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Operation and Diagnostics

Operation and Diagnostics

The operation and diagnostics stories divide the electrical system into individual circuits by function. Each circuit is isolated from the main wiring schematic and only shows the components that are used in it. The story contains information on function, operating conditions, and theory of operation. The circuit schematics are drawn with the components in the operating position, with the power, or battery positive, into them across the top and the ground, or battery negative, across the bottom.

Diagnostic Information

The diagnostic procedures is used to test the complete circuit regardless of the problem or complaint. Select a symptom or system from the quick check or troubleshooting chart and follow the test procedures under that heading.

The diagnostic procedure lists:

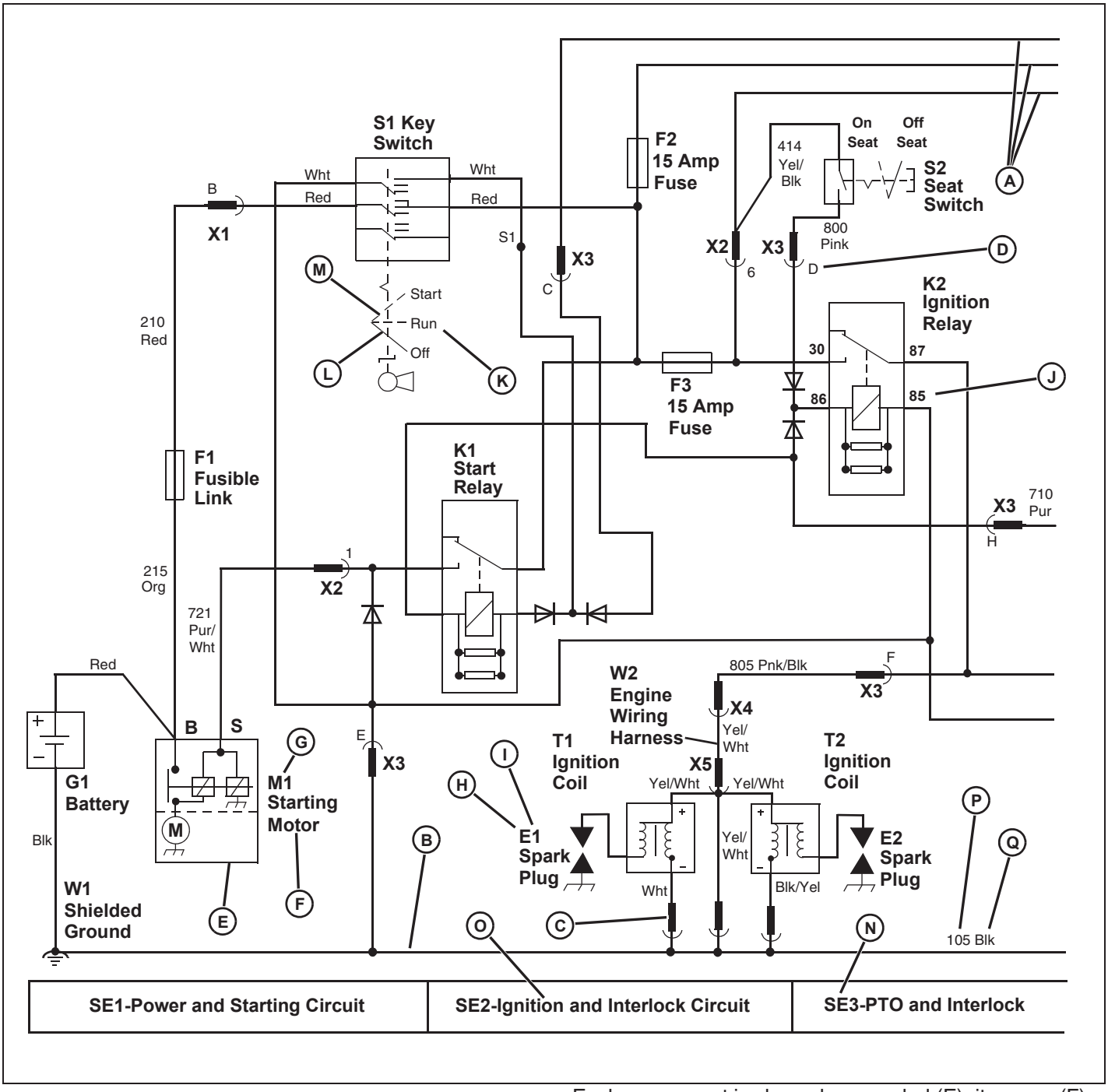
- Test conditions
- Test sequence
- Test location
- Normal reading
- Check or test to perform if reading is not normal

When performing the test or check, be sure to set your machine up to the test conditions listed and follow the sequence carefully. The middle “NORMAL” column gives the reading or condition that should be obtained when performing the test or check. If the results of the test or check are not normal, perform the test, check, or adjustment listed in the third “IF NOT NORMAL” column to repair the malfunction. The detailed tests or adjustments referred to in the “IF NOT NORMAL” column are located at the end of that group. The system diagram that accompanies each test procedure is drawn to resemble machine components. The key number on the art matches the number in the “TEST LOCATION” column and the leader line points to the exact point the test is to be made.

Wire Color Abbreviation Chart

Blk	**Black**
Blu	**Blue**
Brn	**Brown**
Grn	**Green**
Gry	**Gray**
Org	**Orange**
Pnk	**Pink**
Pur	**Purple**
Red	**Red**
Tan	**Tan**
Wht	**White**
Yel	**Yellow**
Blk/Wht	**Black/White**
Blu/Wht	**Blue/White**
Brn/Wht	**Brown/White**
Brn/Yel	**Brown/Yellow**
Dk Blu	**Dark Blue**
Dk Brn/Lt Grn	**Dark Brown/Light Green**
Dk Brn/Red	**Dark Brown/Red**
Dk Brn/Yel	**Dark Brown/Yellow**
Dk Grn	**Dark Green**
Lt Blue	**Light Blue**
Lt Grn	**Light Green**
Org/Wht	**Orange/White**
Pnk/Blk	**Pink/Black**
Pur/Wht	**Purple/White**
Red/Blk	**Red/Black**
Red/Wht	**Red/White**
Wht/Blk	**White/Black**
Wht/Red	**White/Red**
Yel/Blk	**Yellow/Black**
Yel/Red	**Yellow/Red**
Yel/Wht	**Yellow/White**

Reading Electrical Schematics



The schematic is made up of individual circuits laid out in a sequence of related functions. It is formatted with all power wires (A) across the top and all ground wires (B) across the bottom. Current flow is generally from top to bottom through each circuit and component. All components are shown in the off position. The diagram does not list connector (C) information unless needed to avoid confusion. If the connector is shown, the number next to it is the terminal pin location (D) in the connector.

Each component is shown by a symbol (E), its name (F), and an identification code (G). The identification code contains a device identifying letter (H) and number (I).

The identifying letter is always the same for a specific component, but the identifying numbers are numbered consecutively from upper left to lower right. The terminal designation (J) is placed directly outside the symbol next to the connecting wire path. Switch positions (K) are also placed directly outside the symbol. The solid line (L) shows the position the switch is currently in and dash lines (M) represent other switch positions.

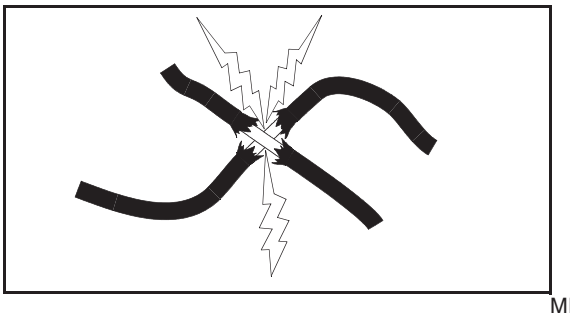
Each circuit is identified at the bottom of the drawing by a section number (N) and section name (O).

The circuit number (P) and wire color (Q) of the wires are shown directly next to the wire path.

The same component name and identification code are used consistently on all diagrams in this section. Components can be easily cross-referenced.

Common Circuit Tests

Shorted Circuit:



MIF

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:

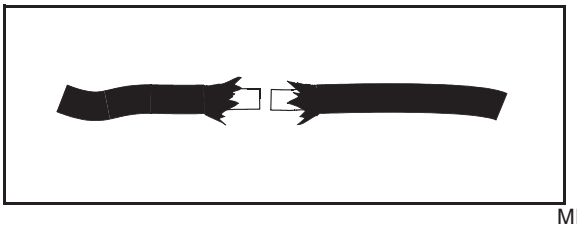
1. Turn component switch on.

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.

High Resistance or Open Circuit:



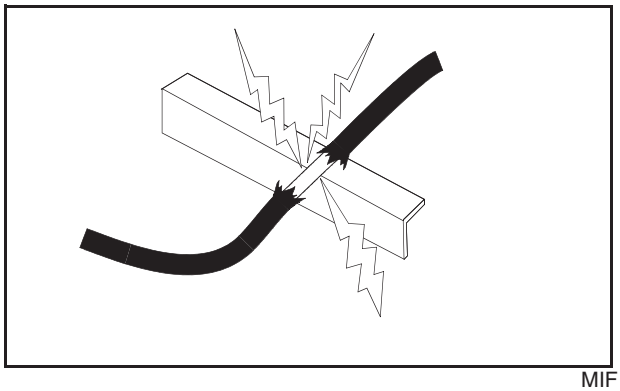
MIF

1. 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:

2. Check all terminals and grounds of the circuit for corrosion.

3. If terminals are not corroded or loose, the problem is in the component or wiring.

Grounded Circuit:



MIF

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

Conductors for 12 Volt Circuits

Standard Conductors For 12 Volt Circuits						
SAE Wire Size (Gauge)	20	18	16	14	12	10
Metric Wire Size (mm)	0.5	0.8	1.0	2.0	3.0	5.0
Typical Stranding	7 X 28	16 X 30	19 X 29	19 X 27	19 X 25	19 X 23
Minimum Conductor Area In Circular Mils	1072	1537	2336	3702	5833	9343

Electrical Section Wiring Harness Legend

W1 - Main Wiring Harness - 4X2

W2 - Main Wiring Harness - 6X4 Gas

W3 - Main Wiring Harness - 6X4 Diesel

W4 - Standard Headlight Wiring Harness

W5 - FE290D - BS08 Engine Wiring Harness

W6 - FE290D - BS08 Engine Wiring Harness

W7 - FE290D - BS08 Engine Wiring Harness

W8 - FD620D - Engine Wiring Harness (Main)

W9 - FD620D - Engine Wiring Harness (Ignition Coils)

W10 - FD620D - Engine Wiring Harness (Ignition Module)

W11 - FD620D - Engine Wiring Harness (Pulser Coils)

W12 - FD620D - Engine Wiring Harness (Stator)

W13 - FD620D - Engine Wiring Harness (Carburetor Heater)

W14 - 3TN66C - JUV Engine Wiring Harness (Starting Motor Solenoid)

W15 - 3TN66C - JUV Engine Wiring Harness (Glow Plugs)

W16 - 3TN66C - JUV Engine Wiring Harness (Fuel Shut-off Solenoid)

W17 - Cargo Box Lift Wiring Harness

W18 - Light and Horn Wiring Harness (North American/European) - Earlier Models

W19 - Light and Horn Wiring Harness (Road Homologated)

W20 - Rear Position/Brake/Turn Wiring Harness (Left)

W21 - Rear Position/Brake/Turn Wiring Harness (Right)

W22 - Front Position/Turn Wiring Harness (Left and Right)

W23 - Trailer Connector Wiring Harness

W24 - License Plate Light Wiring Harness

W25 - Headlight Adaptor Wiring Harness (Domestic Use)

W26 - Hour Meter Wiring Harness

W27 - Front Blade Wiring Harness (Relays)

W28 - Front Blade Wiring Harness (Switch)

W29 - Auxiliary Alternator Wiring Harness (Option)

W30 - Light and Horn Wiring Harness (North American/European) - Later Models

W31 - Backup Alarm Wiring Harness

ELECTRICAL SPECIFICATIONS - 6X4 GAS

Specifications - 6X4 Gas

Battery:

Voltage . . . . . 12 VDC
BCI group U-1
CCA rating (Amps at 0° F) . . . . . 325 amps
Reserve capacity (minutes) 38
Specific gravity . . . . . 1.225 or above
Electrolyte required fill (approximately) . . . . . 1.9 L (2.0 qt)
Load test (minimum) . . . . . 325 amps for 15 seconds

Ignition:

Pulser Coil (Resistance) . . . . . 85 - 270 ohms

Ignition Coil
Primary resistance . . . . . 3.4 - 4.5 ohms
Secondary winding resistance . . . . . 10.4 - 15.6 k ohms

Spark Plug:

Engine AS11 - FS11 (Engine S/N: - 199856)
Type . . . . . NGK BMR2A-10
Gap . . . . . 1.0 mm (0.040 in.)
Torque . . . . . 25 N•m (221 lb-in.)
or
Type . . . . . Champ Right18Y
Gap . . . . . 0.71 mm (0.028 in.)
Torque . . . . . 27 N•m (240 lb-in.)

Engine GS11 - HS11 (Engine S/N: 204959 -)
Type . . . . . NGK BPR2ES
Gap . . . . . 0.63 mm (0.025 in.)
Torque . . . . . 25 N•m (221 lb-in.)

Starting Motor:

Type . . . . . Solenoid Shift
Amp draw (on machine) . . . . . 72 amps (maximum) at 500 rpm
No-load amp draw (free running) . . . . . 50 amps (maximum) at 6000 rpm

Alternator: (FD620D)

High Capacity Alternator . . . . . 45 amp
Regulated amperage/voltage . . . . . 45 amp at 12.2 - 13.8 volts

Stator: (PIN FD620D038267-)

Stator size . . . . . **16 amps**
Regulated amperage/voltage . . . . . **14 amp at 12.2 - 13.8 volts**
Unregulated voltage . . . . . **26 VAC**

Stator: (PIN FD620D009262 - FD620D038266)

Stator size . . . . . **20 amps**
Regulated amperage/voltage . . . . . **16 amp at 12.2 - 13.8 volts**
Unregulated voltage . . . . . **26 VAC**

Engine: Temperature:

Engine Coolant Temperature Light Switch . . . . . **From OFF (open) to ON (closed) at 109° ± 1° C (228° ± 2° F)**

Radiator Core Temperature Switch:

Early Models (To Model Year 2002)
Closes (Continuity - Radiator Fan ON) . . . . . **71 ± 4° C (160° ± 7° F)**
Opens (Infinity - Radiator Fan OFF) . . . . . **60 ± 4° C (140° ± 7° F)**

NOTE: The radiator core temperature switch closes when the coolant heats to 89° C (192° ± 7° F) raising the outer radiator core temperature to 71° C (160° ± 7° F). The outer radiator core temperature is approximately 20° C (36° F) lower than engine coolant temperature.

Later Models (From Model Year 2002)
Closes (Continuity - Radiator Fan ON) . . . . . **93 ± 3° C (200° ± 5° F)**

Lighting:

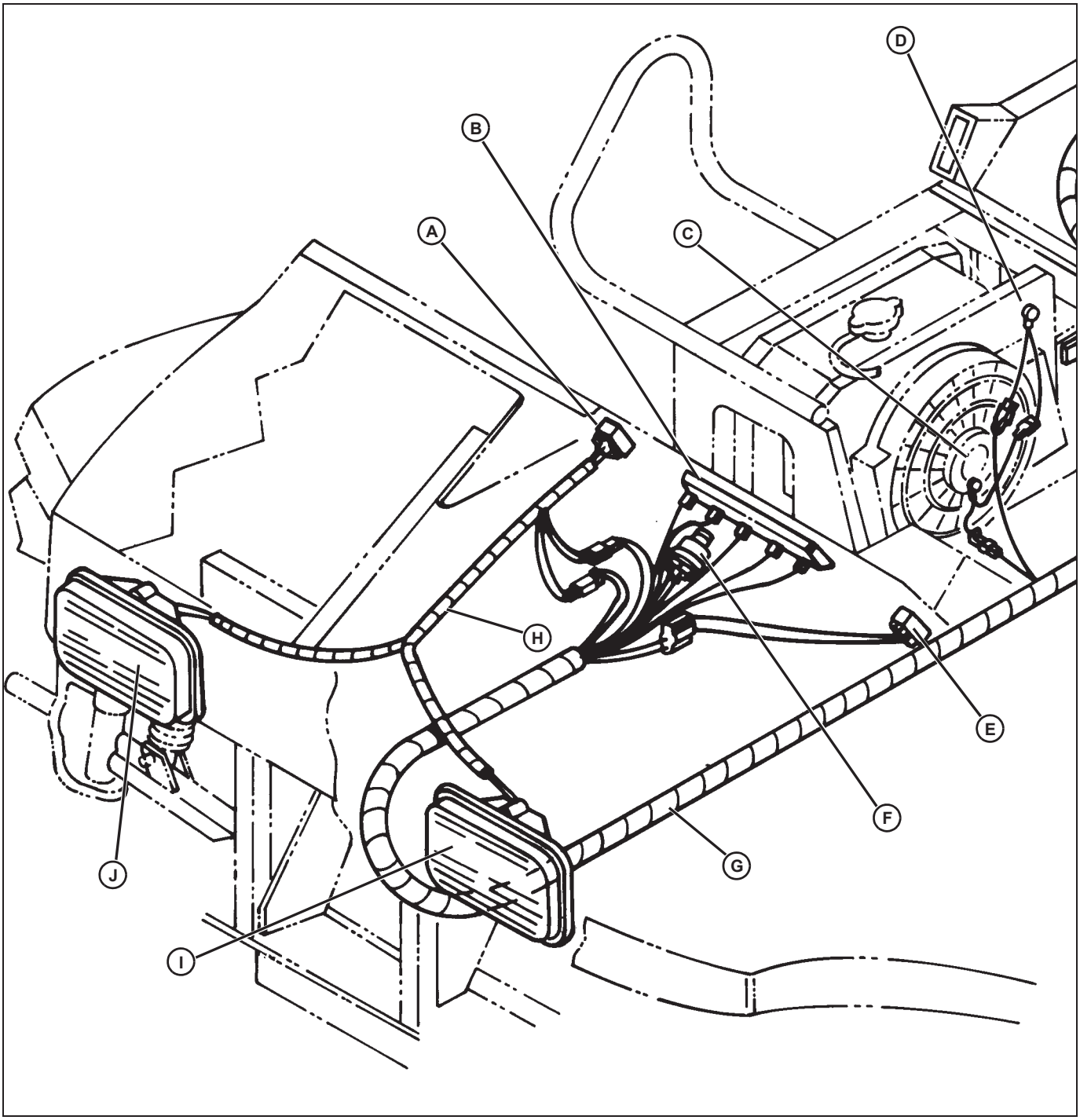
Headlights (halogen) . . . . . **37.5 watts**
Tail/Brake Lights . . . . . **21 watts**
Position Lights . . . . . **10 watts**
Front /Rear Turn Lights . . . . . **21 watts**

Neutral Start Switch:

Neutral (Depressed) . . . . . **Continuity**
In Gear (Released) . . . . . **No Continuity**

Component Location

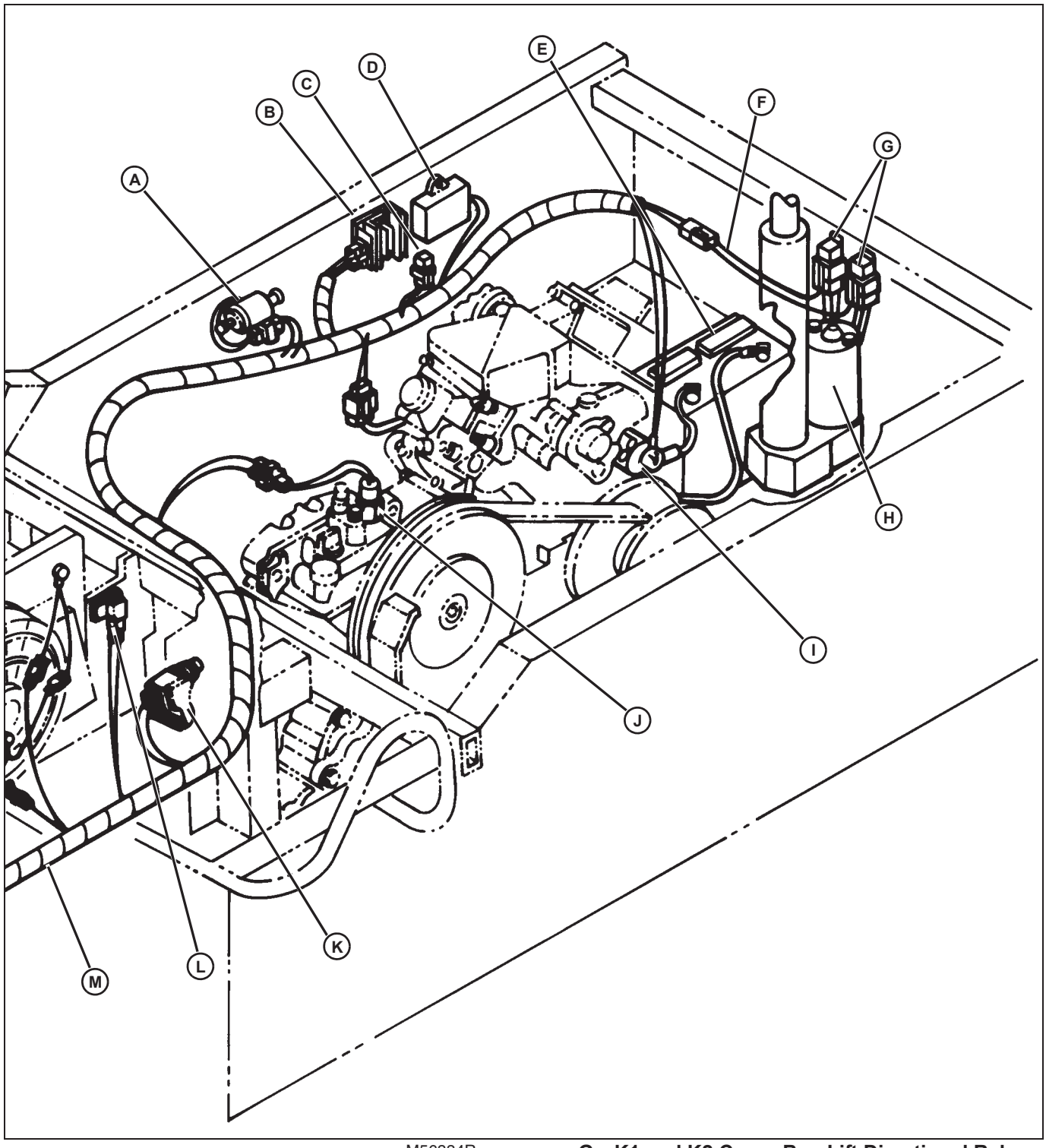
Component Location - 6X4 Gas



M56334L

A - S5 Light Switch
B - Instrument Panel Lights
C - M3 Radiator Fan Motor
D - B3 Radiator Core Temperature Switch
E - Cargo Box Lift Switch (optional)
F - S2 Key Switch
G - W2 Main Wiring Harness
H - W4 Standard Headlight Wiring Harness
I - E4 Headlight
J - E3 Headlight

ELECTRICAL COMPONENT LOCATION



M56334R

A - M2 Fuel Pump
B - N1 Voltage Regulator/Rectifier
C - K1 Start Relay
D - A1 Ignition Module
E - G1 Battery
F - W17 Cargo Box Lift Wiring Harness
G - K1 and K2 Cargo Box Lift Directional Relays
H - M2 Cargo Box Lift Motor
I - M1 Starting Motor
J - S1 Neutral Start Switch
K - S4 Differential Lock Switch
L - S3 Park Brake Switch
M - W2 Main Wiring Harness

Schematics and Harnesses - 6X4 Gas

Electrical Schematic and Wiring Harness Legend - 6X4 Gas

A1 - Ignition Module (SE3, W2)

B1 - Left Pulser Coil (SE3, W2)

B2 - Right Pulser Coil (SE3, W2)

B3 - Radiator Core Temperature Switch (SE4, W2)

B4 - Engine Temperature Switch (SE5, W2)

B5 - Engine Oil Pressure Switch (SE5, W2)

E1 - Spark Plug (SE3, W2)

E2 - Spark Plug (SE3, W2)

E3 - Right Headlight (SE6, W2)

E4 - Left Headlight (SE6, W2)

F1 - Fusible Link (SE1, W2)

F2 - Fusible Link (SE1, W2)

F3 - Fusible Link (SE1, W2)

G1 - Battery (SE1, W2)

G2 - Stator (SE2, W2)

G3 - High Capacity Alternator (Optional) (SE2, W2)

H1 - Discharge Light (SE5, W2)

H2 - Park Brake Light (SE5, W2)

H3 - Differential Lock Light (SE5, W2)

H4 - Engine Coolant Temperature Light (SE5, W2)

H5 - Engine Oil Pressure Light (SE5, W2)

K1 - Start Relay (SE1, W2)

M1 - Starting Motor (SE1, W2)

M2 - Fuel Pump (SE4, W2)

M3 - Radiator Fan Motor (SE4, W2)

M4 - Cargo Box Lift Kit Motor (Optional) (SE5, W2)

N1 - Voltage Regulator/Rectifier (SE2, W2)

R1 - Carburetor Heater (SE4, W2)

S1 - Neutral Start Switch (SE1, W2)

S2 - Key Switch (SE1, W2)

S3 - Park Brake Switch (SE5, W2)

S4 - Differential Lock Switch (SE5, W2)

S5 - Cargo Box Lift Kit Switch (Opt.) (SE5, W2)

S6 - Light Switch (SE6, W2)

T1 - Ignition Coil (SE3, W2)

T2 - Ignition Coil (SE3, W2)

V1 - Diode (SE1, W2)

V2 - Diode (SE5, W2)

W1 - Shielded Ground (SE1, W2)

Connectors:

X1 - W2 Main Wiring Harness to W8 Engine Wiring Harness (SE1, W2; SE2, W2; SE3, W2; SE5, W2)

X2 - W8 Engine Wiring Harness to W9 Engine Wiring Harness and W13 Engine Wiring Harness (SE3, W2)

X3 - W9 Engine Wiring Harness to W10 Engine Wiring Harness (SE3, W2)

X4 - W10 Engine Wiring Harness to W11 Engine Wiring Harness (SE3, W2)

X5 - W2 Main Wiring Harness to M3 Radiator Fan Motor (SE4, W2)

X6 - M3 Radiator Fan Motor to B3 Radiator Core Temperature Switch (SE4, W2)

X7 - B3 Radiator Core Temperature Switch to W1 Shielded Ground (SE3, W2)

X8 - W2 Main Wiring Harness to S5 Cargo Box Lift Kit Switch (Opt.) (SE5, W2)

X9 - W2 Main Wiring Harness to W17 Cargo Box Lift Kit Wiring Harness (SE5, W2)

X10 - W2 Main Wiring Harness to W4 Standard Headlight Wiring Harness (SE6, W2; SE2, W18)

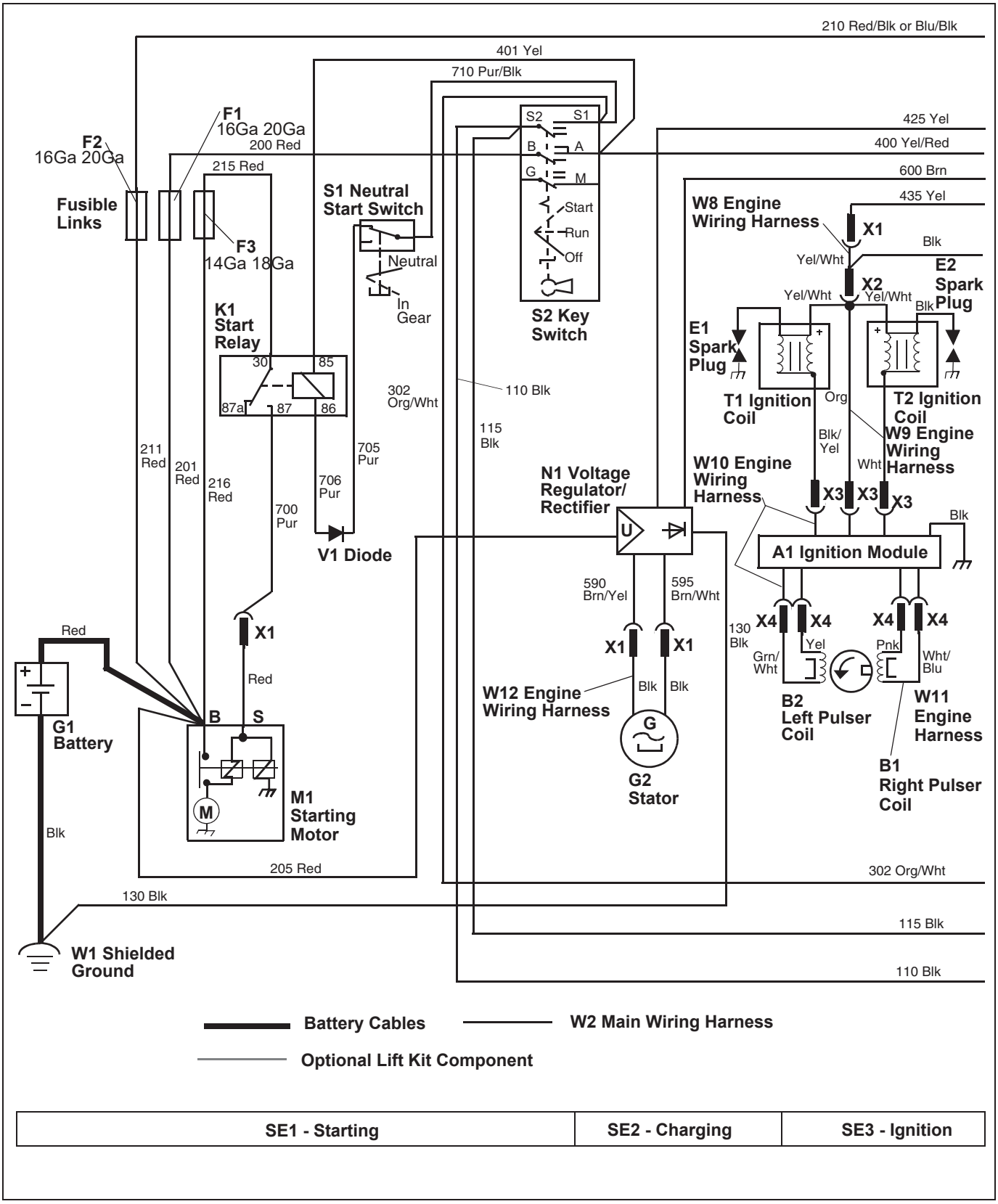
X11 - W4 Standard Headlight Wiring Harness to W2 Main Wiring Harness (SE6, W2; SE1, W18)

X12 - W29 Auxiliary Alternator Wiring Harness to W2 Main Wiring Harness (SE2, W2)

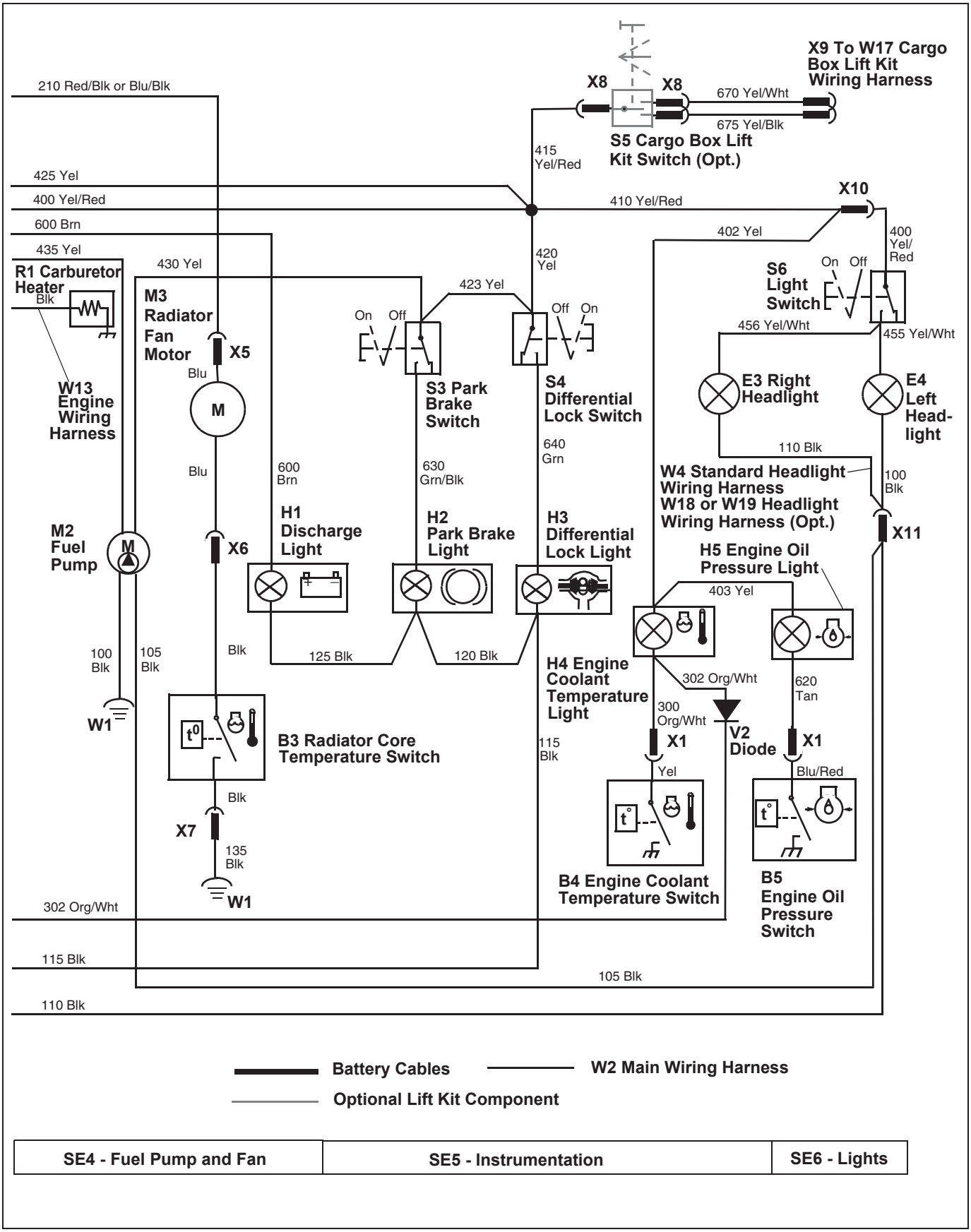
X13 - W29 Auxiliary Alternator Wiring Harness to N1 Voltage Regulator(SE2, W2)

W2 Standard Electrical Schematic - 6X4 Gas

W2 Standard Electrical Schematic - 6X4 Gas (1 of 2)



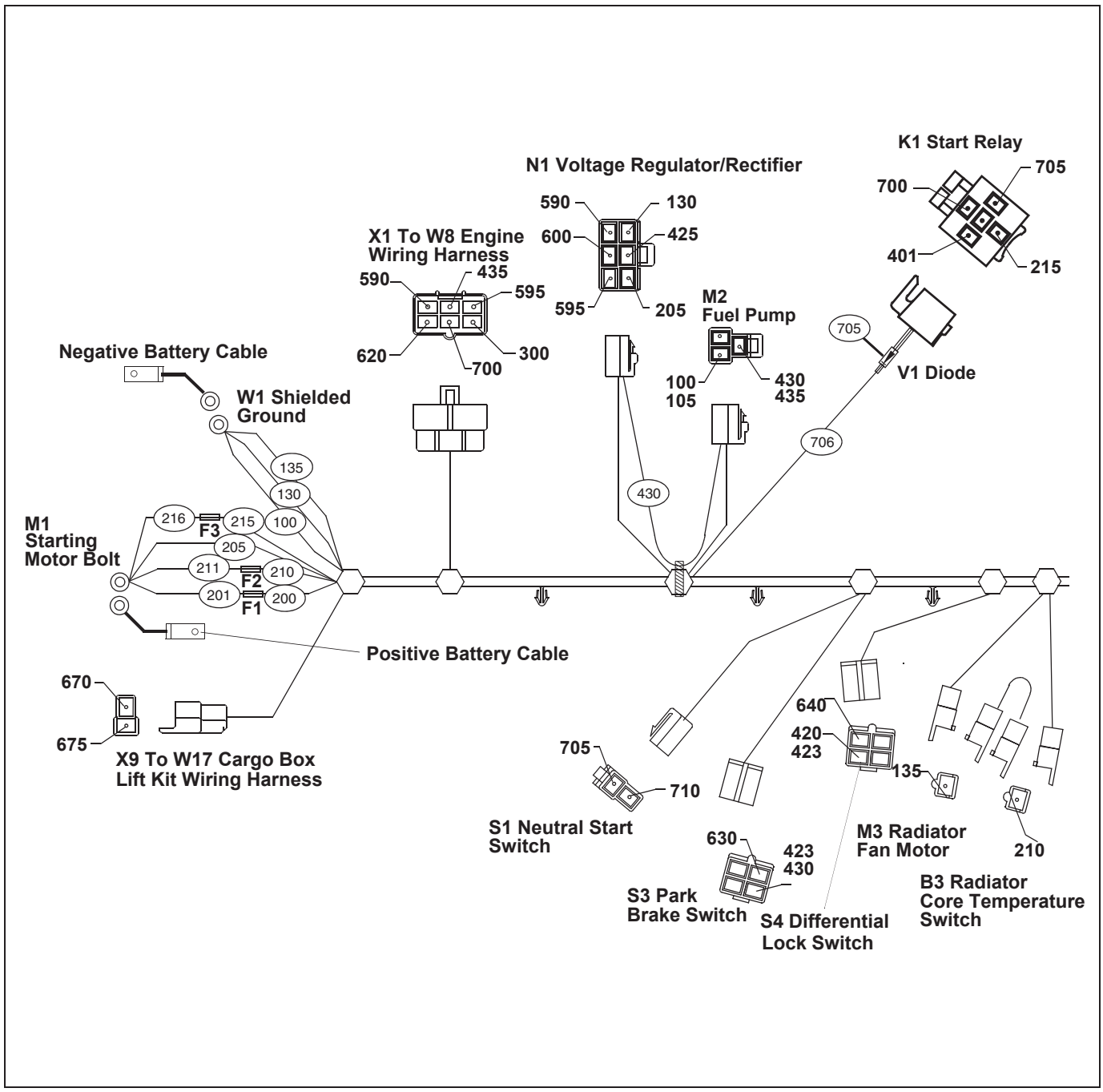
W2 Standard Electrical Schematic - 6X4 Gas (2 of 2)



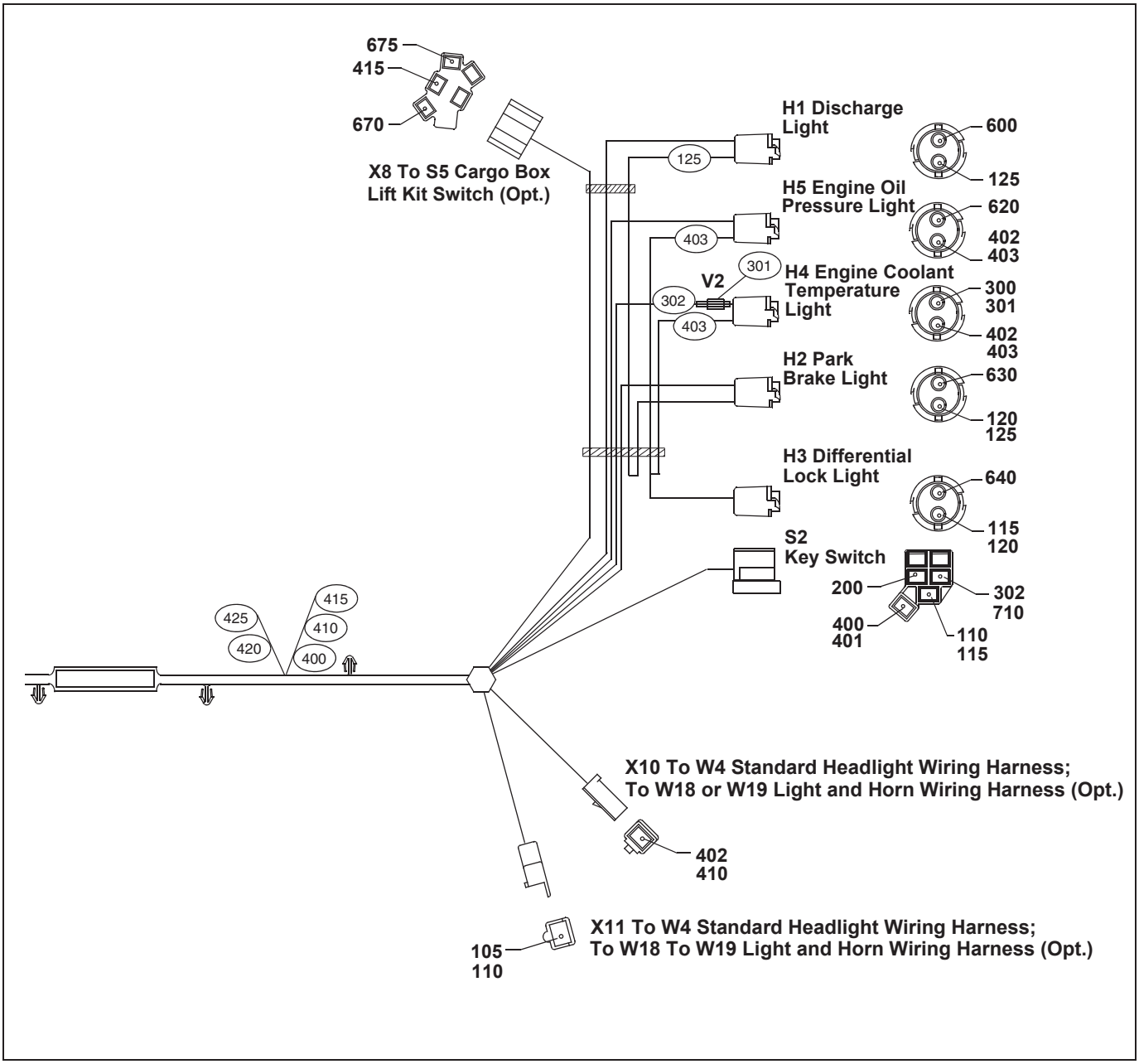
SE4 - Fuel Pump and Fan	SE5 - Instrumentation	SE6 - Lights

W2 Main Wiring Harness - 6X4 Gas

W2 Main Wiring Harness - 6X4 Gas (1 of 2)



W2 Main Wiring Harness - 6X4 Gas (2 of 2)

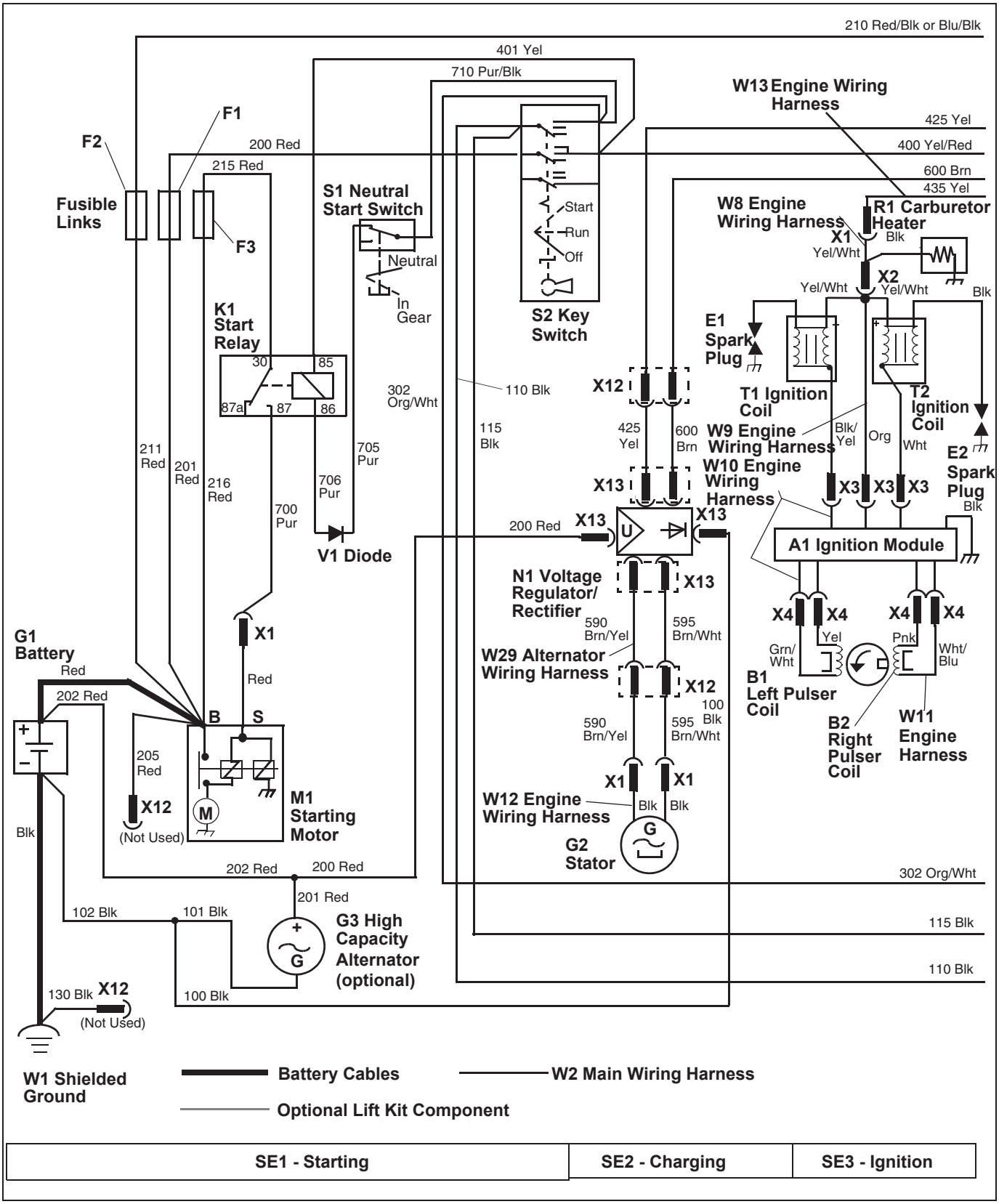


W2 Main Wiring Harness Color Code Table - 6X4 Gas

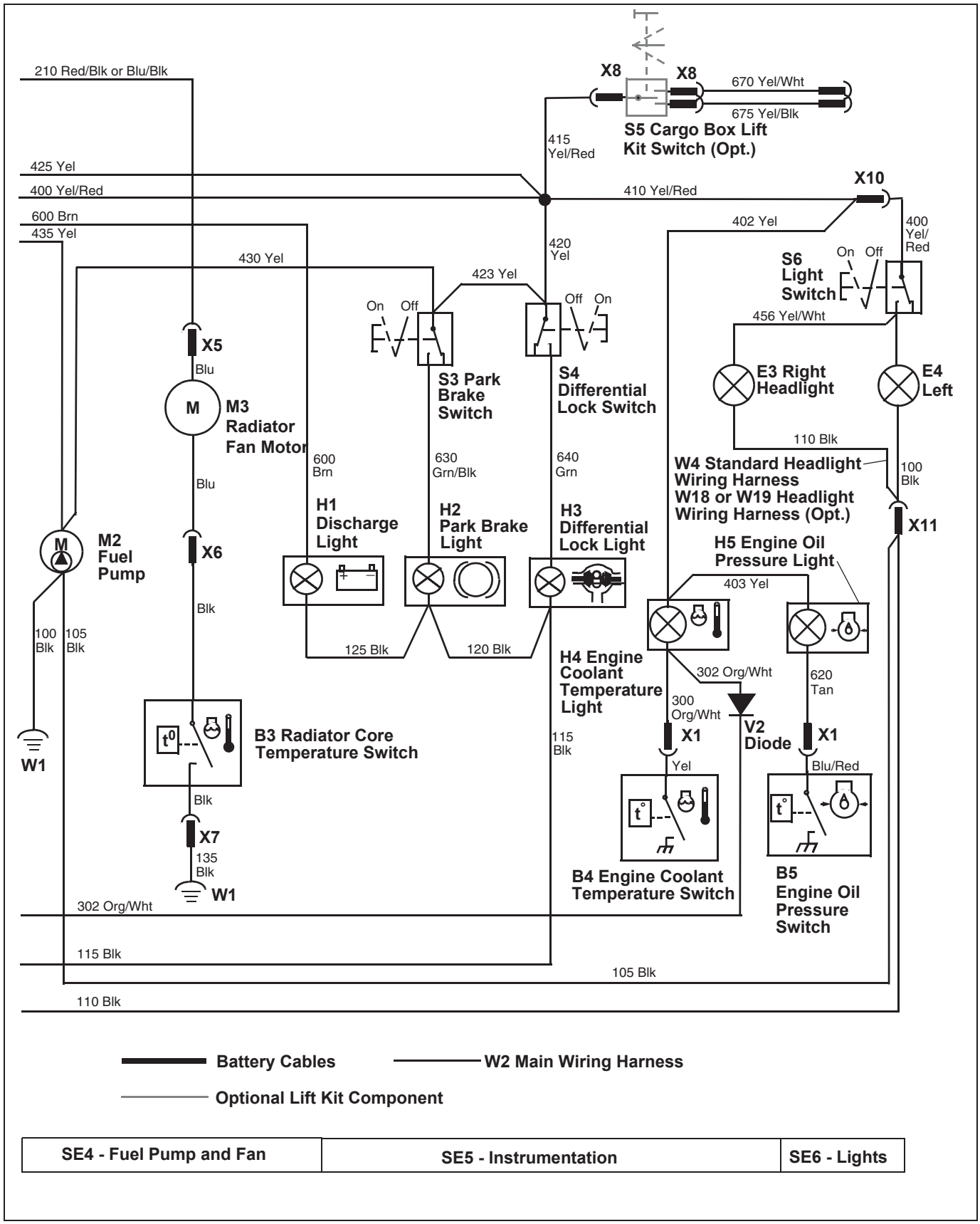
Circuit Number	Wire Size	Color	Termination Points
100	1.0	Blk	M2, W1 Gnd
105	1.0	Blk	X11, M2
110	0.5	Blk	S2, X11
115	0.5	Blk	H3, S2
120	0.5	Blk	H2, H3
125	0.5	Blk	H1, H2
130	2.0	Blk	N1, W1 Gnd
135	1.0	Blk	X7, W1 Gnd
200	1.0	Red	F1, S2
201	0.5	Red-Fuse	F1 Fuse soldered inline; M1, 200 Red
205	2.0	Red	M1, N1
210	1.0	Red/Blk, or Blu/Blk	F2, M3
211	0.5	Red-Fuse	F2 Fuse soldered inline; M1, 210 Red
215	2.0	Red	F3, K1
216	0.8	Red-Fuse	F3 Fuse soldered inline; M1, 215 Red
300	0.5	Org/Wht	H4, X1
301	0.5	Diode	Soldered inline; 302 Org/Wht
302	0.5	Org/Wht	H4, S2
400	1.0	Yel/Red	S2, solder connection (410 Yel/Red, 415 Yel/Red, 420 Yel)
401	0.8	Yel	S2, K1
402	0.8	Yel	X10, H4
403	0.8	Yel	H4, H5
410	1.0	Yel/Red	Solder connection (400 Yel/Red), X10
415	1.0	Yel/Red	Solder connection (400 Yel/Red), X8
420	0.8	Yel	Solder connection (400 Yel/Red), S4
423	0.8	Yel	S4, S3
425	1.0	Yel	Solder connection (400 Yel/Red), N1
430	0.8	Yel	S3, M2
435	0.8	Yel	M2, X1
590, 595	2.0	Brn/Yel	N1, X1
600	0.5	Brn	N1, H1
620	0.5	Tan	H5, X1
630	0.8	Gry/Blk	S3, H2
640	0.5	Grn	S4, H3
670, 675	1.0	Yel/Wht	X8, X9
700	2.0	Pur	K1, X1
705	0.8	Pur	V1 Diode, S1
706	0.8	Pur	K1, V1 Diode
710	0.8	Pur/Blk	S1, S2

W2 Electrical Schematic with Auxiliary Alternator - 6X4 Gas

W2 Electrical Schematic with Auxiliary Alternator - 6X4 Gas (1 of 2)

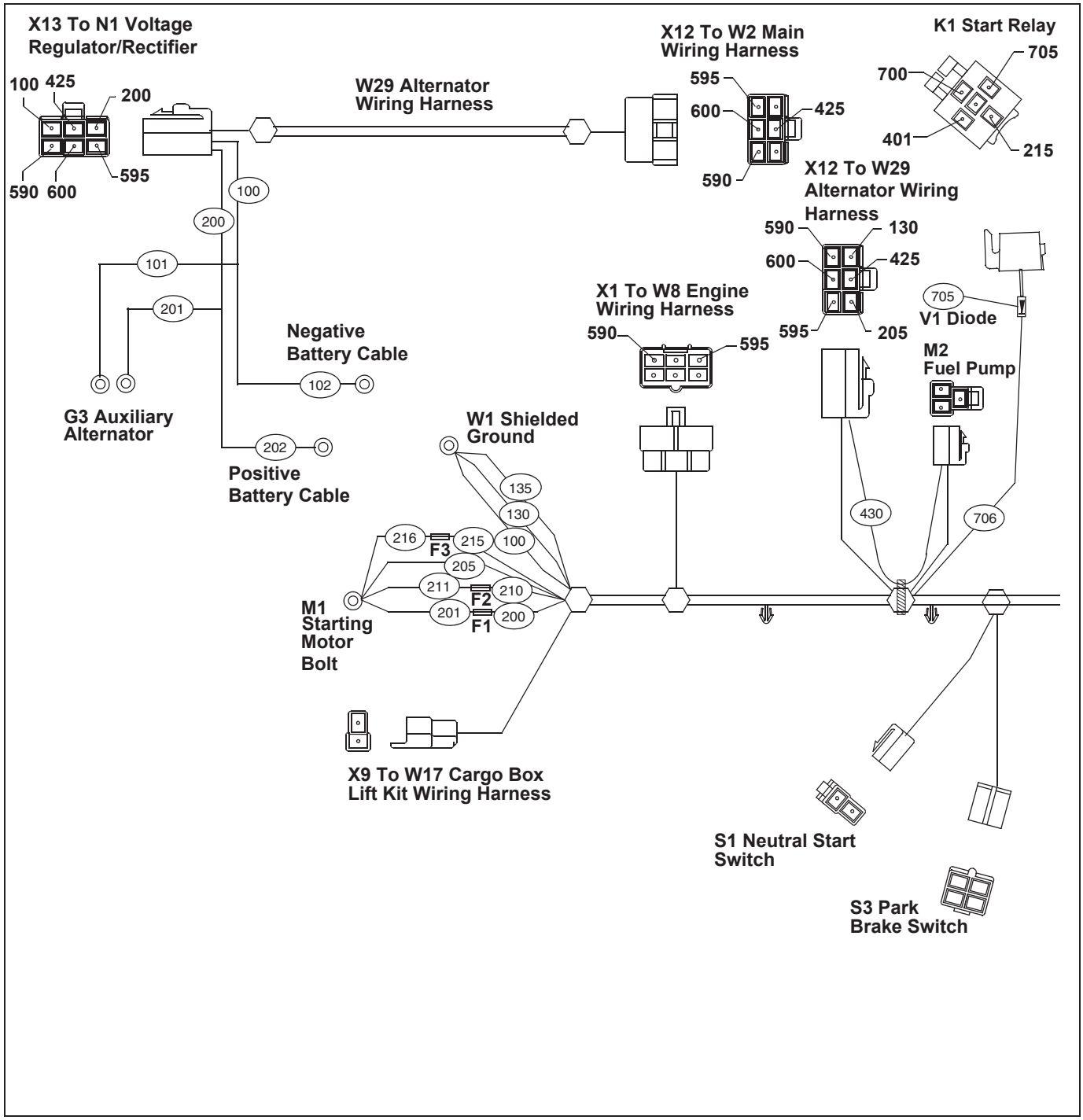


W2 Electrical Schematic with Auxiliary Alternator - 6X4 Gas (2 of 2)

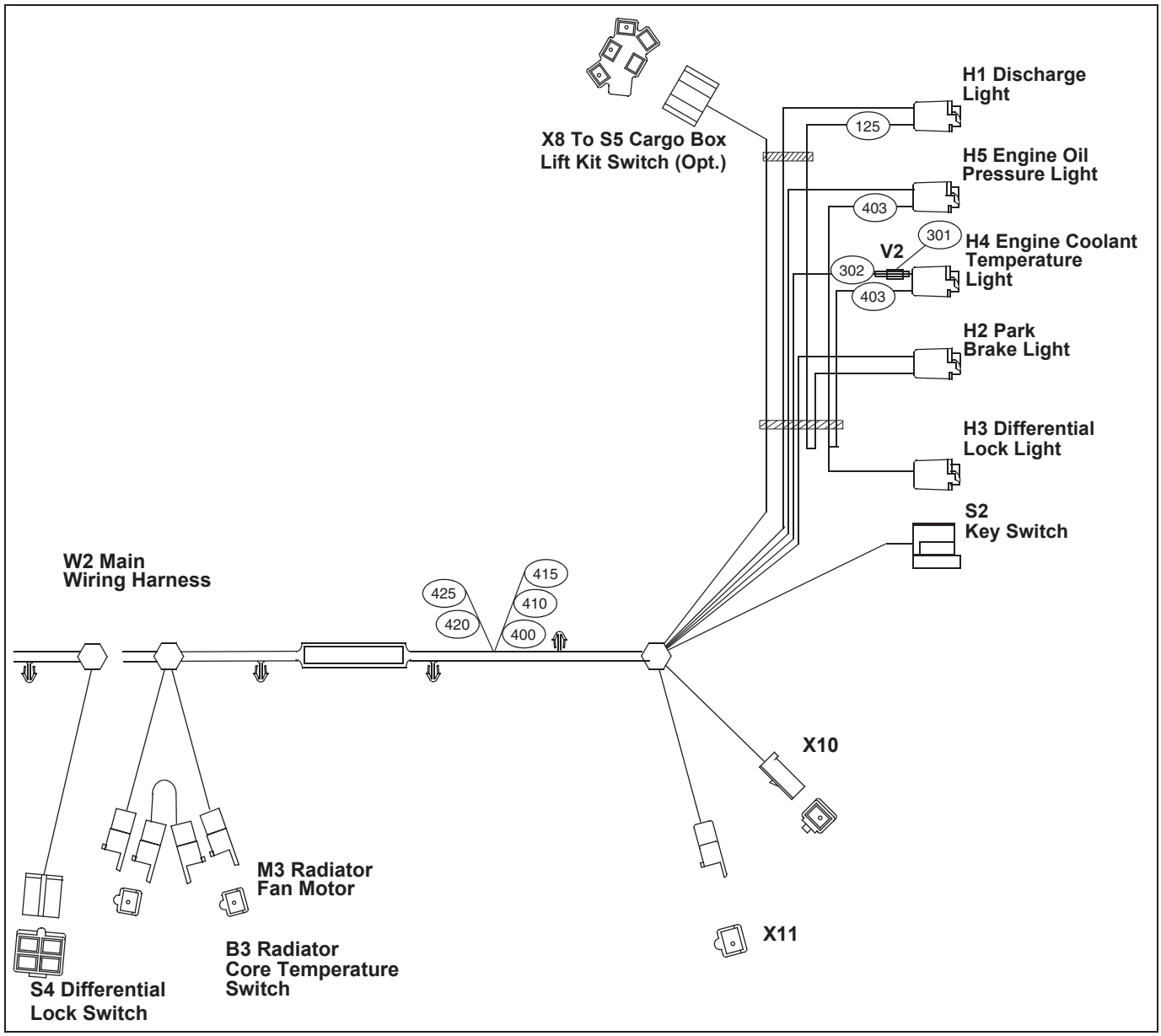


W29 Auxiliary Alternator Wiring Harness - 6X4 Gas

W29 Auxiliary Alternator Wiring Harness - 6X4 Gas (1 of 2)



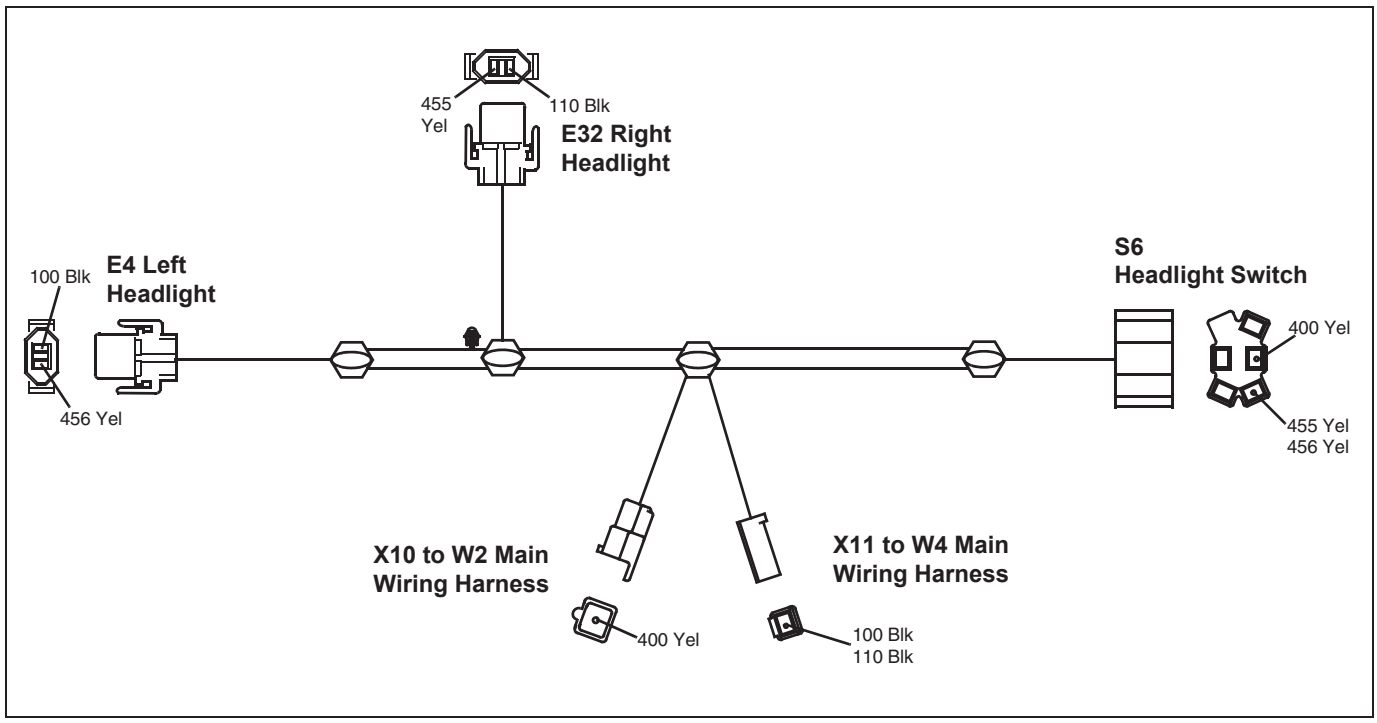
W29 Auxiliary Alternator Wiring Harness - 6X4 Gas (2 of 2)



W29 Wiring Harness Wire Color Code Table - 6X4 Gas

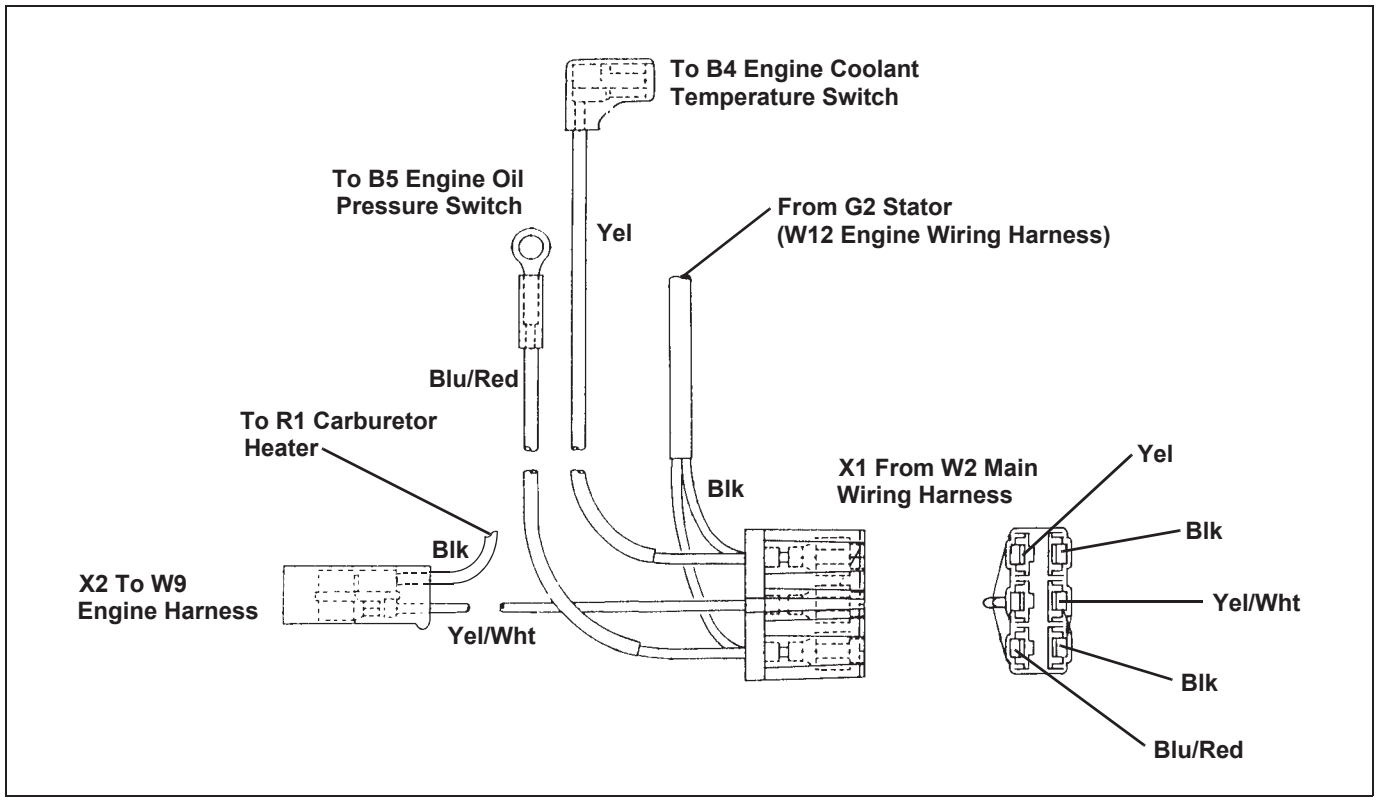
Circuit Number	Wire Size	Color	Termination Points
100	3.0	Blk	X13, N1
101	3.0	Blk	G3 Gnd
102	5.0	Blk	Solder Splice to 100/ 101 Blk, Battery Neg
200	3.0	Red	Solder Splice, X13
201	3.0	Red	Solder Splice, G3
202	5.0	Red	Solder Splice to 200/ 201 Blk, Battery Pos
425	1.0	Yel	W2, X12, X 13
590	3.0	Brn/Wht	W2, X12, X13
595	3.0	Brn/Yel	W2, X12, X13
600	1.0	Blu	W2, X12, X13

W4 Standard Headlight Wiring Harness - 6X4 Gas



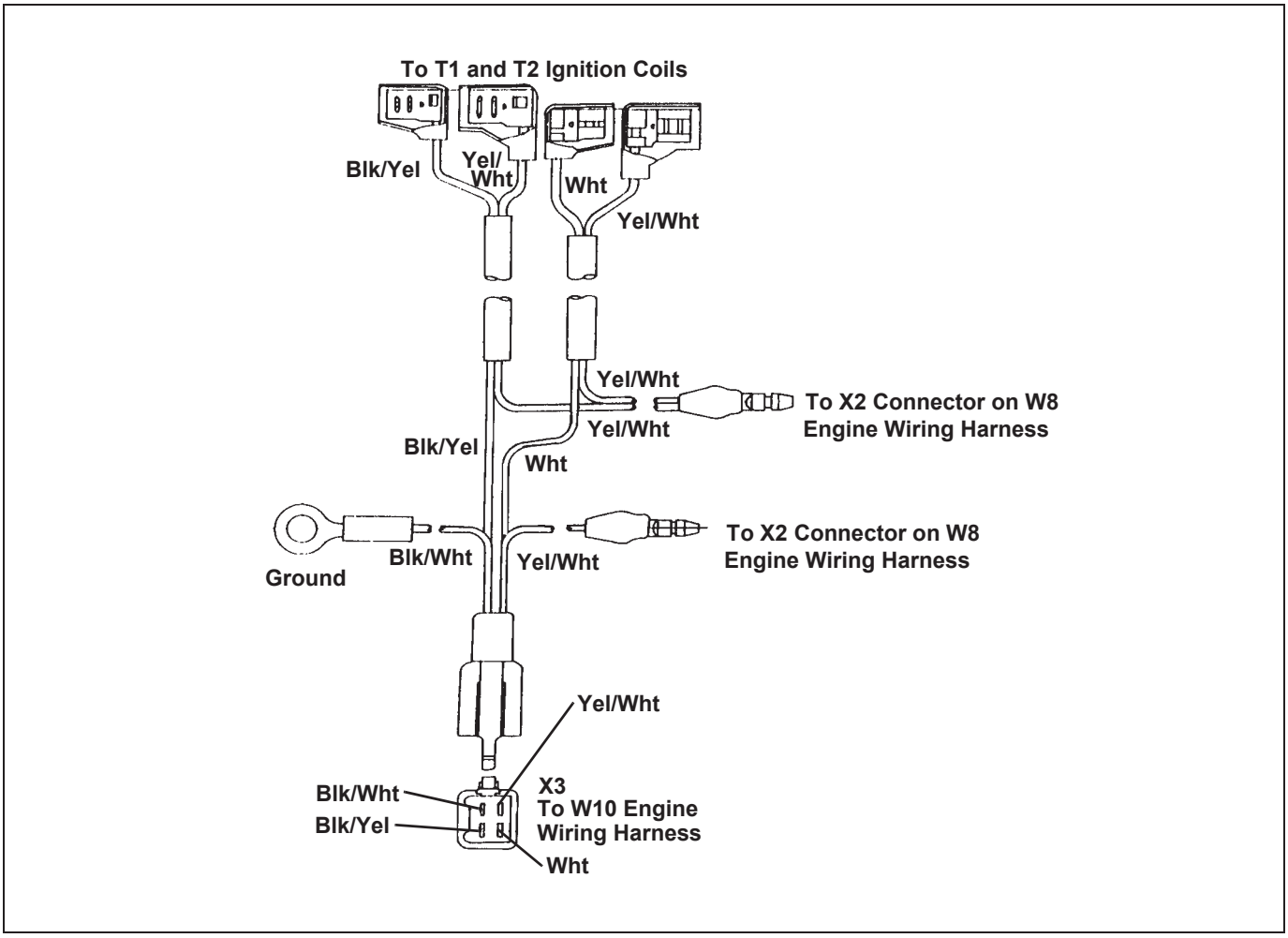
MIF

W8 Engine Wiring Harness



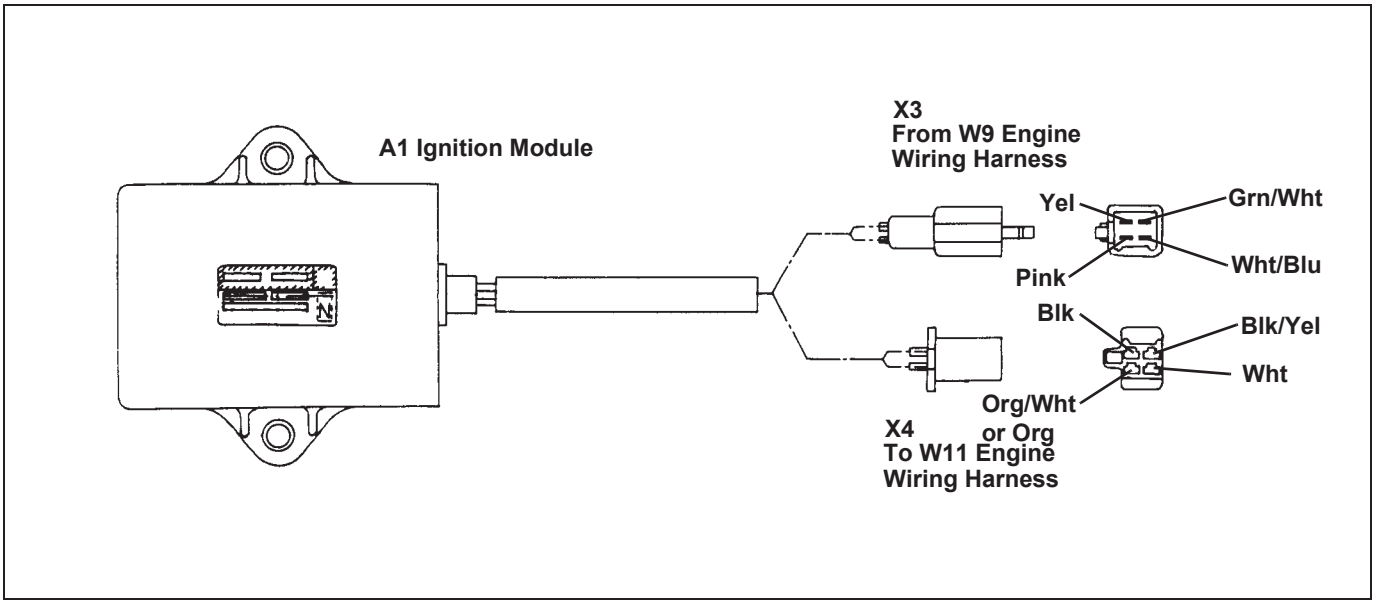
M72546

W9 Engine Wiring Harness



M72547

W10 Engine Wiring Harness



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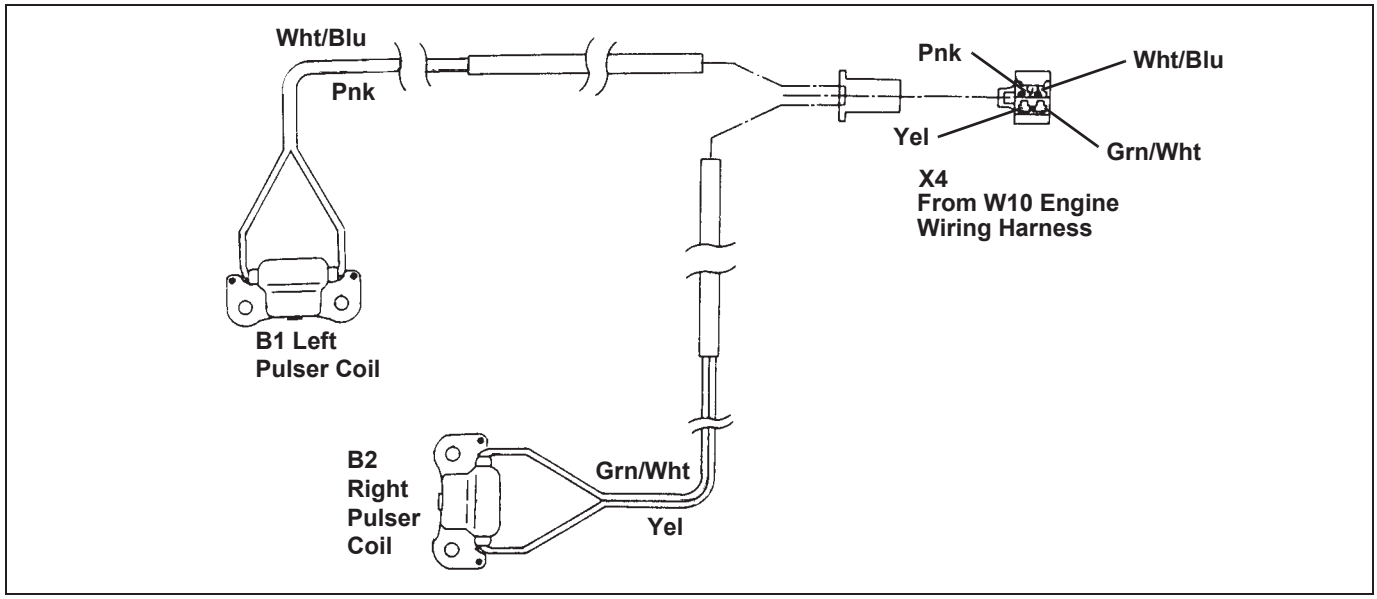
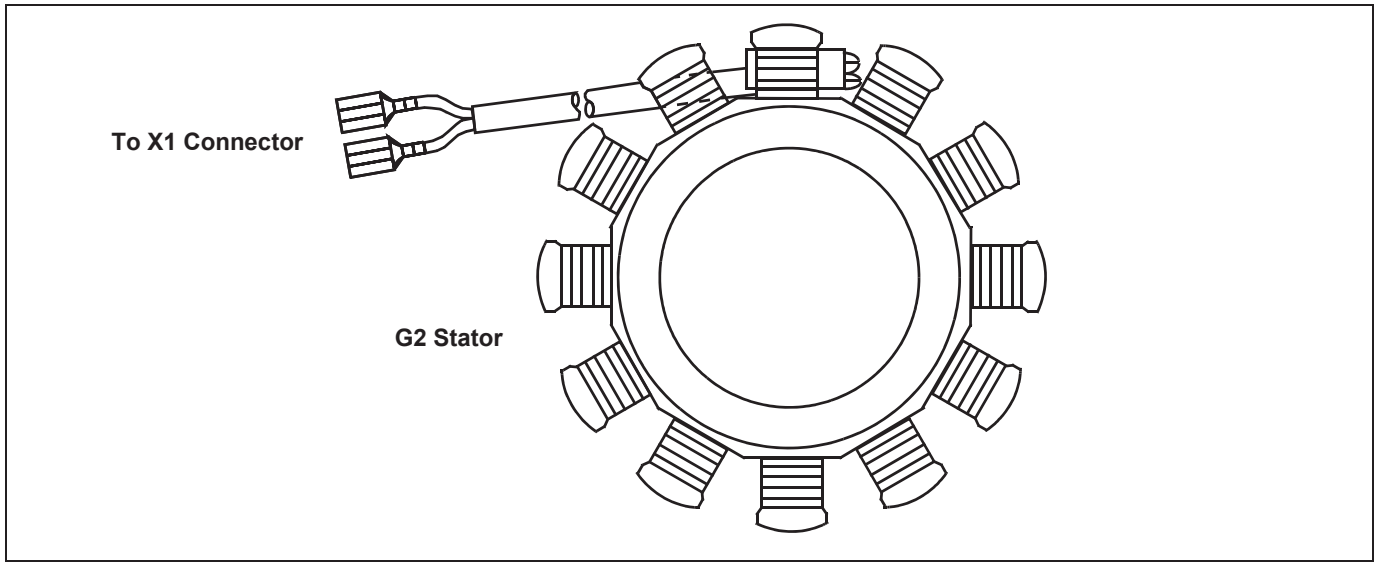
W11 Engine Wiring Harness



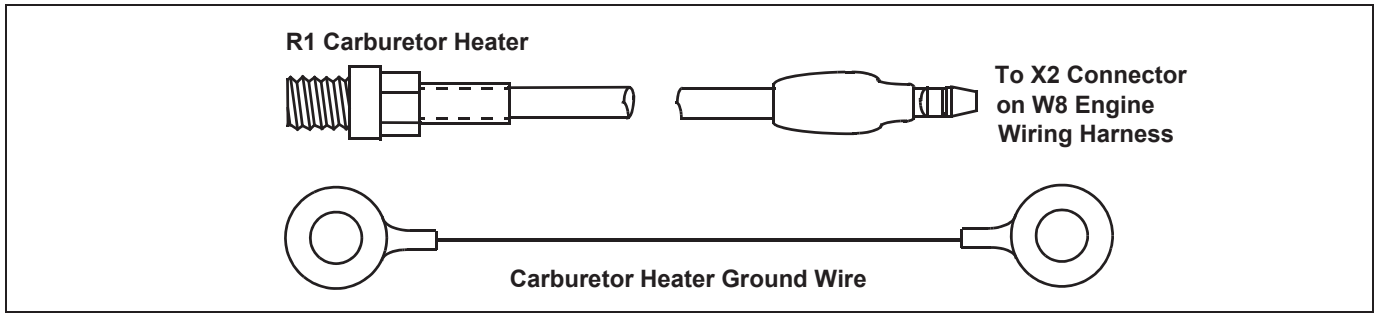
M72549

W12 Engine Wiring Harness



MIF

W13 Engine Wiring Harness



MIF

Operation and Diagnostics - 6X4 Gas

Troubleshooting - 6X4 Gas

System: Electrical

(1) Does starter have cranking problems?

Yes - See “Power Circuit Diagnosis - 6X4 Gas” on page 292.

Yes - See “Cranking Circuit Diagnosis - 6X4 Gas” on page 296.

Yes - See “Ground Circuit Tests” on page 396.

Yes - See “Battery Test” on page 372.

(2) Does engine crank but not start?

Yes - See “Ground Circuit Tests” on page 396.

Yes - See “Ignition Circuit Diagnosis - 6X4 Gas” on page 299.

(3) Is there spark from the ignition?

Yes - See “Ignition Circuit Diagnosis - 6X4 Gas” on page 299.

(4) Is the fuel pump operating?

Yes - See “Ignition Circuit Diagnosis - 6X4 Gas” on page 299.

(5) Does the engine not shut off?

Yes - Check for a shorted circuit.

(6) Is an improper component working with a switch?

Yes - Check for a shorted circuit.

(7) Is there a problem with the engine oil light?

Yes - See “Indicator Lights Circuit Diagnosis - 6X4 Gas” on page 307.

(8) Does the battery go dead, discharge, or over charge?

Yes - See “Charging Circuit Diagnosis - 6X4 Gas” on page 303.

(9) Is there a discharge light problem?

Yes - See “Charging Circuit Diagnosis - 6X4 Gas” on page 303.

(10) Are there cooling fan problems?

Yes - See “Indicator Lights Circuit Diagnosis - 6X4 Gas” on page 307.

(11) Are there instrumentation light problems?

System: Electrical

Yes - See “Indicator Lights Circuit Diagnosis - 6X4 Gas” on page 307.

(12) Are there light and horn problems?

Yes - See “Road Homologated Light and Horn Circuit Diagnosis” on page 493 or “Light and Horn Circuit Diagnosis (Earlier Model)” on page 447 or “Light and Horn Circuit Diagnosis (Later Model)” on page 468.

(13) Are there domestic headlight problems?

Yes - See “Standard Headlight Circuit Diagnosis - 6X4 Gas” on page 312.

(14) Are there cargo box lift problems?

Yes - See “Cargo Box Lift System Troubleshooting Chart” on page 405 and “Cargo Box Lift Circuit Diagnosis” on page 406.

Power Circuit Operation - 6X4 Gas

Function:

Provides unswitched power to the primary components whenever the battery is connected.

Operating Conditions, Unswitched Circuits:

Voltage must be present at the following components with the key switch “OFF”:

- Battery Positive Terminal
- “B” Terminal of Starting Motor
- “B” Terminal of Key Switch
- Voltage Regulator/Rectifier
- Alternator Positive Terminal (if equipped)
- Radiator Fan Motor

The positive battery cable connects the battery to the starting motor. The starting motor bolt is used as a tie point for the rest of the electrical system. In systems with an alternator an additional positive battery cable connects to the alternator bolt.

The battery cables, starting motor tie point and alternator connections must be good for the machine’s electrical system to work properly.

The ground cable connections are equally important. Proper starting motor and alternator operation depends on these cables and connections to carry the high current for its operation.

The connection between the starting motor and key switch is fused by a fusible link. This is a short piece of wire that is designed to fail if current load is too high or a short occurs. It protects the wiring harness from damage.

The charge wires running between the voltage regulator/ rectifier and starting motor and between the alternator and the battery positive terminal are unprotected.

Switched Power:

Voltage must be present at the following components with the key switch “ON or RUN” position:

- “A “and “S1” Terminals of key switch
- Start Relay
- Voltage Regulator/Rectifier
- Ignition Module
- Fuel Pump
- Park Brake Switch
- Differential Lock Switch
- Light Switch (Standard or Homologated)
- Lift Switch Connector
- Engine Coolant Temperature Light
- Engine Oil Pressure Light

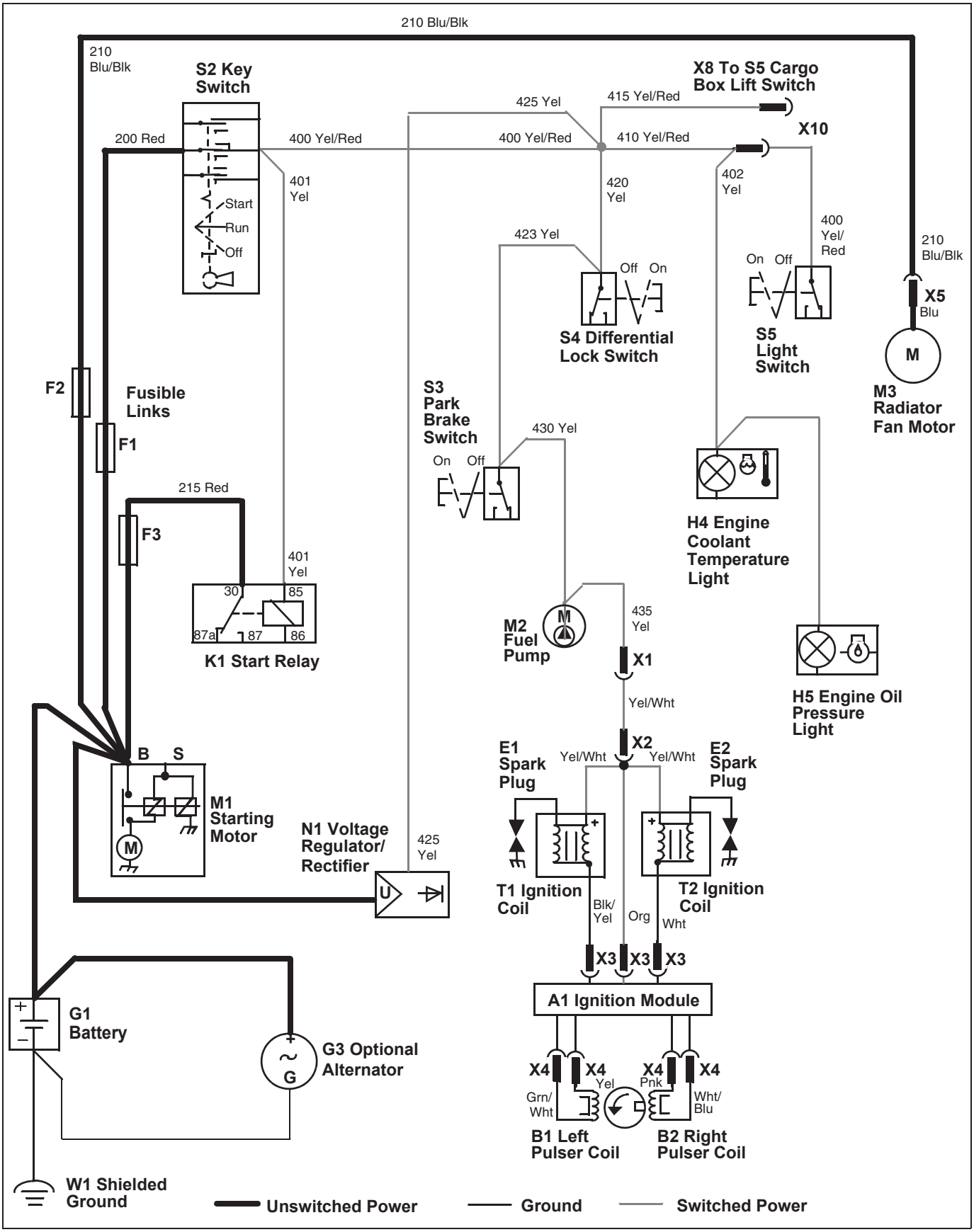
These circuits are controlled by the key switch and are protected by the fusible link.

Optional Lighting Kit and Lift Kit Power Circuits:

See the appropriate schematics and diagnostic procedure for these kits.

When optional kits are installed, the positive wires for these kits are also connected to the starting motor. These leads also contain fusible links to protect the wiring harnesses.

Power Circuit Schematic - 6X4 Gas



Power Circuit Diagnosis - 6X4 Gas

Test Conditions:

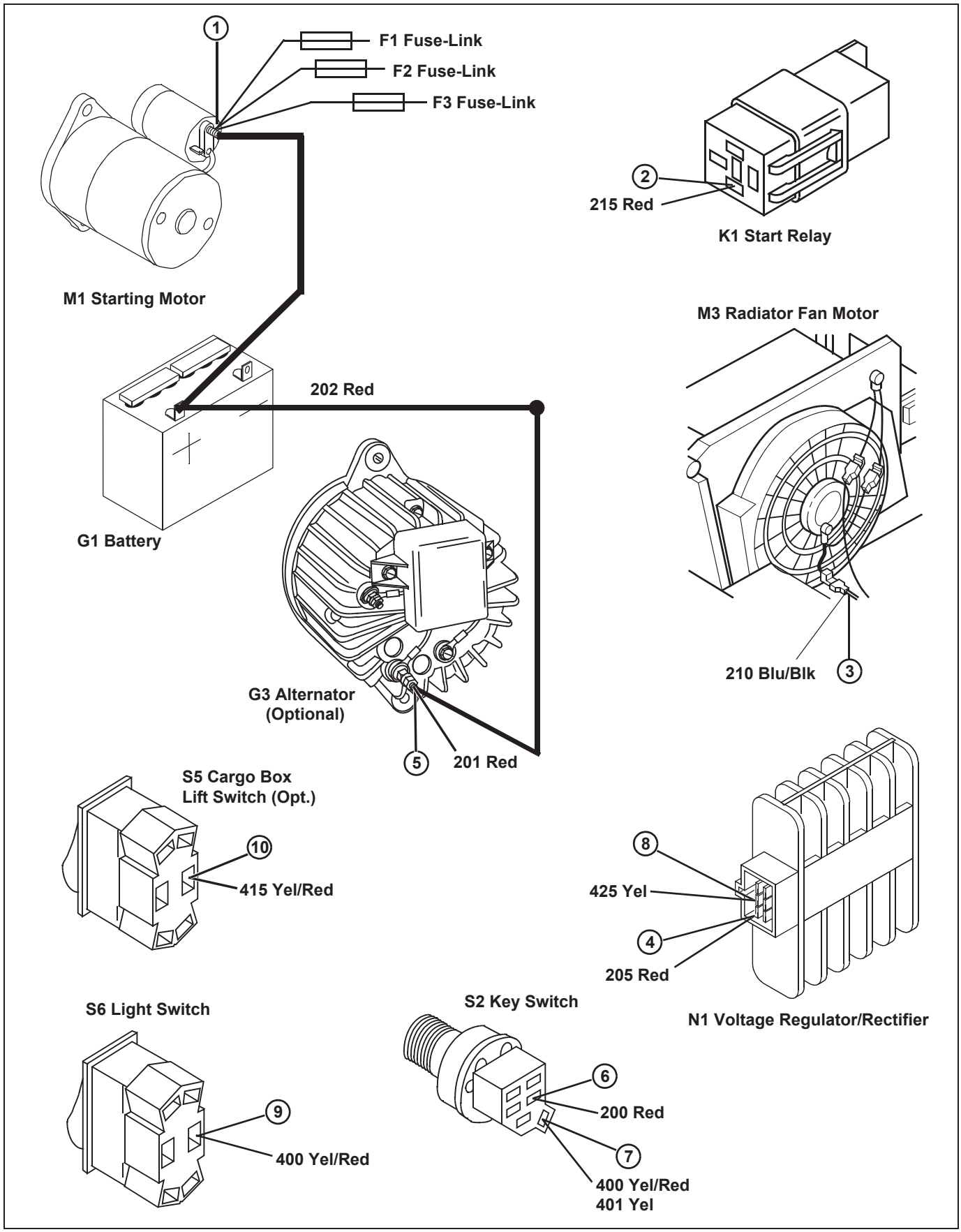
- Key switch in OFF position

Test/Check Point	Normal	If Not Normal
1. Starting motor battery terminal	Battery voltage	Check battery cables and test battery. See “Battery Test” on page 372.
2. Start relay	Battery voltage	Check 215 Red wire. Replace F3 fusible link.
3. Radiator fan motor	Battery voltage	Check 210 Blu/Blk wire and connections. Replace F2 fusible link.
4. Voltage regulator/rectifier	Battery voltage	Check 205 Red wire and connections.
5. Alternator, high capacity (optional)	Battery voltage	Check 202 and 201 Red in W29 Harness
6. Key switch	Battery voltage	Check 200 Red wire and connections. Replace F1 fusible link.

Test Conditions:

- Key switch in RUN position

Test/Check Point	Normal	If Not Normal
7. Key switch	Battery voltage	Replace S2 key switch.
8. Voltage regulator/rectifier	Battery voltage	Check 425 Yel wire and connections.
9. Light switch	Battery voltage	Check 400 Yel/Red wire and connections.
10. Lift switch connector	Battery voltage	Check 415 Yel/ Red wire connection.

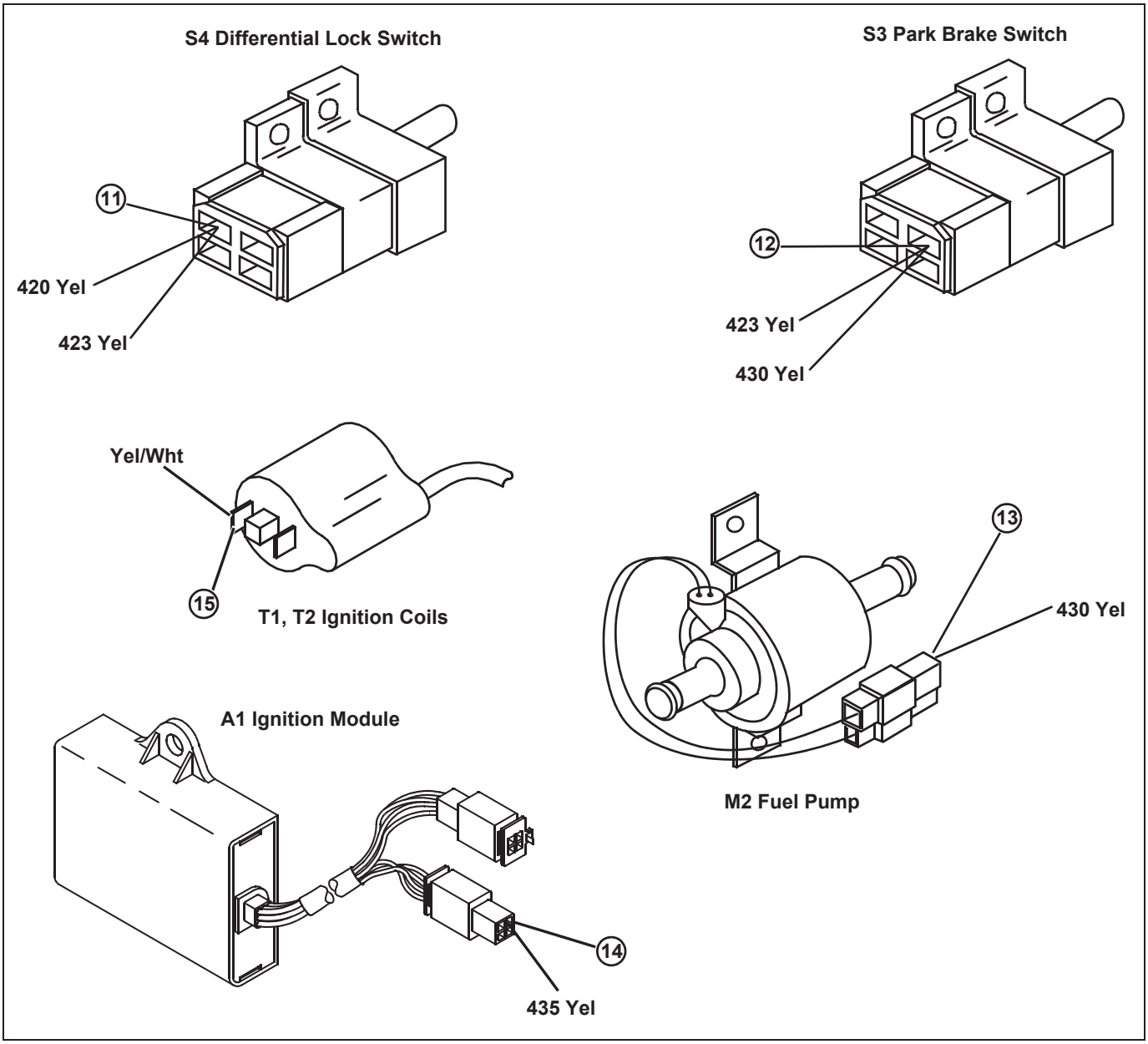

1
F1 Fuse-Link
F2 Fuse-Link
F3 Fuse-Link
M1 Starting Motor
2
215 Red
K1 Start Relay
M3 Radiator Fan Motor
202 Red
G1 Battery
G3 Alternator
(Optional)
5
201 Red
210 Blu/Blk
3
S5 Cargo Box
Lift Switch (Opt.)
10
415 Yel/Red
8
425 Yel
4
205 Red
N1 Voltage Regulator/Rectifier
S6 Light Switch
9
400 Yel/Red
S2 Key Switch
6
200 Red
7
400 Yel/Red
401 Yel

Power Circuit Diagnosis - 6X4 Gas (continued)

Test Conditions:

- Key switch in ON position

Test/Check Point	Normal	If Not Normal
11. Differential lock switch	Battery voltage	Check connection of 420 Yel wire.
12. Park brake switch	Battery voltage	Check 423 Yel wire and connections.
13. Fuel pump motor	Battery voltage	Check 430 Yel wire and connections.
14. Ignition module	Battery voltage	Check 435 Yel wire and connections.
15. Ignition coils	Battery voltage	Check X3 engine harness connector and Yel/Wht wire at ignition module.



Cranking Circuit Operation - 6X4 Gas

Function:

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

Operating Conditions:

- Key switch in START position
- Transmission in NEUTRAL

Theory of Operation:

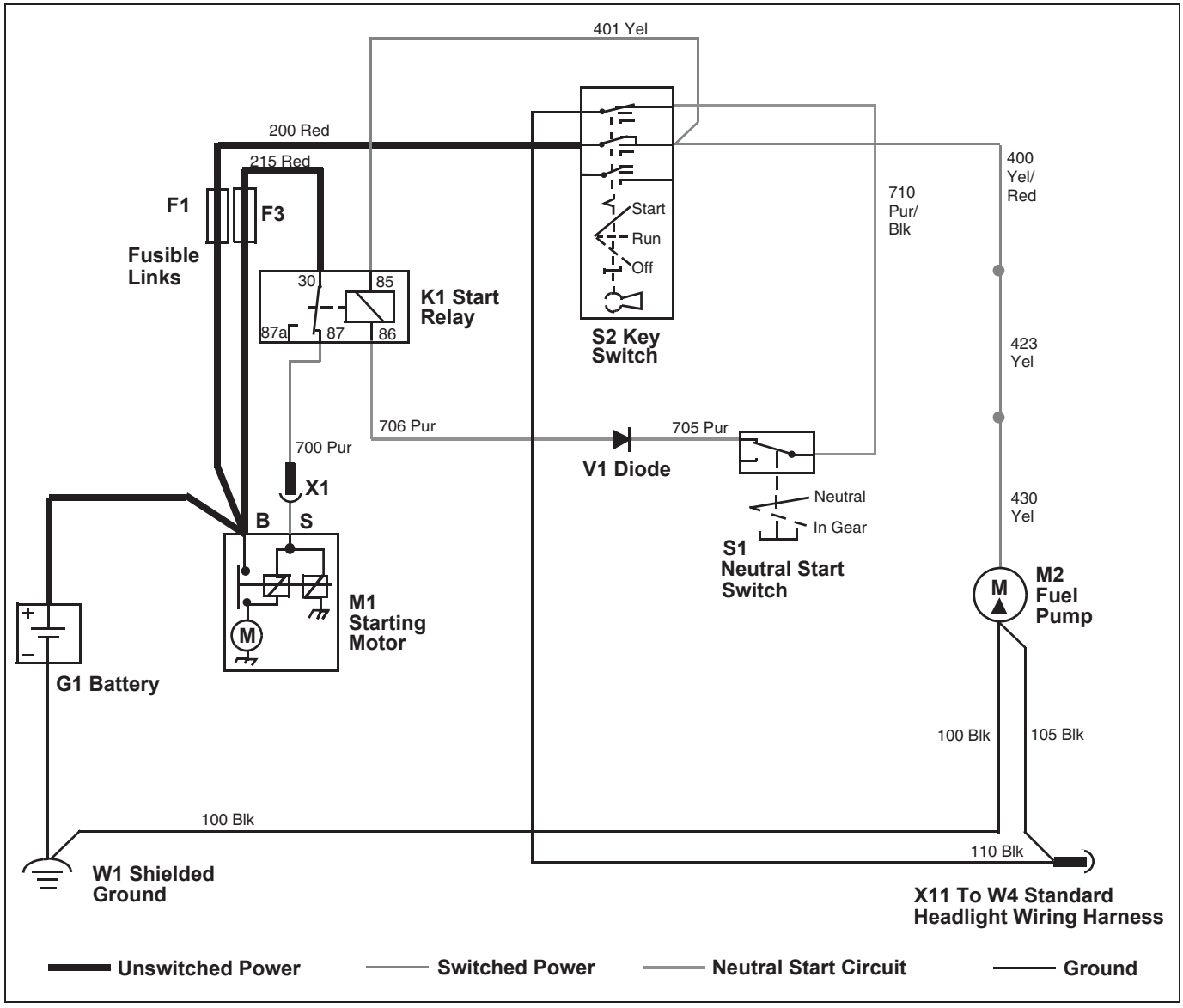
Current from the power circuit (200 Red) flow through a fusible link to the key switch.

The S2 key switch allows current to flow to the start relay when in the run or start position (401 Yel). With the transmission in neutral the S2 key switch connects the neutral start circuit (706 Pur, V1 Diode, 705 Pur and 710 Pur) to ground, allowing the start relay to activate.

The start relay then allows a higher current to pass from the battery, through the F2 fusible link and start relay to energize the starter solenoid (215 Red, 700 Pur).

With the starting motor solenoid activated, high current from the battery passes through the battery cable, across the solenoid and energizes the starting motor.

Cranking Circuit Schematic - 6X4 Gas



Cranking Circuit Diagnosis - 6X4 Gas

Test Conditions:

- Transmission in NEUTRAL and brake set
- Key switch in OFF position

Test/Check Point	Normal	If Not Normal
1. Key switch	Battery voltage	Check 200 Red wire and F3 fusible link. See “Power Circuit Diagnosis - 6X4 Gas” on page 292.
2. Start relay	Battery voltage	Check 215 red wire and connections. Replace F2 fusible link.

Test Conditions:

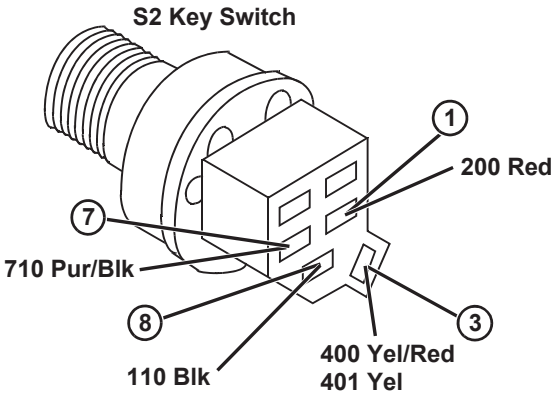
- Key switch in START position

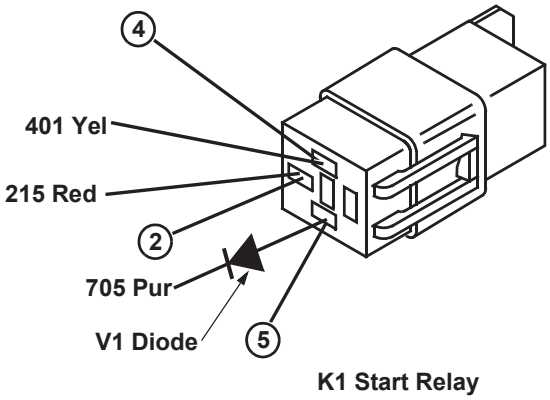
Test/Check Point	Normal	If Not Normal
3. Key switch	Battery voltage	Replace S2 key switch.
4. Start relay	Battery voltage	Test 401 Yel wire and connections.

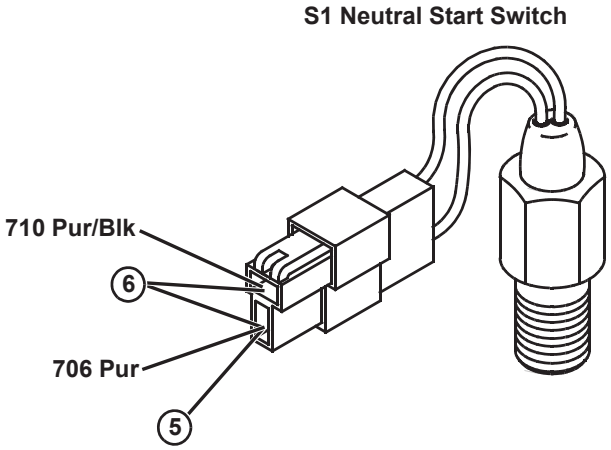
Test Conditions:

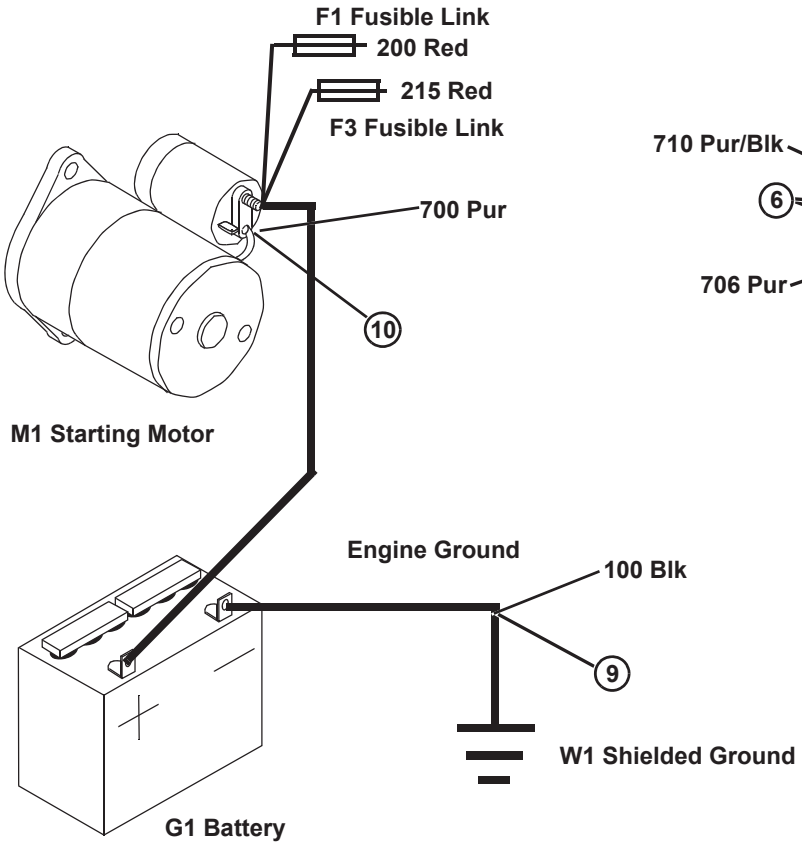
- Remove connector from start relay
- Change meter to ohm scale
- Test for continuity to ground with transmission in neutral and key switch in START position

Test/Check Point	Normal	If Not Normal
5. Relay connector to neutral start switch	Continuity in one direction only	Continuity in both directions replace V1 diode or wiring harness. No continuity in either direction, repair wire.
6. Neutral start switch (Switch disconnected)	Continuity across neutral start switch	Check transmission linkage neutral adjustment. Replace neutral start switch.
7. Neutral start switch to key switch	Continuity	Repair 710 Pur/Blk wire.
8. Key switch	Continuity across switch in START position	Replace S2 key switch.
8. Key switch to engine ground	Continuity	Check Blk wires and connection at fuel pump, light harness connector, and engine and battery ground location. Repair wires and/or connections.
10. Starting motor solenoid “S” terminal	Battery voltage	No voltage: Test 700 Pur wire and connections. Replace K1 start relay. Voltage: Check battery ground cable and connections. Test or replace starting motor solenoid.


S2 Key Switch
1
200 Red
7
710 Pur/Blk
8
110 Blk
400 Yel/Red
401 Yel
3


4
401 Yel
215 Red
2
705 Pur
V1 Diode
5
K1 Start Relay


S1 Neutral Start Switch
710 Pur/Blk
6
706 Pur
5


F1 Fusible Link
200 Red
215 Red
F3 Fusible Link
700 Pur
10
M1 Starting Motor
Engine Ground
100 Blk
9
W1 Shielded Ground
G1 Battery

Ignition Circuit Operation - 6X4 Gas

Function:

To create a spark at the correct time, that ignites the fuel and air mixture.

Operating Conditions:

- Key switch must be in the START or RUN position.

Theory of Operation:

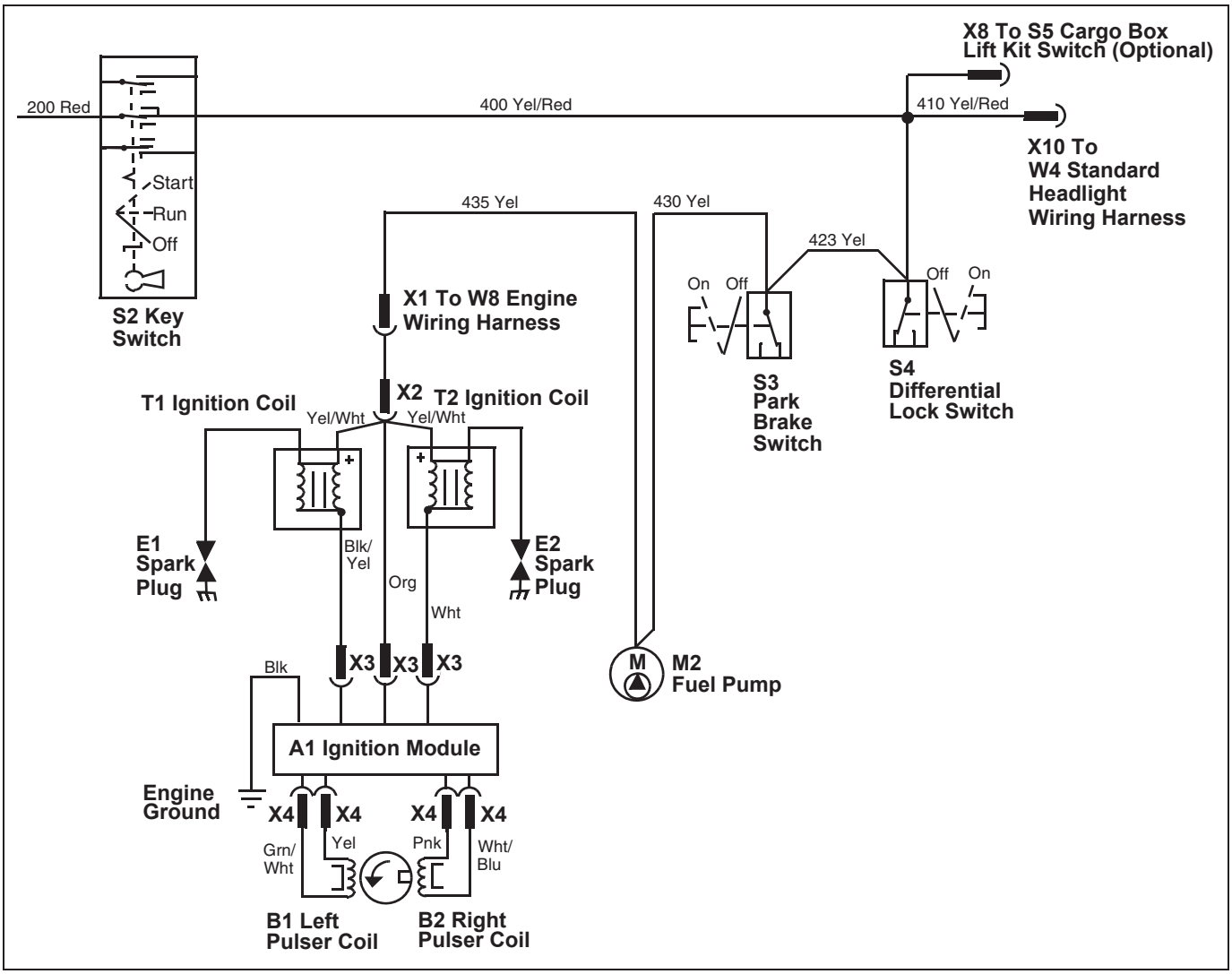
The ignition system is a transistor controlled, battery ignition design. The battery supplies current to the ignition coils. The timing is controlled by the ignition module and is not adjustable. The engine is shutoff by de-energizing the ignition coils.

Current flows from the key switch to the left and right ignition coils. The differential lock, park brake and fuel pump are all powered by this circuit.

Two pulser coils, one for each cylinder, are mounted in a fixed position next to the flywheel. As the flywheel turns, a tab on the flywheel travels past the pulser coils and produces current in the pulser coils by electromagnetic induction. Pulser coil current flows to the ignition module as a signal for the module to ground the coil primary windings. When the current flow stops in the primary windings, the magnetic field collapses and induces high voltage in the secondary coil windings. The high voltage current travels through the plug wire and jumps the gap at the spark plug, igniting the fuel/air mixture.

Each spark plug fires on both the compression and exhaust stroke. The spark produced during the exhaust stroke does not affect engine operation because there is no compression or combustible mixture in the cylinder.

Ignition Circuit Schematic - 6X4 Gas



Ignition Circuit Diagnosis - 6X4 Gas

Test Conditions:

- Key switch in RUN position

Test/Check Point	Normal	If Not Normal
1. Main wiring harness to engine wiring harness connector	Battery voltage	Check connections at differential lock and park brake switches and at the fuel pump. See “Power Circuit Diagnosis - 6X4 Gas” on page 292.
2. Positive terminals of right and left ignition coils	Battery voltage	Check Yel/Wht wire of coil harnesses and X2 connections at engine harness connector.
3. Ignition module connector module side. (Org or Org/Wht wire lead)	Battery voltage	Check Org wire and connections through module and engine harness power connector.
4. Right and left negative terminal of ignition coils. (Wht and Blk/Yel leads)	Battery voltage minus voltage drop across coils	No voltage: Replace ignition coil.

Test Conditions:

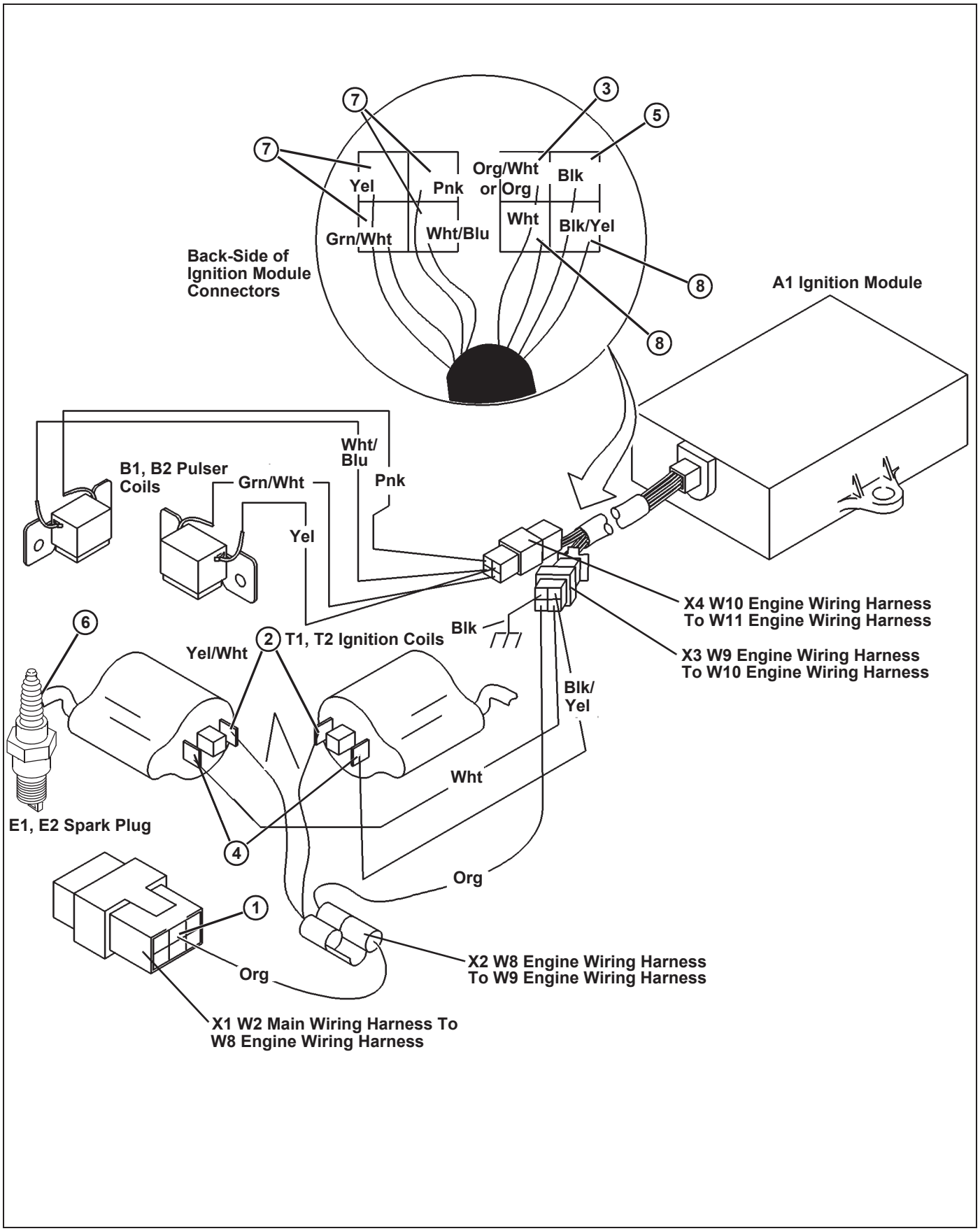
- Key switch to OFF position

Test/Check Point	Normal	If Not Normal
5. Ignition module connector (Blk ground wire)	Maximum 0.1 ohms resistance	Check ignition module ground connection.

Test Conditions:

- Meter set to AC voltage
- Plug wires grounded
- Key switch to START position
- Engine cranking

Test/Check Point	Normal	If Not Normal
6. Spark plugs	Spark plug tester: Hot blue spark	Inspect or replace spark plug(s).
7. Pulser coil connection (Wht/Blu and Pnk, then Grn/Wht and Yel)	0.1 - 1.0 VAC Coil resistance 85 - 270 ohms	Check pulser coil connections. Test pulser coil resistance. Replace pulser coil.
8. Ignition module connector (Wht then Blk/Yel wire leads)	Using test light: Rapid flashing light, not steady glow. Coil resistance: Primary windings 3.4 - 4.6 ohms. Secondary windings 10.4 - 15.5 ohms	Flashing light: Check coil resistance. No Light: Check connections. Replace ignition module.


7
7
3
5
Yel
Pnk
Org/Wht
or Org
Blk
Grn/Wht
Wht/Blu
Wht
Blk/Yel
Back-Side of
Ignition Module
Connectors
8
8
A1 Ignition Module
Wht/
Blu
B1, B2 Pulser
Coils
Grn/Wht
Pnk
Yel
X4 W10 Engine Wiring Harness
To W11 Engine Wiring Harness
6
Blk
2
T1, T2 Ignition Coils
Yel/Wht
X3 W9 Engine Wiring Harness
To W10 Engine Wiring Harness
Blk/
Yel
Wht
E1, E2 Spark Plug
4
Org
1
X2 W8 Engine Wiring Harness
To W9 Engine Wiring Harness
Org
X1 W2 Main Wiring Harness To
W8 Engine Wiring Harness

M56701

Charging Circuit Operation - Stator

Function:

To maintain battery voltage between 12.4 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 (Stator equipped):

The charging system is a permanent magnet and stator design. Charging output is controlled by a voltage regulator/rectifier.

With the key switch in the run position, battery sensing circuit current flows from battery positive terminal to starting motor terminal, fusible link, key switch, and regulator-rectifier. The battery sensing circuit allows the voltage regulator/rectifier to monitor battery voltage.

As the flywheel turns, a permanent magnet located in the flywheel induces AC current in the stator. The AC current flows to the voltage regulator/rectifier. The voltage regulator/rectifier converts AC current to DC current needed to charge the battery.

If battery voltage is low, the voltage regulator/rectifier allows DC current to flow to the battery to charge it through the battery charging circuit (205 Red). When the battery is fully charged, the voltage regulator stops current flow to the battery.

If the stator output current falls below the system usage or is insufficient to maintain a preset voltage, the voltage regulator provides current to turn on the discharge indicator light.

The ground circuit provides a path to ground for the voltage regulator/rectifier

Charging Circuit Operation - Auxiliary Alternator (Optional)

Function:

To maintain battery voltage between 12.4 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 consists of the G3 alternator with an integrated voltage regulator/rectifier. Charging output is controlled by a regulator/rectifier.

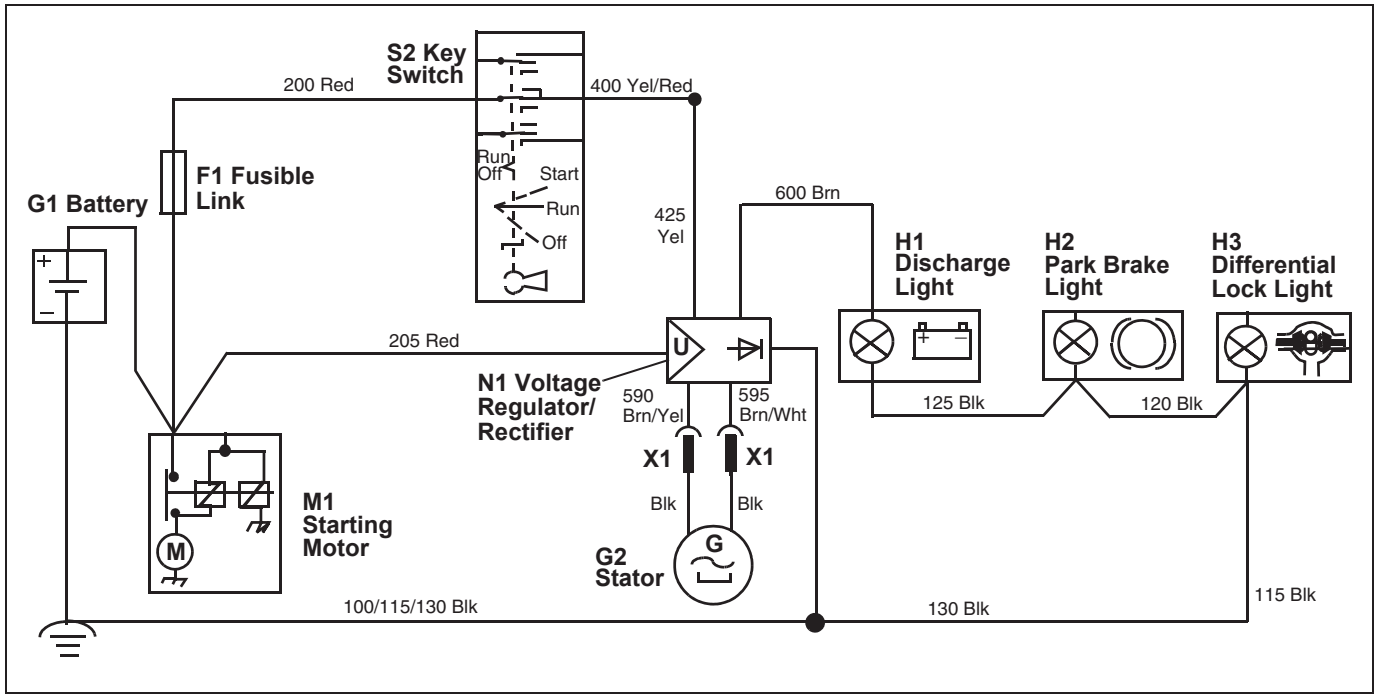
With the key switch in the RUN position, battery sensing circuit current flows from battery positive terminal 202 and 201 Red wires to the auxiliary alternator internal voltage regulator/rectifier. The battery sensing circuit allows the voltage regulator/rectifier to monitor battery voltage.

A rotating permanent magnet in the alternator induces AC current in the alternator stator coils. The AC current flows to the voltage regulator/rectifier. The voltage regulator/rectifier converts AC current to DC current needed to charge the battery.

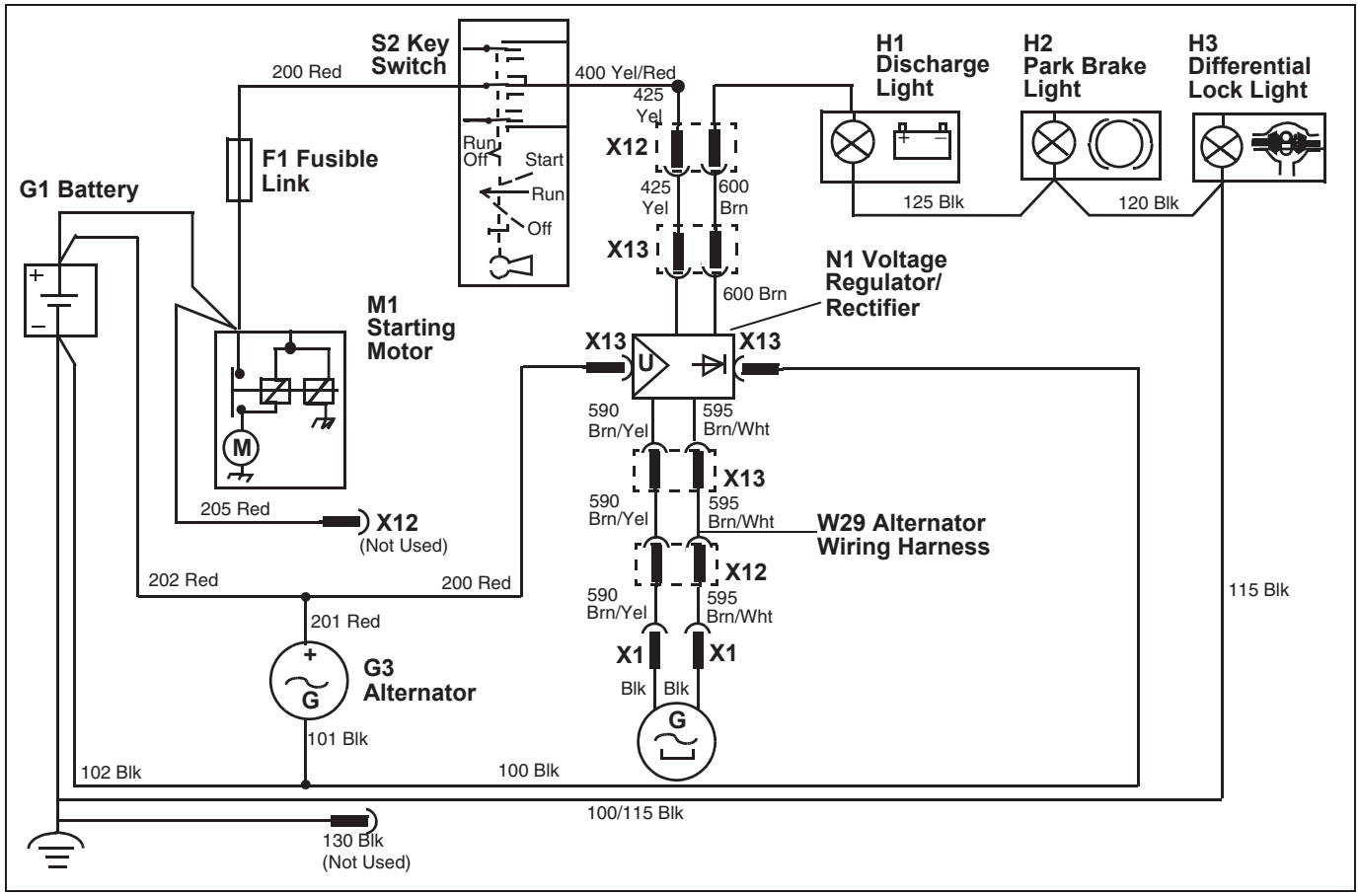
If battery voltage is low, the regulator/rectifier allows DC current to flow to the battery to charge it through the battery charging circuit (201 and 202 Red). When the battery is fully charged, the voltage regulator/rectifier stops current flow to the battery.

The ground circuit (101 and 102 Blk) provides a path to ground for the voltage regulator/rectifier.

Charging Circuit Schematic - Stator



Charging Circuit Schematic - Auxiliary Alternator



Charging Circuit Diagnosis - 6X4 Gas

Test Conditions:

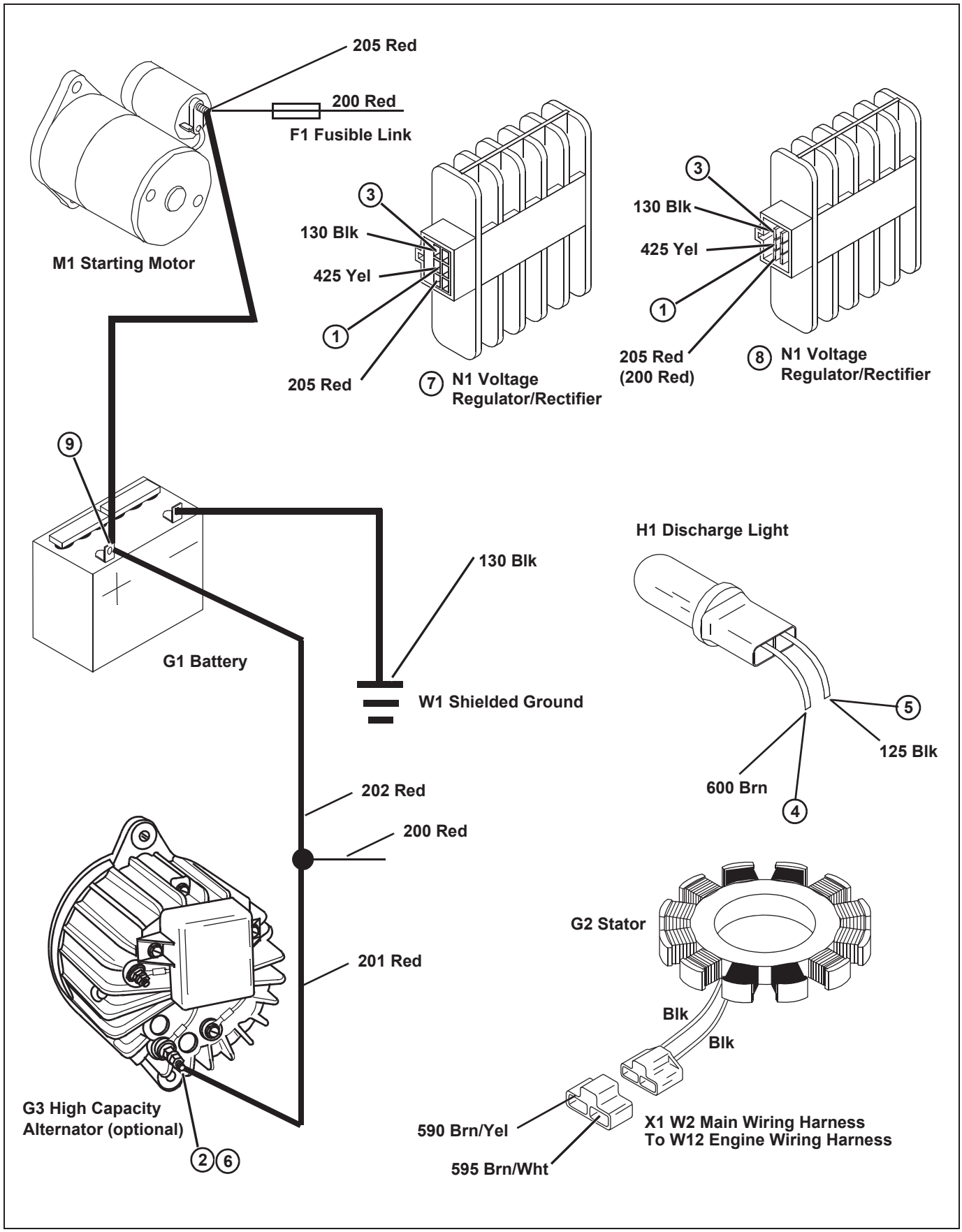
- Transmission in NEUTRAL
- Engine OFF

Test/Check Point	Normal	If Not Normal
1. Voltage regulator/rectifier	Battery voltage	Check 425 Yel wire and connections. Check F1 fusible link and S2 key switch. See “Power Circuit Diagnosis - 6X4 Gas” on page 292.
2. High Capacity Alternator (If equipped)	Battery voltage	Check 202 and 201 Red wires and connections.
3. Voltage regulator/rectifier	Greater than 0 volts - less than 0.2 volts	Greater than 0.2 volts: Test voltage regulator/rectifier ground circuit.
4. Charge indicator light (600 Brn Wire)	Battery voltage	Check 600 Brn wire and connections X12, X13.
5. Charge indicator light	Greater than 0 volts - less than 0.2 volts	0 volts: Replace bulb. Greater than 0.2 volts: Check all connections and ground wires for open or poor connections.

Test Conditions:

- Stator disconnected
- Engine running at high idle

Test/Check Point	Normal	If Not Normal
6. High capacity alternator	Minimum unregulated voltage output - 45 amps at 12.2-13.8 V	Check stator leads and connector. Check flywheel magnets. Replace stator.
7. Voltage regulator/rectifier (Machine SN -007496) (Engine SN -038265)	Minimum 20 Amps at 12.2 -13.8 V	Replace voltage regulator/rectifier. See “Alternator Output - 4X2” on page 392.
8. Voltage regulator/rectifier (Machine SN 007497-) (Engine SN 038266 -)	Minimum 16 Amps at 12.2 -13.8 V	See “Stator - Regulated Amperage and Voltage Tests” on page 375. Replace voltage regulator/rectifier.
9. Battery	Voltage above normal battery voltage	Check for excessive load on electrical system.


205 Red
200 Red
F1 Fusible Link
M1 Starting Motor
3
130 Blk
425 Yel
1
205 Red
7 N1 Voltage Regulator/Rectifier
3
130 Blk
425 Yel
1
205 Red
(200 Red)
8 N1 Voltage Regulator/Rectifier
9
G1 Battery
130 Blk
W1 Shielded Ground
H1 Discharge Light
5
125 Blk
600 Brn
4
202 Red
200 Red
201 Red
G3 High Capacity Alternator (optional)
2 6
G2 Stator
Blk
Blk
590 Brn/Yel
595 Brn/Wht
X1 W2 Main Wiring Harness
To W12 Engine Wiring Harness

Indicator Lights Circuit Operation - 6X4 Gas

Function:

Engine Oil Pressure Light:

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

Engine Coolant Temperature Light:

Inform operator of critical engine and coolant operating temperature by illuminating a warning light.

Park Brake Light:

Informs the operator that the park brake is ON by illuminating a warning light.

Differential Lock Light:

Inform the operator that the differential Lock is ON by illuminating a warning light.

Operating Condition:

The key switch must be in RUN position.

Theory of Operation:

Oil Pressure Light:

With the engine OFF and key in RUN position, oil pressure will be below 28 kPa (4 psi). The oil pressure switch will be closed, completing the circuit path to ground and illuminating the light. This will inform the operator that the light is functioning.

When the engine is started and running, the light should go out when the oil pressure is adequate to open the pressure switch, turning out the light.

Engine Coolant Temperature Light:

When the key switch is in the START position, the ground circuit is allowed to pass through the V2 diode and the key switch starting circuit to ground. This will momentarily turn on the light as a bulb check, When the engine starts and the key switch is returned to the RUN position, the light will go out. If the engine temperature reaches 109° C ± 1° C (228° F ± 2° F), the sensor will close, providing a path to ground through the engine block.

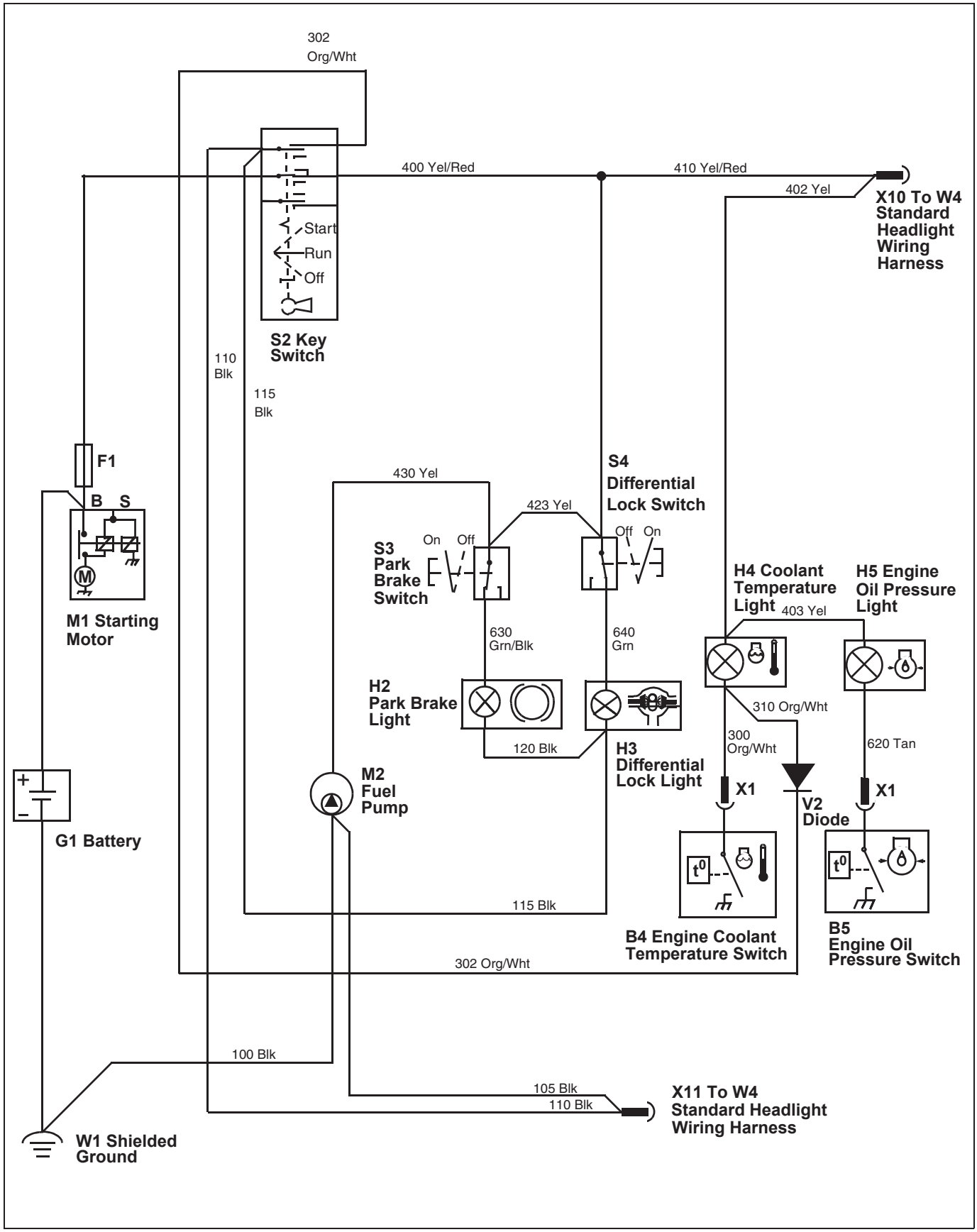
Park Brake Light:

When the park brake is set the switch is released (closes), allowing current to flow to the warning light. When the brake is released the switch is opened and the light goes out.

Differential Lock Light:

When the differential lock lever is moved to engage the differential lock, the switch is depressed (closed), allowing current flow to the light. When the differential is released, the switch is released (open), and the light goes out.

Indicator Lights Circuit Schematic - 6X4 Gas



Indicator Lights Circuit Diagnosis - 6X4 Gas

Test Conditions:

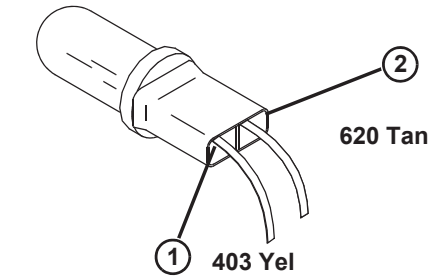
- Key switch in RUN position
- Engine OFF
- Differential lock engaged
- Park brake set

Test/Check Point	Normal	If Not Normal
1. Engine oil pressure light	Battery voltage	Check 402 and 403 Yel Wires and connections. See “Power Circuit Diagnosis - 6X4 Gas” on page 292.
2. Engine oil pressure light	Battery voltage	Replace light bulb.
3. Engine oil pressure switch	Battery voltage	Check 620 Tan wire and connections.
4. Engine oil pressure switch (Wire lead disconnected)	Continuity to ground	Check engine ground. If OK replace engine oil pressure switch.
5. Engine coolant temperature light	Battery voltage	Check 402 Yel wire. See “Power Circuit Diagnosis - 6X4 Gas” on page 292.
6. Engine coolant temperature light	Battery voltage	Replace light bulb.
7. Engine coolant temperature switch	Battery voltage	Check 300 Org/Wht wire and connections.
8. Engine coolant temperature switch	Switch closes at 108° - 110° C (226° - 230° F). Switch opens at 101° - 107° C (214° - 225° F).	Replace Switch. See “Engine Coolant Temperature Switch Test - 6X4’s” on page 390.

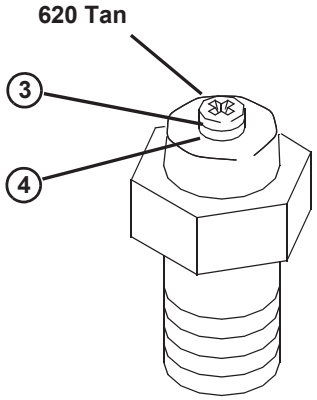
Test Conditions:

- Meter positive lead to voltage source
- Negative lead to ground side of coolant light

Test/Check Point	Normal	If Not Normal
9. Engine coolant temperature light (Momentarily turn key switch to start. This tests ground circuit and diode for bulb test circuit)	Battery voltage	Test V2 diode and check 302 Org/Wht wire lead and connections to S2 key switch.
10. Key switch	Continuity to ground. Maximum 0.1 ohm resistance,	Check ground wire 110, 105, 100 Blk wires and connections.
11. Key switch	Battery voltage	Test or replace key switch. Test V2 diode.

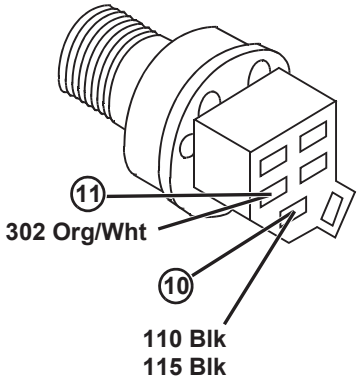


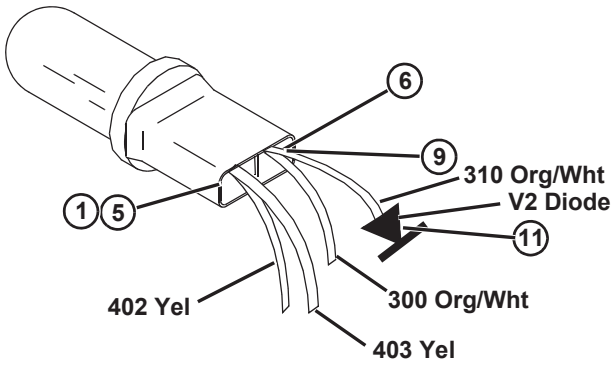
H5 Oil Pressure Light



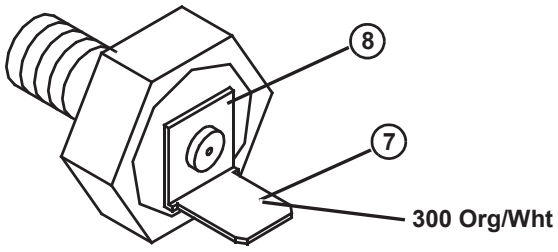
B5 Engine Oil Pressure Switch

S2 Key Switch





H4 Engine Coolant Temperature Light



B4 Engine Coolant Temperature Switch

Fuel Pump and Fan Motor Operation - 6X4 Gas

Radiator Fan Motor:

Operates whenever the coolant switch is closed.

The radiator core temperature switch closes when the coolant heats to 89° C (192° ± 7° F) raising the outer radiator core temperature to 71° C (160° ± 7° F).

NOTE: The outer radiator core temperature is approximately 20° C (36° F) lower than engine coolant temperature.

The fan motor will stop when the coolant temperature drops to 80° C (177° ± 7° F), the outer radiator core temperature cools to 60° ± 4° C (140° ± 7° F), and the radiator core temperature switch opens. The radiator fan motor circuit is connected directly to the battery and does not depend upon the start switch position.

Theory of Operation:

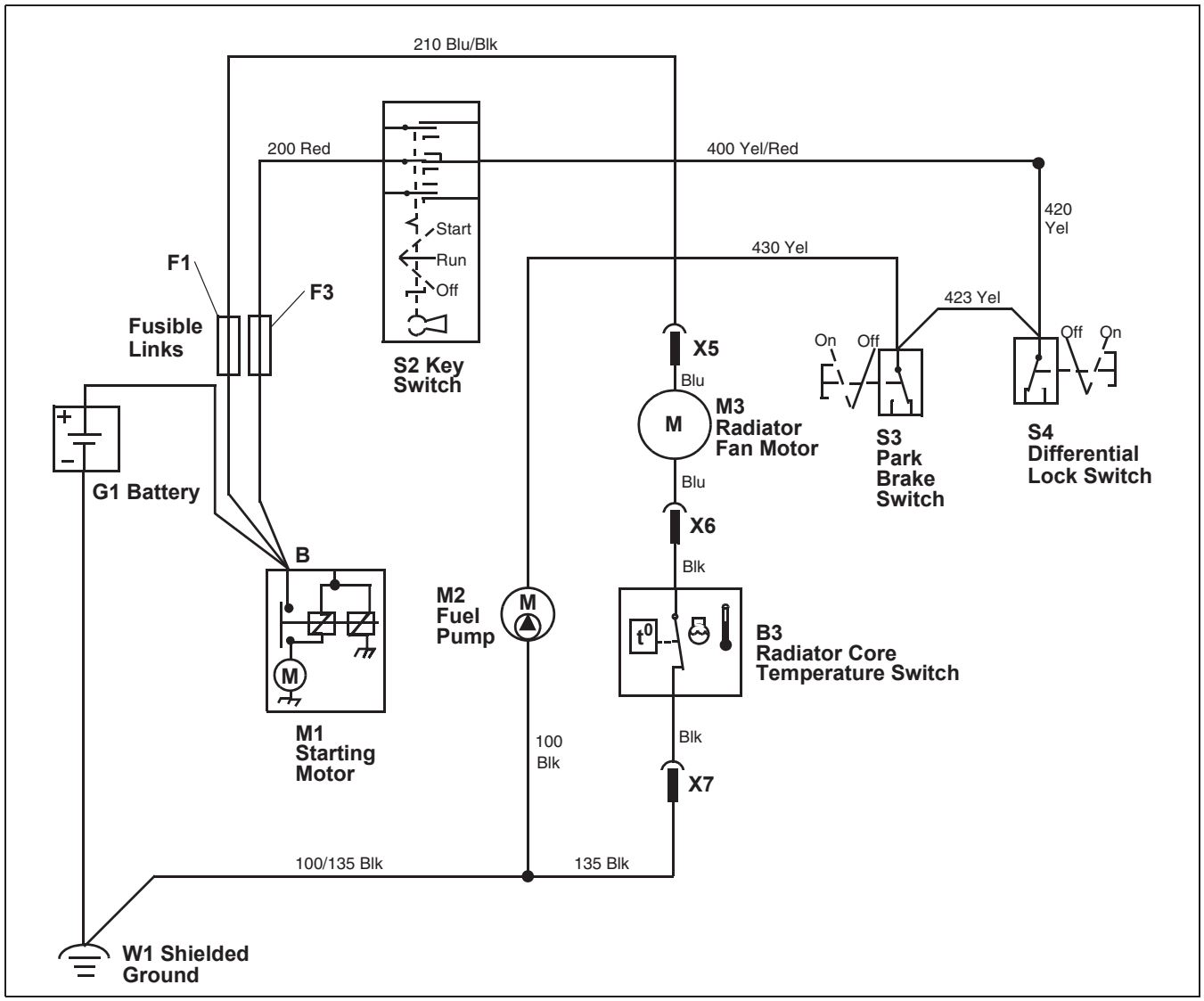
Operates when the radiator core temperature switch closes when coolant heats the outer radiator core to 71° ± 4° C (160° ± 7° F). The radiator core temperature switch monitors outer radiator core temperature, not engine coolant temperature.

Fan motor may run after engine is shutoff. Fan motor will stop when outer radiator core temperature cools to 60° ± 4° C (140° ± 7° F) and radiator core temperature switch opens.

Fuel Pump:

Operates whenever the key is in the run or start position.

Fuel Pump and Fan Motor Schematic - 6X4 Gas



Fuel Pump and Fan Motor Diagnosis - 6X4 Gas

Test Conditions:

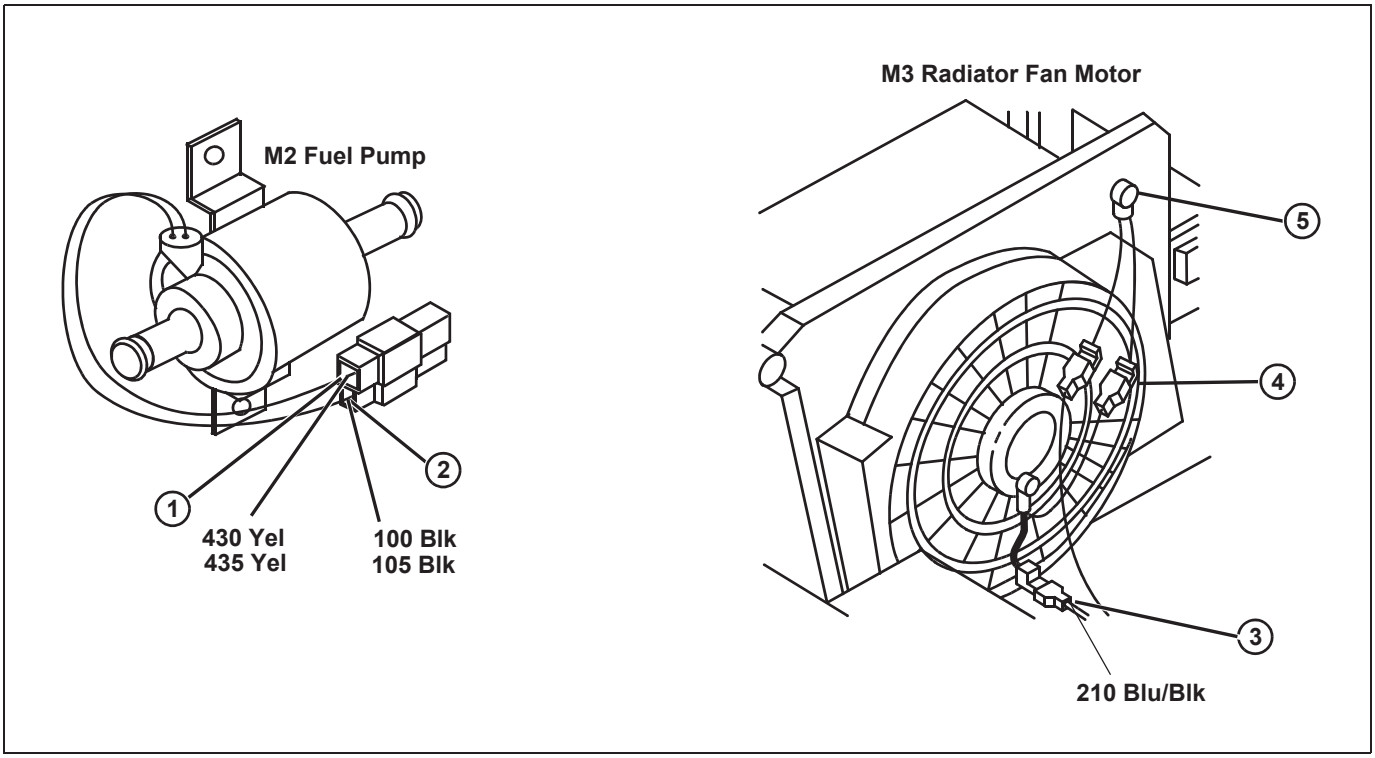
- Key switch in RUN position

Test/Check Point	Normal	If Not Normal
1. Fuel pump	Battery voltage	Check connector. See “Power Circuit Diagnosis - 6X4 Gas” on page 292.
2. Fuel pump.	Greater than 0 - less than 0.2 volts	No voltage: Replace pump. Greater than 0.2 volts: Check ground wire (100 Blk) and connections.

Test Conditions:

- Key switch in OFF position

Test/Check Point	Normal	If Not Normal
3. Radiator fan	Battery voltage	Check 210 Blu/Blk wire and connections. Replace F1 fusible link.
4. Fan to B3 radiator core temperature switch connector. Disconnect and jump fan lead to good ground.	Fan should run. Fan amperage draw - 7 amps	Replace fan.
5. Radiator core temperature switch	Coolant switch closes (fan starts) at 67° - 75° C (153° - 167° F). Coolant switch opens at 56° - 64° C (133° - 147° F).	Check Blk wire, X7, and 135 Blk wire. Replace switch.



Standard Headlight Circuit Operation - 6X4 Gas

NOTE: If the Light and Horn kit option is added, the new harness plugs into the light harness connector (X10) and connector (X11). The light switch and the original light harness are removed.

Function:

Provides power to the headlights.

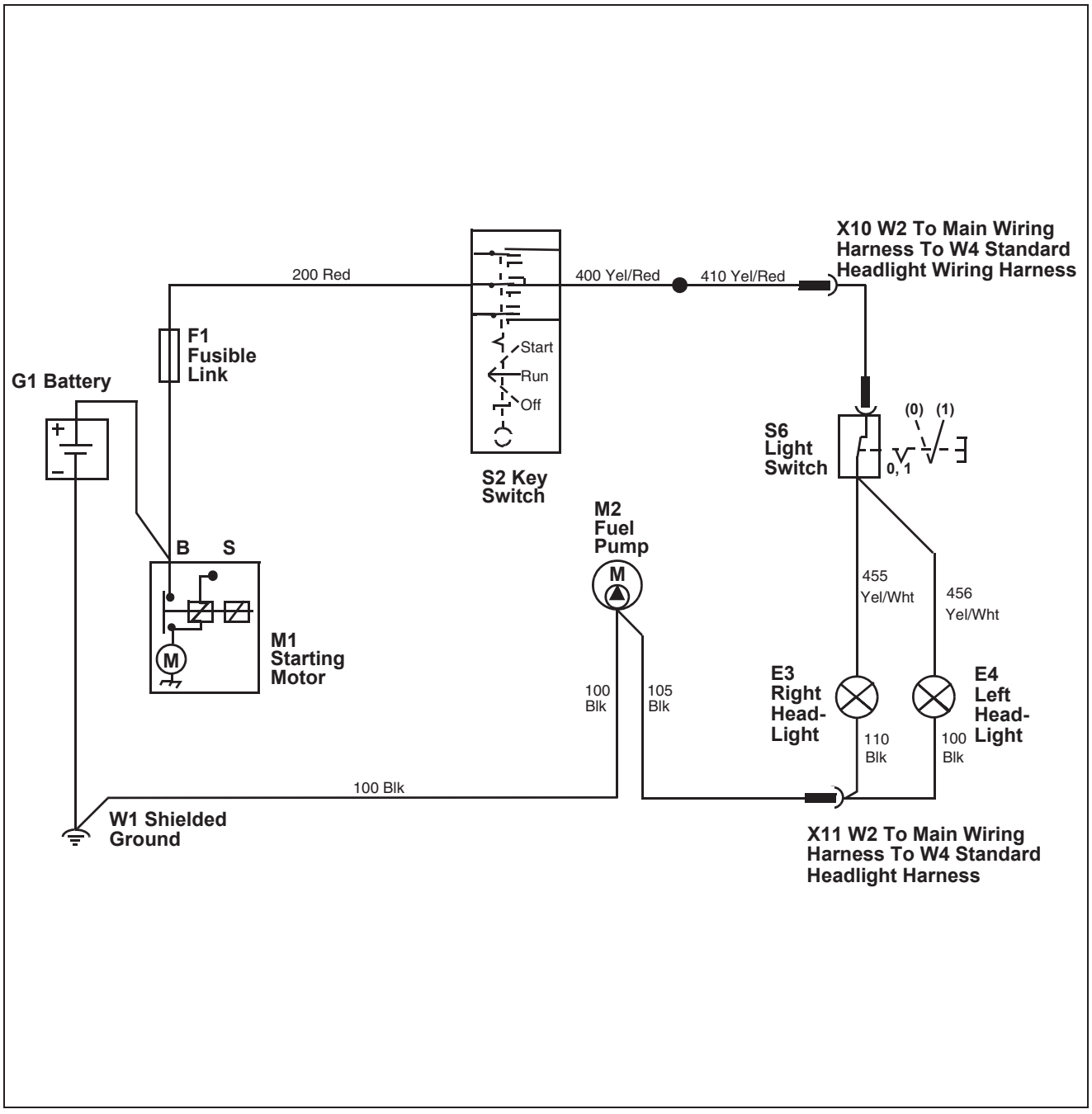
Operating Conditions:

The key switch must be in the RUN position.

Theory of Operation:

The headlight harness is attached to the W2 main wiring harness. Power from the headlight harness connector X10 is connected to the S6 light switch. Current then flows from the switch to the headlights.

Standard Headlight Circuit Schematic - 6X4 Gas

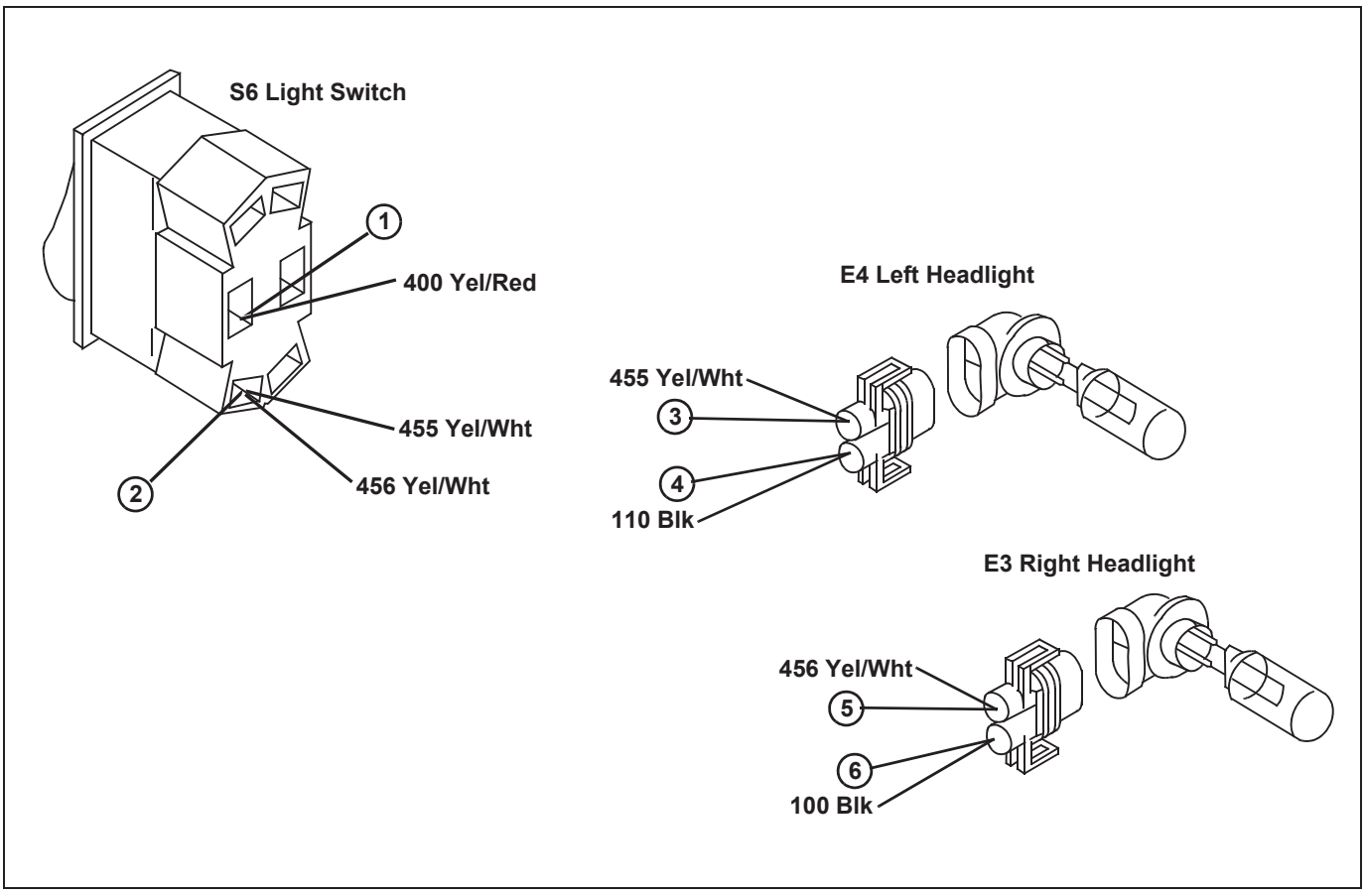


Standard Headlight Circuit Diagnosis - 6X4 Gas

Test Conditions:

- Key switch must be in the RUN position
- Light switch ON

Test/Check Point	Normal	If Not Normal
1. Light switch	Battery voltage	Check connection at X10 connector. See “Power Circuit Diagnosis - 6X4 Gas” on page 292.
2. Light switch	Battery voltage	Replace light switch.
3. Left headlight	Battery Voltage	Check 455 Yel/Wht wire and connections.
4. Left headlight	Greater than 0 volts - less than 0.2 volts	0 volts: Replace headlight. Greater than 0.2 volts: Check ground circuit connection at light harness ground connector X11 and 105 and 100 Blk wires and connections.
5. Right headlight	Battery voltage	Check 456 Yel/Wht wire and connections.
6. Right headlight	Greater than 0 volts - less than 0.2 volts	0 volts: Replace headlight. Greater than 0.2 volts: Check ground circuit connection at light harness ground connector X11and 105 and 100 Blk wires and connections.



Tests and Adjustments

Common Circuit Tests

Shorted/Grounded Circuit:

A shorted circuit on the ground side of a component (i.e. improper wire-to-wire or wire to ground contact) may result in improper component operation.

A shorted circuit on the power side of a component or contact of two power circuits (i.e. improper wire-to-wire or wire to ground contact) may result in blown fusible link and fuses.

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 components stop operating.

4. Shorted or improper connections will be the last two wires disconnected.

High Resistance or Open Circuit:

High resistance or open circuits usually result in slow, dim, or no component operation (i.e. poor, corroded, or severed 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 ground connections of the circuit for corrosion.

2. If terminals are not loose or corroded, the problem is in the component or wiring.

Ground Circuit Test

Reason:

To check for open circuits, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

Equipment:

- Ohmmeter or Voltmeter

NOTE: The voltmeter method checks ground connections under load.

Procedure - Ohmmeter Method:

1. Park machine on level surface.

2. Turn key switch off.

3. Move forward/reverse pedals to neutral position.

4. Lock park brake.

5. Raise hood.

6. Connect ohmmeter red lead to ground terminal of circuit or component to be tested that is closest to the battery negative terminal. Work backward from the battery on the ground side of the problem circuit until the resistance reading increases above 0.1 ohms. If the reading is 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 the connectors closely, as disconnecting and connection may temporarily solve problem.

Procedure - Voltmeter Method:

1. Park machine on level surface.

2. Move forward/reverse pedals to NEUTRAL position.

3. LOCK park brake.

4. Turn key switch to ON position.

5. Raise hood.

6. Connect voltmeter negative (black) lead to negative (-) terminal of battery.

7. Connect voltmeter positive (red) lead to ground terminal of circuit or component to be tested. Be sure that the component circuit is activated (key on, switch(es) closed) so that 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 voltage is 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 Test

CAUTION: Avoid injury! 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:

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

If you spill acid on yourself:

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

If acid is swallowed:

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

Reason:

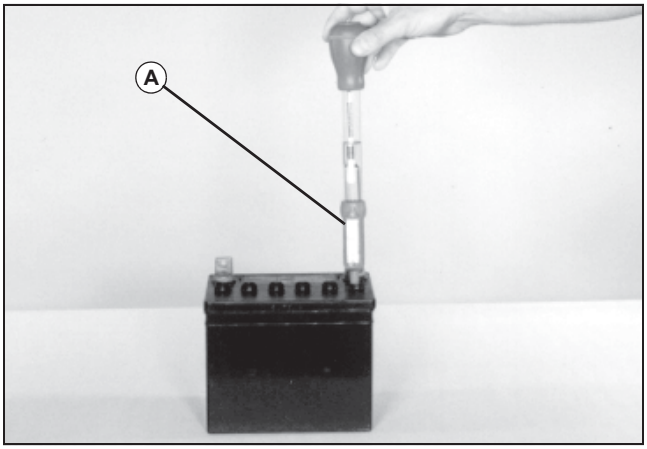
To check condition of battery and determine battery voltage.

Equipment:

- Hydrometer
- Voltmeter or JT05685 Battery Tester

Procedure:

1. Park machine on level surface.
2. Turn key switch off.
3. Lock park 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 is added, charge battery for 20 minutes at 10 amps.
8. Remove surface charge by placing a small load on the battery for 15 seconds.



M49596

9. Use a hydrometer (A) to check for a minimum specific gravity of 1.225 with less than 50 point variation in each cell.

Results:

- If all cells are less than 1.175, charge battery at 10 amp rate.
- If all cells are less than 1.225 with less than 50 point variation, charge battery at 10 amp.
- If all cells are more than 1.225 with less than 50 point variation, load test battery.
- If more than 50 point variation, replace battery.

Use a voltmeter or JT05685 Battery Tester to check for a minimum battery voltage of 12.4 volts.

Results:

- If battery voltage is less than 12.4 VDC, charge battery See “Charge Battery” on page 373.
- If battery voltage is more than 12.4 VDC, test specific gravity (see Step 9).

Install battery.

Charge Battery

Reason:

To increase battery charge after the battery has been discharged.

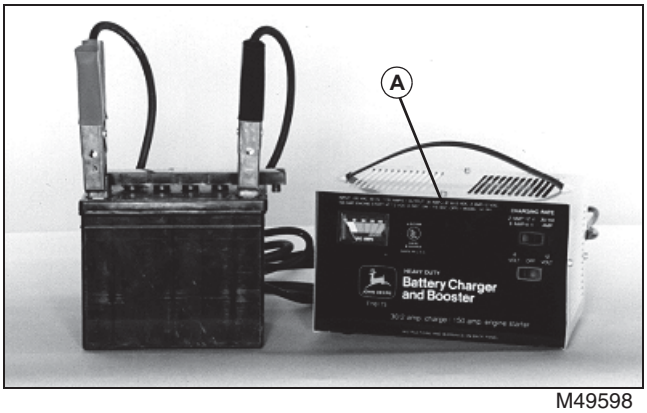
Equipment:

- Battery charger (variable rate)

Procedure:

NOTE: See "Battery Test" on page 372, before charging battery.

1. Park machine on level surface.
2. Turn key switch off.
3. Lock park brake.
4. Clean cable ends, battery terminals and top of battery.
5. Remove battery to workbench.



M49598

6. Connect variable rate charger (A) to battery.
7. Start charger at slow rate. Increase charge rate one setting at a time. Check charger ammeter after 1 minute at each setting. Maintain 10 amp charge rate. Use boost setting as necessary.
8. Check if battery is accepting 10 amp charge rate after 10 minutes at boost setting.

Results:

- If battery will not accept 10 amp charge after 10 minutes at boost setting, replace battery;
- If battery is accepting 10 amp charge after 10 minutes at boost setting, and battery did not need water, go to Steps 9 and 10.
- If 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 9 and 10.

9. Set charger at 15 - 25 amps.

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

10. Check specific gravity after 30 minutes (60 minutes for maintenance-free battery).

Results:

- If more than 50 point variation between cells, replace battery;
- If less than 50 point variation between cells, go to Step 10 and 11.

NOTE: If battery was discharged at slow or unknown rate, charge battery 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.)

11. Continue to charge battery until specific gravity is 1.230 - 1.265 points.
12. Load test battery. See "Battery Load Test" on page 373
13. Install battery.

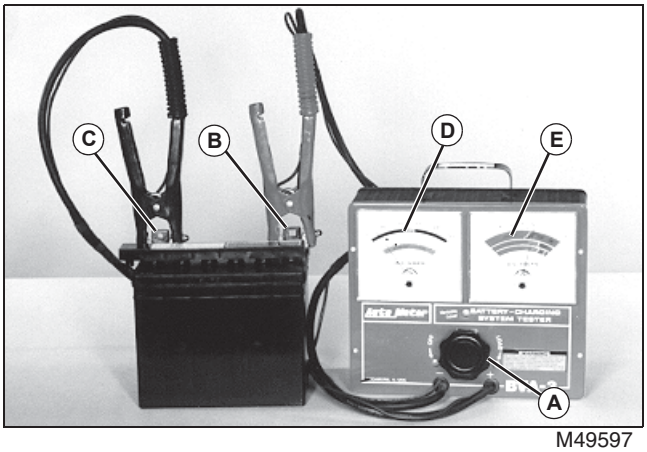
Battery Load Test

Equipment:

- JT05685 Battery Tester

Procedure:

1. Park machine on level surface.
2. Turn key switch off.
3. Move forward/reverse pedals to neutral position.
4. Lock park brake.
5. Clean cable ends, battery terminals and top of battery.
6. Remove battery.



M49597

7. Turn load knob (A) counterclockwise to off position.

8. Connect tester positive (red) cable to battery positive (+) terminal (B).

9. Connect tester negative (black) cable to battery negative (-) terminal (C).

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

- Cold cranking amperage rating of battery (use blue scale), or
- Three times ampere hour rating (use black scale).

11.Hold for 15 seconds and turn load knob (A) of tester counterclockwise to off position.

12.Repeat Steps 10 and 11 above and read condition of battery at DC Volts scale (E).

Results:

- If battery does not pass test and has not been charged, charge battery and retest.
- If battery does not pass test and has been charged, replace battery.

Stator - Unregulated Voltage Output Test - Gas Engines

Reason:

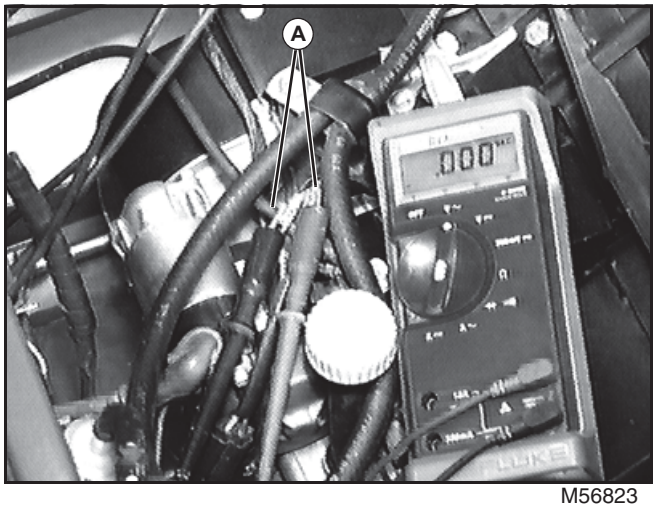
To measure stator voltage output to determine condition of stator and flywheel magnets.

Equipment:

- Voltmeter

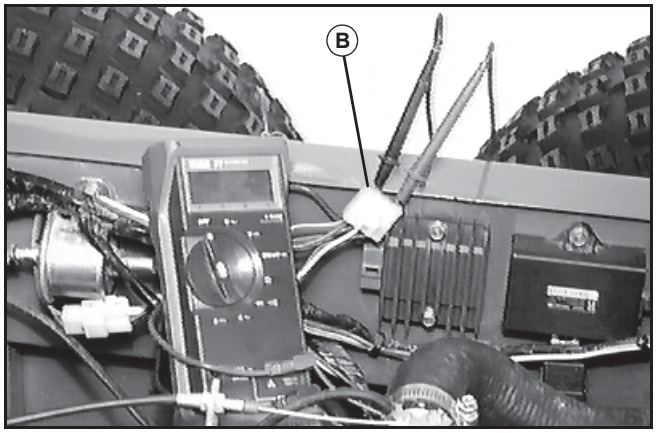
Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.



M56823

4. Disconnect two pin connectors (A) on wires routed from stator.
5. Connect voltmeter to pin connectors on wires routed from stator.



M56824

6. Disconnect wiring harness connector (B) from voltage regulator.
7. Connect voltmeter to brown/white and brown/yellow wires in connector.
8. Set voltmeter on AC volt scale.
9. Start and run engine at FAST idle and read meter:

- **4X2 should have a minimum of 34 volts AC at FAST idle (3750 ± 100 rpm).**
- **6X4 should have a minimum of 26 volts AC at FAST idle (3650 ± 50 rpm; - FD620D075777) (3850 ± 75 rpm; FD620D075778 -)**
- If reading is BELOW specification, check stator and flywheel magnets.

See “Flywheel Magnet(s) Test - Gas Engines” on page 385.

Stator - Regulated Amperage and Voltage Tests

Reason:

To determine regulated voltage (charging) output of voltage regulator/rectifier.

Equipment:

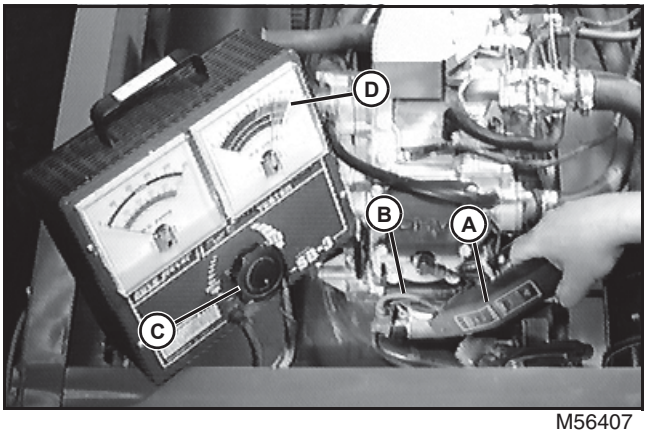
- JT05712 Current Gun
- JT05685 Battery Tester

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Remove seats and operator's station black plastic shroud on 4X2.
4. Cargo box RAISED and LOCKED.

NOTE: Battery must be in good state of charge.

See "Battery Test" on page 372.



M56407

5. Put JT05712 Current Gun (A) around positive (red) battery cable (B) going to starting motor so current-flow arrow points towards battery. Set current gun for DC current.

IMPORTANT: Avoid damage! Turn load knob (C) fully counterclockwise (out) into OFF position BEFORE making any test connections.

6. Connect battery tester to battery.

IMPORTANT: Avoid damage! Perform this test quickly to prevent damage to battery tester. DO NOT apply full load to battery for more than 5 - 10 seconds.

7. Turn load knob (C) clockwise (in) until voltage on tester voltage scale (D) reads **11 volts for 5 seconds only** to partially drain battery.
8. Quickly turn load knob (C) completely counterclockwise (out) into OFF position.
9. Start and run engine at FAST idle. Battery voltage should read between **12.2 - 14.7 volts DC.**
10. Turn load knob (C) clockwise (in) until voltage on tester voltage scale (D) reads **11 volts** and look at current gun (A) for a "minimum" amperage reading:

- 13 amps 4X2 Gas (All)
- 16 amps 6X4 Gas (- FD620D038265)
- 14 amps 6X4 Gas (FD620D038266 -)
- 40 amps 6X4 Diesel (All)
- Quickly turn load knob (C) completely counterclockwise (out) into OFF position.
- **After load test, voltmeter should return to a maximum of 14.7 volts DC.**
- If current gun amp reading is BELOW specification, test for unregulated voltage output. If unregulated voltage output test meets specifications and you have verified voltage and ground to voltage regulator/rectifier, replace voltage regulator/rectifier.

See "Stator - Unregulated Voltage Output Test - Gas Engines" on page 374.

- If at anytime voltage increase exceeds 14.7 volts DC, replace voltage regulator/rectifier.

Alternator - Unregulated Amperage Test - Diesel Engines

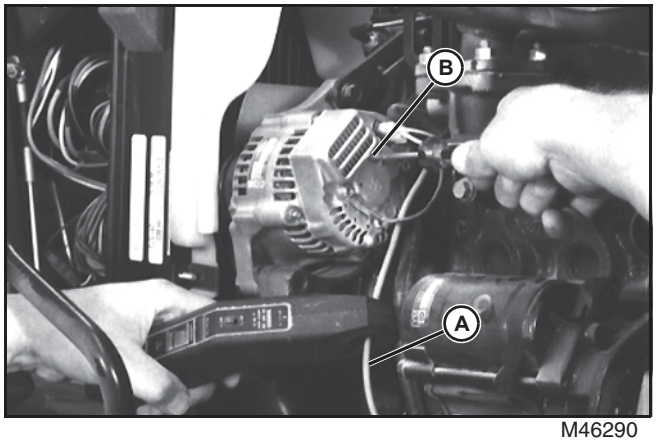
Reason:

To determine charging output of the alternator stator.

Equipment:

- JT05712 Current Gun

Connections:



M46290

1. Put JT05712 Current Gun over alternator red wire (A). Set Current Gun for DC current.

Procedure:

IMPORTANT: Avoid damage! 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 3550 rpm.

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 . . . . . 45 amps

Results:

- If reading does not meet specifications, verify voltage at the alternator regulated terminal and good alternator ground. If voltage and ground are OK, replace the alternator.
- If reading meets the specification, replace the regulator. See “Alternator” in Diesel Engine Section.

Auxiliary Alternator - Regulated Amperage and Voltage Tests

Reason:

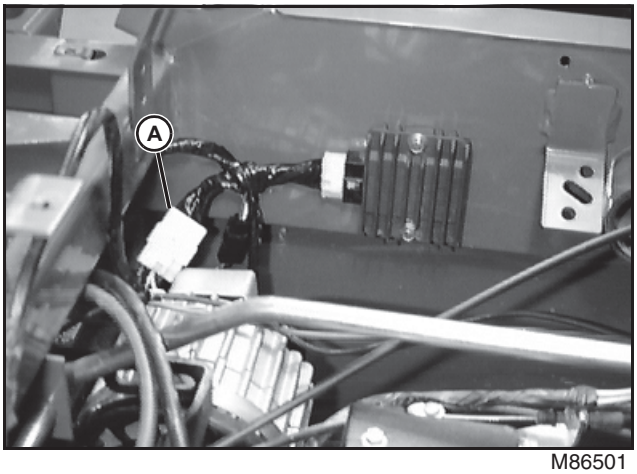
To determine regulated voltage (charging) output of auxiliary alternator.

Equipment:

- JT05712 Current Gun
- JT05685 Battery Tester

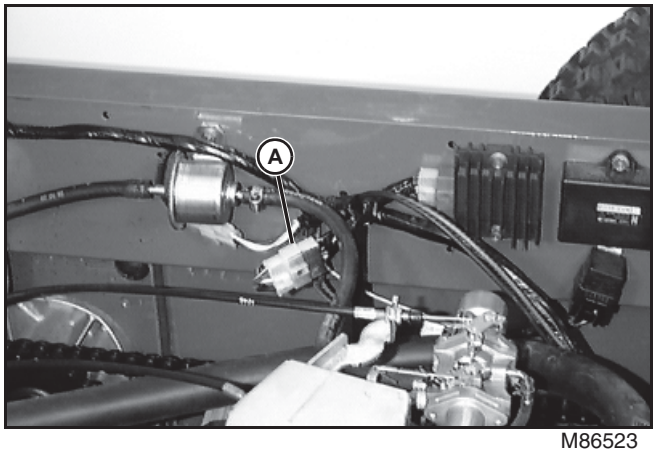
Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.



M86501

4X2 Gas

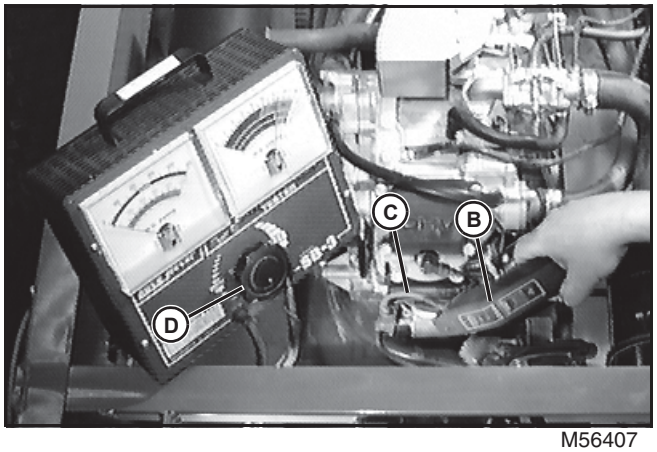


M86523

6X4 Diesel

4. Disconnect the auxiliary wiring harness connector (A) from the main wiring harness.

NOTE: Battery must be in good state of charge. See “Battery Test” on page 372.



M56407

5. Put JT05712 Current Gun (B) around positive (red) battery cable (C) going to starting motor so current-flow arrow points towards battery. Set current gun for DC current.

IMPORTANT: Avoid damage! Turn load knob (D) fully counterclockwise (out) into OFF position BEFORE making any test connections.

6. Connect battery tester to battery.

- Connect RED cable on tester to positive (+) terminal on battery.
- Connect BLACK cable on tester to negative (-) terminal on battery.

IMPORTANT: Avoid damage! Perform this test quickly to prevent damage to battery tester. DO NOT apply full load to battery for more than five to ten seconds.

7. Start and run engine at FAST idle.

8. Read battery voltage.

9. Turn LOAD knob in until maximum amperage output is obtained.

10.Connect the auxiliary wiring harness connector to the main wiring harness.

Specifications:

Battery Voltage . . . . . 12.4 Volts

Regulated Amperage/ Voltage . . . . . 45 amps (minimum) at 12.2 - 13.8 volts

Starting Motor Solenoid Test

Reason:

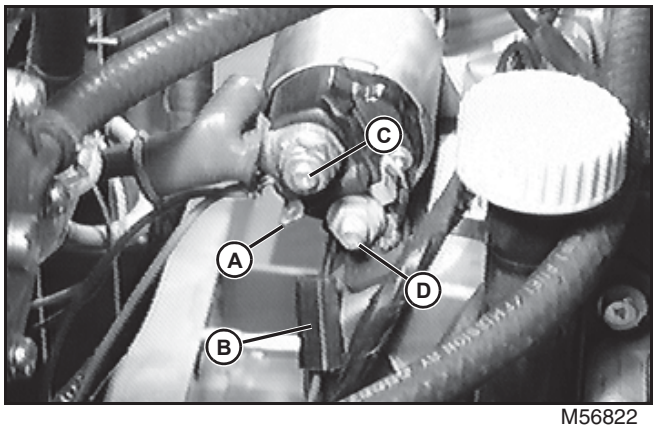
To determine if starting motor solenoid or starting motor is defective.

Equipment:

- Jumper wire.

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Disconnect and ground spark plug lead(s).
4. Cargo box RAISED and LOCKED.



M56822

5. Disconnect wire (B) from starting motor solenoid terminal (A).

6. Connect jumper wire to positive battery terminal (+) and briefly jump to starting motor solenoid terminal (A).

- **Starting motor runs - solenoid is good, check circuit wiring.**
- **Starting motor DOES NOT run - go to Step 7.**

7. Remove rubber boot(s) from terminals (C and D).

8. Connect jumper wire between starting motor solenoid large terminals (C and D).

Results

- **Starting motor runs - replace solenoid.**
- **Starting motor DOES NOT run - check battery cables, then replace starting motor.**

Starting Motor Loaded Amperage Draw Test

Reason:

To determine the amperage required to crank the engine and check starting motor operation under load.

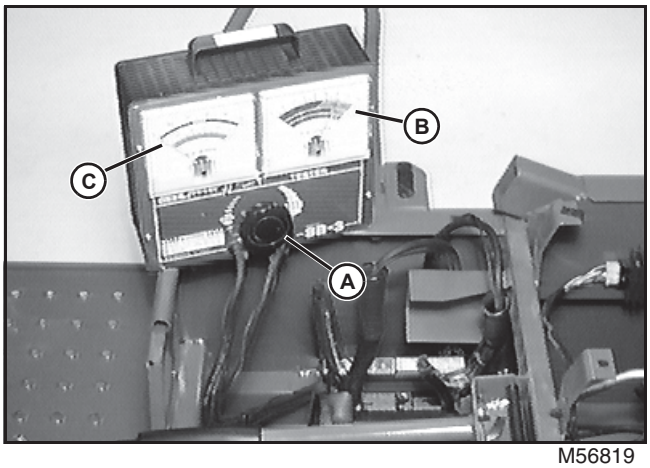
Equipment:

- JT05685 Battery Tester

Procedure:

1. Park machine on flat surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Remove seats and operator's station black plastic shroud on 4X2.
4. Cargo box RAISED and LOCKED.
5. Disconnect and ground spark plug lead(s).

IMPORTANT: Avoid damage! Turn load knob (A) fully counterclockwise (out) into OFF position before making any test connections.



M56819

6. Connect JT05685 Battery Tester to battery.
7. Crank engine - read and record voltage on DC voltage scale (B) of battery tester.
8. Turn key switch to OFF position.

IMPORTANT: Avoid damage! Perform following procedure within 15 seconds to prevent damage to tester and/or machine components.

9. Turn load knob (A) clockwise (in) until DC voltage (B) reads the same as when cranking.
10. Read and record DC amperage (C).
11. Turn load knob (A) completely counterclockwise (out) into OFF position.

Results:

- **Maximum starting motor draw on 4X2 should be 51 amps at 750 rpm.**
- **Maximum starting motor draw on 6X4 gas should be 72 amps at 500 rpm.**
- Maximum starting motor draw on 6X4 diesel should be 60 amps.
- If amperage is above specification, perform 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, wear, or damage.

Starting Motor No-load Amperage and rpm Tests

Reason:

To determine if starting motor is binding or has excessive amperage draw under no-load.

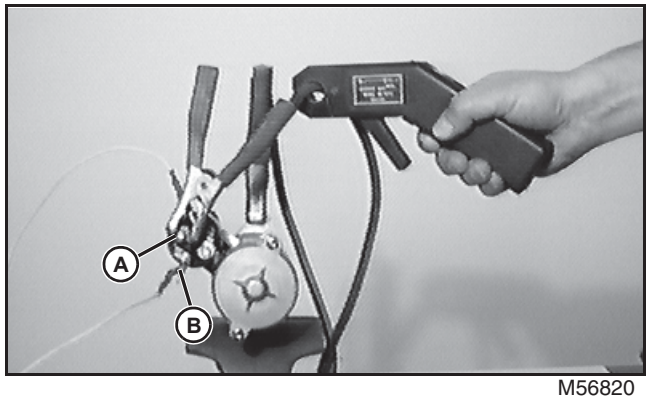
Equipment:

- JT05712 Current Gun
- JDM71 Vibration Tachometer or JT07270 Digital Pulse Tachometer

Procedure:

NOTE: Check that battery is fully charged and of proper size to ensure accuracy of test.

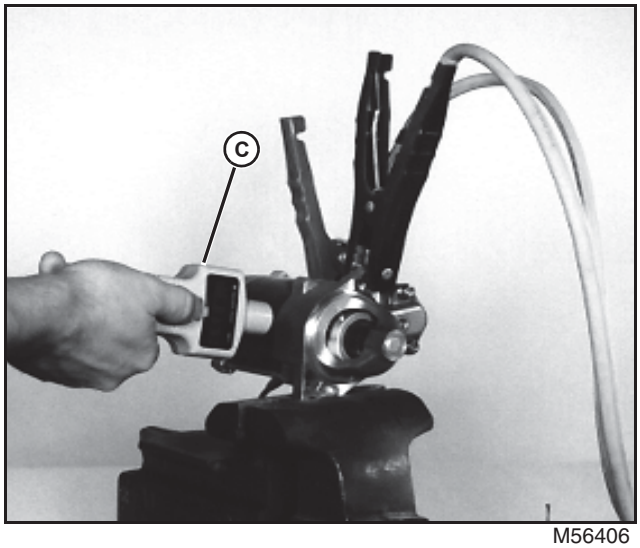
1. Park machine on flat surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.
4. Remove starting motor assembly to workbench.
5. Connect jumper cables to battery.



M56820

6. Connect negative jumper cable to starting motor body and positive cable (red) to solenoid battery terminal (A).

7. Use reflective tape on starting motor worm gear and JT05719 Photo Tachometer to measure starting motor rpm'.



M56406

8. Put JT05712 current gun around positive jumper cable (red).

IMPORTANT: Avoid damage! Complete this test in 20 seconds or less to prevent starting motor damage.

9. Use jumper wire to briefly connect terminal (A) and solenoid engagement terminal (B).

10.Measure and record starting motor amperage with current gun and rpm with tachometer (C).

Results:

- A good starting motor should have **a maximum amperage reading of 50 amps and a minimum rotational reading 6000 rpm.**
- If amperage reading is above 50 amps or starting motor rpm is less than 6000, check for binding or seized bearings, sticky brushes, and dirty or worn commutator.
- Repair or replace starting motor.

Spark Test - Gas Engines

Reason:

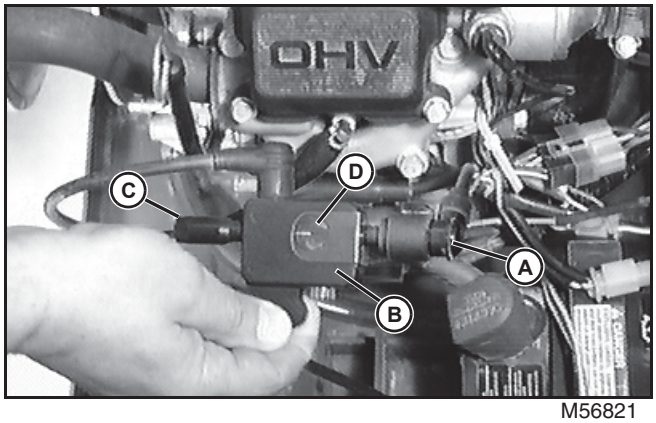
To check overall condition of ignition system.

Equipment:

- D-05351ST - Spark Tester

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.



M56821

4. Remove high tension lead (A) from spark plug and connect to spark tester (B).
5. Connect spark tester lead to spark plug.

IMPORTANT: Avoid damage! Do not adjust spark tester gap beyond 5.0 mm (0.20 in.) as damage to ignition system components could occur.

6. Adjust spark tester gap to **4.2 mm (0.166 in.)** with screw (C).
7. Turn key switch to START position and watch spark (D) at spark tester.

Results:

- If engine will start, watch spark with engine running. There should be a strong, steady, blue spark
- 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.

Spark Plug Cap Test - Gas Engines

Reason:

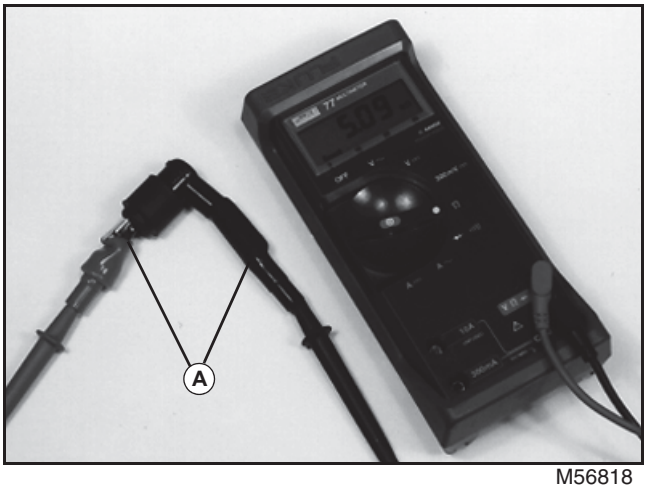
To determine if spark plug cap is defective.

Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.
4. Disconnect spark plug cap.



M56818

5. Measure resistance across spark plug cap terminals (A).

Results:

- Resistance should be **approximately 5000 ohms**, the same as marked on the spark plug cap.
- If resistance DOES NOT meet specification, replace spark plug cap.

Brake Pedal Switch and Park Brake Switch Tests

Reason:

To make sure the brake pedal switch and park brake switch have continuity when plunger is RELEASED.

Equipment:

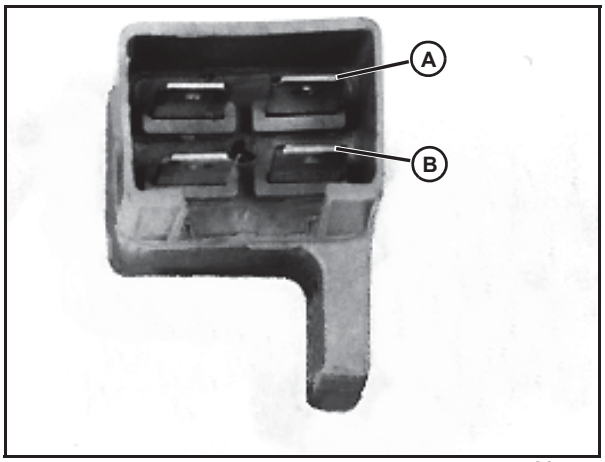
- Ohmmeter

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Remove front hood, seats, and operator's station black plastic shroud.
4. Disconnect harness connector from brake pedal and park brake switch.
5. Check continuity.

Results:

NOTE: Two of the four terminals ARE NOT used in each of these applications.



M56409

- there should BE continuity between terminals (A and B) when plunger is RELEASED,
- there should NOT BE continuity between terminals (A and B) when plunger is DEPRESSED.
- If continuity is NOT correct, replace switch.

Neutral Start Switch Test

Reason:

To make sure the neutral start switch terminals have continuity when the gear shift is in neutral position.

Equipment:

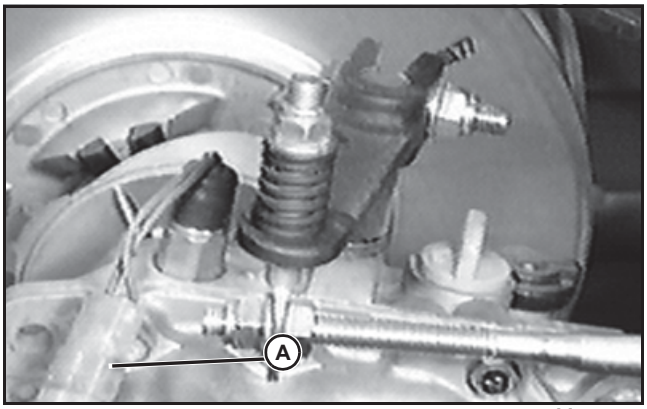
- Ohmmeter

Procedure:

1. Park machine on level surface and turn key switch OFF.

NOTE: When transaxle shift lever is in NEUTRAL the neutral start switch plunger is DEPRESSED.

2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.



M56088

4. Disconnect neutral start switch from harness and check continuity across neutral start switch terminals (A).

Results:

- There should BE continuity when shift lever is in NEUTRAL position**.**
- If the neutral start switch DOES NOT have continuity with the plunger DEPRESSED (while the gear shift is in NEUTRAL position), replace the switch.
- Move transaxle shift lever into FORWARD and then REVERSE (this should RELEASE switch plunger) and check continuity across neutral start switch terminals (A).
- **There should NOT BE continuity when shift lever is in FORWARD and REVERSE.**
- If the neutral start switch DOES have continuity with the plunger RELEASED (while the gear shift is in either FORWARD or REVERSE position), replace the switch.

Relay Test

Reason:

To check relay terminal continuity in the energized and de-energized condition.

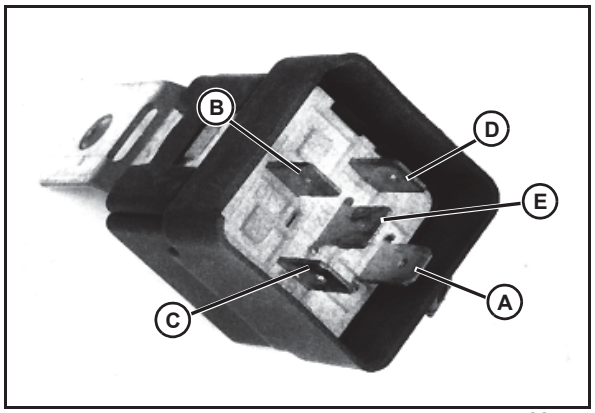
Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.
4. Disconnect relay connector from harness.
5. Check continuity.

Results:



M56817

- **There should be continuity between terminals (A) and (E), and between terminals (C) and (D);**
- **There should NOT be continuity between terminals (E) and (B).**
- Connect a jumper wire from battery positive (+) terminal to relay terminal (C). Connect a jumper wire from relay terminal (D) to ground (-).
- **There should be continuity between terminals (A) and (B).**
- If continuity is NOT correct, replace relay.

Engine Oil Pressure Switch Test - 6X4's

Reason:

To determine if the oil pressure switch is functioning properly.

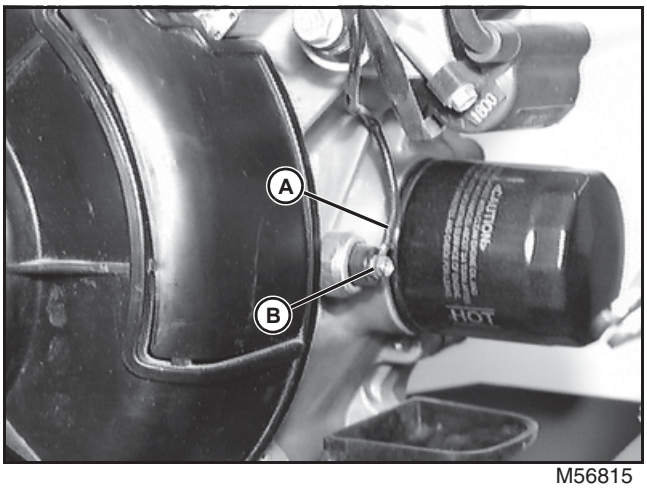
Equipment:

- Ohmmeter

Procedure:

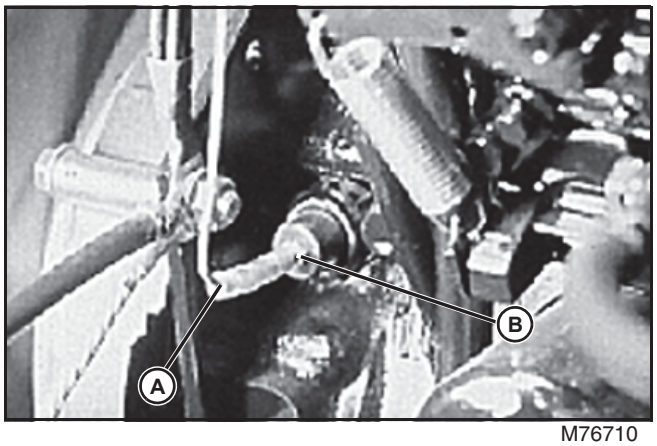
1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.

IMPORTANT: Avoid damage! Do not allow wire connector to contact engine or frame because there will be voltage at that point during the test.



M56815

6X4 Gas



M76710

6X4 Diesel

4. Disconnect wiring lead (A) from switch.
5. **Connect black lead of meter to engine block and red lead of meter to terminal (B) of switch.**
6. **Set ohmmeter for 1X ohms scale**.
7. **Read meter.**

Results:

- **There should be continuity to ground.**
- If the switch does NOT have continuity to ground, replace the switch.
- Start and run engine.
- **Read meter**.

NOTE: BE SURE to apply John Deere Pipe Thread Sealant with TEFLON®, or an equivalent to threads of switch anytime it is installed.

Results:

- **The switch should NOT have continuity to ground.**
- If the switch DOES have continuity to ground with the engine running, check engine oil pressure. (See Oil Pressure Test in Engine Tests and Adjustments Section.)
- If the oil pressure is to specification, replace the switch.

Fuse Test

Reason:

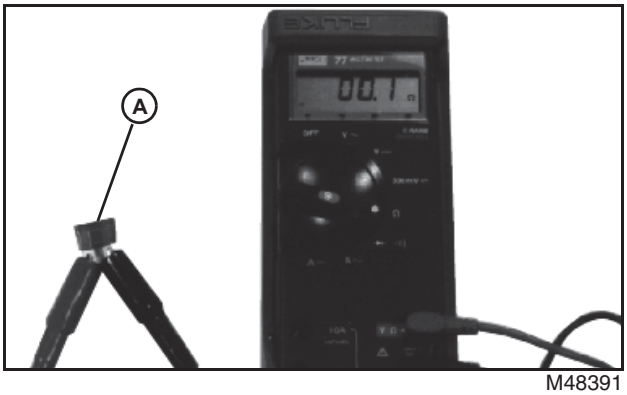
To verify that the fuse has continuity.

Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Remove fuse from connector.



M48391

2. Check visually for broken filament (A).
3. Connect ohmmeter or continuity tester to each end of fuse.
4. Check for continuity.

Results:

- If continuity is not indicated, replace fuse.

Light Switch Test

Reason:

To make sure the light switch terminals have continuity when the light switch is **ON**.

Equipment:

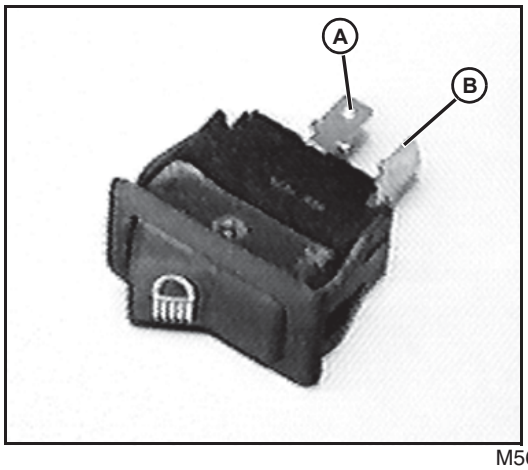
- Ohmmeter or Continuity Tester

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.

NOTE: You may want to remove front hood for easy access to dash panel electrical components.

3. Disconnect light switch connector.



M56813

4. Move light switch to the ON and then the OFF position. Check continuity between terminals (A and B).

Results:

- **Terminals should have continuity with switch ON.**
- **Terminals should NOT have continuity with switch OFF.**
- If continuity is NOT correct, replace light switch.

Differential Lock Switch Test

Reason:

To make sure differential lock switch terminals have continuity when the plunger is DEPRESSED.

Equipment:

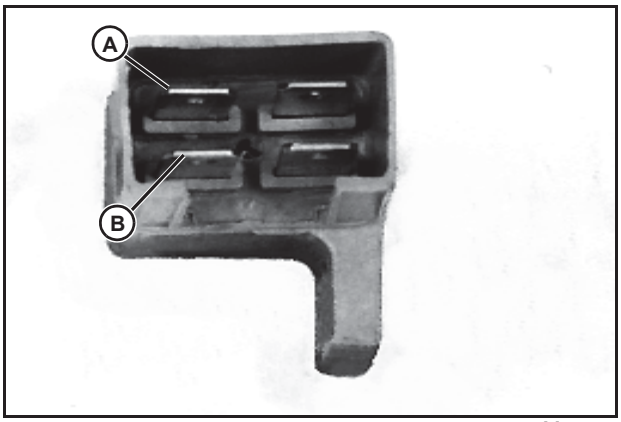
- Ohmmeter

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Remove seats and operator's station black plastic shroud.
4. Disconnect differential lock switch connector.
5. Check continuity.

Results:

NOTE: Two of these terminals ARE NOT used in this application.



M56409

- there should NOT BE continuity between terminals (A and B) when plunger is RELEASED,
- there should BE continuity between terminals (A and B) when plunger is DEPRESSED.
- If continuity is NOT correct, replace switch.

Key Switch Test

Reason:

To verify key switch functions are operating properly.

Equipment:

- Ohmmeter or Continuity Tester

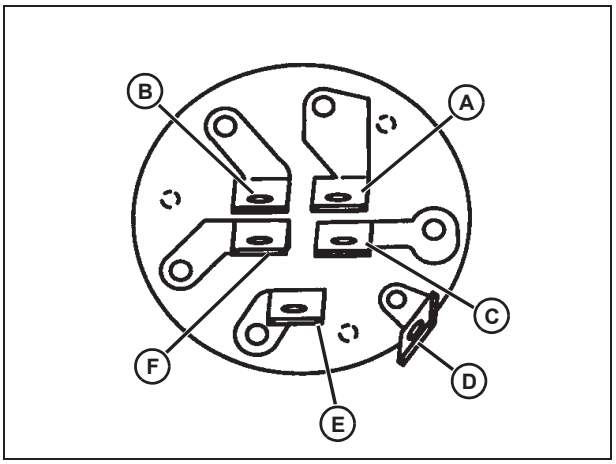
Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.

NOTE: You may want to remove front hood for easy access to dash panel electrical components.

3. Disconnect key switch connector.

NOTE: DO NOT refer to markings stamped on terminals. Identify terminals by art keys ONLY. Terminal combinations other than those listed in chart should NOT have continuity.



M56827

4. Use an ohmmeter to test switch continuity in OFF, RUN, and START positions.

Switch Position Terminal Continuity

- OFF: A and B
- RUN: C and D
- START: C and D
- E and F

Results:

- If any continuity is NOT correct, replace switch.

Fuel Shutoff Solenoid Test - Gas Engine

Reason:

To determine if the fuel shutoff plunger retracts when the solenoid is energized.

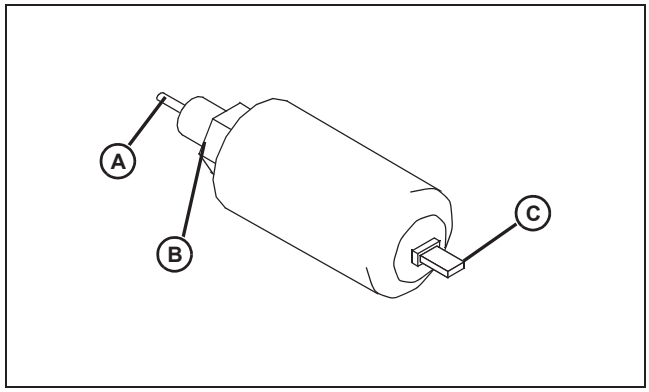
Equipment:

- 2 jumper wires

Procedure:

CAUTION: Avoid Injury! Keep gasoline away from sparks, flame, or hot engine parts or personal injury can result.

1. Disconnect fuel shutoff solenoid connector.
2. Remove fuel shutoff solenoid, washer.



NOTE: It may be necessary to push plunger (A) inward slightly for plunger to retract.

3. Connect a jumper wire from the battery positive (+) terminal to solenoid terminal (C).
4. Connect a jumper wire from the battery negative (-) terminal to solenoid threads (B). Plunger should now retract with the solenoid energized.
5. Remove jumper wire from the battery negative (-) terminal. Plunger should extend.

Results:

- If plunger does not move, replace solenoid.

Flywheel Magnet(s) Test - Gas Engines

Reason:

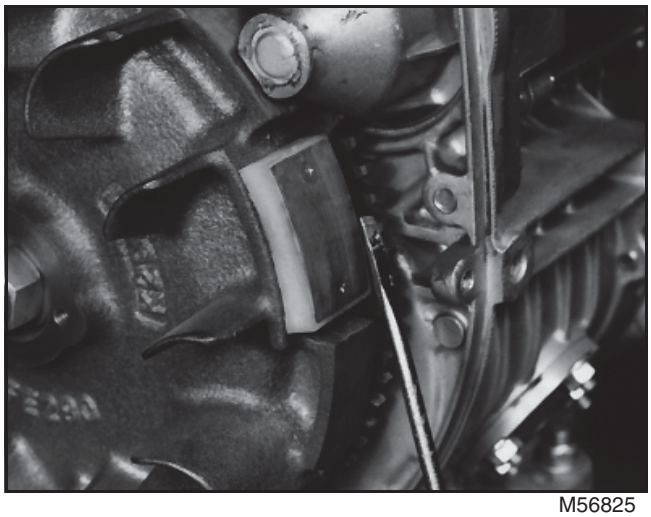
To make sure flywheel magnet(s) have enough force to induce current into ignition coil.

Equipment:

- Screwdriver.

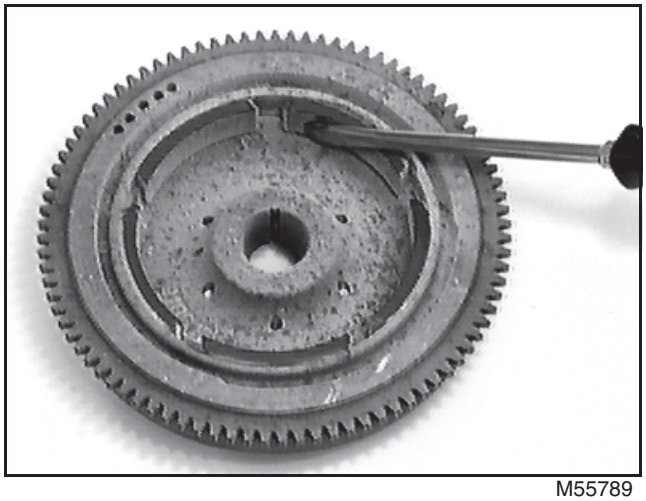
Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.
4. Remove flywheel housing from 4X2 or 6X4 engine and flywheel from 6X4 engine.



M56825

4X2 Gas



M55789

6X4 Gas

5. Loosely hold screwdriver blade about 25 mm (1.0 in.) away from magnet(s).

Results:

- Each magnet should attract blade to it.
- If blade is NOT attracted to magnet(s), flywheel must be replaced.

Bulb Test

Reason:

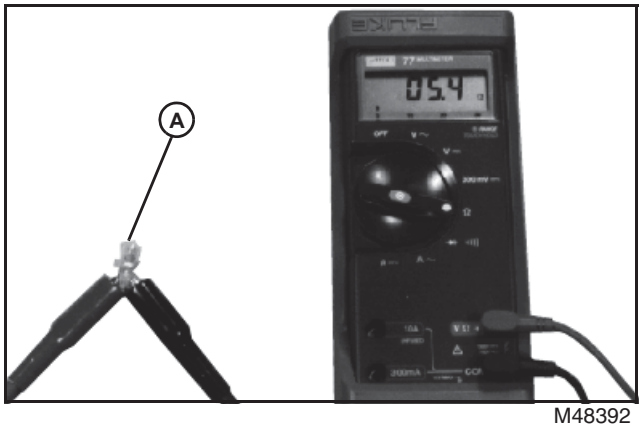
To verify that the bulb has continuity.

Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Remove bulb from socket.



M48392

2. Check visually for broken filament (A).
3. Connect ohmmeter or continuity tester to each terminal of bulb.
4. Check for continuity.

Results:

- If continuity is not indicated, replace bulb.

Ignition Coil Air Gap Adjustment - 4X2

Reason:

To adjust air gap between ignition coil and flywheel magnets to a specified dimension needed for proper ignition timing.

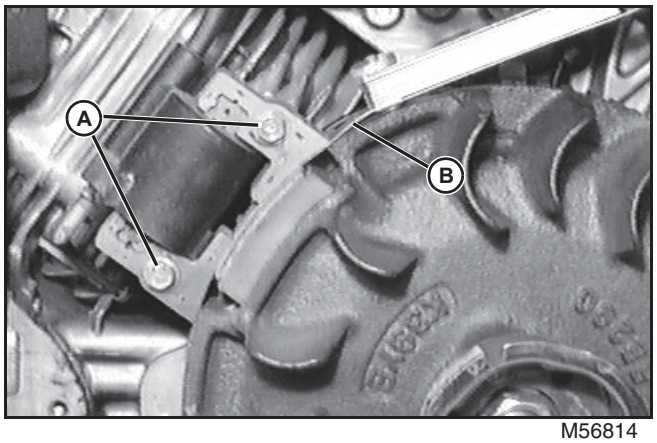
Equipment:

- Flat bladed feeler gauge.

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.
4. Remove flywheel housing.
5. Turn flywheel magnet away from coil.

IMPORTANT: Avoid damage! The engine is very sensitive to this adjustment so both legs of coil must have the same air gap.



M56814

6. Loosen ignition coil cap screws (A).
7. **Select the 0.3 mm (0.12 in.) feeler gauge blade (B) and insert it between flywheel and coil legs.**

NOTE: If a misfire condition exists, adjust air gap to a minimum of 0.25 mm (0.10 in.) to increase magnetic force.

8. Turn flywheel until magnet aligns with legs of ignition coil and feeler gauge spans both legs of coil and the flywheel magnet at the same time.
9. Hold coil in position and tighten cap screws (A). Turn flywheel to remove feeler gauge.

Pulser Coil Test - 6X4 Gas

Reason:

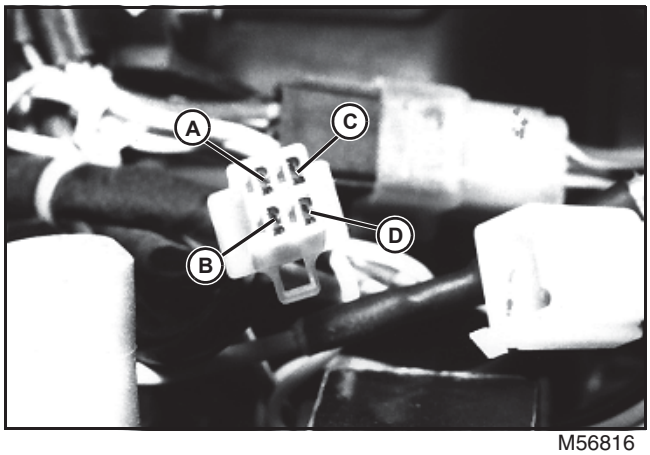
To determine condition of pulser coil windings and verify pulser coil wire continuity.

Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Disconnect 4 - pin pulser connector.



M56816

4. **Measure resistance between Wht/Blu wire (A) and Pnk wire (B), then Grn/Wht wire (C) and Yel wire (D) at pulser side of connector.**

Results:

- **If resistance does not read between 85 - 270 ohms, replace pulser coil.**

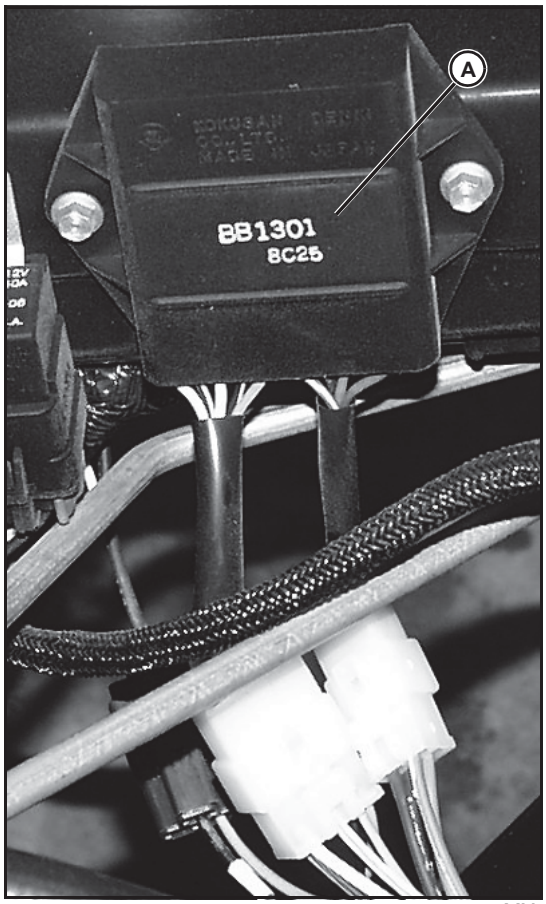
Ignition Module Test

Reason:

To determine if the ignition module is defective.

Procedure:

1. Park machine on level surface.
2. Turn all switches to the OFF position.
3. Shift lever in NEUTRAL and park brake LOCKED.
4. Cargo box RAISED and LOCKED.
5. Locate the ignition module mounted on the inside right frame rail.



MX0700

6. The ignition module (A) is very sensitive to the type of ohmmeter used to check resistance. Due to variations in ohmmeters, the best way to determine if the ignition module is good is to replace the questionable ignition module with a known good module.

Results:

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

Ignition Coil Test

Reason:

Check the windings of the ignition coil.

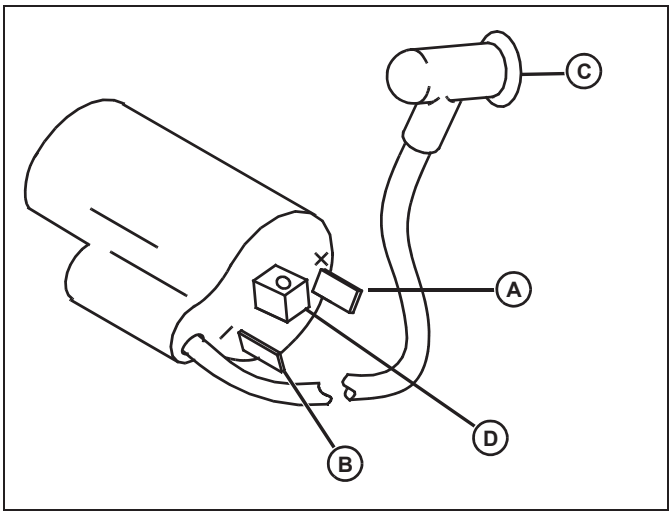
Test Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface.
2. Turn all switches to the OFF position.
3. Shift lever in NEUTRAL and park brake LOCKED.
4. Cargo box RAISED and LOCKED.
5. Disconnect wires from ignition coil terminals.

Primary windings:



MIF

1. Connect one ohmmeter lead to coil positive (+) (wide) terminal (A).
2. Connect other ohmmeter lead to coil negative (-) terminal (B).
3. Measure resistance across primary windings. Resistance should measure approximately 4.6 ohms.

Secondary windings:

1. Connect one ohmmeter lead to coil positive (+) terminal (A).
2. Connect other ohmmeter lead to high tension lead (C).
3. Measure resistance across secondary windings. Resistance should measure approximately 16,500 ohms.

Open Circuit Check:

1. Connect one ohmmeter lead to coil positive (+) terminal (A) or negative (-) terminal (B).

NOTE: Do not connect ohmmeter lead to ignition coil mounting screws, as this will result in an inaccurate reading.

2. Connect other ohmmeter lead to coil core (D).

3. Measure resistance from primary leads to coil core. There should be no continuity (open circuit) between coil primary terminals and coil core.

4. Connect one ohmmeter lead to high tension lead (C).

NOTE: Do not connect ohmmeter lead to ignition coil mounting screws, as this will result in an inaccurate reading.

5. Connect other ohmmeter lead to coil core (D).

6. Measure resistance from high tension lead to coil core. There should be no continuity (open circuit) between high tension lead and coil core.

7. Repeat test procedures on other ignition coils.

Results:

- If the ohmmeter readings are not within specifications, replace coil.
- If ohmmeter readings are within specifications, the coils are probably good. If system still does not perform properly after all tests/checks, replace coil with a good coil.

Radiator Core Temperature Switch Test - Removed

Reason:

To verify radiator core temperature/fan motor switch is functioning properly at specified temperatures to turn cooling fan ON and OFF to protect engine from over heating.

Equipment:

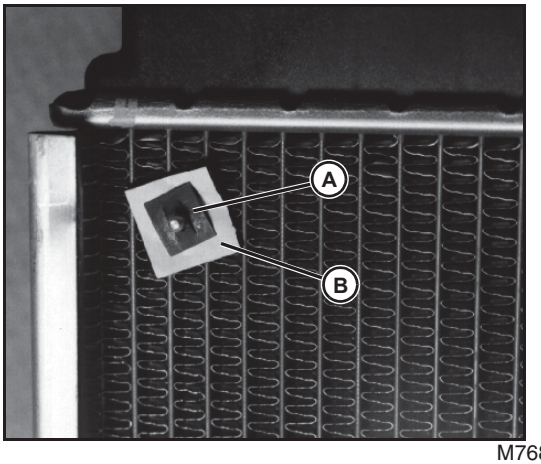
- Thermometer
- Glass Container
- Heating Unit
- Ohmmeter

Procedure (Early Models):

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.

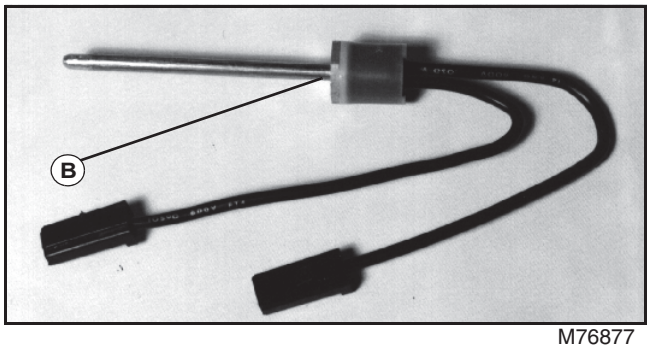
CAUTION: Avoid Injury! Radiator fan can start at any time, even with ignition key is OFF position. Always disconnect the negative battery cable before doing any electrical repair.

3. Remove seats and operator's station black plastic shroud.
4. Disconnect electrical leads to radiator core temperature/fan motor switch sending unit on top rear inside edge of radiator.
5. Remove screen bolted to frame under passenger's right side grab handle.
6. Remove slide-in screen on right side of radiator.



M76888

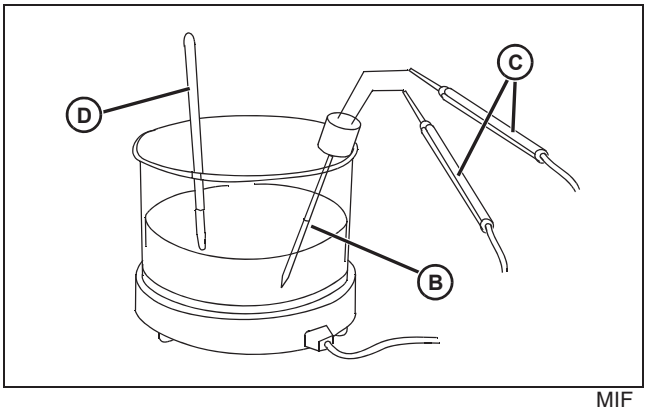
7. Reaching up into frame where screens were removed, bend tabs of push-on nut (A) and remove nut and protective pad (B) from end of radiator core temperature/fan motor switch.



M76877

8. Pull radiator core temperature/fan motor switch (B) from left side of radiator.

CAUTION: Avoid Injury! DO NOT allow switch or thermometer to rest against the side or bottom of glass container when heating water. Either may rupture if over heated.



MIF

9. Connect lead wires from ohmmeter probes (C), to switch terminals.

10.Suspend switch (B) and a thermometer (D) in a container of water.

11.Heat and stir the water. Observe water temperature when continuity occurs. Water temperature should be 71° ± 4° C (160° ± 7° F).

Results:

- If continuity does not occur within temperature listed, replace switch.

Specifications:

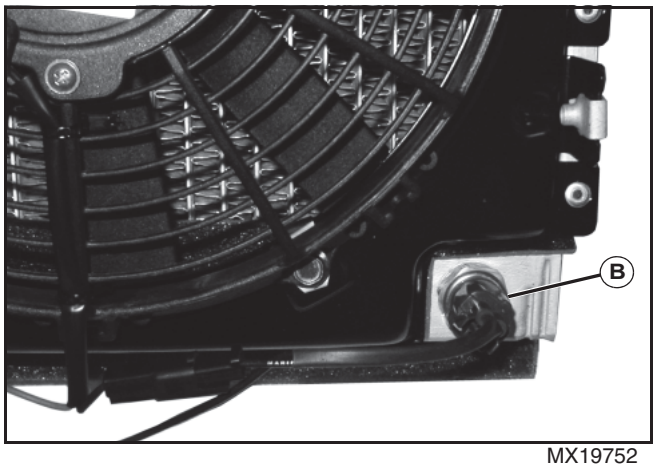
- Switch closes (fan should turn **ON**) when temperature reaches **71° ± 14° C (160° ± 7° F).**
- Switch opens (fan should turn **OFF**) when temperature reaches **60° ± 14° C (140° ± 7° F).**
- If switch fails to meet either of these specifications, replace it.

Procedure (Later Models):

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.

CAUTION: Avoid Injury! Radiator fan can start at any time, even with ignition key is OFF position. Always disconnect the negative battery cable before doing any electrical repair.

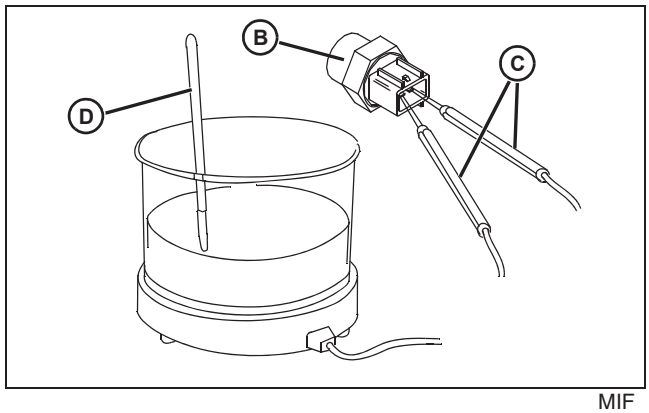
3. Remove seats and operator's station black plastic shroud.
4. Disconnect electrical leads to radiator core temperature/ fan motor switch sending unit on bottom rear edge of radiator.



MX19752

5. Remove radiator core temperature/fan motor switch (B) from radiator.

CAUTION: Avoid Injury! DO NOT allow switch or thermometer to rest against the side or bottom of glass container when heating water. Either may rupture if over heated.



MIF

6. Connect lead wires from ohmmeter probes (C), to switch terminals.

7. Suspend switch (B) and a thermometer (D) in a container of water.

8. Heat and stir the water. Observe water temperature when continuity occurs. Water temperature should be to specification.

Results:

- If continuity does not occur within temperature listed, replace switch.

Specifications:

NOTE: Plastic housing of switch for gas engines is green. Plastic housing of switch for diesel engines is yellow.

Closes - Gas Engines
Continuity - Radiator Fan ON . . 93 ± 3° C (200° ± 5° F)

Closes - Diesel Engines
Continuity - Radiator Fan ON . . 86 ± 3° C (187° ± 5° F)

Engine Coolant Temperature Switch Test - 6X4's

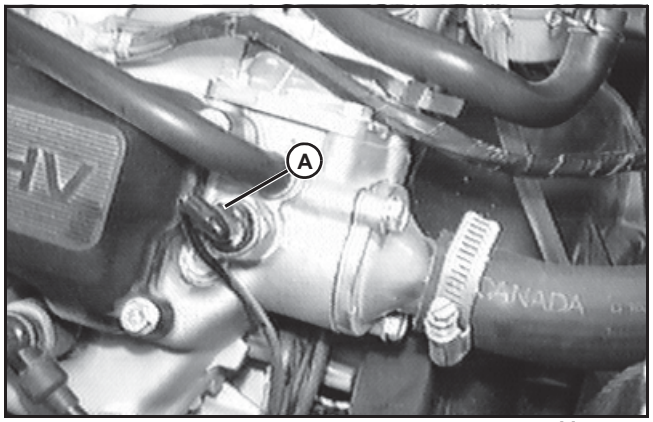
Reason:

To verify coolant temperature switch is functioning properly.

NOTE: Perform the test with the engine at room temperature.

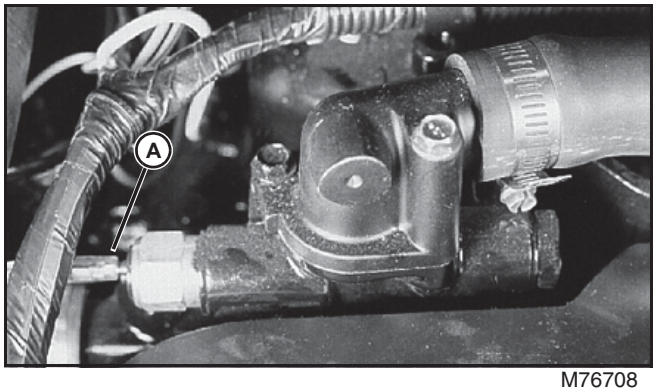
Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.



M56403

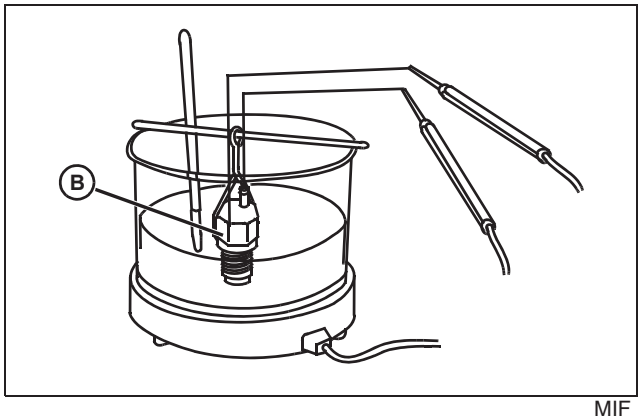
6X4 Gas



M76708

6X4 Diesel

4. Check for continuity between the terminal (A) and the sensor body. If there is continuity, replace engine coolant temperature switch.
5. Remove coolant temperature sensor.



MIF

6. Place sensor (B) in antifreeze solution heated to **109° ± 1° C (228° ± 2° F)**. Measure continuity while sensor is heated.

Results:

- Replace sensor if continuity does not occur at temperature listed above.

Unregulated Voltage Output Test - 6X4 Diesel

Reason:

To measure alternator output.

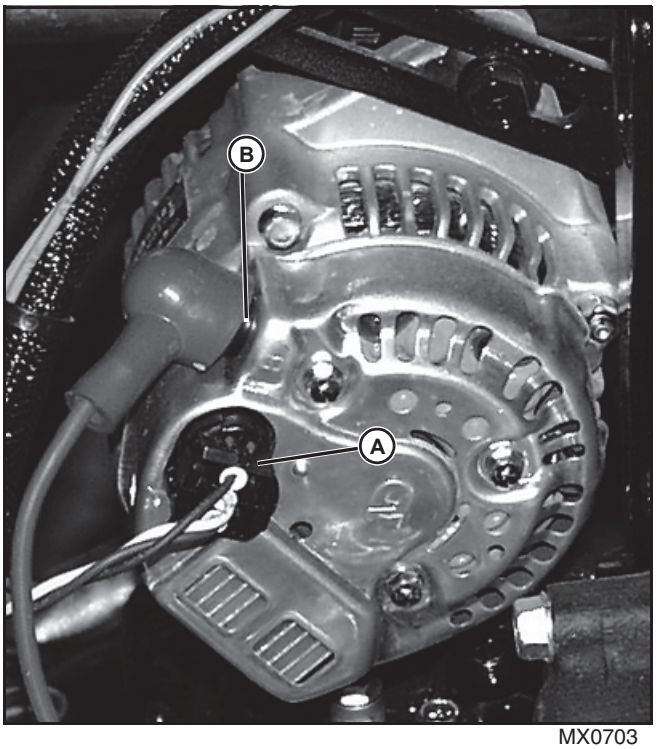
Equipment:

- Voltmeter

Procedure:

1. Park machine on level surface.
2. Turn all switches to the OFF position.
3. ENGAGE park brake, place gear shift in NEUTRAL position and DISENGAGE differential lock.
4. Raise cargo box, or remove the optional component installed on the machine as needed to provide clearance.

CAUTION: Avoid Injury! Engine parts may be hot. Allow engine to cool before servicing.



MX0703

5. Disconnect three pin connector (A) from alternator.
6. Connect voltmeter, set to read AC voltage, to alternator outputs (B).
7. Start and run engine at fast idle. The meter should read a minimum of 50 volts AC at FAST idle (3530 rpm).

Results:

- If reading is BELOW specification, test alternator.

Specifications:

Slow Idle . . . . . 32 VAC

Fast Idle. . . . . 50 VAC

Unregulated Amperage Test - 6X4 Diesel

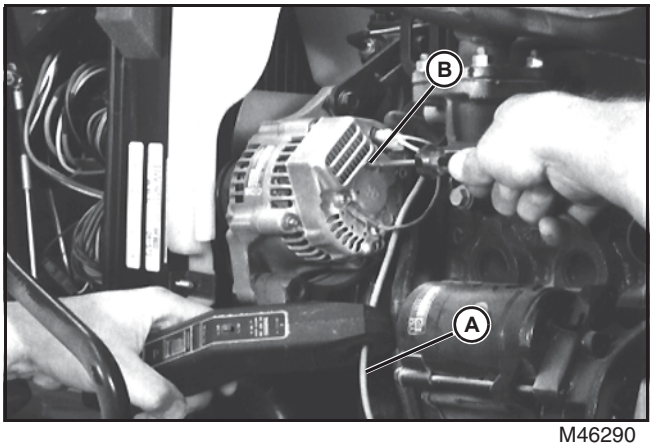
Reason:

To determine charging output of the alternator stator.

Equipment:

- JT05712 Current Gun

Connections:



M46290

1. Put JT05712 Current Gun over alternator red wire (A). Set Current Gun for DC current.

Procedure:

IMPORTANT: Avoid damage! 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 3550 rpm.
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 . . . . . .40 amps

Results:

- If reading does not meet specifications, verify voltage at the alternator regulated terminal and good alternator ground. If voltage and ground are OK, replace the alternator.
- If reading meets the specification, replace the regulator. See Alternator Repair in Diesel Engine Section.

Electrical System Amperage Draw Tests

Reason:

To measure amperage draw of electrical components when battery has a discharge problem.

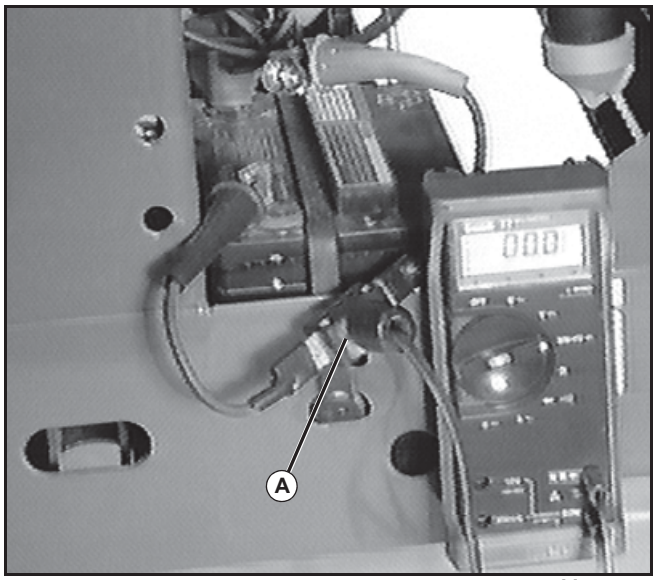
NOTE: The battery will discharge if operating several electrical components at the same time with the engine at low idle.

Equipment:

- Ammeter
- JT05792 Ammeter Shunt Assembly

Procedure:

1. Turn key switch to OFF position.



M56831

2. Disconnect battery positive cable. Connect ammeter shunt (A) to battery positive cable and battery positive terminal.

3. Turn key switch to ON position.

4. Turn one component ON at a time and measure amperage draw. Several components can be ON to measure total amperage draw to match a specific operating condition that a battery discharge occurs.

Component Amperage Draw

The following tables show approximate component amperage draw and charging output.

NOTE: Fluke Multi-Meter set at 300 mV scale for following tests.

Some of the following tests apply only to Optional Kits or Road Homologated Machines.

Component Amperage Draw* Tests conducted with key switch ON. Fuel pump and ignition amperage draw included for gas engines.

Item	4X2	6X4 Gas	6X4 Diesel
Fuel pump and ignition	N/A	0.9 - 1	N/A
Radiator fan motor	N/A	6	10
Brake light*	3.6	4.7	4.7
Differential lock light*	1.4	1.4	1.4
Headlights, position light and license plate light.*	6.9	6.9	6.9
Road homologated headlights*	9.1	9.1	9.1
Position and license plate lights*	3.95	3.9	3.9
Turn signal lights*	1.9 - 4.9	1.9 - 4.9	1.9 - 4.9
Hazard lights*	2.1 - 8.8	2.1 - 8.8	2.1 - 8.8
Lift motor (Maximum load)*	25	25	25
Lift motor (No load)*	7.9	7.9	7.9
Horn*	6.1	6.1	6.1
Hour meter*	1.1	1.1	1.1

Alternator Output - 4X2

RPM	FE290D Amperage Output
1200	3.6
3850	13.7

Alternator Output - 6X4 Gas

RPM	FD620D-AS11 (FD620D038266 -) Amperage Output	FD620D-AS11 (- FD620D038265) Amperage Output
1200	7.5	3.1
3600	15.8	21.3
3850	16	N/A

Alternator Output - 6X4 Diesel

RPM	3TN66C - JUV with cold engine Amperage Output	3TN66C - JUV with hot engine Amperage Output
1000	23	16
3550	51	42

Stator Output Results:

- If component amperage draw exceeds stator output at that engine speed, the battery will discharge. Either reduce amperage draw or do not let engine idle for extended periods of time.

Glow Plug Relay Test

Reason:

To check relay terminal continuity in the energized and de-energized condition.

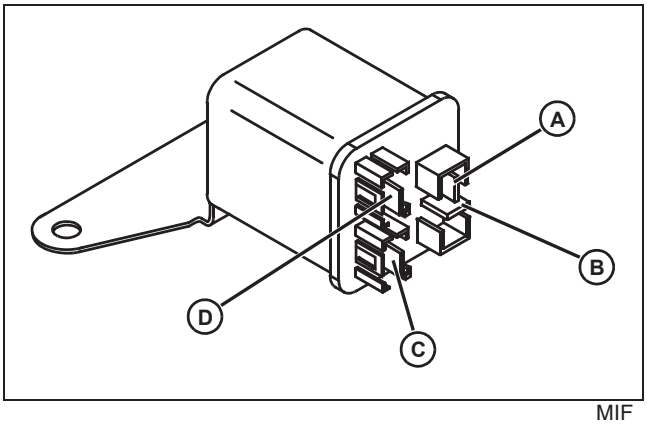
Equipment:

- Ohmmeter or continuity tester
- 12 volt battery and jumper wires

Energized Procedure:

1. Park machine on level surface.
2. Turn all switches to the OFF position.
3. ENGAGE park brake, place gear shift in NEUTRAL position.
4. Cargo box RAISED and LOCKED.
5. Locate the relays mounted on the inside right frame rail.
6. Disconnect glow plug relay connector from harness.
7. Check terminal continuity using an ohmmeter or continuity tester.

Results:



MIF

- There should be continuity between terminals (A) and (B).
- There should NOT be continuity between any other terminals.

De-energized Procedure

1. Connect a jumper wire from battery positive (+) terminal to relay terminal (A). Connect a jumper wire from relay terminal (B) and ground (-).

Results:

- There should be continuity between terminals (C) and (D).
- If continuity is NOT correct, replace relay.

Glow Plug Test

Reason:

To test operation of glow plugs.

Equipment:

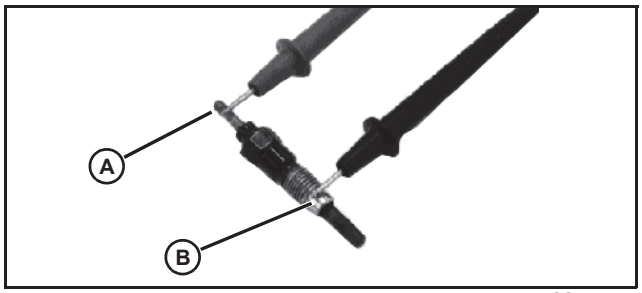
- Ohmmeter

Procedure:

1. Park machine on level surface.
2. Turn all switches to the OFF position.
3. ENGAGE park brake, place gear shift in NEUTRAL position.
4. Cargo box RAISED and LOCKED.

NOTE: Cover glow plug hole to prevent debris from entering cylinder when glow plug is removed.

5. Remove glow plug lead. Remove glow plug.



M46296

6. Check continuity across terminal (A) and glow plug body (B). The reading should be between 0.3 - 0.5 ohms.

Results:

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

Fuel Shutoff Solenoid Test - Diesel Engine

Reason:

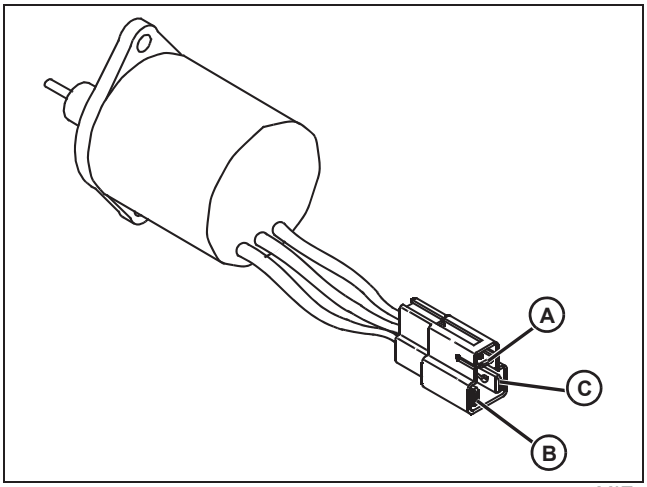
To verify fuel shutoff solenoid is functioning properly.

Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface and turn start switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.
4. Disconnect fuel shutoff solenoid connector.



MIF

5. Measure and record the resistance across each combination of terminals as listed below.

	Blk Wire (A)	Red Wire (B)	Wht Wire (C)
Blk Wire (A)		12	0.4
Red Wire (B)	12		12.4
Wht Wire (C)	0.4	12.4	

The red lead (+) position of the meter is listed down the side and the black lead (-) position of the meter is listed across the top of the chart.

Results:

If continuity is not correct, replace fuel shutoff solenoid.

Hazard Lights Switch Test

Reason:

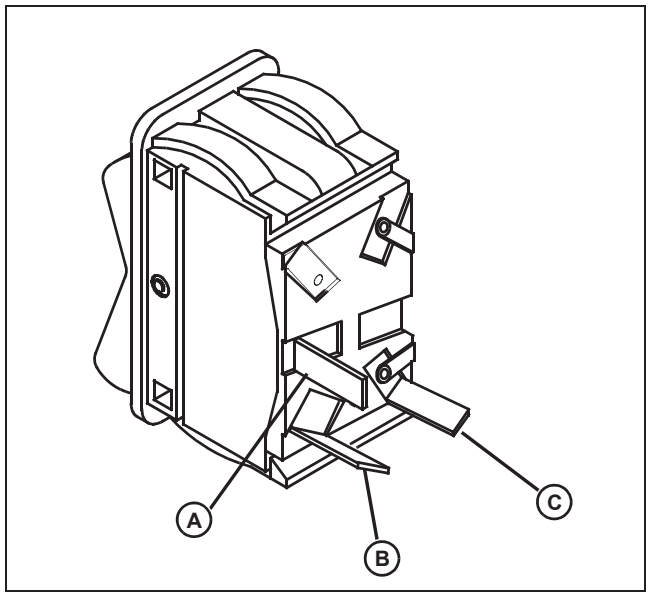
To verify hazard switch functions are operating properly.

Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface.
2. Turn all switches to the OFF position.
3. Ensure park brake is LOCKED, place gear shift in NEUTRAL position.
4. Remove the hood.
5. Disconnect hazard lights switch connector from harness.
6. Use an ohmmeter to test switch continuity in the OFF and ON positions.



MIF

7. Set the multimeter to measure ohms to sequentially test continuity across each terminal combination (A), (B), and (C).

OFF Position Continuity:

No continuity between any terminals.

ON Position Continuity:

Continuity between all terminals.

Results:

- If any continuity is NOT correct, replace the hazard lights switch.

Turn Signal Switch Test

Reason:

To verify turn signal switch functions are operating properly.

Equipment:

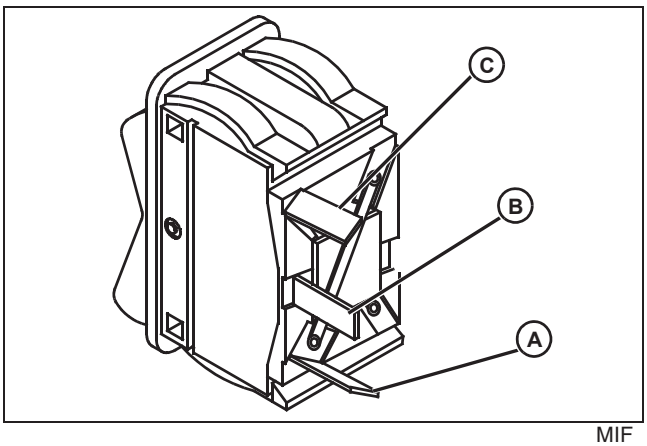
- Ohmmeter

Procedure:

1. Park machine on level surface.
2. Turn all switches to the OFF position.
3. Ensure park brake is LOCKED, place gear shift in NEUTRAL position.
4. Remove the hood.
5. Disconnect turn signal switch connector from harness.
6. Use an ohmmeter to test switch continuity in OFF, RIGHT, and LEFT positions.
7. Set the multimeter to measure ohms to sequentially test continuity across each terminal combination.

OFF Position Continuity:

No continuity between any terminals.



MIF

Right Turn Position Continuity

B to A . . . . . Continuity
B to C . . . . . No Continuity
A to C . . . . . No Continuity

Left Turn Position Continuity:

B to C . . . . . Continuity
B to A . . . . . No Continuity
A to C . . . . . No Continuity

Results:

- If any continuity is NOT correct, replace the turn signal switch.

Horn Switch Test

Reason:

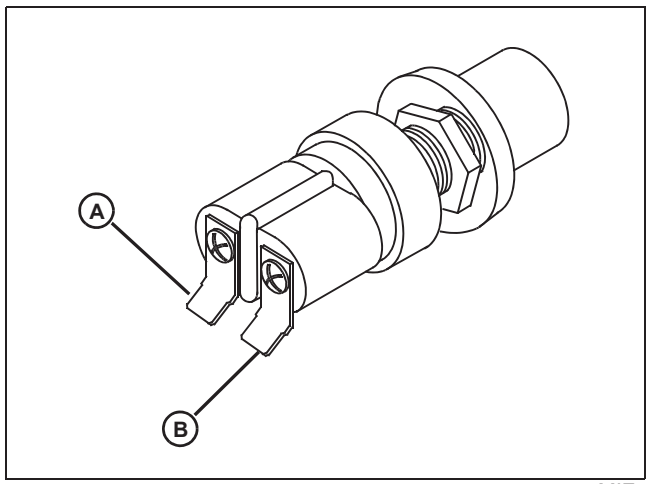
To verify the horn switch is operating properly.

Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Park machine on level surface.
2. Turn all switches to the OFF position.
3. Ensure park brake is LOCKED, place gear shift in NEUTRAL position and DISENGAGE differential lock.
4. Remove the grill from the front of the machine. Remove the entire hood if necessary. See Miscellaneous Section.
5. Disconnect the horn switch connectors from the switch



MIF

6. With the button released, check continuity across both switch terminals (A) and (B). There should be no continuity.
7. Depress the horn switch button. Continuity should exist between both terminals (A) and (B).

Results:

- If continuity is not correct, replace horn switch.

Ground Circuit Tests

Reason:

To check for opens, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

Equipment:

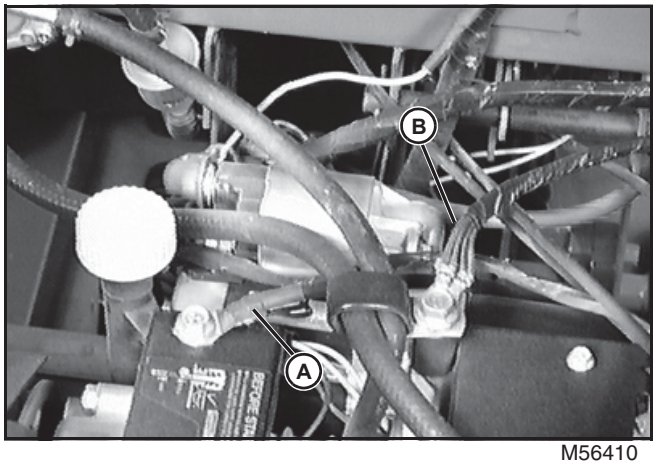
- Ohmmeter or Voltmeter.

The voltmeter method checks ground connections under load.

Procedure:

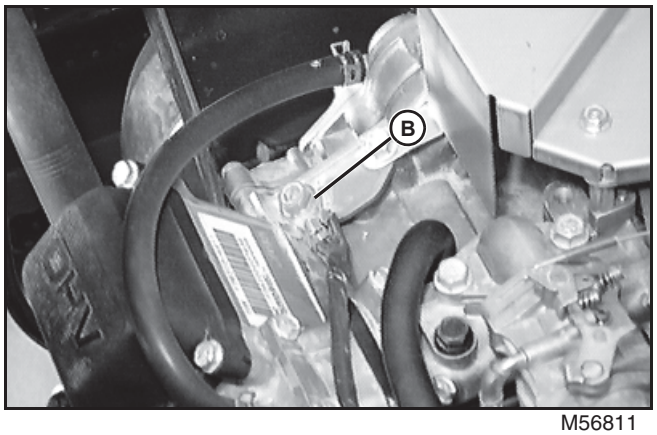
Ohmmeter Method:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake LOCKED.
3. Cargo box RAISED and LOCKED.



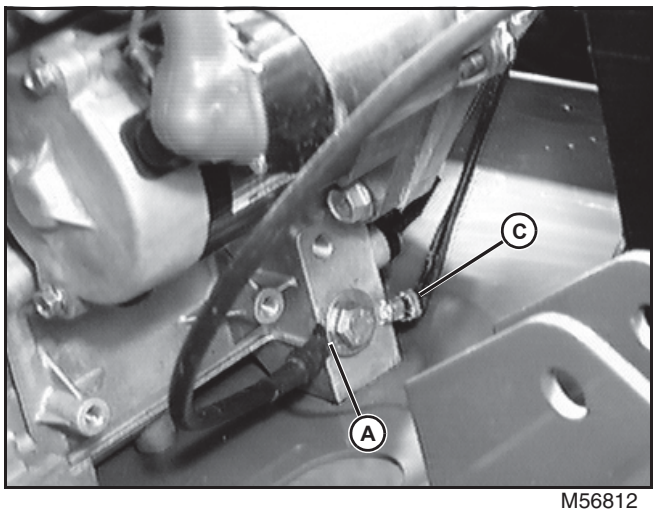
M56410

4X2 Engine and frame ground



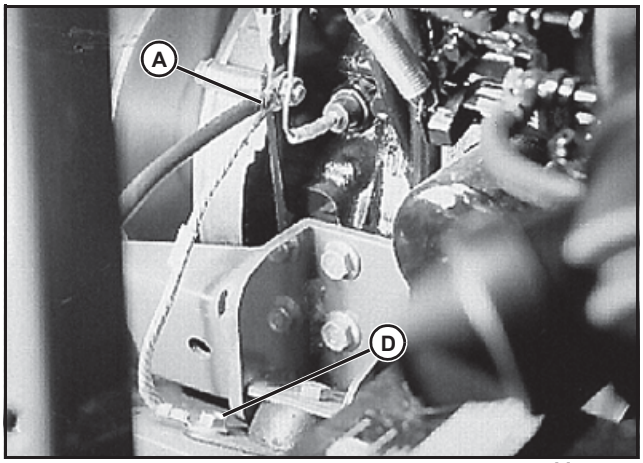
M56811

6X4 Gas Engine ground



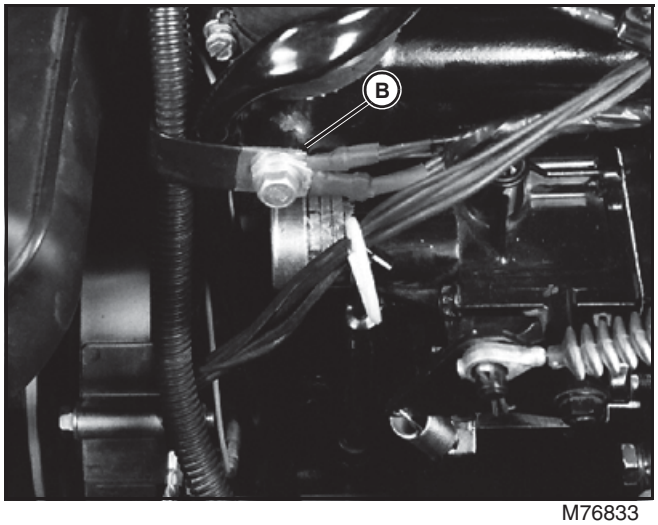
M56812

6X4 Gas frame ground



M76709

6X4 Diesel frame ground



M76833

6X4 Diesel engine ground

4. Put meter red lead on ground terminal of circuit or component:

- Harness ground (A),
- Light Kit ground (B),
- Voltage Regulator/Rectifier ground (C), and/or
- Frame ground (D) to be tested that is closest to the battery negative terminal.

5. Resistance reading must be very close to or the same as the battery negative terminal reading.

6. Work backwards from the battery on the ground side of the problem circuit until the resistance reading increases above 0.1 ohms.

7. The problem is between the last two test points.

8. If a problem is indicated, disconnect the wiring harness connector to isolate the wire or component and check resistance again.

9. Maximum allowable resistance in the circuit is 0.1 ohms.

10.Check both sides of connectors closely as disconnecting and connecting may temporarily solve problem.

Voltmeter Method:

1. Park machine on level surface and turn key switch ON.

2. Shift lever in NEUTRAL and park brake LOCKED.

3. Cargo box RAISED and LOCKED.

4. Connect voltmeter negative (black) lead to negative terminal of battery.

5. Put meter positive (red) lead on ground terminal of circuit or component (A, B, and/or C) to be tested.

6. Be sure the component circuit is activated (key ON, switches CLOSED) so voltage will be present at the component.

7. Record voltage. Voltage must be greater than 0 but less than 1 volt.

8. Some components will have a very small voltage reading on the ground side and still be operating correctly.

Results:

- If voltage is 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.

Cargo Box Lift Kit

Cargo Box Lift Specifications

Electrical Input12 VDC

Lift Capacity 4X2 250 Kg minimum (550 lbs) minimum

Lift Capacity 6X4 400 Kg minimum (880 lbs) minimum

Lift Rate 1.27 cm/sec (0.5 in./sec)

Stroke Length 130 mm (5.12 in.)

Current Draw28 amps @ 12 VDC - Full Load

Duty Cycle25% on time at rated load per cycle

Motor ProtectionAutomatic reset thermal overload in windings

Overload ProtectionBall Detent Overload Clutch

Temperature Range -40° to 66° C (-40° to 150° F)

DriveBall Bearing Screw

ConnectorPackard Series 56

Lead Wires14 gauge

MountingClevis mounting only

Restraining Torque 17 N•m (150 lb-in.)

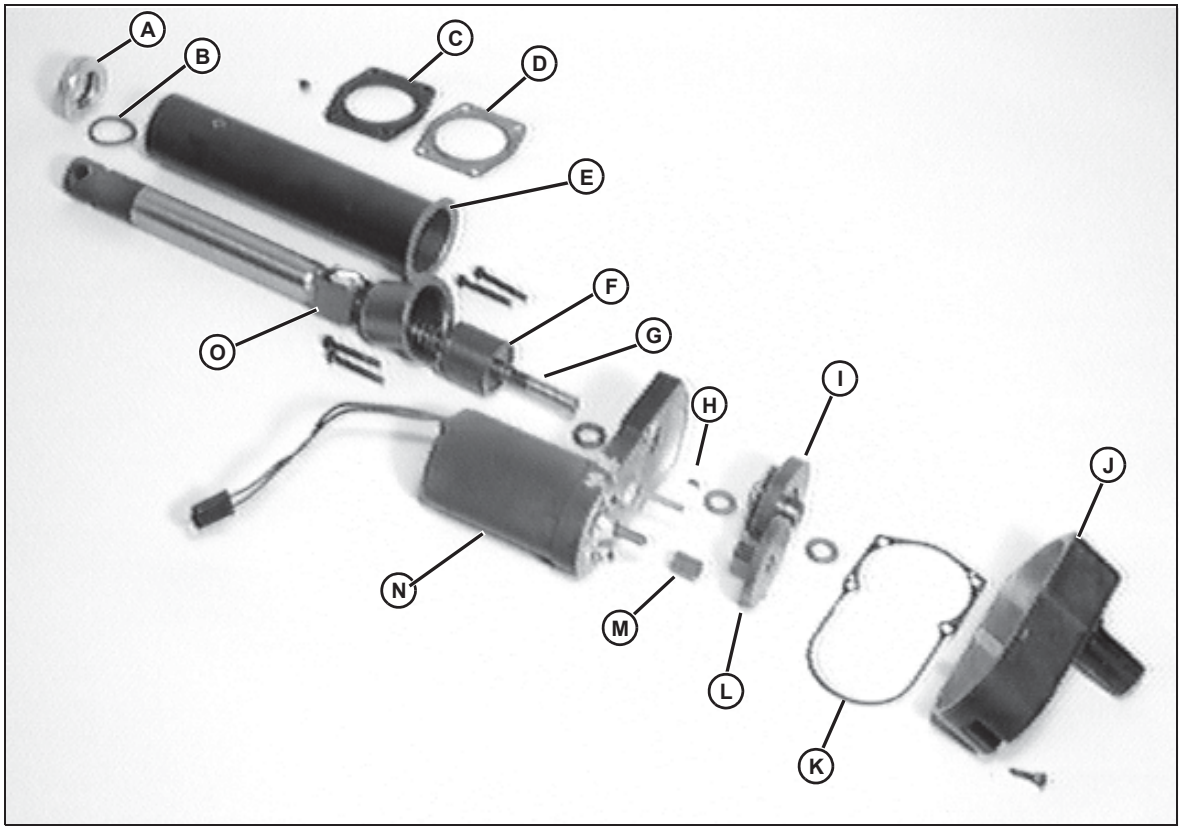
End Play 1.14 mm maximum (0.045 in.) maximum

Static Load 1818 Kg (4000 lbs)

Duty cycle means that for an actuator operating continuously for 10 seconds, it must cool for 30 seconds.

Component Location

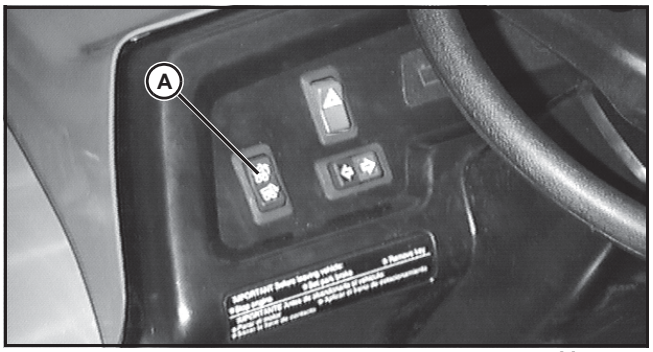
Actuator Components



M56349

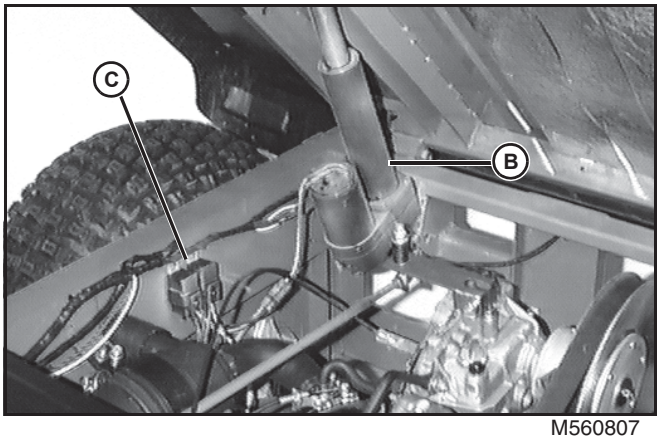
A - Seal
B - O-Ring
C - Retaining Plate
D - Tube Seal
E - Cover Tube
F - Brake
G - Screw
H - Key
I - Clutch
J - Lower Gear Housing
K - Gasket
L - Reduction Gear
M - Motor Gear
N - Motor
O - Ball Bearing Nut

Cargo Box Lift System Components



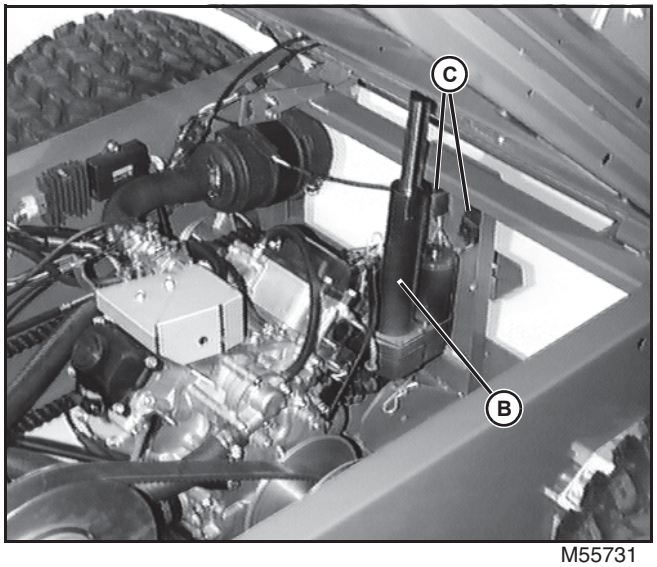
M56079

The lift control switch (A) is a three position self-centering switch.



M560807

4X2 Component Location



M55731

6X4 Gas (shown) or 6X4 Diesel

The switch (A), actuator (B), directional control relays (C), and relay harness are the same. Only the locations are different.

Schematics and Harnesses

Wiring Harness Legend - Cargo Box Lift Kit

F1 - Fusible Link (SE1, W17; SE1, W1; SE1, W2; SE1, W3)

G1 - Battery (SE1, W17; SE1, W1; SE1, W2; SE1, W3)

K1 - Raise Relay (SE2, W17)

K2 - Lower Relay (SE2, W17)

M1 - Starting Motor (SE1, W17; SE1, W1; SE1, W2; SE1, W3)

M2 - Cargo Box Lift Motor (SE2, W17)

S2 - Key Switch (SE1, W17; SE1, W1; SE1, W2; SE1, W3)

S5/S6 - Lift Switch (SE2, W17; SE6, W1; SE5, W2; SE6, W3)

W1 - Shielded Ground (SE1, W17; SE1, W1; SE1, W2; SE1, W3)

Connectors:

X1 - W17 Cargo Box Lift Kit Wiring Harness to Cargo Box Lift Motor (SE2, W17)

To S5/S6 Lift Switch:

X6 - S5/S6 Lift Switch to W1 4X2 Main Wiring Harness and W3 6X4 Diesel Main Wiring Harness (SE2, W17; SE6, W1; SE6, W3)

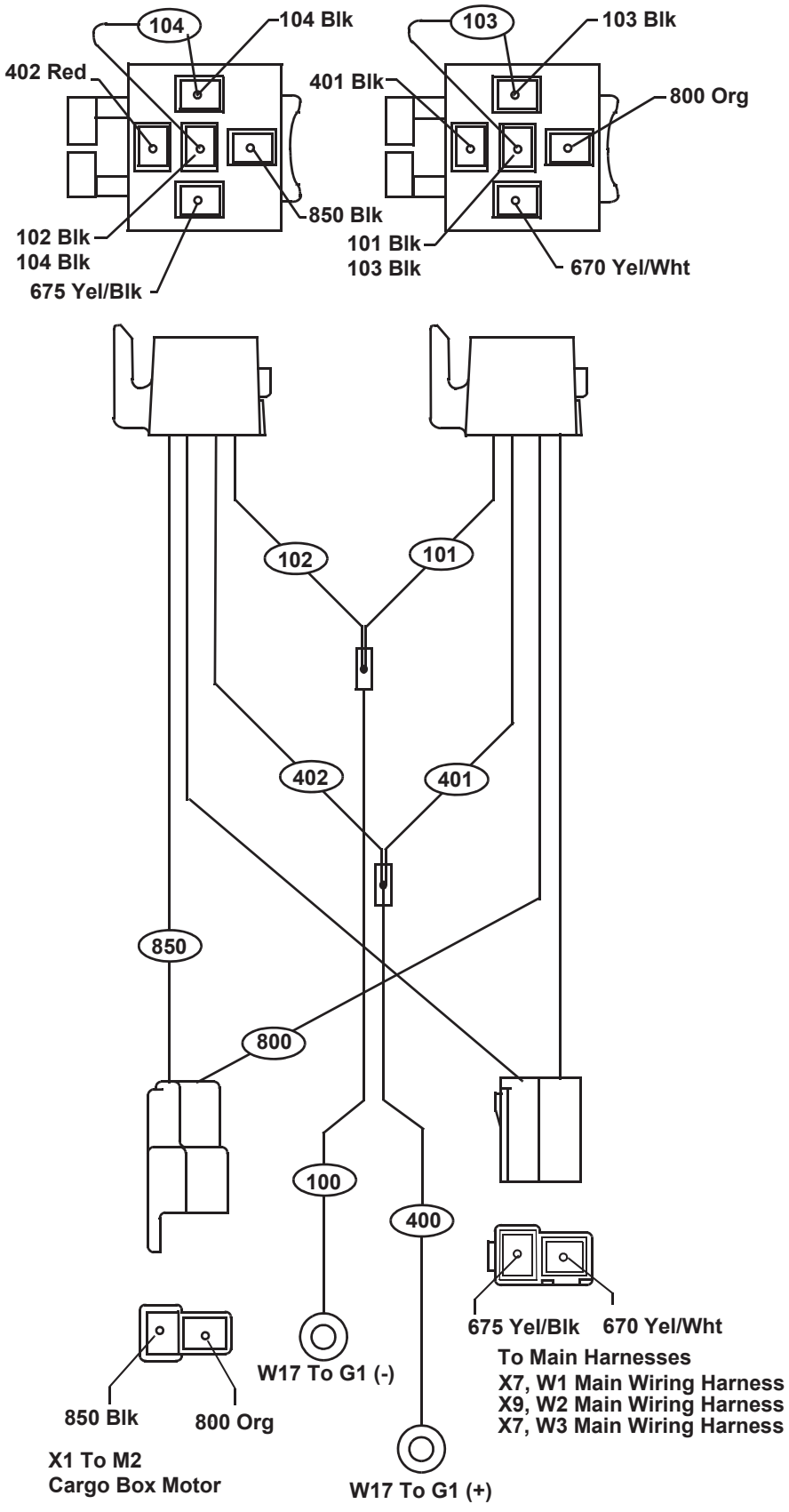
X8 - S5/S6 Lift Switch to 6X4 Gas Main Wiring Harness (SE2, W17; SE5, W2)

To W17 Cargo Box Lift Kit Main Wiring Harness:

X6 - W17 Cargo Box Lift Kit Wiring Harness to W1 4X2 Main Wiring Harness and W3 6X4 Diesel Main Wiring Harness (SE2, W17; SE6, W1; SE6, W3)

X8 - W17 Cargo Box Lift Kit Wiring Harness to 6X4 Gas Main Wiring Harness (SE2, W17; SE6, W2)

W17 Cargo Box Lift Wiring Harness



W17 Cargo Box Lift Wire Color Codes

Circuit Number	Wire Size	Color	Termination Points
100	3.0	Blk	G1 (-), 101 and 102 splice
101	2.0	Blk	K1, 102 and 100 splice
102	2.0	Blk	K2, 101 and 100 splice
103	0.8	Blk	K1, K1
104	0.8	Blk	K2, K2
400	3.0	Red	G1 (+), 401 and 402 splice, K1
401	2.0	Blk	400 and 402 splice, K1
402	2.0	Red	400 and 401 splice, K2
670	0.8	Yel/Wht	X7 (4X2 or 6X4 diesel) or X9 (6X4 gas), K1
675	0.8	Yel/Blk	X7 (4X2 or 6X4 diesel) or X9 (6X4 gas), K2
800	2.0	Org	K1, X1
850	2.0	Blk	K2, X1

Cargo Box Lift Circuit Operation

Function:

Controls the direction of current through the actuator motor, raising and lowering the cargo box.

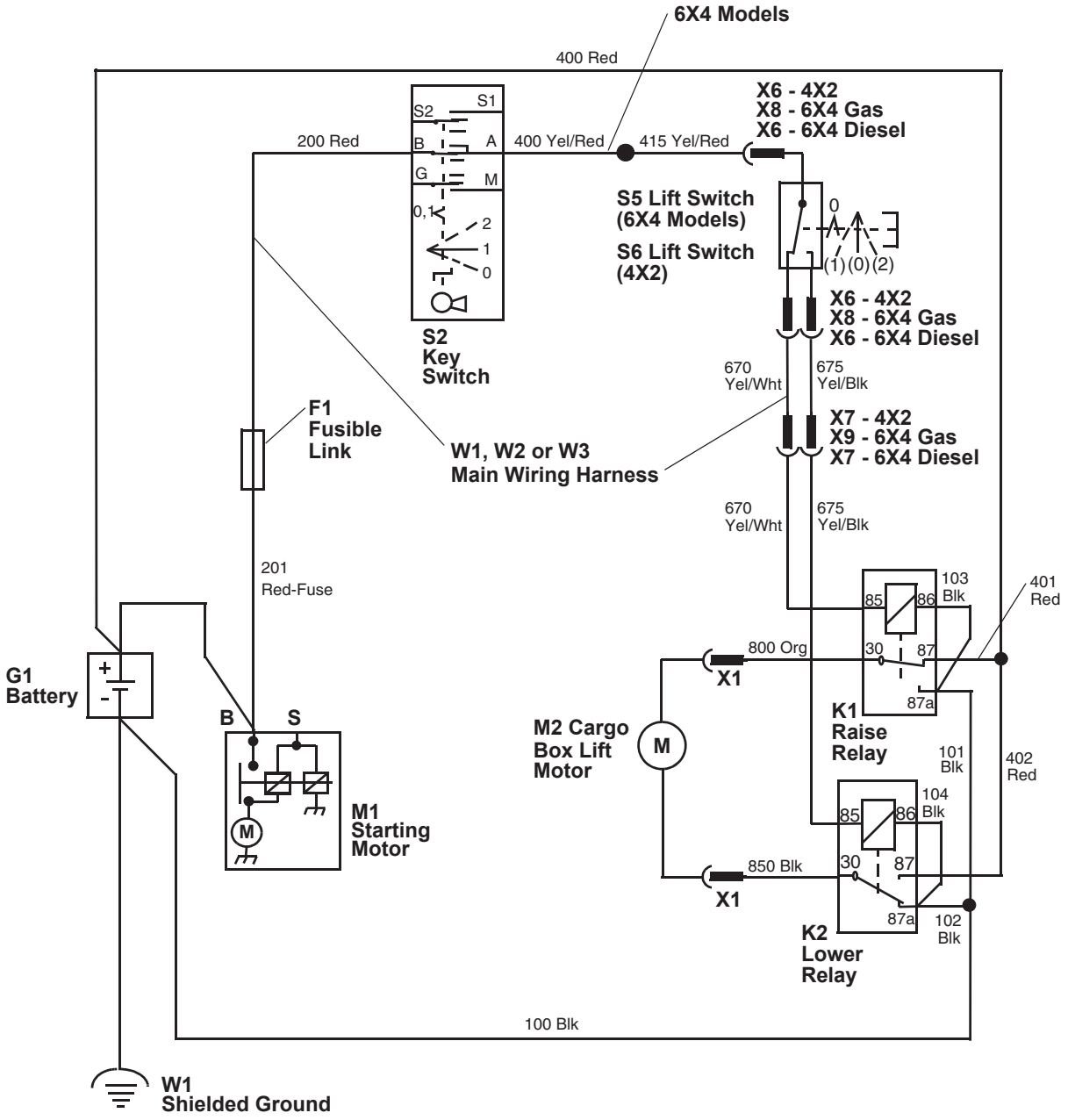
Theory of Operation:

The primary controlling circuit passes through the key switch and lift control switch. Therefore, the key must be in the RUN position for the system to operate. When the lift control switch is held to the raise or lower position, it energizes the appropriate directional relay.

The secondary circuit is connected directly to the battery positive bolt. It is protected by a fusible link. When the control circuit energizes a directional relay, the relay allows the secondary high current from the battery to flow to the motor.

The motor ground circuit grounds through the other non-operating relay to the battery negative bolt.

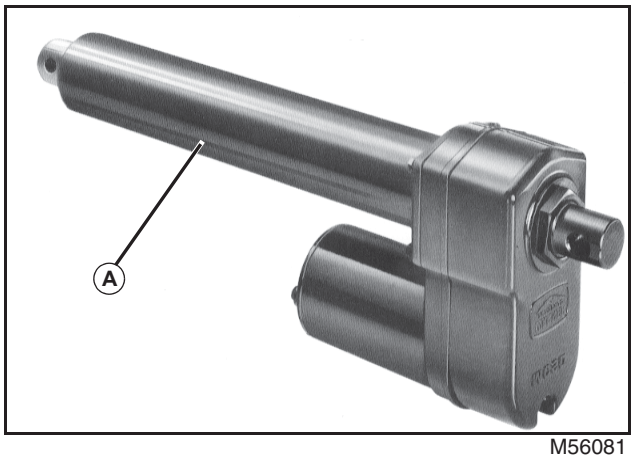
Cargo Box Lift Circuit Schematic



SE1 - Starting	SE2 - Cargo Box Lift Kit

Operation and Diagnostics

Cargo Box Lift Theory of Operation



M56081

The heart of the cargo box lift system is a linear actuator (A). It is an electromechanical, ball-bearing screw type actuator. It consist of a electric motor, gear train, drive screw and ram.

The electric motor turns the drive screw that extends and retracts the stainless steel ram from the ram tube. The direction in which the motor turns is determined by which way current flows through it. Current flow is controlled by the lift control switch and directional control relays.

Cargo Box Lift System Troubleshooting Chart

System: Electrical

(1) Does the lift operate?

No - Lift not receiving power; check connection and fusible links at starter. See “Cargo Box Lift Circuit Diagnosis” on page 406.

No - Excessive load; reduce load.

No - Fusible link burnt; replace.

No - Faulty switch. See “Cargo Box Lift Circuit Diagnosis” on page 406.

(2) Will the lift extend or raise cargo box?

No - Lift not receiving power; check connection and fusible links at starter. See “Cargo Box Lift Circuit Diagnosis” on page 406.

No - Thermal overload cut-out; let cool.

No - Stripped nut or gears; check for excessive shock loads.

No - Excessive load; reduce load.

No - Clutch worn; replace clutch.

System: Electrical

No - Brake worn, seized, or broken; replace brake.

No - Actuator binding; check distribution of load, cargo box, and lift pivot points for binding or wear.

(3) Will lift retract to lower cargo box?

No - Lift not receiving power; check connection and fusible links at starter. See “Cargo Box Lift Circuit Diagnosis” on page 406.

No - Brake worn, seized, or broken; replace brake.

No - Actuator binding; check distribution of load, cargo box, and lift pivot points for binding or wear.

(4) Does the lift stop in mid-stroke?

Yes - Thermal overload cut-out; let cool.

Yes - Brake worn, seized, or broken; replace brake.

Yes - Low voltage.

Yes - Actuator binding; check distribution of load, cargo box, and lift pivot points for binding or wear.

(5) Will the lift hold its position?

No - Brake worn, seized, or broken; replace brake.

(6) Is the lift slow?

Yes - Excessively loaded; reduce load.

Yes - Low voltage.

(7) Is there a fast thumping noise?

Yes - Excessively loaded; reduce load.

Yes - Clutch worn; replace clutch.

(8) Does the switch operate in the wrong direction?

Yes - Wire locations switched at lift control switch outlet terminals or in lift motor connector.

Cargo Box Lift Circuit Diagnosis

Test Conditions:

- Key switch in OFF position

Test/Check Point	Normal	If Not Normal
1. Battery positive post	Battery voltage (11.8 - 13.3 volts)	Check and clean battery cable connections. Test battery.
2. Terminal 87 of both control relays	Battery voltage	Check for failed fusible link. Test continuity of 400 Red wire between battery positive post and relays. Also check for short to ground. Perform Raise Motor Amperage Draw Test.
3. Key switch “B” terminal	Battery voltage	Check for failed fusible link. Check connections and continuity of 200 Red wire.

Test Conditions:

- Turn key switch to RUN position

4. Key switch “A” terminal	Battery voltage	Replace key switch.
5. Cargo box motor control switch	Battery voltage	Check connections and continuity of 415 Yel/Red wire.

Test Conditions:

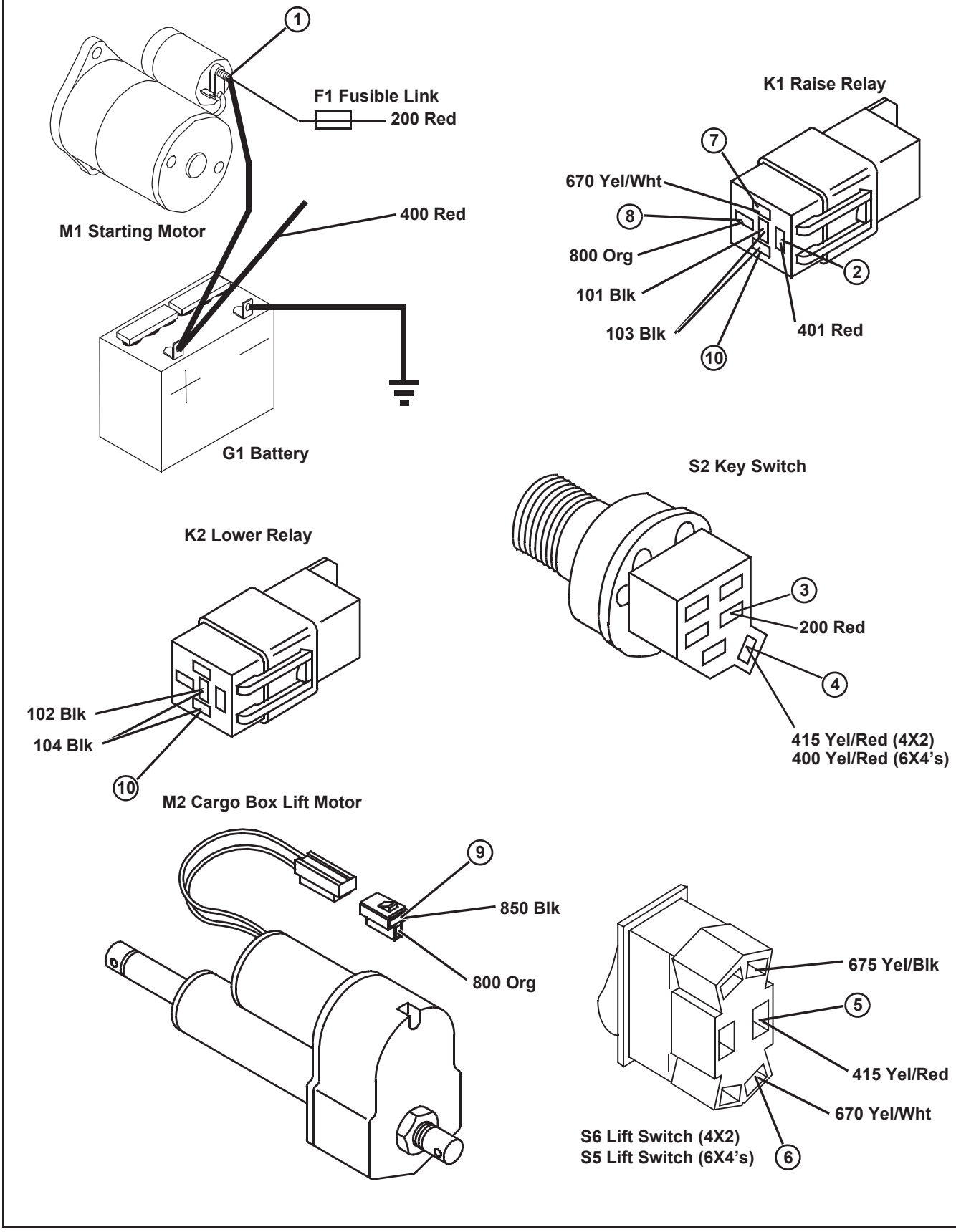
- Turn key switch to RUN position
- Depress cargo box motor control switch to raise position. Hold in position for the following test.

6. Cargo box motor control switch Yel/Wht wire	Battery voltage	Replace cargo box control switch

Test Conditions:

- Turn key switch to RUN position
- If no voltage, test with switch in lower position. Position of raise wire and lower wire may be switched. Switch position of Yel/Blk wire and Yel/Wht wire if switch direction does not match box direction.

7. Raise relay terminal 85	Battery voltage	Check connections and continuity of 670 Yel/Wht wire.
8. Raise relay terminal 30	Battery voltage	Replace relay.
9. Motor connector	Battery voltage	Check connections and continuity of 800 Org wire between connector and relay.
10. Motor connector (ground side)	Greater than 0 volts - less than 0.2 volts OR: Disconnect motor connector and measure resistance of ground circuit for less than 1 ohm resistance	Check connections at lower relay and continuity through 30 and 87a. Replace relay. Check ground wires 100, 101, 102, 103 and 104 Blk connections and continuity. Check battery ground cable connections.


1
F1 Fusible Link
200 Red
400 Red
M1 Starting Motor
G1 Battery
K1 Raise Relay
7
670 Yel/Wht
8
800 Org
101 Blk
103 Blk
10
2
401 Red
S2 Key Switch
3
200 Red
4
415 Yel/Red (4X2)
400 Yel/Red (6X4's)
K2 Lower Relay
102 Blk
104 Blk
10
M2 Cargo Box Lift Motor
9
850 Blk
800 Org
675 Yel/Blk
5
415 Yel/Red
670 Yel/Wht
S6 Lift Switch (4X2)
S5 Lift Switch (6X4's)
6

Cargo Box Lift Circuit Diagnosis (Continued)

Test Conditions:

- Turn key switch to RUN position
- If no voltage, test with switch in lower position. Position of raise wire and lower wire may be switched. Switch position of Yel/Blk wire and Yel/Wht wire if switch direction does not match box direction.

Test/Check Point	Normal	If Not Normal
11. Actuator motor	Operates and raises maximum load and holds set position	Motor operates slow. Will not hold position. See “Cargo Box Motor Amperage Draw Test” on page 410.

Test Conditions:

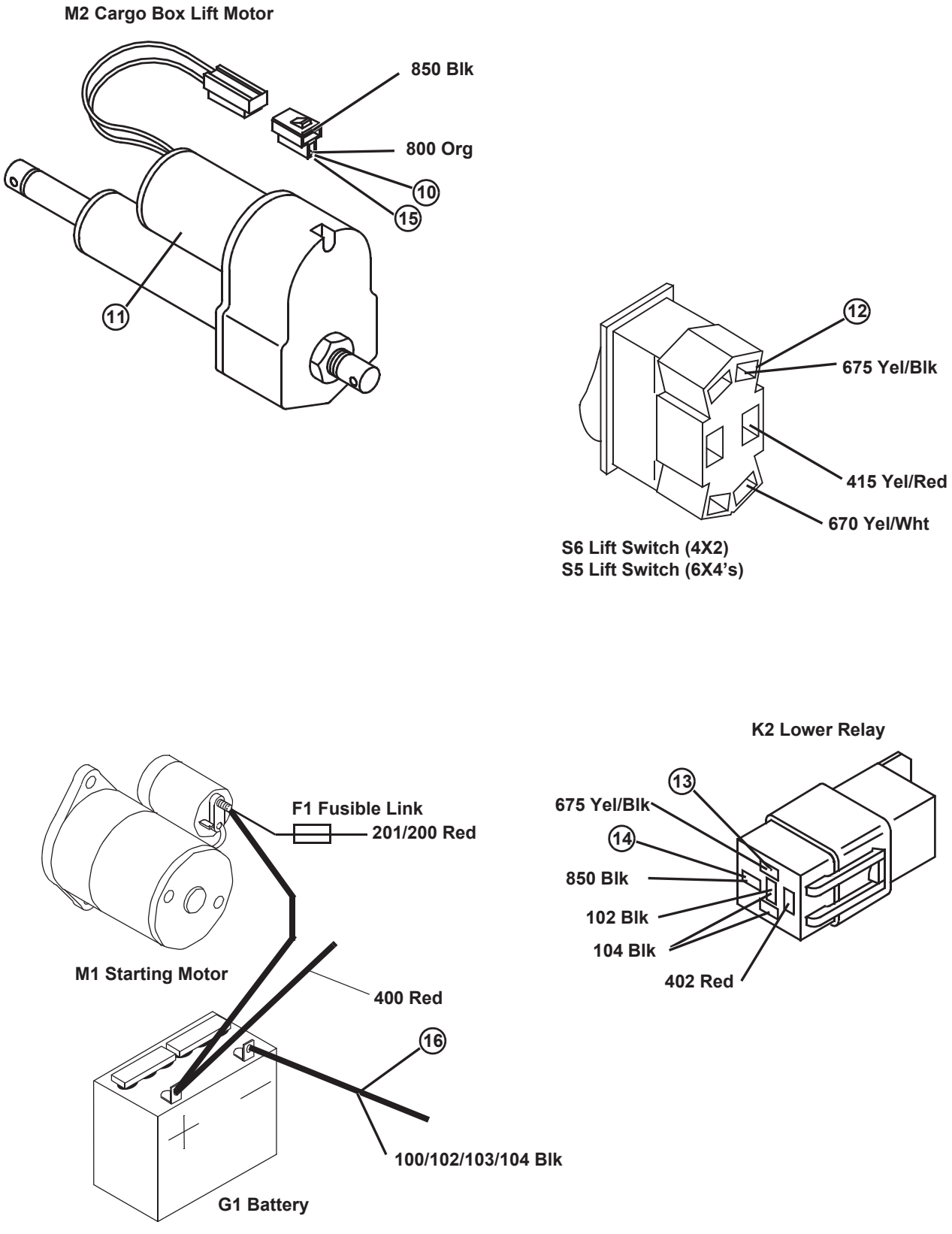
- Turn key switch to RUN position
- Depress and hold cargo box control switch to lower position.

12. Cargo box control switch Yel/Blk wire	Battery voltage	Replace cargo box control switch.

Test Conditions:

- Turn key switch to RUN position
- If no voltage, test with switch in raised position. Position of raise wire and lower wire may be switched.

13. Lower relay terminal 85	Battery voltage	Check connections and continuity of 675 Yel/Blk wire.
14. Lower relay terminal 30	Battery voltage	Replace relay.
15. Cargo box motor connector	Battery voltage	Check connections and continuity of 800 Org wire between motor and relay.
16. Cargo box motor connector (ground side).	Greater than 0 volts - less than 0.2 volts	Check connections at raise relay and continuity through 30 and 87a. Replace relay. Check 100, 101, 102, 103 and 104 Blk ground wire connections and continuity.


M2 Cargo Box Lift Motor
850 Blk
800 Org
10
15
11
12
675 Yel/Blk
415 Yel/Red
670 Yel/Wht
S6 Lift Switch (4X2)
S5 Lift Switch (6X4's)
K2 Lower Relay
13
675 Yel/Blk
14
850 Blk
102 Blk
104 Blk
402 Red
F1 Fusible Link
201/200 Red
M1 Starting Motor
400 Red
16
100/102/103/104 Blk
G1 Battery

Cargo Box Tests and Adjustments

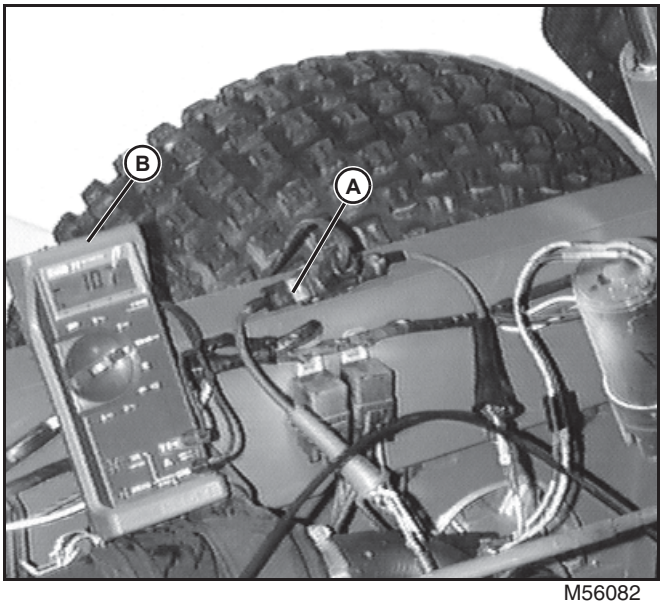
Cargo Box Motor Amperage Draw Test

Reason:

To determine the condition of cargo box motor and actuator assembly.

Equipment:

- JT05792 Shunt
- JT05791 Multimeter
- Jumper Wire



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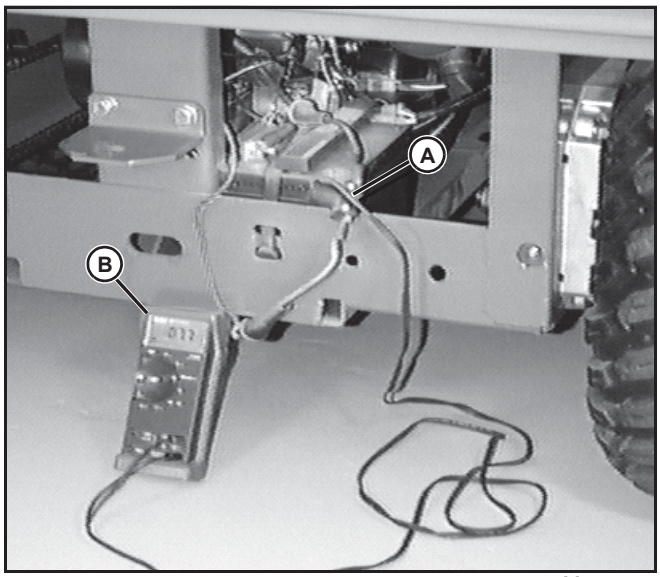
4X2



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6X4 Gas

Procedure:

1. Battery fully charged and key in RUN position.
2. Connect JT05792 shunt (A) in series between battery connection and cargo box motor. (Some jumper wire required).
3. Connect shunt leads to JT05791 Multimeter (B).
4. Set meter to the milli-amp scale.
5. Raise box and observe amperage reading
6. Lower box and observe amperage reading.

Specifications:

Maximum Amperage Draw

No Load Up . . . . . 3 - 6 amps
No Load Down . . . . . 3 - 4 amps
With Clutch Operating . . . . . 4 - 28 amps
4X2 - 550 lb Load . . . . . .28 amps
6X4 - 880 lb Load . . . . . 28 Amps

Results:

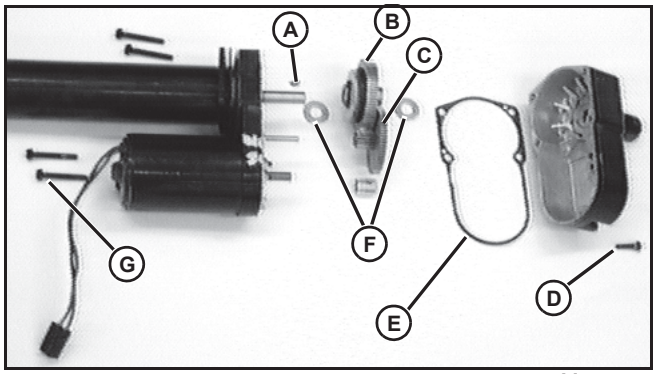
- If amperage is below specification, cargo box motor is OK, or if unit does not raise, check for stripped gears or worn clutch.
- If amperage is zero, check control circuit or fusible link.
- If control circuit and fusible link are OK, and motor will not run, thermal protector or motor maybe defective. Replace motor.
- If amperage is above specification, check cargo box for binding or gears, worm gear, or bearings causing an excessive load.
- Repair or replace cargo box actuator.

Cargo Box Repair

Actuator Repair Kits

- Clutch Kit
- Seal Kit
- Motor

Replace Actuator Clutch



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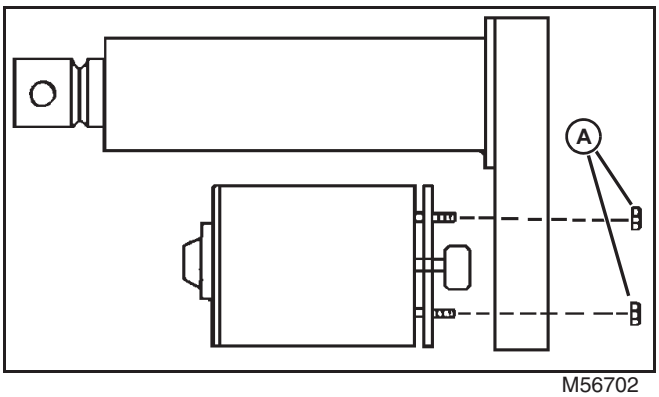
A - Key
B - Clutch
C - Intermediate Gear
D - Screw, 2.3 N•m (20 lb-in.)
E - Gasket
F - Thrust Washers
G - Screws, 8 N•m (70 lb-in.)

1. Remove gear case housing, intermediate gear (C), clutch (B), and thrust washers (F).
2. Install new clutch.
3. Install new gear case housing gasket (E).
4. Tighten hardware evenly.

Replace Motor

IMPORTANT: Avoid damage! When replacing motor, note direction that motor gear is installed. Intermediate gear teeth should ride close to the center of motor gear.

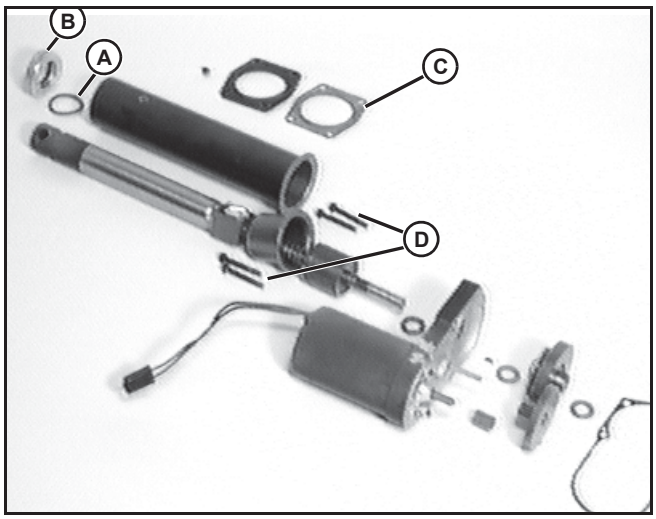
1. Remove gear case housing.
2. Remove nuts from motor.
3. Replace motor and seal.



M56702

4. Tighten nuts (A) evenly to 8 N•m (70 lb-in.).

Cover Tube Seal



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If tube is removed or leaking, replace the upper o-ring (A) and lip seal (B). Drive seal and o-ring from end of tube use a disk and driver.

1. Install new seal and o-ring flush with end of tube.
2. Install new tube retaining gasket (C).
3. Install thrust tabbed thrust washer and thicker thrust washer.
4. Tighten bolts (D) evenly.