

## 1986 - 2003 HARLEY DAVIDSON SPORTSTER TROUBLESHOOTING MANUAL CYCLETECH

This chapter covers troubleshooting procedures. Each section provides typical symptoms and logical methods for isolating the cause(s). There may be several ways to solve a problem, but only a systematic approach will be successful in avoiding wasted time and possibly unnecessary parts replacement.

An engine needs three elements to run properly: correct air/fuel mixture, compression and a spark at the right time.

If one basic requirement is missing, the engine will not run.

Gather as much information as possible to aid in diagnosis. Never assume anything and do not overlook the obvious. Make sure there is fuel in the tank. Make sure the fuel shutoff valve is in the on position.

In most cases, specialized test equipment is not needed to determine whether repairs can be performed at home. On the other hand, be realistic and do not attempt repairs beyond personal capabilities.

If the motorcycle does require the attention of a professional, describe the symptoms, conditions and previous repair attempts accurately and fully. The more information a technician has available, the easier it will be to diagnose.

Refer to **Table 1** and **Table 2** at the end of this chapter.

### STARTING THE ENGINE

#### Engine Fails to Start (Spark Test)

Perform the following spark test to determine if the ignition system is operating properly:

#### CAUTION

*Before removing the spark plugs, clean all debris from the plug base and surrounding area. Dirt that falls into the cylinder causes rapid engine wear.*

1. Disconnect the spark plug wire and remove the spark plug as described in Chapter Three.

#### NOTE

*A spark tester is a useful tool for testing spark output. **Figure 1** shows the Motion Pro Ignition System Tester (part No. 08-0122). This tool is inserted in the spark plug cap and its base is grounded against the cylinder head. The tool's air gap is adjustable, and it allows the visual inspection of the spark while testing the intensity of the spark.*

2. Cover the spark plug hole with a clean shop cloth to reduce the chance of gasoline vapors being emitted from the hole.



3. Insert the spark plug (**Figure 2**), or spark tester (**Figure 3**), into its plug cap and ground the spark plug base against the cylinder head. Position the spark plug so the electrode is visible.

**WARNING**

*Mount the spark plug, or tester, away from the spark plug hole in the cylinder so the spark plug or tester cannot ignite the gasoline vapors in the cylinder. If the engine is flooded,*

*do not perform this test. The firing of the spark plug can ignite fuel ejected through the spark plug hole.*

**NOTE**

*If a spark plug is used, perform this test with a new spark plug.*

4. Turn the ignition switch on.

**WARNING**

*Do not hold the spark plug, wire or connector, or a serious electrical shock may result.*

5. Turn the engine over. A crisp blue spark should be evident across the spark plug electrode or spark tester terminals.

6. If the spark is good, check for one or more of the following possible malfunctions:

- a. Obstructed fuel line or fuel filter.
- b. Low compression or engine damage.
- c. Flooded engine.
- d. Incorrect ignition timing.

**NOTE**

*If the engine backfires during starting, the ignition timing may be incorrect due to a defective ignition component. Refer to **Ignition Timing Adjustment** in Chapter Three for more information.*

7. If the spark is weak or if there is no spark, refer to *Engine is Difficult to Start* in this section.

**Engine is Difficult to Start**

Check for one or more of the following possible malfunctions:

1. Fouled spark plug(s).
2. Improperly adjusted enrichment valve.
3. Intake manifold air leak.
4. A plugged fuel tank filler cap.
5. Clogged fuel line.
6. Contaminated fuel system.
7. An improperly adjusted carburetor.
8. A defective ignition module.
9. A defective ignition coil.
10. Damaged ignition coil primary and/or secondary wires.
11. Incorrect ignition timing.
12. Low engine compression.
13. Incorrect engine oil viscosity.
14. Discharged battery.
15. A defective starter.
16. Loose or corroded starter and/or battery cables.
17. A loose ignition sensor and module electrical connector.
18. Incorrect pushrod length (intake and exhaust valve pushrods interchanged).

## Engine Will Not Crank

Check for one or more of the following possible malfunctions:

1. Ignition switch turned off.
2. A faulty ignition switch.
3. Engine run switch in off position.
4. A defective engine run switch.
5. Loose or corroded starter and battery cables.
6. A discharged or defective battery.
7. A defective starter.
8. A defective starter solenoid.
9. A defective starter shaft pinion gear.
10. Slipping overrunning clutch assembly.
11. A seized piston(s).
12. Seized crankshaft bearings.
13. A broken connecting rod.

## ENGINE PERFORMANCE

The following check lists assume the engine runs, but is not operating at peak performance. Refer to the following procedure(s) that best describes the symptom(s).

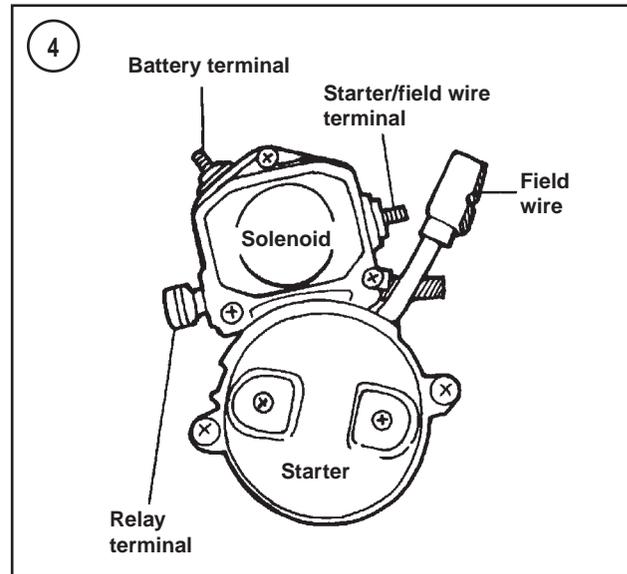
### Spark Plugs Fouled

If the spark plugs continually foul, check for the following:

1. Severely contaminated air filter element.
2. Incorrect spark plug heat range.
3. Rich fuel mixture.
4. Worn or damaged piston rings.
5. Worn or damaged valve guide oil seals.
6. Excessive valve stem-to-guide clearance.
7. Incorrect carburetor float level.

### Engine Runs But Misfires

1. Fouled or improperly gapped spark plugs.
2. Damaged spark plug cables.
3. Incorrect ignition timing.
4. Defective ignition components.
5. An obstructed fuel line or fuel shutoff valve.
6. Obstructed fuel filter.
7. Clogged carburetor jets.
8. Loose battery connection.
9. Wiring or connector damage.
10. Water or other contaminants in the fuel.
11. Weak or damaged valve springs.
12. Incorrect camshaft/valve timing.
13. Damaged valve(s).
14. Dirty electrical connections.
15. Intake manifold or carburetor air leak.
16. A plugged carburetor vent hose.
17. Plugged fuel tank vent system.



### Engine Overheating

1. Incorrect carburetor adjustment or jet selection.
2. Incorrect ignition timing or defective ignition system components.
3. Improper spark plug heat range.
4. Low oil level.
5. Oil not circulating properly.
6. Leaking valves.
7. Heavy engine carbon deposits.

### Engine Runs Rough with Excessive Exhaust Smoke

1. Clogged air filter element.
2. Rich carburetor adjustment.
3. Choke not operating correctly.
4. Water or other fuel contaminants.
5. Clogged fuel line and/or filter.
6. Spark plug(s) fouled.
7. Defective ignition components or wiring.
8. Short circuits from damaged wire insulation.
9. Loose battery cable connections.
10. Incorrect camshaft/valve timing.
11. Intake manifold or air filter air leak (carbureted models).

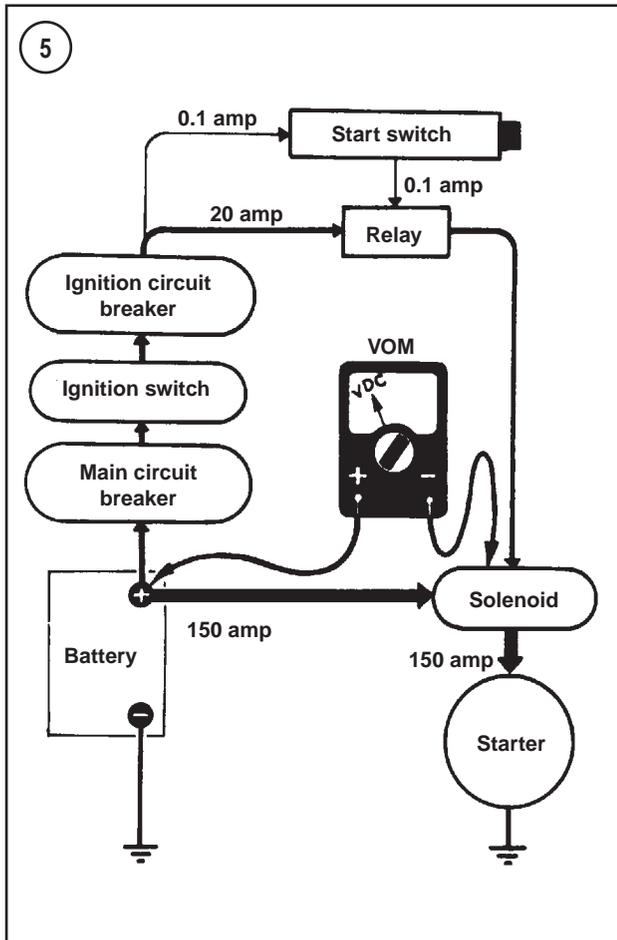
### Engine Loses Power

1. Incorrect carburetor adjustment.
2. Engine overheating.
3. Incorrect ignition timing.
4. Incorrectly gapped spark plugs.
5. An obstructed muffler(s).
6. Dragging brake(s).

### Engine Lacks Acceleration

1. Incorrect carburetor adjustment.

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2. Clogged fuel line.
3. Incorrect ignition timing.
4. Dragging brake(s).

### Valve Train Noise

1. A bent pushrod(s).
2. A defective hydraulic lifter(s).
3. A bent valve(s).
4. Rocker arm seizure or damage (binding on shaft).
5. Worn or damaged camshaft gear bushing(s).
6. Worn or damaged camshaft gear(s).
7. Worn or damaged camshaft drive chain(s).

## ELECTRICAL COMPONENT REPLACEMENT

Most dealerships and suppliers will not accept the return of any electrical part. Consider and test results carefully before replacing a component that tests only slightly out of specification.

## STARTING SYSTEM

The starting system consists of the battery, starter, starter relay, solenoid, start button, starter mechanism and related wiring.

When the ignition switch is turned on and the start button is pushed in, current is transmitted from the battery to the starter relay. When the relay is activated, it activates the starter solenoid that mechanically engages the starter with the engine.

Starting system problems are most often related to a loose or corroded electrical connection.

Refer to **Figure 4** for starter and solenoid terminal identification.

### Troubleshooting Preparation

Before troubleshooting the starting system, check for the following:

1. The battery is fully charged.
2. Battery cables are the proper size and length. Replace damaged or undersized cables.
3. All electrical connections are clean and tight. High resistance caused from dirty or loose connectors can affect voltage and current levels.
4. The wiring harness is in good condition, with no worn or frayed insulation or loose harness sockets.
5. The fuel tank is filled with an adequate supply of fresh gasoline.
6. The spark plugs are in good condition and properly gapped.
7. The ignition system is working correctly.

### Voltage Drop Test

Before performing the steps listed in *Starter Testing* in this section, perform this voltage drop test. These steps check the entire starting circuit to find weak or damaged electrical components that may be causing the starting system problem. A voltmeter is required to test voltage drop.

1. To check voltage drop in the solenoid circuit, connect the positive voltmeter lead to the positive battery terminal. Connect the negative voltmeter lead to the solenoid terminal (**Figure 5**).
2. Turn the ignition switch on and push the starter button while reading the voltmeter scale. Note the following:
  - a. The circuit is operating correctly if the voltmeter reading is 1 volt or less. A voltmeter reading of 12 volts indicates an open circuit.
  - b. A voltage drop of more than 1 volt indicates a problem in the solenoid circuit.
  - c. If the voltage drop reading is correct, continue with Step 3.

*NOTE*

Steps 3 and 4 check the voltage drop across the starter ground circuit. To check any ground circuit in the starting circuit, repeat this test and leave the negative voltmeter lead connected to the battery and connect the positive voltmeter lead to the ground in question.

3. To check the starter ground circuit, connect the negative voltmeter lead to the negative battery terminal. Connect the positive voltmeter lead to the starter housing (**Figure 6**).
4. Turn the ignition switch on and push the starter button while reading the voltmeter scale. The voltage drop must not exceed 0.2 volts. If it does, check the ground connections between the meter leads.
5. If the problem is not found, refer to *Starter Testing* in this section.

### Starter Testing

*CAUTION*

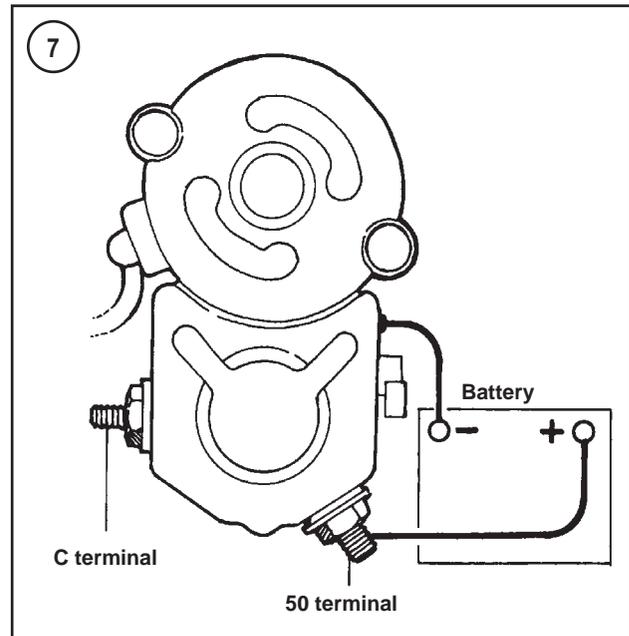
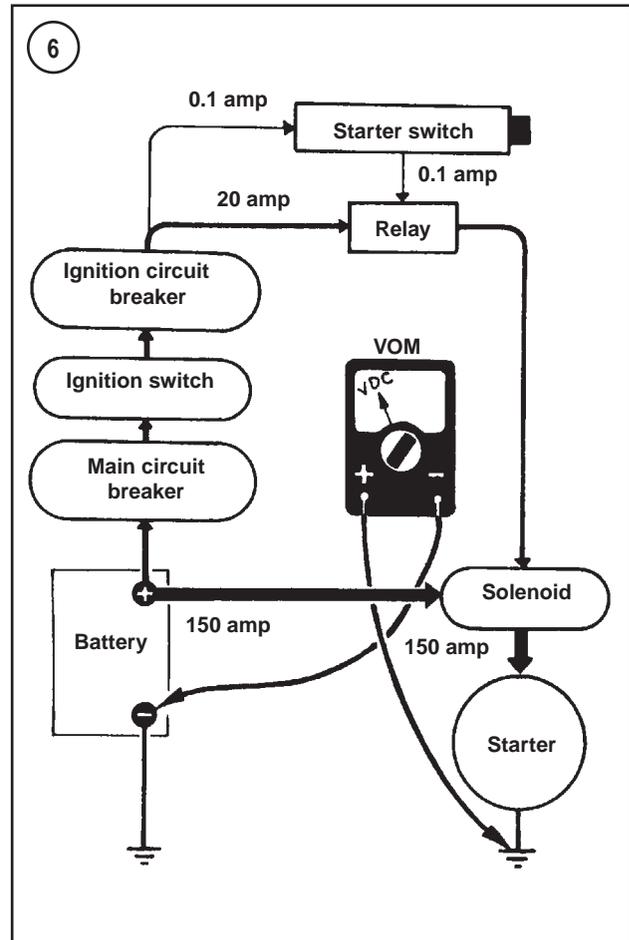
Never operate the starter for more than 30 seconds at a time. Allow the starter to cool before reusing it. Failing to allow the starter to cool after continuous starting attempts can damage the starter.

The basic starter-related troubles are:

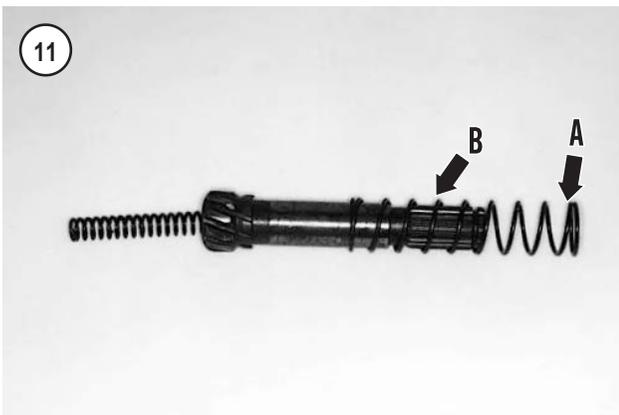
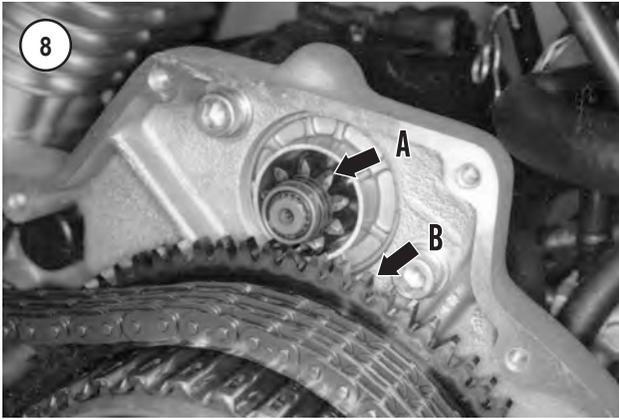
1. Starter does not spin.
2. Starter spins but does not engage.
3. The starter will not disengage after the start button is released.
4. Loud grinding noises when starter turns.
5. Starter stalls or spins too slowly.

### Starter does not spin

1. Turn the ignition switch on and push the starter button while listening for a click at the starter relay in the electrical panel. Turn the ignition switch off and note the following:
  - a. If the starter relay clicks, test the starter relay as described in this section. If the starter relay test readings are correct, continue with Step 2.
  - b. If the solenoid clicks, go to Step 3.
  - c. If there was no click, go to Step 5.
2. Check the wiring connectors between the starter relay and solenoid. Note the following:
  - a. Repair any dirty, loose fitting or damaged connectors or wiring.
  - b. If the wiring is in good condition, remove the starter as described in Chapter Twelve. Perform the solenoid and starter current draw bench tests described in this section.
3. Perform a voltage drop test between the battery and solenoid terminals as described in this section. The normal voltage drop is less than 1 volt. Note the following:



- a. If the voltage drop is less than 1 volt, perform Step 4.
- b. If the voltage drop is more than 1 volt, check the solenoid and battery wires and connections for dirty or loose fitting terminals; clean and repair as required.



4. Remove the starter as described in Chapter Twelve. Momentarily connect a fully charged 12-volt battery to the starter as shown in **Figure 7**. If the starter is operational, it will turn when connected to the battery. Disconnect the battery and note the following:

- a. If the starter turns, perform the solenoid pull-in and hold-in tests as described in *Solenoid Testing (Bench Tests)* in this section.
- b. If the starter does not turn, disassemble the starter as described in Chapter Twelve, and check it for opens, shorts and grounds.

5. Check for voltage at the starter button. Note the following:

- a. If there is voltage at the starter button, test the starter relay as described in this section.
- b. If there is no voltage at the starter button, check continuity across the starter button. If there is voltage leading to the starter button but no voltage leaving the starter button, replace the button switch and retest. If there is no voltage leading to the starter button, check the starter button wiring for dirty or loose-fitting terminals or damaged wiring; clean and/or repair as required.

#### *Starter spins but does not engage*

If the starter spins but the pinion gear does not engage the clutch shell ring gear, perform the following:

1. Remove the primary drive cover as described in Chapter Six or Chapter Seven.
2. Check the starter pinion gear (A, **Figure 8**). If the teeth are chipped or worn, inspect the clutch shell ring gear (B, **Figure 8**) for the same problems. Note the following:
  - a. If the starter pinion gear or clutch ring gear is damaged, service the parts.
  - b. If the starter pinion gear and clutch shell ring gear are not damaged, continue with Step 3.
3. Remove and disassemble the starter as described in Chapter Twelve. Then check the overrunning clutch assembly (**Figure 9**) for the following:
  - a. Roller damage (**Figure 10**).
  - b. Compression spring damage (A, **Figure 11**).
  - c. Excessively worn or damaged pinion teeth (A, **Figure 8**).
  - d. Pinion does not run in overrunning direction.
  - e. Damaged clutch shaft splines (B, **Figure 11**).
  - f. Damaged overrunning clutch assembly (**Figure 12**).
4. Replace worn or damaged parts as required.

***Starter will not disengage after the start button is released***

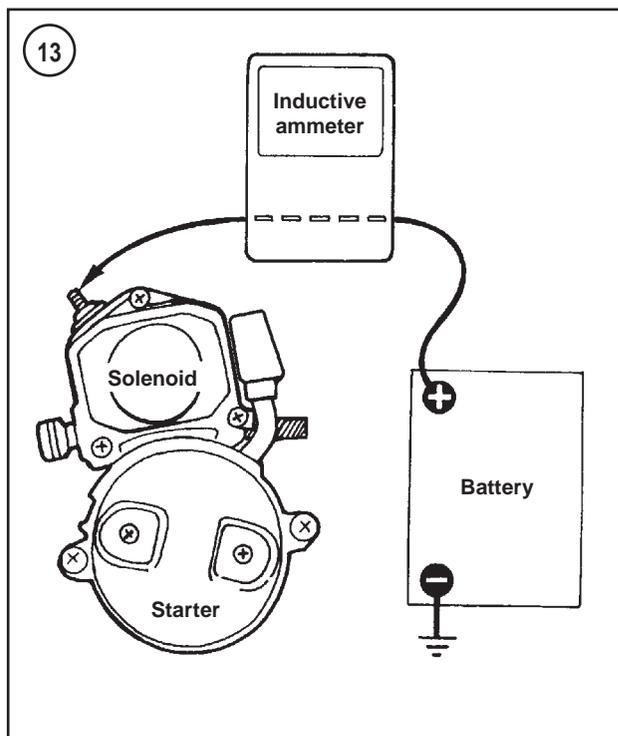
1. A sticking solenoid, caused by a worn solenoid compression spring (A, **Figure 11**), can cause this problem. Replace the solenoid if damaged.
2. On high-mileage motorcycles, the starter pinion gear (A, **Figure 8**) can jam on a worn clutch ring gear (B). Unable to return, the starter will continue to run. This condition usually requires ring gear replacement.
3. Check the start button switch and starter relay for internal damage. Test the start switch as described in the *Switches* section in Chapter Twelve. Test the starter relay as described in this chapter.

***Loud grinding noises when the starter turns***

Incorrect starter pinion gear and clutch shell ring gear engagement (B, **Figure 8**) or a broken overrunning clutch mechanism (**Figure 12**) can cause this problem. Remove and inspect the starter as described in Chapter Twelve.

***Starter stalls or spins too slowly***

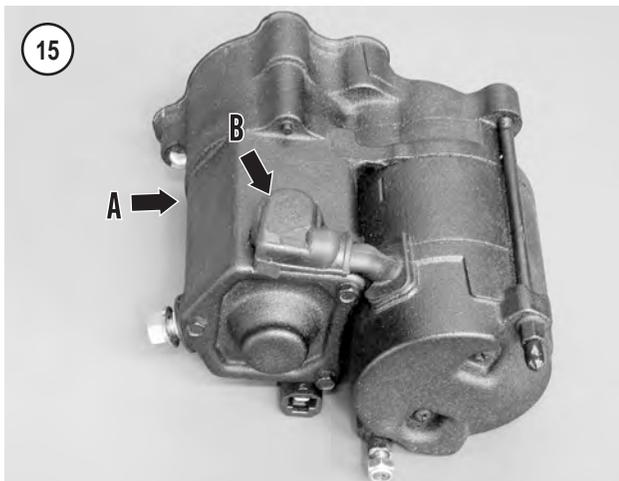
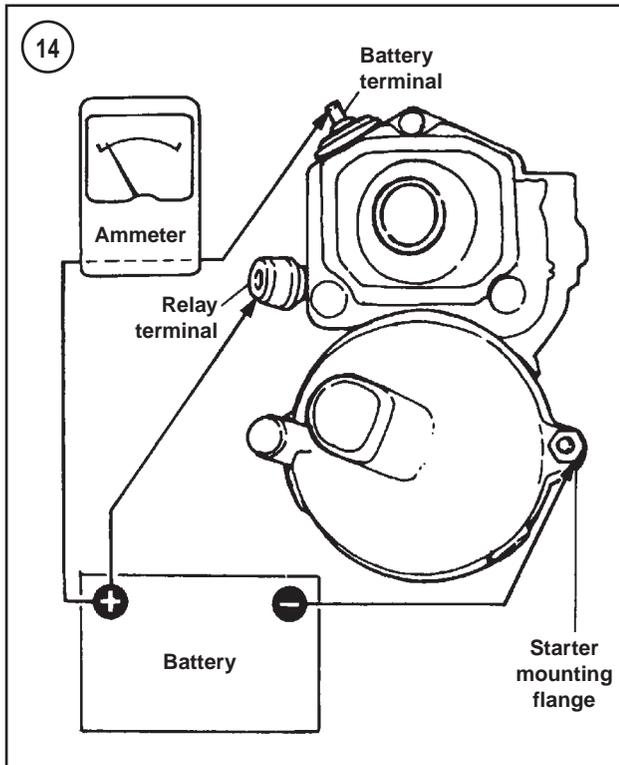
1. Perform a voltage drop test between the battery and solenoid terminals as described in this section. The normal voltage drop is less than 1 volts. Note the following:
  - a. If the voltage drop is less than 1 volt, continue with Step 2.
  - b. If the voltage drop exceeds 1 volt, check the solenoid and battery wires and connections for dirty or loose-fitting terminals; clean and repair as required.
2. Perform a voltage drop test between the solenoid terminals and the starter. The normal voltage drop is less than 1 volt. Note the following:
  - a. If the voltage drop is less than 1 volt, continue with Step 3.
  - b. If the voltage drop exceeds 1 volt, check the solenoid and starter wires and connections for dirty or loose-fitting terminals; clean and repair as required.
3. Perform a voltage drop test between the battery ground wire and the starter as described. The normal voltage drop is less than 0.2 volts. Note the following:
  - a. If the voltage drop is less than 0.2 volts, continue with Step 4.
  - b. If the voltage drop exceeds 0.2 volts, check the battery ground wire connections for dirty or loose-fitting terminals; clean and repair as required.
4. Refer to *Starter Current Draw Tests* in this section and perform the first test. Note the following:
  - a. If the current draw is excessive, check for a damaged starter. Remove the starter as described in Chapter Twelve and perform the second test.
  - b. If the current draw reading is correct, continue with Step 5.



5. Remove the primary drive cover as described in Chapter Six or Chapter Seven. Check the starter pinion gear (A, **Figure 8**). If the teeth are chipped or worn, inspect the clutch ring gear (B, **Figure 8**) for the same problem.
  - a. If the starter pinion gear or clutch ring gear is damaged, service it.
  - b. If the starter pinion gear and clutch ring gear are not damaged, continue with Step 6.
6. Remove and disassemble the starter as described in Chapter Twelve. Check the disassembled starter for opens, shorts and grounds.

**Starter Current Draw Tests**

The following current draw test measures the current (amperage) the starter circuit requires to crank over the engine. Refer to **Table 1** for current draw specifications.



A short circuit in the starter or a damaged pinion gear assembly can cause excessive current draw. If the current draw is low, suspect an undercharged battery or an open circuit in the starting circuit.

#### Current draw test (starter installed)

##### NOTE

*This test requires a fully charged battery and an inductive ammeter.*

1. Shift the transmission into neutral.
2. Disconnect the two spark plug caps from the spark plugs. Then ground the plug caps with two extra spark

plugs or grounding tool. Do not remove the spark plugs from the cylinder heads.

3. Connect an inductive ammeter between the starter terminal and positive battery terminal (**Figure 13**). Connect a jumper cable from the negative battery terminal to ground (**Figure 13**).
4. Turn the ignition switch on and press the start button for approximately ten seconds. Note the ammeter reading.

##### NOTE

*The current draw is high when the start button is first pressed, then it will drop and stabilize at a lower reading. Refer to the lower stabilized reading during this test.*

5. If the current draw exceeds the specification in **Table 1**, check for a defective starter or starter drive mechanism. Remove and service these components as described in Chapter Twelve.
6. Disconnect the ammeter and jumper cables.

#### Current draw test (starter removed)

This test requires a fully charged 12-volt battery, an inductive ammeter, a jumper wire (14-gauge minimum) and three jumper cables (6-gauge minimum).

Refer to **Figure 14**.

1. Remove the starter as described in Chapter Twelve.

##### NOTE

*The solenoid must be installed on the starter during the following tests.*

2. Mount the starter in a vise with soft jaws.
3. Connect the 14-gauge jumper cable between the positive battery terminal and the solenoid relay terminal.
4. Connect a jumper cable (6-gauge minimum) between the positive battery terminal and the ammeter.
5. Connect the second jumper cable between the ammeter and the battery terminal on the starter solenoid.
6. Connect the third jumper cable between the battery negative terminal and the starter motor mounting flange.
7. Read the ammeter; the maximum no-load current specification is 90 amps. A damaged pinion gear assembly will cause an excessively high current draw reading. If the current draw reading is low, check for an undercharged battery, or an open field winding or armature in the starter.

#### Solenoid Testing (Bench Tests)

This test requires a fully charged 12-volt battery and three jumper wires.

1. Remove the starter as described in Chapter Twelve.

##### NOTE

*The solenoid (A, **Figure 15**) must be installed on the starter during the following tests.*

2. Disconnect the field wire (B, **Figure 15**) from the solenoid before performing the following tests. Insulate the end of the wire terminal so that it cannot short out on any of the test connectors.

**CAUTION**

*Because battery voltage is being applied directly to the solenoid and starter in the following tests, do not leave the jumper cables connected to the solenoid for more than 5 seconds; otherwise, the voltage will damage the solenoid.*

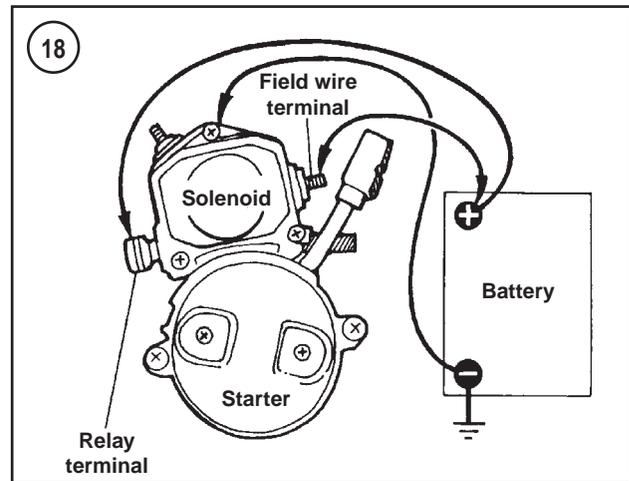
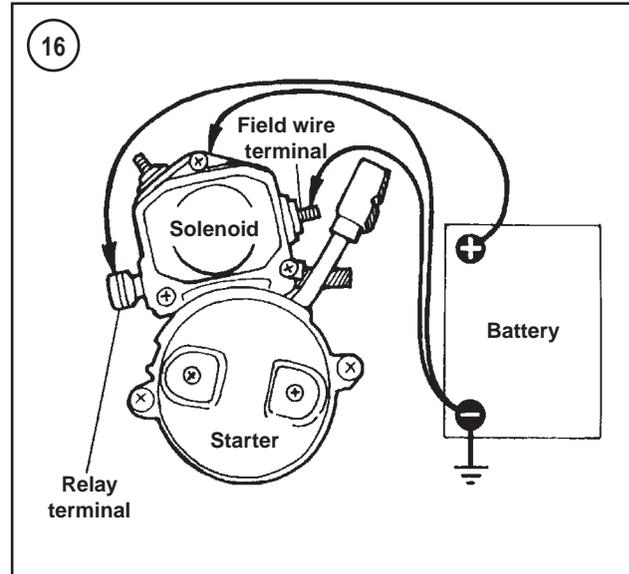
**NOTE**

*Thoroughly read the following procedure to become familiar with and understand the procedures and test connections, then perform the tests in the order listed and without interruption.*

3. Perform the solenoid pull-in test as follows:
  - a. Connect one jumper wire from the negative battery terminal to the field wire terminal on the solenoid (**Figure 16**).
  - b. Connect one jumper wire from the negative battery terminal to the solenoid housing (ground) (**Figure 16**).
  - c. Touch a jumper wire from the positive battery terminal to the starter relay terminal (**Figure 16**). The pinion shaft (**Figure 17**) should pull into the housing.
  - d. Leave the jumper wires connected and continue with Step 4.
4. To perform the solenoid hold-in test, perform the following:
  - a. With the pinion shaft pulled in (Step 3), disconnect the field wire terminal jumper wire from the negative battery terminal and connect it to the positive battery terminal (**Figure 18**). The pinion shaft should remain in the housing. If the pinion shaft returns to its original position, replace the solenoid.
  - b. Leave the jumper wires connected and continue with Step 5.
5. To perform the solenoid return test, perform the following:
  - a. Disconnect the jumper wire from the starter relay terminal (**Figure 19**); the pinion shaft should return to its original position.
  - b. Disconnect all of the jumper wires from the solenoid and battery.
6. Replace the solenoid if the starter shaft failed to operate as described in Steps 3-5. Refer to the *Starter Solenoid* in Chapter Twelve.

**Starter Relay Removal/Testing/Installation**

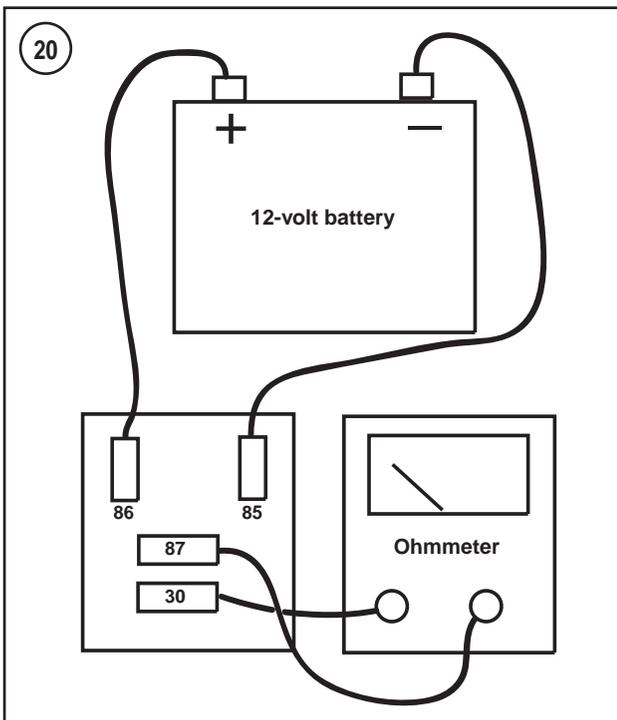
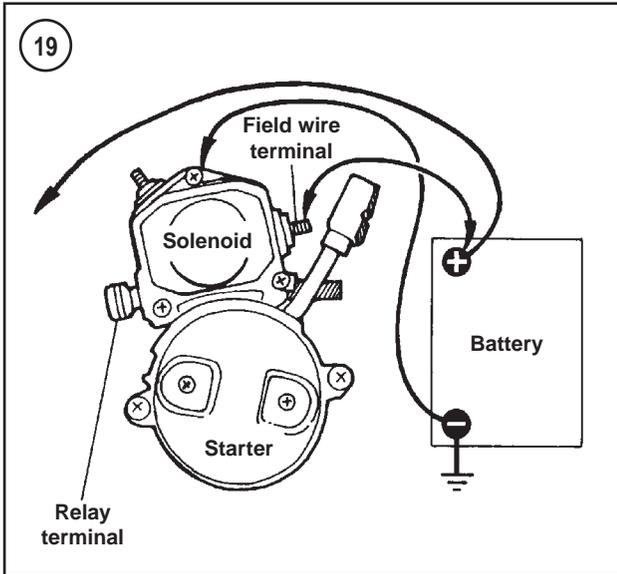
Check the starter relay operation with an ohmmeter, jumper wires and a fully charged 12-volt battery.



1. Remove the starter relay as described in *Fuses (1998-2003 Models)* in Chapter Twelve.

**CAUTION**

*The battery negative lead must be connected to the relay terminal No. 2 to avoid internal diode damage.*



2. Connect an ohmmeter and 12-volt battery between the relay terminals shown in **Figure 20**. This setup will energize the relay for testing.
3. Check for continuity through the relay contacts using an ohmmeter while the relay coil is energized. The correct reading is 0 ohm. If resistance is excessive or if there is no continuity, replace the relay.
4. If the starter relay passes this test, reinstall the relay.

## CHARGING SYSTEM

The charging system consists of the battery, alternator and a solid state voltage regulator/rectifier.

The alternator generates alternating current (AC) which the rectifier converts to direct current (DC). The regulator maintains the voltage to the battery and load (lights, ignition and accessories) at a constant voltage despite variations in engine speed and load.

A malfunction in the charging system generally causes the battery to remain undercharged.

### Service Precautions

Before servicing the charging system, observe the following precautions to prevent damage to any charging system component:

1. Never reverse battery connections.
2. Do not short across any connection.
3. Never start the engine with the alternator disconnected from the voltage regulator/rectifier unless instructed to do so during testing.
4. Never attempt to start or run the engine with the battery disconnected.
5. Never attempt to use a high-output battery charger to help start the engine.
6. Before charging the battery, remove it from the motorcycle as described in Chapter Twelve.
7. Never disconnect the voltage regulator/rectifier connector with the engine running. The voltage regulator/rectifier (**Figure 21**) is mounted on the front frame cross member.
8. Do not mount the voltage regulator/rectifier unit in another location.
9. Make sure the negative battery terminal is connected to the terminal on the engine.

### Troubleshooting Sequence

If the battery is discharged, perform the following procedures as listed:

1. Test the battery as described in Chapter Twelve. Charge the battery if necessary. If the battery will hold a charge while riding, perform the *Charging System Output Test* as described in this section.
2. If the charging system output is within specification, determine the total amount of current demand by the electrical

system and all accessories as described in *Electrical System Current Load Test* in this section.

3. If the charging system output exceeds the current demand and the battery continues to not hold a charge, perform the *Battery Current Draw Test* as described in this section.

4. If the charging system output is not within specification, test the stator and voltage regulator as described in this section.

### Charging System Output Test

This test requires a load tester. When using a load tester, refer to the manufacturer's instructions.

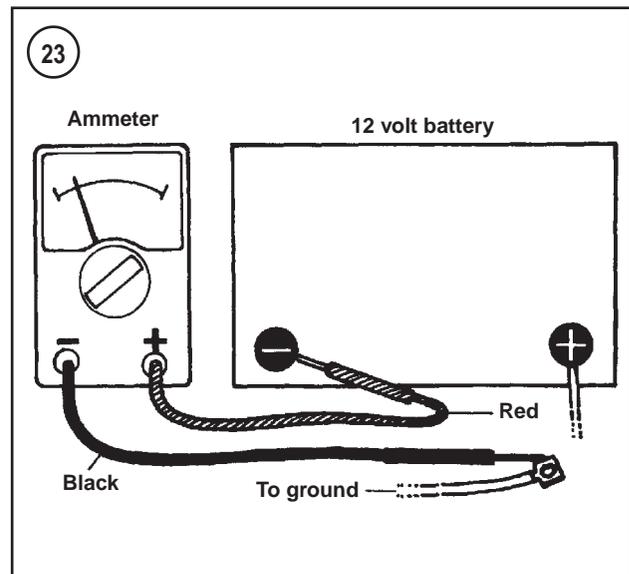
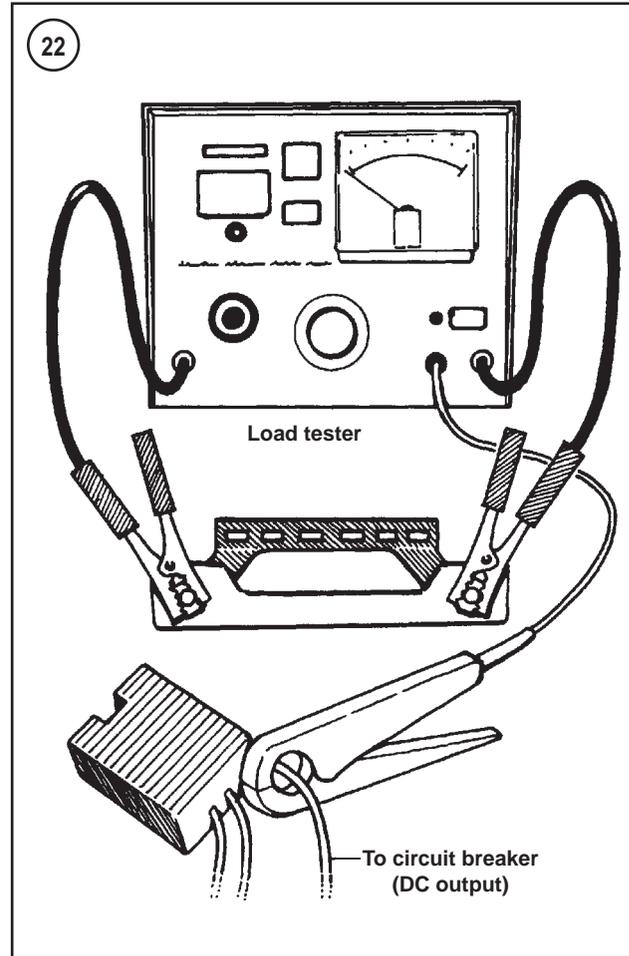
1. To perform this test, the battery must be fully charged.
2. Connect the load tester to the battery per the manufacturer's instructions (**Figure 22**).
3. Start the engine and slowly bring the speed up to 3000 rpm while reading the load tester scale. With the engine running at 3000 rpm, operate the load tester switch until the voltage scale reads 13.0 volts. The tester should show a regulated (DC) current output reading of 19-23 amps.
4. With the engine still running at 3000 rpm, turn the load off and read the load tester voltage scale. Battery voltage should not exceed 15 volts. Turn the engine off and disconnect the load tester from the motorcycle.
5. Perform the *Stator Test* described in this section. If the stator tests acceptable, a defective voltage regulator/rectifier or a wiring short circuit is indicated. Eliminate the possibility of a poor connection or damaged wiring before replacing the voltage regulator/rectifier.

### Electrical System Current Load Test

This test, requiring a load tester, measures the total current load of the electrical system and any additional accessories while the engine is running. Perform this test if the battery is continually discharged, yet the charging system output is within specifications.

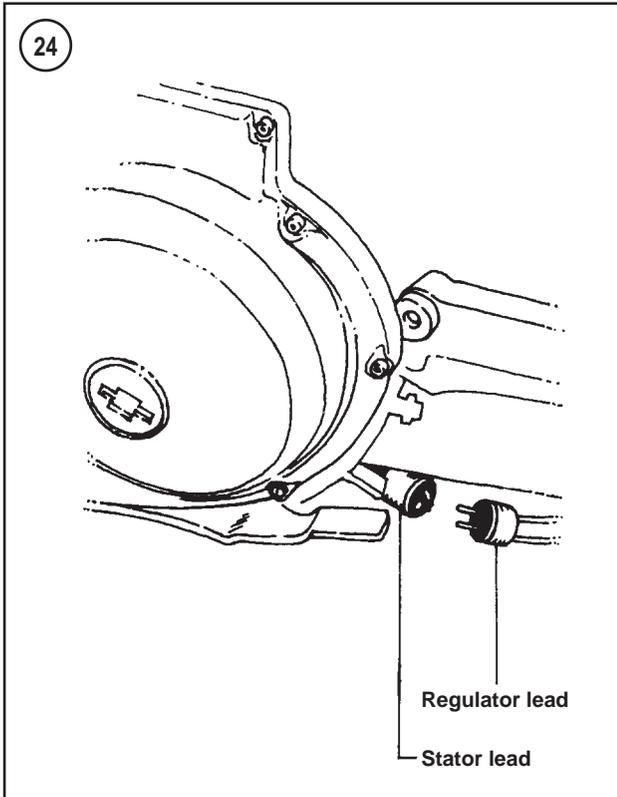
If aftermarket electrical components have been added to the motorcycle, the increased current demand may exceed the charging systems capacity and result in a discharged battery.

1. Connect a load tester to the battery per the manufacturer's instructions. When using a load tester, refer to the manufacturer's instructions.
2. Turn the ignition switch on but do not start the engine. Then turn on all electrical accessories and switch the headlight beam to high.
3. Read the ampere reading (current draw) on the load tester and compare it to the test results obtained in the *Charging System Output Test* in this section. The charging system output test results (current reading) must exceed the electrical system current load by 3.5 amps for the battery to remain sufficiently charged.
4. If the current load is below specified levels and aftermarket accessories have been added to the motorcycle, dis-



connect them and repeat Step 3. If the electrical system current load is now within the specification, the problem is with the additional accessories.

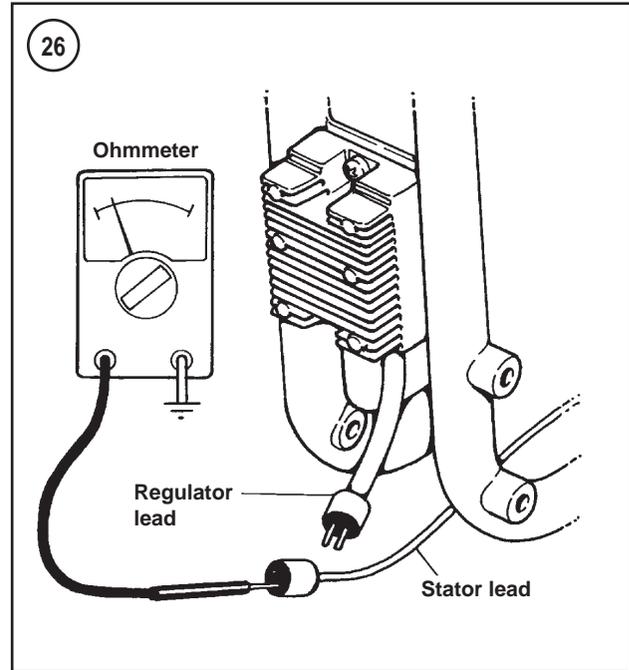
5. If no accessories have been added to the motorcycle, a short circuit may be causing the battery to discharge.



### Battery Current Draw Test

Perform this test if the battery will not hold a charge when the motorcycle is not being used. A current draw that exceeds 3.0 mA will discharge the battery. The battery must be fully charged to perform this test.

1. Disconnect the negative battery cable as described in Chapter Twelve.
2. Connect an ammeter between the negative battery cable end and the ground stud on the engine crankcase as shown in **Figure 23**.
3. With the ignition switch, lights and all accessories turned off, read the ammeter. If the current drain exceeds 3.0 mA, continue with Step 4.



4. Refer to the appropriate wiring diagram at the end of this manual. Check the charging system wires and connectors for shorts or other damage.
5. Unplug each electrical connector separately and check for a reduction in the current draw. If the meter reading changes after a connector is disconnected, the source of the current draw has been found. Check the electrical connectors carefully before testing the individual component.
6. After completing the test, disconnect the ammeter and reconnect the negative battery cable.

### Stator Test

1. With the ignition turned off, disconnect the regulator/rectifier connector that is located below the rear of the primary case (**Figure 24**) on 1986-1990 models or at the front of the crankcase (**Figure 25**) on 1991-2003 models.
2. Connect an ohmmeter between either stator connector terminal and ground (**Figure 26**). The ohmmeter should read infinity (no continuity). If the reading is incorrect, the stator is grounded and must be replaced. Repeat this test for the other stator connector terminal.
3. Connect an ohmmeter between both stator connector terminals. The ohmmeter should read 0.2-0.4 ohms. If the resistance is higher than specified, replace the stator.
4. Check stator AC output as follows:
  - a. Connect an AC voltmeter between the stator connector terminals as shown in **Figure 27**.
  - b. Start the engine and slowly increase idle speed. On 1986-1990 models, the voltage should read 12-18 volts per each 1000 rpm. On 1991-1994 models, the voltage should read 19-26 volts per each 1000 rpm. On 1995-2003 models, voltage should read 38-52 volts at 2000 rpm.

- c. If the AC voltage output reading is below the prescribed range, the trouble is probably a faulty stator (**Figure 28**, typical) or rotor. If these parts are not damaged, perform the *Charging System Output Test* in this section.

**NOTE**

*On 1991-2003 models, if the stator AC output test indicate a faulty stator, check the stator wires where they are held in place by the flat metal clamp plate shown in **Figure 29**. The clamp plate may have rubbed through the wire's insulation.*

5. Reconnect the regulator/rectifier connector.

**Voltage Regulator Ground Test**

1. Switch an ohmmeter to the appropriate scale.
2. Connect one ohmmeter lead to a good engine or frame ground and the other ohmmeter lead to the regulator base. Read the ohmmeter scale. The correct reading is 0 ohm. Note the following:
  - a. If there is low resistance (0 ohm), the voltage regulator is properly grounded.
  - b. If there is high resistance, remove the voltage regulator and clean its frame mounting points.
3. Check the voltage regulator connector (1986-1990 models: **Figure 24** or 1991-2003 models: **Figure 25**) and make sure it is clean and tightly connected.

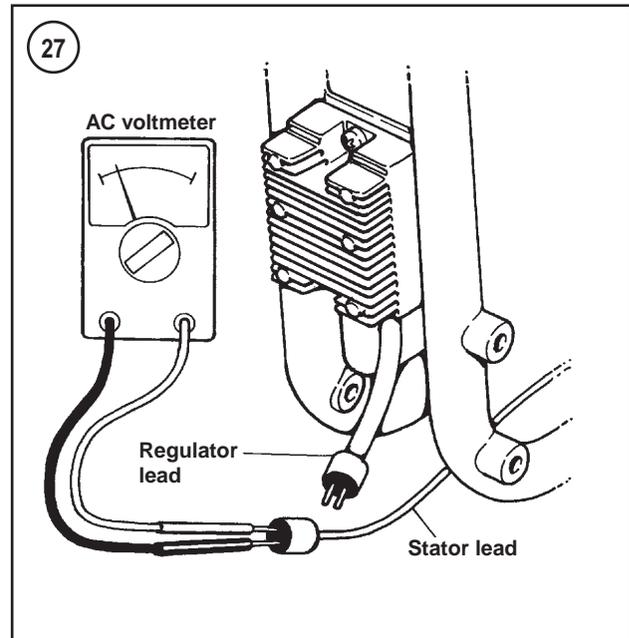
**Voltage Regulator Bleed Test**

1. Disconnect the voltage regulator connector (1986-1990 models: **Figure 24** or 1991-2003 models: **Figure 25**). Do not disconnect the wire from the voltage regulator to the circuit breaker.
2. Connect one probe of a 12-volt test lamp to a good ground.
3. Connect the other test lamp probe to one of the voltage regulator pins, then to the other pin.
4. If the test lamp lights, replace the voltage regulator.
5. If the test lamp does not light the voltage regulator is functioning properly. Reconnect the voltage regulator connector.

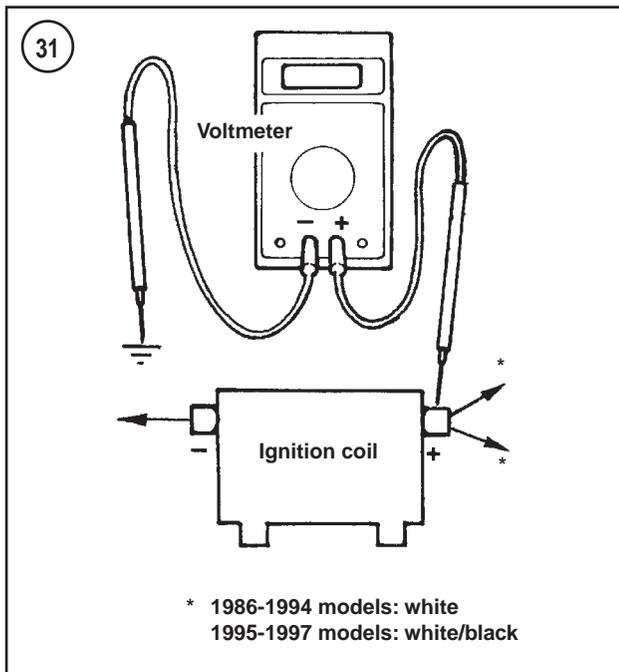
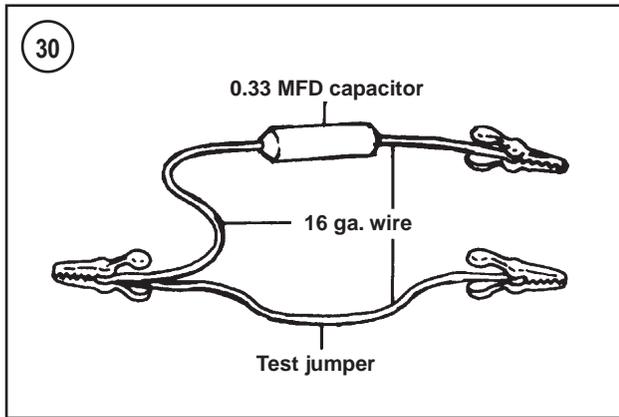
**IGNITION SYSTEM  
(1986-1997 MODELS)**

**Precautions**

- The following steps must be taken to protect the ignition system:
1. Never disconnect any of the electrical connectors while the engine is running.
  2. Make sure all electrical connectors are free of corrosion and are completely coupled to each other.

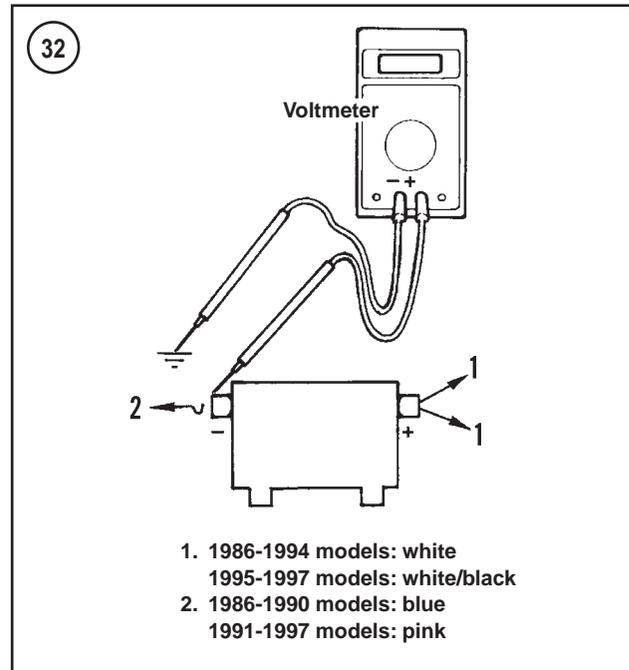


3. Do not operate the start switch if the ignition module is not grounded. The black ignition module wire is the ground wire. Inspect the wire end for corrosion and damage. Be sure the ignition module is mounted securely.
4. Apply dielectric grease to all electrical connectors prior to reconnecting them. This helps seal out moisture.



### Troubleshooting Preparation

1. Refer to the wiring diagrams at the end of this manual for the specific model.
2. Check the wiring harness for visible signs of damage.
3. Make sure all connectors are properly attached to each other and locked in place.
4. Check all electrical components for a good ground.
5. Check all wiring for short circuits or open circuits.
6. Make sure all ignition circuit breakers or fuses are in good condition.
7. Make sure the fuel tank has an adequate supply of fresh gasoline.
8. Check the spark plug cable routing and the connections at the spark plugs. If there is no spark or only a weak one, repeat the test with new spark plugs. If the condition remains the same with new spark plugs and if all external wiring connections are good, the problem is most likely in the ignition system. If a strong spark is present, the problem is probably not in the ignition system. Check the fuel system.



9. Remove the spark plugs and examine them as described in Chapter Three.

### Ignition Tests

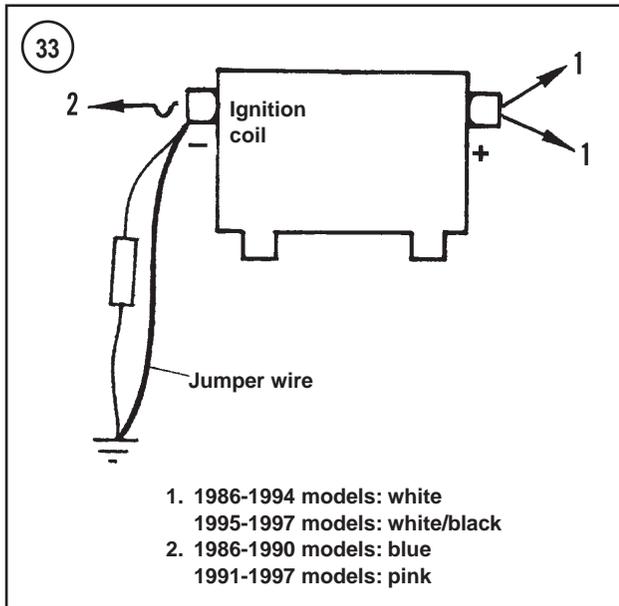
#### *No spark at spark plug (1986-1990 models)*

1. To perform this test, the battery must be fully charged (Chapter Twelve).
2. Make sure the black ignition module ground lead is fastened securely and make sure the battery ground lead is fastened and in good condition.

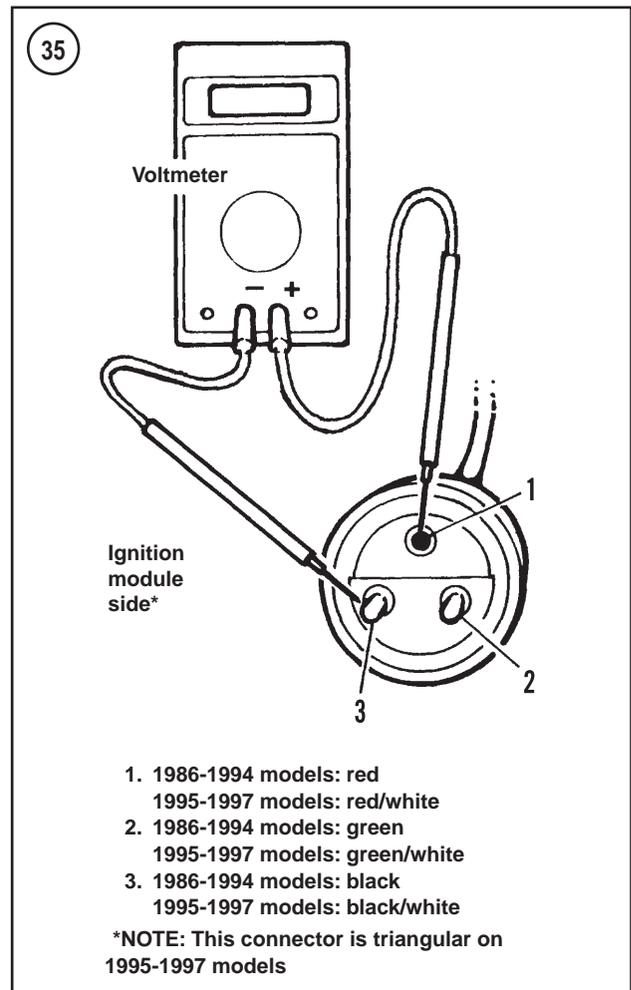
#### NOTE

*When performing the following test procedures, it is necessary to fabricate a test jumper from two lengths of 16 gauge wire, three clips and a 0.33 MFD capacitor (Figure 30). The test jumper should be long enough to reach from the ignition coil to a good engine ground.*

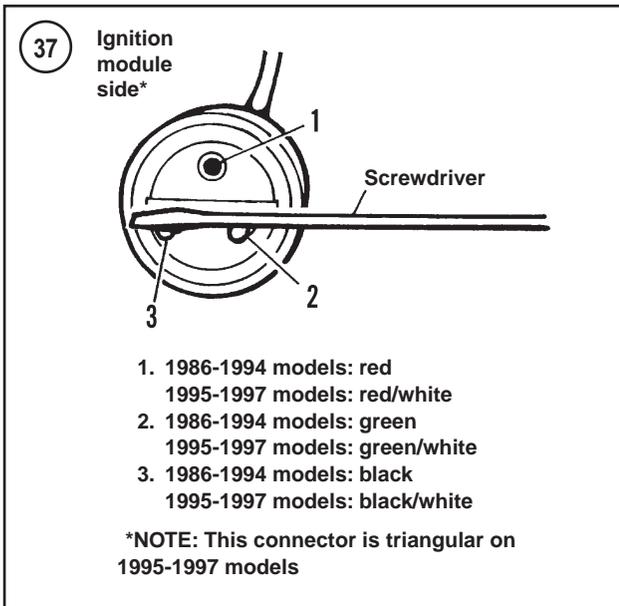
3. Perform the following:
  - a. Connect the positive voltmeter lead to the white ignition coil wire terminal and the negative voltmeter lead to ground (Figure 31).
  - b. Turn the ignition switch on. The voltmeter should read 11-13 volts. Turn the ignition switch off.
  - c. If the voltage is correct, proceed to Step 4.
  - d. If the voltage is incorrect, check the main and ignition circuit breakers (Chapter Twelve). Also check for loose or damaged ignition system wiring.
4. Perform the following:
  - a. Disconnect the blue wire from the ignition coil terminal (Figure 32).



- b. Turn the ignition switch on.
  - c. Connect the negative voltmeter lead to ground. Connect the positive voltmeter lead to the white and blue ignition coil terminals (**Figure 33**). The voltmeter should read 12 volts at both terminals. Turn the ignition switch off.
  - d. If the voltage is correct, proceed to Step 5.
  - e. If the voltage is incorrect, check the ignition coil resistance as described in this section. If the resistance is within the prescribed range, proceed to Step 5.
5. Perform the following:
- a. Disconnect the blue wire from the ignition coil terminal (**Figure 33**) if not previously disconnected.
  - b. Remove one of the spark plugs. Then connect the spark plug wire and connector to the spark plug and touch the spark plug base to a good ground (**Figure 34**). Position the spark plug so the electrodes are visible.
  - c. Turn the ignition switch on.
  - d. Connect the jumper wire (without the capacitor) between a good engine ground and the ignition coil blue wire terminal as shown in **Figure 33**. Then momentarily touch the jumper wire with the capacitor to the ignition coil blue wire terminal (**Figure 33**) while observing the spark plug firing tip. The spark plug should spark. Turn the ignition switch off and remove the jumper wire assembly.
  - e. If there was spark, proceed to Step 6.
  - f. There was no spark, replace the ignition coil.
  - g. Do not reinstall the spark plug at this time.
6. Perform the following:
- a. Reconnect the ignition coil blue wire to its terminal on the ignition coil.
  - b. Turn the ignition switch on.
  - c. Disconnect the sensor plate electrical connector located behind the sprocket cover.



- d. Connect the positive voltmeter lead to the ignition module red wire socket and the negative voltmeter lead to the ignition module black pin as shown in **Figure 35**. The voltmeter should read 4.5-5.5 volts. Disconnect the voltmeter and turn the ignition switch off.
- e. If voltage is correct, proceed to Step 7.
- f. If voltage is incorrect, check the ignition module (**Figure 36**) ground wire and the module for dirty or loose-fitting terminals. If okay, proceed to Step 7.



7. Make sure the ignition switch on. Then momentarily ground a screwdriver across the ignition module green and black connector pins (**Figure 37**) while observing the spark plug firing tip. There should be a strong spark at the spark plug firing tip as the screwdriver is removed. Note the following:

- a. If there was a spark, check the sensor resistance as described in this section.
- b. If there was no spark, check the ignition module resistance as described in this section.

8. Install and reconnect all parts removed for this procedure.

#### **No spark at spark plug (1991-1997 models)**

1. To perform this test, the battery must be fully charged (Chapter Twelve).
2. Make sure the black ignition module ground lead is fastened securely and make sure the battery ground lead is fastened and in good condition.

#### **NOTE**

When performing these test procedures, it is necessary to fabricate a test jumper from two lengths of 16 gauge wire, three clips and a 0.33 MFD capacitor; see **Figure 30**. The test jumper should be long enough to reach from the ignition coil to a good engine ground.

3. Perform the following:
  - a. On 1991-1993 models, connect the positive voltmeter lead to the white ignition coil wire terminal and the negative voltmeter lead to ground (**Figure 31**). On 1994-1997 models, connect the positive voltmeter lead to the white/black ignition coil wire terminal and the negative voltmeter lead to ground (**Figure 31**).
  - b. Turn the ignition switch on. The voltmeter should read 11-13 volts. Turn the ignition switch off.
  - c. If the voltage is correct, proceed to Step 4.
  - d. If the voltage is incorrect, check the main and ignition circuit breakers or fuses (Chapter Twelve). Also check for loose or damaged ignition system wiring.
4. Perform the following:
  - a. Disconnect the pink wire from the ignition coil terminal (**Figure 32**).
  - b. Turn the ignition switch on.
  - c. Connect the negative voltmeter lead to ground. On 1991-1993 models, connect the positive voltmeter lead to the white and pink ignition coil terminals separately. On 1994-1997 models, connect the positive voltmeter lead to the white/black and pink ignition coil terminals separately. The voltmeter should read 12 volts at both terminals. Turn the ignition switch off.
  - d. If the voltage is correct, proceed to Step 5.
  - e. If the voltage is incorrect, check the ignition coil resistance as described in this section. If the resistance is within the prescribed range, proceed to Step 5.
5. Perform the following:
  - a. Disconnect the pink wire from the ignition coil terminal if not previously disconnected.
  - b. Remove one of the spark plugs. Then connect the spark plug wire and connector to the spark plug and touch the spark plug base to a good ground (**Figure 34**). Position the spark plug so the electrodes are visible.
  - c. Turn the ignition switch on.
  - d. Connect the jumper wire (without the capacitor) between a good ground and the ignition coil pink terminal (**Figure 33**). Then momentarily touch the jumper wire with the capacitor to the ignition coil pink terminal while observing the spark plug firing tip. The spark plug should spark when the wire is disconnected. Turn the ignition switch off and remove the jumper wire assembly.
  - e. If there is spark, proceed to Step 6.
  - f. If there is no spark, replace the ignition coil.
  - g. Do not reinstall the spark plug at this time.

6. Perform the following:
  - a. Reconnect the ignition coil pink wire to its terminal on the ignition coil.
  - b. Turn the ignition switch on.
  - c. Disconnect the sensor plate electrical connector (**Figure 38**).
  - d. On 1991-1993 models, connect the positive voltmeter lead to the ignition module red wire socket and the negative voltmeter lead to the ignition module black/white pin as shown in **Figure 35**. On 1994-1997 models, connect the positive voltmeter lead to the ignition module red/white wire socket and the negative voltmeter lead to the ignition module black/white pin as shown in **Figure 35**. The voltmeter should read 11.5-12.5 volts. Disconnect the voltmeter and turn the ignition switch off.
  - e. If the voltage is correct, proceed to Step 7.
  - f. If the voltage is incorrect, check the ignition module (**Figure 36**) ground wire and the module for dirty or loose-fitting terminals. If okay, proceed to Step 7.
- 7A. On 1991-1993 models, turn the ignition switch on. Then momentarily ground a screwdriver across the ignition module green and black/white connector pins (**Figure 37**) while observing the spark plug firing tip. There should be a strong spark at the spark plug firing tip as the screwdriver is removed.
  - a. If there is spark, check the sensor resistance as described in this chapter.
  - b. If there is no spark, check the ignition module resistance as described in this chapter.
- 7B. On 1994-1997 models, turn the ignition switch on. Then momentarily ground a screwdriver across the ignition module green/white and black/white connector pins (**Figure 37**) while observing the spark plug firing tip. There should be strong spark at the spark plug firing tip as the screwdriver is removed.
  - a. If there is spark, check the sensor resistance as described in this chapter.
  - b. If there is no spark, check the ignition module resistance as described in this chapter.
8. Install and reconnect all parts removed for this procedure.

### Intermittent Ignition Problems

Intermittent problems are usually caused by temperature or vibration variances. Perform the following.

#### Temperature test

##### NOTE

*Perform Steps 1-3 with the engine cold.*

1. Remove the outer timing cover, inner timing cover and gasket as described in Chapter Twelve.
2. Start the engine.



3. Spray the sensor (**Figure 38**) with a refrigerant (available at electronic supply stores). If the engine dies, replace the sensor as described in Chapter Twelve.
4. Allow the engine to warm to normal operating temperature. Then apply heat to the sensor with a heat gun. If the engine dies, replace the sensor as described in Chapter Twelve.
5. Remove the ignition module cover from the left side of the motorcycle. With the engine running, apply heat to the ignition module (**Figure 36**) with a heat gun. If the engine dies, replace the module as described in Chapter Twelve.
6. Install the inner timing cover, gasket and outer timing cover as described in Chapter Twelve.

#### Vibration test

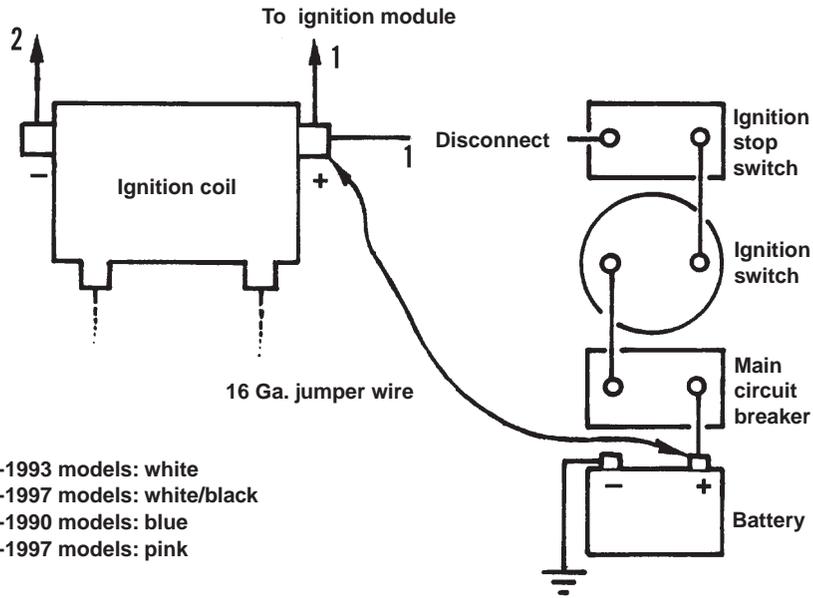
Read this procedure completely before starting. Refer to **Figure 39**.

1. Check the battery connections. Retighten or repair as required.
2. On 1986-1993 models, check the module ground wire connection. If necessary, remove the ground wire at the frame and scrape all paint at the mounting point. Using a star washer, reinstall the ground wire.
3. Start the engine and retest. If there is still an intermittent problem, proceed to Step 4.
- 4A. On 1986-1993 models, disconnect the white ignition stop switch wire terminal at the ignition coil. On 1986-1993 models, do not disconnect the white module wire at the ignition coil. Refer to the wiring diagram at the end of the manual.
- 4B. On 1994-1997 models, leave the white/black wire connected.
- 5A. On 1986-1993 models, connect a 16 ga. jumper wire from the positive battery terminal to the white ignition coil terminal.
- 5B. On 1994-1997 models, connect a 16 ga jumper wire from the positive battery terminal to the white/black wire ignition coil terminal.

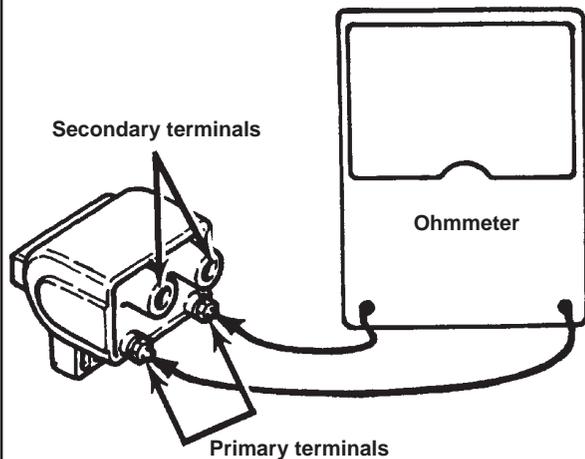
##### WARNING

*Steps 4 and 5 have bypassed the ignition stop switch. When performing Step 6, the engine*

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can only be stopped by removing the jumper wire. Test by removing the jumper wire before riding the motorcycle. It is suggested to test ride the motorcycle on a paved surface in a secluded area away from all traffic. If you do not feel that you can perform this test safely, or if you do not have access to a safe riding area, refer testing to a dealership.

6. Test-ride the motorcycle. If the problem has stopped, use voltage drop and wiggle tests to identify an intermittent open caused by a broken wire, poor connection, or defective switch in the starter safety circuit. If the problem con-

tinues, look for an intermittent open in the ignition control module and cam position sensor wiring.

7. Stop the motorcycle and then shift it into neutral. Disconnect the jumper wire and reconnect the white wire (1986-1993 models) at the ignition coil terminal.

### Ignition Coil Testing

Disconnect the coil secondary and primary wires before testing. Refer to **Figure 40**. Compare readings to specifications noted in **Table 2**.

#### NOTE

When switching between ohmmeter scales in the following tests, always cross the test leads and zero the needle to assure a correct reading (analog meter only).

1. Measure the coil primary resistance between both coil primary terminals.
2. Measure the coil secondary resistance between both secondary terminals.
3. Replace the ignition coil if either test is not within specification.

### Ignition Control Module and Sensor Resistance Testing (1986-1990 Models)

The following tests require a Fluke 23 or Harley-Davidson KMT multimeter (part No. HD35500). If any other meter is used, the results may be different than the specified values listed in these tests.

### Ignition module ground test

1. Remove the outer timing cover, inner timing cover and gasket as described in Chapter Twelve
2. Disconnect the sensor (**Figure 38**).
3. Connect the ohmmeter positive lead to the module connector black pin and the ohmmeter negative lead to ground.
4. The correct resistance reading should be 0-1 ohms. If the reading exceeds 1 ohm, replace the module.
5. Reconnect the connector.

### Power supply diode test

1. Disconnect the white ignition coil-to-module connector (**Figure 39**).
2. Connect the ohmmeter positive lead to the white ignition coil connector and the negative lead to the module ground wire. The resistance should be 800-1300 ohms.
3. Switch the test leads. The ohmmeter reading should be infinite.
4. Replace the module if any test readings are incorrect.
5. Reconnect the ignition coil-to-module connector.

### Coil driver transistor check

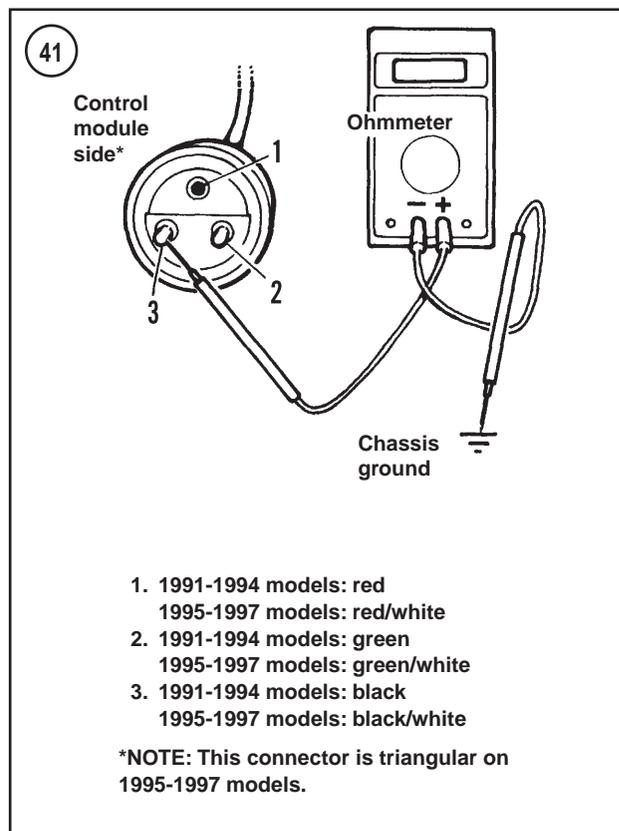
1. Disconnect the blue ignition coil-to-module connector (**Figure 39**).
2. Connect the ohmmeter positive lead to the blue ignition coil connector and the negative lead to the module ground wire. The ohmmeter reading should be infinite.
3. Switch the test leads. The resistance should be 400-800 ohms.
4. Replace the module if any readings is incorrect.
5. Reconnect the ignition coil-to-module connector.

### Ignition sensor ground test

1. Remove the outer timing cover, inner timing cover and gasket as described in Chapter Twelve.
2. Disconnect the sensor (**Figure 38**).
3. Connect the ohmmeter positive lead to the sensor connector red pin and the ohmmeter negative lead onto the sensor plate.
4. The ohmmeter should read infinite resistance.
5. Check the sensor connector black and green pins. In each case, the ohmmeter should read infinite resistance.
6. If any reading other than infinite was recorded, replace the sensor plate.
7. Reconnect the sensor connector.

### Ignition sensor output test

1. Remove the outer timing cover, inner timing cover and gasket as described in Chapter Twelve.
2. Disconnect the sensor connector (Figure 38).



3. Connect the ohmmeter positive lead to the sensor connector green pin and the ohmmeter negative lead to the sensor connector black pin. The correct resistance reading should be infinite.
4. Switch the test leads. The resistance reading should be 300-750 ohms.
5. Replace the sensor plate if any test readings are incorrect.
6. Reconnect the module to sensor connector.

### Ignition Module and Sensor Resistance Testing (1991-1997 Models)

The following tests require a Fluke 23 or Harley-Davidson KMT multimeter (part no. HD35500). If any other meter is used, the results may be different than the specified values listed in these tests.

Refer to **Figure 41**.

1. Disconnect the battery negative terminal. (Chapter Twelve).
2. Remove the outer timing cover, inner timing cover and gasket as described in Chapter Twelve
3. Disconnect the sensor (**Figure 38**).
4. Connect the positive ohmmeter lead to the black module pin and the negative ohmmeter lead to ground.
5. The correct resistance reading is 0-1 ohm. If the reading exceeds 1 ohm, replace the module.
6. Reconnect the connector.



### Ignition Module Harness Resistance Test (1991-1997 Models)

Refer to **Figure 43**

1. Turn the ignition stop switch (**Figure 42**) to the off position.
2. Disconnect the 7-prong ignition module electrical connector.
3. Disconnect the sensor plate 3-prong electrical connector.
4. On 1991-1993 models connect the positive ohmmeter lead to the No. 4 ignition module connector on the wiring harness side, not on the module side. On 1994-1997 models connect the positive ohmmeter lead to pin No. 7 on the ignition module connector on the wiring harness side, not on the module side. Connect the negative ohmmeter lead to a good engine ground. Wiggle the wiring harness and read the resistance indicated on the ohmmeter. It should be 0-1 ohm. Note the following:
  - a. If the resistance reading is correct, perform Step 5.
  - b. If a high resistance reading is obtained, check for dirty or loose-fitting terminals or a bare or damaged wire; clean and repair as required.
5. Connect the positive ohmmeter lead to the No. 1 ignition module connector socket on the wiring harness side, not on the module side. Connect the negative ohmmeter lead to a good ground. Wiggle the wiring harness and read the ohmmeter scale. It should be infinity (high resistance). Note the following:
  - a. If the reading is infinity, perform Step 6.
  - b. If the meter shows a resistance reading, the wire is shorting to ground. Repair the wire and retest.
  - c. On 1991-1993 models, repeat this test for the following ignition module connector sockets: No. 2, 3, 5, 6 and 7.
  - d. On 1994-1997 models, repeat this test for the following ignition module connector sockets: No. 2, 3, 4, 5 and 6.
6. Check each of the ignition module socket wires (except No. 4 on 1991-1993 models or No. 7 on 1994-1997 models) for continuity with an ohmmeter set on the appropriate scale. The reading for each wire should be 0-1 ohm. An infinite reading indicates that there is an open in the wire; check for a dirty, loose-fitting or a damaged connector or wire. Repair as needed and retest.

## IGNITION SYSTEM (ALL 1998-2003 MODELS [EXCEPT 1200S MODELS])

Review *Precautions* and *Troubleshooting Preparation in Ignition System (1986-1997 Models)* in this chapter.

Refer to the wiring diagrams at the end of this manual.

### Tools

Troubleshooting the ignition system requires a breakout box (part No. HD-42682) as well as the breakout box harness adapters (part No. HD-42962). When connected inline in the ignition system, the breakout box provides test points for checking a live circuit.

If the breakout box is not available, fabricate a test harness (**Figure 44**) from 12 lengths of 16-gauge wire, a male Deutsch (6-pin) connector and two female Deutsch connectors (6-socket). Wire the No. 1 pin on the male connector to the No. 1 socket on each female connector. No. 2 pin to No. 2 socket, etc.

During testing, connect the harness between the two ends of the ignition control module connector (**Figure 45**) when instructed to install the test harness. Probe the second female connector at the indicated test points.

Troubleshooting the ignition system also requires the Harley-Davidson harness test kit (part No. HD-41404). Different-sized terminals are used in the connectors on a Sportster. This kit is equipped with different-sized probes for checking the voltage and resistance of the various-sized terminals without damaging the wire insulation.

### Troubleshooting Tests

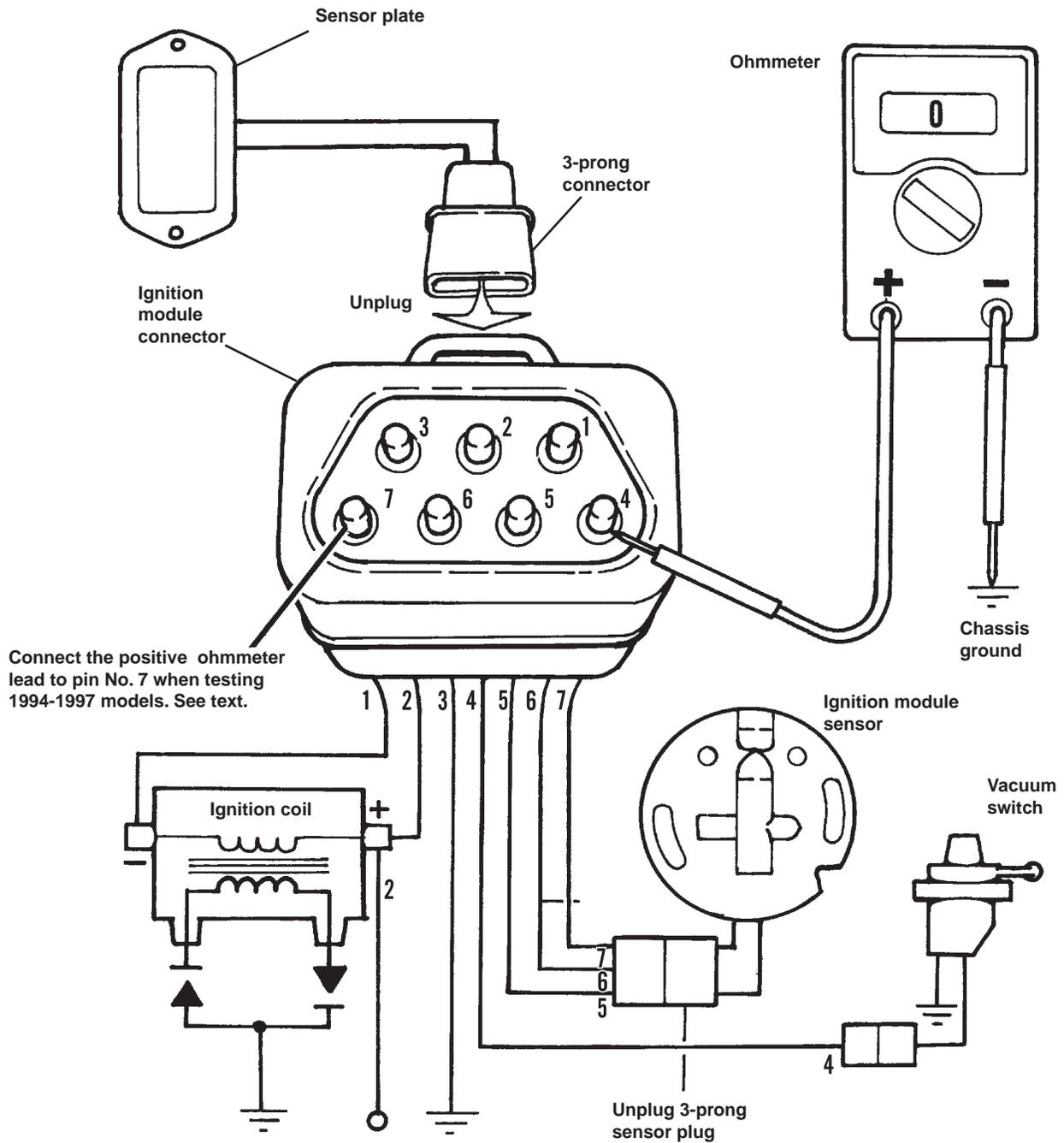
1. Perform the procedures described in *Troubleshooting Preparation* in this chapter.
2. Perform the spark test described in *Starting the engine* in this chapter.
  - a. If there is good spark, the problem is not in the ignition system. Check the fuel system.
  - b. If there is no spark or only a weak one, recheck with a new spark plug(s). If the condition remains the same with new spark plugs and if all external wiring connections are good, the problem is most likely in the ignition system; perform the *Ignition Test (Continuous or No Spark at Spark Plug)* described in this section.

### Ignition Test (Continuous or No Spark at Spark Plug)

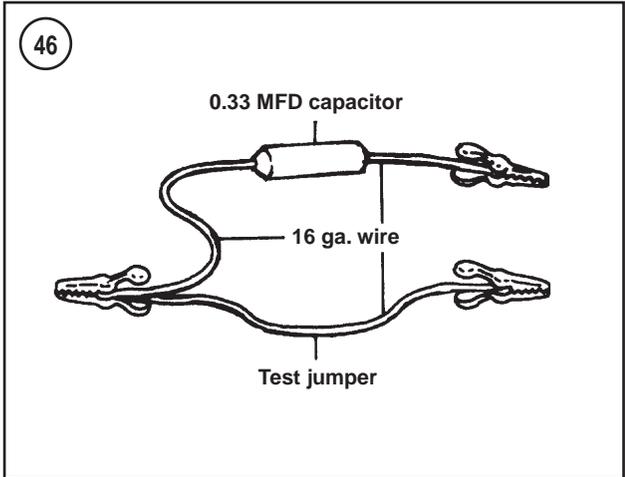
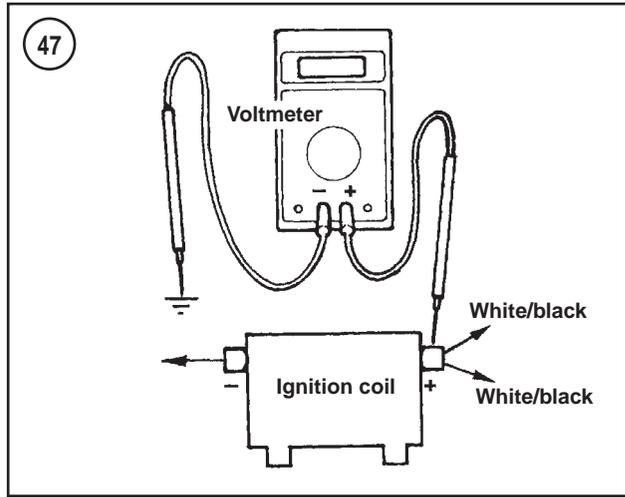
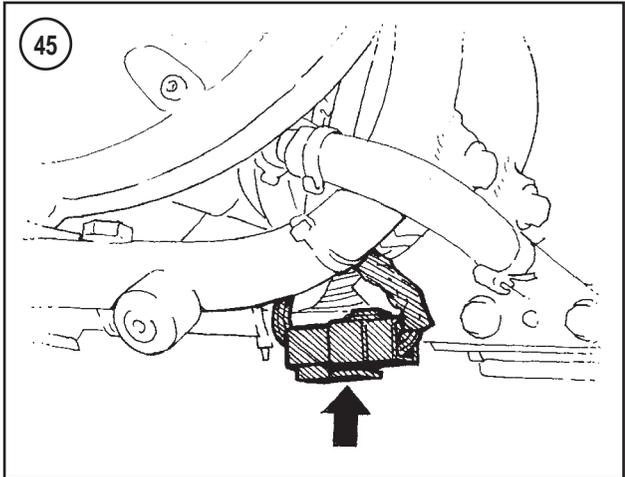
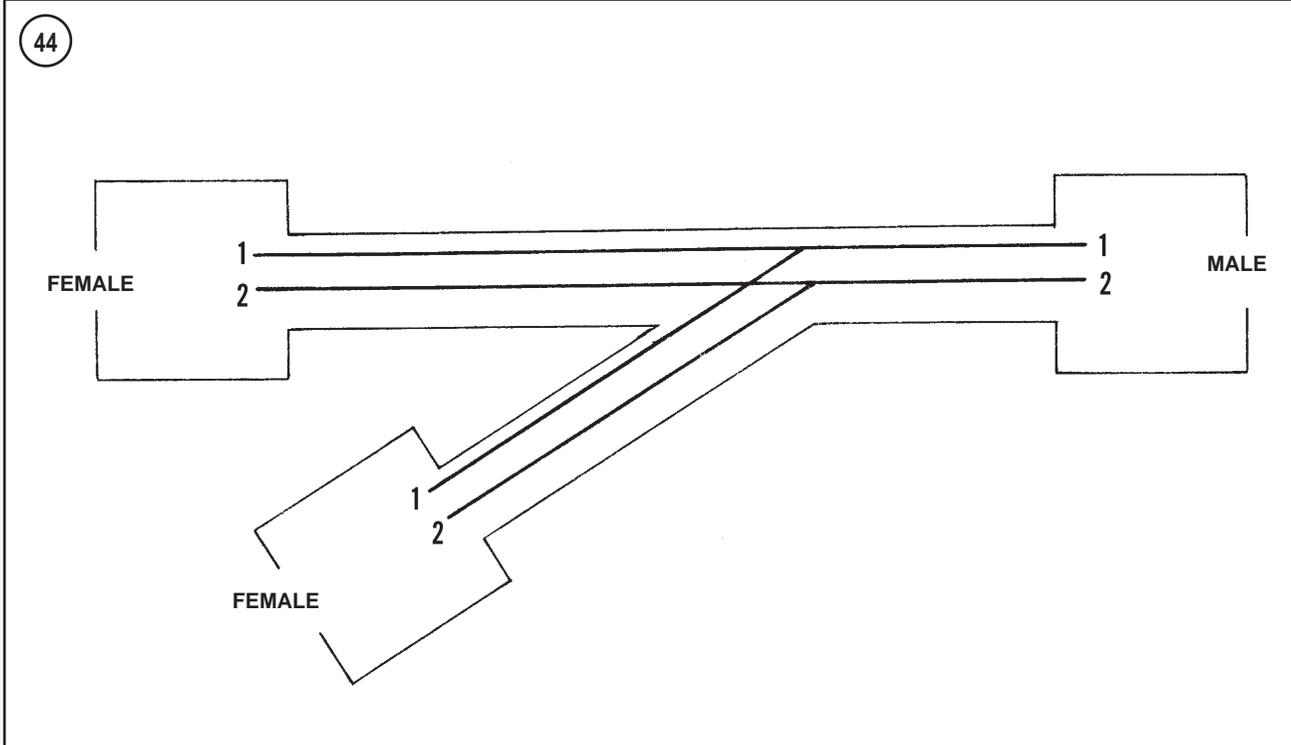
1. To perform this test, the battery must be fully charged. Check the battery as described in Chapter Twelve.
2. Make sure the ignition module ground is good.

#### NOTE

*When performing the following test procedures, it will be necessary to fabricate a test*



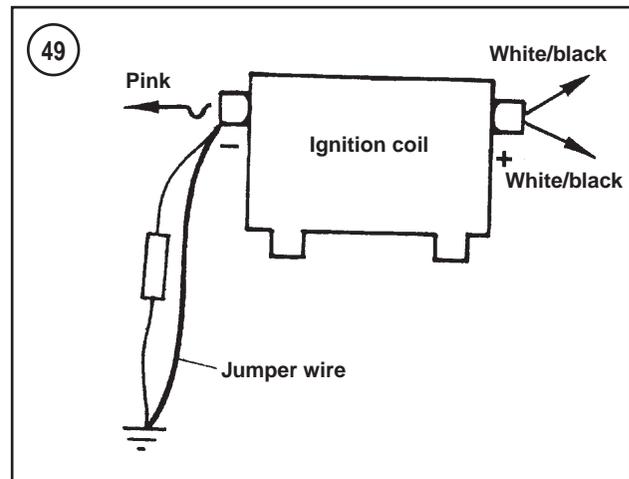
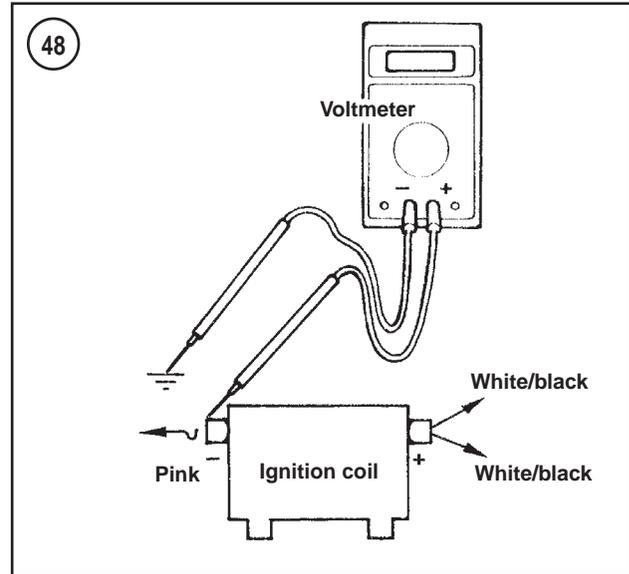
1. 1991-1997 models: pink
2. 1991-1997 models: white
3. 1991-1997 models: black
4. 1991-1997 models: violet/white
5. 1991-1993 models: green  
1994-1997 models: green/white
6. 1991-1993 models: black  
1994-1997 models: black/white
7. 1991-1993 models: red  
1994-1997 models: red/white



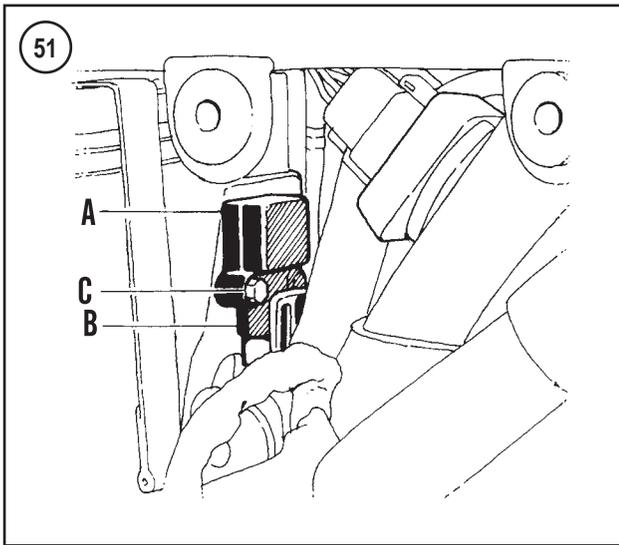
*jumper from two lengths of 16-gauge wire, three clips and a 0.33 microfarad (MFD) capacitor (Figure 46). The test jumper must be long enough to reach from the ignition coil to a good engine ground.*

3. Perform the following:
  - a. Connect the positive voltmeter lead to the white/black ignition coil wire terminal and the negative voltmeter lead to ground (Figure 47).
  - b. With the ignition switch on. The voltmeter should read 11-13 volts.
  - c. If the voltage is correct, proceed to Step 4.

- d. If the voltage is incorrect, check the ignition system wiring as described in *Ignition Circuit Wiring Check* section in this section.
4. Perform the following:
  - a. Disconnect the pink wire from the ignition coil terminal (**Figure 48**).
  - b. Turn the ignition switch on.
  - c. Connect the negative voltmeter lead to ground. Connect the positive voltmeter lead to the white/black and pink ignition coil terminals separately. The voltmeter should read 12 volts at both terminals.
  - d. If the voltage is correct, proceed to Step 5.
  - e. If the voltage is incorrect, replace the ignition coil.
5. Perform the following:
  - a. Disconnect the pink wire from the ignition coil terminal (**Figure 49**).
  - b. Remove one of the spark plugs. Connect the spark plug wire and connector to the spark plug and ground the spark plug base to the engine cylinder head (**Figure 50**). Position the spark plug so the electrodes are visible.
  - c. Turn the ignition switch on.
  - d. Connect the jumper wire without the capacitor between a good engine ground and the ignition coil pink wire terminal, as shown in **Figure 49**. Momentarily touch the jumper wire with the capacitor to the ignition coil pink wire terminal (**Figure 49**) while observing the spark plug firing tip. The spark plug should fire. Turn the ignition switch off and remove the jumper wire assembly.
  - e. If there is spark, proceed to Step 6.
  - f. If there is no spark, replace the ignition coil.
  - g. Reinstall the spark plug.
6. Perform the following:
  - a. Reconnect the ignition coil pink wire to its terminal on the ignition coil.
  - b. Turn the ignition switch on.
  - c. Disconnect the 6-terminal ignition connector (**Figure 45**).
  - d. At the harness end of the connector, connect the positive voltmeter lead to the ignition module socket No. 1 (white/black wire) and the negative voltmeter lead to the ignition module socket No. 6 (black wire). The voltmeter should read 11-13 volts. Disconnect the voltmeter and turn the ignition switch off.
  - e. If the voltage is correct, proceed to Step 7.
  - f. If the voltage is incorrect, check the continuity between socket No. 1 (white/black wire) on the ignition module connector and the white/black wire at the ignition coil. If there is continuity, repair the open between socket No. 6 (black wire) and ground. If there is no continuity, repair the open in the white/black wire.
7. Perform the following:
  - a. Disconnect the 6-terminal ignition module connector (**Figure 45**).
  - b. Turn the ignition switch on.



- c. At the harness end of the connector, connect the positive voltmeter lead to socket No. 5 (pink wire) and the black voltmeter lead to socket No. 6 (black wire). The voltmeter should read 11-13 volts. Disconnect the voltmeter and turn the ignition switch off.
- d. If the voltage is correct, proceed to Step 8.
- e. If the voltage is incorrect, check the continuity between socket No. 5 (pink wire) and the pink-wire terminal at the ignition coil. If there is continuity, repair the short to ground on the pink wire. If there is no continuity, repair the open circuit in the pink wire.
8. Perform the following:
  - a. Install the test harness between the halves of the ignition coil connector (**Figure 45**), and check the voltage between the green/gray wire and the black wire.
  - b. Turn the ignition switch on.
  - c. Connect the red voltmeter lead to terminal No. 4 on the test harness, and connect the negative voltmeter lead to terminal No. 6 on the test harness. The voltmeter should read 0.6-1.1 volts. Disconnect the voltmeter and turn the ignition switch off.



- d. If the voltage is correct, proceed to Step 9.
  - e. If the voltage is incorrect, check the bank angle sensor as described in this section.
9. Perform the following:
- a. Remove the timing cover.
  - b. Crank the engine and observe the rotor LED. If it is flashing, replace the ignition module. If it is not flashing, proceed to substep c.
  - c. Crank the engine and observe the rotor cup. If the rotor is rotating, replace the ignition module. If it does not rotate, remove the gearcase cover (Chapter Five) and check for an engine mechanical failure.
10. Install and reconnect all parts removed for this procedure.

### Ignition Circuit Wiring Check

1. Check the ignition circuit fuse. If the fuse is burned out, find the source of the problem.
2. Check the voltage at the gray wire at the fuse block.
  - a. Turn the ignition switch on.
  - b. Connect the positive voltmeter lead to the gray-wire terminal and connect the negative voltmeter lead to a

good ground. The voltmeter should read battery voltage. Disconnect the voltmeter and turn the ignition switch off.

- c. If the voltage is correct, perform Step 3.
  - d. If the voltage is incorrect, check for an open circuit between the battery, 30-amp circuit breaker, ignition switch, and fuse block. Make the necessary repairs.
3. Check for voltage at the right control switch connector.
- a. Disconnect the right control connector from the switch (Chapter Twelve).
  - b. Turn the ignition switch on.
  - c. On the harness side of the connector, attach the positive voltmeter lead to pin No. 3 (gray wire) and connect the negative voltmeter lead to a good ground. The voltmeter should read battery voltage. Disconnect the voltmeter and turn the ignition switch off.
  - d. If voltage is correct, perform step 4.
  - e. If voltage is incorrect, repair the open in the gray wire between the connector and fuse block.
4. Perform the following:
- a. Connect the right control switch connector to its mate.
  - b. Turn the ignition switch on.
  - c. Turn the engine stop switch to the run position.
  - d. Connect the positive voltmeter lead to pin No. 5 (white/black wire) on the harness side of the connector, and connect the negative voltmeter lead to a good ground. The voltmeter should read battery voltage. Disconnect the voltmeter and turn the ignition switch off.
  - e. If voltage is correct, repair the open in the white/black wire between the ignition coil and right-hand switch connector (No. 22).
  - f. If voltage is incorrect, check the engine stop switch and its wiring. Repair or replace the faulty component as necessary.

### Bank Angle Sensor Check

1. Inspect the bank angle sensor (A, **Figure 51**). Note the following:
  - a. Make sure the sensor connection is secure.
  - b. Make sure the sensor is mounted correctly. It must be secure against the battery case and sit upright on the case.
  - c. Make sure there is no ferrous metal within 1/4 inch of the side, face or top of the sensor.

#### CAUTION

*To avoid damaging the terminals in Step 2, remove the bank angle sensor before disconnecting the connector.*

2. Remove the bank angle sensor (A, **Figure 51**) and disconnect the sensor connector (B).
3. Turn the ignition on.
4. Measure the voltage between socket A (green/gray wire) on the sensor connector and socket B (black wire) of the

connector. Disconnect the voltmeter and turn the ignition switch off. Note the following:

- a. If the voltage was zero volts, perform Step 5.
  - b. If the voltage was 3.0-3.5 volts, perform Step 6.
  - c. If the voltage measured 11-13 volts, repair the short in the green/gray wire.
5. Perform the following:
- a. Disconnect the bank angle sensor connector.
  - b. Disconnect the 6-terminal ignition module connector (**Figure 45**).
  - c. Check the continuity between socket A (green/gray wire) on the sensor connector and socket No. 4 (light green/gray wire) on the harness end of the ignition module connector. If there is continuity, perform substep d. If there is no continuity, repair the open circuit in the green/gray wire.
  - d. Check the continuity between socket B (black wire) on the sensor connector and ground. If there is continuity, perform substep e. If there is no continuity, repair the open circuit in the black wire.
  - e. Check the continuity between socket A (green/gray wire) on the sensor connector and ground. If continuity is present, repair the short to ground in the green/gray wire. If continuity is not present, perform substep f.
  - f. Inspect the harness for damage; repair as necessary. If the harness is not damaged, replace the ignition module.
6. Perform the following:
- a. Turn the ignition on.
  - b. Measure the voltage between socket B (black wire) on the sensor connector and socket C (gray wire) on the connector. If the voltmeter reads 11-13 volts, perform Step c. If the voltage is not 11-13 volts, repair the open circuit in the gray wire between the sensor connector and the ignition fuse.
  - c. Make sure that the sensor connection and/or its mounting location/position were not the source of the malfunction. See Step 1.
  - d. Replace the sensor, if it fails any of these steps.

### IGNITION SYSTEM (1998-2003 1200S MODELS)

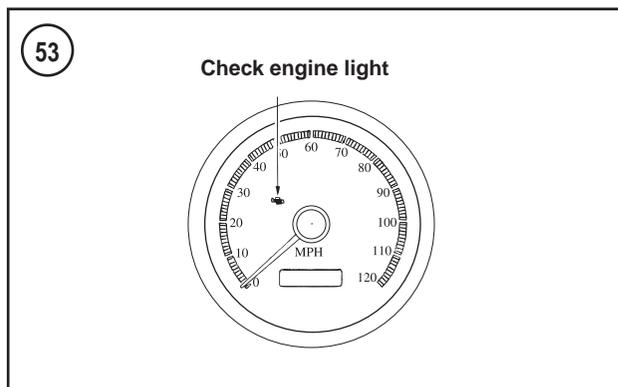
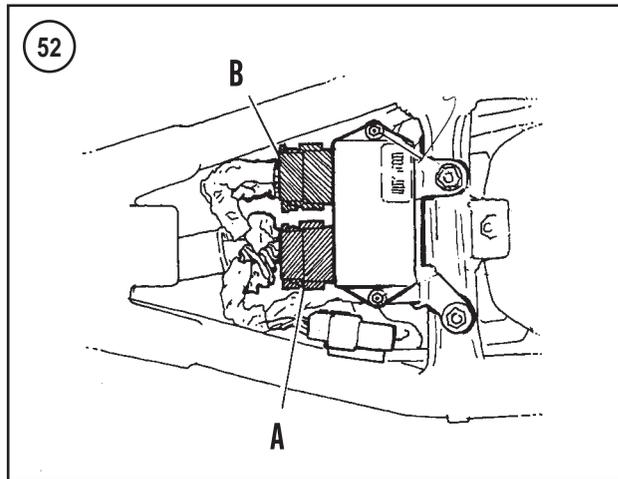
Review *Precautions and Troubleshooting Preparation in Ignition System (1986-1997 Models)* in this chapter.

Refer to the wiring diagrams at the end of this manual.

#### Tools

Troubleshooting the ignition system requires a breakout box (part No. HD-42682). The breakout box connects inline between the ignition module and the wiring harness. It provides test points for checking a live circuit.

If a breakout box is not available, fabricate two test harnesses as shown in **Figure 44**. Make each test harness from 24 lengths of 18-gauge wire, a male Deutsch connector



(12-pin) and two female Deutsch connectors (12-socket). Wire the No. 1 pin on the male connector to the No. 1 socket on each female connector, No. 2 pin to No. 2 socket, etc.

When the test harness is required, test points are identified as terminals on the black- or gray-colored harness, (terminal No. 2 on the black test harness, for example). Consequently, take care to identify one harness as black and the other as gray. Use black connector housings on one harness and gray housings on the other or wrap the wires of one test harness with black electrical tape and wrap the wires of the second harness with gray tape.

To connect the test harnesses, disconnect the black (connector No. 10) and gray (connector No. 11) ignition-module connectors from the ignition module. Connect the gray test harness in-line between the ignition module and gray ignition-module connector (A, **Figure 52**). Connect the black test harness in-line between the ignition-module and black ignition-module connector (B, **Figure 52**). Probe the second female connector on each respective test harness at the indicated test point.

Troubleshooting the ignition system also requires a harness test kit (part No. HD-41404). Different-sized terminals are used in the connectors on a Sportster. This kit is equipped with different sized probes for checking the voltage and resistance of the various-sized terminals without damaging the wire insulation.

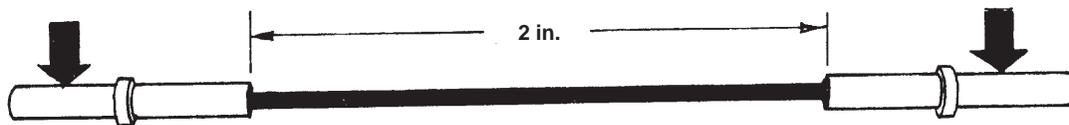
54

**CODE DESCRIPTION TROUBLESHOOTING CHART**

Code	Component/circuit	Action
12	MAP sensor	Figure 68
16	Battery voltage	Figure 69
24	Front coil	Figure 70
25	Rear coil	Figure 70
35	Tachometer	
	1998 models	Figure 71
	1999-2003 models	Figure 72
41	Cam position sensor	Figure 73
44	Bank angle sensor	Figure 74
52	1998 models: RAM/ROM failure	Replace ignition module*
52	1999-2003 models: RAM failure	Replace ignition module*
53	1999-2003 models: ROM failure	Replace ignition module*
54	EE PROM failure	Replace ignition module*

\*Before replacing the ignition module confirm it is defective by taking it to a dealership. Further testing requires the scanalyzer.

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**Diagnostic Trouble Codes**

The 1200S models have an on-board diagnostic system to help troubleshoot the ignition system. During operation, the system identifies faults and stores this information as a two-digit diagnostic trouble code.

If a trouble code has been set, the check engine light (**Figure 53**) will come on. During normal operation, the check engine light illuminates for approximately four seconds when the ignition is turned on. The check-engine light then turns off and remains off. If a diagnostic trouble code has been set, the check-engine light turns on for four seconds, turns off, and then turns back on for eight seconds or it remains on beyond the eight-second period.

Trouble codes can be retrieved with the Scanalyzer (Part No. HD-41325) or by counting the number of times the check-engine light flashes. If using the Scanalyzer for code retrieval, follow the manufacturer's instructions. Code(s) can also be retrieved by performing the procedure described in this section. Use the chart in **Figure 54** to identify the defective system and to determine a course of action.

**Retrieving codes**

Diagnostic trouble codes are displayed as a series of flashes at the check-engine light. To retrieve any stored diagnostic trouble codes, a jumper made of 18-gauge wire

and two Deutsch sockets (part No. 72191-94), as shown in **Figure 55**, is required.

To retrieve the diagnostic trouble codes without the Scanalyzer, perform the following:

1. Remove the left side cover from the motorcycle.
2. Remove the data link connector (**Figure 56**) from its holder on the back of the side cover.
3. Remove the protective cover (A, **Figure 57**) from the data link connector (B), and connect the jumper to pins No. 1 and No. 2 on the data link connector.
4. Turn the ignition switch to ignition. After approximately eight seconds, the system enters the diagnostic mode.
  - a. The diagnostic mode begins with a ready signal, which is a series of rapid flashes of approximately three per second. The ready signal indicates that the system is ready to flash a diagnostic trouble code.
  - b. This is followed by a two-second pause.
  - c. The system then flashes the first digit of the stored diagnostic trouble code. The check-engine light will illuminate for one second and then turn off for one second. Count the number of flashes, and record this number.
  - d. The system will pause for two seconds, and then flash the second digit of the diagnostic trouble code. Count the number of flashes, and record this number.

- e. The system will pause for two seconds, and then flash the ready signal, which indicates it is ready to flash the next code.
  - f. The system will pause for two seconds, and then flash the first digit of the next diagnostic trouble code.
5. The system displays codes, sequentially, one-at-a-time, until each diagnostic trouble code has been displayed. The system then repeats. The check-engine light will continue to flash stored codes until the jumper wire is disconnected. When the codes repeat, this indicates that all the stored codes have been displayed.
  6. Find the diagnostic trouble code in **Figure 54**, and perform the procedure indicated in the chart. If multiple codes have been set, troubleshoot the lowest numbered code first. The source of subsequent codes may be the same malfunction that has caused the first.
  7. Reinstall the protective cover onto the data link connector, and fit the connector into its holder in the back of the left side cover.
  8. Align the side cover pins with the grommets in the frame, and push the side cover into place.

### Clearing codes

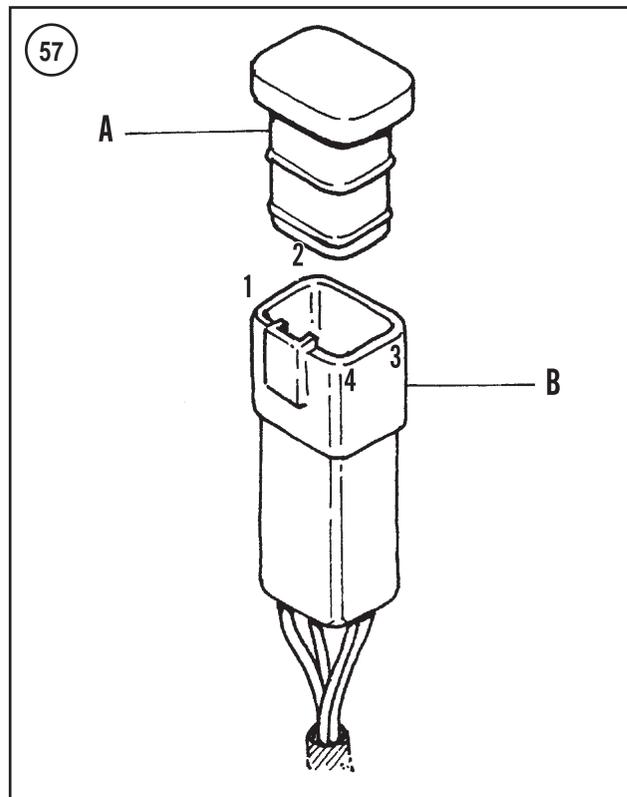
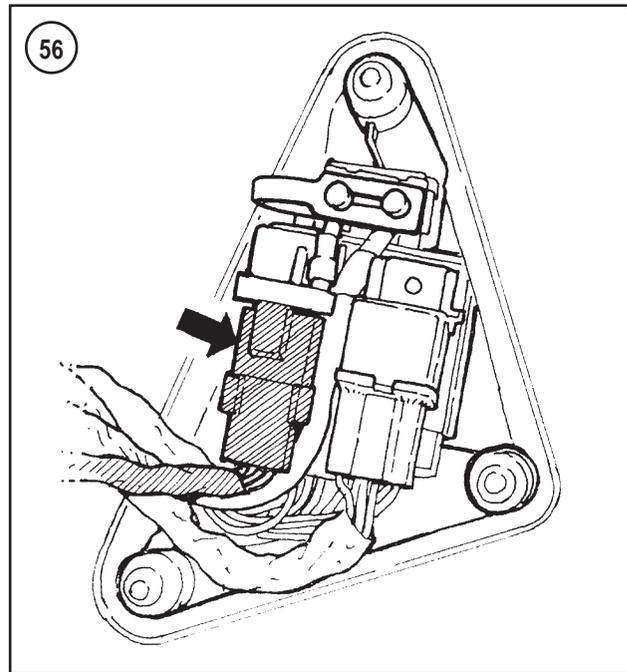
The system will retain the trouble codes until they are cleared with the Scanalyzer or until the motorcycle has been run through 50 start-run cycles. After a fault has been corrected, the memory is erased automatically after 50 start-run cycles if the fault does not reoccur. A start-run cycle occurs when the engine is started and run for at least 30 seconds before being turned off.

### Ignition Control Module Replacement

Before replacing the ignition module, confirm that the ignition module is defective by having a dealership test it. There are several ignition-module tests that can only be performed with a Scanalyzer (part no. HD-41325).

### Troubleshooting Tests

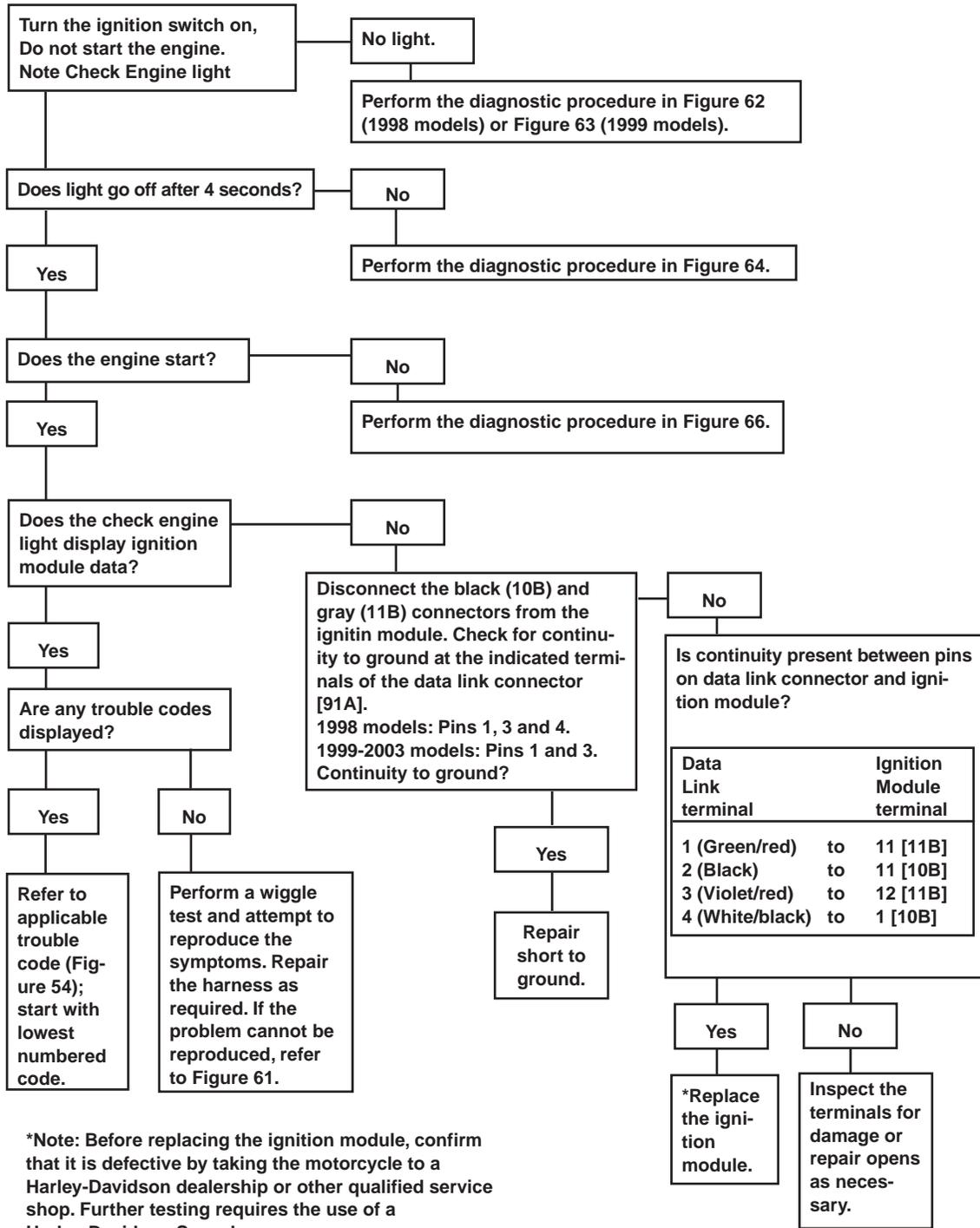
1. Review *Precautions and Troubleshooting Preparations in Ignition System (1986-1997 Models)* in this chapter. Refer to the wiring diagrams at the end of this manual.
2. Perform the spark test as described in *Starting The Engine* in this chapter.
  - a. If there is spark, the problem is not in the ignition system. Check the fuel system.
  - b. If there is no spark or only a weak one, recheck the ignition with new spark plugs. If the condition remains the same with new spark plugs and if all external wiring connections are good, the problem is most likely in the ignition system; perform the procedure in **Figure 58**. Follow the procedure in the chart until the problem is resolved.



### Wiggle Test

- Several troubleshooting procedures advise performing a wiggle test. Perform the following when so advised:
1. Connect the meter as instructed in the flow chart.
  2. Wiggle the wiring harness and observe the meter.
  3. Large resistance fluctuations indicate the presence of an intermittent short in the harness. Check the wiring harness.

## RETRIEVING DIAGNOSTIC CODES (1998-2003 1200S MODELS)

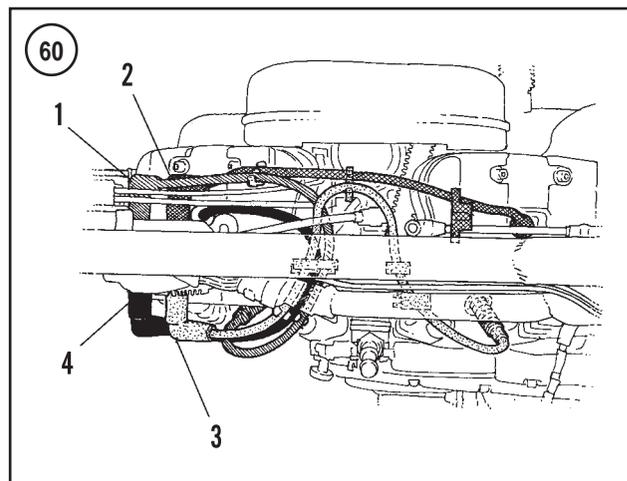
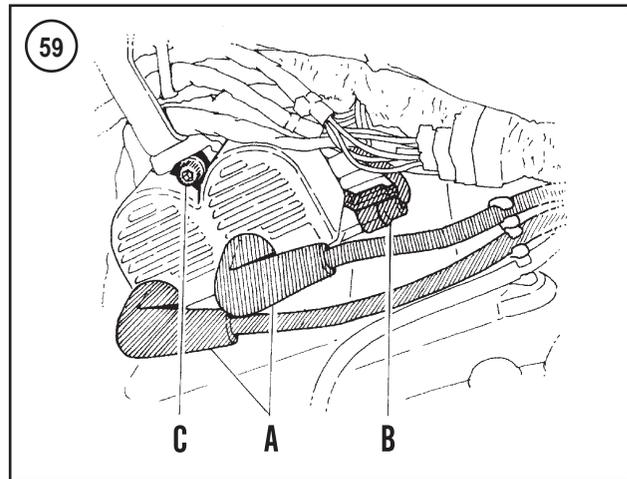


### Spark Plug Cable Resistance Test

1. Disconnect the spark plug cable from the spark plug and from the ignition coil.
2. Connect the probes of an ohmmeter to the cable terminals.
3. Replace the spark plug cable if the resistance is not within the specification in **Table 2**.
4. Repeat this procedure for the remaining cables.

### Ignition Coil Test (1998-2003 1200S Models)

1. Disconnect the spark plug wires (A, **Figure 59**) from the coil towers on the coil.
2. Disconnect the ignition coil connector (B, **Figure 59**) from the ignition-coil primary terminals.
3. Measure the resistance in the primary windings.
  - a. Measure the resistance between primary terminals A and B on the ignition coil.
  - b. Measure the resistance between primary terminals B and C on the coil.
  - c. Compare the readings to the specification in **Table 2**.
4. Measure the resistance of the secondary windings.
  - a. Measure the resistance between both secondary terminals (No. 1 and 4) on the front coil (**Figure 60**).
  - b. Measure the resistance between both secondary terminals (No. 2 and 3) on the rear coil (**Figure 60**).
  - c. Compare the readings to the specification in **Table 2**.
5. Replace the ignition coil if any reading is not within specification.



### Troubleshooting Symptoms

Refer to **Figures 61-74** for various symptoms and testing procedures.

### FUEL SYSTEM

Begin fuel system troubleshooting with the fuel tank and work through the system, reserving the carburetor as the final point. Do not assume the carburetor is the problem. Unnecessary carburetor adjustment can compound the problem.

### Identifying Carburetor Conditions

Refer to the following conditions to identify whether the engine is running lean or rich.

#### *Rich*

1. Fouled spark plugs.
2. Engine misfires and runs rough under load.
3. Excessive exhaust smoke as the throttle is increased.

4. An extreme rich condition causes a choked, or dull sound from the exhaust and an inability to clear the exhaust with the throttle held wide open.

#### *Lean*

1. Blistered or very white spark plug electrodes.
2. Engine overheats.
3. Slow acceleration and engine power is reduced.
4. Flat spots on acceleration that are similar in feel to when the engine starts to run out of gas.
5. Engine speed fluctuates at full throttle.

### Troubleshooting

Isolate fuel system problems to the fuel tank, fuel shutoff valve and filter, fuel hoses, external fuel filter (if used) or carburetor. In the following procedures, it is assumed that the ignition system is working properly.

Refer to **Figure 75** or **Figure 76** and the following sections for possible causes of fuel system problems.

## SYMPTOMS

Symptom	Possible cause	Action
Hard to Start	Battery discharged	Troubleshoot the charging system as described in this chapter
	Spark plugs	Perform the procedure in Figure 67
	Ignition coil	Perform the procedure in Figure 67
	Plug wires	Perform the procedure in Figure 67
	Valve sticking	Refer to the Chapter Four
Engine hesitates, stumbles, surges, misfires or is sluggish	Water or dirt in the fuel system	Drain the fuel system and refill with fresh fuel
	Manifold leak	Spray water around the intake manifold seals while the engine idles. If idle speed changes, replace the seals.
	MAP sensor is not operating properly	Check the vacuum hose connection and perform the procedure in Figure 68
	Water or dirt in the fuel system	Drain the fuel system and refill with fresh fuel
	Spark plug	Perform the procedure in Figure 68
Engine exhaust emits black smoke or spark plugs are fouled	EVAP hose disconnected from carburetor (California models)	Reconnect
	Throttle plates not opening fully	Adjust the throttle cable as described in Chapter Three
	Clogged air filter	Replace the air filter (Chapter Three)
	MAP sensor is not operating properly	Check the vacuum hose connection and perform the procedure in Figure 68

### Fuel level system

The fuel level system is shown in **Figure 77** or **Figure 78**. Proper carburetor operation depends on a constant and correct carburetor fuel level. As fuel is drawn from the float bowl during engine operation, the float level in the bowl drops. As the float drops, the fuel valve moves from its seat and allows fuel to flow through the seat into the float bowl. Fuel entering the float bowl causes the float to rise and push against the fuel valve. When the fuel level reaches a predetermined level, the fuel valve is pushed against the seat to prevent the float bowl from overflowing.

If the fuel valve fails to close, the engine will run rich or flood with fuel. Symptoms of this problem are rough running, excessive black smoke and poor acceleration. This condition will sometimes clear up when the engine is run at wide-open throttle and the fuel is being drawn into the engine before the float bowl can overflow. However, as the engine speed is reduced, the rich running condition returns.

Several things can cause fuel overflow. In most instances, a small piece of dirt is trapped between the fuel valve and seat, or the float level is incorrect. If fuel is flowing out of the overflow tube connected to the bottom of the float bowl, the fuel valve inside the carburetor is being held open. First check the position of the fuel shutoff valve lever (A, **Figure 79**). Turn the fuel shutoff valve lever off. Then lightly tap on the carburetor float bowl and turn the fuel shutoff valve lever on. If the fuel flow stops running out of

the overflow tube, whatever was holding the fuel valve off of its seat has been dislodged. If fuel continues to flow from the overflow tube, remove and service the carburetor. See Chapter Ten or Chapter Eleven.

#### NOTE

*Fuel will not flow from the vacuum-operated fuel shutoff valve on 1995-2003 models until the engine is running.*

### Starting enrichment (choke) system

A cold engine requires a rich mixture to start and run properly. On all models, a cable-actuated starter enrichment valve is used for cold starting.

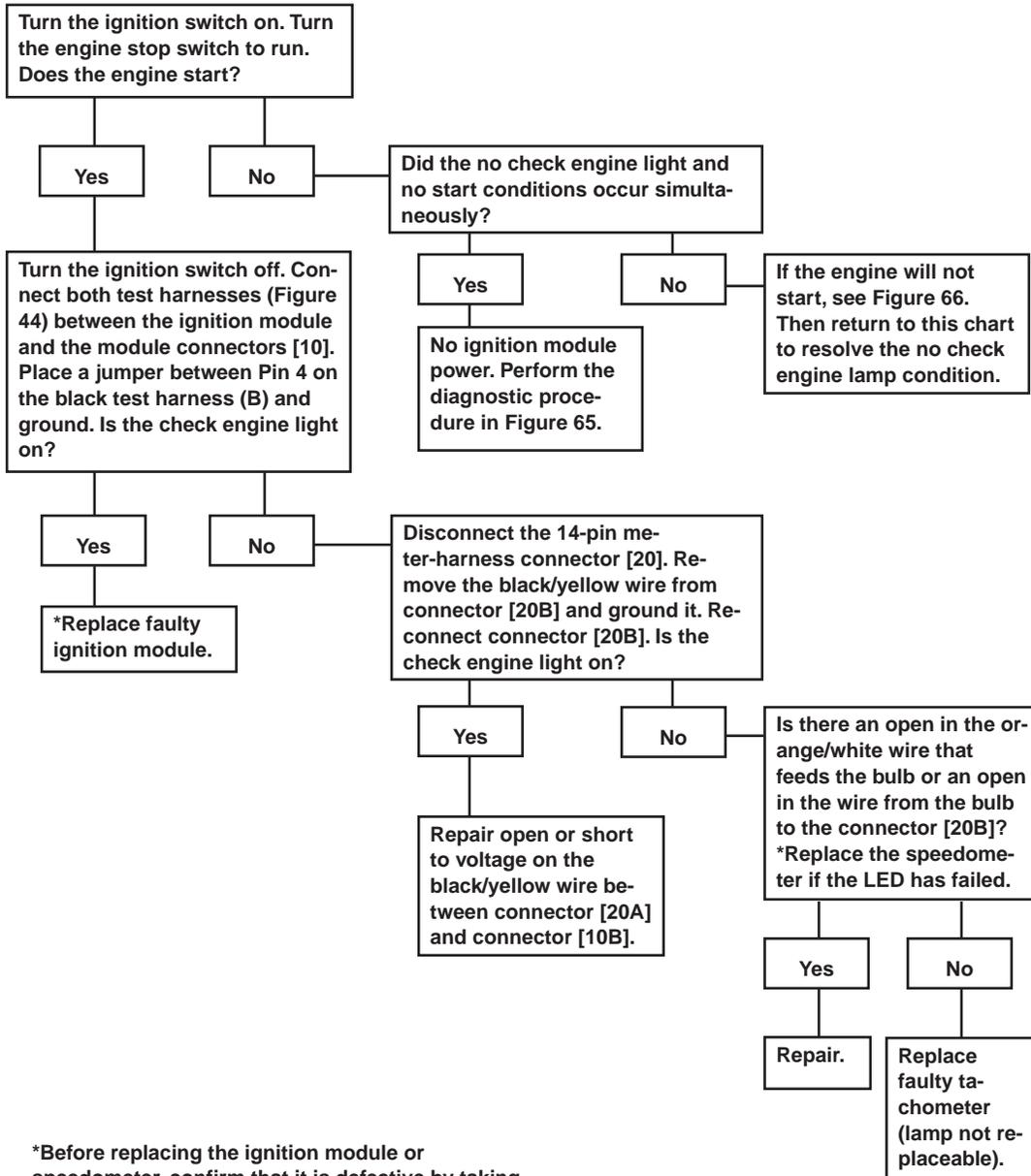
If the engine is difficult to start when cold, check the starting enrichment (choke) cable adjustment described in Chapter Three.

### Accelerator pump system

During sudden acceleration, the diaphragm type accelerator pump system (**Figure 80** or **Figure 81**) provides additional fuel to the engine. Without this system, the carburetor would not be able to provide a sufficient amount of fuel.

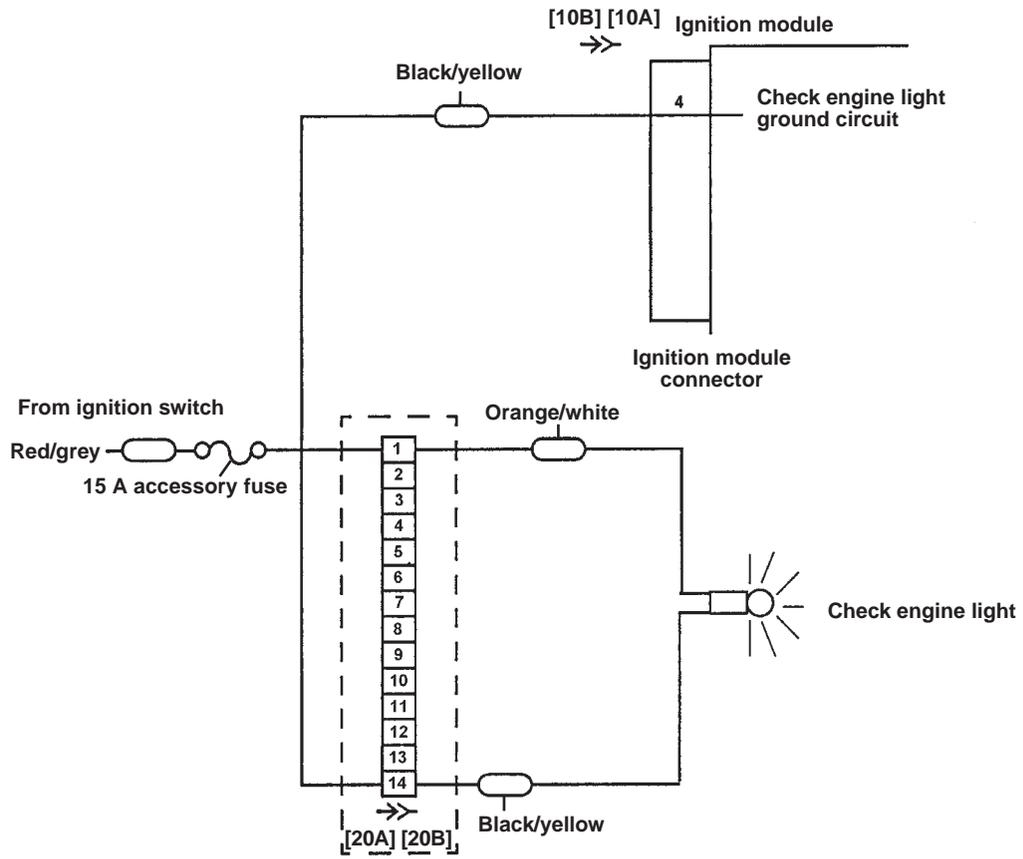
The system consists of a spring-loaded neoprene diaphragm that is compressed by the pump lever during sudden

## NO CHECK ENGINE LAMP WITH KEY ON (1998 MODELS)

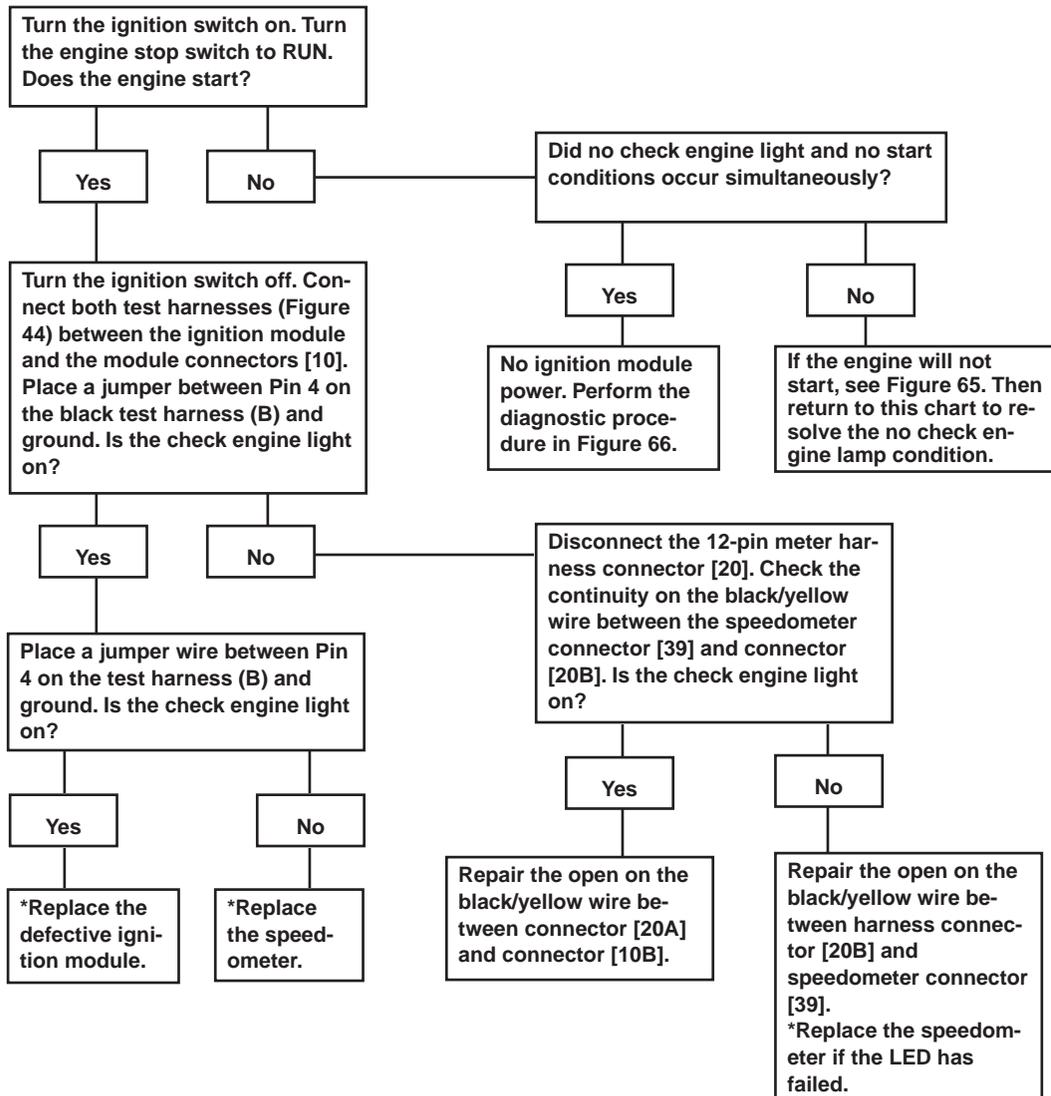


\*Before replacing the ignition module or speedometer, confirm that it is defective by taking the motorcycle to a dealership. Further testing requires the use of a Scanalyzer.

**CHECK ENGINE LIGHT CIRCUIT (1998 MODELS)**

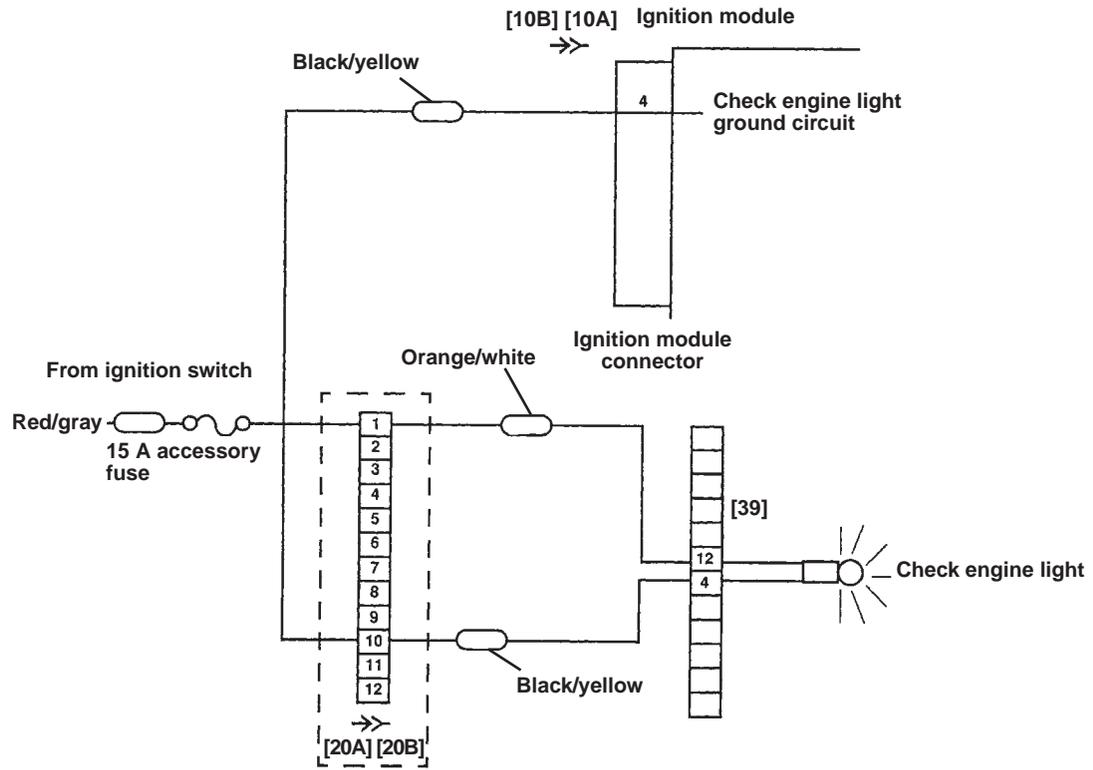


## NO CHECK ENGINE LIGHT WITH KEY ON (1999-2003 MODELS)

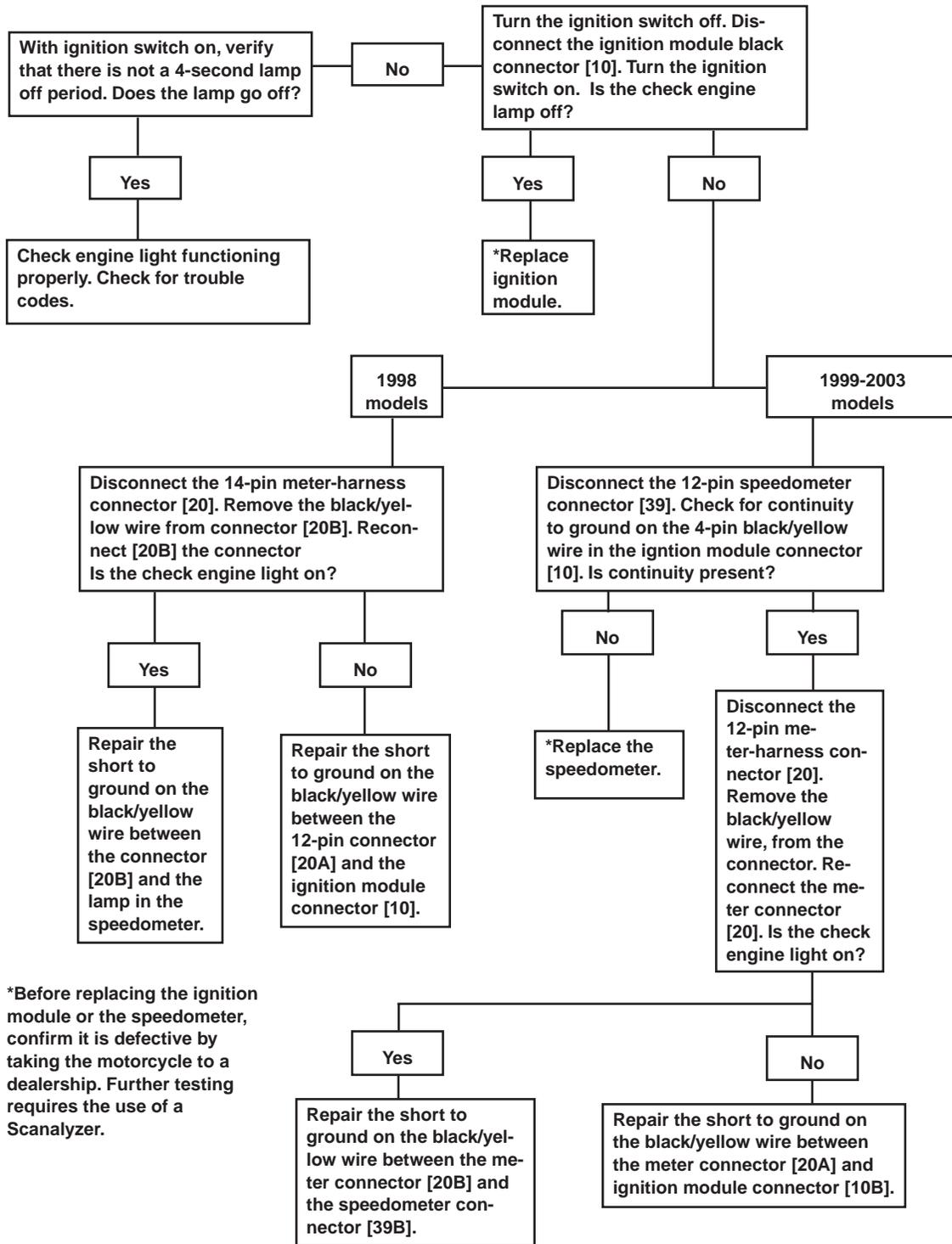


\*Before replacing the ignition module or speedometer, confirm that it is defective by taking the motorcycle to a dealership. Further testing requires the Scanalyzer.

### CHECK ENGINE LIGHT CIRCUIT (1999-2003 MODELS)

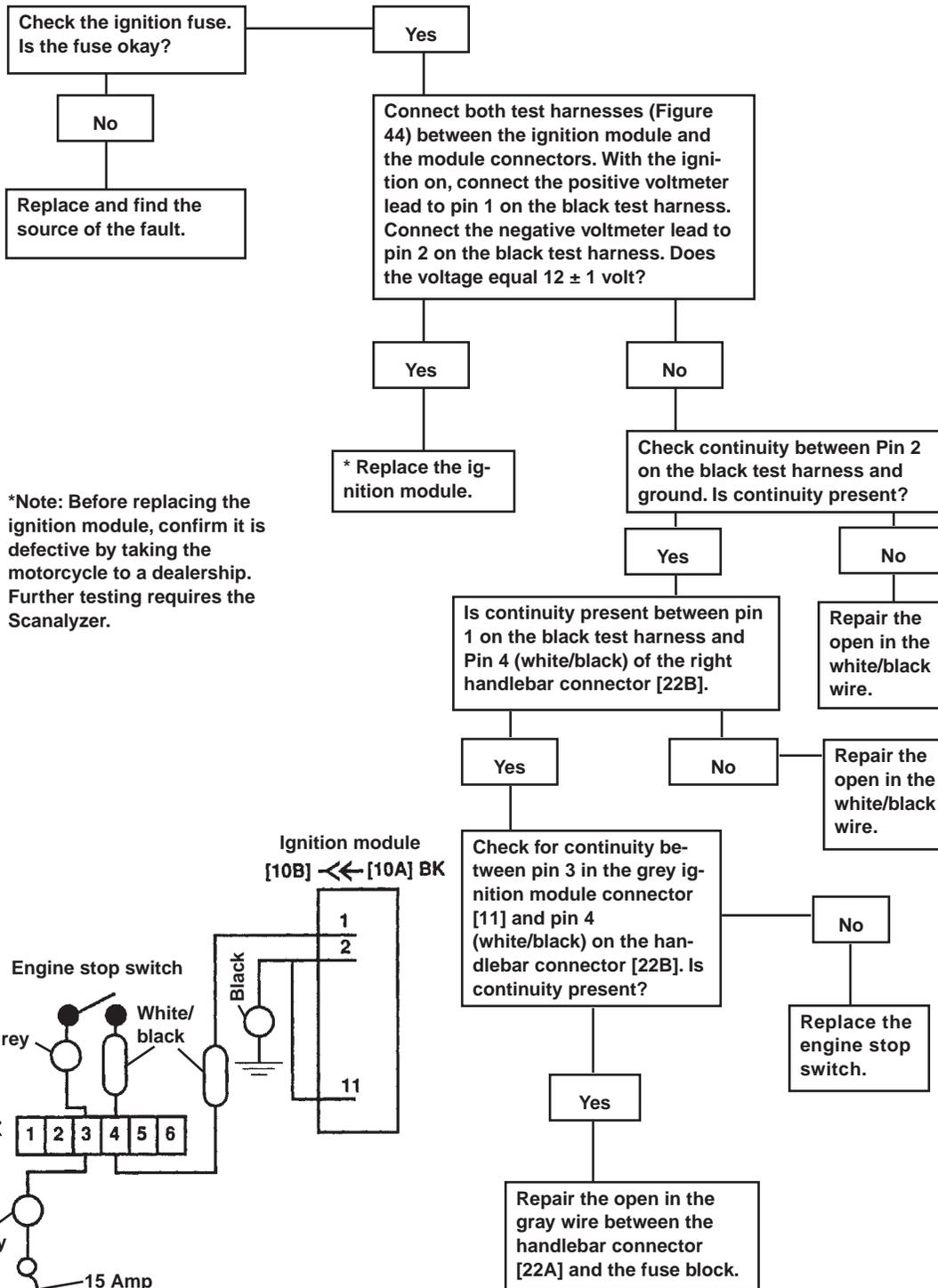


### CHECK ENGINE LIGHT CONTINUOUSLY ON

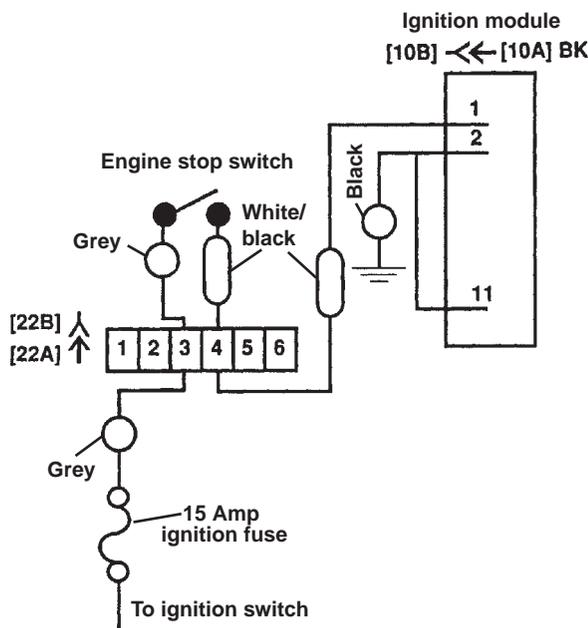


\*Before replacing the ignition module or the speedometer, confirm it is defective by taking the motorcycle to a dealership. Further testing requires the use of a Scanalyzer.

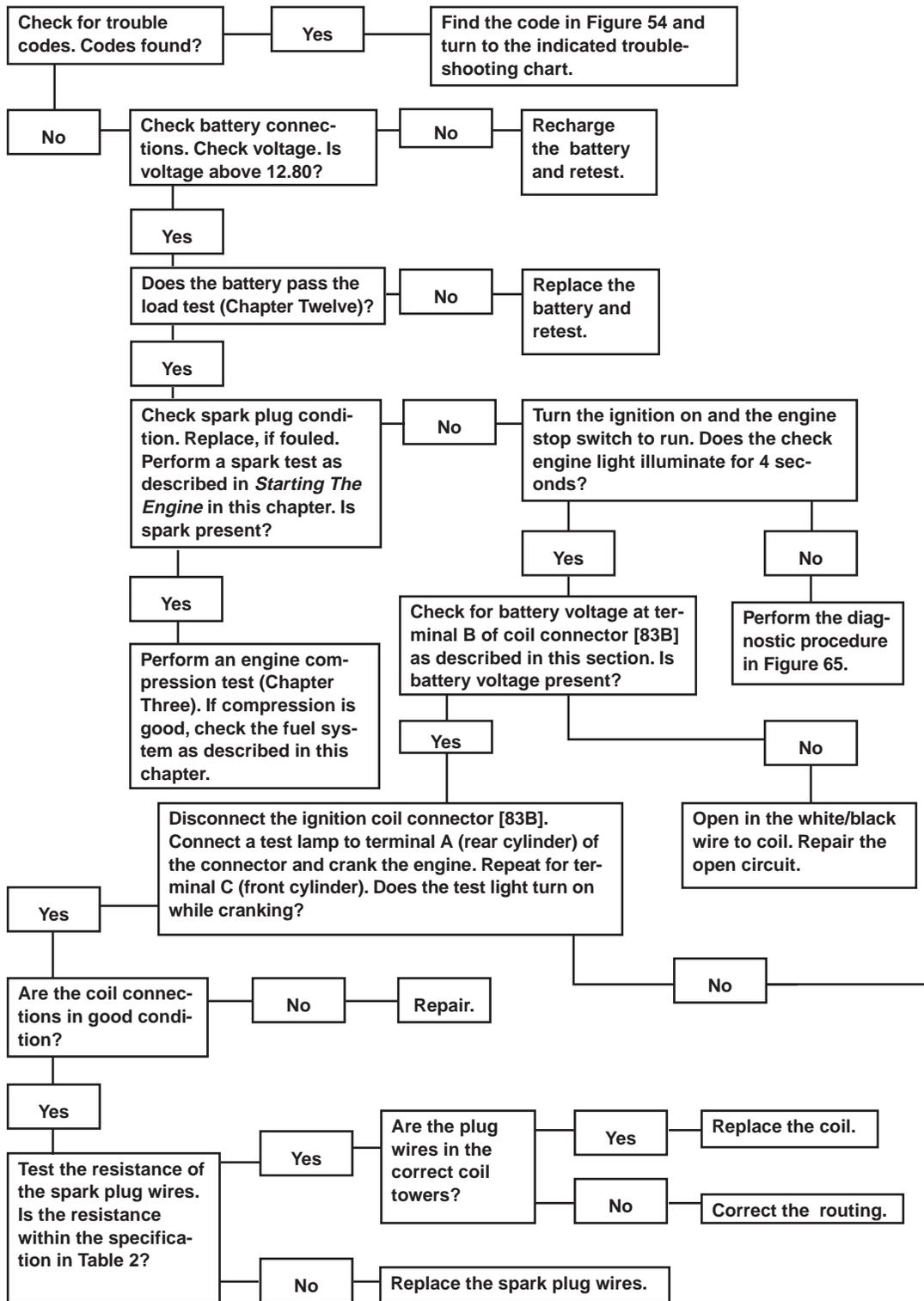
## NO SPARK, NO CHECK ENGINE LIGHT WITH KEY ON

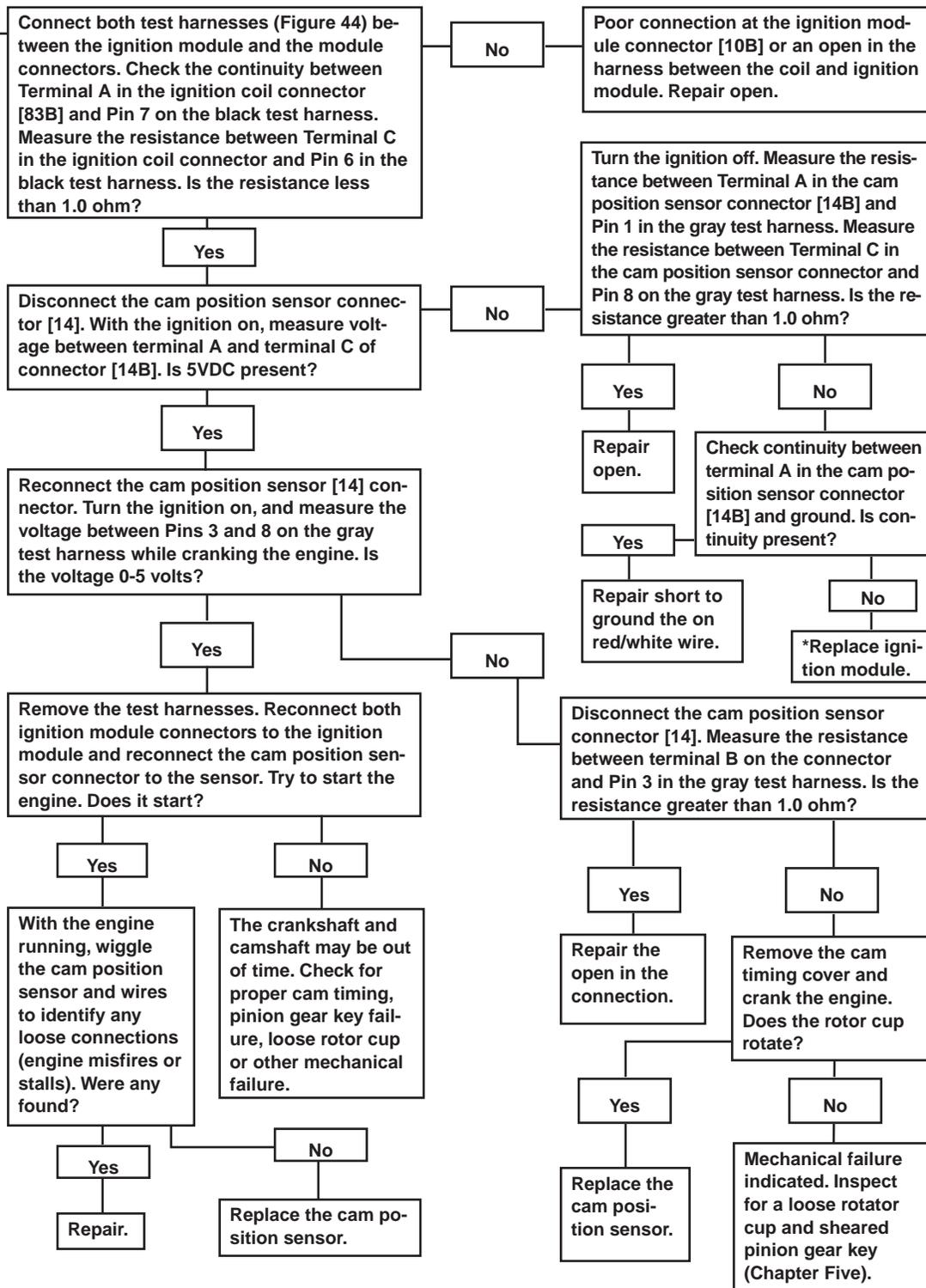


\*Note: Before replacing the ignition module, confirm it is defective by taking the motorcycle to a dealership. Further testing requires the Scanalyzer.



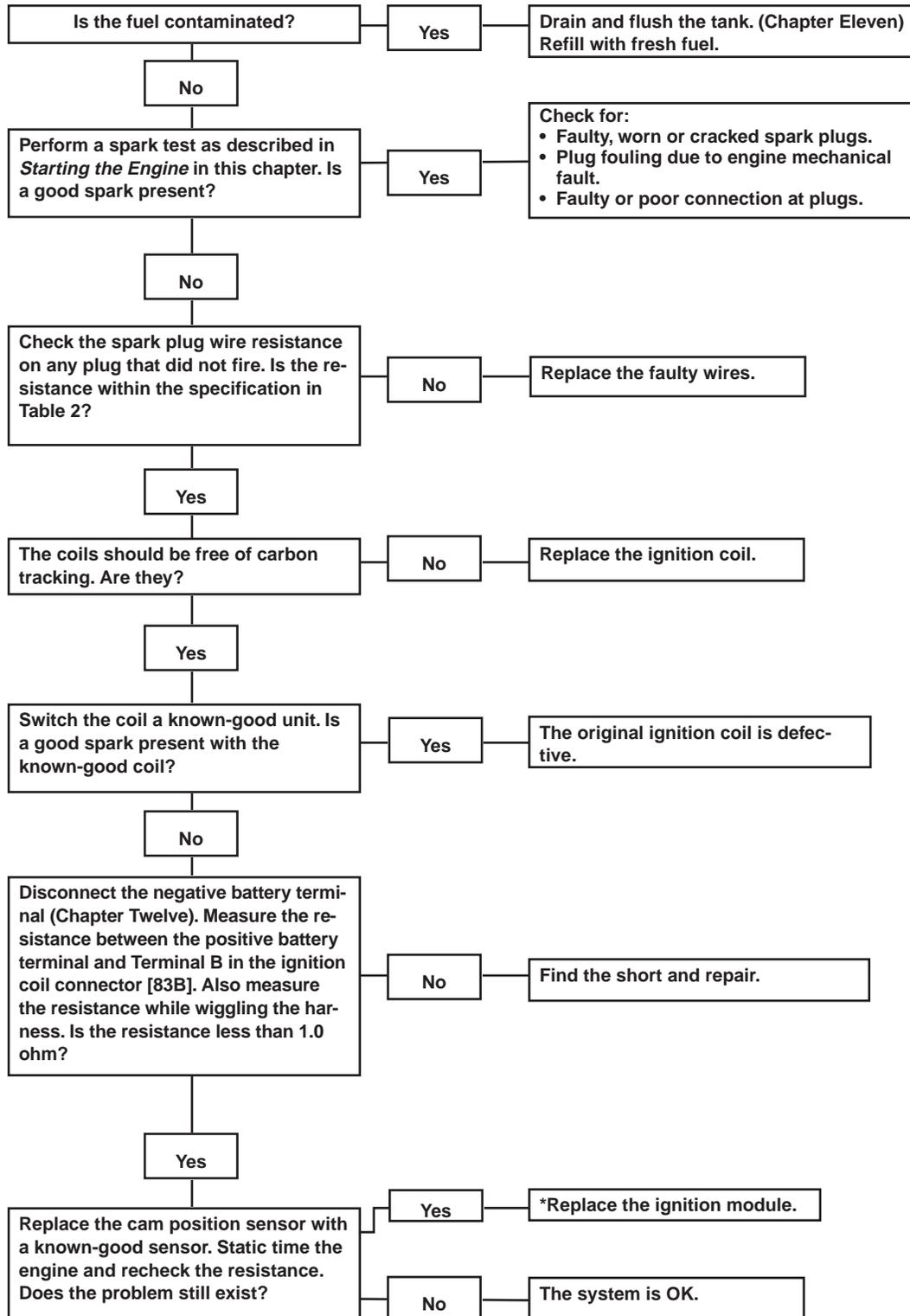
## ENGINE CRANKS BUT WILL NOT START

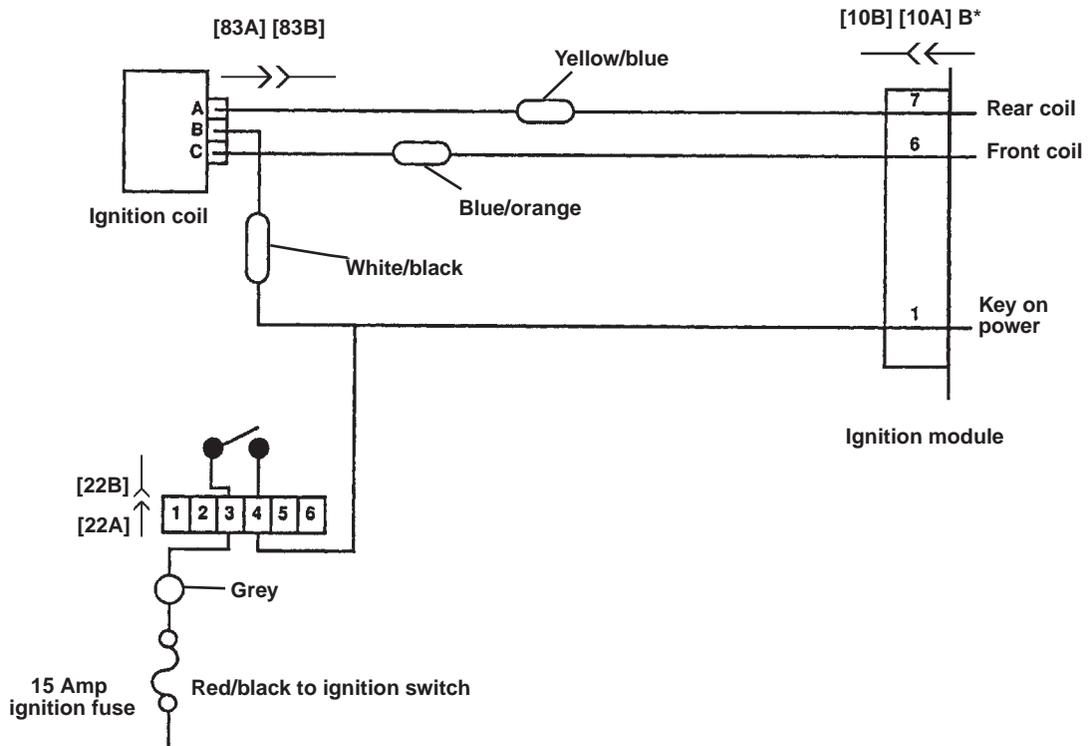




\*Before replacing the ignition module, confirm it is defective by taking it to a dealership. Further testing requires the Scanalyzer.

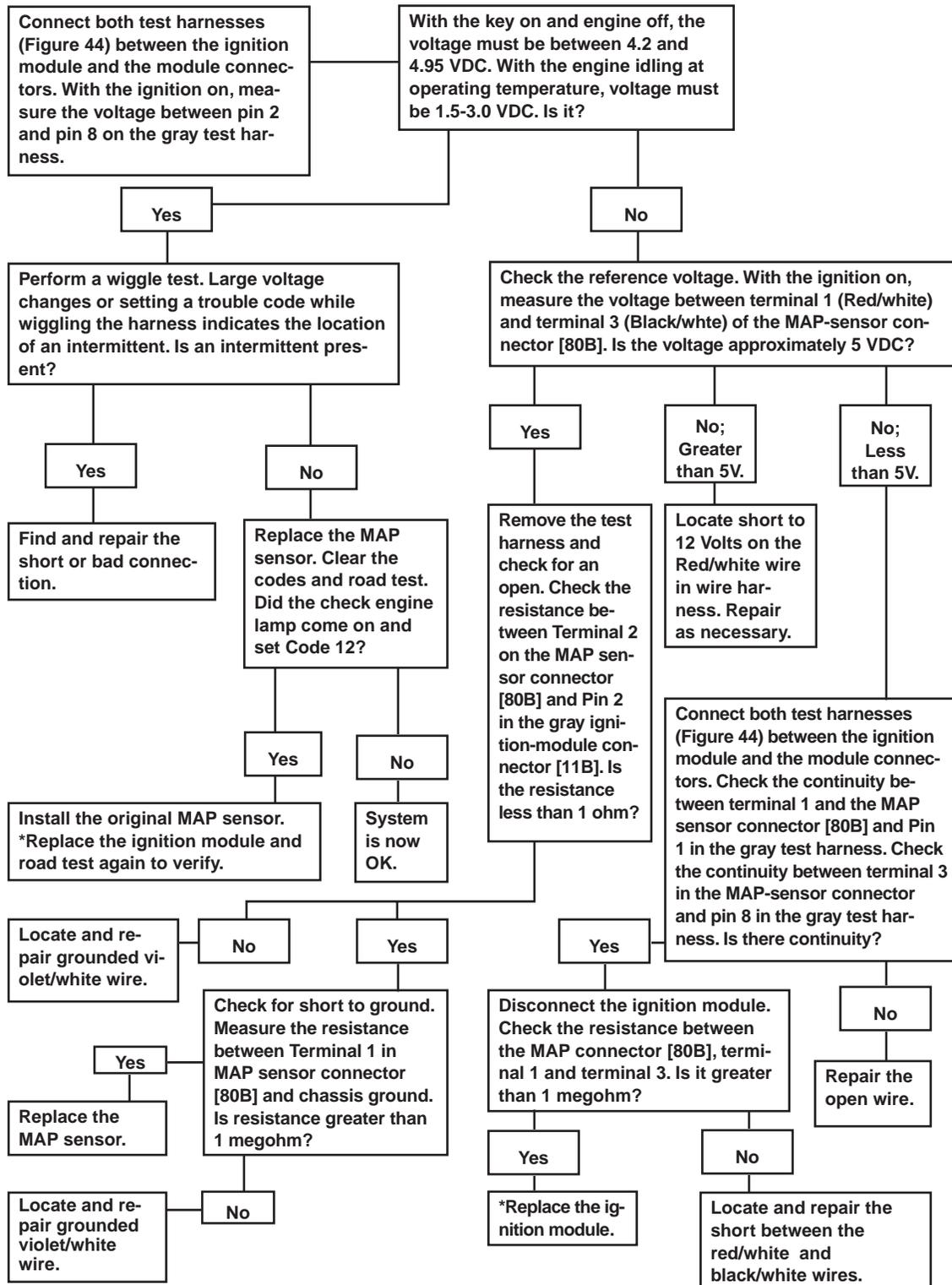
## MISFIRE

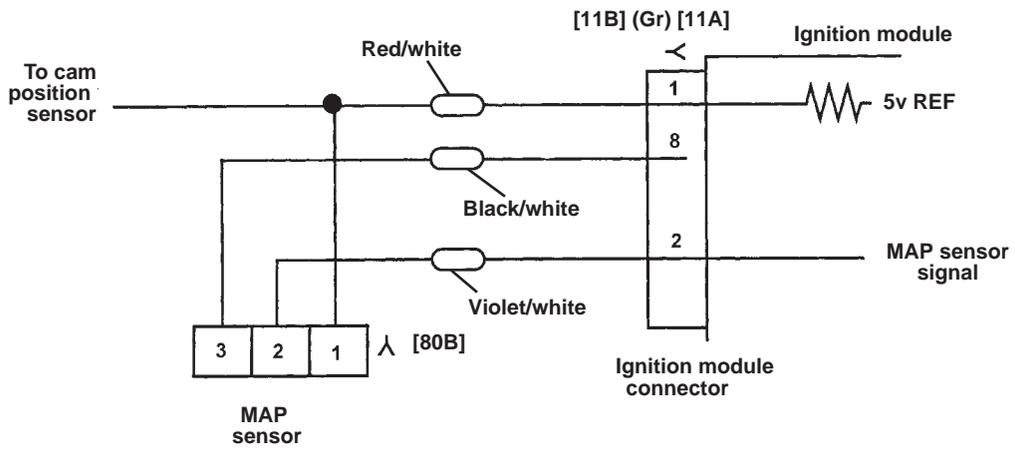




**\*Note:** Before replacing the ignition module, confirm it is defective by taking the motorcycle to a dealership. Further testing requires the Scanalyzer.

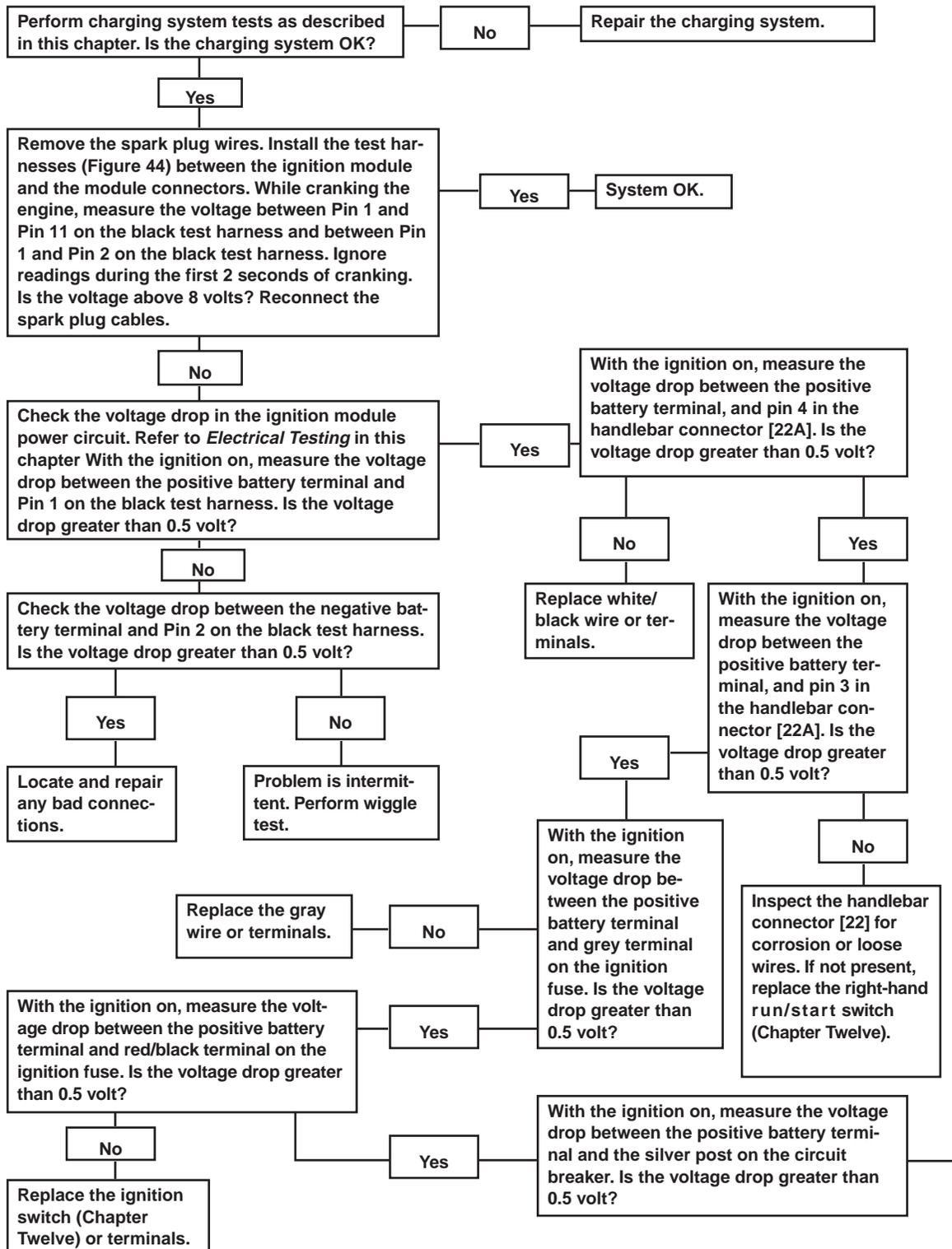
## MAP SENSOR

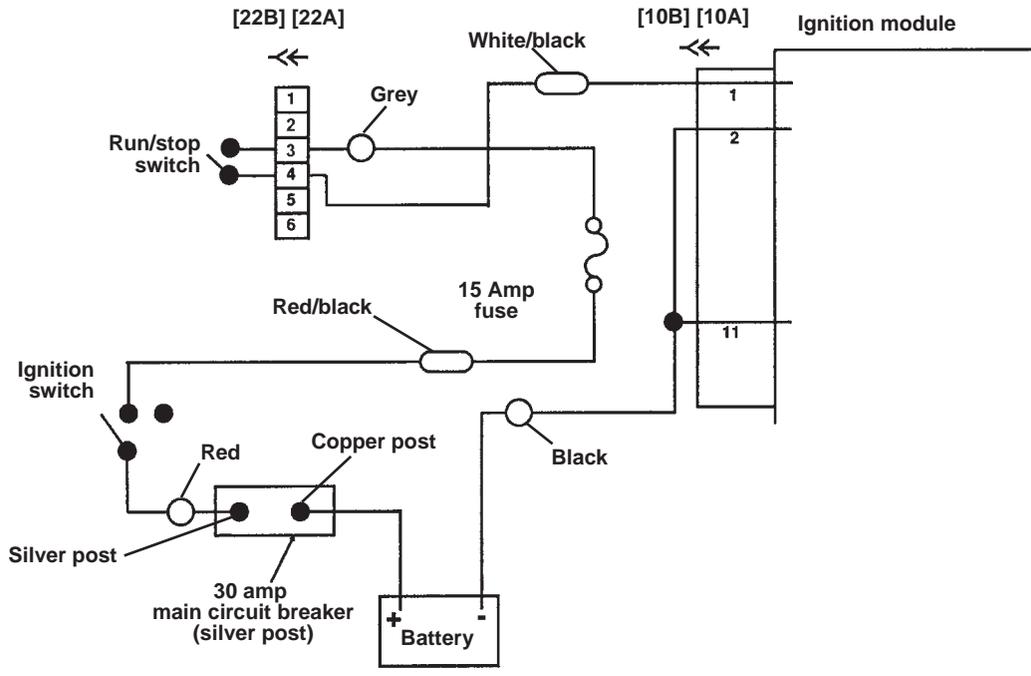
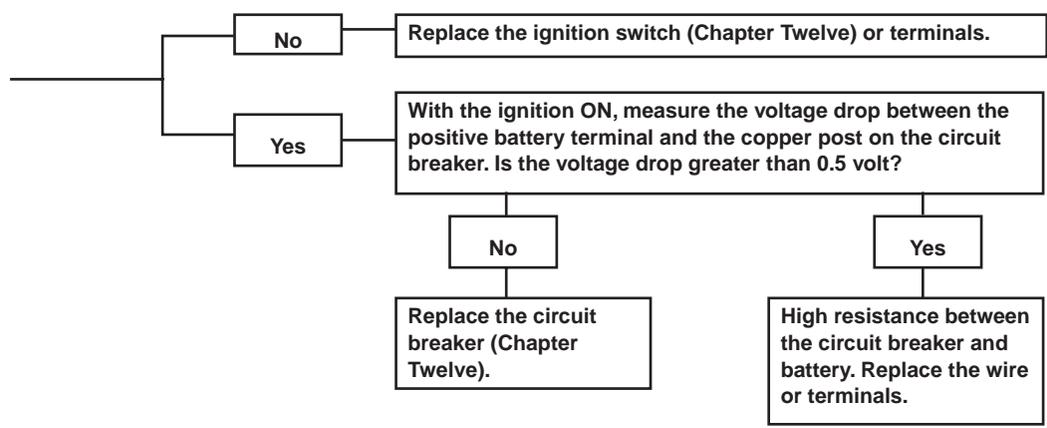




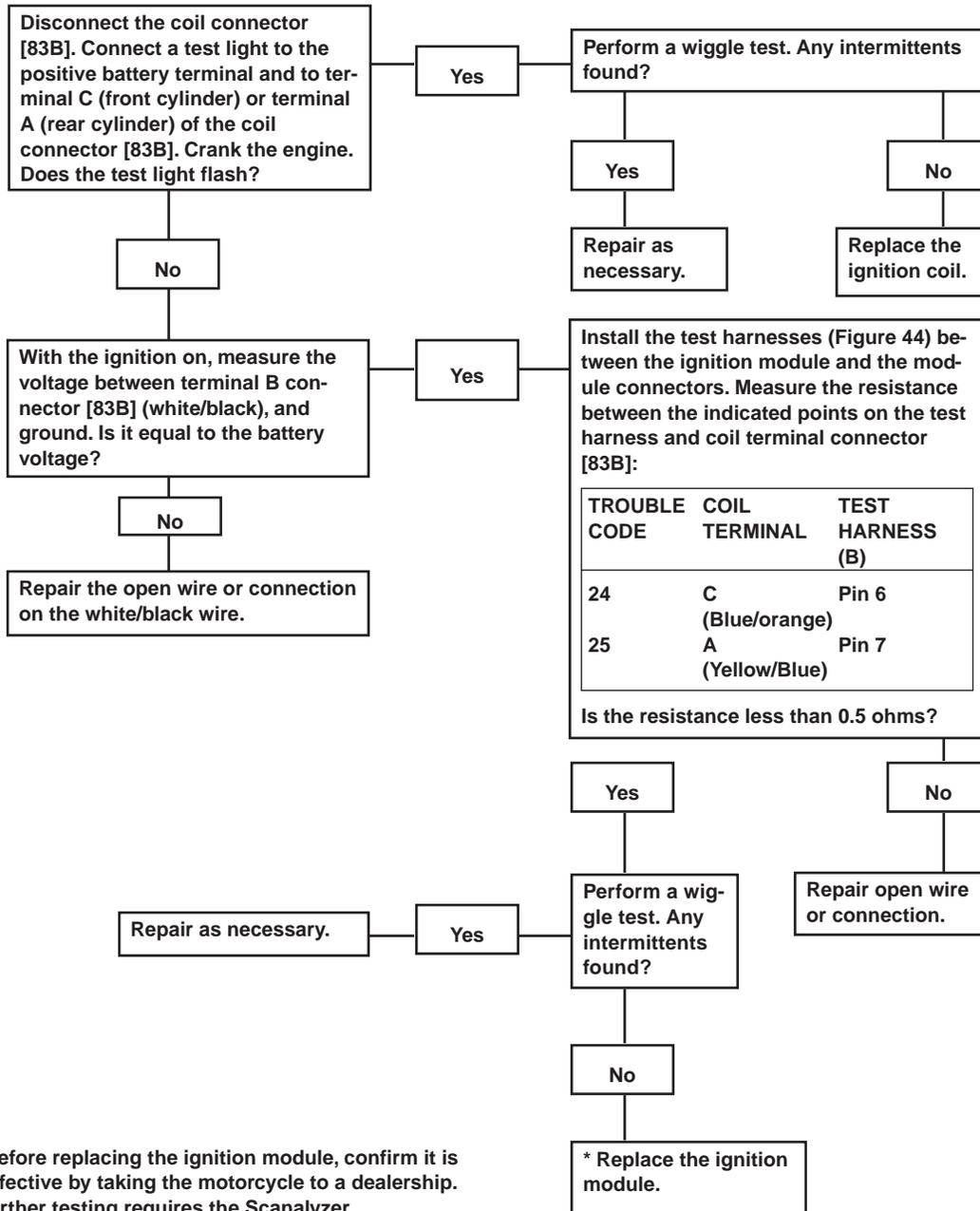
**\*Before replacing the ignition module, confirm it is defective by taking the motorcycle to a dealership. Further testing requires the Scanalyzer.**

## BATTERY VOLTAGE

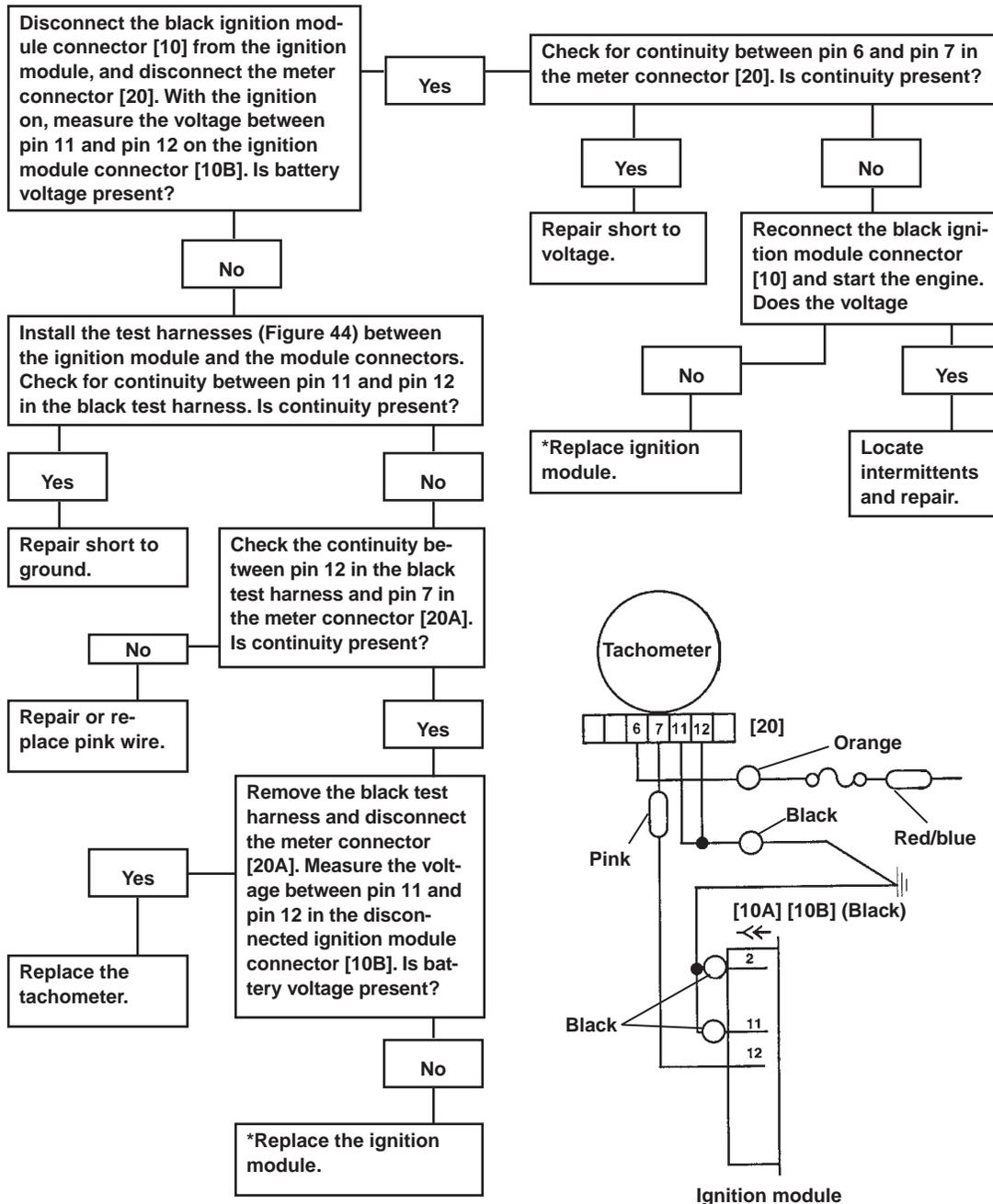




## IGNITION COIL

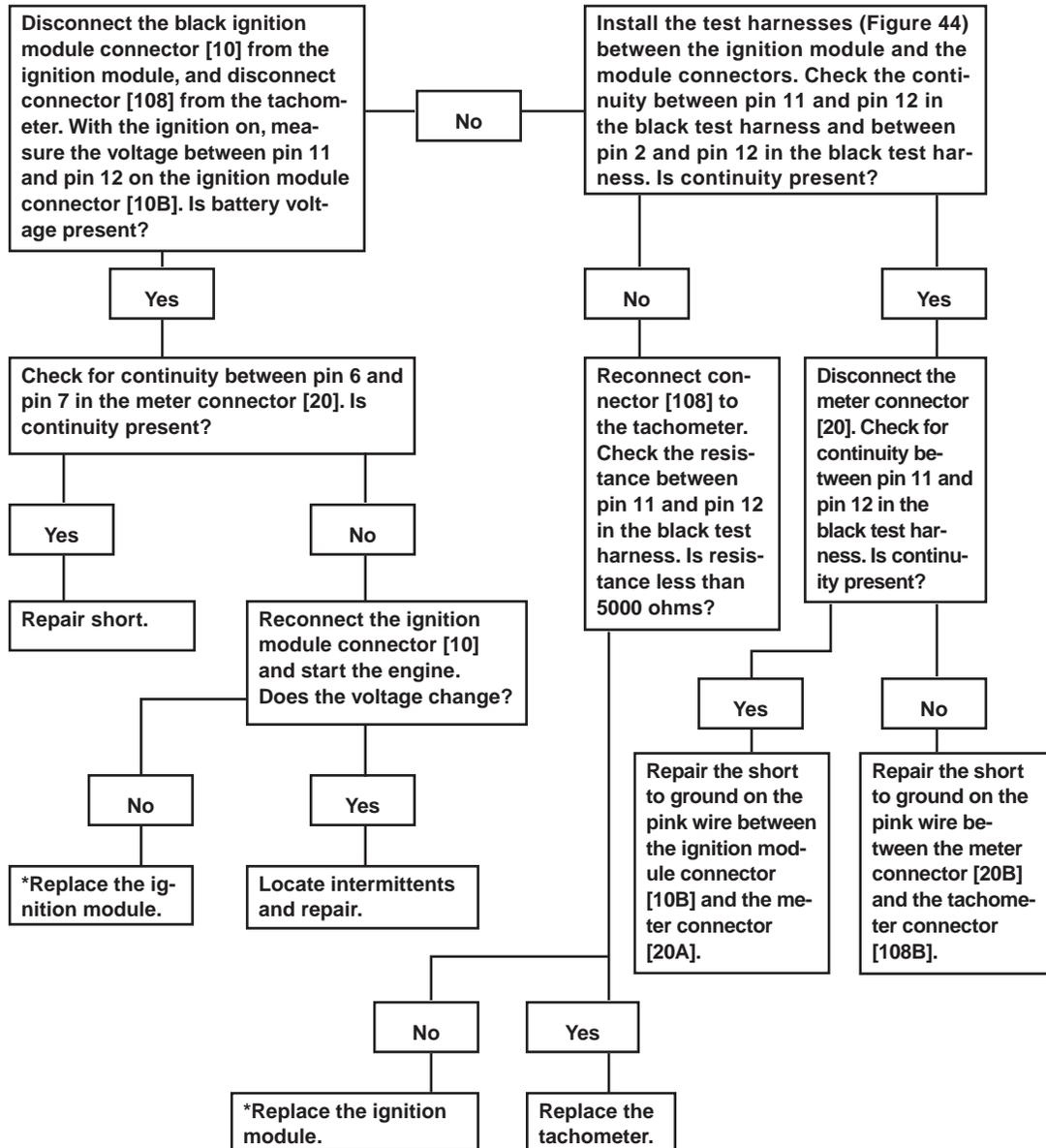


## TACHOMETER (1998 1200S MODELS)



\*Before replacing the ignition module, confirm it is defective by taking the motorcycle to a dealership. Further testing requires the Scanalyzer.

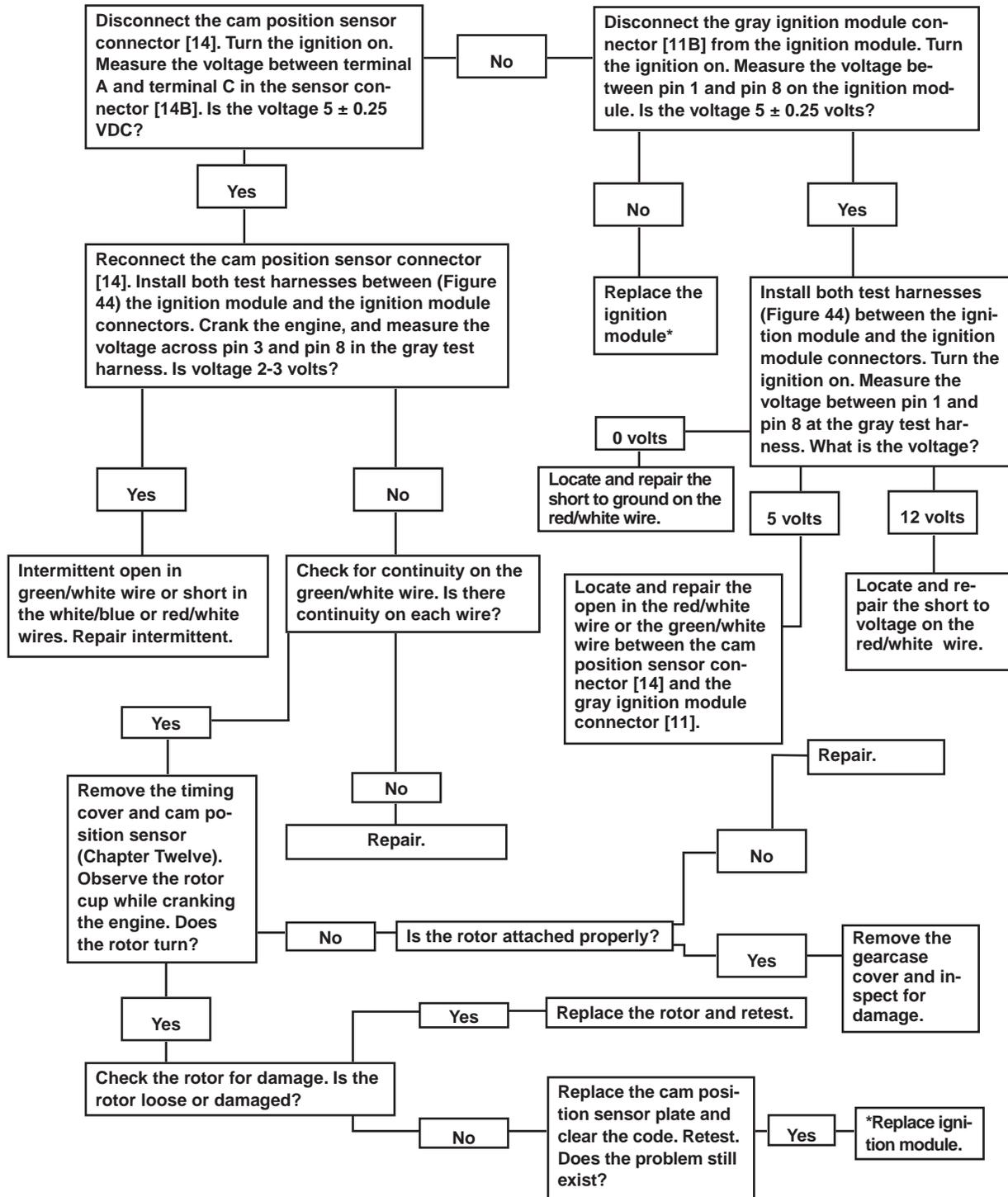
## TACHOMETER (1999-2003 1200S MODELS)



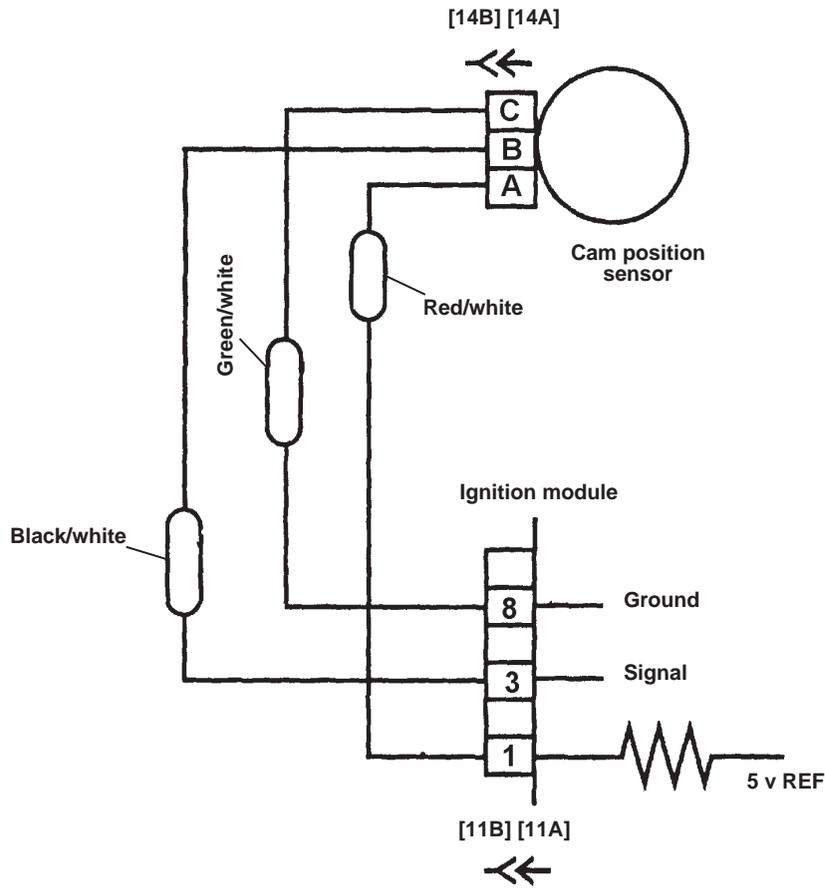
\*Before replacing the ignition module, confirm it is defective by taking the motorcycle to a dealership. Further testing requires the Scanalyzer.



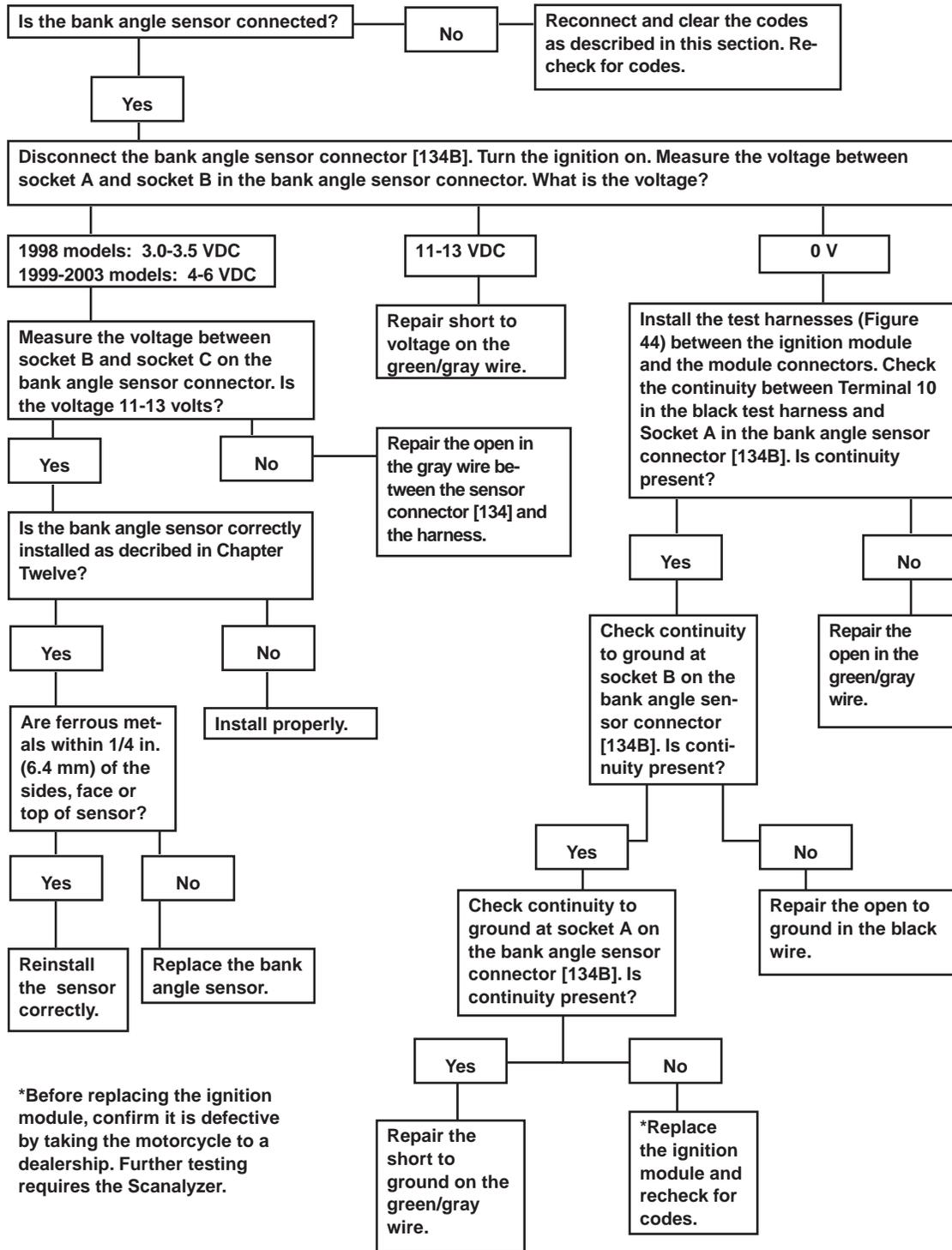
## CAM POSITION SENSOR

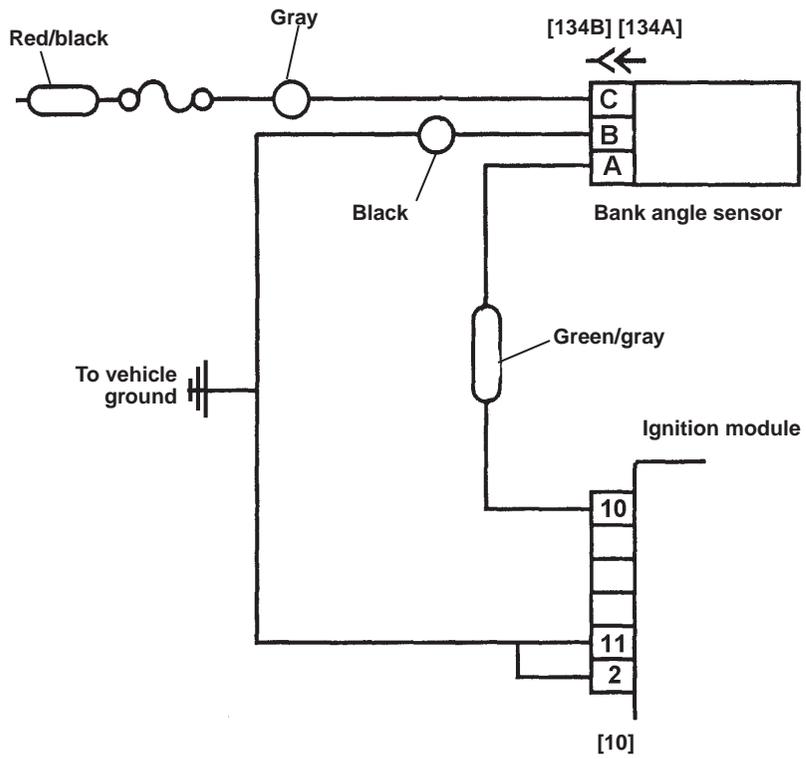


\*Before replacing the ignition module, confirm it is defective by taking the motorcycle to a dealership. Further testing requires the Scanalyzer.



## BANK ANGLE SENSOR





## KEIHIN CARBURETOR TROUBLESHOOTING (1986-1987 MODELS)

Fuel overflows

Check:

- \* Worn float needle valve or dirty seat
- \* Incorrect float level
- \* Damaged float bowl O-ring or loose float bowl mounting screws
- \* Damaged float pin or loose locking screw
- \* Damaged float

Poor idling

Check:

- \* Idle misadjusted
- \* Worn idle mixture screw
- \* Blocked jet or port in carburetor bore
- \* Air leak at carburetor mounting
- \* Accelerator pump rod too long or misadjusted

Poor acceleration

Check:

- \* Clogged accelerator pump
- \* Worn accelerator pump diaphragm
- \* Idle mixture misadjusted (early models with idle mixture adjustment)
- \* Clogged pilot jet
- \* Float level too high

Low power at all speeds

Check:

- \* Dirty or plugged carburetor passages
- \* Clogged fuel lines
- \* Clogged fuel strainer in tank
- \* Air leak at carburetor mount
- \* Dirty air filter
- \* Loose carburetor jets

Poor power at high speeds

Check:

- \* Loose or clogged main jet
- \* Incorrect float level
- \* Dirty or plugged carburetor passages

Poor fuel economy

Check:

- \* Float level too low
- \* Loose jets
- \* Clogged bleed tubes of jets
- \* Choke not opening fully
- \* Dirty air filter

Fuel starvation

Check:

- \* Clogged fuel line
- \* Carburetor dirty
- \* Fuel tank strainers clogged or dirty
- \* Accelerating pump not operating correctly
- \* Fuel tank dirty

## CV CARBURETOR TROUBLESHOOTING (1988-2003 MODELS)

Hard starting

Check:

- \* Fuel overflow from float assembly
- \* Enrichener system inoperative
- \* Plugged pilot jet and/or passage
- \* Fuel overflow

Fuel overflows

Check:

- \* Incorrect fuel level
- \* Damaged float assembly
- \* Worn float needle valve or dirty seat
- \* Incorrect float alignment
- \* Damaged float bowl O-ring or loose float bowl mounting screws
- \* Plugged fuel tank vent cap on 1990-1991 models
- \* Plugged or damaged continuous vent system on 1992-2003 models
- \* Incorrect fuel tank cap installed (non-vent type)

Poor idling

Check:

- \* Incorrect idle speed
- \* Plugged pilot jet system
- \* Loose pilot jet
- \* Air leak at carburetor mounting
- \* Enrichener valve nut loose or damaged

Poor acceleration

Check:

- \* Fuel level too low
- \* Clogged fuel passages
- \* Clogged jets
- \* Plugged fuel tank vent cap on 1990-1991 models
- \* Plugged or damaged continuous vent system on 1992-2003 models
- \* Incorrect fuel tank cap installed (non-vent type)
- \* Enrichener valve nut loose or damaged
- \* Worn or damaged needle jet or needle
- \* Throttle cable misadjusted
- \* Air leak at carburetor mounting
- \* Damaged vacuum piston

Poor power at low engine speeds

Check:

- \* Incorrect idle speed adjustment
- \* Contaminated air filter element
- \* Damaged vacuum piston
- \* Worn or damaged needle jet or needle
- \* Clogged pilot jet system
- \* Plugged float bowl vent or overflow
- \* Enrichener valve nut loose or damaged
- \* Plugged fuel tank vent cap on 1990-1991 models
- \* Plugged or damaged continuous vent system on 1992-2003 models
- \* Clogged fuel supply
- \* Air leak at carburetor mounting

(continued)

Poor power at high engine speeds

Check:

- \* Incorrect fuel level
- \* Loose or plugged main jet
- \* Contaminated air filter element
- \* Damaged vacuum piston
- \* Worn or damaged needle jet or needle
- \* Plugged float bowl vent or overflow
- \* Enrichener valve nut loose or damaged
- \* Plugged fuel tank vent cap on 1990-1991 models
- \* Plugged or damaged continuous vent system on 1992-2003 models
- \* Clogged fuel supply
- \* Air leak at carburetor mounting

Poor fuel economy

Check:

- \* Incorrect enrichment use
- \* Damaged vacuum piston
- \* Contaminated air filter element
- \* Loose jets
- \* Fuel level too high
- \* Worn or damaged needle jet or needle
- \* Plugged float bowl vent
- \* Enrichener valve nut loose or damaged
- \* Incorrect carburetor adjustment

Vacuum piston doesn't rise in bore correctly

Check:

- \* Vacuum piston binds in bore
- \* Diaphragm torn or damaged
- \* Vacuum piston spring binding
- \* Enrichener valve open or leaking
- \* Diaphragm cap loose or damaged
- \* Piston vent clogged
- \* Diaphragm incorrectly installed (pinched at lip)

Vacuum piston doesn't close

Check:

- \* Broken spring
- \* Diaphragm torn or damaged
- \* Vacuum piston binds in bore

acceleration. This causes the diaphragm to force fuel from the pump chamber, through a check valve and into the carburetor venturi. The diaphragm spring returns the diaphragm to the uncompressed position, which allows the chamber to refill with fuel.

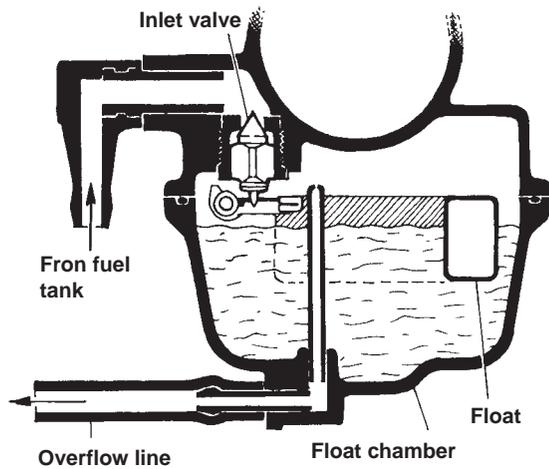
If the engine hesitates during sudden acceleration, check the operation of the accelerator pump system. Carburetor service is covered in Chapter Ten or Chapter Eleven.

#### *Vacuum-operated fuel shutoff valve testing (1995-2003 models)*

A vacuum-operated fuel shutoff valve is used on 1995-2003 models. A vacuum hose is connected between the fuel shutoff valve diaphragm and the carburetor. When the engine is running, vacuum is applied to the fuel shutoff valve through this hose. For fuel to flow through the fuel

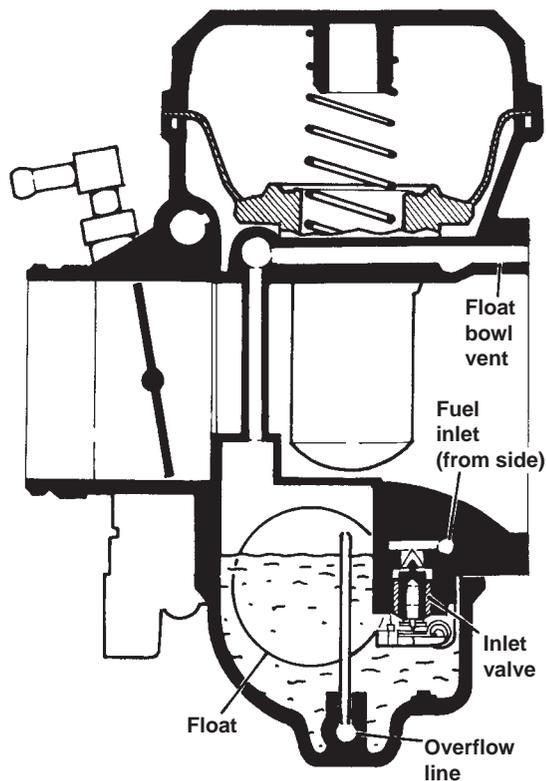
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### FUEL SUPPLY SYSTEM (1986-1987 MODELS)



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### FUEL SUPPLY SYSTEM (1988-2003 MODELS)

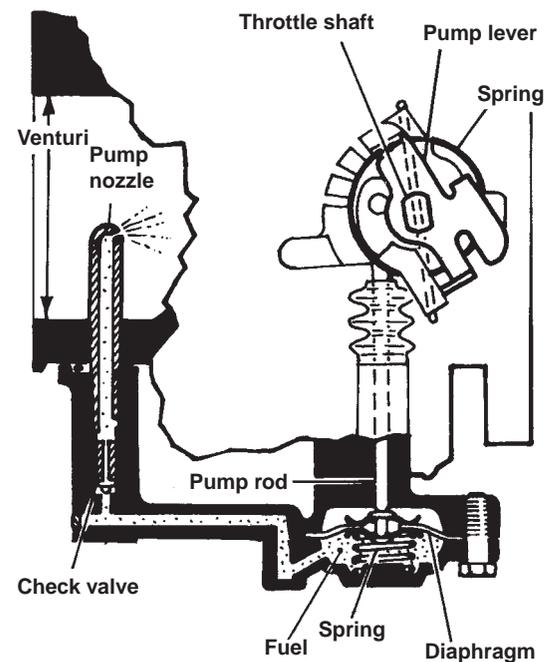


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### ACCELERATOR PUMP SYSTEM (1986-1987 MODELS)



valve, a vacuum must be present with the fuel shutoff valve handle in the on or reserve position. The following steps troubleshoot the fuel shutoff valve by applying a vacuum from a separate source. A hand-operated vacuum pump (**Figure 82**, typical), gas can, drain hose that is long enough to reach from the fuel valve to the gas can, and hose clamp are required for this test.

1. Refer to *Safety* in Chapter One.
2. Disconnect the negative battery cable as described in Chapter Twelve.
3. Visually check there is fuel in the tank.
4. Turn the fuel shutoff valve (A, **Figure 79**) to the off position and disconnect the fuel hose (B) from the fuel shutoff valve. Plug the open end of the hose.

5. Connect the drain hose to the fuel shutoff valve and secure it with a hose clamp. Insert the end of the drain hose into a gas can.
6. Disconnect the vacuum hose from the fuel shutoff valve.
7. Connect a hand-operated vacuum pump (**Figure 82**, typical) to the fuel shutoff valve vacuum hose nozzle.
8. Turn the fuel shutoff valve lever to the on position.

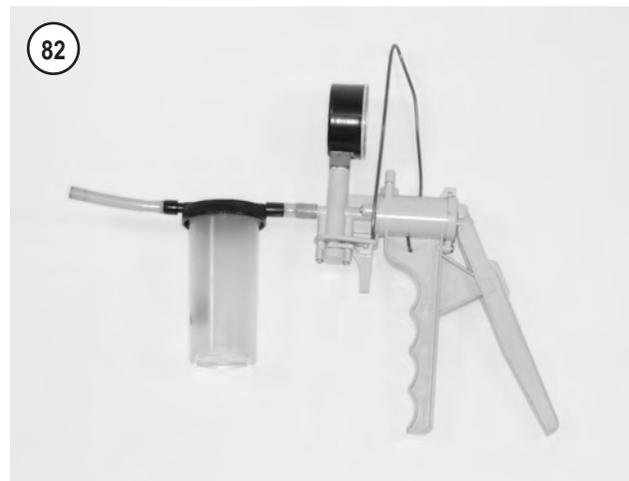
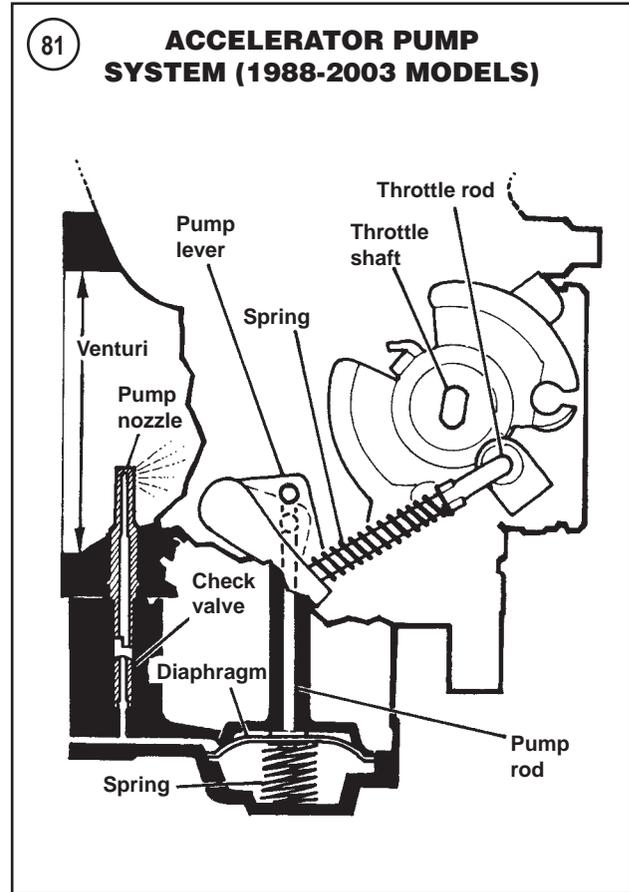
**CAUTION**

*In Step 8, do not apply more than specified vacuum or the fuel shutoff valve diaphragm will be damaged.*

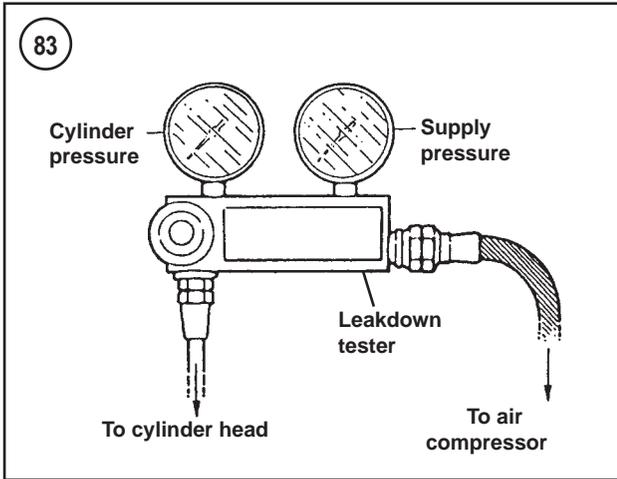
9. Apply 25 in. (635 mm) Hg of vacuum to the valve. Fuel should flow through the fuel shutoff valve when the vacuum is applied.
10. With the vacuum still applied, turn the fuel shutoff valve lever to the reserve position. Fuel should continue to flow through the valve.
11. Release the vacuum and make sure the fuel flow stops.
12. Repeat Steps 9-11 five times. Fuel should flow with vacuum applied and stop flowing when the vacuum is released.
13. Turn the fuel shutoff valve off. Disconnect the vacuum pump and drain hoses.
14. Reconnect the fuel hose (B, **Figure 79**) to the fuel shutoff valve (A).
15. If the fuel valve failed this test, replace the fuel shutoff valve as described in Chapter Ten or Chapter Eleven.

### ENGINE NOISES

1. A knocking or pinging during acceleration can be caused by using a lower octane fuel than recommended or a poor grade of fuel. Incorrect carburetor jetting and an incorrect spark plug heat range (too hot) can cause pinging. Refer to *Spark Plugs* in Chapter Three. Also check for excessive carbon buildup in the combustion chamber or a defective ignition module.
2. A slapping or rattling noise at low speed or during acceleration can be caused by excessive piston-to-cylinder wall clearance. Also check for a bent connecting rod(s) or worn piston pin and/or piston pin hole in the piston(s).
3. A knocking or rapping during deceleration is usually caused by excessive rod bearing clearance.
4. A persistent knocking and vibration or other noises are usually caused by worn main bearings. If the main bearings are in good condition, check for the following:
  - a. Loose engine mounts.
  - b. Cracked frame.
  - c. Leaking cylinder head gasket(s).
  - d. Exhaust pipe leaks at cylinder head(s).
  - e. Stuck piston ring(s).
  - f. Broken piston ring(s).
  - g. Partial engine seizure.
  - h. Excessive connecting rod bearing clearance.
  - i. Excessive connecting rod side clearance.



- j. Excessive crankshaft runout.
5. Rapid on-off squeal indicates a compression leak around the cylinder head gasket or spark plug.
6. For valve train noise, check for the following:
  - a. Bent pushrod(s).
  - b. Defective lifter(s).
  - c. Valve sticking in guide.
  - d. Worn cam gears and/or cam.
  - e. Damaged rocker arm or shaft. Rocker arm may be binding on shaft.



tion. If the motorcycle is ridden far enough, the water cannot buildup in the crankcase and should not be a problem. Once the engine heats up to normal operating temperature, the water evaporates and exits the engine. However, if the motorcycle is ridden for short trips or repeatedly started and stopped and allowed to cool off without the engine getting warm enough, water will start to collect in the crankcase. With each short run of the engine, more water collects. As this water mixes with the oil in the crankcase, sludge is produced. Water sludge can eventually cause engine damage as it circulates through the lubrication system and blocks off oil passages. Water draining from drain holes in exhaust pipes indicate water buildup.

### LEAKDOWN TEST

A leakdown test can determine engine problems from leaking valves, blown head gaskets or broken, worn or stuck piston rings. A leakdown test is performed by applying compressed air to the cylinder and then measuring the loss percentage. A cylinder leakdown tester (Figure 83, typical) and an air compressor are required to perform this test.

Follow the manufacturer's directions along with the following information when performing a cylinder leakdown test.

1. Start and run the engine until it reaches normal operating temperature.
2. Remove the air filter (Chapter Three). Then set the throttle and choke valves in the wide open position.
3. Remove the ignition timing inspection plug from the crankcase (Figure 84).
4. Set the piston for the cylinder being tested to TDC on its compression stroke. Refer to *Ignition Timing* in Chapter Three.
5. Remove the spark plugs (Chapter Three).

#### NOTE

*The engine may want to turn over when air pressure is applied to the cylinder. To prevent this from happening, shift the transmission into fifth gear and apply the rear brake.*

6. Make a leakdown test following the leakdown tester manufacturer's instructions. Listen for air leaking while noting the following:

- a. Air leaking through the exhaust pipe indicates a leaking exhaust valve.
- b. Air leaking through the carburetor indicates a leaking intake valve.

#### NOTE

*Air leaking through the valves can also be caused by pushrods that are too long.*

- c. Air leaking through the ignition timing inspection hole indicates worn or broken piston rings, a leaking cylinder head gasket or a worn piston.



### ENGINE SMOKE

The color of engine smoke can help diagnosis engine problems or operating conditions.

#### Black Smoke

Black smoke is an indication of a rich air/fuel mixture where an excessive amount of fuel is being burned in the combustion chamber.

#### Blue Smoke

Blue smoke indicates that the engine is burning oil in the combustion chamber as it leaks past worn valve stem seals and piston rings. Excessive oil consumption is another indicator of an engine that is burning oil. Perform a compression test (Chapter Three) to isolate the problem.

#### White Smoke or Steam

It is normal to see white smoke or steam from the exhaust after first starting the engine in cold weather. This is actually condensed steam formed by the engine during combus-

7. Repeat for the other cylinder.
8. If the pressure loss between cylinders differs by more than 12 percent, the engine is in poor condition and further testing is required.

## ENGINE LUBRICATION

An improperly operating engine lubrication system will quickly lead to engine damage. The engine oil tank should be checked weekly and the tank refilled as described in Chapter Three.

Oil pump service is covered in Chapter Five.

### Oil Light

The oil light, mounted on the indicator light panel (**Figure 85**), will come on when the ignition switch is turned on before starting the engine. After the engine is started, the oil light should go off when the engine speed is above idle.

If the oil light does not come on when the ignition switch is turned on and the engine is not running, check for a burned out oil light bulb. If the bulb is okay, check the oil pressure switch (**Figure 86**) as described in Chapter Twelve.

If the oil light remains on when the engine speed is above idle, turn the engine off and check the oil level in the oil tank as described in Chapter Three. If the oil level is satisfactory, check the following:

1. Oil may not be returning to the tank from the return line. Check for a clogged or damaged return line or a damaged oil pump.
2. If the motorcycle is operated in conditions where the ambient temperature is below freezing, ice and sludge may be blocking the oil feed pipe. This condition will prevent the oil from circulating properly.

### Oil Consumption High or Engine Smokes Excessively

1. Worn valve guides.
2. Worn valve guide seals.
3. Worn or damaged piston rings.
4. Restricted oil tank return line.
5. Oil tank overfilled.
6. Oil filter restricted.
7. Leaking cylinder head surfaces.

### Oil Fails to Return to Oil Tank

1. Oil lines or fittings restricted or damaged.
2. Oil pump damaged or operating incorrectly.
3. Oil tank empty.
4. Oil filter restricted.



### Excessive Engine Oil Leaks

1. Clogged air filter breather hose.
2. Restricted or damaged oil return line to oil tank.
3. Loose engine parts.
4. Damaged gasket sealing surfaces.
5. Oil tank overfilled.

## CLUTCH

All clutch troubles, except adjustments, require partial clutch disassembly to identify and cure the problem. Refer to Chapter Six or Chapter Seven for clutch service procedures.

Make sure the clutch cable is properly adjusted (Chapter Three) before investigating internal problems.

### Clutch Chatter or Noise

This problem is generally caused by worn or warped friction and steel plates. Also check for worn or damaged bearings.

### Clutch Slip

1. Incorrect clutch adjustment.
2. Worn friction plates.
3. Weak or damaged diaphragm spring.
4. Damaged pressure plate.

### Clutch Dragging

1. Incorrect clutch adjustment.
2. Warped clutch plates.
3. Worn or damaged clutch shell or clutch hub.

## TRANSMISSION

Refer to Chapter Eight or Chapter Nine for transmission service procedures. Make sure that the clutch is not causing the trouble before working on the transmission.



### Jumping Out of Gear

1. Incorrect shifter pawl adjuster.
2. Worn or damaged shifter parts.
3. Bent shift forks.
4. Severely worn or damaged gears.

### Difficult Shifting

1. Worn or damaged shift forks.
2. Loose or damaged detent plate.
3. Worn or damaged shift shaft assembly.
4. Worn or damaged detent arm.
5. Worn shift fork drum groove(s).
6. Loose, worn or damaged shifter fork pin(s).
7. Damaged shift shaft splines.

### Excessive Gear Noise

1. Worn or damaged bearings.
2. Worn or damaged gears.
3. Excessive gear backlash.

## ELECTRICAL TESTING

This section describes typical test equipment and how to troubleshoot with it.

Never assume anything and do not overlook the obvious, such as a blown fuse or an electrical connector that has separated. Test the simplest and most obvious items first and try to make tests at easily accessible points on the motorcycle. Make sure to troubleshoot systematically.

Refer to the color wiring diagrams at the end of the manual for component and connector identification. Use the wiring diagrams to determine how the circuit should work by tracing the current paths from the power source through the circuit components to ground. Also check any circuits that share the same fuse, ground or switch. If the other circuits work properly and the shared wiring is good, the cause must be in the wiring used only by the suspect circuit. If all related circuits are faulty at the same time, the probable cause is a poor ground connection or a blown fuse(s).

### Preliminary Checks and Precautions

Before starting any electrical troubleshooting, perform the following:

1. Inspect the fuse for the suspected circuit, and replace it if blown. Refer to *Circuit Breakers and Fuses* in Chapter Twelve.
2. Inspect the battery (Chapter Twelve). Make sure it is fully charged and the battery leads are clean and securely attached to the battery terminals.
3. Electrical connectors are often the cause of electrical system problems. Inspect the connectors as follows:
  - a. Disconnect each electrical connector in the suspect circuit and make sure there are no bent terminals in the electrical connector. A bent terminal will not connect to its mate, causing an open circuit.
  - b. Make sure the terminals are pushed all the way into the connector. If not, carefully push them in with a narrow blade screwdriver.
  - c. Check the wires where they attach to the terminals for damage.
  - d. Make sure each terminal is clean and free of corrosion. Clean them, if necessary, and pack the connectors with dielectric grease.
  - e. Push the connector halves together. Make sure the connectors are fully engaged and locked together.
  - f. Never pull the wires when disconnecting a connector. Pull only on the connector housing.
4. Never use a self-powered test light on circuits that contain solid-state devices. The solid-state devices may be damaged.

### Intermittent Problems

Problems that do not occur all the time can be difficult to isolate during testing. For example, when a problem only occurs when the motorcycle is ridden over rough roads (vibration) or in wet conditions (water penetration). Note the following:

1. Vibration. This is a common problem with loose or damaged electrical connectors.
  - a. Perform a continuity test as described in the appropriate service procedure or under *Continuity Test* in this section.
  - b. Lightly pull or wiggle the connectors while repeating the test. Do the same when checking the wiring harness and individual components, especially where the wires enter a housing or connector.
  - c. A change in meter readings indicates a poor connection. Find and repair the problem or replace the part. Check for wires with cracked or broken insulation.

#### NOTE

*An analog ohmmeter is useful when making this type of test. Slight needle movements are visibly apparent, which indicate a loose connection.*

2. Heat. This is a common problem with connectors or joints that have loose or poor connections. As these connections heat up, the connection or joint expands and separates, causing an open circuit. Other heat related problems occur when a component starts to fail as it heats up.

- a. Troubleshoot the problem to isolate the circuit.

**CAUTION**

*A heat gun will quickly raise the temperature of the component being tested. Do not apply heat directly to the circuit or use heat in excess of 140° F (60° C) on any electrical component.*

- b. To check a connector, perform a continuity test as described in the appropriate service procedure or under *Continuity Test* in this section. Then repeat the test while heating the connector with a heat gun. If the meter reading was normal (continuity) when the connector was cold, and then fluctuated or read infinity when heat was applied, the connection is bad.
  - c. To check a component, allow the engine to cool, and then start and run the engine. Note operational differences when the engine is cold and hot.
  - d. If the engine will not start, isolate and remove the suspect component. Test it at room temperature and again after heating it with a heat gun. A change in meter readings indicates a temperature problem.
3. Water. When the problem occurs when riding in wet conditions or in areas with high humidity, start and run the engine in a dry area. Then, with the engine running, spray water onto the suspected component/circuit. Water-related problems often stop after the component heats up and dries.

### Test Light or Voltmeter

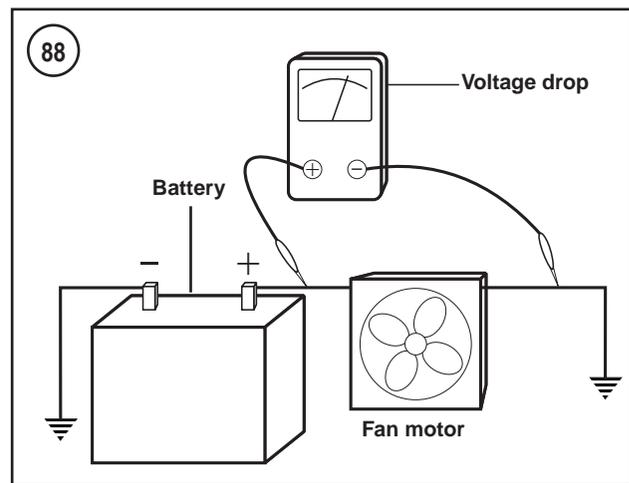
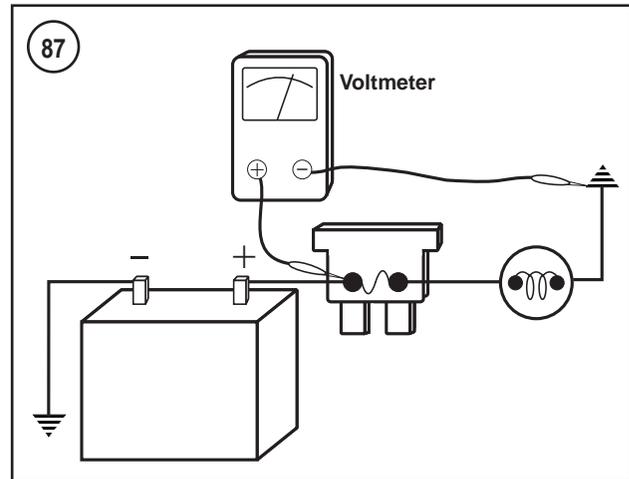
Use a test light to check for voltage in a circuit. Attach one lead to ground and the other lead to various points along the circuit. It does not make a difference which test lead is attached to ground. The bulb lights when voltage is present.

Use a voltmeter in the same manner as the test light to find out if voltage is present in any given circuit. The voltmeter, unlike the test light, also indicates how much voltage is present at each test point.

### Voltage test

Unless otherwise specified, make all voltage tests with the electrical connectors still connected. Insert the test leads into the backside of the connector and make sure the test lead touches the electrical terminal within the connector housing. If the test lead only touches the wire insulation, it will cause a false reading.

Always check both sides of the connector because one side may be loose or corroded, thus preventing electrical

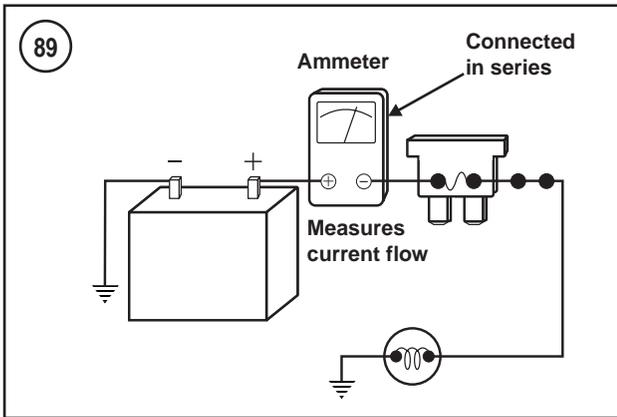


flow through the connector. This type of test can be performed with a test light or a voltmeter.

1. Attach the voltmeter negative test lead to a confirmed ground location. If possible, use the battery ground connection. Make sure the ground is not insulated.
2. Attach the voltmeter positive test lead to the point to be tested (**Figure 87**).
3. Turn the ignition switch on. If using a test light, the test light will come on if voltage is present. If using a voltmeter, note the voltage reading. The reading should be within 1 volt of battery voltage. If the voltage is less there is a problem in the circuit.

### Voltage drop test

The wires, cables, connectors and switches in the electrical circuit are designed to carry current with low resistance. This ensures current can flow through the circuit with a minimum loss of voltage. Voltage drop indicates where there is resistance in a circuit. A higher-than-normal amount of resistance in a circuit decreases the flow of current and causes the voltage to drop between the source and destination in the circuit.



Because resistance causes voltage to drop, a voltmeter is used to measure voltage drop when current is running through the circuit. If the circuit has no resistance, there is no voltage drop so the voltmeter indicates 0 volts. The greater the resistance in a circuit, the greater the voltage drop reading.

To perform a voltage drop:

1. Connect the positive meter test lead to the electrical source (where electricity is coming from).
2. Connect the voltmeter negative test lead to the electrical load (where the electricity is going). Refer to **Figure 88**.
3. If necessary, activate the component(s) in the circuit.
4. Read the voltage drop (difference in voltage between the source and destination) on the voltmeter. Note the following:
  - a. The voltmeter should indicate 0 volts. If there is a drop of 1 volt or more, there is a problem within the circuit. A voltage drop reading of 12 volts indicates an open in the circuit.
  - b. A voltage drop of 1 or more volts indicates that a circuit has excessive resistance.
  - c. For example, consider a starting problem where the battery is fully charged but the starter turns over slowly. Voltage drop would be the difference in the voltage at the battery (source) and the voltage at the starter (destination) as the engine is being started (current is flowing through the battery cables). A corroded battery cable would cause a high voltage drop (high resistance) and slow engine cranking.
  - d. Common sources of voltage drop are loose or contaminated connectors and poor ground connections.

### Short test

A test light may also be used.

1. Remove the blown fuse from the fuse panel.
2. Connect the voltmeter across the fuse terminals in the fuse panel. Turn the ignition switch on and check for battery voltage.
3. With the voltmeter attached to the fuse terminals, wiggle the wiring harness relating to the suspect circuit at approximately 6 in. (15 cm) intervals. Start next to the fuse panel

and work systematically away from the panel. Note the voltmeter reading while progressing along the harness.

4. If the voltmeter reading changes or the test light blinks, there is a short-to-ground at that point in the harness.

### Ammeter

Use an ammeter to measure the flow of current (amps) in a circuit (**Figure 89**). When *connected in series* in a circuit, the ammeter determines if current is flowing through the circuit and if that current flow is excessive because of a short in the circuit. Current flow is often referred to as current draw. Comparing actual current draw in the circuit or component to current draw specification (if specified by the manufacturer) provides useful diagnostic information.

### Self-powered Test Light

A self-powered test light can be constructed from a 12-volt light bulb, a pair of test leads and a 12-volt battery. When the test leads are touched together the light bulb should go on.

Use a self-powered test light as follows:

1. Touch the test leads together to make sure the light bulb goes on. If not, correct the problem.
2. Disconnect the motorcycle's battery or remove the fuse(s) that protects the circuit to be tested. Do not connect a self-powered test light to a circuit that has power applied to it.
3. Select two points within the circuit where there should be continuity.
4. Attach one lead of the test light to each point.
5. If there is continuity, the test light bulb will come on.
6. If there is no continuity, the test light bulb will not come on, indicating an open circuit.

### Ohmmeter

#### CAUTION

*To prevent damage to the ohmmeter, never connect it to a circuit that has power applied to it. Always disconnect the battery negative lead before using an ohmmeter.*

Use an ohmmeter to measure the resistance (in ohms) to current flow in a circuit or component.

Ohmmeters may be analog type (needle scale) or digital type (LCD or LED readout). Both types of ohmmeters have a switch that allows the user to select different ranges of resistance for accurate readings. The analog ohmmeter also has a set-adjust control, which is used to zero or calibrate the meter (digital ohmmeters do not require calibration). Refer to the ohmmeter's instructions to determine the correct scale setting.

Use an ohmmeter by connecting its test leads to the circuit or component to be tested. If an analog meter is used, it must be calibrated by touching the test leads together and turning

the set-adjust knob until the meter needle reads zero. When the leads are uncrossed, the needle should move to the other end of the scale, indicating infinite resistance.

During a continuity test, a reading of infinite resistance indicates an open in the circuit or component. A reading of zero indicates continuity, that is, there is no measurable resistance in the circuit or component. A measured reading indicates the actual resistance to current flow that is present in that circuit. Even though resistance is present, the circuit has continuity.

### Continuity test

Perform a continuity test to determine the integrity of a circuit, wire or component. A circuit has continuity if it forms a complete circuit; that is if there are no opens in either the electrical wires or components within the circuit. A circuit with an open, on the other hand, has no continuity.

This type of test can be performed with a self-powered test light or an ohmmeter. An ohmmeter gives the best results.

1. Disconnect the negative battery cable or disconnect the test circuit/component from its power source.
2. Attach one test lead (test light or ohmmeter) to one end of the part of the circuit to be tested.
3. Attach the other test lead to the other end of the part or the circuit to be tested.
4. The self-powered test light comes on if there is continuity. An ohmmeter reads 0 or low resistance if there is continuity. A reading of infinite resistance indicates no continuity; the circuit is open.
5. If testing a component, note the resistance and compare this to the specification if available.

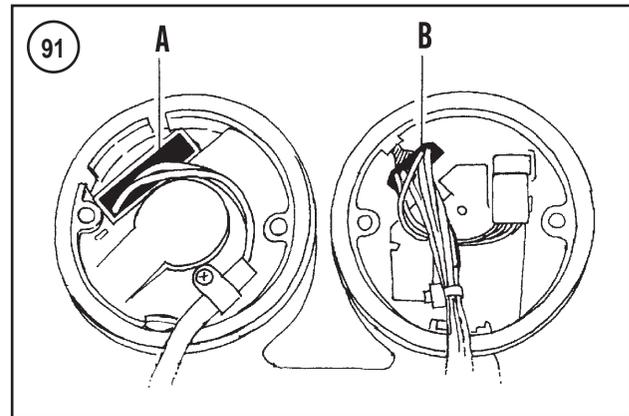
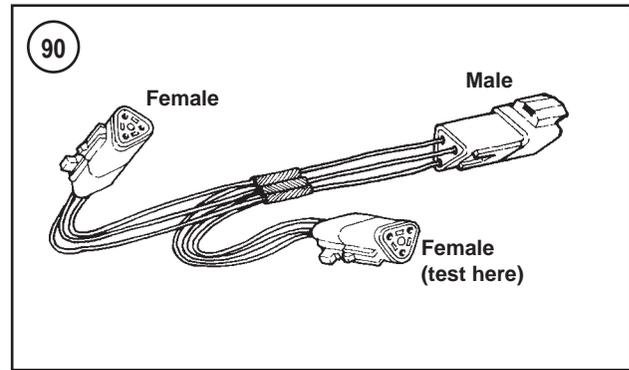
### Short test

An analog ohmmeter or one with an audible continuity indicator works best for short testing. A self-powered test light may also be used.

1. Disconnect the negative battery cable (Chapter Twelve).
2. If necessary, remove the blown fuse from the fuse panel (Chapter Twelve).
3. Connect one test lead of the ohmmeter to the load side (battery side) of the fuse terminal in the fuse panel.
4. Connect the other test lead to a confirmed ground location. Make sure the ground is not insulated. If possible, use the battery ground connection.
5. Wiggle the wiring harness relating to the suspect circuit at approximately 6 in. (15 cm) intervals. Watch the ohmmeter while progressing along the harness.
6. If the ohmmeter needle moves or the ohmmeter beeps, there is a short-to-ground at that point in the harness.

### Jumper Wire

Use a jumper wire to bypass a potential problem and isolate it to a particular point in a circuit. If a faulty circuit



works properly with a jumper wire installed, an open exists between the two jumped points in the circuit.

To troubleshoot with a jumper wire, first use the wire to determine if the problem is on the ground side or the load side of a device. Test the ground by connecting the wire between the lamp and a good ground. If the lamp comes on, the problem is the connection between the lamp and ground. If the lamp does not come on with the wire installed, the lamp's connection to ground is good, so the problem is between the lamp and the power source.

To isolate the problem, connect the wire between the battery and the lamp. If it comes on, the problem is between these two points. Next, connect the wire between the battery and the fuse side of the switch. If the lamp comes on, the switch is good. By successively moving the wire from one point to another, the problem can be isolated to a particular place in the circuit.

Note the following when using a jumper wire:

1. Make sure the wire gauge (thickness) is the same as that used in the circuit being tested. Smaller gauge wire rapidly overheats and could melt.
2. Make sure the jumper wire has insulated alligator clips. This prevents accidental grounding (sparks) or possible shock. Install an inline fuse/fuse holder in the jumper wire.
3. A jumper wire is a temporary test measure. Do not leave a jumper wire installed as a permanent solution. This creates a fire hazard.

## SPEEDOMETER DIAGNOSTIC CODES

Diagnostic code	Fault	Troubleshooting chart
d01	Speed sensor power output shorted low	<sup>1</sup> Figure 94 or Figure 96
d02	Speed sensor power output shorted high or open	<sup>1</sup> Figure 94 or Figure 96
d03	Not used	–
d04	Not used	–
d05	Speed sensor return shorted high	<sup>1</sup> Figure 94 or Figure 97
d06	Speed sensor return shorted low	<sup>1</sup> Figure 94 or Figure 97
d07	Not used	–
d08	Speedometer power overvoltage	<sup>1</sup> Figure 94 or Figure 97
d09	Speed sensor output shorted high	<sup>2</sup> Figure 100 or Figure 101
d10	Speed sensor output shorted low or open	<sup>2</sup> Figure 100 or Figure 101
CAL 14	Speedometer application calibration number for domestic (U.S. models)	–
CAL 15	Speedometer application calibration number for HDI models	–
5-digit number <sup>3</sup>	Speedometer pulses per unit after all does are displayed	–

1. Refer to Figure 94 for 1997-1998 models except late-model 1998 883 models. Refer to Figure 96 or Figure 97 for late model 1998 883 models and 1999 models.  
2. Refer to Figure 100 for 1997-1998 models except late-model 1998 883 models. Refer to Figure 101 for late model 1998 883 models and 1999 models.  
3. 2002-2003 models. Number will vary depending on part number.

4. Never use a jumper wire across any load (a component that is connected and turned on). This would cause a direct short and blow the fuse(s).

### ELECTRONIC SPEEDOMETER/TACHOMETER

Refer to the following procedures to troubleshoot problems related to the electronic speedometer/tachometer.

#### Tools

A speedometer test harness is required to troubleshoot the speed sensor. Fabricate the harness from one 3-pin Deutsch male connector, two 3-socket Deutsch female connectors, and 6-inch lengths of 18-gauge wire. Use three wires to connect the male connector to one of the female connectors and splice the second female connector to the wires. See **Figure 90**.

During testing, connect the harness between the two sides of the speed sensor connector when instructed to install the test harness. Probe the second female connector at the indicated test points.

#### Speedometer Diagnostics (1998 883 and All 1999-2003 Models)

The speedometer in 1999-2003 models and in some late-model 1998 883 models has a self-diagnostic function. This speedometer can be identified by its amber back light

and its 12-terminal connector on the back of the speedometer (A, **Figure 91**).

When in the diagnostic mode, the speedometer runs a series of tests and then displays the results of these tests as diagnostic codes.

To enter the diagnostic mode, perform the following:

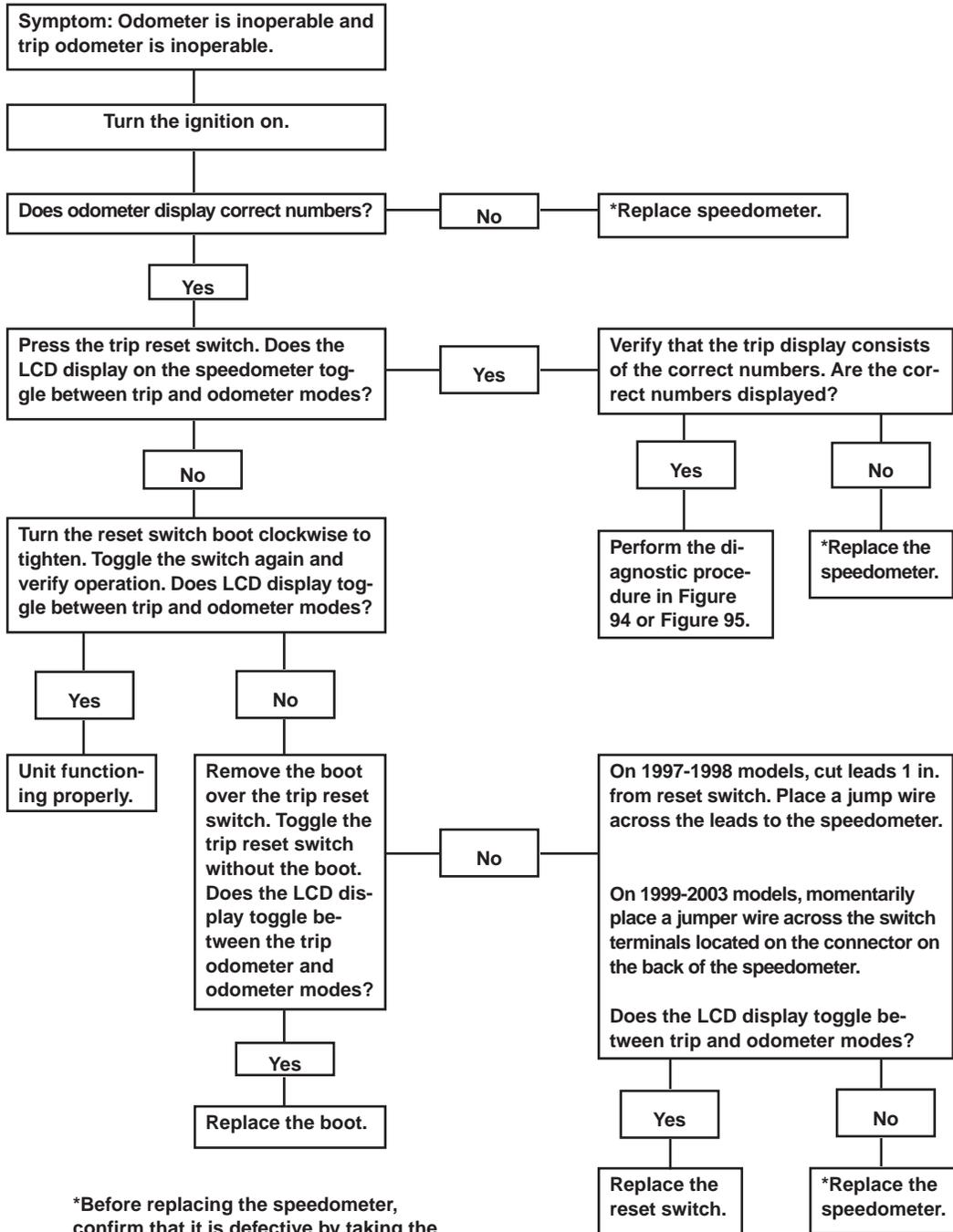
1. Press and hold the reset switch.
2. Turn the ignition on.
3. When you enter the diagnostic mode, the first code, d01, will appear in the odometer display followed by a status indicator, either SEt or CLr. For example: d01SEt indicates that code d01 has been set. The code d01CLr indicates d01 is clear.

#### NOTE

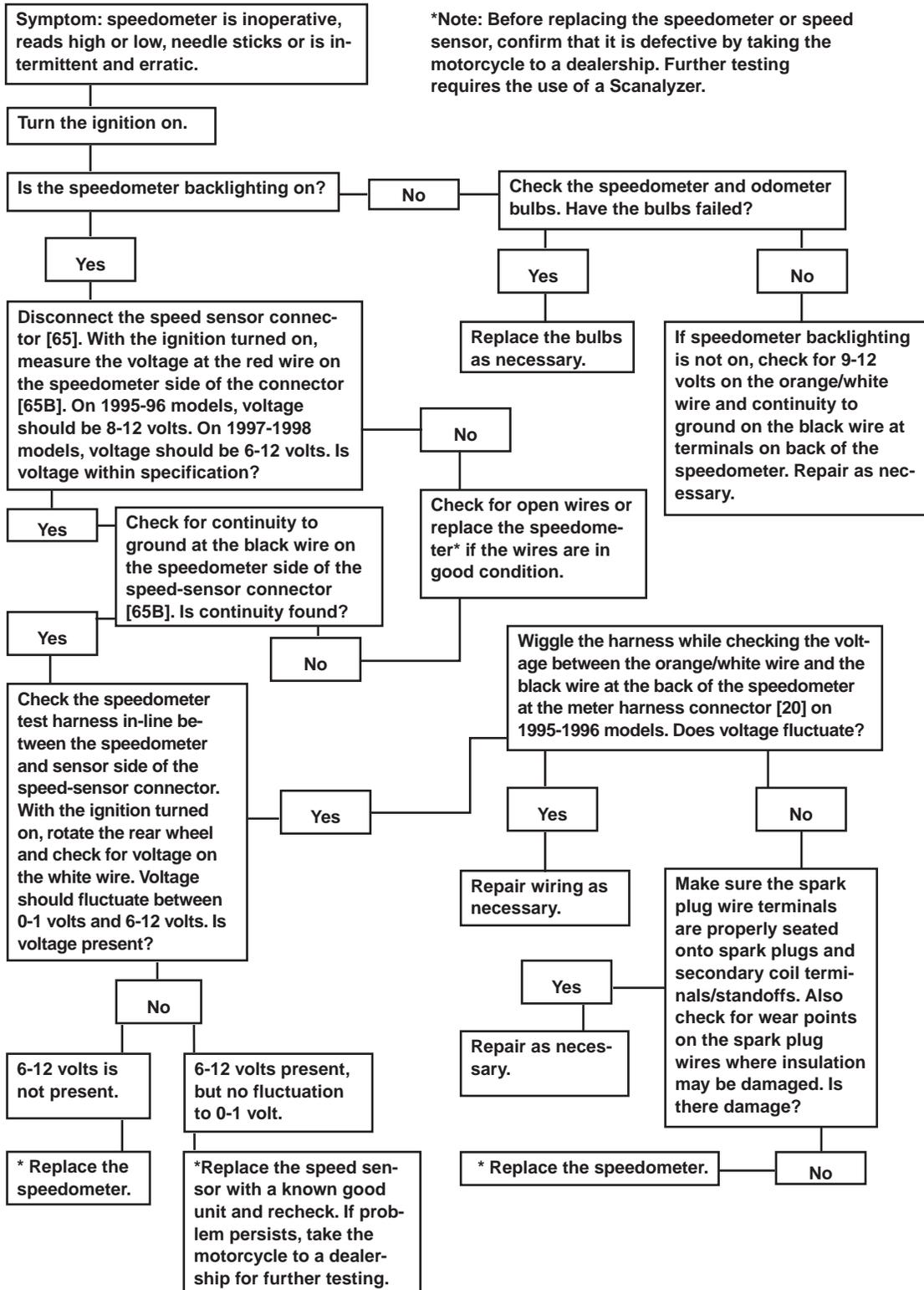
*When in the diagnostic mode never press the reset switch for more than five seconds. This erases all stored diagnostic codes.*

4. Briefly press the reset switch to display the next code and its status. Codes are displayed sequentially by code number.
5. Toggle through the codes one by one and note which codes have been set. When all codes have been displayed, the speedometer will display the calibration number (CAL 14 or CAL 15).
6. When a diagnostic code has been set, refer to the chart in **Figure 92** to identify the fault and appropriate troubleshooting chart (**Figures 93-97**).
7. Diagnostic codes are cleared whenever the reset switch is pressed and held for five seconds while the speedometer

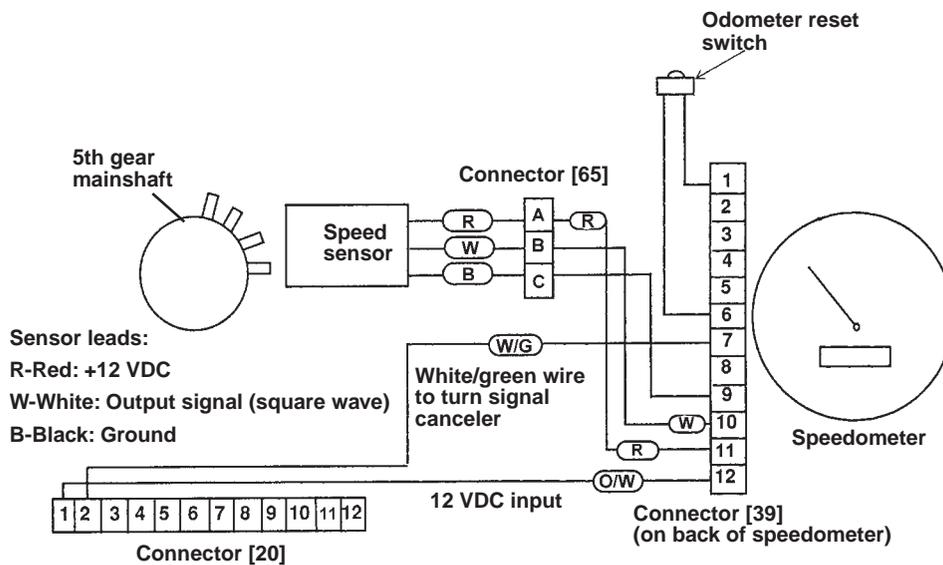
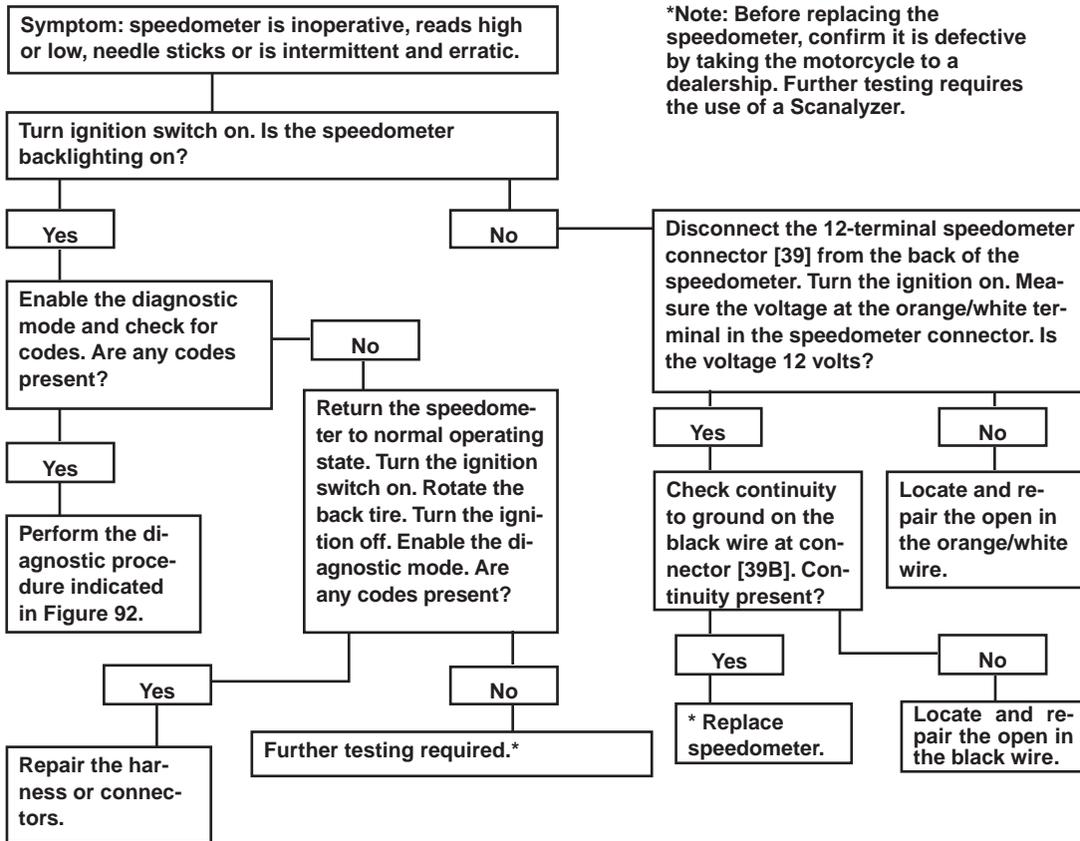
## ODOMETER, TRIP ODOMETER AND RESET SWITCH (1997-2003 MODELS)



## INOPERATIVE, INACCURATE OR ERRATIC SPEEDOMETER (1995-1998 MODELS EXCEPT LATE MODEL 1998 883 MODELS)

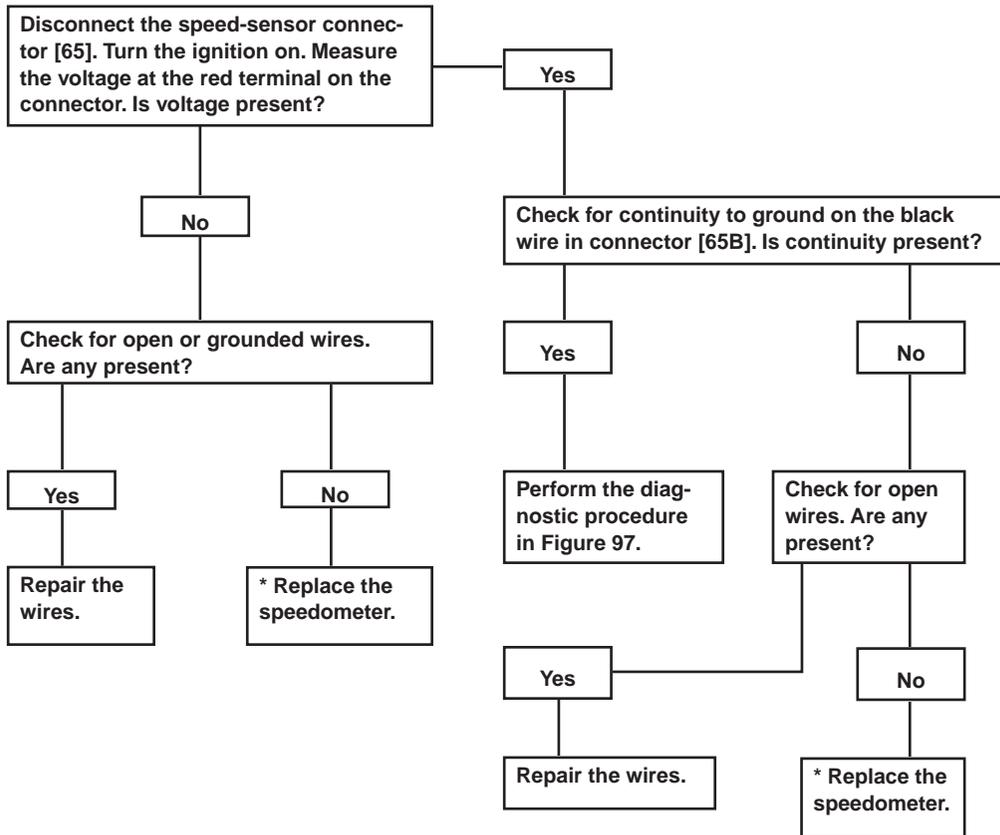


## INOPERATIVE, INACCURATE OR ERRATIC SPEEDOMETER (LATE-MODEL 1998 883 AND 1999-2003 MODELS)

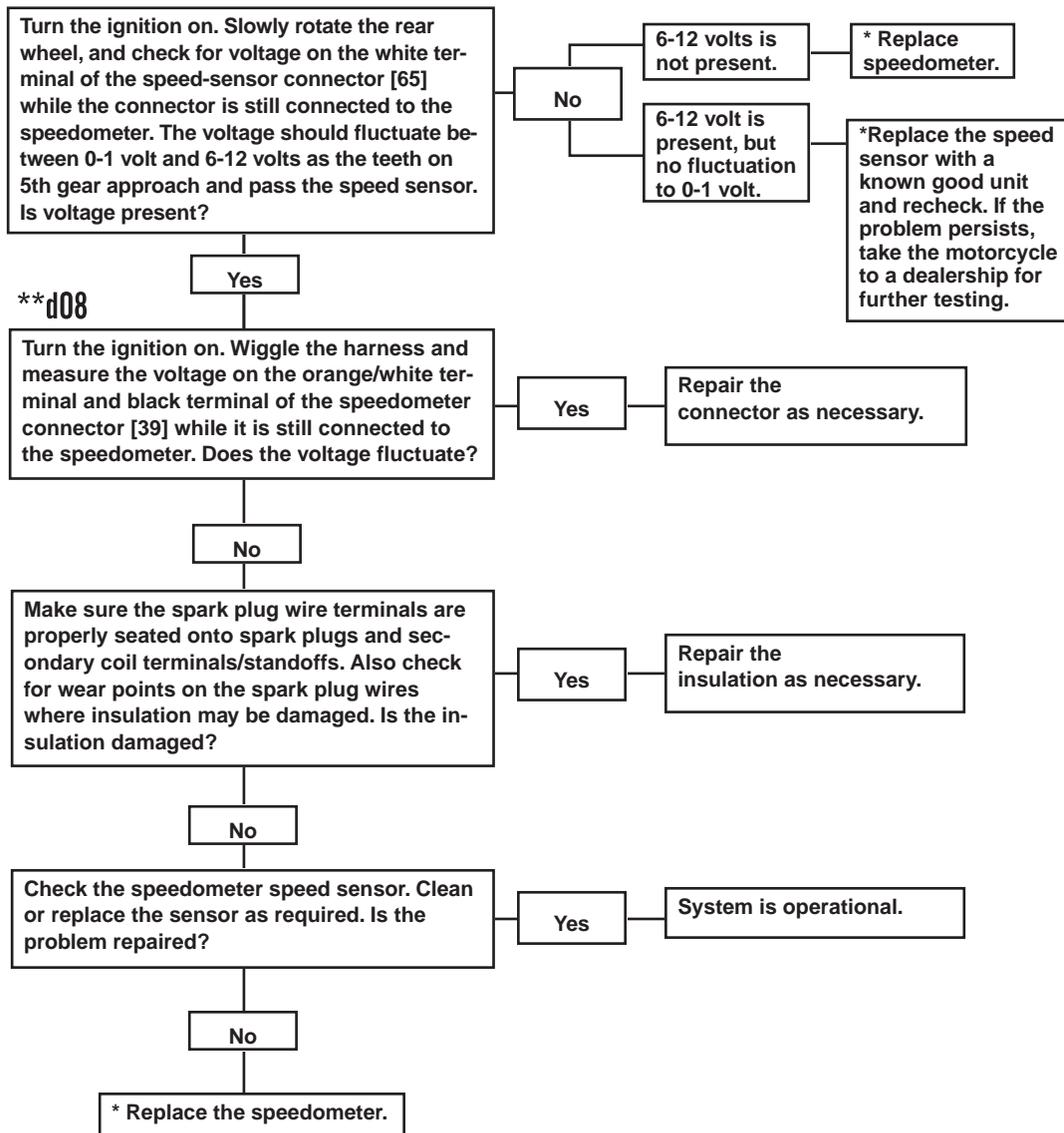


**SPEEDOMETER DIAGNOSTIC CODES d01 AND d02  
(LATE MODEL 1998 883 AND 1999-2003 MODELS)**

\*Note: Before replacing the speedometer, confirm that it is defective by taking the motorcycle to a dealership. Further testing requires the use of a Scanalyzer.



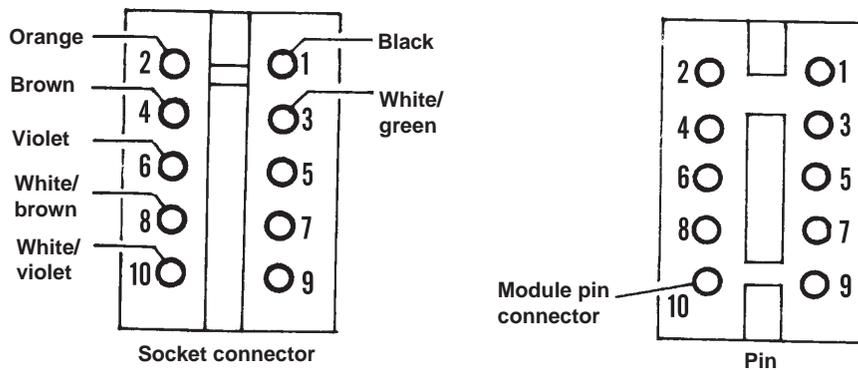
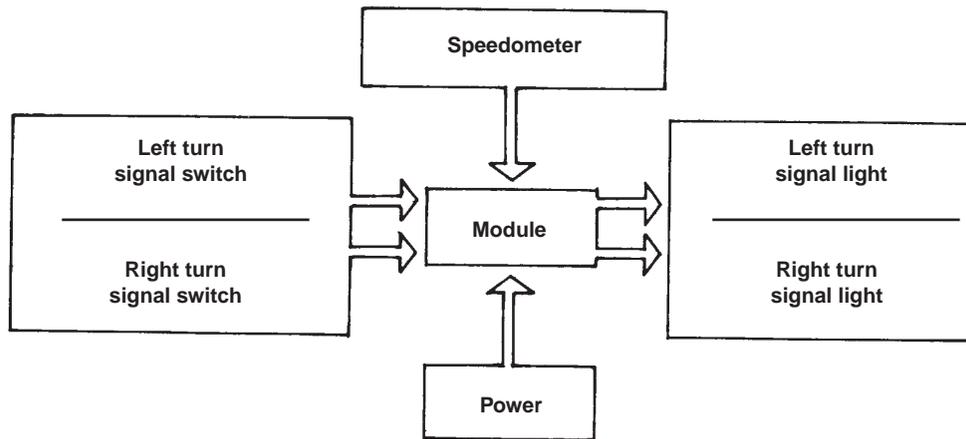
## SPEEDOMETER: DIAGNOSTIC CODES d05, d06 AND d08 (LATE MODELS 1998 883 AND 1999-2003 MODELS)



\*Note: Before replacing the speedometer or speed sensor, confirm it is defective by taking the motorcycle to a dealership. Further testing requires the Scanalyzer.

\*\*Begin troubleshooting diagnostic code d08 here.

### TURN SIGNAL MODULE CONNECTORS (1991-1993 MODELS)



is in the diagnostic mode. All codes will be cleared whether they have been displayed or not.

8. To exit the diagnostic mode, turn the ignition switch from on to off and then to on again. Do not press the reset switch while doing so. Diagnostic codes are also cleared when the vehicle speed reaches 5 mph.

#### Speedometer/Tachometer Troubleshooting (1995-1998 Models, Except 1998 883 Models)

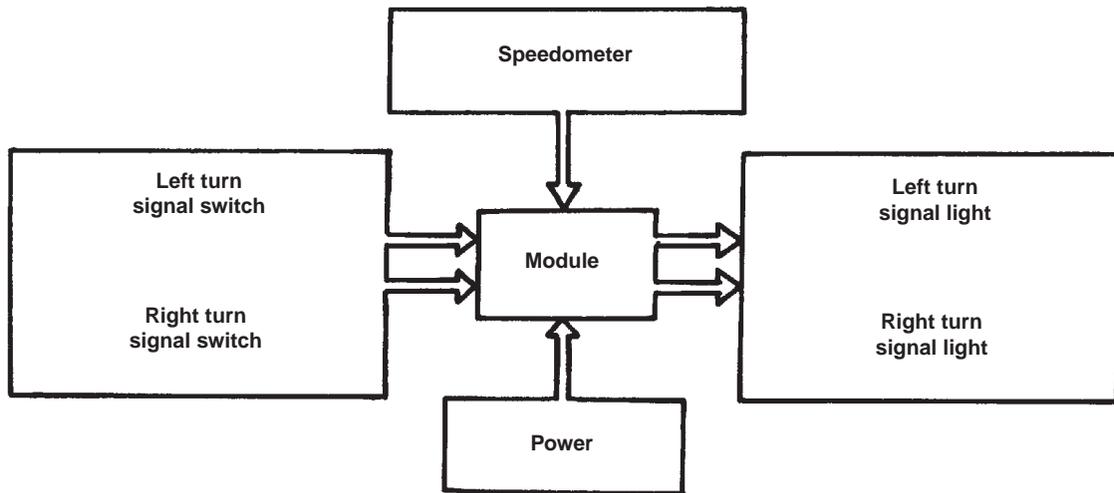
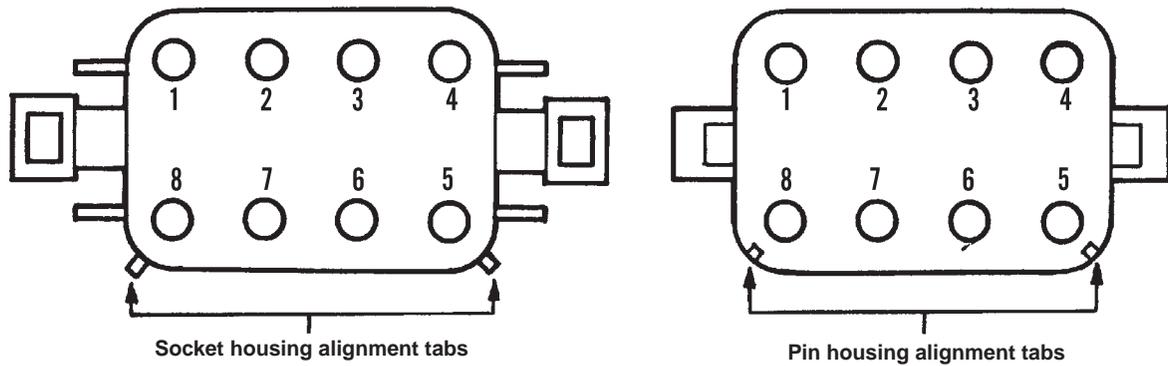
Find the symptom that best describes the condition in **Figure 93** or **Figure 94** and perform the indicated test procedures. Some test procedures, however, require the use of the speedometer tester (part No. HD-41354). Take the motorcycle to a dealership when indicated to do so in the troubleshooting chart.

#### TURN SIGNAL MODULE (1991-1996 MODELS)

##### Performance Test (1991-1993 Models)

If the turn signals are not working properly, perform the following performance test. A jumper wire, ohmmeter and voltmeter will be required.

1. Remove the turn signal module as described in Chapter Twelve.
2. After removing the module, identify the socket connector and module pin connectors using the diagram in **Figure 98**.
3. With ignition switch off, check for ground at pin No. 1.
4. Turn the ignition switch on.
5. Check for voltage at pin No. 2. Voltmeter should read 12 volts.
6. Connect a jumper wire between pins No. 2 and No. 4. The right front and rear turn signal lights should illuminate.

**TURN SIGNAL MODULE CONNECTORS (1994-1996 MODELS)**

Pin number	Wire color	Description/function
1	Black	Module ground to motorcycle
2	Orange/white	12vdc input from accessory circuit breaker
3	White/green	Speedometer reed switch input
4	Brown	Pulsed 12 vdc for flashing right turn signal lights
5	Violet	Pulsed 12 vdc for flashing left turn signal lights
6	White/brown	12 vdc from right turn signal switch (when pressed)
7	White/violet	12 vdc from left turn signal switch (when pressed)
8	–	Not used

7. Connect a jumper wire between pins No. 2 and No. 6. The left front and rear turn signal lights should illuminate.
8. Connect a jumper wire between pins No. 4 and No. 8 and depress the right turn signal switch button. The right front and rear turn signal lights should illuminate.
9. Connect a jumper wire between pins No. 6 and No. 10 and depress the left turn signal switch button. The left front and rear turn signal lights should illuminate.
10. Remove the jumper wire and turn the ignition switch off.
11. If the module passed all six tests, the module is serviceable. If the module failed one or more tests, refer to *Troubleshooting* in this section.

### Performance Test (1994-1996 Models)

If the turn signals are not working properly, perform the following performance test. A jumper wire, ohmmeter and voltmeter will be required.

1. Remove the turn signal module as described in Chapter Twelve.
2. After removing the module, identify the socket connector and module pin connectors using the diagram in **Figure 99**.
3. With ignition switch off, check for ground at pin No. 1.
4. Turn the ignition switch on.
5. Check for voltage at pin No. 2. Voltmeter should read 12 volts.
6. Connect a jumper wire between pins No. 2 and No. 4. The right front and rear turn signal lights should illuminate.
7. Connect a jumper wire between pins No. 2 and No. 5. The left front and rear turn signal lights should illuminate.

#### CAUTION

*Do not use a jumper on 1996 models in Steps 8 or 9. The turn signal switch will be damaged.*

- 8A. On 1994-1995 models, connect a jumper wire between pins No. 4 and No. 6 and depress the right turn signal switch button. The right turn signal lights should illuminate.
- 8B. On 1996 models, depress the right turn signal button and check for 12 volts at pin No. 6.
- 9A. On 1994-1995 models, connect a jumper wire between pins No. 5 and No. 7 and depress the left turn signal switch button. The Left turn signal lights should illuminate.
- 9B. On 1996 models, depress the left turn signal button and check for 12 VDC at pin No. 7.
10. Remove the jumper wire and turn the ignition switch off.
11. If the module passed all six tests, the module is serviceable. If the module failed one or more tests, refer to *Troubleshooting* in this section.

### Troubleshooting

The following troubleshooting procedures help isolate specific problems to the module. If it is necessary to access the turn signal module, remove it as described in Chapter Twelve.

Refer to **Figure 98** or **Figure 99** for socket and module pin connector identification.

#### *One or both turn signals do not flash. Light on front or rear side is lit, but does not flash*

1. Remove the lens and check for a burned out bulb. Replace bulb if necessary.
2. If the bulb is good, check for the following:
  - a. Check the bulb socket contacts for corrosion. Clean contacts and recheck. If corrosion consistently builds on the contacts, wipe the contacts with a dielectric grease before installing the bulb.
  - b. Check for a broken bulb wire. Repair the wire or connector.
  - c. Check for a loose bulb socket where it is staked to the housing. If the bulb socket is loose, replace the light assembly.
  - d. Check for a poor ground connection. If the ground is poor, scrape the ground mounting area or replace damaged ground wire(s), as required.

#### *Turn signals do not operate on one side*

1. Perform the checks listed under *One or both turns signals do not flash. Light on front or rear side is lit, but does not flash* in this section. If these checks do not locate the problem, proceed to Step 2.
2. Inoperative handlebar directional switch. Perform the following:
  - a. Turn the ignition switch on.
  - b. Disconnect the turn signal module electrical connector.
  - c. Locate pin No. 8 or No. 10 (1991-1993 models) or pin No. 6 or No. 7 (1994-1996 models) on the socket connector.
  - d. With a voltmeter set on the DC scale, connect the negative lead to a good ground and the positive lead to one of the pin numbers specified in substep c and press the turn signal switch. The voltmeter should read 12 volts when the switch is pressed in.
  - e. If there is a 12 volt reading, proceed to Step 3.
  - f. If there is no voltage reading, proceed to Step 4.
3. If 12 volts were recorded in Step 2, and the lights and connecting wires are in good condition, the module may be damaged. Replace the module and retest.
4. If no voltage was recorded in Step 2, check the handlebar switch and related wiring for damage. Further tests can be made by performing continuity and voltage checks.
5. Reconnect the turn signal module electrical connector.

### *Turn signals/hazard lights do not operate on both sides*

1. If none of the turn signals or hazard flashers operate, check the turn signal module for proper ground with an ohmmeter. Using the wiring diagram at the end of this manual, trace the ground connection from the module to the frame tab. If a ground is not present, remove the ground wire at the frame and scrape the frame and clean the connector. Check the ground wire for breaks. Repair as required. If a ground is present, perform Step 2.

#### **CAUTION**

*Do not operate the module without pin No. 1 grounded. Otherwise, the module will burn out.*

2. Refer to the appropriate wiring diagram and locate the accessory circuit breaker. Turn the ignition switch on and check for voltage on the hot or load side of the circuit breaker with a voltmeter. If there is no voltage, refer to Chapter Twelve and check the following components:

- a. Accessory circuit breaker.
- b. Main circuit breaker.
- c. Starter relay.
- d. Ignition switch.
- e. Circuit wiring.

### *Turn signals do not cancel*

1. Support the motorcycle so that the front wheel clears the ground.

2A. On 1994 models, connect an ohmmeter to the speedometer white/green wire and ground. Spin the front wheel and watch the ohmmeter scale. The ohmmeter should alternate between 0 ohms and infinity.

- a. If ohmmeter reading is correct, disconnect the module pin connector. With a voltmeter set on the DC scale, connect the negative lead to a good ground and the positive lead to the No. 3 pin (white/green) socket connector. The voltmeter should read 12 volts. If ohm and volt readings are correct, the module is damaged.
- b. If ohmmeter reading is incorrect, check for damaged wiring from the speedometer white/green wire to the module. If wiring is okay, the reed switch in the speedometer may be damaged.

2B. On 1995-1996 models, set a voltmeter to the DC scale. Connect the positive meter lead to pin 3 and connect the negative meter lead to a good ground. Turn the ignition on and spin the rear wheel. The voltmeter readings should alternate between 0-1 volts and 8-12 volts. If the voltage is within specification, replace the turn signal module. If the readings are not within specification, check the speedometer wiring and the speedometer.

## **TURN SIGNAL MODULE (1997-2003 MODELS)**

Use the following troubleshooting charts (**Figures 100-103**) to help isolate specific turn signal problems. Find the particular symptom and follow the procedures until the problem is corrected. If it is necessary to access the turn signal module, remove it as described in Chapter Twelve.

The troubleshooting charts refer to various connectors by code numbers. The connectors are identified in the wiring diagrams located at the end of this manual.

Refer to **Figure 104** to identify the socket and pin connectors in the turn signal module connector.

## **EXCESSIVE VIBRATION**

Excessive vibration is usually caused by loose engine mounting hardware. High speed vibration may be due to a bent axle shaft or loose or faulty suspension components. Vibration can also be caused by the following conditions:

1. Improperly balanced wheel(s).
2. Defective or damaged tire(s).
3. Defective or damaged wheel(s).
4. Tight primary chain links.
5. Severely worn primary chain.
6. Loose or damaged engine mounting bracket.
7. Internal engine wear or damage.
8. Broken frame.

## **FRONT SUSPENSION AND STEERING**

Poor handling may be caused by improper tire pressure, a damaged or bent frame or front steering components, worn wheel bearings or dragging brakes.

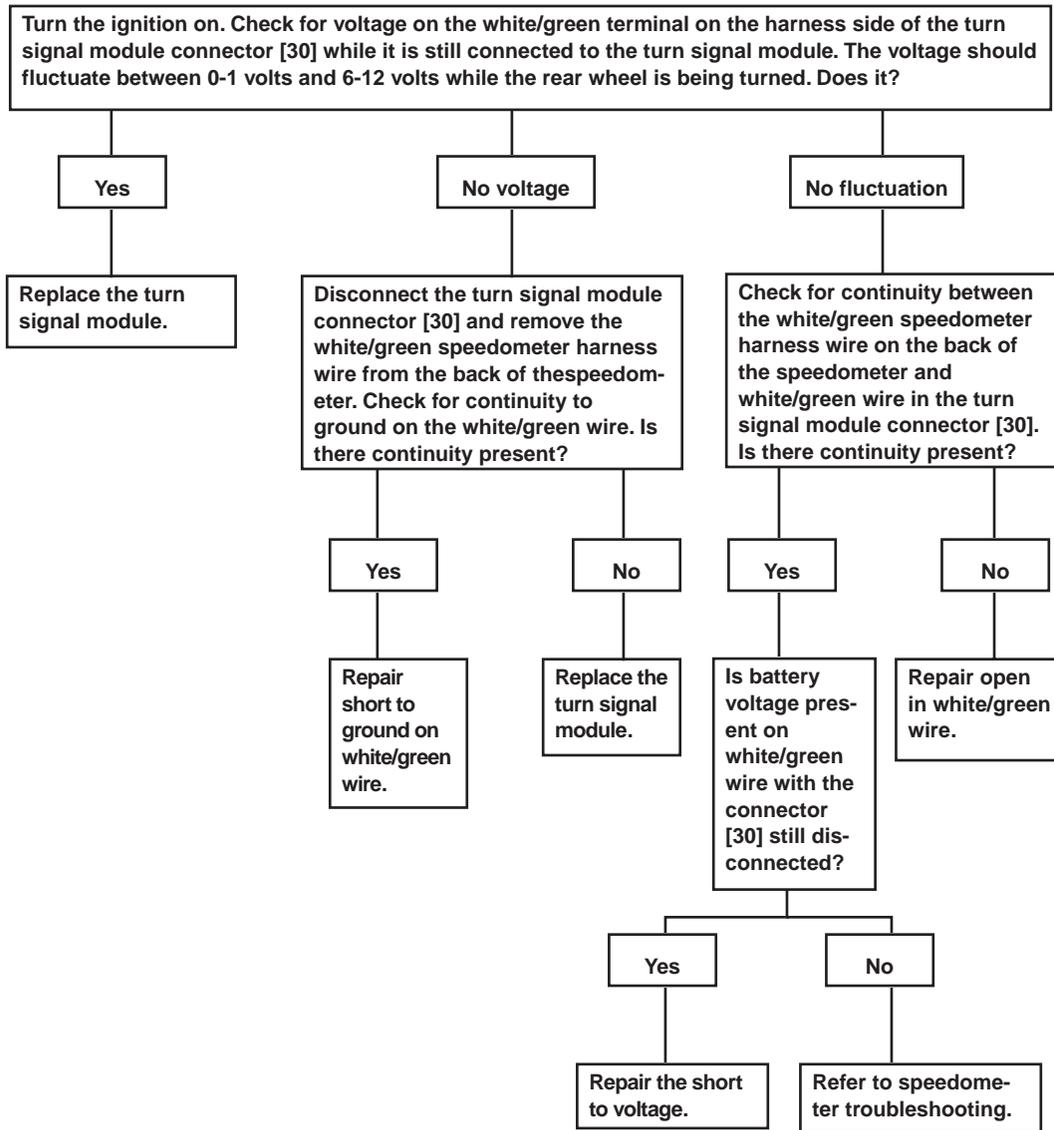
### **Irregular or Wobbly Steering**

1. Loose wheel axle nut(s).
2. Loose or worn steering head bearings.
3. Excessive wheel hub bearing play.
4. Damaged cast wheel.
5. Spoke wheel out of alignment.
6. Unbalanced wheel assembly.
7. Worn hub bearings.
8. Incorrect wheel alignment.
9. Bent or damaged steering stem or frame (at steering neck).
10. Tire incorrectly seated on rim.
11. Excessive front end loading from non-standard equipment.

### **Stiff Steering**

1. Low front tire air pressure.
2. Bent or damaged steering stem or frame at the steering neck.

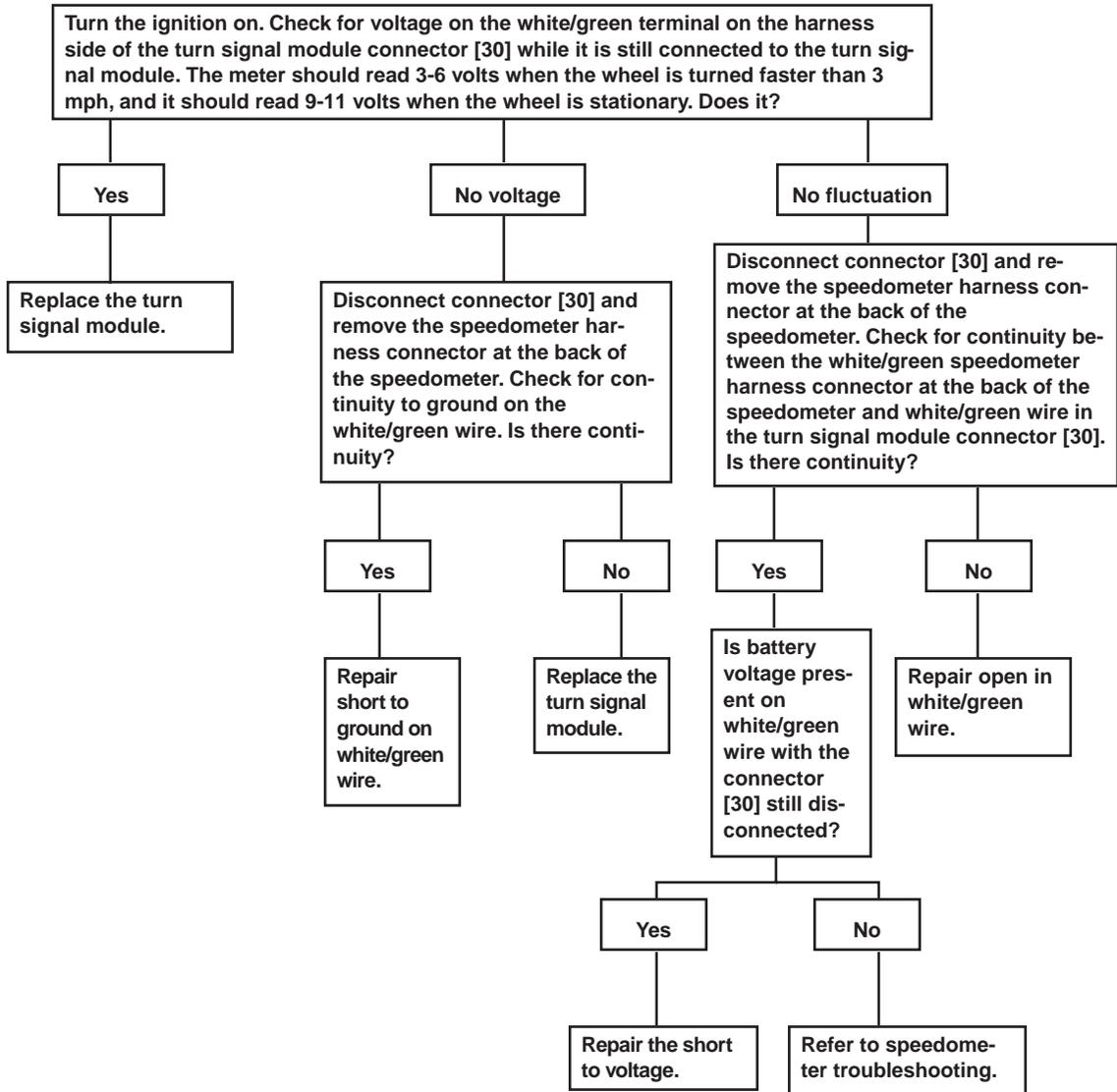
## TURN SIGNALS WILL NOT CANCEL (1997-1998 MODELS, EXCEPT LATE-MODEL 1998 833 MODELS)\*



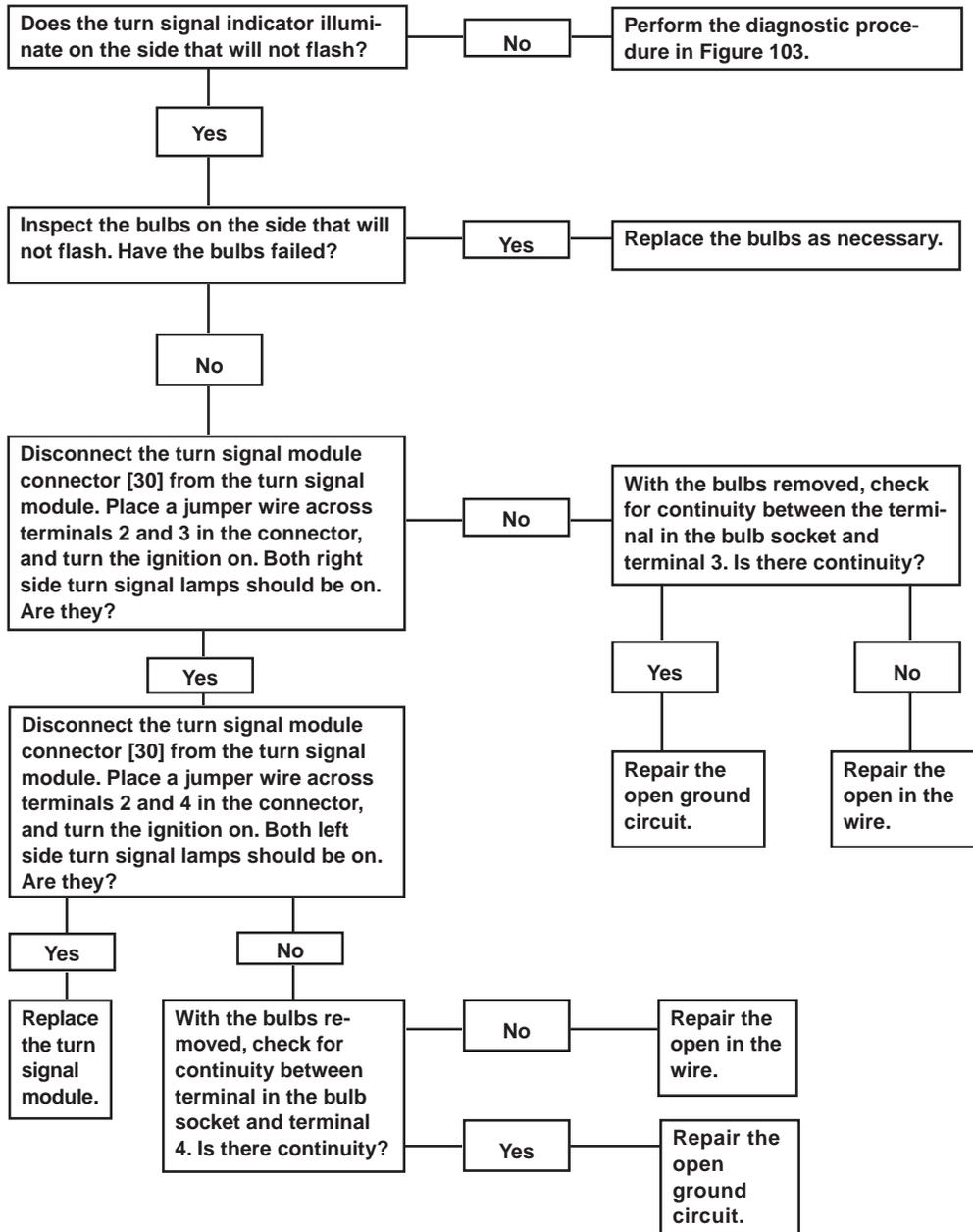
\*Late model 1998 883 models are equipped with a speedometer featuring self-diagnostic capabilities.

## TURN SIGNALS WILL NOT CANCEL (LATE MODEL 1998 883CC AND 1999-2003 MODELS)

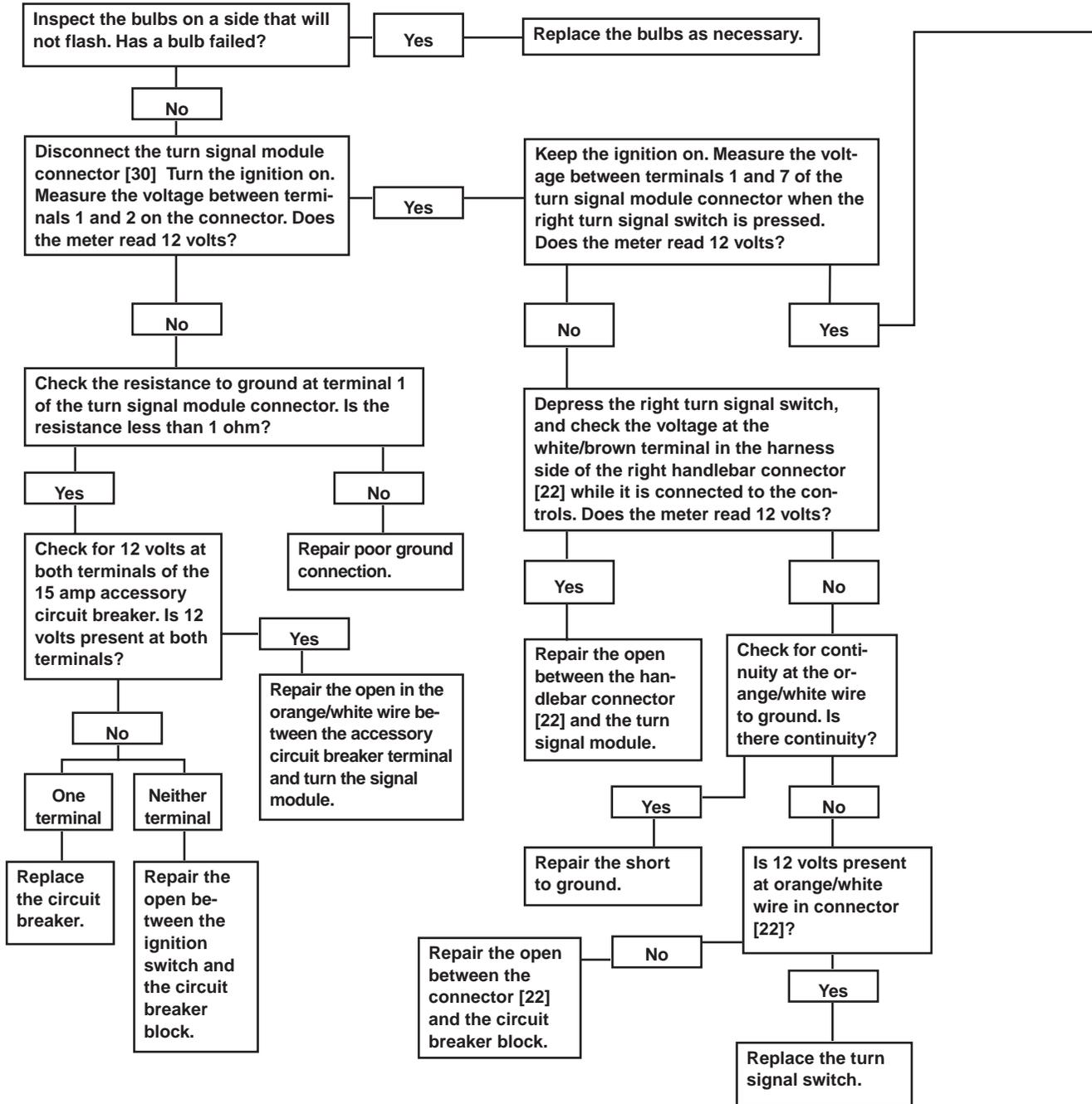
Use this chart for speedometer trouble codes 9 (speed output shorted high) and 10 (speed output shorted low or open).

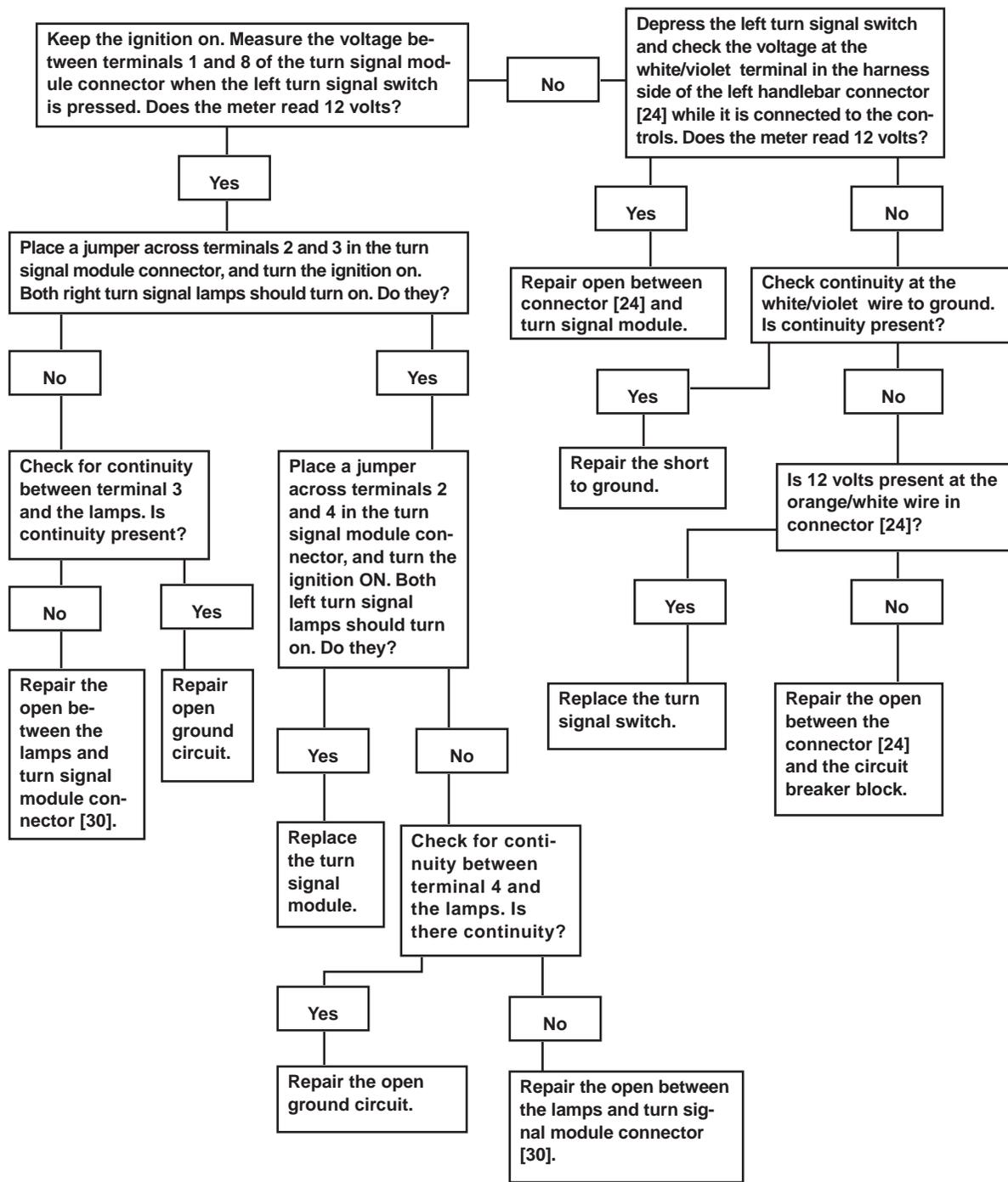


**TURN SIGNALS WILL NOT FLASH RIGHT, WILL NOT FLASH LEFT  
(1997-2003 MODELS, EXCEPT LATE-MODEL 1998 883 MODELS)**

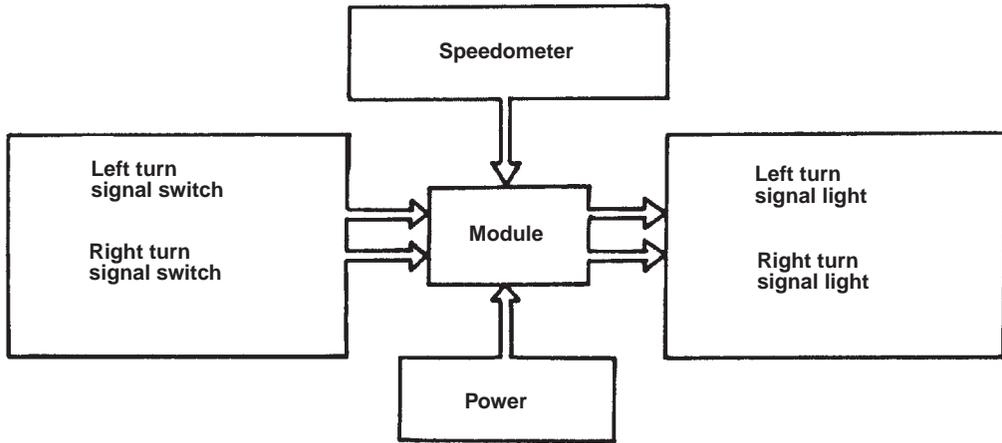
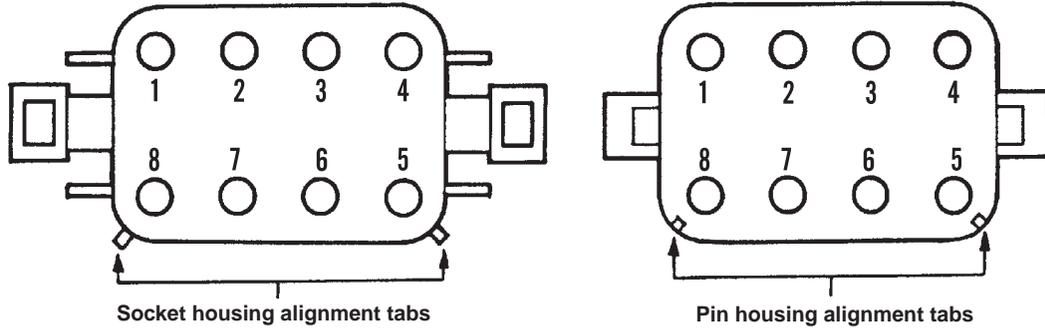


**TURN SIGNALS WILL NOT FLASH, 4-WAY FLASHES INOPERABLE**





**TURN SIGNAL MODULE CONNECTORS  
(1994-2003 MODELS)**



Pin number	Wire color	Description/function
1	Black	Module ground to motorcycle
2	Orange/white	12vdc input from accessory circuit breaker
3	White/green	Speedometer reed switch input
4	Brown	Pulsed 12 vdc for flashing right turn signal lights
5	Violet	Pulsed 12 vdc for flashing left turn signal lights
6	-	Not used
7	White/brown	12 vdc from right turn signal switch (when pressed)
8	White/violet	12 vdc from left turn signal switch (when pressed)

3. Loose or worn steering head bearings.

### **Stiff or Heavy Fork Operation**

1. Incorrect fork oil viscosity.
2. Excessive amount of fork oil.
3. Bent fork tubes.
4. Incorrect fork springs.

### **Poor Fork Operation**

1. Low fork oil level
2. Contaminated fork oil.
3. Worn or damaged fork tubes.
4. Bent or damaged fork tubes.
5. Incorrect fork springs.
6. Heavy front end loading from non-standard equipment.

### **Poor Rear Shock Absorber Operation**

1. Rear shocks adjusted incorrectly.
2. Incorrect loading.
3. Heavy rear end loading from non-standard equipment.
4. Weak or worn springs.
5. Damper unit leaking.
6. Shock shaft worn or bent.
7. Incorrect rear shock springs.

## **BRAKE PROBLEMS**

All models are equipped with front and rear disc brakes. Perform the maintenance specified in Chapter Three to minimize brake system problems. Brake system service is covered in Chapter Sixteen. When refilling the front and rear master cylinders, use only DOT 5 silicone-based brake fluid.

### **Insufficient Braking Power**

Worn brake pads or disc, air in the hydraulic system, glazed or contaminated pads, low brake fluid level, or a leaking brake line or hose can cause this problem. Visually check for leaks. Check for worn brake pads. Also check for a leaking or damaged primary cup seal in the master cylinder. Bleed and adjust the brakes. Rebuild a leaking master cylinder or brake caliper. Brake drag will result in excessive heat and brake fade. See *Brake Drag* in this section.

### **Spongy Brake Feel**

This problem is generally caused by air in the hydraulic system. Bleed and adjust the brakes as described in Chapter Sixteen.

### **Brake Drag**

Check brake adjustment. Check for insufficient brake pedal and/or hand lever free play. Also check for worn, loose or missing parts in the brake calipers. Check the brake disc for warp or excessive runout.

### **Brakes Squeal or Chatter**

Check brake pad thickness and disc condition. Make sure that the pads are not loose. Check that the anti-rattle springs are properly installed and in good condition. Clean off any dirt on the pads. Loose components can also cause this. Check for:

1. Warped brake disc.
2. Loose brake disc.
3. Loose caliper mounting bolts.
4. Loose front axle nut.
5. Worn wheel bearings.
6. Damaged hub.

**Table 1 and Table 2 are on the following page.**

**Table 1 STARTER SPECIFICATIONS**

<b>Current draw</b>	
Normal	160-200 amps
Maximum	250 amps
Maximum no-load current @ 11.5 volts	90 amps
Minimum no-load speed @ 11.5 volts	3000 rpm

**Table 2 ELECTRICAL SPECIFICATIONS**

<b>Alternator</b>	
Stator coil resistance	0.2-0.4 ohms
AC voltage output	19-26 Vac per 1000 rpm
Battery capacity	12 volt, 19 amp hr.
<b>Ignition coil</b>	
Primary resistance	
1200S models	0.4-0.6 ohms
All other models	2.5-3.1 ohms
Secondary resistance	
1986-1992 models	11,250-13,750 ohms
1993-2003 models	
1200S models	11,700-12,700 ohms
All other models	10,000-12,500 ohms
<b>Spark plug cable resistance (1998-2003 1200S)</b>	
Front left cable (No. 1)	5039-11,758 ohms
Rear center cable (No.2)	4665-10,886 ohms
Rear left cable (No. 3)	5787-13,504 ohms
Front center cable (No. 4)	4882-11,392 ohms
<b>Voltage regulator</b>	
Voltage output	
1986-1993 models	13.8-15 VDC @ 75° F (24° C)
1994-2003 models	14.3-14.7 VDC @75° F (24° C)
Amps @ 3600 rpm	
1986-1990 models	19 amps
1991-2003 models	22 amps