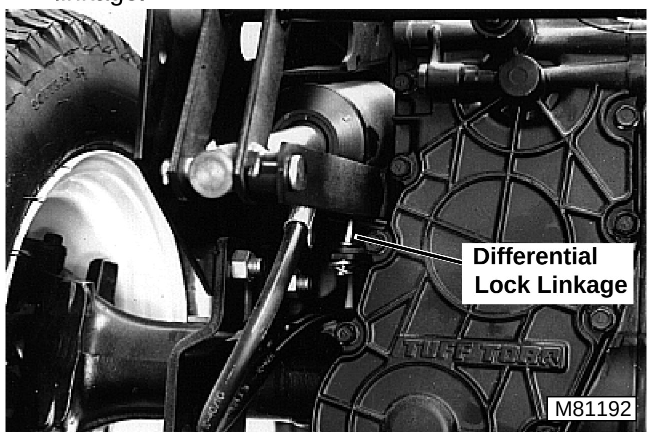
2. Remove fuel tank.
3. If equipped, remove rear PTO shield, disconnect rear PTO control rod, and the two (2) PTO switch connectors.
4. Remove hitch plate.



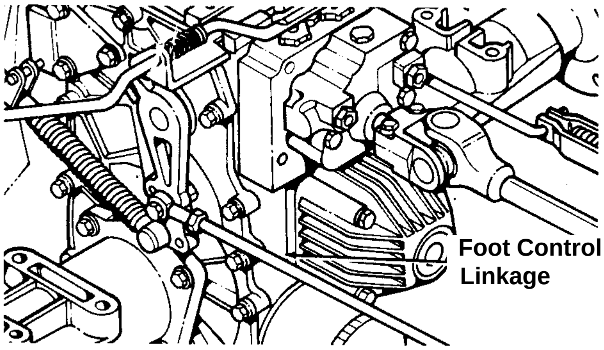
5. Disconnect charge pump-to-steering valve hose and oil cooler-to-charge pump line.
6. Loosen drive shaft from transaxle.



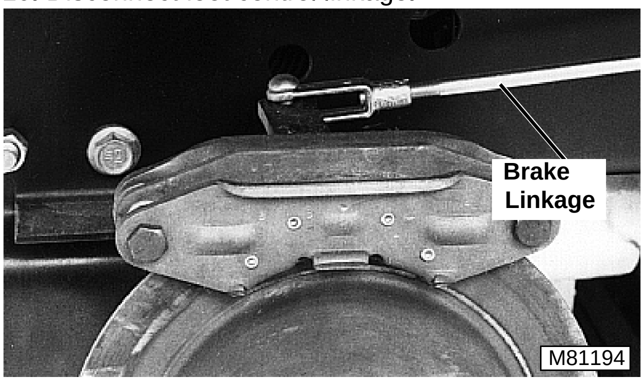
7. Disconnect brake linkage.
8. For AWS units only, disconnect rear intermediate linkage.



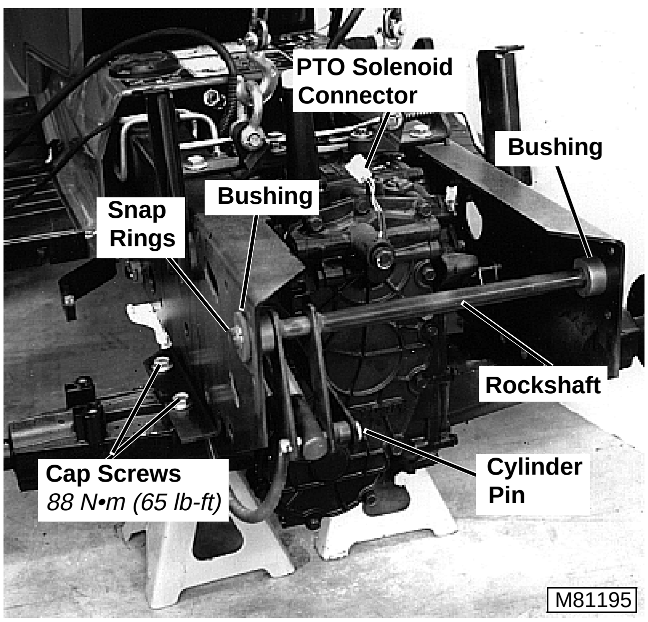
9. Disconnect differential lock linkage.



10. Disconnect foot control linkage.



11. For European units only, disconnect right and left brake linkage.
12. Lift rear of tractor and install jack stands.
13. Remove rear tires.



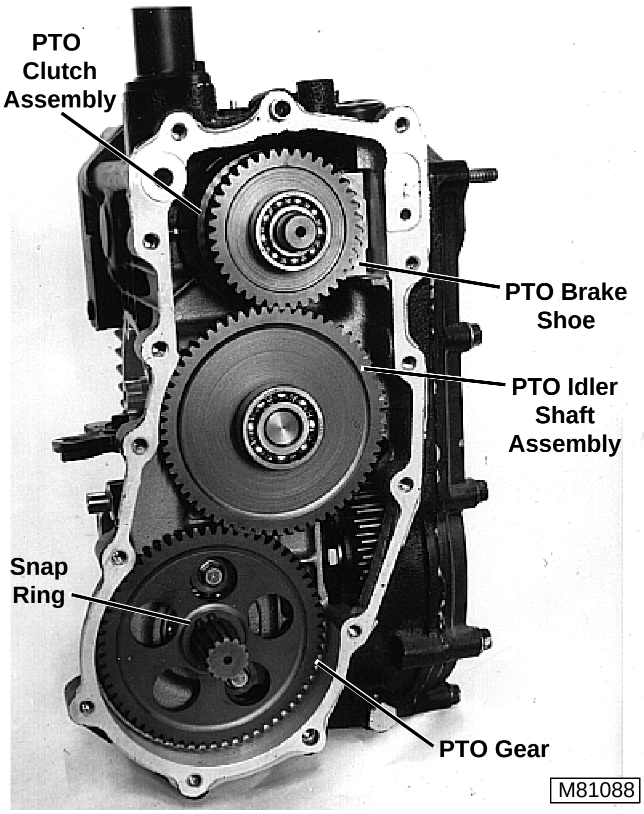
14. Remove lift cylinder pin, snap rings and bushings to remove rockshaft.
15. Disconnect PTO solenoid connector.
16. Attach transaxle to a hoist.
17. Remove cap screws and carefully remove transaxle.
18. Repair transaxle as necessary.
19. Connect drive shaft while installing transaxle.

Installation is done in the reverse order of removal.

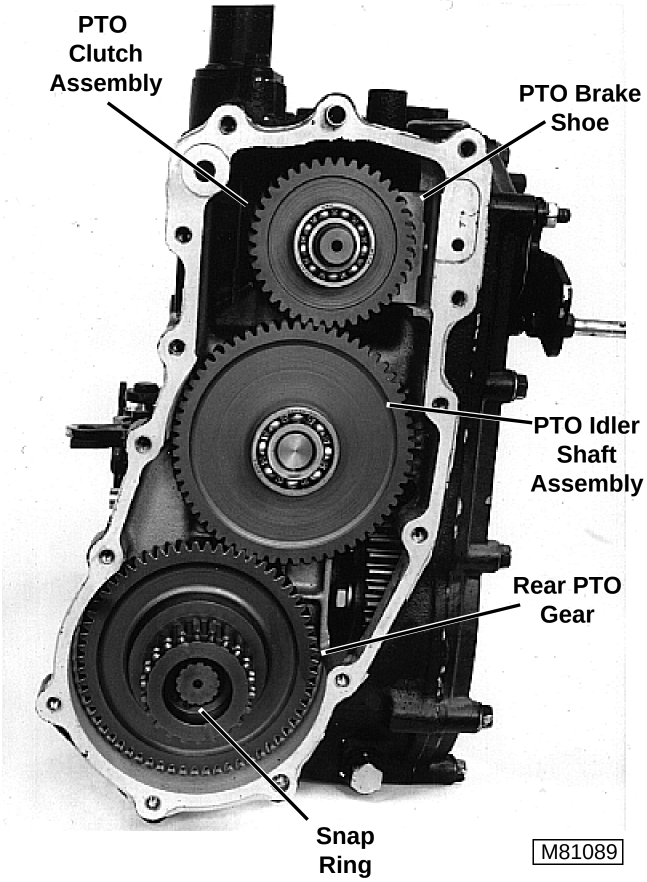
- Tighten transaxle mounting cap screws to **88 N•m (65 lb-ft)**.

TRANSAXLE—DISASSEMBLY

1. For AWS models, remove rear steering linkage. (See REAR STEERING LINKAGE—REMOVAL in the STEERING section.)
2. Remove control arm damper. (See CONTROL ARM DAMPER—REMOVAL/INSTALLATION.)
3. Remove hydrostatic transmission and pump. (See HYDROSTATIC TRANSMISSION—REMOVAL.)
4. Remove axle housings. (See REAR AXLE ASSEMBLY—REMOVAL/INSTALLATION and REAR AXLE ASSEMBLY—DISASSEMBLY/ASSEMBLY.)
5. Remove brakes. (See BRAKES—REMOVAL/INSTALLATION in the BRAKES section.)

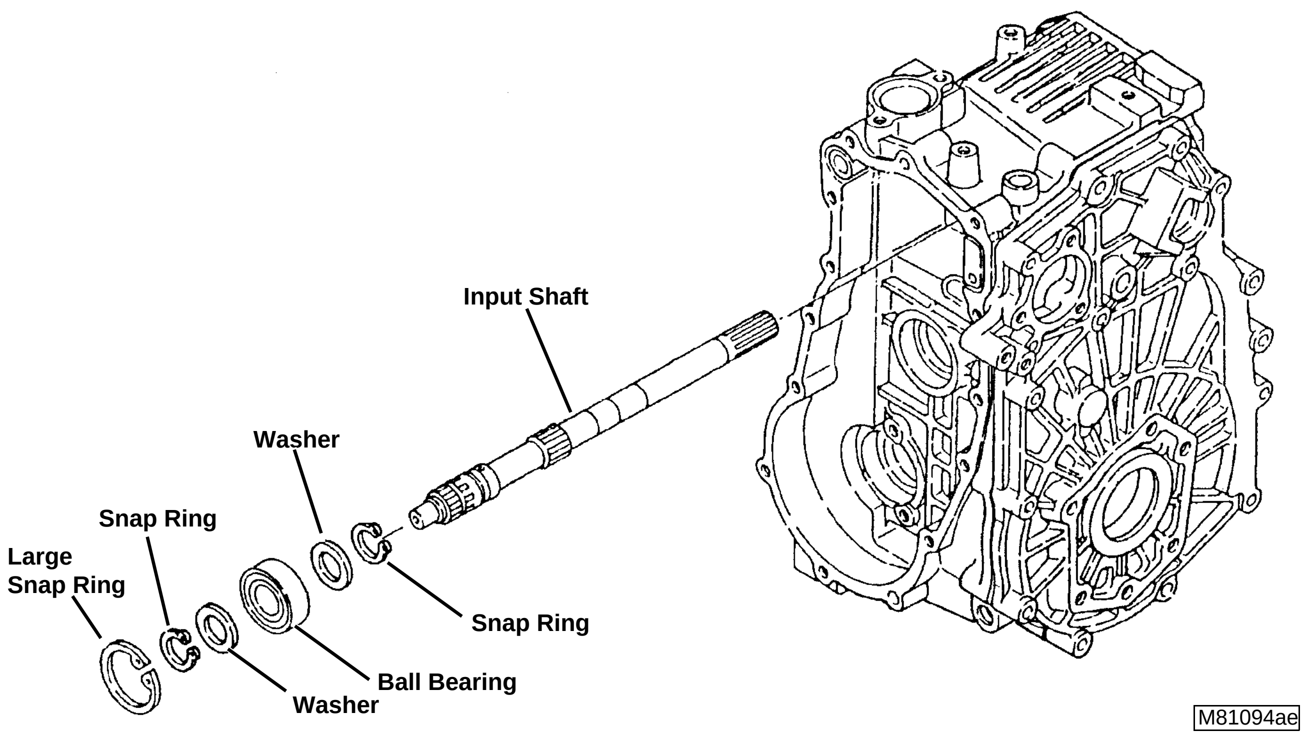


3TN66, Later 3TNA72



With Rear PTO Option

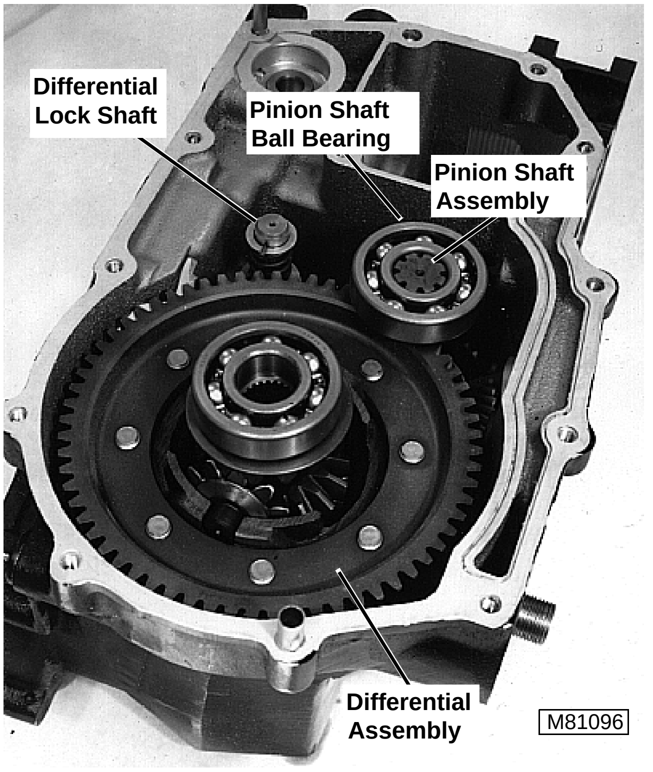
6. Remove PTO idler shaft assembly, snap ring, PTO gear (or rear PTO gear).
7. Remove PTO brake and clutch. (See PTO BRAKE—REMOVAL/INSTALLATION.)



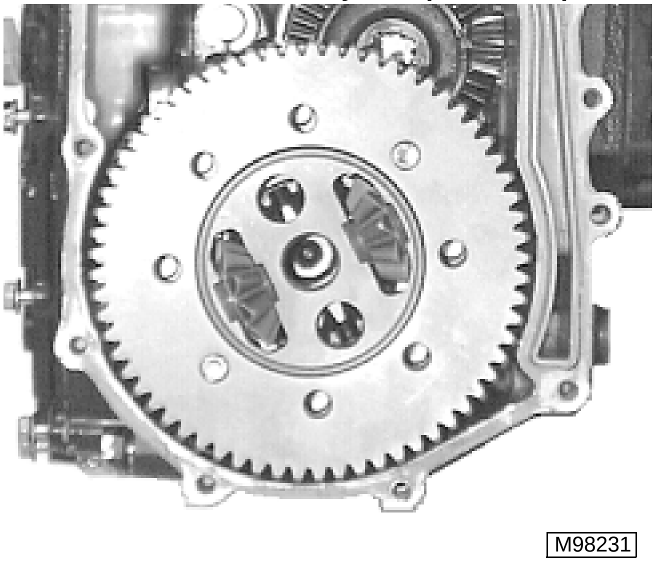
8. Remove large snap ring and input shaft assembly.

9. Lay transaxle on left side and remove right cover assembly.

IMPORTANT: Bearing, washer and differential pinion located on top of differential assembly are loose. Do not drop or lose parts.



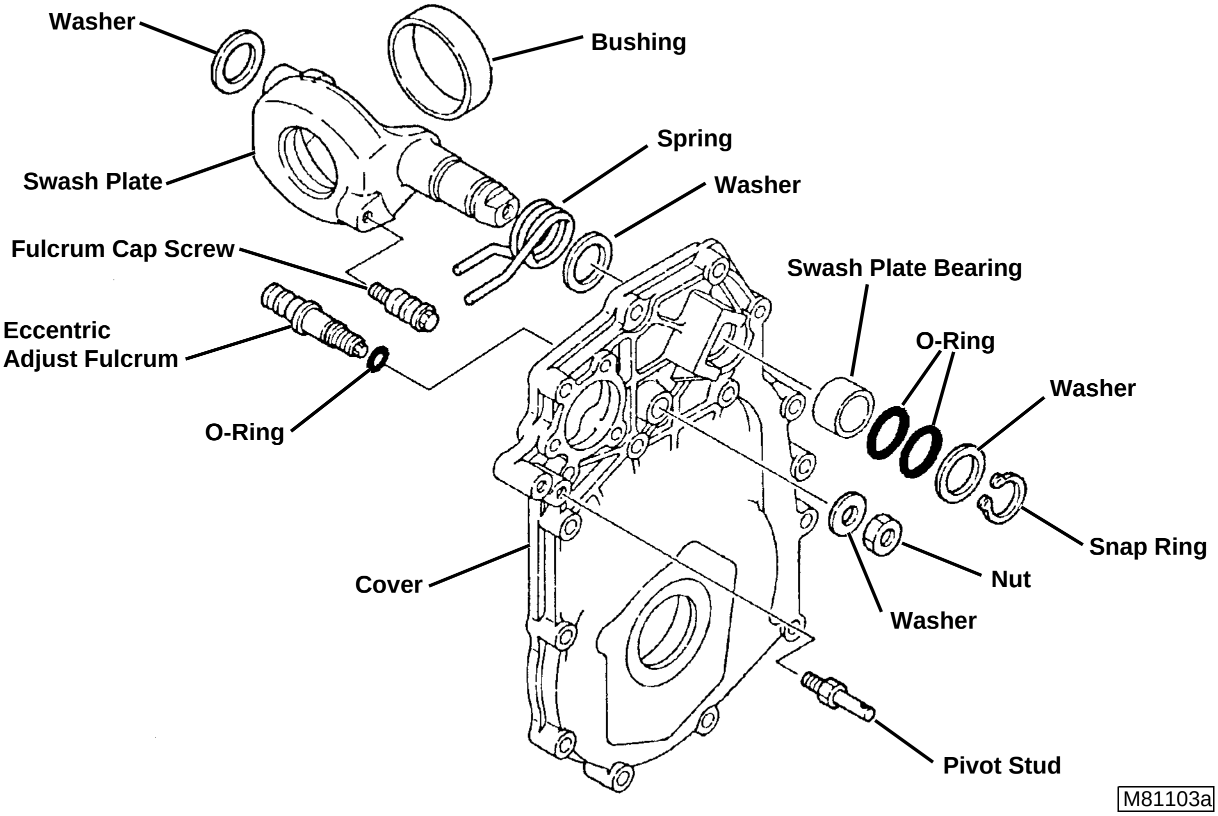
Differential Assembly S.N. (— 080001)



Differential Assembly S.N. (080001 —)

10. Remove final pinion shaft ball bearing. Bearing may remain in cover assembly.
11. Lift final gear and differential assembly and differential lock shaft from transaxle case together as an assembly.
12. Remove final pinion shaft assembly.

TRANSAXLE (RIGHT COVER)—DISASSEMBLY/ASSEMBLY



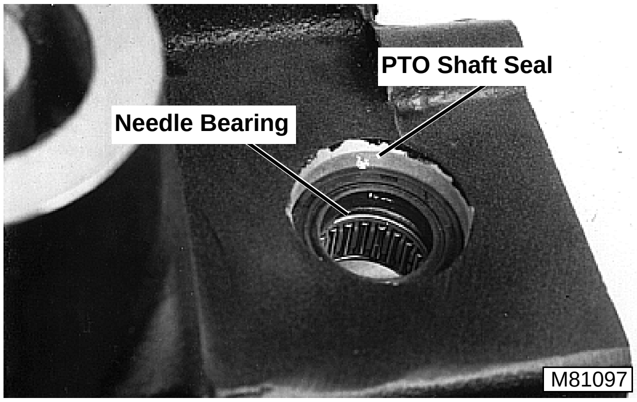
1. Remove snap ring, nut and washers.
2. Pull swash plate from cover.

NOTE: Pump swash plate, bushing, and thin thrust plate must be replaced as a set.

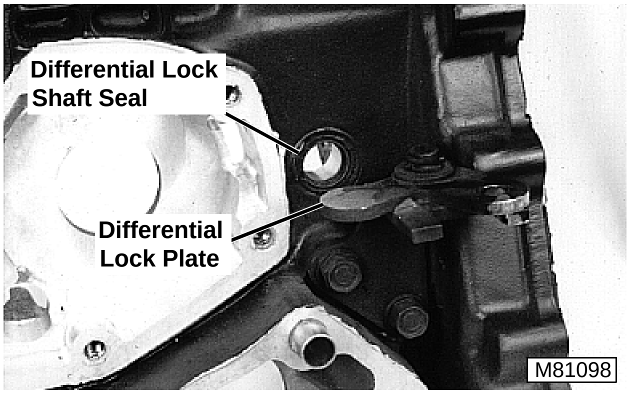
3. Inspect transaxle cover components.
4. Check bushing, bearing and swash plate contact surfaces for wear or damage. Replace as necessary.
5. Inspect O-rings for cuts or damage.
6. Install spring so legs are crossed and each leg of spring fits into a groove of the fulcrum cap screw.
7. If swash plate bearing was removed, install new bearing until end of bearing is even with the inside surface of the cover.
8. Put petroleum jelly on all O-rings. Install swash plate assembly and remaining components.

NOTE: Use medium strength thread lock and sealer.

TRANSAXLE CASE—INSPECTION



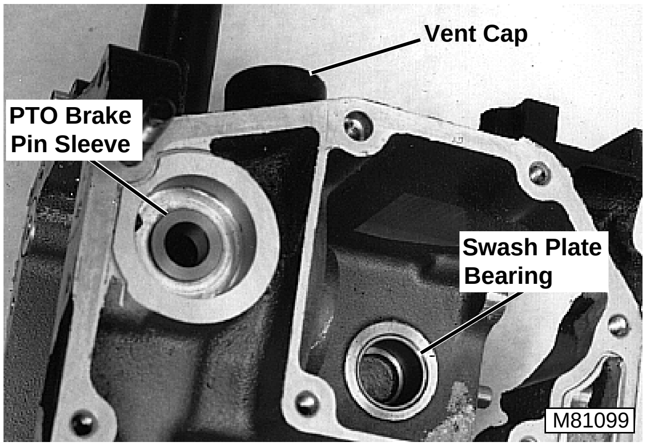
1. Remove front PTO shaft seal.
2. Inspect needle bearing for wear or damage. Remove if necessary. Install new needle bearing from inside case with bearing identification marks toward the inside of the case. Push bearing tight against shoulder in bore.
3. Install new seal with the open, spring side towards the inside of the case.
4. Push seal against shoulder in bore.



5. Replace differential lock shaft seal.

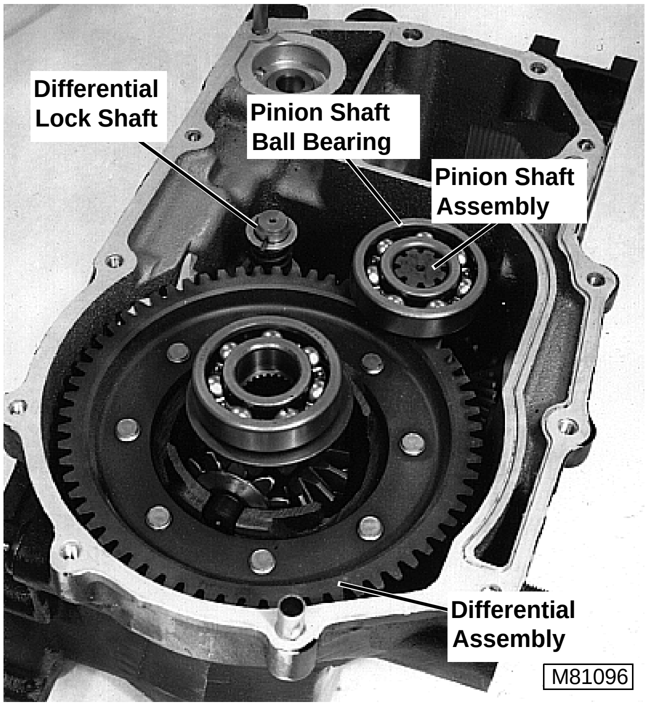
NOTE: *Differential lock plate may have to be removed to install new seal.*

6. Install new seal with the open, spring side towards inside of case. Push seal tight against bottom of bore.

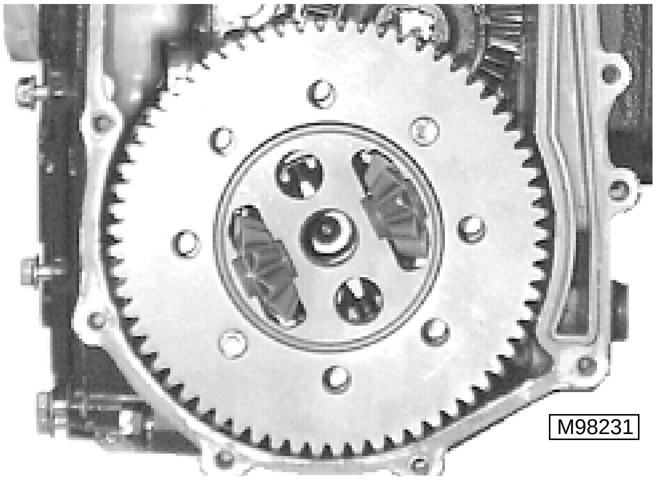


7. Inspect PTO brake pin sleeve for scoring or damage. Replace if necessary.
8. Push sleeve out from inside of case.
9. Install new sleeve into case until flange of sleeve is tight against case.
10. Inspect swash plate bearing for wear or damage. Replace if necessary.
11. Install new bearing using a disk driver. Push bearing to bottom of bore.
12. Inspect vent cap for damage or obstructions. Replace as necessary.

TRANSAXLE—ASSEMBLY



Differential Assembly S.N. (—080001)



Differential Assembly S.N. (080001 —)

1. Apply clean hydraulic oil to all internal components.
2. Install final pinion shaft assembly into transaxle case with bevel gear end in first.

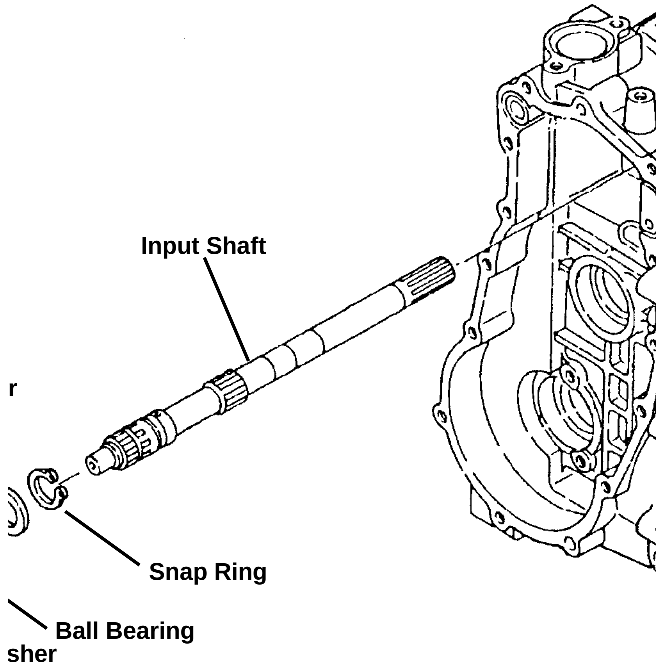
IMPORTANT: Bearing and washer on top of differential assembly are loose. Do not drop or lose parts.

3. Put fork of differential lock shaft into groove of collar on differential assembly. Install differential assembly and differential lock shaft together into transaxle case.
4. Install ball bearing.

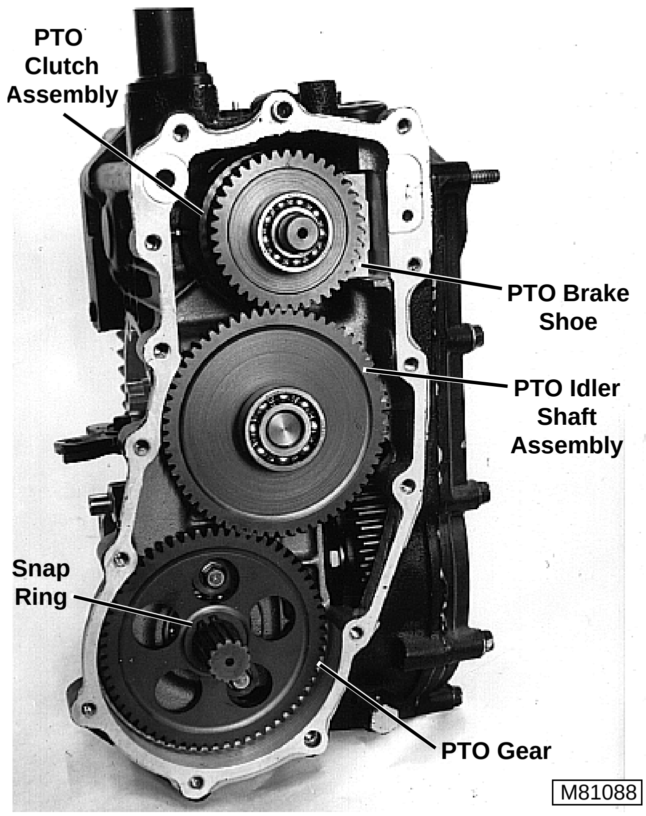
5. Apply a bead of John Deere Form-in-Place Gasket to mating surface of transaxle case.
6. Carefully lower cover assembly onto case while making sure bearings and shafts fit into bores properly. Make sure washer on swash plate does not fall out of position.

Transaxle Case Cap Screw Torque Specifications:

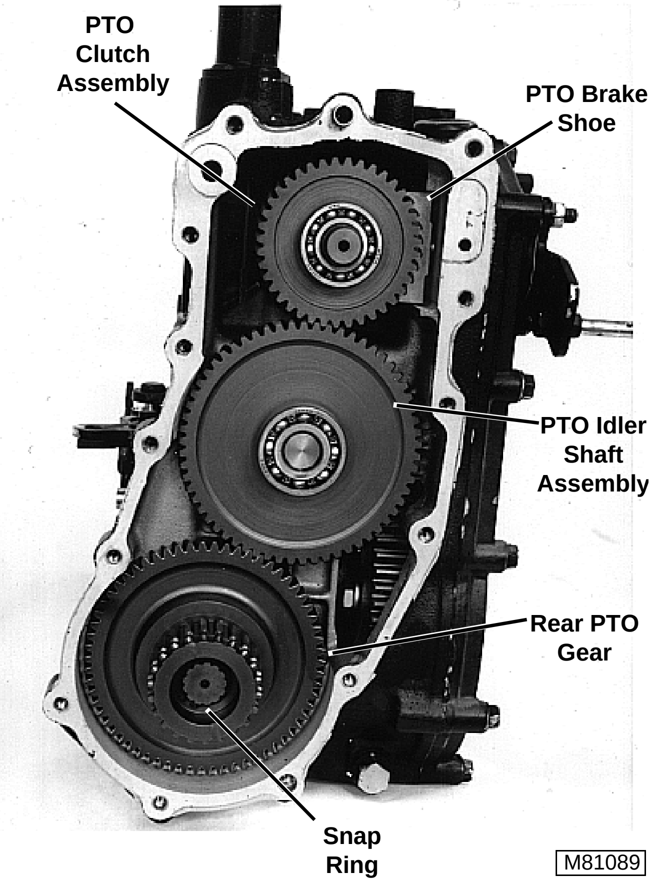
Used Transaxle Case . . . . 25 N•m (18 lb-ft)
New Transaxle Case . . . . 30 N•m (22 lb-ft)



7. Assemble bearing, washers and snap rings on input shaft.
8. Install input shaft assembly and large snap ring.



Without Rear PTO Option



With Ream PTO Option

9. Install PTO brake and clutch. (See PTO BRAKE—REMOVAL/INSTALLATION).
10. Install PTO drive train. (See PTO DRIVE TRAIN—REMOVAL/INSTALLATION.)
11. Install brakes. (See BRAKES—REMOVAL/INSTALLATION in the BRAKES section.)
12. Install axle housings. (See REAR AXLE ASSEMBLY—REMOVAL/INSTALLATION.)
13. Install hydrostatic transmission and pump.
14. Install control arm damper. (See CONTROL ARM DAMPER—REMOVAL/INSTALLATION.)
15. For AWS models, install rear steering linkage. (See REAR STEERING LINKAGE INSTALLATION in the STEERING section.)

CONTENTS

Page

STEERING

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SPECIFICATIONS

GENERAL SPECIFICATIONS

Type . . . . Power, hydrostatic
Tilt Wheel . . . . Standard

TEST AND ADJUSTMENT SPECIFICATIONS

Steering System Leakage:

Oil Temperature . . . . 43°C (110°F)
Engine Speed. Fast Idle
Maximum Turns with Constant Torque
of 6.8 N•m (60 lb-in.) in Either Direction. . . . . 4 rpm
Steering Valve System Pressure . . . . 6371—7357 kPa (924—1067 psi)

Toe-in Adjustment:

Front Tires .1—6 mm (0.04—0.24 in.)
Rear Tires (All Wheel Steer) . . . . front-to-back difference from frame for each tire, 0—10 mm (0—0.40 in.)

REPAIR SPECIFICATIONS

Steering Wheel Nut Torque . . . . .38 N•m (28 lb-ft)
Steering Valve End Cover Cap Screw Torque . . . . 17 N•m (150 lb-in.)
Check Ball Plug Torque . . . . 17 N•m (150 lb-in.)
Front Axle Pivot Cap Screw and Lock Nut Torque . . . . 68 N•m (50 lb-ft)
Tie Rod Lock Nut Torque . . . . 61 N•m (45 lb-ft)
Rear Steering Linkage Lock Nut Torque . . . . 170 N•m (125 lb-ft)
Adjusting Nut Jam Nuts Torque . . . . 68 N•m (50 lb-ft)
Rear Steering Side Pivots Pivot Lock Nut Torque . . . . 108 N•m (80 lb-ft)
Mounting Cap Screw and Nut Torque . . . . 84 N•m (62 lb-ft)
Rear Axle Pivot Bracket Cap Screws Torque. . . . . 91 N•m (67 lb-ft)
Pivot Nut Torque. . . . . 67—83 N•m (49—61 lb-ft)
Ball Joint Castellated Nut Torque. . . . . 45—57 N•m (33—42 lb-ft)

SERVICE TEST EQUIPMENT AND TOOLS

Bushing, Bearing and Seal Driver Set . . . . To install seals and bushings
8 mm Cap Screw . . . . .To adjust front steering linkage
10 mm Cap Screw . . . . To adjust rear steering linkage

OTHER MATERIAL

John Deere Multi-Purpose Lubricant . . . .Lubricate wheel spindles and steering pivots

SERVICE PARTS KITS

The following kits are available through your parts catalog:

- Steering Valve Centering Spring Kit
- Steering Valve Seal Kit

THEORY OF OPERATION

STEERING SYSTEM OPERATION—ALL WHEEL STEER

Function:

Offer hydraulic all wheel power steering for ease of operation.

System Operation:

Pressure oil is supplied by the charge pump of the hydrostatic transmission to the inlet port of the steering valve. When the steering wheel is not turned, the oil flows directly through the valve and out the power beyond port to the hydraulic control valve. When the steering wheel is turned to make a left turn, the pressure oil is routed through the steering valve and out the left turn port. The oil then flows down left turn line to the head end of the steering cylinder. The cylinder rod is pushed out, rotating the front pivot plate to the left which pushes the left tie rod and spindle and pulls the right tie rod and spindle. This turns the front wheels to the left. The return oil from the rod end of the cylinder is routed through right turn line to the right turn port of the steering valve. The oil is routed through the valve to the return port.

On all wheel steer units, linkage connects the front pivot plate to the rear pivot plate, which allows the front and rear sets of wheels to pivot in opposite directions. When the front pivot plate is rotated clockwise, the front intermediate linkage is pushed to the left which rotates the front steering arm counterclockwise. This moves the middle linkage, rear pivot arm, and rear intermediate linkage rearward. The rear pivot plate is rotated counterclockwise, which pushes the left rear tie rod, rear spindle plate, rear spindle housing, and rear spindle hub and pulls the right side linkage. This turns the rear wheels to the right. With the front wheels turned to the left and the rear wheels turned to the right, a short turning radius is accomplished.

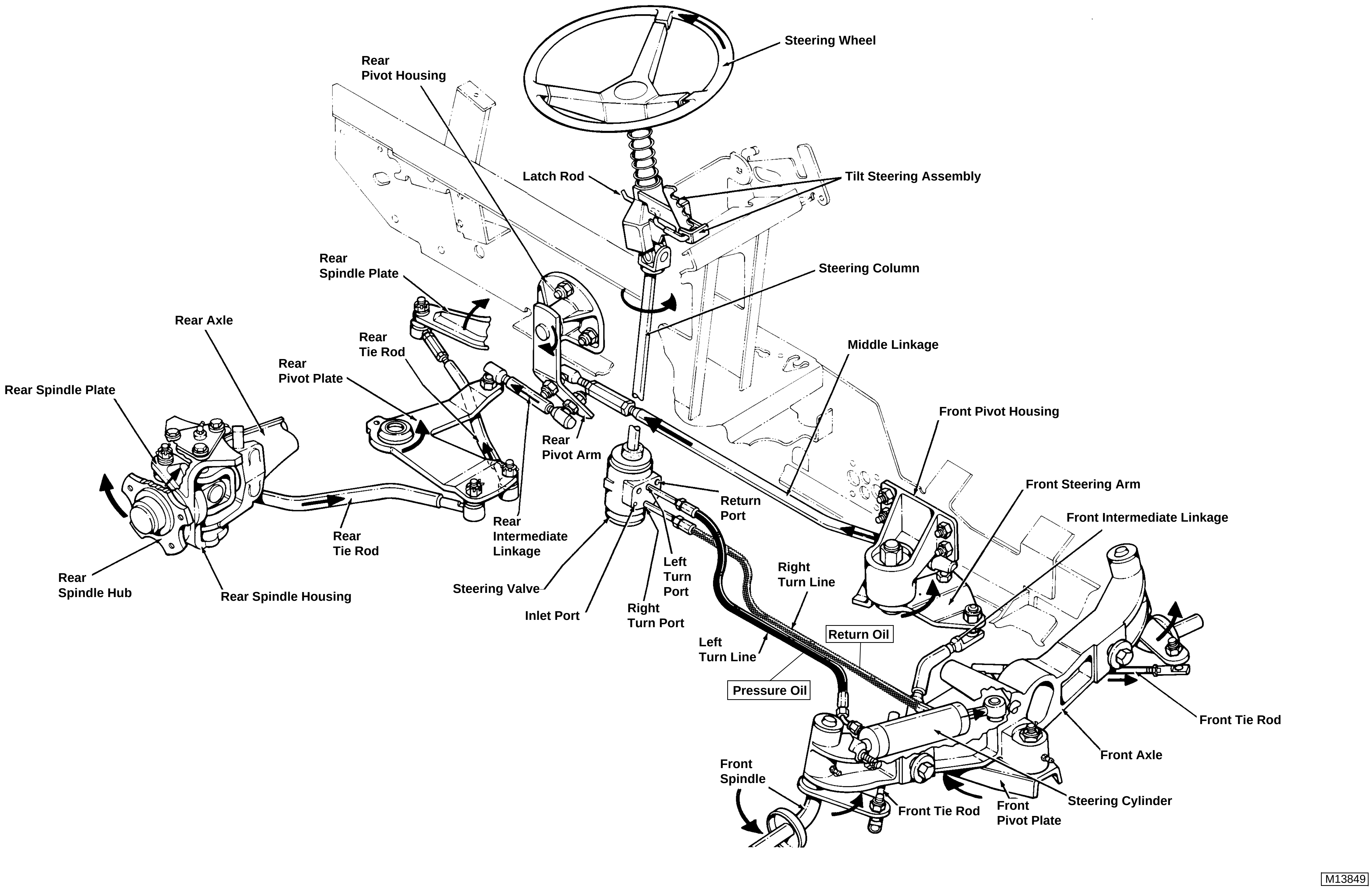
When the steering wheel is turned to make a right turn, the pressure oil is routed the opposite way through the valve. The oil comes out the right port of the valve to the rod end of the cylinder. The cylinder rod is pushed in and the front pivot plate rotates the opposite way. The return oil flows through the lines to the left port of the valve and out the return port.

The steering valve is designed to allow manual steering if the engine is not running or if there is a failure of the hydraulic pump.

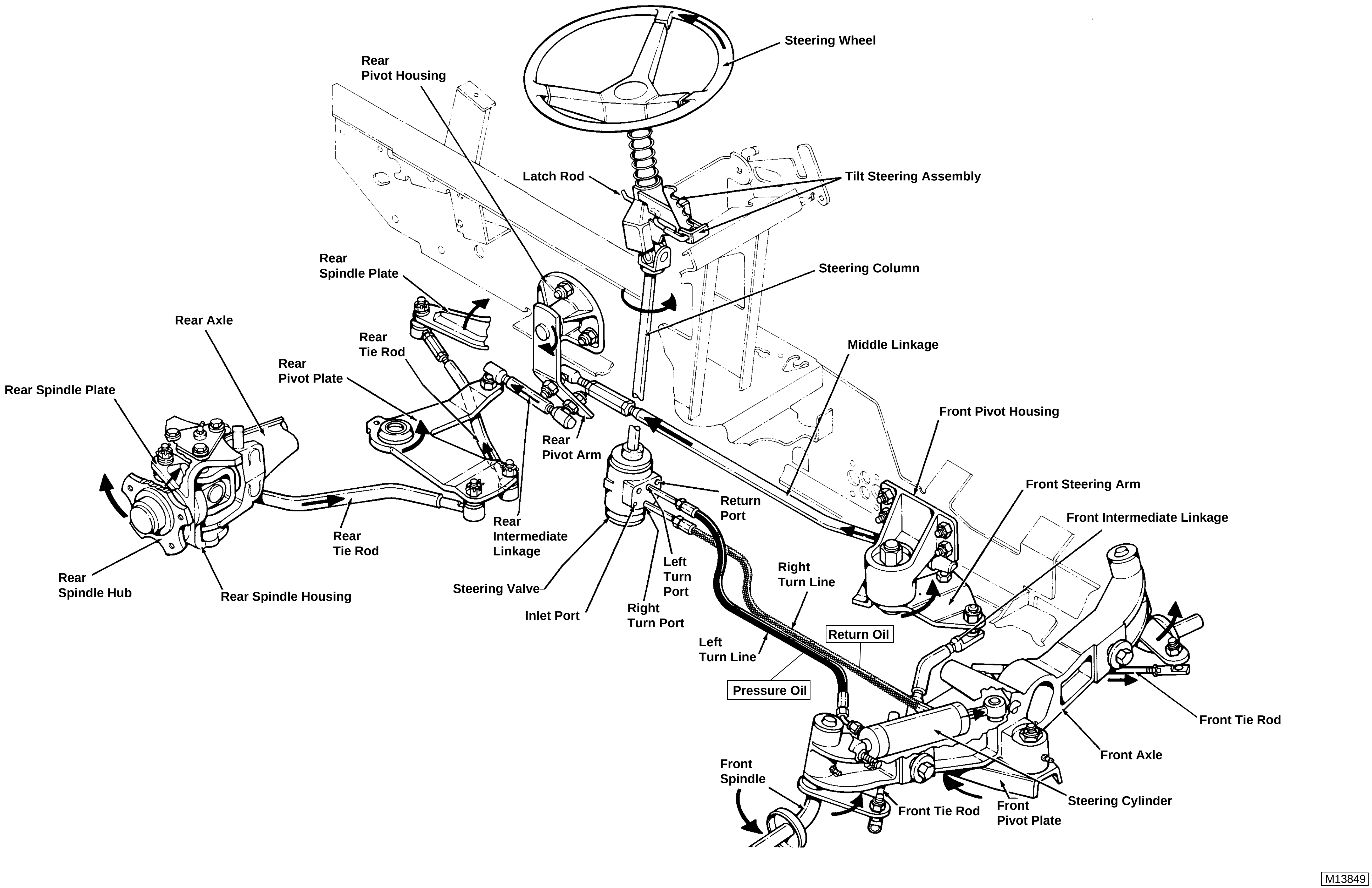
NOTE: To see how the steering valve fits into the entire hydrostatic/hydraulic system, open the fold-out Hydraulic System Schematic.

The tilt steering assembly allows the steering wheel to be adjusted for operator comfort. A spring loaded rod locks the steering column in four different positions.

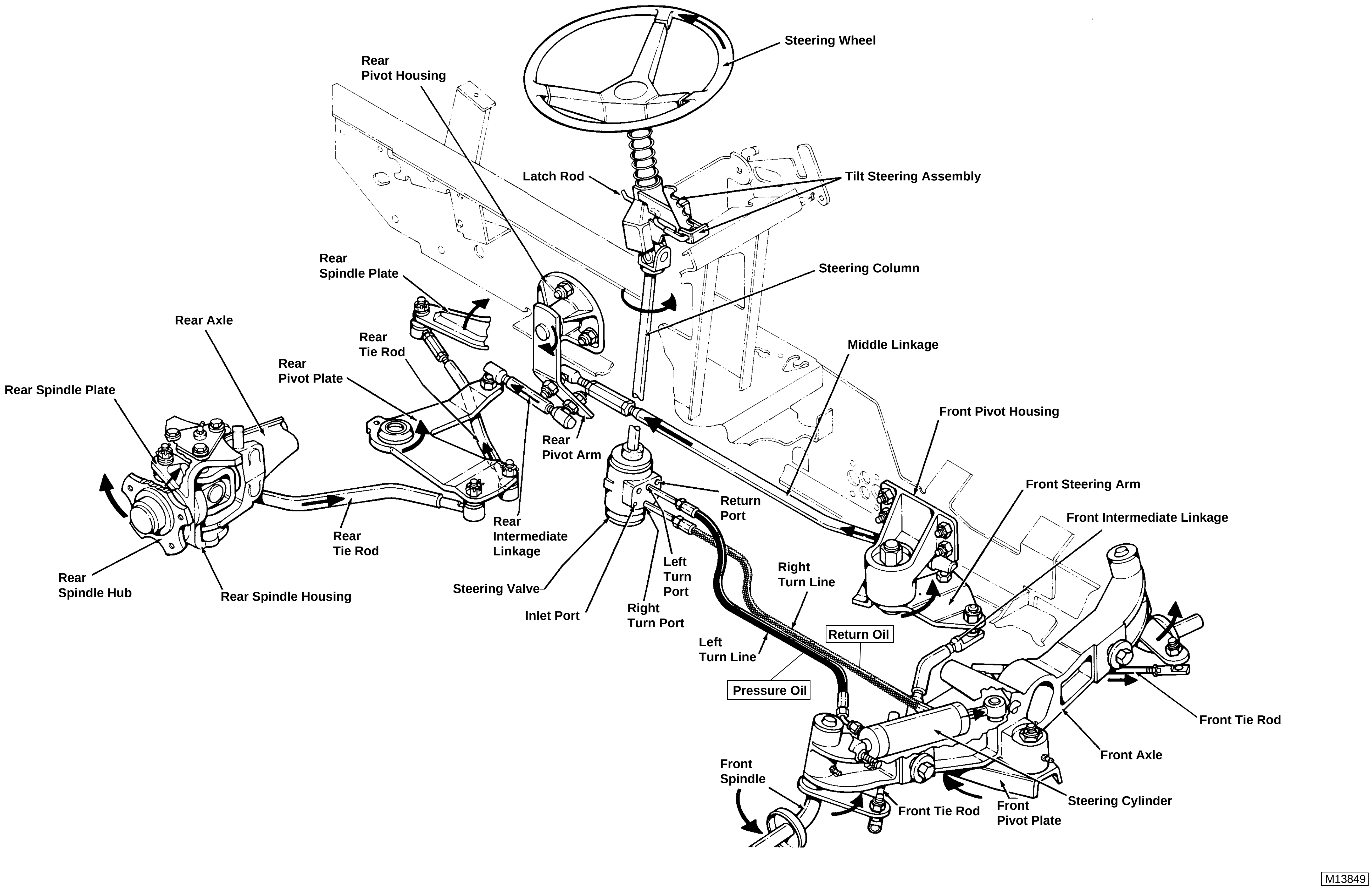
STEERING SYSTEM OPERATION—ALL WHEEL STEER



STEERING SYSTEM OPERATION—ALL WHEEL STEER



STEERING SYSTEM OPERATION—ALL WHEEL STEER



STEERING VALVE OPERATION —NEUTRAL

Function:

Controls oil flow to and from the steering cylinder. In neutral, the steering valve blocks oil flow to the cylinder, holding the wheels in a fixed position and allows oil to flow to the hydraulic system.

System Operation:

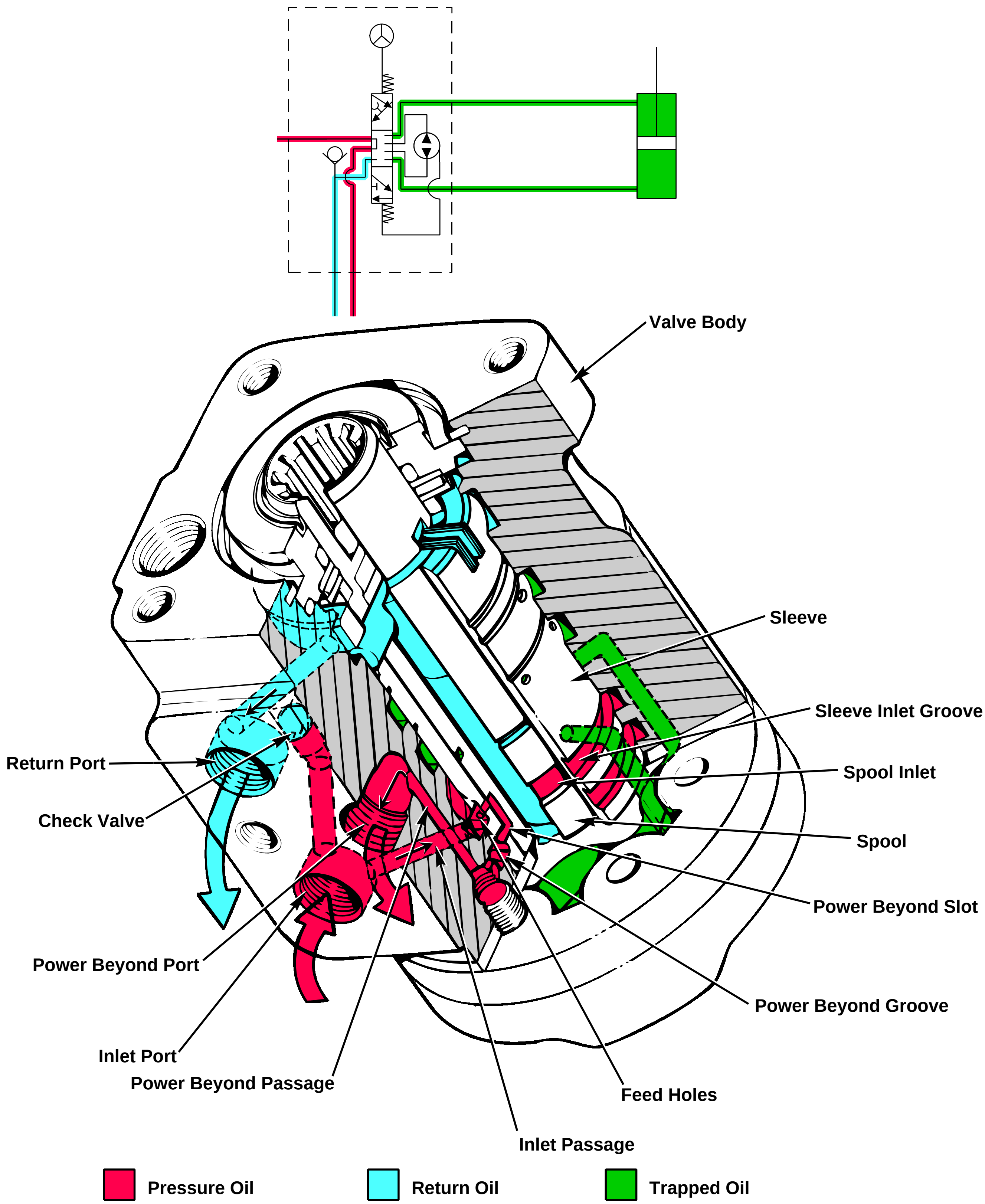
The steering valve is an open center type valve. This valve consists of a self-centering fluid control valve (spool and sleeve) and a metering pump. The valve and pump are hydraulically and mechanically interconnected inside the valve.

Pressure oil comes into the steering valve body at the inlet port. The oil then flows through inlet passage to a series of grooves, passages, and slots in the valve body, sleeve, and spool to come out the power beyond passage and power beyond port to go on to the lift system. The amount of oil that flows this way varies with the speed of the turn. All the oil will follow this path when the steering valve is in neutral. There will be some oil when a slow turn is made, and there will be less oil when a fast turn is made. No oil is available to the power beyond port when the steering is dead headed.

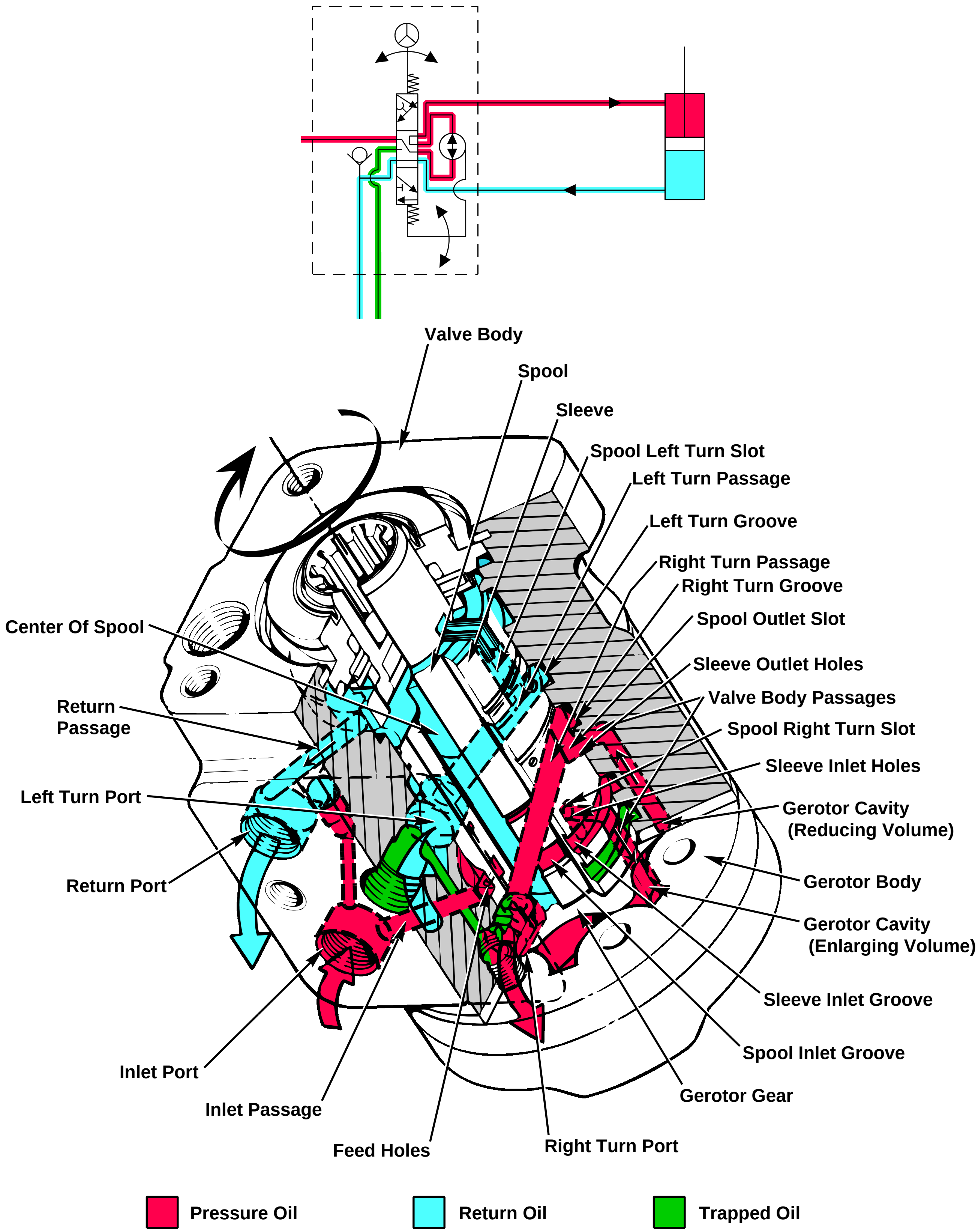
When the valve is in neutral, the turn passages are closed. The oil in the steering cylinder and lines is trapped oil. The small amount of internal leakage oil will go out the return port as return oil back to the sump.

A system relief valve located in the hydrostatic transmission is used to prevent damage to the steering or hydraulic system components. When the oil flow is blocked, by the lift system or the steering valve, the relief valve will open when the hydraulic pressure goes above 6861 kPa (995 psi).

STEERING VALVE OPERATION—NEUTRAL



STEERING VALVE OPERATION—TURNING



STEERING VALVE OPERATION—TURNING

Function:

Controls pressure oil flow to the proper end of the steering cylinder to turn the front wheels.

System Operation:

Pressure oil comes into the steering valve body at the inlet port. The oil then flows through inlet passage to a series of grooves, holes, slots, and passages to the gerotor. The steering wheel is turning which turns the gerotor gear in the gerotor body so that some of the cavities are enlarging in volume and the oil fills them. At the same time, some of the gerotor cavities are reducing in volume which feeds the pressure oil out to another series of passages, grooves, slots and holes. They provide a path to one of the steering ports (in this drawing the right turn port) and on to the steering cylinder. The gerotor controls the rate at which oil flows to the steering cylinder. The return oil coming back from the steering cylinder is routed into the other steering port (in this case, left turn) to the center of the spool. From the center of the spool the oil goes out the return port back to sump.

Smooth turning is insured by the design of the gerotor. Its geometry causes it to fill and empty its cavities 6 times as fast as the steering wheel is being turned.

STEERING VALVE OPERATION—MANUAL

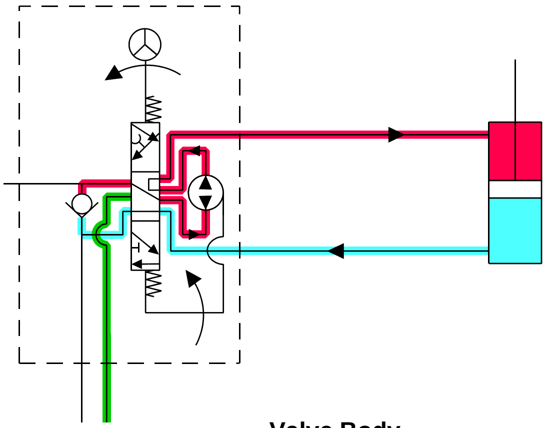
Function:

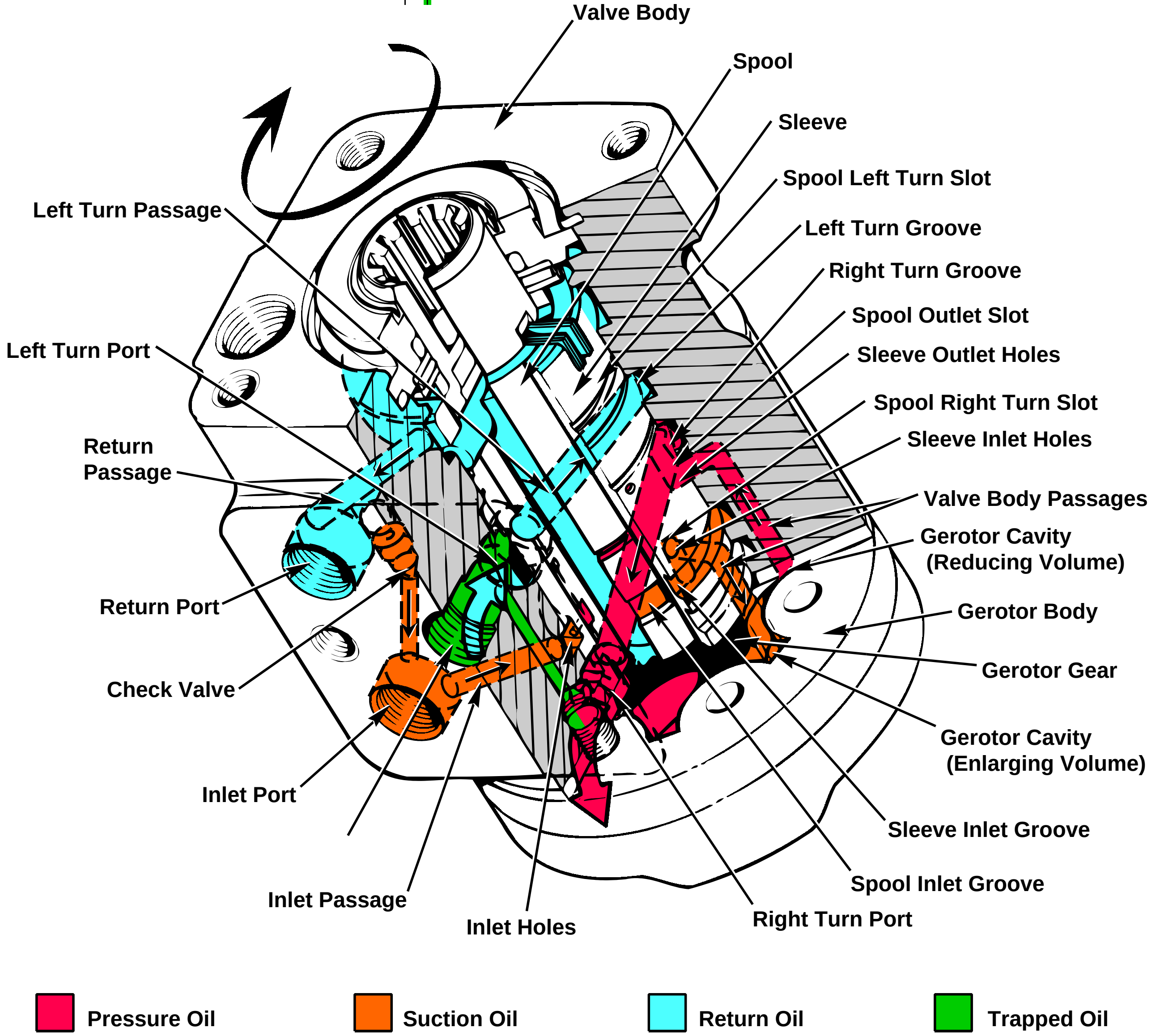
Provides manual steer operation to make a left or right turn if hydraulic oil pressure and flow is not available.

System Operation:

When the hydraulic system is not operating, engine not running or hydraulic pump failure, it is still possible to steer the machine. The gerotor must create the pressure and flow necessary to move the steering cylinder as the steering wheel is being turned. As some of the gerotor cavities reduce in volume, pressure oil is forced out of the cavities through a series of passages, holes, grooves, and slots in the valve body, sleeve, and spool to one of the steering ports (in this drawing right turn). The pressure oil is then routed to the steering cylinder. The return oil from the steering cylinder returns in the other port (in this case the left turn port) through another series of passages, grooves, slots, and holes to the center of the spool. From the center of the spool the oil is routed to the return port. The return port is connected to the inlet port through the check valve. The check valve allows the oil from return port to be drawn back into the system. This suction oil is routed through the valve body, sleeve, and spool to gerotor cavities that are enlarging in volume. As the steering wheel is turned the enlarging volume cavities become the reducing volume cavities and the oil is transferred.

STEERING VALVE OPERATION—MANUAL





STEERING SYSTEM CHART

Check or Solution / Problem or Symptom	Steers hard or no steering in both directions	Steers hard or no steering in one direction	Steering pulls in one direction	Steering wheel creeps	Shimmy or vibration	Wheels turn on engine start-up	Noise during turn	Slow steering response
System relief valve pressure not within specification	●					●		●
Steering cylinder has external or internal oil leakage	●	●	●	●		●	●	●
Steering valve has external or internal oil leakage	●	●	●	●			●	●
Steering cylinder lines restricted or leaking	●	●					●	●
Return lines to transmission and oil cooler restricted or leaking	●						●	●
Front axle spindles or front pivot plate binding, not lubricated	●	●			●		●	●
Rear spindle housing and rear pivot plate binding, not lubricated	●	●					●	●
Front steering arm, rear pivot arm, or middle linkage binding	●	●			●			●
Front tie rods bent, loose, or toe-in not correct	●		●		●			
Rear tie rods bent, loose, or toe-in not correct	●		●		●			
Intermediate linkage rods bent, loose, or adjusted incorrectly	●		●		●			

STEERING SYSTEM TROUBLE SHOOTING CHART (continued)

Check or Solution / Problem or Symptom	Steers hard or no steering in both directions.	Steers hard or no steering in one direction.	Steering pulls in one direction.	Steering wheel tilt assembly will not move.	Shimmy or vibration.	Noise during turn.	Slow steering response.
Steering cylinder ball joint loose, worn, not lubricated, rod bent.	●	●	●		●	●	
Steering column binding, universal joint worn, snap rings missing.	●			●		●	●
Steering column tilt assembly binding, spring weak.				●			
Wheel bearings rough, not lubricated, hubs have excessive play, rims bent.	●		●		●		
Tire size incorrect, circumference mismatched, air pressure incorrect.	●		●		●		
Incorrect rear weights or wheel weights for attachment.	●				●		
Toe-in is not to specification.	●	●					

DIAGNOSIS

STEERING SYSTEM

Test Conditions:

- Machine parked on level surface.
- Park brake engaged.
- Steering cylinder (A) disconnected.
- Hydraulic oil at room temperature.
- Engine running at fast idle.

Test/Check Point	Normal	If Not Normal
1. Steering wheel.	Turns smoothly with no binding.Steering cylinder extends and retracts. Maximum of 3 revolutions of steering wheel to fully extend cylinder. Compare steering effort with cylinder connected.	Steering cylinder does not move—perform hydraulic checks, step 2. Steering cylinder moves—perform steering linkage checks, step 7. Steering wheel binds or will not lock in place—go to step 14. Steering wheel revolutions more than 3—perform hydraulic checks, step 2.
2. **Hydraulic checks**: System relief valve test port.	Pressure setting within specification 6371—7357 kPa (924—1067 psi).	See CHARGE PUMP FLOW AND PRESSURE TEST in the ELECTRICAL section.
3. Steering cylinder.	No external/internal oil leakage.	See STEERING VALVE AND CYLINDER LEAKAGE TEST.
4. Steering valve.	No external/internal oil leakage.	See STEERING VALVE AND CYCLINDER LEAKAGE TEST.
5. Steering lines.	Not pinched, cracked or leaking.	Replace as necessary.
6. Return lines to transmission and oil cooler (not shown).	Not restricted, pinched, cracked or leaking.	Replace as necessary.

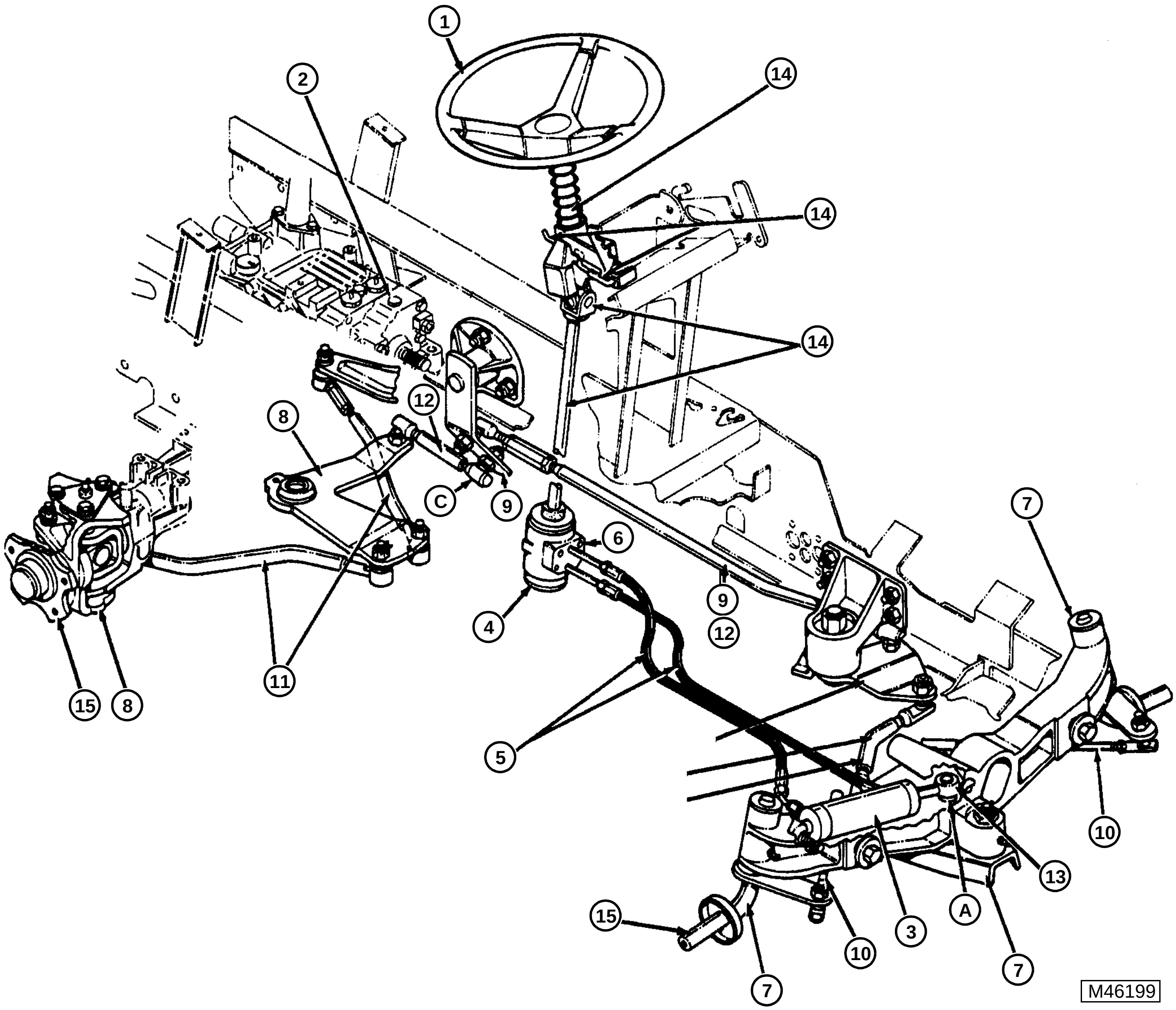
Test Conditions:

- Key switch in OFF position.
- Front intermediate linkage (B) disconnected.
- Rear intermediate linkage (C) disconnected.
- Front wheels off ground for front axle check.
- Rear wheels off ground for rear axle check.

Steering Linkage Checks:

Test/Check Point	Normal	If Not Normal
7. Front axle spindles and front pivot plate.	Turns with little resistance. Axle bushings lubricated, no side freeplay.	Repair axle, spindle, or plate.
8. Rear spindle housing and rear pivot plate.	Turns with little resistance. Bearings lubricated, no side freeplay.	Repair spindle housing or pivot plate.

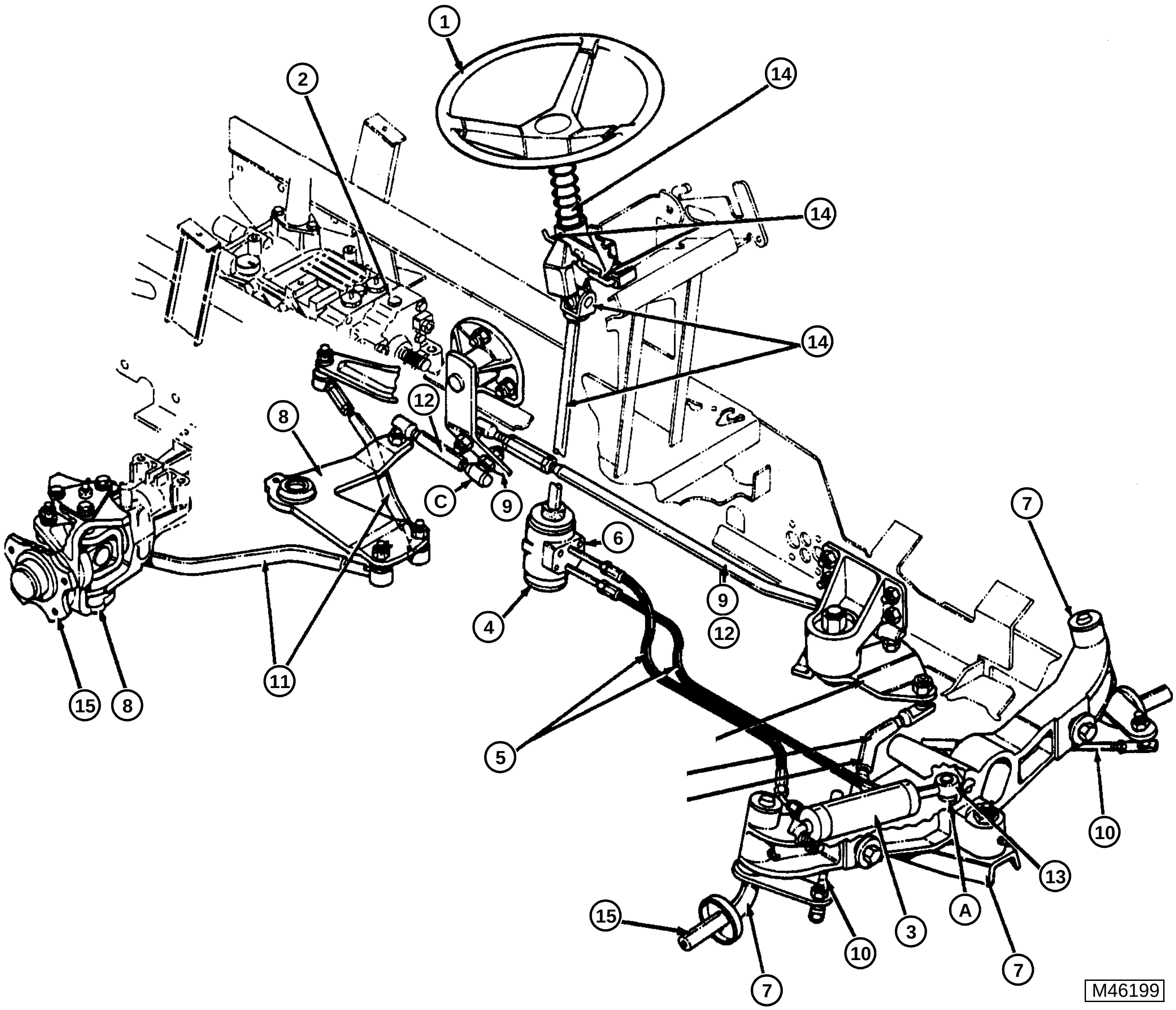
STEERING SYSTEM TEST POINTS



STEERING SYSTEM DIAGNOSIS (continued)

Test/Check Point	Normal	If Not Normal
9. Front steering arm, rear pivot arm and middle linkage.	Turns with little resistance. Bearings not rough, no side freeplay.	Repair steering arm, pivot arm, or linkage.
10. Front tie rods. Late models have a new front axle with only one tie rod.	Tie rods are not bent. Rod ends are tight. Toe-in is 1—6 mm (0.04—0.24 in.) with pin through front pivot plate.	Replace if necessary. Adjust toe-in.
11. Rear tie rods.	Tie rods are not bent. Rod ends are tight. Wheels are straight with pin through rear pivot plate.	Replace if necessary. Adjust toe-in.
12. Intermediate linkage rods.	Rods are not bent. Rod ends are tight. Adjusted correctly if pin can be installed in both front and rear pivot plate.	Replace if necessary. Adjust linkage. See TOE-IN ADJUSTMENT.
13. Steering cylinder ball joint.	Ball joint is tight, not worn and properly lubricated. Rod not bent.	Replace if necessary.
14. Steering column and tilt assembly.	Steering column not binding. Snap rings in place. Universal joint not binding or worn. Tilt assembly not binding. Spring holds latch rod in notch.	Tilt steering wheel will not lock in place, or may lock in only one position or will not hold position—See tilt steering rod repair. Replace if necessary.
15. Tires and wheels.	Correct size, matched circumference, and proper air pressure. Rims not bent. Tires running true (no wobble). No excessive play in wheelhubs. Wheel bearings lubricated and not rough.	Replace as needed. Inflate tires to recommended pressure.
16. Rear weights or wheel weights (not shown).	Proper rear ballast.	Add or subtract weights. See Operator's Manual.

STEERING SYSTEM TEST POINTS (continued)



TESTS AND ADJUSTMENTS

HYDRAULIC OIL WARM-UP PROCEDURE

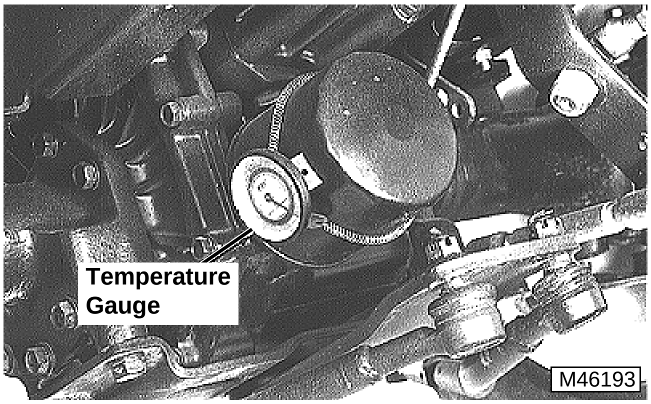
Reason:

When making hydraulic tests the oil must be heated to the specified temperature for the tests to be accurate.

Test Equipment:

- JDG282 Temperature Gauge

Procedure:



1. Install JDG282 Temperature Gauge on transmission oil filter.
2. Put cardboard in front of radiator to restrict air flow. Remove radiator screen and cut cardboard using the screen as a template. Install cardboard in screen slot.
3. Apply park brake. Start engine and run at full throttle.
4. Move and hold hydraulic lever in implement raise position.
5. Periodically cycle all hydraulic functions to distribute heated oil.
6. Heat oil to temperature specified in test.

IMPORTANT: Remove cardboard after test to prevent overheating the engine.

STEERING VALVE AND CYLINDER LEAKAGE TEST

Reason:

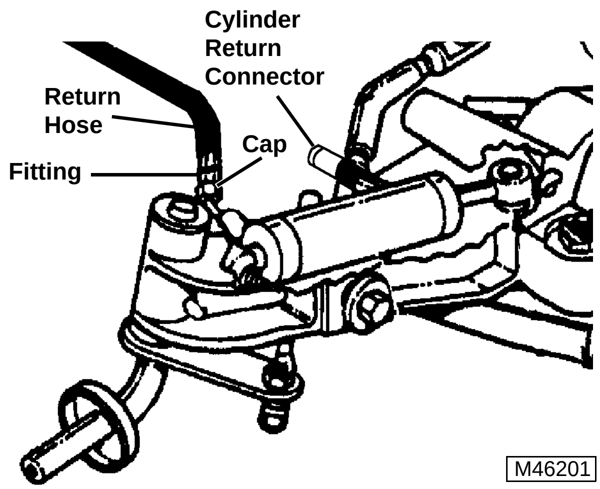
To check the steering valve and cylinder for internal leakage.

Test Equipment:

- Torque Wrench
- JT03375, 9/16—18 M ORFS x 7/16—20 M 37° Fitting
- JT05484, 7/16 - 20 F 37° Cap

Procedure:

1. Remove steering wheel cap.
2. Turn wheels for a complete right turn.



3. Disconnect return hose from the steering cylinder.
4. Cap return hose with JT03375 Fitting and JT05484 Cap.

c CAUTION

Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

5. Heat hydraulic oil to 43°C (110°F). (See HYDRAULIC OIL WARM-UP PROCEDURE.)
6. Run engine at fast idle.
7. Turn steering wheel right with a constant torque of **6.8 N•m (60 lb-in.)**.
8. Observe the number of rotations of the steering wheel that occurs in one minute. Also observe leakage from cylinder return connector. Compare results to specifications.
9. Reinstall hose.

Results:

- If steering wheel rpm is more than **4 rpm**, and there is leakage (steady stream) from the cylinder return connector, the steering cylinder is leaking. Replace cylinder. Repeat test.
- If steering wheel rpm is still more than **4 rpm**, repair or replace steering valve.

TOE-IN ADJUSTMENT —TWO WHEEL STEER

Reason:

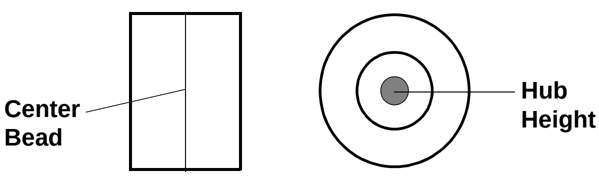
Correct toe-in adjustment prevents tire wear and steering wander.

Procedure:

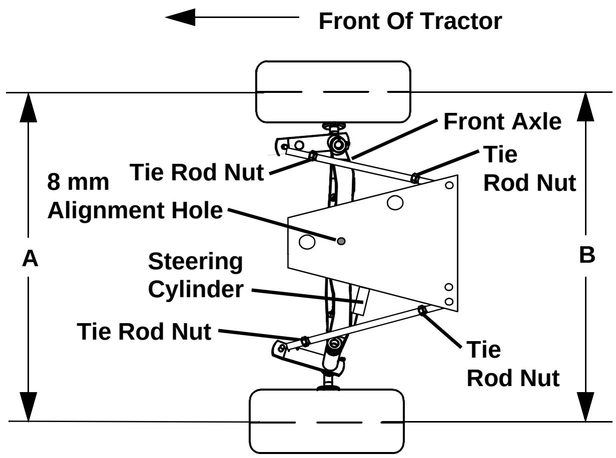
1. Park machine on level surface.
2. Inspect tie rods and steering cylinder for damage.

NOTE: *Toe-in cannot be adjusted with wheels off the ground or on an uneven surface. Pivot plate to axle joint must be snug. Be sure the jam nut and cotter pin are tight. Add washers if needed.*

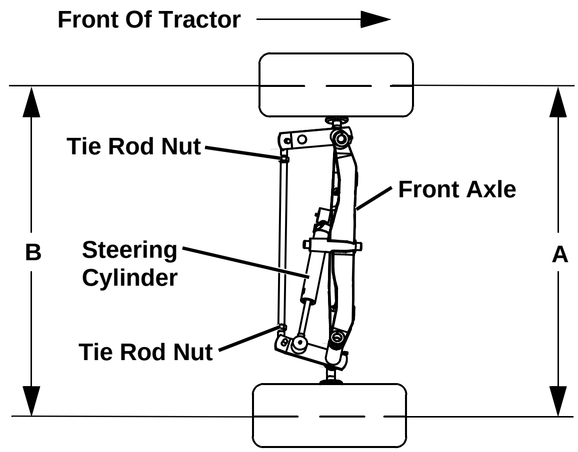
IMPORTANT: Late model two wheel steer front axles have only one tie rod. Procedures remain the same.



NOTE: *Measuring point should be from center of tire, hub height.*



Early Model Front Axle Bottom View



3. **Early Model Front Axle Only**—Turn steering wheel until an 8 mm cap screw can be installed through the front pivot plate hole into axle hole.
4. **Early Model Front Axle Only**—If necessary adjust tie rods until front tires are pointing straight ahead.
5. Measure distance (A) from front of right front tire to front of left front tire. Record distance.
6. Measure distance (B) from back of right front tire to back of left front tire. Record distance.
7. Distance (A) should be 1—6 mm (0.04—0.24 in.) less than distance (B).
8. Loosen tie rod nuts and adjust tie rods equally to achieve the specified toe-in.

Specifications:

Toe-In . . . .
Front Distance (A) should be 1—6 mm (0.04—0.24 in.) less than Rear Distance (B).

TOE-IN ADJUSTMENT (FRONT AXLE)—ALL WHEEL STEER

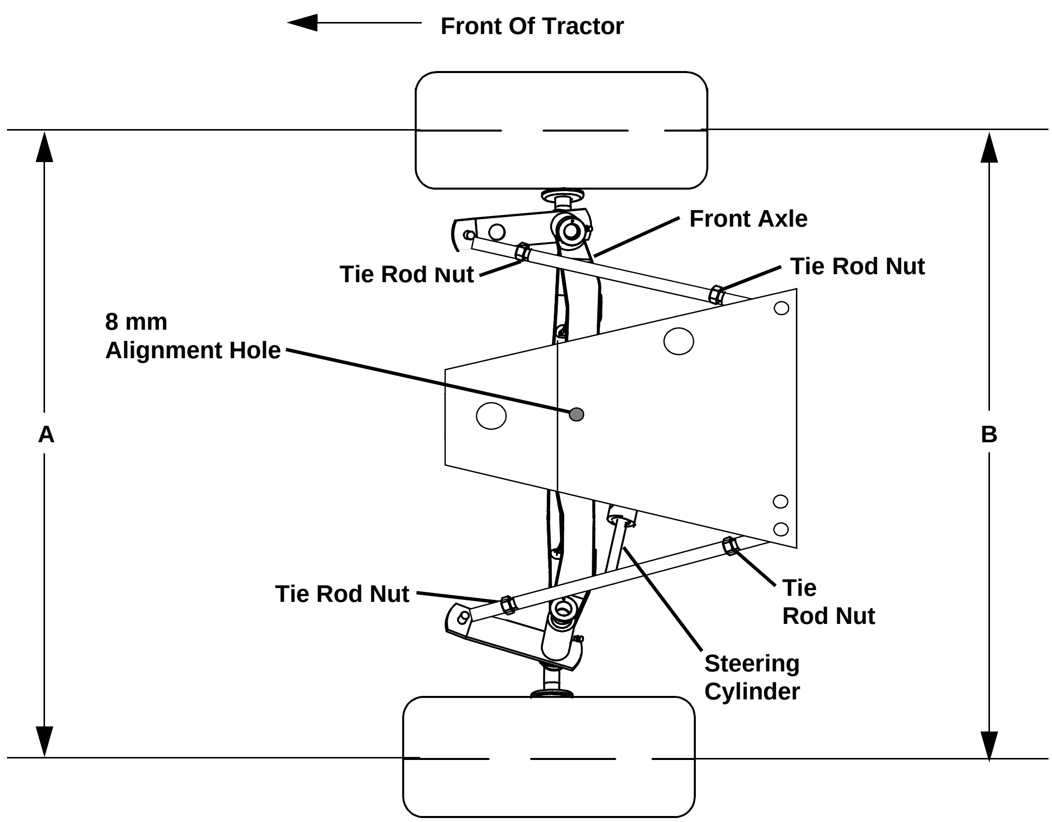
Reason:

Correct toe-in adjustment prevents tire wear and steering wander.

Procedure:

1. Park machine on level surface.

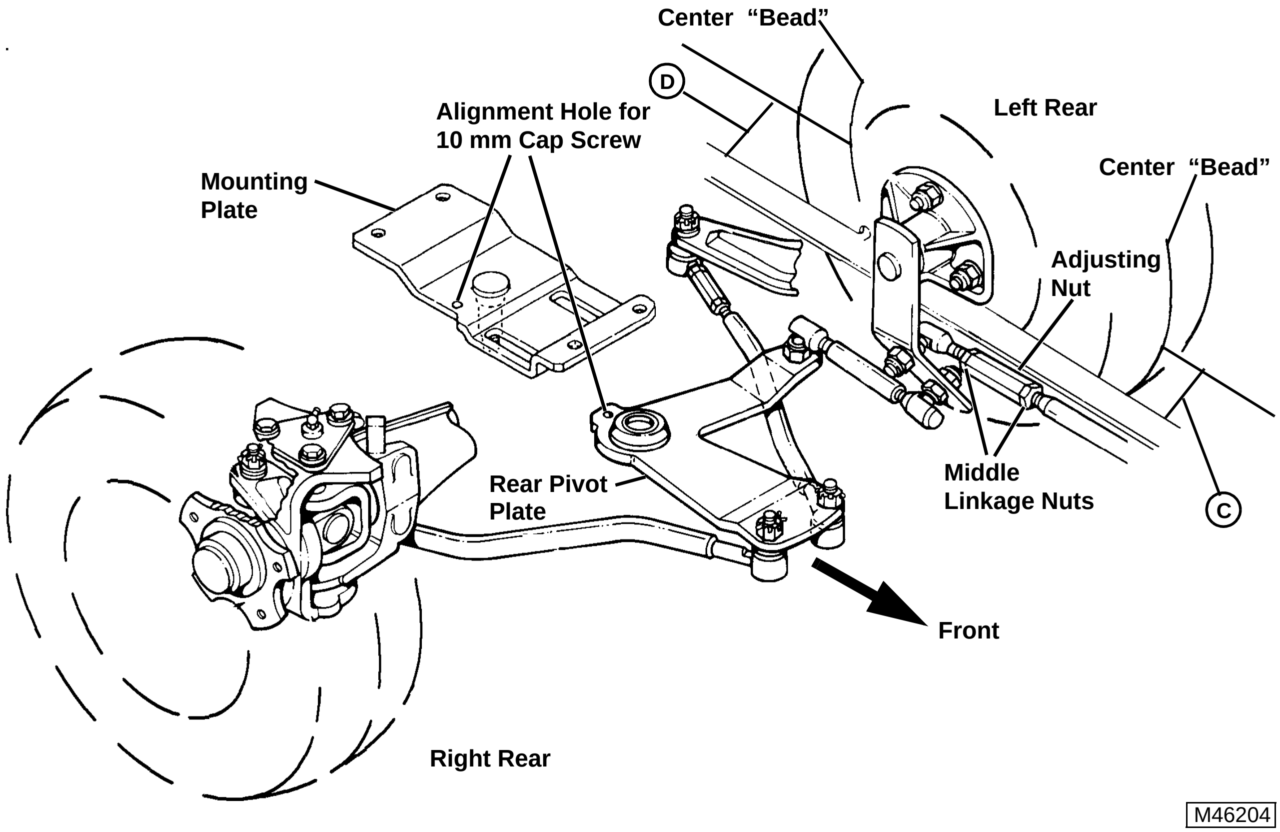
NOTE: Toe-in cannot be adjusted with wheels off the ground or on an uneven surface. Pivot plate to axle joint must be snug. Be sure the jam nut and cotter pin are tight. Add washers if needed.



Early Model Front Axle
Bottom View

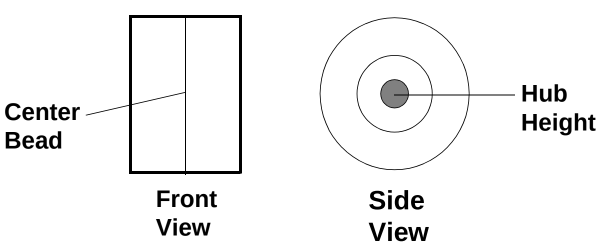
2. Turn steering wheel until an 8 mm cap screw can be installed through the front pivot plate hole into the front axle hole.

TOE-IN ADJUSTMENT (REAR AXLE)—ALL WHEEL STEER



IMPORTANT: The 10 mm cap screw must be perpendicular to rear pivot plate and mounting plate when installed. If 10 mm cap screw is at an angle, the toe-in will be incorrect.

3. If necessary loosen middle linkage nuts and turn adjusting nut until an 10 mm cap screw can be installed through the rear pivot plate hole into the rear mounting plate hole. Tighten nuts.



NOTE: Measuring point should be from center of tire, hub height.

4. Measure distance (A) from front of right front tire to front of left front tire. Record distance.
5. Measure distance (B) from back of right front tire to back of left front tire. Record distance.
6. Distance (A) should be 1—6 mm (0.04—0.24 in.) less than distance (B).
7. Measure from the center "bead" of left rear tire — from front of tire to tractor frame (C) and then back of tire to tractor frame (D). Record measurements. Adjust linkage until difference in measurements is 0—10.0 mm (0—0.40 in.).
8. Repeat exact procedure for right rear tire.

Specifications:

Toe-In

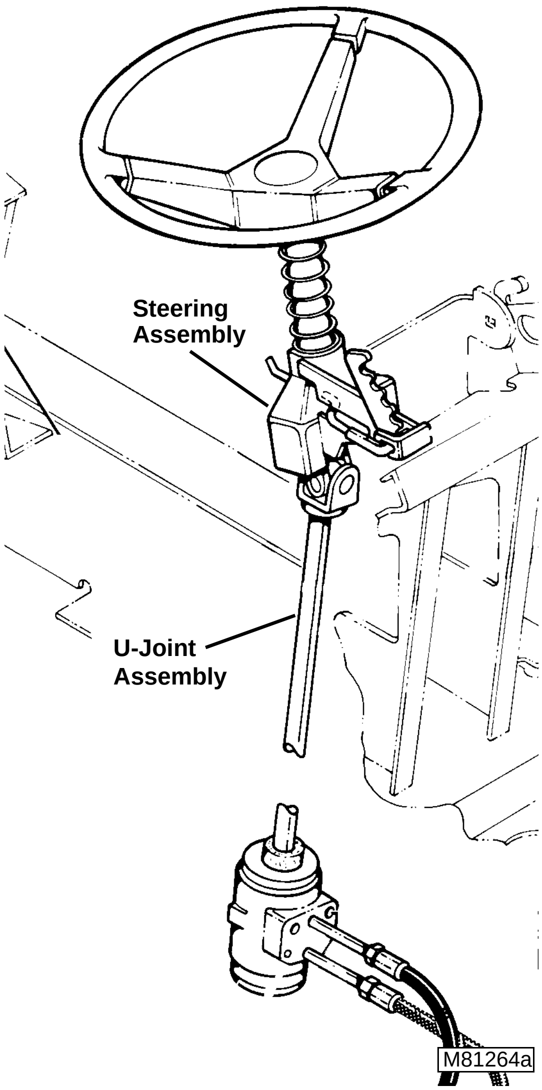
Front Tires . . . . . . Distance (A) should be 1—6 mm (0.04—0.24 in.) less than distance (B).

Rear Tires . . . . Right rear tire parallel to frame 0—10.0 mm (0—0.40 in.).

Left rear tire parallel to frame . .0—10.0 mm (0—0.40 in.).

REPAIR

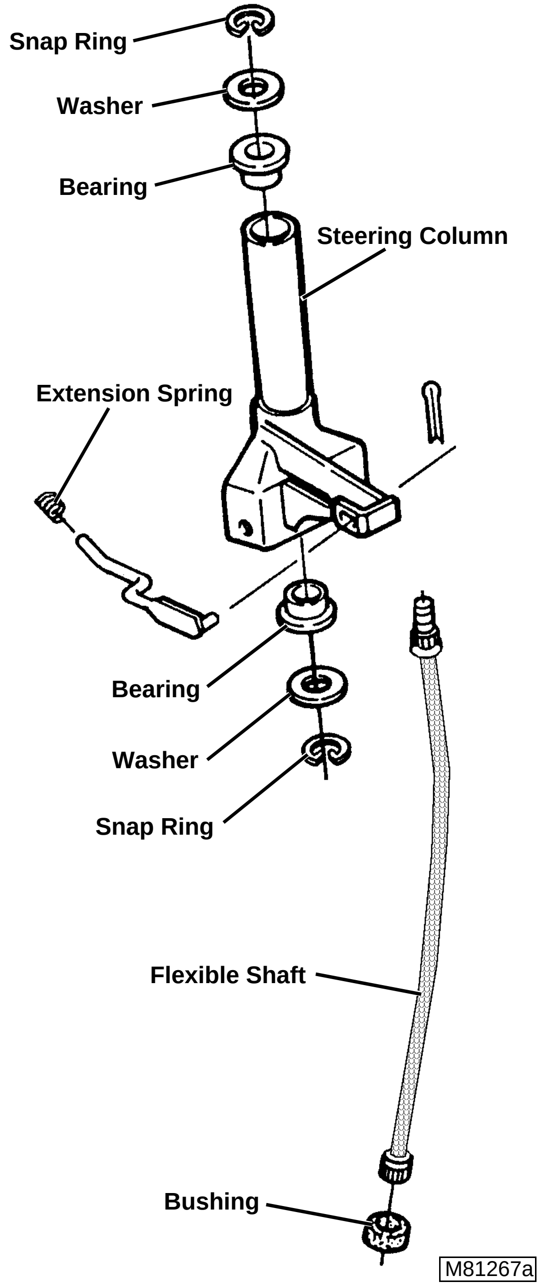
STEERING COLUMN—REMOVAL/INSTALLATION



1. Remove steering wheel.

IMPORTANT: Late models use a flexible shaft instead of the U-joint assembly.

2. Remove footrest for access to lower dash panel mounting screws.
3. Remove all components necessary to remove dash panel and access steering assembly.
4. Make repairs to steering column as necessary.
5. Apply multipurpose grease to splined end of steering column shaft.

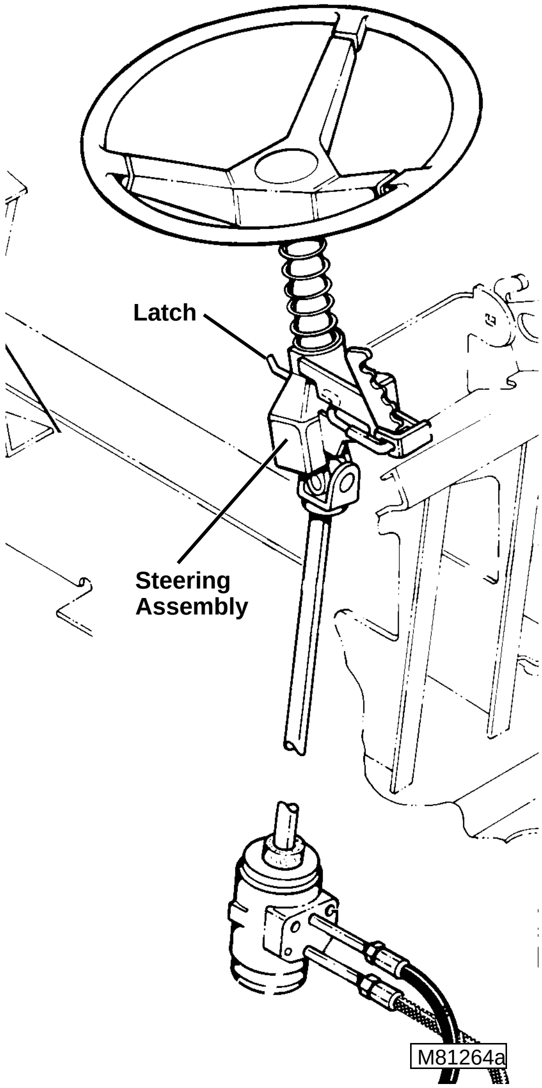


NOTE: After installing steering column, make sure foam washer is against steering valve.

Specifications:

Steering Wheel Nut . . . . 38 N•m (28 lb-ft)

TILT STEERING ROD—REMOVAL/ INSTALLATION



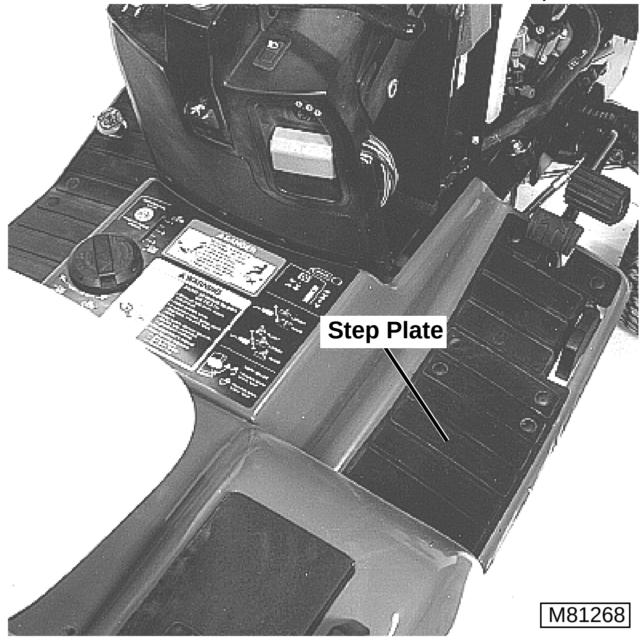
1. Remove steering wheel and pull console up over the steering post.

NOTE: It has been found that adding two washers at notch end will act as a guide and prevent twisting of rod.

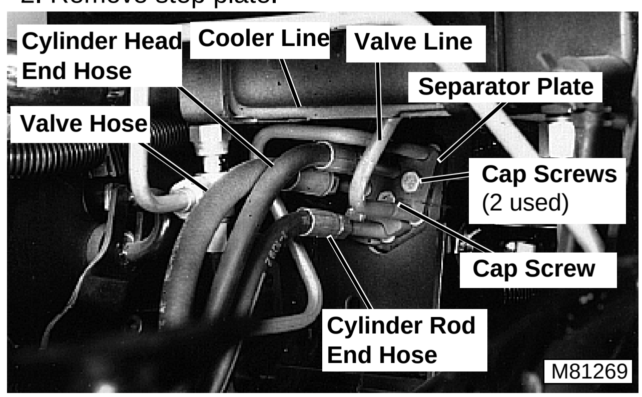
2. Remove tilt steering adjusting rod and put an additional 1 mm (0.04 in.) bend in end of rod opposite the spring attachment point. Without additional bend in rod, it may hang up in corner of tilt latch knob not allowing latches to seat into tilt notches.

STEERING VALVE—REMOVAL/ INSTALLATION

1. Remove radiator. (See RADIATOR—REMOVAL/ INSTALLATION in Miscellaneous Section.)



2. Remove step plate.

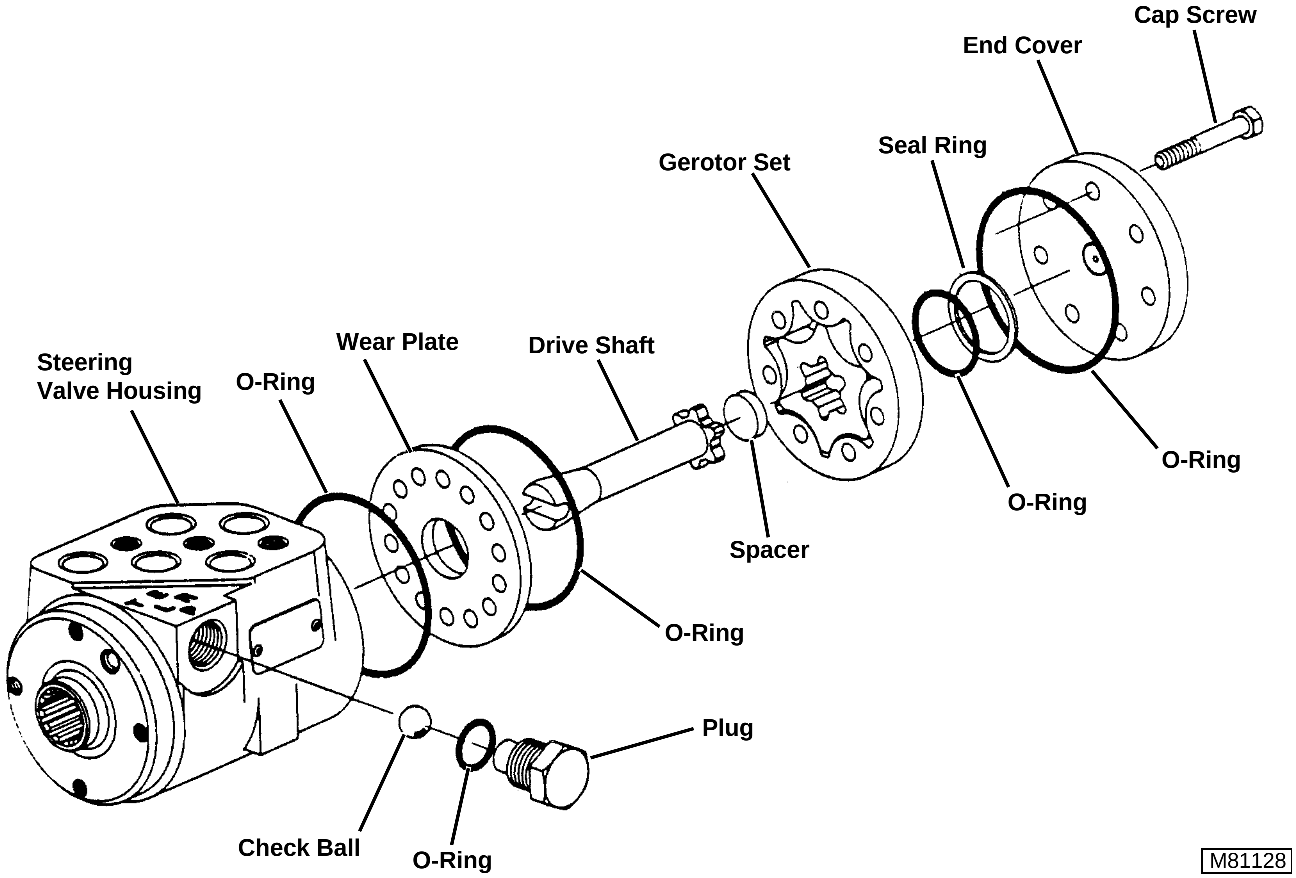


3. Remove cap screws.
4. Remove separator plate.
5. Remove steering valve to cooler line.
6. Remove steering valve to cylinder rod end hose, pump to steering valve hose, and steering valve to cylinder head end hose.
7. Remove steering valve to control valve line.
8. Remove cap screw and steering valve.
9. Make repairs to valve as necessary.

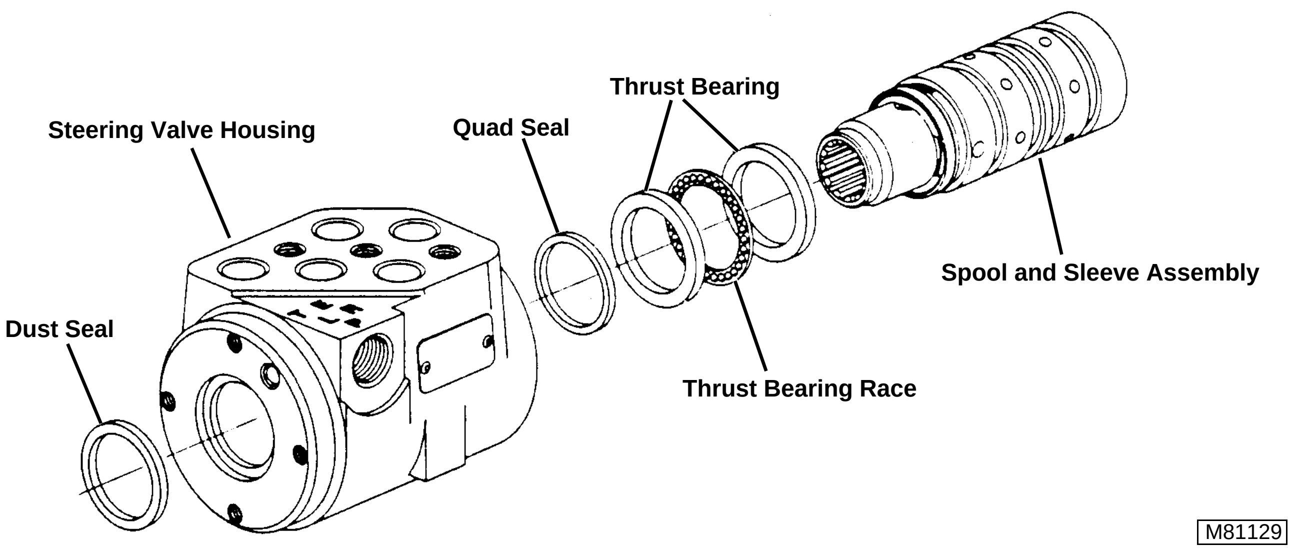
NOTE: When installing steering valve, install cap screw finger-tight.

IMPORTANT: Always use new O-rings. Damaged or used O-rings will leak.

STEERING VALVE—DISASSEMBLY/ASSEMBLY



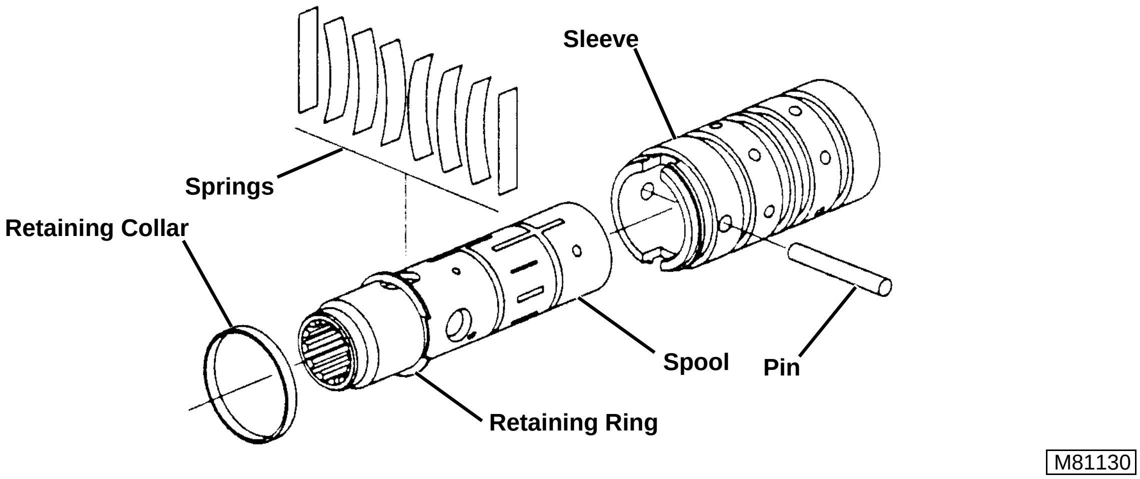
1. Remove cap screws to remove components from housing.
2. Remove manual steering check components.
3. Check ball, O-ring, and plug.



4. Pull spool and sleeve assembly from housing.
5. Remove components.

IMPORTANT: Use care not to damage seal bore during removal.

6. Pry dust seal from housing.

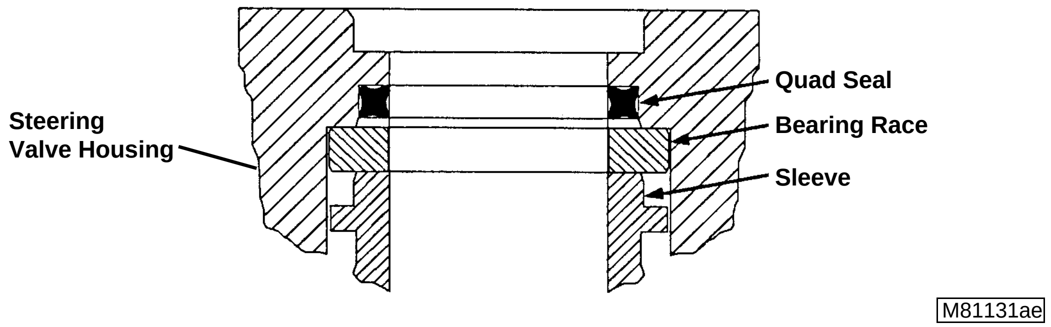


7. Remove pin to separate sleeve from spool.
8. Remove retaining collar.

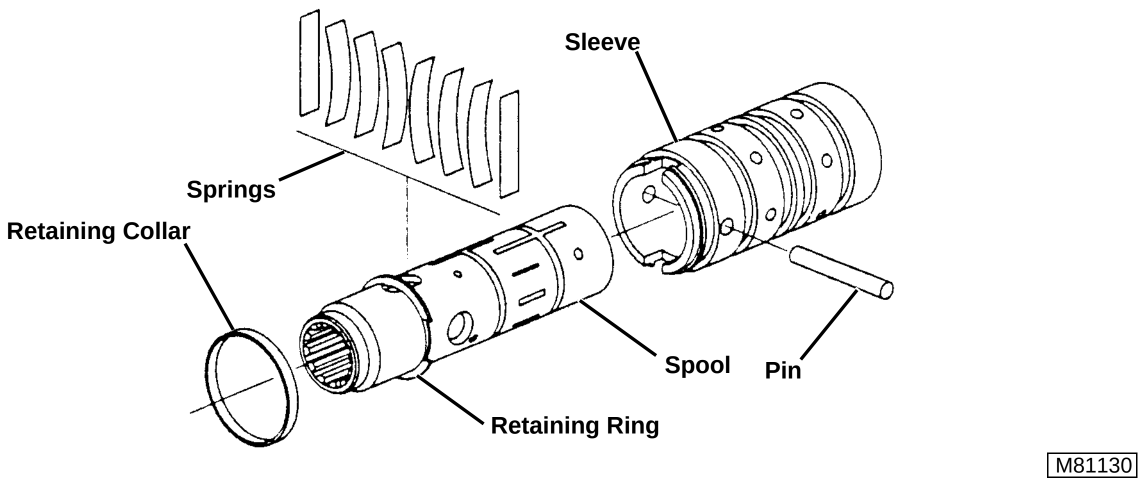
c CAUTION

Use care when removing springs because springs are under tension.

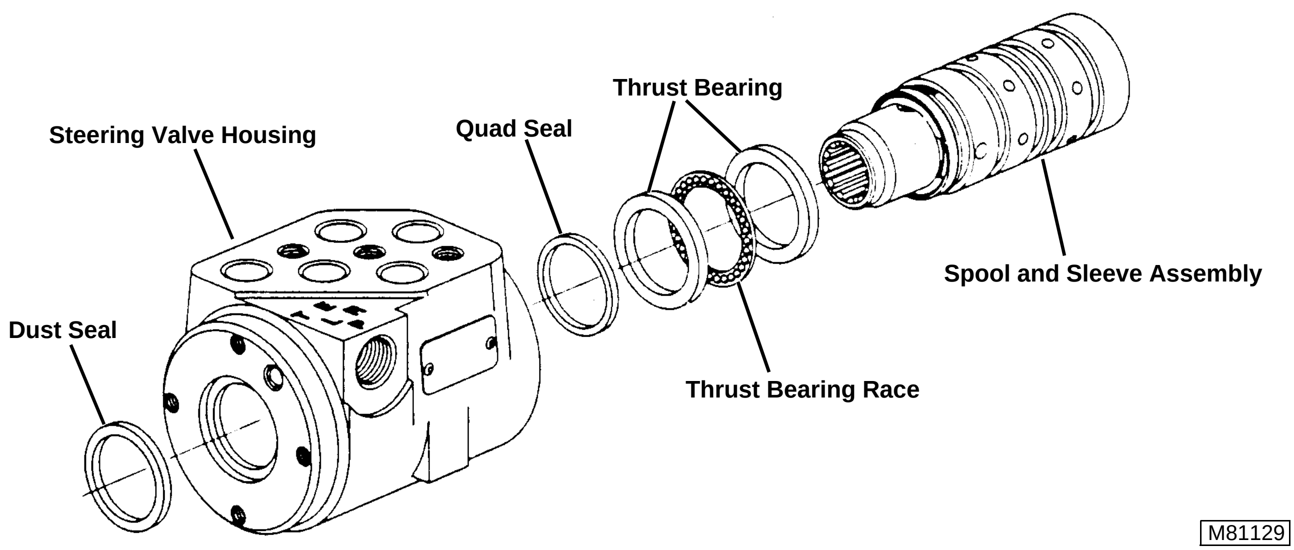
9. Remove retaining ring.
10. Inspect all machined mating surfaces for scratches or burrs. Clean all parts in clean solvent and air dry.



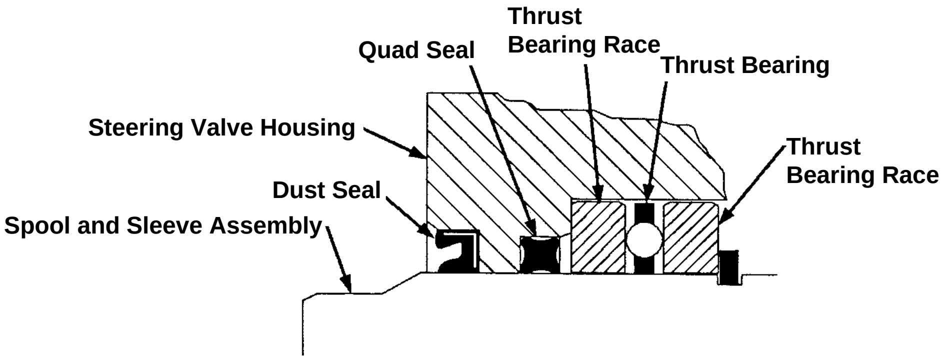
11. Install one bearing race and sleeve into valve housing.
12. While holding sleeve and bearing race tightly into housing, install quad seal into groove between bearing race and housing. Make sure the seal is not twisted.
13. Remove sleeve and bearing race.



14. Install retaining ring.
15. Install two flat leafs of springs in slot of spool. Then install curved leafs between flat leafs, three at a time. Install retaining collar over springs.
16. Apply clean hydraulic oil to spool and install spool in sleeve. Springs must fit into notches of sleeve.
17. Install pin.



18. Install dust seal with open side of seal away from housing. Use a disk driver to push seal to bottom of bore. Apply petroleum jelly to seal lips and quad seal.



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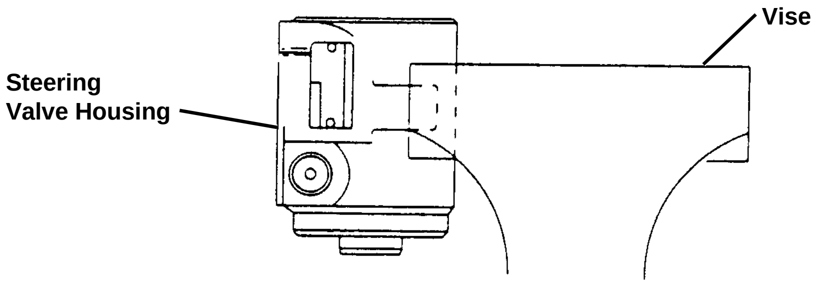
19. Install thrust bearing components.

20. Apply clean hydraulic oil to spool and sleeve assembly. Carefully install assembly into housing so not to damage seals.



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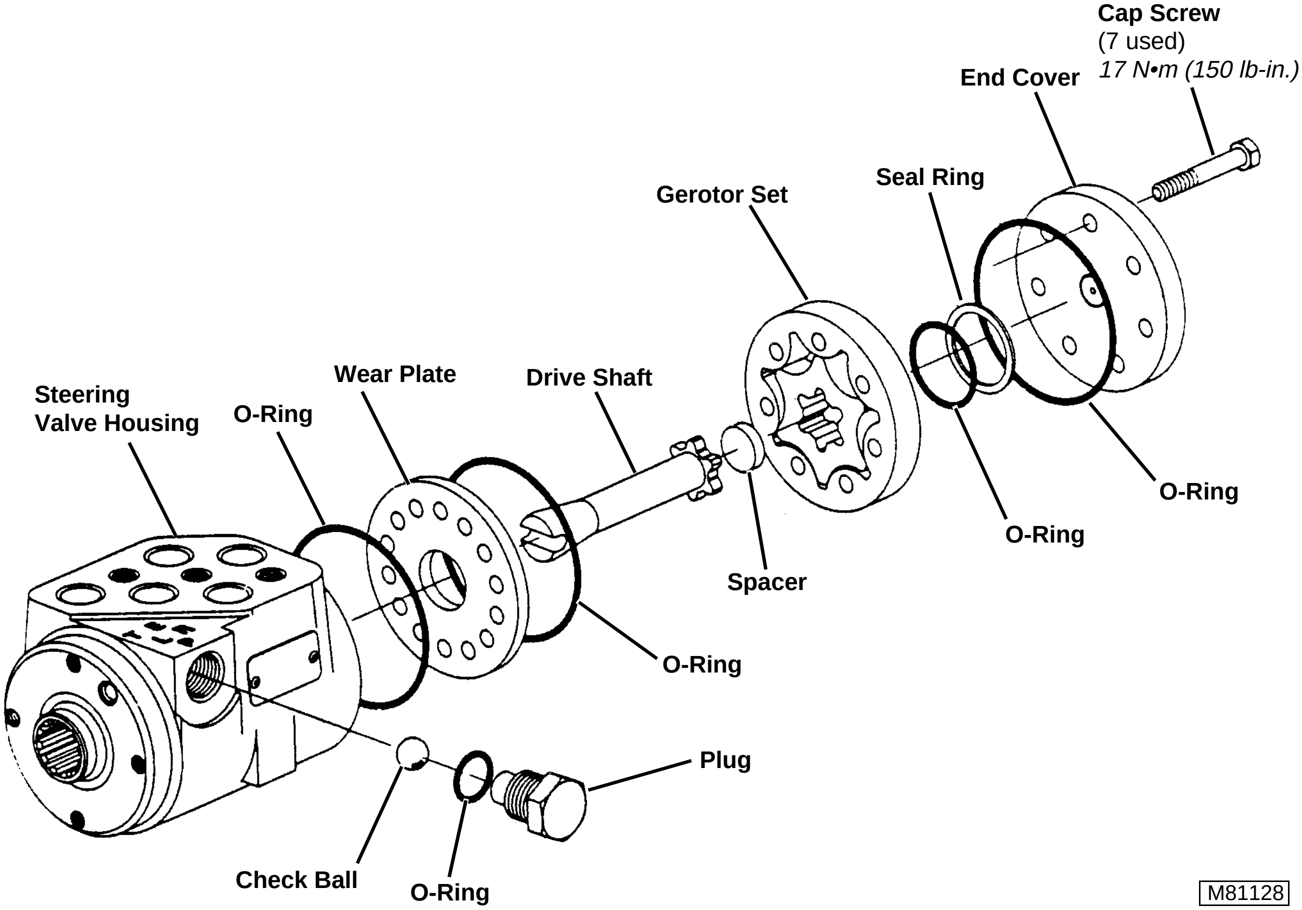
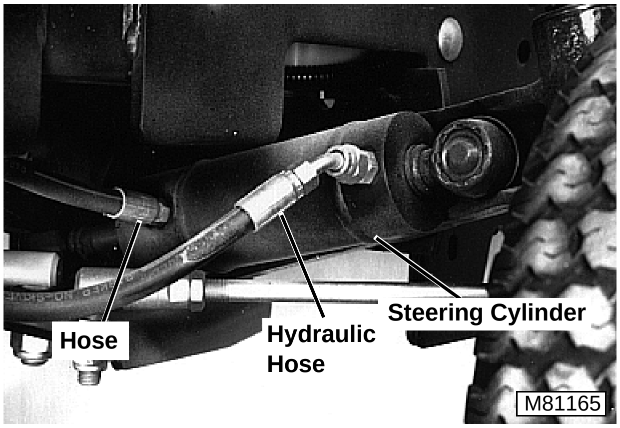
IMPORTANT: Tighten vise only enough to hold housing or damage may occur to housing and sleeve.

21. Put housing in a vise with the gerotor end up.

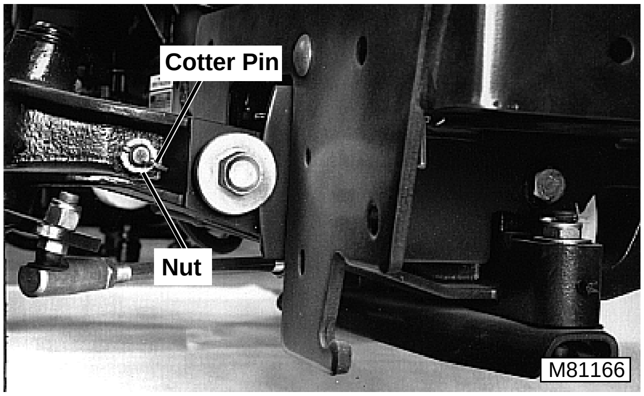


22. Install parts in housing.
23. Align holes of wear plate with housing holes.
24. Make sure drive shaft slot fits on pin and holes of wear plate align with holes of housing.
25. Align holes of gerotor with holes of wear plate.
26. Install cap screws and tighten in a criss-cross pattern to **17 N•m (150 lb-in.).**
27. Remove steering valve from vise. Install ball, O-ring and plug. Tighten plug to **17 N•m (150 lb-in.)**

STEERING CYLINDER—REMOVAL/ INSTALLATION



1. Disconnect hydraulic hose and loosen hose.



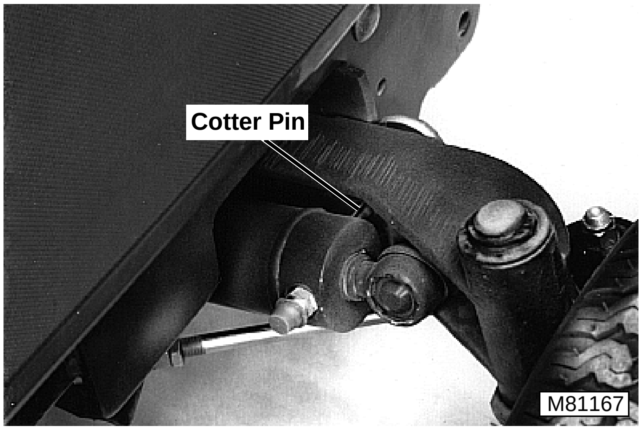
2. Remove cotter pin and nut from each end of steering cylinder.

NOTE: Cylinder ball joint ends are tapered. Use a forked tool or soft-faced hammer to loosen stud ends.

3. Remove steering cylinder and disconnect cylinder from hose.
4. Replace steering cylinder if necessary.

NOTE: Be sure hole in the head end ball joint of steering cylinder is parallel to the cylinder rod. This will allow the cotter pin to be installed easily.

5. Connect steering cylinder to hose.

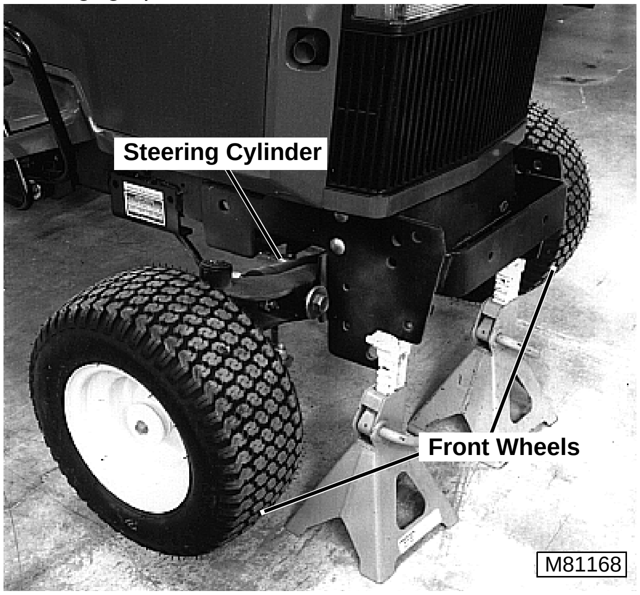


6. Install cylinder making sure spring pin fits into hole of axle casting.
7. Install nuts and cotter pins.
8. Connect hydraulic hose.
9. Bleed the steering system.

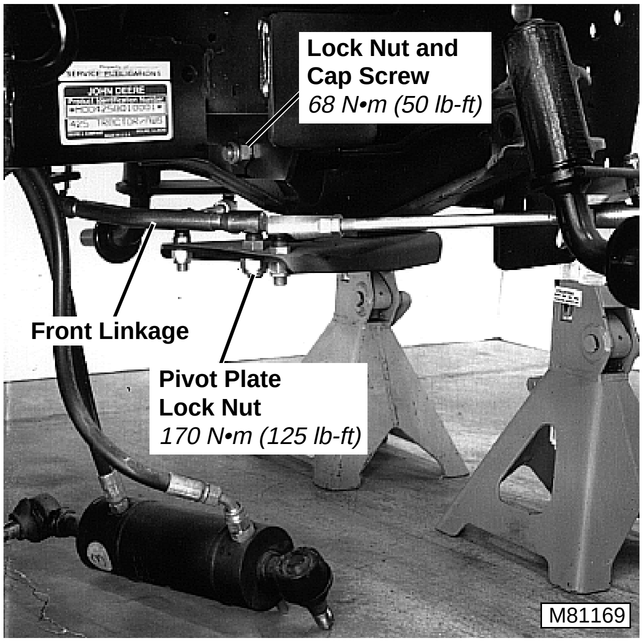
FRONT AXLE—REMOVAL/ INSTALLATION

NOTE: Late model two wheel steer front axles have only one tie rod.

1. Engage park brake.



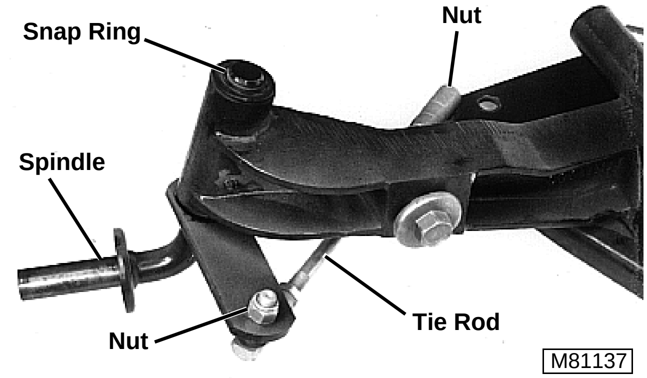
2. Lift front of tractor until front wheels are off the ground. Install jack stands.
3. Remove two front wheels.
4. Remove steering cylinder without disconnecting hydraulic lines. (See STEERING CYLINDER—REMOVAL/INSTALLATION.)



5. For all wheel steer (AWS) units only, disconnect front intermediate linkage from pivot plate.
6. Install a lift or hoist on axle. Remove lock nut and cap screw to remove front axle assembly.
7. Repair or replace axle assembly.
8. Apply multi-purpose grease to pivot bushings in axle assembly.
9. Lift axle assembly into position, while making sure tractor frame fits between head of guide bolts and axle.
10. Install cap screw and lock nut. Tighten cap screw and lock nut to **68 N•m (50 lb-ft)**.
11. Install pivot plate lock nut if removed. Tighten cap screw and lock nut to **170 N•m (125 lb-ft)**.
12. For AWS units, connect front intermediate linkage to pivot plate.
13. Install steering cylinder. (See STEERING CYLINDER—REMOVAL/INSTALLATION.)
14. Install front wheels and lower tractor to the ground.
15. Check and adjust axle toe-in. (See TOE-IN ADJUSTMENT (FRONT AXLE)—ALL WHEEL STEER.)

FRONT AXLE—DISASSEMBLY/ ASSEMBLY

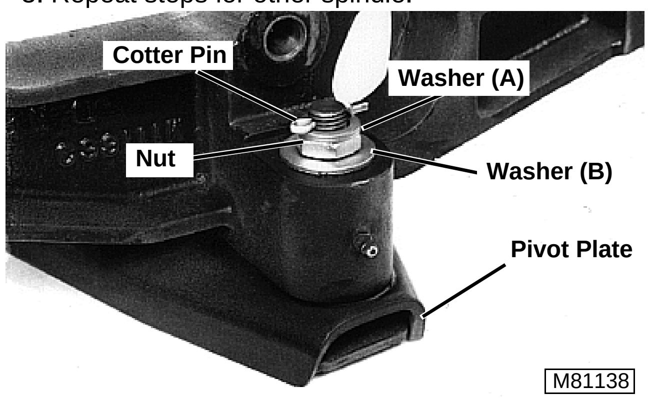
NOTE: All axle repair can be done while on the tractor except for the axle pivot bushings.



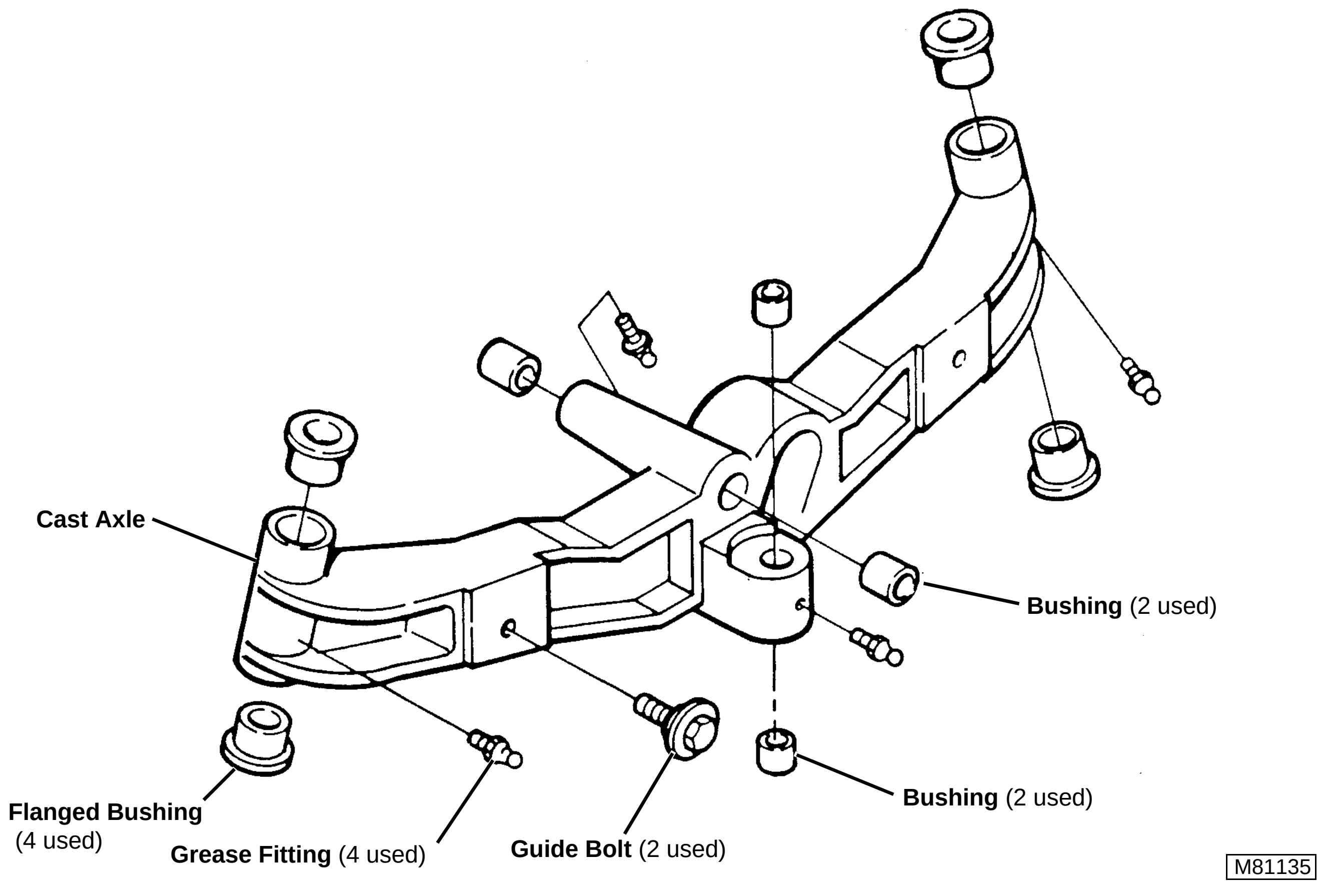
1. Remove nut and snap ring to remove spindle.

NOTE: Late model front axles have only one tie rod.

2. Remove nut and tie rod.
3. Repeat steps for other spindle.

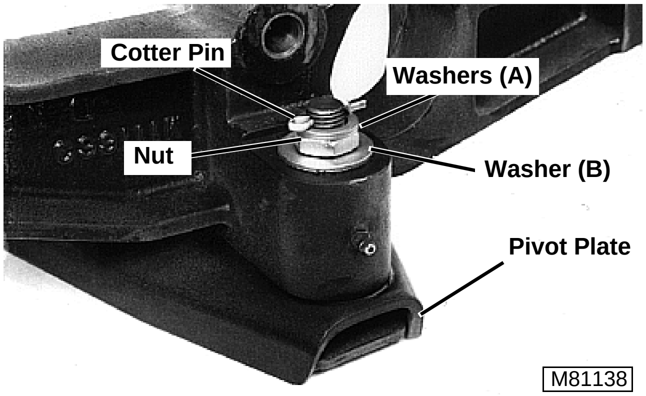


4. Remove cotter pin, washer (A), nut, washer (B), and pivot plate.

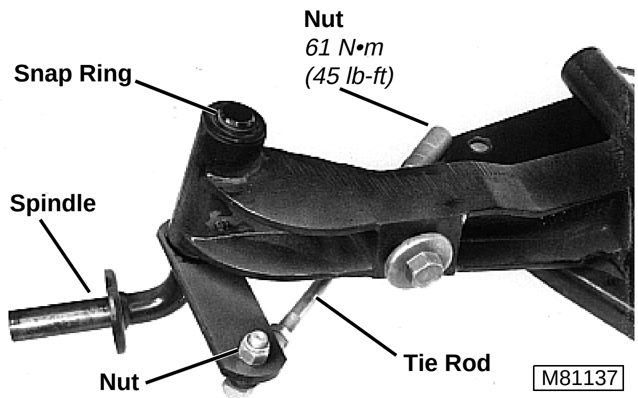


NOTE: Remove components from axle and replace as necessary. Late model two wheel steer front axles have only one tie rod.

5. Install flanged bushings into axle until flange is tight to 1 mm (0.04 in.) maximum gap to casting.
6. Install bushings into bore until end of bushing is even with casting surface.
7. Install guide bolts.



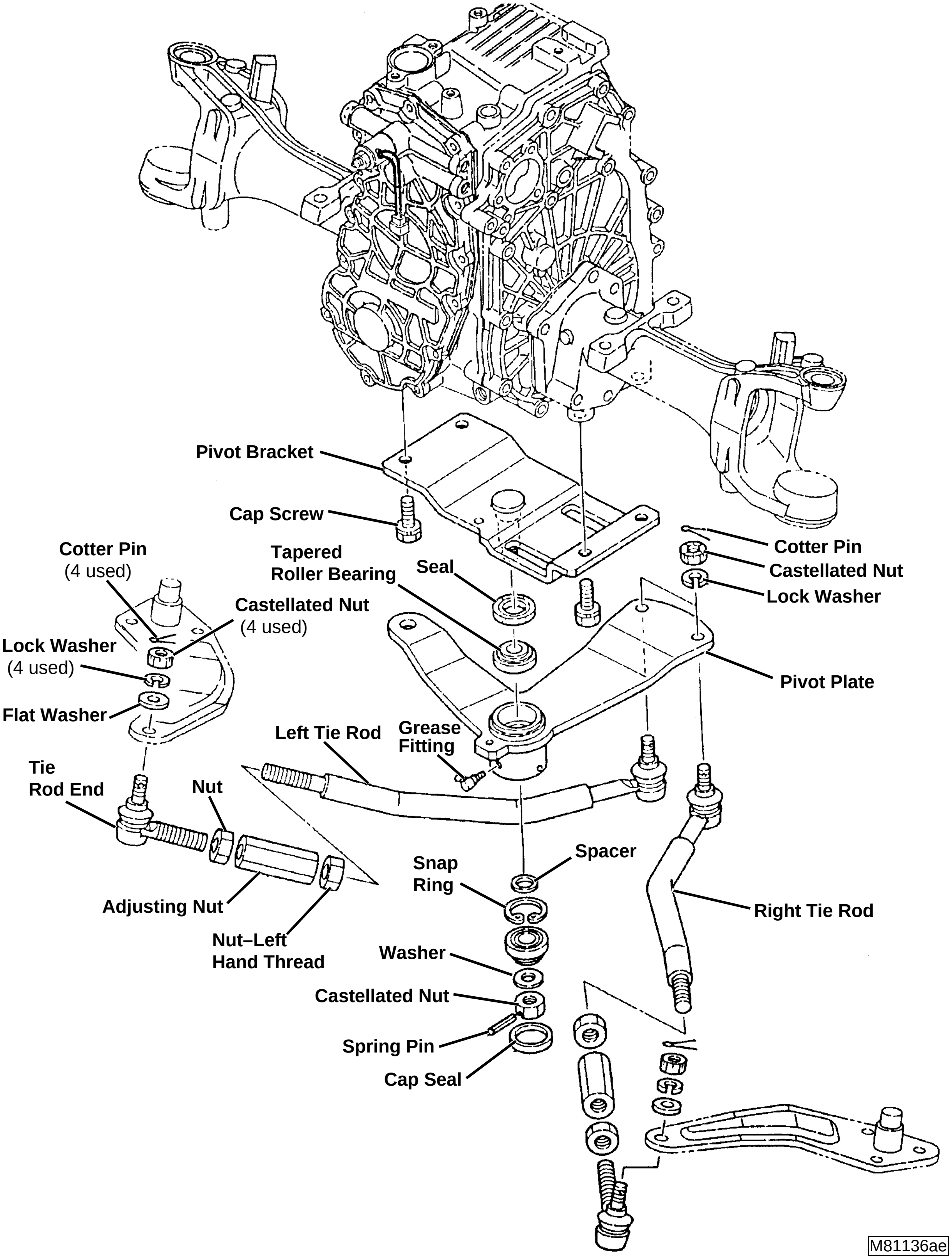
8. Install pivot plate, washer (B) and nut (C). Tighten nut and then loosen 1/4 turn.
9. Install washers (A) as necessary to fill gap between cotter pin and nut.
10. Check length of tie rod from center of stud to center of stud:
   - For two wheel steer units, adjust rod length to approximately 292 mm (11-1/2 in.).
   - For AWS units, adjust rod length to approximately 313 mm (12-5/16 in.).



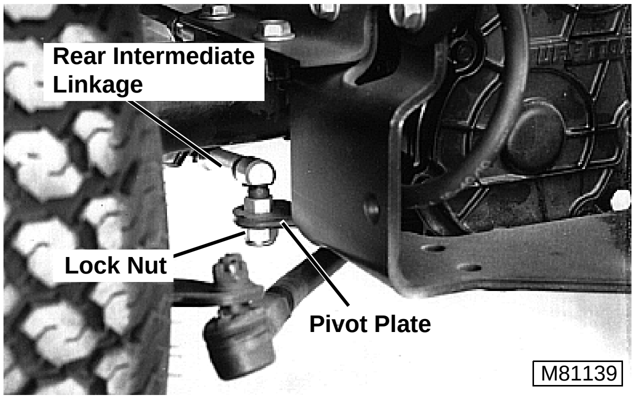
11. Install tie rod and nut. Tighten nut to **61 N•m (45 lb-ft)**.
12. Install spindle, snap ring and nut.
13. Repeat above procedures for other spindle.
14. Check and adjust axle toe-in after axle is installed. (See TOE-IN ADJUSTMENT.)

REAR STEERING LINKAGE—ALL WHEEL STEER

NOTE: Exploded view of rear steering linkage is shown. Refer to cross sectioned art for arrangement of pivot bearings.

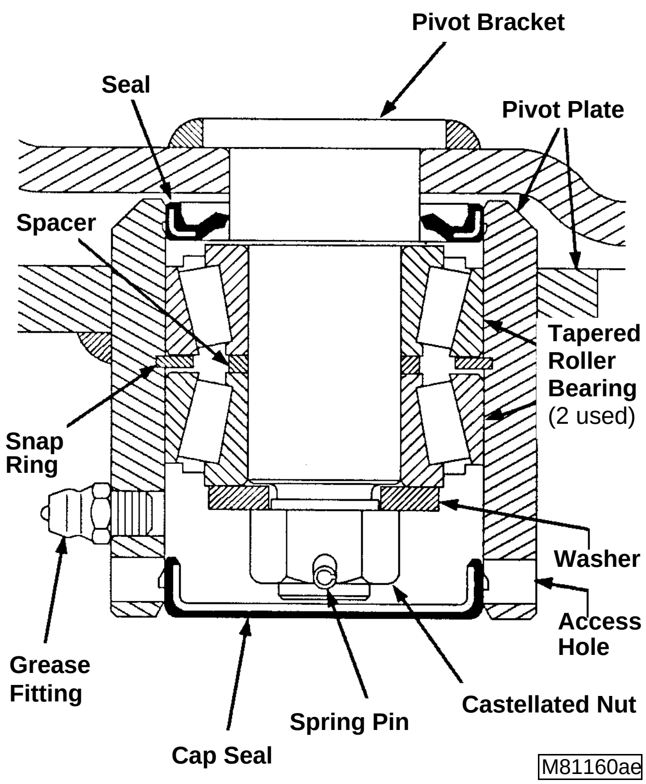


REAR STEERING LINKAGE—REMOVAL



1. Remove lock nut to disconnect rear intermediate linkage from pivot plate.
2. Remove left and right tie rod assemblies by removing hardware parts from knuckle arm end and parts from pivot plate end of tie rods.
3. Remove cap screws and washers to remove pivot assembly.

REAR STEERING LINKAGE—DISASSEMBLY



1. Pry cap seal from pivot plate using small access holes.
2. Use a punch through a small access hole to remove spring pin.
3. Remove nut, washer and pivot plate assembly parts.

NOTE: Outer race of tapered bearings is slip fit.

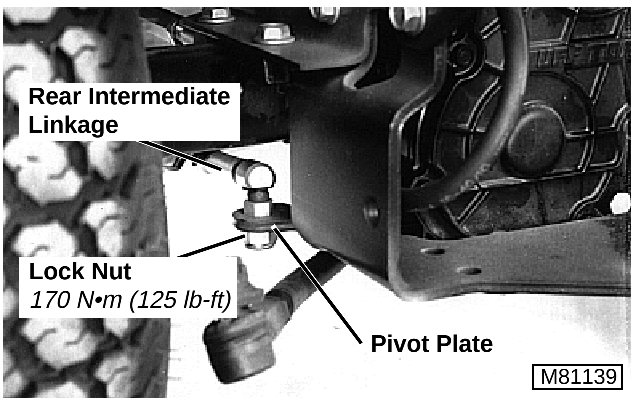
4. Remove pivot plate components.
5. Inspect bearings and ball joints for wear. Replace as necessary.

REAR STEERING LINKAGE—ASSEMBLY

1. Apply extreme pressure grease to rollers of bearings.
2. Install snap ring, upper bearing and seal into pivot plate. Install seal with closed side into bore first and even with top of pivot plate.
3. Install pivot plate, spacer, lower bearing, washer and nut. Tighten nut while making sure slot of nut aligns with hole in pivot shaft.
4. Install spring pin. Fill cavity with extreme pressure grease and install cap seal.

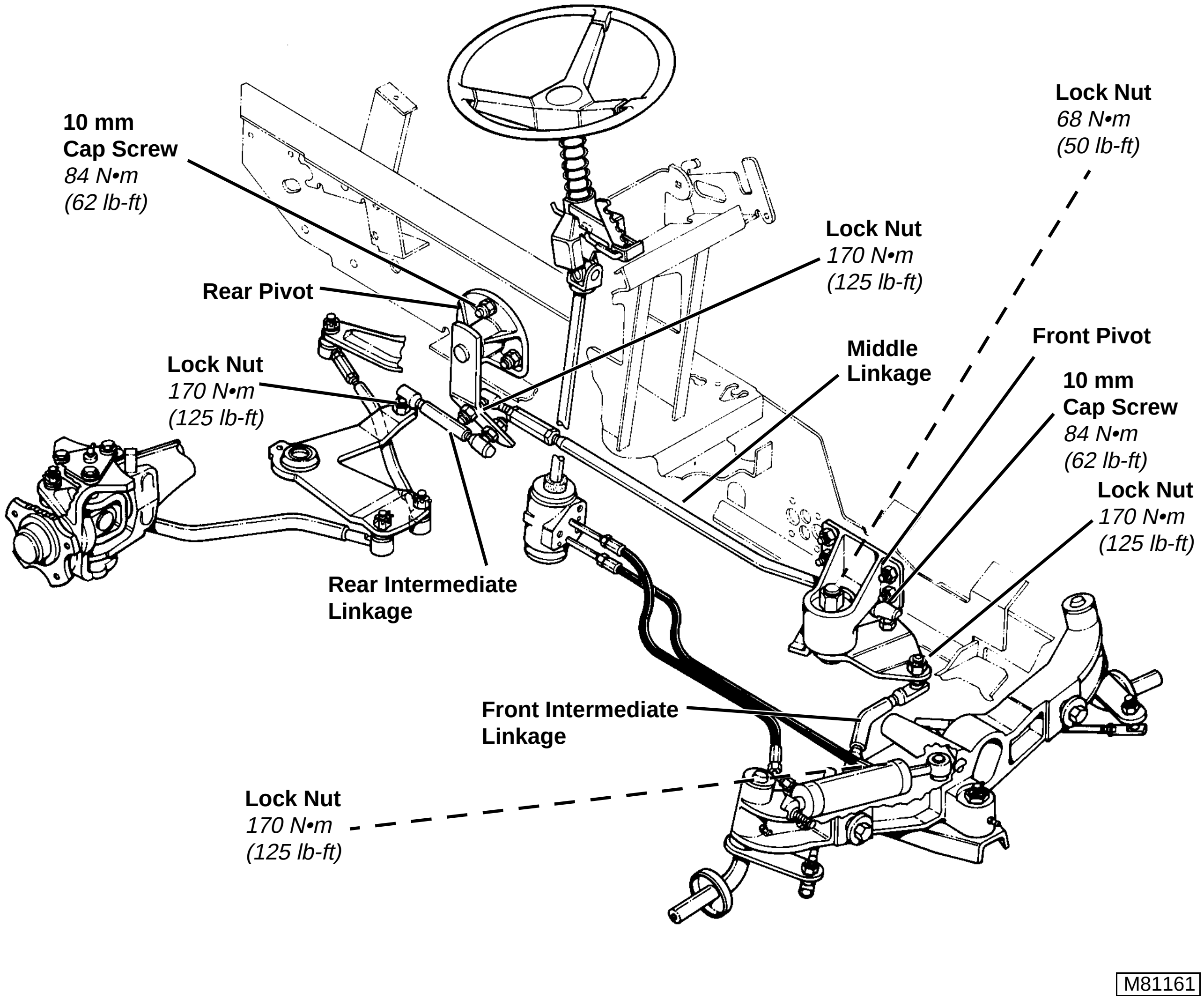
REAR STEERING LINKAGE—INSTALLATION

1. Install pivot assembly using cap screws and washers. Tighten cap screws to **91 N•m (67 lb-ft)**.
2. Install right and left tie rods.
3. Check and adjust rear axle toe-in. (See TOE-IN ADJUSTMENT.)



4. Connect rear intermediate linkage to pivot plate using lock nut. Tighten lock nut to **170 N•m (125 lb-ft)**.

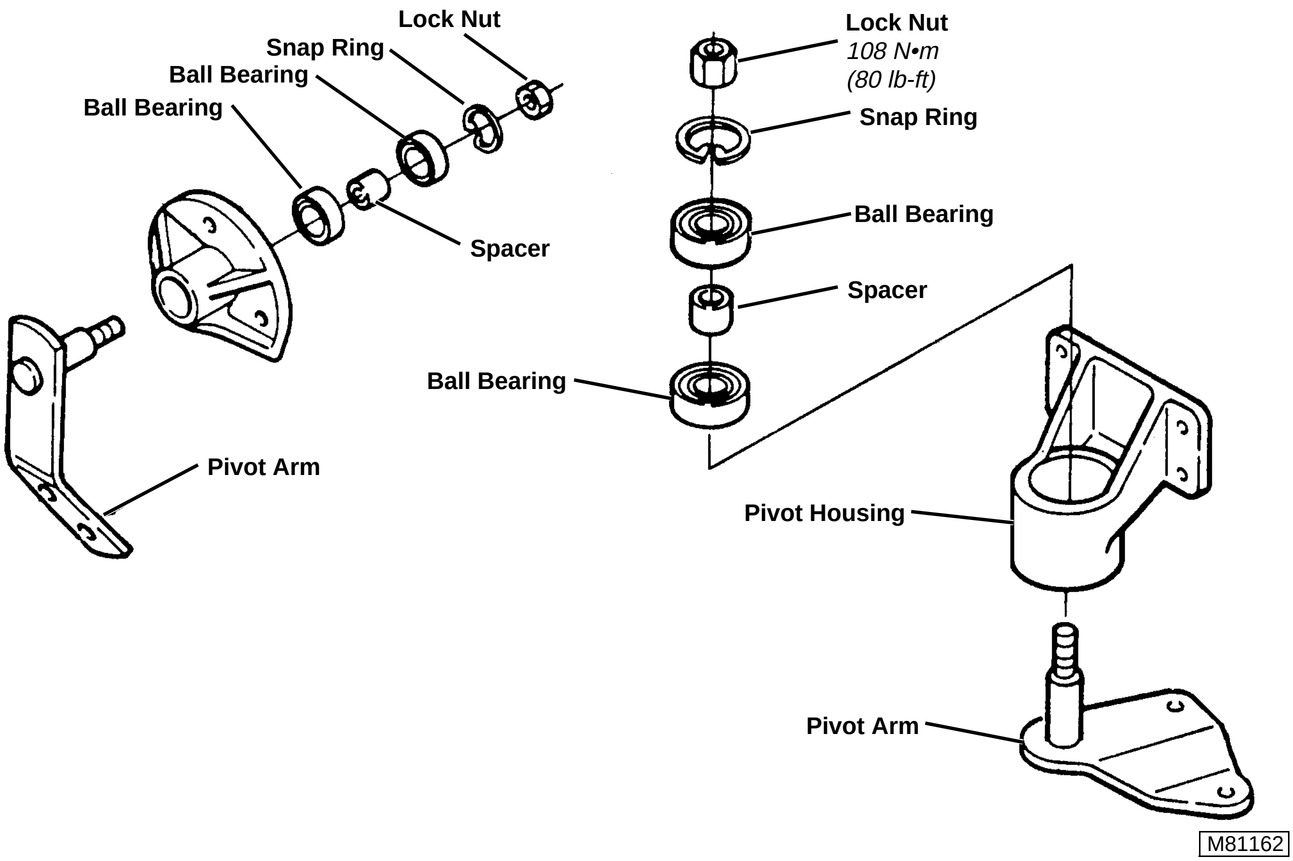
STEERING INTERMEDIATE LINKAGE (ALL WHEEL STEER)—REMOVAL/INSTALLATION



NOTE: *Front and rear intermediate linkages are not adjustable. Ball joint ends are peened to rod. Complete linkage must be replaced if any part is worn or damaged.*

1. Remove lock nut from each end of linkage.
2. Remove front pivot or rear pivot by removing cap screws and nuts. Install front and rear pivots.
3. Install tie strap around wiring harness and through hole in front pivot to keep wiring harness away from engine mount.
4. Install linkages using lock nuts. Make sure front and rear steering assemblies are centered. Tighten lock nut to **170 N•m (125 lb-ft)**.
5. Install 8 mm cap screw in front pivot plate and tighten to **84 N•m (62 lb-ft)**.
6. Install 10 mm cap screw in rear pivot plate and tighten to **84 N•m (62 lb-ft)**.
7. Connect front end of middle linkage to front pivot plate using lock nut. Tighten lock nut to **68 N•m (50 lb-ft)**.
8. Loosen jam nuts and turn adjusting nut until stud of rear ball joint of middle linkage fits into rear pivot arm. Install lock nut. Tighten lock nut to **170 N•m (125 lb-ft)**.
9. Remove pins from front and rear pivot plates.

FRONT AND REAR PIVOTS—DISASSEMBLY/ASSEMBLY



1. Remove nut and snap ring. Replace parts as necessary.
2. Install bearings, spacer and snap ring in housing.
3. Install pivot arm and lock nut. Tighten lock nut to **108 N•m (80 lb-ft)**.

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CONTENTS

BRAKES

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SPECIFICATIONS

GENERAL SPECIFICATIONS

Brakes

Type. . . . . Internal wet disk

TEST AND ADJUSTMENT SPECIFICATIONS

Brake/Differential Linkage Adjustment

With 45 N (10 lb force) applied to brake and difflock arm just contacting difflock shaft, adjust difflock link outward . . . . 6 turns

Brake Freeplay Adjustment—European

Brake pad to disk clearance . . . . 0.1—0.4 mm (0.004—0.015 in.)

REPAIR SPECIFICATIONS

Transaxle Brake Cover Cap Screws Torque—Used Transaxle Case . . 25 N•m (18 lb-ft)
Transaxle Brake Cover Cap Screws Torque—New Transaxle Case . 30 N•m (22 lb-ft)
Brake Switch Striker Torque . . . . 12 N•m (108 lb-in.)

European Brakes

Pad-to-Disk Clearance . . . . 0.1—0.4 mm (0.004—0.015 in.)
Brake Assembly Mounting Cap Screws Torque . . . . 54—82 N•m (40—60 lb-ft)
Brake Pad Cap Screws and Lock Nuts Torque . . . . 16—20 N•m (12—15 lb-ft)
Brake Switch Striker Cap Screw Torque . . . . 12 N•m (108 lb-in.)
Brake Arm Cap Screw Torque . . . . 16—20 N•m (12—15 lb-ft)

OTHER MATERIAL

TY15130 John Deere Form-in-Place Gasket . . . . Seal mating surfaces of transaxle

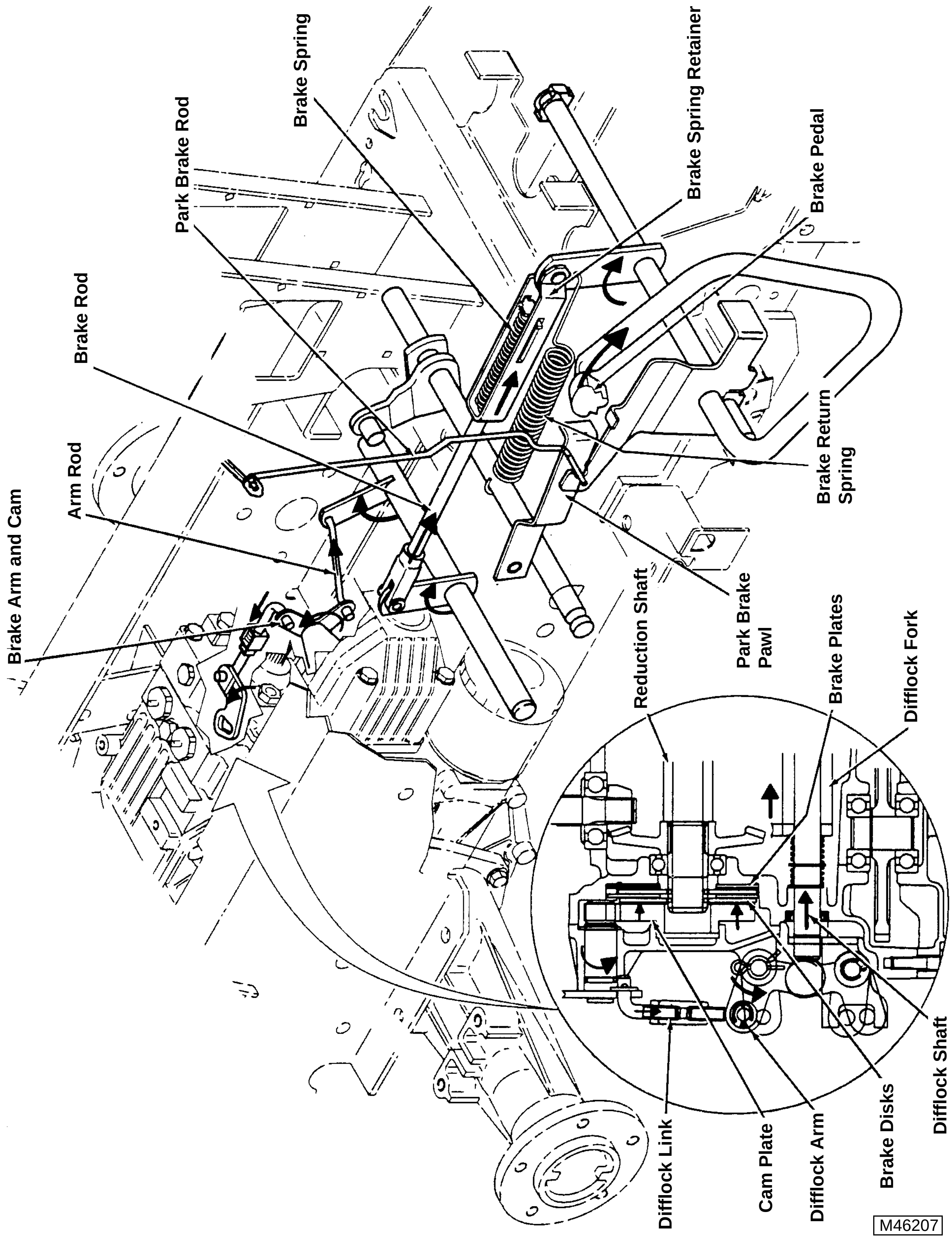
LOCTITE PRODUCTS U.S./Canadian/LOCTITE No.
TY6305/TY9485/#764 Cure Primer
. . . . Clean threads and sealing surfaces
TY9370/TY9477/#242 Thread Lock and Sealer (Medium Strength)
. . . . Retain brake mounting cap screws

SERVICE PARTS KITS

Brake Friction Plate Kit
Brake Friction Pads (European Brakes)

COMPONENT LOCATION

BRAKE SYSTEM COMPONENT LOCATION



THEORY OF OPERATION

BRAKE SYSTEM OPERATION

NOTE: See COMPONENT LOCATION.

Function:

Provide a means of stopping the tractor and also prevent movement when not in use.

System Operation:

When the brake pedal is depressed, the brake spring retainer is pulled forward. The brake spring is compressed and spring tension pulls the brake rods and the brake arm and cam forward. As the brake arm and cam rotates, the cam plate rotates, rolling three balls up a ramp. When the balls move up the ramp, the cam plate pushes against the brake plates, forcing the brake plates and brake discs together.

The brake plates are attached to the transaxle housing through external tangs on the plates. The brake plates cannot rotate. Brake discs that are splined to the reduction shaft are located between the brake plates. The brake discs rotate whenever the reduction shaft rotates. The pressure of the brake plates against the brake discs stops the reduction shaft rotation.

At the same time the brake arm and cam is engaged, the differential lock is also engaged to provide braking to both rear wheels. The brake arm and cam pushes the difflock link and arm rearward. The difflock shaft and fork move into the transaxle and engage the difflock pins to lock both axles together.

When the brake pedal is released, the brake return spring pulls the brake pedal and linkage to the disengaged position. The linkage pulls the cam plate away, releasing the pressure against the plates and disk.

The brake pedal can be locked in the engaged position to be used as a parking brake. When the park brake rod is engaged, the park brake pawl contacts a tab on the brake pedal to hold the pedal in the engaged position.

TROUBLESHOOTING

TROUBLE SHOOTING CHART

Problem or Symptom / Check or Solution	Poor or no brakes.	Brakes binding or brake effort excessive.	Brakes will not release.	Park brake will not engage.	Park brake will not release.	Park brake will not hold.	Brakes noisy or chatter.	Excessive brake wear.
Brake pedal or linkage bent, binding, or worn.	●	●	●	●	●	●	●	●
Brake spring broken or collapsed.	●	●	●	●		●	●	
Brake return spring broken or stretched.			●	●	●			●
Brake linkage freeplay adjustment incorrect.	●	●	●	●	●	●		●
Brake arm and cam bent, binding, or worn.	●	●	●	●	●	●	●	●
Difflock arm bent, binding, or worn.	●	●	●	●	●	●	●	●
Brake plates and disks warped, grooved, or worn.	●	●	●	●	●	●	●	●
Park brake rod and pawl bent or binding.		●	●	●	●	●	●	
Transaxle internal brake components binding or worn.	●	●	●	●	●	●	●	●
Transaxle internal differential lock components binding or worn.	●	●	●	●	●	●	●	●

DIAGNOSIS

BRAKE SYSTEM

Test Conditions:

- Operator in seat.
- Start and run engine at half throttle.

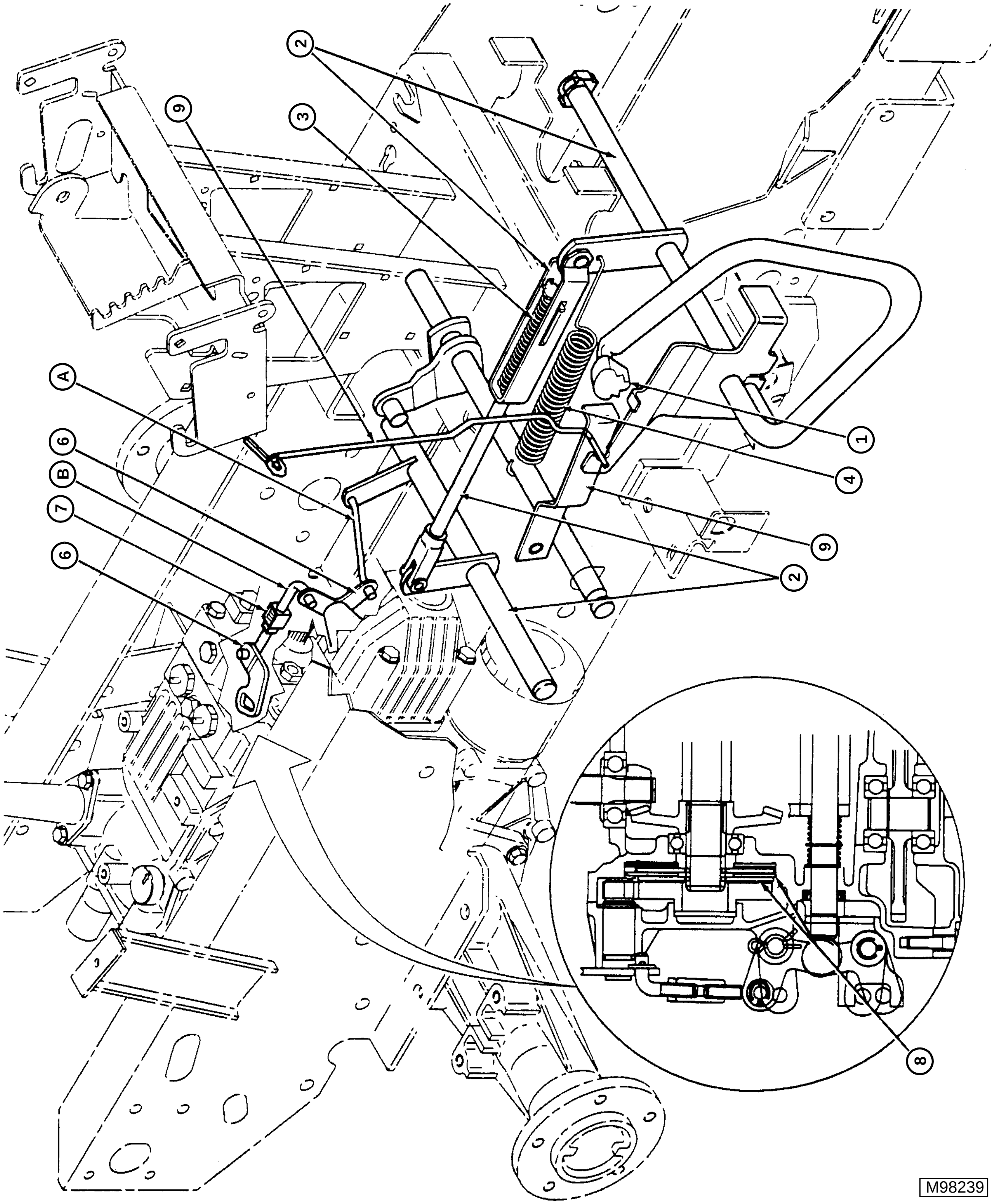
Test/Check Point	Normal	If Not Normal
1. Depress forward pedal fully, then depress brake pedal quickly.	Unit should stop aggressively (rear tires skid on concrete). Both rear tires lock up (stop) and brake evenly. Brake pedal should depress smoothly. Brake shoe to disk clearance: 0.1—0.4 mm (0.004—0.015 in.)	Check transaxle internal brake components. Go to step 5. Check transaxle internal differential components. Go to step 6. Check brake linkage. Go to step 2. Adjust brake clearance. If OK, go to step 5.

Test Conditions:

- Key switch in off position.
- Disconnect brake arm rods.
- 455—Disconnect difflock link.

Test/Check Point	Normal	If Not Normal
1. Brake pedal and linkage.	Linkage not bent, binding, or worn.	Replace.
2. Brake spring.	Spring not broken or collapsed.	Replace.
3. Brake return spring.	Pedal returns to disengaged position. Spring not broken or stretched.	Replace brake return spring.
4. Brake arm and cam.	Arm not bent, binding, or worn.	455—Replace and inspect transaxle internal brake components for binding.
5. Difflock arm.	Arm not bent, binding, or worn.	Replace and inspect transaxle internal differential lock components for binding.
6. Difflock link.	Link not bent or worn. Spring not broken.	Replace.
7. Brake plates and discs.	Not warped, grooved, or worn. Brakes shoes not worn or glazed.	Replace.
8. Park brake rod and pawl.	Not bent or binding.	Replace.

BRAKE SYSTEM TEST POINTS



TESTS AND ADJUSTMENTS

BRAKE/DIFFERENTIAL LINKAGE ADJUSTMENT

Reason:

To adjust brake linkage for proper braking and differential lock engagement when the brake pedal is applied. Unit creeps when on a slope with park brake engaged. Brakes may not stop unit completely when operating on an incline.

Test Equipment:

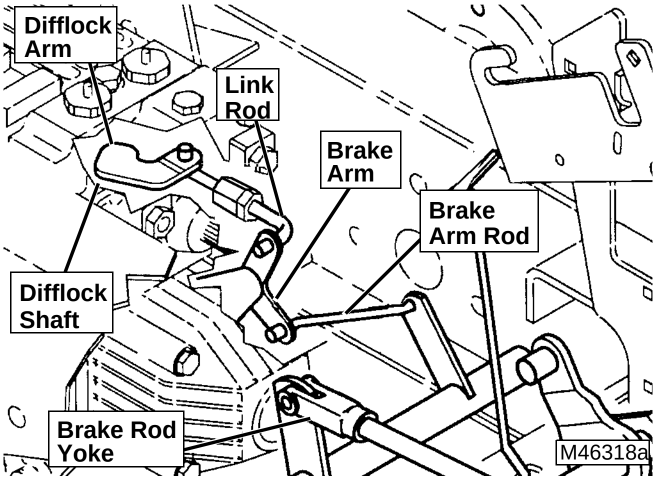
- Spring Scale

Procedure:

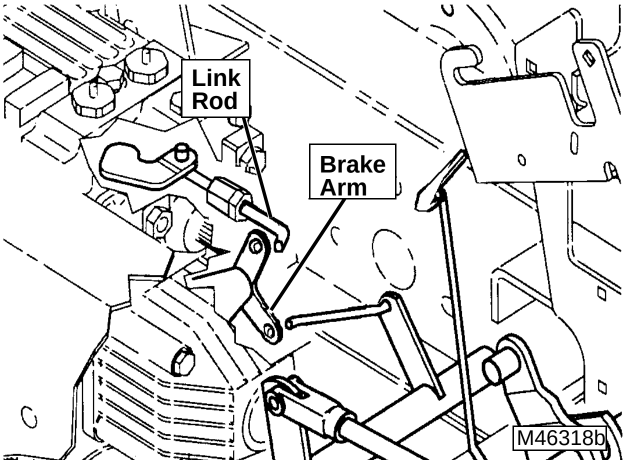
1. Release brake pedal.

> **CAUTION**
>
> **Do not pre-load brakes as excessive wear of brake components will result.**

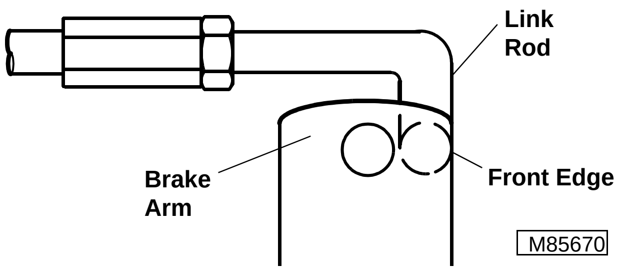
2. Disconnect brake arm rod from brake arm. Easiest if done from left underside of tractor by pulling the cotter pin from the brake arm rod end.
3. Disconnect the forward end of link rod from brake arm.



4. Connect spring scale to bottom of brake arm and pull forward with **45 N (10 lb. force)**.
5. Push link rod rearward until difflock arm contacts the difflock shaft.



6. Check alignment of link rod and brake arm as shown below.



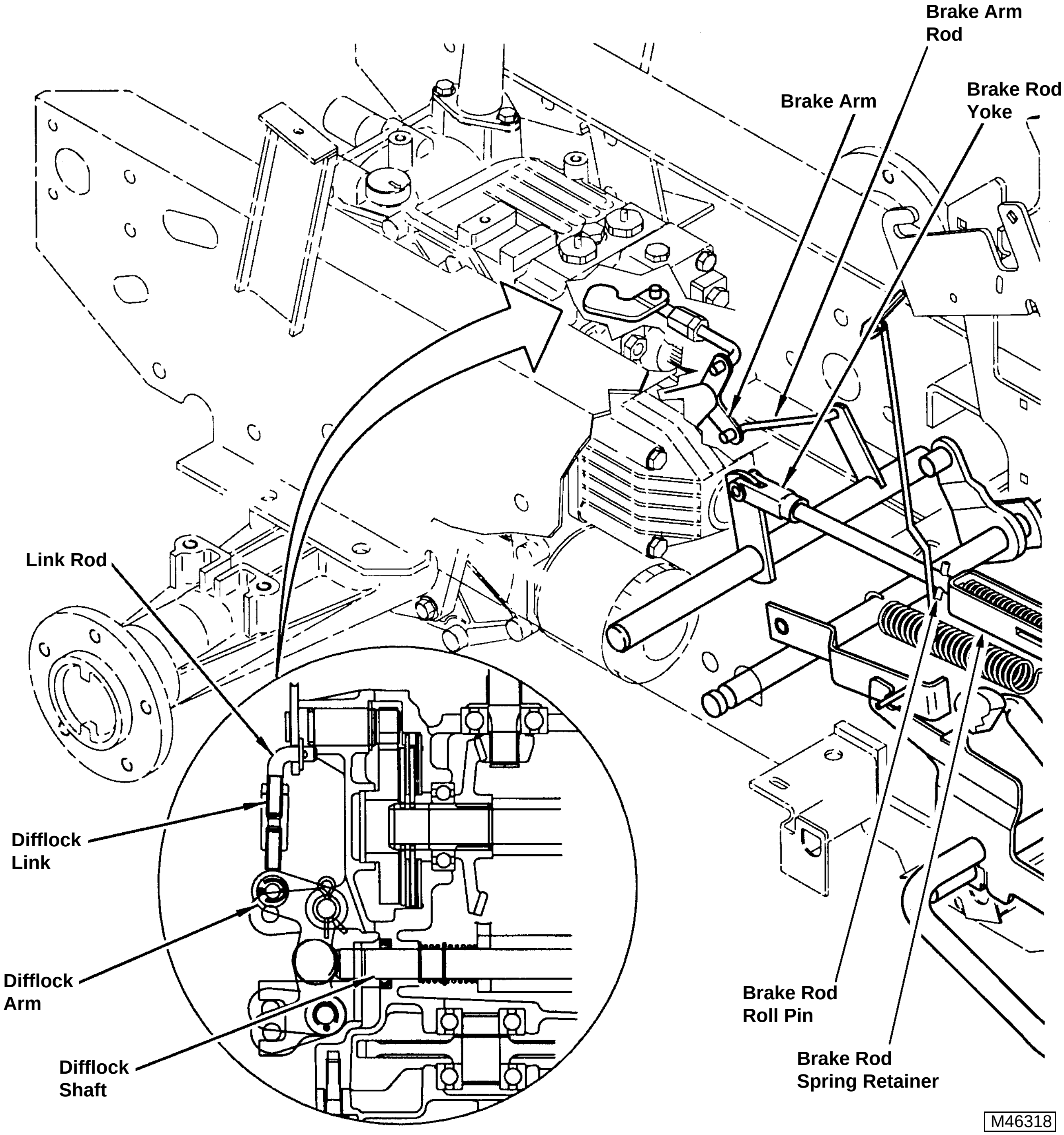
7. Front of link rod should be flush or up to 2 mm (0.08 in.) behind front edge of brake arm.
8. Adjust rod by turning inward or outward (link has left hand threads) one full turn at a time.
9. Remove spring scale slowly to relieve tension.
10. Reinstall link rod, brake arm rod and cotter pins.
11. Adjust brake rod yoke until there is no freeplay in the brake linkage with the brake pedal released. Check linkage for binding after adjustment. If rear wheels are rotated and brakes drag, linkage is too tight. Rotate rear wheels to be sure difflock is not engaged and brakes do not drag.
12. Retest unit on slope with park brake engaged.
13. If unit will not hold on slope without tires creeping, repeat above steps until unit will hold.

Results:

If the brake/differential linkage adjustment is correct:

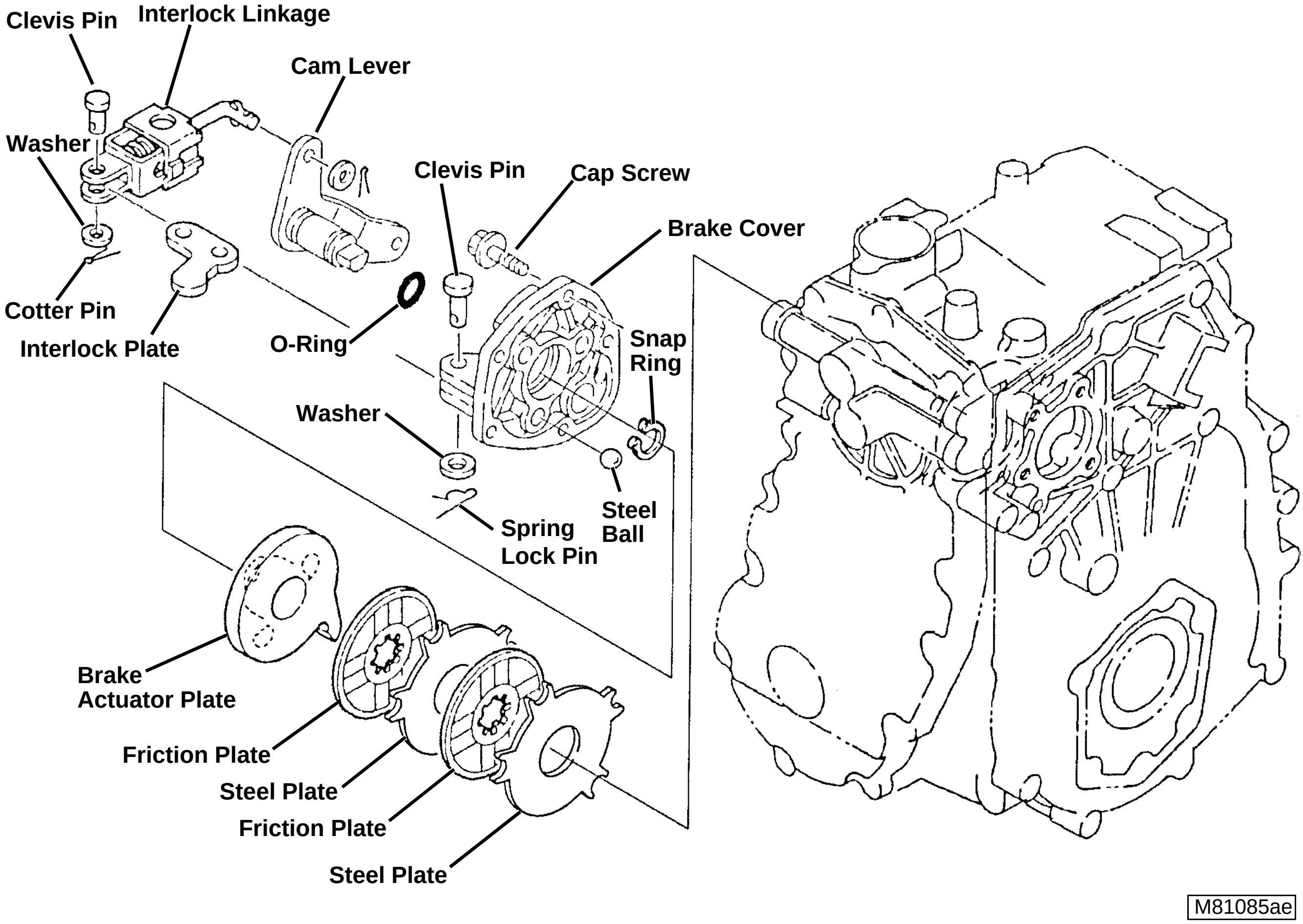
- The brake linkage should not have any freeplay with the brake pedal released and the differential lock should not be engaged.
- The differential lock will be engaged when the brakes are engaged.
- With the park brake locked, the brake rod roll pin must be 3—6 mm (0.12—0.24 in.) away from brake rod spring retainer. If not, shorten brake rod at brake rod yoke.
- Engage brake. See if it holds on slope in question.
- If brakes don’t hold, this indicates that linkage is “bottoming out” on differential lock, preventing “full” brake engagement.

BRAKE/DIFFERENTIAL LINKAGE—DISASSEMBLY/ASSEMBLY



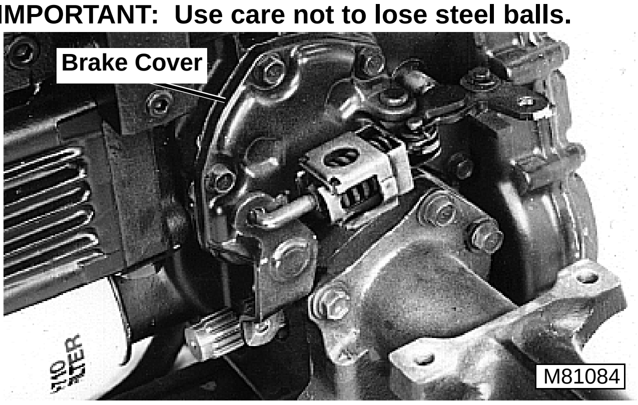
REPAIR

BRAKES—REMOVAL/INSTALLATION



1. Remove transaxle. (See TRANSAXLE—REMOVAL/INSTALLATION in the HYDROSTATIC POWER TRAIN section.)

IMPORTANT: Use care not to lose steel balls.



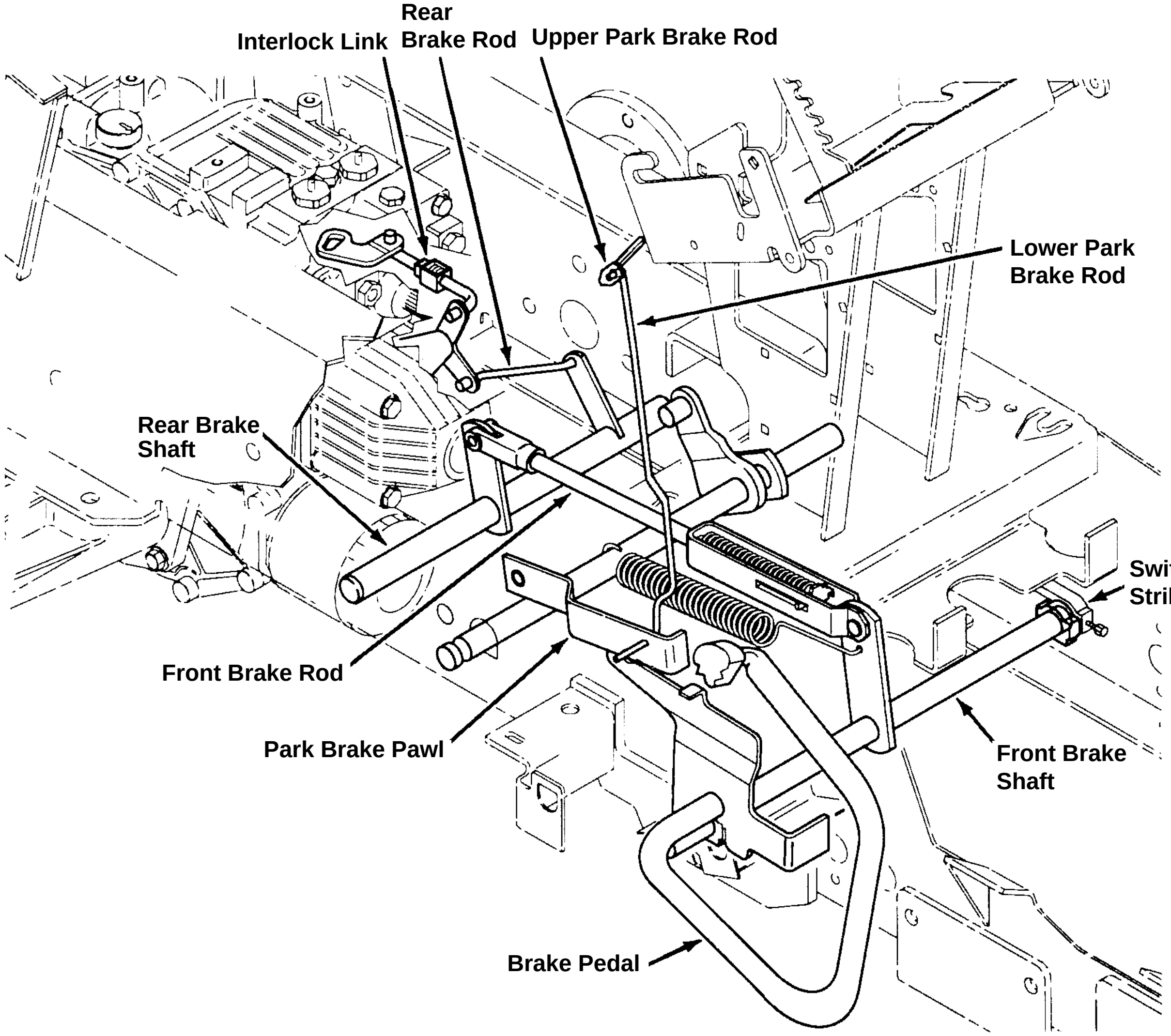
2. Inspect components on brake cover. Replace as necessary. Apply petroleum jelly to O-ring.
3. Inspect plates for wear or spline damage. If groove pattern in friction plates is no longer visible, replace plates.
4. Apply petroleum jelly to balls and install balls in cover.
5. Install steel plates and friction plates alternately beginning with a steel plate.
6. Apply a bead of John Deere Form-in-Place Gasket to brake cover mating surface of transaxle case.
7. Install brake actuator plate and brake cover assembly.

Brake Cover Cap Screw Torque Specifications:

Used Transaxle Case . . . . 25 N•m (18 lb-ft)
New Transaxle Case. . . . . 30 N•m (22 lb-ft)

8. Check brake/differential linkage adjustment. (See BRAKE/DIFFERENTIAL ADJUSTMENT.)

BRAKE LINKAGE—ADJUSTMENT



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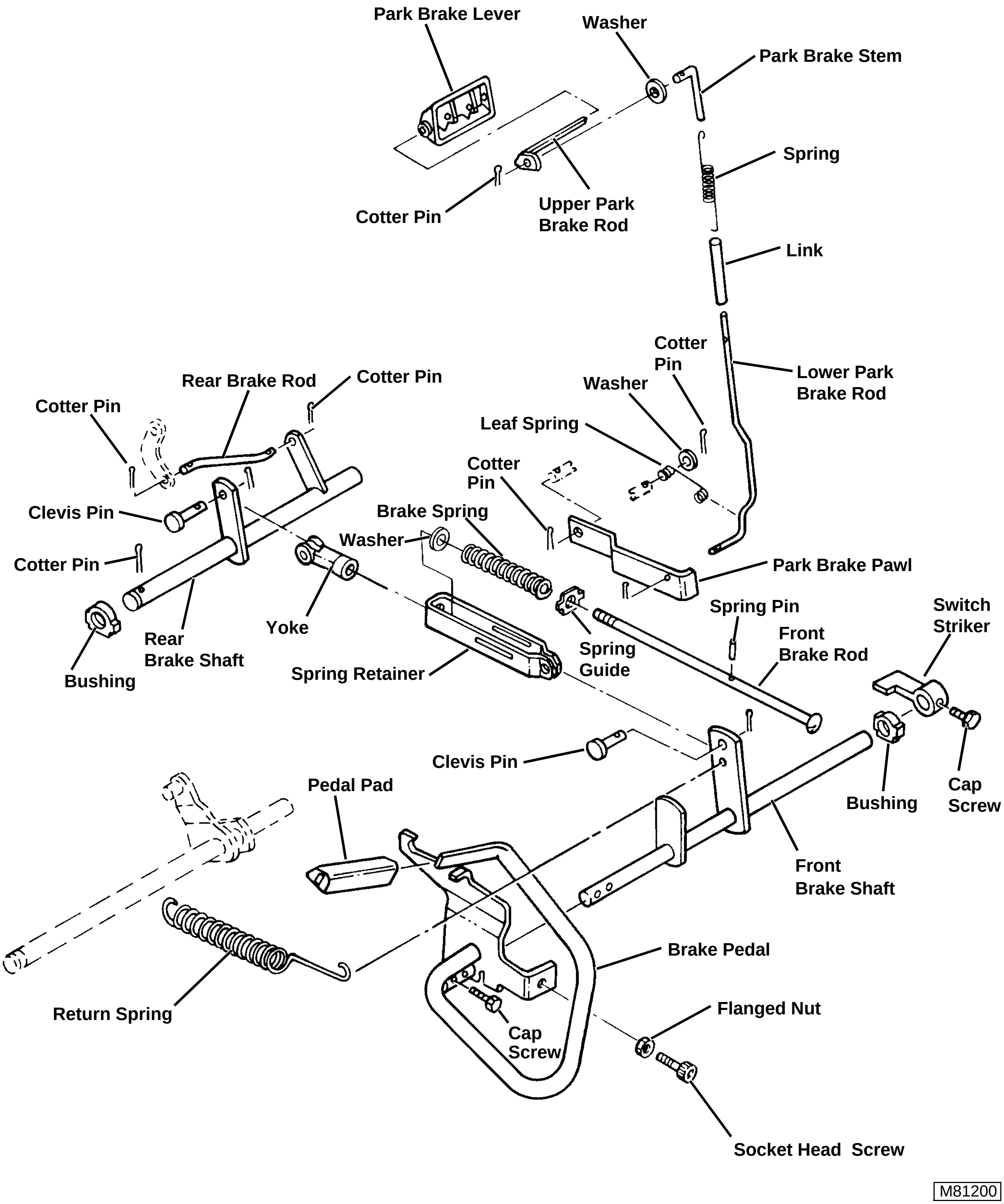
1. Adjust brake/differential linkage after repair. (See BRAKE/DIFFERENTIAL LINKAGE ADJUSTMENT.)
2. Adjust brake switch striker. (See BRAKE SWITCH TEST AND ADJUSTMENT in the ELECTRICAL section.)
3. Tighten switch cap screw to **12 N•m (108 lb-in.)**.

BRAKE/DIFFERENTIAL LINKAGE—DISASSEMBLY/ASSEMBLY



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CONTENTS

HYDRAULICS

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SPECIFICATIONS

GENERAL SPECIFICATIONS

Transaxle

Hydraulic Oil J20D	Low Viscosity HY-GARD
Oil Capacity (Two-Wheel Steer)	6.6 L (7.0 qt)
All-Wheel Steer	5.7 L (6.0 qt)
Hydraulic Oil Filter	Use original John Deere filters

Charge Pump

Size	6 cc/rev.
Relief Valve	6371—7350 kPa (924—1066 psi)
Observed Flow	17 L/m (4.5 gpm)
Minimum Flow	13 L/m (3.4 gpm) @ 3200 rpm

Hydraulic Control Valve

Leakage (Max)	16 cc/min @ 6895 kPa (0.053 oz/min @ 1000 psi)
Couplers	0.635 cm (1/4 in.) ISO

Hydraulic Lift Cylinder

Bore	63.5 mm (2.5 in.)
Stroke	101.6 mm (4.0 in.)
Rod	25.4 mm (1.0 in.)

TEST AND ADJUSTMENT SPECIFICATIONS

NOTE: Make sure engine idle and wide-open throttle speeds are correct before performing any of the hydraulic tests.

Implement Relief Valve Pressure	6371—7350 kPa (924—1066 psi)
Charge Pump	
Engine RPM	Wide open throttle
Pump Flow	17.0 L/m (4.5 gpm)
Minimum Pump Flow	13.2 L/m (3.5 gpm)
Lift Cylinder Leakage Test	
Hydraulic Oil Temperature	43°C (110°F)
Engine Speed	Slow idle
Leakage	No leakage
Control Valve Leakage Test	
Engine Speed	Slow idle
Leakage	No more than a drip from "out" port of control valve

REPAIR SPECIFICATIONS

Spring Retainer Retaining Screw Torque	4 N•m (36 lb-in.)
End Cap Retaining Screws Torque	4 N•m (36 lb-in.)
Detent Ball Retaining Screws Torque	4 N•m (36 lb-in.)
Spool Detent Torque	4 N•m (36 lb-in.)
Drain Plugs Torque	38 N•m (28 lb-ft)
Lift Check Valves Cap Screws Torque	24 N•m (18 lb-ft)

SPECIAL OR ESSENTIAL TOOLS

JDG282 Temperature Gauge—Used to measure hydraulic oil temperature.

AM102420 Quick Coupler—Used to connect to the implement couplers.

JT031111 9/16-18 M x 7/16-20 M 37° Orb—Used to connect to the implement couplers.

JT03017 Hose—Used to connect pressure gauge to couplers during pressure tests.

JT03117 Pressure Gauge, 13790 kPa (2000 psi) —Used to measure hydraulic oil pressure.

JT01765 Consumer Products Hydraulic Fitting Kit—Used for Charge Pump Flow and Pressure Quick Test at Couplers.

JT05469 Flowmeter Kit—Used to measure flow rate of hydraulic oil.

AM1-2420 1/4 Male Quick-Coupler—Used to connect flowmeter to work ports.

JT03216 Connector and 9/16-18 M 37° x 9/16-18 M Orb—Used to connect flowmeter to work ports.

JT03342 Coupler and 3/4” F NPT x 9/16-18 F 37° Orb—Used to connect flowmeter to work ports.

OTHER MATERIALS

Number	Name	Use
LOCTITE® PRODUCTS TY9370/TY9477/#242	Thread Lock and Sealer (Medium Strength)	Used to seal threads on control valve screws, spool detent and small plugs.

SERVICE PARTS KITS

The following kits are available through your parts catalog:

- Control Valve Seal Kit
- Load Check Valve Kit
- Spool Spring Center Kit
- Spool Detent Float Kit

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THEORY OF OPERATION

HYDRAULIC SYSTEM

Function:

The hydraulic system provides fluid power to charge the hydrostatic pump and operate the power steering, lift cylinder and any optional auxiliary hydraulic attachments.

System Operation:

The hydraulic systems is an "open center" type system. In this type of system the charge pump provides a continuous flow of oil through a circuit that connects all of the controlling valves. If the valves are not operated, the flow of oil passes through the "open center" of each valve and then returns to the transmission case. In an open center circuit, the first controlling valve takes priority over the next valve downstream in the circuit.

The charge pump draws hydraulic oil from the transaxle case, through the filter, then supplies a constant flow of oil to the steering valve and control valve. Return oil from the steering valve and hydraulic control valve is routed through the oil cooler then back to the transaxle case.

The hydraulic control valve is controlled by two levers on the steering column. The top lever controls the lift spool that controls the flow of oil to and from the lift cylinder. The lower lever operates the auxiliary control spool valve, used to operate hydraulic test equipment attached to the tractor. An optional shutoff valve can be installed in the line running to the lift cylinder. When in the off position, the lift cylinder is blocked out of the system, allowing attachments requiring dual function controls to be operated without the deck or hitch moving up or down.

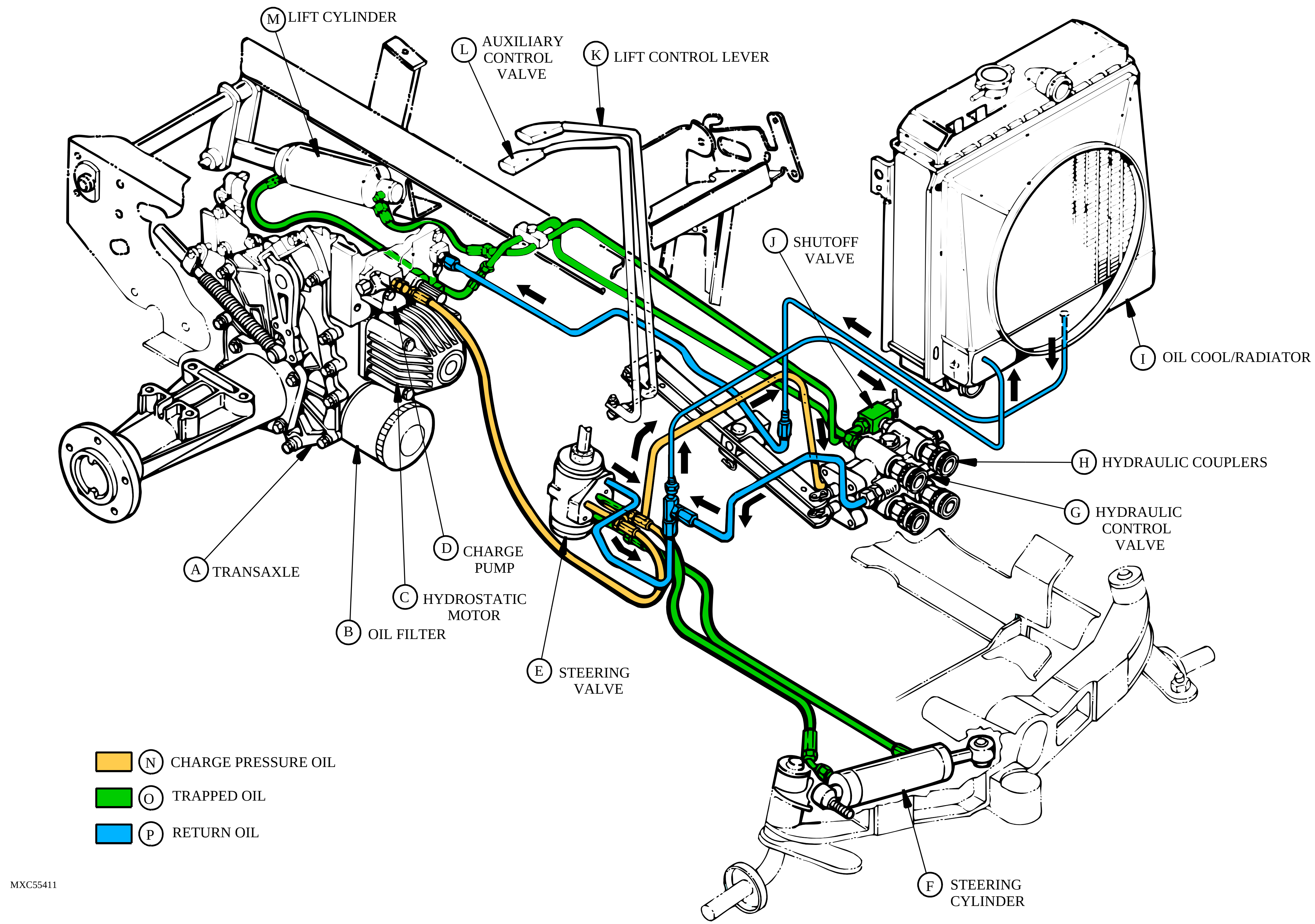
See Section 6—POWER TRAIN for operation, test and repair of charge pump and valves.

See Section 7—STEERING for operation and test of the steering valve and cylinder.

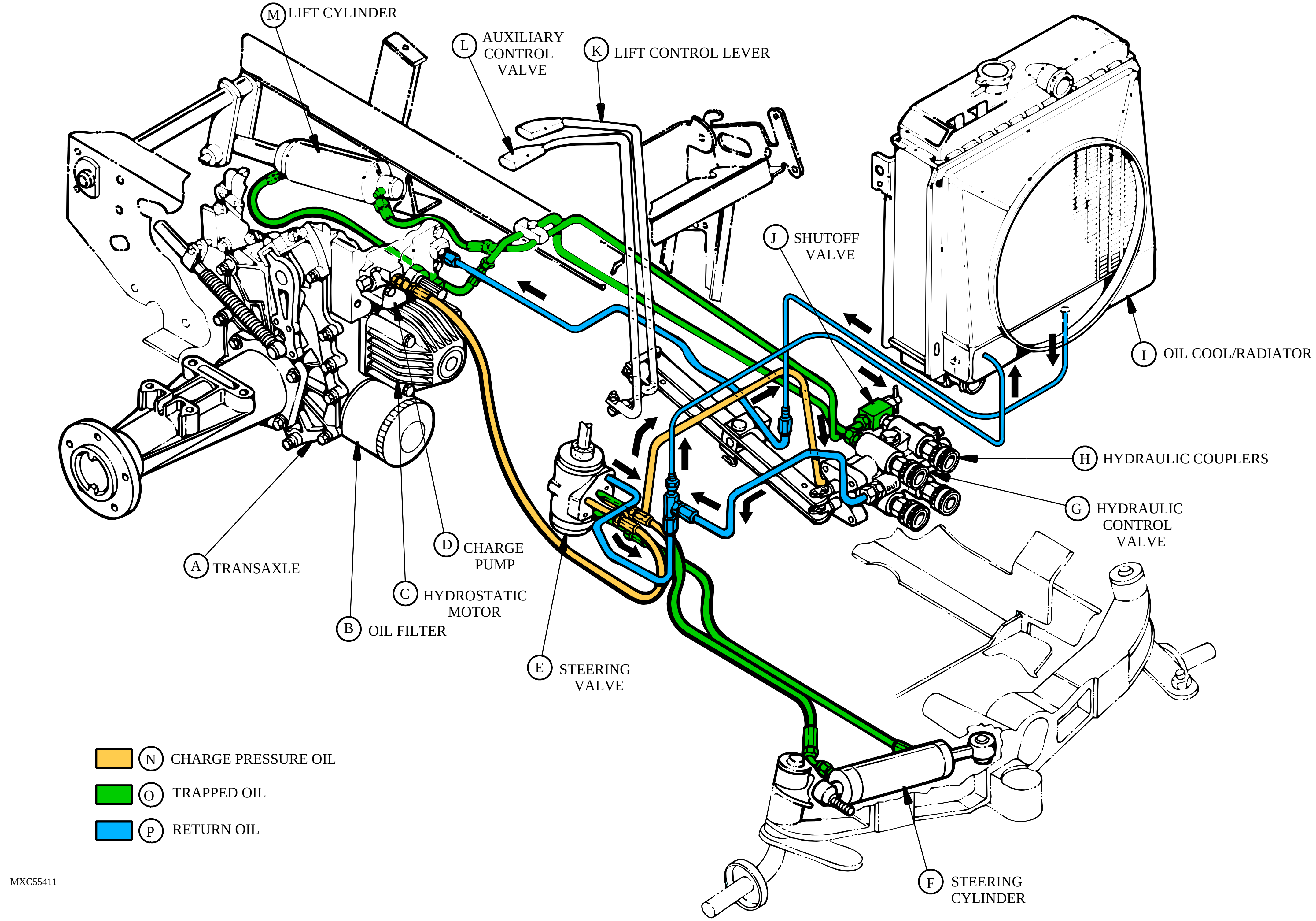
See this section for operation, test and repair of the hydraulic control valve.

NOTE: Couplers are optional on some models but the auxiliary spool valve is functional.

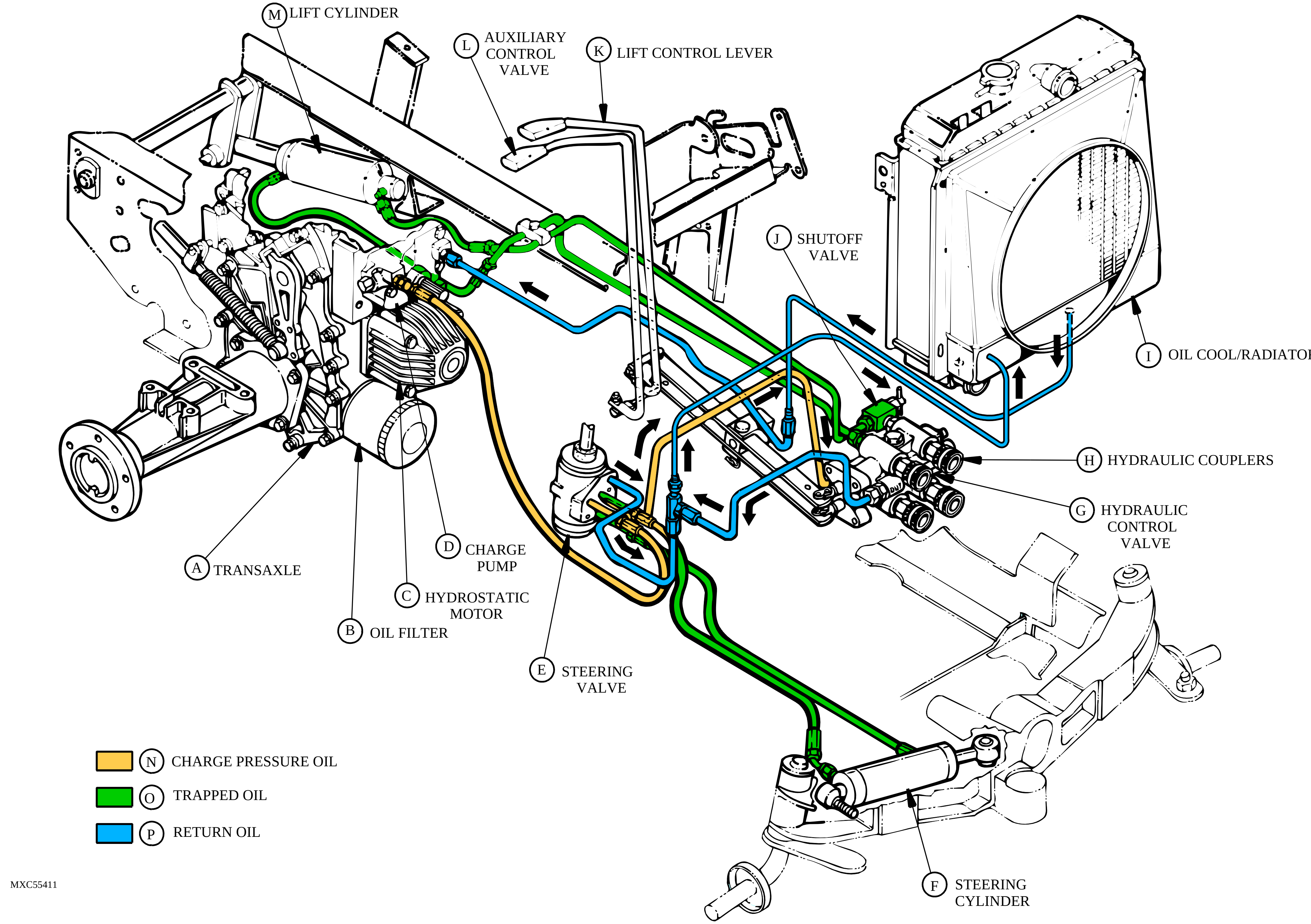
HYDRAULIC COMPONENTS AND OIL FLOW



HYDRAULIC COMPONENTS AND OIL FLOW



HYDRAULIC COMPONENTS AND OIL FLOW



HYDRAULIC CONTROL VALVE OPERATION—NEUTRAL

Function:

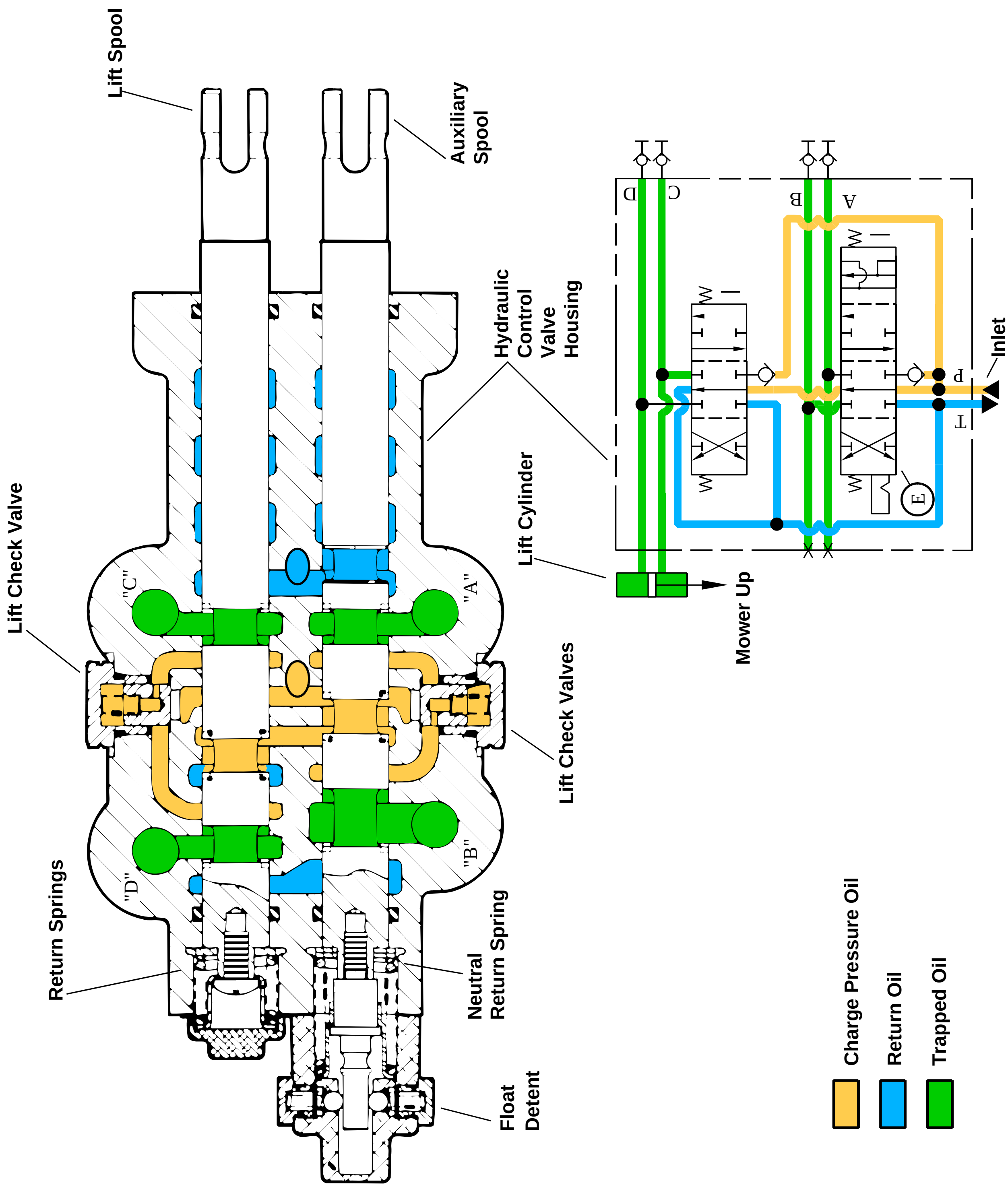
The hydraulic control valve controls oil flow to the lift cylinder and the auxiliary hydraulic outlets (if equipped). When both spool valves are in the neutral position they block oil flow to the lift cylinder and to any attachments, holding them in the desired position.

System Operation:

The hydraulic control valve housing contains two separate, open-center spool valves. The lift cylinder spool and the auxiliary outlet control spool. The lift spool is a three position valve, controlling raise and lower and is returned to neutral when the lever is released by the centering springs. When in the neutral position, oil passes through the "open center" passage and exits the valve housing at the "OUT" port. The auxiliary valve is a four position valve, controlling the raise, lower and neutral functions of the couplers connected to any auxiliary equipment. It also is returned to neutral by the centering springs. It also has a fourth dented position when pushed completely forward for "float". (See HYDRAULIC CONTROL VALVE OPERATION—FLOAT).

System pressure oil is present at the work port inlet passages. Because the passages are blocked by the spool valves, there is no oil flow, leaving the lift check valves closed. The spool valves also block the work ports. No oil is allowed to enter or leave, hydraulically locking the lift cylinder or attached implement in position.

HYDRAULIC CONTROL VALVE OPERATION—NEUTRAL



HYDRAULIC CONTROL VALVE OPERATION—RAISE

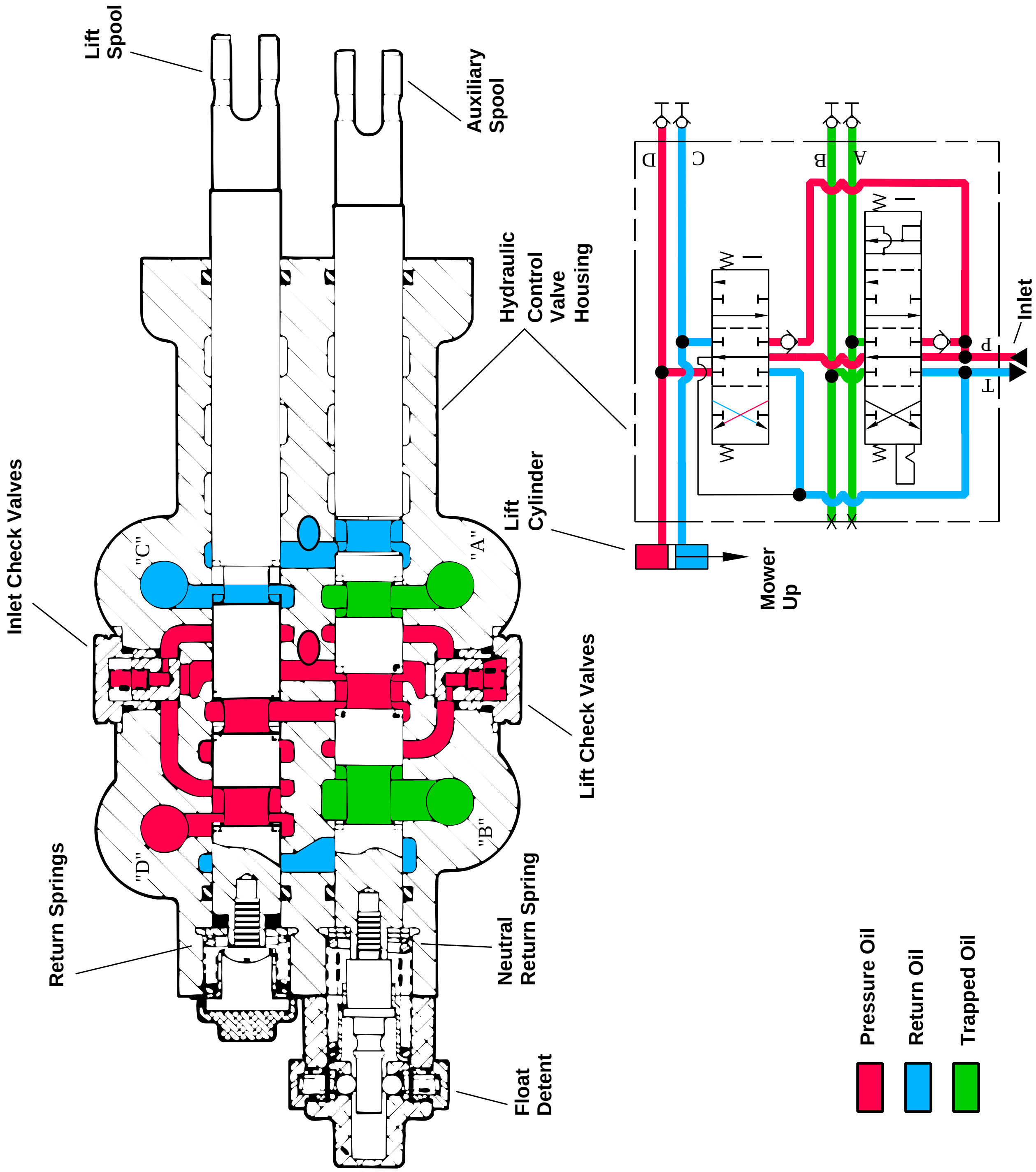
Function:

Controls the flow of pressure oil to the piston side of lift cylinder and allows return oil from the cylinder to exit the valve housing.

System Operation:

As the control lever and linkage moves the spool valve toward the lift position, the open center passage is closed off, increasing inlet pressure at work port. When inlet pressure overcomes the pressure of the work port, and oil flow starts to move the load, the lift check valve opens. The lift check valve prevents the load from dropping before inlet pressure overcomes the load or if the hydraulic system should lose pressure. High pressure oil acting against the cylinder, makes the cylinder extend. The oil from the rod end of the cylinder returns though port and exits the control valve.

HYDRAULIC CONTROL VALVE OPERATION—RAISE



HYDRAULIC CONTROL VALVE OPERATION—FLOAT

Function:

In "float" position the spool valve equalizes the pressure between both work ports, allowing oil to freely enter or leave the auxiliary cylinder. This allows the implement to follow or "float" with the contour of the ground.

System Operation:

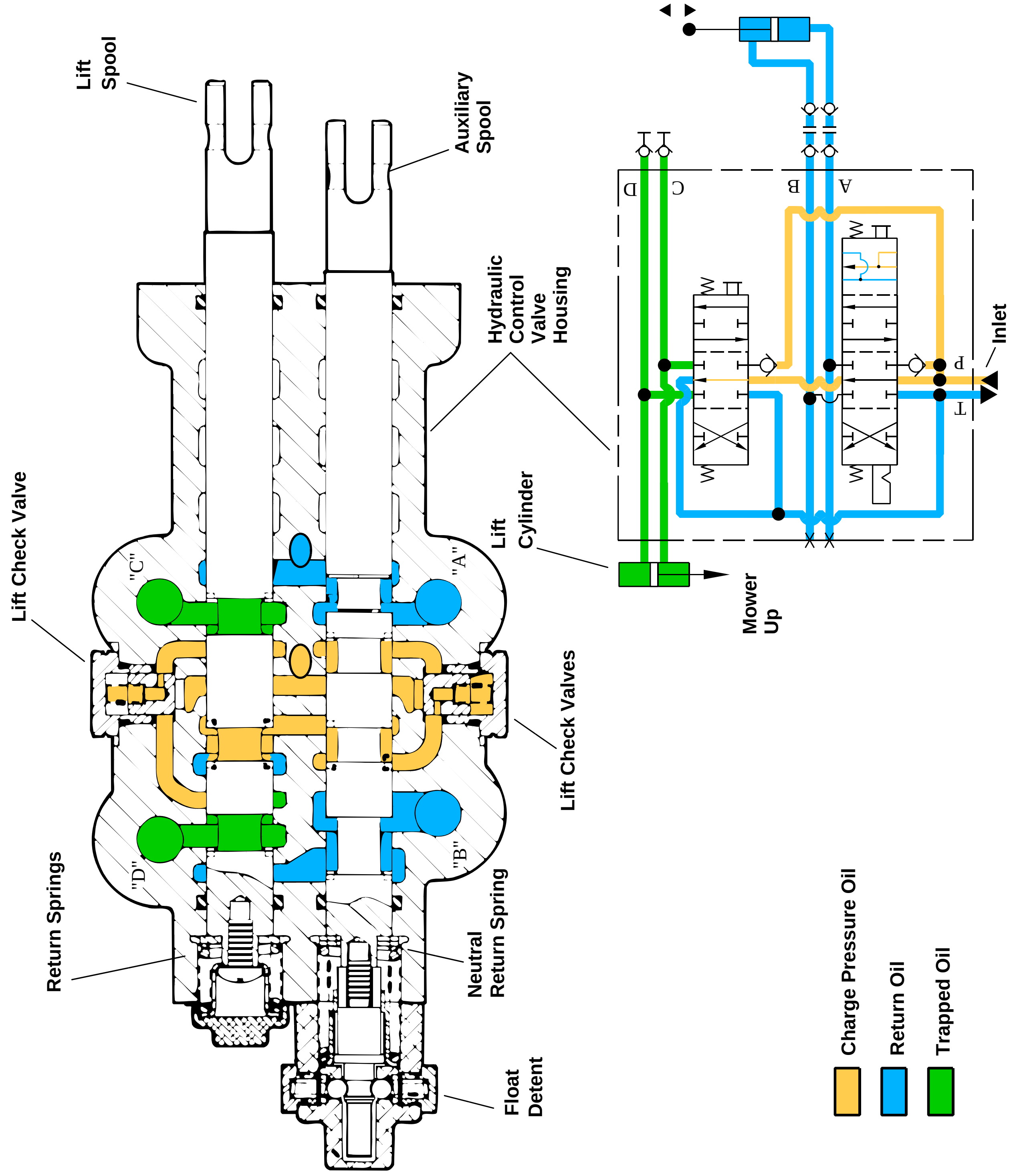
When the shift linkage moves the control spool into the "float" position (lever fully forward), it is held there by detents. The spool will remain in this position until it is manually brought back out of the detents. In the float position, the open center circuit is still open, allowing oil flow to exit the control valve and also to be available for the operation of the lift cylinder. Both pressure and return work ports are open to the return circuit. As the cylinder extends or retracts, oil is drawn from the return circuit.

LIFT CYLINDER SHUT-OFF VALVE—OPTIONAL

Function:

The shutoff valve is supplied with the front hitch kit. Its purpose is to lock the lift cylinder in a set position so when using the front coupler work ports, the deck or rear hitch will not move. This will provide a positive movement of the attachment.

HYDRAULIC CONTROL VALVE OPERATION—FLOAT



TROUBLESHOOTING

TROUBLESHOOTING CHART

Check or Solution / Problem or Symptom	Mower will not lift.	Hydraulic system inoperative.	Slow hydraulic functions.	Low lift capacity.	Erratic operation of implement attached to couplers.	Mower deck or attachment drops with control valve in neutral.	Hydraulic noise.	Control levers stick, hard to operate, do not align.	Hydraulic oil foams.	Frequent failure of hydraulic line or O-rings.	Hitch drops or will not hold implement up.	Mower will not lower.
Optional shutoff valve is installed and is shut off.	●	●						●				●
Lift linkage is binding or disconnected. Deck height adjustment is all the way up.	●	●						●				●
Check hydraulic oil level. Replace filter.	●	●	●		●		●	●	●			
See CHARGE PUMP FLOW AND PRESSURE QUICK TEST AT COUPLERS.	●	●	●	●	●		●	●	●	●		
Hydraulic line damaged causing a restriction.	●	●	●				●	●				●
Coupler tips worn or damaged Replace couplers.			●		●			●				
Implement relief valve setting incorrect.	●	●	●	●	●		●	●		●		
Hydraulic control spool valve scored.	●		●			●		●			●	
See CONTROL VALVE LEAKAGE TEST.	●		●		●	●		●			●	
Control valve spool not neutralizing. Check linkage for binding or repair valve.			●		●	●	●	●			●	
Lift cylinder leaking. See LIFT CYLINDER LEAKAGE TEST.	●	●	●	●	●	●		●			●	
Implement lift or operating cylinder is leaking.			●	●	●	●		●			●	
Air leak on suction side of charge pump.	●	●	●		●	●	●	●	●			

TROUBLESHOOTING CHART (continued)

Check or Solution / Problem or Symptom	Mower will not lift.	Hydraulic system inoperative.	Slow hydraulic functions.	Low lift capacity.	Erratic operation of implement attached to couplers.	Mower deck or attachment drops with control valve in neutral.	Hydraulic noise.	Control levers stick, hard to operate, do not align.	Hydraulic oil foams.	Frequent failure of hydraulic line or O-rings.
Lift cylinder not locked out.			●		●			●		
Transmission case vent plugged.	●	●	●		●		●			
Hydraulic oil contaminated. Flush, change oil and filter.		●	●	●	●		●	●	●	●
Excessive load.			●	●	●		●			●

DIAGNOSIS

PRELIMINARY HYDRAULIC SYSTEM INSPECTION

Test Conditions:

- Engine off.
- Unit on level surface.

Test/Check Point	Normal	If Not Normal
1. Check hydraulic oil.	Between marks on dipstick. John Deere Low Viscosity HY-GARD Transmission and Hydraulic Oil. Not foamy. Not milky. No metal particles. Not discolored or burned.	Add John Deere Low Viscosity HY-GARD Transmission and Hydraulic Oil. Drain and replace. Check for air leak and use of correct fluid. Check for water in oil. Check for mechanic failure. Check for causes of overheating. Plugged radiator, hydraulic control valve stuck, implement relief malfunction.
2. Oil leaks.	No leakage.	Repair cause.
3. Oil cooler and radiator.	Radiator screen, cooler and radiator free of dirt and debris.	Clean as required.

NOTE: Start engine. Operate all hydraulic functions.

Test/Check Point	Normal	If Not Normal
1. Steering.	Quick and positive steering response. Full right to full left with only slight effort. Steering wheel does not drift when driving in straight line	See the STEERING SYSTEM section for steering system diagnosis.
2. Lift cylinder control lever.	Implement should raise and lower with the ability of "feather" control. Holds implement up for a reasonable time (4 minutes) when in neutral.	See CHARGE PUMP FLOW AND PRESSURE QUICK TEST AT COUPLERS and CONTROL VALVE LEAKAGE TEST. If cylinder rod leaked down 25.4 mm (1 in.) in the 1—2 minute range, check for cylinder leakage first, then proceed with tests.
3. Auxiliary hydraulic control lever.	Adequate pressure and flow out of front couplers. Hold pressure to attachment when in neutral.	See CONTROL VALVE LEAKAGE TEST.
4. Transmission speed.	Positive speed control response, control forward, neutral, and reverse.	See the POWER TRAIN section for transmission and speed control linkage diagnosis.
5. Hydraulic oil filter.	Filter replaced at normal service intervals or replaced to verify filter is not restricted.	Change hydraulic filter.

Test/Check Point	Normal	If Not Normal
6. Hydraulic system checks.	All functions normal. Release Unit Complaint found.	Perform all the steps in HYDRAULIC SYSTEM DIAGNOSIS. Perform tests and adjustments to isolate and repair the malfunction. Complaint not found and unable to duplicate complaint. Factory assistance for a dealer is available through the Dealer Technical Assistance Center (DTAC).

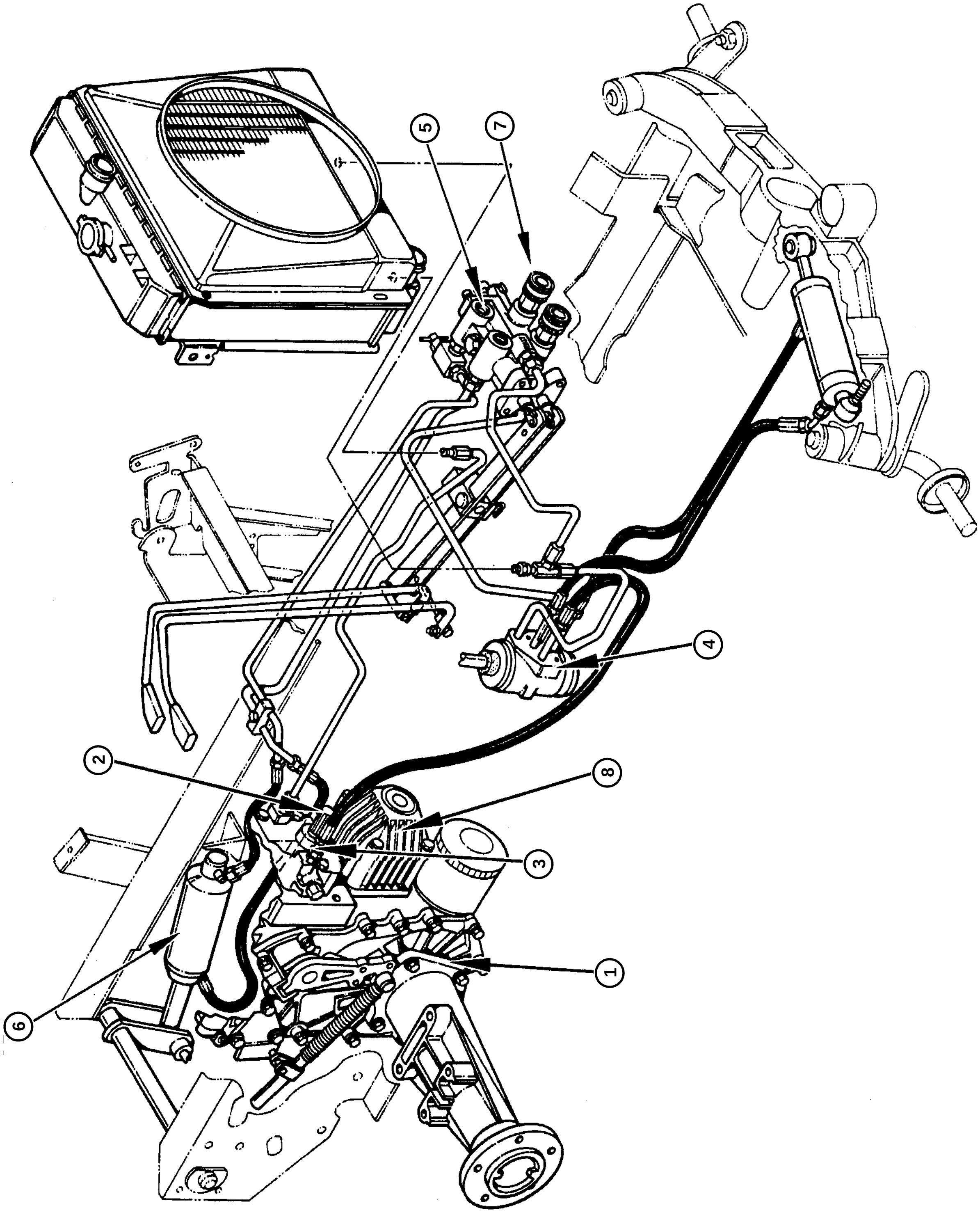
HYDRAULIC SYSTEM

Test Conditions:

- Park brake engaged.
- Engine not running.

Test/Check Point	Normal	If Not Normal
1. Hydraulic/transmission dipstick—oil level check.	Proper level, viscosity, type and condition per the preliminary hydraulic checks.	Drain and replace fluid and filter.
2. Transmission input shaft.	Transmission drive shaft is turning hydrostatic transmission input shaft.	Repair as necessary.
3. Charge pump flow and relief valve test.	Constant, foam free flow from charge pump. Pump flow within specification. Pressure relief valve in specification.	Perform CHARGE PUMP FLOW AND RELIEF VALVE TEST.
4. Steering valve.	Steering is responsive and turns quickly full right and left.	See the STEERING section for steering system diagnosis.
5. Hydraulic control valve (deck lift).	Lifts and holds deck and hitch in the raised position. Control lever returns to neutral.	Perform CONTROL VALVE LEAKAGE TEST. Check linkage for binding. Repair or replace control valve.
6. Hydraulic cylinders.	Lifts and hold implement in a raised position. No leakage at rod seal or connectors.	Perform LIFT CYLINDER LEAKAGE TEST. Replace cylinder.
7. Auxiliary couplers.	Relief pressure within specification. Hydraulic flow within specification. Spool leakage within specification.	Perform IMPLEMENT RELIEF VALVE PRESSURE QUICK TEST. Perform CHARGE PUMP FLOW AND PRESSURE QUICK TEST AT COUPLERS. Perform CONTROL VALVE LEAKAGE TEST and FLOAT TEST.
8. Hydrostatic transmission	Operates in forward and reverse. Returns to neutral and does not creep.	See the POWER TRAIN section for hydrostatic system diagnosis.

HYDRAULIC SYSTEM TEST POINTS



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TESTS AND ADJUSTMENTS

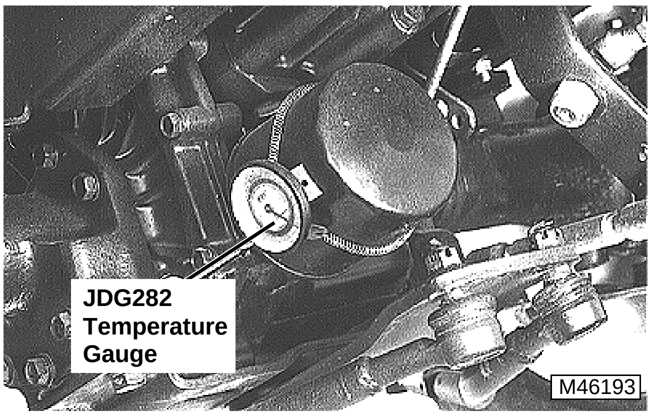
HYDRAULIC OIL WARM-UP PROCEDURE

Reason:

When making hydraulic tests the oil must be heated to normal operating temperature for the tests to be accurate.

Test Equipment:

- JDG282 Temperature Gauge



Procedure:

1. Install JDG282 Temperature Gauge on transmission oil filter.

IMPORTANT: DO NOT overheat engine.

2. Apply park brake. Start engine and run at full throttle.
3. Move and hold hydraulic lever in implement raise position.
4. Periodically cycle all hydraulic functions to distribute heated oil.
5. Heat oil to temperature specified in test.

IMPLEMENT RELIEF VALVE PRESSURE QUICK TEST

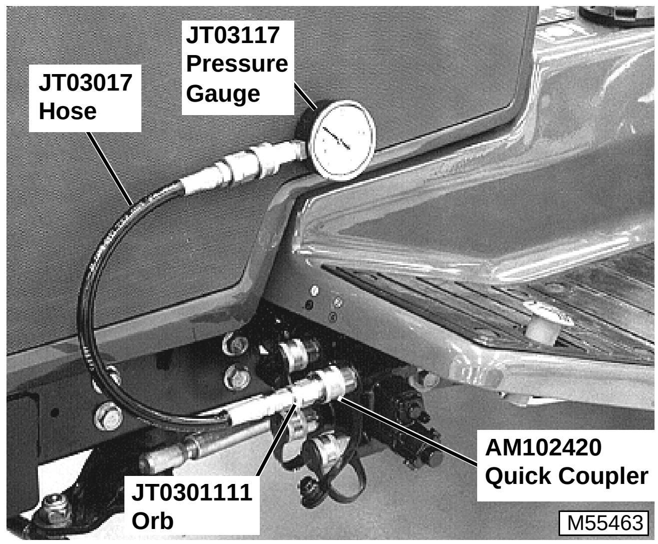
Reason:

To determine relief valve setting and help determine condition of hydraulic pump.

Test Equipment:

- AM102420 Quick Coupler
- JT031111 9/16-18 M x 7/16-20 M 37° Orb
- JT03017 Hose
- JT03117–13790 kPa (2000 psi) Pressure Gauge

Procedure:



1. Install pressure gauge into couplers as shown.
2. Start and run engine at wide open throttle.
3. Move the corresponding hydraulic control lever to the raise or lower position.
4. Observe pressure gauge reading.

Results:

- If pressure is above **6371—7350 kPa (924—1066 psi)**, pump and valve are in good condition.
- If there is no pressure, repeat test using different coupler. If pressure exists, replace coupler and repeat test.
- If pressure is below **6371—7350 kPa (924—1066 psi)**, check:
  —Implement relief valve spring. Add shim. If pressure cannot be increased, check charge pump for damage.

  —Replace charge pump.

  —If pump seems in good condition, check for damaged implement relief valve, stuck closed charge pressure control valve, or scored lube reduction valve.

CHARGE PUMP FLOW AND PRESSURE QUICK TEST AT COUPLERS

Reason:

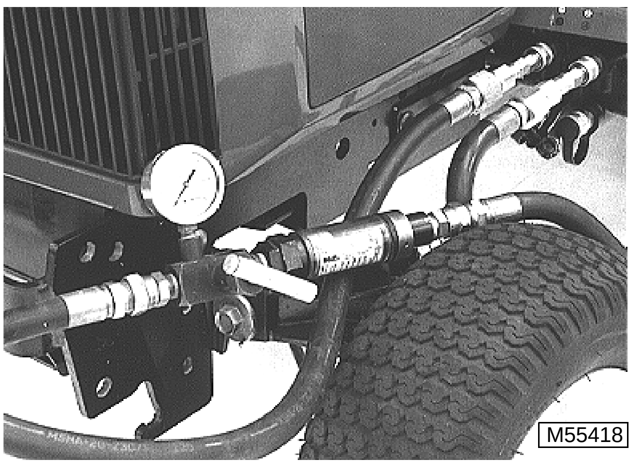
To check condition of the charge pump and the charge implement relief valve setting.

NOTE: This test can be misleading if there is a malfunction of the steering valve, hydraulic control valve or lift cylinder.

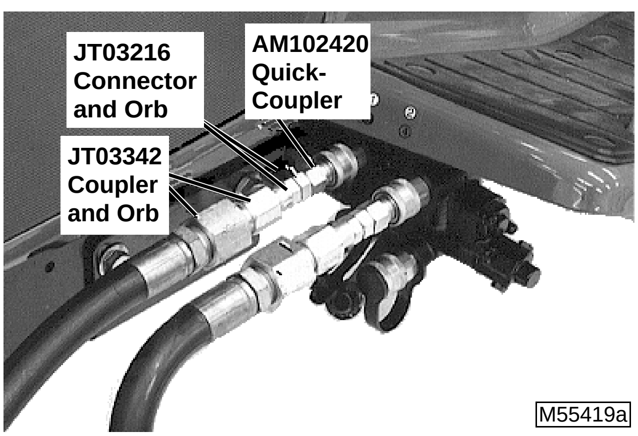
Test Equipment:

- JT01765 Consumer Products Hydraulic Fitting Kit
- JT05469 Flowmeter Kit
- AM102420 1/4 Male Quick-Coupler
- JT03216 Connector and 9/16–18 M 37° x 9/16–18 M Orb
- JT03342 Coupler and 3/4" F NPT x 9/16–18 F 37° Orb

Procedure:



1. If machine is not equipped with quick-couplers, install couplers.



2. Connect flowmeter to work ports using fitting shown.

Flow Test Procedure:

1. Open flowmeter control valve.
2. Start engine and run at wide open throttle. Oil must be at normal operating temperature.
3. Move cylinder lift control lever to get oil flow through meter in correct direction.
4. Observe flowmeter reading.

Results:

- If pump flow is above **13.2 L/m (3.5 gpm)**, pump is in good condition.
- If there is no pump flow, check:
  —Drive shaft not turning input shaft
  —Sheared charge pump drive key
  —Charge pressure control valve stuck closed
  —Lube reduction valve modulation orifice plugged
- If pump flow is below **17.0 L/m (4.5 gpm)**, foamy or erratic, check:
  —Hydraulic oil level
  —Replace filter and repeat test
  —Transaxle vent for plugging
  —Filter seal for leaks
  —O-ring at inlet of charge pump leaking
  —Leak in case passage between filter and charge pump
- If pump flow is still below **17.0 L/m (4.5 gpm)**, check:
  —Implement relief valve for damage or debris that could be holding valve open.
  —Charge pressure control valve for scoring or debris that could be holding valve closed.
  —Charge pump for damage. If problem cannot be found, perform flow and pressure test at charge pump to eliminate the possibility of the steering valve or hydraulic control valve malfunctioning, giving false test results. (See the HYDROSTATIC POWER TRAIN section.)

Pressure Test Procedure:

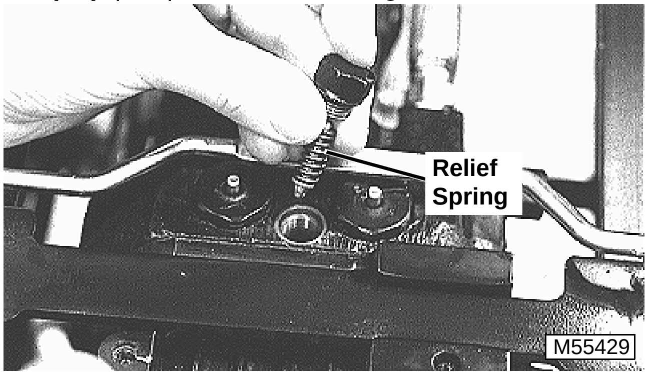
1. Flowmeter is still connected as in Flow Test Procedure.
2. Start engine and run at wide open throttle.

> **CAUTION**
>
> **Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids. If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable source. Such information is available from the Deere & Company Medical Department in Moline, Illinois, U.S.A.**

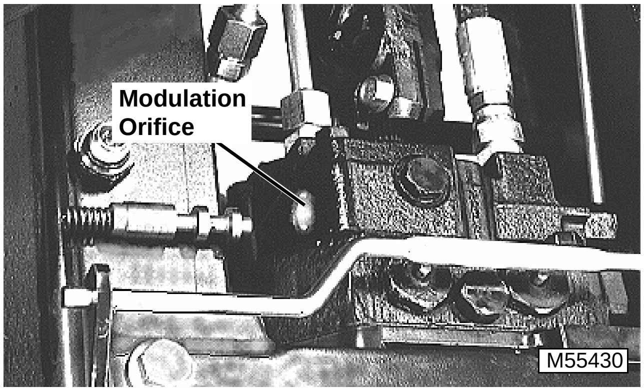
3. Close flowmeter valve. Observe pressure reading.

Results:

- If pressure is within **6371—7350 kPa (924—1066 psi)**, pump and valve are in good condition.



- If pressure is below **6371—7350 kPa (924—1066 psi)**, check implement relief spring. Add shim. If pressure cannot be increased, check charge pump for damage.



- If pump seems in good condition, check condition of lube reduction valve modulation orifice for plugging.
- Check hydrostatic pump for excessive leakage.

LIFT CYLINDER LEAKAGE TEST

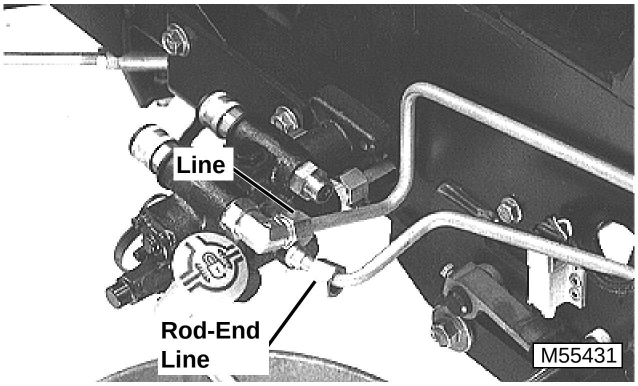
Reason:

To determine if lift cylinder is leaking.

> **CAUTION**
>
> **Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids. If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable source. Such information is available from the Deere & Company Medical Department in Moline, Illinois, U.S.A.**

First Procedure:

1. Remove any attachment that is attached rear hitch.
2. With deck lift arms in raised position, shut off engine.



3. Disconnect lift cylinder rod-end line from control valve.

IMPORTANT: Hold control lever in the raised position before starting engine. If lever is not held back, full pump output will flow out "OUT" port of control valve. Also be ready to shut off engine. If valve leaks, oil will flow out "OUT" port.

4. Move hydraulic control valve lever to "lift" position.
5. Start engine. Operate at slow idle.
6. Observe cylinder rod-end line for continuous oil leakage.

Results:

- If no leakage, repeat test with cylinder and control valve in the lower position.
- If hydraulic oil continually leaks out of fitting, replace lift cylinder.

Second Procedure:

1. Shut off engine and connect line.
2. Start engine and lower (retract) cylinder.
3. Shut off engine. Remove line.
4. Hold control lever in the lower position.
5. Start engine and observe flow from line.

Results:

- No leakage, cylinder is good.
- Leakage, replace cylinder.

CONTROL VALVE LEAKAGE TEST

Reason:

To determine the condition of spool valves and housing.

Test Equipment:

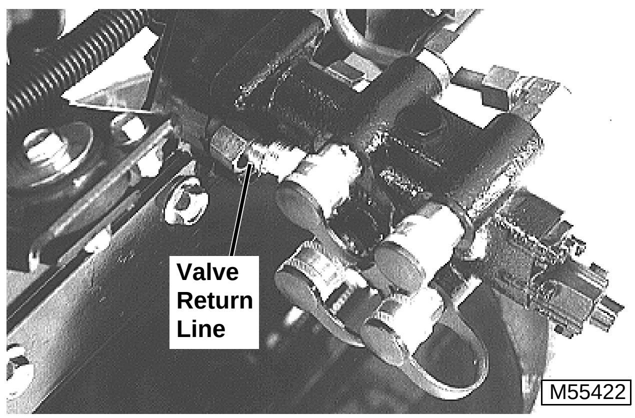
- Small container or drain pan.

Procedure:

1. Heat hydraulic oil to specifications. (See HYDRAULIC OIL WARM-UP PROCEDURE.)
2. Move lift cylinder to raise position.
3. Shut off engine.

CAUTION

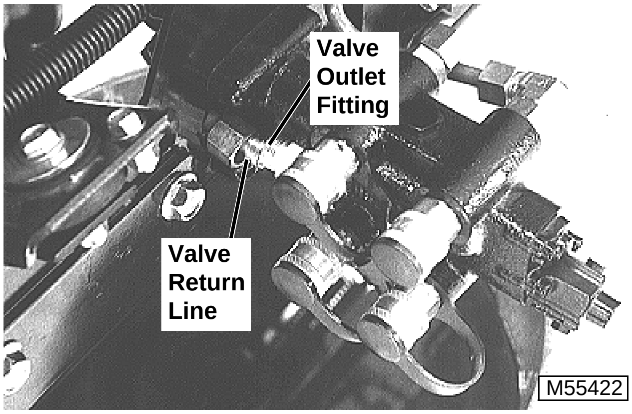
Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids. If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable source. Such information is available from the Deere & Company Medical Department in Moline, Illinois, U.S.A.



4. Disconnect control valve return line.

IMPORTANT: To avoid putting full pump flow into container, DO NOT return control valve lever to "neutral" position with engine running.

5. Move and hold control lever to the raise position.
6. Start engine and run at slow idle.



7. Observe oil flow from valve outlet fitting.
8. Shut off engine. Connect control valve return line.
9. Start engine and retract lift cylinder.
10. Shut off engine. Disconnect control valve return line.
11. Move and hold control valve to the lower position. Start engine and observe oil flow.
12. Repeat test for auxiliary valve. Because this valve is not always used, it is functional and could cause problems with the hydraulic system and not necessarily a complaint by the customer.

Results:

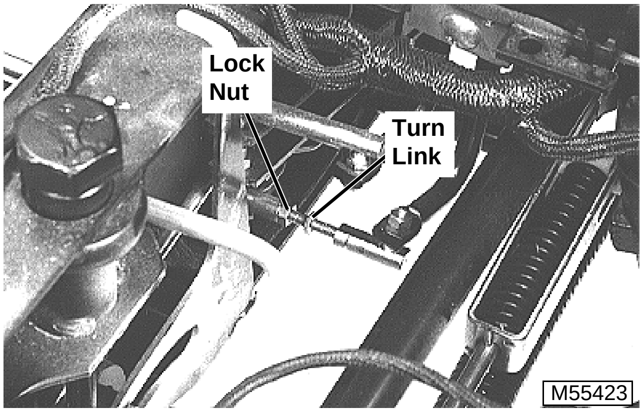
- If leakage is more than one drip out of control valve, replace control valve.

CONTROL VALVE LINKAGE ADJUSTMENT

Reason:

To position control levers underneath each other for appearance.

Procedure:



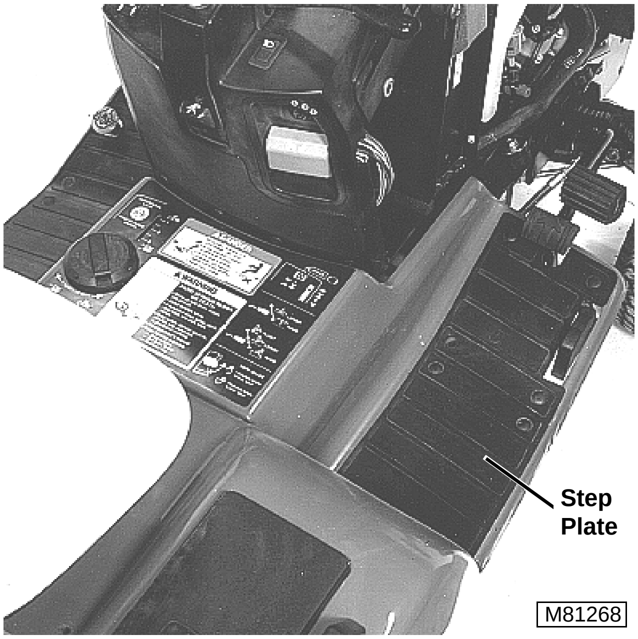
1. Loosen lock nut and turn link to align control levers. Tighten lock nut.

NOTE: If there are insufficient threads to make adjustment, check for bent linkage.

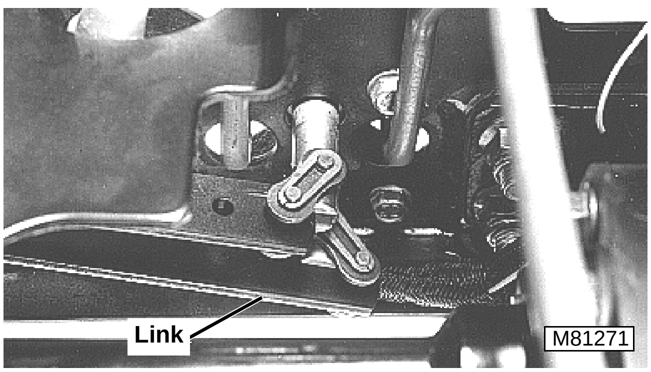
REPAIR

HYDRAULIC CONTROL VALVE—REMOVAL/INSTALLATION

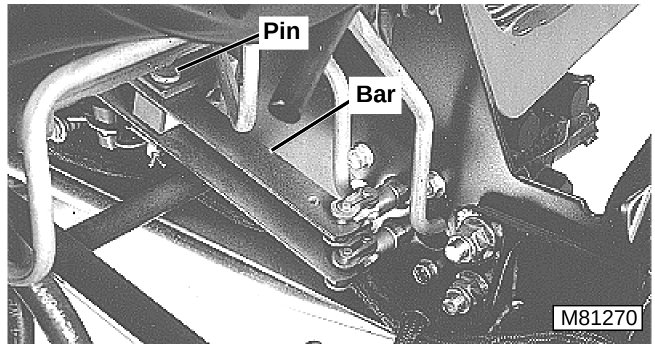
1. Remove radiator. (See RADIATOR—REMOVAL/INSTALLATION in MISCELLANEOUS section.)



2. Remove step plate.

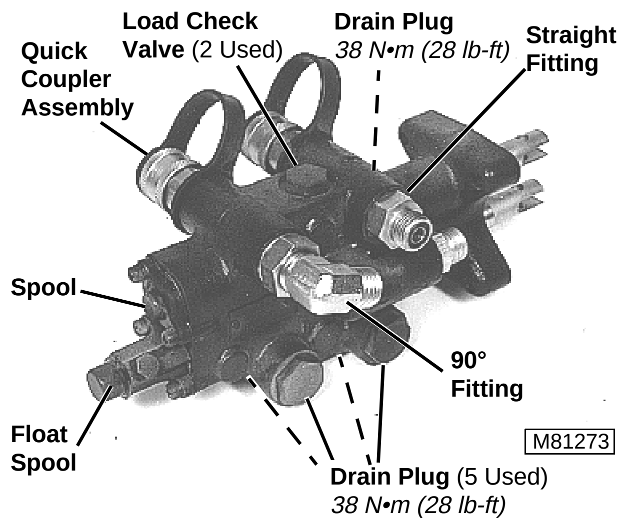


NOTE: *Turn spool 90° to remove/install link.*



3. When connecting bar, install link and pin in holes closest to the engine.
4. Make repairs to valve as necessary. (See HYDRAULIC CONTROL VALVE—DISASSEMBLY/INSPECTION AND ASSEMBLY.)

HYDRAULIC CONTROL VALVE—DISASSEMBLY/INSPECTION AND ASSEMBLY



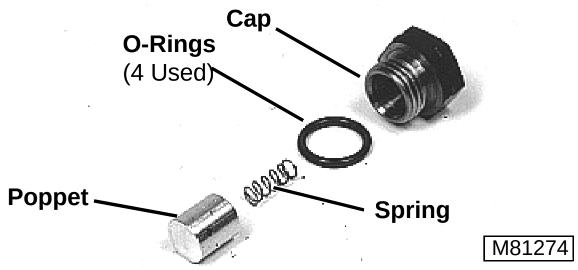
IMPORTANT: Always use new O-rings. Damaged or used O-rings will leak.

1. Remove quick-coupler assembly, which includes a cap and O-rings (4 used).
2. Remove load check valves and O-rings (2 used).
3. Remove straight fittings with O-rings (3 used).
4. Remove 90° fitting with O-ring.
5. Remove drain plugs with O-rings (5 used).
6. Remove up/down float spool assembly.
7. Remove up/down spool assembly.

Installation is done in the reverse order of removal.

- Tighten fittings.
- Tighten drain plugs to **38 N•m (28 lb-ft)**.

LOAD CHECK VALVE:



1. Disassemble quick coupler assembly, which includes a cap and O-rings (4 used), spring, and check valve poppet.

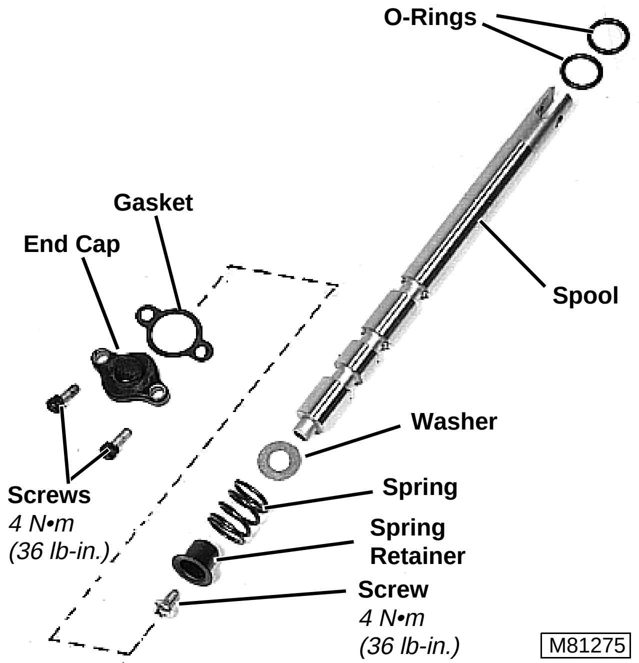
Installation is done in the reverse order of removal.

- Tighten cap to **24 N•m (18 lb-ft)**.

NOTE: The quick-coupler assembly is serviced as a separate assembly and is replaced as a kit only.

UP/DOWN SPOOL ASSEMBLY:

IMPORTANT: Always use new O-rings. Damaged or used O-rings will leak.



1. Disassemble up/down float spool assembly.

NOTE: O-rings are located in spool bore at each end of control valve. The gasket and O-rings are serviced as a separate assembly and replaced as a kit only. The remaining parts, except the spool and washers, are serviced as a separate assembly and are replaced as kits only.

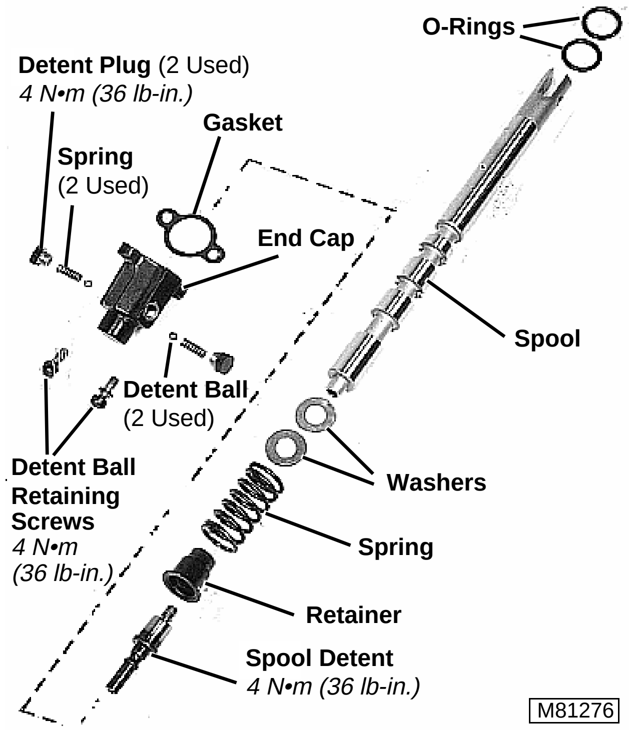
Installation is done in the reverse order of removal.

- Tighten screws to **4 N•m (36 in.-ft)**.

UP/DOWN FLOAT SPOOL ASSEMBLY:

IMPORTANT: Spool and housing are matched and must be replaced as a unit. Make sure spool is installed in original bore to ensure proper operation. Always use new O-rings. Damaged or used O-rings will leak.

2. Apply thread lock and sealer (medium strength) to threads of screws.
3. Apply multi-purpose grease to spring after installed on spool.



NOTE: O-rings are located in spool bore at each end of control valve. The gasket and O-rings are serviced as a separate assembly and replaced as a kit only. The remaining parts, except the spool and washers, are serviced as a separate assembly and are replaced as kits only.

IMPORTANT: Spool and housing are matched and must be replaced as a unit. Make sure spool is installed in original bore to ensure proper operation. Always use new O-rings. Damaged or used O-rings will leak.

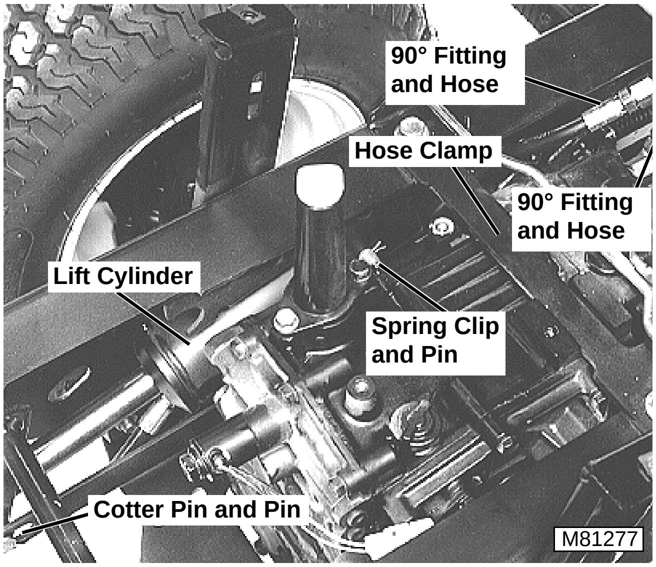
4. Apply thread lock and sealer (medium strength) to threads of screws, detent plugs, and detent.
5. Apply multi-purpose grease to springs and balls.

Installation is done in the reverse order of removal.

- Tighten spool detent, detent ball retaining screws and detent plugs to **4 N•m (36 lb-in.)**.

LIFT CYLINDER—REMOVAL/ INSTALLATION

1. Remove fuel tank. (See FUEL TANK—REMOVAL/ INSTALLATION in MISCELLANEOUS section.)



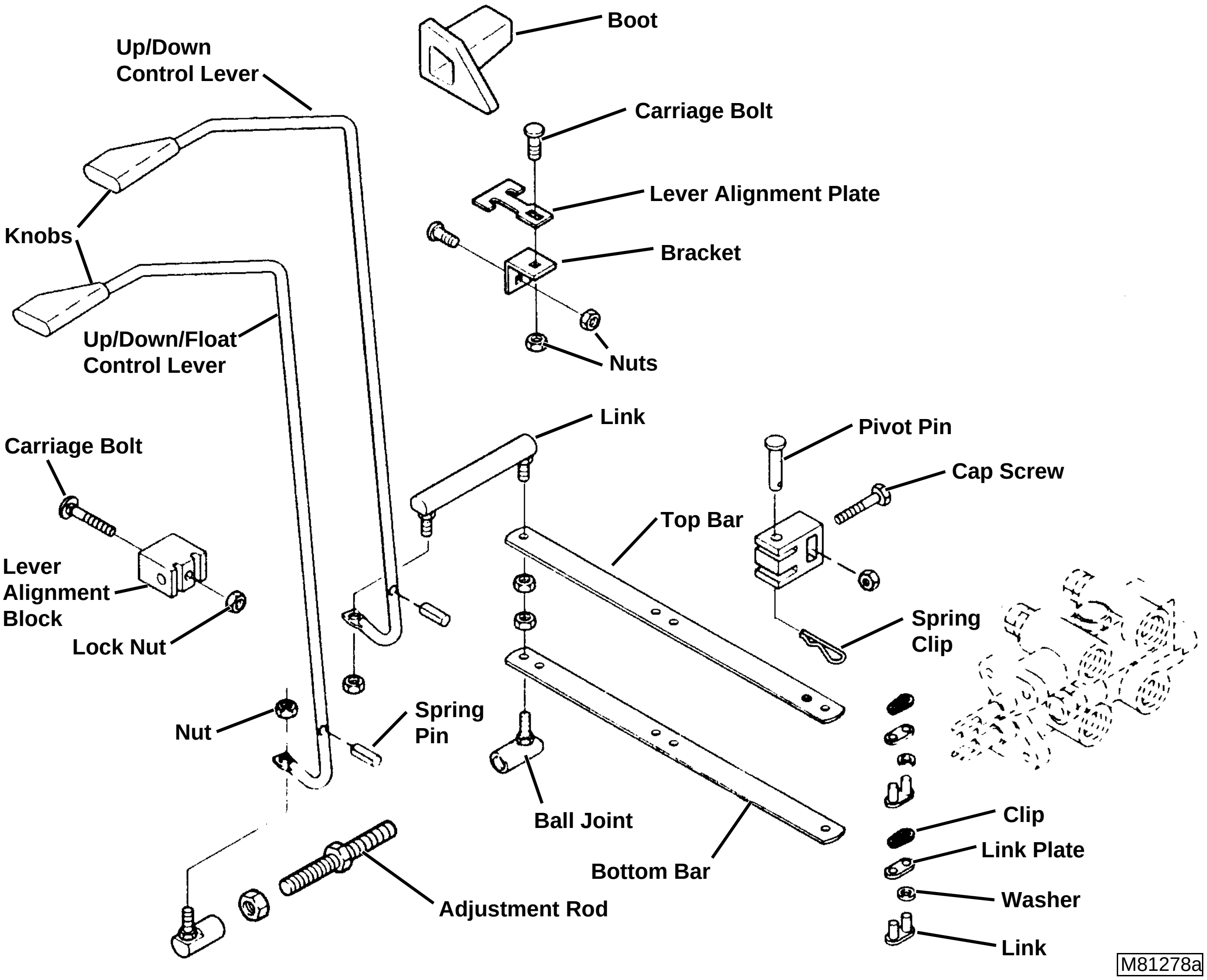
NOTE: Cylinder is removed with hoses attached. Lift cylinder is not serviceable.

2. Remove cotter pin and pin.
3. Remove lift cylinder.
4. Remove spring clip and pin.
5. Remove hose clamp.
6. Remove lift cylinder head end-to-end control valve 90° fitting and hose.
7. Remove lift cylinder rod end-to-end control valve straight fitting and hose.

Installation is done in the reverse order of removal.

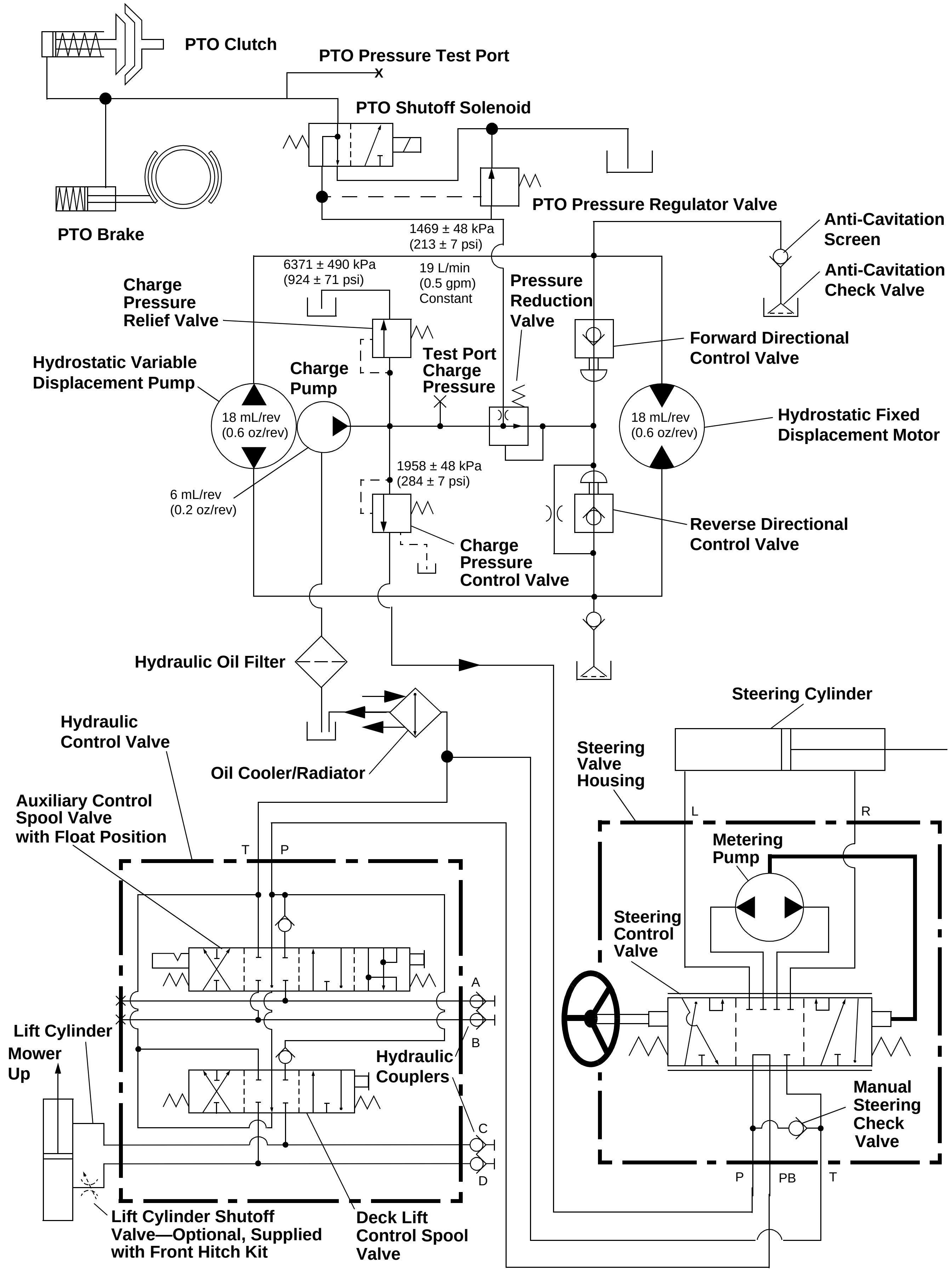
- Tighten fittings.

HYDRAULIC CONTROL LEVERS AND LINKAGE—INSPECTION



1. Remove dash panels to access controls levers.
2. Inspect linkage for bent or damage parts.
3. Repair or replace.

HYDRAULIC SCHEMATIC—POWER TRAIN



CONTENTS

MISCELLANEOUS

Page

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SPECIFICATIONS

REPAIR SPECIFICATIONS

Spark Plug Torque. . . . . 20 N•m (177 lb-in.)
Muffler Mounting Nuts Torque . . . . 15 N•m (130 lb-in.)
Deflection . . . . 12—19 mm (0.48—0.75 in.)
Hydraulic Line Fittings Torque . . . . 24 N•m (18 lb-ft)

OTHER MATERIALS

Number	Name	Use
LOCTITE® PRODUCTS Loctite#/U.S. #/Canadian TY9370/TY9477/#242	Thread Lock & Sealer (Medium Strength)	To seal threads on control valve screws, spool detent and small plugs.

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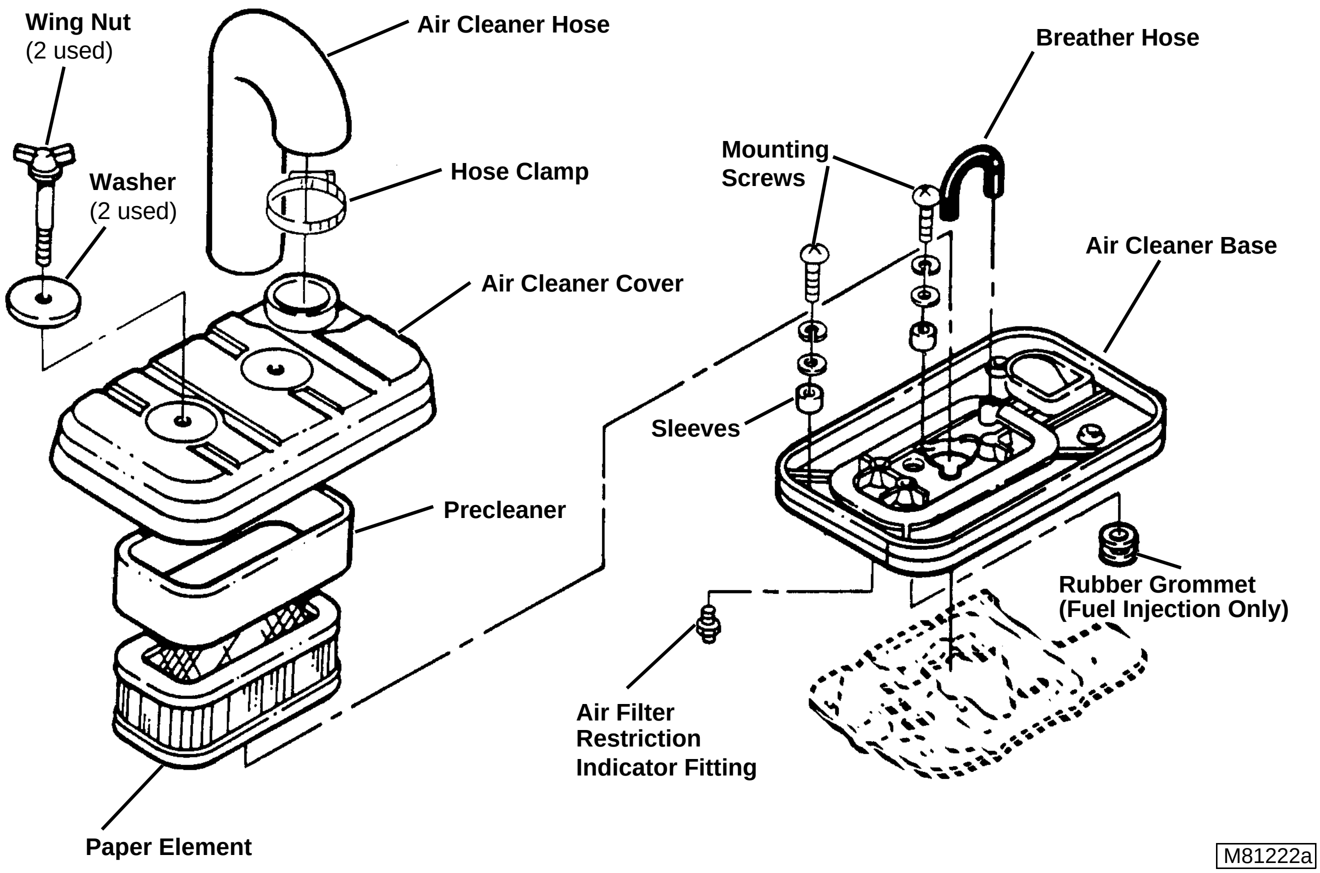
REPAIR

AIR CLEANER (FD620)—REMOVAL/INSPECTION/INSTALLATION



NOTE: On carbureted engines, a fitting is used in place of rubber grommet.

1. Inspect precleaner and paper element for dirt and dust.
2. Clean precleaner if necessary:
3. Wash in warm, soapy water.
4. Rinse in clean water.
5. Squeeze to remove water.
6. Let air dry.
7. Apply 30 mL (1 oz) of clean engine oil to precleaner. Squeeze to distribute oil evenly and to remove excess oil.

IMPORTANT: DO NOT wash paper element. Clean or replace paper element as necessary.

8. Tap element gently to remove dust.
9. Replace element if oily, dirty or damaged.

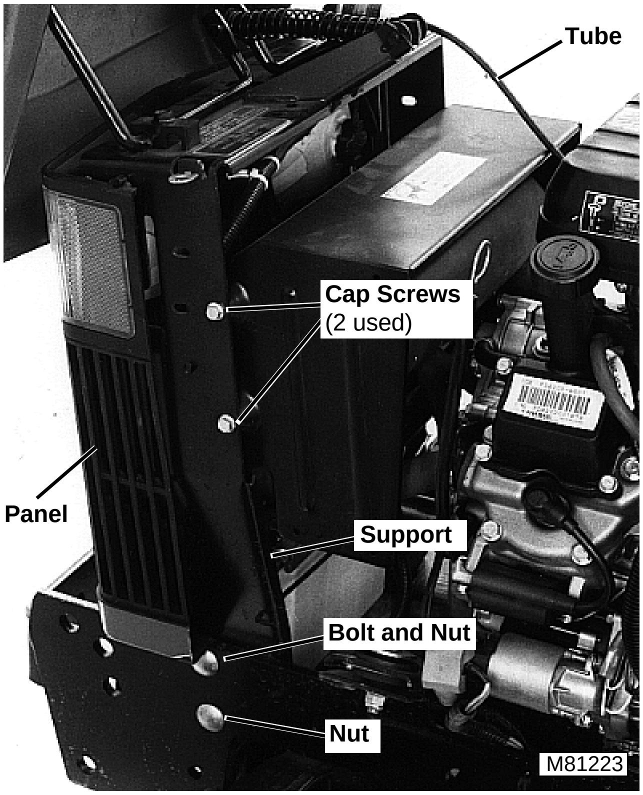
IMPORTANT: When installing base make sure breather hose extension (on bottom of base) is fully inserted into crankcase breather hose.

10. Apply Thread Lock and Sealer (Medium Strength) on mounting screws before installation.
11. When installing breather hose, turn hose so end is pointing directly into carburetor/throttle body.

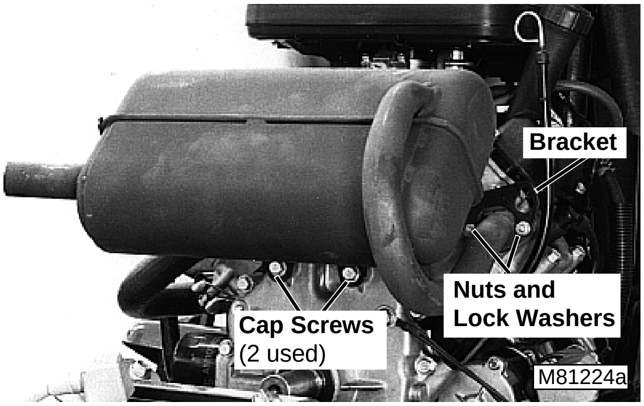
M

MUFFLER (FD620D)—REMOVAL/ INSTALLATION

> ⚠ **CAUTION**
>
> **Muffler and shield may be hot. Allow muffler and shield to cool before removing.**



1. Disconnect tube.
2. Remove cap screws from each side.
3. Remove front grille panel.
4. Remove carriage bolt and nut.
5. Loosen nut and tilt front support away from engine.



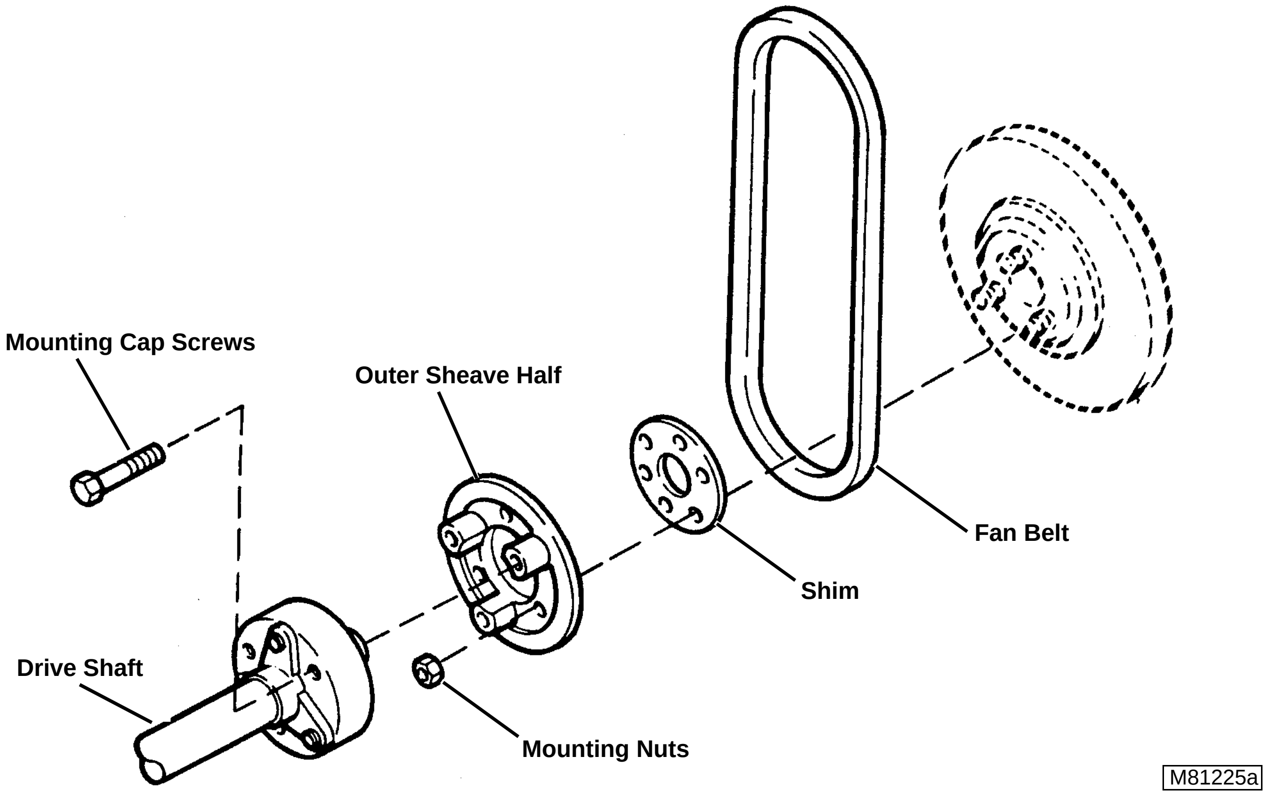
NOTE: Heat shield is removed to show detail.

6. Engine lift bracket is on left side only.
7. Remove nuts and lock washers, bracket and cap screws.
8. Remove muffler with heat shield and gaskets.
9. Bracket is installed between nuts and lock washers and muffler.
10. Install all parts and tighten all hardware.

FAN BELT (FD620D)—REMOVAL/ INSTALLATION

NOTE: Remove spark plugs to allow for easy flywheel rotation during outer sheave half installation.

1. Remove spark plugs.



NOTE: Rotate outer sheave half as nuts are tightened to allow belt to center in sheave halves.

2. Check and adjust fan belt tension. (See FAN/ ALTERNATOR BELT REMOVAL/INSTALLATION.)
3. Install and tighten spark plugs to **20 N•m (177 lb-in.).**
4. Install and tighten mounting nuts **15 N•m (130 lb-in.)**.

M

Specifications:

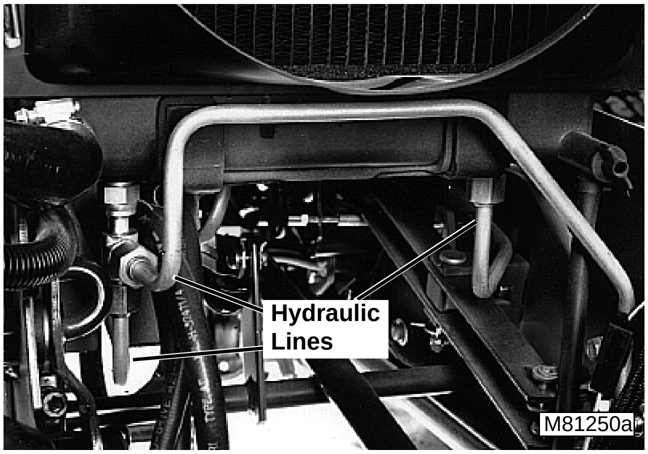
Deflection . . . . .12—19 mm (0.48—0.75 in.)

RADIATOR—REMOVAL/INSPECTION

IMPORTANT: Cooling fins break loose and plug cooler passages. These plugged passages cause oil pressure to increase. This pressure may burst the cooler, releasing oil into the anti-freeze coolant. The hydraulic oil is forced into the radiator and eventually out the coolant reservoir.

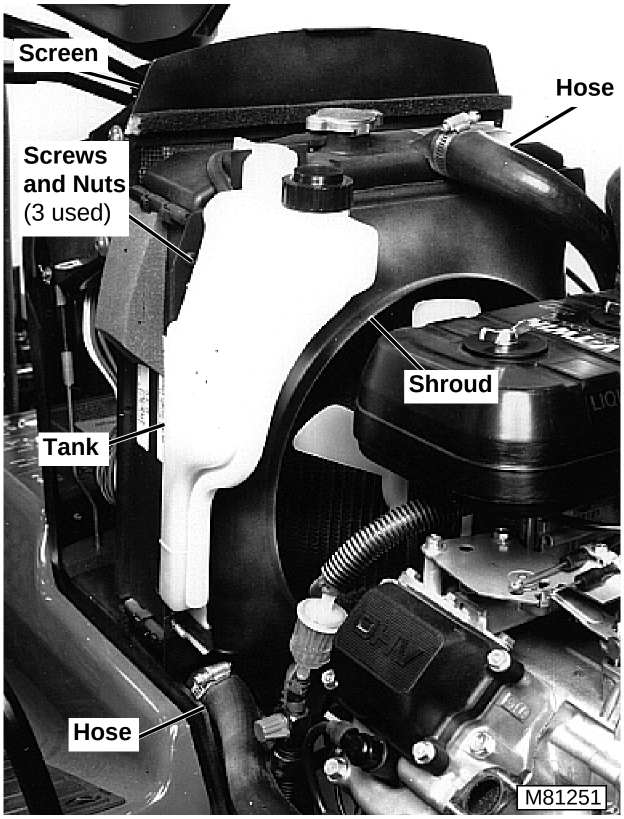
NOTE: Cooling system capacity is approximately 2.8 L (3.0 qt).

1. Drain coolant.

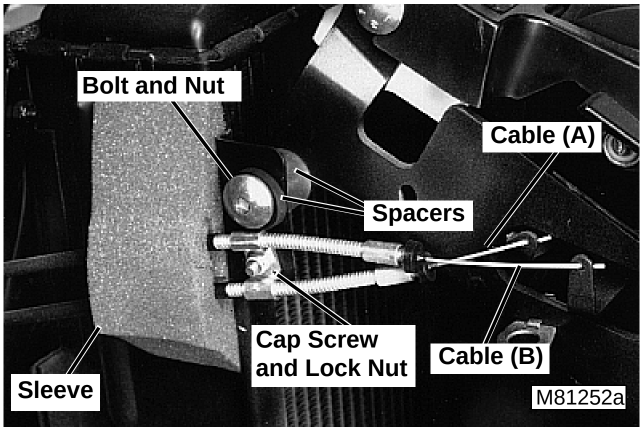


NOTE: Engine is removed to show detail.

2. Disconnect hydraulic lines to drain oil from transmission oil cooler.



3. Remove hoses.
4. Remove screen.
5. Remove recovery tank.
6. Remove screws and nuts. Put fan shroud over engine fan.



NOTE: Choke control cable (B) is equipped on 425 tractor only.

7. Remove cap screw and lock nut.
8. Disconnect cable(s) (A and B). Remove cables from foam sleeve.
9. Remove bolt and nut and spacers from each side of radiator. Remove radiator.

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⚠ CAUTION

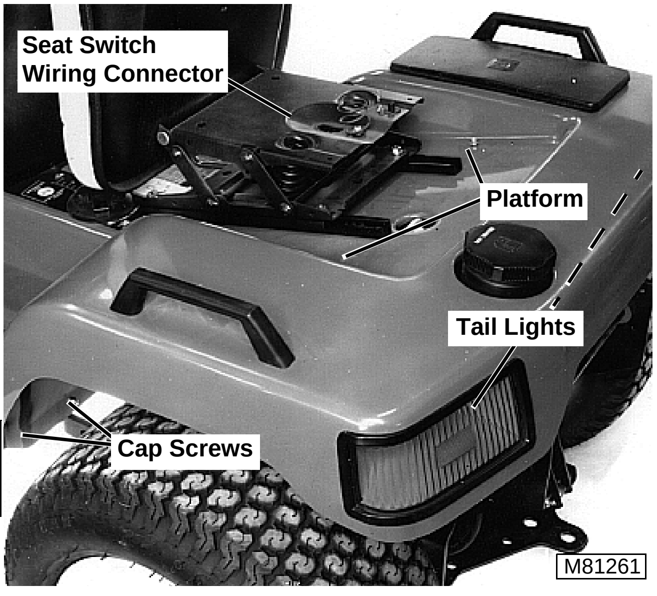
Reduce compressed air to less than 210 kPa (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

10. Check radiator for debris lodged in fins. Clean radiator using compressed air or pressure washer.
11. Inspect radiator for bent fins, cracks and damaged seams. Repair as necessary.

Installation is done in the reverse order of removal.

- Connect hydraulic lines. Tighten fittings to **24 N•m (18 lb-ft)**.
- Close drain valve and fill radiator with proper coolant to top of filler neck.
- Start engine and allow it to reach proper operating temperature. Check radiator, hoses and connections for leaks. Adjust coolant level in recovery tank.
- Check transaxle oil level. Fill transaxle with proper oil, as necessary.

FUEL TANK—REMOVAL/ INSTALLATION

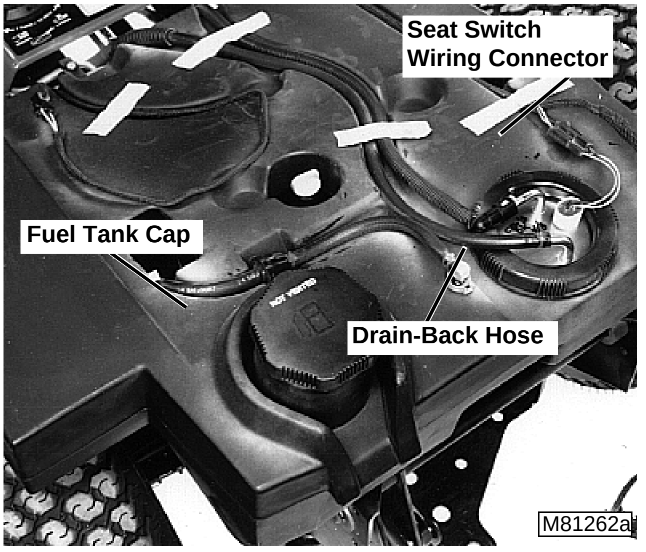


1. After disconnecting seat switch wiring connector, insert connector through hole in platform, to avoid possible damage to wiring harness or connector when removing platform.
2. Disconnect tail lights.
3. Remove cap screws and platform.

⚠ CAUTION

445 tractor: Release of fluids from pressurized fuel system can cause serious injuries. Relieve fuel system pressure before servicing.

4. Partially open fuel tank cap to relieve pressure in fuel tank. Tighten cap.



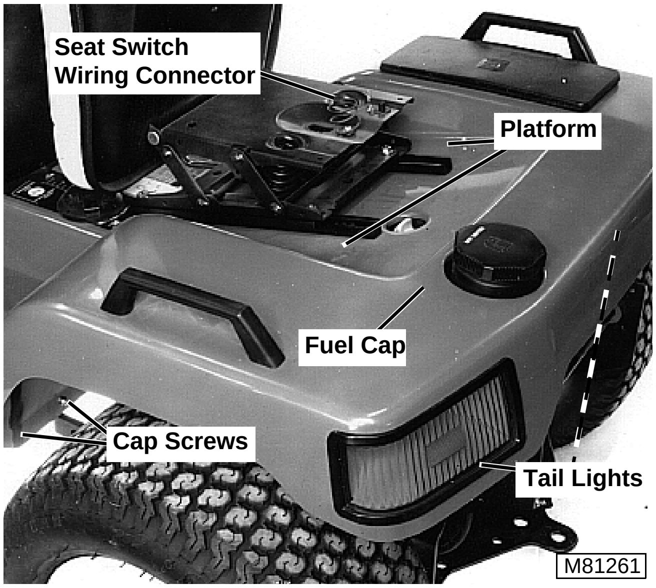
NOTE: *Drain-back hose is equipped on 445 and 455 tractors only.*

NOTE: *Late model tractors (domestic only) have a vented fuel cap instead of vent hoses with fuel tank relief/check valve. Additionally, these tractors have a fuel shut-off solenoid instead of the carburetor vent solenoid.*

IMPORTANT: 425, 445, 455: If fuel runs back out the fill hose/tube—shorten fill hose (PT18801) 22.2 mm (7/8 in.) on the end connecting to the fuel fill neck on the rear cab panel. This will level out the fuel fill hose and eliminate the "up hill" orientation of the hose. All cab enclosures beginning with and including S.N. TY00400A015150 should have this done.

5. Remove fuel tank.

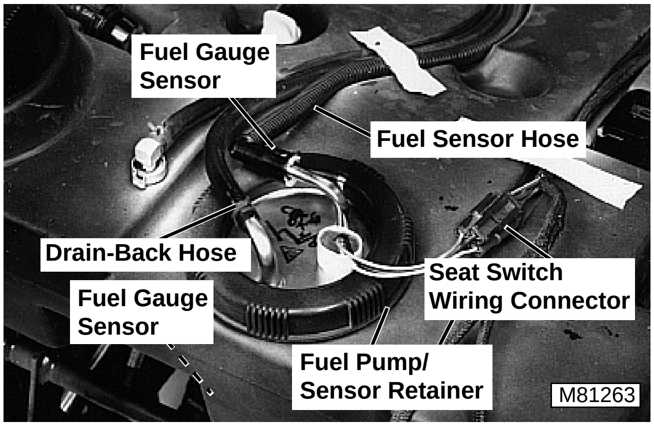
FUEL PUMP/FUEL GAUGE SENSOR—REMOVAL/ INSTALLATION



1. After disconnecting seat switch wiring connector, insert connector through hole in platform, to avoid possible damage to wiring harness or connector when removing platform.
2. Disconnect tail lights.
3. Remove cap screws and platform.

> ⚠ **CAUTION**
>
> **445 tractor: Release of fluids from pressurized fuel system can cause serious injuries. Relieve fuel system pressure before servicing. Partially open fuel tank cap to relieve pressure in fuel tank.**

4. Tighten fuel tank cap.



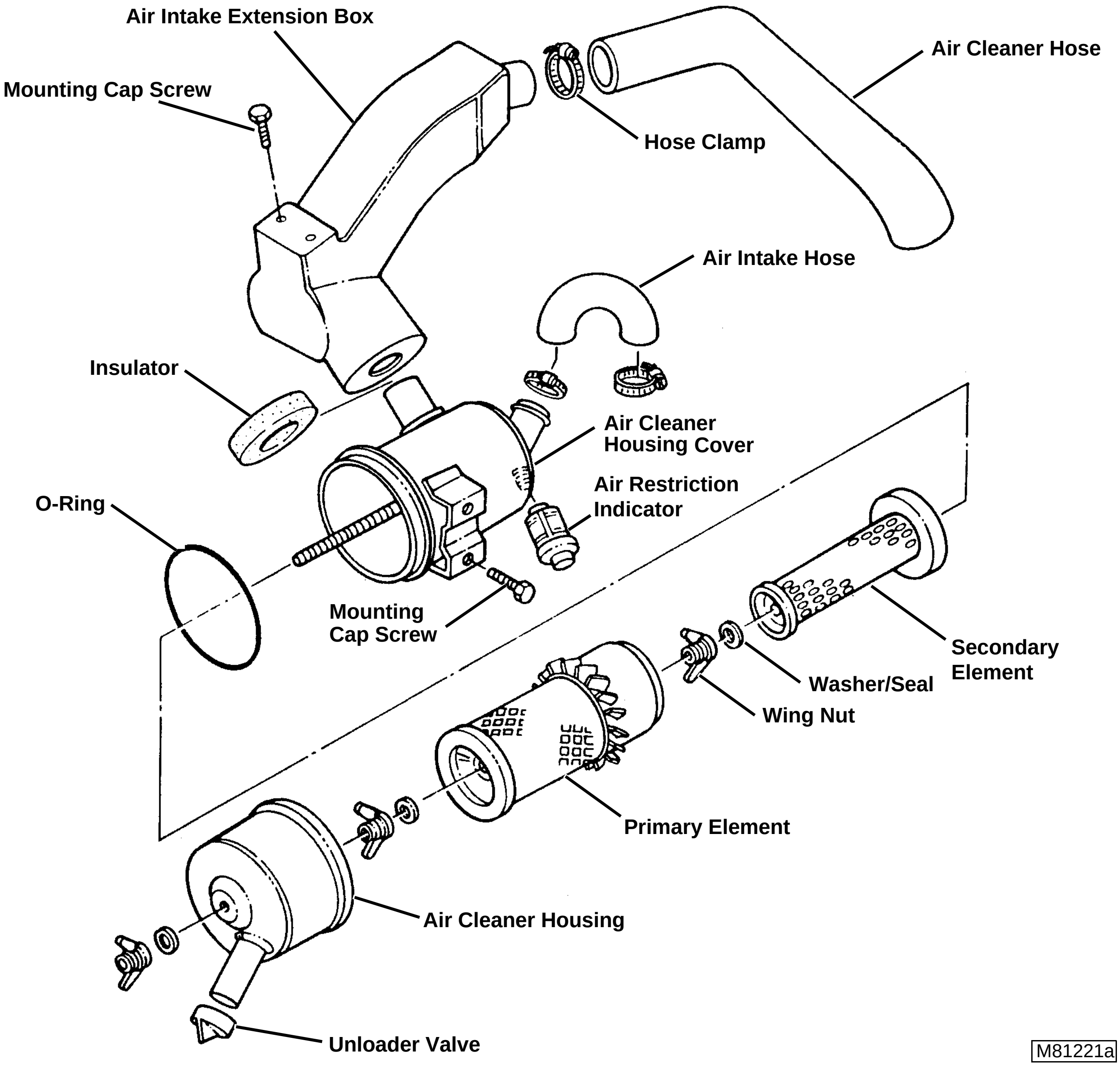
NOTE: Drain-back hose is equipped on 445 and 455 tractors only.

5. Disconnect seat switch wiring connector.
6. Remove drain-back hose.
7. Remove fuel sensor hose and fuel gauge sensor.
8. Remove fuel pump/sensor retainer.
9. Remove fuel pump assembly.
10. Inspect parts for wear or damage. Replace if necessary.

Installation is done in the reverse order of removal.

M

AIR CLEANER (455)—DISASSEMBLY/INSPECTION/ASSEMBLY



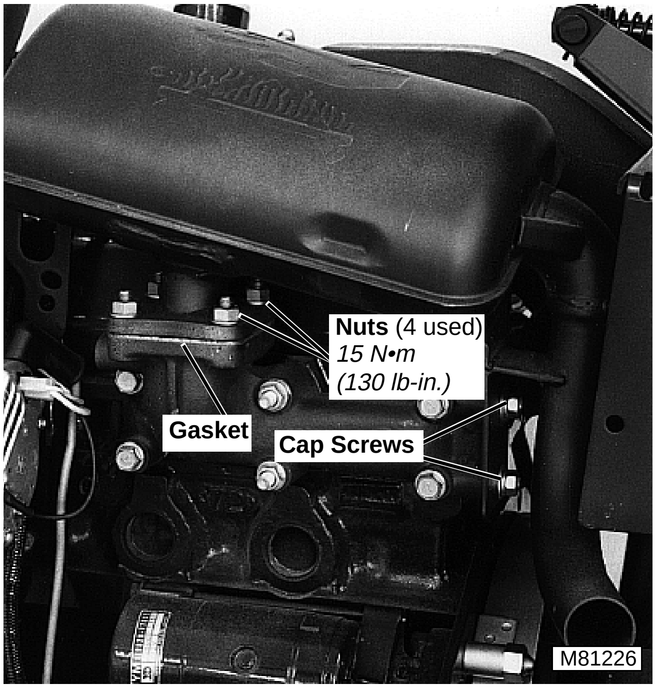
1. Replace primary element when air restriction indicator reaches red line.
2. Replace secondary element when air restriction indicator shows 330 mm (13 in.) or more vacuum and primary element has already been replaced.

M

MUFFLER (455)—REMOVAL/ INSTALLATION

CAUTION

Muffler may be hot. Allow muffler to cool before removing.



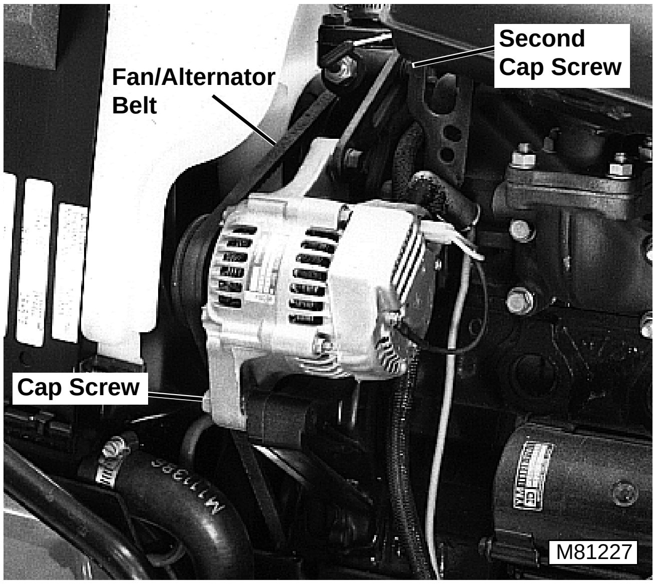
1. Remove mounting nuts.
2. Remove cap screws.
3. Replace gasket.

Installation is done in the reverse order of removal.

- Tighten cap screws.
- Tighten mounting nuts to **15 N•m (130 lb-in.)**.

FAN/ALTERNATOR BELT (455)—REMOVAL/INSTALLATION

1. Disconnect drive shaft. (See DRIVE SHAFT—REMOVAL/INSTALLATION in HYDROSTATIC POWER TRAIN section.)



2. Loosen cap screw.
3. Remove second cap screw.
4. Remove fan/alternator belt.

Installation is done in the reverse order of removal.

- Adjust belt tension.
- Tighten cap screws.

Specifications:

Deflection . . . . 12—19 mm (0.472—0.748 in.)

M

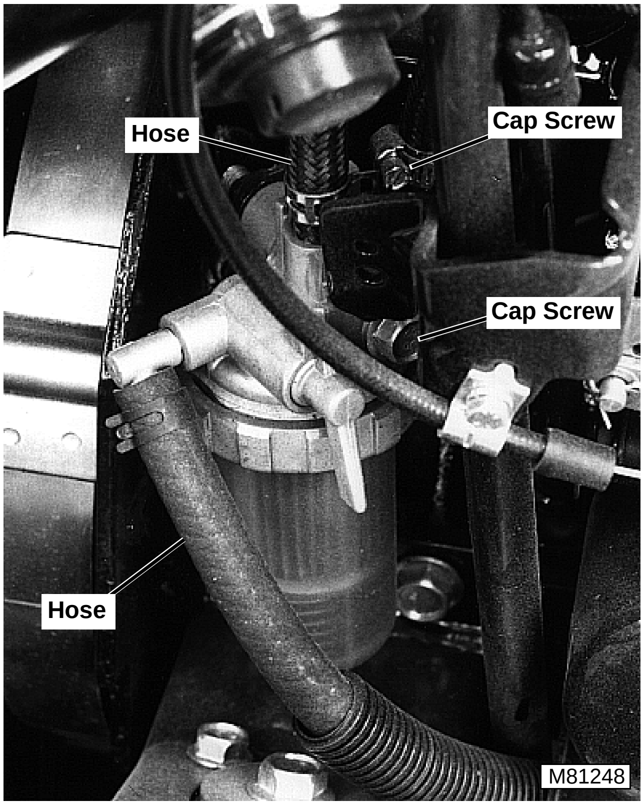
FUEL FILTER (455)—REMOVAL/ INSTALLATION

CAUTION

Release of fluids from pressurized fuel system can cause serious injuries. Relieve fuel system pressure and be sure engine is cool before servicing.

CAUTION

Gasoline is extremely flammable. Do not smoke. Always work in a ventilated area away from open flame or spark producing equipment, this includes equipment that utilizes pilot lights.

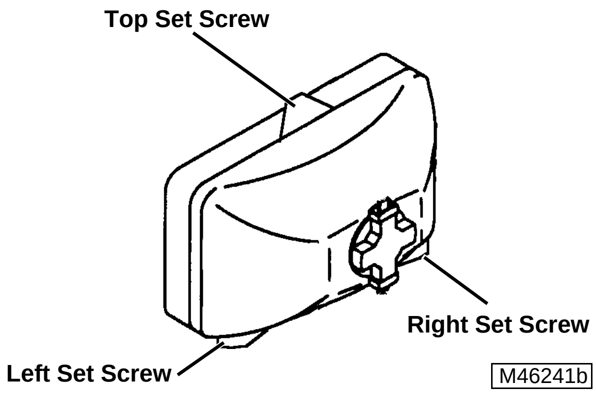


1. Turn fuel shutoff valve off.
2. Disconnect hoses after removing mounting cap screws.

Installation is done in the reverse order of removal.

- Replace filter.

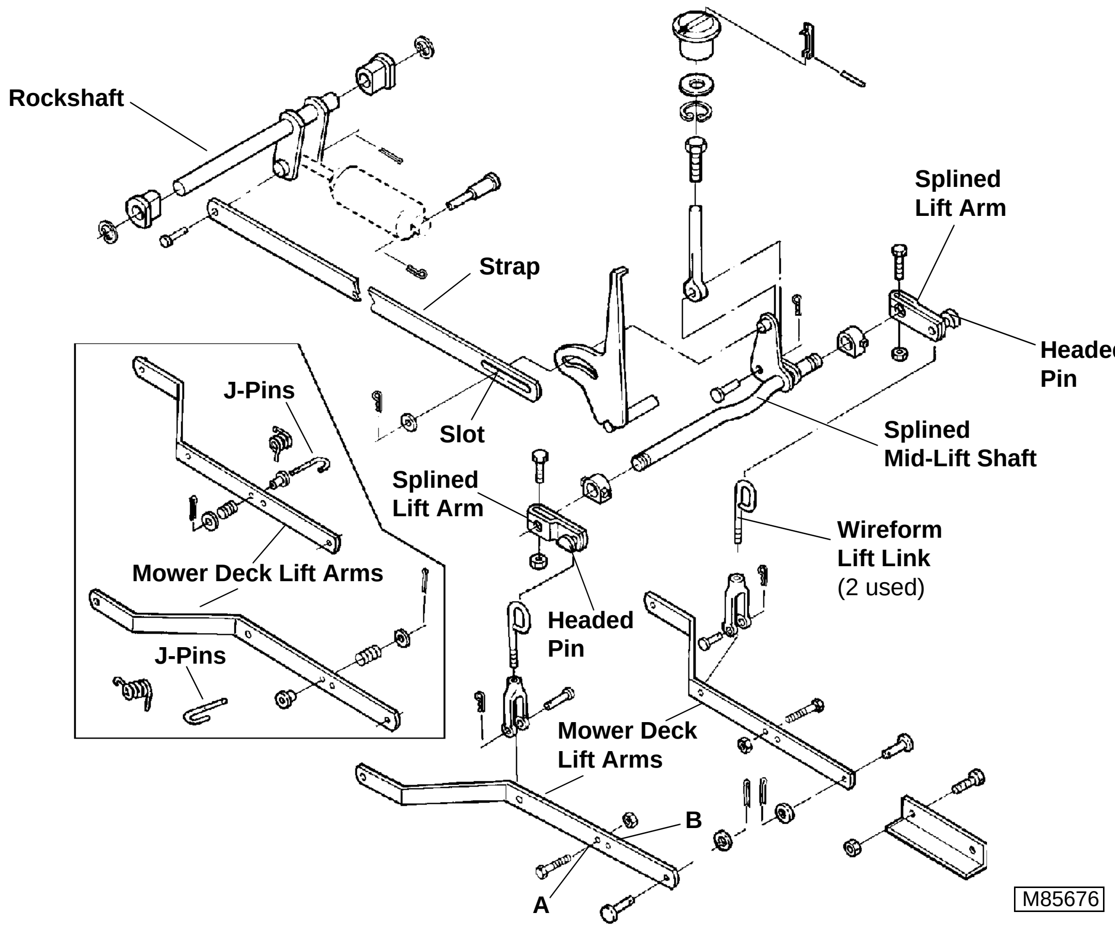
HEADLIGHTS—ADJUSTMENT



1. Turn top set screw in or out to adjust headlight up or down.
2. Left and right set screw adjustment will turn headlight either left or right.

IMPORTANT: Late model headlights have two washers on each set screw. Add or remove these washers to adjust the headlights.

LIFT LINKAGE ADJUSTMENT



Reason:

To make sure that splined lift arms are properly indexed to splined mid-lift welded shaft.

IMPORTANT: DO NOT remove J-pins or stop bolts from the mower lift arms. They are the stops that keep the gear case from being pushed into other tractor components.

Procedure:

1. Inspect for bent or broken mid-shaft, height indicator, etc. Replace components if necessary.
2. Be sure J-pins or stop bolts are installed correctly.
3. Remove fender deck and footrest.
4. Extend rockshaft cylinder completely (pull back on top SCV lever).
5. Locate strap underneath tractor (this strap is the link that connects the rockshaft cylinder to the splined mid-lift welded shaft). This strap has a slot in it pointing towards the front of the tractor. The welded pin in the splined mid-lift shaft travels within this slot.
6. Rotate mid-lift shaft so that welded pin is at the end of the slot in the shaft (towards the front of the tractor).
7. Splined lift arms are right hand and left hand. These arms have headed pins welded to them that support the lift links. Headed pins have a flattened side. The flat side must point down.
8. Once splined lift arms are positioned correctly (with headed pin flat side down), you are ready to index the splined arm on the splined shaft.

NOTE: It is helpful to use a pencil or awl and put a line across the splined lift arm and shaft that it clamps to indicate its original indexed position prior to adjustment.

9. Locate top front corner of each splined lift arm (above headed pin where radius begins). This is the point where you will be measuring from down to the bottom edge of the tractor frame.
10. Mount splined lift arm on splined mid-lift shaft to within these measurements—All-wheel steer tractor **100—110 mm (4.0—4.3 in.)**, two-wheel steer tractor **118—128 mm (4.6 to 5.0 in.)**. Find spline that is within these ranges.

M

IMPORTANT: The J-pin function (or stop bolt) on all models is to limit the amount of deck rise. This protects the underside of tractor from contacting mower deck gearbox.

Early Model Two Wheel Steer Tractors—Mower stop J-pin mounts on the lift arms.

Late Model (with stop bolts) Two-Wheel Steer (with single tie rods) and All-Wheel Tractors—The bolts should be in hole “B”. Hole “A” should be used for two-wheel steer tractors with two tie rods.

All-Wheel Steer Tractors—Mower stop J-pin mounts in tractor frame and extends down to limit lift arm rise.

11. Adjust wireform lift link, so that mower deck lift arms barely touch the two mower stop J-pins.

IMPORTANT: Any mower deck adjustments made after this point must lengthen these links (DO NOT SHORTEN). Shortening the linkage puts pressure on the splined mid-lift shaft.

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