2006 VRSC MODELS

SERVICE MANUAL

Part Number 99501-06A

VRSCSE2 SERVICE SUPPLEMENT

Part Number 99525-06

ELECTRICAL DIAGNOSTICS

Part Number 99499-06A

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COOLING SYSTEM 6

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Table 6-1. Capacities

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Engine coolant	2.4	2.54
Engine oil w/filter	4.3	4.5

Table 6-2. Coolant Pressure

ITEM	KPA	PSI
Cap lower limit	96	14
Rated cap pressure	110	16
Cap upper limit	124	18
System pressure	103	15

Table 6-3. Coolant Temperatures

ITEM	˚C	˚F
Thermostat initially opens	85	185
Thermostat fully open	100	212
Engine temperature lamp	117	243
Antifreeze protection	- 36.7	- 34

Table 6-4. Fan Operation

STATUS	˚C	˚F
On	103	217
Off	98	208

TORQUE VALUES

ITEM	TORQUE		NOTES
Radiator drain plug	2.3-2.8 Nm	21-24 **in-lbs**	Hand tighten, page 6-9
Front cylinder coolant drain plug	9.7 Nm	86 **in-lbs**	page 6-9
Air bleed plug	9-11 Nm	80-97 **in-lbs**	page 6-9
Radiator drain plug	2.3-2.8 Nm	21-24 **in-lbs**	Hand tighten, page 6-10
Thermostat housing fasteners	9.7 Nm	86 **in-lbs**	page 6-11
Pipe connection clamp	6-10 Nm	53-88 ft-lbs	page 6-11
Air bleed plug	9-11 Nm	80-97 **in-lbs**	page 6-11
Radiator drain plug	2.3-2.8 Nm	21-24 **in-lbs**	Hand tighten, page 6-12
Water pump mounting fasteners	9.7 Nm	86 **in-lbs**	page 6-13
Hose clamp - bright	3-4 Nm	27-35 **in-lbs**	page 6-13
Hose cover	3-4 Nm	27-35 **in-lbs**	page 6-13
Air bleed plug	9-11 Nm	80-97 **in-lbs**	page 6-13
Coolant hose clamps	3-4 Nm	27-35 **in-lbs**	page 6-16
P-clamp	6-10 Nm	53-88 **in-lbs**	page 6-16
Pipe clamp	6.5 Nm	57 **in-lbs**	page 6-16
Air bleed plug	9-11 Nm	80-97 **in-lbs**	page 6-16
Oil line fittings	40-44 Nm	29-32 ft-lbs	page 6-19
Cross member fasteners	20-26 Nm	15-19 ft-lbs	page 6-22
Top radiator mounting nuts	19-27 Nm	15-20 ft-lbs	page 6-22
Pipe clamp	6.5 Nm	57 **in-lbs**	page 6-22
P-clamp	6-10 Nm	53-88 **in-lbs**	page 6-22

ITEM	TORQUE		NOTES
Radiator hose clamps	3-4 Nm	27-35 **in-lbs**	page 6-22
Oil cooler to radiator	8-10 Nm	71-88 **in-lbs**	page 6-26
Radiator oil line bracket	5-7 Nm	43-62 **in-lbs**	page 6-26
Oil line manifolds to oil cooler fasteners	8-10 Nm	71-88 **in-lbs**	page 6-26

COOLANT FLOW 6.2

GENERAL

The VRSC engine is cooled by a an ethylene-glycol coolant and the lubricating engine oil.

The ethylene-glycol coolant is pressurized and circulated through the engine and a cooling radiator by an impeller type water pump utilizing a thermostat controlled bypass.

The coolant pressure determines the coolant boiling point. The boiling point rises as the pressure increases and drops as the pressure decreases. At the rated system pressure of 103 kPa (15 psi), the boiling point rises to over 121˚ C (250˚ F).

The engine oil also cools the engine. Specifically, an oil jet under each piston sprays a mist of oil to lower the operating temperature of that piston. See 3.4 OIL FLOW.

FLOW DESCRIPTION

See Figure 6-1. To warm the engine up quickly, the ethylene-glycol coolant is re-circulated through the cylinders (13) and combustion chamber (12) in the cylinder heads. The thermostat (4) blocks the passage to the radiator (11) to recirculate the coolant.

As coolant exits the pump (3), it flows through the crankcase and around the cylinder liners (13) removing the heat build-up caused by the motion of the piston rings. From the cylinder liners (13), the coolant flows up through the cylinder head and around the exhaust valves and combustion chamber (12). After the coolant passes around the combustion chamber (12), it then flows back through the closed thermostat (4) into the pump (3) to repeat the cycle. This flow continues until the coolant reaches 85˚ C (185˚ F) and the thermostat (4) opens.

Once the coolant exceeds 100˚ C (212˚ F), the thermostat (4) remains open and blocks the by-pass between the entrance and exit ports of the case.

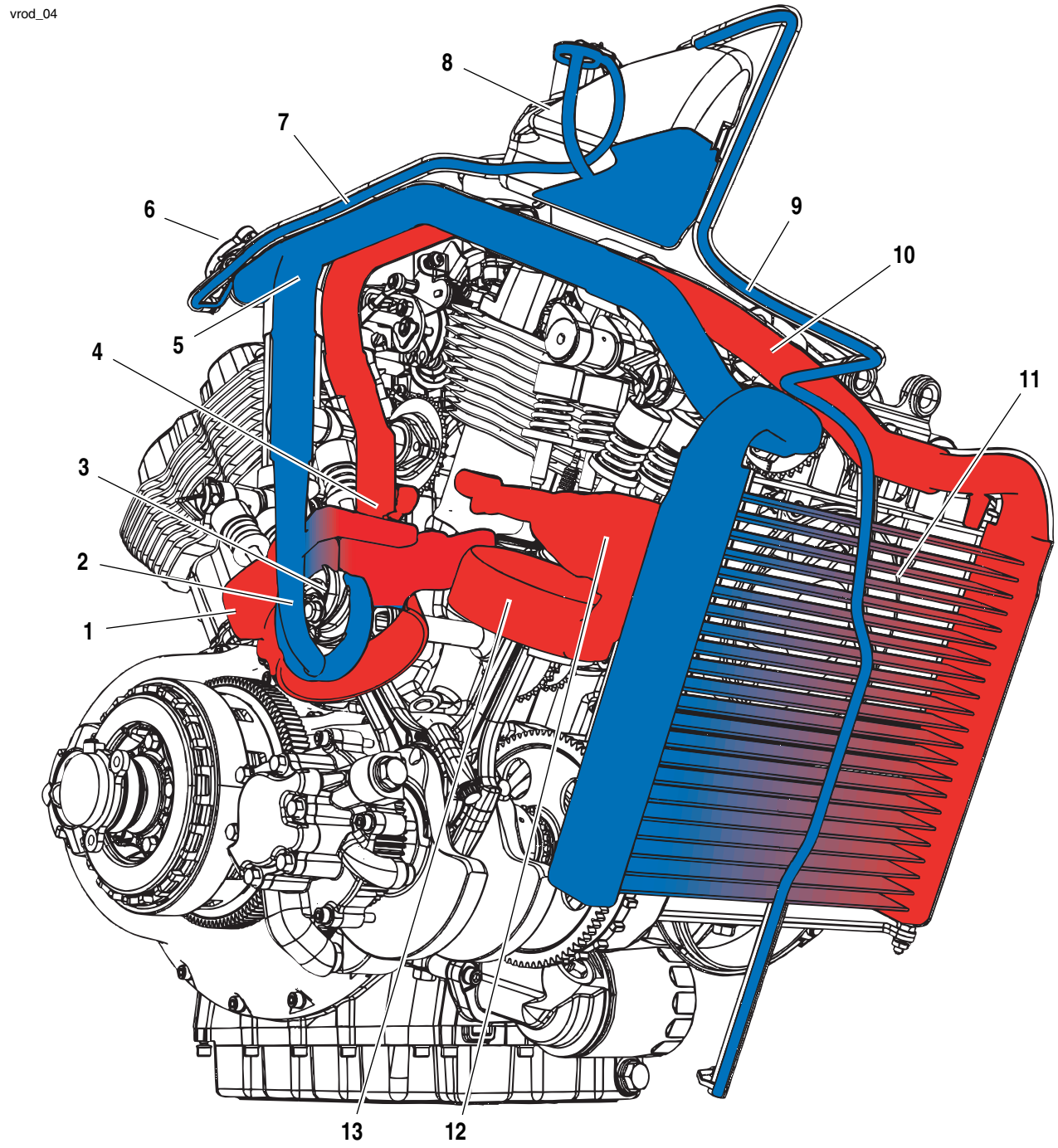
An engine coolant temperature (ECT) sensor is mounted to the thermostat (4). If the temperature should exceed 117˚ C (243˚ F), the engine coolant temperature indicator on the instrument cluster will illuminate.

After the coolant leaves the cylinder heads, it flows through the radiator coolant inlet pipe (5) to the radiator (11). The ethylene-glycol is cooled as it flows through the radiator (11) from left to right.

To increase the amount of air flowing through the radiator (11), two cooling fans will turn on when the coolant temperature exceeds 103˚ C (217˚ F) and will turn off when the temperature drops below 98˚ C (208˚ F).

The coolant exits the top right of the radiator (11) and flows through the radiator outlet coolant pipe (10) to the coolant pump (3) inlet.

The pressure cap (6) and radiator filler neck pressurize the coolant system. When the coolant pressure exceeds the pressure cap (6) lower limit of 96 kPa (14 psi), the lower valve opens and the excess pressure and expanded coolant flow to the overflow bottle (8) through the overflow tube (7). The overflow bottle (8) is vented to the atmosphere through a long tube (9) which loops over the top of the radiator/oil cooler assembly and down below the coolant level. When the pressure drops, the pressure cap (6) vacuum valve opens to draw coolant back into the coolant inlet pipe (5) from the overflow bottle (8).



1. Red - hot coolant
2. Blue - cooled coolant
3. Water pump
4. Thermostat
5. Coolant inlet pipe
6. Pressure cap
7. Overflow tube
8. Overflow bottle
9. Overflow bottle vent tube
10. Coolant outlet pipe
11. Radiator
12. Combustion chamber coolant passages
13. Cylinder coolant passages

Figure 6-1. Engine Coolant Flow

TROUBLESHOOTING

⚠ WARNING

The troubleshooting section of this manual is a guide to diagnose problems. read the appropriate sections of this manual before performing any work. Improper repair and/ or maintenance could result in death or serious injury.

Low Engine Temperature

1. Open thermostat.
2. Defective engine coolant sensor.
3. Defective cooling fan.

High Engine Temperature

1. Stuck thermostat.
2. Blocked hoses, pipes or passages.
3. Defective cooling fan.
4. Faulty water pump.
5. Low coolant level.
6. Air in hoses, pipe or passages.
7. Defective pressure cap.
8. Defective engine coolant sensor.

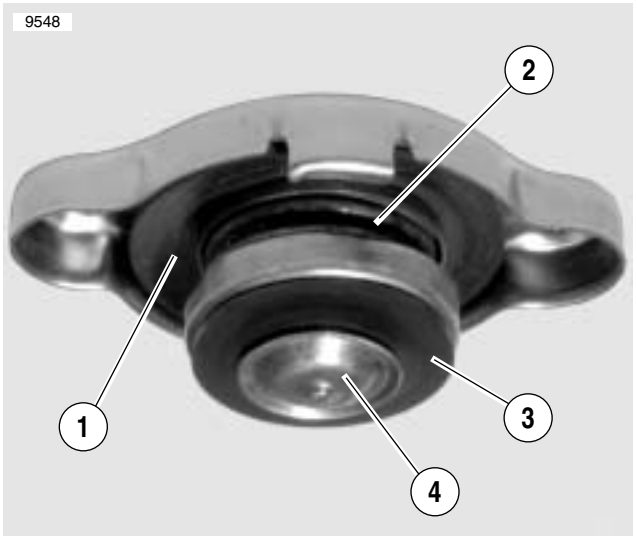
Coolant Leaks

1. Damaged pressure cap gasket.
2. Faulty water pump.
3. Deteriorated O-rings on water pump.
4. Damaged engine gasket.
5. Leaking hose or hose connection.

PRESSURE CAP

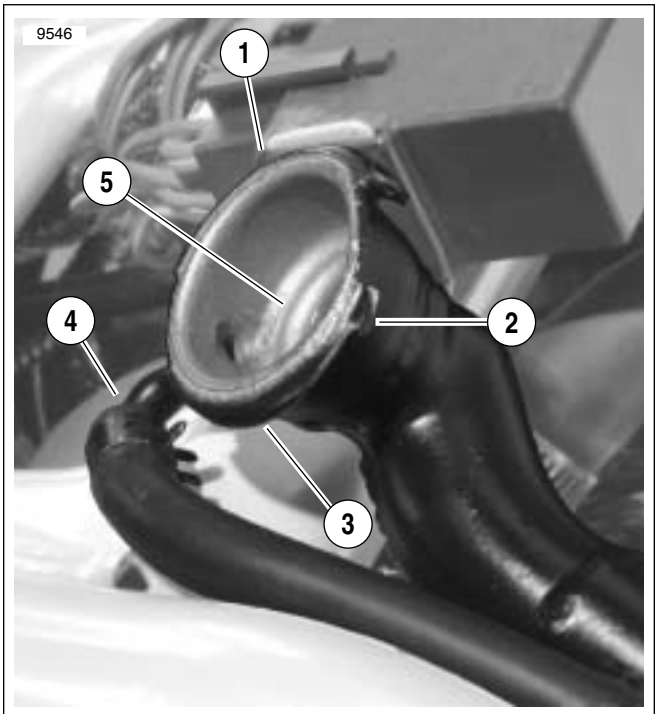
The pressure cap and radiator filler neck pressurize the coolant system. The pressure cap's upper spring diaphragm gasket seals to the upper sealing seat in the filler neck. The lower pressure limiting valve in the pressure cap seals to the lower seat. The filler neck has an overflow tube between and upper and lower sealing seat.

Rising pressure compresses the spring and the lower valve opens. Excess pressure and expanded coolant flow to the overflow bottle through the overflow tube. When the pressure drops, the vacuum valve opens to draw coolant back into the radiator through the overflow tube from the overflow bottle.



1. **Upper sealing gasket**
2. **Spring diaphragm**
3. **Lower sealing gasket**
4. **Vacuum valve**

Figure 6-2. Pressure Cap



1. **Upper sealing seat**
2. **Safety stop**
3. **Cam**
4. **Overflow tube**
5. **Lower sealing seat**

Figure 6-3. Filler Neck

PRESSURE CAP TEST

PART NO.	SPECIALTY TOOL
HD-45335	Coolant system pressure tester

The pressure cap should be tested for the correct operating range every time the antifreeze is changed or any cooling system maintenance performed.

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. See Figure 6-3. Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop (2). Let pressure escape. Press down and turn cap to pass over safety stops and remove.
2. Inspect cap for gasket deterioration and broken springs.
3. Turn butterfly valve parallel to boss on COOLANT SYSTEM PRESSURE TESTER (HD-45335) tester head and turn pressure cap adapter onto tester head. Turn butterfly valve perpendicular to seal tester head.

NOTE

To test new caps, wet the upper sealing gasket before turning onto adapter.

4. Turn pressure cap onto adapter. Rotate to safety stops.
5. See Figure 6-4. Pump handle to pressurize pressure limiting valve in cap. Stop pumping when pressure valve in cap opens.
6. Replace pressure cap if:
   a. Leaks below low limit, 96 kPa (14 psi).
   b. Opens above high limit, 124 kPa (18 psi).
   c. Pressure falls rapidly when pressurized within range.
7. Open butterfly valve and remove adaptor and cap.

Figure 6-4. Pressure Cap Test

SYSTEM PRESSURE TEST

PART NO.	SPECIALTY TOOL
HD-45335	Coolant system pressure tester

The cooling system can be pressure tested to identify a leak and to verify a blown engine gasket.

1. Before troubleshooting cooling system, be sure engine coolant level is at COLD FULL mark on overflow bottle when the motorcycle is on the jiffy stand.
2. Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops and remove.
3. See Figure 6-3. Clean and inspect filler neck, upper (1) and lower (5) sealing seats, overflow tube (4), and overflow bottle.

NOTE

Bent filler neck cams and safety stops can cause cap to leak or affect pressure limiting valve. Replace the coolant pipe as required.

4. See Figure 6-5. Turn butterfly valve parallel to boss on COOLANT SYSTEM PRESSURE TESTER (HD-45335) head and turn adapter onto head. Turn butterfly valve perpendicular to seal head to adapter.

NOTE

Wet the upper sealing surfaces before turning adapter onto tester head.

5. Turn double ended pressure cap onto the end of the adapter and onto filler neck. Rotate to the safety stops.

CAUTION

When performing the coolant system pressure test, never exceed the upper limit rating of the pressure cap. Excessive pressure can rupture cooling pipes, hoses, and radiator.

6. Pump tester until pressure reaches 103 kPa (15 psi).
7. Refer to Table 6-5. Match movement of needle to system pressure.

Table 6-5. System Pressure Test

NEEDLE MOVEMENT	LEAK	ACTION
Holds steady for 2 minutes	None	None
Drops slowly	Small	Dye test
Drops quickly	Major	Visual

8. Release pressure in system by turning butterfly pressure valve perpendicular to head. Wait until pressure is released before removing double ended cap from filler neck.

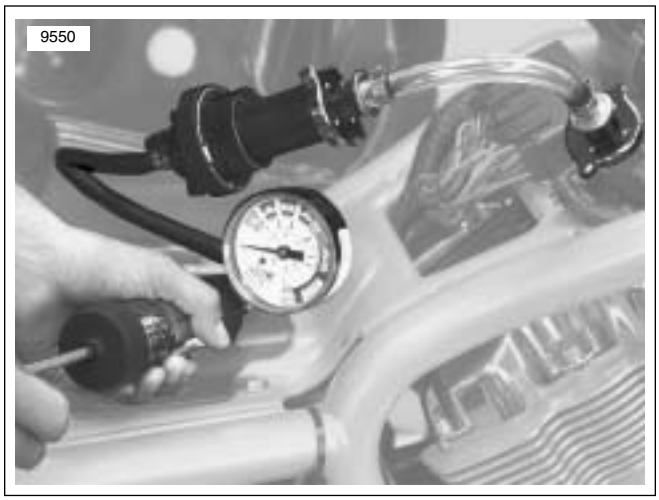


Figure 6-5. System Pressure Test

LEAK DETECTION DYE TEST

PART NO.	SPECIALTY TOOL
HD-29545-6	Coolant fluorescent leak detection dye
HD-35457	Black light leak detector

NOTE

If the coolant overflow bottle is empty when the engine is cold, it is possible that air has been drawn into the coolant system. The system must be purged of any trapped air and refilled with coolant.

1. Before troubleshooting cooling system be sure engine coolant level is at COLD FULL mark on overflow bottle when the motorcycle is on the jiffy stand.

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a).

2. Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops of filler neck and remove.
3. If filler neck is full of coolant, remove an amount of coolant equal to the amount of dye.
4. See Figure 6-6. Pour COOLANT FLUORESCENT LEAK DETECTION DYE (HD-29545-6) into filler neck.

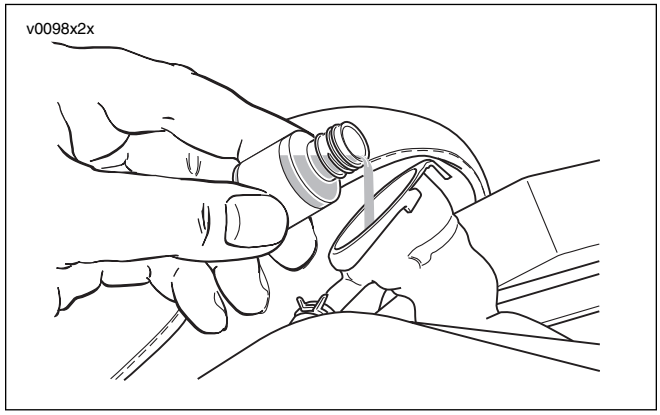


Figure 6-6. Pouring Dye into Filler Neck

5. Reinstall pressure cap and run engine for 10 minutes.
6. Use BLACK LIGHT LEAK DETECTOR (HD-35457) to illuminate entire cooling system. A yellow fluorescence at any spot indicates a leak.
7. Remove oil dipstick and inspect engine oil for yellow dye.

NOTE

Dye in the oil may indicate a damaged engine head gasket. Draining and replacing coolant contaminated oil will be necessary as part of engine service.

TESTS FOR BLOWN GASKET

PART NO.	SPECIALTY TOOL
HD-45335	Coolant system pressure tester

If a pressure test indicates a leak but there is no visible leak, even after a leak detection dye test, perform the following tests to verify a damaged engine gasket.

1. Start and run cold engine. White smoke from exhaust system indicates a blown gasket.
2. Run engine. Shut off engine.
   a. Remove oil level dipstick. Light colored foam on dipstick indicates a blown gasket.
   b. Open oil drain plug and drain a small amount of oil. Water or coolant will drain out first if gasket is blown.

CAUTION

Do not allow pressure to build up past the maximum for system. If pressure rises past, turn off engine and turn butterfly pressure valve perpendicular to tester head to release pressure.

⚠WARNING

Do not continue to run engine unattended with COLLANT SYSTEM PRESSURE TESTER installed. There is no safety valve with the pressure cap removed and the COLLANT SYSTEM PRESSURE TESTER installed.

3. With COOLANT SYSTEM PRESSURE TESTER (HD-45335) installed, start cold engine and idle engine to normal operating temperature.
   a. If gauge indicates fast pressure build up, a gasket is blown.
   b. If pressure does not build up immediately, pump tester to system pressure. If gauge needle vibrates, there is a compression or combustion leak. Disconnect one spark plug at a time. The needle will stop vibrating when spark is removed from leaking cylinder.

NOTE

After replacing an engine head gasket, draining and replacing contaminated oil will be necessary as part of engine service.

ENGINE COOLANT 6.3

GENERAL

GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTI-FREEZE & COOLANT provides temperature protection to -36.7˚ C (-34˚ F).

GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTI-FREEZE & COOLANT is pre-diluted and ready to use full-strength. DO NOT add water. A mixture of de-ionized water and ethylene glycol-based antifreeze may be used if GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT is unavailable.

NOTE

When temperatures drop below -36.7˚ C (-34˚ F), a mixture of ethylene glycol-based antifreeze and de-ionized water can be mixed to provided additional protection. Follow the directions on the container of un-diluted ethylene glycol to arrive at a percentage mixture that will provide protection for the anticipated temperatures.

REPLACING COOLANT

PART NO.	SPECIALTY TOOL
HD-23688	Coolant & battery tester - Fahrenheit
HD-26568	Coolant & battery tester - Celsius

⚠WARNING

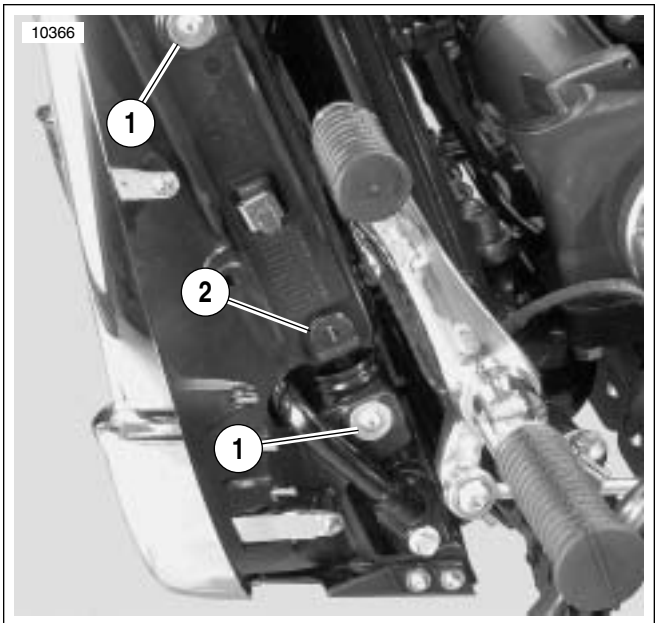
Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
3. Open seat. Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops and remove.
4. Use COOLANT AND BATTERY TESTER (HD-23688 or HD-26568) to test antifreeze protection.
   a. Place a few drips of sample on prism and close cover.
   b. Hold prism up to light and read temperature scale through eye piece.

NOTE

There are several scales visible in eye piece. Read only the temperature scale labeled ethylene-glycol. If the indicated temperature is less than the rated or required protection, replace the antifreeze.

5. Remove airbox cover. Remove air filter top, and air filter. See 1.3 AIRBOX AND AIR FILTER.



1. **Radiator cover fastener and washer**
2. **Radiator drain plug**

Figure 6-7. Radiator Left Side (cover removed) (typical) (VRSCA shown)

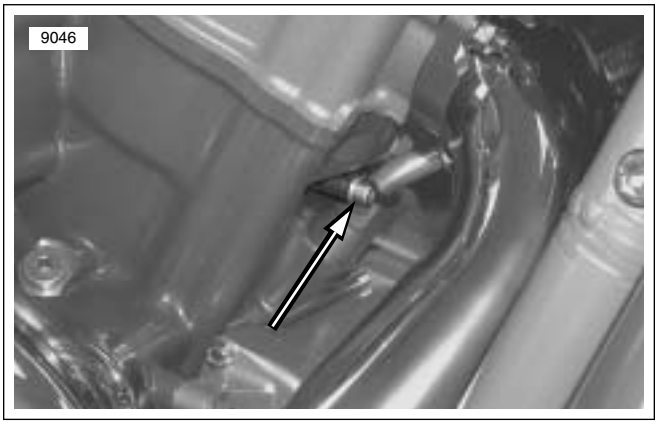


Figure 6-8. Front Cylinder Coolant Drain Plug @ 9.7 Nm (86 in-lbs)

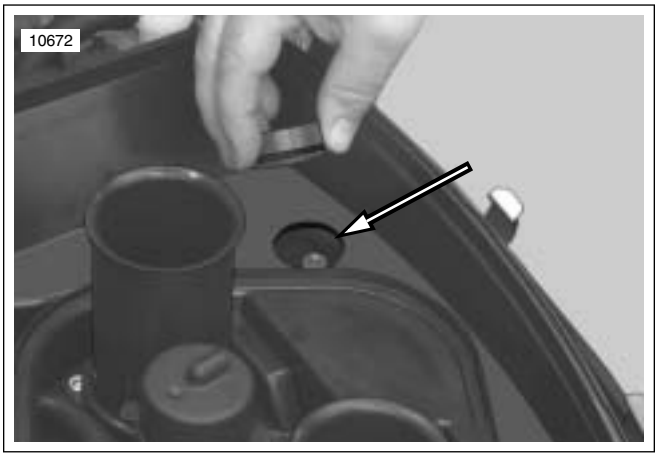


Figure 6-9. Air Bleed Plug @ 9-11 Nm (80-97 in-lbs)

6. See Figure 6-7. Remove left side radiator trim cover. Place a container under engine coolant radiator.
7. See Figure 6-10. Loosen but do not remove radiator drain plug. Orient radiator drain plug so that slot in threads is open to container and allow coolant to drain from the radiator.
8. Hand tighten radiator drain plug.

NOTE

*Locate dot on coolant drain plug. This indicates location of the drain slot is in drain plug. Correct torque on the radiator drain plug is 2.3-2.8 Nm (21-24 **in-lbs**).*

9. See Figure 6-8. Place a container under engine and remove front cylinder coolant drain plug. Allow remaining coolant to drain from engine.

NOTE

With the motorcycle in normal orientation, there is no need to remove the rear cylinder coolant drain plug.

10. Install and tighten front cylinder coolant drain plug to 9.7 Nm (86 **in-lbs**).
11. Reinstall radiator trim cover.

CAUTION

De-ionized water must be used with the antifreeze in the cooling system. Hard water can cause scale accumulation in water passages which reduces cooling system efficiency, leading to overheating and engine damage. (00195a)

⚠WARNING

Coolant mixture contains toxic chemicals, which may be fatal if swallowed. If swallowed, do not induce vomiting; call a physician immediately. Use in a well ventilated area. Irritation to skin or eyes can occur from vapors or direct contact. In case of skin or eye contact, flush thoroughly with water and go to hospital, if necessary. Dispose of used coolant according to federal, state and local regulations. (00092a)

12. See Figure 6-9. Loosen air bleed plug.
13. Through the filler neck, fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT up to lower sealing surface in filler neck.
14. Reinstall pressure cap and tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**).
15. Reinstall air filter, air filter top, and airbox cover.
16. Reinstall maxi-fuse and side cover.
17. After running engine, check coolant level in overflow bottle with coolant cold with motorcycle on jiffy stand. If level is below COLD FULL line, add antifreeze to overflow bottle until fluid level reaches COLD FULL line.
18. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand.

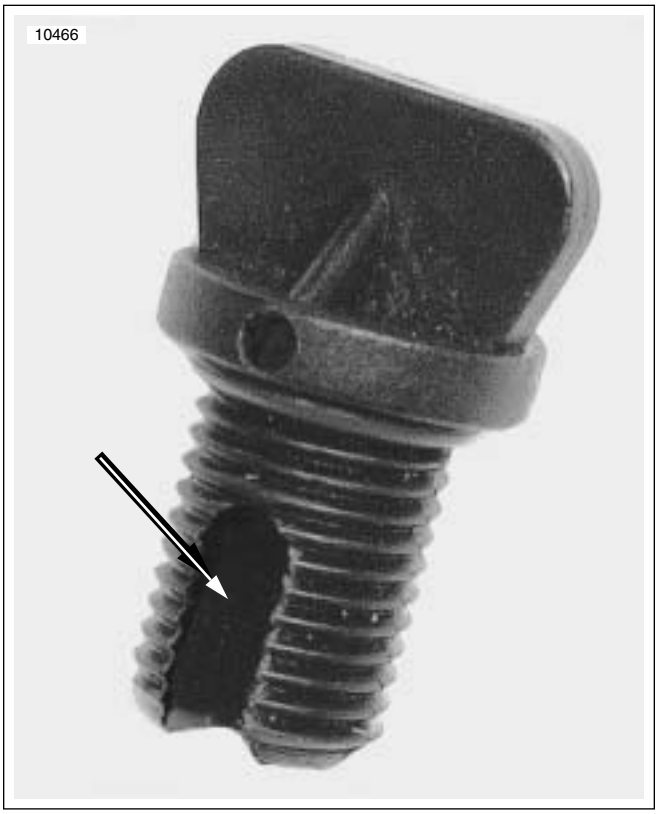


Figure 6-10. Slot in Radiator Drain Plug

THERMOSTAT 6.4

GENERAL

The thermostat is a valve that remains closed until the engine reaches operating temperature. When the coolant temperature exceeds 85˚ C (185˚ F), the thermostat opens allowing engine coolant to flow out of the engine to the radiator. The thermostat is fully open at 100˚ C (212˚ F).

REMOVAL

PART NO.	SPECIALITY TOOL
HD-45307	Thermostat removal tool

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. Allow cooling system and engine to cool.
2. Remove right side cover and maxi-fuse.
3. Open seat and remove pressure cap.
4. Remove left side radiator trim cover.
5. Loosen radiator drain plug and orient slot in drain plug to drain engine coolant into suitable container. See 6.3 ENGINE COOLANT.
6. Hand tighten radiator drain plug.

NOTE

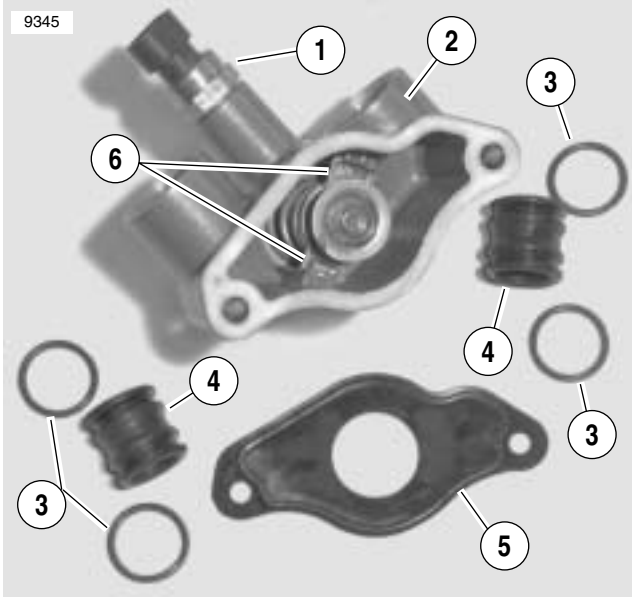
*Correct torque on the radiator drain plug is 2.3-2.8 Nm (21-24 **in-lbs**).*

7. Remove air filter cover, air filter top, air filter, breather hose, velocity stacks, and air filter bottom. See 1.3 AIRBOX AND AIR FILTER.
8. Remove pipe clamp and p-clamp from coolant pipes.
9. Loosen lower clamp on hose to engine coolant pipe. Pull coolant outlet pipe and hose up.
10. Loosen and remove fasteners and lock washers holding housing to engine case. Pull thermostat housing off engine.
11. See Figure 6-11. Disconnect coolant temperature sensor (1) from wiring harness.

NOTE

See Figure 6-11. The sensor (1) for the engine coolant temperature is threaded into the engine side of the thermostat housing. When illuminated red, the engine coolant temperature indicator lamp on the instrument cluster indicates that the coolant temperature has exceeded 117˚ C (243˚ F).

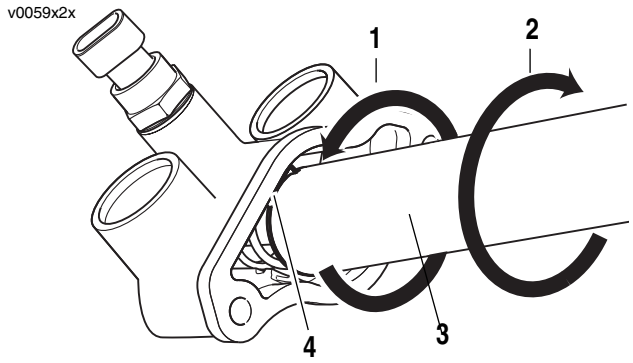
12. Pull thermostat tubes (4) and O-rings (3) out of engine.



1. **Engine coolant temperature sensor**
2. **Thermostat housing**
3. **O-ring**
4. **Thermostat tube**
5. **Gasket**
6. **Tabs**

Figure 6-11. Thermostat and Housing

13. See Figure 6-12. To remove thermostat from housing, engage tabs on thermostat with slots of THERMOSTAT REMOVAL TOOL (Part No. HD-45307).
14. Press on end of tool to compress thermostat spring while turning tool 90° counterclockwise (CCW). Remove thermostat.



1. **To remove - counterclockwise**
2. **To install - clockwise**
3. **Thermostat removal tool (HD-45307)**
4. **Tab**

Figure 6-12. Thermostat Removal Tool

INSTALLATION

PART NO.	SPECIALITY TOOL
HD-45307	Thermostat removal tool

1. See Figure 6-12. To install **new** thermostat into housing, engage slots of THERMOSTAT REMOVAL TOOL (HD-45307) into tabs of thermostat while compressing thermostat spring. Turn tool 90° clockwise (CW) to lock thermostat into housing.

NOTE

New components can be lubricated with engine coolant to ease assembly.

2. See Figure 6-11. With **new** O-rings (3) on thermostat tubes (4), push tubes into engine case.
3. Connect engine coolant temperature sensor (1) to wiring harness.
4. Be sure lower clamp is in place on hose to engine coolant pipe.
5. Orient **new** thermostat housing gasket (5) to mating surface on engine case.
6. Push housing pipe into pipe hose and over thermostat tubes (4). Fit housing (2) to engine case.
7. Thread in housing fasteners and tighten to 9.7 Nm (86 **in-lbs**).
8. With lower hose clamp in correct orientation, tighten clamp to 3-4 Nm (27-35 **in-lbs**).
9. Install pipe clamp and p-clamp. Tighten fasteners to 6-10 Nm (53-88 ft-lbs).
10. Install air filter bottom, velocity stacks, O-rings and breather hose. See 1.3 AIRBOX AND AIR FILTER.
11. Loosen air bleed plug. Remove pressure cap and fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through filler neck.
12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and reinstall pressure cap.
13. Reinstall air filter, air filter top and airbox cover.
14. Reinstall maxi-fuse and side cover.
15. Rinse the motorcycle with water to remove any spilled coolant.
16. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
17. Continue to run engine, check level, and add antifreeze until coolant level remains at COLD FULL line with the motorcycle on the jiffy stand.

WATER PUMP 6.5

REMOVAL

⚠ WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
3. Open seat and remove pressure cap.
4. Remove left side radiator trim cover.
5. Loosen and orient slot in radiator plug to drain engine coolant into suitable container.
6. Place a suitable container under engine and remove front engine coolant drain plug to drain coolant from engine.

NOTE

With the motorcycle in normal orientation, there is no need to remove the rear engine coolant drain plug.

7. Hand tighten radiator drain plug.

NOTE

Correct torque on the radiator drain plug is 2.3-2.8 Nm (21-24 ***in-lbs****).*

8. Install and tighten front engine coolant drain plug to 9.7 Nm (86 **in-lbs**).
9. Reinstall left side radiator trim cover.
10. Remove airbox cover. Remove air filter top and air filter. See 1.3 AIRBOX AND AIR FILTER.
11. Remove pipe clamp and p-clamp from coolant pipes. See 6.6 COOLANT PIPES AND HOSES.
12. Remove hose cover clamp from upper end of hose to coolant pipe and loosen lower hose clamp. Pull coolant pipe up.
13. See Figure 6-13. Unbolt water pump bolts and remove water pump cover.
14. Remove the insert.
15. See Figure 6-14. Using a soft mallet, tap on side of water pump to loosen.
16. See Figure 6-15. Remove bearing housing assembly with the O-rings and gasket.

Figure 6-13. Removing Cover

Figure 6-14. Removing Water Pump (clutch cover removed for clarity)

Figure 6-15. Water Pump Bearing Housing Assembly (clutch cover removed for clarity)

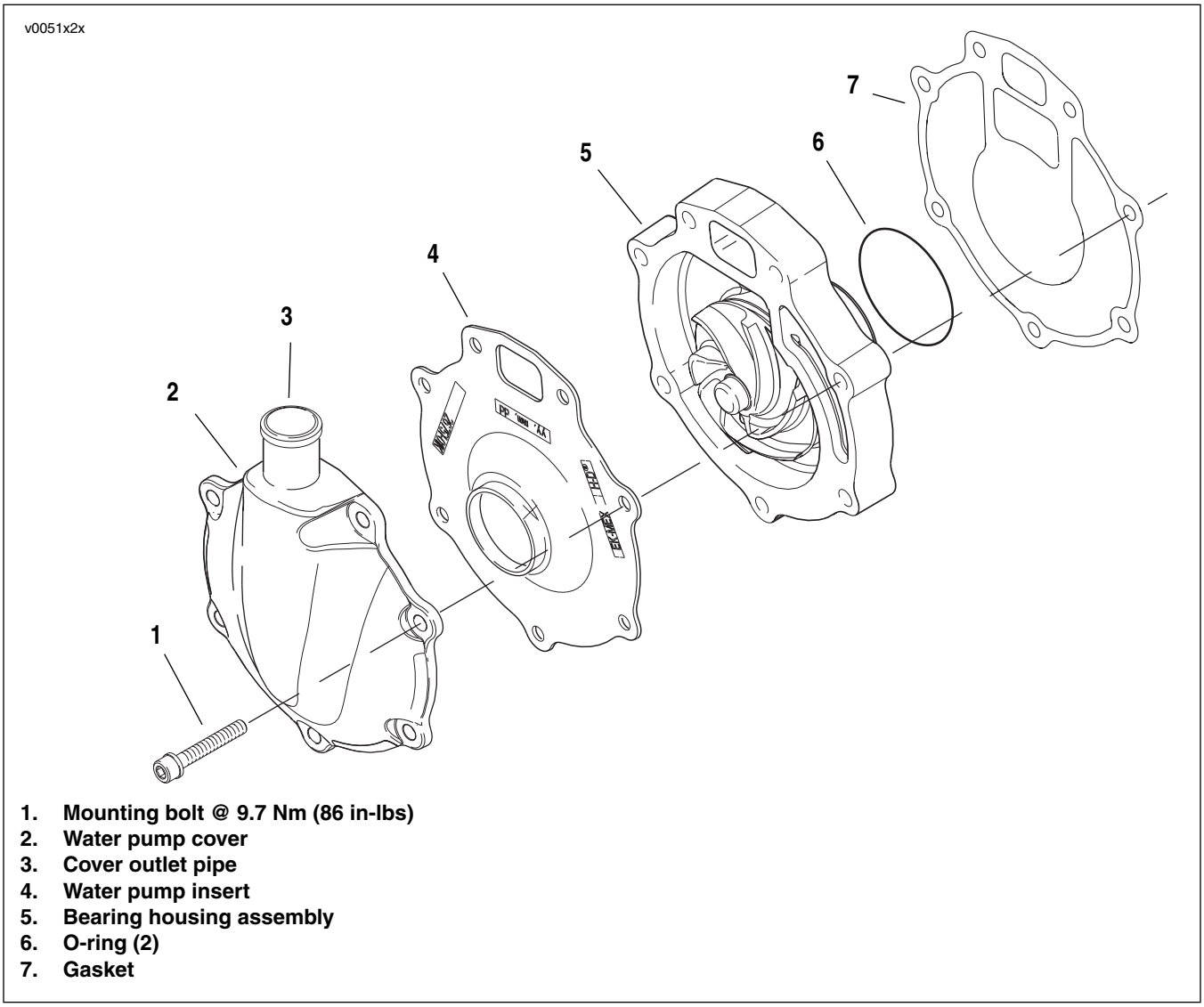
INSTALLATION

1. Clean engine cavity.
2. See Figure 6-16. Lube and install **new** O-ring (6) on bearing housing assembly (5).
3. Install **new** gasket (7) with part numbers facing away from engine block.
4. Align pump square drive with drive shaft and push water pump into engine cavity.

NOTE

A lubricant, as tire soap or detergent and water, can be used to lubricate the hose to aid in pushing hose over neck beads.

5. Thread on mounting bolts (1) holding bearing housing assembly (5), water pump insert (4) and water pump cover (2) over water pump cavity.
6. Tighten water pump mounting bolts to 9.7 Nm (86 **in-lbs**).
7. Push pump to engine coolant pipe hose on cover outlet pipe (3).
8. Install lower bright hose clamp and tighten to 3-4 Nm (27-35 **in-lbs**).
9. Install and tighten hose cover to 3-4 Nm (27-35 **in-lbs**).
10. Install pipe clamp and p-clamp. See 6.6 COOLANT PIPES AND HOSES.
11. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through filler neck.
12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and reinstall pressure cap.
13. Reinstall maxi-fuse and right side cover.
14. Rinse motorcycle with water to remove any spilled collant.
15. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
16. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand.



1. **Mounting bolt @ 9.7 Nm (86 in-lbs)**
2. **Water pump cover**
3. **Cover outlet pipe**
4. **Water pump insert**
5. **Bearing housing assembly**
6. **O-ring (2)**
7. **Gasket**

Figure 6-16. Water Pump

COOLANT PIPES AND HOSES 6.6

REMOVAL

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

3. Remove the negative battery cable.

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

4. Open seat and remove pressure cap.
5. Remove left side radiator trim cover. Remove radiator plug and drain engine coolant into suitable container.
6. Remove air filter top, air filter, breather hose, velocity stacks and air filter bottom. See 1.3 AIRBOX AND AIR FILTER.
7. See Figure 6-17. Loosen pipe clamp (4). Loosen and remove fastener (7) holding p-clamp (8) to engine.
8. Squeeze clamp (17) and pull off end of overflow hose (23) at overflow bottle (14). Pull drain hose to radiator/oil cooler off overflow bottle. Remove overflow bottle (14).
9. Loosen clamps (12, 19) on bottom of hoses to water pump and thermostat.
10. Use a long thin screwdriver (Snap-on Part No. SDD1410) to loosen clamps (12) and pull hoses (10, 13) off radiator.
11. Remove engine coolant pipes (2, 3) with hoses (10, 13, 20, 21).

DISASSEMBLY

1. See Figure 6-17. Cut shrink clamps (9) from the coolant inlet and the coolant outlet pipes (2, 3) and hoses (10, 13, 21).

NOTE

To remove shrink clamps without cutting, use a soldering iron and, carefully, melt a slice through the band without damaging the hose.

2. Loosen overflow hose clamp (17) and remove overflow hose (23) from filler neck.
3. Remove hose cover (22) and loosen upper clamp (19) from the water pump to coolant inlet pipe hose.
4. Clean hose mounting stems on the engine coolant inlet pipe (2) and the engine coolant outlet pipe (3) with a wire brush.
5. Inspect all components and replace as required.

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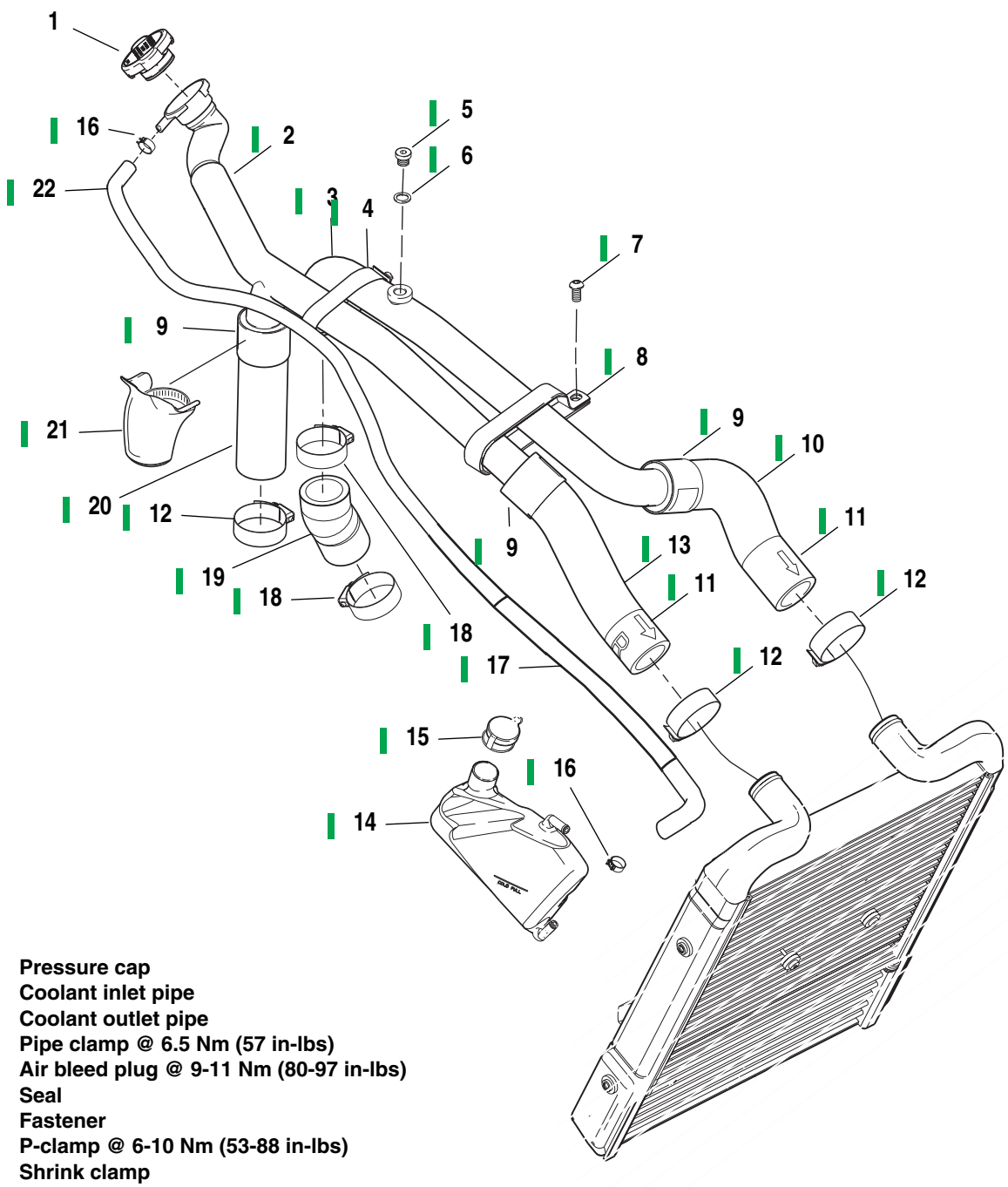


1. Pressure cap
2. Coolant inlet pipe
3. Coolant outlet pipe
4. Pipe clamp @ 6.5 Nm (57 in-lbs)
5. Air bleed plug @ 9-11 Nm (80-97 in-lbs)
6. Seal
7. Fastener
8. P-clamp @ 6-10 Nm (53-88 in-lbs)
9. Shrink clamp
10. Hose - engine coolant outlet pipe to radiator
11. Embossed arrow - top and front
12. Clamp - bright @ 3-4 Nm (27-35 in-lbs)
13. Hose - coolant inlet pipe to radiator
14. Overflow bottle
15. Cap
16. Clamp - overflow hose
17. Sleeve hose
18. Clamp - black @ 3-4 Nm (27-35 in-lbs)
19. Hose
20. Hose
21. Hose cover
22. Overflow hose

Figure 6-17. Coolant Pipes and Hoses

ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-25070	Robinair heat gun

1. See Figure 6-17. If removed, thread the air bleed plug (5) with **new** seal (6) into the coolant outlet pipe (3).
2. Remove **new** shrink clamp (9) from packaging brace by squeezing band to collapse, then fold in half and remove from cardboard. Slide shrink clamps over hoses.
3. Orient radiator hoses with embossed arrow (11) on top and towards front. Push hose over fitting beads on coolant inlet and coolant outlet pipes (2, 3).
4. Orient shrink clamps (9) so print on the clamp is visible after shrinking. Slide clamp over end of hose to overlap the bulge formed by fitting bead of coolant pipe.

CAUTION

Do NOT use open flame to shrink clamp. Using an open flame could result in uncontrolled melting of clamp.

5. Using an ROBINAIR HEAT GUN (Part No. HD-25070) or similar tool, apply heat to shrink clamps (9). Move heat tool around clamp continuously to prevent burning.

NOTE

Heated area must cover at least 1/3 of clamp surface. If heating shrink clamp while hose and pipe are still mounted in motorcycle, take care not to damage surrounding components.

6. Heat until print turns grey and remove heat.

NOTE

Check seal by trying to rotate hose on fitting by hand. Hose and clamp should NOT turn when using reasonable torque.

7. Repeat for each shrink clamp required.

INSTALLATION

1. See Figure 6-17. With upper black clamp (18) on hose (19) and lower black clamp (18) loose, install coolant outlet pipe (3).
2. With embossed arrow (11) pointing towards front and on top, push hose (10) over neck bead of radiator inlet neck. Push hose (20) onto outlet neck of thermostat housing.

NOTE

A lubricant, tire soap or detergent and water, can be used to lubricate the hose to aid in pushing hose over neck beads.

3. With hose cover (22), clamp (19), and bright clamp (12) loose on hose, install coolant inlet pipe (2).
4. With embossed arrow (11) pointing towards front and on top, push hose (13) over neck bead of radiator outlet and push hose (21) over water pump inlet neck.
5. Use a long thin screwdriver (Snap-on Part No. SDD1410) to tighten clamps (12, 19) to 3-4 Nm (27-35 **in-lbs**).
6. Install p-clamp (8) and pipe clamp (4) over both pipes. Tighten pipe clamp (4) to 6.5 Nm (57 **in-lbs**) and tighten p-clamp to 6-10 Nm (53-88 **in-lbs**).
7. Install, through right side cover opening, overflow bottle (14) with hose (15), and cap (16). L-shaped catch on bottom of bottle fits to slot in battery bracket. Push on drain hose to radiator/oil cooler assembly.
8. Install and clamp overflow hose (17) to filler neck and overflow bottle cap (14).
9. Pressure test to 103 kPa (15 psi).
10. Install air filter bottom, velocity stacks, O-rings, and breather hose. See 1.3 AIRBOX AND AIR FILTER.
11. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through filler neck.
12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**). and reinstall pressure cap.
13. Reinstall the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
14. Install air filter, air filter top and airbox cover.
15. Install right side cover and maxi-fuse.
16. Rinse motorcycle with water to remove any spilled coolant.
17. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
18. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with the motorcycle on the jiffy stand.

OIL LINE FITTINGS 6.7

GENERAL

Oil in at the crankcase fitting. Oil out at the oil filter fitting.

REMOVAL

PART NO.	SPECIALTY TOOL
HD-46503	Oil line remover

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

3. Remove negative battery cable.
4. Snap the plastic dust cap from the quick connect oil line fitting at the crankcase (oil in) and slide it up the oil pipe.

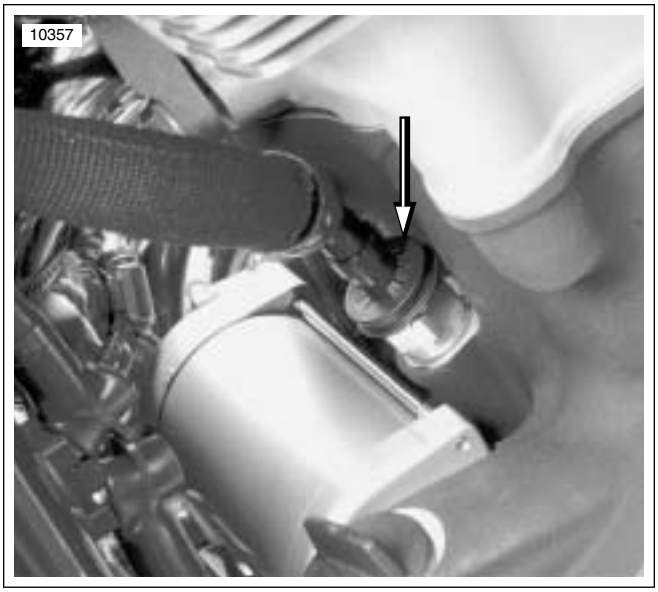


Figure 6-18. Crankcase Oil Line (oil in) Fitting

5. See Figure 6-19. Close the OIL LINE REMOVER (HD-46503) over the oil line. Match the notches in the tool flange to the U-bends in the spring clip.
6. See Figure 6-20. Rotate the tool to expand the spring clip out of the groove in the oil fitting.
7. With a cup under the fitting, use finger and thumb to hold the OIL LINE REMOVER (HD-46503) squarely against the fitting to keep the spring clip expanded. Use only enough pressure to hold the tool square. Excess pressure will prevent simultaneously pulling the line and tool from the fitting.
8. Pull the oil line and the tool from the fitting.
9. Repeat to remove the oil line from the remaining oil line fitting.
10. Remove oil line fittings and plug the holes until they can be replaced.
11. Remove radiator/oil cooler assembly. See 6.8 RADIATOR/OIL COOLER.
12. Supporting the radiator/oil cooler assembly, pull the assembly far enough forward to access the oil filter (oil out) fitting.
13. Snap the plastic dust cap from the quick connect oil line fitting at the oil filter.
14. Use the OIL LINE REMOVER (HD-46503) to remove the oil line from the fitting.
15. Remove the radiator/oil cooler assembly.

Figure 6-19. Oil Line Remover (HD-46503)

Figure 6-20. Oil Line Fitting with Spring Clip

INSTALLATION

1. Install oil line fittings with O-ring into crankcase (oil in) and oil filter mount (oil out). Tighten to 40-44 Nm (29-32 ft-lbs).
2. See Figure 6-21. Supporting the radiator/oil cooler assembly, push the flanged oil line into the oil filter (oil out) fitting until it clicks in place under the spring clip.
3. Snap the plastic dust cap over the spring clip groove.
4. Install the radiator/oil cooler assembly. See 6.8 RADIATOR/OIL COOLER.
5. Push the flanged oil line into the crankcase (oil in) fitting until it clicks in place under the spring clip.

NOTE

Yellow witness band on the flanged oil line will not be visible if the oil line has been correctly snapped into the fitting.

6. Snap the plastic dust cap over the spring clip groove.

NOTE

Dust cap will not snap onto fitting if the oil line is not correctly installed on fitting.

7. Lightly tug on oil line to verify that it is securely locked to fitting.
8. Check oil level and add oil if required.
9. Reinstall the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
10. Install maxi-fuse and right side cover.
11. After running engine,
    a. Inspect oil fittings for oil leaks.
    b. Check oil level and add oil if required.
    c. Check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand. See 1.6 COOLING SYSTEM.

Figure 6-21. Flanged Oil Line

RADIATOR/OIL COOLER 6.8

GENERAL

The heat exchangers, or radiators, for both engine cooling and oil cooling are bolted together in a single radiator/oil cooler assembly. The radiator/oil cooler assembly is fasten to the frame with:

- Double threaded studs near the steering head.
- Two pins and rubber grommets on the bottom of the oil cooler that fit the frame cross member.

REMOVAL

PART NO.	SPECIALTY TOOL
HD-46503	Oil line remover

WARNING

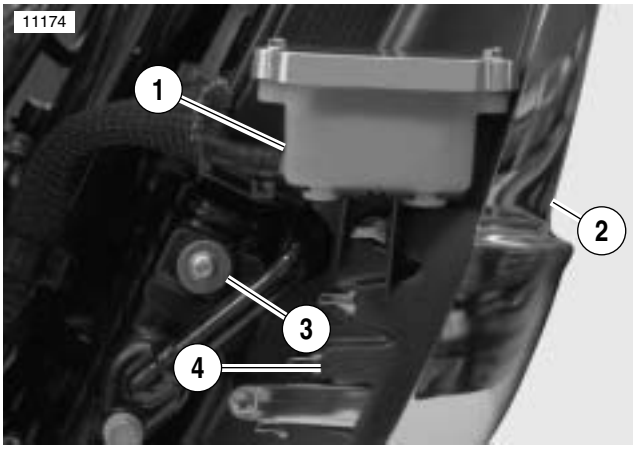
Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

3. Remove negative battery cable.
4. Remove airbox decorative cover, airbox cover, air filter cover and air filter. See 1.3 AIRBOX AND AIR FILTER.
5. See Figure 6-24. Remove fastener and right radiator trim cover.
6. Pull rear brake master cylinder reservoir straight away from its mounting slots in right side of radiator cover.



1. **Rear brake master cylinder reservoir**
2. **Chrome inlet bezel**
3. **Fastener and washer**
4. **Radiator cover**

Figure 6-22. Right Side Radiator

7. See Figure 6-24. Remove fastener and left radiator trim cover.

NOTE

Before removing wiring harnesses, carefully note wire routing. In particular, pay close attention to locations of cable wraps that must be replaced.

8. Clip cable wrap tying cooling fan wire harness to crankshaft position sensor (CKP) harness.
9. Push straight down to remove stator to regulator connector [46] from metal clip on side of radiator cover.
10. Push connectors and wire harnesses away from coolant drain plug up and behind shift lever.
11. Place a container under left side of radiator.

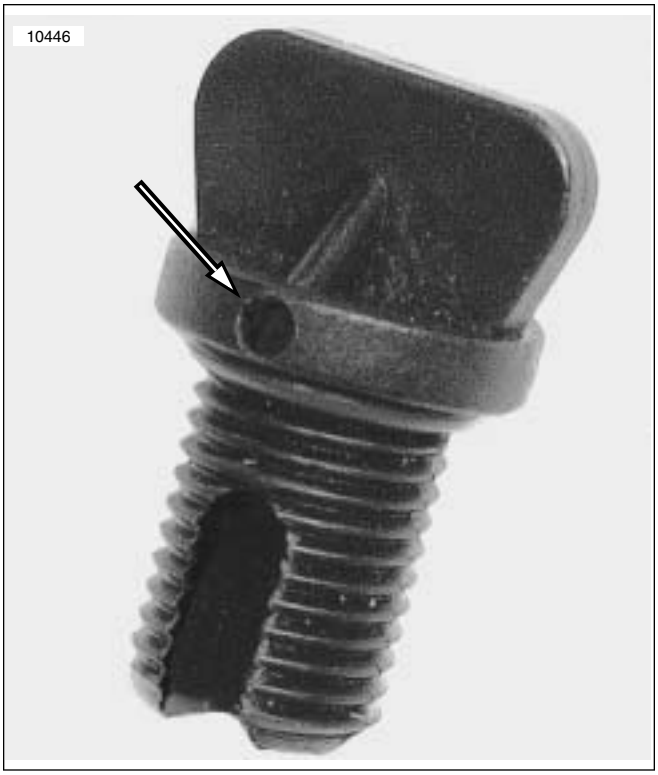
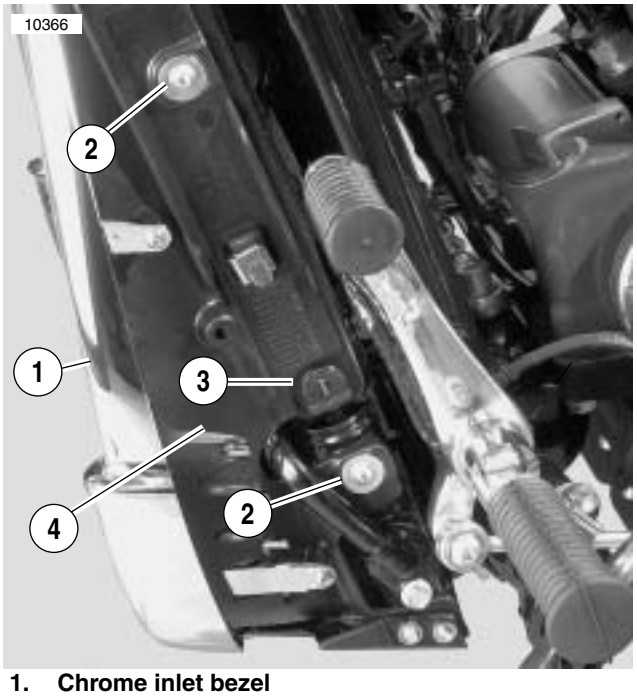


Figure 6-23. Slot in Radiator Drain Plug

NOTE

Locate dot on coolant drain plug. This indicates location of the drain slot is in drain plug.

12. See Figure 6-24. Loosen but do not remove coolant drain plug (3). Turn drain plug until slot in threads drains into container.
13. Open seat and remove pressure cap to accelerate coolant drain from radiator.
14. Hand tighten coolant drain plug. See 6.3 ENGINE COOLANT.
15. Place a container under engine, remove oil filler plug/dipstick, and oil drain plug and drain oil. Reinstall dipstick and drain plug. See 1.7 ENGINE OIL AND FILTER.
16. Separate stator to regulator connector [46].
17. Remove top cooling fan connector [97T] from radiator cover by rocking first one way and with a finger pull the connector tab to compress butterfly peg.
18. Separate top cooling fan wiring harness connector [97T] and bottom cooling fan connector [97B].
19. Separate crank position sensor connector [79]
20. Cover front fender with shop towel or protective cover. Remove fasteners and washers on each side of radiator cover. Remove radiator cover with chrome inlet bezels attached.



1. Chrome inlet bezel
2. Fastener and washer
3. Coolant drain plug
4. Radiator cover

Figure 6-24. Left Side Radiator (typical) (VRSCA shown)

NOTE

Both the oil line lines to the oil cooler remain fastened to the radiator/oil cooler assembly. The drain hose from the expansion bottle also remains clipped to the assembly.

21. Use a long thin screwdriver (Snap-on Part No. SDD1410) to loosen worm drive clamps on both engine coolant hoses at radiator.
22. Disconnect the end of drain hose from the overflow bottle.
23. See Figure 6-25. Loosen but do not remove nuts holding assembly to front engine mount studs.
24. Remove fasteners under radiator assembly that hold cross member to frame. Gently pull bottom of radiator/oil cooler assembly forward.
25. Snap the plastic dust cap from the quick connect oil line fitting at the oil filter (oil out).
26. See Figure 6-19. Close the OIL LINE REMOVER (HD-46503) over the oil line. Match the notches in the tool flange to the U-bends in the spring clip.
27. See Figure 6-20. Holding the oil line in the palm of the hand, rotate the tool to expand the spring clip out of the groove in the oil fitting.
28. With a cup under the fitting, use finger and thumb to hold the OIL LINE REMOVER (HD-46503) squarely against the fitting to keep the spring clip expanded. Use only enough pressure to hold the tool square. Excess pressure will prevent pulling the line and tool from the fitting simultaneously.
29. Pull the oil line and the tool from the fitting.
30. Repeat to remove the oil line from the crankcase (oil in) oil line fitting. See 6.7 OIL LINE FITTINGS.
31. Remove nuts holding radiator assembly to engine mount studs and remove radiator/oil cooler assembly.
32. Retain bushings, grommets and washers.

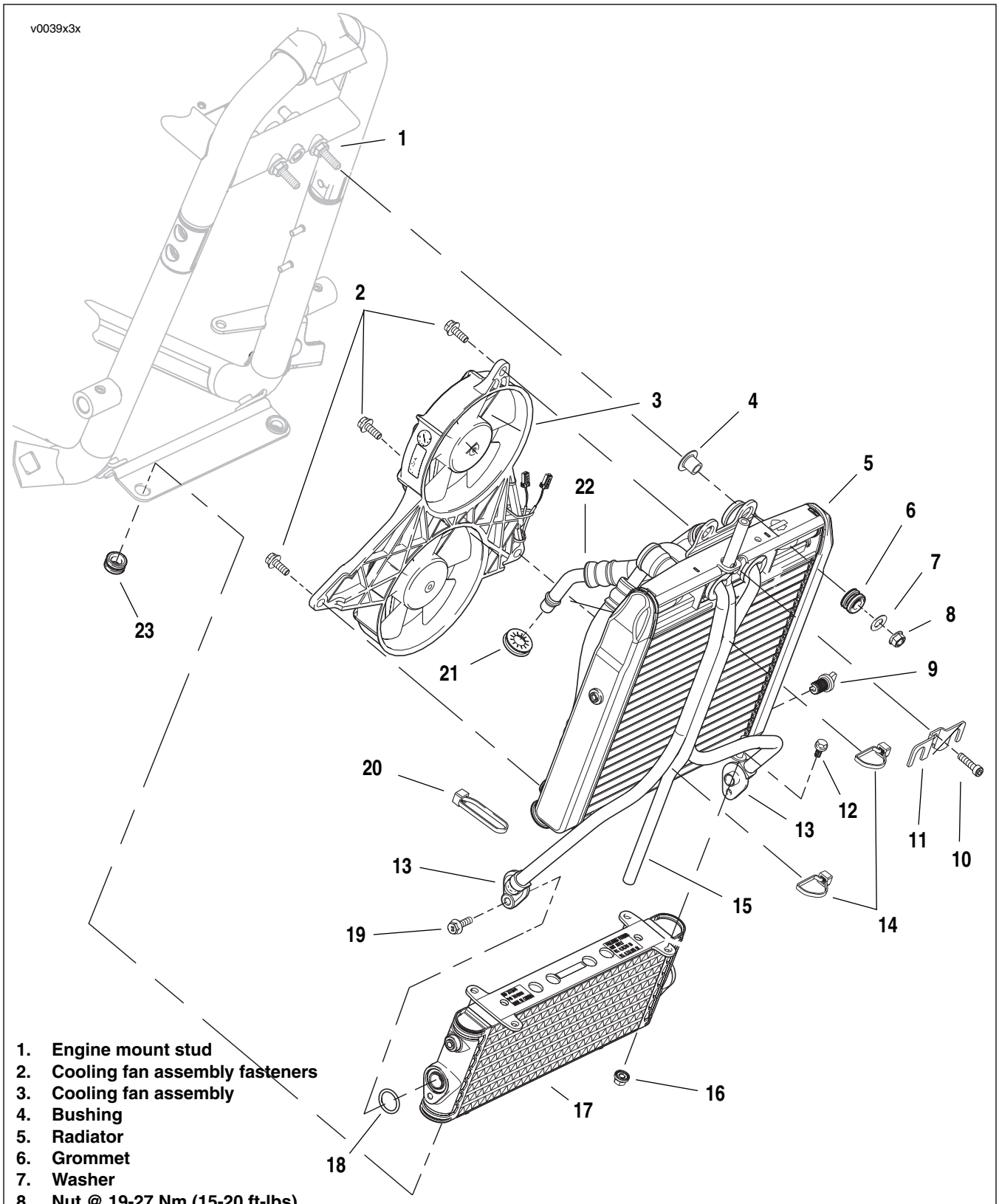
INSTALLATION

PART NO.	SPECIALTY TOOL
HD-46503	Oil line remover

CAUTION

Carefully clean the front surface of the radiator regularly. Leaves and other debris can collect on the radiator surface and degrade radiator performance. This could lead to engine overheating and engine damage. (00197a)

1. Cover front fender with a shop towel or protective cover.
2. Hold radiator/oil cooler assembly up to frame.
3. Line up and fit inlet and outlet pipes to radiator hoses.
4. Push oil line into oil out fitting on oil filter. Snap plastic ring around spring clip groove on fitting. See 6.7 OIL LINE FITTINGS.
5. Thread on but do not tighten nuts holding radiator/oil cooler assembly to engine mount studs.
6. Push oil line into oil in fitting on crankcase. Snap plastic ring around spring clip groove on fitting. See 6.7 OIL LINE FITTINGS.
7. See Figure 6-25. Slip grommets (23) into cross member on frame. Install radiator into cross member on frame.
8. Tighten cooling system fasteners to following:
   a. Cross member fasteners to 20-26 Nm (15-19 ft-lbs).
   b. Top mounting nuts (8) to 19-27 Nm (15-20 ft-lbs).
   c. Pipe clamp to 6.5 Nm (57 **in-lbs**).
   d. P-clamp to 6-10 Nm (53-88 **in-lbs**).
   e. Hose clamps to 3-4 Nm (27-35 **in-lbs**).
9. Route overflow hose (15) to overflow bottle.
10. Install radiator cover.



1. Engine mount stud
2. Cooling fan assembly fasteners
3. Cooling fan assembly
4. Bushing
5. Radiator
6. Grommet
7. Washer
8. Nut @ 19-27 Nm (15-20 ft-lbs)
9. Engine coolant drain plug
10. Bolt@ 8-10 Nm (71-88 in-lbs)
11. Radiator oil line bracket
12. Fastener @ 10-12 Nm (89-106 in-lbs)
13. Oil line manifold
14. Cable wrap
15. Overflow hose
16. Nut
17. Oil cooler
18. Oil line manifold O-ring
19. Fastener
20. Cable wrap - through oil cooler
21. Plastic dust cap
22. Oil line
23. Grommet

Figure 6-25. Radiator/Oil Cooler Assembly (typical) (VRSCA shown)

11. Mate:
    a. Crank position sensor connector [79] halves.
    b. Top and bottom cooling fan connector [97T], [97B] halves.
    c. Stator to voltage regulator connector [46] halves.
12. Push top fan connector [97T] into radiator cover.
13. Cable wrap fan wiring harness to crank position sensor wiring harness and mounting both through frame clip.
14. Install left and right side radiator covers.
15. Fill engine with oil. See 1.7 ENGINE OIL AND FILTER.
16. Install air filter bottom, velocity stacks, O-rings and breather hose. See 1.3 AIRBOX AND AIR FILTER.
17. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through filler neck. See 6.3 ENGINE COOLANT.
18. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and reinstall pressure cap.
19. Install air filter, air filter top and air filter cover. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

CAUTION

Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)

CAUTION

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

20. Reinstall the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
21. Install right side cover and maxi-fuse.
22. After running engine, inspect oil fittings for oil leaks. Check oil level and add oil if required.
23. After running engine, check coolant level in overflow bottle with coolant cold with motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
24. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand.

OIL COOLER 6.9

REMOVAL

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

1. Allow cooling system to cool.
2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a).

3. Remove negative battery cable.
4. Remove oil lines from oil fittings. See 6.7 OIL LINE FITTINGS.
5. Remove the radiator/oil cooler assembly. See 6.8 RADIATOR/OIL COOLER.
6. See Figure 6-25. With assembly on bench and holding a cup under each line, remove the fasteners holding oil line manifolds to oil cooler. Discard O-rings.
7. If replacing oil lines:
   a. Remove oil line bracket fastener and bracket with spacers bushings, grommets and washers.
   b. Cut cable wraps around drain hose and oil lines.
   c. Remove drain hose and oil cooler outlet and inlet pipes.
8. Cut cable wrap holding expansion bottle drain hose to oil cooler.
9. Remove fasteners holding oil cooler to engine coolant radiator. Remove oil cooler.

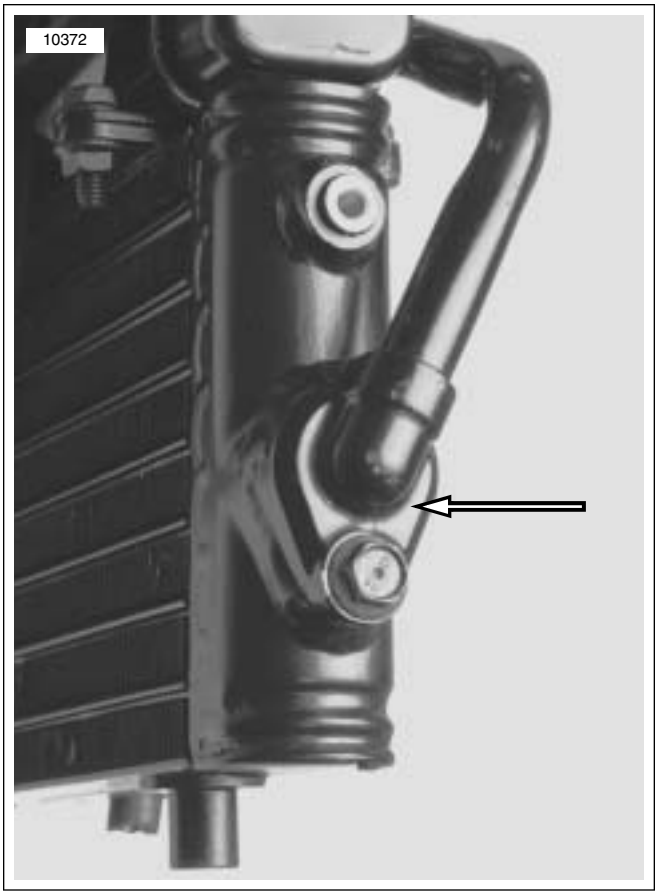


Figure 6-26. Oil Line Manifold

INSTALLATION

1. See Figure 6-27. Install oil cooler to engine coolant radiator. Tighten front and rear fasteners (4) to 10-12 Nm (89-106 **in-lbs**).
2. If installing oil pipes:
   a. Route oil pipes in front and over top of engine coolant radiator.
   b. Install radiator oil line bracket (2) over the oil lines and tighten fastener to 8-10 Nm (71-88 **in-lbs**).
   c. Install **new** O-rings in the oil cooler ports.
   d. Install fasteners holding oil line manifolds to oil cooler. Tighten to 8-10 Nm (71-88 **in-lbs**).
   e. Route drain hose (1) on centerline of oil cooler.

NOTE

Incorrect routing of drain hose may cause interference with radiator cover.

   f. Cable wrap (5) oil lines (7, 3) and drain hose (1) to coolant radiator at upper and lower points on straight portion prior to bend in lines.
   g. Cable wrap end of drain hose through oil cooler cooling fins (6).
   h. See Figure 6-25. Install spacer, bushings grommet, and washers to radiator/oil cooler assembly mounting bracket.
3. Install the radiator/oil cooler assembly. See 6.8 RADIATOR/OIL COOLER.

CAUTION

Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)

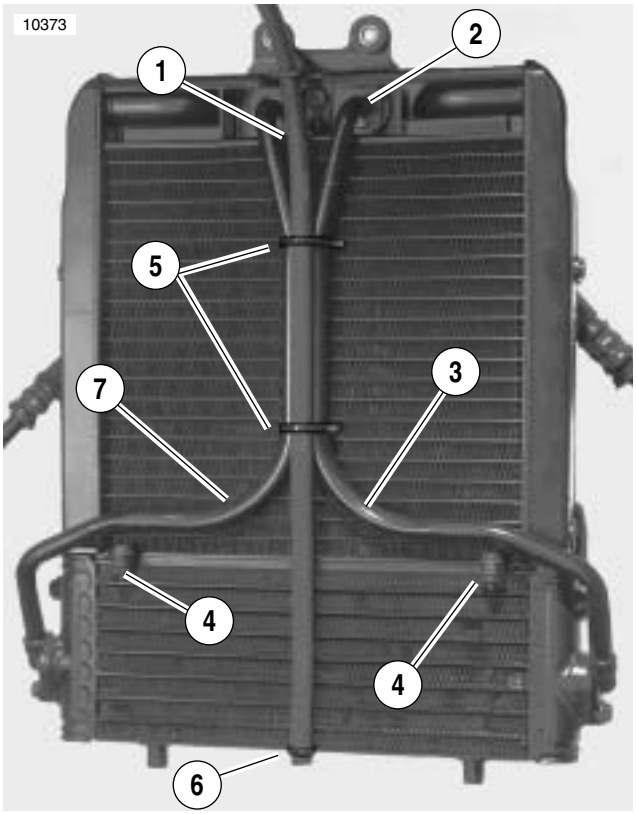
CAUTION

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

4. Install the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
5. Install maxi-fuse and right side cover.
6. After running engine:
   a. Inspect oil pipes and fittings for oil leaks.
   b. Check oil level and add oil if required.
   c. Check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand and add coolant if required.



1. **Drain hose**
2. **Oil line bracket**
3. **Oil line to crankcase**
4. **Oil cooler to radiator fasteners @ 10-12 Nm (89-106 in-lbs)**
5. **Cable wrap**
6. **Cable wrap through cooling fins**
7. **Oil line from oil filter**

Figure 6-27. Radiator/Oil Cooler Assembly

NOTES

Table Of Contents

SUBJECT **PAGE NO.**

TRANSMISSION 7

SPECIFICATIONS 7.1

Table 7-1. Primary Gearing

ENGINE OUTPUT	TRANSMISSION INPUT	RATIO
64	117	1.828

Table 7-2. Transmission Gearing

GEAR	INPUT	OUTPUT	RATIO
1st	18	45	2.500
2nd	25	42	1.680
3rd	29	39	1.345
4th	31	36	1.161
5th	25	26	1.040

Table 7-3. Secondary Gearing

TRANSMISSION OUTPUT	REAR WHEEL	RATIO
30 (HDI)	72	2.4
28 (DOM)	72	2.571

Table 7-4. Overall Gear Ratio (HDI)

GEAR	RATIO
1st	10.969
2nd	7.371
3rd	5.900
4th	5.095
5th	4.563

Table 7-5. Overall Gear Ratio (DOM)

GEAR	RATIO
1st	11.752
2nd	7.898
3rd	6.322
4th	5.459
5th	4.889

TORQUE VALUES

ITEM	TORQUE		NOTES
Drive sprocket flange nut	160 Nm	118 ft-lbs	page 7-3
Drive sprocket flange seal retainer fasteners	23 Nm	17 ft-lbs	page 7-3
Drive sprocket locking bolts	88-102 Nm	65-75 ft-lbs	page 7-3
Drive sprocket flange nut	160 Nm	118 ft-lbs	page 7-7

DRIVE SPROCKET FLANGE 7.2

REPLACEMENT

PART NO.	SPECIALTY TOOL
HD-45331-A	Final drive sprocket flange locking tool
HD-45332	Final drive sprocket locking device installer

NOTE

The drive sprocket flange can be replaced on the transmission output shaft with the shaft removed from the engine cases. See DISASSEMBLY - 2ND GEAR END under 7.3 OUTPUT SHAFT. The following procedure replaces the drive sprocket flange without removing the engine from the motorcycle.

1. Remove the fasteners and the drive sprocket cover. See 1.17 DRIVE BELT REPLACEMENT.
2. With rear wheel on ground, loosen retaining bolts holding drive sprocket to drive sprocket flange.
3. Support motorcycle with rear wheel off the ground. Remove snap ring and loosen rear wheel axle nut. Move wheel forward and slip belt off wheel sprocket. Pull belt off of drive sprocket.
4. Remove drive sprocket retaining bolts from drive sprocket. Discard bolts.
5. Rotate sprocket to fit spoke pattern of mounting flange and remove sprocket.
6. See Figure 7-2. Use awl to remove the flange nut lock ring (4) from the drive sprocket flange (1).
7. Remove the plastic cap (5).
8. Fit the lock pins of the FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (HD-45331-A) to the sprocket mounting holes in the drive sprocket flange (1).

CAUTION

Do not use an impact wrench to remove or install the drive sprocket flange nut. Damage to the threads on the output shaft of the transmission can result.

9. Fit a thin-wall 30 mm socket onto the flange nut.
10. See Figure 7-1. Holding the FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (HD-45331-A) with a 1/2 in. drive breaker bar in the square hole, loosen and remove the flange nut.

NOTE

Drive sprocket flange nut is one time use only, but do not discard at this time. Retain removed nut to pull flange on shaft during assembly.

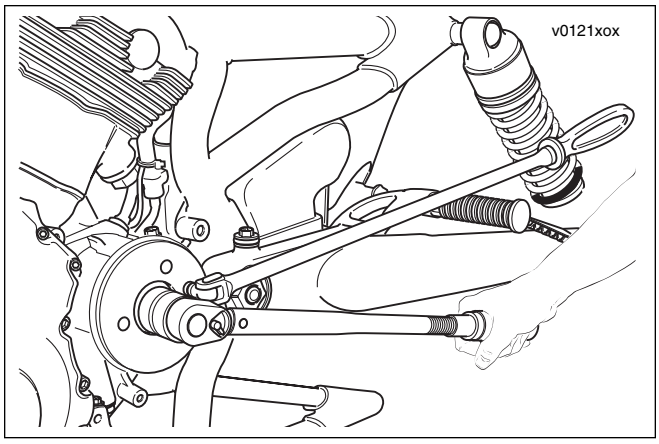
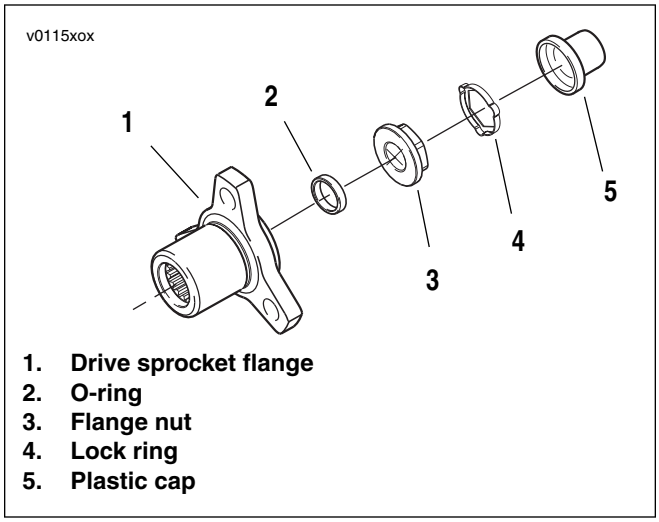


Figure 7-1. Loosen Output Shaft Nut with Final Drive Sprocket Flange Locking Tool (HD-45331-A) (typical) (VRSCA shown)



1. **Drive sprocket flange**
2. **O-ring**
3. **Flange nut**
4. **Lock ring**
5. **Plastic cap**

Figure 7-2. Drive Sprocket Flange Components

11. Obtain three 3/8 x 5 in. bolts with washers and nuts. Install a Metric Bolt Grip Puller Set (Snap-on Part No. DC2001) onto the flange and shaft. Remove the drive sprocket flange.

NOTE

The drive sprocket flange seal is held in place with a retainer. It is recommended that the seal be replaced anytime the drive sprocket flange is removed.

12. Remove the fasteners and the seal retainer.
13. Remove and discard the flange seal and O-ring.
14. Install a **new** O-ring and **new** flange seal in the seal retainer. Lubricate the flange seal with Harley-Davidson Motorcycle oil 20W50.
15. Slide the seal retainer on the drive sprocket flange. and slide the splined drive sprocket flange onto the output shaft.
16. Install the FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (HD-45331-A). Hold the tool with a 1/2 in. drive extension.

CAUTION

Do not attempt to drive flange on with a hammer. Damage to the output shaft can result.

CAUTION

Do not use an impact wrench to remove or install the drive sprocket flange nut. It can damage the threads on the output shaft of the transmission.

17. Use the old flange nut to pull the drive sprocket flange onto the shaft.
18. Remove and discard the old flange nut.
19. Install a **new** O-ring behind the flange nut and install the **new** flange nut.
20. Tighten the flange nut to 160 Nm (118 ft-lbs).
21. Install fasteners in seal retainer and tighten in a alternating pattern to 23 Nm (17 ft-lbs).
22. See Figure 7-2. Position locking ring (4) over the flange nut (3).
23. See Figure 7-14. With three 3/8x5 in. bolts with washers and nuts and install a Metric Bolt Grip Puller Set (Snap-on Part No. CJ2001) onto the flange and shaft.

CAUTION

Never use a hammer to hit on the Final Drive Sprocket Locking Device Installer (HD-45332). Damage to output shaft bearing could result.

24. Turn screw down against the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (HD-45332) to crimp lock ring in position.
25. Cap flange nut.
26. Install drive sprocket by matching spokes of drive sprocket to open spaces of mounting flange and rotating sprocket to align sprocket bolt holes behind mounting flange bolt holes.
27. Install and tighten three **new** locking bolts to 88-102 Nm (65-75 ft-lbs).
28. Install the belt and the drive sprocket cover. See 1.17 DRIVE BELT REPLACEMENT.

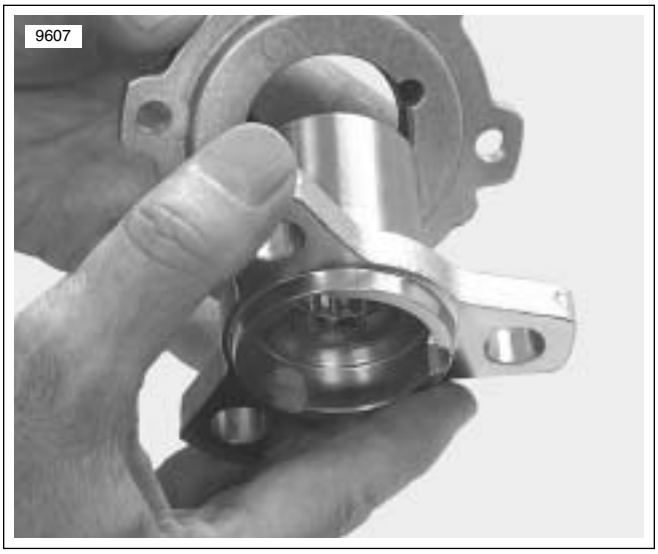


Figure 7-3. Seal Retainer and Drive Sprocket Flange

OUTPUT SHAFT 7.3

GENERAL

This procedure starts with the input shaft and output shaft removed from the engine. See 3.11 UPPER AND LOWER CRANKCASE SERVICE for removal of input shaft and output shaft.

DISASSEMBLY - 2ND GEAR END

Bearing Removal - 2nd Gear End

PART NO.	SPECIALTY TOOL
HD-45331-A	Final drive sprocket flange locking tool

1. See Figure 7-4. Remove lock ring from output flange nut.
2. See Figure 7-5. Place output shaft in FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (HD-45331-A) to remove the output shaft nut, use a 30 mm socket cut down to 39.6 mm (1.56 in.) to clear the flange.

NOTE

Output flange nut is one time use only, but do not discard at this time. Retain removed nut to pull flange on shaft during assembly.

3. See Figure 7-6. Obtain three 3/8 x5 inch bolts with washers and nuts and install a Metric Bolt Grip Puller Set (Snap-on Part No. CJ2001) onto the flange and shaft. Remove output shaft drive flange and seal retainer.
4. See Figure 7-7. Remove output shaft bearing.

NOTE

If no further disassembly of this end is needed, go to step 5. If further disassembly is needed, go to step 13.

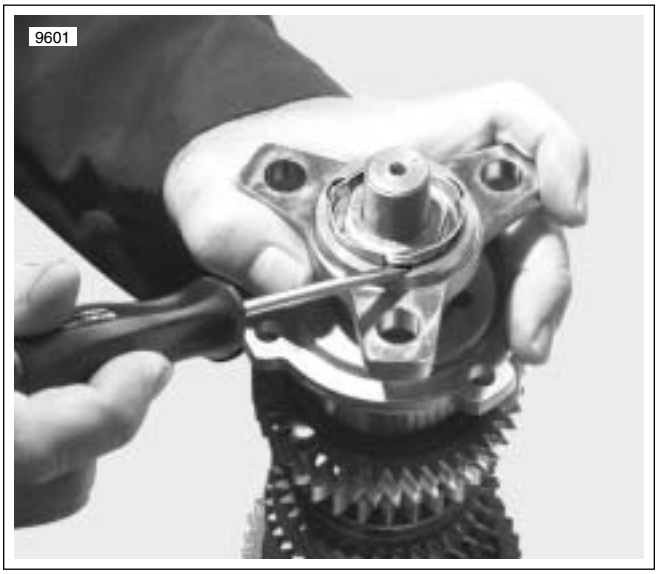


Figure 7-4. Output Shaft Lock Ring

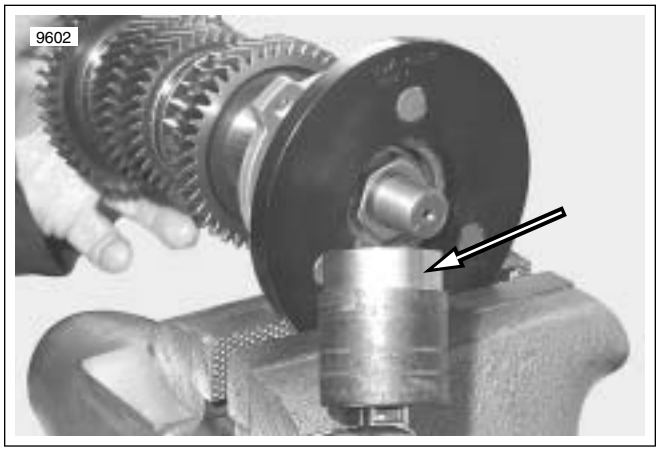


Figure 7-5. Modify Socket for Output Nut Removal

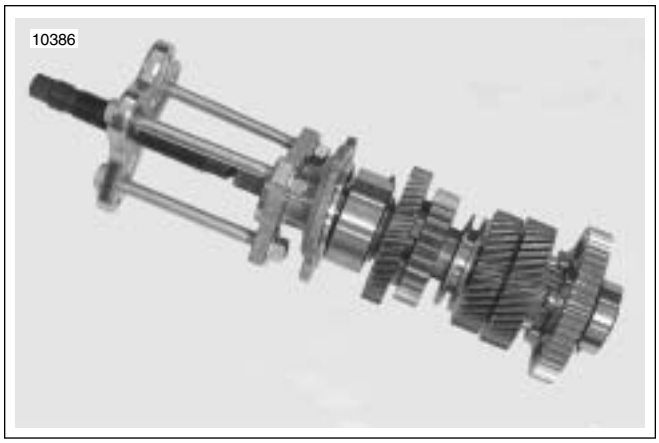


Figure 7-6. Removing Output Drive Flange

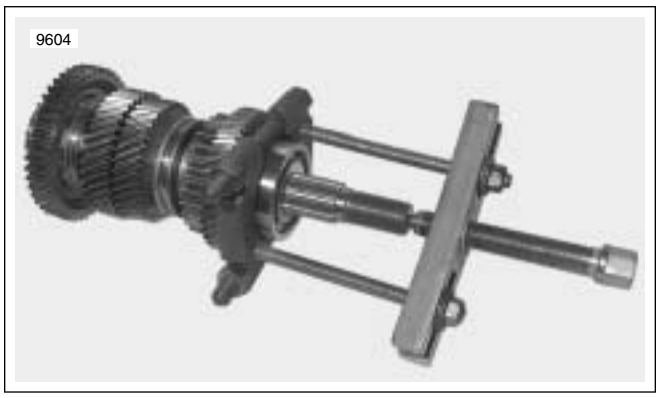


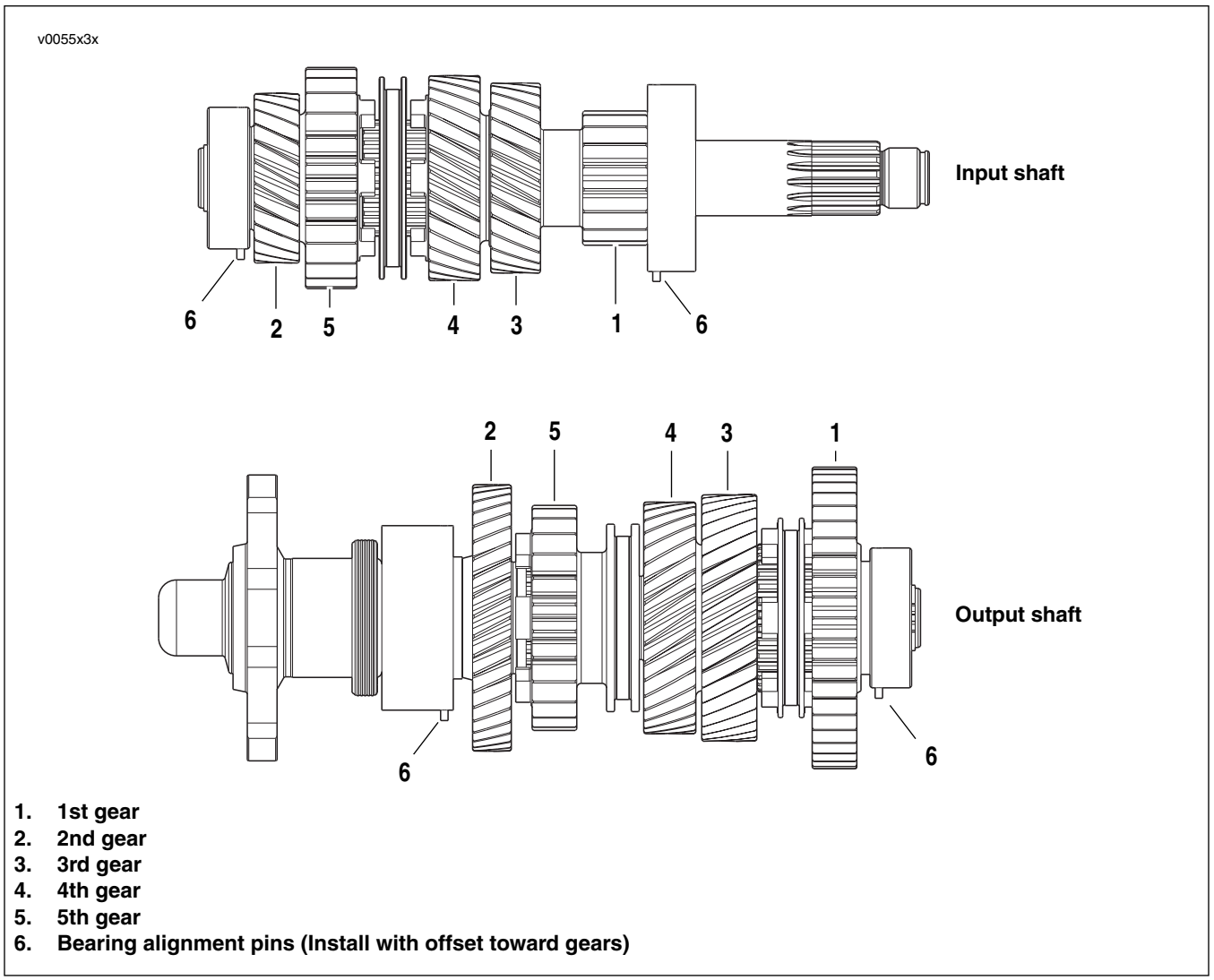
Figure 7-7. Output Shaft Bearing

Bearing Installation - 2nd Gear End

PART NO.	SPECIALTY TOOL
HD-45331-A	Final drive sprocket flange locking tool
HD-45332	Final drive sprocket locking device installer

5. See Figure 7-9. and Figure 7-8. Lubricate **new** bearing. Position bearing on shaft with bearing alignment pin offset toward gears and press onto shaft. Use a pressing ring so installation force is on the inner race only.

Figure 7-8. Output Shaft Bearing



1. **1st gear**
2. **2nd gear**
3. **3rd gear**
4. **4th gear**
5. **5th gear**
6. **Bearing alignment pins (Install with offset toward gears)**

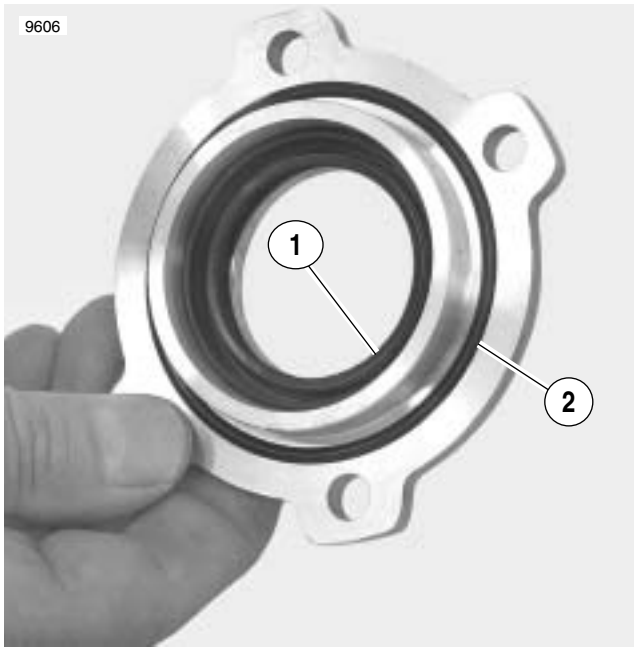
Figure 7-9. Transmission Input Shaft and Output Shaft Assemblies

6. See Figure 7-10. Replace flange seal and O-ring. Lubricate the flange seal with Harley-Davidson Motorcycle Oil 20W50.
7. See Figure 7-11. Slide seal retainer on the output flange.
8. Place output shaft in FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (HD-45331-A) to install the output shaft nut.

CAUTION

Do not attempt to drive flange on with a hammer. Damage to the output shaft can result.

9. Use the **old** output shaft nut to pull the output flange on the shaft.
10. See Figure 7-12. Remove and discard the **old** output shaft nut.



1. Drive flange seal
2. O-ring

Figure 7-10. Seal Retainer

Figure 7-11. Seal Retainer and Output Flange

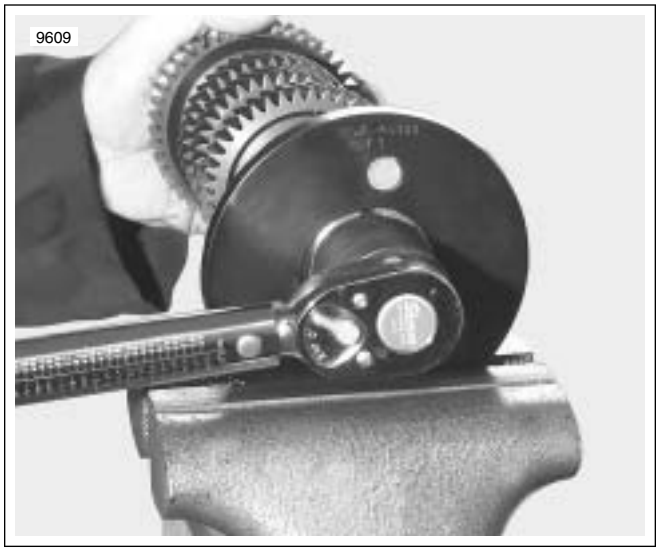
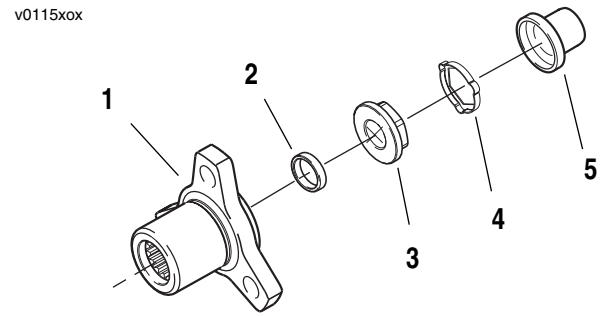


Figure 7-12. Remove/Tighten Output Shaft Nut

11. See Figure 7-13. Install a **new** O-ring (2) behind a **new** drive sprocket flange nut (3) and install the **new** flange nut (3). Tighten nut to 160 Nm (118 ft-lbs).
12. Position lock ring (4) over flange nut (3).
13. See Figure 7-14. With three 3/8 x5 inch bolts with washers and nuts and install a Metric Bolt Grip Puller Set (Snap-on Part Number CJ2001) onto the flange and shaft. Turn screw down against the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (HD-45332) to crimp lock ring in position.
14. Cap nut.

CAUTION

Never use a hammer to hit on the Final Drive Sprocket Locking Device Installer (HD-45332). Damage to output shaft bearing could result.



1. **Output shaft flange**
2. **O-ring**
3. **Flange nut**
4. **Lock ring**
5. **Plastic cap**

Figure 7-13. Output Shaft Components

Figure 7-14. Crimping Output Shaft Nut Lock-Ring

15. See Figure 7-15. Remove ground washer.
16. See Figure 7-16. Remove 2nd gear.
17. See Figure 7-17. Remove split cage bearing and hardened washer.
18. See Figure 7-18. Remove 5th gear.

NOTE

4th gear is part of output shaft and is not removable. Damage to 4th gear requires replacement of the output shaft.

Figure 7-15. Remove Ground Washer

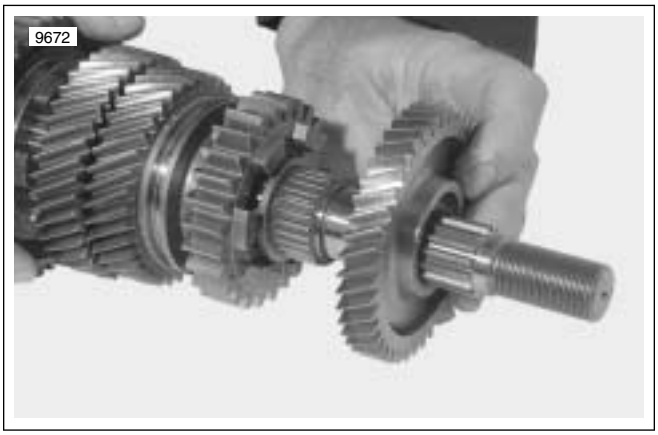


Figure 7-16. 2nd Gear

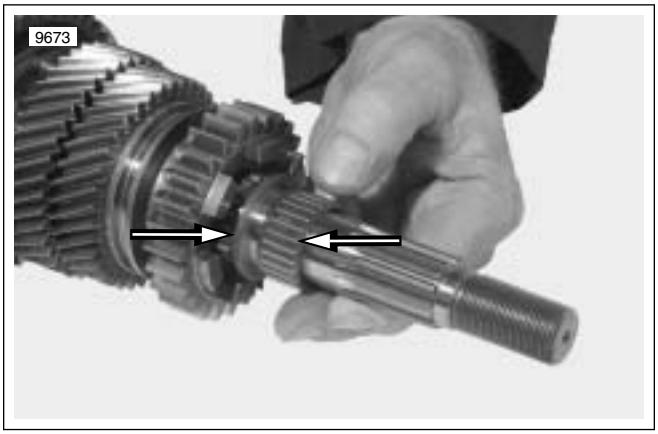


Figure 7-17. Bearing and Washer

Figure 7-18. 5th Gear

ASSEMBLY - 2ND GEAR END

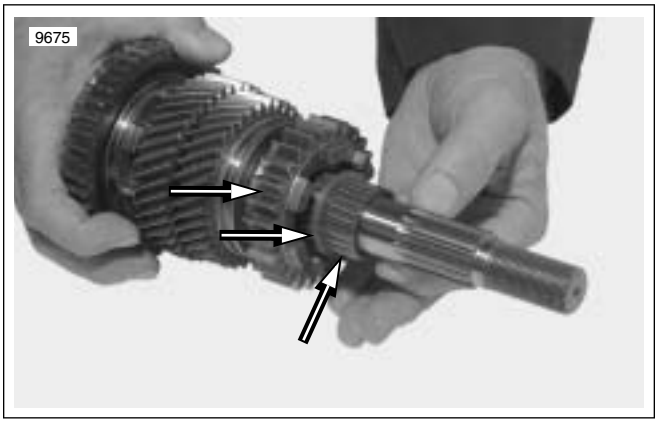


Figure 7-19. 5th Gear Installation

1. See Figure 7-19. Install 5th gear ground washer and split cage bearing.

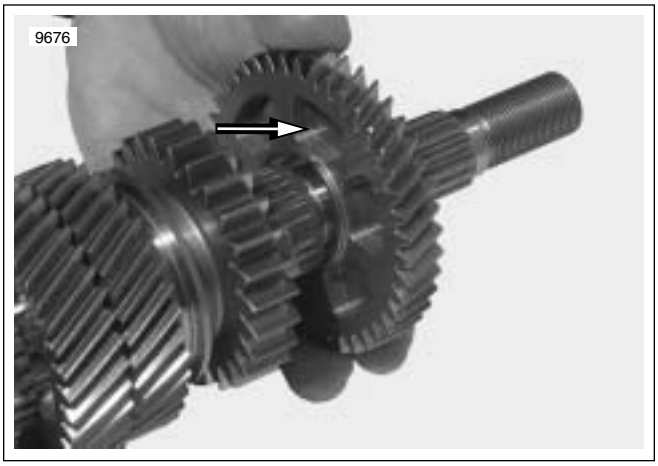


Figure 7-20. 2nd Gear Installation

2. See Figure 7-20. Install 2nd gear. Note 2nd gear pockets are installed toward the 5th gear engagement dogs.

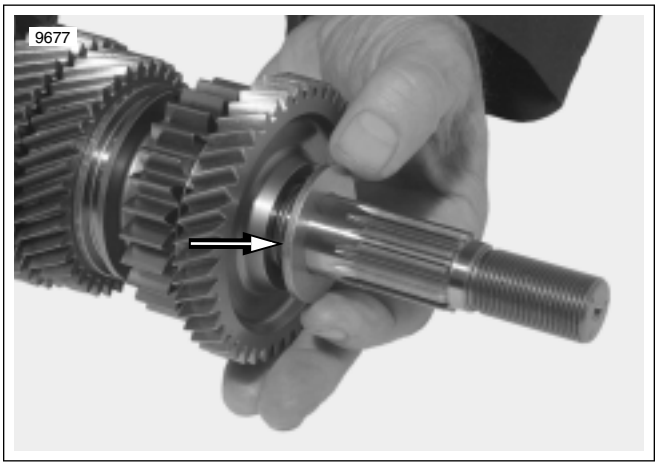


Figure 7-21. Hardened Washer

3. See Figure 7-21. Install hardened washer.
4. To complete output shaft assembly - 2nd gear end, go to Bearing Installation - 2nd Gear End.

Bearing Removal - 1st Gear End

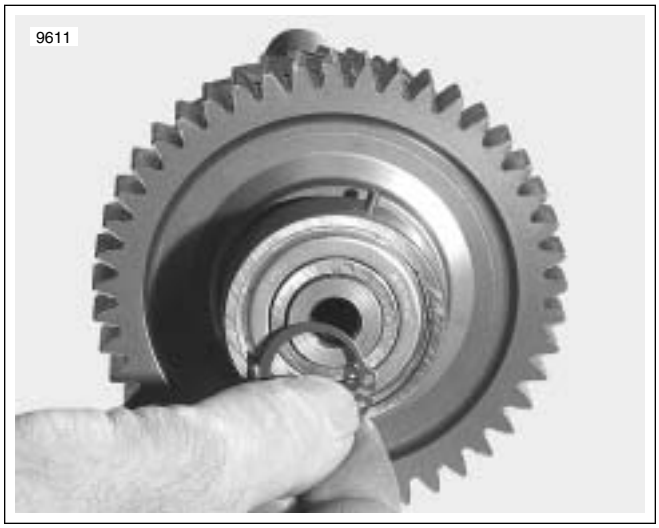


Figure 7-22. 1st Gear Bearing Retaining Ring

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

5. See Figure 7-22. Remove the retaining ring from the 1st gear bearing end of the output shaft.

Figure 7-23. 1st Gear Bearing Removal

6. See Figure 7-23. Remove and discard 1st gear bearing.

NOTE

Once removed, transmission bearings MUST be replaced.

NOTE

If no further disassembly of this end is needed, go to step 7.
If further disassembly of this end is needed, go to step 8.

Bearing Installation - 1st Gear End

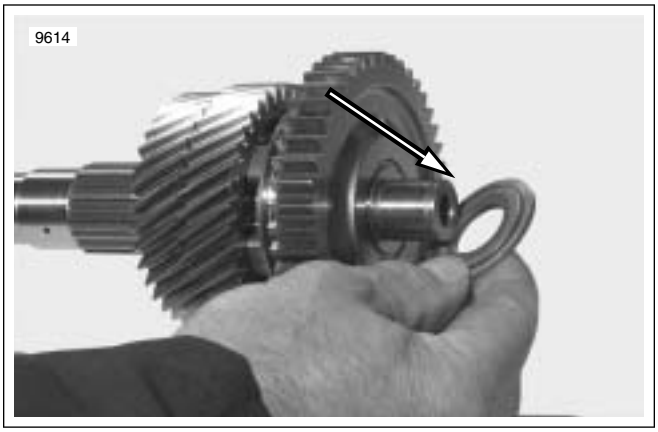


Figure 7-24. Thrust Washer

7. See Figure 7-24. Check position of stepped thrust washer. Step should face 1st gear, flat side toward bearing.

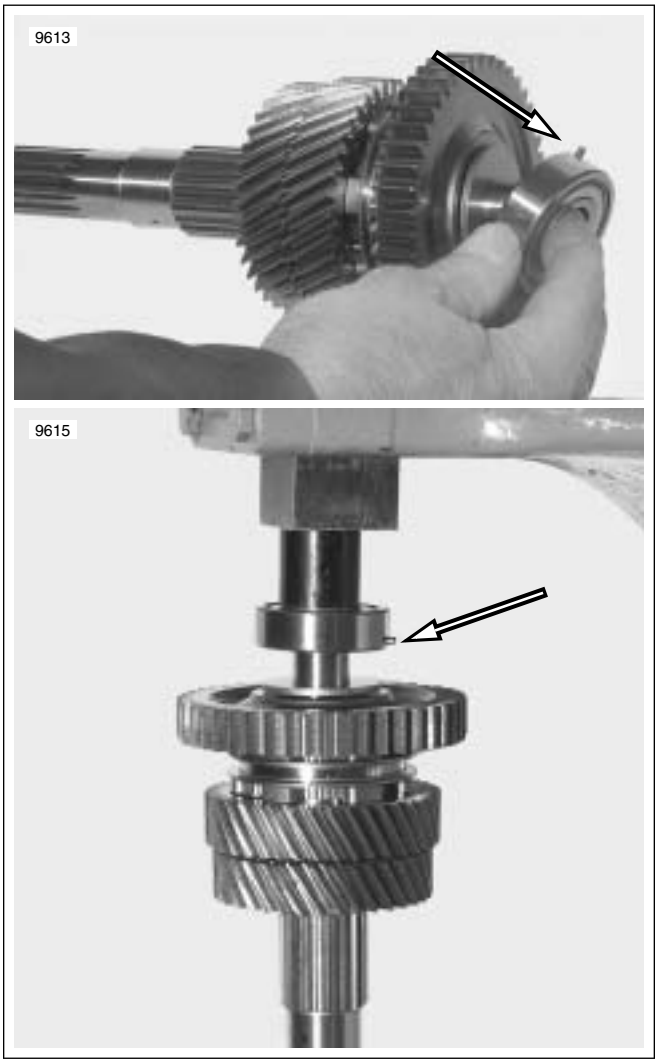


Figure 7-25. 1st Gear Bearing Installation

8. See Figure 7-25. Install **new** bearing with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

9. Install retaining ring.
10. See Figure 7-9. Remove stepped washer and 1st gear (1).

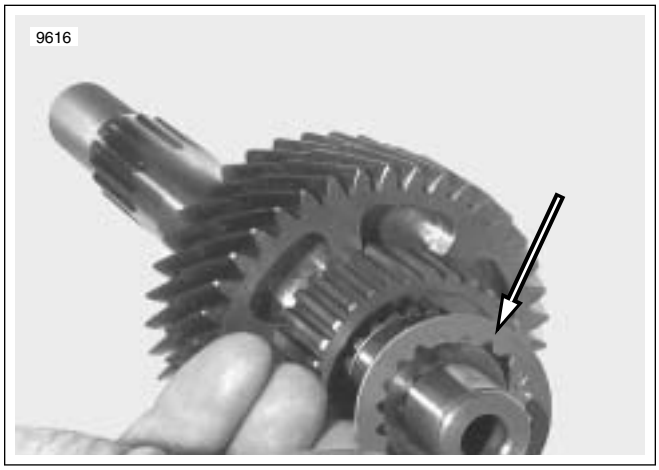


Figure 7-26. Splined Washer

11. See Figure 7-26. Remove splined washer.

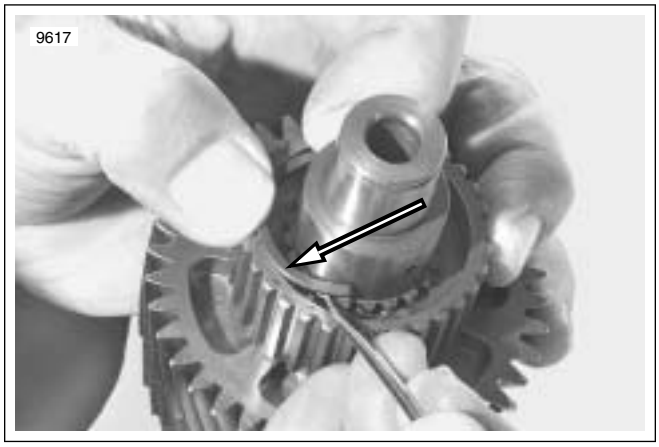


Figure 7-27. Half Moon Keepers

12. See Figure 7-27. Remove the half moon keepers.

13. See Figure 7-28. Remove the splined slider.
14. See Figure 7-29. Remove half moon keepers.
15. See Figure 7-30. Remove 3rd gear and split cage needle bearing.

NOTE

Fourth (4th) gear is part of the output shaft and is not removable.

Figure 7-28. Splined Slider

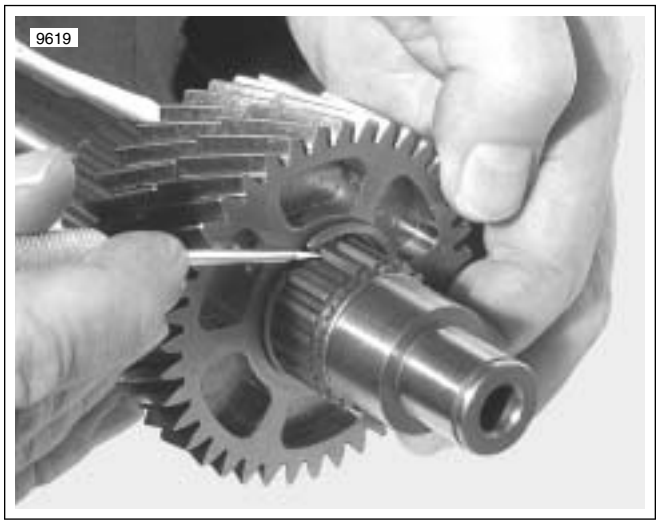


Figure 7-29. Half Moon Keepers

Figure 7-30. 3rd Gear

ASSEMBLY - 1ST GEAR END

Carefully clean and inspect parts to be reused. Examine gears for cracks, chipping and excessive wear.

1. See Figure 7-31. Install split cage needle bearing. Install 3rd gear.
2. See Figure 7-32. Install half moon keepers.
3. See Figure 7-33. Install splined slider.
4. See Figure 7-34. Install half moon keepers.

Figure 7-31. 3rd Gear

Figure 7-32. Half Moon Keepers

Figure 7-33. Splined Slider

Figure 7-34. Half Moon Keepers

5. See Figure 7-35. Install splined thrust washer with flat side out as shown.
6. See Figure 7-36. Install shift fork slider.
7. See Figure 7-37. Install 1st gear.
8. To complete output shaft assembly - 1st gear end, go to Bearing Installation - 1st Gear End.

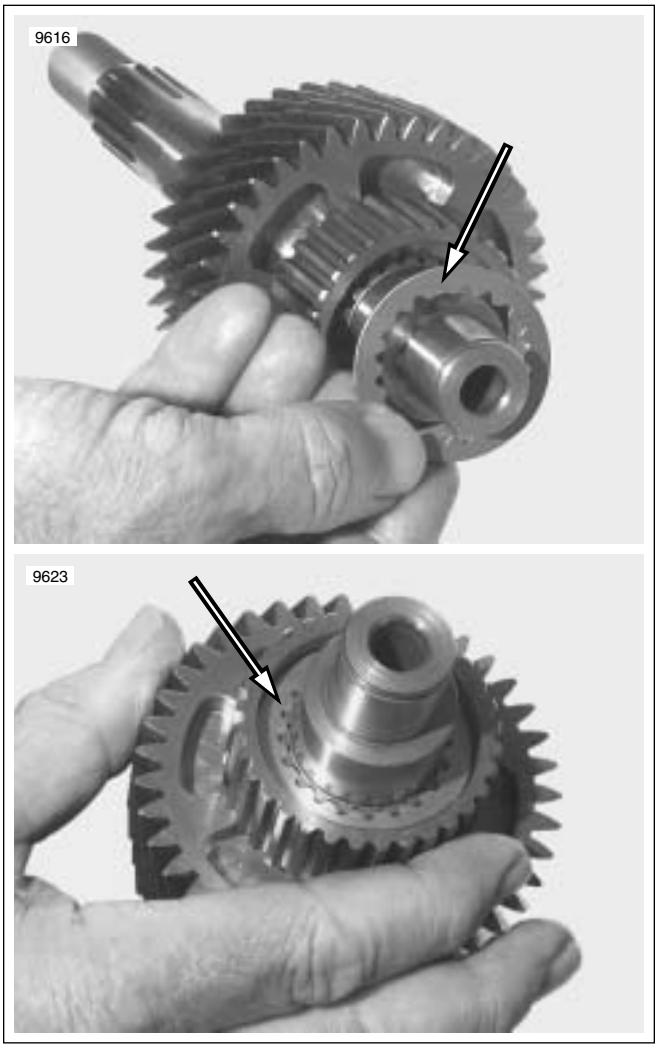


Figure 7-35. Splined Thrust Washer

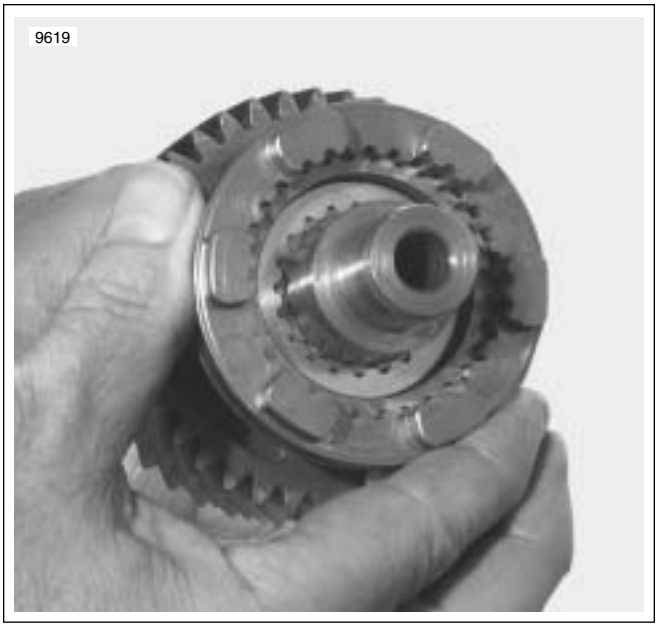


Figure 7-36. Shift Fork Slider

Figure 7-37. 1st Gear

DISASSEMBLY - 2ND GEAR END

Bearing Removal - 2nd Gear End

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

1. See Figure 7-38. Remove retaining ring at 2nd gear crankcase bearing.

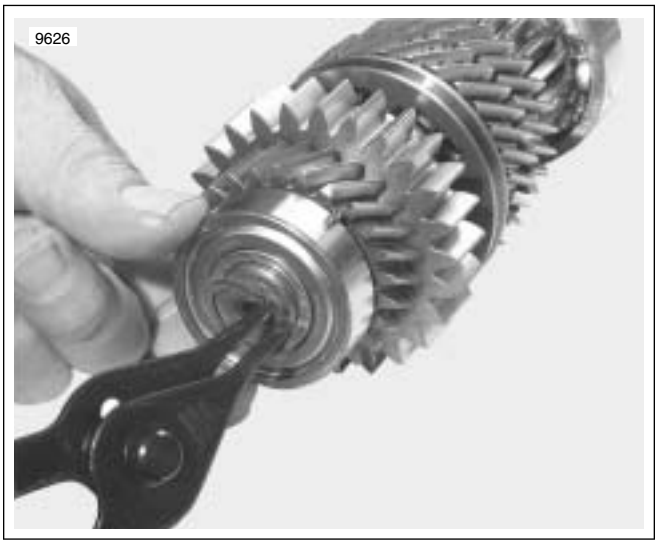


Figure 7-38. 2nd Gear Bearing Retaining Ring

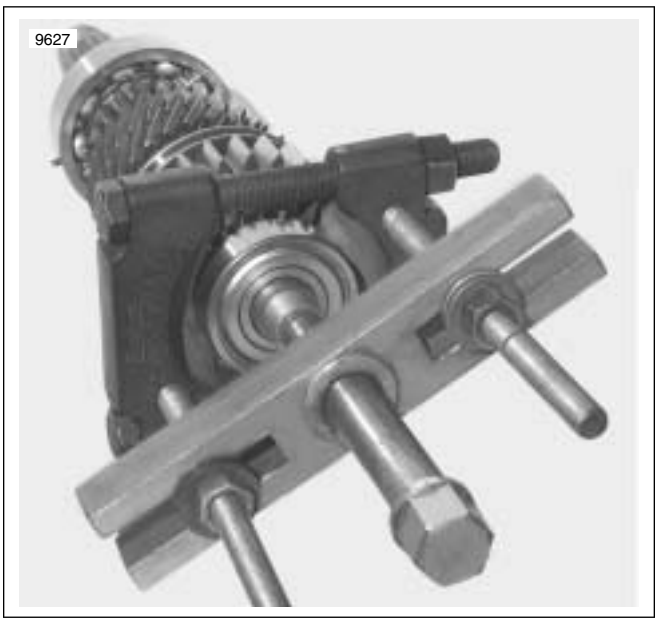


Figure 7-39. 2nd Gear Bearing Removal

2. See Figure 7-39. Use puller to remove 2nd gear bearing. To protect the end of the shaft use END CAP (HD-34902), part of BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER (HD-34902-B).

NOTE

If no further disassembly of this end is needed go to step 3. If further disassembly of this end is needed go to step 4.

Bearing Installation - 2nd Gear End

3. See Figure 7-40. Install **new** bearing with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

Figure 7-40. 2nd Gear Bearing Alignment Pin

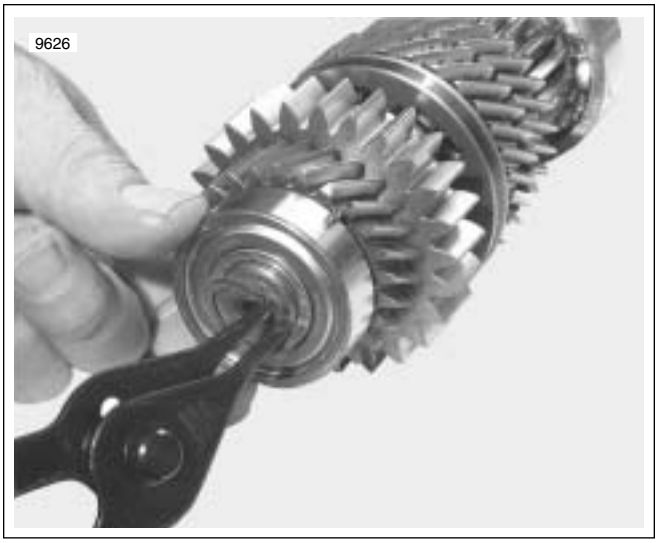


Figure 7-41. 2nd Gear Bearing Retaining Ring

4. See Figure 7-41. Install retaining ring.

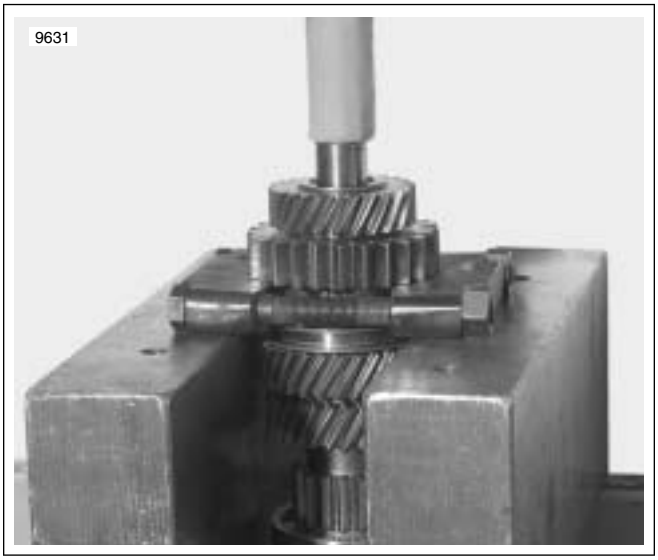


Figure 7-42. 2nd and 5th Gear Removal

5. See Figure 7-42. Place a puller clamp behind 5th gear and press off 2nd and 5th gear. Support the input shaft when removing the gears.

NOTE

2nd gear is an interference fit and MUST be replaced when removed from the input shaft regardless of its condition.

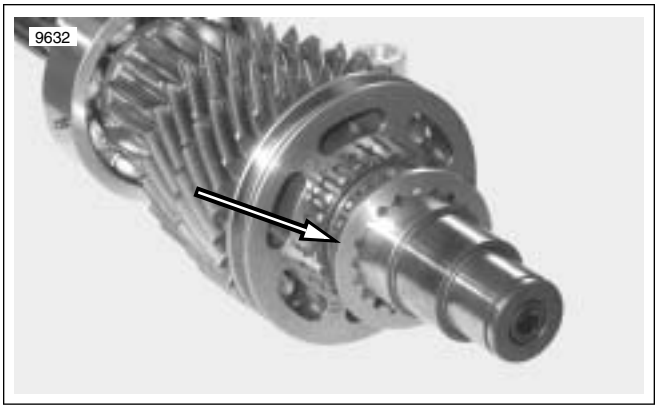


Figure 7-43. Splined Thrust Washer

6. See Figure 7-43. Remove the splined thrust washer.

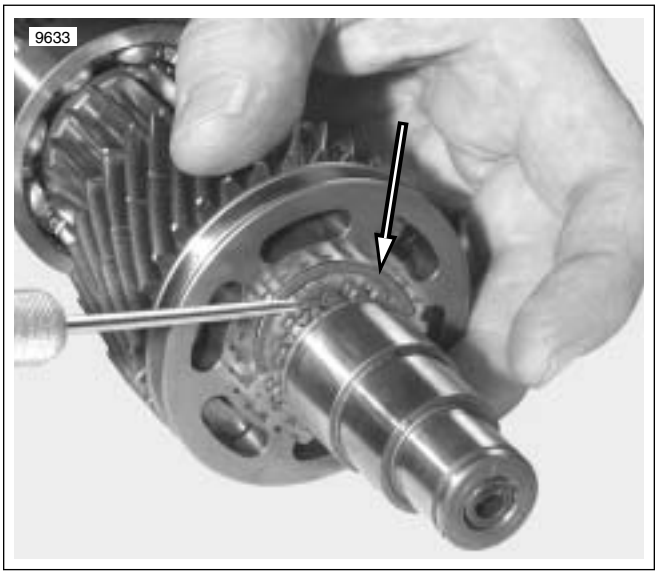


Figure 7-44. Half Moon Keepers

7. See Figure 7-44. Remove half moon keepers.

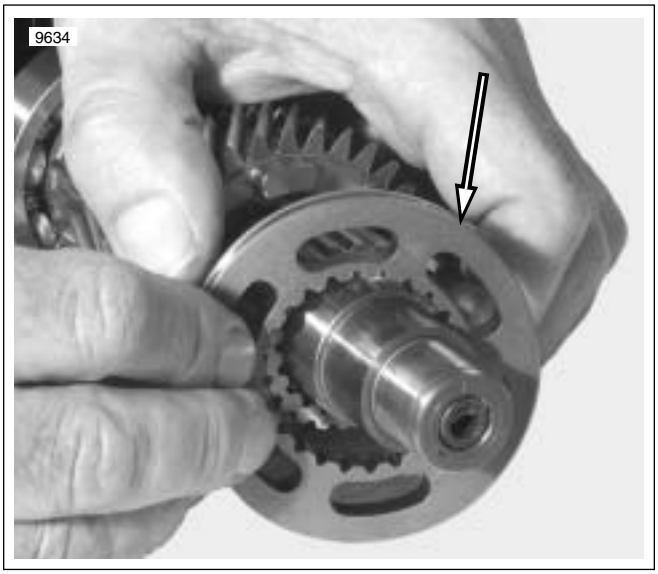


Figure 7-45. Shifting Fork Ring

8. See Figure 7-45. Remove shifting fork ring.

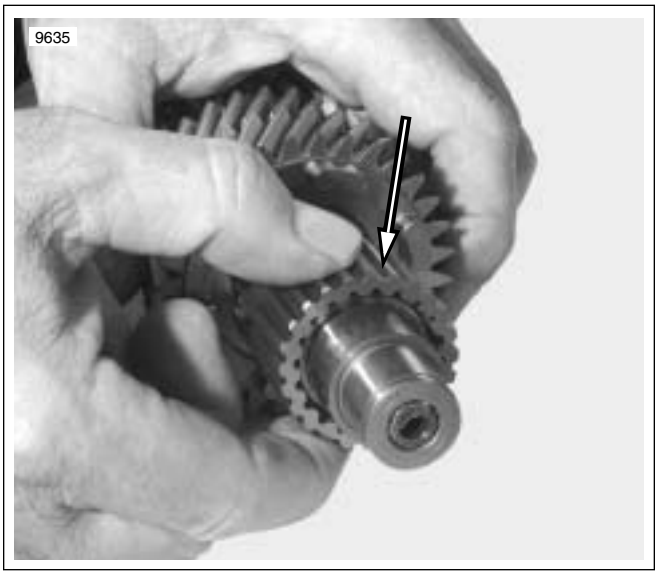


Figure 7-46. Splined Slider

9. See Figure 7-46. Remove splined slider.

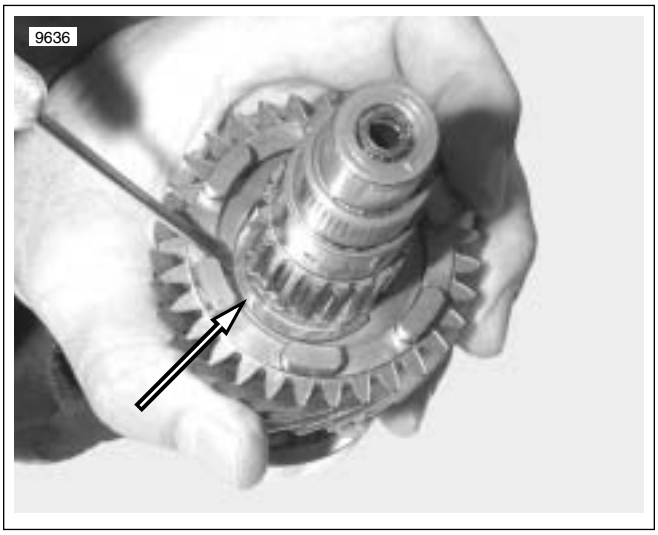


Figure 7-47. Half Moon Keepers

10. See Figure 7-47. Remove half moon keepers.

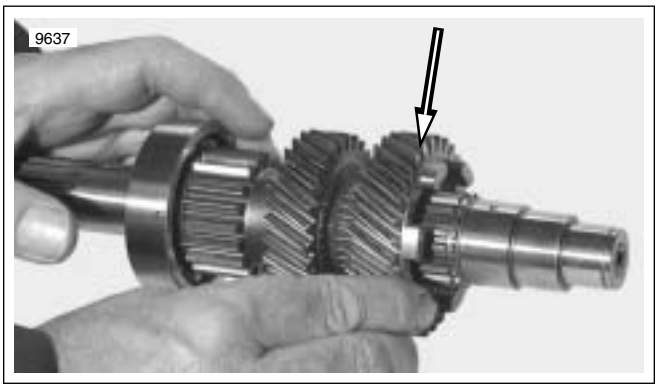


Figure 7-48. 4th Gear

11. See Figure 7-48. Remove 4th gear.

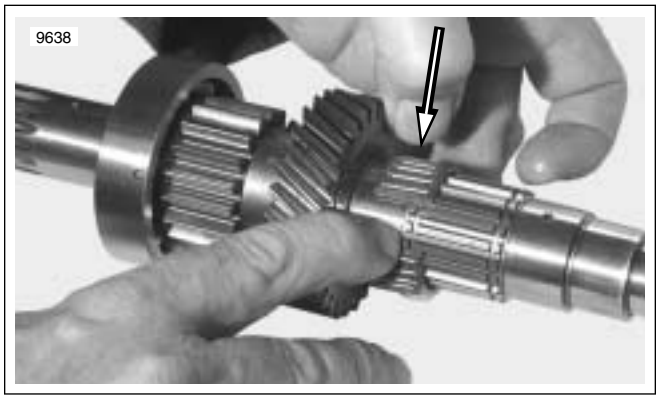


Figure 7-49. Split Cage Bearing

12. See Figure 7-49. Remove split cage bearing.

NOTE

See Figure 7-9. 1st gear and 3rd gear are part of the input shaft assembly and are not removable. Damage to 1st or 3rd gear requires replacement of the input shaft.

ASSEMBLY - 2ND GEAR END

1. See Figure 7-50. Lubricate **new** split cage bearing and position on shaft. Install 4th gear and place half moon keepers in position.

Figure 7-50. 4th Gear and Keepers

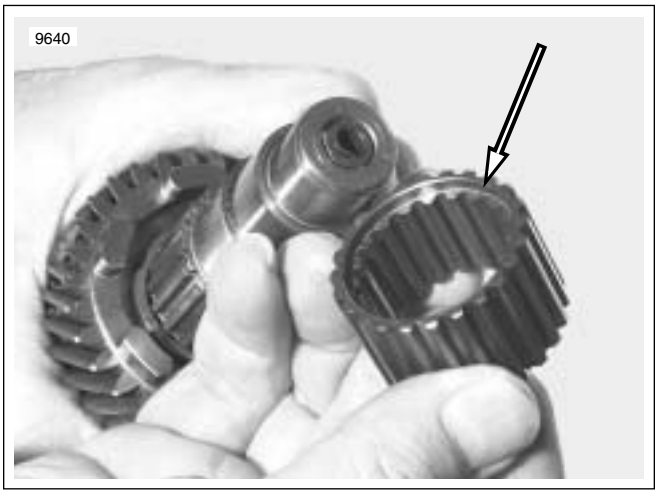


Figure 7-51. Splined Slider

2. See Figure 7-51. Insert splined slider with stepped side toward 4th gear.

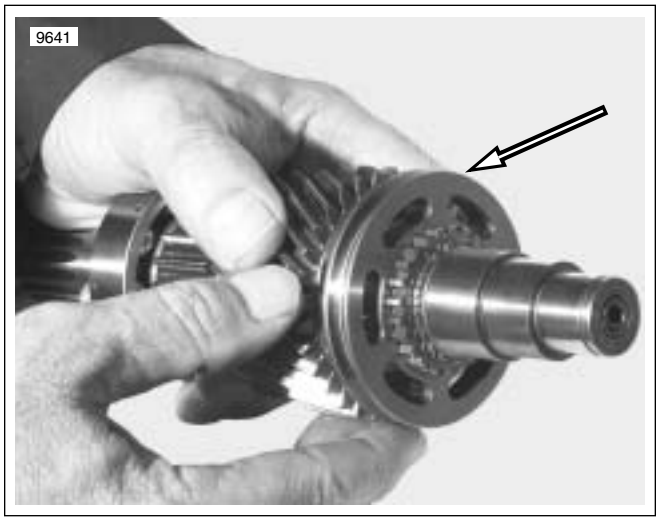


Figure 7-52. Shift Fork Slider

3. See Figure 7-52. Install shift fork slider.

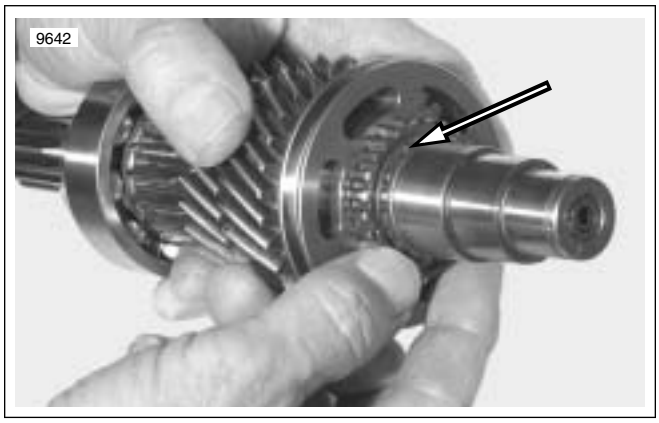


Figure 7-53. Half Moon Keepers

4. See Figure 7-53. Install half moon keepers.

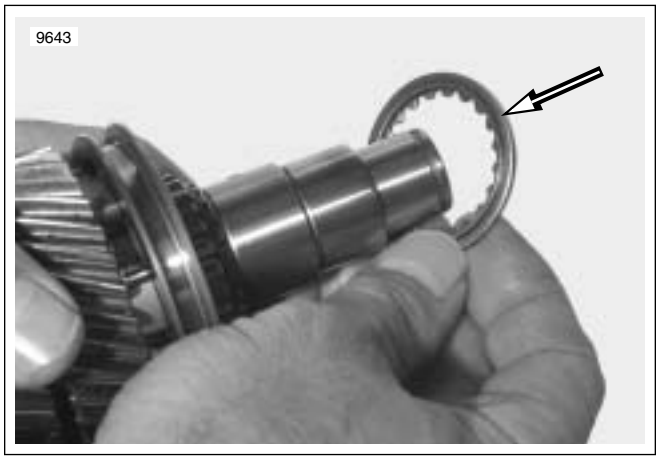


Figure 7-54. Splined Thrust Washer

5. See Figure 7-54. Install splined thrust washer, stepped side toward gears.

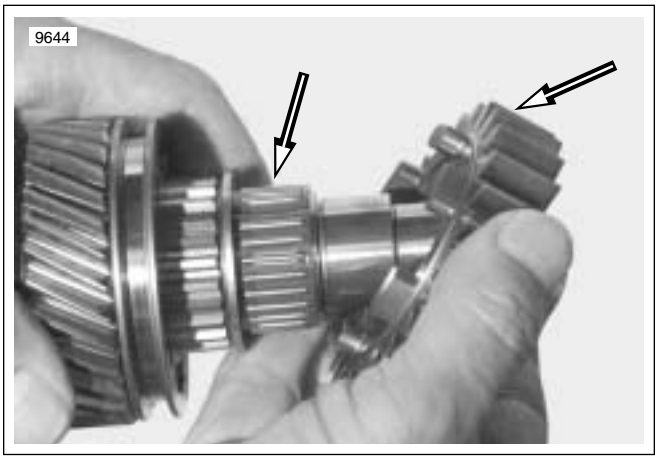


Figure 7-55. Bearing and 5th Gear

6. See Figure 7-55. Install lubricated **new** split cage bearing behind splined thrust washer. Install 5th gear over split cage bearing.

NOTE

2nd gear is an interference fit and MUST be replaced when removed from the input shaft, regardless of its condition.

7. See Figure 7-55. Install **new** 2nd gear. Use a pressing ring to clear the shaft. Press gear on shaft until it bottoms on the gearset.
8. To complete input shaft assembly -2nd gear end go to **Bearing Installation - 2nd Gear End**.

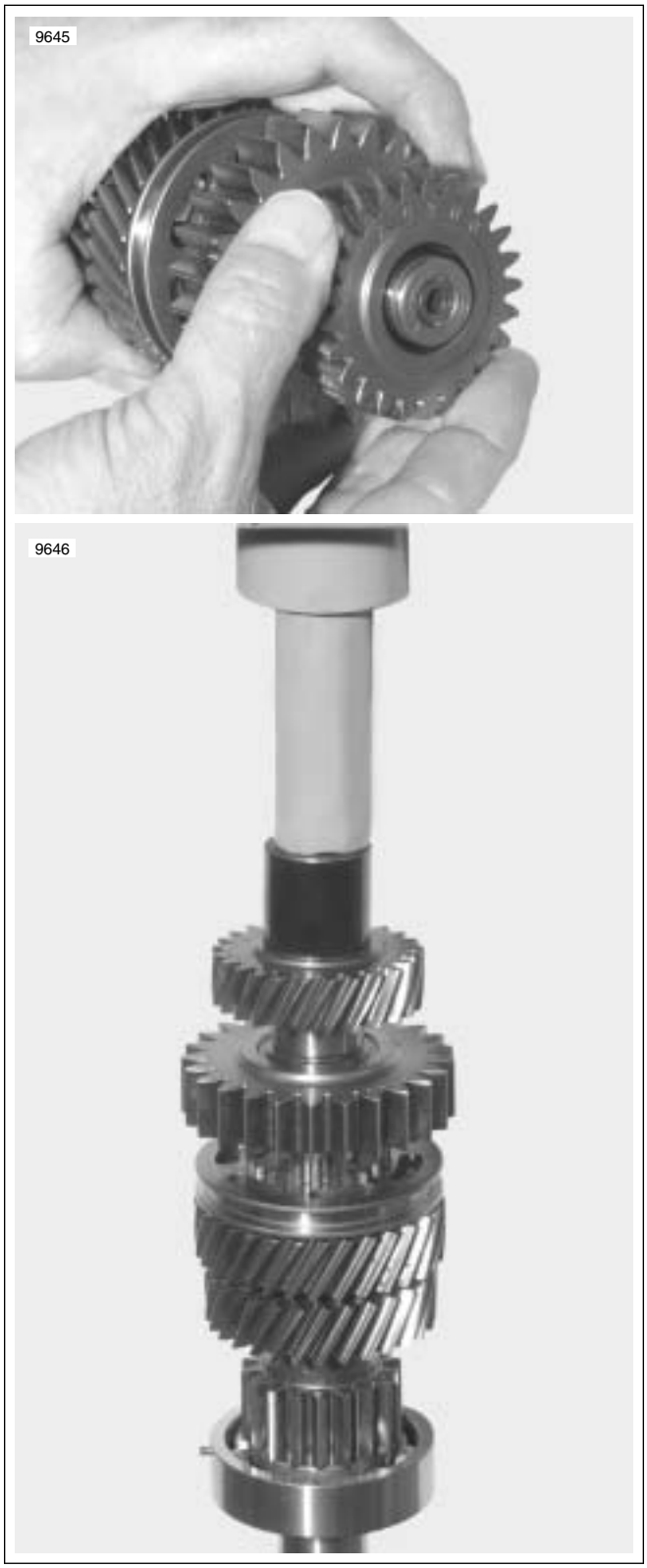


Figure 7-56. 2nd Gear

DISASSEMBLY - 1ST GEAR END

Bearing Removal - 1st Gear End

9. See Figure 7-57. Remove 1st gear crankcase bearing.

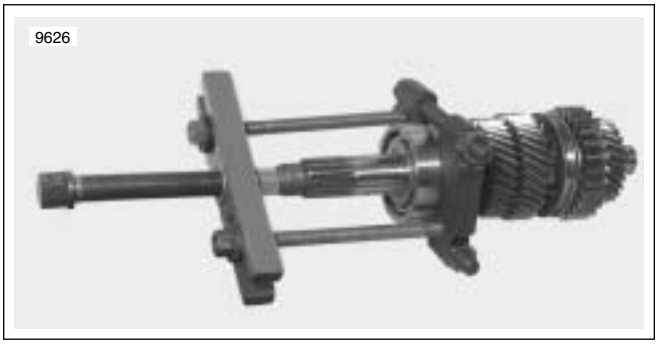


Figure 7-57. 1st Gear Bearing Removal

ASSEMBLY - 1ST GEAR END

Bearing Installation - 1st Gear End

10. See Figure 7-58. Install **new** bearing, with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.

Figure 7-58. 1st Gear Bearing Replacement

NOTES

Table Of Contents

SUBJECT **PAGE NO.**

ELECTRICAL 8

SPECIFICATIONS 8.1

Table 8-1. Ignition System Specifications

IGNITION	DATA
Idle speed	1150-1250 RPM
Spark plug size	12 mm
Spark plug gap	0.035 in.
	0.89 mm
Spark plug type	Harley-Davidson No. 10R12A (no substitute)
Ignition coil primary resistance	0.41 ± 0.04 ohms
Ignition coil secondary resistance	4000 ± 450 ohms

Table 8-2. Fuse Specifications

FUSE	RATING (AMPERES)
Maxi-fuse	40
Battery fuse (instrument console/fan relay)	15
Ignition fuse	15
Lighting fuse	15
Accessory fuse	15
ECM fuse	15
Security fuse	15
Fuel pump fuse	15

Table 8-3. Charging System Specifications

CHARGING SYSTEM	DATA
Battery	12 amp hour/200 CCA
Alternator AC voltage output, open circuit (at stator connector)	19 VAC ± 10% per 1000 rpm 22.5 VAC ± 10% @ idle (1200 rpm)
Alternator stator coil resistance	0.1 - 0.3 ohms
Regulator voltage output (with fully charged battery)	14.5 ± 0.25 volts @ 1200 rpm 68˚ F± 9˚ F(20˚ C ± 5˚ C)
Regulator current	22A min. @ 1200 RPM 36A min. @ 3500 RPM

TORQUE VALUES

ITEM	TORQUE		NOTES
CKP sensor fastener	8.2-10.7 Nm	73-95 **in-lbs**	page 8-7
Side cover fastener	4.1-6.8 Nm	36-60 **in-lbs**	page 8-8
Ignition/light switch fastener	6-10 Nm	53-88 **in-lbs**	page 8-9
Seat latch fasteners	6-10 Nm	53-88 **in-lbs**	page 8-9
Ignition/light switch fastener	6-10 Nm	53-88 **in-lbs**	page 8-10
Rotor fastener	See procedure	83 Nm (60 ft-lbs). Loosen one full turn and tighten to 180 Nm (132 ft-lbs)	page 8-12
Stator mounting fastener	8.2-10.7 Nm	72-95 **in-lbs**	page 8-14
Stator harness clip fastener	8.2-10.7 Nm	72-95 **in-lbs**	page 8-14
Alternator cover fastener	9.7 Nm	85 **in-lbs**	page 8-14
Derby cover fastener	8.2-10.7 Nm	72-95 **in-lbs**	page 8-14
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**	page 8-14
Voltage regulator fastener	6-10 Nm	53-88 **in-lbs**	page 8-16
Voltage regulator ground wire fastener	16-20 Nm	12-15 ft-lbs	page 8-16
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**	page 8-16
Battery cable nut	6-10 Nm	53-88 **in-lbs**	page 8-21
Battery terminal bolt	6.8-10.8 Nm	60-96 **in-lbs**	page 8-21
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**	T27 TORX, page 8-34
Handlebar switch housing screws	4.0-5.1 Nm	35-45 **in-lbs**	T25 TORX, page 8-34
Handlebar clamp screw	6.8-9.0 Nm	60-80 **in-lbs**	T27 TORX, page 8-39
Handlebar switch housing screws	4.0-5.1 Nm	35-45 **in-lbs**	T25 TORX, page 8-39
Passenger seat mounting fastener	11-17 Nm	97-150 **in-lbs**	page 8-42
Passenger seat mounting fastener	11-17 Nm	97-150 **in-lbs**	page 8-43
Handlebar cover fastener	1.3-1.9 Nm	12-16 **in-lbs**	page 8-45
Headlamp bracket fastener	11-18 Nm	8-13 ft-lbs	page 8-45
Instrument cluster to housing fasteners	1.3-1.9 Nm	12-16 **in-lbs**	page 8-46
Instrument housing hinge fastener	2.2-2.8 Nm	20-24 **in-lbs**	page 8-46
Top housing fastener	2.2-2.8 Nm	20-24 **in-lbs**	page 8-46
VSS mounting fastener	8.2-10.7 Nm	73-95 **in-lbs**	page 8-48

ITEM	TORQUE		NOTES
Neutral switch	12.8-16.5 Nm	113-146 **in-lbs**	page 8-49
Oil pressure switch	10.8-13.6 Nm	96-120 **in-lbs**	page 8-50
Battery terminal bolt	6.8-10.8 Nm	60-96 **in-lbs**	page 8-50
Horn flange nut	6-8 Nm	53-70 **in-lbs**	page 8-53
Horn assembly acorn nut	9-15 Nm	80-132 **in-lbs**	page 8-53
Cooling fan fasteners	5-7 Nm	44-62 **in-lbs**	page 8-55
Radiator cover fastener	4.1-6.8 Nm	36-60 **in-lbs**	page 8-55
Radiator trim cover fastener	3-4 Nm	26-35 **in-lbs**	page 8-55

BULB REQUIREMENTS 8.2

GENERAL

Refer to Table 8-4. This table gives the location and bulb requirements for Harley-Davidson VRSC motorcycles.

NOTES

- *All VRSC speedometers, tachometers indicator lamps and odometers are illuminated with LEDs.*
- *LEDs are non-repairable. The entire instrument cluster must be replaced if an LED fails.*

Table 8-4. Bulb Chart

LAMP DESCRIPTION (ALL LAMPS 12 VOLT)	NO. OF BULBS REQUIRED	CURRENT DRAW (AMPERAGE)	WATTAGE	PART NO.
Headlamp				
Low Beam	1	4.30	55.0	68881-01
High Beam	1	5.10	65.3	67717-01
Low Beam (HDI)	1	4.30	55.0	68881-01
High Beam (HDI)	1	5.10	65.3	67717-01
Tail/stop lamp				
Tail Lamp	1	0.59	8.3	68168-89A
Stop Lamp	1	2.25	28.8	68168-89A
Tail Lamp (HDI)	1	0.42	5.7	68169-90A
Stop Lamp (HDI)	1	1.75	23.6	68169-90A
Turn signal lamps				
Front/Running	2	2.25/0.59	28.8/8.3	68168-89
Rear	2	2.25	28.8	68572-64B
Front/Running (HDI)	2	1.75	21.0	68163-84
Rear (HDI)	2	1.75	21.0	68163-84
License plate lamp				
License Plate Illumination	2	0.33	4.6	68193-95
License Plate Illumination (HDI)	2	0.37	5.2	53436-97

RELAY/FUSE BLOCK 8.3

GENERAL

The relay/fuse block assembly consists of two relay/fuse blocks and is located under the airbox cover, next to the radiator cap. All relays and fuses (with the exception of the main battery fuse - see 8.5 MAXI-FUSE) are contained in these two relay/fuse blocks.

RELAY/FUSE BLOCK REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Open seat.
3. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.
4. See Figure 8-1. Gently lift up each relay/fuse block cover release tab (2) and slide each relay/fuse block assembly out of the cover.

See Figure 8-2. Each relay/fuse block assembly contains both fuses (1) and relays (3). There is one unused, empty fuse socket (2).

FUSE REPLACEMENT

1. See Figure 8-3. Grasp the suspect fuse and gently pull straight out of the fuse socket.
2. Inspect the fuse element. Replace the fuse if the element is burned or broken.
3. Line up the pins of the fuse with the socket holes in the relay/fuse block. Push gently down on the fuse body until it bottoms out in the socket.

NOTE

Two spare fuses are located in the left relay/fuse block.

CAUTION

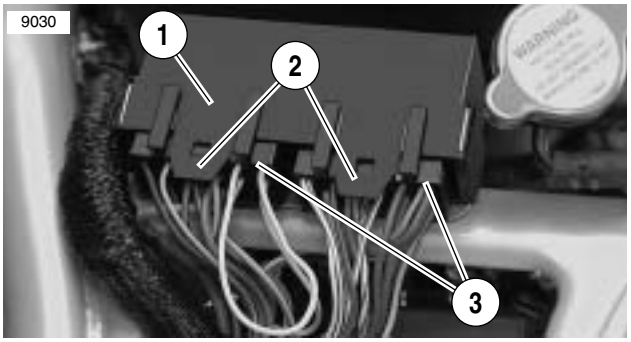
Always use replacement fuses that are of the correct type and amperage rating. Use of incorrect fuses can result in damage to the electrical system. (00222a)

NOTE

Use only automotive type ATO fuses as replacements.

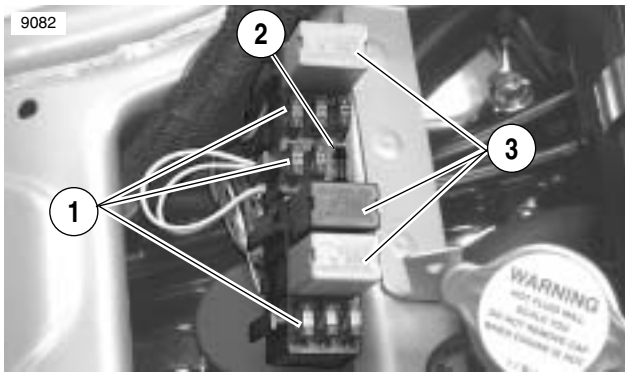
RELAY REPLACEMENT

1. See Figure 8-3. If a relay is diagnosed as defective, grasp the body of the relay and with a gentle rocking motion, pull straight out of the socket.
2. Line up the pins of the **new** relay with the socket holes in the relay/fuse block. Push gently down on the relay body until it bottoms out in the socket.



1. **Relay/fuse block cover**
2. **Release tabs**
3. **Relay/fuse block assemblies**

Figure 8-1. Relay/Fuse Block Assembly (typical)



1. **Fuses**
2. **Empty fuse socket**
3. **Relays**

Figure 8-2. Relays and Fuses (typical)

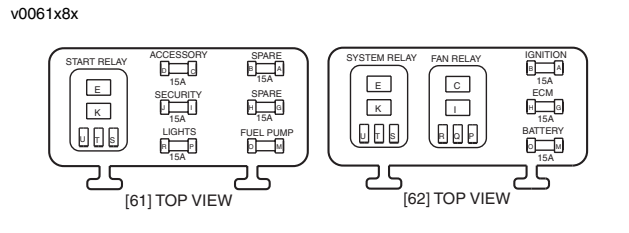


Figure 8-3. Relay/Fuse Block Layout (typical)

RELAY/FUSE BLOCK INSTALLATION

1. See Figure 8-1. Slide each relay/fuse block assembly back into relay/fuse block cover. Push relay/fuse block assembly into the cover until cover release tab locks into place.
2. Replace airbox cover. See 1.3 AIRBOX AND AIR FILTER.
3. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.
4. Replace maxi-fuse and right side cover.
5. Test the vehicle system that is controlled by the relay or fuse that was replaced.

CRANK POSITION SENSOR: CKP 8.4

GENERAL

See Figure 8-4. The crank position sensor (CKP) (1) is a variable reluctance (VR) sensor that generates an AC signal by sensing the passing of the 22 teeth (2) machined in the left side rotor (3). Two consecutive teeth are missing in the flywheel to establish a reference point. The CKP sensor sends a signal to the ignition module. This signal is used to reference engine position (TDC) and engine speed. The CKP sensor is located near the lower front left corner of the engine crankcase.

REMOVAL

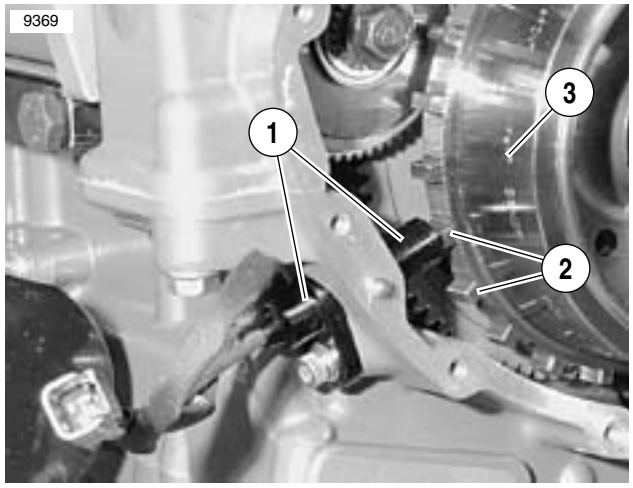
1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove left side radiator trim cover.
3. Clip and remove cable strap securing CKP sensor wiring harness to fan wiring harnesses.
4. Disconnect CKP sensor harness connector [79A].
5. See Figure 8-5. Unlatch cable clip (3) on top of jiffy stand bracket and remove CKP sensor cable harness.
6. Remove fastener and captive washer (2). Carefully remove CKP sensor and O-ring (1) from engine crankcase.

INSTALLATION

NOTE

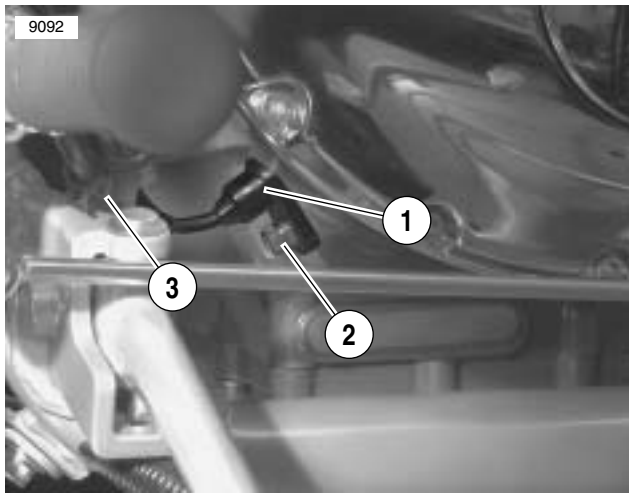
*The **new** CKP O-ring has a blue teflon coating that provides lubrication during installation. It is not necessary to coat the O-ring with engine oil to install it.*

1. See Figure 8-5. Install **new** CKP sensor and O-ring (1) with fastener and captive washer (2). Tighten to 8.2-10.7 Nm (73-95 **in-lbs**).
2. Route CKP sensor wiring harness through cable clip (3) on top of jiffy stand bracket. Latch cable clip.
3. Route CKP sensor wiring harness to wiring harness on left side of radiator and attach to connector [79B].
4. Secure CKP sensor wiring harness to fan wiring harnesses with **new** cable strap.
5. Install left side radiator trim cover. Make sure no wires become pinched under cover.
6. Replace maxi-fuse and right side over.
7. Start engine and verify operation.



1. **Crank position sensor**
2. **Sensor teeth**
3. **Rotor**

Figure 8-4. Rotor and Crank Position Sensor



1. **Crank position sensor and O-ring**
2. **Fastener with captive washer@ 8.2-10.7 Nm (73-95 in-lbs)**
3. **Cable clip**

Figure 8-5. Crank Position Sensor Mounting (typical)

MAXI-FUSE 8.5

GENERAL

There is a main battery fuse to protect the motorcycle wiring. This 40-amp maxi-fuse provides main battery power to the motorcycle. It is located in a rubber-coated fuse holder behind the motorcycle's right front side cover.

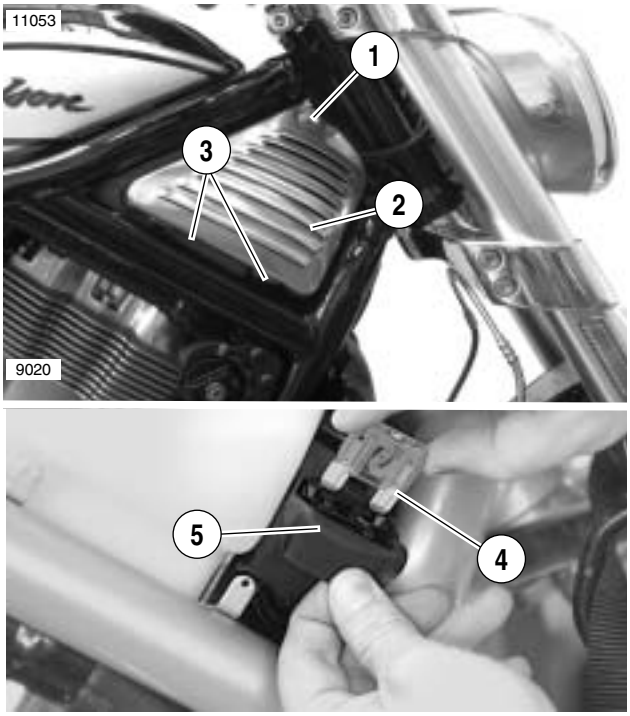
REPLACEMENT

1. See Figure 8-6. Remove the fastener (1) securing the side cover (2). Carefully lift the side cover off the mounting tabs (3) and set it aside.

2. Grasp the fuse holder (5) in one hand, the plastic body of the maxi-fuse (4) in the other, and pull the maxi-fuse straight out of the fuse holder.

3. Insert the prongs of the **new** maxi-fuse in the fuse holder slots. Push the maxi-fuse firmly down into the fuse holder.

4. Replace the side cover and install the fastener. Tighten to 4.1-6.8 Nm (36-60 **in-lbs**).



1. **Fastener @ 4.1-6.8 Nm (36-60 in-lbs)**
2. **Side cover**
3. **Mounting tabs**
4. **Maxi-fuse (40-amp)**
5. **Fuse holder**

Figure 8-6. Maxi-Fuse Removal and Replacement

IGNITION/LIGHT SWITCH (VRSCA/VRSCD) 8.6

GENERAL

The ignition/light switch is non-repairable. If damaged, it must be replaced. The replacement ignition/light switch includes a fork lock, plunger and keys. The ignition/light switch and fork lock should be replaced at the same time so one key is used for both ignition and fork lock.

⚠WARNING

The automatic-on headlamp feature provides increased visibility for riders. Be sure headlamp is on at all times. Low visibility of rider can result in death or serious injury. (00030a)

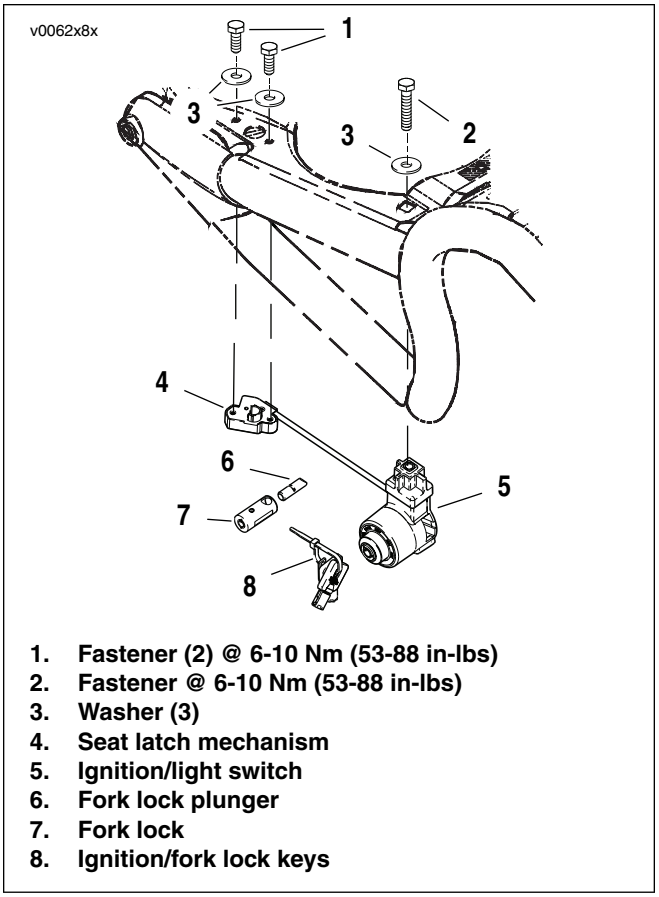
REPLACEMENT

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
2. Unlock and open seat.
3. See Figure 8-7. Remove two fasteners (1), washers (3) and seat latch mechanism (4) from frame.
4. Remove fastener (2), washer (3) and ignition/light switch (5) from frame.
5. Using IGNITION SWITCH CONNECTOR REMOVAL TOOL (HD-45961), carefully release latching tab securing wiring harness connector to back of ignition/light switch. Pull connector out of ignition/light switch socket.
6. Insert wiring harness connector into **new** ignition/light switch socket. Gently push connector into socket until it locks into place.
7. See Figure 8-7. Install ignition/light switch into hole in frame. Make sure square boss on top of switch fits into square hole in frame. Secure with fastener (2) and washer (3). Tighten fastener to 6-10 Nm (53-88 **in-lbs**).
8. Secure seat latch mechanism to frame with two fasteners (1) and washers (3). Tighten fasteners to 6-10 Nm (53-88 **in-lbs**).
9. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.

CAUTION

When closing the seat, make sure the ignition switch is in the FUEL position. If the ignition switch is in any other position when the seat is closed, the seat latch mechanism could be damaged. (00196a)

10. Replace fork lock and plunger. See 2.41 FORK LOCK (VRSCA/VRSCD).
11. Replace right side cover and maxi-fuse.
12. Test all functions of ignition/light switch.



1. **Fastener (2) @ 6-10 Nm (53-88 in-lbs)**
2. **Fastener @ 6-10 Nm (53-88 in-lbs)**
3. **Washer (3)**
4. **Seat latch mechanism**
5. **Ignition/light switch**
6. **Fork lock plunger**
7. **Fork lock**
8. **Ignition/fork lock keys**

Figure 8-7. Ignition/Light Switch (VRSCA/VRSCD)

IGNITION/LIGHT SWITCH (VRSCR) 8.7

GENERAL

The ignition switch is non-repairable. If damaged, it must be replaced. The replacement ignitions witch includes a fork lock, plunger and keys. The ignition switch and fork lock should be replaced at the same time so one key is used for both ignition and fork lock.

⚠WARNING

The automatic-on headlamp feature provides increased visibility for riders. Be sure headlamp is on at all times. Low visibility of rider can result in death or serious injury. (00030a)

REPLACEMENT

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
2. See Figure 8-8. Remove ignition switch protective cover by pressing in location shown by arrows using thumb and index fingers. Simultaneously lift up at bottom of protective switch cover with index finger of opposite hand and pull cover away from base of switch.

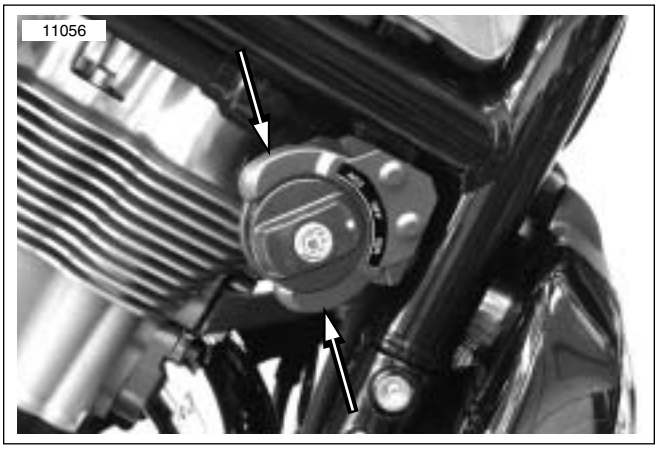


Figure 8-8. Ignition Switch Cover

3. See Figure 8-9. Remove fasteners and remove ignition switch from frame.

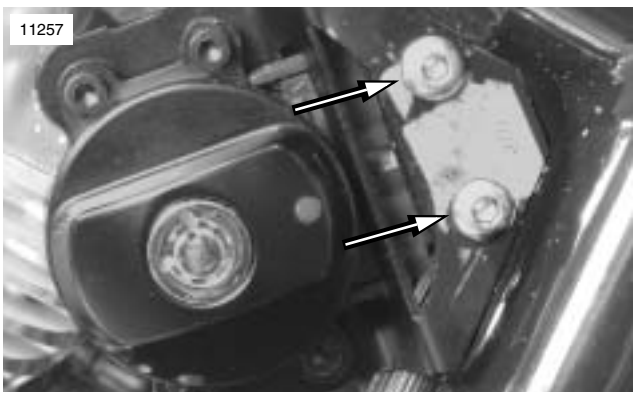


Figure 8-9. Ignition Switch Fasteners

4. See Figure 8-10. Carefully release latching tabs securing wiring harness connector to back of ignition switch. Pull connector out of ignition/light switch socket.

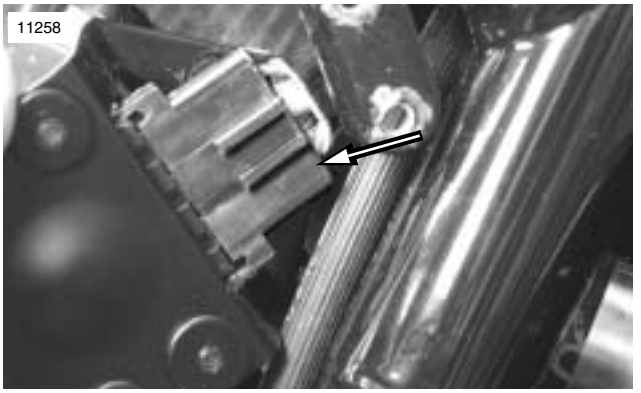


Figure 8-10. Ignition Switch Connector (switch turned over showing back side)

5. Insert wiring harness connector into **new** ignition switch. Gently push connector into socket until it locks into place.
6. See Figure 8-9. Install ignition switch to frame. Secure with fasteners. Tighten fasteners to 4-7 Nm (35-62 **in-lbs**).
7. Replace right side cover and maxi-fuse.
8. Test all functions of ignition switch.

ALTERNATOR 8.8

GENERAL

The alternator is located behind the alternator cover, on the left side of the engine. The alternator consists of permanent magnets mounted around the circumference of a rotor and a series of radial wire coils statically mounted in a stator assembly. When rotated by the engine, the rotor magnets induce a voltage in the wire coils of the stator alternately reversing polls.

The rotor of the alternator is bolted to the crankshaft. On the crankshaft side of the rotor is a ball clutch mechanism that works in combination with the starter limiter gear to enable the starter ring gear and the rotor/crankshaft to rotate independently of each other. The circumference of the rotor is machined with teeth that identify a reference point for the crank position sensor (CKP).

The stator is bolted to the inside of the alternator cover and delivers induced voltage to a voltage regulator through a wire harness that passes through a boss in the side of the alternator cover.

The alternator cover is secured with 14 fasteners. The derby cover is located on the alternator cover, secured with two fasteners.

NOTE

For diagnostic information, see the VRSC Electrical Diagnostic Manual.

⚠CAUTION

The alternator stator is mounted in the alternator cover. The alternator rotor is mounted on the end of the engine crankshaft. Be careful to keep fingers away from the edges of the alternator cover when removing or installing the cover. The magnetic attraction between the stator and rotor is strong and could cause the cover to be pulled toward the engine case with enough force to cause moderate injury.

REMOVAL

PART NO.	SPECIALTY TOOL
HD-45304	Alternator stator cover remover/installer
HD-45340	Gasket alignment dowels
HD-45314	Crankshaft rotating wrench
HD-45315	Alternator rotor remover

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove fastener securing bottom of left radiator trim cover. Remove trim cover.
3. See Figure 8-11. Push straight down to remove stator to regulator connector [46] from metal clip on side of radiator cover.
4. Separate stator connector half [46A] from voltage regulator connector [46B] half.
5. Unlatch cable clip on top of jiffy stand and remove alternator wiring harness.

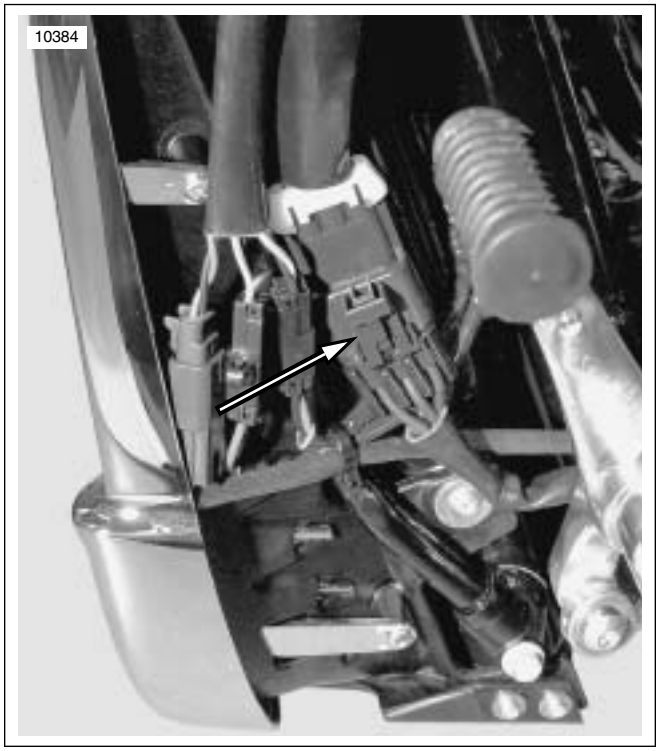


Figure 8-11. Stator-to-Regulator Connector [46] (typical) (VRSCA shown)

6. Remove two fasteners securing derby cover. Remove cover.

7. Place drip pan underneath alternator cover to catch any residual oil that may drain out when cover is removed.

8. Remove alternator cover fasteners in reverse order of torque sequence. See INSTALLATION under 8.8 ALTERNATOR.

9. Install two GASKET ALIGNMENT DOWELS (Part Number HD-45340) in two of the alternator cover holes to steady cover as it is removed.

10. See Figure 8-12. Using two inspection cover fasteners (3), position ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL (Part Number HD-45304) (4) as shown.

11. Remove the alternator cover.

12. Inspect rotor for wear or damage. The rotor and ball clutch assembly for the starter ring gear are replaced as one assembly.

13. Holding 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH (HD-45314), loosen rotor fastener. Air impact tool may be used for REMOVAL ONLY.

14. Install ALTERNATOR ROTOR REMOVER (HD-45315) and hand tighten.

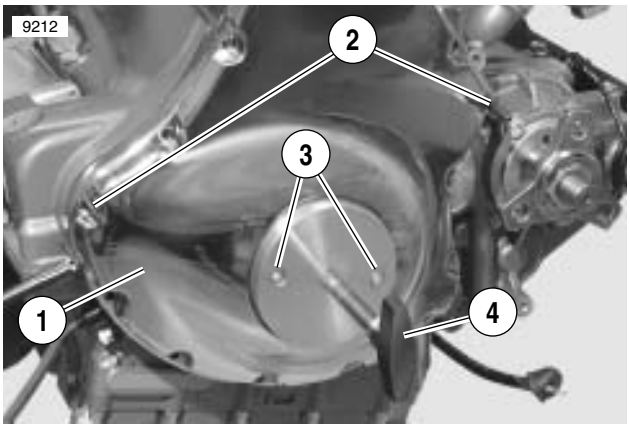
15. See Figure 8-13. Use an impact socket and wrench to tighten the tool removing the rotor from the crankshaft taper.

16. To install a rotor assembly, use the following procedure:

    a. Install rotor shell and tighten rotor nut to 83 Nm (60 ft-lbs).

    b. Loosen one full turn.

    c. Tighten to 180 Nm (132 ft-lbs).



1. **Alternator cover**
2. **Gasket alignment dowel (2)**
3. **Derby cover fasteners**
4. **Alternator cover remover/installer tool (HD-45304)**

Figure 8-12. Removing Alternator Cover

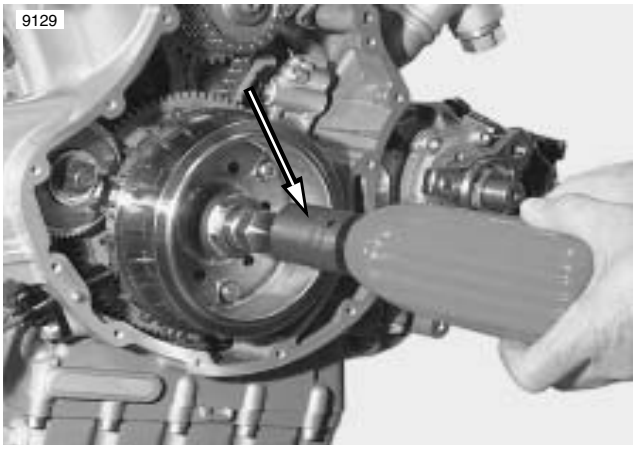


Figure 8-13. Alternator Rotor Remover (HD-45315)

DISASSEMBLY

1. Remove three wire leads from connector [46A] (6). Insert a pick (Snap-on TT600-3) into square under locking tang and pivot end of pick toward terminal to depress the locking tang. Gently pull on wire to pull terminal from wire end of connector (6).

2. See Figure 8-14. Remove fastener (4) and wire harness clip (5) from alternator cover (1).

3. Remove stator mounting fasteners (3) and captive washers from stator (2). Remove three stator mounting fasteners (3) and pull stator straight up out of alternator cover (1). Note orientation of slot in cover stator hub and clip on stator.

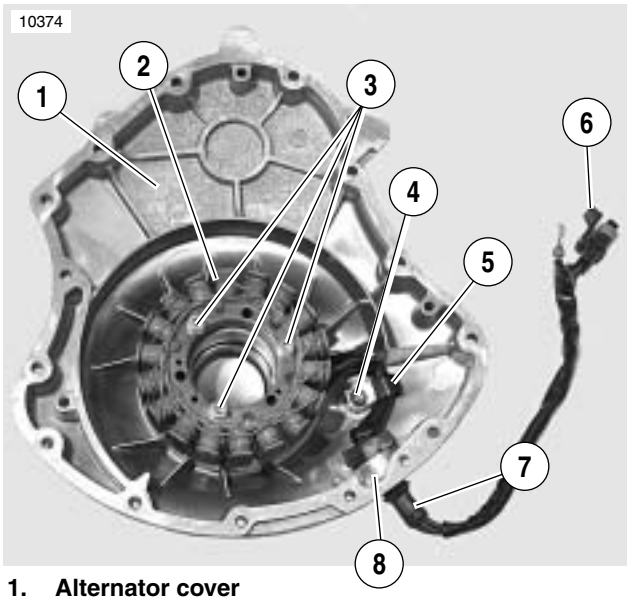
4. Using point of awl, carefully press rib on grommet (7) away from crankcase and then insert awl into bore between grommet and casting.

5. Tilt awl slightly squirting isopropyl alcohol or glass cleaner into opening. Repeat this step at one or two other locations around grommet.

6. See Figure 8-15. While pushing on rib (4) from outside of crankcase, draw grommet (1) through bore by pulling on T-stop (2). Rock grommet back and forth to facilitate removal. Exercise caution to avoid damaging rib on grommet if stator is to be reused.

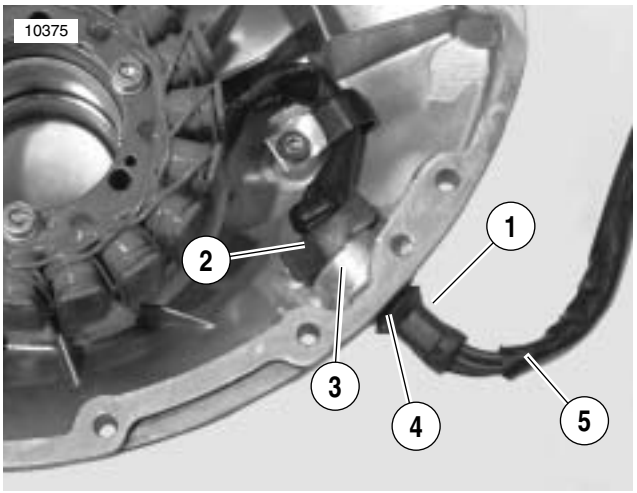
7. Draw stator wire harness (5) and socket terminals through crankcase bore. For best results, feed one wire and socket terminal at a time.

8. Remove stator and wire harness from alternator cover.



1. **Alternator cover**
2. **Stator**
3. **Stator mounting fasteners @ 8.2-10.7 Nm (72-95 in-lbs)**
4. **Fastener @ 8.2-10.7 Nm (72-95 in-lbs)**
5. **Harness clip**
6. **Harness connector [46A]**
7. **Grommet**
8. **Boss**

Figure 8-14. Removing Stator from Alternator Cover



1. **Grommet**
2. **T-stop**
3. **Boss**
4. **Rib**
5. **Wire harness**

Figure 8-15. Stator Wiring Harness Grommet

ASSEMBLY

1. Thoroughly clean alternator cover and gasket sealing surface on engine case. Remove all sealing material from gasket sealing surfaces.
2. See Figure 8-15. From inside cover, feed socket terminals and stator wire harness (5) through boss (3) on cover wall. For best results, feed one wire and socket terminal at a time.
3. Lubricate grommet (1) with isopropyl alcohol or glass cleaner. Grommet must be clean and free of dirt and oily residue.
4. Grasp T-stop (2) behind grommet (1). Push grommet (1) into bore in boss (3) while carefully pulling on outside wire harness (5). Installation is complete when T-stop (2) contacts boss (3) and rib (4) exits crankcase bore.
5. See Figure 8-14. With stator (2) oriented to cover (1) so that wire harness exits alternator cover at approximately 3 o'clock, line up three fastener holes in stator with holes in alternator cover (1).
6. Install three stator mounting fasteners (3) and alternately tighten to 8.2-10.7 Nm (72-95 **in-lbs**).
7. Install harness clip (5) over wire harness into alternator cover. Secure with fastener (4). Tighten to 8.2-10.7 Nm (72-95 **in-lbs**).
8. Push wire socket terminals into connector [46A].

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-45304	Alternator stator cover remover/installer
HD-45340	Gasket alignment dowels

1. See Figure 8-12. Make sure ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL (Part Number HD-45304) (4) is installed as shown. Secure to alternator cover with two derby cover fasteners. Turn handle of tool clockwise (CW) several turns.
2. Make sure two GASKET ALIGNMENT DOWELS (Part Number HD-45340) (2) are installed in case.
3. Slide **new** alternator cover gasket onto alignment dowels and press flush against engine case.
4. Slide alternator cover onto alignment dowels. Turn handle of remover/installer counterclockwise (CCW) until it turns freely. Remove two derby cover fasteners and remover/installer tool.

NOTE

To avoid oil leaks caused by warping of alternator cover, in next step, tighten fasteners in alternating pattern back and forth across face of cover. See Figure 8-16.

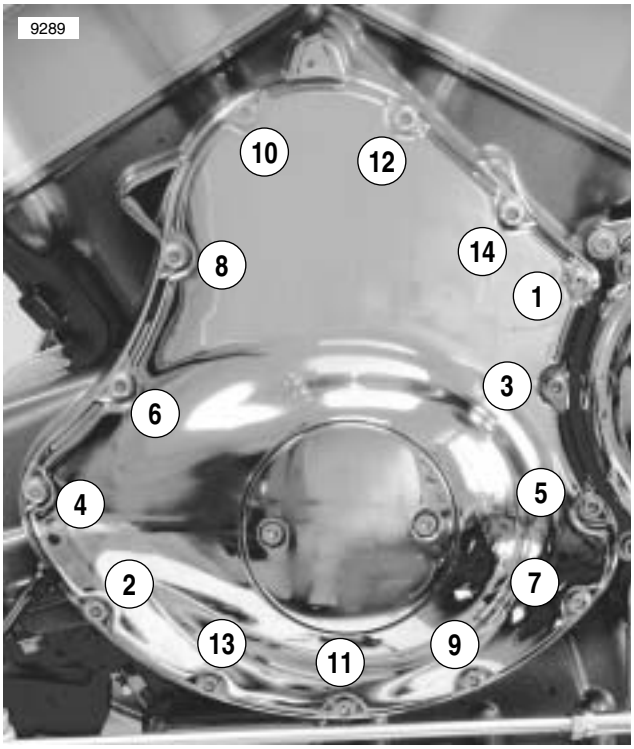


Figure 8-16. Alternator Cover Torque Sequence Fasteners @ 9.7 Nm (86 in-lbs)

5. See Figure 8-16. Secure alternator cover to engine case with 14 fasteners. Tighten to 9.7 Nm (86 **in-lbs**).
6. Clean derby cover. Inspect O-ring on derby cover. Replace if damaged.
7. Install derby cover on alternator cover with two fasteners. Tighten to 8.2-10.7 Nm (72-95 **in-lbs**).
8. Route stator wiring harness through cable clip on top of jiffy stand. Latch cable clip.
9. Plug stator connector into three-wire voltage regulator connector. Secure connector to left side of radiator cover with connector clip.
10. Install radiator trim cover onto radiator cover. Make sure no wires become pinched under cover. Secure with fastener. Tighten to 3-4 Nm (26-35 **in-lbs**).

VOLTAGE REGULATOR 8.9

GENERAL

The voltage regulator is mounted between the front frame downtubes, directly above the radiator.

NOTE

The voltage regulator cannot be repaired. Replace the unit if it fails.

REMOVAL

1. Open seat.
2. Remove the airbox assembly. See 1.3 AIRBOX AND AIR FILTER.

CAUTION

Cover the injector intakes with duct tape to prevent objects from falling down the injector bore. Do NOT use shop cloths or objects that could damage the injector butterflies. (00212a)

3. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
4. Remove left and right radiator trim covers. See 1.4 RADIATOR SIDE COVERS (VRSCA/VRSCD), or 1.5 RADIATOR SIDE COVERS (VRSCR).

NOTE

Before removing voltage regulator wires, carefully note wire routing. In particular, pay close attention to locations of cable straps that must be replaced.

5. See Figure 8-18. Remove fastener, washer and voltage regulator ground wire from front cylinder head. Cut and remove any cable straps securing ground wire to frame.

Figure 8-17. Airbox Removed, Injector Intakes Protected

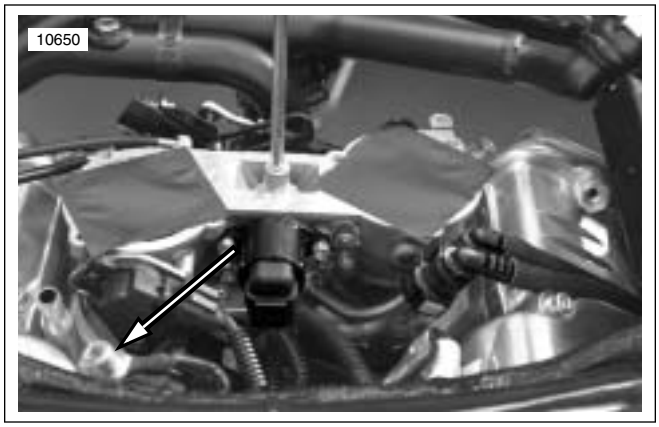


Figure 8-18. Voltage Regulator Grounding Fastener

6. See Figure 8-19. Press down to remove stator to regulator connector clip from left side of radiator cover. Separate stator connector [46A] from regulator connector [46B].
7. Remove all other wiring harness cable straps and clips attached to left side of radiator cover.
8. See Figure 8-20. Pull rear brake master cylinder reservoir straight away from its mounting slots in right side of radiator cover.
9. Remove radiator side covers. See 1.4 RADIATOR SIDE COVERS (VRSCA/VRSCD), or 1.5 RADIATOR SIDE COVERS (VRSCR).
10. Disconnect voltage regulator connector [77B] from maxi-fuse connector [77A]. This connector is located on the front of the radiator near the top.
11. Remove two fasteners securing voltage regulator to frame and remove voltage regulator from vehicle.

INSTALLATION

1. Attach **new** voltage regulator to frame with two mounting fasteners. Tighten to 6-10 Nm (53-88 **in-lbs**).
2. Route voltage regulator wire harnesses.
   a. Route ground wire along left top frame tube to mounting fastener on front cylinder head.
   b. Route maxi-fuse wire along top of radiator and plug into connector [77A].
   c. Route three-wire harness along top of radiator and down left side. Mate alternator connector [46B} to stator connector [46A].
3. See Figure 8-18. Attach voltage regulator ground wire to front cylinder head. Tighten to 16-20 Nm (12-15 ft-lbs).
4. Secure voltage regulator wire harnesses with cable straps at appropriate locations.
5. Attach radiator side covers.
6. See Figure 8-20. Press rear brake master cylinder reservoir back into its mounting slots in right side of radiator cover.
7. Reroute wiring harnesses down left side of radiator cover and attach with corresponding clips or cable straps.
8. Attach left and right radiator covers. See 1.4 RADIATOR SIDE COVERS (VRSCA/VRSCD), or 1.5 RADIATOR SIDE COVERS (VRSCR).
9. Remove duct tape from injector intakes.
10. Install airbox assembly. See 1.3 AIRBOX AND AIR FILTER.
11. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.
12. Replace maxi-fuse. See 8.5 MAXI-FUSE.
13. See the VRSC Electrical Diagnostic Manual and check voltage regulator for proper output.

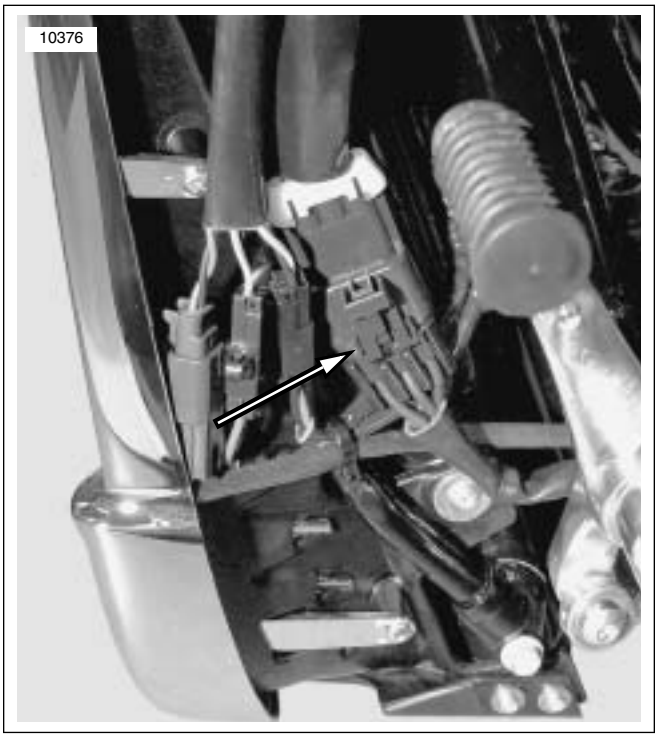


Figure 8-19. Stator to Regulator Connector [46] (typical) (VRSCA shown)

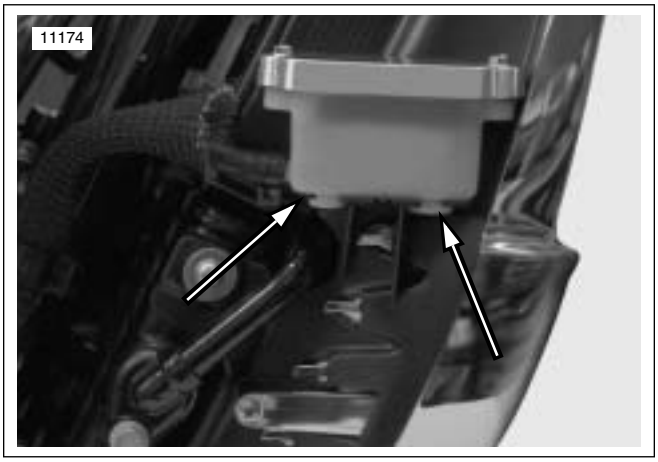


Figure 8-20. Rear Brake Master Cylinder Reservoir Mounting Slots

BATTERY 8.10

GENERAL

Three different procedures may be performed to provide a good indicator of battery condition: a voltage test, a conductance test, or a load test.

A battery may be tested, whether fully charged or not, via conductance test. In order to perform a load test, however, the battery must be fully charged.

VOLTMETER TEST

The voltmeter test provides a general indicator of battery condition. Check the voltage of the battery to verify that it is in a 100% fully charged condition. Refer to Table 8-5.

If the open circuit (disconnected) voltage reading is below 12.6V, charge the battery. See CHARGING. Then recheck the voltage after the battery has set for one to two hours. If the voltage reading is 12.7V or above, perform the LOAD TEST described in this section.

Table 8-5. Voltmeter Test For Battery Charge

VOLTAGE (OCV)	STATE OF CHARGE
12.7	100%
12.6	75%
12.3	50%
12.0	25%
11.8	0%

CONDUCTANCE TEST

Test the battery using the MCR-101 HD ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER. Perform a battery test as follows:

1. Connect the MCR-101 HD analyzer leads to the vehicle's battery.
2. Follow the instructions in the analyzer's instruction manual to perform a battery test.

The test results will include a decision on the battery's condition, the measured state of charge and the measured CCA.

See Figure 8-21. The analyzer's printer will provide you with a printout including one of five possible test results:

- GOOD BATTERY–return the battery to service.
- GOOD-RECHARGE–fully charge the battery and return to service.
- CHARGE & RETEST–Fully charge the battery and retest.
- REPLACE BATTERY–replace the battery and retest.
- BAD CELL-REPLACE–replace the battery and retest.

NOTE

A REPLACE BATTERY test result may also mean a poor connection between the battery cables and the vehicle. After disconnecting the battery cables from the battery, retest the battery using the out-of-vehicle test before replacing.

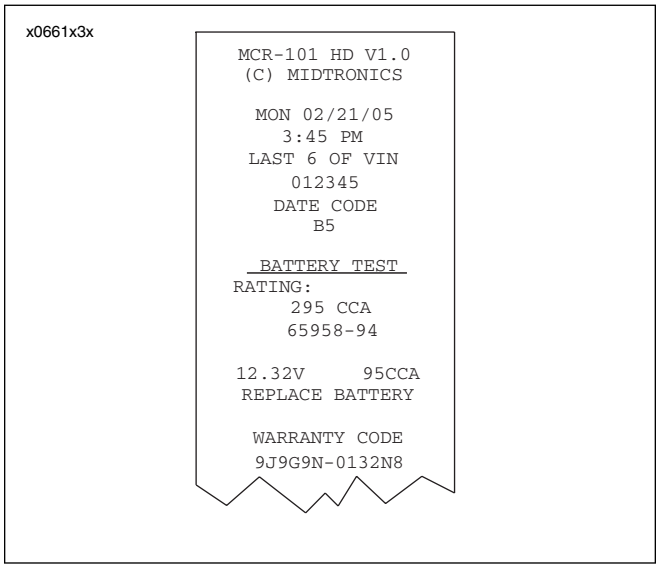


Figure 8-21. Battery Test Results–Printout

LOAD TEST

The load test measures battery performance under full current load. To load test the battery, proceed as follows:

1. Remove battery from motorcycle. See DISCONNECTION/REMOVAL under 1.8 BATTERY MAINTENANCE.

CAUTION

Load testing a discharged battery can result in permanent battery damage.

2. Always fully charge the battery before testing or test readings will be incorrect. See CHARGING. Load testing a discharged battery can also result in permanent battery damage.

3. After charging, allow battery to stand for at least one hour before testing.

WARNING

Turn battery load tester OFF before connecting tester cables to battery terminals. Connecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00252a)

4. See Figure 8-22. Connect tester leads to battery posts and place induction pickup over negative (black) cable.

CAUTION

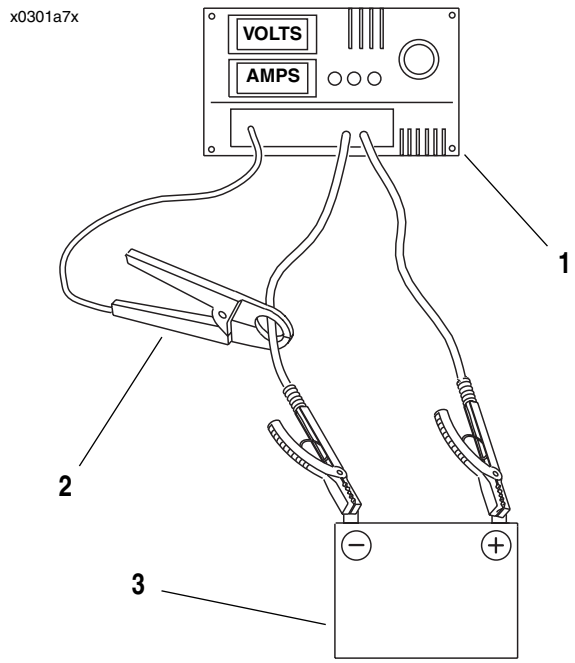
To avoid load tester and/or battery damage, do not leave the load tester switch turned ON for more than 20 seconds.

5. Refer to Table 8-6. Load battery at 50% of CCA rating using the load tester. Voltage reading after 15 seconds should be 9.6V or more at 70°F (21°C).

WARNING

Turn battery load tester OFF before disconnecting tester cables to battery terminals. Disconnecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00253a)

6. Install the battery in the motorcycle. See DISCONNECTION/REMOVAL under 1.8 BATTERY MAINTENANCE.



1. **Load tester**
2. **Induction pickup**
3. **Battery**

Figure 8-22. Load Test Battery

Table 8-6. Load Test-Cold Cranking Amps

COLD CRANKING AMPERAGE (CCA)	100%	50%
VRSC models	200	100

WARNING

Turn battery load tester OFF before disconnecting tester cables to battery terminals. Disconnecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00253a)

7. Install the battery in the motorcycle. See DISCONNECTION/REMOVAL under 1.8 BATTERY MAINTENANCE.

CHARGING

General

Charge the battery if any of the following conditions exist:

- Vehicle lights appear dim.
- Electric starter sounds weak.
- Battery has not been used for an extended period of time.
- The open circuit (disconnected) voltage reading is below 12.6V. See VOLTMETER TEST under 8.10 BATTERY.

Safety Precautions

Never charge a battery without reading the charger manufacturers instructions. In addition to the manufacturer's instructions, follow these general safety precautions:

- Always wear proper eye, face and hand protection.
- Always charge batteries in a well-ventilated area.
- Turn the charger OFF before connecting the leads to the battery to avoid dangerous sparks.
- Never try to charge a visibly damaged or frozen battery.
- Connect the charger leads to the battery; red positive (+) lead to the positive (+) terminal and black negative (–) lead to the negative (–) terminal. If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure that the ignition and all electrical accessories are turned off.
- Make sure that the charger leads to the battery are not broken, frayed or loose.
- If the battery becomes hot, or if violent gassing or spewing of electrolyte occurs, reduce the charging rate or turn off the charger temporarily.
- Always turn the charger OFF before removing charger leads from the battery to avoid dangerous sparks.

⚠WARNING

Explosive hydrogen gas, which escapes during charging, could cause death or serious injury. Charge battery in a well-ventilated area. Keep open flames, electrical sparks and smoking materials away from battery at all times. KEEP BATTERIES AWAY FROM CHILDREN. (00065a)

CAUTION

If the battery releases an excessive amount of gas during charging, decrease the charging rate. If the battery gets hotter than 110˚F. (43˚C) during charging, discontinue charger and allow the battery to cool. Overheating may result in plate distortion, internal shorting, dry-out or other damage.

Charging Battery

CAUTION

Remove battery from motorcycle before charging. Electrolyte leakage will damage motorcycle parts. (00213a)

1. Remove the battery from the motorcycle. See DISCONNECTION/REMOVAL under 1.8 BATTERY MAINTENANCE. Place battery on a level surface.

⚠WARNING

Unplug or turn OFF battery charger before connecting charger cables to battery. Connecting cables with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00066a)

2. Connect the red battery charger lead to the positive (+) terminal of the battery.
3. Connect the black battery charger lead to the negative (–) terminal of the battery.

CAUTION

Do not reverse the charger connections described in the following steps or the charging system of the motorcycle could be damaged. (00214a)

NOTE

If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure that the ignition and all electrical accessories are turned off.

4. Step away from the battery and turn on the charger. Refer to the charging instructions in Table 8-7.

⚠WARNING

Unplug or turn OFF battery charger before disconnecting charger cables from battery. Disconnecting clamps with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00067a)

5. After the battery is fully charged, disconnect the black battery charger lead to the negative (–) terminal of the battery.
6. Disconnect the red battery charger lead to the positive (+) terminal of the battery.
7. Mark the charging date on the battery.
8. Perform either a conductance test or load test to determine the condition of the battery. See CONDUCTANCE TEST or LOAD TEST under 8.10 BATTERY.
9. If charging battery because voltmeter test reading was below 12.6 V, perform voltmeter test. See VOLTMETER TEST under 8.10 BATTERY.
10. Install the battery in the motorcycle. See DISCONNECTION/REMOVAL under 1.8 BATTERY MAINTENANCE.

Table 8-7. Battery Charging Rates/Times (Approximate)

BATTERY AMP HOUR	STATE OF CHARGE		3 AMP CHARGER	6 AMP CHARGER	10 AMP CHARGER	20 AMP CHARGER
	VOLTAGE	% OF CHARGE				
12	12.7	100%	-	-	-	-
	12.6	75%	1 hour, 10 minutes	34 minutes	20 minutes	10 minutes
	12.3	50%	2 hours, 20 minutes	1 hour, 10 minutes	40 minutes	20 minutes
	12.0	25%	3 hours, 20 minutes	1 hour, 40 minutes	1 hour	30 minutes
	11.8	0%	4 hours, 30 minutes	2 hours, 14 minutes	1 hour, 20 minutes	40 minutes

NOTE

The figures listed above assume that the battery is charging at room temperature. If warmer than room temperature, use a slightly shorter charging time. If colder, use a slightly longer charging time.

NOTE

*The use of constant current chargers to charge sealed maintenance-free batteries is not recommended. Any overcharge will cause dry-out and premature battery failure. If a constant current charger is the only type available, do **not** exceed the charge times listed above and do **not** continue charging the battery if it gets hot. When charging, never exceed 15 volts.*

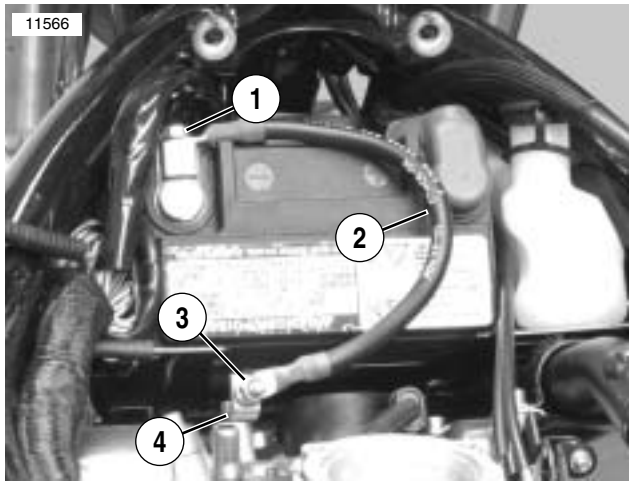
BATTERY CABLES 8.11

GENERAL

Replacement of the negative battery cable will be described here. The positive battery cable is an integral part of the main wiring harness.

NEGATIVE CABLE REPLACEMENT

1. Open seat.
2. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.
3. See Figure 8-23. Remove battery negative terminal (1) fastener.
4. Remove nut (3) securing negative cable (2) to stud on adapter bracket (4) and negative battery cable.
5. Install **new** negative cable. Secure with nut on adapter bracket stud. Tighten to 6-10 Nm (53-88 **in-lbs**).
6. Secure other end of negative cable to battery terminal with fastener. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
7. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.



1. **Battery terminal @ 6.8-10.8 Nm (60-96 in-lbs)**
2. **Negative cable**
3. **Nut @ 6-10 Nm (53-88 in-lbs)**
4. **Adapter bracket**

Figure 8-23. Negative Cable (typical)

HEADLAMP (VRSCA/VRSCR) 8.12

GENERAL

The headlamp contains separate high and low-beam headlamp bulbs. Each bulb is a replaceable high output quartz halogen bulb type.

CAUTION

When replacement is required, use only the specified sealed beam unit or bulb, available from a Harley-Davidson dealer. An improper wattage sealed beam or bulb, can cause charging system problems. (00209a)

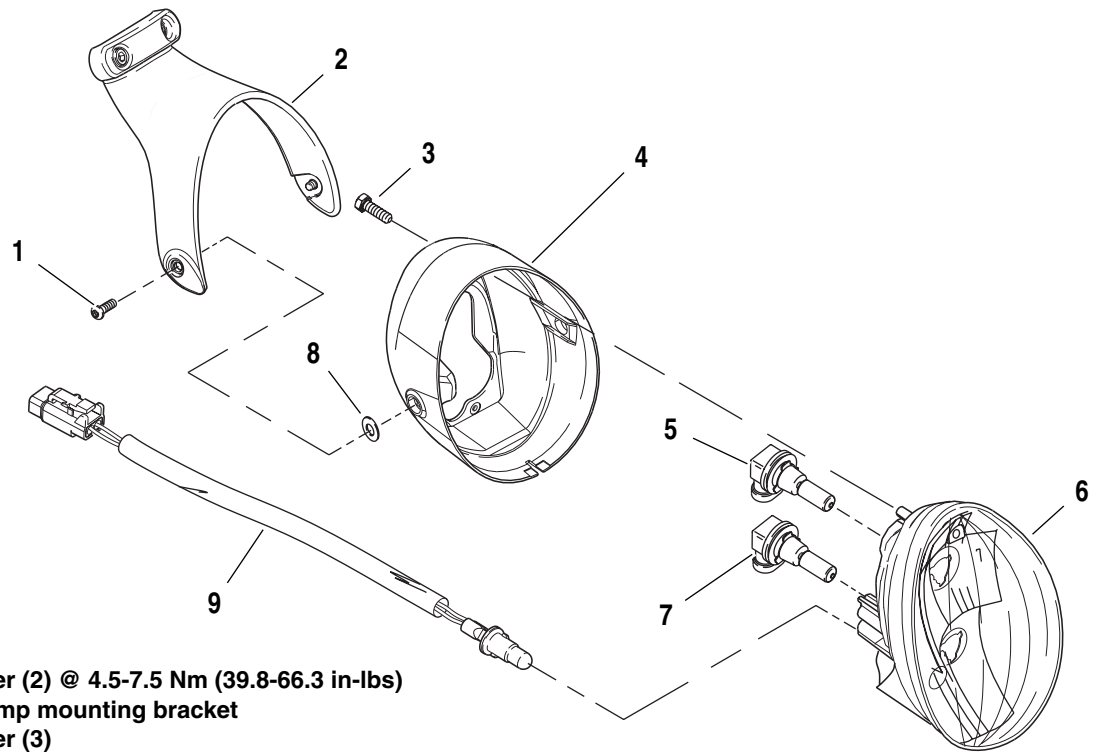
CAUTION

Never touch the quartz bulb. Fingerprints will etch the glass and decrease bulb life. Grab the bulb with paper or a clean, dry cloth. Failure to do so could result in bulb damage. (00210a)

WARNING

Handle bulb carefully and wear eye protection. Bulb contains Halogen gas under pressure, which, if not handled carefully, could cause serious eye injury. (00062a)

vd0048xxx



1. **Fastener (2) @ 4.5-7.5 Nm (39.8-66.3 in-lbs)**
2. **Headlamp mounting bracket**
3. **Fastener (3)**
4. **Headlamp bucket**
5. **Light bulb, low beam**
6. **Headlamp lens/reflector assembly**
7. **Light bulb, high beam**
8. **Fiber washer (2)**
9. **Position lamp and harness (HDI only)**

Figure 8-24. Headlamp

HEADLAMP BULB

Removal

NOTE

It is not necessary to disassemble the headlamp assembly in order to replace headlamp bulbs.

1. See Figure 8-24. To replace the low beam or high beam headlamp bulb, reach behind the headlamp bucket and grasp the appropriate headlamp bulb socket connector.
2. Squeeze the release latches on the connector and pull the connector away from the headlamp bulb.
3. While facing the headlamp from behind (looking toward the front of the motorcycle), twist the headlamp bulb approximately 45 degrees counterclockwise (CCW) and gently pull straight out of the headlamp.

Installation

NOTE

The low beam headlamp bulb (labeled H11) mounts in the top hole in the rear of the headlamp assembly. The high beam bulb (labeled H9) mounts in the bottom hole.

1. See Figure 8-24. To install a **new** headlamp bulb, insert it into the hole in the rear of the headlamp. Facing the headlamp assembly from the rear (looking toward the front of the motorcycle):
   a. Position the low beam bulb with its connector housing pointing to approximately 4 o'clock.
   b. Position the high beam bulb with it's connector housing pointing to approximately 5 o'clock.
2. Gently twist the bulb clockwise (CW) approximately 45 degrees, until it stops.

CAUTION

Do NOT force the connector onto the headlamp bulb socket. The two headlamp connectors are not interchangeable. Forcing the wrong connector onto the bulb will damage the connector pins and/or bulb socket.

3. Gently push the headlamp wiring connector onto the headlamp bulb socket until it clicks into place.

HEADLAMP (VRSCD) 8.13

GENERAL

The headlamp contains separate high and low-beam headlamp bulbs. Each bulb is a replaceable high output quartz halogen bulb type.

CAUTION

When replacement is required, use only the specified sealed beam unit or bulb, available from a Harley-Davidson dealer. An improper wattage sealed beam or bulb, can cause charging system problems. (00209a)

CAUTION

Never touch the quartz bulb. Fingerprints will etch the glass and decrease bulb life. Grab the bulb with paper or a clean, dry cloth. Failure to do so could result in bulb damage. (00210a)

WARNING

Handle bulb carefully and wear eye protection. Bulb contains Halogen gas under pressure, which, if not handled carefully, could cause serious eye injury. (00062a)

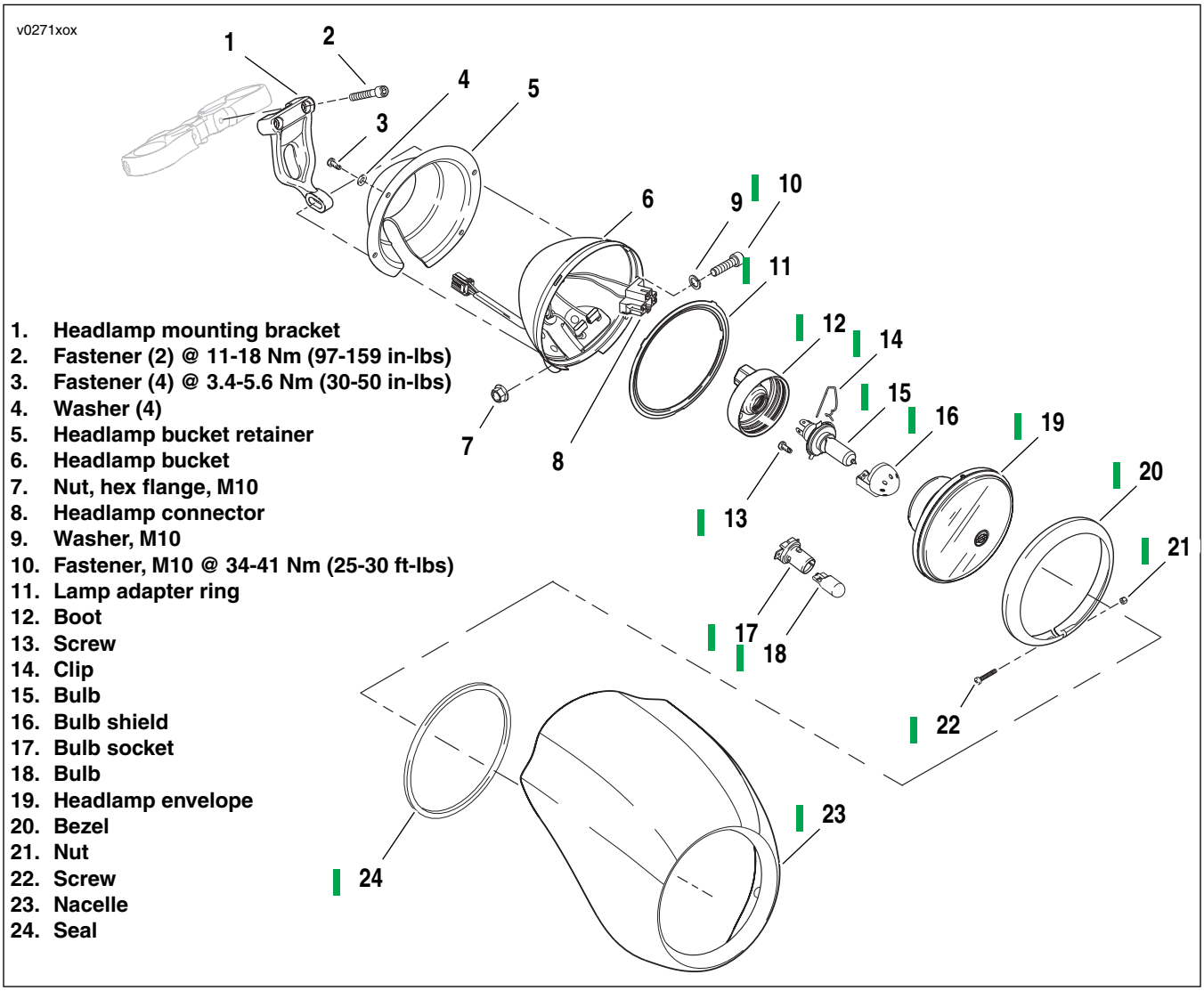


Figure 8-25. Headlamp (VRSCD)

HEADLAMP BULB

Removal

NOTE

It is necessary to partially disassemble the headlamp in order to replace headlamp bulbs. Note the positions of the mounting screws in the headlamp bucket retainer for reassembly.

1. See Figure 8-25. Loosen M10 fastener (10) and allow headlamp/nacelle assembly to drop slightly forward.
2. Remove fasteners (3), washers (4) and remove headlamp bucket retainer (5) from nacelle (23).
3. Reach behind the headlamp bucket (6) and grasp the headlamp connector (8).
4. Squeeze the release latches on the connector and pull the connector away from the headlamp bulb.
5. While facing the headlamp from behind (looking toward the front of the motorcycle), twist the headlamp bulb approximately 45 degrees counterclockwise (CCW) and gently pull straight out of the headlamp.

Installation

1. See Figure 8-25. To install a **new** headlamp bulb, insert it into the hole in the rear of the headlamp. Facing the headlamp assembly from the rear (looking toward the front of the motorcycle):
2. Position the headlamp bulb with its connector housing pointing to approximately 4 o'clock.
3. Gently twist the bulb clockwise (CW) approximately 45 degrees, until it stops.

CAUTION

Do NOT force the connector onto the headlamp bulb socket. The two headlamp connectors are not interchangeable. Forcing the wrong connector onto the bulb will damage the connector pins and/or bulb socket.

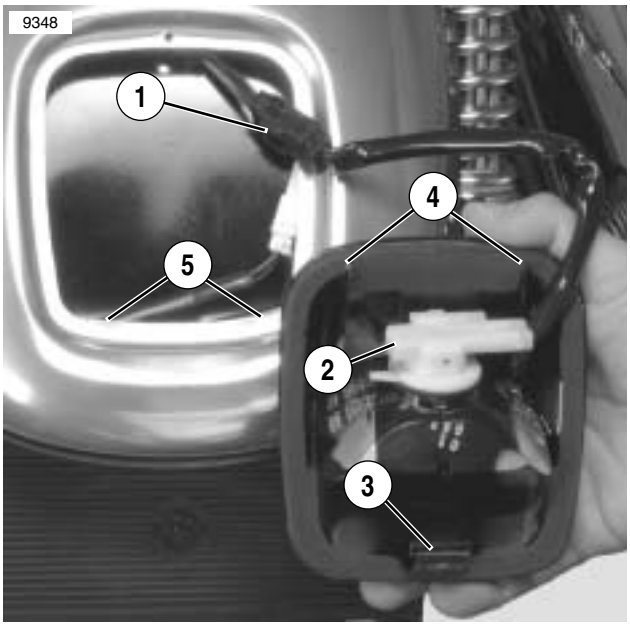
4. Gently push the headlamp wiring connector onto the headlamp bulb socket until it clicks into place.
5. Install headlamp bucket retainer (5) with washers (4) and fasteners (3). Tighten fasteners to 3.4-5.6 Nm (30-50 **in-lbs**).
6. Move headlamp/nacelle assembly into place and snug fastener (10) and perform headlamp alignment. See 1.26 HEADLAMP ALIGNMENT.

TAIL LAMP 8.14

REMOVAL

1. See Figure 8-26. Insert a small screwdriver into middle hole of license plate light cover. Push forward with screwdriver to release tail lamp housing retaining clip.
2. Lift rear of tail lamp housing up and slide housing assembly away from fender.
3. See Figure 8-27. To replace tail lamp bulb:
   a. Turn bulb socket assembly clockwise (CW) and pull outward from tail lamp housing.
   b. Remove bulb by turning counterclockwise (CCW) and pulling from bulb socket assembly.
   c. Push **new** bulb into bulb socket assembly and turn clockwise.
   d. Insert bulb socket assembly into tail lamp housing and turn counterclockwise to lock in place.
4. To replace license plate bulb:
   a. Remove license plate bulb by turning housing counterclockwise. Tab on bulb housing must clear tab on license plate light housing.
   b. Pull bulb from socket and replace with **new** bulb.
   c. Install housing by aligning tabs and turning clockwise.
5. To replace entire tail lamp assembly:
   a. Press down on release latch on connector socket.
   b. Detach socket from wiring harness connector.

Figure 8-26. Releasing Tail Lamp Retaining Clip



1. **Tail lamp connector**
2. **Tail lamp bulb socket assembly**
3. **Retaining clip**
4. **Mounting tabs**
5. **License plate bulb (2)**

Figure 8-27. Tail Lamp Wiring (typical) (VRSCA shown)

INSTALLATION

1. See Figure 8-27. Route all electrical connectors and wiring harnesses to either side of tail lamp opening in fender, away from tail lamp bulb housing.

2. If entire tail lamp assembly was replaced, insert wiring harness connector in socket and push together gently until release latch locks in place.

NOTE

When installing tail lamp assembly, make sure tail lamp bulb is pointing toward rear of vehicle.

3. Install tail lamp assembly as follows:

   a. Insert tabs on front of tail lamp housing under forward edge of fender opening.

   b. **Carefully** push tail lamp assembly toward front of vehicle.

   c. Engage retaining clip with rear edge of fender opening. Gently press down on tail lamp assembly until clip locks in place.

NOTE

Retaining clip must engage rear fender opening for tail lamp to remain locked into position in rear fender.

⚠WARNING

Check for proper tail lamp operation before riding motorcycle. Visibility is a major concern for motorcyclists. Failure to have proper lamp operation could result in death or serious injury.

4. Turn ignition ON and test for proper tail lamp and brake lamp operation.

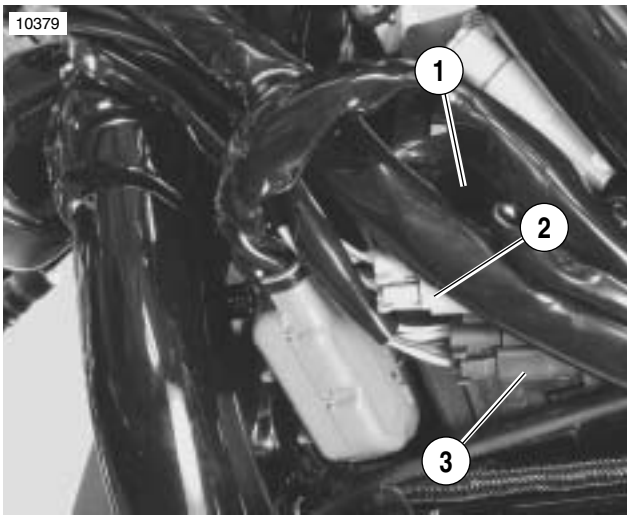
TURN SIGNALS/RUNNING LIGHTS 8.15

BULB REPLACEMENT

1. Locate notch on edge of front or rear turn signal lens cap.
2. Insert coin in notch. Carefully twist coin until lens pops out of turn signal housing.
3. Replace bulb.
   a. Push bulb in and turn counterclockwise.
   b. Pull bulb from socket when tab on bulb clears opening on socket.
   c. Push new light bulb in and turn clockwise to lock in place.
4. Snap lens back into turn signal housing with the notch facing down.

NOTE

If after replacing a bulb, the turn signal or running lamp will not light, check the wiring, the ground at the socket and/or the switch.



1. Front turn signal connector [31]
2. Right handlebar controls connector [22]
3. Left handlebar controls connector [24]

Figure 8-28. Front Turn Signal and Handlebar Control Switch Connectors (typical) (VRSCA shown)

LAMP REPLACEMENT

General

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
2. Change turn signal. See Front Turn Signals or Rear Turn Signals under 8.15 TURN SIGNALS/RUNNING LIGHTS.
3. Replace right side cover and replace maxi-fuse.

Front Turn Signals

NOTE

Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable wraps which must be replaced if removed.

1. Remove left side cover.
2. See Figure 8-29. Separate front turn signal connector [31B] from socket [31A].
3. Note locations of turn signal wires in connector. Remove corresponding turn signal wire terminals from connector. See the VRSC Electrical Diagnostic Manual for more information.
4. Wrap wire lead around end of turn signal wire and pull through routing hole in upper fork clamp. Leave wire lead in routing hole.
5. See Figure 8-30. Hold retainer and loosen ball stud clamp to remove turn signal.
6. Pull turn signal wire through the handlebar cable clips around handlebar controls wire sheath.

Figure 8-29. Front Turn Signal Connector [31] (typical) (VRSCA shown)

7. Lay old turn signal assembly next to **new** one and cut **new** wires to length. Trim sheath back approximately 63.5 mm (2.5 in) from ends of wires. See the VRSC Electrical Diagnostic Manual for more information.

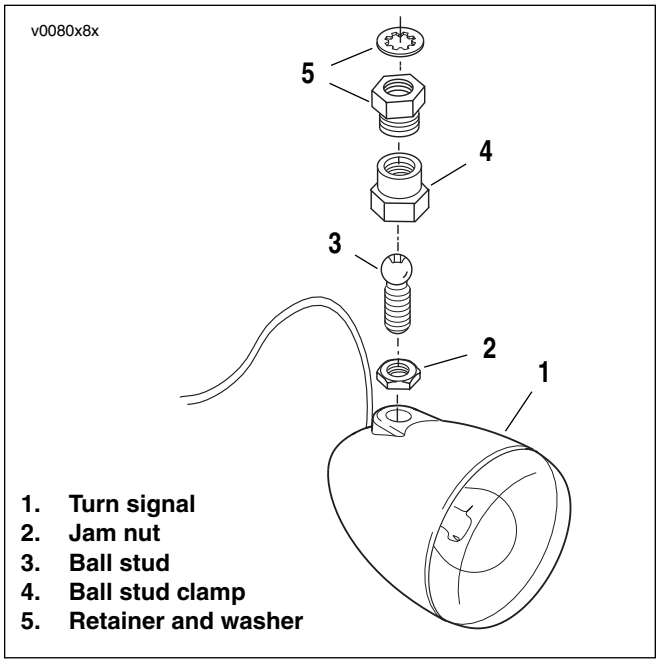
8. Install **new** turn signal lamp housing and route wire harness through handlebar cable clips.

9. Wrap wire lead around turn signal wires and pull through routing hole in fork clamp.

10. Crimp **new** pin terminals onto wires.

11. Insert terminals into turn signal connector and mate connector [31B] to socket [31A].

12. Install left side cover.



1. **Turn signal**
2. **Jam nut**
3. **Ball stud**
4. **Ball stud clamp**
5. **Retainer and washer**

Figure 8-30. Front Turn Signal Mounting

Rear Turn Signals

NOTE

Before removing turn signal wires, carefully note routing and location of each wire terminal in connector.

1. See 8.14 TAIL LAMP. Remove tail lamp housing assembly from rear fender. Locate appropriate rear turn signal harness and connector inside tail lamp housing recess in rear fender.

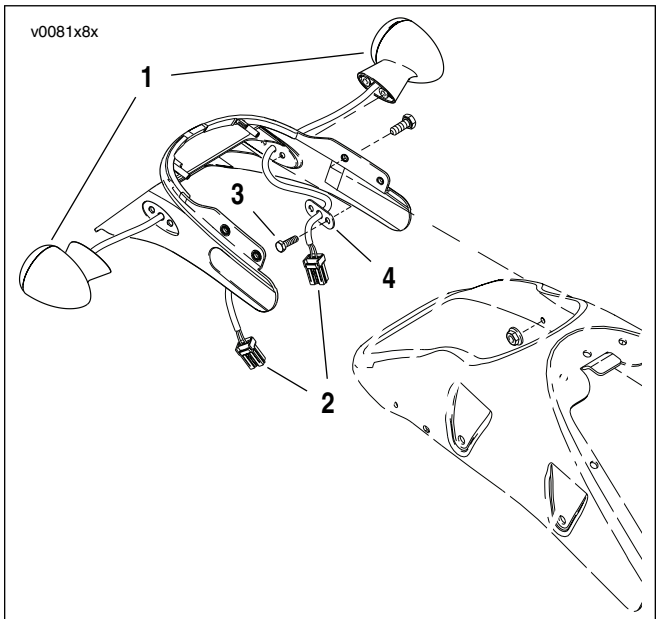
2. See Figure 8-31. Drawing shows rear lighting module assembly removed from rear fender for clarity. Note locations of turn signal wires in connector. Remove turn signal wire terminals from connector. See the VRSC Electrical Diagnostic Manual for more information.

3. Remove fasteners and support plate. Remove turn signal housing from vehicle. Carefully pull turn signal wiring harness through holes in fender.

4. Install **new** turn signal housing and support plate, routing wiring harness back through holes in fender. Bring wire ends into tail lamp housing recess in rear fender.

5. Insert terminals into turn signal connector and mate connector to socket.

6. See 8.14 TAIL LAMP and install tail lamp housing assembly into rear fender.



1. **Turn signal assembly (2)**
2. **Turn signal connector (2)**
3. **Fastener (4)**
4. **Support plate (2)**

Figure 8-31. Rear Turn Signal Mounting (typical) (VRSCA shown)

HANDLEBAR SWITCH ASSEMBLIES 8.16

GENERAL

The left handlebar switches include the headlamp HI - LO switch, horn and left turn signal switch.

The right handlebar switches include the engine start and RUN - OFF switch and right turn signal switch. The individual switches are non-repairable and must be replaced if they malfunction.

NOTE

To replace or repair individual switches in either the right or left handlebar switch assemblies, see SWITCH REPAIR/REPLACEMENT following the REMOVAL/INSTALLATION procedures.

REPAIR PROCEDURES

See 8.17 RIGHT HANDLEBAR SWITCH and 8.18 LEFT HANDLEBAR SWITCH. The removal and installation steps listed apply when replacing the entire switch assembly, switch housing or handlebars.

The information below is useful when repairing handlebar switch assemblies.

1. To access wires and avoid damaging conduit with radiant heating device, push conduit back and secure with extra 177.8 mm (7.0 in.) cable strap in kit.

2. Strip 12.7 mm (0.5 in.) of insulation off switch wires. Twist stripped ends of switch wires until all strands are tightly coiled.

3. Cut dual wall heat-shrink tubing, supplied in repair kit into 25.4 mm (1.0 in.) segments. Slide tubing over each wire of **new** switch assembly.

4. Splice existing and **new** switch wires, matching wire colors. Solder the spliced connections. For best results, do one wire at a time.

5. Center the heat-shrink tubing over the soldered splices.

⚠WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

6. Using the UltraTorch UT-100 Robinair Heat Gun with heat shrink attachment or other suitable radiant heating device, uniformly heat the heat-shrink tubing to insulate and seal the soldered connections. Apply heat just until the meltable sealant exudes out both ends of tubing and it assumes a smooth cylindrical appearance.

CAUTION

Electrically connected solder outside the tubing may cause a short to ground.

7. Inspect the melted sealant for solder beads. Excess solder or heat may force some solder out with the melted sealant. Use a small needle nose pliers to remove any solder found. Briefly heat the connection to reseal the tubing if solder beads were removed. Use less solder or reduce heating time or intensity when doing subsequent splices.

RIGHT HANDLEBAR SWITCH 8.17

REMOVAL

NOTE

The removal and installation steps listed apply when replacing a switch housing and its wire harness. Replacing a switch housing alone, repairing a switch housing, or replacing handlebars will not require removal of the wire harness to the switch housing.

1. Remove maxi-fuse. See 8.5 MAXI-FUSE.

2. See Figure 8-32. If removing the switch housing and wire harness, remove the left side cover and locate the right switch housing connector [22].

3. Depress the latch on the socket housing and separate the switch housing connector halves.

4. Remove secondary locking wedge and depress terminal latches inside socket housing to backout socket terminals and wires.

CAUTION

Do not remove the switch housing assembly without first placing a 5/32 in. (4 mm) thick cardboard insert between the brake lever and lever bracket. Removing the assembly without the insert in place may result in damage to the rubber boot and plunger of the fronT-stoplight switch.

5. See Figure 8-33. Place the cardboard insert between the brake lever and lever bracket.

6. Using a T27 TORX drive head, remove the two screws with flat washers securing the handlebar clamp to the master cylinder housing. Remove the brake lever/master cylinder assembly and clamp from the handlebar.

7. Using a T25 TORX drive head, remove the upper and lower switch housing screws.

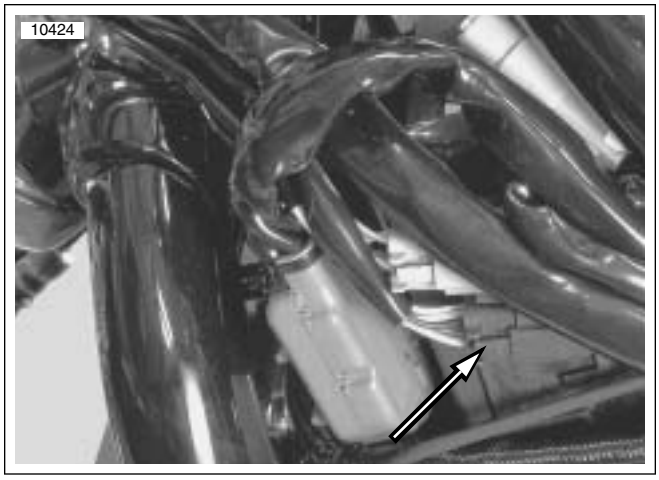


Figure 8-32. Right Switch Housing Connector [22] (typical) (VRSCA shown)

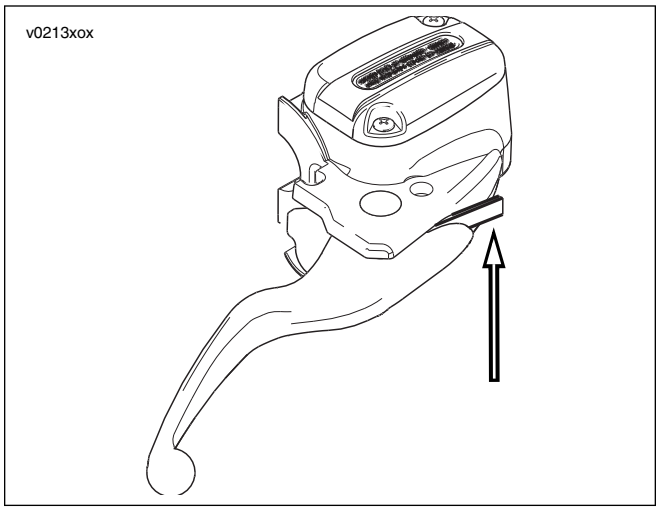


Figure 8-33. Install 4 mm (5/32 in.) Thick Cardboard Insert

8. To remove the housing with the wire harness, wrap switch housing wires to wire lead and pull wires through opening in upper fork clamp. Leave wire lead in fork clamp.

9. Remove the friction shoe from the end of the tension adjuster screw.

NOTE

The friction screw is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

10. Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.

11. Remove the throttle control grip from the end of the handlebar.

12. Pull the crimped inserts at the end of the throttle and idle control cable housings from the lower switch housing. For best results, use a rocking motion while pulling. Place a drop of light oil on the retaining rings, if necessary. Remove the cables from the switch housing.

13. Pull the wire harness through the handlebar clips and remove the housing and wire harness.

INSTALLATION

1. Thread the lose ends of the wire harness through the handlebar clips. Wrap the free ends of the wire harness to the wire lead and pull through the opening in the upper fork clamp.

2. Route wire harness around steering head.

3. Crimp socket terminals on ends of wire and push through connector wire seal and into socket housing.

4. Install internal seal and locking wedge

5. Mate connector [22] halves.

6. Assemble the switch housing. With the concave side facing upward, install the friction shoe so that the pin hole is over the point of the adjuster screw.

NOTE

The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

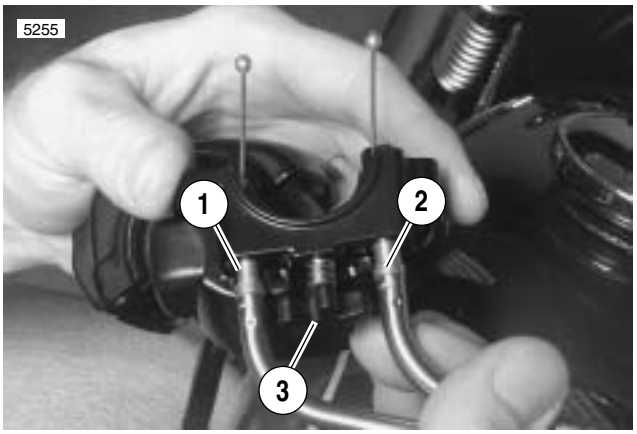
7. See Figure 8-34. Push the throttle and idle control cables into the lower switch housing until they snap in place. Note the different diameter inserts crimped into the end of the throttle and idle cable housings.

   a. Push the silver insert of throttle cable housing into the hole in front of tension adjuster screw.

   b. Push the gold insert (1) of idle cable housing into the hole at the rear of tension adjuster screw.

NOTE

To aid assembly, place a drop of light oil on the retaining rings of the crimped inserts. Always replace the retaining rings if damaged or distorted.



1. Idle cable insert (gold insert, rear hole)
2. Throttle cable insert (silver insert, front hole)
3. Tension adjuster screw

Figure 8-34. Right Lower Switch Housing

8. See Figure 8-35. Route the cable to the upper switch housing as shown.

9. Slide the throttle control grip over the end of the right handlebar until it bottoms against the closed end. Rotate the grip so that the ferrule notches are at the top. To prevent binding, pull the grip back about 3.2 mm (1/8 in.).

10. See Figure 8-36. Position lower switch housing beneath the throttle control grip. Install the brass ferrules onto the cable so that the end fittings seat in the ferrule recess. Seat the ferrules in their respective notches on the throttle control grip. Verify that the cables are captured in the grooves molded into the grip.

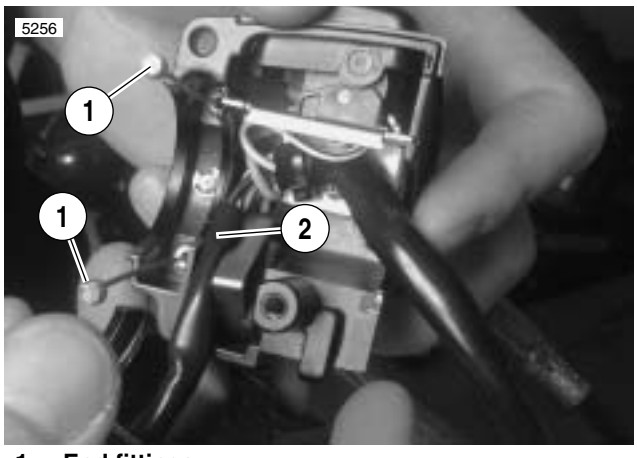
11. Position the upper switch housing over the handlebar and lower switch housing.

12. Verify that the wire harness conduit runs in the depression at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.

13. Start the upper and lower switch housing screws, but do not tighten.

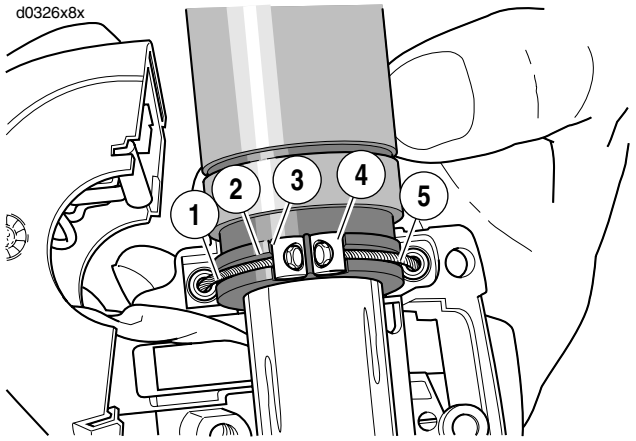
CAUTION

See Figure 8-37. Do not remove the 4 mm (5/32 in.) thick cardboard insert wedged between the brake lever and lever bracket. Removal will result in damage to the rubber boot and plunger of the fronT-stoplight switch during installation of the master cylinder assembly.



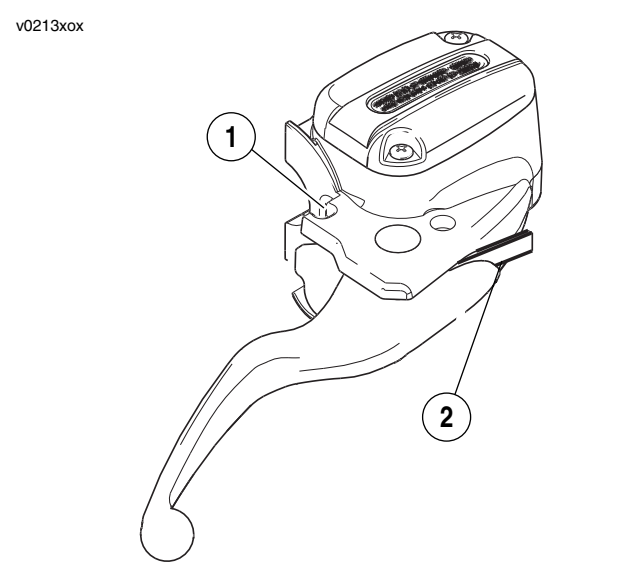
1. End fittings
2. Upper switch housing cable

Figure 8-35. Route Cable to Upper Switch Housing



1. Throttle cable (silver insert, front hole)
2. Groove in throttle grip
3. Notch
4. Brass ferrule
5. Idle cable (gold insert, rear hole)

Figure 8-36. Throttle Cable Installation



1. Groove
2. 4 mm (5/32 in.) cardboard insert

Figure 8-37. Leave Cardboard Insert in Place

14. See Figure 8-38. Position the brake lever/master cylinder assembly inboard of the switch housing assembly, engaging the tab on the lower switch housing in the groove at the top of the brake lever bracket.

15. Align the holes in the handlebar clamp with those in the master cylinder housing and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.

16. Using a T25 TORX drive head, tighten lower and upper switch housing screws to 4.0-5.1 Nm (35-45 **in-lbs)**.

NOTE

Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.

17. Remove the cardboard insert between the brake lever and lever bracket.

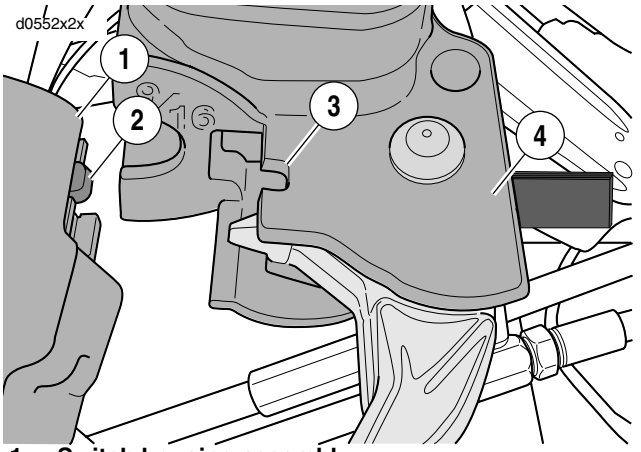
⚠WARNING

Check all lighting and switch operations before riding motorcycle. Visibility is a major concern for motorcyclists. Failure to have lighting and proper switch operations could result in death or serious injury.

18. Replace the maxi-fuse. Replace the right side cover.

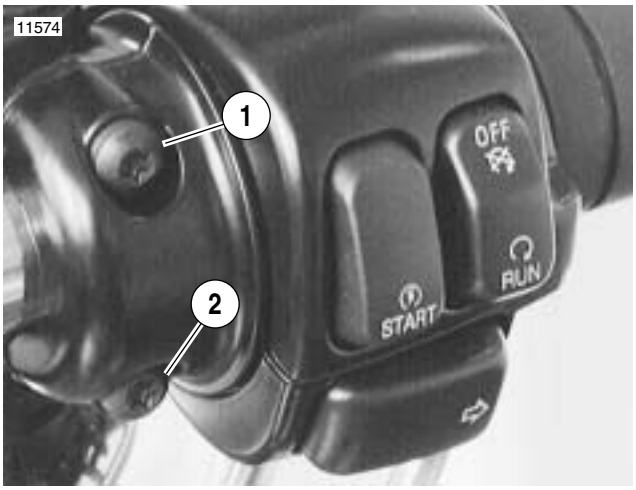
19. Replace the left side cover.

20. Test the switches for proper operation.



1. **Switch housing assembly**
2. **Tab**
3. **Groove**
4. **Brake lever bracket**

Figure 8-38. Switch Housing Alignment (typical)



1. **Upper screw**
2. **Lower screw and flat washer**

Figure 8-39. Handlebar Clamp Screws (typical) (VRSCA shown)

DISASSEMBLY

CAUTION

See Figure 8-37. Do not remove the switch housing assembly without first placing a 4 mm (5/32 in.) cardboard insert between the brake lever and lever bracket. Removing the assembly without the insert in place may result in damage to the rubber boot and plunger of the fronT-stoplight switch.

1. Place the cardboard insert between the brake lever and lever bracket.
2. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
3. If replacing lower housing switches, perform steps 4 through 7 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
4. See Figure 8-39. Using a T27 TORX drive head, loosen the upper screw securing the handlebar clamp to the master cylinder housing. Remove the lower clamp screw with flat washer.
5. Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
6. Remove the friction shoe from the end of the tension adjuster screw.

NOTE

The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

7. Remove the throttle control grip from the end of the handlebar.

SWITCH REPAIR/REPLACEMENT

Upper Housing Repair

NOTE

Replace the engine stop and engine start switches as a single assembly even if only one switch is determined to be faulty.

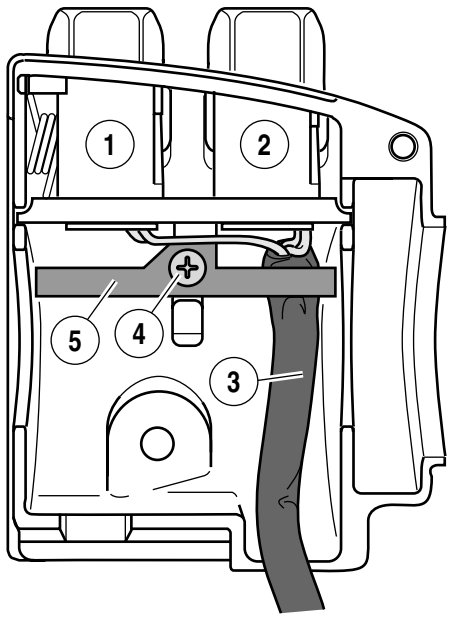
1. See Figure 8-40. From inside the switch housing, remove the screw with lock washer to release the bracket. Remove the bracket and switch assembly from the housing.
2. Move cable conduit from beneath wing of bracket. Cut wires 6.4 mm (0.25 in.) from old switches. Discard old switch and bracket assembly.
3. Slide conduit forward over cut ends of switch wires and cut off 12.7 mm (0.5 in.) of conduit material. Push conduit back to access switch wires.
4. Separate **new** engine stop switch and engine start switch wires into two bundles.

NOTE

Replacement stop switch and start switch wires are cut to length (63.5 mm/2.5 in. and 50.8 mm/2.0 in., respectively) and partially stripped.

5. See 8.16 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in Figure 8-41. Route wires downstream of splices beneath wing on engine stop switch side of bracket as seen in Figure 8-40.
7. See Figure 8-41. Install a **new** 177.8 mm (7.0 in.) cable strap (5) beneath wing on engine start switch side of bracket and capture wire splices.
8. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
9. See Figure 8-40. Install screw and lock washer to secure bracket inside housing. Verify that wing on engine stop switch side of bracket captures edge of conduit as shown.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. Continue with ASSEMBLY on page 8-37.

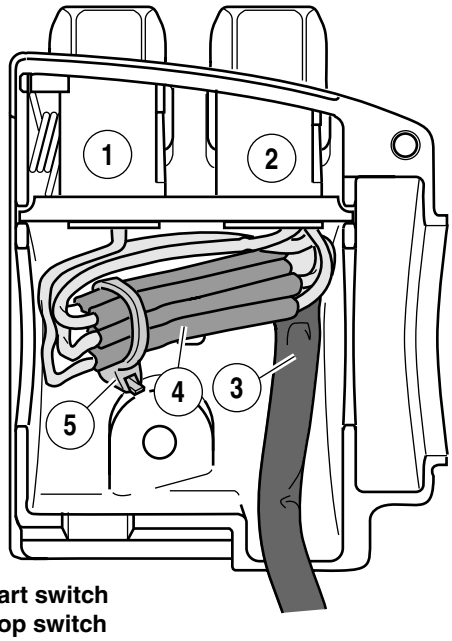
d0327x8x



1. **Start switch**
2. **Stop switch**
3. **Conduit**
4. **Screw with lockwasher**
5. **Bracket**

Figure 8-40. Upper Housing Without Splices

d0328x8x



1. **Start switch**
2. **Stop switch**
3. **Conduit**
4. **Splices**
5. **Cable strap**

Figure 8-41. Upper Housing With Splices

Lower Housing Repair

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.

2. Remove the screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.

TURN-RIGHT SIGNAL SWITCH

1. Cut wire 38.1 mm (1.5 in.) from old switch. Discard old switch assembly.

NOTE

Replacement turn-right signal switch wires are cut to length (1.5 in./38.1 mm) and partially stripped.

2. See 8.16 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.

3. Continue with ASSEMBLY on page 8-37.

FRONT-STOP LIGHT SWITCH

1. Carefully remove the wedge between the switch and switch housing, if present. To remove the switch from the housing, depress the plunger and slowly rotate switch upward while rocking slightly.

2. Cut wires 25.4 mm (1.0 in.) from old switch. Discard old switch.

NOTE

Replacement stoplight switch wires are cut to length (63.5 mm/2.5 in.) and partially stripped.

3. See 8.16 HANDLEBAR SWITCH ASSEMBLIES for information on repair practices.

4. Carefully depress plunger against inside wall of switch housing. With thumb over plunger bore, move switch into the installed position in the switch housing cavity. When plunger is positioned against thumb, slowly rotate switch downward while rocking slightly. Release the plunger only after switch is properly positioned in the cavity.

5. Verify that the plunger is square in the bore and that the boot is not compressed, collapsed or torn. If necessary, gently work the plunger in and out until boot is fully extended.

6. See Figure 8-42. Push down on switch so that it bottoms against housing and wires run in groove at base of cavity. With the concave side facing outward, insert wedge between switch and outboard side of switch housing.

7. Push wedge down until it also bottoms against housing. Verify that the plunger is still square in the bore and then place a drop of RTV Silicone Sealant on upper corner of wedge.

8. Continue with ASSEMBLY on page 8-37.

ASSEMBLY

1. See Figure 8-43. Insert tapered end of **new** 177.8 mm (7.0 in.) cable strap into round hole in turn signal switch bracket and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

NOTE

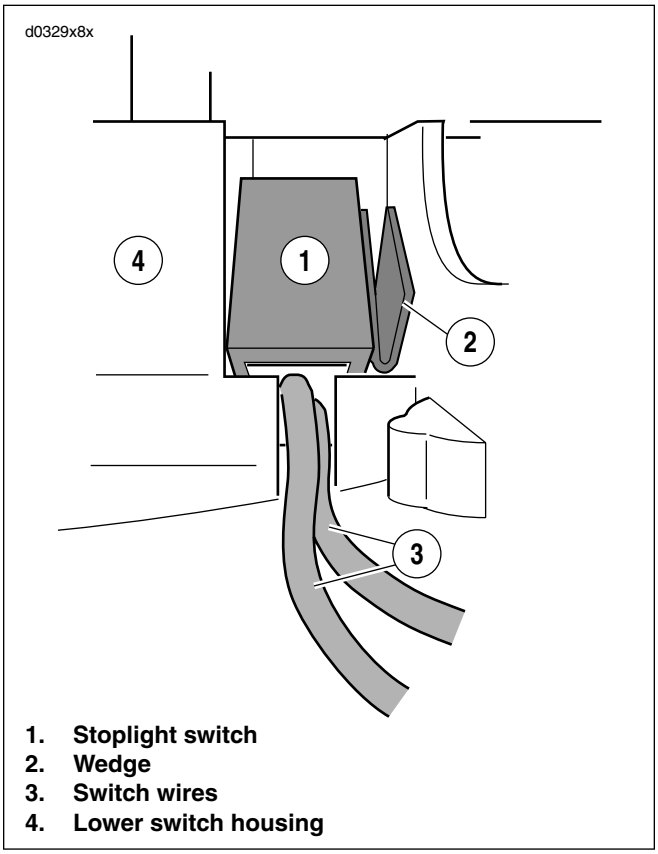
Be sure that all splices are positioned above the turn signal switch bracket.

2. Place the turn signal switch assembly into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.
3. Start screw with lockwasher to secure bracket inside housing.

CAUTION

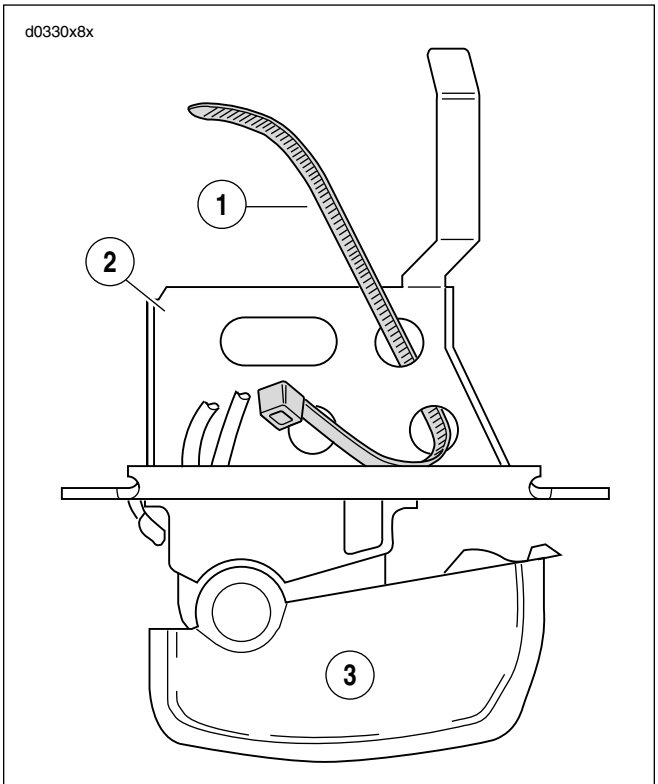
If routed incorrectly, wires may be pinched by casting or handlebar resulting in switch failure.

4. Loop switch wires so that spliced lengths are positioned across bracket.
5. Capturing conduit about 6.4 mm (0.25 in.) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
6. Install second 177.8 mm (7.0 in.) cable strap capturing conduit and wire splices. Securely tighten cable strap to draw splices to conduit. Remove any excess cable strap material.
7. Tighten screw to secure bracket inside housing.
8. Route wire bundle to upper switch housing by gently pressing conduit into channel next to angular arm of bracket. Secure bundle to arm using third cable strap. Cut any excess cable strap material. If necessary, bend angular arm of bracket downward to firmly secure fronT-stoplight switch in position.
9. See INSTALLATION on page 8-32.
   a. If lower housing switches were replaced, perform the whole procedure.
   b. If upper housing switches were replaced, begin with step 11.



1. **Stoplight switch**
2. **Wedge**
3. **Switch wires**
4. **Lower switch housing**

Figure 8-42. Install Stoplight Switch



1. **Cable strap**
2. **Bracket**
3. **Right turn signal switch**

Figure 8-43. Insert Cable Strap in Switch Bracket

LEFT HANDLEBAR SWITCH 8.18

REMOVAL

NOTE

The removal and installation steps listed apply when replacing a switch housing and its wire harness. Replacing a switch housing alone, repairing a switch housing, or replacing handlebars will not require removal of the wire harness to the switch housing.

1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
2. See Figure 8-44. If removing the switch housing and wire harness, remove the left side cover and locate the left switch housing connector [24].
3. Depress the latch on the socket housing and separate the switch housing connector halves.
4. Remove secondary locking wedge and depress terminal latches inside socket housing to backout socket terminals and wires.
5. Using a T27 TORX drive head, remove the two screws with flat washers securing the handlebar clamp to the clutch lever and master cylinder bracket. Remove the clutch hand lever assembly and clamp from the handlebar.
6. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
7. Remove the grip sleeve from the end of the handlebar if damaged.
8. To remove the housing with the wire harness, wrap switch housing wires to wire lead and pull wires through opening in upper fork clamp. Leave wire lead in fork clamp.
9. Pull the wire harness through the handlebar clips and remove the housing and wire harness.

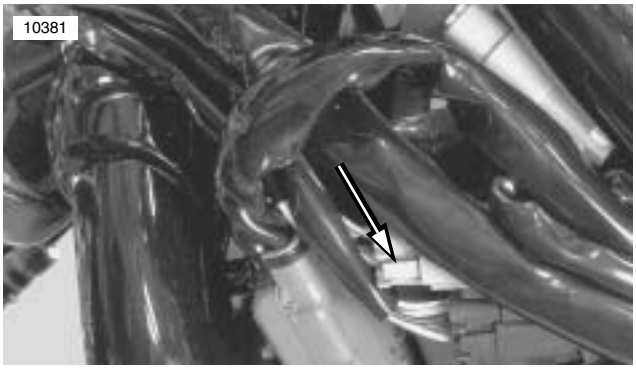
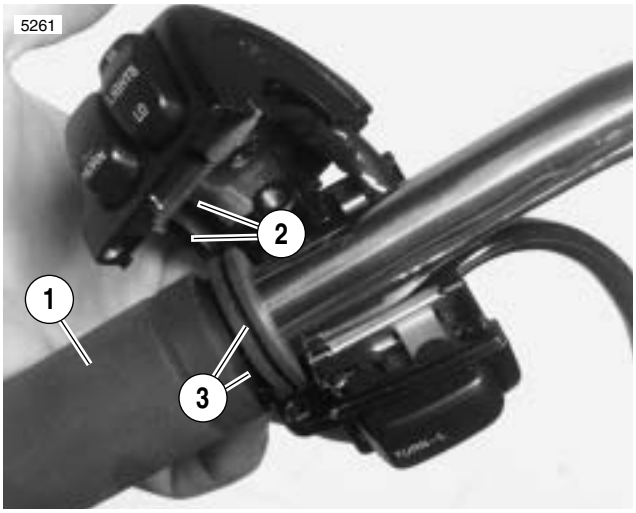
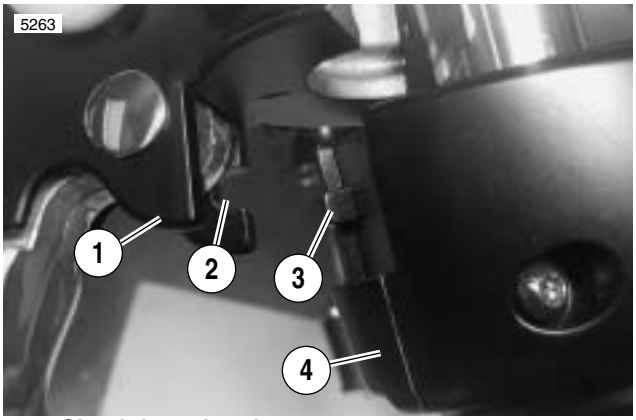


Figure 8-44. Left Switch Housing Connector [24] (typical) (VRSCA shown)



1. **Grip sleeve**
2. **Ribs**
3. **Grooves**

Figure 8-45. Left Handlebar Switch Housings



1. **Clutch lever bracket**
2. **Groove**
3. **Tab**
4. **Switch housing assembly**

Figure 8-46. Clutch Lever Bracket

INSTALLATION

1. Thread the lose ends of the wire harness through the handlebar clips. Wrap the free ends of the wire harness to the wire lead and pull through the opening in the upper fork clamp.
2. Route wire harness around steering head.
3. Crimp socket terminals on ends of wire and push through connector wire seal and into socket housing.
4. Install internal seal and locking wedge
5. Mate connector [24] halves.
6. the grip sleeve was removed, thoroughly clean handlebar to remove all adhesive residue. Pour adhesive into new grip. Roll grip to evenly distribute adhesive on inside surfaces. Install grip on handlebar with a twisting motion.
7. See Figure 8-45. Install upper and lower switch housings on handlebar. Be sure that ribs (2) on outboard side of switch housings fit in grooves (3) molded into grip.
8. Verify that the wire harness conduit runs in the groove at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.
9. Start the upper and lower switch housing screws, but do not tighten.
10. See Figure 8-46. Position the clutch hand lever assembly inboard of the switch housing assembly, engaging the tab (3) on the lower switch housing in the groove (2) at the bottom of the clutch lever bracket.
11. Align the holes in the handlebar clamp with those in the clutch lever bracket and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten screws to 6.8 Nm (60-80 **in-lbs**) using a T27 TORX drive head.
12. Using a T25 TORX drive head, tighten lower and upper switch housing screws to 4.0-5.1 Nm (35-45 **in-lbs**).

NOTE

Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.

⚠WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

13. Replace the maxi-fuse. and the right side cover.
14. Replace the left side cover.
15. Test the switches for proper operation.

DISASSEMBLY

1. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
2. If replacing lower housing switches, perform step 3 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
3. Using a T27 TORX drive head, loosen the upper screw securing the handlebar clamp to the clutch lever bracket. Remove the lower clamp screw with flat washer.

SWITCH REPAIR/REPLACEMENT

Upper Housing Repair

NOTE

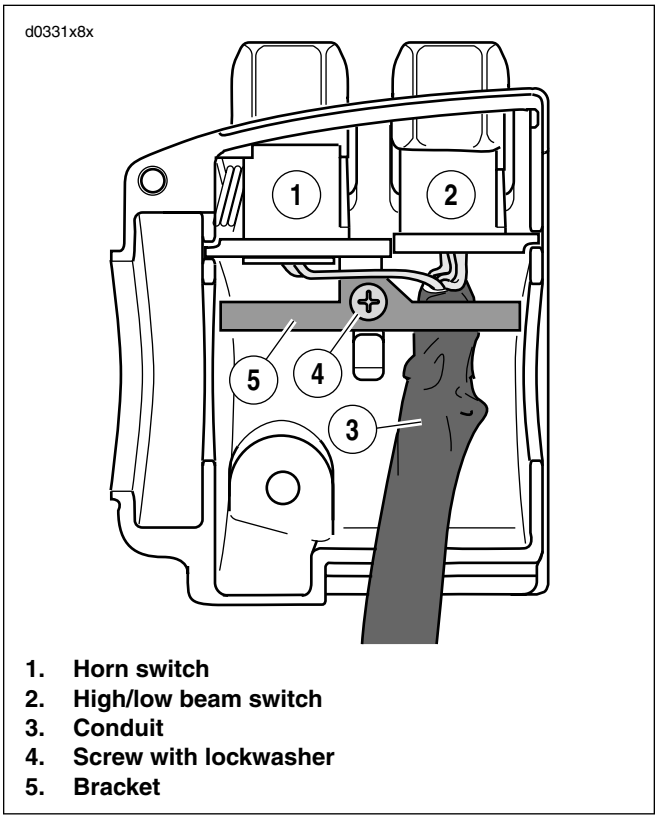
Replace the horn switch and high/low beam switch as a single assembly even if only one switch is determined to be faulty.

1. See Figure 8-47. From inside the switch housing, remove the screw with lockwasher (4) to release the bracket (5). Remove bracket and switch assembly from the housing.
2. Move cable conduit (3) from beneath wing of bracket. Cut wires 6.4 mm (0.25 in.) from old switches (1, 2). Discard old switch and bracket assembly.
3. Slide conduit forward over cut ends of switch wires and cut off 12.7 mm (0.5 in.) of conduit (3) material. Push conduit back to access switch wires.
4. Separate the **new** horn switch (1) and high/low beam switch (2) wires into two bundles.

NOTE

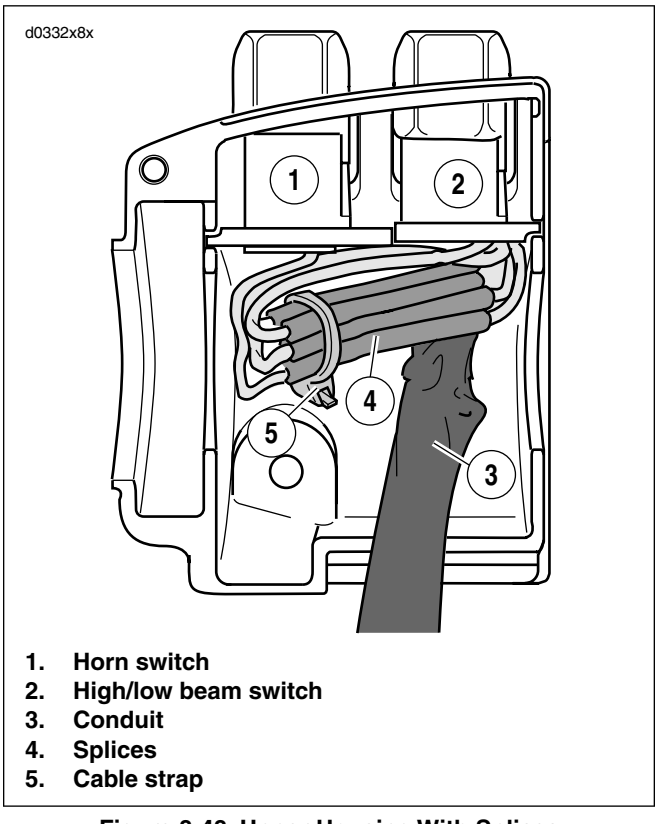
Replacement high/low beam switch and horn switch wires are cut to length (63.5 mm/2.5 in. and 50.8 mm/2.0 in., respectively) and partially stripped.

5. See 8.16 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in Figure 8-48. Route wires downstream of splices beneath wing on high/low beam switch side of bracket as seen in Figure 8-47.
7. See Figure 8-48. Install a **new** 177.8 mm (7.0 in.) cable strap (5) beneath wing on horn switch side (1) of bracket and capture wire splices (4).
8. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
9. See Figure 8-47. Install screw and lockwasher (4) to secure bracket (5) inside housing. Verify that wing on high/low switch (2) side of bracket captures edge of conduit (3) as shown.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. Continue with ASSEMBLY on page 8-41.



1. **Horn switch**
2. **High/low beam switch**
3. **Conduit**
4. **Screw with lockwasher**
5. **Bracket**

Figure 8-47. Upper Housing Without Splices



1. **Horn switch**
2. **High/low beam switch**
3. **Conduit**
4. **Splices**
5. **Cable strap**

Figure 8-48. Upper Housing With Splices

Lower Housing Repair

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. Remove screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
3. Cut wires 38.1 mm (1.5 in.) from old switch (Turn-L(eft) Signal Switch). Discard switch assembly.
4. See 8.16 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.

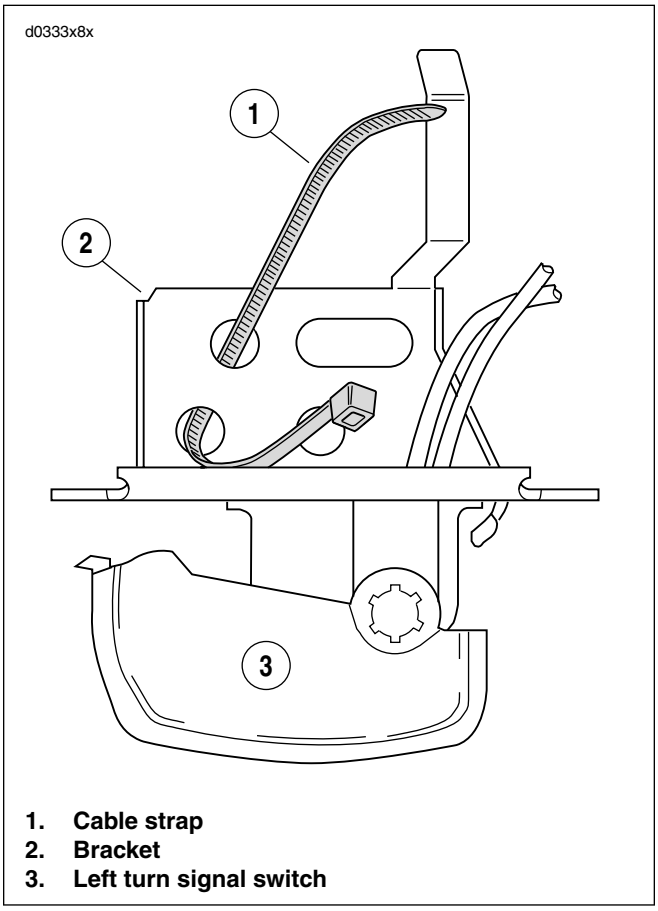
ASSEMBLY

1. See Figure 8-49. Insert tapered end of **new** 177.8 mm (7.0 in.) cable strap into round hole in turn signal switch bracket and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

NOTE

Be sure that all splices are positioned above the turn signal switch bracket.

2. Place the turn signal switch assembly into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.
3. Start screw with lockwasher to secure bracket inside housing.
4. Loop switch wires so that spliced lengths are positioned across bracket.
5. Capturing conduit about 6.4 mm (0.25 in.) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
6. Tighten screw to secure bracket inside housing.
7. Route wire bundle to upper switch housing below and then forward of the main wire harness, positioning conduit in channel next to angular arm of bracket. Secure bundle to arm using **new** cable strap. Cut any excess cable strap material.
8. See INSTALLATION on page 8-39.
   a. If lower housing switches were replaced, perform the whole procedure.
   b. If upper housing switches were replaced, begin with step 7.



1. **Cable strap**
2. **Bracket**
3. **Left turn signal switch**

Figure 8-49. Insert Cable Strap in Switch Bracket

TURN SIGNAL SECURITY MODULE: TSSM (VRSCA/D) 8.19

GENERAL

The Turn Signal Security Module (TSSM) is located beneath the passenger seat, mounted in a bracket on the rear fender.

REMOVAL

1. Verify security lamp is not blinking (vehicle is disarmed).
2. Remove maxi-fuse. See 8.5 MAXI-FUSE.
3. Unlock and open seat.
4. See Figure 8-50. Remove fastener and washer. Slide passenger seat forward slightly to detach it from the mounting tab on the rear of the fender. Then slide seat back and out from underneath seat strap. Remove passenger seat from motorcycle.
5. See Figure 8-51. Squeeze wiring harness connector release latches and carefully pull wiring harness connector out of connector socket on TSSM.
6. Lift up TSSM and slide it out of mounting bracket.

INSTALLATION

1. Slide **new** TSSM into mounting bracket. Make sure TSSM slides all the way forward in the bracket.
2. Carefully insert wiring harness connector into TSSM socket. Push connector all the way in until release latches lock in place.

CAUTION

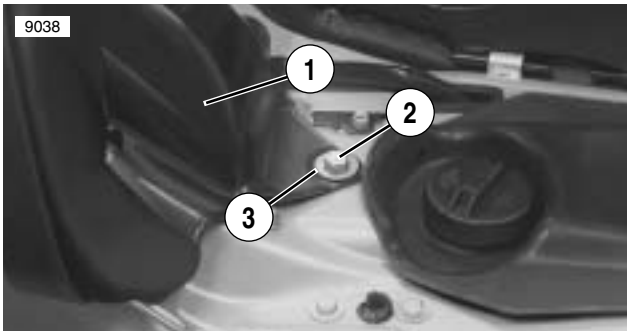
The wiring harness connector is keyed and can only be inserted fully in the TSSM socket one way. DO NOT force the connector into the socket. Doing so can damage the connector and/or socket.

3. See Figure 8-50. Slide passenger seat under seat strap and engage mounting tab on the fender into slot in bottom rear of seat. Make sure TSSM wiring harness is not pinched under seat frame.
4. Attach passenger seat to motorcycle with fastener and washer. Tighten to 11-17 Nm (97-150 **in-lbs**).
5. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.

CAUTION

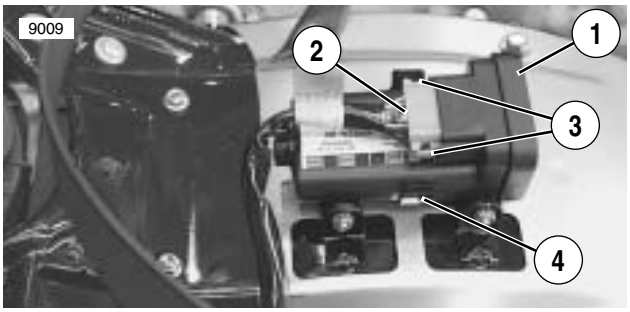
When closing the seat, make sure the ignition switch is in the FUEL position. If the ignition switch is in any other position when the seat is closed, the seat latch mechanism could be damaged. (00196a)

6. Replace maxi-fuse and right side cover.



1. **Passenger seat**
2. **Fastener @ 11-17 Nm (97-150 in-lbs)**
3. **Washer**

Figure 8-50. Passenger Seat Attachment



1. **TSSM**
2. **Wiring harness connector**
3. **Connector release latch (2)**
4. **TSSM mounting bracket**

Figure 8-51. Turn Signal Security Module Mounting

TURN SIGNAL SECURITY MODULE: TSSM (VRSCR) 8.20

GENERAL

The Turn Signal Security Module (TSSM) is located beneath the passenger seat, mounted in a bracket on the rear fender.

REMOVAL

1. Verify security lamp is not blinking (vehicle is disarmed).
2. Remove maxi-fuse. See 8.5 MAXI-FUSE.
3. Open seat.
4. See Figure 8-52. Remove fastener and washer. Slide passenger seat forward slightly to detach it from the mounting tab on the rear of the fender. Then slide seat out from underneath seat strap. Remove passenger seat from motorcycle.
5. See Figure 8-53. Squeeze wiring harness connector release latches and carefully pull wiring harness connector out of connector socket on TSSM.
6. Lift up TSSM and slide it out of mounting bracket.

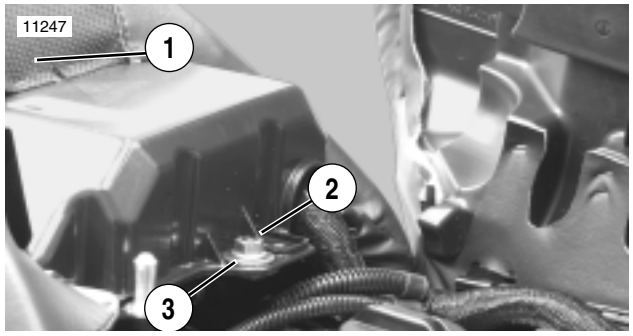
INSTALLATION

1. Slide **new** TSSM into mounting bracket. Make sure TSSM slides all the way forward in the bracket.
2. Carefully insert wiring harness connector into TSSM socket. Push connector all the way in until release latches lock in place.

CAUTION

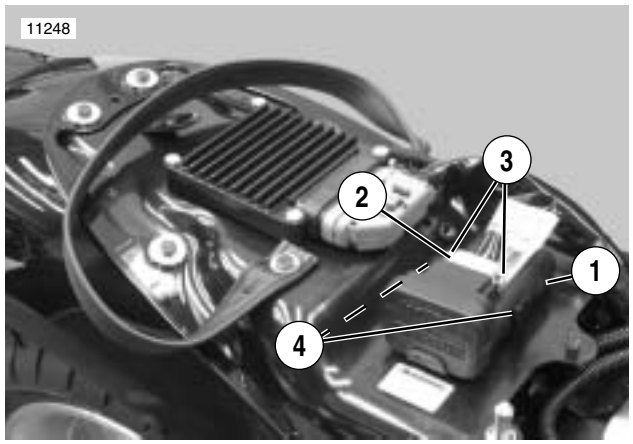
The wiring harness connector is keyed and can only be inserted fully in the TSSM socket one way. DO NOT force the connector into the socket. Doing so can damage the connector and/or socket.

3. See Figure 8-52. Slide passenger seat under seat strap and engage mounting tab on the fender into slot in bottom rear of seat. Make sure TSSM wiring harness is not pinched under seat frame.
4. Attach passenger seat to motorcycle with fastener and washer. Tighten to 20-26 Nm (15-19 ft-lbs).
5. Replace maxi-fuse and right side cover.



1. **Passenger seat**
2. **Fastener @ 20-26 Nm (15-19 ft-lbs)**
3. **Washer**

Figure 8-52. Passenger Seat Attachment



1. **TSSM**
2. **Wiring harness connector**
3. **Connector release latch (2)**
4. **TSSM mounting bracket**

Figure 8-53. Turn Signal Security Module Mounting

INSTRUMENT CLUSTER (VRSCA) 8.21

GENERAL

The instrument cluster contains the speedometer, tachometer, fuel gauge and indicator lamps. It is a sealed unit. If any of the instruments or indicator lamps becomes defective, the entire instrument cluster must be replaced.

REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.

2. See Figure 8-54. To free lower end of top handlebar cover, loosen two mounting fasteners holding headlamp bracket to upper triple clamp.

3. Without removing cover, remove two fasteners (6) securing handlebar top cover (2) and instrument housing bezel (1) to handlebar bottom cover (5).

CAUTION

See Figure 8-55. Bezel hook holds bottom of bezel and top cover to lower handlebar cover and can be damaged if forced during removal or installation.

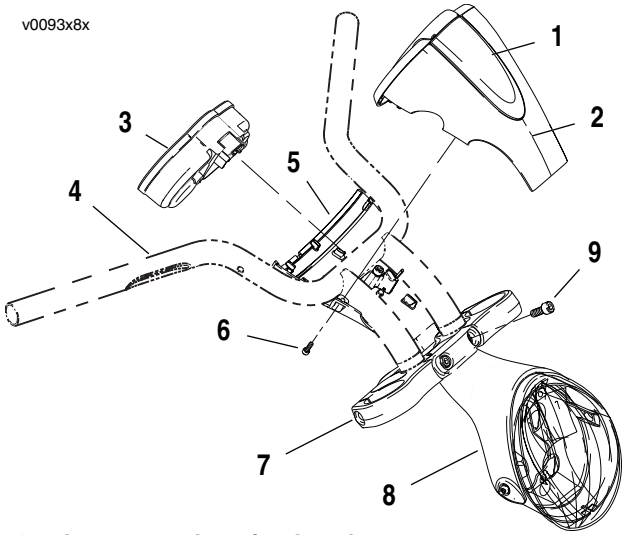
4. From headlamp bracket end of cover, gently tilt top handlebar cover and instrument bezel up and back to remove cover and bezel.

NOTE

Bezel can remain snapped to upper handlebar cover.

5. See Figure 8-56. Squeeze two release latches together and gently pull wiring harness connector [39] from instrument cluster socket.

6. Remove instrument cluster from handlebar bottom cover.



1. **Instrument housing bezel**
2. **Handlebar top cover**
3. **Instrument cluster**
4. **Handlebars**
5. **Handlebar bottom cover**
6. **Fastener (2) @ 1.3-1.9 Nm (12-16 in-lbs)**
7. **Upper triple clamp**
8. **Headlamp and headlamp bracket**
9. **Fastener (2) @ 11-18 Nm (8-13 ft-lbs)**

Figure 8-54. Instrument Cluster Removal

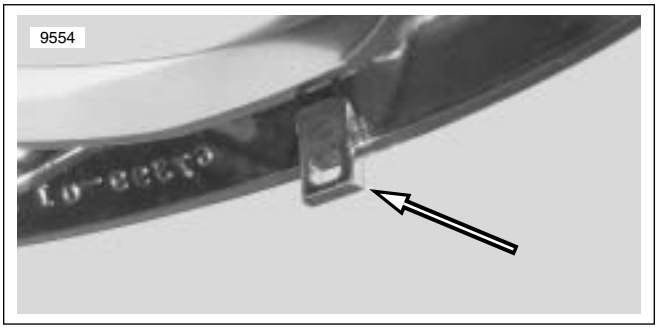
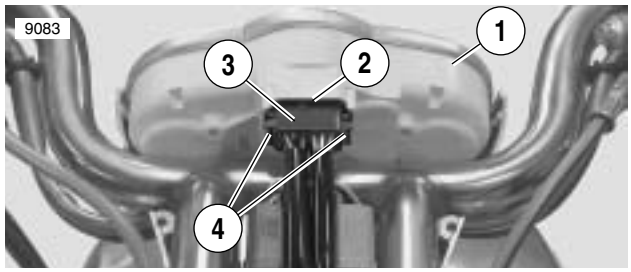


Figure 8-55. Bezel Hook



1. **Instrument cluster**
2. **Instrument cluster socket**
3. **Wiring harness connector [39]**
4. **Release latch (2)**

Figure 8-56. Instrument Cluster Harness Connector [39]

INSTALLATION

1. Set **new** instrument cluster into handlebar bottom cover.
2. See Figure 8-56. Install wiring harness connector into instrument cluster socket. Gently push connector into socket until release latches lock into place.

CAUTION

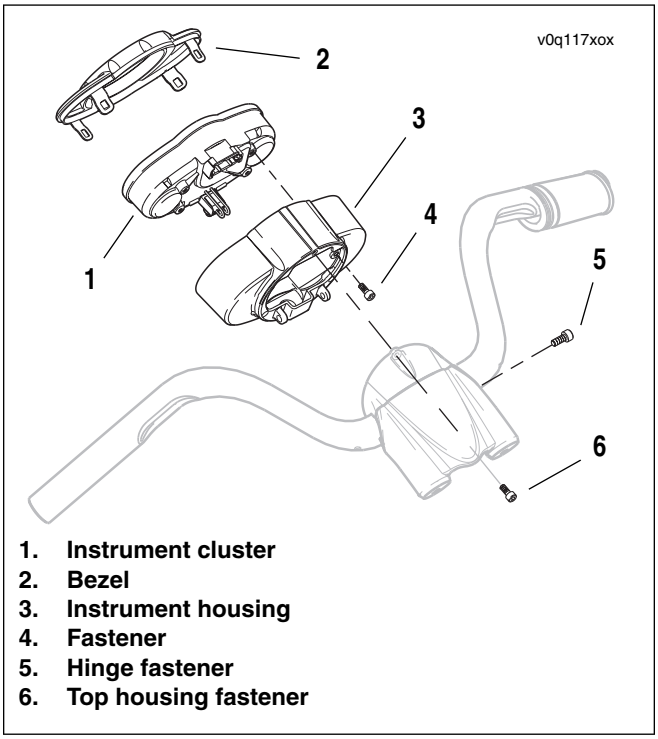
See Figure 8-55. Bezel hook holds bottom of bezel and top cover to lower handlebar cover and can be damaged if forced during removal or installation.

3. See Figure 8-54. Orient instrument housing bezel and handlebar top cover, and fit bezel hook over tab on handlebar bottom cover. Gently press handlebar top cover and instrument housing bezel down until bezel hook snaps onto tab.
4. Fit bottom end of handlebar top cover behind headlamp mounting bracket. Bezel edge should fit snugly to grooved rim of lower and upper cover.
5. Secure handlebar covers with two fasteners. Tighten fasteners to 1.3-1.9 Nm (12-16 **in-lbs**).
6. Tighten headlamp bracket fasteners to 11-18 Nm (8-13 ft-lbs).
7. Replace maxi-fuse and right side cover.
8. Verify that instrument cluster is operational:
   a. Turn ignition/seat release switch to the ACC position. Instrument background lighting will illuminate, gauge needles will sweep their full range of motion and the battery, security, coolant temperature and check engine indicator lamps will illuminate.
   b. Turn ignition/seat release switch to the LOCK position.

INSTRUMENT CLUSTER (VRSCD) 8.22

REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. See Figure 8-57. Remove fastener at top of instrument housing.
3. Holding instrument housing to prevent damage to air box cover, rotate housing open.
4. See Figure 8-58. Squeeze two release latches together and pull wiring harness connector [39B] from instrument cluster.
5. See Figure 8-57. Loosen and remove hinge fastener and slide housing off of hinge peg
6. Remove four fasteners and separate housing, instrument cluster and bezel.



1. **Instrument cluster**
2. **Bezel**
3. **Instrument housing**
4. **Fastener**
5. **Hinge fastener**
6. **Top housing fastener**

Figure 8-57. VRSCD Instrument Cluster

INSTALLATION

1. See Figure 8-57. Assemble bezel, instrument cluster and housing. Install and tighten fasteners to 1.3-1.9 Nm (12-16 **in-lbs**).
2. Fit hinge of housing to peg on handlebar clamp. Install and tighten fastener to 2.2-2.8 Nm (20-24 **in-lbs**).
3. Squeeze two release latches together and mate connector [39B] to instrument cluster.
4. Close housing. Install and tighten top housing fastener to 2.2-2.8 Nm (20-24 **in-lbs)**.
5. Replace maxi-fuse and right side cover.
6. Verify that instrument cluster is operational:
   a. Turn ignition/seat release switch to the ACC position. Instrument background lighting will illuminate, gauge needles will sweep their full range of motion and the battery, security, coolant temperature and check engine indicator lamps will illuminate.
   b. Turn ignition/seat release switch to the LOCK position.

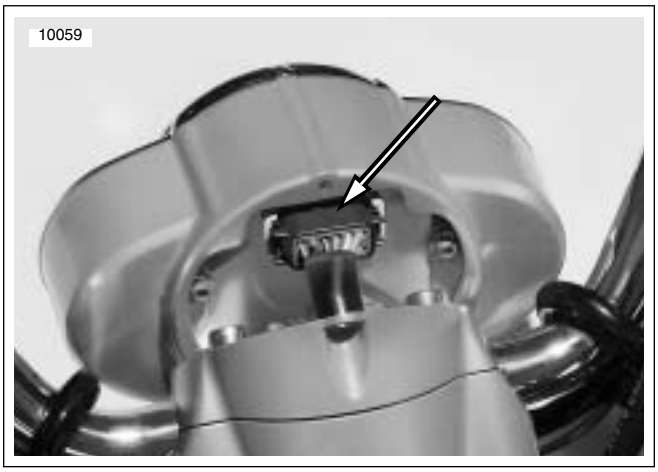


Figure 8-58. Instrument Cluster Connector [39B]

INSTRUMENT CLUSTER (VRSCR) 8.23

GENERAL

The instrument cluster contains the speedometer, tachometer, fuel gauge and indicator lamps. It is a sealed unit. If any of the instruments or indicator lamps becomes defective, the instrument cluster must be replaced as a unit.

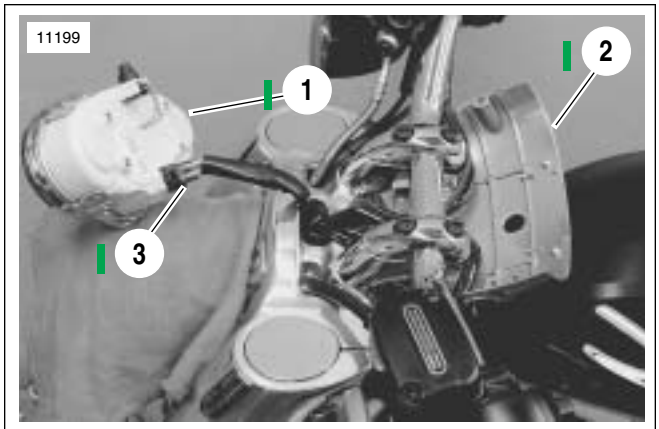
REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. See Figure 8-59. Remove two instrument cluster fasteners (one per side) and remove instrument cluster cover.
3. See Figure 8-60. Place a shop towel over headlamp bucket to protect finish. carefully tilt instrument cluster (1) off bottom handlebar cover (2) and rest instrument cluster on shop towel.
4. Unplug connector (3) from instrument cluster.

NOTE

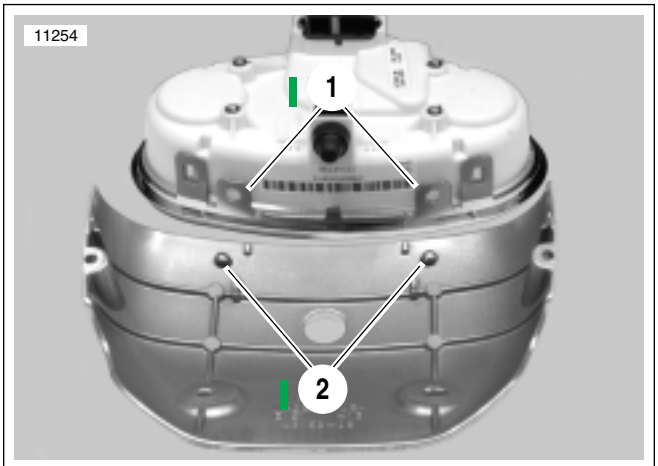
If necessary to remove bottom handlebar cover, remove two fasteners located on bottom of handlebar cover at bottom of handlebar risers. When installing, tighten fasteners to 6-10 Nm (53-89 ***in-lbs****).*

Figure 8-59. Instrument Cluster Fasteners



1. **Instrument cluster**
2. **Bottom handlebar cover**
3. **Connector [39B]**

Figure 8-60. Handlebar Assembly



1. **Instrument cluster locating tabs**
2. **Bottom handlebar cover locators**

Figure 8-61. Instrument Bezel and Bottom Handlebar Cover (removed for photo clarity)

INSTALLATION

1. See Figure 8-61. Align instrument cluster locating tabs (1) and bottom handlebar cover locators (2).
2. See Figure 8-60. Mount instrument cluster (1). Connect wiring harness to instrument cluster.
3. See Figure 8-59. Install instrument cluster cover and install instrument cluster fasteners. Tighten to 1.3-1.9 Nm (12-17 **in-lbs**).
4. Install maxi-fuse and right side cover.
5. Verify proper operation of instrument cluster.

VEHICLE SPEED SENSOR: VSS 8.24

GENERAL

The vehicle speed sensor (VSS) is a hall effect sensor that takes readings off a drive gear in the transmission.

The VSS is located behind the rear cylinder on the back of the engine case, below the cam chain tension adjuster.

REMOVAL

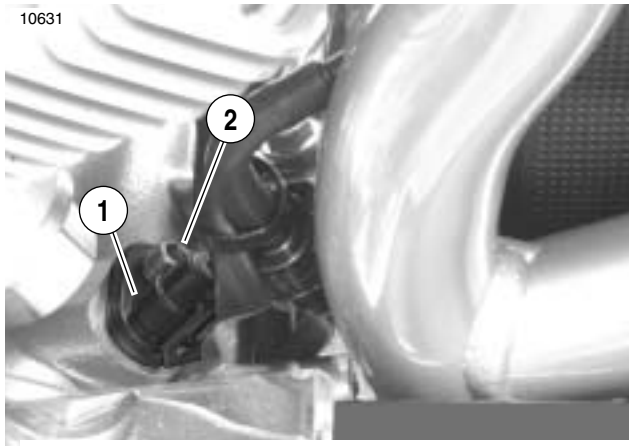
1. Remove right side cover and maxi-fuse.
2. See Figure 8-62. Disconnect VSS wiring harness cable connector [65B] from the VSS.
3. Remove the fastener securing the VSS. Carefully pull the VSS and O-ring straight out of the transmission case.

INSTALLATION

NOTE

*The **new** VSS O-ring has a blue teflon coating that provides lubrication during installation. It is not necessary to coat the O-ring with engine oil to install it.*

1. See Figure 8-62. Install **new** VSS with O-ring, and fastener (2). Tighten to 8.2-10.7 Nm (73-95 **in-lbs**).
2. Install maxi-fuse and side cover.



1. **Vehicle speed sensor**
2. **Fastener @ 8.2-10.7 Nm (73-95 in-lbs)**

Figure 8-62. Vehicle Speed Sensor (typical)

NEUTRAL SWITCH 8.25

GENERAL

The neutral switch is located on the bottom of the engine case near the rear of the engine. The two-terminal switch is normally closed. When the transmission is in NEUTRAL and the ignition switch is in the IGN position, the neutral switch causes the NEUTRAL indicator lamp to illuminate.

REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Make sure transmission is shifted into NEUTRAL.
3. Place a clean container under motorcycle to catch any oil that may escape.
4. See Figure 8-63. Remove two wiring harness connectors (2) from neutral switch (1). Gently pull connectors straight off switch studs.
5. Using a 7/8 in. box wrench, remove neutral switch and O-ring from engine case.

INSTALLATION

NOTE

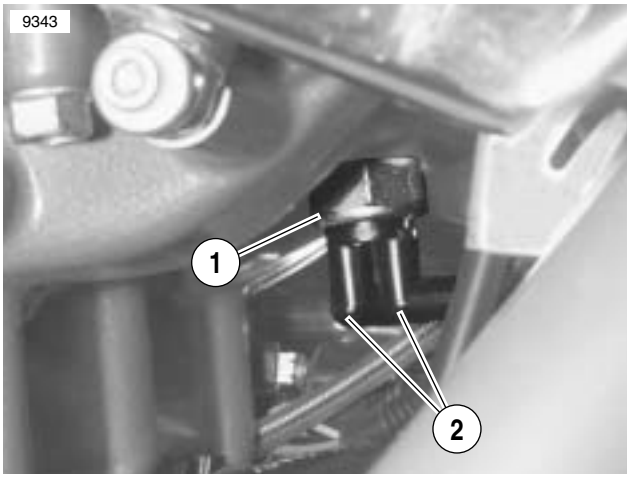
The transmission shifter must be in the NEUTRAL position when installing the switch to allow the switch ball to engage the shifter cam ramp.

1. See Figure 8-64. Lubricate **new** O-ring (2) with engine oil.
2. Install neutral switch with O-ring into engine case. Tighten to 12.8-16.5 Nm (113-146 **in-lbs**).

NOTE

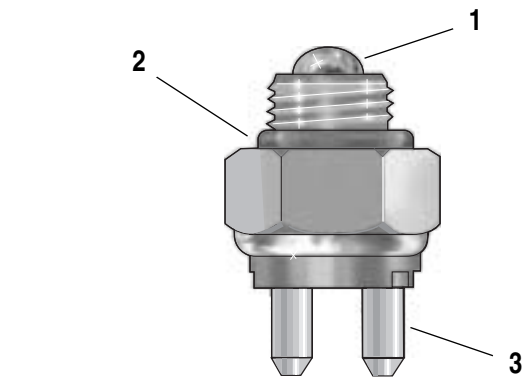
The neutral switch is not polarity sensitive. Either connector may be attached to either stud.

3. See Figure 8-63. Install wiring harness connectors (2) onto studs on neutral switch (1). Gently push connectors until they bottom out on studs.
4. Replace maxi-fuse and right side cover.
5. Test neutral switch for proper operation.
   a. Turn ignition switch to IGN position.
   b. Verify that transmission shifter is in NEUTRAL.
   c. Check to see that NEUTRAL indicator lamp illuminates.
   d. Turn off ignition switch.
6. If any oil escaped while neutral switch was removed from vehicle, check the engine oil level. See 1.7 ENGINE OIL AND FILTER. Replenish engine oil as necessary.



1. Neutral switch
2. Wiring harness connectors (2)

Figure 8-63. Neutral Switch Location (typical)



1. Ball
2. O-ring
3. Switch stud

Figure 8-64. Neutral Switch (typical)

OIL PRESSURE SWITCH 8.26

GENERAL

The oil pressure switch monitors oil pressure in the crankcase. If the oil pressure drops below 13.8-34.5 kPa (2-5 psi), the oil pressure switch is tripped and illuminates the low oil pressure indicator light. The oil pressure switch is located in the valley on top of the engine crankcase between the cylinders.

REMOVAL

1. Open seat.
2. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.

CAUTION

Cover the injector intakes with duct tape to prevent objects from falling down the injector bore. Do NOT use shop cloths or objects that could damage the injector butterflies. (00212a)

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

3. Disconnect negative battery cable.
4. Remove horn assembly.
5. Remove MAP sensor.
6. Remove the idle air control (IAC) motor wiring harness connector [87B] and throttle position sensor (TPS) connector [88B] from the fuel injector assembly. Tuck the wiring harnesses back out of the way.
7. See Figure 8-65. Remove the wiring harness connector from the oil pressure switch.

NOTES

- *The engine in the figure has been stripped to clarify the location of the oil pressure switch.*
- *It will be necessary to use a universal adapter and extension with the oil pressure switch socket in the next step to fully seat the socket on the oil pressure switch. In place of a universal adapter and standard extension, a Snap-on Wobble Extension, such as the FXW8 or FXW11A may be used.*

CAUTION

When removing the oil pressure switch, take care to avoid damaging wiring connectors and sensor bodies located nearby.

8. Using OIL PRESSURE SWITCH SOCKET (HD-45300), remove the oil pressure switch.

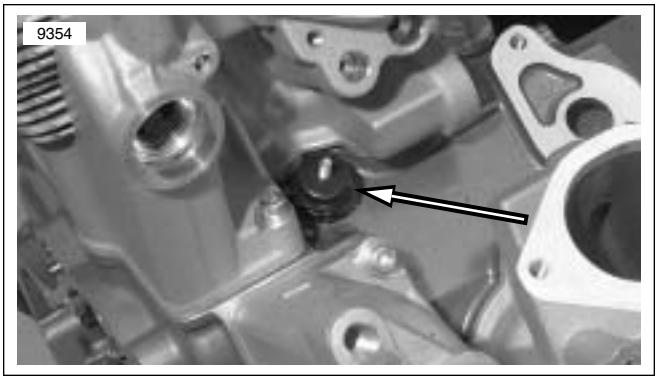


Figure 8-65. Oil Pressure Switch (typical)

INSTALLATION

NOTE

Perform step 1 below only if original oil pressure switch is being re-installed. New switches have a sealant contact patch on the threads. If new switch is being installed, begin with step 2.

1. Coat threads of oil pressure switch with LOCTITE® HIGH PERFORMANCE PIPE SEALANT with TEFLON (LOCTITE® Part No. PST565).
2. Using OIL PRESSURE SWITCH SOCKET (HD-45300), install oil pressure switch. Tighten to 10.8-13.6 Nm (96-120 **in-lbs**).
3. Attach wiring connector to oil pressure switch.
4. Attach IAC motor and TPS sensor wiring harness connectors [87B] and [88B].
5. Install MAP sensor.
6. Install horn assembly.
7. Connect negative battery cable. Tighten bolt to 6.8-10.8 Nm (60-96 **in-lbs**).
8. Remove duct tape from injector intakes.
9. Replace airbox cover. See 1.3 AIRBOX AND AIR FILTER.
10. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.
11. Test oil pressure switch for proper operation.

STOP LIGHT SWITCH (VRSCA) 8.27

GENERAL

The stop light switch monitors brake fluid pressure in the rear brake line. When the vehicle operator steps on the rear brake pedal and pressure in the brake line reaches a preset level, the stop light switch is tripped and illuminates the stop light. The stop light switch is located on the rear brake line T-fitting.

REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Unlock and open seat.
3. Remove exhaust mufflers and collector. See 2.7 EXHAUST SYSTEM (VRSCA).
4. See Figure 8-66. Remove two wiring harness terminal connectors (1) from stop light switch (2).
5. Place a clean container under stop light switch and brake line to catch escaping fluid.
6. Using a 1-inch open end wrench, remove stop light switch from T-fitting (3).

INSTALLATION

NOTE

Perform step 1 below only if original rear stop light switch is being re-installed. new switches have a sealant contact patch on the threads. If new switch is being installed, begin with step 2.

1. Coat threads of stop light switch with LOCTITE® HIGH PERFORMANCE PIPE SEALANT with TEFLON (LOCTITE® Part No. PST565).
2. Install stop light switch to brake line T-fitting. Tighten switch with a 1-inch open end wrench.
3. Attach two wiring harness terminal connectors to stop light switch.
4. Install exhaust collector and mufflers. See 2.7 EXHAUST SYSTEM (VRSCA)
5. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.

CAUTION

When closing the seat, make sure the ignition switch is in the FUEL position. If the ignition switch is in any other position when the seat is closed, the seat latch mechanism could be damaged. (00196a)

⚠WARNING

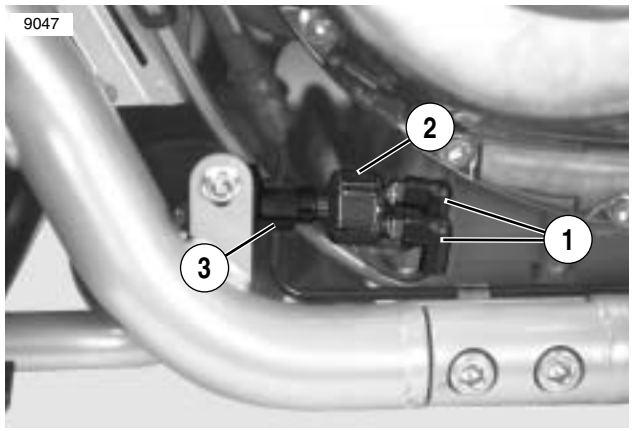
After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

6. Bleed brake system. See 1.10 BLEEDING BRAKES.

⚠WARNING

Check for proper tail lamp/stop light operation before riding motorcycle. Visibility is a major concern for motorcyclists. Failure to have proper lamp operation could result in death or serious injury.

7. Replace maxi-fuse and right side cover.
8. Check tail lamp/stop light for proper operation.



1. **Wiring harness terminal connector (2)**
2. **Stop light switch**
3. **Rear brake line T-fitting**

Figure 8-66. Stop Light Switch (VRSCA)

STOP LIGHT SWITCH (VRSCD/VRSCR) 8.28

GENERAL

The stop light switch monitors brake fluid pressure in the rear brake line. When the vehicle operator steps on the rear brake pedal and pressure in the brake line reaches a preset level, the stop light switch is tripped and illuminates the stop light. The stop light switch is located on the rear brake line T-fitting.

REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove exhaust mufflers and collector. See 2.8 EXHAUST SYSTEM (VRSCD/VRSCR).
3. See Figure 8-67. Remove wiring harness terminal connector (1) from stop light switch (2).
4. Place a clean container under stop light switch and brake line to catch escaping fluid and protect any painted parts.
5. Using an open end wrench, remove stop light switch from brake hose fitting (3).

INSTALLATION

NOTE

Perform step 1 below only if original rear stop light switch is being re-installed. new switches have a sealant contact patch on the threads. If new switch is being installed, begin with step 2.

1. Coat threads of stop light switch with LOCTITE® HIGH PERFORMANCE PIPE SEALANT with TEFLON (LOCTITE® Part No. PST565).
2. Install brake hose fitting to stop light switch using a **new** brake line washer on each side of brake hose fitting. and install into rear brake master cylinder. Tighten switch with an open end wrench to 23-29 Nm (17-21 ft-lbs).
3. Attach wiring harness terminal connector to stop light switch.
4. Install exhaust collector and mufflers. See 2.8 EXHAUST SYSTEM (VRSCD/VRSCR).

⚠WARNING

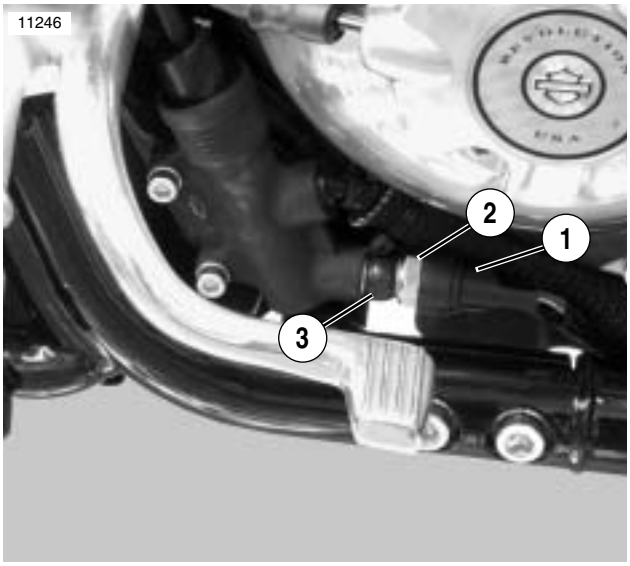
After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

5. Bleed brake system. See 1.10 BLEEDING BRAKES.

⚠WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

6. Replace maxi-fuse and right side cover.
7. Check tail lamp/stop light for proper operation.



1. **Wiring harness terminal connector (2)**
2. **Stop light switch**
3. **Rear brake hose fitting**

Figure 8-67. Stop Light Switch

HORN

INSPECTION

The horn is located on the left side of the motorcycle, mounted under the top frame rail, between the engine cylinder heads.

If the horn fails to sound or does not sound satisfactorily, check for loose, frayed or damaged horn terminal wires, discharged battery or corroded ground.

The horn is permanently sealed and non-repairable. If defective, it must be replaced.

NOTE

No tonal adjustments can be made to this horn.

REPLACEMENT

1. See Figure 8-68. Remove acorn nut (1) and washer (2) and detach horn assembly from motorcycle.
2. Remove ground wire (9) and horn power wire (10) from posts on back side of horn (8).
3. Remove nut (7) securing horn to mounting bracket (6).

NOTE

When tightening the flange nut in the next step, make certain the horn does not come in contact with the horn cover. If it does, loosen the flange nut, reposition the horn, and retighten the flange nut.

CAUTION

Overtightening the flange nut can cause permanent horn damage resulting in reduced volume and tone quality.

4. Install **new** horn on bracket. Secure with flange nut (7). Tighten to 6-8 Nm (53-70 **in-lbs**).
5. See Figure 8-69. Attach wiring.
   a. Connect BK ground wire to silver post (2).
   b. Connect Y/BK horn power wire to copper post (3).

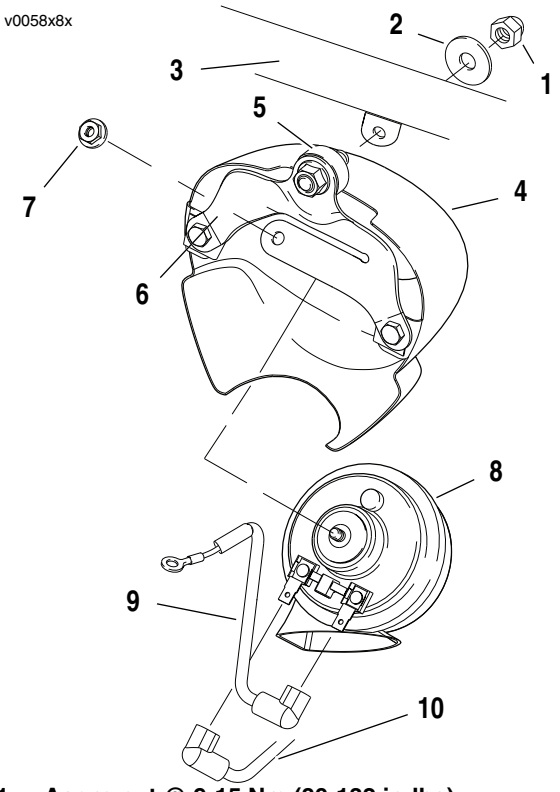
CAUTION

Improperly installed horn can strike fins on the cylinder heads during operation. The interference can cause substantial cosmetic damage.

6. See Figure 8-68. Attach horn assembly to motorcycle using washer (2) and acorn nut (1). Tighten to 9-15 Nm (80-132 **in-lbs**).

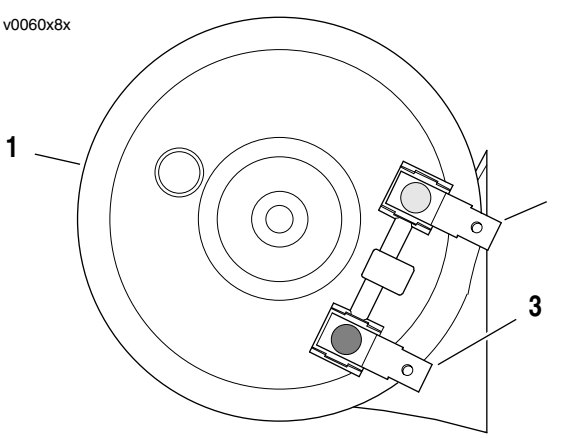
NOTE

When tightening the acorn nut in the next step, make certain the horn cover does not come in contact with the fins on the cylinder heads. If it does, loosen the acorn nut, reposition the horn assembly and retighten the nut.



1. **Acorn nut @ 9-15 Nm (80-132 in-lbs)**
2. **Washer**
3. **Motorcycle Frame**
4. **Horn cover**
5. **Rubber mount**
6. **Horn mounting bracket**
7. **Flange nut @ 6-8 Nm (53-70 in-lbs)**
8. **Horn**
9. **Ground wire**
10. **Horn power wire**

Figure 8-68. Horn (typical)



1. **Horn (back side view)**
2. **Silver post (BK ground wire)**
3. **Copper post (Y/BK power wire)**

Figure 8-69. Horn Wiring (typical)

COOLING FANS 8.30

GENERAL

The two cooling fans are mounted one above the other in a single assembly behind the radiator. The cooling fans are controlled electronically and are turned on and off as necessary to maintain an acceptable coolant temperature range.

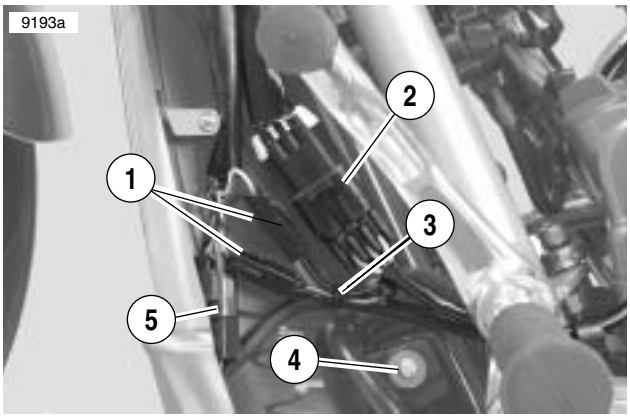
REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove fastener and right radiator trim cover.
3. Pull rear brake master cylinder reservoir straight away from its mounting slots in right side of radiator cover.
4. Remove fastener and left radiator trim cover.

NOTE

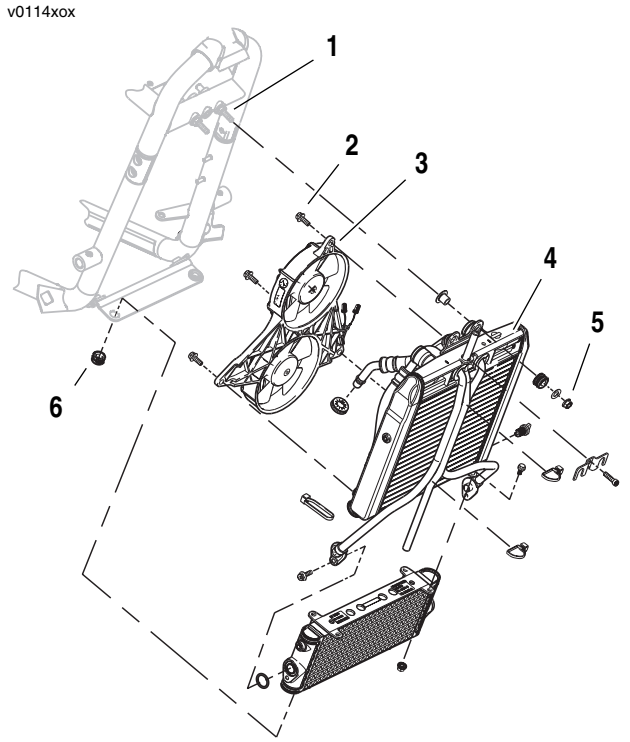
Before removing wiring harnesses, carefully note wire routing. In particular, pay close attention to locations of cable wraps that must be replaced.

5. See Figure 8-70. Clip cable wrap (3) to secure cooling fan wire harness to crankshaft position sensor (CKP) harness.
6. Push straight down to remove stator to regulator connector (2) [46] from metal clip on side of radiator cover.
7. Push connectors and wire harnesses away from coolant drain plug up and behind shift lever.
8. Place a container under left side of radiator. See 6.3 ENGINE COOLANT.
9. Loosen but do not remove coolant drain plug. Turn drain plug until slot in threads drains into container.
10. Open seat and remove pressure cap to accelerate coolant drain from radiator.
11. Hand tighten coolant drain plug.
12. Place a container under engine, remove oil filler plug/dipstick, and oil drain plug and drain oil. Reinstall dipstick and drain plug. See 1.7 ENGINE OIL AND FILTER.
13. Separate stator to regulator connector (2) [46].
14. Remove top cooling fan connector (1) [97T] from radiator cover by rocking first one way and with a finger pull the connector tab to compress butterfly peg.
15. Separate top cooling fan wiring harness connector (1) [97T] and bottom cooling fan connector [97B].
16. Separate crank position sensor connector (5) [79]
17. Cover front fender with shop towel or protective cover. Remove fasteners and washers on each side of radiator cover. Remove radiator cover with chrome inlet bezels attached.
18. Remove the radiator and oil cooler assembly. See 6.8 RADIATOR/OIL COOLER.
19. Separate oil line quick connect fittings. See 6.7 OIL LINE FITTINGS.



1. **Cooling fan connectors [97T] [97B]**
2. **Stator to regulator connector [46]**
3. **Cable wrap**
4. **Radiator cover fastener and washer**
5. **Crankshaft position sensor connector [79]**

Figure 8-70. Cooling Fan Wiring Harness Connectors (typical) (VRSCA shown)



1. **Frame radiator mounting studs**
2. **Fan fasteners @ 5-7 Nm (44-62 in-lbs)**
3. **Cooling fan assembly**
4. **Radiator**
5. **Fasteners @ 19-27 Nm (14-20 ft-lbs)**
6. **Cross member grommet**

Figure 8-71. Radiator Mounting (typical) (VRSCA shown)

DISASSEMBLY

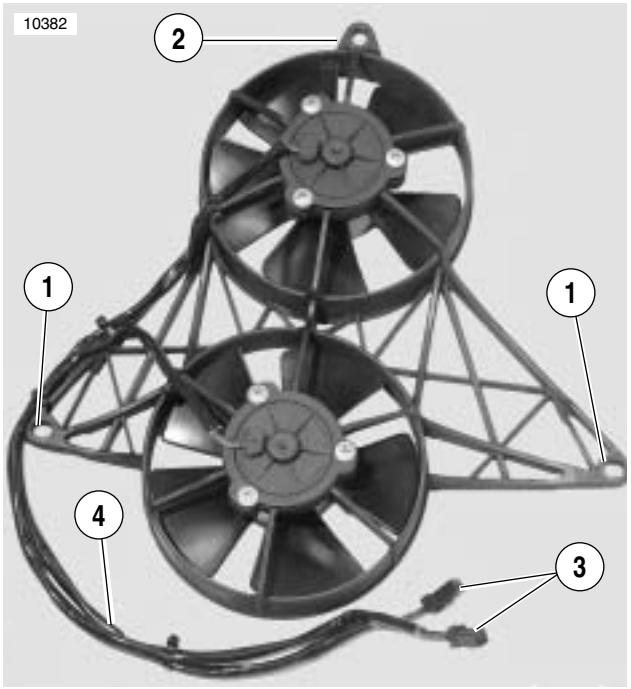
1. See Figure 8-72. Remove two lower mounting fasteners (1) on fan assembly.
2. Loosen upper radiator mounting fastener (2).
3. Remove the cooling fan assembly.

ASSEMBLY

1. See Figure 8-72. Install cooling fan assembly with fan wiring harness to left side of radiator.
2. See Figure 8-71. Thread in and tighten fan fasteners (1, 2) to 5-7 Nm (44-62 **in-lbs**).

INSTALLATION

1. Install radiator/oil cooler assembly. See 6.8 RADIATOR/OIL COOLER.
2. Mate oil lines quick connect lines. See 6.7 OIL LINE FITTINGS.
3. Mount radiator cover with fasteners (3) and washers. Tighten to 4.1-6.8 Nm (36-60 **in-lbs**).
4. See Figure 8-70. Cable wrap (3) cooling fan wiring harnesses to crankshaft position sensor (CKP) wiring harness (5).
5. Mate cooling fan wiring harness connectors [97T] and [97B]. Press butterfly peg of connector into mounting on radiator cover.
6. Mate stator to regulator connector [46] and slide stator to regulator connector (2) down on metal clip on left side radiator cover.
7. Install left side radiator trim cover and fastener. Tighten to 3-4 Nm (26-35 **in-lbs**).
8. Push rear brake master cylinder reservoir into mounting slots in right side of radiator cover.
9. Install right radiator trim cover and fastener. Tighten to 3-4 Nm (26-35 **in-lbs**).
10. Fill radiator with engine coolant. See 6.3 ENGINE COOLANT.
11. Fill engine with oil. See 1.7 ENGINE OIL AND FILTER.
12. Replace maxi-fuse and right side cover.
13. Test cooling fan operation. See the VRSC Electrical Diagnostic Manual.



1. **Lower mounting fastener locations**
2. **Upper mounting fastener location**
3. **Connectors**
4. **Wiring harness**

Figure 8-72. Cooling Fan Assembly

NOTES

Table Of Contents

APPENDIX

GLOSSARY A.1

Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
A	Amperes
AC	Alternating Current
ACC	Accessory
ACR	Automatic Compression Release
AGM	Absorbed Glass Mat (battery)
AMP	Ampere
AWG	American Wire Gauge
B+	Battery voltage
BAS	Bank Angle Sensor
BTDC	Before Top Dead Center
C	Celsius (Centigrade)
CA	California
CAL	Calibration
CC	Cubic Centimeters
CCA	Cold Cranking Amps
CKP	Crankshaft Position
cm	Centimeter
CV	Constant Velocity
DC	Direct Current
DLC	Data Link Connector
DOM	Domestic
DTC	Diagnostic Trouble Code
DVOM	Digital Volt Ohm Meter
ECM	Electronic Control Module
ECT	Engine Coolant Temperature
EEPROM	Electrically Erasable Programmable Read Only Memory
EFI	Electronic Fuel Injection
ET	Engine Temperature
EVAP	Evaporative Emissions Control System
F	Fahrenheit
ft-lbs	Foot-Pounds
fl oz.	Fluid Ounce
g	Gram
GAL	Gallon
GAWR	Gross Axle Weight Rating
GND	Ground (electrical)
GVWR	Gross Vehicle Weight Rating
HDI	Harley-Davidson International
Hg	Mercury
IAC	Idle Air Control
IAT	Intake Air Temperature
ICM	Ignition Control Module
ID	Inside Diameter

Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
IGN	Ignition Light/Key Switch
IM	Instrument Module
In.	Inch
INJ PW	Injector Pulse Width
in-lbs	Inch-Pounds
Kg	Kilogram
Km	Kilometer
kPa	Kilopascal
km/hr	Kilometers Per Hour
L	Liter
LCD	Liquid Crystal Display
LED	Light Emitting Diode
mA	Milliampere
MAP	Manifold Absolute Pressure
ml	milliliter
mm	millimeter
MPH	Miles Per Hour
ms	millisecond
Nm	Newton-Meter
N/A	Not Applicable
no.	number
O2	oxygen
OD	Outside Diameter
OEM	Original Equipment Manufacturer
oz	Ounce
P&A	Parts and Accessories
PN	Part Number
PSI	Pounds Per Square Inch
RES	Reserve
RPM	Revolutions Per Minute
SCFH	Cubic Feet per Hour at Standard Conditions
TDC	Top Dead Center
TP	Throttle Position
TSM	Turn Signal Module
TSSM	Turn Signal/Security Module
V	Volt
VAC	Volts of Alternating Current
VDC	Volts of Direct Current
VIN	Vehicle Identification Number
VSS	Vehicle Speed Sensor

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APPENDIX

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NOTE

This section provides information unique to VRSCSE2 model motorcycles. Any information not presented in this supplement can be found in the VRSC Models Service Manual.

AIRBOX COVER 1.1

REMOVAL

1. Unlock and open seat.
2. Remove Maxi-Fuse.

Figure 1-1. Airbox Cover

NOTE

Remove airbox cover before mounting motorcycle on a lift. Remove and install airbox cover slowly to avoid damaging front of airbox cover and console on speedometer assembly.

3. See Figure 1-1. Remove airbox cover by turning bailhead fastener 1/4 turn counterclockwise (CCW).

Figure 1-2. Lift Airbox Cover

4. See Figure 1-2. Gently lift rear of airbox cover while paying close attention to clearance between speedometer and front of airbox cover and console.

Figure 1-3. Wire Lead

5. Slide airbox cover back and away from location holes.
6. See Figure 1-3. Disconnect wire lead from airbox cover.

INSTALLATION

Figure 1-4. Wire Lead

NOTE

Install airbox cover after mounting motorcycle from lift. Remove and install airbox cover slowly to avoid damaging front of airbox cover and console on speedometer assembly.

1. See Figure 1-4. Connect wiring harness lead to airbox cover.
2. See Figure 1-5. Carefully align location pins on airbox cover with location holes on motorcycle.
3. See Figure 1-6. Slide airbox cover into position on motorcycle while paying close attention to clearance between speedometer and console on front of airbox.

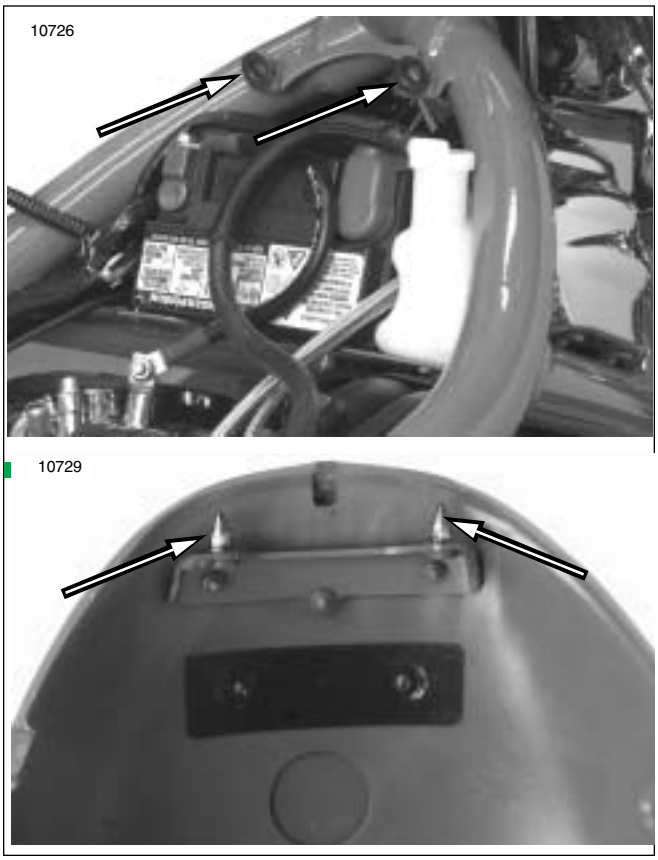


Figure 1-5. Align Location Pins with Location Holes

Figure 1-6. Install Airbox Cover

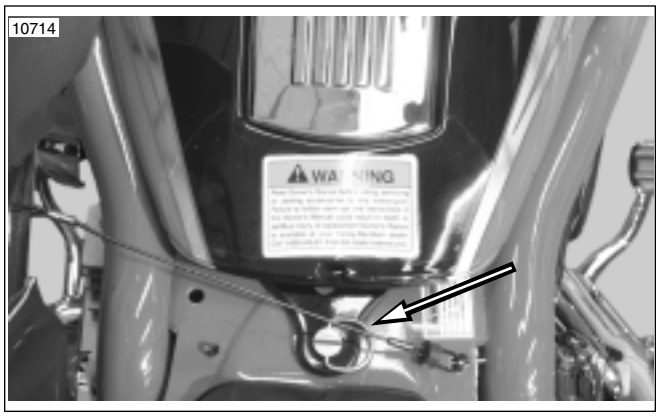


Figure 1-7. Bailhead Fastener

NOTE

Avoid pinching wiring harness by making sure it is positioned under airbox clear of obstructions.

4. See Figure 1-7. Lock airbox cover into place on motorcycle by turning bailhead fastener 1/4 turn clockwise (CW).
5. Install Maxi-Fuse.
6. Close and lock seat.
7. Turn ignition to the ON position and verify proper function of gauge panel on top of airbox cover.

AIRBOX COVER CONSOLE 1.2

REMOVAL

1. Remove airbox cover.

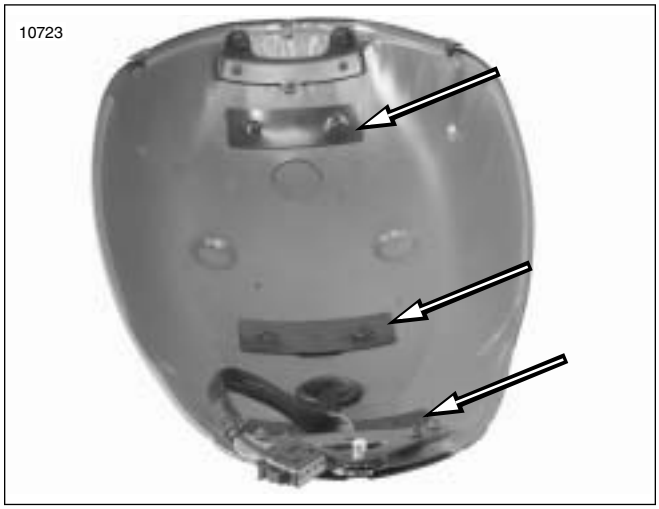


Figure 1-8. Remove Screws and Brackets

NOTE

Front, middle and rear brackets and fasteners are each different. Mark brackets and fasteners relative to position before removing to ensure proper assembly.

It may be necessary to use a low heat source when removing fasteners.

2. See Figure 1-8. Remove and retain fasteners and brackets from underside of airbox cover.

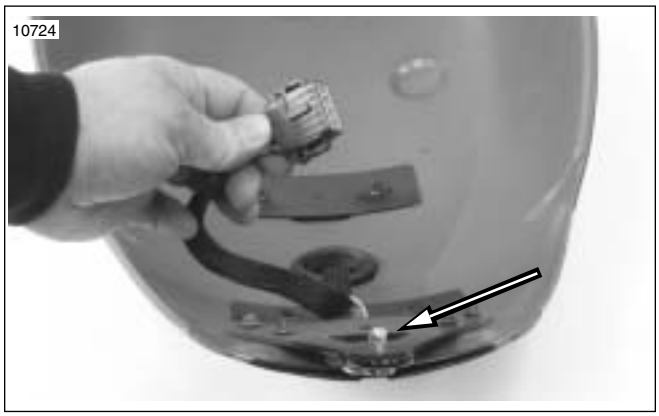


Figure 1-9. Wiring Harness Passage Hole

3. See Figure 1-9. Remove console from airbox cover and guide wiring harness through passage hole in airbox cover.

INSTALLATION

1. See Figure 1-10. Guide wiring harness through hole in airbox cover.

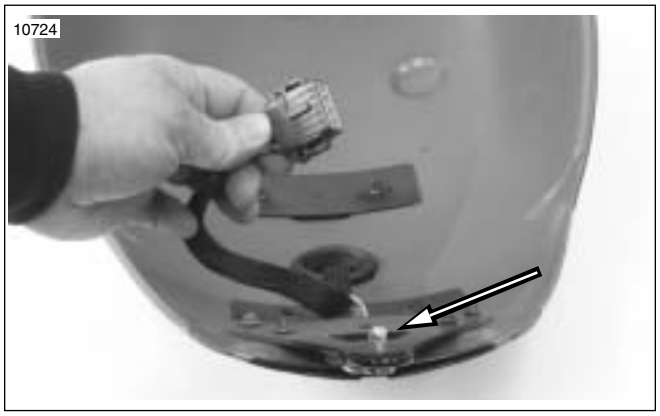


Figure 1-10. Insert Wiring Harness

2. See Figure 1-11. Install console to airbox cover and guide wiring harness through passage hole in airbox cover.
3. Install brackets in marked positions, apply threadlocker and tighten fasteners.

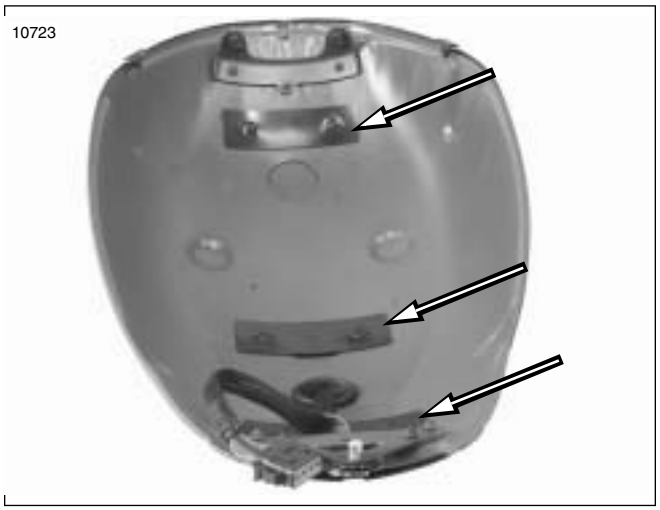


Figure 1-11. Install Screws and Brackets

4. Install airbox cover.

HEADLAMP ALIGNMENT 1.3

INSPECTION

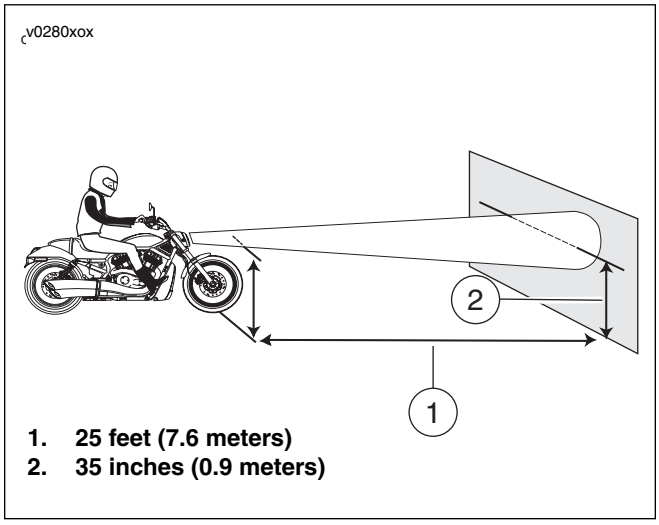
⚠WARNING

The automatic-on headlamp feature provides increased visibility for riders. Be sure headlamp is on at all times. Low visibility of rider can result in death or serious injury. (00030a)

Check headlamp for proper height and lateral alignment:

- When the new owner takes delivery of the motorcycle.
- When there is a change in load (adding luggage, etc.).

1. Verify correct front and rear tire pressure. See TIRES AND WHEELS.
2. Place motorcycle on level floor (or pavement) in an area with minimum light.
3. See Figure 1-12. Position motorcycle 7.6 m (25 ft) away from a screen or wall (1). Measure the vertical distance from center of headlamp to floor, and draw a horizontal line (2) on screen or wall at same height above floor.
4. Load vehicle with rider, passenger (if normally present) and any cargo. Weight will compress vehicle suspension slightly.
5. Stand motorcycle upright with both tires resting on floor and with front wheel held in straight alignment (directly forward).
6. See Figure 1-13. Turn ignition switch ON. Set handlebar headlamp switch to HI beam position.
7. Check light beam for alignment.
   a. The main beam, which is a broad, flat pattern of light, should be centered equally above and below the horizontal line.
   b. The main beam of light should also be directed straight ahead. Properly adjusted headlamps project an equal area of light to right and left of center.
   c. Adjust headlamp alignment if necessary.



1. 25 feet (7.6 meters)
2. 35 inches (0.9 meters)

Figure 1-12. Headlamp Alignment (typical)

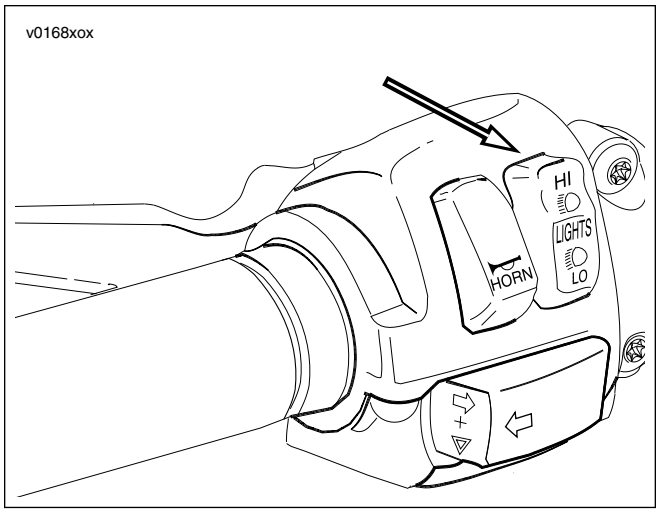


Figure 1-13. Headlamp Switch (typical)

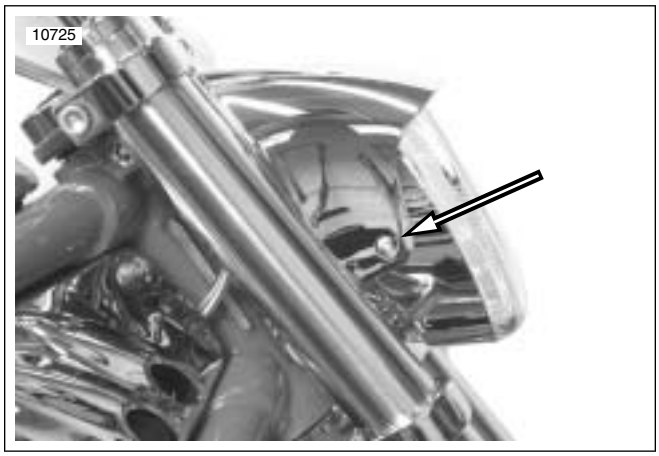


Figure 1-14. Headlamp Alignment Fastener Location

CRITICAL FASTENERS 1.4

INSPECTION

Inspect critical fasteners, except head bolts:

- At the first scheduled service interval.
- At every 19,000 km (12,000 mile) service interval thereafter.

Refer to Table 1-1. Tighten all critical fasteners, except head bolts, to service manual specifications. Replace any damaged or missing hardware.

Table 1-1. Critical Fasteners

SYSTEM	FASTENER	TORQUE	
Hand controls	Upper and lower switch housings	4.0-5.1 Nm	35-45 **in-lbs**
	Clutch lever handlebar clamp	6.8-9.0 Nm	60-80 **in-lbs**
	Master cylinder handlebar clamp	6.8-9.0 Nm	60-80 **in-lbs**
	Handlebar Clamps to Riser	16-20 Nm	140-180 **in-lbs**
Brakes	Banjo bolts	23.0-29.8 Nm	17-22 ft-lbs
	Lower brake caliper mounting pin	38.0-51.5 Nm	28-38 ft-lbs
	Brake disc screws, front	21.7-32.5 Nm	16-24 ft-lbs
	Brake disc screws, rear	40.7-47.5 Nm	30-35 ft-lbs
	Reservoir screws	0.7-0.9 Nm	6-8 **in-lbs**
	Rear master cylinder mounting nut	54.2-67.8 Nm	40-50 ft-lbs
Axle nuts	Front axle	68-75 Nm	50-55 ft-lbs
	Rear axle	190-203 Nm	140-150 ft-lbs
Front fork/handlebars	Lower fork pinch bolts	41-47 Nm	30-35 ft-lbs
	Upper bracket pinch bolts	41-47 Nm	30-35 ft-lbs
Frame	Lower frame rail bolts	61-75 Nm	45-55 ft-lbs

MAINTENANCE SCHEDULE 1.5

Table 1-2. Maintenance Schedule

ITEM SERVICED	PROCEDURE	1000 mi 1600 km	4000 mi 6400 km	8000 mi 12,800 km	12,000 mi 19,300 km	16,000 mi 25,700 km	20,000 mi 32,100 km	NOTES
Engine oil and filter	Replace	X	X	X	X	X	X	
Oil lines and brake system	Inspect for leaks	X	X	X	X	X	X	1
Air cleaner	Inspect, service as required	X	X	X	X	X	X	
Tires	Check pressure, inspect tread	X	X	X	X	X	X	
Clutch fluid	Check level and condition	X	X	X	X	X	X	
Rear belt and sprockets	Inspect, adjust belt	X	X	X	X	X	X	1
Throttle, brake and clutch controls	Check, adjust and lubricate	X	X	X	X	X	X	1
Jiffy stand	Inspect and lubricate	X	X	X	X	X	X	1
Brake fluid	Check levels and condition	X	X	X	X	X	X	5
Brake pads and discs	Inspect for wear	X	X	X	X	X	X	
Spark plugs	Inspect		X		X		X	
	Replace				X			
Electrical equipment and switches	Check operation	X	X	X	X	X	X	
Front fork oil		Replace every 28,000 miles (45,000 km)						1
Steering head bearings	Adjust	X					X	1, 2
Rear fork bushings		Check every 28,000 miles (45,000 km)						1
Valve lash	Adjust				X			1, 4
Cooling system	Inspect; check clamps for tightness, check coolant freeze point	X		X		X		1
Coolant		Replace every 28,000 miles (45,000 km).						1
Radiator	Clean	X	X	X	X	X	X	
Seat latch	Lubricate	X	X	X	X	X	X	1
Critical fasteners	Check tightness	X		X		X		1
Battery	Check battery and clean connections							3
Road test	Verify component and system functions	X	X	X	X	X	X	

NOTES:

1. Should be performed by an authorized Harley-Davidson dealer, unless you have the proper tools, service data and are mechanically qualified.
2. Disassemble, lubricate and inspect every 28,000 miles (45,000 km).
3. Perform annually.
4. Could vary with frequency of operation and riding style.
5. Change D.O.T. 4 Brake fluid every two-years.

FIRST SCHEDULED MAINTENANCE

- A Harley-Davidson dealer should perform the first scheduled service listed in the Owner's Manual. See the Maintenance and Lubrication section in your Owner's Manual for more information.

Table 1-3. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Engine oil and filter	Drain plug torque	35 Nm (25.8 ft-lbs)
	Oil capacity	4.7 L (5 qts) with filter
	Filter	Hand tighten 2/3-1 turn after gasket contact
	Oil filter wrench part number	HD-44067
	Oil filter part number	63793-01K
Engine coolant	Coolant capacity	2.4 L (2.5 qt)
	Harley-Davidson Extended Life Antifreeze & Coolant	99822-02
Clutch	Reservoir cover screw torque	0.7-0.9 Nm (6-8 **in-lbs**)
	Reservoir banjo bolt torque	23-31 Nm (17-23 ft-lbs)
	Secondary clutch actuator cover fastener torque	6-10 Nm (53-88 ft-lbs)
	Clutch bleeder screw torque	9-11 Nm (80-100 **in-lbs**)
	Clutch fluid (D.O.T. 4) part number	HD-99953-99A
Transmission	Drive sprocket flange nut torque	160 Nm (118 ft-lbs)
Tire condition and pressure *All 2006 models use Dunlop radial tires only.	Pressure for solo rider	Front: 248 kPA (36 psi) Rear: 262 kPA (38 psi)
	Pressure for rider and passenger	Front: 248 kPA (36 psi) Rear: 276 kPA (40 psi)
	Wear	Replace tire if 0.8 mm (1/32 in.) or less of tread pattern remains
Brake fluid reservoir level	D.O.T. 4 hydraulic brake fluid part number	99953-99A
	Proper fluid level (front)	3.2 mm (1/8 in.) below gasket surface
	Proper fluid lever (rear)	12.7 mm (1/2 in.) below top of reservoir
	Master cylinder reservoir cover torque (front)	0.8-1.2 Nm (7-11 **in-lbs)**
	Master cylinder reservoir cover torque (rear)	3-4 Nm (26.5-35.3 **in-lbs**)
Brake pad linings and discs	Minimum brake pad thickness	Replace when wear indicatior lines are no longer visible
	Minimum brake disc thickness	See stamp on side of disc
Drive belt	Upward measurement force applied at midpoint of bottom belt strand	10 lb. (4.5 kg)
	Measure belt deflection with motorcycle cold and the approximate weight of the owner on motorcycle.	6 mm (3/8 in.)
Air cleaner	Air cleaner cover wing nut torque	Hand tighten

Table 1-3. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Fuel	Capacity	14 L (3.7 gallons)
	Pump octane requirement	91 (95 RON)
Clutch and throttle cables	Lubricant	SUPER OIL Part No. 94968-85TV (1/4 fl. oz.)
	Handlebar switch housing screw torque	4.0-5.1 Nm (35-45 **in-lbs**)
Spark plugs	Type	10R12A
	Gap	0.89 mm (0.035 in.)
	Torque	23 NM (17 ft-lbs)
Engine idle speed	Idle speed	1300 RPM ± 50 RPM (non-adjustable)
Front fork oil	Amount	Using the PRO-LEVEL OIL GAUGE (HD-59000A) adjust the oil level to 85 mm (3.3 in.) from top of fork tube.
	Type	HYDRAULIC FORK OIL (TYPE E) Part No. 99884-80 (16 oz.)
Battery	Battery terminal torque	60-96 **in-lbs** (6.8-10.9 Nm)

ENGINE LUBRICATION

Your motorcycle comes equipped with H-D® 360 20W50 engine lubrication.

If H-D 20W50 is not available, the second choice would be to add an acceptable diesel engine oil. We suggest the mixture of the fluids be changed as soon as possible. DO NOT add diesel engine oil to the primary chaincase or transmission.

NOTE

To switch lubricant to SYN3, completely drain the HD20W50 before filling with SYN3. A residual amount of fluid will remain. It is not required to flush out the residual fluid.

⚠CAUTION

Prolonged or repeated contact with used motor oil may be harmful to skin and could cause skin cancer. Promptly wash affected areas with soap and water. (00358a)

⚠CAUTION

If swallowed, do not induce vomiting. Contact a physician immediately. In case of contact with eyes, immediately flush with water. Contact a physician if irritation persists. (00357a)

CAUTION

Do not switch lubricant brands indiscriminately because some lubricants interact chemically when mixed. Use of inferior lubricants can damage the engine. (00184a)

Refer to Table 1-4. If it is necessary to add oil and H-D® 360 20W50 engine lubrication is not available, use an oil certified for diesel engines.

Acceptable diesel engine oil designations include:

- CF-4
- CG-4
- CH-4
- CI-4

The preferred viscosities for the diesel engine oils, in descending order are:

- 20W50
- 15W40
- 10W40

At the first opportunity, see a Harley-Davidson dealer to change back to 100 percent Harley-Davidson oil.

Table 1-4. Recommended Engine Oils

HARLEY-DAVIDSON TYPE	VISCOSITY	HARLEY-DAVIDSON RATING	LOWEST AMBIENT TEMPERATURE	COLD WEATHER STARTS BELOW 50˚ F (10˚ C)
HD Multi-grade	SAE 10W40	HD 360	Below 40˚ F (4˚ C)	Excellent
HD Multi-grade	SAE 20W50	HD 360	Above 40˚ F (4˚ C)	Good

NOTES

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CHASSIS 2

SUBJECT **PAGE NO.**

NOTE

This section provides information unique to VRSCSE2 model motorcycles. Any information not presented in this supplement can be found in the VRSC Models Service Manual.

SPECIFICATIONS 2.1

Table 2-1. Dimensions

ITEM	MM	IN
Wheel base	1699.3	66.9
Overall length	2363	93
Overall width	924.8	36.4
Road clearance	127	5.0
Overall height	1105.9	43.5
Saddle height	688.3	27.1

Table 2-2. Weights

ITEM	KG	LBS
Dry weight	298	657
GVWR	464.2	1022.4
GAWR - front	163	358.0
GAWR - rear	302	664

NOTE

Gross Vehicle Weight Rating (GVWR) (maximum allowable loaded vehicle weight) and corresponding Gross Axle Weight Ratings (GAWR) are given on a label located on the left front frame cross tube.

Table 2-3. Fluid Capacities

ITEM	LITERS	U.S.
Fuel tank total	14.0	3.7 gal
Oil tank w/filter	4.3	4.5 qts
Coolant	2.4	2.54 qts

Table 2-4. Wheel/Brake Disc/Tire Runout

RUNOUT	MM	IN
Wheel - rim lateral	1.02	0.040
Wheel - rim radial	0.76	0.030
Front brake disc - lateral	0.3	0.012
Rear brake disc - lateral	0.3	0.012
Tire - lateral	1.52	0.060
Tire - radial	2.29	0.090

Table 2-5. Tires

WHEEL	DUNLOP SPORTMAX™ SIZE
Front	120/70Z/R-19
Rear	240/40R-18

⚠WARNING

Do not inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)

Table 2-6. Tire Pressures

DUNLOP TIRES (ONLY)	FRONT		REAR	
	kPa	PSI	kPa	PSI
Solo rider	248	36	262	38
Rider & passenger	248	36	290	42

⚠WARNING

Match tires, tubes, air valves and caps to the correct wheel rim. Contact a Harley-Davidson dealer. Mismatching can result in damage to the tire bead, allow tire slippage on the rim or cause tire failure, which could result in death or serious injury. (00023a)

NOTE

See TIRES AND WHEELS for important information regarding tires.

⚠WARNING

Use only Harley-Davidson approved tires. See a Harley-Davidson dealer. Using non-approved tires can adversely affect stability, which could result in death or serious injury. (00024a)

- Use tubeless tires on all Harley-Davidson disc wheels.
- Do not use inner tubes in radial tires.
- Always use the correct size tires. Tire sizes are molded on the tire sidewall.

TORQUE VALUES 2.2

ITEM	TORQUE		NOTES
Belt guard grommet torque	6-10 Nm	53-88 **in-lbs**	page 2-18
Debris deflector	6-10 Nm	53-88 **in-lbs**	page 2-18
Drive sprocket cover	6-10 Nm	53-88 **in-lbs**	page 2-18
Drive sprocket locking bolts	88-102 Nm	65-75 ft-lbs	page 2-16
Billet exhaust clamps	32-37 Nm	24-27 ft-lbs	page 2-5
Handlebar clamp fasteners	41-47 Nm	31-35 ft-lbs	page 2-26
Rear riser cover	6-10 Nm	53-88 **in-lbs**	page 2-26
Rear axle nut	190-203 Nm	140-150 ft-lbs	page 2-20
Front axle covers	0.7-0.9 Nm	6-8 **in-lbs**	page 2-6
Rear axle covers	41-68 Nm	30-50 ft-lbs	page 2-11
Water pump hose cover fasteners	1.1-1.4 Nm	10-12 **in-lbs**	w/LOCTITE® 242
Footpeg fasteners	26 Nm	19 ft-lbs	page 2-24

VEHICLE IDENTIFICATION NUMBER (V.I.N.)

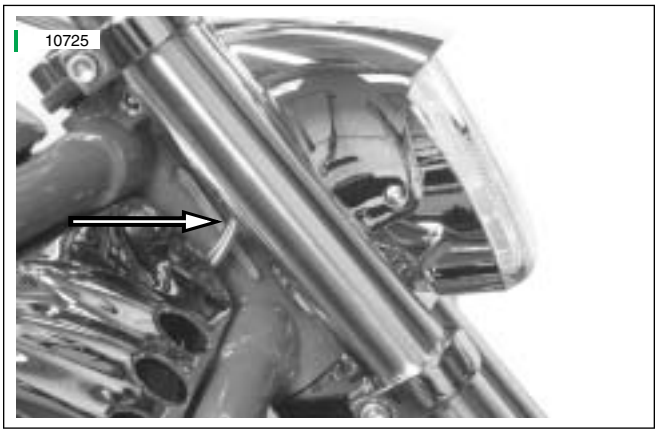


Figure 2-1. VIN Location

See Figure 2-1. The full 17 digit serial, or Vehicle Identification Number (V.I.N.) is stamped on the right side of the steering head and on a label located on the right side down tube.

See Figure 2-2. An abbreviated V.I.N. is stamped on the left side crankcase at the base between the cylinders. Sample V.I.N. as it appears on the steering head - **1HD1PMG155K800000**
Sample abbreviated V.I.N. as it appears on the left crankcase - **PMG5800000**

NOTE

Always give the full 17 digit Vehicle Identification Number when ordering parts or making any inquiry about your motorcycle.

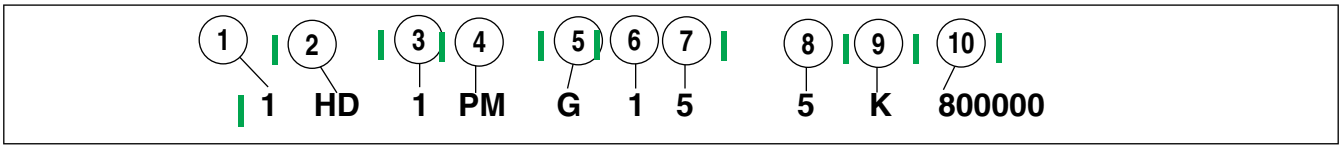


Figure 2-2. VRSCSE2 Vehicle Identification Number (typical)

Table 2-7. Harley-Davidson 2006 VRSC Model V.I.N. Description

ITEM	DESCRIPTION	POSSIBLE VALUES
1	Market destination	1=Originally manufactured for sale within the United States 5=Originally manufactured for sale outside of the United States
2	Manufacturer	HD=Harley-Davidson
3	Motorcycle type	1=Heavyweight motorcycle 901 cc and larger
4	Model	PM = VRSCSE2
5	Engine type	G=VRSCSE2, 1250cc liquid-cooled, fuel injected
6	Introduction date	1=Regular 2=Mid-year 3=California/regular 4=Cosmetic changes and/or special introductory date 5=California/cosmetic changes and/or special introductory date 6=California/mid-year
7	VIN check digit	Can be 0-9 or X
8	Model year	6=2006
9	Plant of manufacture	K=Kansas City, MO. USA
10	Sequential number (last 6 digits)	varies

EXHAUST SYSTEM 2.4

REMOVAL

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

1. Remove right side cover and remove maxi-fuse.
2. See Figure 2-3. Loosen upper muffler clamp.

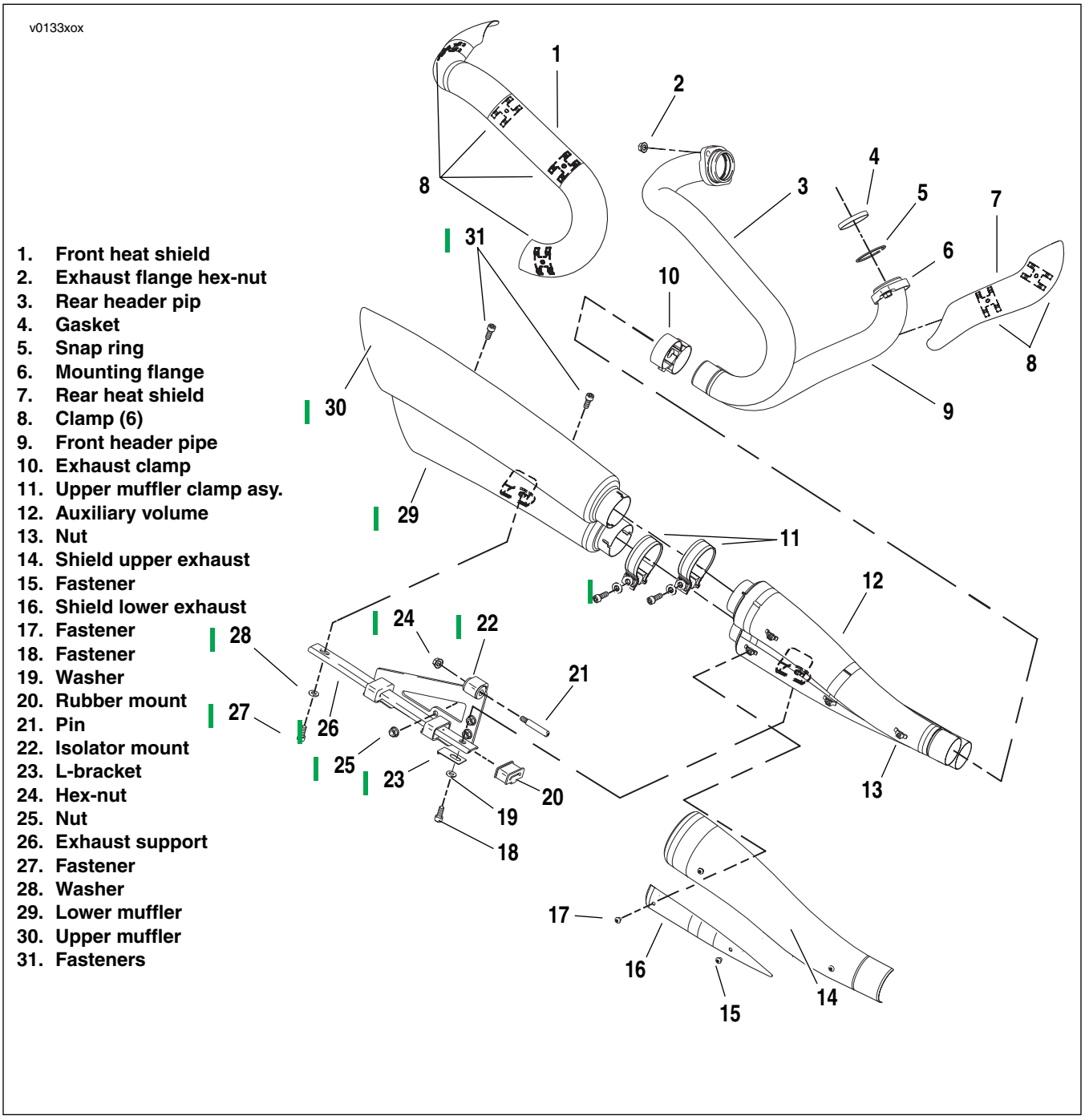


Figure 2-3. Exhaust System

3. Remove the two fasteners holding the upper muffler to the bottom muffler.
4. Slide upper muffler rearward to disconnect from the auxiliary volume.
5. Remove both heat shields from front and rear header pipes. It's not necessary to remove the heat shield from the auxiliary volume.
6. Remove the auxiliary volume fastener and the lower muffler fastener from the lower part of the exhaust support bracket. Save the L-bracket found under the exhaust support.

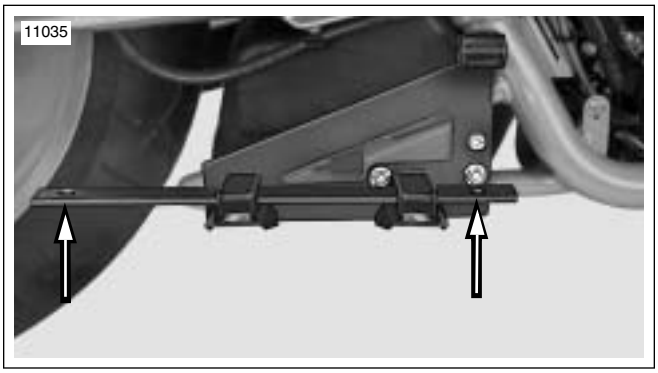


Figure 2-4. Exhaust Support Fastener Locations (typical) (exhaust system removed)

NOTE

Remove the left side drive sprocket cover for easier access to rear cylinder lower exhaust flange bolt.

7. Remove flanged hex-nuts holding exhaust flange to front and rear cylinders.
8. Remove hex-nut and pin on exhaust support bracket.
9. Remove header pipes with the auxiliary volume and lower muffler attached. Lift and adjust assembly until header pipes slide out and away from the cylinder heads.

NOTE

To maintain the alignment of these components, keep the lower muffler, the auxiliary volume, the exhaust clamp, and the front and rear header pipes firmly connected.

INSTALLATION

NOTE

Do not torque fasteners until required to do so by the following installation instructions. Hand tightening each fastener will pull the exhaust system into a position that will allow the crush of the exhaust gaskets during the torquing sequence to to draw the exhaust system up to the engine.

1. Install **new** exhaust header gaskets.
2. See Figure 2-3. Gently lift the lower muffler, auxiliary volume, and header pipe assembly into position.

NOTE

A second technician may be required to hold the header pipes when aligning the exhaust header flanges with the studs in the cylinder heads.

3. Slip both front and rear header flanges over the studs in the cylinder heads. Thread hex-nuts on header flange studs. Do not tighten.
4. Install support pin in isolator mount on the exhaust support. Thread on the hex-nut. Do not tighten.
5. Hold a 1/2 in. spacer between the frame rail and the header pipe exhaust clamp.
6. Thread in the lower muffler fastener through the exhaust support.
7. Thread in the auxiliary volume fastener through the L-bracket and the exhaust support. Do not tighten.
8. Torque the pin hex-nut to 23 Nm (17 ft-lbs).
9. Place clamp on upper muffler. Slide muffler over upper opening of auxiliary volume. Position clamp with compression fastener to inboard with tightening nut upward.
10. Thread upper muffler fasteners into the lower muffler. Do not tighten.
11. Torque the fasteners to the indicated torque in the following order:
    a. Upper and lower muffler clamp - 65 Nm (48 ft-lbs).
    b. Upper muffler fasteners - 23 Nm (17 ft-lbs).
    c. Lower muffler and auxiliary volume fasteners to support bracket - 23 Nm (17 ft-lbs).
    d. Exhaust flange hex-nuts - 8-12 Nm (71-106 **in-lbs**).
12. Check the tightness of the exhaust clamp by tightening the clamp nut to 61-69 Nm (45-51 ft-lbs).
13. Reinstall front and rear heat shields. Tighten the heat shield fasteners to 10 Nm (88 **in-lbs**).
14. If removed, reinstall drive sprocket cover. Tighten to 6-10 Nm (53-88 **in-lbs**).
15. Reinstall the maxi-fuse and the right side cover.

FRONT AXLE COVERS 2.5

REMOVAL

1. See Figure 2-5. Loosen but do not remove set screw from cover. Remove covers from front axle.
2. Remove front axle covers from axle.

INSTALLATION

NOTE

Covers are identified with an embossed LH (left hand) or RH (right hand) inside bottom of cover to indicate installed location.

1. Orient cover contours over axle end so that set screw is on bottom and will tighten down against axle nut.
2. Tighten set screws to 6-8 **in-lbs** (0.7-0.9 Nm).

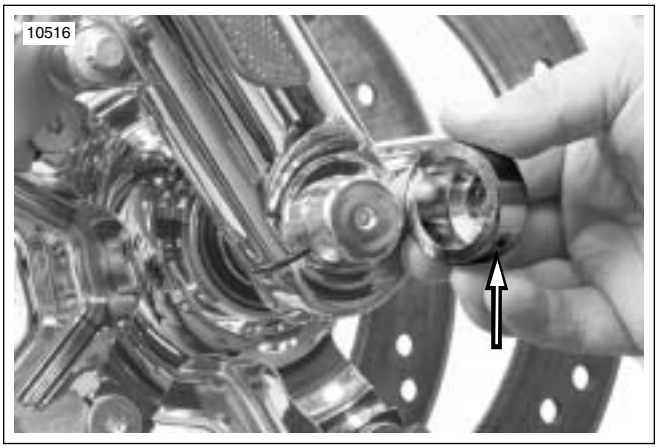


Figure 2-5. Set Screw

FRONT WHEEL 2.6

GENERAL

Maximum tire mileage and good handling qualities are directly related to wheel and tire care. Wheels and tires should be inspected regularly for wear. If handling problems occur, check TROUBLESHOOTING in the appropriate VRSC Service Manual for possible causes.

Preliminary Inspection - Brake Discs

1. Measure brake disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
2. If warped, replace disc. Maximum allowable lateral runout of a spring washer mounted brake disc is 0.3 mm (0.012 in.).
3. If scored, replace disc.

Preliminary Inspection - Wheel/Tire

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. Inspect tire for wear and wear pattern. Replace tire as necessary.
3. Inspect air valve. Replace as necessary.
4. Inspect wheel bearing end play and service bearings if necessary. If end play is 0.051 mm (0.002 in.) or more, replace the wheel bearings. See SEALED WHEEL BEARINGS in appropriate VRSC Service Manual.

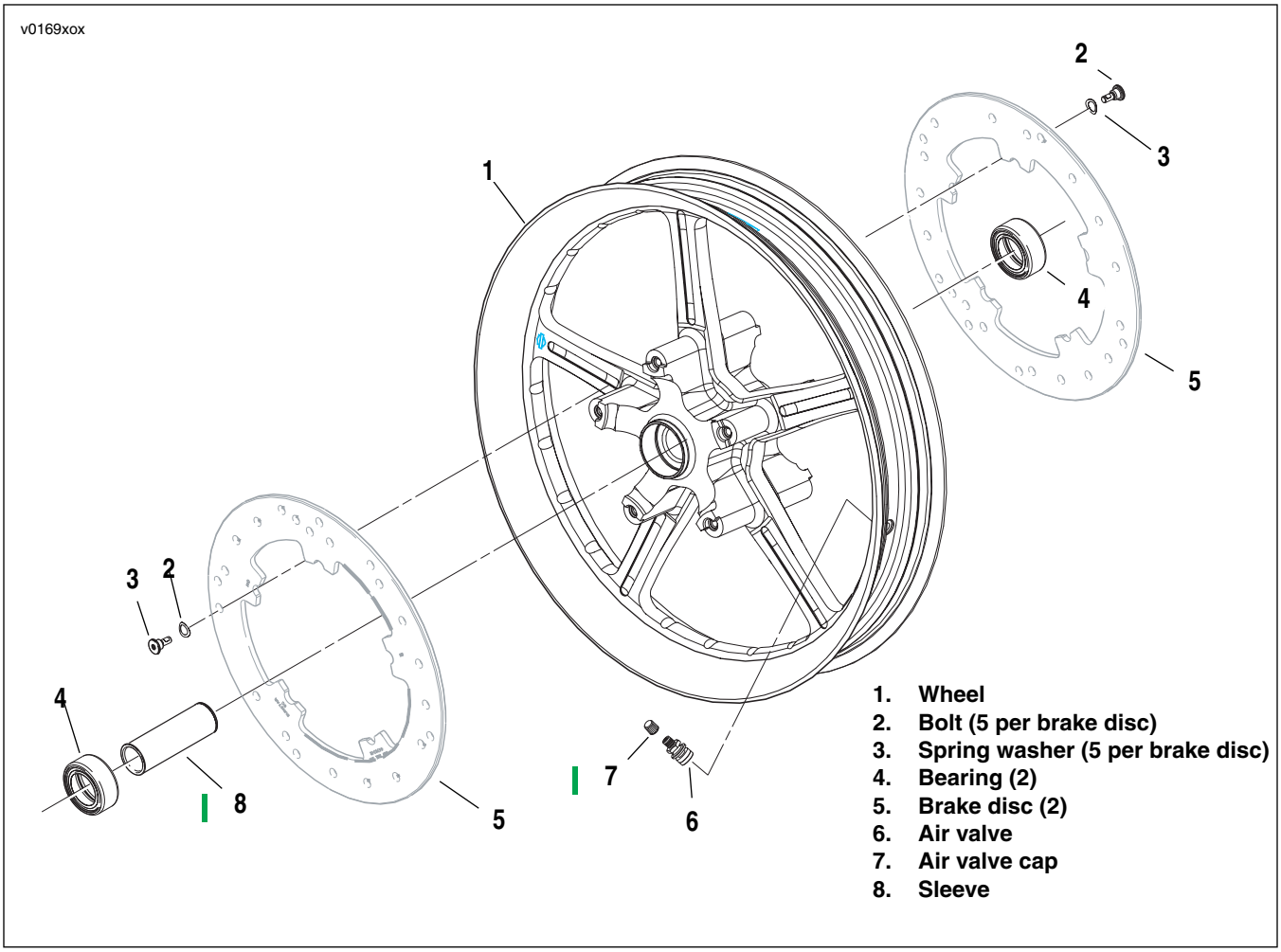


Figure 2-6. Front Wheel Components

REMOVAL

1. Block motorcycle underneath frame so front wheel is off the ground.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a).

2. Remove right side cover and maxi-fuse.
3. See Figure 2-7. Remove both upper and lower mounting bolts to remove brake caliper assembly.
4. Support calipers using a rubber bungee cord. Be careful not to scratch fender or fork slider finish.
5. Repeat to remove opposite caliper.

NOTE

Do not operate front brake lever with the front wheel removed or the caliper piston may be forced out of piston bore. Reseating the piston requires disassembly of the caliper.

6. See Figure 2-8. Loosen pinch bolts (2) in right side axle holder (4).
7. Insert screwdriver or steel rod through hole in axle (1) on right side. While holding axle stationary, remove axle nut (5).
8. Pull axle out while retaining the left and right wheel spacers (3).
9. Remove wheel assembly from forks.

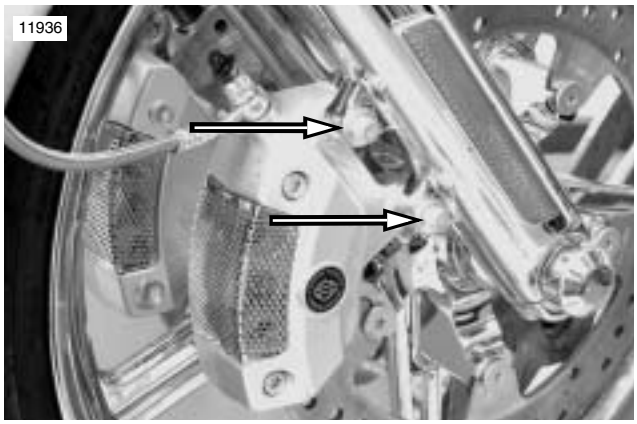
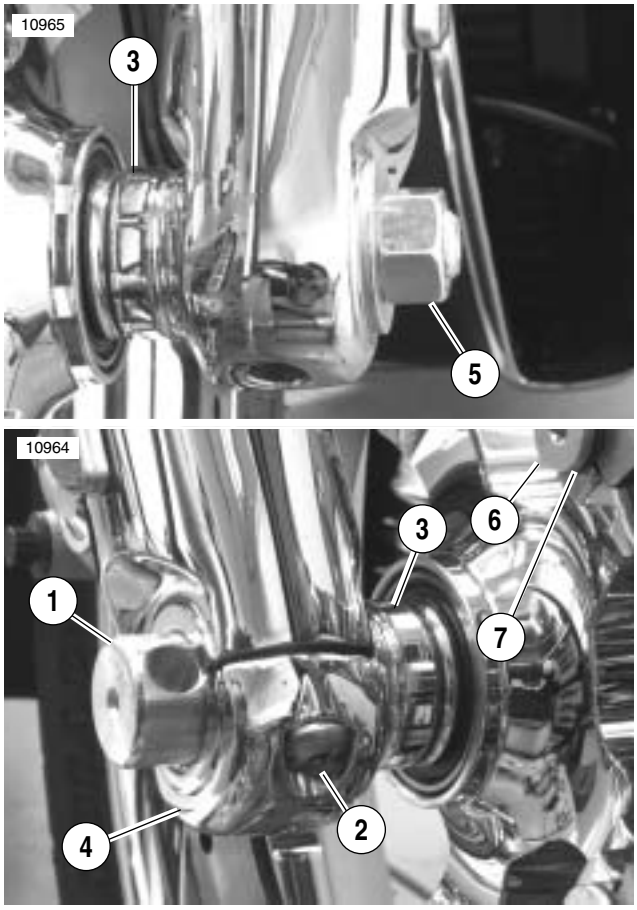


Figure 2-7. Caliper Mounting Bolts



1. **Axle**
2. **Pinch bolts (screws)**
3. **Left and right wheel spacer**
4. **Axle holder (right side only)**
5. **Axle nut**
6. **Bolt**
7. **Spring washer**

Figure 2-8. Front Wheel Mounting

DISASSEMBLY

NOTE

See TIRES in appropriate VRSC Service Manual to service tire or valve stem assembly.

1. Remove spacers from left and right sides.
2. If tire replacement is necessary, remove tire and valve stem. See TIRES in appropriate VRSC Service Manual.
3. If wheel bearing replacement is necessary, remove the sleeve and press out the sealed wheel bearings. See SEALED WHEEL BEARINGS in appropriate VRSC Service Manual.
4. If it is necessary to remove brake discs and if wheel is to be assembled with same discs, mark both wheel and discs, so they can be installed in their original locations.
5. See Figure 2-6. If removing brake discs (5), remove five bolts (2) and spring washers (3) securing brake disc to the wheel (1). Repeat procedure to remove disc on opposite side of wheel. Discard bolts and spring washers.

CLEANING AND INSPECTION

1. Thoroughly clean all parts in solvent.
2. Inspect all parts for damage or excessive wear.

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

3. Inspect brake discs. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc. Also replace discs if warped or badly scored. See BRAKE PADS AND DISCS in appropriate VRSC Service Manual.
4. Inspect brake pads. Minimum brake pad thickness is 1.6 mm (0.06 in.). See BRAKE PADS AND DISCS in appropriate VRSC Service Manual.

ASSEMBLY

⚠WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

NOTE

Always install first of two bearings on the side with the lettering on the wheel hub (primary side).

1. If sealed wheel bearings must be serviced, always replace bearings as a complete set. See SEALED WHEEL BEARINGS in appropriate VRSC Service Manual.

⚠WARNING

Do not inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)

2. If necessary, mount tire, valve stem and balance wheel assembly as required. See TIRES in appropriate VRSC Service Manual.
3. Verify that wheel and tire are true. See TIRES and DISC RIM RUNOUT in appropriate VRSC Service Manual.

⚠WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

4. See Figure 2-6. If necessary, install brake discs in their original positions. Verify that brake disc is clean.
   a. On left side of wheel, install five **new** bolts (2) and five **new** spring washers (3) to attach left brake disc. Tighten bolts to 21-31 Nm (16-23 ft-lbs).
   b. On right side of wheel, install five **new** bolts (2) and five **new** spring washers (3 to attach right brake disc. Tighten bolts to 21-31 Nm (16-23 ft-lbs).
5. After wheel is balanced, apply a coat of LOCTITE® ANTI-SEIZE LUBRICANT to entire surface of right side bearing race.

INSTALLATION

1. Apply a liberal coat of LOCTITE® ANTI-SEIZE LUBRICANT to the axle.

NOTE

Install wheel with lettered side of wheel hub facing the left side (primary side) of motorcycle.

2. See Figure 2-9. Place wheel and spacers into front fork and install axle (5). Verify that axle spacers on right and left side are properly installed.

3. Thread on the axle nut. While holding axle stationary, tighten axle nut to 68-75 Nm (50-55 ft-lbs).

4. Pull fork leg so that it just contacts the axle spacer (2) and then tighten axle holder pinch bolts (3) to 16 Nm (12 ft-lbs). Ensure that gap between the axle holder (4) and the fork slider (1) is equal at front and rear of axle holder.

⚠WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

5. Install the brake caliper to the fork legs.

   a. Loosely install long mounting bolt into top hole on fork leg.

   b. Install short mounting bolt into bottom hole on fork leg. Tighten bottom mounting bolt to 38-52 Nm (28-38 ft-lbs).

   c. Final tighten top mounting bolt to 38-52 Nm (28-38 ft-lbs).

6. Install brake caliper on other side of wheel.

⚠WARNING

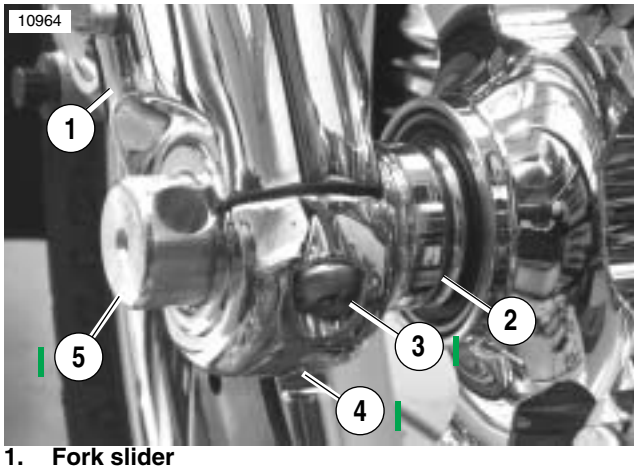
Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a).

7. Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads.

8. Reinstall maxi-fuse and right side cover.

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)



1. **Fork slider**
2. **Axle spacer**
3. **Axle holder pinch bolt (2)**
4. **Axle holder**
5. **Axle**

Figure 2-9. Aligning Fork to Wheel

REAR AXLE COVERS 2.7

REMOVAL

1. See Figure 2-10. Remove and retain bolt and nut fastening bottom of shock absorber to swing arm.

Figure 2-10. Remove Bolt

2. See Figure 2-11. Pivot Shock Absorber Pivot shock absorber back and upward from swingarm.

Figure 2-11. Pivot Shock Absorber

3. See Figure 2-12. Remove axle cover from swingarm.

Figure 2-12. Cover Removed

INSTALLATION

1. See Figure 2-11. Place left side axle cover over axle on swingarm.
2. Pivot shock absorber back into position on swingarm.
3. See Figure 2-10. Fasten shock absorber to swingarm using bolt and nut retained earlier. Tighten bolt to 41-68 Nm (30-50 ft-lbs).
4. Repeat for other side.

REAR WHEEL 2.8

GENERAL

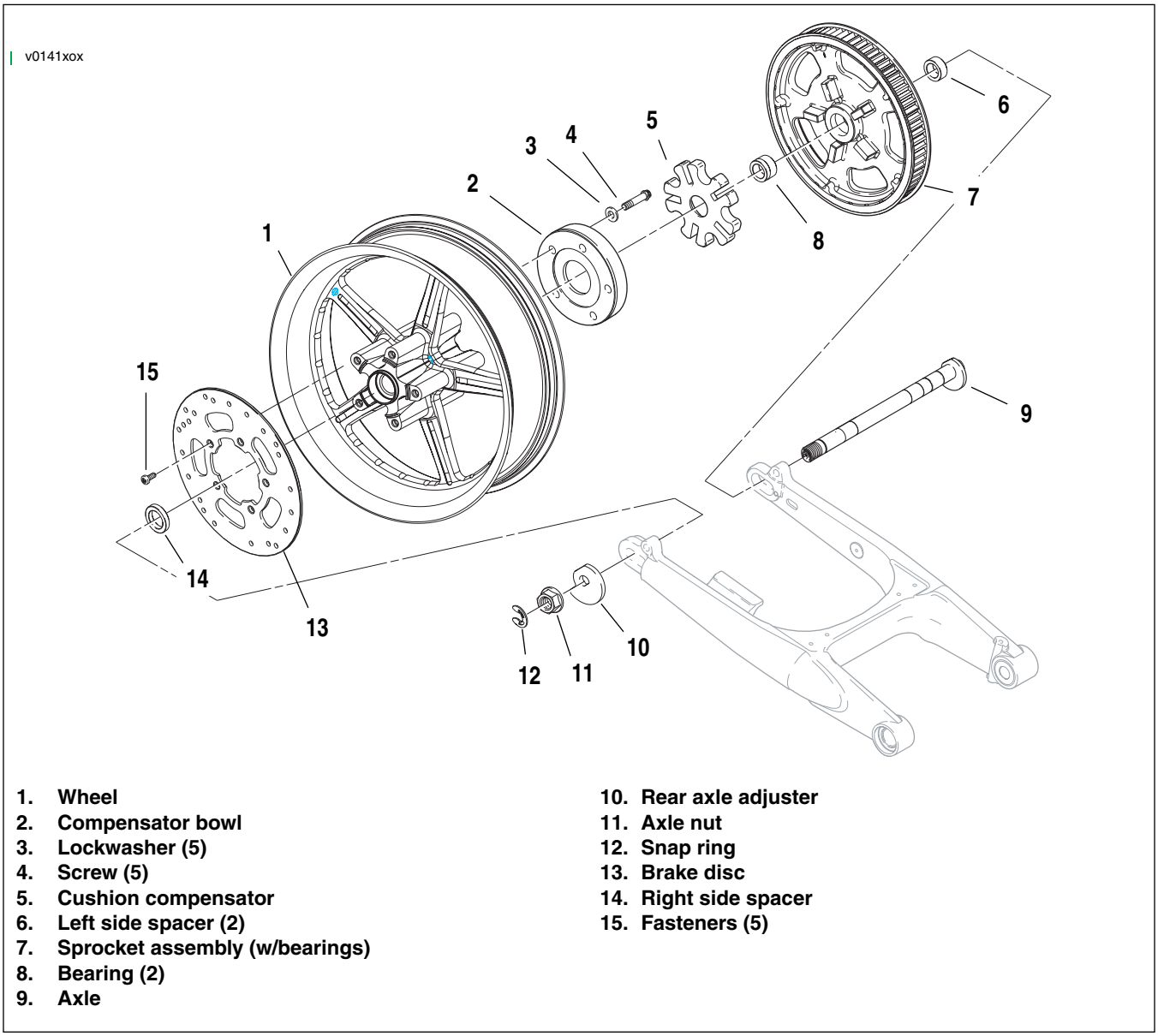
Maximum tire mileage and good handling qualities are directly related to care given wheels and tires. Wheels and tires should be inspected regularly for wear. If handling problems occur, check TROUBLESHOOTING in appropriate VRSC Service Manual for possible causes.

Preliminary Inspection - Brake Disc

1. Measure brake disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
2. Replace disc if warped. Maximum allowable runout of a rear brake disc is 0.3 mm (0.012 in.).
3. If scored, replace disc.

Preliminary Inspection - Wheel/Tire

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. Inspect tire for wear and wear pattern. Remove wheel assembly and replace tire as necessary. See TIRES in appropriate VRSC Service Manual.
3. Inspect air valve. Replace as necessary.
4. Inspect wheel bearing end play and service bearings if necessary. If end play is 0.051 mm (0.002 in.) or more, replace the wheel bearings. See SEALED WHEEL BEARINGS in appropriate VRSC Service Manual.



1. **Wheel**
2. **Compensator bowl**
3. **Lockwasher (5)**
4. **Screw (5)**
5. **Cushion compensator**
6. **Left side spacer (2)**
7. **Sprocket assembly (w/bearings)**
8. **Bearing (2)**
9. **Axle**
10. **Rear axle adjuster**
11. **Axle nut**
12. **Snap ring**
13. **Brake disc**
14. **Right side spacer**
15. **Fasteners (5)**

Figure 2-13. Rear Wheel Components

REMOVAL

1. Block motorcycle underneath frame so weight of motorcycle is off of rear wheel.

NOTE

A scissors style jack will allow you to raise or lower the motorcycle at different points throughout the procedure to provide both clearance and alignment during removal and installation.

2. Remove right side cover and maxi-fuse.
3. See Figure 2-14. Remove fasteners holding lower debris deflector to rear fork. Remove debris deflector.
4. If necessary, remove fasteners holding belt guard to rear fork. Back lower shock bolt out until belt guard is free and remove belt guard. Remove and retain lower shock bolt and nut.
5. Remove chrome axle covers. See 2.7 REAR AXLE COVERS.
6. Remove fasteners and remove brake disc from wheel.
7. Remove snap ring, axle nut and adjuster from right side of axle.
8. Relieve belt tension by rotating axle adjusters.

CAUTION

Support rear tire from underneath and protect wheel finish during removal. Failure to support rear tire may cause damage to the motorcycle as the axle is removed.

9. Tap axle towards left side until rear brake caliper is free.
10. Slide rear caliper up off of brake disc towards front of motorcycle. Using a bungee cord, secure caliper. Be sure rubber bumper stays with caliper.
11. Remove axle. Identify and set aside right and left spacers, right side axle adjuster, axle nut, and snap ring.

CAUTION

Chrome plated wheels can be scratched or damaged when slid out of and into the rear fork. Exercise caution to avoid dragging wheel and sprocket surfaces against rear fork components.

12. Move wheel forward and slip belt off sprocket. Adjust height of the scissors jack to allow removing wheel assembly without damaging components.

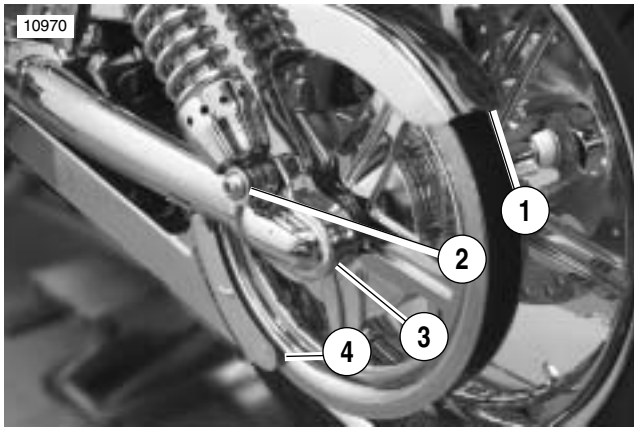
NOTE

Note the height of the license plate bracket. Pulling the rear wheel can break off the reflector brackets.

13. Pull wheel and drive belt sprocket assembly from rear fork.

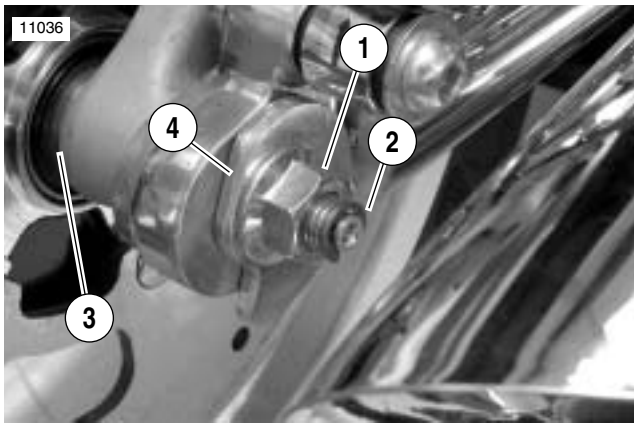
NOTE

Do not operate rear brake pedal with the rear wheel removed or the caliper piston may be forced out of piston bores. Reseating the piston requires disassembly of the caliper.



1. **Belt guard**
2. **Lower shock bolt**
3. **Left side axle adjuster**
4. **Debris deflector**

Figure 2-14. Rear Axle: Left Side



1. **Axle nut**
2. **Snap ring**
3. **Right side spacer**
4. **Right side axle adjuster**

Figure 2-15. Rear Axle (right side, typical))

DISASSEMBLY

1. See Figure 2-16. Pull sprocket out of rubber compensator cushion and compensator bowl (4) mounted to disc wheel.
2. Pull compensator spacer (2) and compensator cushion (1) from compensator bowl (4) mounted to disc wheel.
3. If tire replacement is necessary, remove tire and valve stem. See TIRES in appropriate VRSC Service Manual.

NOTE

If drive sprocket bearing surface is rough or if bearing is leaking grease, replace bearing in CLEANING AND INSPECTION procedures.

4. See Figure 2-13. If necessary, remove screws (4) and helical spring lockwashers (3) holding compensator bowl (2) to disc wheel (1). Remove compensator bowl (2).
5. If necessary, remove fasteners (15) that hold brake disc (16) to disc wheel (1) and remove brake disc (16).

CLEANING AND INSPECTION

1. Clean all parts in solvent and inspect all parts for damage or excessive wear.

NOTE

The wheels are chrome plated. Damage from harsh chemicals, acid based wheel cleaners, brake dust and lack of maintenance can occur. Use HARLEY-DAVIDSON WHEEL & TIRE CLEANER (Part No. 94658-98) to clean the wheels and tires and then use HARLEY BRIGHT CHROME CLEANER (Part No. 94683-99) to protect the wheel surfaces.

2. Inspect rear belt. See DRIVE BELT AND WHEEL SPROCKET in appropriate VRSC Service Manual.
3. Inspect sprocket bearing. If bearing surface is rough or if bearing was leaking grease, replace sprocket bearing as follows:
   a. Supporting hub inside compensator dogs. use a suitable drift to press bearing out of sprocket hub.
   b. Lubricate the bearing bore in the sprocket hub.
   c. Supporting hub from cosmetic side in such a manner as to not damage machined surface, use a suitable drift to press in a **new** bearing. To avoid damaging bearing, drift should press on outside race of bearing.
4. Inspect compensator cushion for missing chunks or excessive debris beyond normal wear marks. Replace if necessary.
5. Inspect brake disc. Replace disc if warped or badly scored. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
6. If sealed wheel bearings must be serviced, see SEALED WHEEL BEARINGS in appropriate VRSC Service Manual.

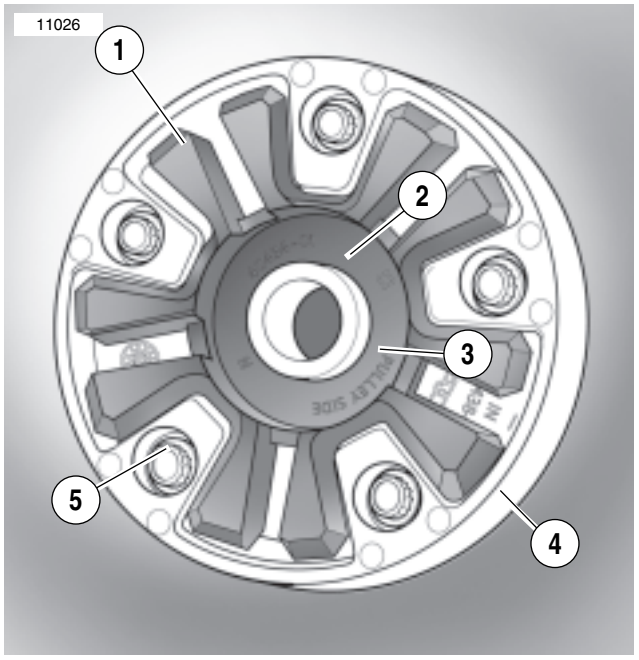
⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

7. Inspect brake pads, calipers, and brake lines. Replace pads and service calipers and brake lines as required. See BRAKE PADS AND DISCS in appropriate VRSC Service Manual.

ASSEMBLY

1. If necessary, mount tire, valve stem and balance wheel assembly as required. See TIRES in appropriate VRSC Service Manual.
2. Install brake disc, if removed, on valve stem side of wheel.
   a. Apply a drop of LOCTITE® 243 (blue) to the five bolts that hold on rear brake disc.
   b. Thread in and alternately tighten to 41-53 Nm (30-38 ft-lbs).
3. Install compensator bowl. Thread in screws and helical spring lockwashers. Tighten to 61-75 Nm (45-55 ft-lbs).
4. Verify that wheel and tire are true and balanced. See DISC RIM RUNOUT and TIRES in appropriate VRSC Service Manual.
5. After wheel is balanced, apply LOCTITE® ANTI-SEIZE LUBRICANT to entire surface of left side (compensator bowl) bearing race only.
6. See Figure 2-16. Lubricate compensator cushion (1) with a detergent spray like Windex™ and install compensator cushion. Be sure the PULLEY SIDE legend (3) is facing out.
7. Install the compensation spacer (2) with the grooved end in the cushion (1).
8. Insert sprocket dogs into compensator cushion to mate sprocket to rear wheel.



1. **Compensator cushion**
2. **Compensator spacer**
3. **PULLEY SIDE legend**
4. **Compensator bowl**

Figure 2-16. Compensator Cushion in Compensator Bowl

INSTALLATION

1. Hold rear disc with rear wheel and install wheel into rear fork.
2. Slide drive belt over drive sprocket.

CAUTION

Protect wheel finish and use care when removing or installing brake caliper. Failure to do so may result in damage to the wheel cosmetic finish.

3. Instal brake disc fasteners and tighten to 40.7-47.5 Nm (30-35 ft-lbs).
4. Slide brake calipers over brake disc between brake pads. Lubricate rubber bumper with a detergent spray and slide slot in the caliper over brake anchor weldment on rear fork. Be sure rubber bumper is in place under weldment.
5. Coat axle liberally with LOCTITE® ANTI-SEIZE LUBRICANT and install.
   a. From right side, carefully insert axle through rear fork, left side spacer, drive sprocket, compensator cushion, into wheel assembly.
   b. Continue sliding axle through wheel assembly hub sleeve, right side spacer, brake caliper, and left rear fork. Center right side spacer on wheel bearing to allow axle to pass through. Axle is fully installed when left side cam is tight against rear fork.
   c. Slip on right side axle adjuster. Axle adjuster will only fit in a manner that matches position of left side eccentric.
   d. Coat flange of axle nut with LOCTITE® ANTI-SEIZE LUBRICANT and thread on and finger tighten axle nut.

⚠WARNING

Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)

6. Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads.
7. Verify axle alignment and then check belt deflection. See 2.10 REAR BELT DEFLECTION.
8. Use a wrench to rotate rear axle adjuster until drive belt deflection is within specifications.

⚠WARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)

9. Tighten axle nut to 190-203 Nm (140-150 ft-lbs).
10. Install snap ring.
11. Install chrome axle covers. See 2.7 REAR AXLE COVERS.
12. If belt guard was removed, slide belt guard slots onto rubber grommets. Thread shock mount bolt into belt guard and tighten shock mount bolt to 41-68 Nm (30-50 ft-lbs).
13. Slide debris deflector slots on to its corresponding rubber grommet. Install debris deflector bolt and tighten bolt to 6-10 Nm (53-88 **in-lbs**).
14. Measure belt guard to drive sprocket clearance.
15. If clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.
16. Install maxi-fuse and right side cover.

BELT GUARD/DEBRIS DEFLECTOR 2.9

REMOVAL

NOTE

During removal procedures, inspect grommets and fasteners and replace as necessary.

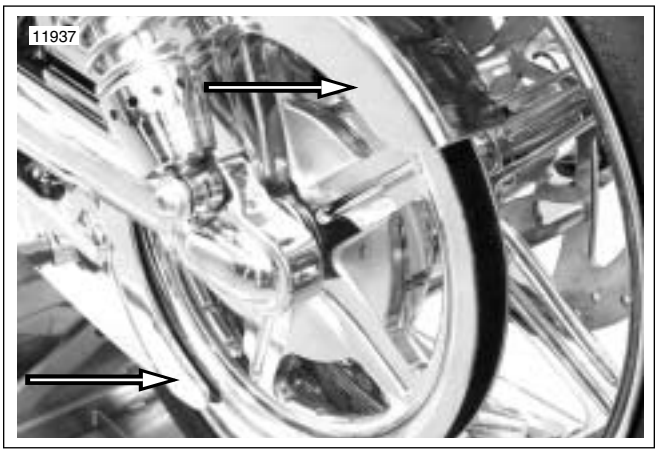


Figure 2-17. Belt Guard and Deflector

Belt Guard

Figure 2-18. Left Side Lower Shock Bolt

1. See Figure 2-17. Remove left side lower shock mount bolt from belt guard without removing shock mount bolt from rear fork.
2. Pull belt guard rearward off of side rubber grommet (Inner left side of swingarm) and upper rubber grommet. If necessary, remove fasteners holding grommets to rear fork.

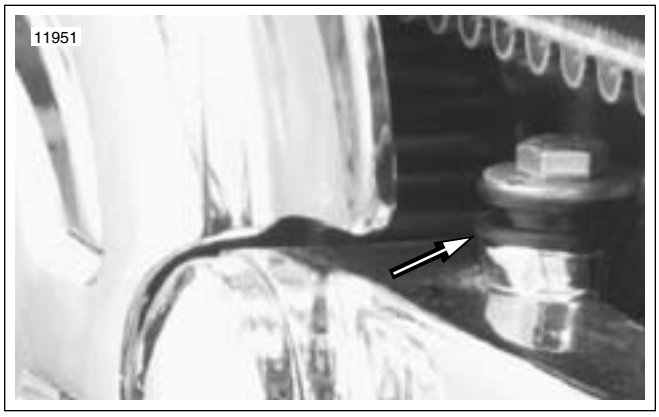


Figure 2-19. Front Upper Rubber Grommet

3. Inspect front upper rubber grommets on rear fork and replace bolts and rubber grommets if necessary.

Debris Deflector

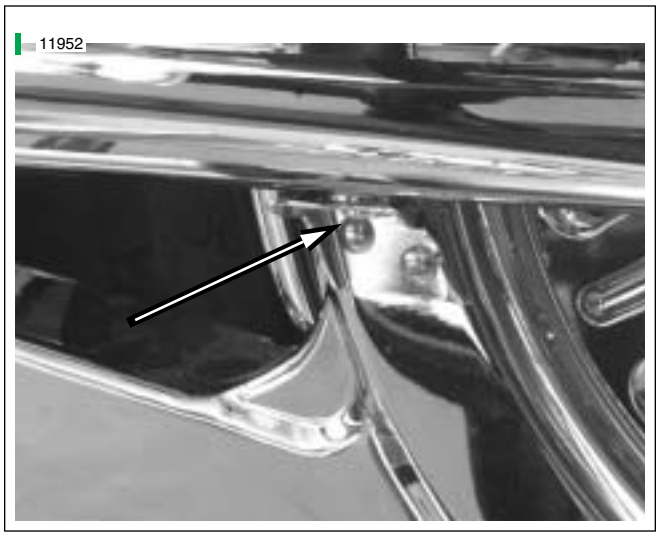


Figure 2-20. Fastener

1. See Figure 2-17. Remove fastener and washer from underside of rear fork near rear shock mount.

2. Pull debris deflector rearward off of lower rubber grommet and remove debris deflector from motorcycle.

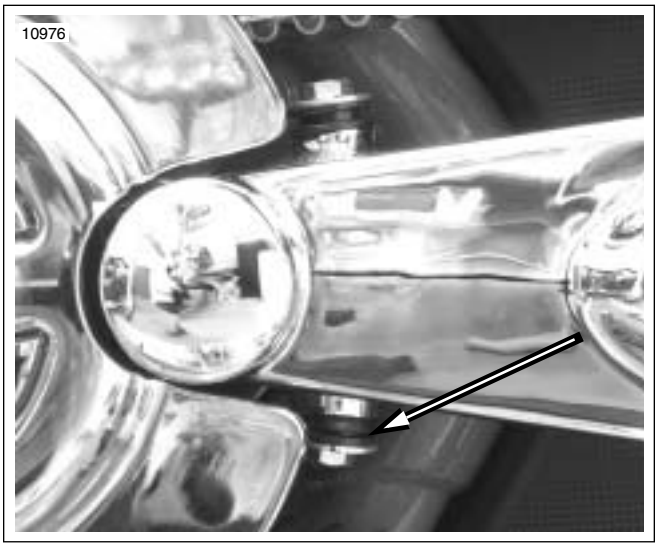


Figure 2-21. Front Lower Rubber Grommet

3. See Figure 2-21. Inspect front lower rubber grommet on rear fork and replace bolt and grommet if necessary.

INSTALLATION

Belt Guard

1. See Figure 2-21. Install rubber grommets and bolts. Tighten to 6-10 Nm (53-88 **in-lbs**).
2. Slide belt guard slots into position on rubber grommets.
3. Thread lower rear shock mounting bolt through belt guard and into nut. Tighten to 41-68 Nm (31-50 ft-lbs).

NOTE

If drive to belt guard clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as necessary.

4. Measure guard to drive belt clearance.

Debris Deflector

1. See Figure 2-21. Install rubber grommets and fasteners./ Tighten to 6-10 Nm (53-88 **in-lbs**).
2. Slide debris deflector slot into position on rubber grommet.
3. Thread rear fastener and washer through debris deflector and into rear fork. Tighten fastener to 6-10 Nm (53-88 **in-lbs**).

REAR BELT DEFLECTION 2.10

INSPECTION

General

There are two methods to perform belt tension inspection on your VRSCSE2 model motorcycle. Method 1 (the most accurate method) uses an OEM stock VRSC debris deflector and a Belt Tension Gauge (HD-35381). Method 2 uses a ruler.

NOTE

Check rear belt tension with motorcycle cold, standing upright, transmission in NEUTRAL and no rider on motorcycle.

PART NO.	SPECIALTY TOOL
HD-35381	Belt tension gauge

Check rear belt deflection:

- As part of the pre-ride inspection.
- At every scheduled service interval.

NOTE

Customers may purchase belt tension gauge from an authorized Harley-Davidson dealer.

CAUTION

Setting tension without using BELT TENSION GAUGE typically results in loose belts. Loose belts will fail due to racheting (jumping a tooth) which causes tensile cord crimping and breakage.

1. Remove chrome lower belt deflector.

MEASUREMENT METHOD 1

Using Standard VRSC Belt Deflector

Figure 2-22. Determining Belt Deflection Using OEM Beltguard and Belt tension Gauge (HD-35381))

2. Obtain an OEM stock VRSC debris deflector and install on motorcycle per procedure in appropriate Service Manual.
3. See Figure 2-24. Using BELT TENSION GAUGE (HD-35381), apply 4.5 kg (10 lbs) of force upward.
4. See Figure 2-24. Verify that the drive belt deflects 8 mm (5/16 in).

NOTE

Belt deflection window on the debris deflector is graduated in 2 mm increments.

MEASUREMENT METHOD 2

Using Ruler

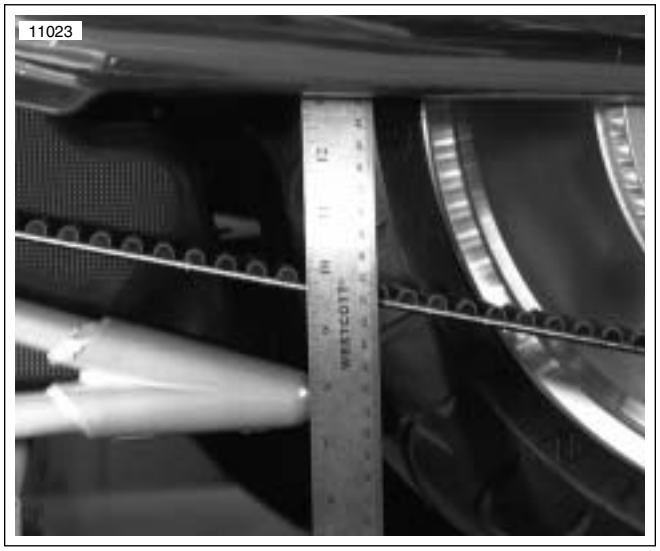


Figure 2-23. Using Ruler to Check Belt Deflection (typical)

1. Remove chrome lower belt deflector.

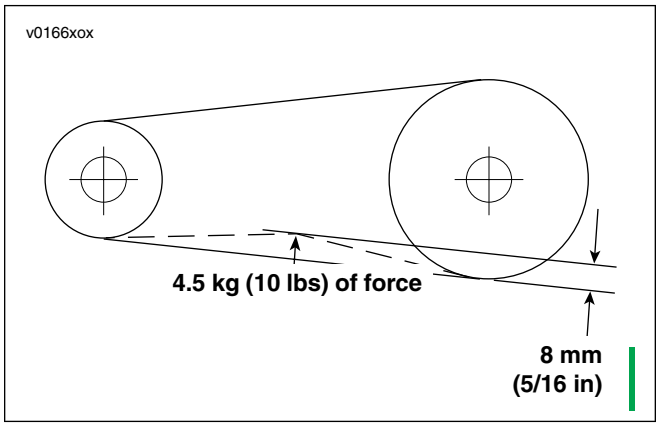


Figure 2-24. Checking Belt Deflection Specifications

2. See Figure 2-23. Place a ruler halfway between transmission and rear sprocket as shown.
3. Use Belt Tension Gauge (HD-35381) and apply 4.5 kg (10 lbs) of force to belt. Position ruler near center of belt and resting against bottom of rear swingarm. Note amount of belt upward travel (deflection) on ruler. Belt deflection should measure 8 mm (5/16 in).

4. If belt adjustment is necessary, see Figure 2-24. Remove snap ring (1) and loosen axle nut (2) on right side of motorcycle.

NOTE

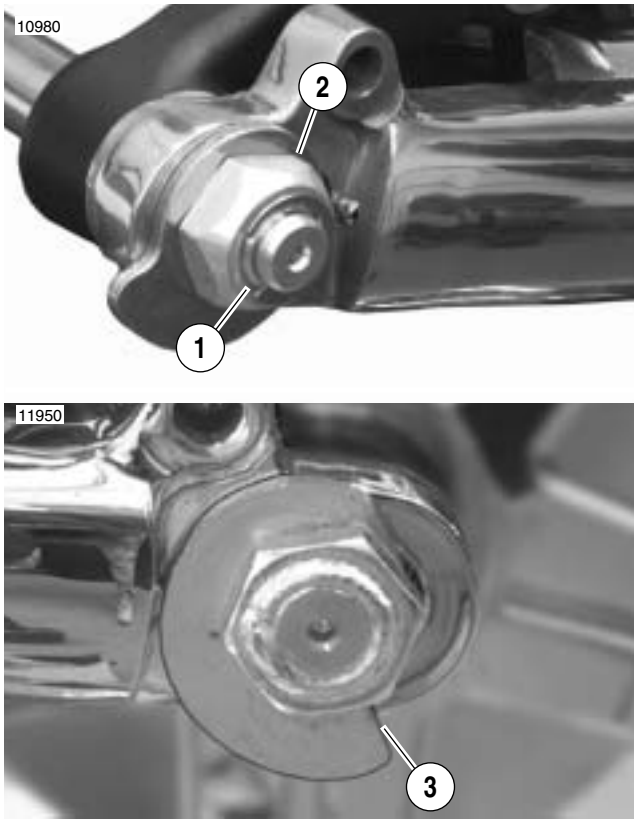
The left cam is welded to the axle and the right cam is keyed to the axle. Clockwise rotation of axle will tighten belt. Counterclockwise rotation will loosen belt.

5. Adjust belt tension on left side by turning the axle adjustment eccentric (3) until the specification is achieved.

⚠WARNING

Do not exceed 203 Nm (150 ft-lbs) when tightening the axle nut. Exceeding 203 Nm (150 ft-lbs) may cause the wheel bearings to seize during operation, which could result in death or serious injury.

6. Tighten axle nut (2).
   a. Tighten axle nut (2) to 190-203 Nm (140-150 ft-lbs).
   b. Install snap ring (1).



1. **Snap ring (right side)**
2. **Axle nut (right side)**
3. **Adjustment eccentric (left side)**

Figure 2-25. Axle Adjusters

FORK TUBE/STEERING NUT COVERS 2.11

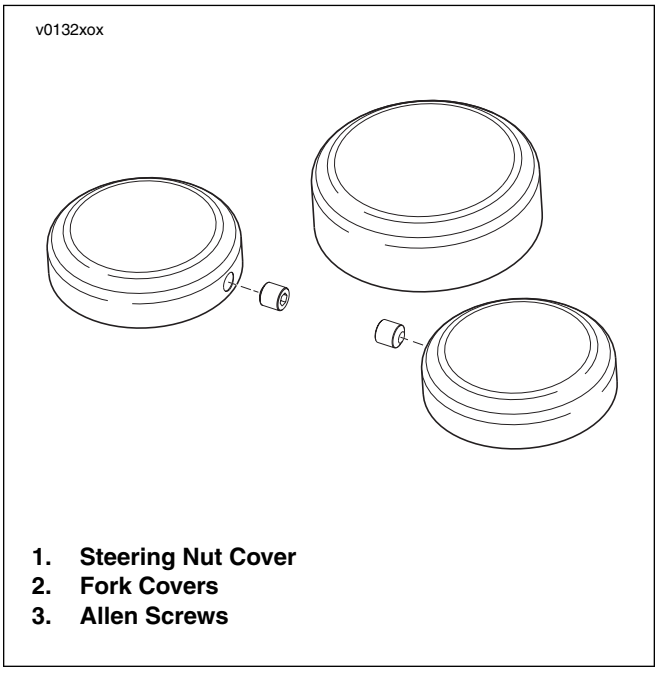
REMOVAL

Steering Nut Cover

1. Grasp nut cover and turn counterclockwise to unscrew from motorcycle.

Fork Covers

1. Loosen allen screws and pull chrome cover off of fork.



1. **Steering Nut Cover**
2. **Fork Covers**
3. **Allen Screws**

Figure 2-26. Steering Nut Cover and Fork Covers

INSTALLATION

Steering Nut Cover

1. Insert threaded shaft and hand tighten.

Fork Covers

1. Install chrome cover on fork and tighten allen screw.

WATER PUMP HOSE COVER 2.12

REMOVAL

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

NOTE

It will be necessary to remove the water pump hose cover to change the water pump, water pump hose or thermostat.

It is not necessary to remove the lower factory hose clamp from hose when removing chrome hose cover.

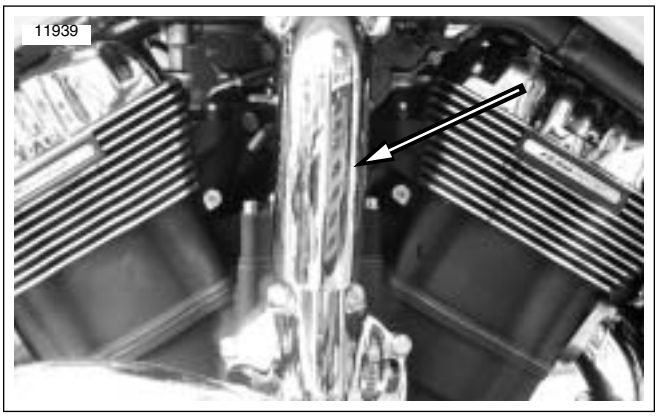
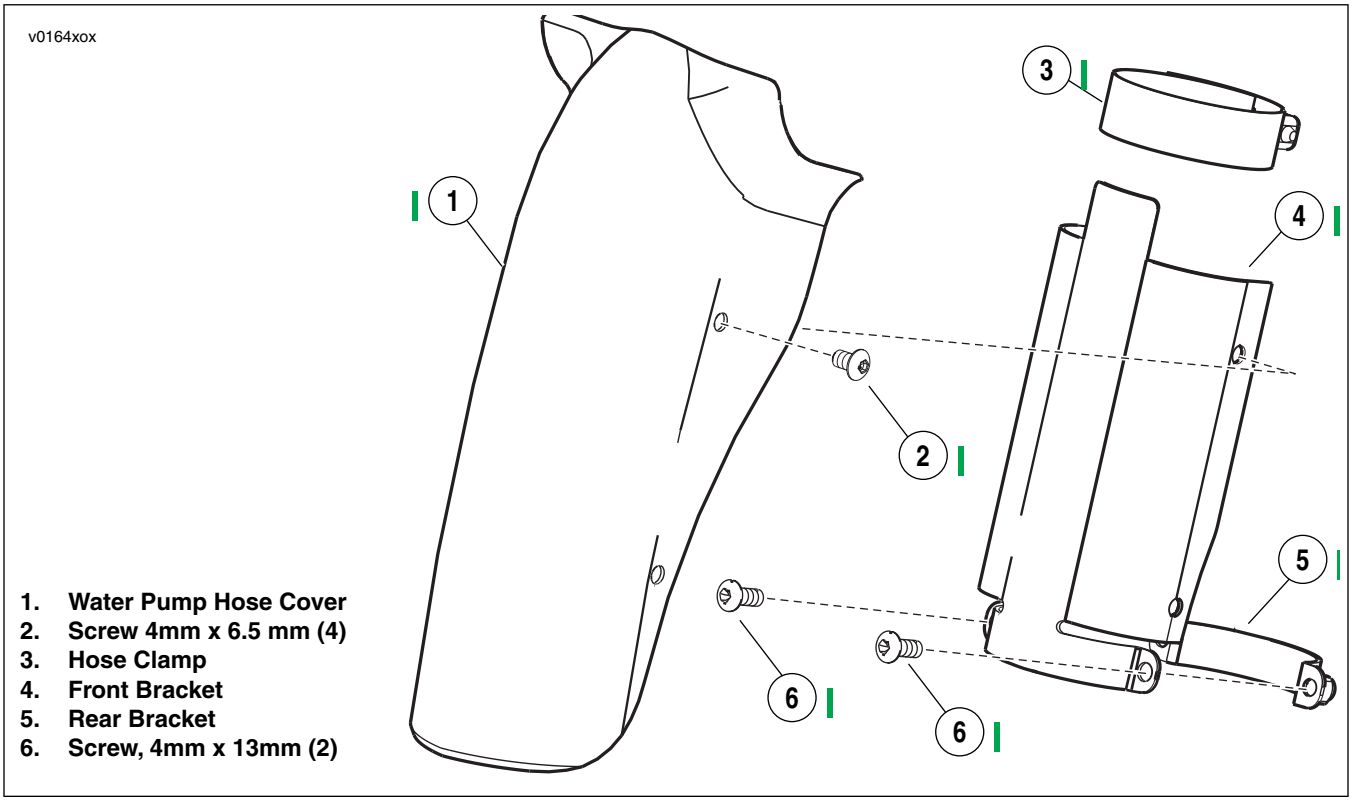


Figure 2-27. Water Pump Hose Cover

1. Remove four 4mm x 6.5mm screws from chrome cover and remove cover from front bracket.
2. Loosen and remove hose clamp.
3. Remove two 4mm x 13mm screws and remove front bracket and rear bracket.

INSTALLATION

1. See Figure 2-28. Hold front bracket and rear bracket in place and install two 4mm x 13mm screw. Tighten screw to 1.1-1.4 Nm (10-12 **in-lbs**).
2. Install upper hose clamp over tab on top of front hose bracket and tighten.
3. Place a drop of LOCTITE® 242 on each water pump hose cover screw.
4. Install water pump hose cover and install four 4mm x 13mm screws. Tighten screws to 1.1-1.4 Nm (10-12 **in-lbs**).



1. **Water Pump Hose Cover**
2. **Screw 4mm x 6.5 mm (4)**
3. **Hose Clamp**
4. **Front Bracket**
5. **Rear Bracket**
6. **Screw, 4mm x 13mm (2)**

Figure 2-28. Water Pump Hose Cover Assembly

CHROME OIL DIPSTICK 2.13

REMOVAL

⚠WARNING

When the engine is hot, grasp the dipstick using a rag or gloved hand. Failure to follow instructions can result in injury.

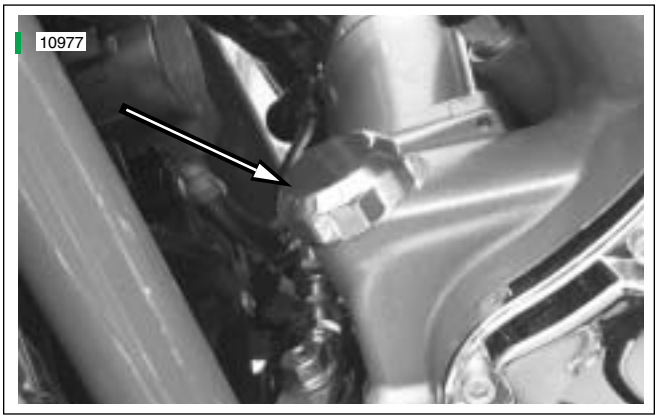


Figure 2-29. Dipstick

1. Grasp dipstick and turn counterclockwise to remove.

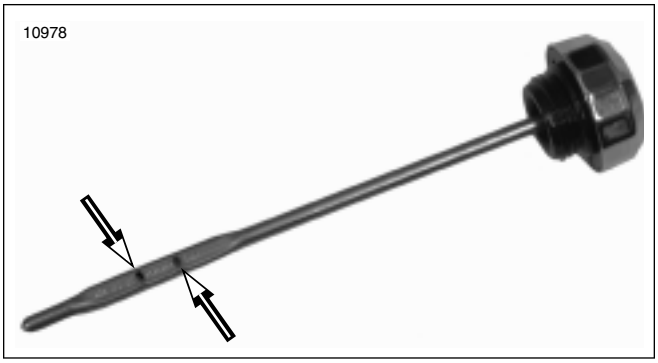


Figure 2-30. Oil Level Indicators

2. Verify oil level per appropriate Owner's Manual.

INSTALLATION

1. Insert dipstick into engine and twist clockwise until an audible clicking is heard.

FOOTPEGS 2.14

REPLACING FOOTPEG PAD

Figure 2-31. Replacing Footpeg Rubber Pad (typical)

1. See Figure 2-31. Move footpeg assembly upward into the folded position.
2. See Figure 2-32. Remove screw (5) and rubber pad (6) from foot peg (8).
3. Install **new** rubber pad on footpeg.
4. Install screw and tighten.

REPLACING FOOTPEG ASSEMBLY

Removal

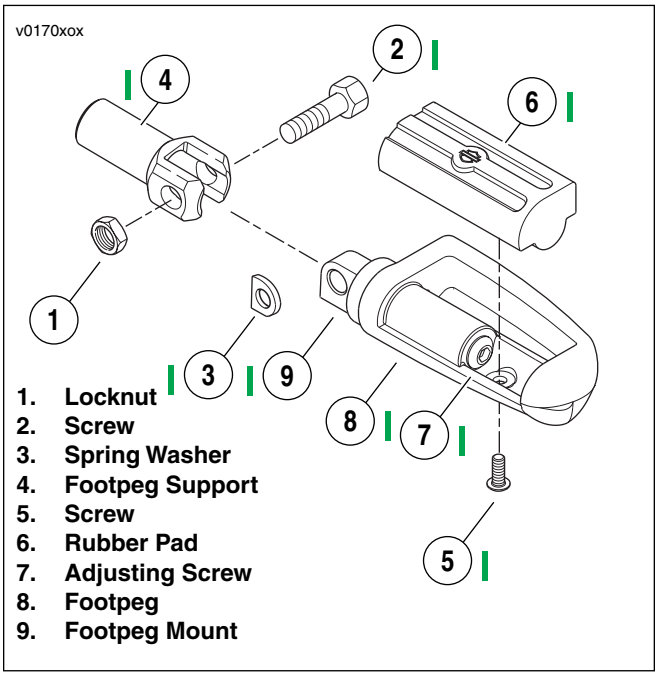


Figure 2-32. Footpeg Assembly (typical)

1. See Figure 2-32. Loosen and remove screw (2) and locknut (1) and spring washer (3).
2. Remove footpeg assembly from motorcycle.

Installation

1. Install footpeg (8) onto footpeg support (4) using screw (2), spring washer (3), and locknut (1). Tighten to 26 Nm (19 ft-lbs).
2. Loosen adjusting screw (7) until footpeg rotates.
3. Position footpeg as desired.
4. Tighten adjusting screw to 26 Nm (19 ft-lbs).
5. Install rubber pad (6), place a drop of LOCTITE® 242 on screw and and install screw (5). Tighten.

REMOVAL

For handlebar wiring removal/installation see 8.4 HANDLEBAR WIRING.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

1. Remove right side cover and remove maxi-fuse.
2. Remove air box cover. See 1.1 AIRBOX COVER.

Figure 2-33. Harness Connectors

3. See Figure 2-33. Remove left side cover. Clearly label and disconnect speedometer [20], tachometer [108], hand controls [22] and [24] harness connectors.

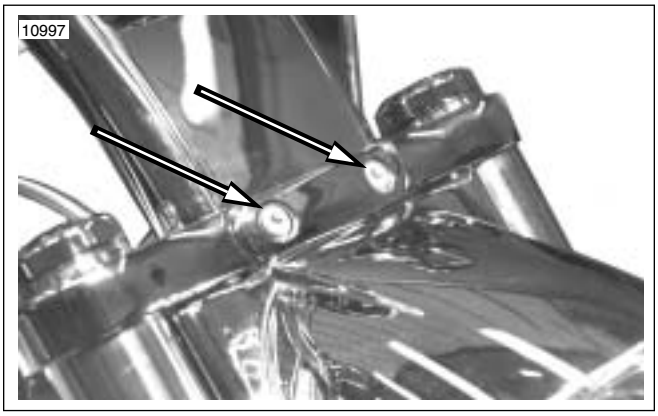


Figure 2-34. Remove Headlight Cover Bolts

4. See Figure 2-34. Remove headlight cover bolts, loosen lower clamps at bottom of headlight cover and pull cover forward.

NOTE

Note position of tie wrap for installation procedure.

5. See Figure 2-35. Remove inner riser cover and cut tie-wrap.

Figure 2-35. Inner Riser Cover

6. Adjust and remove throttle and return cables from switch housing according to appropriate VRSC Service Manual.

Figure 2-36. Remove Mirror and Controls (left side shown)

7. See Figure 2-36. Remove mirrors, grips, brake master cylinder, clutch master cylinder and turn signals from bars according to procedure in appropriate VRSC Service Manual.
8. Loosen handlebar riser mounting bolts, and remove only the left bolt from riser.
9. Turn handlebar riser to clear harness connectors.

Pull harnesses up through handlebar riser.

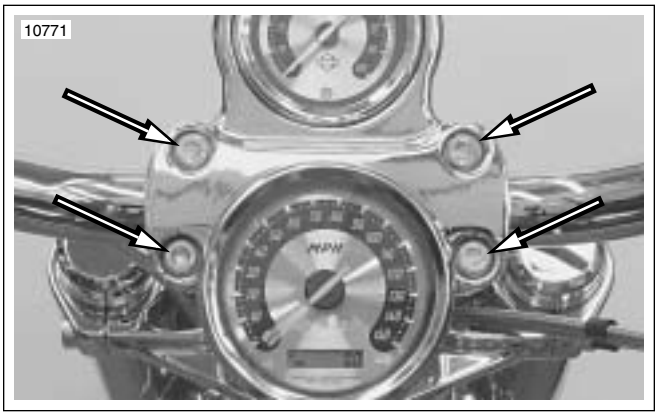


Figure 2-37. Remove Handlebar Clamp Bolts

10. See Figure 2-37. Remove handlebar clamp bolts.
11. Remove handlebars from motorcycle.

INSTALLATION

This procedure is performed with the handlebar wiring harnesses already installed. See 8.5 HANDLEBAR WIRING for wiring harness removal/installation information if needed.

1. Route wiring harnesses through opening in riser.

Figure 2-38. Harness Connectors

2. See Figure 2-38. Connect all harness connectors.

CAUTION

Failure to tie wrap the wiring in original location can result in damage and possible short in the wiring harness from wires becoming pinched.

3. Tie wrap wiring harness to exact location noted in disassembly procedure.
4. Straighten handlebar riser and install left riser bolt removed in step 8. Tighten riser bolts to 41-47 Nm (30-35 ft-lbs).

Figure 2-39. Install Mirror and Controls (left side shown)

5. See Figure 2-39. Install mirrors, switch housings, handgrips, brake master cylinder, clutch master cylinder and turn signals from bars according to procedure in appropriate VRSC Service Manual.
6. Connect and adjust throttle cable and return cables from switch housing according to appropriate VRSC Service Manual.
7. Install left and right side covers.

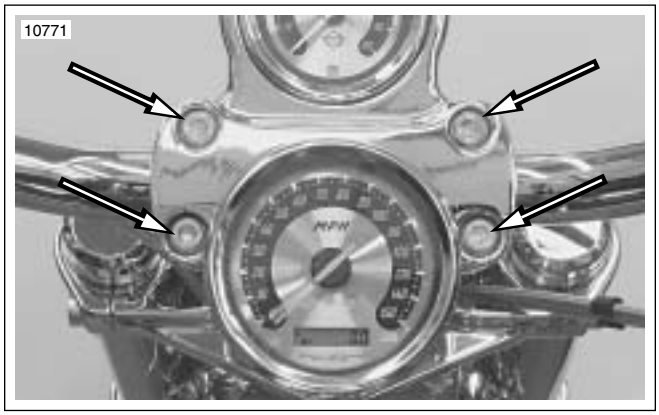


Figure 2-40. Install Handlebar Clamp Bolts

8. See Figure 2-40. Install handlebars to riser and tighten handlebar mount bracket to 16-20 Nm (12-15 ft-lbs).
9. Install inner riser cover and tighten.
10. Install air box cover.
11. Push headlight cover into place and tighten lower clamp fasteners to 4.5-7.5 Nm (3.3-5.5 ft-lbs).
12. Install upper headlight cover bolts and tighten to 11-18 Nm (8-13 ft-lbs).
13. Test all functions of switches, throttle, brakes and clutch before operating motorcycle.

SECONDARY CLUTCH ACTUATOR 2.16

REMOVAL

1. Remove secondary clutch actuator cover.
2. See Figure 2-41. Remove mounting bolts (2) holding secondary clutch actuator (4) to clutch cover.

CAUTION

The piston in the secondary clutch actuator is under pressure. Squeezing the clutch hand lever could push the piston out of its housing.

3. See Figure 2-42. Inspect O-ring (2). Replace if necessary and re-install actuator.

IMPORTANT NOTE

Dispose of clutch fluid in accordance with local regulations.

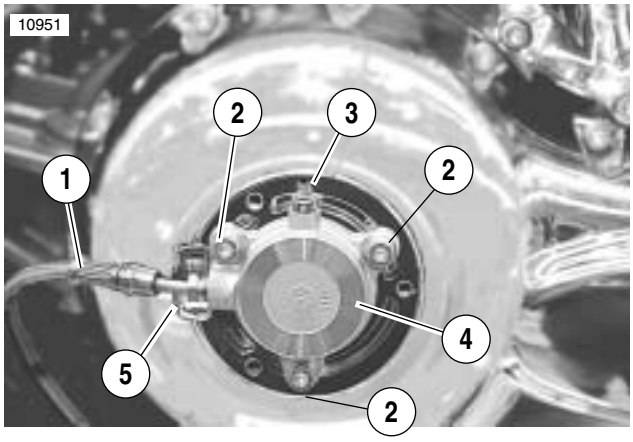
4. See Figure 2-41. If condition indicates replacement of secondary actuator:
   a. Place a suitable container under secondary clutch actuator (4). Loosen flare nut (5) and allow clutch fluid to drain from clutch line (1).
   b. Remove flare nut and remove actuator.
   c. Remove bleeder and drain remaining clutch fluid.

DISASSEMBLY

1. See Figure 2-43. Remove O-ring (3) from bleeder (2).
2. Pull off boot (8), piston (7), seal (6), and spring (5) from housing (1). Slip O-ring (4) off housing.
3. Clean with denatured alcohol or D.O.T. 4 BRAKE FLUID only.
4. Use air hose to clean inlet and bleeder ports.
5. Inspect cylinder housing bore for scoring, pitting or corrosion. Inspect inlet and bleeder ports. Replace housing if necessary.

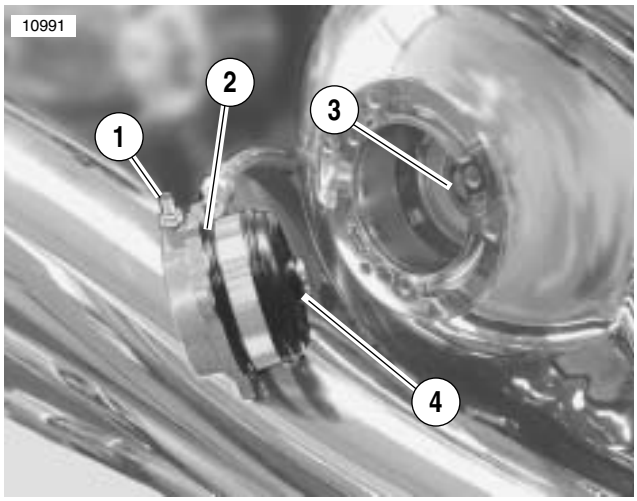
ASSEMBLY

1. See Figure 2-43. Coat cylinder bore, piston, O-ring, boot, and bleeder with lubricant from service kit.
2. Orient a **new** seal (6) with square split lip toward rider side of actuator and fit to piston (7).
3. Insert spring into cylinder bore and insert piston into cylinder bore. Compress and guide seal lip as piston is pressed into bore.
4. Install a **new** O-ring (4) into groove at base of secondary clutch actuator housing (1).
5. Fit boot (8) to piston (7) and push edge of boot over machined lip around housing (1).
6. Fit new O-ring (3) to bleeder (2) and loosely install into housing.



1. **Clutch fluid line**
2. **Mounting bolts**
3. **Bleeder**
4. **Secondary clutch actuator**
5. **Flare nut**

Figure 2-41. Secondary Clutch Actuator Installed



1. **Bleeder**
2. **O-ring**
3. **Clutch release bearing**
4. **Secondary clutch actuator piston**

Figure 2-42. Secondary Clutch Actuator

INSTALLATION

1. Install clutch fluid line flare nut to secondary clutch actuator. Tighten to 9-13 Nm (80-115 **in-lbs**).
2. Loosen bleeder.

⚠WARNING

Be sure no clutch fluid gets on tires, wheels or brakes when adding fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00294a)

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

CAUTION

Do NOT allow dirt or debris to enter the master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation and equipment damage. (00205b)

NOTE

The piston in the secondary clutch actuator is under pressure. Squeezing the clutch hand lever could force the piston out of its housing.

3. Fill reservoir with D.O.T. 4 BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleeder. Tighten bleeder.

NOTE

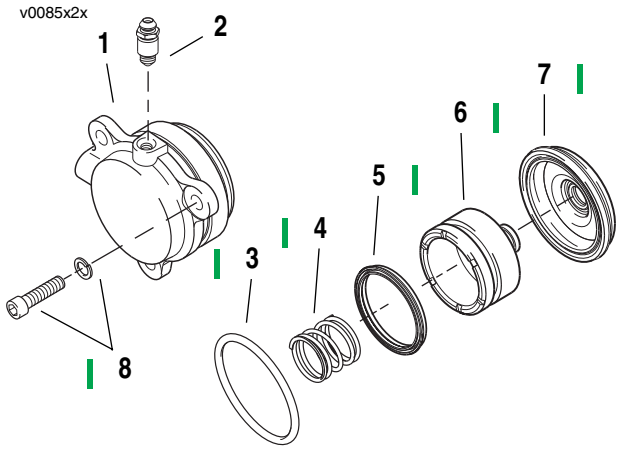
When filling an empty clutch fluid line, a Snap-on BASIC VACUUM BRAKE BLEEDER with a fitting that mates to the bleeder threads can be used to initially draw the fluid down the clutch line with little or no air in the line.

4. Bleed clutch fluid line. See BLEEDING CLUTCH FLUID LINE in VRSC Service Manual.
5. Tighten fasteners as follows:
   a. Banjo bolt to 23-31 Nm (17-23 ft-lbs).
   b. Bleeder to 9-11 Nm (80-100 **in-lbs**).
   c. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
6. Determine sufficient piston travel.

NOTE

Insufficient piston travel may indicate a fluid or pressure leak somewhere in the actuator, clutch fluid line, or clutch master cylinder.

7. Press secondary clutch actuator into its mounting flange on crankcase cover. Install fasteners and tighten to 10 Nm (88 **in-lbs**).
8. Install secondary clutch actuator cover. Tighten to 6-10 Nm (53-88 **in-lbs**).



1. **Secondary clutch actuator housing**
2. **Bleeder**
3. **O-ring**
4. **Spring**
5. **Seal**
6. **Piston**
7. **Boot**
8. **Mounting bolts and washers**

Figure 2-43. Secondary Clutch Actuator Components

REAR FORK PIVOT COVERS 2.17

REMOVAL

1. See Figure 2-44. Use a small flat blade screwdriver and gently pry in area shown by arrow and remove cap from swingarm.

INSTALLATION

1. Orient cover over pivot nut and press cap into place.
2. Repeat for opposite side.

Figure 2-44. Rear Fork Pivot Cover

FUEL TANK COVERS 2.18

REMOVAL (LEFT SIDE COVER)

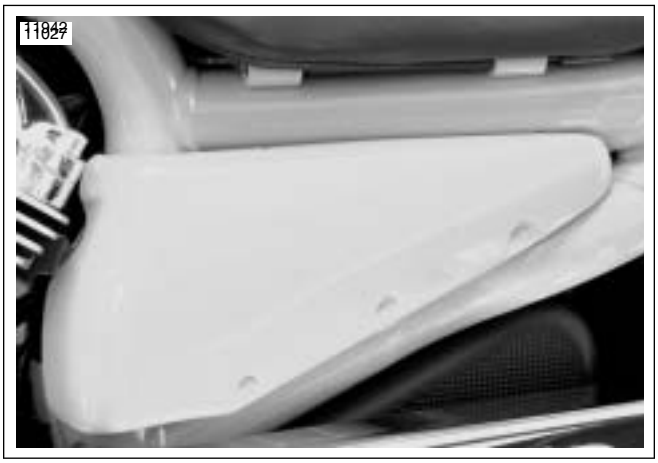


Figure 2-45. Left Side Fuel Tank Cover

See Figure 2-45. Firmly grasp fuel tank cover with fingers and gently rock cover back and forth while pulling cover away from motorcycle. Repeat for both sides if necessary.

INSTALLATION (LEFT SIDE COVER

See Figure 2-45. Firmly press cover into open area in frame where fuel tank is visible. Cover will snap into place, securing cover in place over fuel tank. Repeat for both sides if necessary.

REMOVAL (RIGHT SIDE COVER)

1. See Figure 2-46. Remove seat release button

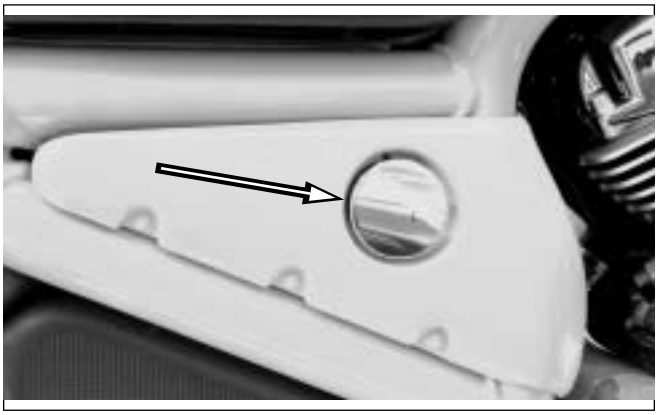


Figure 2-46. Right Side Fuel Tank Cover

2. Firmly grasp fuel tank cover with fingers and gently rock cover back and forth while pulling cover away from motorcycle. Repeat for both sides if necessary.

INSTALLATION (RIGHT SIDE COVER)

1. Firmly press cover into open area in frame where fuel tank is visible. Cover will snap into place, securing cover in place over fuel tank. Repeat for both sides if necessary. Note location of locating recess in seat release button shaft.

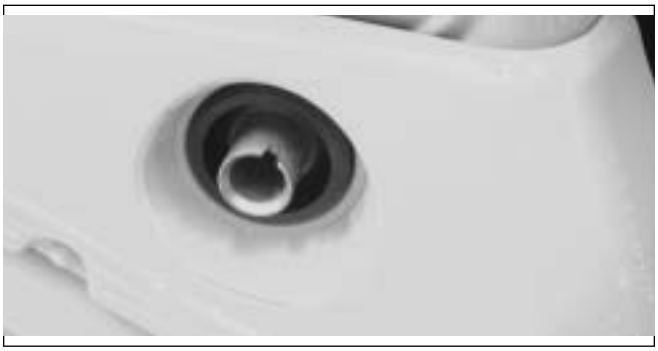


Figure 2-47. Right Side Cover Installed

2. See Figure 2-48. Compress mounting tabs on seat release button.

3. See Figure 2-49. While compressing spring tabs, insert and align tab with slot in

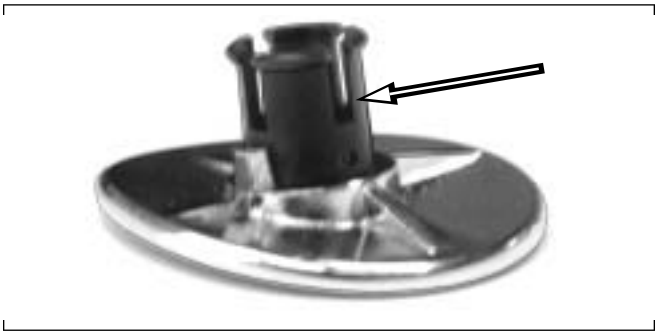


Figure 2-48. Seat Release Button Spring Tabs

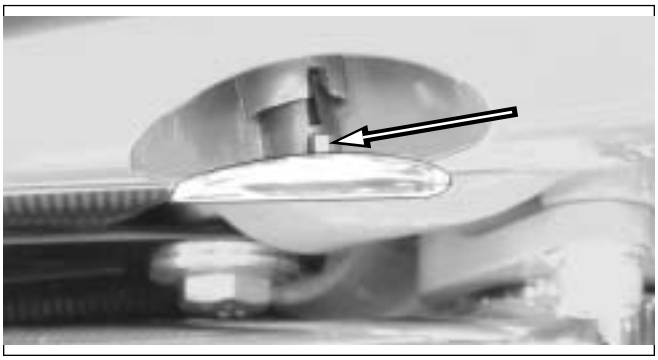


Figure 2-49. Installing Push Button

Table Of Contents

ENGINE 3

SUBJECT **PAGE NO.**

NOTE

This section provides information unique to VRSCSE2 model motorcycles. Any information not presented in this supplement can be found in the VRSC Models Service Manual.

SPECIFICATIONS 3.1

NOTE

The following specifications are specific to the VRSCSE2 Screamin' Eagle 1250 engine. All other procedures and information can be references in the appropriate Service Manual for your model motorcycle.

Table 3-1. Engine General

ITEM	DATA
Number of cylinders	2
Type	4-cycle, 60°, liquid cooled V-twin
Torque (domestic model at crank)	111.2 Nm (82 ft-lbs) @ 7000 rpm
Bore	105 mm (4.13 in.)
Stroke	72 mm (2.84 in.)
Piston displacement (approx.)	1250 cc (76 cubic in.)
Max. engine speed	9000 RPM
Idle speed	1300 rpm ± 50
Engine & transmission weight	89.4 kg (197 lbs)

Table 3-2. Cam Drive

ITEM	DATA
Intake	112 ± 1°
Exhaust	106 ± 1°
Total intake lift	10.9 mm (0.4291 in.)
Duration, intake @ 1 mm	248°
Total exhaust lift	9.98 mm (0.3929 in.)
Duration, exhaust @ 1 mm	206°

Table 3-3. Piston Ring Gap

ITEM	DATA
Top ring gap (maximum)	0.550 mm (0.022 in.)
Top ring gap (minimum)	0.350 mm (0.014 in.)
2nd ring gap (maximum)	0.650 mm (0.026 in.)
2nd ring gap (minimum)	0.400 mm (0.016 in.)
Oil control ring (maximum)	0.890 mm (0.035 in)
Oil control ring (minimum)	0.380 mm (0.015 in.)
Top ring side clearance (maximum)	0.077 mm (0.003 in.)
Top ring side clearance (minimum)	0.032 mm (0.001 in.)
2nd ring side clearance (maximum)	0.075 mm (0.003 in.)
2nd ring side clearance (minimum)	0.030 mm (0.001 in.)

Table 3-4. Crankcase/Cylinder Liner

ITEM	DATA
Cylinder liner cover over stand (maximum)	0.090 mm (0.0035 in.)
Cylinder liner cover over stand (minimum)	0.050 mm (0.0020 in.)
Cylinder head deck flatness (maximum)	0.020 mm (0.0008 in.)
Cylinder head deck flatness (minimum)	0.000 mm (0.0000 in.)

Table 3-5. Cylinder Liner Out of Round

ITEM	DATA
Cylinder liner out of round, installed (maximum)	0.020 mm (0.0008 in.)
Piston major diameter, Class I (maximum)	104.981 mm (4.1331 in.)
Piston major diameter, Class I (minimum)	104.977 mm (4.1330 in.)
Piston major diameter, Class X (maximum)	104.989 mm (4.1334 in.)
Piston major diameter, Class X (minimum)	104.981 mm (4.1331 in.)
Piston major diameter, Class II (maximum)	104.993 mm (4.1336 in.)
Piston major diameter, Class II (minimum)	104.989 (4.1334 in.)

Table 3-6. Piston Major Diameter

ITEM	DATA
Piston major diameter, Class I (maximum)	104.981 mm (4.1331 in.)
Piston major diameter, Class I (minimum)	104.977 mm (4.1330 in.)
Piston major diameter, Class X (maximum)	104.989 mm (4.1334 in.)
Piston major diameter, Class X (minimum)	104.981 mm (4.1331 in.)
Piston major diameter, Class II (maximum)	104.993 mm (4.1336 in.)
Piston major diameter, Class II (minimum)	104.989 (4.1334 in.)

Table 3-7. Running Clearance

ITEM	DATA
Class I liner with class X piston (maximum)	0.019 mm (0.0007 in.)
Class I liner with class X piston (minimum)	0.000 mm (0.0000 in.)
Class II liner with class X piston (maximum)	0.032 mm (0.0013 in.)
Class II liner with class X piston (minimum)	0.011 mm (0.0004 in.)
Class I liner with class I piston (maximum)	0.023 mm (0.0009 in.)
Class I liner with class I piston (minimum)	0.006 mm (0.0002 in.)
Class II liner with class II piston (maximum)	0.024 mm (0.0009 in.)
Class II liner with class II piston (minimum)	0.007 mm (0.0003 in.)

Table 3-8. Piston to Cylinder Liner Wear

ITEM	REPLACE IF WEAR EXCEEDS
Cylinder liner I.D. bore (freestate)	105.085 mm (4.1372 in.)
Cylinder liner out of round (installed)	0.800 mm (0.0031 in.)
Piston major diameter Class X	104.925 mm (4.1309 in.)
Running clearance	0.080 mm (0.0031 in.)

Table 3-9. Piston Rings

ITEM	REPLACE IF WEAR EXCEEDS
Top ring gap	0.700 mm (0.0276 in.)
2nd ring gap	0.080 mm (0.0315 in.)
Oil control ring gap	1.050 mm (0.0413 in.)
Top ring side clearance	0.102 mm (0.0040 in.)
2nd ring side clearance	0.090 mm (0.0035 in.)

Table 3-10. Crankshaft/Crankcase

ITEM	ALTERNATOR SIDE		CLUTCH SIDE	
	MM	IN	MM	IN
Main bearing journal	Blue			
	Max 55.977	2.20382	Max 55.952	2.20283
	Min 55.971	2.20358	Min 55.946	2.20260
	Green			
	Max 55.984	2.20409	Max 55.959	2.20311
	Min 55.977	2.20382	Min 55.952	2.20283
	Red			
	Max 55.990	2.20433	Max 55.965	2.20334
	Min 55.984	2.20410	Min 55.959	2.20312
Main bearing bore	Max 61.019	2.40232		
	Min 61.000	2.40158		
Running clearance	Blue			
	Max 0.059	0.00232	Max 0.059	0.00232
	Min 0.026	0.00103	Min 0.026	0.00103
	Green			
	Max 0.061	0.00240	Max 0.061	0.00240
	Min 0.027	0.00107	Min 0.027	0.00107
	Red			
	Max 0.062	0.00244	Max 0.062	0.00244
	Min 0.029	0.00115	Min 0.029	0.00115
Axial end play	Max 0.060	0.00236		
	Min 0.050	0.00197		

GENERAL

Wear limits are given here as a guideline for measuring used engine components. Replace components when they exceed values listed here.

Table 3-11. Crankshaft/Crankcase

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Main bearing journal	55.940	2.202
Axial end play	0.300	0.011
Main bearing bore	61.019	2.4023

Table 3-12. Connecting Rod/Piston

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Small end bore diameter	22.050	0.868
Piston pin diameter	21.996	0.866

Table 3-13. Connecting Rod/Crankshaft

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Rod bearing journal	47.970	1.888
Rod bearing bore	51.616	2.0321

Table 3-14. Piston/Cylinder Liner

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Cylinder liner i. d. bore (freestate)	100.085	3.9403
Cylinder liner out-of-round (installed)	0.080	0.0031
Piston major diameter Class X	99.925	3.9341
Running clearance	0.080	0.0031

Table 3-15. Piston Rings

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Top ring gap	0.700	0.0276
2nd ring gap	0.750	0.0295
Oil control ring gap	1.050	0.0413
Top ring side clearance	0.100	0.0039
2nd ring side clearance	0.070	0.0028

Table 3-16. Cylinder Heads

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Cylinder head flatness	0.100	0.0039
Cylinder head cam bore diameter	26.035	1.0250
Tappet bucket o.d. diameter	30.962	1.2190
Cylinder head bucket bore diameter	31.040	1.2220
Valve guide i.d. diameter	6.040	0.2378
Valve stem deflection	0.08	0.00315
Valve seat width - intake	1.700	0.0669
Valve seat width - exhaust	2.00	0.0787
Valve seat-to-guide runout	0.080	0.0031

PISTON PIN 3.3

GENERAL

A special Piston Pin Removal and Installation Tool (Part No. HD-47189) is required to remove and install the piston to the connecting rod assembly for the VRSCSE2. Please refer to the tool instruction sheet for this procedure.

The HD-47189 Piston Pin Clip Installer ensures proper installation of the piston pin clip used to retain the piston pin on all VRSC engines.

NOTE

Piston shown is removed from connecting rod for photo clarity.

PROCEDURE

1. Disassemble engine per procedure in appropriate service manual.

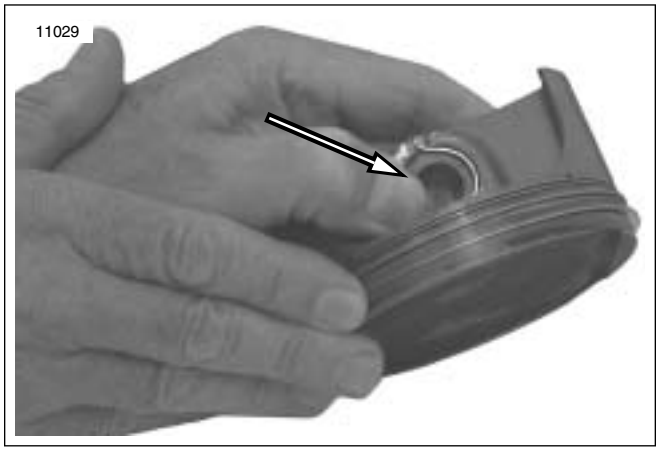


Figure 3-1. Piston Pin Clip Hook (piston removed from connecting rod for photo clarity)

2. See Figure 3-1. With piston installed on connecting rod and piston pin inserted to retain piston, insert new piston pin clip.

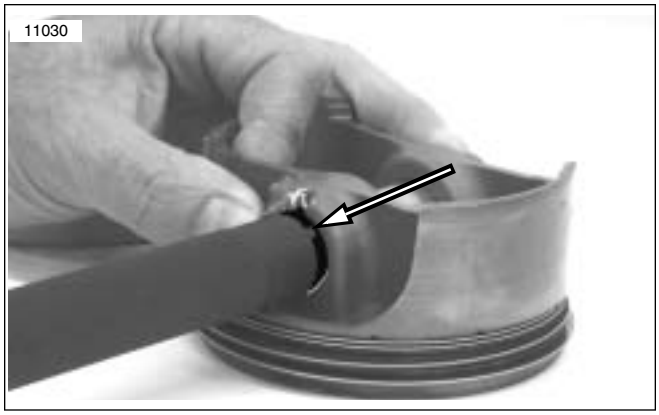


Figure 3-2. Insert Piston Pin Clip Installer with Tab Upward

3. See Figure 3-2. Insert piston pin clip installer into wrist pin. and match tab on tool with hooked portion of piston pin clip.
4. See Figure 3-3. Push inward on piston pin clip installer while turning tool CLOCKWISE to properly install and seat piston pin clip.

Figure 3-3. Piston Pin Clip Installed and Seated

5. Repeat for other piston pin clip.

CAUTION

Failure to install piston pin clip properly can result in severe engine damage.

6. Verify that piston pin clips have seated properly on both sides of piston before installing piston and rod into engine assembly.

CRANKSHAFT 3.4

GENERAL

A special Crankshaft Lifting Tool (Part No. HD-47180) is required to replace lower end bearings without top end teardown of engine.

The HD-47180 Crankshaft Lifting Tool is used to replace the bottom end crankshaft main bearing shells on VRSC engines without requiring top end engine disassembly. Use this tool according to specifications contained in the appropriate Service Manual for your model motorcycle.

PROCEDURE

1. Prepare engine per procedure in appropriate service manual and mount engine to a suitable engine stand.

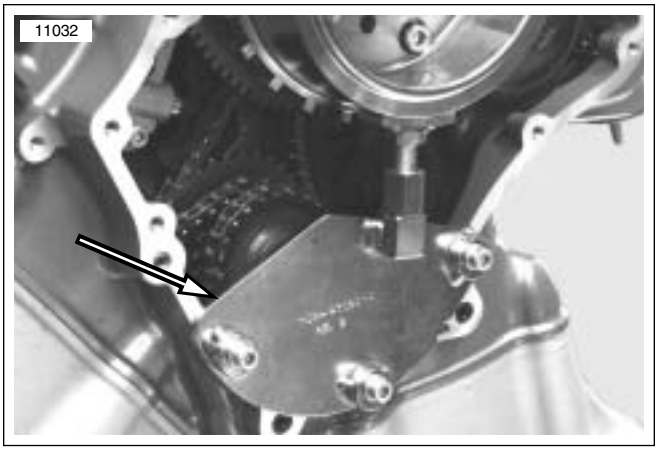


Figure 3-4. Install Large Plate of Tool to Cam Drive Side of Engine

2. See Figure 3-4. Install large plate to engine casting using existing side cover bolts and finger tighten.

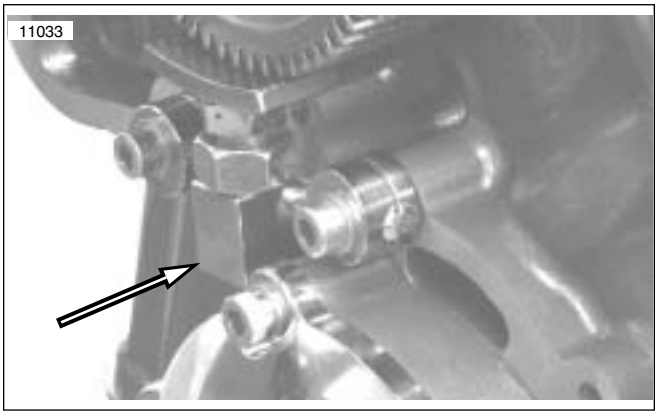
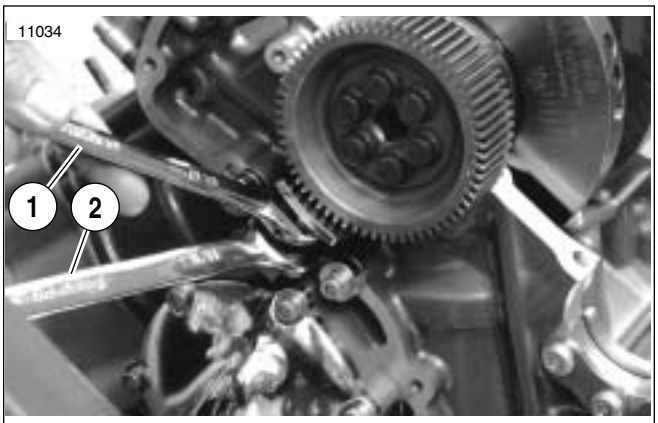


Figure 3-5. Install Small Plate of Tool to Water Pump Side of Engine

3. See Figure 3-5. Install small plate to engine casting using existing side cover bolts and finger tighten.

NOTE

Lift both sides of crankshaft as evenly as possible to avoid damaging the rotating assembly inside the engine.



1. 5/8 Inch Combination Wrench
2. 11/16 Inch Combination Wrench

Figure 3-6. Adjust Tool to Lift Crankshaft

4. See Figure 3-6. Using two box end wrenches, use one to hold tool stationary and the other to adjust tool to lift crankshaft.
5. When crankshaft has been lifted with sufficient clearance, remove crankshaft main bearings according to procedure in appropriate VRSC Service Manual.
6. When bearing have been replaced, assembly engine according to procedure in appropriate VRSC Service Manual.

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FUEL SYSTEM 4

NOTE

This section provides information unique to VRSCSE2 model motorcycles. Any information not presented in this supplement can be found in the VRSC Models Service Manual.

ELECTRIC STARTER 5

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NOTE

This section provides information unique to VRSCSE2 model motorcycles. Any information not presented in this supplement can be found in the VRSC Models Service Manual.

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NOTE

This section provides information unique to VRSCSE2 model motorcycles. Any information not presented in this supplement can be found in the VRSC Models Service Manual.

DRIVE 6

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NOTE

This section provides information unique to VRSCSE2 model motorcycles. Any information not presented in this supplement can be found in the VRSC Models Service Manual.

TRANSMISSION 7

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SUBJECT **PAGE NO.**

NOTE

This section provides information unique to VRSCSE2 model motorcycles. Any information not presented in this supplement can be found in the VRSC Models Service Manual.

ELECTRICAL 8

SPECIFICATIONS 8.1

Table 8-1. Spark Specifications

IGNITION	DATA
Idle speed	1300 RPM
Spark plug size	12 mm
Spark plug gap	0.035 in
	0.89 mm
Spark plug type	Harley-Davidson No. 10R12A (no substitute)
Ignition coil primary resistance at room temperature	0.3-0.5 ohms
Ignition coil secondary resistance at room temperature	3500-4500 ohms

Table 8-2. Circuit Breaker/Fuse Specifications

ITEM	RATING (AMPERES)
Main fuse	40
Ignition fuse	15
Lighting fuse	15
Accessory fuse	15
Battery fuse	15
Security fuse	15
ECM power fuse	15
Fuel pump fuse	15

NOTE

The fuse labeled Security provides basic turn signal functionality on vehicles without a factory-installed security system. Do not remove this fuse or use it as a replacement fuse for other systems.

Table 8-3. Charging Specifications

ITEM	DATA
Battery	12 amp hour/200 CCA
Alternator AC voltage output	16-22 VAC per 1000 RPM
Alternator stator coil resistance	0.1-0.3 ohms
Regulator voltage output @ 3600 RPM	14.4-14.6 volts
Regulator amperes @ 3600 RPM	30-35 amps

TORQUE VALUES 8.2

ITEM	TORQUE		NOTES
Rear view mirror acorn nuts	60-96 **in-lbs**	6.8-10.8 Nm	page 8-3
Turn signal housings setscrew	50-60 **in-lbs**	5.7-6.8 Nm	page 8-3
Switch housings	35-45 **in-lbs**	4-5 Nm	page 8-4
Tach can fastener	10-20 **in-lbs**	1.2-2.2 Nm	page 8-11

FRONT TURN SIGNALS 8.3

BULB REPLACEMENT

NOTE

The same procedure applies to the rear turn signals for bulb replacement.

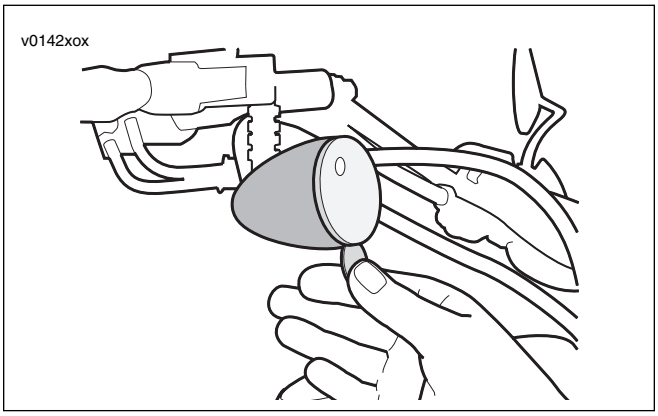


Figure 8-1. Latch Slot

1. See Figure 8-1. Locate latch slot on circumference of turn signal lens. Press in with small screw driver or coin to remove lens.
2. Push bulb in and rotate 1/4 turn counterclockwise to remove.
3. Inspect contacts in socket. If necessary, clean contacts with a small wire brush and electrical contact cleaner.
4. Evenly apply dielectric grease to the contacts and bottom of the **new** bulb.
5. Push and rotate **new** bulb clockwise into socket.
6. Snap-in and rotate turn signal lens to position latch slot on bottom.

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

1. Remove Maxi-Fuse.
2. See Figure 8-2. Remove setscrews (1) from turn signal brackets (3, 11).
3. Loosen jam nuts (8).
4. Use a ball Allen wrench to remove ball studs (2).
5. Remove acorn nut (10), lock washer, and left rear view mirror with washer. Discard lockwasher.
6. Remove acorn nut (10), lock washer, and right rear view mirror with washer. Discard lockwasher.
7. Separate the control housings from the clutch and brake lever brackets.
8. Cut the turn signal lamp wires at the exit from the housing. Remove the turn signal bullet housings.

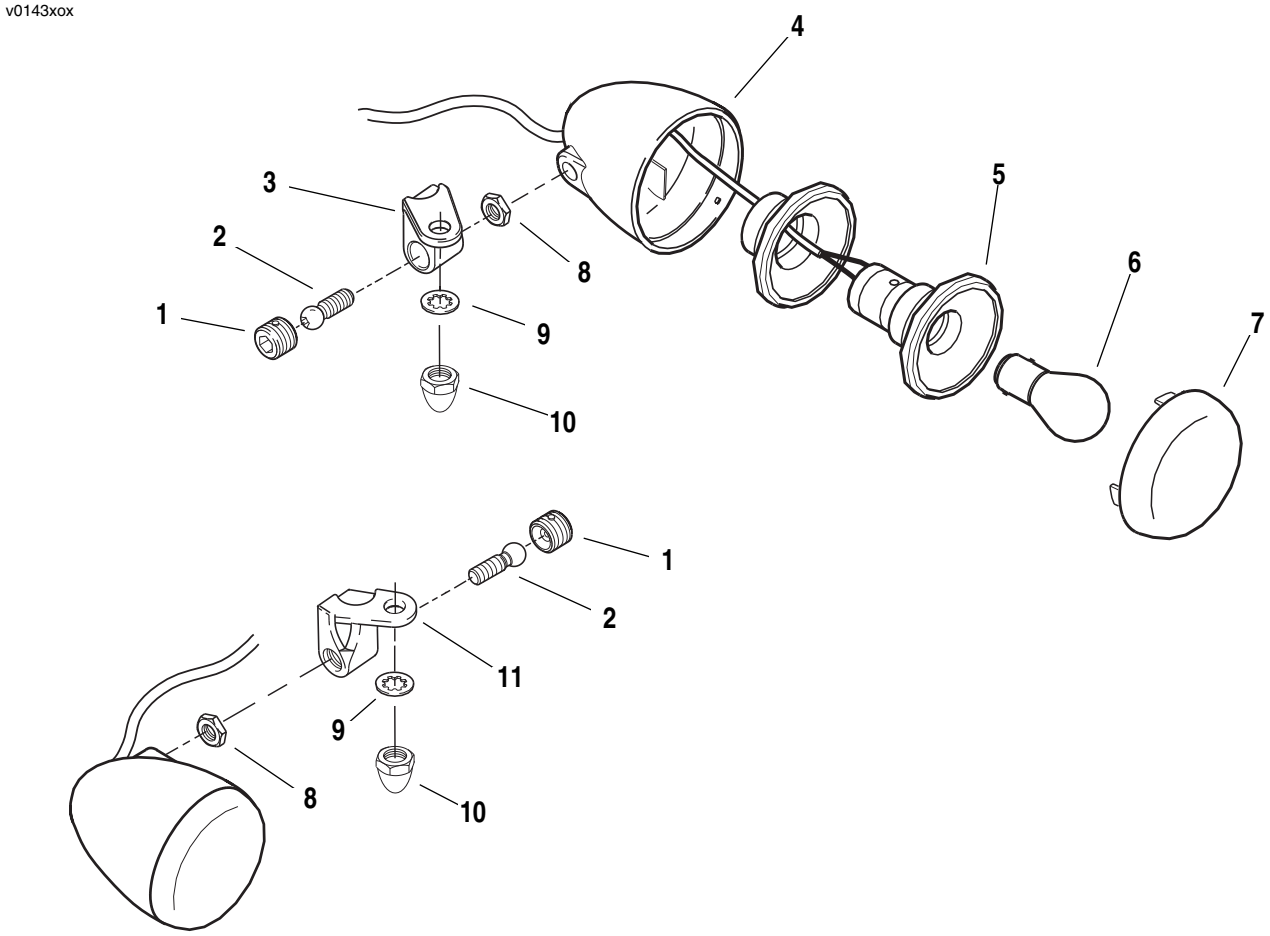
INSTALLATION

1. See Figure 8-2. Trim back the conduit and strip 1/2 in. (12.7 mm) off the turn signal lamp wires from the handlebars grommet inside the control housings.
2. Strip 1/2 in. (12.7 mm) of insulation off wires of the **new** turn signal bullet housing assemblies (9) and thread them through into grommets in control housings.
3. Slide shrink tubing over wires. Twist matching wire colors, solder and heat shrink tubing over each separate splice. See GENERAL REPAIR PROCEDURES under HANDLEBAR SWITCHES in Touring Models Service Manual.
4. Loosely install housings over lever brackets and clamp.
5. Install right front turn signal:
   a. Assemble right turn signal bracket (11) to mirror and small washer with **new** lock washer (9) and acorn nut (10).
   b. Install ball stud (2) through thru signal bracket (11) from inboard side.
   c. Thread on jam nut (8) all the way onto ball stud (2).
   d. Thread ball stud (2) into bullet housing (4).
   e. Finger tighten jam nut (8) against bullet housing (4).
   f. Install but do not tighten setscrew (1) into bracket (11).
6. Install left front turn signal:
   a. Assemble left turn signal bracket (3) to mirror and small washer with **new** lock washer (9) and acorn nut (10).
   b. Install ball stud (2) through thru signal bracket (11) from inboard side.
   c. Thread on jam nut (8) all the way onto ball stud (2).
   d. Thread ball stud (2) into bullet housing (4).
   e. Finger tighten jam nut (8) against bullet housing (4).
   f. Install but do not tighten setscrew (1) into bracket (11).
7. With motorcycle upright with front fork pointed straight ahead, adjust mirrors to clearly reflect area behind motorcycle.

NOTE

Adjust mirrors so a small portion of the rider's shoulder is visible in each mirror. This visually establishes the distance of vehicles to the rear of the motorcycle.

8. Tighten acorn nuts (10) to 60-96 **in-lbs** (6.8-10.8 Nm).
9. Position turn signal housings (4) to point lenses straight ahead. Tighten each setscrew (1) to 50-60 **in-lbs** (5.7-6.8 Nm).



1. **Setscrew**
2. **Ball stud**
3. **Left turn signal bracket**
4. **Bullet housing**
5. **Socket**
6. **Bulb**
7. **Lens**
8. **Jam nut**
9. **Lock washer**
10. **Acorn nut**
11. **Right turn signal bracket**

Figure 8-2. Front Turn Signal Lamp Assembly

NOTE

After setscrew is tightened, it is not necessary, nor desirable, to completely remove setscrew to adjust housing. Loosen setscrew 1/8 turn, adjust housing and tighten setscrew to 50-60 ***in-lbs*** *(5.7-6.8 Nm). Nylon lock pellet on setscrew maintains locking ability after many adjustments. If set screw is completely removed, replace.*

10. Hold each bullet housing and tighten jam nut (8).
11. Adjust the wire conduits inside and outside the housings to avoid pinching the wires. Tighten the housing fasteners to 35-45 **in-lbs** (4-5 Nm).
12. Install Maxi-Fuse.
13. Test handlebar switches to make sure turn signals are functioning properly and wiring is not pinched.

REAR TURN SIGNALS 8.4

BULB REPLACEMENT

1. Locate latch slot on circumference of turn signal lens. Press in with small screw driver or coin to remove lens.
2. Push bulb in and rotate 1/4 turn counterclockwise to remove.
3. Inspect contacts in socket. If necessary, clean contacts with a small wire brush and electrical contact cleaner.
4. Evenly apply dielectric grease to the contacts and bottom of the **new** bulb.
5. Push and rotate **new** bulb clockwise into socket.
6. Snap-in and rotate turn signal lens to position latch slot on bottom.

REMOVAL

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

1. Remove Maxi-Fuse.

NOTE

Before removing turn signal wires, carefully note routing and location of each wire terminal in connector.

2. Remove rear tail lamp housing from rear fender. Locate appropriate rear turn signal harness and connector inside tail lamp housing recess in rear fender.
3. See Figure 8-3. Disconnect socket harness connector from main wiring harness on motorcycle.
4. Support turn signal assembly and remove screw (8) and washer (7).
5. Remove turn signal assembly from motorcycle.

INSTALLATION

1. Install **new** turn signal assembly, routing wiring harness connector back through holes in fender
2. Insert terminals into turn signal connector in main wiring harness and mate harness connectors.
3. Install rear turn signal assembly to rear fender. Insert screw and washer and tighten.
4. Install tail lamp assembly into rear fender.
5. Install Maxi-Fuse.
6. Test handlebar switches to make sure turn signals are functioning properly and wiring is not pinched.

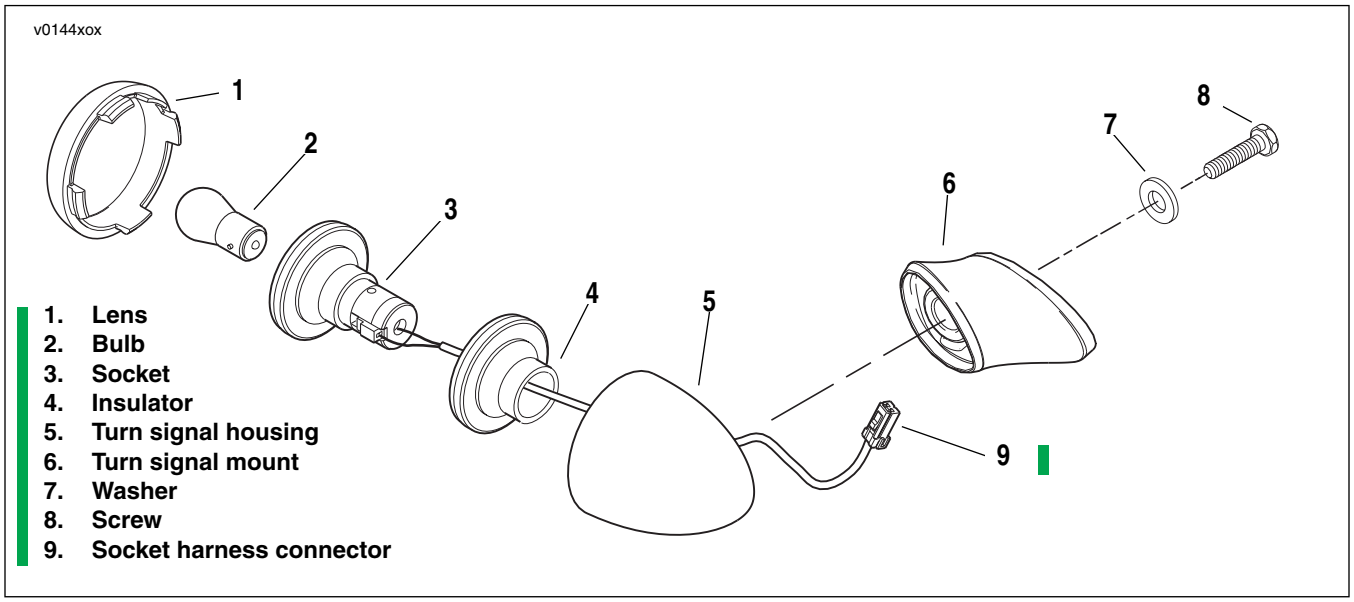


Figure 8-3. Rear Turn Signal Assembly

HANDLEBAR WIRING 8.5

PULLING WIRE LEADS

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

1. Remove maxi-fuse.
2. Remove air box cover.
3. If replacing handlebars, remove handlebars with wiring harness, switch housings and turn signal and carry to workbench. See 2.15 HANDLEBARS. Otherwise handlebars can be left on motorcycle for this procedure.

Figure 8-4. Harness Connectors

4. See Figure 8-4. Remove left side cover and disconnect harness connectors.

Figure 8-5.

5. Remove inner riser cover and cut tie-wraps.

NOTE

Take note of conduit routing and location of cable wraps for assembly.

NOTE

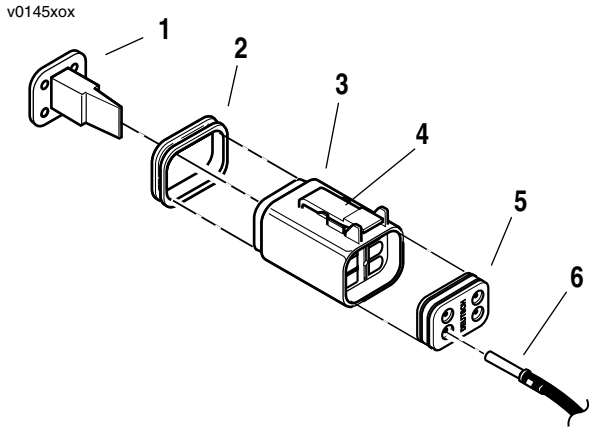
The turn signal wires enter the switch housings through a relief grommet in the housing. The turn signal bullets must be supported throughout this procedure to prevent pulling the grommet or the turn sign wires out of the housing.

6. Remove hand control brackets and switch housings. See HANDGRIPS AND HAND CONTROLS in appropriate VRSC Service Manual.

NOTE

Protect chrome and painted surfaces and tie hand control brackets, cables, and brake lines out of the way.

7. Identify wire leads and remove socket side housings from socket terminal wires (left hand control connector [24], right hand control connector [22]).
   a. See Figure 8-6. Use a screw driver to pry out the locking wedges (1). See DEUTSCH ELECTRICAL CONNECTORS in VRSC Models Service Manual.
   b. See Figure 8-7. Depress internal terminal latches and pull socket terminals out of the wire seal.



1. **Locking wedge**
2. **Internal seal**
3. **Socket housing**
4. **External latch**
5. **Wire seal**
6. **Socket terminal**

Figure 8-6. Deutsch Socket Side Connector (4-pin connector illustrated)

8. Remove turn signal lamp multilock connector from socket terminal wires.
   a. See Figure 8-8. Bend back latches to open the secondary lock. See AMP MULTILOCK ELECTRICAL CONNECTORS in VRSC Models Service Manual.
   b. Insert a pick (Snap-on TT600-3) into square half of terminal cavity until it stops.
9. Pivot end of pick away from terminal and gently tug on socket wire until tang is released.
10. Using mechanics wire, neatly wrap the socket terminals and wires with 1 or 2 twists to form leaders for turn signal and headlamp wires
11. String wire along the wire ends. String sufficient wire to pull conduits through handlebars and leave wire in handlebars.
12. Wrap with electrical tape around open end of conduit past the wire sockets to form a leader.

13. Lightly lubricate conduits and tape with glass cleaner then pull the left and right side wiring and conduits from the handgrip ends through the handlebar and handlebar grommets.
14. See Figure 8-9. Leave the wire leader in each handlebar half.

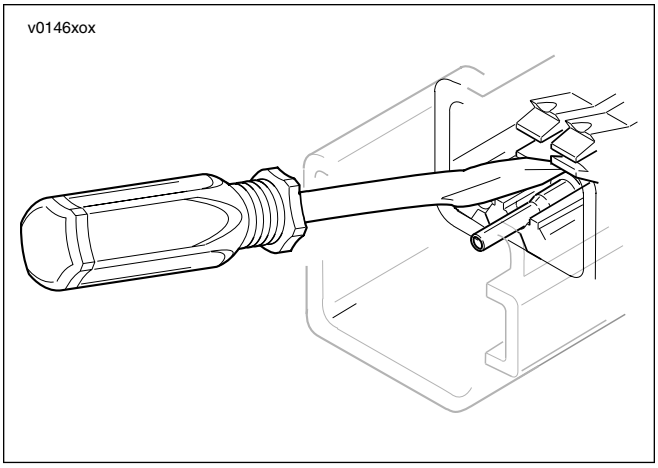
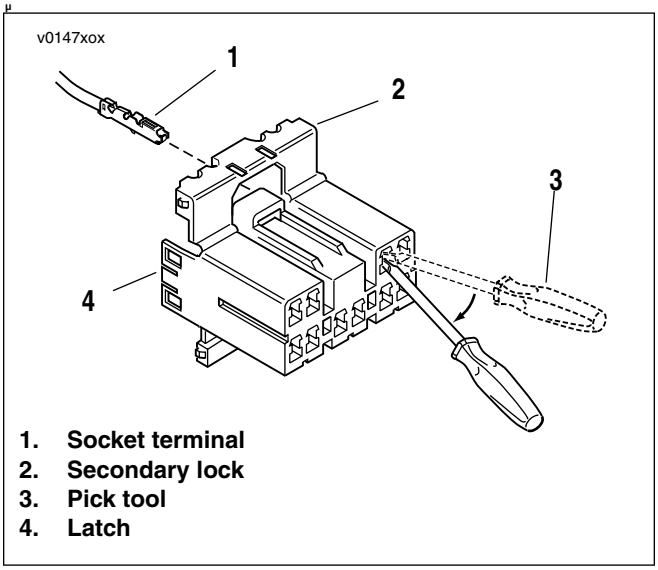


Figure 8-7. Internal Deutsch Terminal Latches



1. **Socket terminal**
2. **Secondary lock**
3. **Pick tool**
4. **Latch**

Figure 8-8. Multilock Socket Terminal Removal

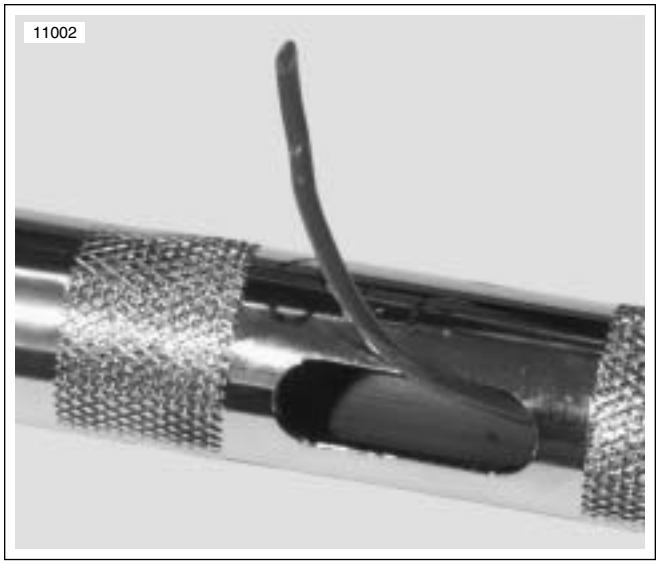


Figure 8-9. Wire Leader in Handlebars (typical) (handlebars removed from motorcycle)

THREADING WIRE LEADS

1. Repair and replace switch, turn signal, and socket wires and grommets as necessary.

NOTE

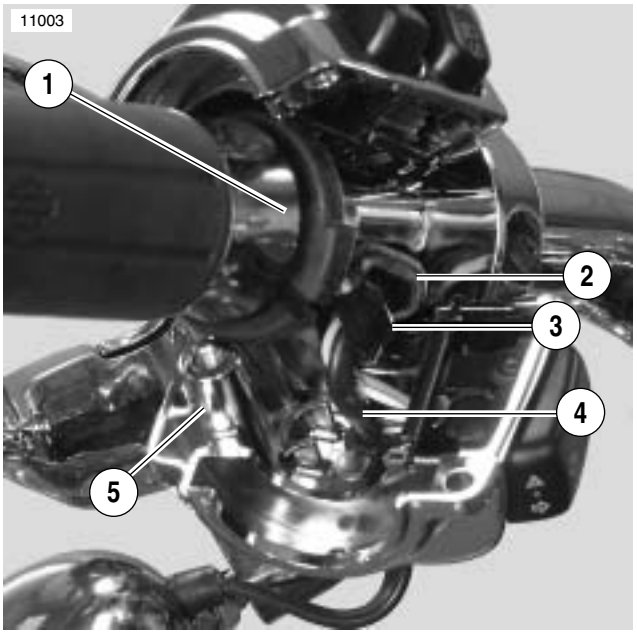
For handlebar switch repair procedures, see HANDLEBAR SWITCHES in VRSC Models Service Manual.

2. Using mechanics wire, neatly wrap the socket terminals, wires and conduits with a few twists to form leaders for turn signal wires.
3. String wire along the wires. String sufficient wire to pull conduits through handlebars.
4. Wrap socket wires with electrical tape and wrap open ends of conduit.

⚠WARNING

Grommets in each of the wiring holes in the handlebar must in position after routing the wiring through the handlebar. Operation without the grommets in place can damage wires, causing a short circuit which could result in death or serious injury. (00416c)

5. If necessary, replace grommets on handlebars wire openings.
6. Lubricate wire conduits with isopropyl alcohol.
7. Thread the wire leaders through the handlebar grommets to the center hole.
8. Pull wire bundles through hand grip grommets to the handlebars center hole.
9. Orient wires in housings.
10. Loosely install left and right switch housings.
11. Final pull wire leaders and unwrap the tape and mechanics wire.
12. Fit wire seal into back of Deutsch socket housings.
13. Refer to Table 8-4. Insert wire color coded socket terminals into numbered chambers in socket housings:
    a. Hold socket terminal 1 in. (25.4 mm) behind contact barrel.
    b. Gently push socket terminal through hole in wire seal into chamber until it “clicks” in place.



1. **Turn signal switch wires**
2. **Handlebar grommet**
3. **High/low beam and horn wires**
4. **Turn signal lamp wires**
5. **Clamping post**

Figure 8-10. Wiring in Left Hand Control Housing (typical)

Table 8-4. Hand Control Deutsch Connectors

WIRE COLOR	CHAMBER NO.
LH CONTROL CONNECTOR [24]	
Orange/White (O/W)	1
Yellow (Y)	2
Blue (BE)	3
White (W)	4
White/Violet (W/V)	5
Yellow/Black (Y/BK)	6
RH CONTROL CONNECTOR [22]	
Orange/White (O/W)	1
Red/Yellow (R/Y)	2
Grey (GY)	3
White/Black (W/BK)	4
White/Brown (W/BN)	5
Black/Red (BK/R)	6

14. Verify that socket will not back out of chamber. Tug on the wire to confirm that is locked.

NOTE

An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-39965) can be used to install Deutsch pin and socket terminals on bare wires.

15. Install internal seals on lip of socket housings.
16. Snap tapered end of locking wedges into socket housings.

NOTE

If the locking wedge does not snap into position, verify that all terminals are fully seated in the socket housing.

17. Repeat for right [22] and left hand control [24] connectors. See DEUTSCH ELECTRICAL CONNECTORS in VRSC Models Service Manual.
18. Refer to Table 8-5. Insert multilock socket terminals into corresponding numbered chambers of turn signal lamp multilock connector [31A] until it snaps into place. The slot in terminal must face tang in chamber.

Table 8-5. Turn Signal Lamp Multilock [31]

HAND	WIRE COLOR	CHAMBER NO.
Left	Black (BK)	1
	Brown (BN)	2
	Blue (BE)	3
Right	Blue (BE)	4
	Violet (V)	5
	Black (BK)	6

19. Gently tug on wire ends to verify that all terminals are locked.

NOTE

An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-41609) can be used to install multilock socket terminals on bare wires.

20. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.
21. If required, carry handlebars with wiring harness, switch housings and turn signals to motorcycle and install. See 2.15 HANDLEBARS.
22. Replace hand control brackets and switch housings. See HANDLEBAR SWITCH ASSEMBLIES in the appropriate VRSC Service Manual.
23. Push turn signal Deutsch socket side [22, 24] into the pin side housings. Push socket side multilock connector [31A] into pin side [31B].
24. Install cable tie-wraps.
25. Install air box cover.
26. Install maxi-fuse.
27. Install left and right side covers.
28. Test front brake lever for pressure and operation.
29. Turn throttle and idle adjustors out. Test for correct operation. Adjust as required. See THROTTLE CABLES in VRSC Models Service Manual.
30. Test all functions of switches, throttle, brakes and clutch before operating motorcycle.

TACHOMETER 8.6

REMOVAL

1. See Figure 8-11. Loosen and remove fastener at the bottom of tachometer can.

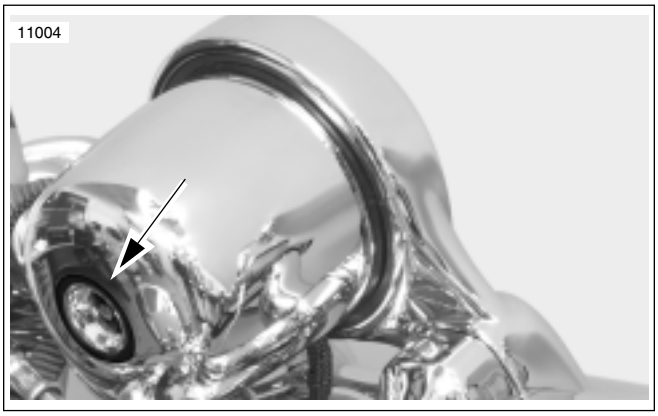


Figure 8-11. Tachometer Can Fastener (typical)

2. Remove tachometer can.
3. See Figure 8-13. Remove wire connectors from terminals (1, 2, 4) on back of tachometer. Save nuts and star washers.
4. Push tachometer out of the top of the tachometer bracket.
5. If replacing tachometer bulb (3), use a flat screwdriver to remove bulb from tachometer.
6. See Figure 8-14. If replacing tachometer wiring, remove wiring from gasket wiring guide (1), cut cable wraps, locate and separate power/ground connector [32] and tachometer signal connector [108]. Remove tachometer wiring.
7. Inspect tachometer gasket. Replace as necessary.

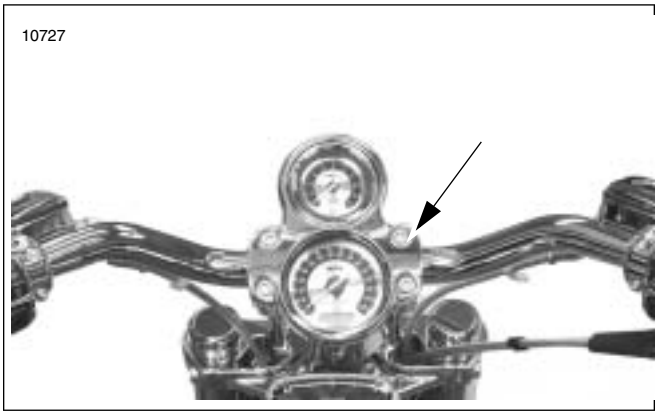
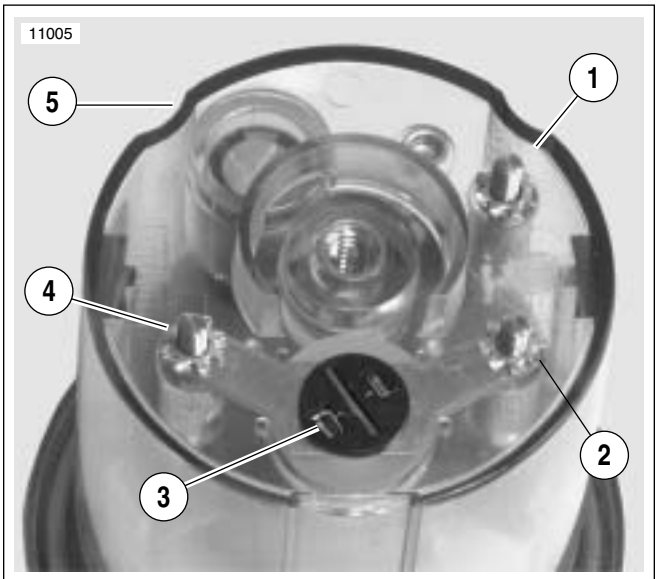


Figure 8-12. Handlebar Clamp/Tachometer Bracket

8. See Figure 8-12. Inspect tachometer bracket.



1. S (signal) terminal
2. G (ground) terminal
3. Tachometer bulb
4. + (power) terminal

Figure 8-13. Tachometer Terminals and Bulb (typical)

1. Wiring guide
2. 1/2 rounds
3. Gasket tab

Figure 8-14. Fitting Tachometer Gasket to Tachometer Bracket (bracket shown removed for photo clarity)

INSTALLATION

1. See Figure 8-13. If necessary, install **new** bulb (3) in tachometer.
2. See Figure 8-14. If necessary, fit **new** rubber tachometer gasket to tachometer bracket with tab (2) in notch (3) at front of bracket.
3. Refer to Table 8-6. If replacing **new** tachometer wiring harness:
   a. Push together socket connector [32B] and pin connector [32A].
   b. Push together tachometer signal connector [108] halves.
   c. Route tachometer wiring to tachometer bracket through frame clips.
   d. Cable wrap wiring.

Table 8-6. Tachometer Wire Connectors

NO.	TYPE	WIRE COLORS	DESCRIPTION
[32]	2-Place Multilock	Orange and white (O/W) Black (BK)	Power/ground
[108]	1-Place AMP	Pink (PK)	Tachometer signal

4. See Figure 8-14. Route tachometer harness wires and braided conduit through wiring guide (1) in tachometer gasket.
5. Orient tachometer face to rider and slide into bracket. Half (1/2) rounds (2) of gasket will fit 1/2 round grooves in tachometer.
6. See Figure 8-13. and refer to Table 8-7. Attach wires to tachometer with star washers and nuts:
   a. **+** terminal (4).
   b. G terminal (2) (star washer on both sides of ground wire connector blade).
   c. S terminal (1).

Table 8-7. Tachometer Connections

WIRE COLOR	TERMINAL	DESCRIPTION
Orange and white (O/W)	+	Power
Black (BK)	G	Ground
Pink (PK)	S	tachometer signal

7. Lubricate gasket with isopropyl alcohol. Fit can slot to tachometer gasket wiring guide and press tachometer can into tachometer gasket until the gasket captures the flare all the way around the circumference of the can opening.
8. Install and tighten fastener to 10-20 **in-lbs** (1.2-2.2 Nm).

SPEEDOMETER 8.7

REMOVAL

1. Remove left side cover and remove maxi-fuse.
2. Remove air box cover.

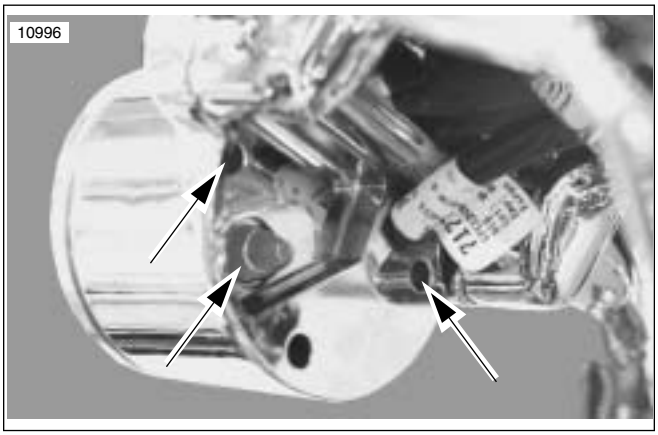


Figure 8-15. Speedometer Fastener and Reset Button Locations

3. See Figure 8-15. Remove screws and unscrew reset button cover from back of speedometer.

Figure 8-16. Inner Riser Cover

4. See Figure 8-16. Remove inner riser cover.
5. Cut tie-wraps holding wiring harnesses together.

Figure 8-17. Remove Speedometer

6. Gently lift pull speedometer from mounting bezel and disconnect wiring harness connector [39] from back of speedometer.

INSTALLATION

1. Connect speedometer wiring harness connector [39] to speedometer.

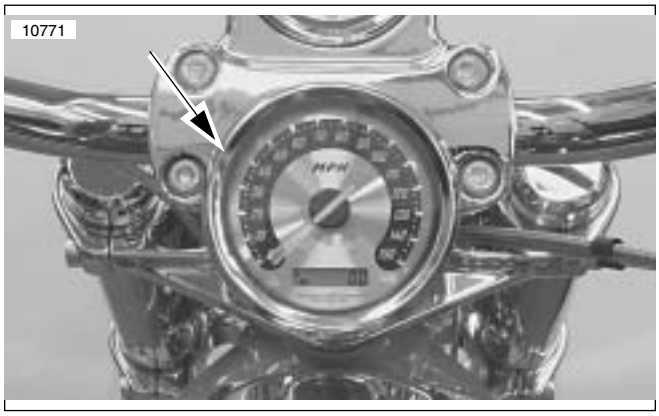


Figure 8-18. Install Speedometer

2. See Figure 8-17. Insert speedometer into mounting bezel.
3. See Figure 8-15. Install screws and reset button cover than tighten mounting screws to 4-6 Nm (35-53 **in-lbs**).
4. Install inner riser cover and tighten fasteners.

CHECK FOR DIAGNOSTIC TROUBLE CODES 8.8

CHECK ENGINE LAMP

To diagnose system problems, start by observing the behavior of the check engine lamp.

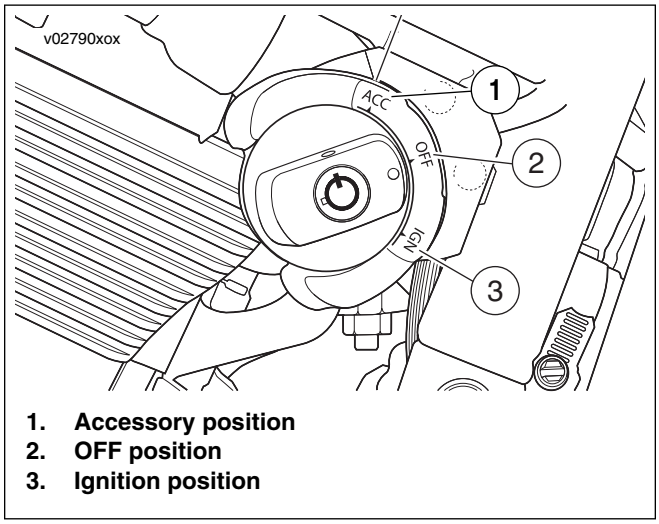
NOTES

See Figure 8-19. "Key ON" means that the ignition key is turned to IGN and the engine stop switch is set to RUN (although the engine is not running).

When ignition key is turned ON, the check engine lamp will illuminate for approximately four seconds and then turn OFF.

If check engine lamp is not illuminated at Key ON, of if it fails to turn OFF after the initial four second period, see 8.25 SPEEDOMETER SELF DIAGNOSTICS.

1. After lamp turns off after being illuminated for the first four second period, one of three situations may occur.
   a. The lamp remains off. This indicates there are no current fault conditions or stored functional trouble codes currently detected by the ECM.
   b. The lamp stays off for only four seconds and then comes back on for an eight second period. This indicates a code is stored, but no current trouble code exists.
   c. If the lamp remains on beyond the eight second period, then a current trouble code exists.
2. See CODE TYPES which follows for a complete description of trouble code formats.



1. **Accessory position**
2. **OFF position**
3. **Ignition position**

Figure 8-19. Ignition Switch

NOTE

Some trouble codes can only be fully diagnosed during actuation. For example, a problem with the ignition coil will be considered a current fault even after the problem is corrected, since the ECM will not know of it's resolution until after the coil is exercised by vehicle start sequence. In this manner, there may sometimes be a false indication of the current trouble code.

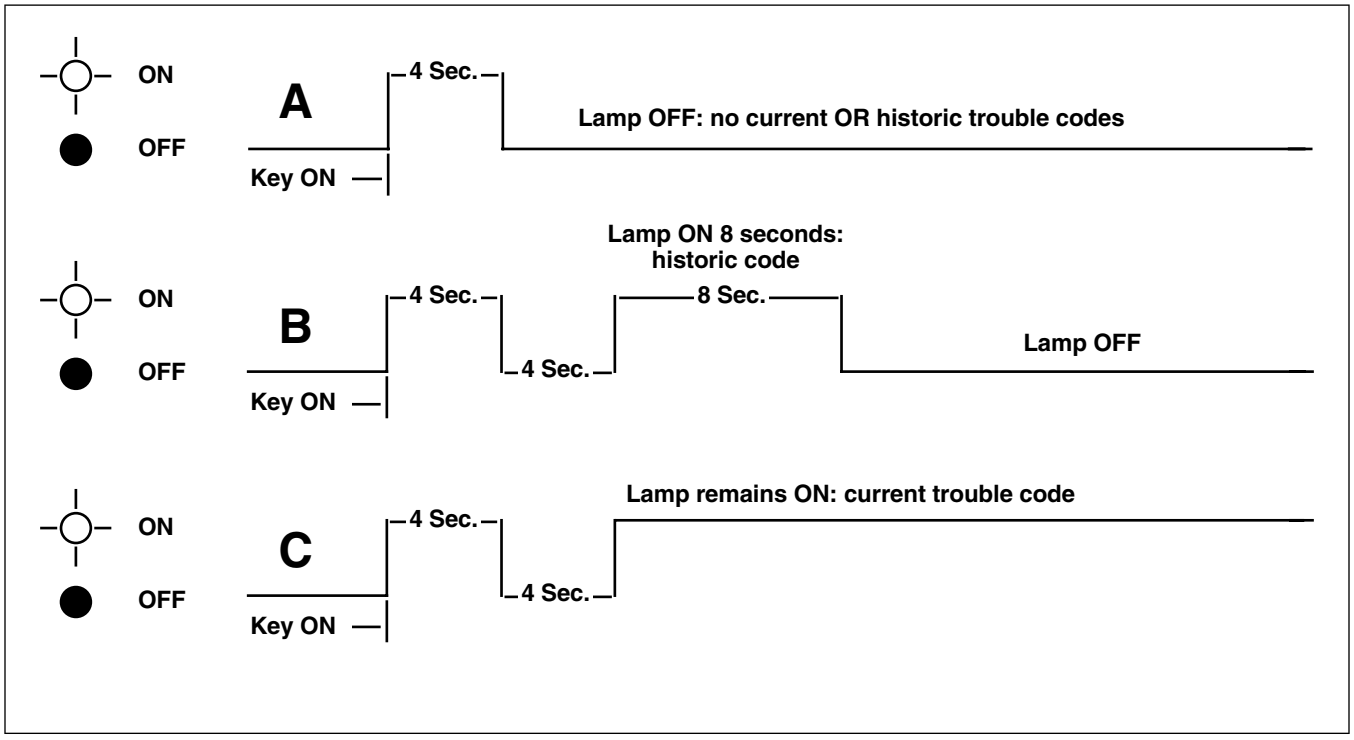


Figure 8-20. Check Engine Lamp Operation

CODE TYPES

There are two types of diagnostic trouble codes (DTC's): Current, and Historic. If a DTC is stored, it can be read using either a a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750) or speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS.

NOTES

To differentiate between current and historic diagnostic codes, a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750) *must be employed.*

All DTC's reside in the memory of the ECM/ICM, TSSM, or speedometer until the DTC is cleared by use of the speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS.

A historic DTC is also cleared after a total of 50 trips has elapsed. A trip consists of a start and run cycle. After the 50 trip retention period, the DTC is automatically erased from memory providing that no subsequent faults of the same type are detected in that period.

Current

Current trouble codes are those which occur during the preset ignition cycle. See the appropriate flow charts for solouations.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic code rather than a current code.

Historic codes are stored for 50 trips to assist in the diagnosis of intermittent faults.

It is important to note that historic codes may also be present whenever the system indicates the existence of a current code. See MULTIPLE TROUBLE CODES if multiple trouble codes are found.

Diagnostic charts are designed for use with current trouble codes and as a result they frequently suggest part replacement. When diagnosing a historic code the charts can be helpful but should not lead to part replacement without verification the part is faulty.

SECURITY LAMP

The security lamp functions in the same manner as the check engine lamp, except that it is controlled by the TSSM. The security lamp will be turned on when codes are present in the TSSM.

RETRIEVING TROUBLE CODES

The speedometer provides two levels of diagnostics.

1. The most sophisticated mode employs a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750).
2. The second mode requires using the speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS.

MULTIPLE TROUBLE CODES

While it is possible for more than one fault to occur and set more than one trouble code, there are several conditions which may result in one fault setting multiple trouble codes:

Serial data codes (DTC U1300, U1301, U1016, U1064, U1097, and U1255) may be accompanied by other codes. Always correct the serial data codes before resolving the other codes.

INITIAL DIAGNOSTIC CHECK: SPEEDOMETER 8.9

GENERAL

Constant power is supplied to the speedometer through terminal 5 of connector [39]. The speedometer turns on when power is applied to terminal 1 of connector [39]. The speedometer goes through an initialization sequence every time power is removed and applied again to terminal 6. The visible part of this sequence is the check engine lamp (in “RUN” mode), security lamp (models with security only), backlighting, odometer and fuel level. Upon key “ON”, the check engine lamp and security lamp will illuminate for 4 seconds and then (if parameters are normal) go out.

To locate faulty circuits or other system problems, follow the diagnostic flow charts in this section. For a systematic approach, always begin with INITIAL DIAGNOSTICS which follows. Read the general information and then work your way through the flow chart box by box.

Loss of power on any of the four power inputs will change speedometer behavior. Refer to Table 8-8.

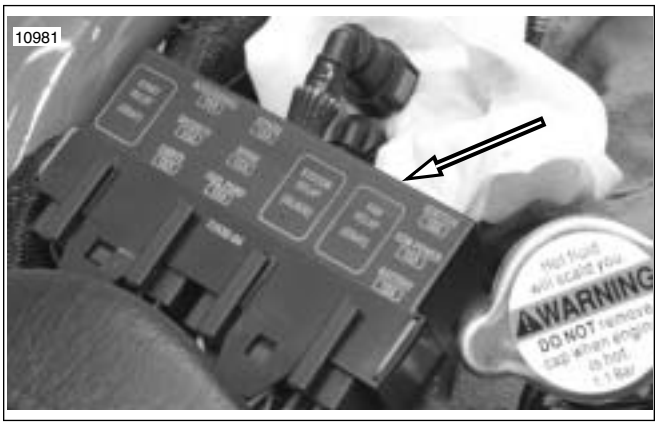


Figure 8-21. Fuse Block Location

Diagnostic Notes

If a numbered circle appears adjacent to a flow chart box, then more information is offered in the diagnostic notes. Many diagnostic notes contain supplemental information, descriptions of various diagnostic tools or references to other parts of the manual where information on the location and removal of components may be obtained.

Circuit Diagram/Wire Harness Connector Table

When working through a flow chart, refer to the illustrations, the associated circuit diagram and the wire harness connector table as necessary. The wire harness connector table for each circuit diagram identifies the connector number, description, type and general location.

In order to perform most diagnostic routines, a Breakout Box and a digital volt/ohmmeter (DVOM) are required. See 8.11 BREAKOUT BOX: SPEEDOMETER.

To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

Reprogramming ECM

Diagnostic charts may suggest ECM replacement. In the event an electronic control module (ECM) needs to be replaced, it must be reprogrammed using a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750). See dealer. Password learn procedure must also be performed. See 8.38 PASSWORD LEARN.

INITIAL DIAGNOSTICS

Diagnostic Tips

If speedometer reads “BUS Er” with the ignition key turned ON (engine stop switch at RUN with engine OFF), check data link connector [91A] terminal 3, ECM connector [78B] terminal 5, TSSM connector [30B] terminal 3 speedometer connector [39B] terminal 2.

Check for an open data test terminal between data link connector [91A] terminal 3 and TSSM connector [30B] terminal 3. With ignition key turned ON, serial data bus voltage should be typically 0.6-0.8 volts. The range of acceptable voltage is greater than 0 and less than 7.0 volts.

To identify intermittants, wiggle instrument and/or vehicle harness while performing steps in the Diagnostic Check charts.

Figure 8-22. Fuses

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the diagnostic check flow charts.

1. Connect BREAKOUT BOX (Part No. HD-42682) between wiring harness connector [39B] and speedometer connector [39A] using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601). See 8.11 BREAKOUT BOX: SPEEDOMETER.

For speedometer diagnostic trouble codes refer to Table 8-9.

Other Diagnostic Trouble Codes (DTC’s)

See 8.24 INITIAL DIAGNOSTIC CHECK: TSSM for any diagnostic trouble codes related to the turn signal security module (TSSM).

See 8.44 INITIAL DIAGNOSTIC CHECK for any diagnostic trouble codes related to the electronic control module (ECM).

Table 8-8. Speedometer Function Chart-Loss Of Input

Terminal 5 (Constant)	Terminal 1 (IGN)	Terminal 6 (ACC)	Terminal 7 (GRD)	Terminal 8 and 11 (Reset Switch)
● Security lamp glows dimly during 4-second bulb check	● Will not “wow” ● Turn signals still functional ● Speedometer will indicate vehicle speed (zero) ● Tachometer unaffected ● Security lamp still functional ● Check engine lamp and battery lamp non-functional ● Diagnostics absent	● Speedometer will be non-functional in accessory and ignition modes ● Security lamp still performs 4-second bulb check in ignition mode	● Speedometer completely non-functional ● Diagnostics absent	● No reset switch function ● Will not “wow”

Table 8-9. Speedometer/Tachometer Diagnostic Trouble Codes (DTC) Priority Chart

DTC	RANKING	FAULT CONDITION	SOLUTION	MODULE
“BUS Er”	1	Serial data bus shorted low/open/high	8.37 DTC U1300, U1301 or “BUS ER”	speedometer
U1300	2	Serial data bus shorted low	8.37 DTC U1300, U1301 or “BUS ER”	speedometer
U1301	3	Serial data bus shorted open/high	8.37 DTC U1300, U1301 or “BUS ER”	speedometer
U1016	4	Loss of ECM serial data	8.15 DTC U1064, U1255 AT SPEEDOMETER	speedometer
U1064	5	Loss of TSSM serial data	8.15 DTC U1064, U1255 AT SPEEDOMETER	speedometer
U1255	6	Missing response from other module (TSSM and/or ECM) at startup	8.67 DTC U1064, U1255 AT ECM	speedometer
B1007	7	Ignition line overvoltage	8.12 DTC B1006, B1007	speedometer
B1006	8	Accessory line overvoltage	8.12 DTC B1006, B1007	speedometer
B1008	9	Reset switch closed	8.13 DTC B1008	speedometer
B1004	10	Fuel level sending unit low	8.48 FUEL SYSTEM ELECTRICAL TEST	speedometer
B1005	11	Fuel level sending unit high/open	8.48 FUEL SYSTEM ELECTRICAL TEST	speedometer

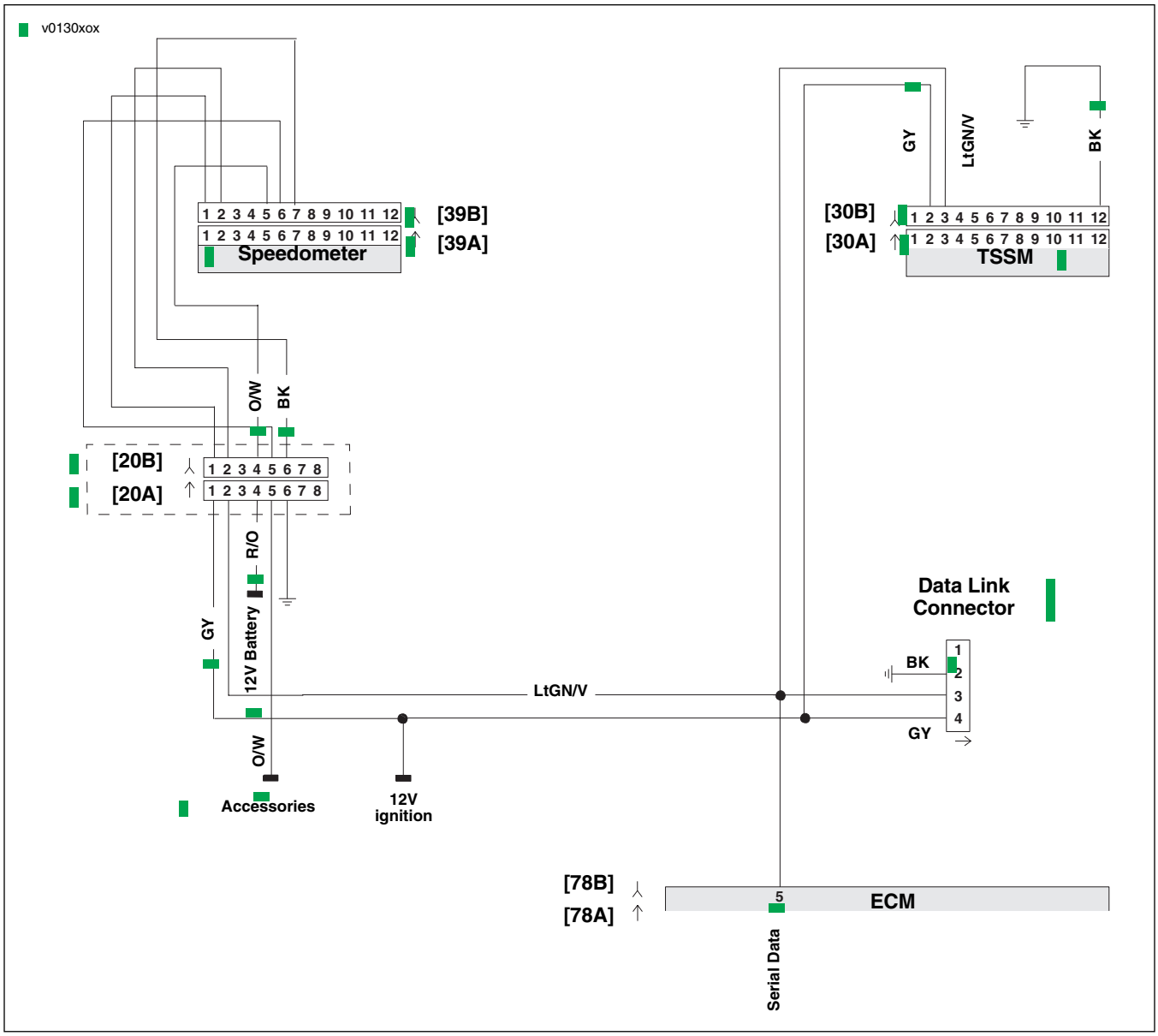
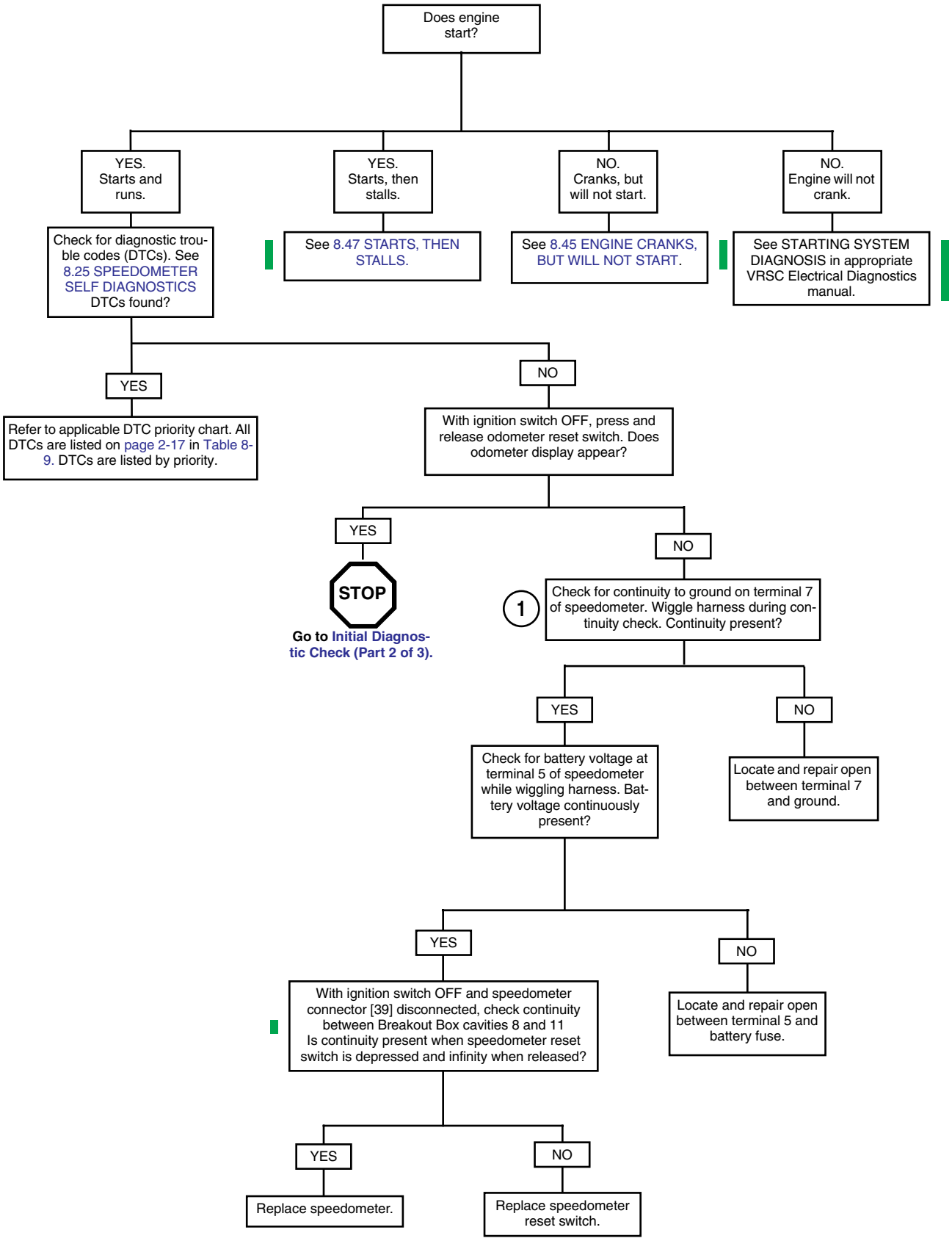


Figure 8-23. Diagnostic Check

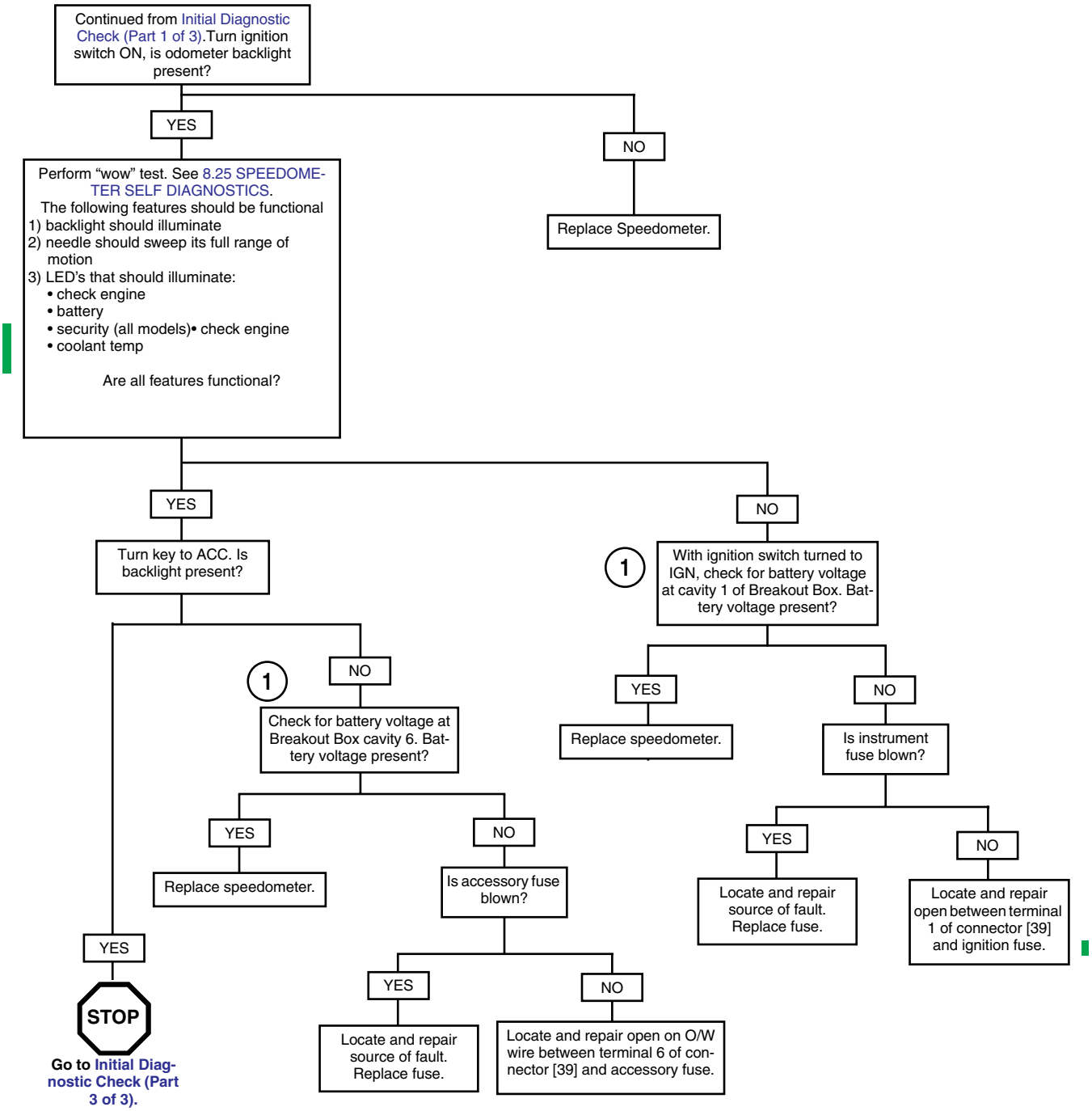
Table 8-10. Wire Harness Connectors in Figure 8-23.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Mini-Deutsch	Under left side cover
[30]	TSSM	12-place Deutsch	Under electrical caddie cover
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

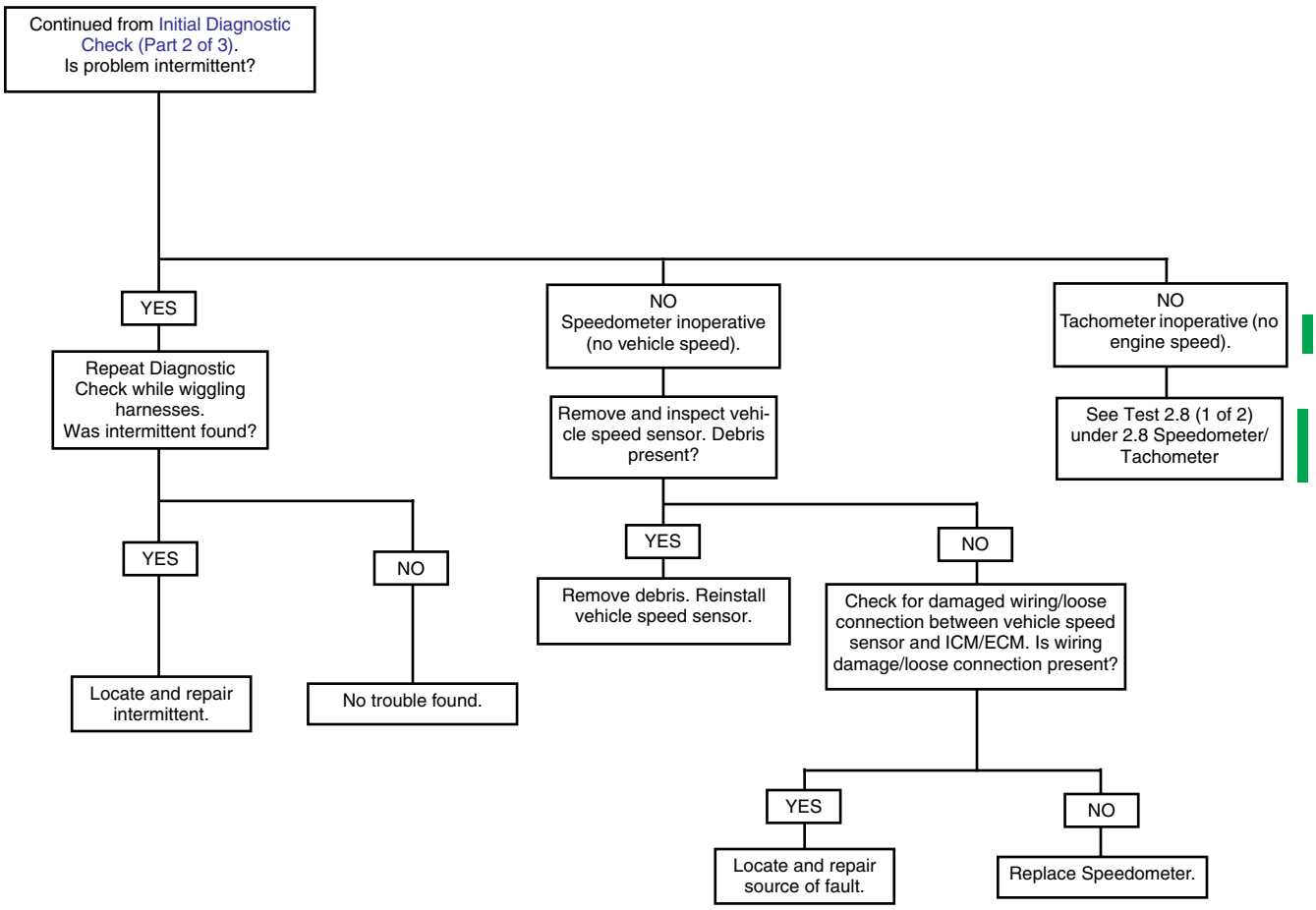
Initial Diagnostic Check (Part 1 of 3)



Initial Diagnostic Check (Part 2 of 3)



Initial Diagnostic Check (Part 3 of 3)



SPEEDOMETER/TACHOMETER 8.10

GENERAL

NOTE

Some icons may illuminate during "wow" test though the icon has no functionality on that vehicle.

The speedometer consists of a speedometer display and several icons. The icons include: check engine, security, battery, low fuel and coolant temp.

Reset Switch

See Figure 8-24. Pressing the odometer reset switch provides the following capabilities:

- Change the odometer display between mileage, trip A and trip B values (press and immediately release).
- Reset an individual trip odometer (press and hold 2-3 seconds).
- Gain access to the diagnostic mode, clear diagnostic trouble codes and exit diagnostic mode. See 8.25 SPEEDOMETER SELF DIAGNOSTICS.
- Display odometer while key is OFF. Press and hold reset switch while key is OFF and odometer mileage will be displayed.
- On models with dual scale speedometers, toggle between miles/kilometers on odometer and trip odometer display. To toggle display, turn key ON. Press and hold reset switch while odometer is displayed. Release switch when change is noted. (If reset switch is held while trip odometer is displayed, trip odometer will reset.)

Figure 8-24. Speedometer

Figure 8-25. Tachometer

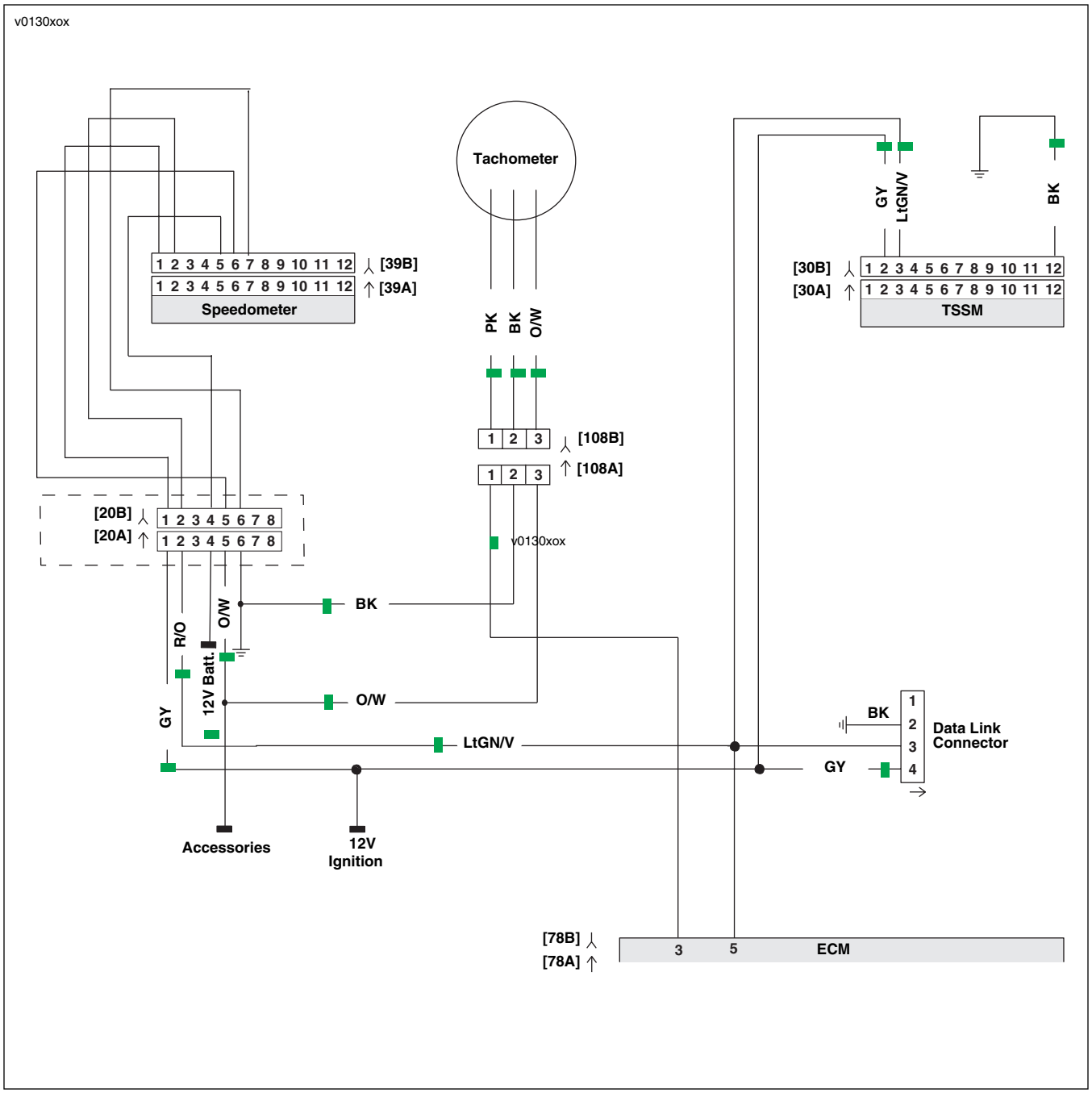


Figure 8-26. Tachometer Circuit

Table 8-11. Wire Harness Connectors in Figure 8-26.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Left Side Cover
[108]	Tachometer	3-place Deutsch-mini	Left Side Cover

SPEEDOMETER THEORY OF OPERATION

The speedometer consists of a vehicle speed sensor, ECM, odometer reset switch and the speedometer. The vehicle speed sensor is mounted on the right side of transmission case below the starter. The sensor circuitry is that of a Hall-Effect sensor that is triggered by the gear teeth of 5th gear on the transmission mainshaft.

The output from the sensor is a series of pulses that are interpreted by ECM circuitry, converted into serial data inside the ECM then sent to the speedometer to control the position of the speedometer needle and the liquid crystal (LCD) odometer display. The vehicle speed serial data is also transmitted to the TSSM for turn signal cancellation.

The odometer mileage is permanently stored and will not be lost when electrical power is turned off or disconnected. The odometer reset switch allows switching between the odometer, trip odometer A and trip odometer B displays.

To zero the trip odometer, have the desired trip odometer display visible, press and keep the reset switch depressed. The trip odometer mileage will be displayed for 2-3 seconds and then the trip mileage will return to zero miles.

The odometer can display six numbers to indicate a maximum of 999999 miles/kilometers. The trip odometers can display six numbers with a tenth of a mile accuracy for a maximum of 99999.9 miles/kilometers.

TACHOMETER THEORY OF OPERATION

The tachometer receives a tach signal from the ECM. The tachometer interprets the signal and converts it into tachometer needle movement.

Any damage to the tachometers PK wire could set a code even if a tachometer is not installed on the vehicle.

NOTE

The system cannot diagnose an open wire. It can only detect a short high or low.

DIAGNOSTICS

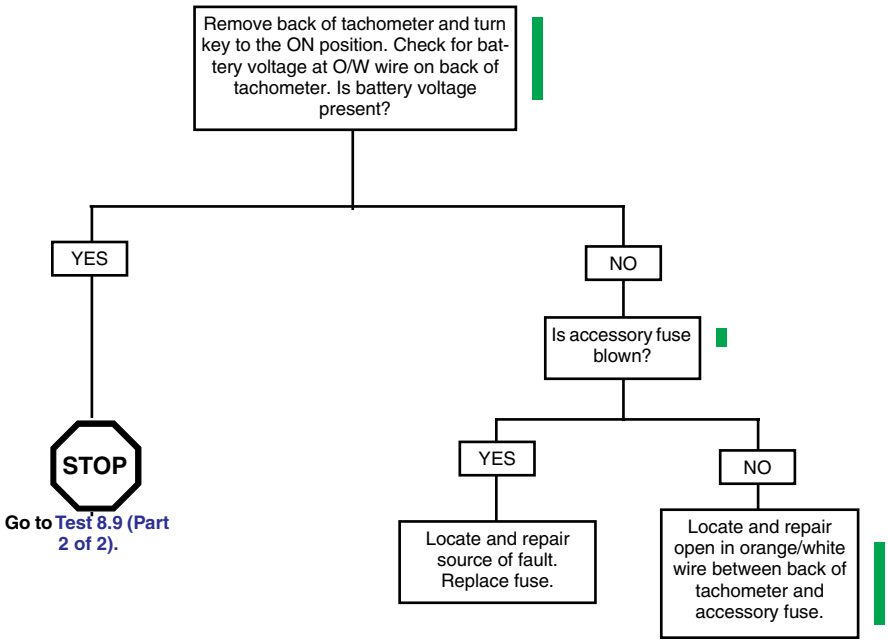
Diagnostic Notes

The reference numbers below correlate with circled numbers on the tachometer diagnostic flow chart.

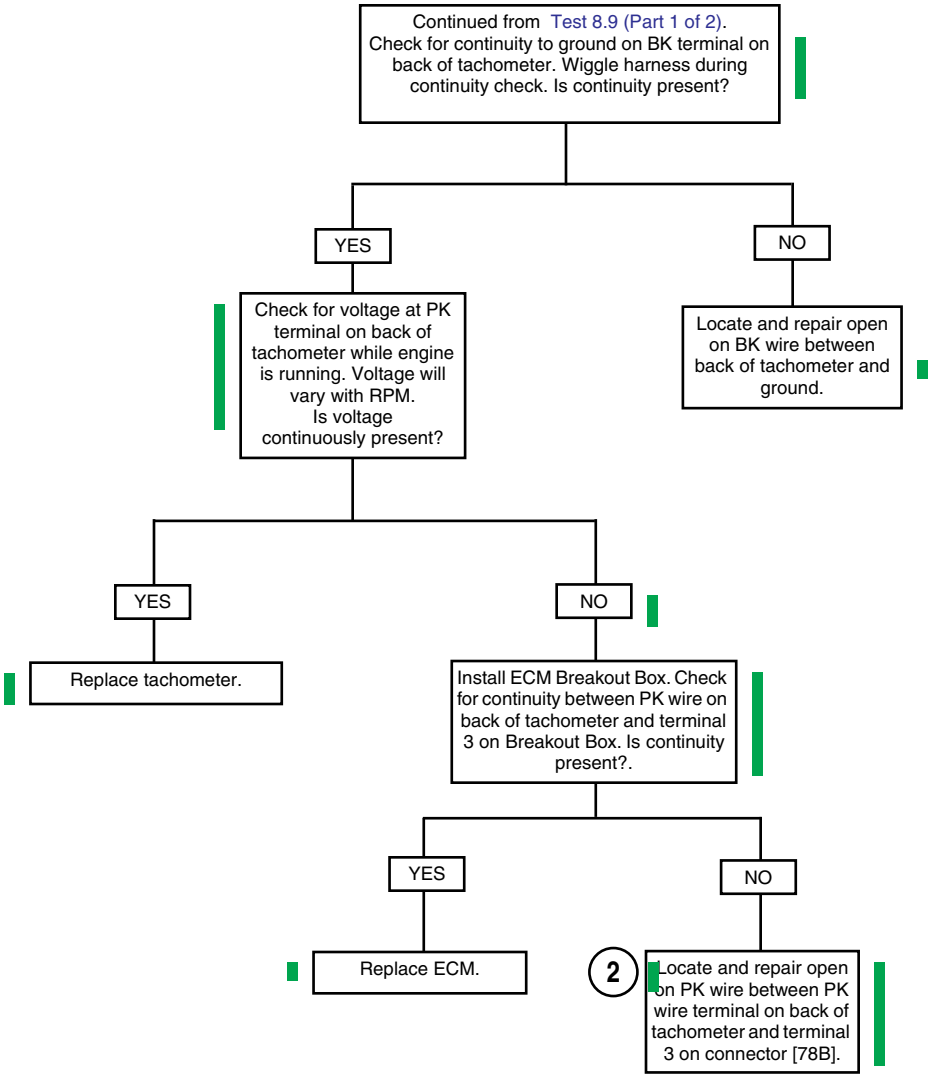
1. If problems are intermittent, wiggle harness while performing tests.
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM.

Test 8.9 (Part 1 of 2)

TACHOMETER INOPERATIVE



Test 8.9 (Part 2 of 2)



BREAKOUT BOX: SPEEDOMETER 8.11

GENERAL

The BREAKOUT BOX (Part No. HD-42682) and INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601) connect to the speedometer connector [39]. Used in conjunction with a digital volt/ohmmeter (DVOM), it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects

NOTE

See wiring diagrams for speedometer terminal functions.

SPEEDOMETER

Installation

1. See Figure 8-27. Bend back the external latches slightly and remove connector [39B].
2. Connect Instrument Harness Adapters to connectors [39A] and [39B].
3. Attach connectors from Breakout Box to Harness Adapters.

Removal

1. Detach connectors from Breakout Box to Harness Adapters.
2. See Figure 8-27. Detach Harness Adapters from connectors [39A] and [39B].
3. Install connector [39B] to speedometer.

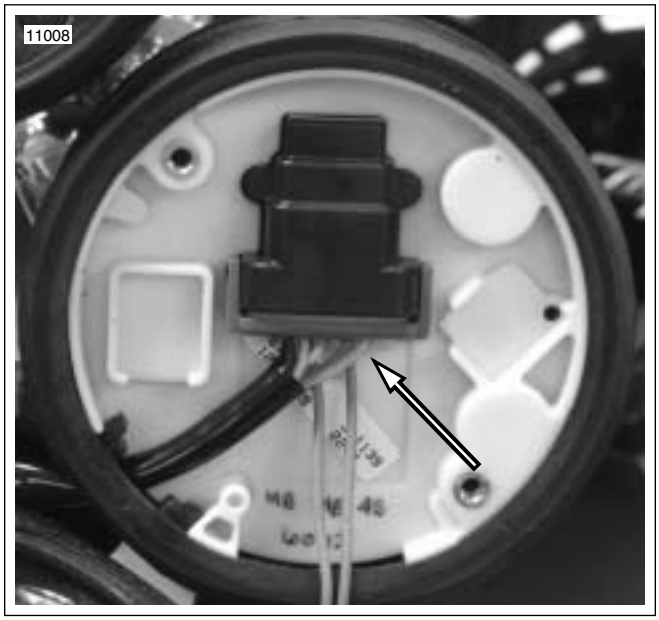


Figure 8-27. Speedometer Connector [39] (typical)

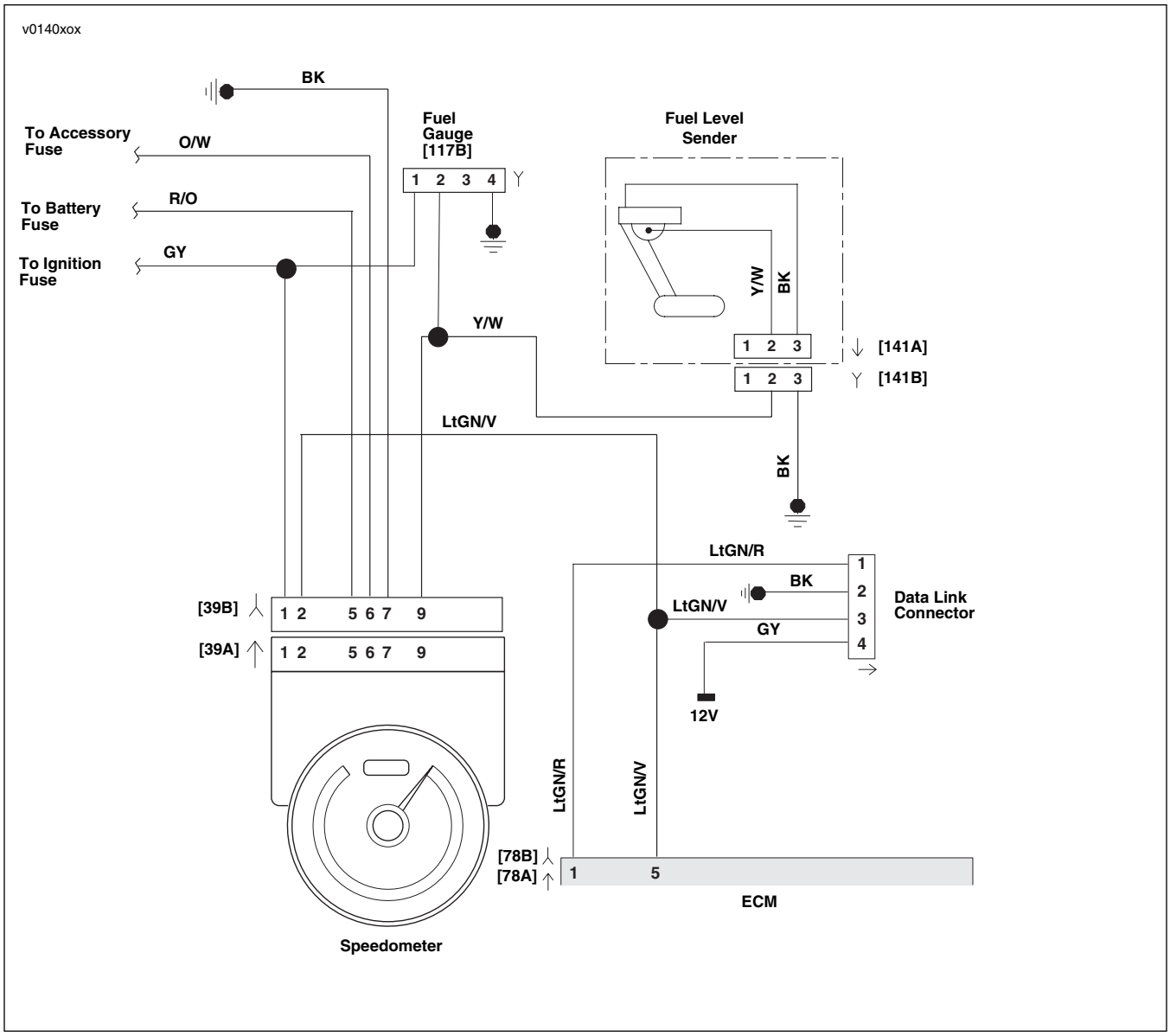


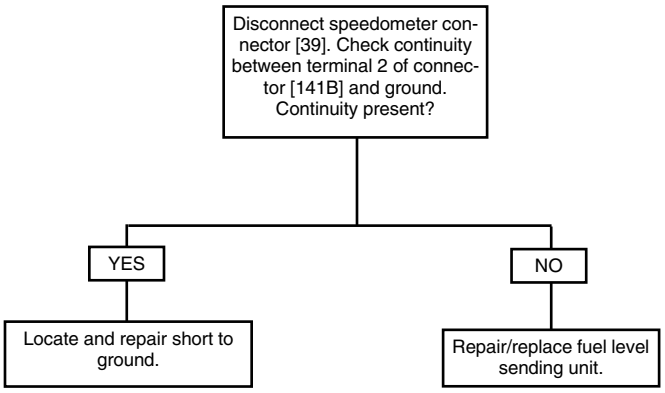
Figure 8-28. Fuel Sender Circuit

Table 8-12. Wire Harness Connectors in Figure 8-28.

NO.	DESCRIPTION	TYPE	LOCATION
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover
[141]	Fuel level sender	3-place Packard	Top of fuel tank

Test 8.10: DTC B1004

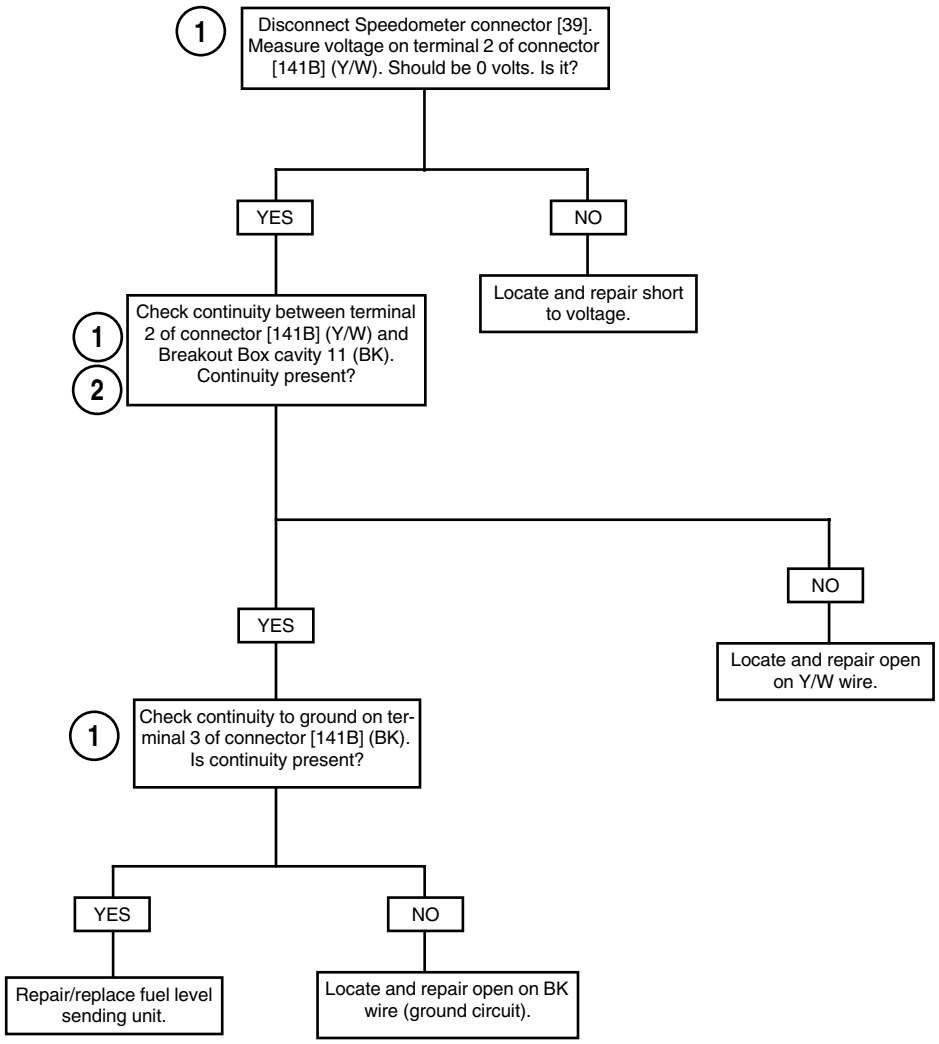
FUEL LEVEL SENDING UNIT



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.10: DTC B1005

FUEL LEVEL SENDING UNIT



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC B1006, B1007 8.12

GENERAL

Accessory Or Ignition Line Over Voltage

Ignition and accessory voltage is constantly monitored by the speedometer (terminal 1-ignition and terminal 6-accessory). If the battery voltage fails to meet normal operating parameters, a diagnostic trouble code is set.

- DTC B1006 is displayed when accessory line voltage is greater than 16.0 volts for longer than 5 seconds.
- DTC B1007 is displayed when ignition line voltage is greater than 16.0 volts for longer than 5 seconds.

NOTE

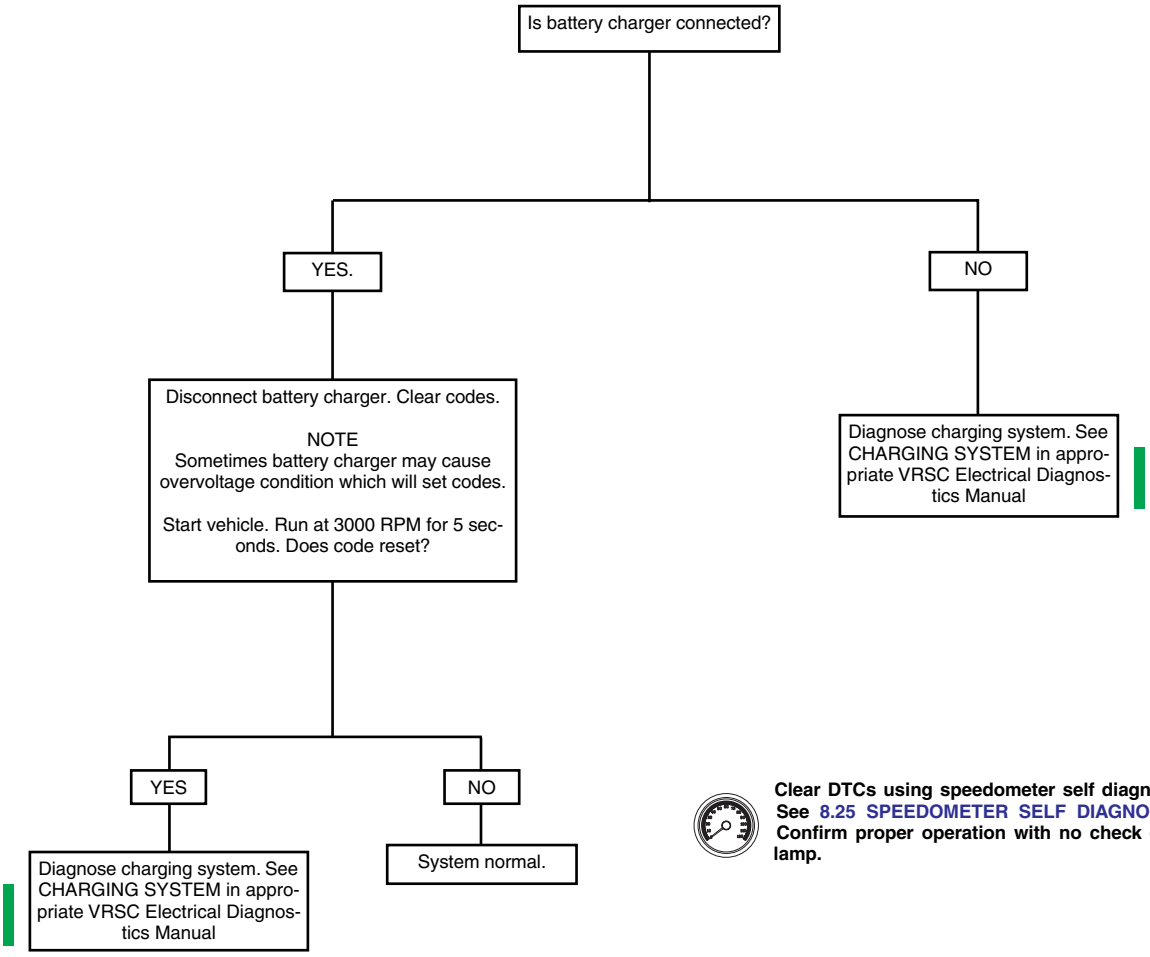
ECM or TSSM may also set a battery voltage diagnostic trouble codes.

Table 8-13. Code Description

DTC	DESCRIPTION
B1006	Accessory line overvoltage
B1007	Ignition line overvoltage

Test 8.11 DTC B1006, B1007

ACCESSORY OR IGNITION LINE OVERVOLTAGE: DTC B1006, B1007



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC B1008 8.13

GENERAL

Reset Switch Closed

DTC B1008 will be set if switch terminals are in a constant shorted state.

Table 8-14. Code Description

DTC	DESCRIPTION
B1008	Reset switch closed

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the flow chart.

1. Connect BREAKOUT BOX (Part No. HD-42682) and ADAPTERS (Part No. HD-41606) between wire harness and speedometer, **leaving speedometer disconnected**.

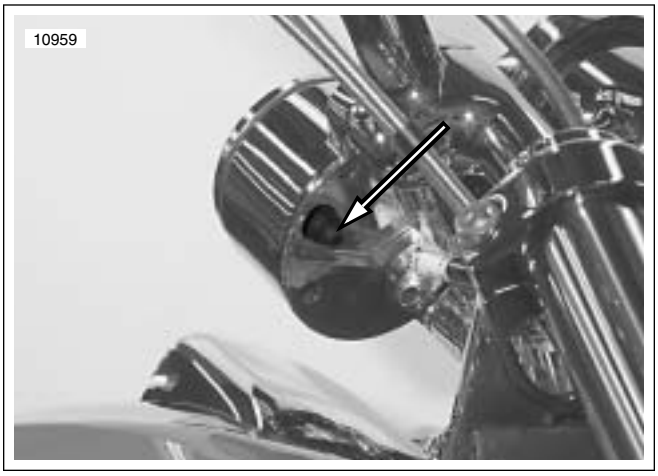


Figure 8-29. Reset Switch

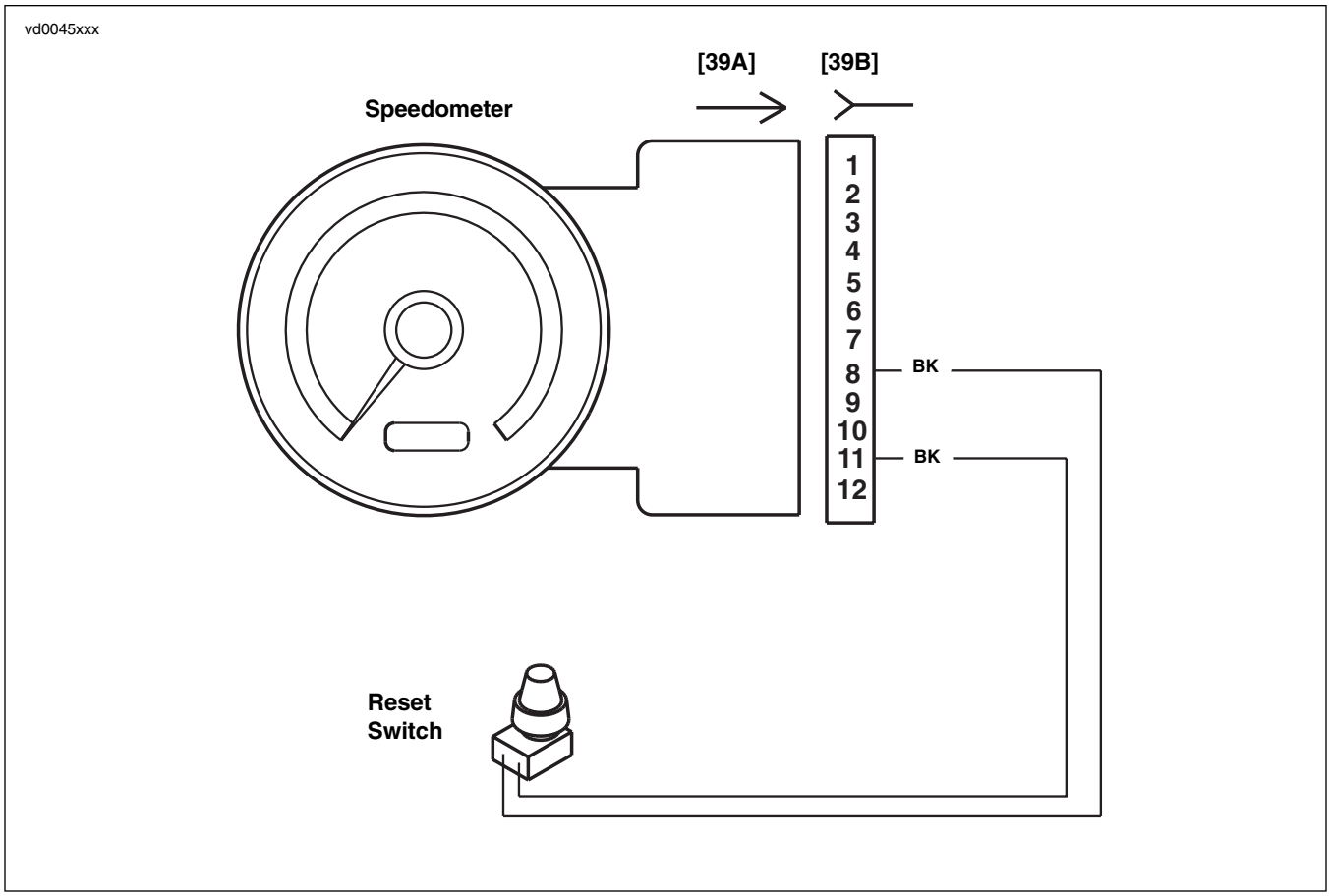


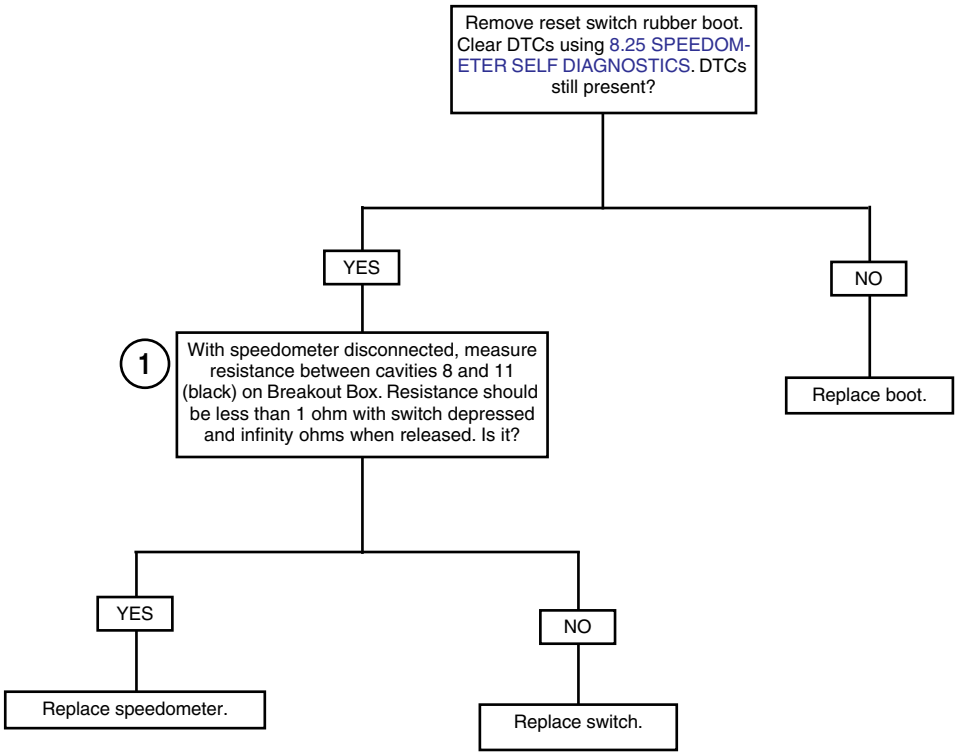
Figure 8-30. Reset Switch Circuit

Table 8-15. Wire Harness Connector in Figure 8-30.

NO.	DESCRIPTION	TYPE	LOCATION
[39]	Speedometer	12-place Packard	back of speedometer

Test 8.12 DTC B1008

RESET SWITCH CLOSED: DTC B1008



Clear DTCs using speedometer self diagnostics. See 8.26 BREAKOUT BOX: TSSM. Confirm proper operation with no check engine lamp.

DTC U1016, U1255 AT SPEEDOMETER 8.14

GENERAL

Loss of ECM Serial Data

The serial data connector provides a means for the electronic control module (ECM), TSSM and speedometer to communicate their current status. When all operating parameters on the serial data bus are within specifications, a state of health message is sent between the components. A diagnostic trouble code (DTC) U1016 indicates that the ECM is not capable of sending this state of health message.

Table 8-16. Code Description

DTC	DESCRIPTION
U1016	Loss of all ECM serial data (state of health)
U1255	Serial data error/missing message

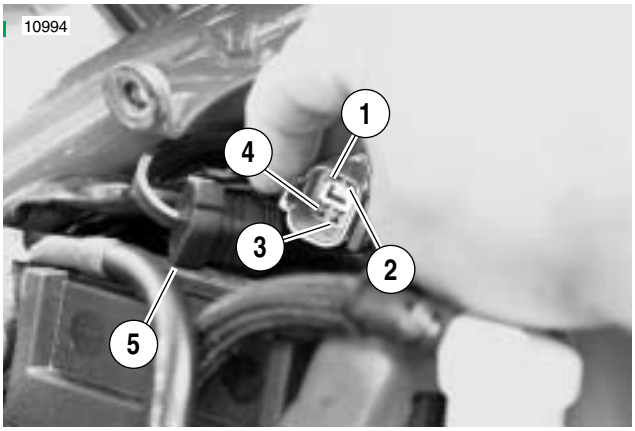
DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow chart.

1. Connect BREAKOUT BOX (Part No. HD-42682) (gray) between TSSM connector [30A] and wire harness connector [30B]. See 8.26 BREAKOUT BOX: TSSM.
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 8.42 BREAKOUT BOX: ECM.

Figure 8-31. ECM Location



1. **Terminal 1: Flash pin-EFI models (Lt GN/R)**
2. **Terminal 2: Ground (BK)**
3. **Terminal 3: Serial data (Lt GN/V)**
4. **Terminal 4: Power (GY)**
5. **Protective cap**

Figure 8-32. Data Link Connector

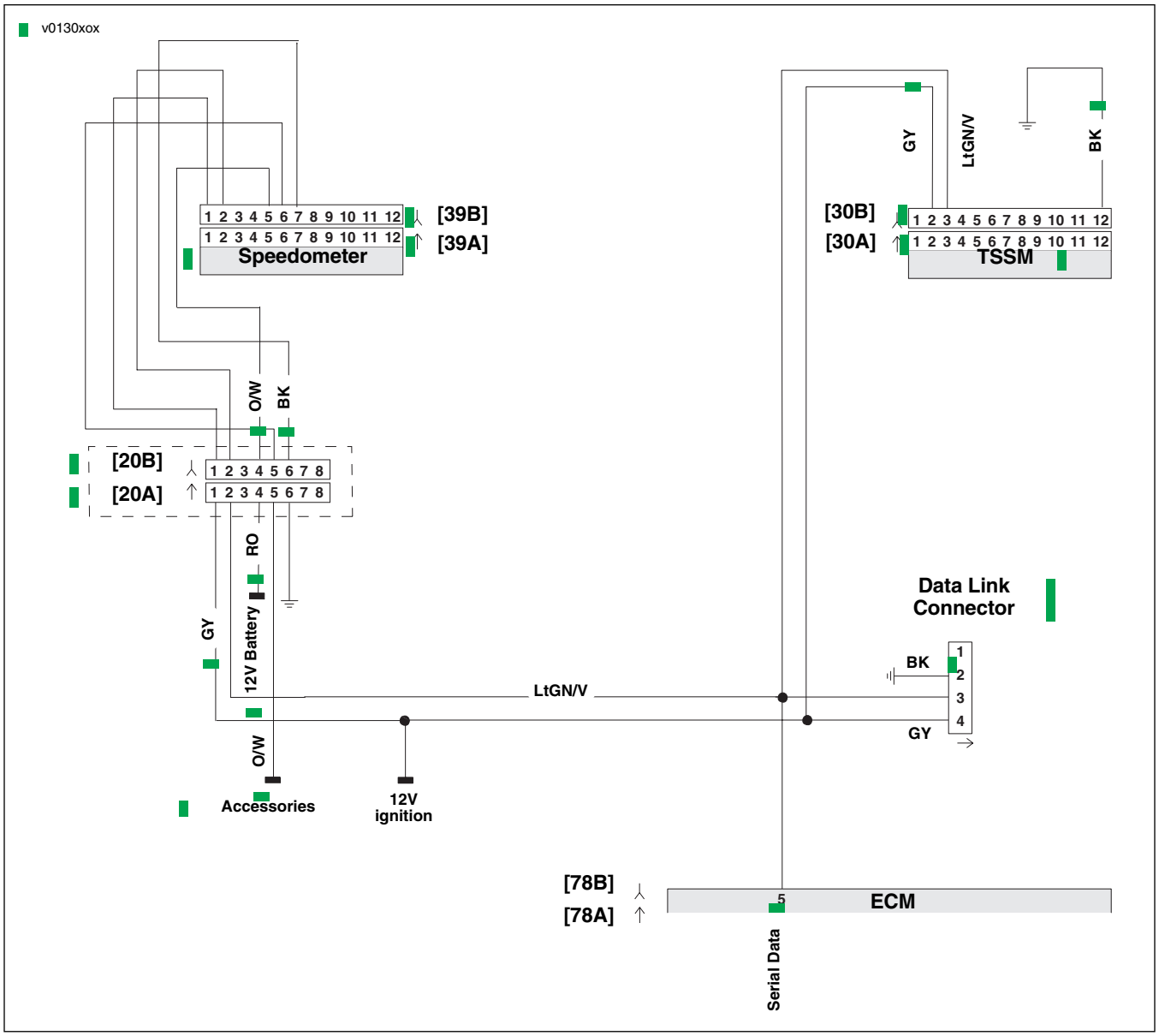


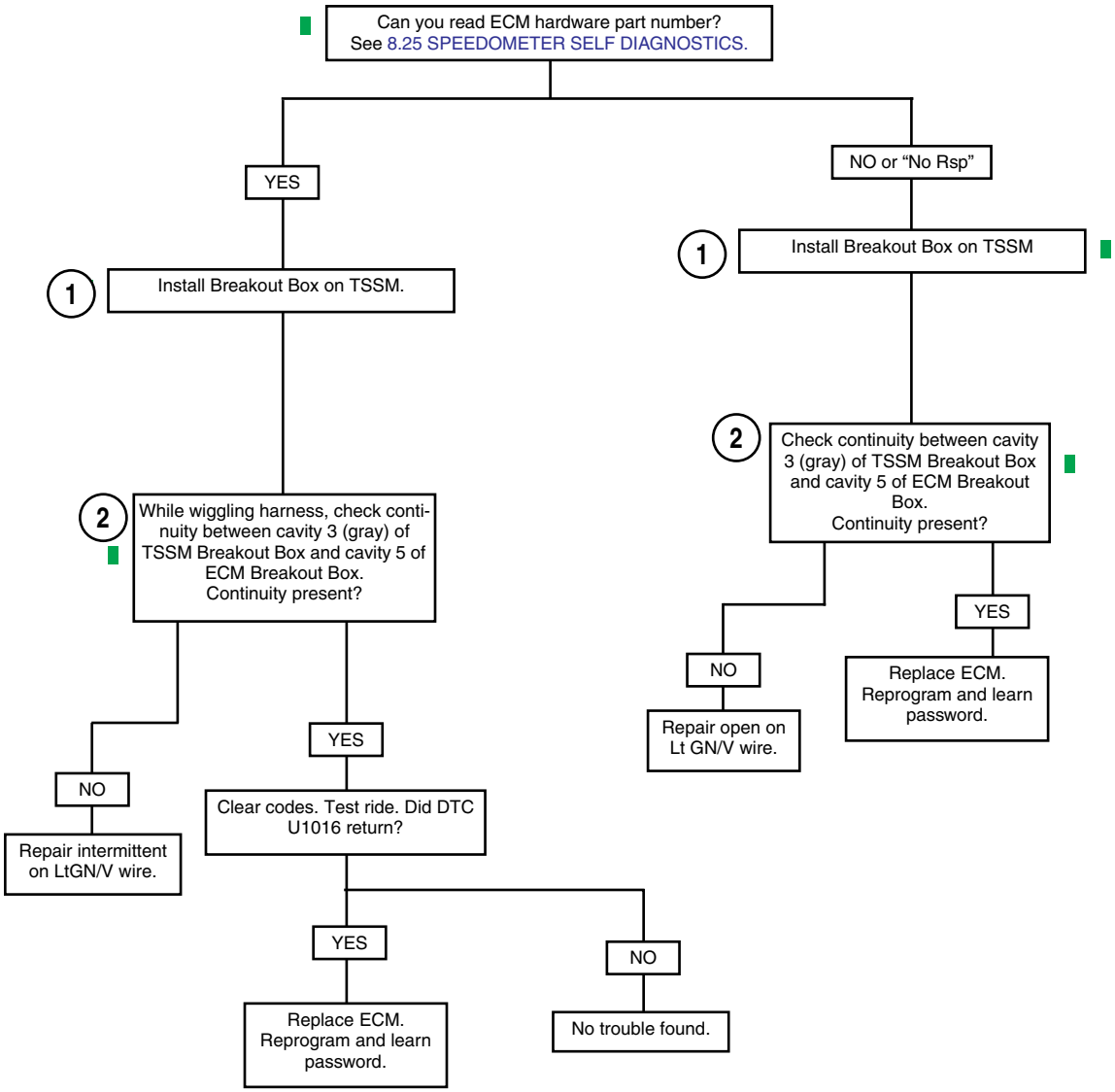
Figure 8-33. Serial Data Circuit

Table 8-17. Wire Harness Connectors in Figure 8-33.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Mini-Deutsch	Under left side cover
[30]	TSSM	12-place Deutsch	Under electrical caddie cover
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Test 8.13 DTC U1016

LOSS OF ECM SERIAL DATA: DTC U1016



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC U1064, U1255 AT SPEEDOMETER 8.15

GENERAL

Loss of TSSM Serial Data

The serial data connector provides a means for the ignition control module (ICM) or electronic control module (ECM), TSSM and speedometer to communicate their current status. When all operating parameters on the serial data bus are within specifications, a state of health message is sent between the components. A diagnostic trouble code (DTC) U1064 indicates that the TSSM is not receiving this state of health message.

Table 8-18. Code Description

DTC	DESCRIPTION
U1064	Loss of TSSM serial data
U1255	Serial data error/missing message

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow chart.

1. Connect BREAKOUT BOX (Part No. HD-42682) as follows:
   a. Mate black socket housing on Breakout Box with speedometer connector [39] using SPEEDOMETER HARNESS ADAPTER (Part No. HD-46601).
   b. Mate black pin housing on Breakout Box with speedometer harness connector [39B] using SPEEDOMETER HARNESS ADAPTER (Part No. HD-46601).
   c. Mate gray socket housing on Breakout Box with TSSM connector [30A].
   d. Mate gray pin housing on Breakout Box with harness connector [30B].

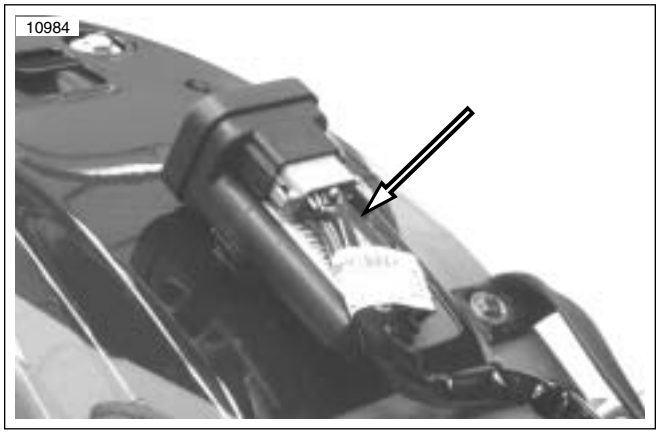
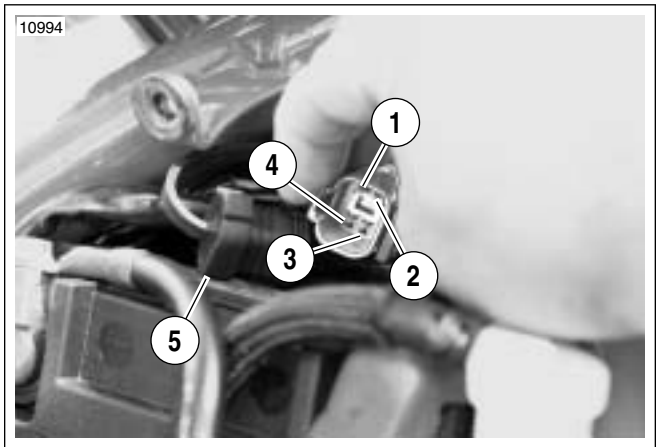


Figure 8-34. TSSM



1. **Terminal 1: flash pin-EFI models (Lt GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**
5. **Protective cap**

Figure 8-35. Data Link Connector

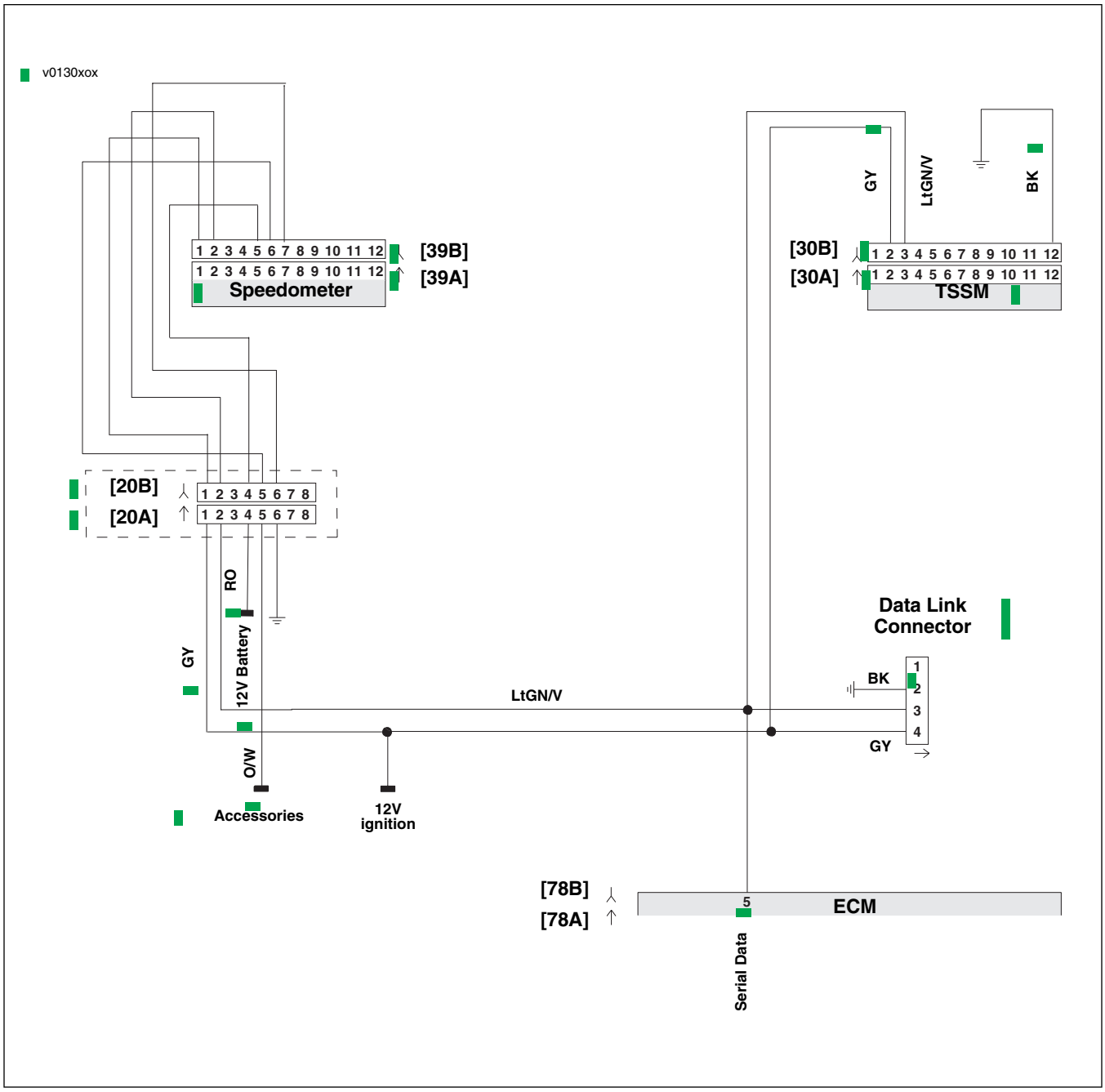


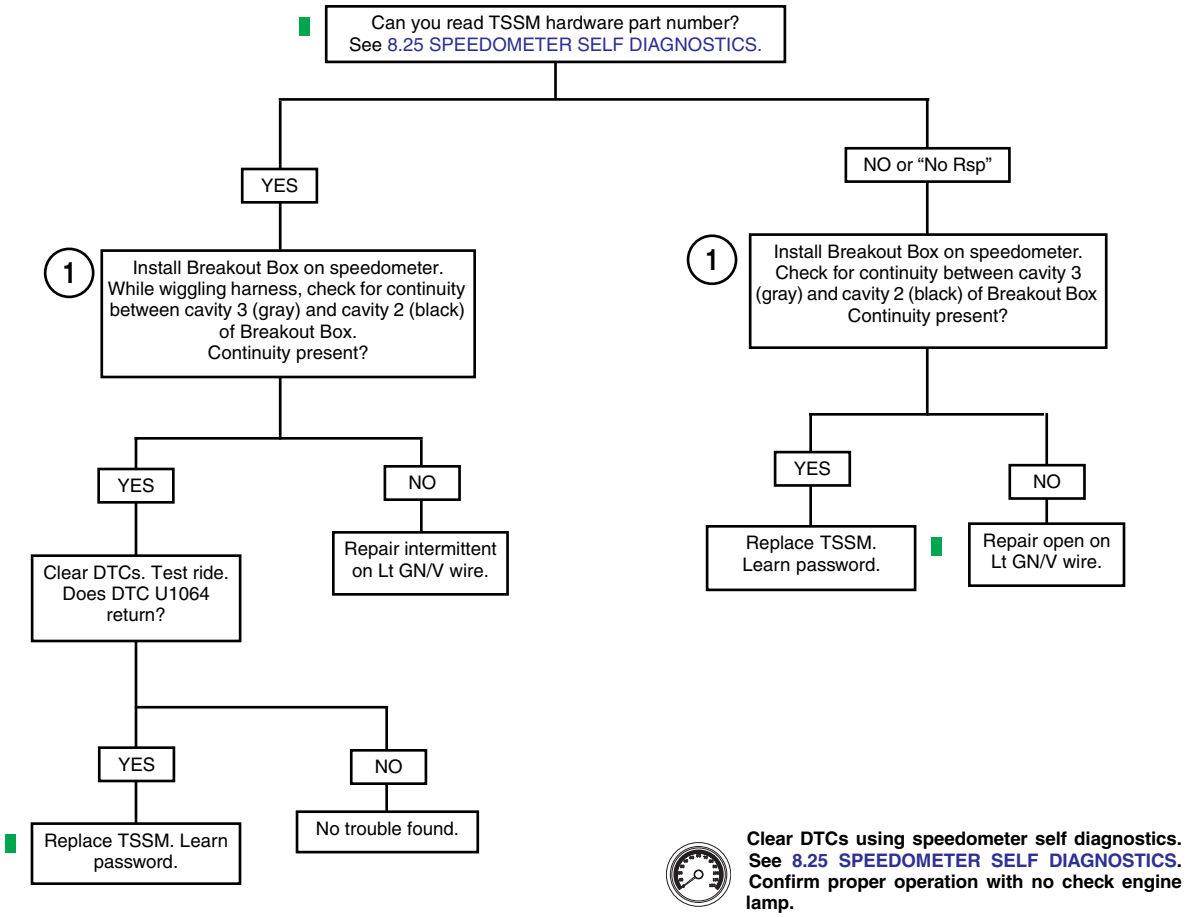
Figure 8-36. Serial Data Circuit

Table 8-19. Wire Harness Connectors in Figure 8-36.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Test 8.14 DTC U1064, U1255

LOSS OF TSSM SERIAL DATA: DTC U1064, U1255



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

TSSM OVERVIEW 8.16

GENERAL

The turn signal module (TSSM) has two major functions:

- Control turn signals
- Serve as bank angle sensor.

The factory installed security system (turn signal security module or TSSM) also includes security and immobilization functions.

See TSSM FEATURES for complete details.

Figure 8-37. TSSM

TROUBLESHOOTING

Problems fall into at least one of four categories:

- Turn signal malfunction.
- Bank angle (engine disable)
- Security lamp problem.
- Security lamp malfunction.

To resolve TSSM problems, four basic steps are involved. In order of occurrence, they are:

1. Retrieve diagnostic trouble codes (DTC's) using SPEEDOMETER SELF DIAGNOSTICS.
2. Diagnose system problems. This involves using special tools and the diagnostic flow charts in this section.
3. Correct problems through the replacement and/or repair of the affected components.
4. After repairs are performed, the work must be validated. This involves clearing the diagnostic trouble codes and confirming proper vehicle operation as indicated by the behavior of the turn signals.

GENERAL FUNCTIONS

The Turn Signal Security Module (TSSM) provides the following functions.

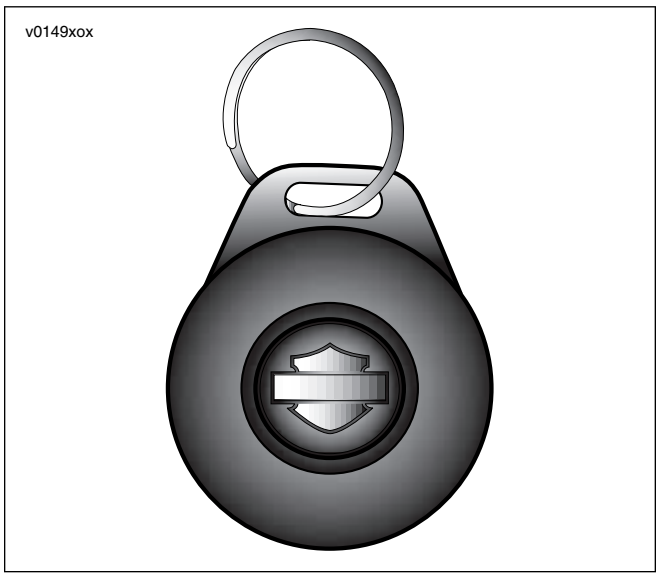


Figure 8-38. Key Fob

NOTE

Some hardware options and software settings are dependant upon vehicle market specifications.

TURN SIGNAL FUNCTIONS

TSSM Features

See TSSM TURN SIGNAL FUNCTIONS for complete details.

- **Manual, turn signal control:** Manual activation/deactivation of left and right turn signal flashing sequences.
- **Automatic turn signal cancellation:** Automatic cancellation of left and right turn signal flashing sequences based on either vehicle speed, vehicle acceleration or turn completion.
- **Emergency flashers:** Four-way left and right turn signal flashing capability.
- **Turn signal lamp diagnostics:** Self-diagnostics for short circuit and open lamp conditions on both left and right turn signal systems.

BANK ANGLE FUNCTIONS

See TSSM BANK ANGLE FUNCTION for complete details.

- Emergency engine shutdown: Monitors vehicle lean and will provide engine shutdown when lean exceeds 45 degrees from vertical for more than one second.
- Emergency outputs disable: Monitors vehicle lean and will disable turn signal lamps and starter motor when lean exceeds 45 degrees from vertical for more than one second.

SECURITY ALARM AND IMMOBILIZATION FUNCTIONS

The following information is an overview of feature of TSSM. See SECURITY SYSTEM (TSSM FUNCTIONS For further information.

Figure 8-39. Key Fob

- **Remote arming/disarming:** See Figure 8-39. Owners may enable or disable security alarm and immobilization functions with a remote, personally carried transmitter.

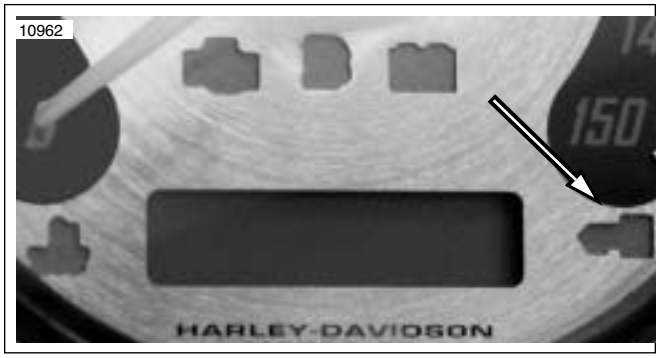


Figure 8-40. TSSM Lamp Location

- **Security status lamp:** See Figure 8-40. A lamp within the instrument module face tells the rider if the system is armed or disarmed.
- **Personal code disarming:** If a key fob is not available, the TSSM allows the rider to disable the security alarm and immobilization functions of the rider knows the previously entered code.
- **Security command confirmation:** When the system is armed or disarmed, the system provides visual feedback to the rider by flashing the turn signals and sounding the siren.
- **Auto-arming:** Automatically enables the security alarm and immobilization functions when the ignition key is switched OFF.

NOTE

Default auto-arming behavior depends upon vehicle market. All vehicles are shipped without self arming, however all vehicles delivered to the Netherlands market require self arming activation using Digital technician. Motorcycles sold in other markets have auto-arming disabled, but may be activated. See 8.18 TSSM VEHICLE DELIVERY.

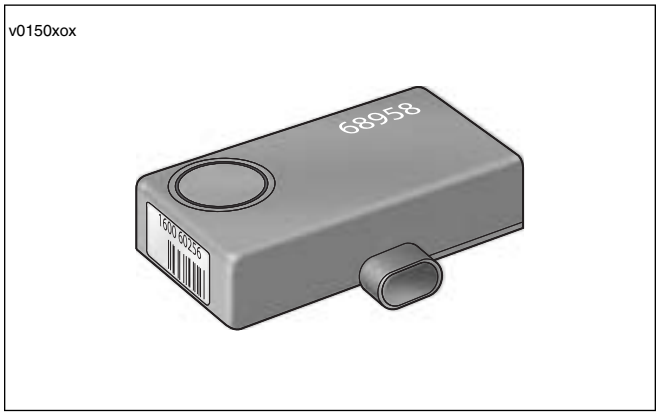


Figure 8-41. Siren

- **Transport mode:** It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the vehicle to be moved in an immobilized state.
- **Starter/ignition disable:** Should the security alarm and immobilization functions be triggered by a vehicle security condition, the starter and ignition system will be disables.
- **Security system alarm:** The system will alternately flash the left and right turn signals and sound the siren if a vehicle security condition is detected while the system is armed.

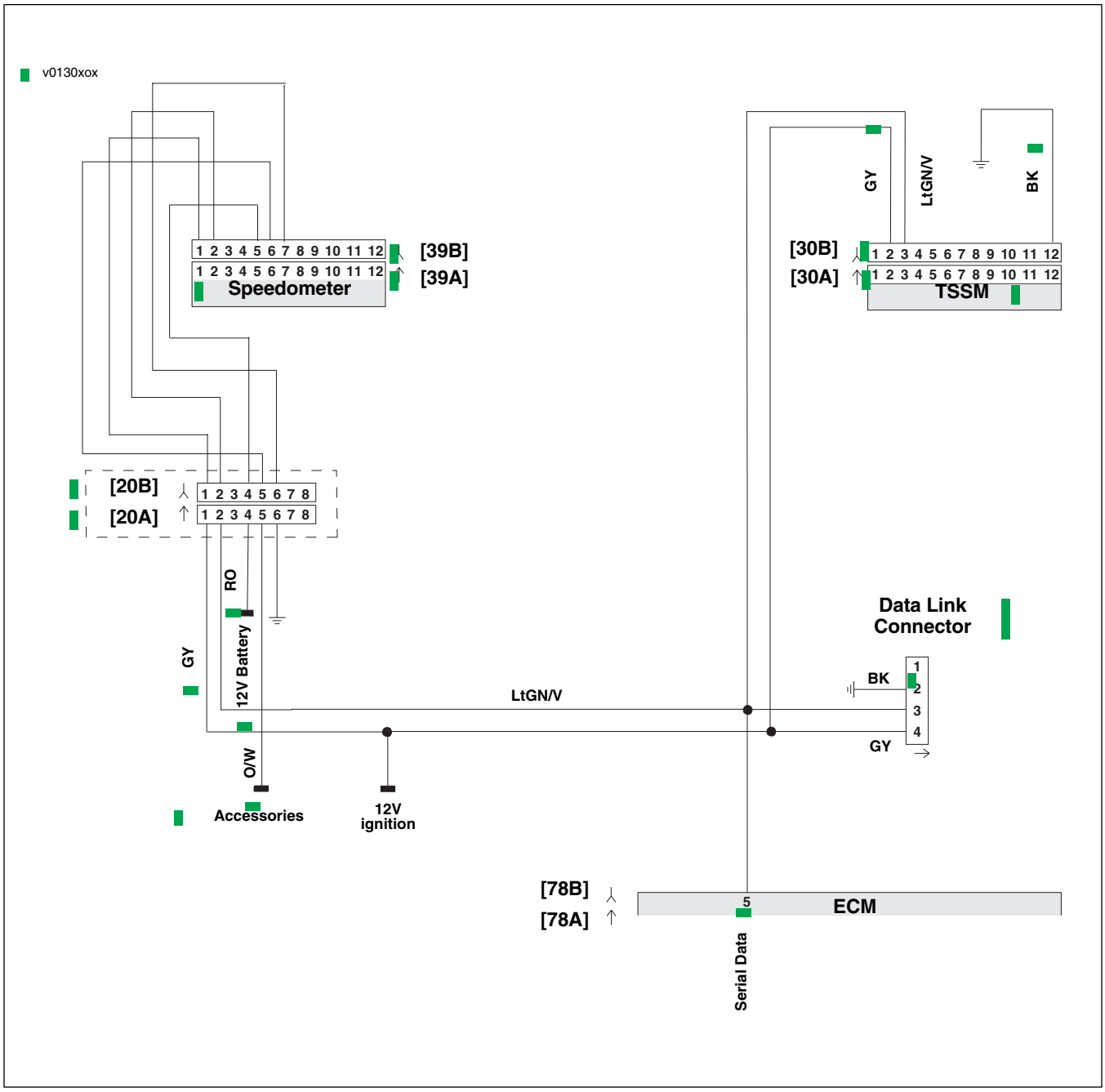


Figure 8-42. Serial Data Circuit

Table 8-20. Wire Harness Connectors in Figure 8-42.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

TSSM VEHICLE DELIVERY 8.18

GENERAL

⚠WARNING

Only Touring Harley-Davidson Motorcycles are suitable for sidecar use. Consult a Harley-Davidson dealer. Use of motorcycles other than Touring models with sidecars could result in death or serious injury. (00040a)

1. Configure TSSM motorcycles by assigning **both** key fobs to the vehicle.
2. Configure TSSM motorcycles by entering a personal code picked by the owner. The personal code allows the owner to operate the system if the key fob is lost or inoperable. Record this code in the owner's manual and instruct the owner to carry a copy.

NOTE

Do not forget to enter a personal code. If a code is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.

Changes to TSSM settings are made by a series of programming operations involving the ignition key, left/right turn signal switches, and key fob (security systems).

At certain steps in the programming sequence, the motorcycle may provide confirmation of settings by flashing the turn signal, turn signal indicators and or security lamp. In addition, when programming a personal code into a TSSM system, the odometer displays the personal code to the user and dynamically updates it as the code is entered or changed.

All programming operations are listed in table format. Follow the numbered steps to configure the system. Is a confirmation response is listed, wait for the confirmation before continuing to the next step. Important information pertaining to certain actions will be found in the NOTES column.

NOTE

DIGITAL TECHNICIAN (Part No. HD-44750) can also be used to configure the TSSM.

SIDECAR CONFIGURATION

⚠WARNING

Only Touring Harley-Davidson Motorcycles are suitable for sidecar use. Consult a Harley-Davidson dealer. Use of motorcycles other than Touring models with sidecars could result in death or serious injury. (00040a)

POWER DISRUPTION AND CONFIGURING

The TSSM will not enter configuration mode on the first attempt after battery voltage has been removed from Pin 1. This will occur after any of the following situations:

- Battery disconnect or power drain.
- Security fuse removal.
- Connecting Breakout Box to TSSM connector.

Therefore, after all battery reconnects, the configuration sequence must be modified as follows:

1. Set run switch to **OFF**, cycle ignition key ON-**OFF**-ON-**OFF**-ON and press left turn signal switch twice.
2. Repeat step listed above.
3. Continue with configuration sequence listed.

KEY FOB ASSIGNMENT

The key fob on TSSM motorcycles must be set so it will operate the alarm system on the vehicle. This assignment **must** be completed with no pauses between steps greater than 10 seconds. Turn the ignition OFF after all key fobs have been assigned. The programming mode will also exit after 60 seconds has elapsed without detecting and fob signal messages of turn signal switch activity.

Two key fobs may be assigned to the TSSM. The first successful attempt to program a fob will disable all previously assigned fobs. If a second fob is to be programmed, it must be done in the same programming sequence as the initial fob.

To assign a key fob to a motorcycle, refer to Table 8-21.

PERSONAL CODE ENTRY

First Time Code Entry ONLY

NOTE

Do not forget to enter a personal code. If a code is not assigned and both key fobs are lost or damaged while the vehicle is armed, the TSSM must be replaced.

The TSSM personal code (Personal Identification Number or PIN) consists of five digits. Each digit can be any number from 1-9. The personal code **must** be used to disarm the security system in case the key fob becomes unavailable.

To set a personal code on a motorcycle with no code previously installed, refer to Table 8-21.. The procedure listed uses 3-1-3-1-3 as the desired personal code.

NOTE

For better security, do not use 3-1-3-1-3 as a personal code. It is shown as an example only.

Decide what five digit code the owner would like to use. The code will be programmed using the turn signal switches and key fob. Keep a record of the code in a secure place such as your wallet or the owner's manual.

- When programming the personal code, the security lamp flashes to provide feedback when entering each digit. The odometer also displays the PIN and the change dynamically.
- The number of security lamp flashes corresponds to the number currently selected for a given digit. Therefore, the lamp may flash 1-9 times depending on the numberentered. The five digit code will change on the odometer display and the active light will blink.
- Press the left turn signal switch one time to increment each digit of the code.
- Quickly press the key fob button twice to advance to the next digit. of the code.

NOTE

The programming mode exits upon turning the ignition switch to OFF, or if no turn signal switch/key fob button activity occurs for 60 second. No data is saved for partial configuration attempts if entering a PIN for the first time. If a PIN has previously been entered, the user can change any digit or group of digits.

Modifying Existing Codes

If a code was previously entered, the lamp will flash the equivalent digit and the odometer will display the existing code with active digit blinking. Each additional press of the left turn switch will increment the digit.

- To advance from 5 to 6, press and release the left turn switch once.
- To advance, from 8 to 2, press and release the left turn switch 3 times.

Table 8-21. TSSM Key Fob Assignment

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is disarmed) This assignment procedure **must** be completed with no pauses between steps greater than 10 seconds
2	Turn **IGN** key **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	1-3 flashes turn signals & indicators depending on vehicle configuration (See 8.18 TSSM VEHICLE DELIVERY regarding battery disconnects.)	1 flash-Worldwide TSM, no security 2 flashes-North American/ Domestic and European/HDI configuration TSSM 3 flashes-Netherlands configuration TSSM
4	Press **right** turn switch **1 time** and release	1 flash turn signals & indicators	
5	Press **left** turn switch **1 time** and release	2 flashes turn signals & indicators	
6	Press and hold **key fob** button until confirmation is received	2 flashes turn signals & indicators	This may take 10-25 seconds
7	If you have two key fobs, press and hold button on second **key fob** until confirmation is received	2 flashes turn signals & indicators	optional step
8	Turn **IGN** key OFF		

Table 8-22. Programming a TSSM Personal Code (Example: 3-1-3-1-3) With No Code Previously Installed

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is disarmed) This assignment procedure **must** be completed with no pauses between steps greater than 10 seconds
2	Turn **IGN** key **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	1-3 flashes turn signals & indicators depending on vehicle configuration (See 8.18 TSSM VEHICLE DELIVERY regarding battery disconnects)	1 flash-Worldwide TSM, no security 2 flashes-North American/ Domestic and European/HDI configuration TSSM 3 flashes-Netherlands configuration TSSM
4	Quickly press **key fob** button **2 times** and release	One flash turn signals and indicators Odometer displays current five-digit personal code (five dashes if no code entered), first digit blinks	Vehicle is in personal code entry mode ready to enter or modify first digit
5	Press **left** turn switch **1 time** and release	Security lamp flashes 1 - 9 times if code was previously entered	A lack of confirmation flashes indicates no digit is entered
6	Press and release **left** turn switch to advance through the digits In this example, you will press and release three times	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 3 and the security lamp will flash three times	You've selected 3 as a number for the first digit
7	Quickly press **key fob** button **2 times** and release	Two flashes turn signals and indicators second digit in odometer display blinks	You've confirmed 3 as a number for the first digit and have advanced to entering the second digit
8	Press **left** turn switch **1 time** and release	none	A lack of confirmation flashes indicates no digit is entered
9	Press and release **left** turn switch to advance through the digits In this example, you will perform this step one time	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 1 and the security lamp will flash one time	You've selected 1 as a number for the second digit
10	Quickly press **key fob** button **2 times** and release	Three flashes turn signals and indicators third digit in odometer display blinks	You've confirmed 1 as a number for the second digit and have advanced to entering the third digit
11	Press **left** turn switch **1 time** and release	none	A lack of confirmation flashes indicates no digit is entered

Table 8-22. Programming a TSSM Personal Code (Example: 3-1-3-1-3) With No Code Previously Installed

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
12	Press and release **left** turn switch to advance through the digits In this example, you will repeat this step three times	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 3 and the security lamp will flash three times	You've selected 3 as a number for the third digit
13	Quickly press **key fob** button **2 times** and release	Four flashes turn signals and indicators fourth digit in odometer display blinks	You've confirmed 3 as a number for the third digit and have advanced to entering the fourth digit
14	Press **left** turn switch **1 time** and release	none	A lack of confirmation flashes indicates no digit is entered
15	Press and release **left** turn switch to advance through the digits In this example, you will perform this step one time	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 1 and the security lamp will flash one time	You've selected 1 as a number for the fourth digit
16	Quickly press **key fob** button **2 times** and release	Five flashes turn signals and indicators fifth digit in odometer display blinks	You've confirmed 1 as a number for the fourth digit and have advanced to entering the fifth digit
17	Press **left** turn switch **1 time** and release	none	A lack of confirmation flashes indicates no digit is entered
18	Press and release **left** turn switch to advance through the digits In this example, you will repeat this step three times	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 3 and the security lamp will flash three times	You've selected 3 as a number for the fifth digit
19	Quickly press **key fob** button **2 times** and release	One flash turn signals and indicators first digit in odometer display blinks	You've confirmed 3 as a number for the fifth digit and have gone back to the first digit
20	Turn **IGN** key OFF		
21	Write down code in owner's manual		
22	Arm the security system and attempt to disarm using personal code entry. Refer to Table 8-28.		

TSSM TURN SIGNAL FUNCTIONS 8.19

GENERAL

The TSSM's turn signal feature has several modes:

- Automatic cancellation
- Manual cancellation
- Four-way flashing
- Diagnostics mode

Turn signals cannot be activated or deactivated when the ignition key is in the ACC position. The turn signals can only be activated or deactivated with the ignition key in the IGN position.

⚠WARNING

Only Touring Harley-Davidson Motorcycles are suitable for sidecar use. Consult a Harley-Davidson dealer. Use of motorcycles other than Touring models with sidecars could result in death or serious injury. (00040a)

AUTOMATIC CANCELLATION

Press the left or right turn switch to activate automatic turn signal cancellation. There is no need to hold the turn switch in when approaching the turn. The TSSM will not cancel the signal before the turn is actually completed.

- When the directional switch is released, the system starts a 20-count. As long as the vehicle is traveling above 7 MPH (11.2 KPH) the directional will always cancel after 20 flashes if the system does not recognize any other input.
- If the vehicle speed drops to 7 MPH (11.2 KPH) or less, including stopped, the directionals will continue to flash. Counting will resume when vehicle reaches 8 MPH (12.8 KPH) and will automatically cancel when the count total equals 20 as stated above.
- The turn signals will cancel within two seconds upon turn completion. A sensor inside the TSSM cancels the signal after the vehicle has been returned to an upright position.

NOTE

The bank angle cancellation function has an automatic calibration feature. Ride the motorcycle for 1/4 mile (0.4 KM) at steady speeds (upright) to calibrate the system. Performance of bank angle function may not be optimal until this calibration is performed. This self-calibration is performed automatically every time the vehicle is started and ridden.

MANUAL CANCELLATION

If you want to stop the turn signals from flashing, briefly depress the turn signal switch a second time.

If you are signalling to turn in one direction and you depress the switch for the opposite turn signal, the first turn signal will cancel and the opposite turn signal begins flashing.

FOUR-WAY FLASHING

Use the following method to activate the four way flashers.

1. With the ignition key ON and security system disarmed, press the left and right turn signal switches at the same time.
2. Turn the ignition key OFF and arm the security system if desired. The four-way flashers will continue for two hours.
3. To cancel four-way flashing, disarm the security system if necessary, turn ignition key ON and press the left and right turn signal switches at the same time.

NOTE

Auto-arming (always active on the Netherlands bikes, user selectable on other vehicles) requires that the four-way flashers be activated within 30 seconds of key OFF or after the vehicle has been disarmed.

This system allows a stranded vehicle to be left in the four-way flashing mode and secured until found.

If the security system is disarmed while the four-way flashers are active, the lights will flash as follows:

1. TSSM stops four-way flashing mode. Motorcycle sits for 1 second with turn signals OFF.
2. TSSM performs disarming function (1 flash).
3. Motorcycle sits for 1 second with turn signals OFF.
4. Motorcycle restarts four-way flashing mode.

DIAGNOSTICS MODE

The TSSM measures the current when the turn signals are used. If there is a burned out light bulb on one side, the remaining light and the corresponding turn signal indicator flash at double the normal rate starting with the fifth flash.

Other diagnostic conditions monitored include:

- Short circuit in the turn signal wiring.
- Open circuit in the turn signal wiring.
- Stuck turn signal switch.

NOTE

A stuck turn signal switch will disable the automatic turn signal cancellation.

If a stuck turn signal switch is detected, you must hold the left and right turn signal switches in for more than one second to activate the four-way flashers.

See 8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES for more information.

TSSM BANK ANGLE 8.20

GENERAL

The turn signals, starter motor, electronic control module, fuel pump and coil will be disabled in the event the vehicle tilts more than 45 degrees from vehicle for longer than one second.

WARNING

Only Touring Harley-Davidson Motorcycles are suitable for sidecar use. Consult a Harley-Davidson dealer. Use of motorcycles other than Touring models with sidecars could result in death or serious injury. (00040a)

OPERATION

The engine will shut off automatically if the vehicle tilts more than 45 degrees from vertical for longer than one second. The engine will automatically shut off even if the tilt occurs at a very slow speed. The odometer displays “tIP” when a tip over condition is detected.

The restart the motorcycle after shutdown has occurred:

1. Return the motorcycle to an upright position.
2. Cycle the ignition switch key **OFF**-ON before restarting the motorcycle.

TSSM SECURITY SYSTEM FUNCTIONS 8.21

GENERAL

Security System Operation

The TSSM provides security and immobilization functions. The TSSM will disable the starter and ignition system. Additional functions include the ability to alternately flash the left and right turn signals and sound the siren if a theft attempt is detected.

Conditions that activate the security system when the system is armed include:

- **Detecting small vehicle movement:** Turn signals flash 3 times and siren chirps once and then turns OFF. If the vehicle is not returned to it's original position the warning will reactivate after four seconds. This cycle will may repeat a maximum of 255 times.
- **Detecting large vehicle movement:** System activates for 30 seconds and then turns OFF. If the vehicle is not returned to it's original positions the alarm will reactivate after 10 seconds. This cycle may repeat up to a maximum of 10 times.
- **Detecting tampering of the security lamp circuit:** System activates for 30 seconds. This cycle repeats once for each tampering incident.
- **Detecting that a battery or ground disconnect has occurred while armed:** Siren activates it's self-alarm mode. Turn signals will not flash.

See ARMING/DISARMING SECURITY SYSTEM (TSSM) for more information.

NOTE

Always disarm the TSSM before removing or disconnecting the battery to prevent the siren from activating. If the TSSM is in auto-arming mode, you must disarm the system using two clicks of the key fob and disconnect the battery or remove the TSSM fuse before the 30 second arming period expires.

Security System Options

The following configuration options are only available on the TSSM unit: alarm sensitivity, auto-arming feature and storage mode.

Default settings for the TSSM include:

- Solo vehicle configuration.
- Medium motion sensitivity on alarm sensitivity.
- Auto-arming standard on HDI vehicles and disabled domestic motorcycles
- Storage mode set to 20 days.

Differences By Market Specifications

The Netherlands TSSM set-up differs from other TSSM set-ups in the following ways:

- The Netherlands configuration always auto-arms itself within 30 seconds after the ignition key is turned OFF.
- The Netherlands version does not have the remote arming only option.

ALARM SENSITIVITY

Sensitivity

The TSSM has four sensitivity settings: extremely low, low, medium or high. The selection picked controls the sensitivity of the security system in regards to mobile detection.

To set alarm sensitivity, refer to Table 8.21 TSSM SECURITY SYSTEM FUNCTIONS.

Transport Mode

It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the motorcycle to be picked up and moved in an armed state. In this mode, any attempt to "hot-wire" the motorcycle will trigger the security system.

- To enter the transport mode, refer to Table 8-24.
- To exit from transport mode and return the system to normal operational functions, disarm the system using either the key-fob or personal code.

NOTE

Transport mode is especially useful when working on HDI vehicles. If it is not used, then the alarm will activate under many typical service activities.

AUTO-ARMING FUNCTION

Auto-arming causes the system to automatically arm itself (no key fob needed) within 30 seconds after the ignition key is turned OFF. During this period, the security lamp stays on solid to indicate auto-arming is starting up.

The motorcycle may be moved during these 30 seconds without triggering the alarm. However, any motion after that period will trigger the security alarm. Upon expiration of the auto-arming period, the turn signals flash twice, the security lamp begins to flash and the siren chirps twice.

The TSSM allows remote arming via key fob at anytime. However, if the system is remotely disarmed (with key fob) but the ignition key in not turned ON within 30 seconds, the system will rearm itself when auto-arming is enabled.

The auto-arming setting depends upon vehicle market specifications.

- Motorcycles sold in North America have auto-arming **disabled** by default. However, the feature may be enabled if the customer desires.
- Vehicles sold elsewhere have auto-arming **enabled** and this setting cannot be changed.

When auto-arming is disabled, the key fob must be used to arm the security system.

To set the auto-arming function, (Domestic only), refer to Table 8-25.

STORAGE MODE

The TSSM has a special mode for long term storage. This mode prevents the security system from draining the battery after a period of days (10, 20, 60 to infinite) without any ignition key switch activity.

- If the TSSM is set to infinite, the system will not go into storage mode.
- Vehicles will enter storage mode whether the security system is armed or disarmed.
- If set to 10 days or greater, the customer must use an approved trickle charger to keep the battery from discharging.

In storage mode, all alarm functions are suspended and the receiver is shut down and will not respond to the key fob. The vehicle is immobilized because the starter motor and electronic control module (ECM) are disabled. When the storage mode is entered, the security lamp stops flashing to conserve power.

To wake up the TSSM from storage mode, the ignition key must be turned ON. This will trigger the alarm if the system was previously armed. You must use the key fob or personal code to disarm the system and stop the alarm.

To set the storage mode preferences, refer to Table 8-26.

Table 8-23. TSSM Alarm Sensitivity

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is disarmed)
2	Turn **IGN** key **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	2 or 3 flashes turn signals & indicators depending on vehicle configuration (See section under 8.18 TSSM VEHICLE DELIVERY regarding battery disconnects.)	2 flashes-North American/ Domestic and European/HDI configuration TSSM 3 flashes-the Netherlands configuration TSSM
4	Press and hold **key fob** button until confirmation is received	1 flash turn signals & indicators	
5	Press **left** turn switch **1 time** and release	turn signals & indicators flash to indicate option selected	1 flash-10 days 2 flashes-20 days 3 flashes-60 days 4 flashes-infinite
6	Press and release **left** turn switch to advance through options	turn signals & indicators flash to indicate option selected	1 flash-10 days 2 flashes-20 days 3 flashes-60 days 4 flashes-infinite
7	Turn **IGN** key OFF		

Table 8-24. TSSM Transport Mode

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is dis-armed)
2	Turn **IGN** key **ON**		
3	Press and hold **key fob** button until confirmation is received	3 flashes turn signals & indicators	
4	Turn **IGN** key OFF		
5	Press and hold **key fob** button until confirmation is received	3 flashes turn signals & indicators	The vehicle can be moved without tripping the alarm

Table 8-25. Selecting TSSM Auto-arming Function (Not Available on HDI Vehicles)

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is dis-armed)
2	Turn **IGN** key **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	2 or 3 flashes turn signals & indicators depending on vehicle configuration (See section under 8.18 TSSM VEHICLE DELIVERY regarding battery disconnects.)	2 flashes-North American/ Domestic and European/HDI configuration TSSM 3 flashes-the Netherlands configuration TSSM
4	Press and hold **key fob** button until confirmation is received	1 flash turn signals & indicators	
5	Press and hold **key fob** button until confirmation is received	2 flashes turn signals & indicators	
6	Press **left** turn switch **1 time** and release	turn signals & indicators flash to indicate option selected	1 flash- auto-arming disabled 2 flashes- auto-arming enabled
7	Press and release **left** turn switch to advance through options	turn signals & indicators flash to indicate option selected	
8	Turn **IGN** key OFF		

Table 8-26. TSSM Storage Mode Preferences

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is disarmed)
2	Turn **IGN** key **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	2 or 3 flashes turn signals & indicators depending on vehicle configuration (See section under 8.18 TSSM VEHICLE DELIVERY regarding battery disconnects.)	2 flashes-North American/ Domestic and European/HDI configuration TSSM 3 flashes-the Netherlands configuration TSSM
4	Press and hold **key fob** button until confirmation is received	1 flash turn signals & indicators	
5	Release and then hold **key fob** button until confirmation is received	2 flashes turn signals & indicators	
6	Release and then hold **key fob** button until confirmation is received	3 flashes turn signals & indicators	
7	Press **left** turn switch **1 time** and release	turn signals & indicators flash to indicate option selected	1 flash-10 days 2 flashes-20 days 3 flashes-60 days 4 flashes-infinite
8	Press **left** turn switch to advance through options	turn signals & indicators flash to indicate option selected	1 flash-10 days 2 flashes-20 days 3 flashes-60 days 4 flashes-infinite
9	Turn **IGN** key OFF		

TSSM ARMING/DISARMING SECURITY SYSTEM 8.22

GENERAL

There are two methods to arm the security system:

- Using key fob.
- Using auto-arming. See 8.21 TSSM SECURITY SYSTEM FUNCTIONS.

NOTE

The vehicle cannot be armed with the engine running or the ignition ON.

There are two ways to disarm the security system:

- Using key-fob. This method works in all situations **except** before turning ignition key ON when TSSM storage mode is activated.
- Using personal code.

SECURITY LAMP

Refer to Table 8-27. The security lamp within the speedometer provides feedback to the rider confirming armed or disarmed status.

Table 8-27. Security Lamp Status

LAMP	MODE
Does not flash	No security system (TSM), security system not armed or storage mode active
Flashes every second	10 minute timeout after failed personal code entry attempt or a battery reconnect has occurred while armed
Flashes every 2 seconds	Security system armed
Flashes 3 times a second	Personal code entry mode
Stays on solid with ignition key OFF	Auto-arming is starting up. You have 30 seconds before system is armed.
Stays on solid with ignition key ON	If solid for more than 4 seconds after key ON, a current DTC is present
Four-way flashers flash 6 times (TSM)	See 8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES

USING KEY FOB

General

The TSSM's reception range for the key fob signal depends on a specific receiver pattern.

NOTE

Environmental and geographic conditions may affect signal range.

Arming the System

1. Hold key fob horizontal at waist level.
2. Point key fob at front of vehicle.
3. Hold down key fob button twice. The system will respond with one turn signal flash.

Disarming the System

1. Hold key fob horizontal at waist level.
2. Point key fob at front of vehicle.
3. Quickly press key fob button twice. The system will respond with one turn signal flash.

NOTE

Disarming function may require practice. The key fob button must be pressed twice within 1.5 seconds to send disarm command. the action is very similar to double-clicking a computer mouse. Light quick taps work best; very hard or very slow taps are less likely to work.

Troubleshooting

If the key fob button has been pressed a number of times while away from the vehicle, the fob may fall out of synchronization with the TSSM. If this happens, the TSSM might fail to recognize the key fob's commands.

To correct this, press and hold key fob button for 10-15 seconds until the security system responds with two turn signal flashes. After confirmation, you may resume normal fob operation.

USING THE PERSONAL CODE

General

The personal code consists of five digits entered using the left and right turn signal switches. Each digit can be an number from 1-9. the personal code is intended to be used to disarm the vehicle in case the key fob becomes unavailable or inoperable.

See 8.18 TSSM VEHICLE DELIVERY to set a personal code.

Disarming the System

Refer to Table 8-28. If you make an error while disarming the TSSM using the personal code, the alarm will activate for 30 seconds after the last digit is entered. After a failed attempt, the security lamp will flash once every second for 10 minutes. **During this time, the vehicle will not accept any attempt to enter a personal code.**

Table 8-28. Entering A Personal Code To Disarm TSSM (Example: 3-1-3-1-3)

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		
2	Turn **IGN** key to **ACC**		
3	Hold **both** turn switches in until confirmation	security lamp blinks at fast rate	System is ready for personal code entry
4	Enter first digit of code (3) by pressing **left** turn switch **3 times**		
5	Press **right** turn switch **1 time**		Serves as “enter” key for first digit
6	Enter second digit of code (1) by pressing **left** turn switch **1 time**		
7	Press **right** turn switch **1 time**		Serves as “enter” key for second digit
8	Enter third digit of code (3) by pressing **left** turn switch **3 times**		
9	Press **right** turn switch **1 time**		Serves as “enter” key for third digit
10	Enter fourth digit of code (1) by pressing **left** turn switch **1 time**		
11	Press **right** turn switch **1 time**		Serves as “enter” key for fourth digit
12	Enter fifth digit of code (3) by pressing **left** turn switch **3 times**		
13	Press **right** turn switch **1 time**	security lamp stops blinking	System is disarmed. You may use the vehicle or program another key fob

TSSM

To diagnose system problems, start by observing the behavior of the security lamp.

NOTE

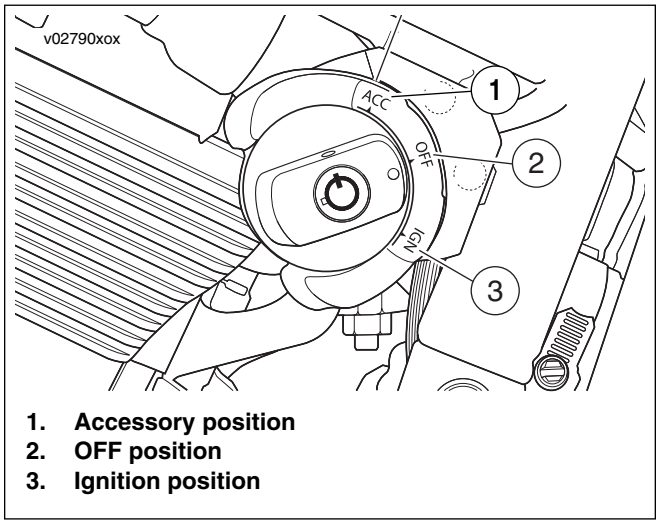
See Figure 8-43. "Key ON" means ignition key is turned to IGN and engine stop switch is set to RUN (although engine is not running).

See Figure 8-44. When ignition key is turned ON, security lamp will illuminate for approximately 4 seconds and turn OFF.

If speedometer security lamp is not illuminated at Key ON, or if it fails to turn OFF after initial 4 second period, instrument module may need to be replaced.

The speedometer security lamp will also illuminate for 8 seconds after bulb check if historic diagnostic trouble codes (DTC's) are present. The security lamp will stay ON if current DTC's are set. If a historic DTC is present, security lam will illuminate for 50 ignition cycles or until DTC is cleared manually.

1. See Figure 8-44. After lamp turns OFF after being illuminated for first 4-second period, one of three events may occur:
   a. Lamp remains OFF. This indicates there are no current fault conditions or stored historic DTC's currently detected by TSSM.
   b. Lamp stays OFF for only 4-seconds and then illuminates for an 8-second period. This indicates a historic DTC is stored, but no current DTC exists.
   c. If lamp remains ON beyond 8-seconds a current DTC exists.
2. See CODE TYPES under 8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES for a complete description of DTC formats



1. **Accessory position**
2. **OFF position**
3. **Ignition position**

Figure 8-43. Ignition Switch

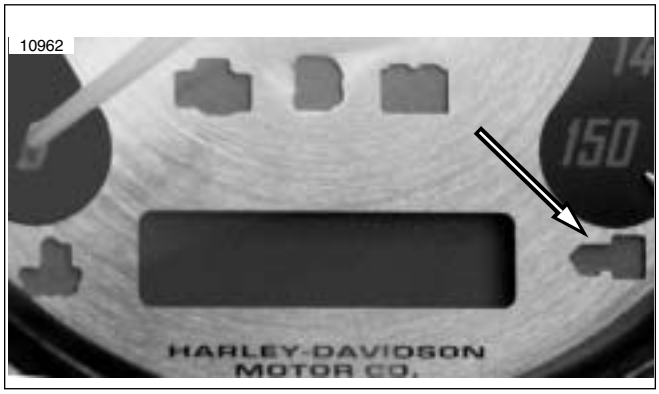


Figure 8-44. Security Lamp

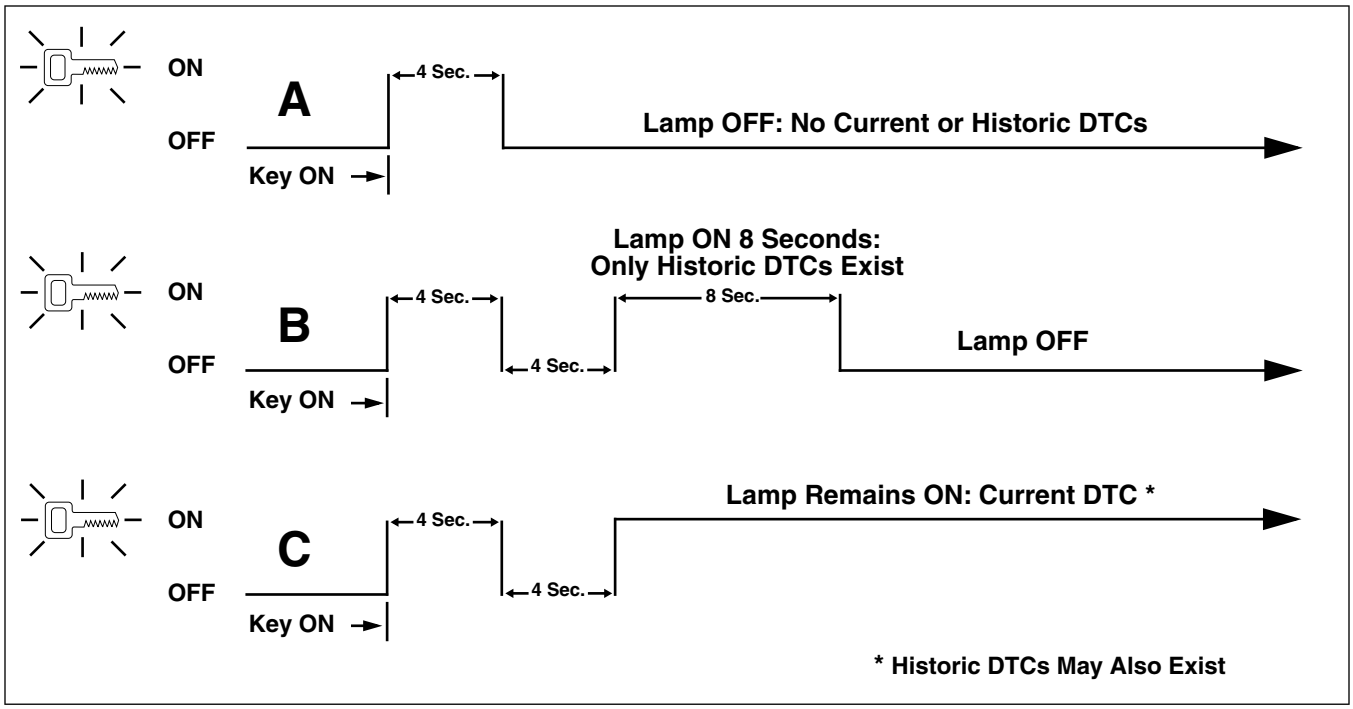


Figure 8-45. Security Lamp Operation

CODE TYPES

There are two types of diagnostic trouble codes (DTC's): current and historic. If a DTC is stored, it can be read using one of the following methods:

- Speedometer self-diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS.
- A computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750).

NOTE

You must use Digital Technician to differentiate between current and historic DTC's. See 8.24 INITIAL DIAGNOSTIC CHECK: TSSM.

All DTC's reside in the memory of the ECM, or TSSM until the DTC is cleared by use of speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS.

A historic DTC is also cleared after a total of 50 trips has elapsed. A trip consists of a start/run cycle. After the 50 trip retention period, the DTC is automatically erased from memory providing that no faults of the same type are detected in that period.

Current

Current DTC's are those which are present during current ignition cycle. See appropriate flow charts for solutions.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic DTC rather than a current DTC. For example, intermittent output shorts can become typical historic DTC's.

Historic DTC's can only be retrieved using a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750).

Historic DTC's are stored for 50 ignition cycles after any DTC was last set as current to assist in diagnostics of intermittent faults. On the 50th cycle, the DTC will clear itself. The check engine lamp will not indicate existence of only historic DTC's.

It is important to note that historic DTC's will exist whenever the system indicates existence of a current fault. See MULTIPLE DIAGNOSTIC TROUBLE CODES if multiple DTC's are found.

Diagnostic charts are designed for use with current DTC's and as a result they frequently suggest part replacement. When diagnosing a historic DTC, the charts can be helpful but should not lead to part replacement without verification of the part being faulty.

RETRIEVING TROUBLE CODES

The TSSM allows 2 levels of diagnostics.

- The most sophisticated mode employs a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750).
- The second mode is to perform SPEEDOMETER SELF DIAGNOSTICS. See 8.25 SPEEDOMETER SELF DIAGNOSTICS.

Use of self diagnostics assumes that Digital Technician is not available.

MULTIPLE DIAGNOSTIC TROUBLE CODES

While it is possible for more than one fault to occur and set more than one DTC, there are several conditions which may result in **one** fault setting **multiple** DTCs.

Serial data DTC's (U1016, U1064, U1097, U1255, U1300 and U1301) may be accompanied by other DTC's. Always correct serial data DTC's before resolving other DTC's.

Refer to Table 8-18. This table gives most TSSM DTC's a priority ranking.

INITIAL DIAGNOSTIC CHECK: TSSM 8.24

GENERAL

To locate faulty circuits or other system problems, follow the diagnostic flow charts in this section. For a systematic approach, always begin with INITIAL DIAGNOSTICS which follows. Read the general information and then work your way through the flow chart box by box.

Diagnostic Notes

If a numbered circle appears adjacent to a flow chart box, then more information is offered in the diagnostic notes. Many diagnostic notes contain supplemental information, descriptions of various diagnostic tool or references to other parts of the manual where information on the location and removal of components may be obtained.

Circuit Diagram/Wire Harness Connector Table

When working through a flow chart, refer to the illustrations, the associated circuit diagram and the wire harness connector table as necessary. The wire harness connector table for each circuit diagram identifies the connector number, description, type and general location.

In order to perform most diagnostic routines, a Breakout Box and a digital volt/ohmmeter (DVOM) are required. See 8.26 BREAKOUT BOX: TSSM.

To perform circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

Job/Time Code Values

Some charts may contain warranty job/time codes. Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

Reprogramming ECM

Diagnostic charts frequently suggest ECM replacement. In the event an ECM (electronic control module) needs to be replaced, the replacement module must be reprogrammed using a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750). See your dealer. Password learn procedure must also be performed. See 8.38 PASSWORD LEARN.

INITIAL DIAGNOSTICS

Diagnostic Tips

- If speedometer reads “BUS Er” with ignition key ON (engine stop switch at RUN with engine OFF), check for an open or short to ground between data link connector [91A] terminal 3, ECM connector [78B] terminal 5, TSSM connector [30B] terminal 3 or speedometer connector [39B] terminal 2.
- Check for an open diagnostic test terminal between data link connector [91A] terminal 3 and TSSM connector [30B] terminal 3. With ignition key turned ON, serial data bus voltage should be typically 0.6-0.8 volts. The range of acceptance voltage is 0-7.0 volts.
- To identify intermittants, wiggle instrument and/or vehicle harness while performing steps in the Diagnostic Check charts.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the diagnostic flow charts.

1. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness connector {39B} and speedometer connector {39A] using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601). See 8.11 BREAKOUT BOX: SPEEDOMETER.
2. Compare TSSM system behavior to symptoms in Table 8-30.

NOTE

All TSSM diagnostic trouble codes are listed in Table 8-29.

Other Diagnostic Trouble Codes (DTC’s)

See 8.11 BREAKOUT BOX: SPEEDOMETER for any DTC’s related to the speedometer.

See 8.44 INITIAL DIAGNOSTIC CHECK for any DTC’s related to the electronic control module (ECM).

Table 8-29. TSSM Diagnostic Trouble Codes (DTC) and Fault Conditions

PRIORITY	DTC	FAULT CONDITION	SOLUTION
1	“BUS Er”	Serial data bus shorted low/open/high	8.37 DTC U1300, U1301 or “BUS ER”
2	U1300	Serial data low	8.37 DTC U1300, U1301 or “BUS ER”
3	U1301	Serial data high	8.37 DTC U1300, U1301 or “BUS ER”
4	U1016	Loss of ECM serial data (state of health)	8.14 DTC U1016, U1255 AT SPEEDOMETER
5	U1097	Loss of Speedometer serial data (state of health)	8.68 DTC U1097, U1255 AT ECM
6	U1255	Missing response from other module (speedometer) at startup	8.68 DTC U1097, U1255 AT ECM
7	B1135	Accelerometer fault	8.34 DTC B1135
8	B1151	Sidecar BAS low	Sidecar DTCs apply only to Touring models. If these DTCs are present on VRSCSE2 models, the TSSM is not properly configured.
	B1152	Sidecar BAS high	
	B1153	Sidecar BAS out of range	
9	B1134	Starter output high	8.33 DTC B1134
10	B1121	Left turn output fault	8.30 TURN SIGNAL ERRORS
11	B1122	Right turn output fault	8.30 TURN SIGNAL ERRORS
12	B0563	Battery voltage high	8.31 DTC B0563
13	B1131	Alarm output low	8.32 DTC B1131, B1132
14	B1132	Alarm output high	8.32 DTC B1131, B1132
15	B1141	Ignition switch open/low	8.30 TURN SIGNAL ERRORS

Table 8-30. Symptoms That May Not Set Diagnostic Trouble Codes

SYMPTOM	SOLUTION
Fob signal to TSSM weak or fails	See 8.29 KEY FOB SIGNAL TO TSSM WEAK OR FAILS
Turn signal will not cancel or cancels erratically	See Turn Signal Error 1A in 8.30 TURN SIGNAL ERRORS
Turn signal flashes double normal rate, all bulbs good	See Turn Signal Error 3A in 8.30 TURN SIGNAL ERRORS

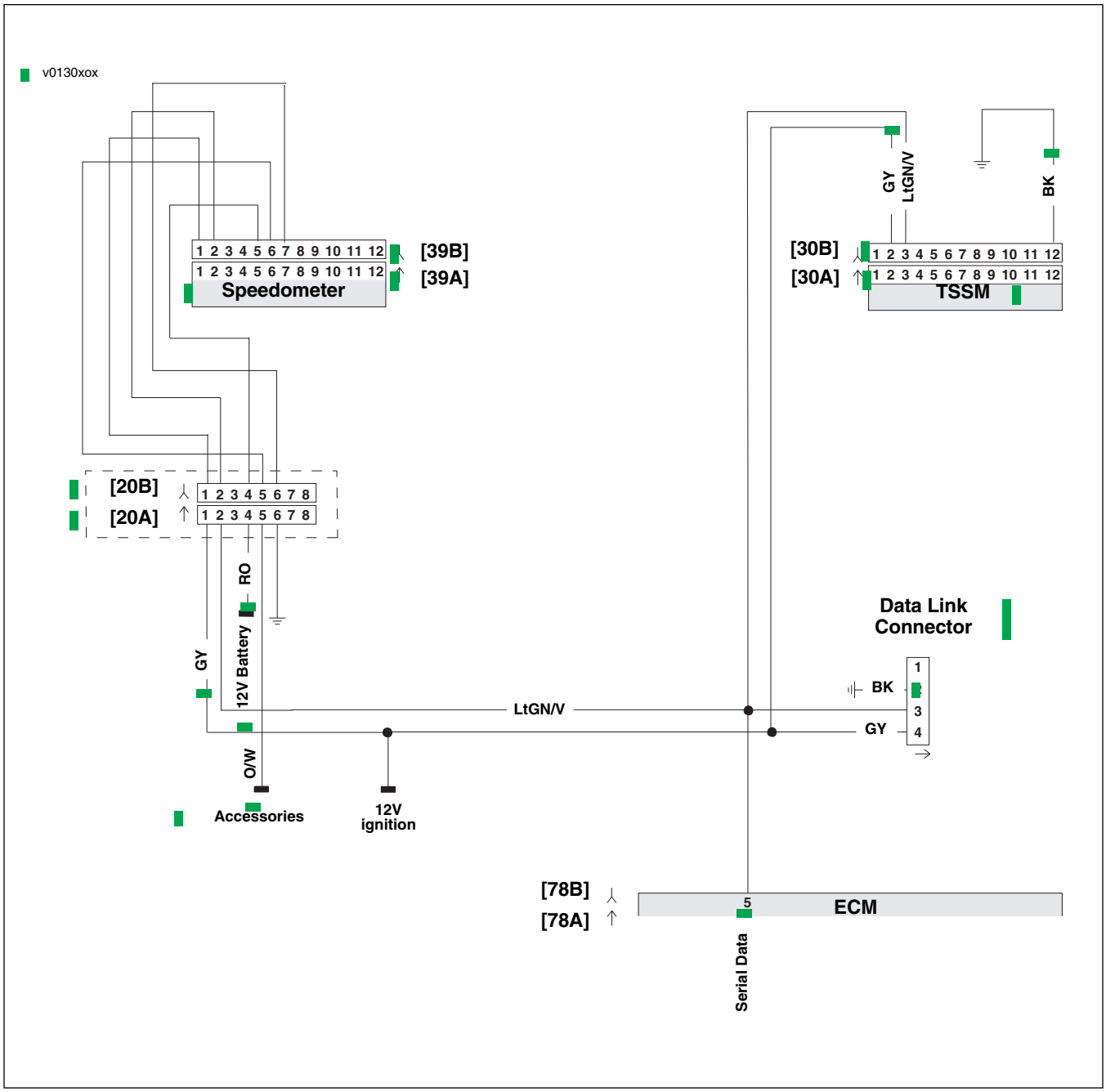
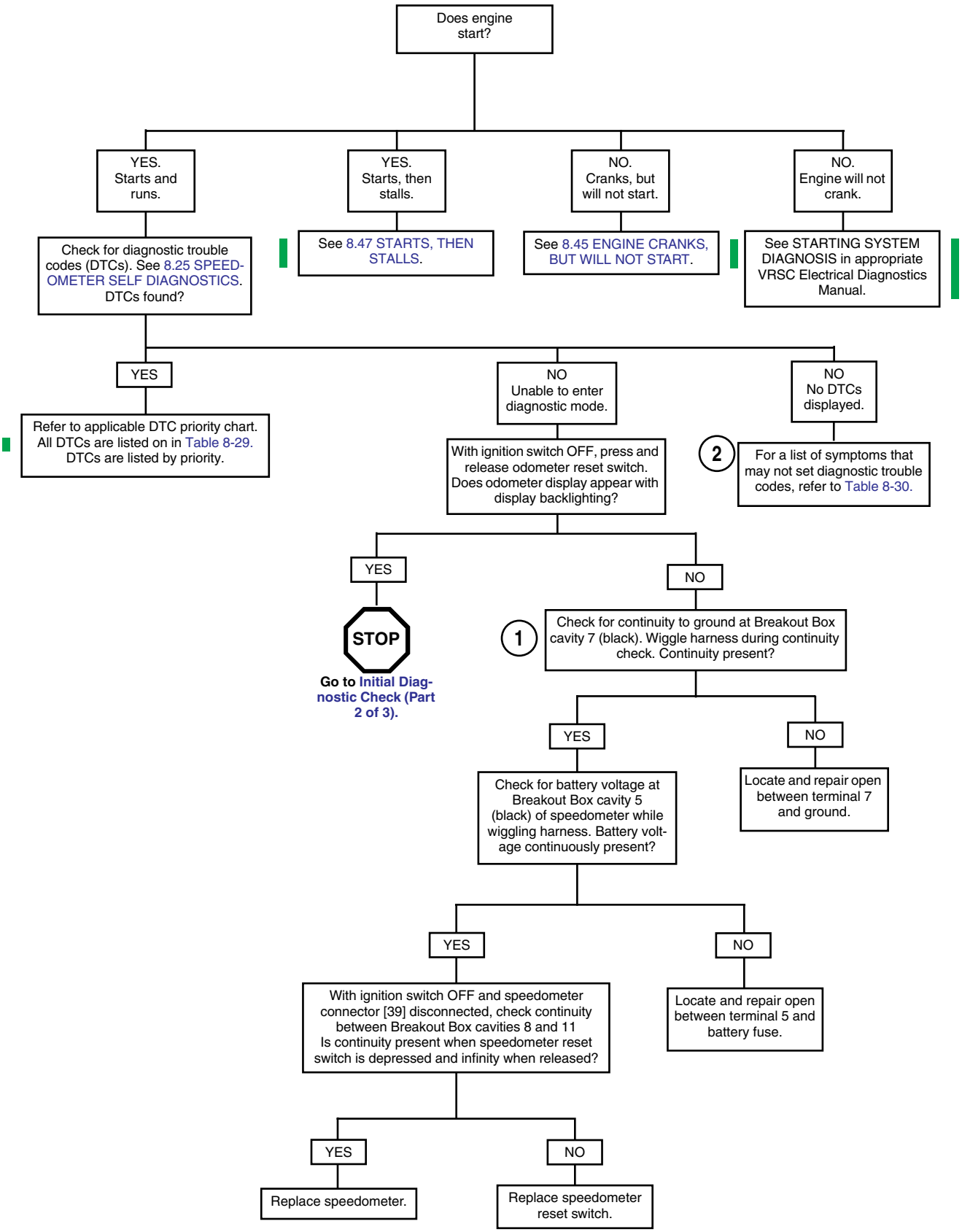


Figure 8-46. Diagnostic Check

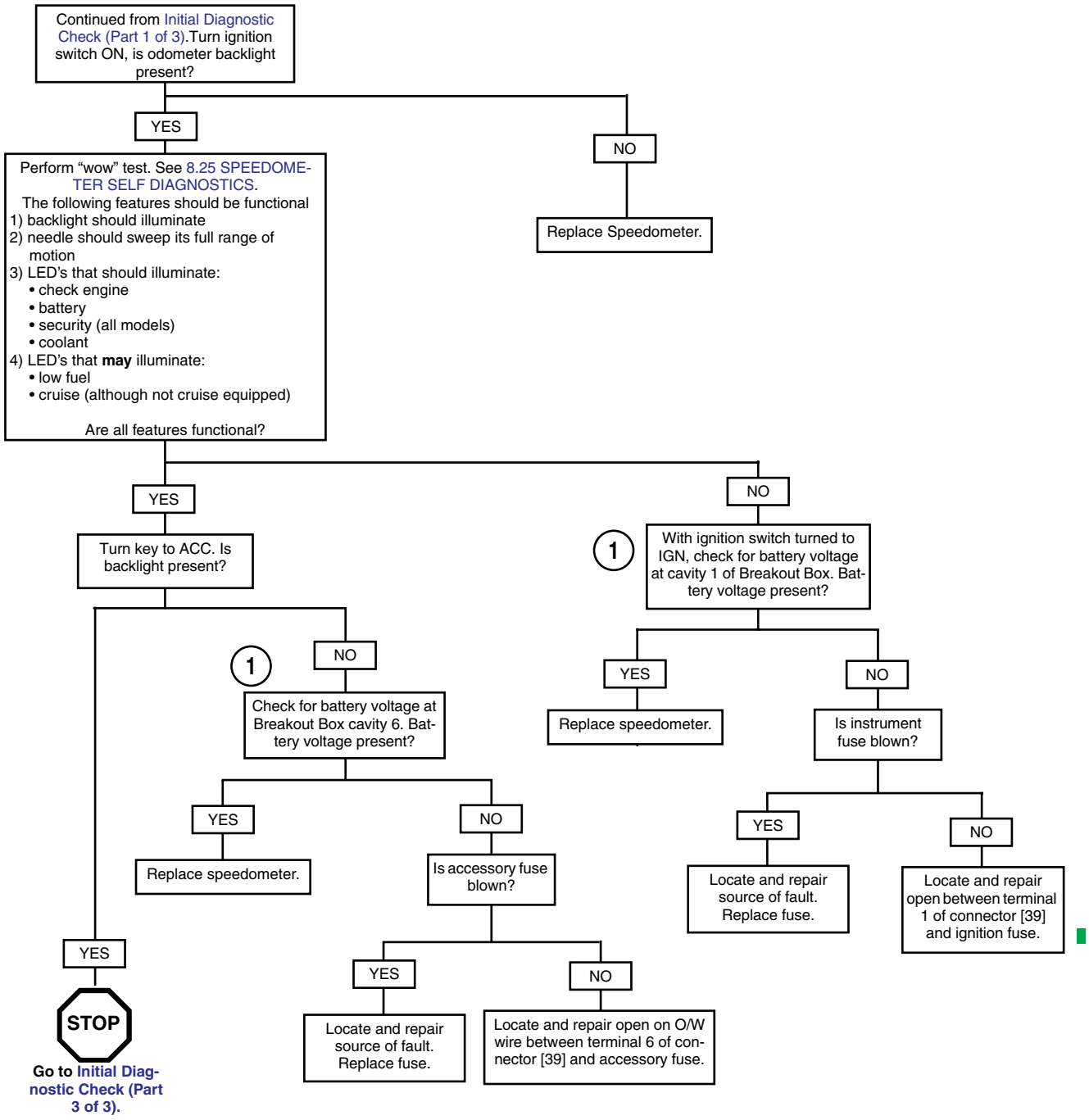
Table 8-31. Wire Harness Connectors in Figure 8-46.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

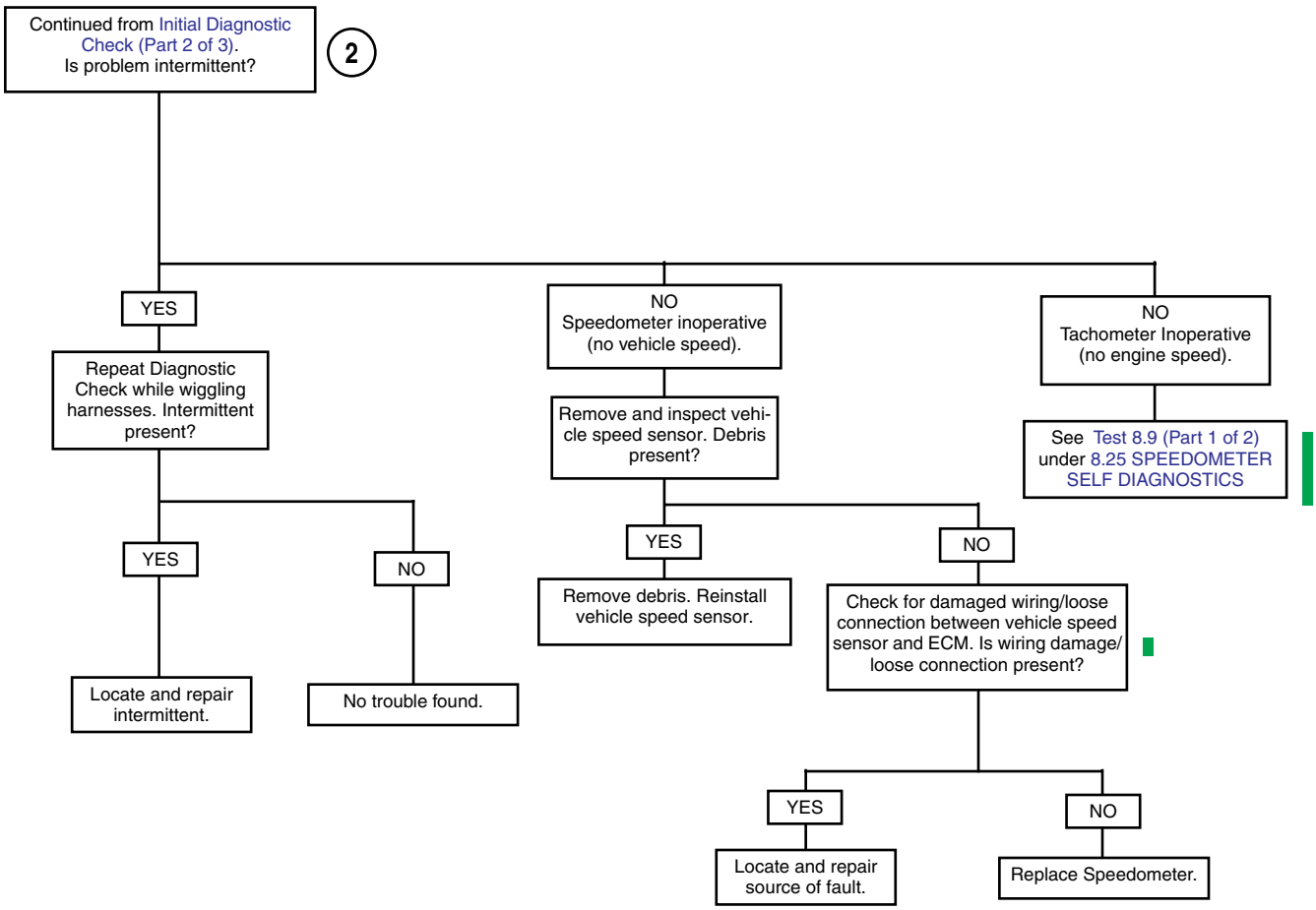
Initial Diagnostic Check 8.23 (Part 1 of 3)



Initial Diagnostic Check 8.23 (Part 2 of 3)



Initial Diagnostic Check 8.23 (Part 3 of 3)



SPEEDOMETER SELF DIAGNOSTICS 8.25

GENERAL

The speedometer is capable of displaying and clearing speedometer, TSSM, and ECM diagnostic trouble codes (DTCs) (diagnostic mode).

DIAGNOSTICS

Diagnostic Tips

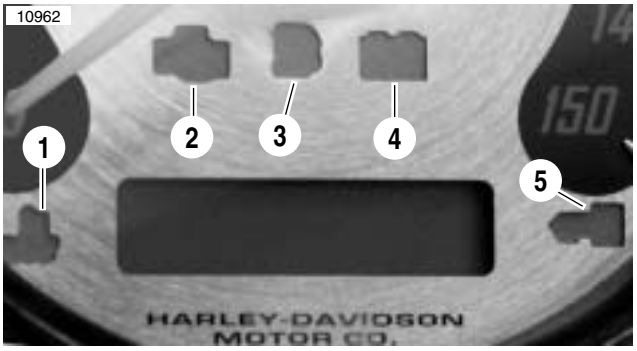
- For a quick check of speedometer function, a “wow” test can be performed. Press and hold odometer reset switch then turn ignition switch ON. Release reset switch. See Figure 8-47. Background lighting should illuminate, gauge needles should sweep their full range of motion, and indicator lamps [battery, coolant, security, low fuel, check engine and cruise] should illuminate. Some lamps may illuminate even though they do not apply to the vehicle. For example, the cruise lamp may illuminate although this feature does not apply to VRSCSE2 models.
- If speedometer fails “wow” test, check for battery, ground, ignition, speedometer reset switch and accessory wiring to speedometer. If any feature in the speedometer is non-functional, see 8.44 INITIAL DIAGNOSTIC CHECK.

Diagnostic Notes

Use of speedometer self diagnostics assumes that DIGITAL TECHNICIAN (Part No. HD-44750) is not available.

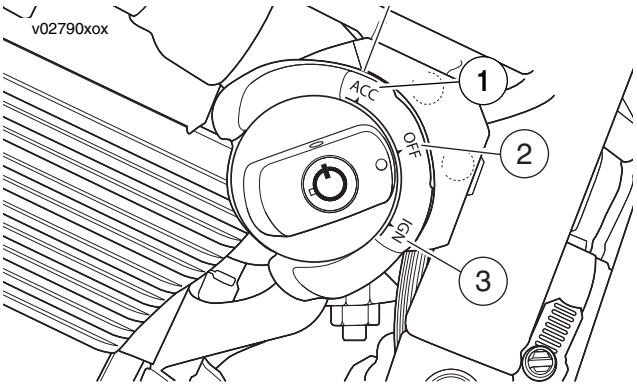
The reference numbers below correlate with the circled numbers in the Speedometer Self Diagnostics chart.

1. To exit diagnostic mode, turn ignition switch OFF.
2. To clear DTCs for the selected module, press the odometer reset switch for more than 5 seconds when a DTC is displayed. This procedure will clear all DTCs for the selected module.



1. **Coolant temperature**
2. **Check engine**
3. **Low fuel**
4. **Battery**
5. **Security**

Figure 8-47. Speedometer



1. **Accessory position**
2. **OFF position**
3. **Ignition position**

Figure 8-48. Ignition Switch

Speedometer Self Diagnostics

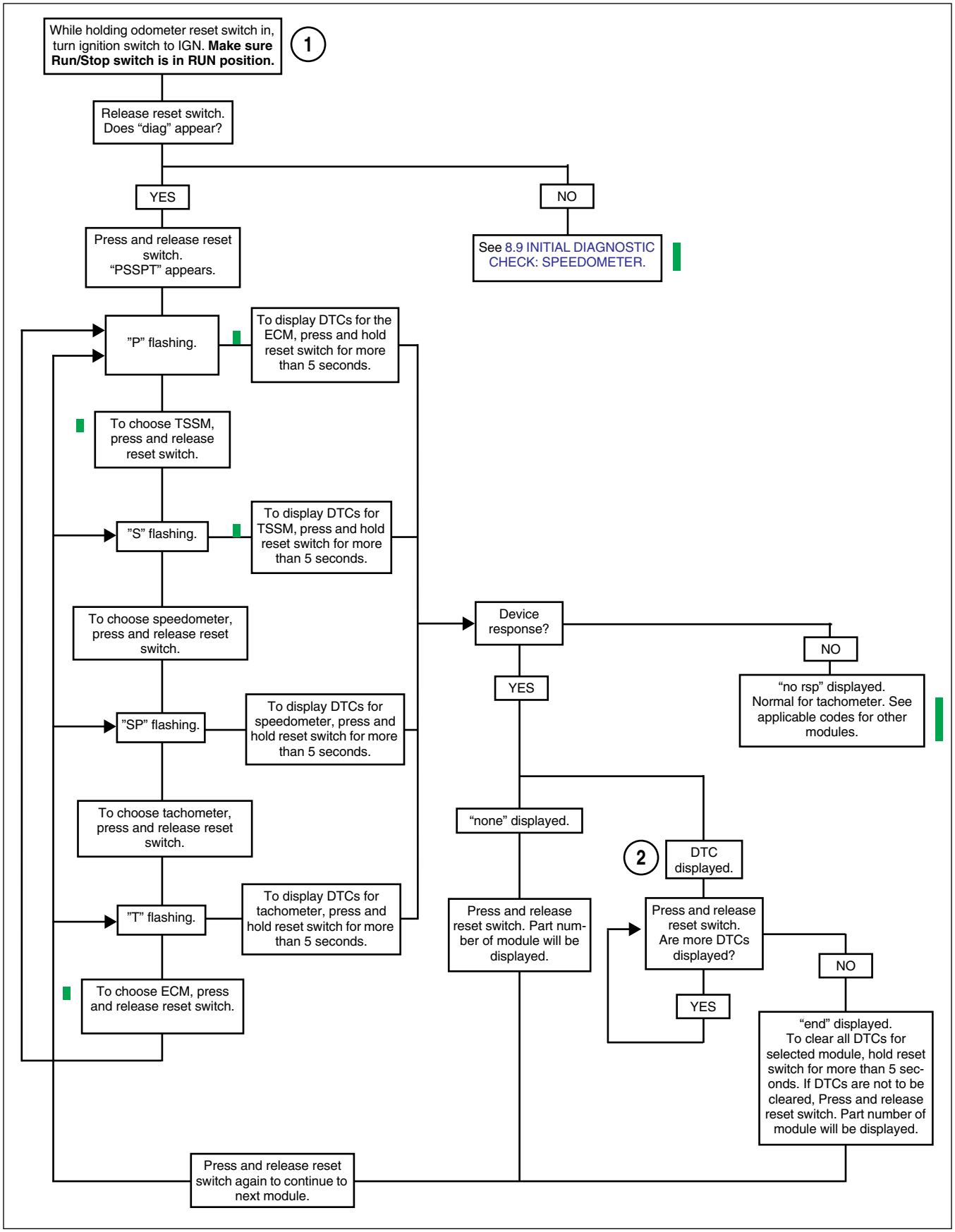


Figure 8-49. Speedometer Self Diagnostics

BREAKOUT BOX: TSSM 8.26

GENERAL

The BREAKOUT BOX (Part No. HD-42682) splices into the main harness. Used in conjunction with a digital volt/ohmmeter (DVOM), it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects.

INSTALLATION

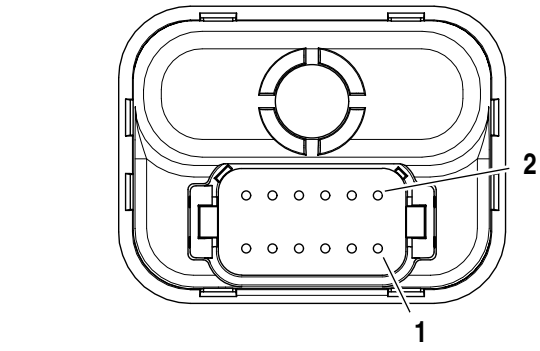
1. Gain access to TSSM. See VRSC Service Manual.
2. See Figure 8-50. Depress latches on connector [30B].
3. See Figure 8-51. Attach Breakout Box to connector.
   a. Mate gray socket housing on Breakout Box with TSSM connector [30A].
   b. Mate gray pin housing on Breakout Box with wire harness connector [30B].

REMOVAL

1. See Figure 8-50. Depress latches on connector [30B].
2. Detach gray Breakout Box connector from TSSM connector [30A].
3. Detach gray Breakout Box connector from wire harness connector [30B].
4. Reinstall TSSM. See the VRSC Service Manual.
5. Install parts removed for access.

NOTE

Vehicle will not start with TSSM disconnected or incorrectly mounted.



1. **Terminal 1**
2. **Terminal 12**

Figure 8-50. TSSM Connector Pins

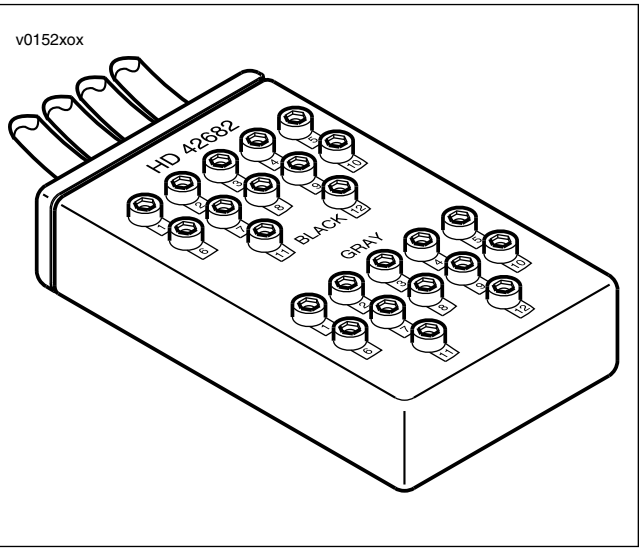


Figure 8-51. Breakout Box: TSSM

Table 8-32. TSSM Connector [30B]

TERMINAL	FUNCTION	TERMINAL	FUNCTION
1	Battery	7	Right turn switch input
2	Ignition	8	Left turn switch input
3	serial data	9	Start relay control
4	Security indicator lamp	10	Ignition enable signal (not used)
5	Left turn feed	11	Alarm signal
6	Right turn feed	12	Ground

NO SECURITY LAMP AT KEY ON 8.27

GENERAL

No TSSM Power (Security Equipped Vehicles Only)

See Figure 8-52. When the Ignition/Light Key Switch is turned to IGNITION, the security lamp should illuminate for 4 seconds. Following the initial period of illumination, the lamp should go off for 4 seconds. It may then come back on for an 8 second period, indicating a historic diagnostic trouble code (DTC) or remain on, indicating a current DTC.

Power and ground are supplied to the Security lamp from the speedometer circuitry. The TSSM activates an LED driver circuit in the speedometer to illuminate the security lamp. A lack of power to the TSSM will cause the security lamp to be inoperative and will also create a no start situation.

DIAGNOSTICS

Diagnostic Tips

- Check for open in BN/V wire.
- Check for blown battery fuse. See Figure 8-53.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. Connect BREAKOUT BOX (Part No. HD-42682) (gray) as follows:
   a. Mate gray socket housing on Breakout Box with TSSM connector [30A].
   b. Mate gray pin housing on Breakout Box with wire harness connector [30B].
2. Connect BREAKOUT BOX (Part No. HD-42682) (black) as follows:
   a. Mate black socket housing on Breakout Box with speedometer connector [39A] (at the back of the speedometer) using INSTRUMENT HARNESS ADAPTERS (Part No.HD-46601).
   b. Mate black pin housing on Breakout Box with wire harness connector [39B] using INSTRUMENT HARNESS ADAPTERS (Part No.HD-46601).
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple pin probe and patch cord between breakout Breakout Box and ground. Align blade with slot in terminal of Breakout Box.
4. Security lamp failure requires speedometer replacement. See the VRSC Service Manual.

Figure 8-52. Security Lamp

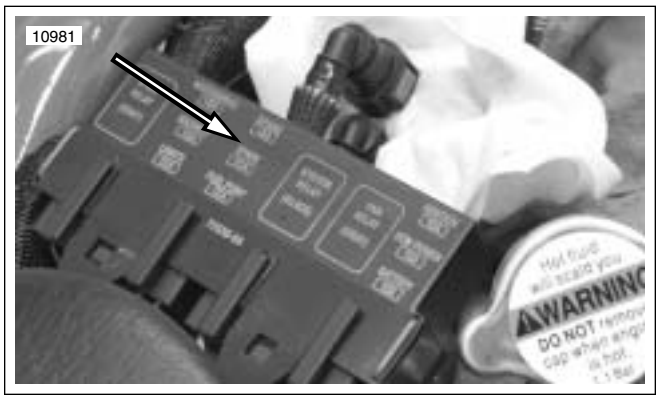


Figure 8-53. Fuse Block Location: Typical

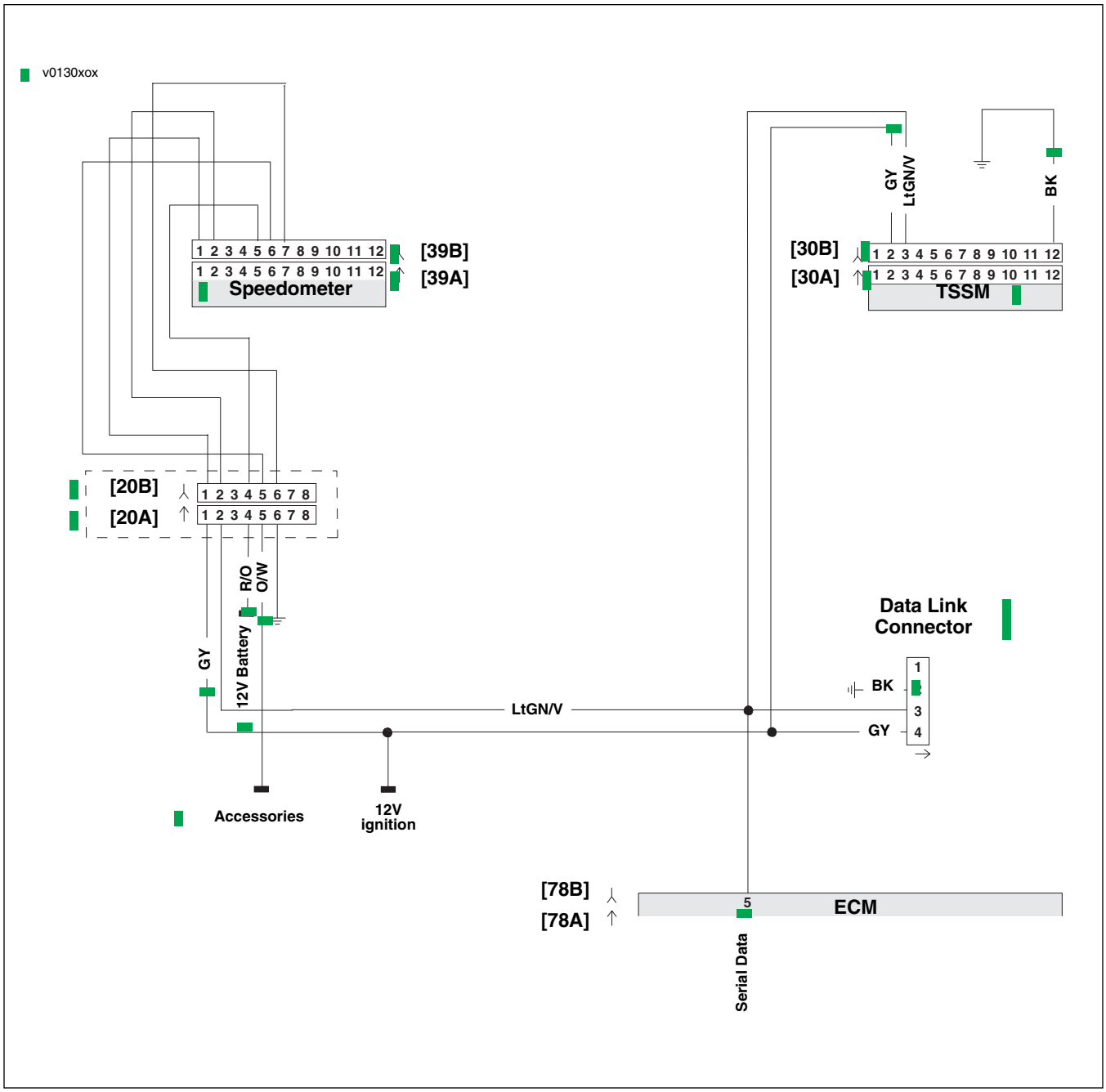


Figure 8-54. Security Lamp Circuit

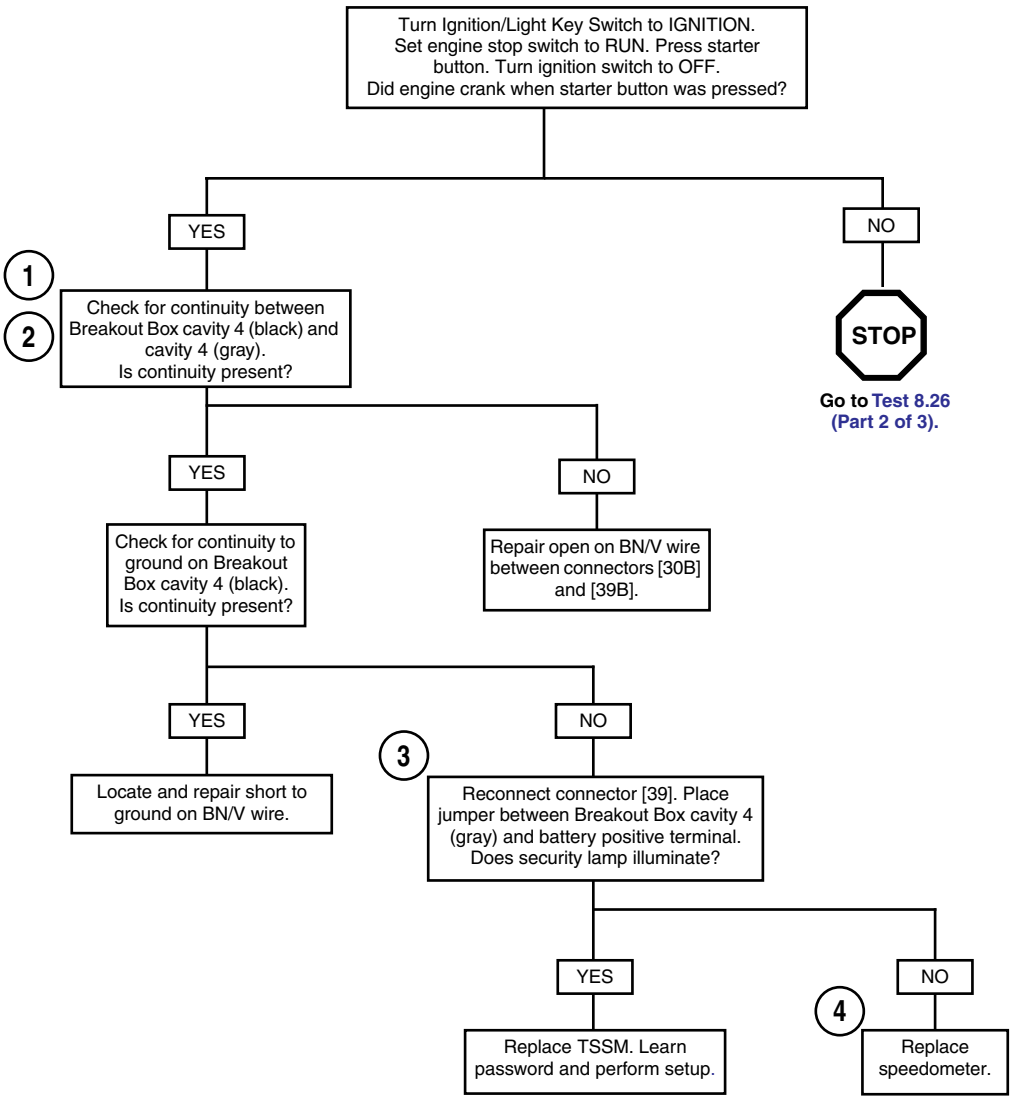
Table 8-33. Wire Harness Connectors in Figure 8-54.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Test 8.26 (Part 1 of 3)

NO SECURITY LAMP AT KEY ON

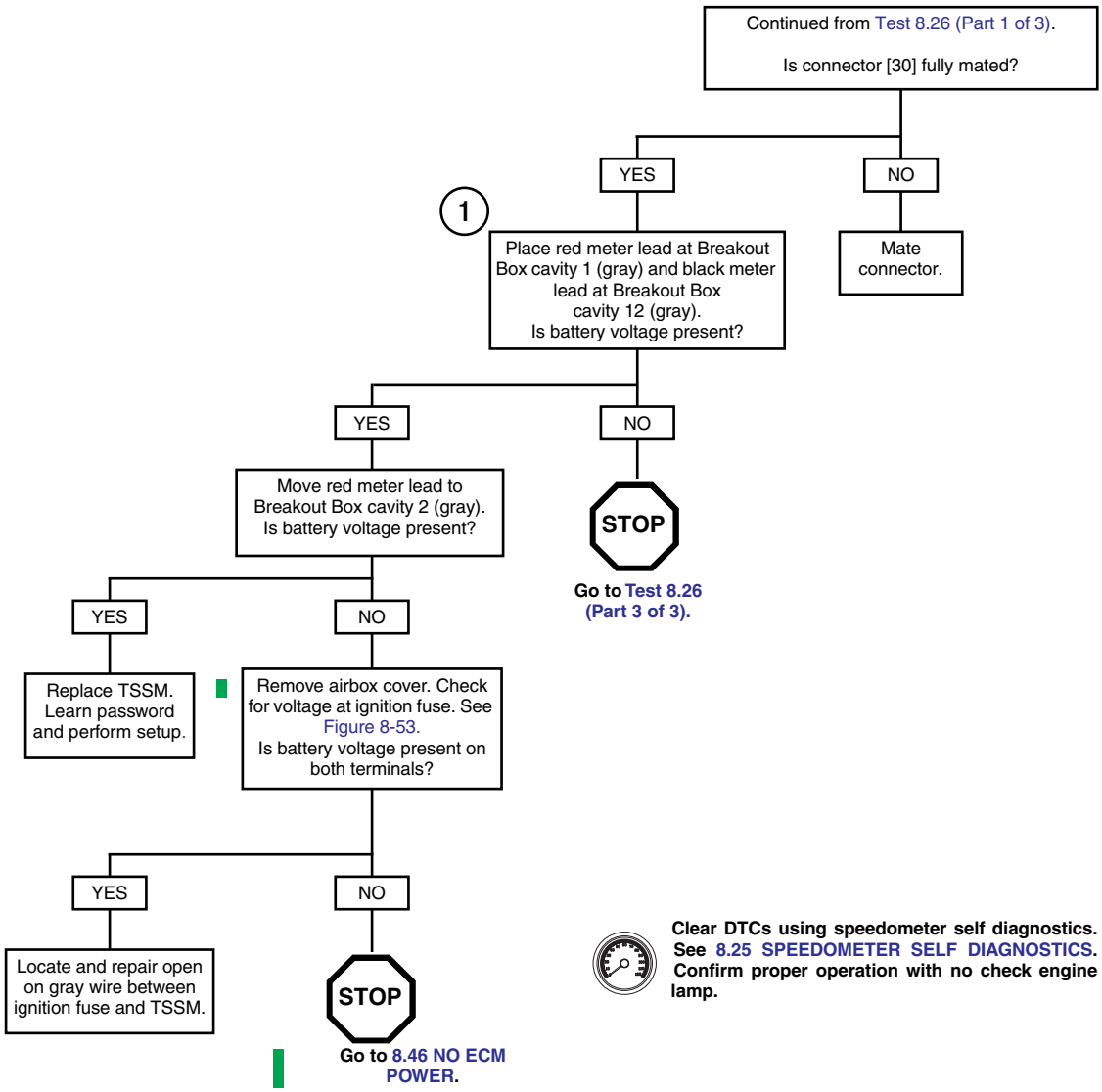
Security equipped vehicles only.



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

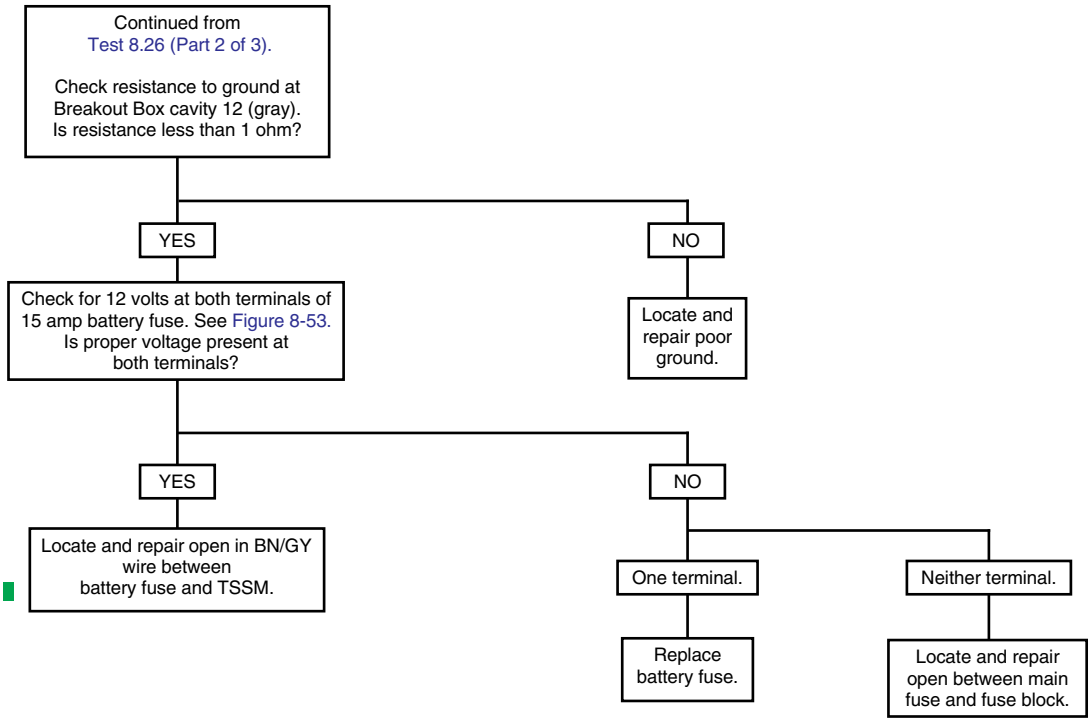
Test 8.26 (Part 2 of 3)

NO SECURITY LAMP AT KEY ON



Test 8.26 (Part 3 of 3)

NO SECURITY LAMP AT KEY ON



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

SECURITY LAMP ON CONTINUOUSLY 8.28

GENERAL

See Figure 8-55. When the Ignition/Light Key Switch is turned to IGNITION, the security lamp should illuminate for 4 seconds. Following the initial period of illumination, the lamp should go off for 4 seconds. It may then come back on for an 8 second period, indicating a historic diagnostic trouble code (DTC) or remain on, indicating a current DTC.

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

Figure 8-55. Security Lamp

DIAGNOSTICS

Diagnostic Notes

The reference number below correlates with the circled number on the flow chart.

1. Connector [39B] is on the back of the speedometer. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black pin probe and patch cord.

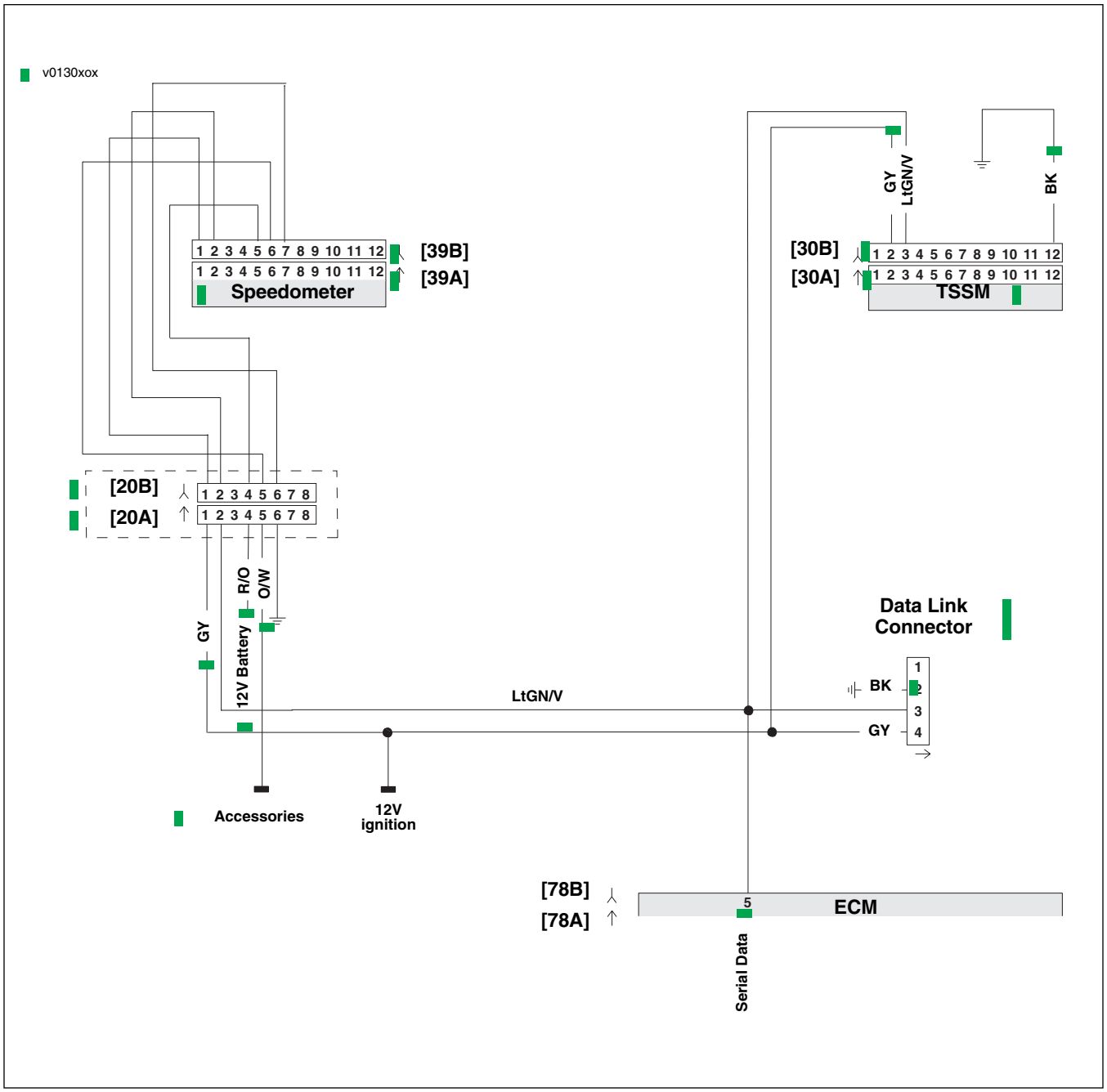


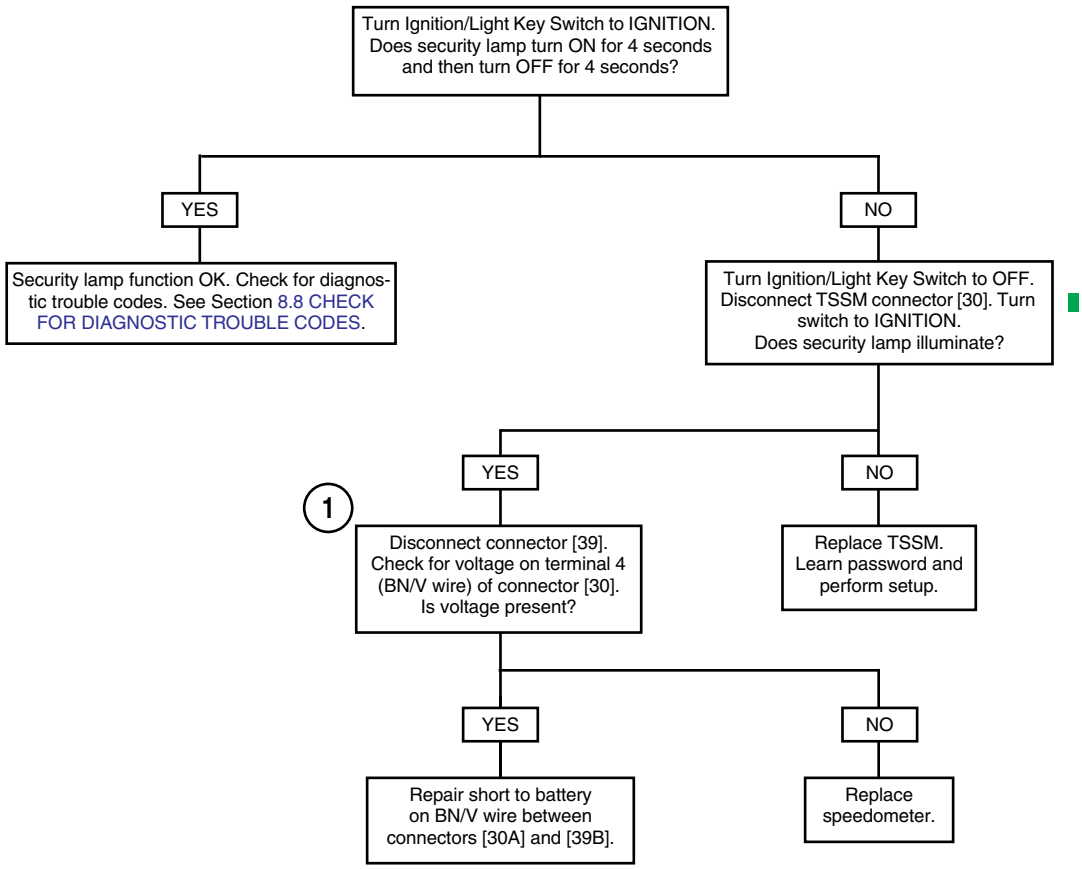
Figure 8-56. Security Lamp Circuit

Table 8-34. Wire Harness Connectors in Figure 8-56.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Test 8.27

SECURITY LAMP ON CONTINUOUSLY



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

KEY FOB SIGNAL TO TSSM WEAK OR FAILS 8.29

GENERAL

Security Equipped Vehicles Only

This section applies only to those vehicles equipped with the optional security system.

NOTE

*Disarming function may require practice. The key fob button **must** be pressed twice within 1.5 seconds to send the disarm command. The action is very similar to double-clicking a computer mouse. Light quick taps work best; very hard or very slow taps are less likely to work.*

See Figure 8-57. The key fob sends a RF signal to activate all remote TSSM functions. The left front turn signal switch wire serves as the vehicle's antenna. If the TSSM does not respond (no confirmation at arming/disarming system) or responds weakly (limited range, won't consistently arm/disarm or synchronize), follow the Test flow chart.

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

DIAGNOSTICS

Diagnostic Tips

- Verify key fob battery voltage is at least 2.9 volts. See 8.39 TSSM MAINTENANCE.
- Interference from physical surroundings may affect RF transmission. Place fob next to left handgrip and disarm with two clicks or move motorcycle to a new location and retest.
- Check for damage to antenna wire. Does left turn signal work?

NOTE

See 8.22 TSSM ARMING/DISARMING SECURITY SYSTEM. Use only the proper key fob for your market and TSSM package.

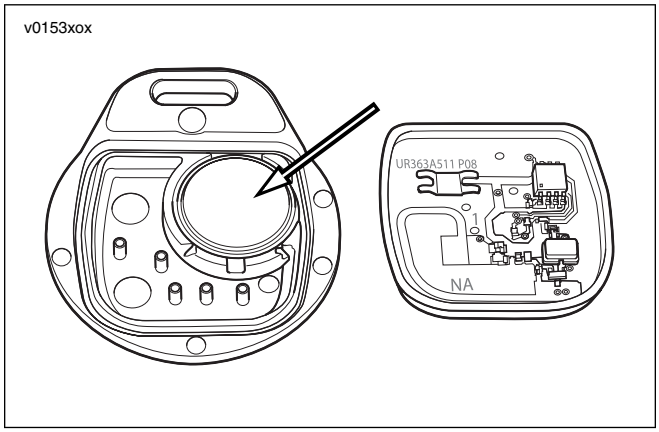


Figure 8-57. Key Fob Battery

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the flow chart.

1. After a battery disconnect, the TSSM will not enter the configuration mode on the first attempt. All attempts to assign a fob or enter the configuration mode will require at least two attempts.

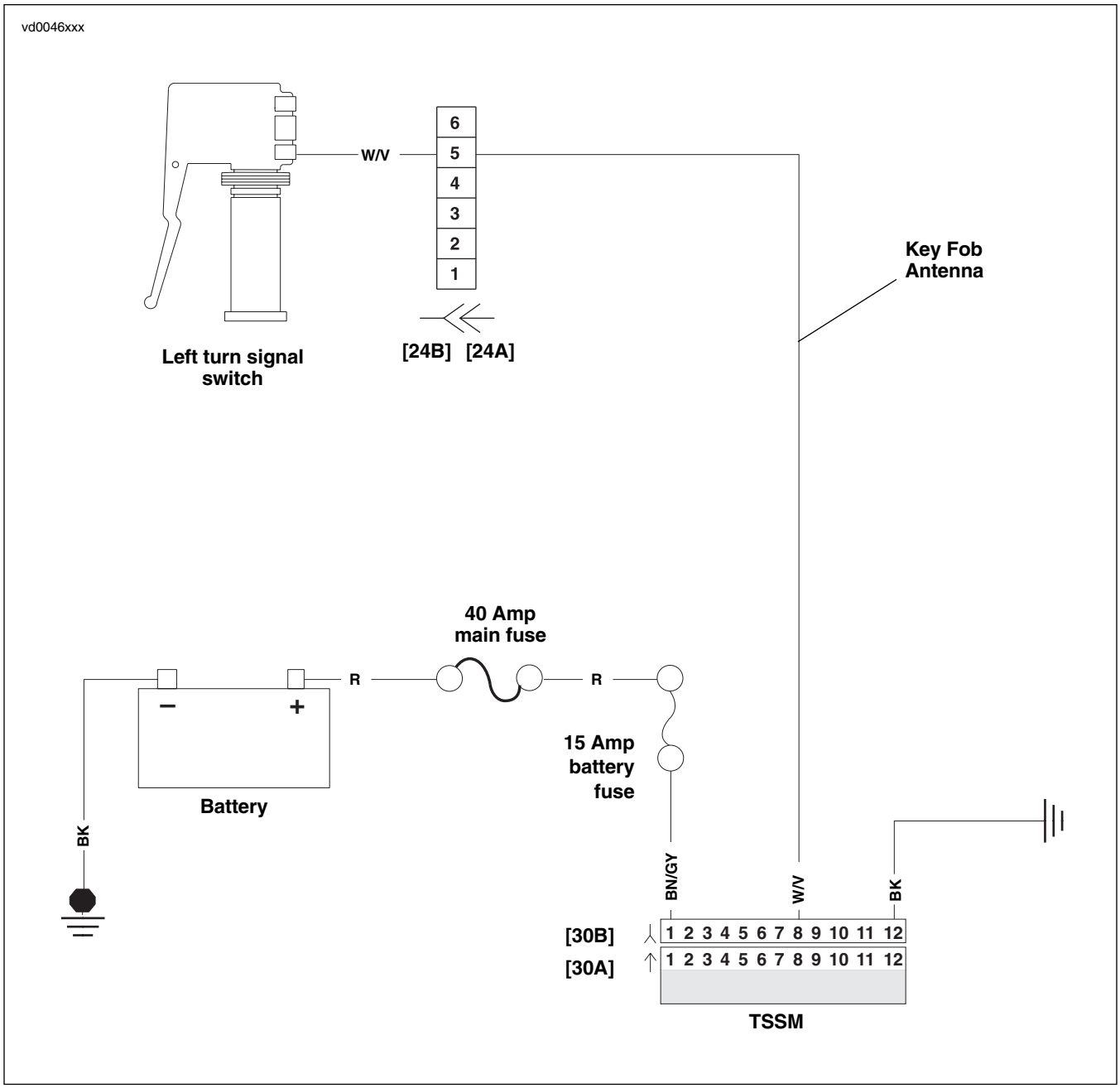


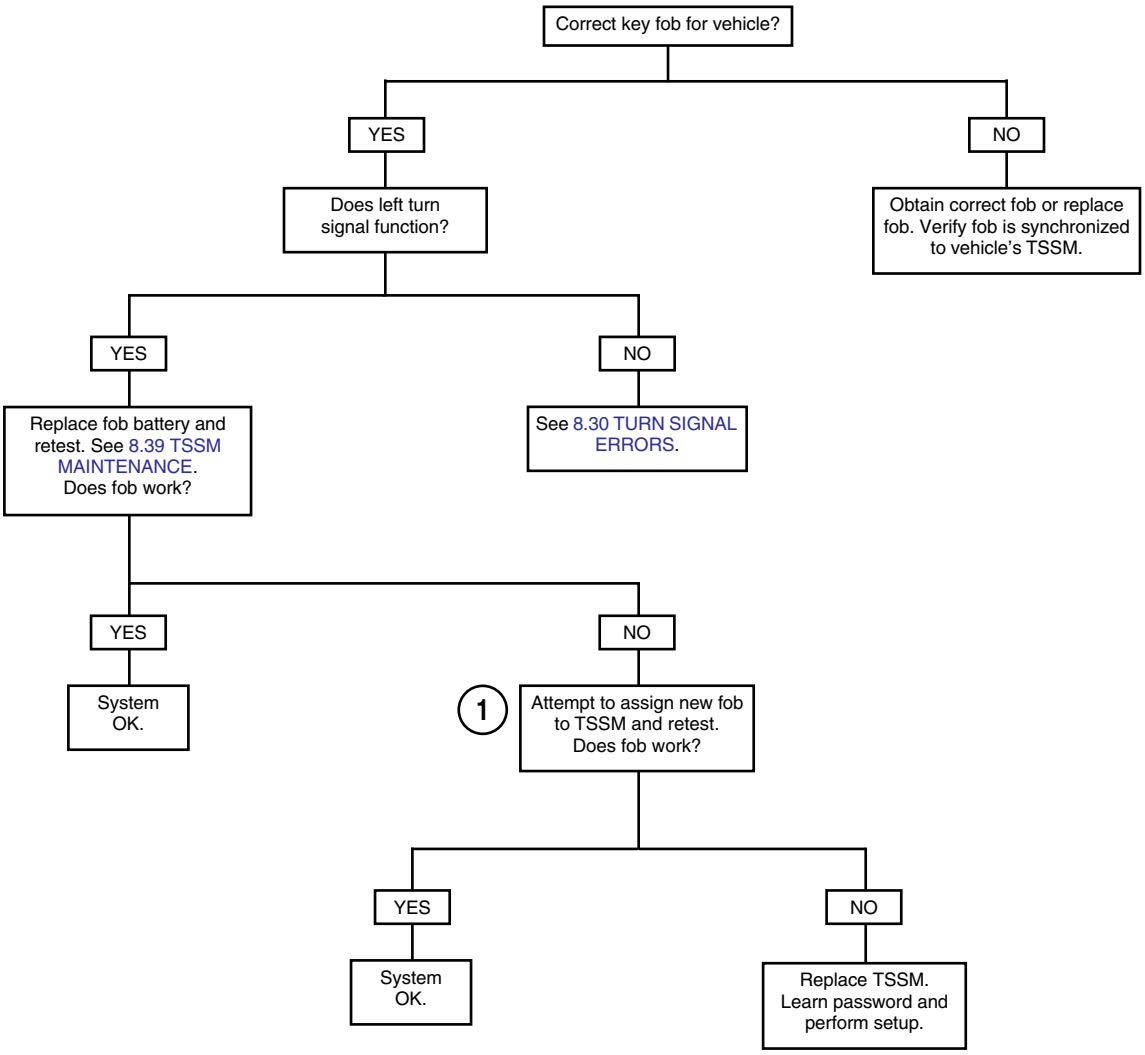
Figure 8-58. Antenna Circuit

Table 8-35. Wire Harness Connectors in Figure 8-58.

NO.	DESCRIPTION	TYPE	LOCATION
[24]	Left hand controls and horn	6-place Deutsch	Under left side cover
[30]	TSSM	12-place Deutsch	Passenger seat

Test 8.28

FOB SIGNAL TO TSSM WEAK OR FAILS



TURN SIGNAL ERRORS 8.30

GENERAL

The turn signals will automatically cancel either based on the speed/acceleration of the vehicle or based upon turn completion. See 8.30 TURN SIGNAL ERRORS

For turn signal diagnostics, refer to Table 8-36.

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

DIAGNOSTICS

Diagnostic Tips

- Diagnostic trouble code DTC B1121 and B1122 will illuminate the security lamp.
- DTC B1141 will not illuminate the security lamp.
- When the TSSM is in four-way flasher mode, a fault on either the left or right turn lamp output will not cause either DTC B1121 and DTC B1122 to be set. If fault occurs on both left and right outputs, then both DTC B1121 and DTC B1122 will be set.
- When the TSSM detects an over current or short to ground condition, it will turn off the turn lamp outputs. The outputs will be automatically reactivated once the fault is removed.

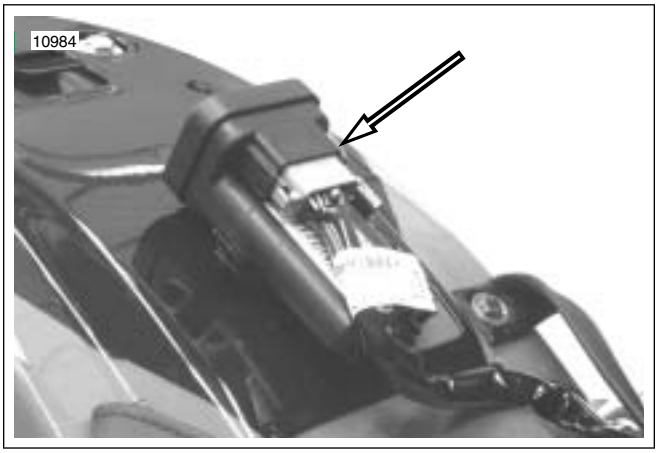


Figure 8-59. TSSM (typical)

Table 8-36. Turn Signal Errors

SYMPTOM	START WITH FLOW CHART	DTC(S)
Turn signals will not cancel upon turn completion	Turn Signal Error 1A (Part 1 of 2)	N/A
Turn signals cancel erratically	Turn Signal Error 1A (Part 2 of 2)	N/A
Turn signals will not flash, 4-way flashers inoperable	Turn Signal Error 2A	B1121, B1122, B1141
Left or right turn signals flash at double the normal rate while all bulbs are working	Turn Signal Error 3A	N/A

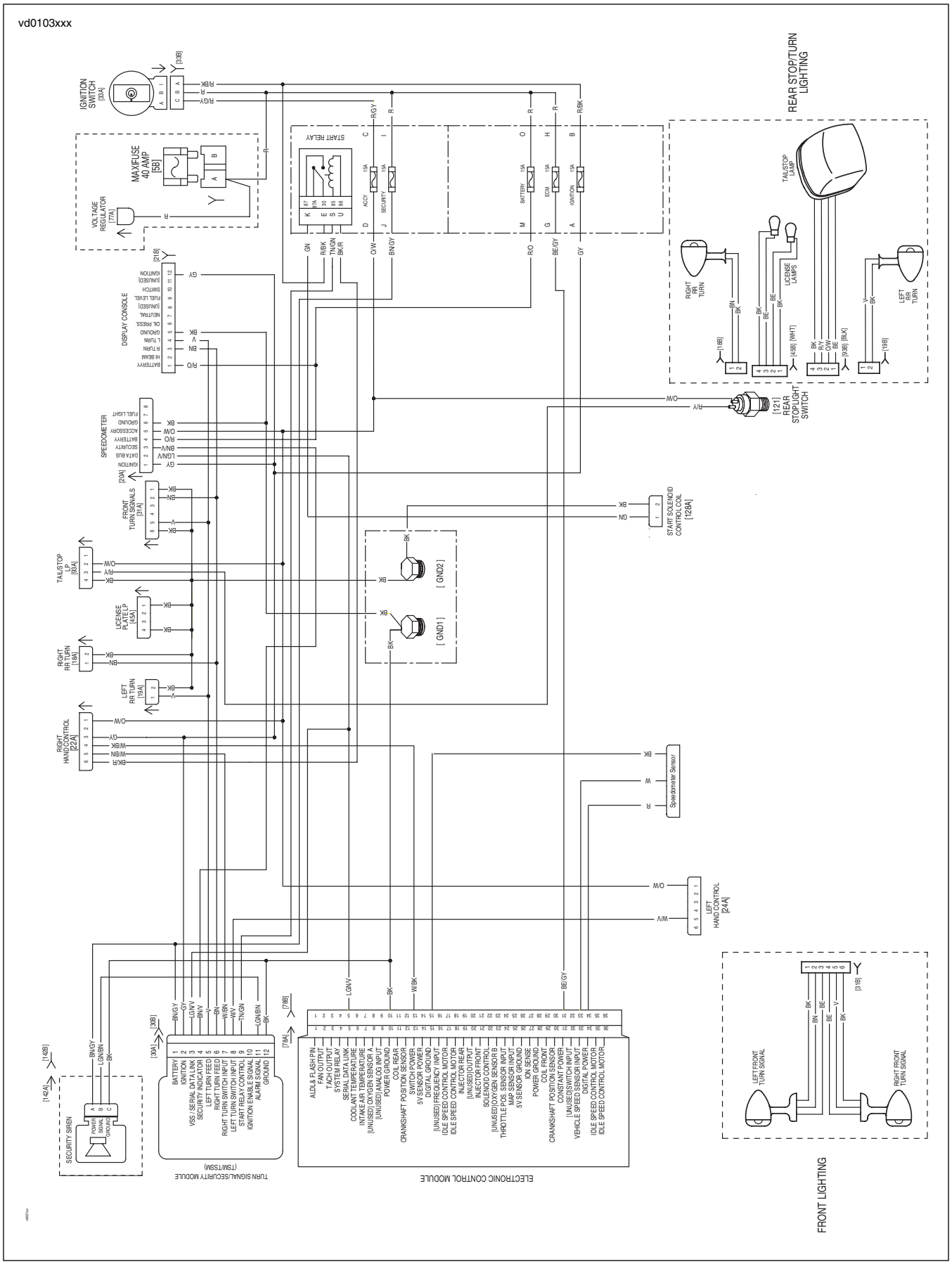


Figure 8-60. Turn Signal Circuit

Table 8-37. Wire Harness Connectors in Figure 8-60.

NO.	DESCRIPTION	TYPE	LOCATION
[19]	Left rear turn signal	2-place Multilock	inside tail lamp lens
[18]	Right rear turn signal	2-place Multilock	inside tail lamp lens
[22]	Right hand controls	6-place Deutsch	Inside left side cover
[24]	Left hand controls and horn	6-place Deutsch	Inside left side cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[31]	Front turn signals	6-place Multilock	Inside left side cover
[78]	Electronic control module (ECM)	36-place Packard	Under left side cover

Diagnostic Notes: All Turn Signal Flow Charts

The reference numbers below correlate with the circled numbers on the turn signal flow charts.

1. Gain access to vehicle's TSSM. Perform the following procedure:
   a. See Figure 8-62. Position TSSM in same orientation it is mounted on vehicle. Turn on ignition switch. Turn on 4-way flashers by depressing both left and right turn signal switches simultaneously. Turn ignition off; 4-way flashers should continue to flash.
   b. Tilt module greater than 45 degrees to the left.
   c. Repeat step a.
   d. Tilt module greater than 45 degrees to the right.
2. Connect SPEEDOMETER TESTER (Part No. HD-41354) to connector [65B]. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404):
   a. See Figure 8-66. Unplug harness connector [65B].
   b. Plug gray male probes into terminals B and C of harness connector [65B].
   c. Plug black female probes into terminals B and C of SPEEDOMETER TESTER (Part No. HD-41354).
   d. Connect jumper wire between probe on terminal B of connector [65B] and terminal B of Speedometer Tester. Connect second jumper wire between probe on terminal C of connector [65B] and terminal C of Speedometer Tester.
3. To enable diagnostic mode, see 8.25 SPEEDOMETER SELF DIAGNOSTICS.
4. Connect BREAKOUT BOX (Part No. HD-42682) (gray) between TSSM connector [30A] and wiring harness connector [30B]. See 8.26 BREAKOUT BOX: TSSM.
5. Closely inspect handlebar controls for pinched wiring.
6. Remove BREAKOUT BOX (Part No. HD-42682) (gray) from between TSSM connector [30A] and wiring harness connector [30B]. Reconnect [30].
7. Connect BREAKOUT BOX (Part No. HD-42682) (black) and 6-pin Harness Adapters (Part no. HD-42962) between wiring harness connector [24A] and left hand control harness connector [24B].
8. Connect BREAKOUT BOX (Part No. HD-42682) (black) and 6-pin Harness Adapters (Part no. HD-42962) between wiring harness connector [22A] and right hand control harness connector [22B].
9. Check for corrosion at rear lighting harness connector [7], front lighting harness connector [31] and TSSM [30].

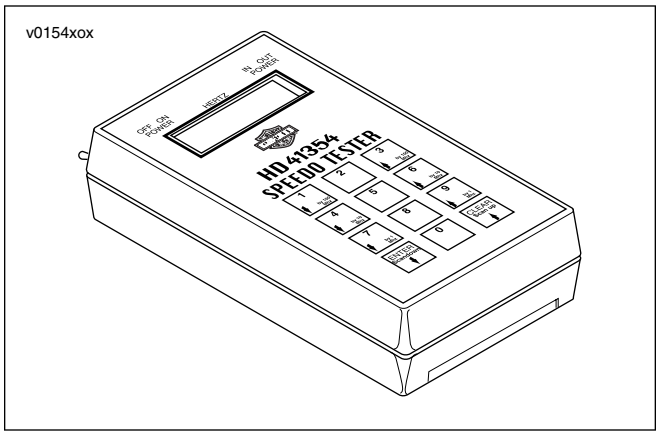
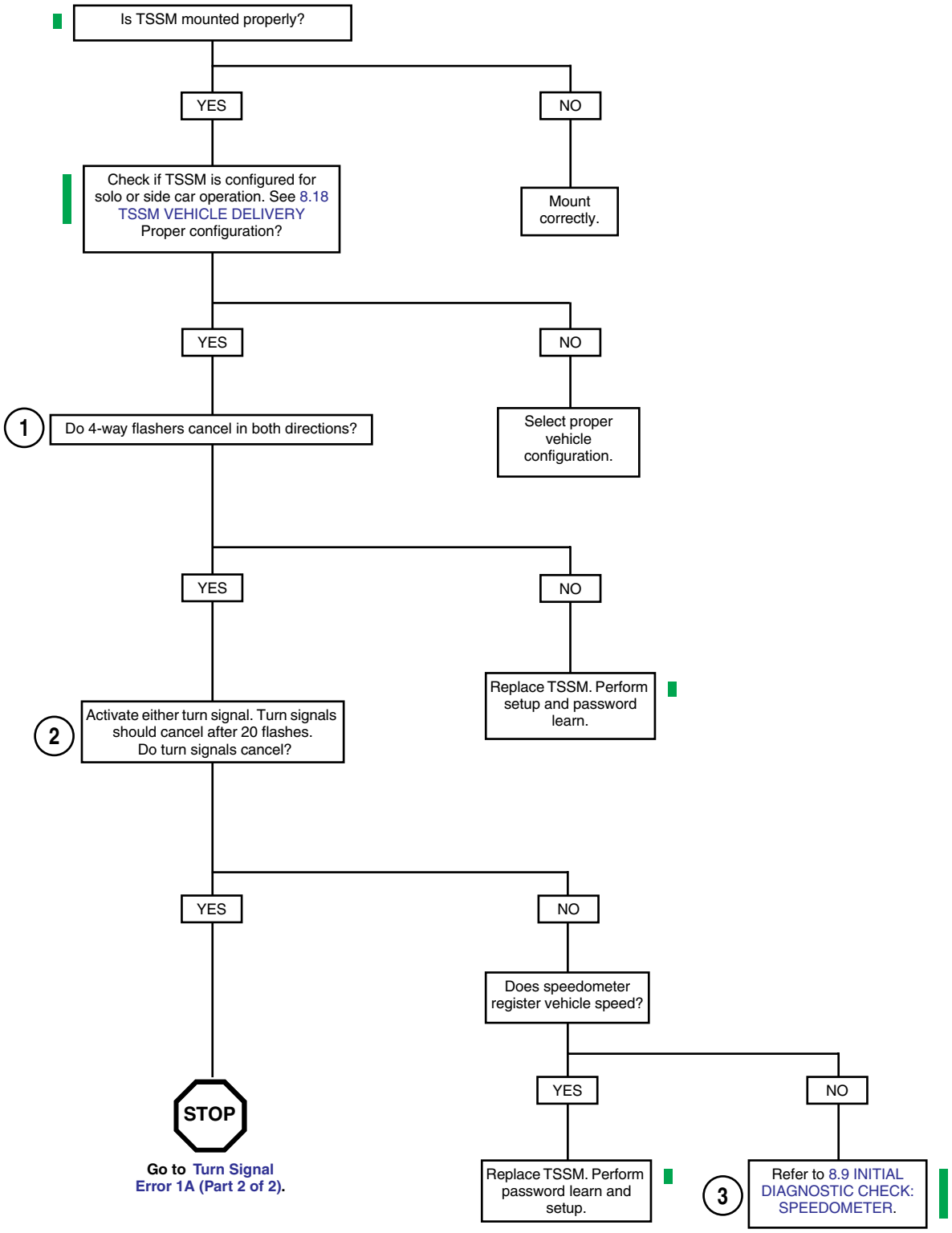


Figure 8-61. Speedometer Tester

Figure 8-62. Tilting TSSM

Turn Signal Error 1A (Part 1 of 2)

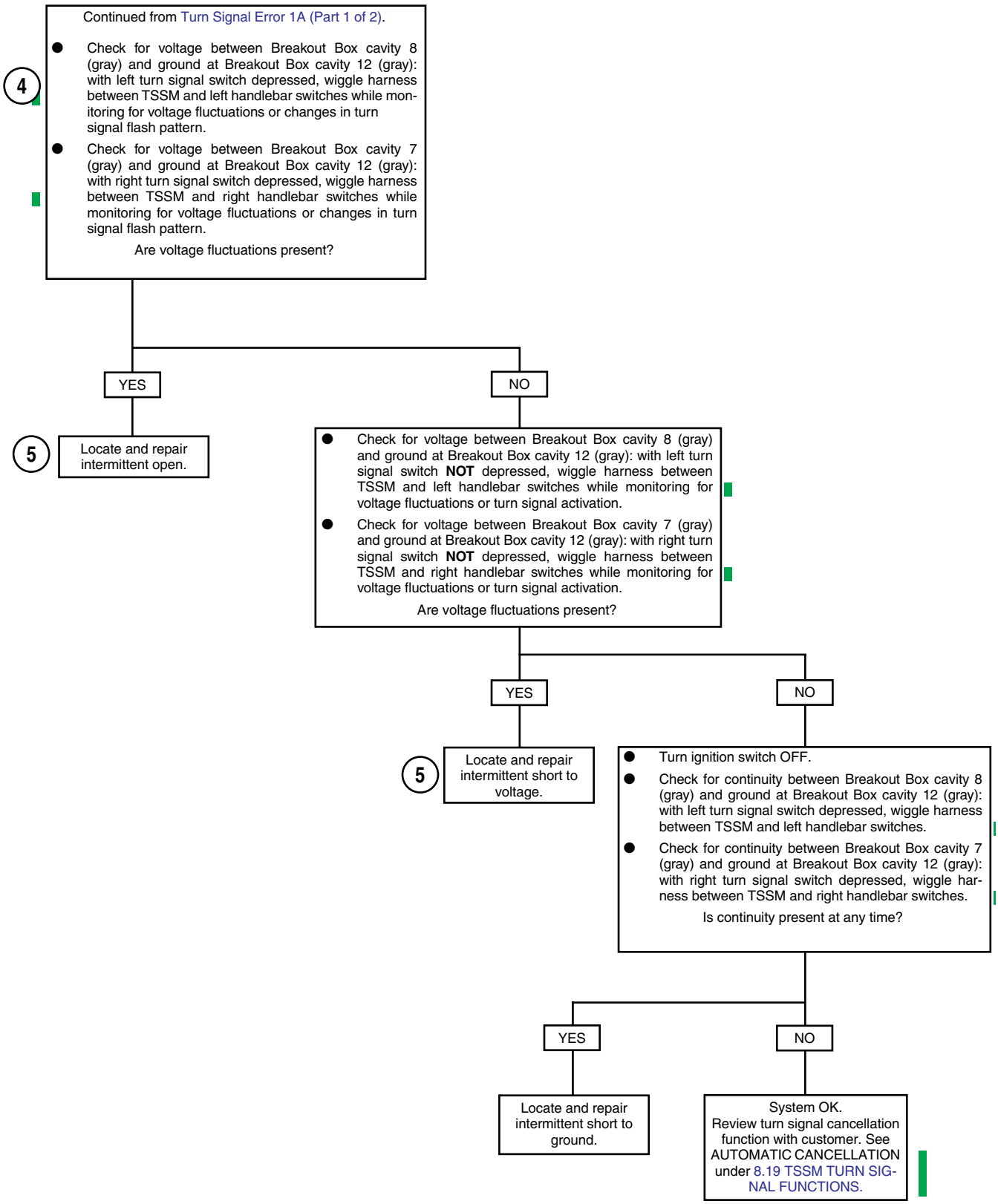
WILL NOT CANCEL UPON TURN COMPLETION



Go to Turn Signal Error 1A (Part 2 of 2).

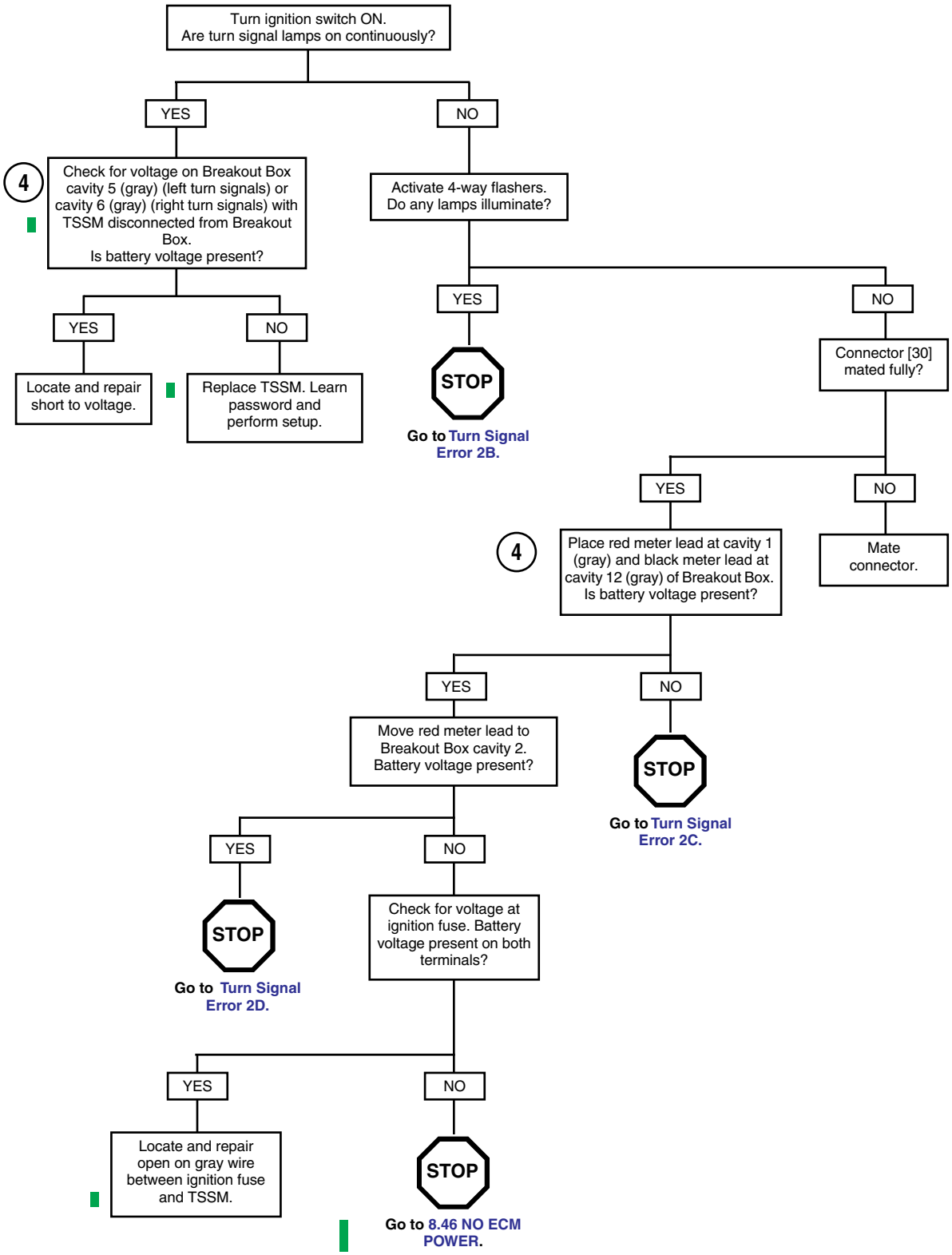
Turn Signal Error 1A (Part 2 of 2)

CANCELS ERRATICALLY



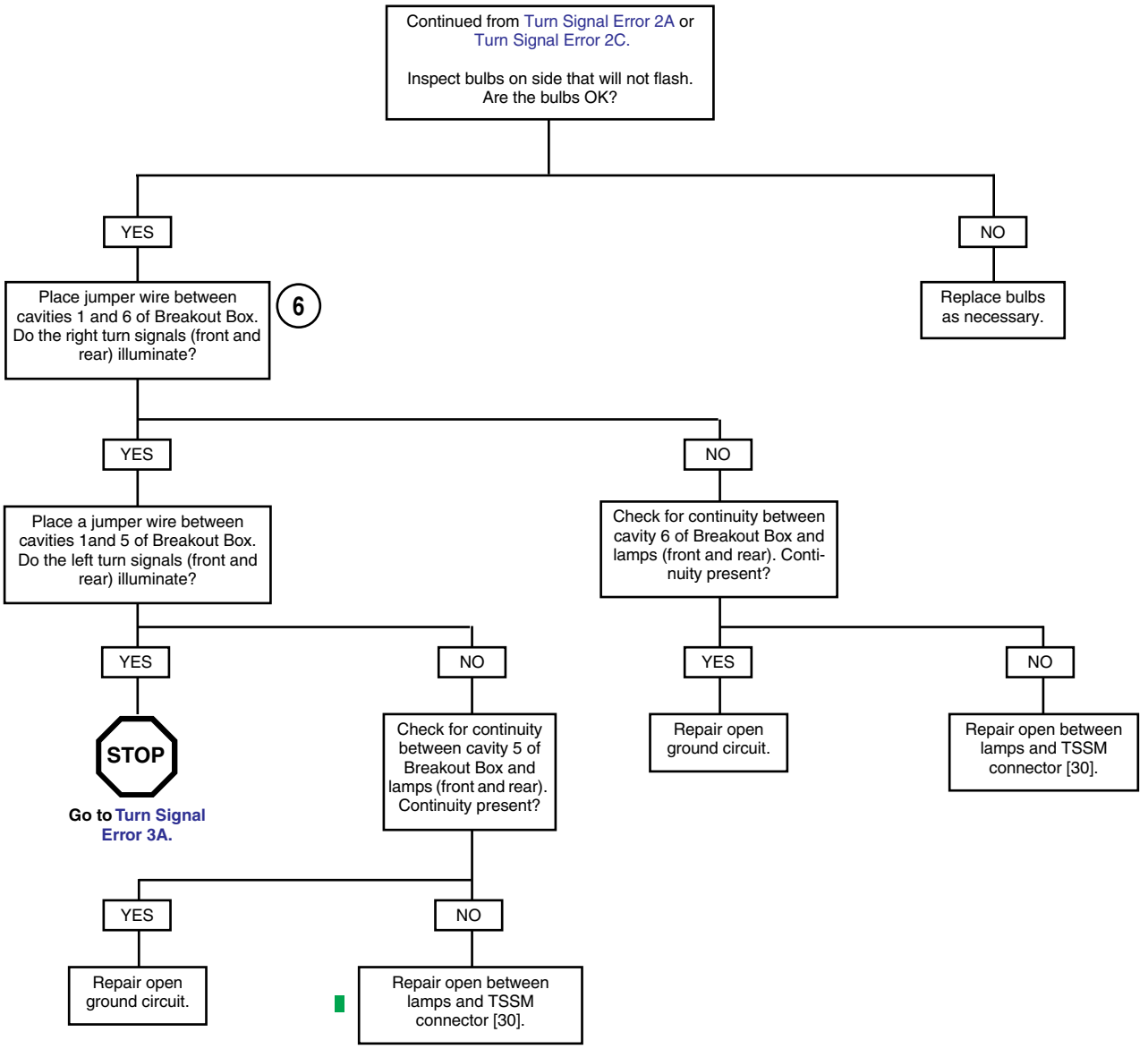
Turn Signal Error 2A

WILL NOT FLASH, 4-WAY FLASHERS INOPERABLE: DTC B1121, B1122, B1141



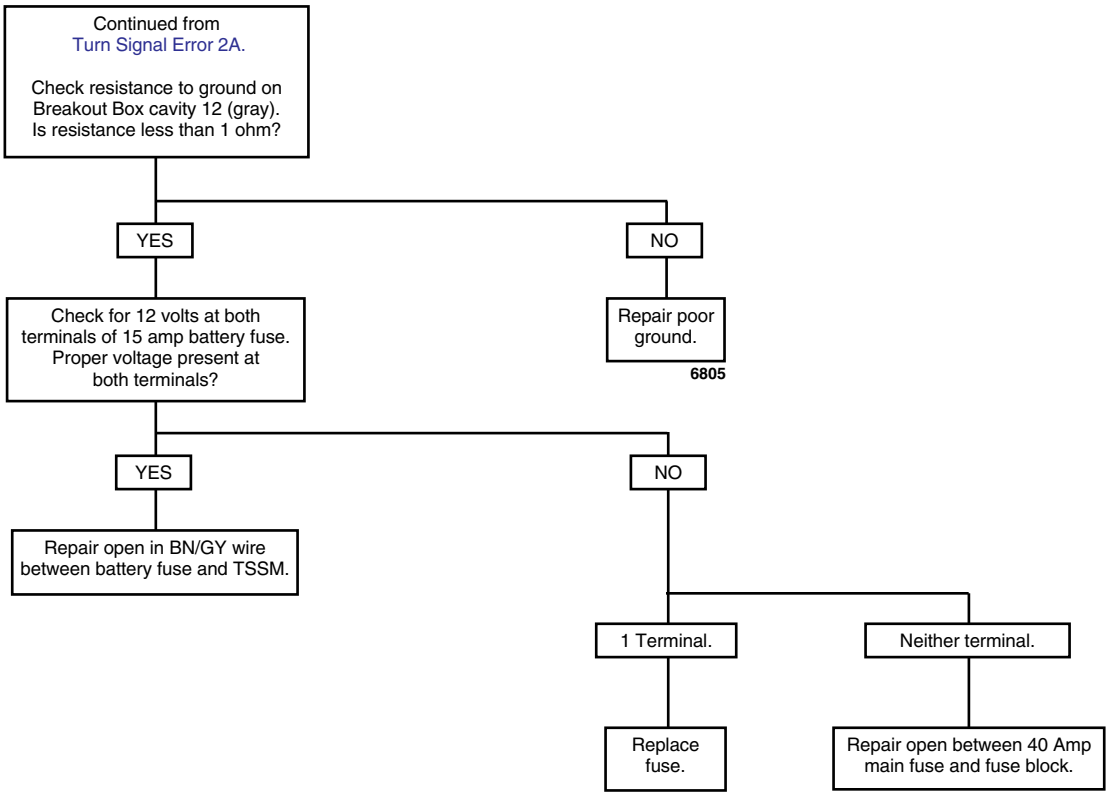
Turn Signal Error 2B

WILL NOT FLASH, 4-WAY FLASHERS INOPERABLE: DTC B1121, B1122, B1141



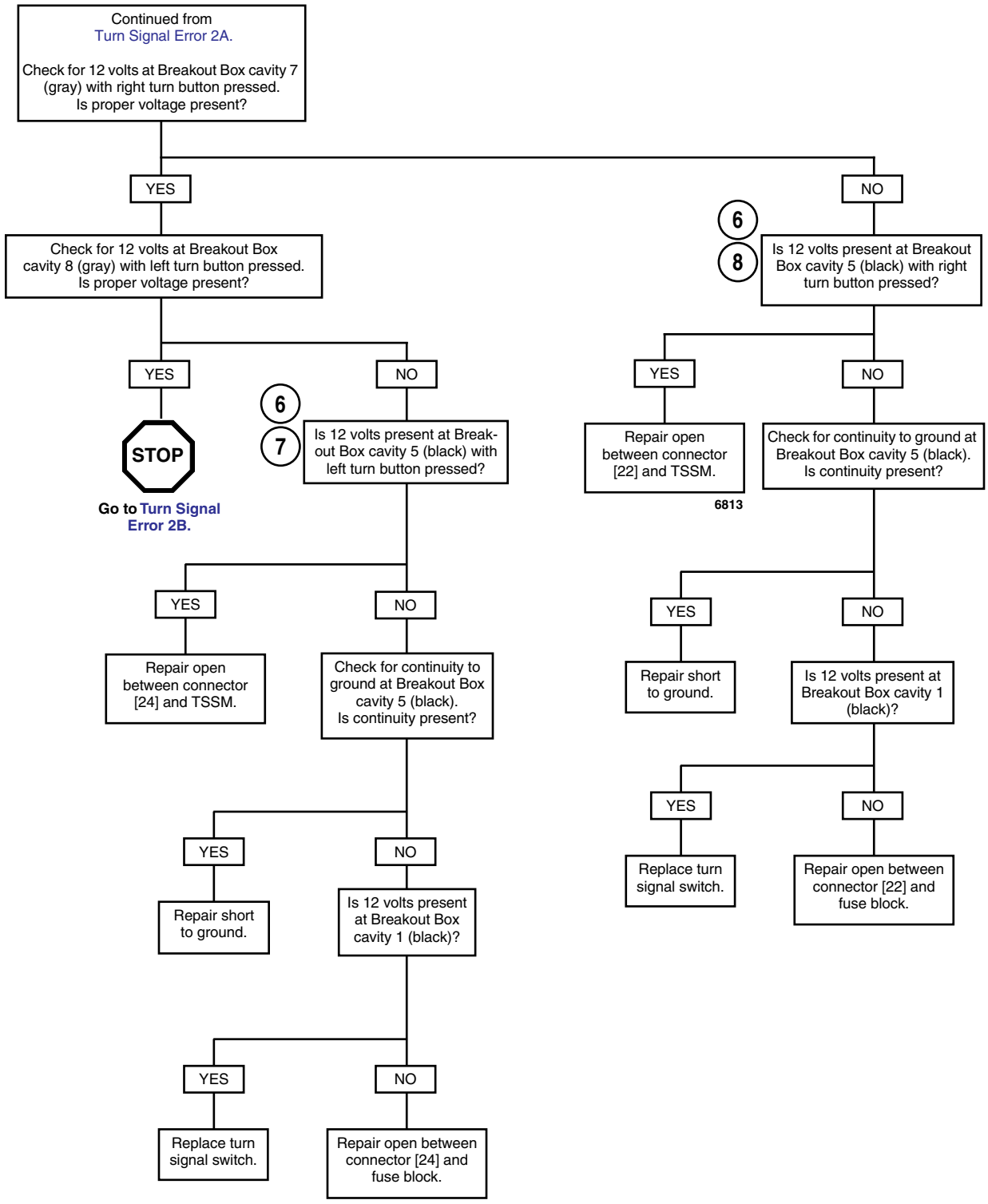
Turn Signal Error 2C

WILL NOT FLASH, 4-WAY FLASHERS INOPERABLE: DTC B1121, B1122, B1141



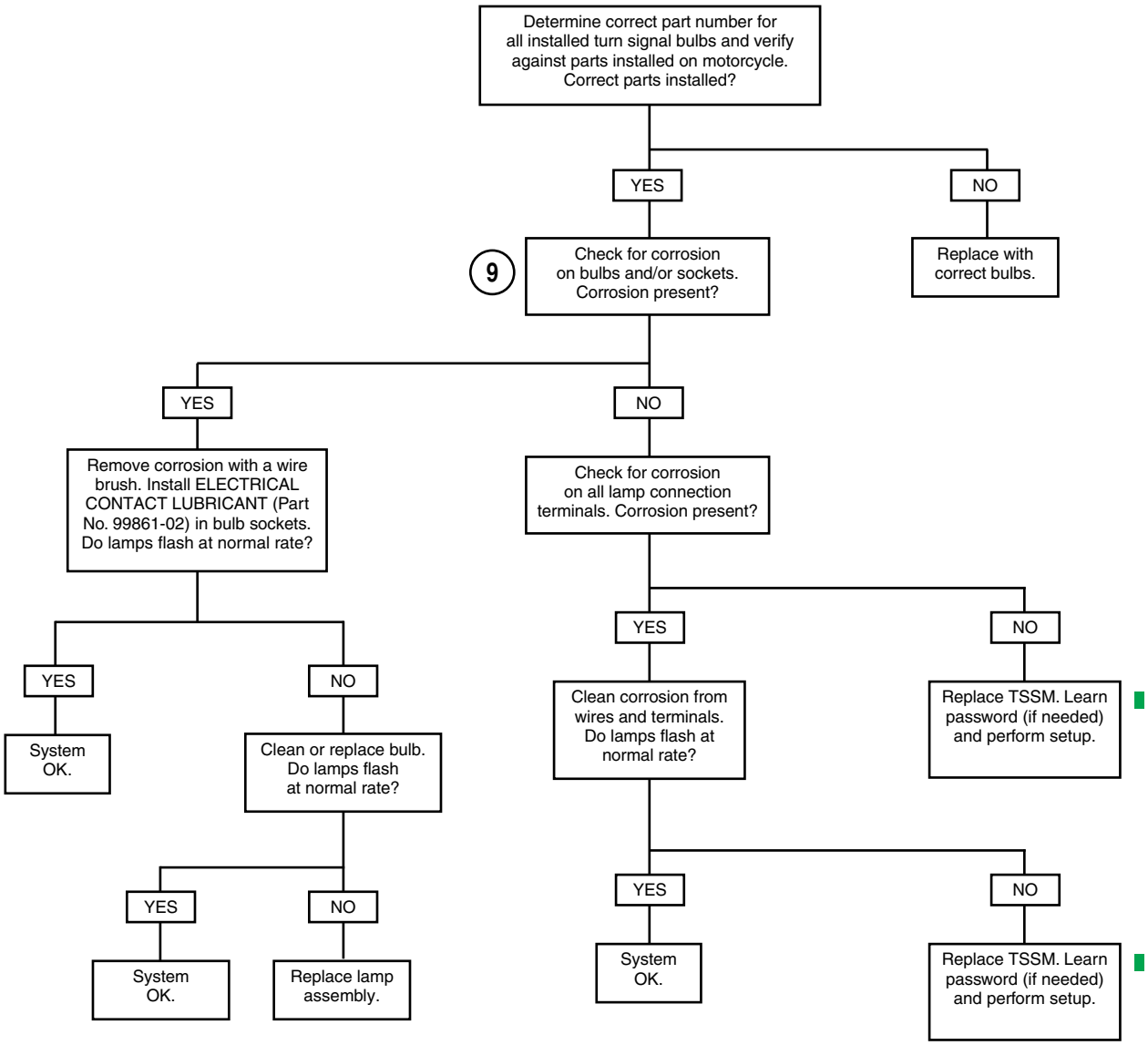
Turn Signal Error 2D

WILL NOT FLASH, 4-WAY FLASHERS INOPERABLE: DTC B1121, B1122, B1141



Turn Signal Error 3A

FLASH AT DOUBLE NORMAL RATE, ALL BULBS WORKING



DTC B0563 8.31

GENERAL

Battery Voltage High

The TSSM continually checks the battery voltage during IGN/OFF and IGN/RUN power modes. If the voltage exceeds 16.0 volts for more than 5.0±0.5 seconds, the TSSM sets diagnostic trouble code (DTC) B0563.

DIAGNOSTICS

Diagnostic Tips

- This DTC may set when the vehicle is placed on a battery charger, on fast charge, for a long period of time.
- The TSSM does not illuminate the security lamp when this DTC is set.

Diagnostic Notes

See CHARGING SYSTEM tests in appropriate VRSC Electrical Diagnostic Manual to correct. Problem may be faulty voltage regulator.

DTC B1131, B1132 8.32

GENERAL

Alarm Output Low (DTC B1131) or Alarm Output High (DTC B1132)

See Figure 8-63. An alarm cycle is activated when the TSSM is connected, the siren has been armed by the TSSM and a security event occurs. See 8.21 TSSM SECURITY SYSTEM FUNCTIONS. Under normal armed operation, the siren input (terminal B) is driven low by the TSSM to trigger the audible alarm. When the siren input is driven high by the TSSM the audible alarm stops.

DIAGNOSTICS

Diagnostic Tips

- If the siren is armed and the internal siren battery is dead, shorted, disconnected, or has been charging for a period longer than 24 hours, the siren will respond with three chirps on arming instead of two.
- The internal siren battery may not charge if the vehicle's battery is less than 12.5 volts.
- If the siren does not chirp two or three times on a valid arming command from the TSSM, the siren is either not connected, not working, or the siren wiring was opened or shorted while the siren was disarmed.
- If the siren enters the self-driven mode where it is powered from the siren internal nine-volt battery, the turn-signal lamps will not alternately flash. If the TSSM activates the siren, the turn-signal lamps will flash. If the siren has been armed and a security event occurs, and the siren is in self-driven mode, the siren will alarm for 20 to 30 seconds and then turn off for 5 to 10 seconds. This alarm cycle will be repeated ten times if the siren is in the self-driven mode.
- If the siren does not stop alarming after it has been armed, then either the TSSM output or siren input may be shorted to ground, or the siren vehicle battery connection is open or shorted to ground, or the siren vehicle ground connection is open, or a security event has occurred. See 8.21 TSSM SECURITY SYSTEM FUNCTIONS for a description of alarm functions.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow chart.

1. Use BREAKOUT BOX (Part No. HD-42682) and HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray pin probe and patch cord. See 8.26 BREAKOUT BOX: TSSM.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray socket probe and patch cord.

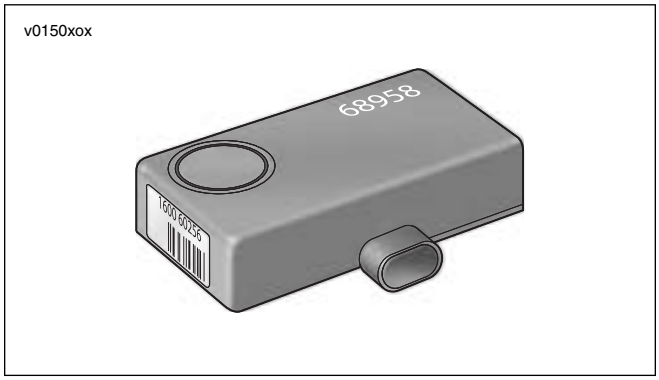


Figure 8-63. Siren

3. Having the correct multi meter ohm scale is important for this test. Some meters may read infinity for high ohm values. If this is the case, check your ohm scale and retest.

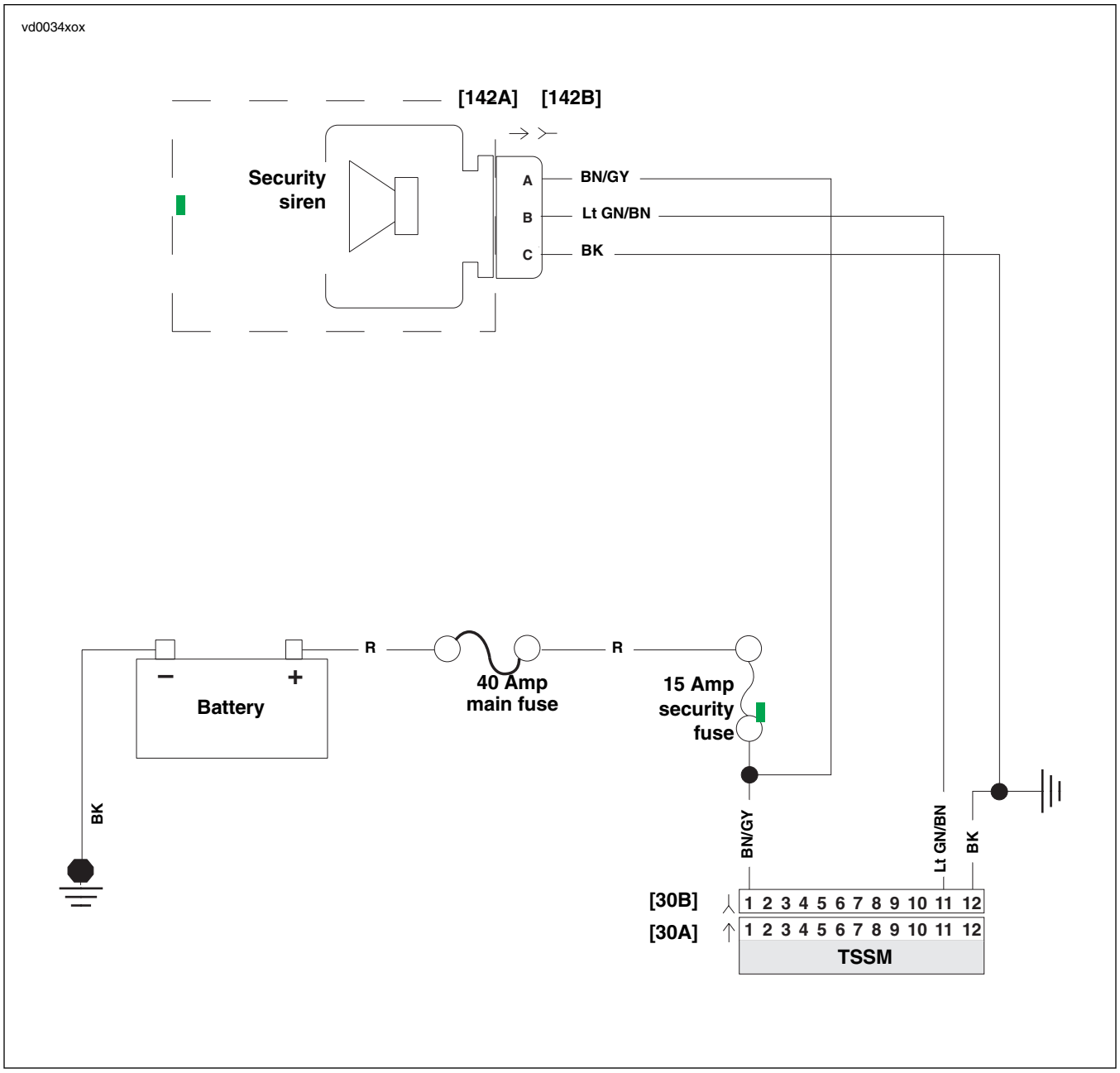


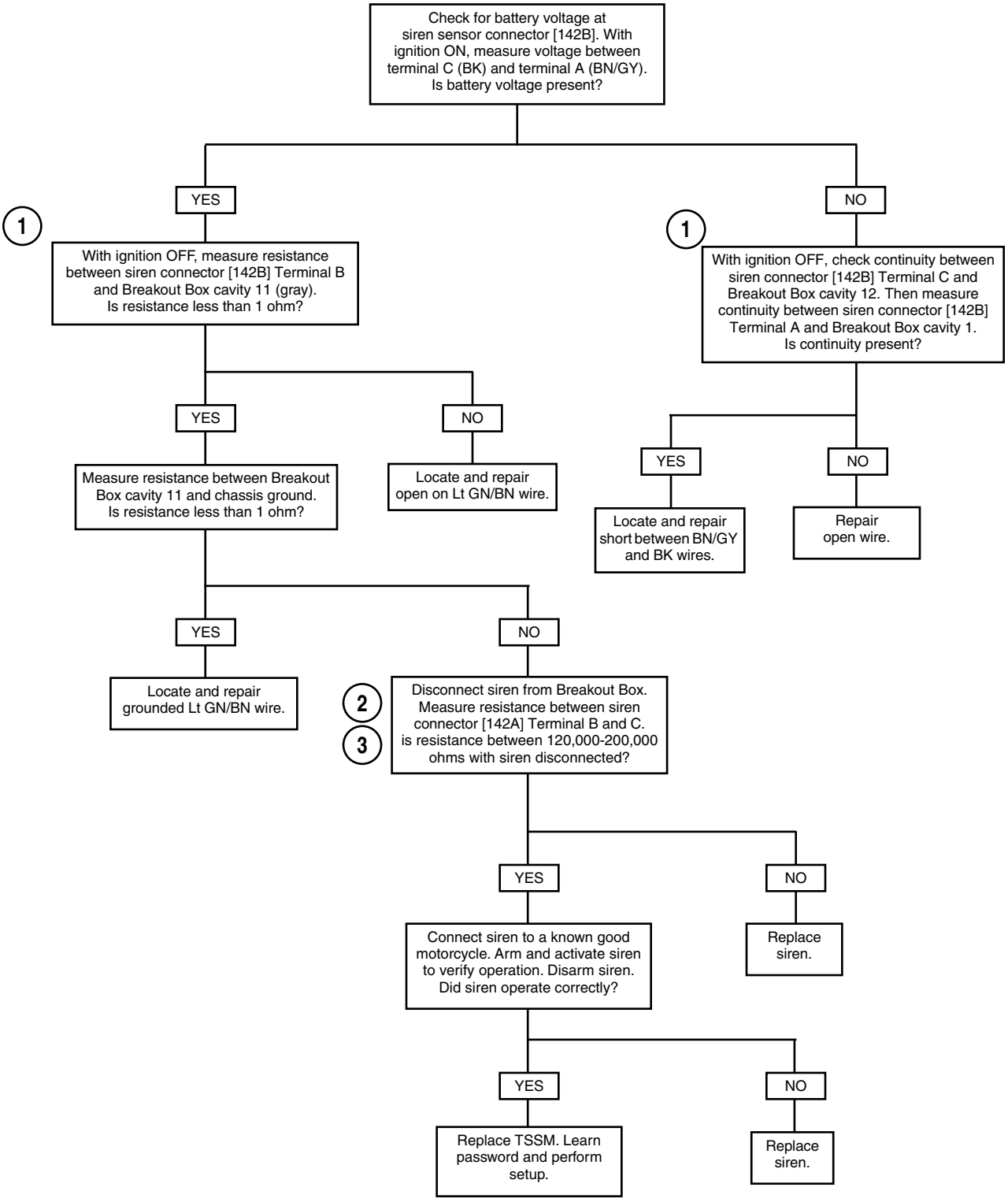
Figure 8-64. Siren Circuit

Table 8-38. Wire Harness Connectors in Figure 8-64.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSSM	12-place Deutsch	Under passenger seat
[142]	Security siren	3-place Packard	Electrical panel behind fender extension

Test 8.31

ALARM OUTPUT: DTC B1131, B1132



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC B1134 8.33

GENERAL

Starter Output High

With the TSSM disarmed, ignition ON and RUN/STOP switch set to RUN, the starter relay is grounded. Battery voltage is applied to the starter relay and coil which are grounded through the TSSM. This diagnostic trouble code (DTC) is set when that ground is not established through the TSSM.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. Connect BREAKOUT BOX (Part No. HD-42682) (gray) to wire harness connector [30] leaving TSSM disconnected. See 8.26 BREAKOUT BOX: TSSM.

Figure 8-65. Starter Relay

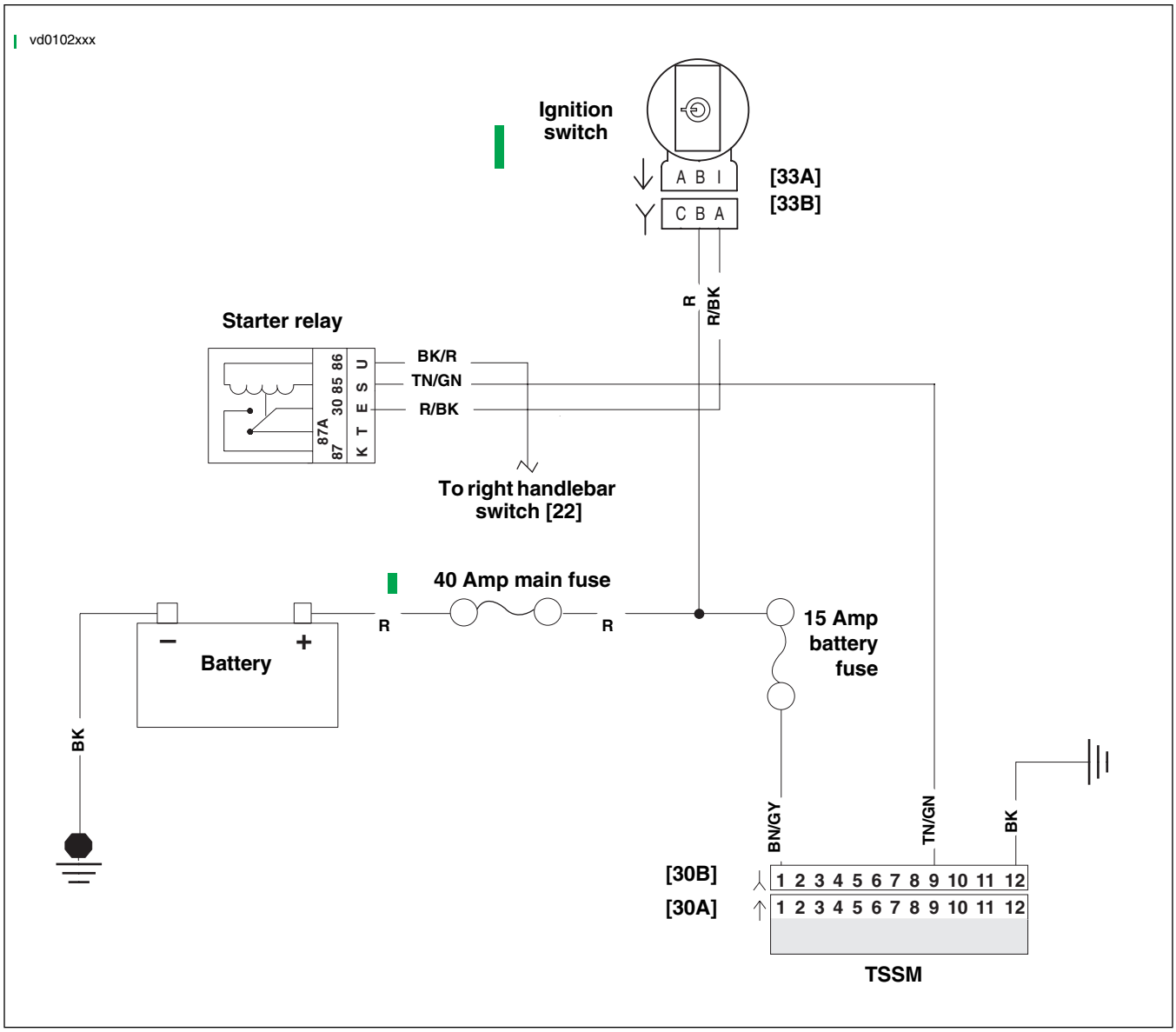


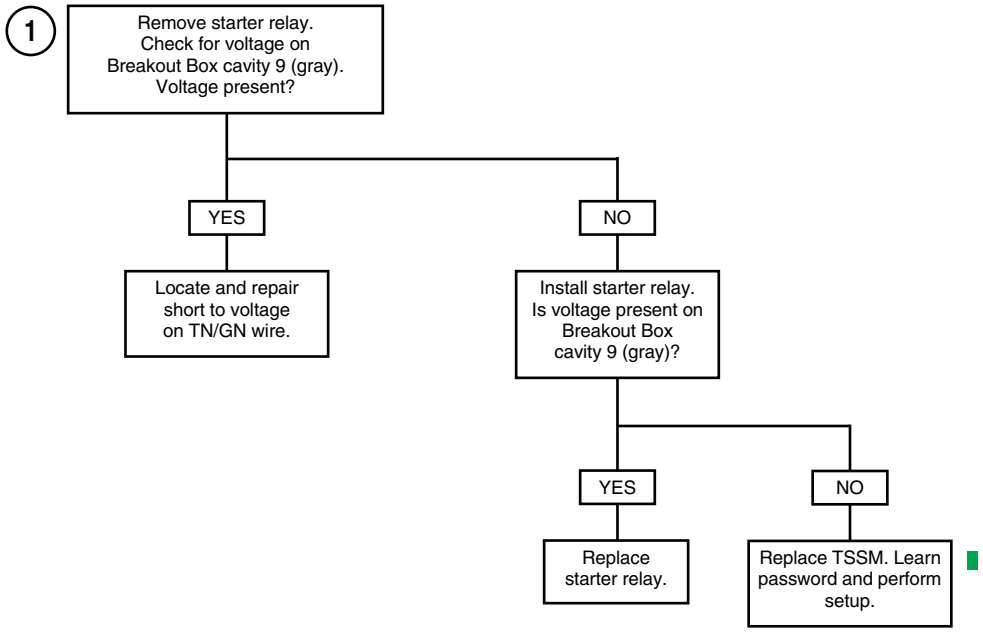
Figure 8-66. Starter/TSSM Circuit

Table 8-39. Wire Harness Connectors in Figure 8-66.

NO.	DESCRIPTION	TYPE	LOCATION
[5]	Main fuse	Spade terminals	Under right side cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[61]	Starter relay	5-place Amp	Under airbox cover, in fuse block

Test 8.32

STARTER OUTPUT HIGH: DTC B1134



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC B1135 8.34

GENERAL

Accelerometer Fault

This diagnostic trouble code (DTC) indicates a failure which requires replacement of the TSSM.

NOTE

When DTC B1135 is set, the tip-over engine shutdown, TSSM tamper alarm and bank angle sensors are disabled. The security lamp will also illuminate on vehicles with security systems.

DTC U1016, U1255 AT TSSM 8.35

GENERAL

Loss of ECM Serial Data

The serial data connector provides a means for the electronic control module (ECM), TSSM and speedometer to communicate their current status. When all operating parameters on the serial data bus are within specifications, a state of health message is sent between the components. A diagnostic trouble code (DTC) U1016 indicates that the ECM is not capable of sending this state of health message. A DTC U1255 indicates that no messages were present during power up of the current key cycle. A DTC U1016 indicates that there was communication on the data bus since power up, but was lost or interrupted during that key cycle.

Table 8-40. Code Description

DTC	DESCRIPTION
U1016	Loss of all ECM serial data (state of health)
U1255	Serial data error/missing message

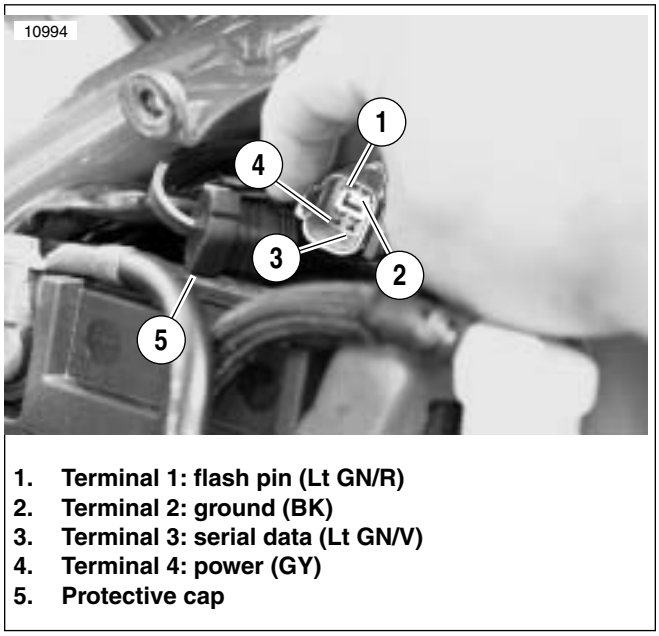
DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow chart.

1. Connect BREAKOUT BOX (Part No. HD-42682) (gray) between TSSM connector [30A] and wire harness connector [30B]. See 8.26 BREAKOUT BOX: TSSM.
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 8.42 BREAKOUT BOX: ECM.

Figure 8-67. ECM Location



1. **Terminal 1: flash pin (Lt GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**
5. **Protective cap**

Figure 8-68. Data Link Connector

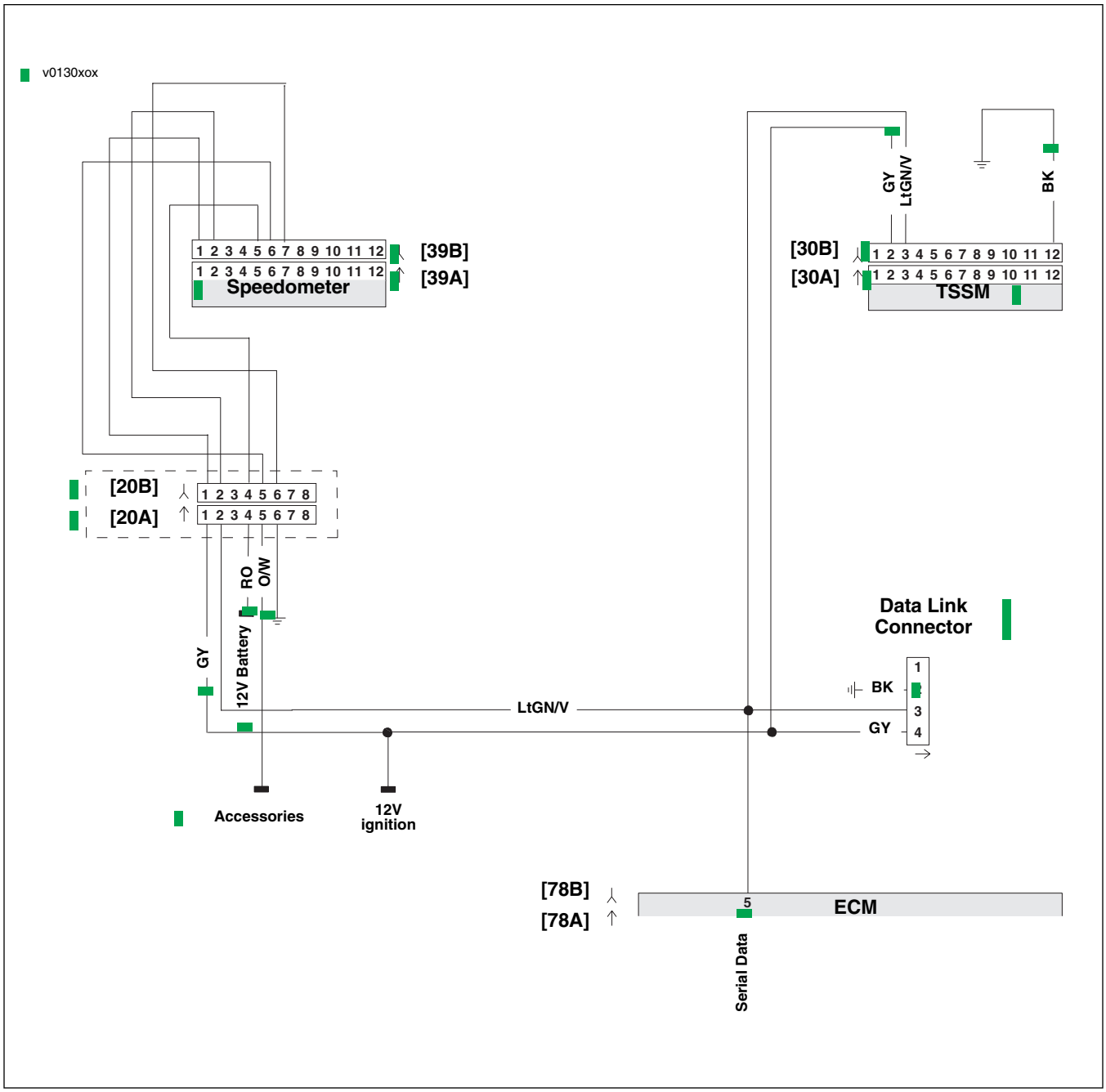


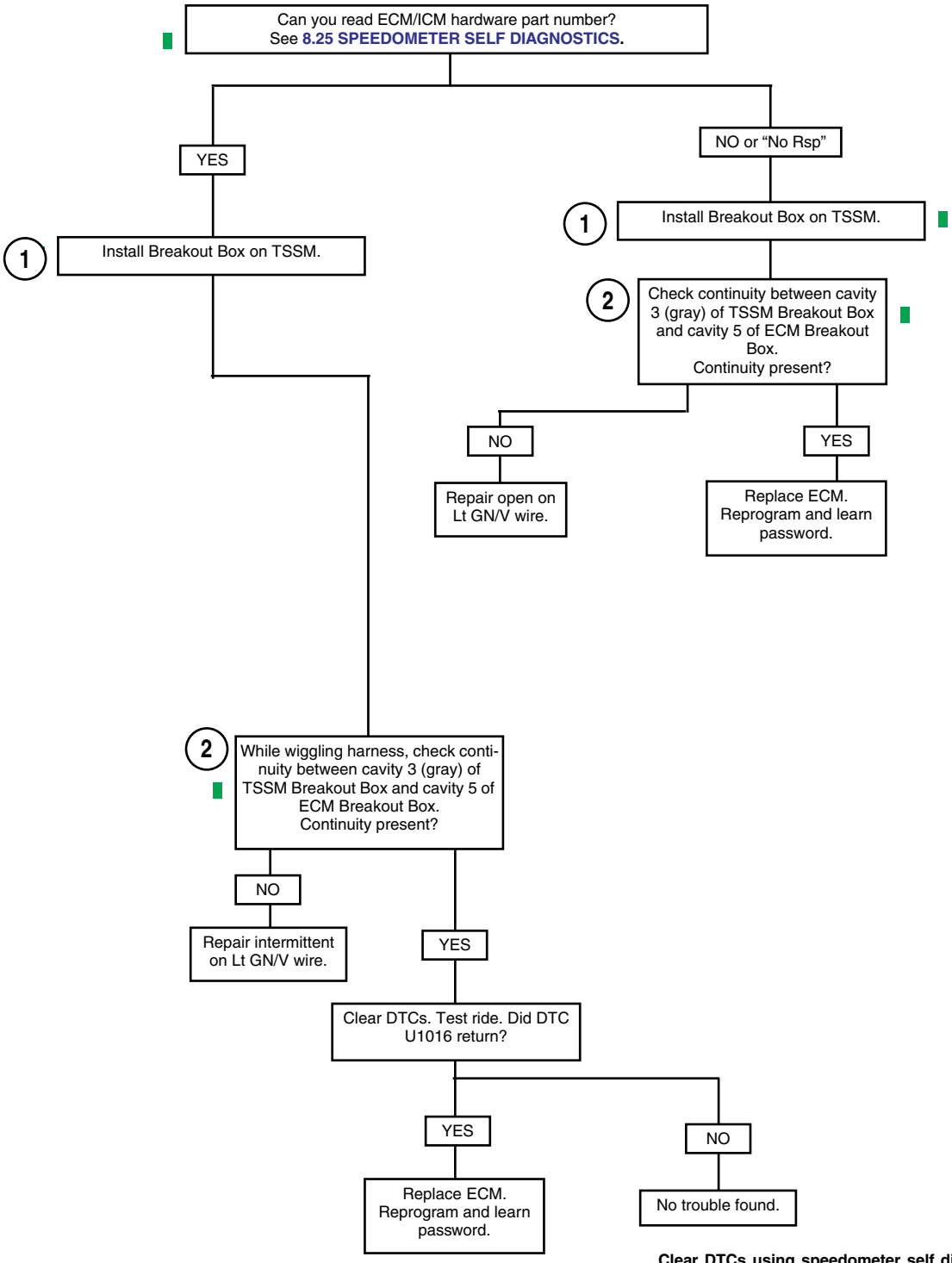
Figure 8-69. Serial Data Circuit

Table 8-41. Wire Harness Connectors in Figure 8-69.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Test 8.34

LOSS OF ECM SERIAL DATA: DTC U1016



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC U1097, U1255 AT TSSM 8.36

GENERAL

Loss of Speedometer Serial Data

The serial data line provides a means for the speedometer, ECM and TSSM to communicate their current status. When all operating parameters are within specifications, a state of health message is sent between the components. A diagnostic trouble code (DTC) U1097 indicates that the speedometer is not capable of sending this state of health message. A DTC U1255 indicates that no messages were present during power up of the current key cycle. A DTC U1097 indicates that there was communication on the data bus since power up, but was lost or interrupted during that key cycle.

Table 8-42. Code Description

DTC	DESCRIPTION
U1097	Loss of all speedometer serial data (state of health)
U1255	Serial data error/missing message

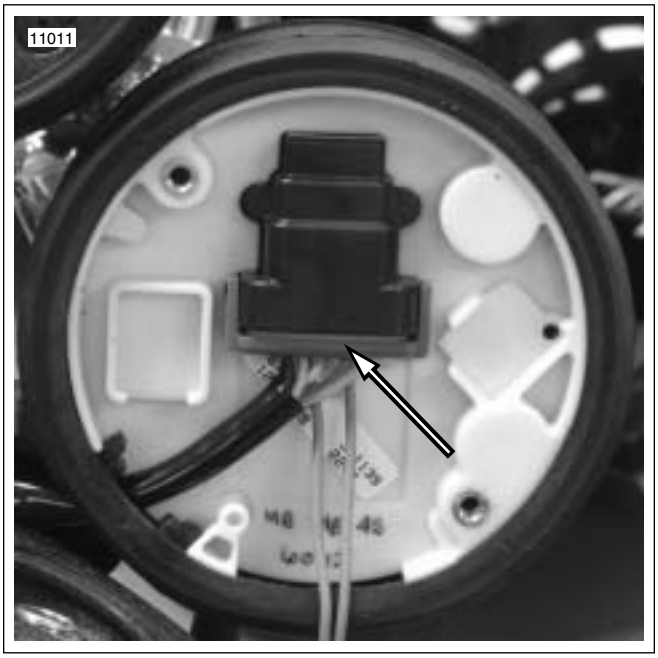


Figure 8-70. Speedometer Connector [39] (typical)

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow chart.

1. Connect BREAKOUT BOX (Part No. HD-42682) as follows:
   a. Mate gray pin housing on Breakout Box with TSSM harness connector [30B]. Leave TSSM [30A] disconnected.
   b. Mate black pin housing on Breakout Box with harness connector [39B] using INSTRUMENT HARNESS ADAPTERS (Part No.HD-46601). Leave speedometer [39A] disconnected.

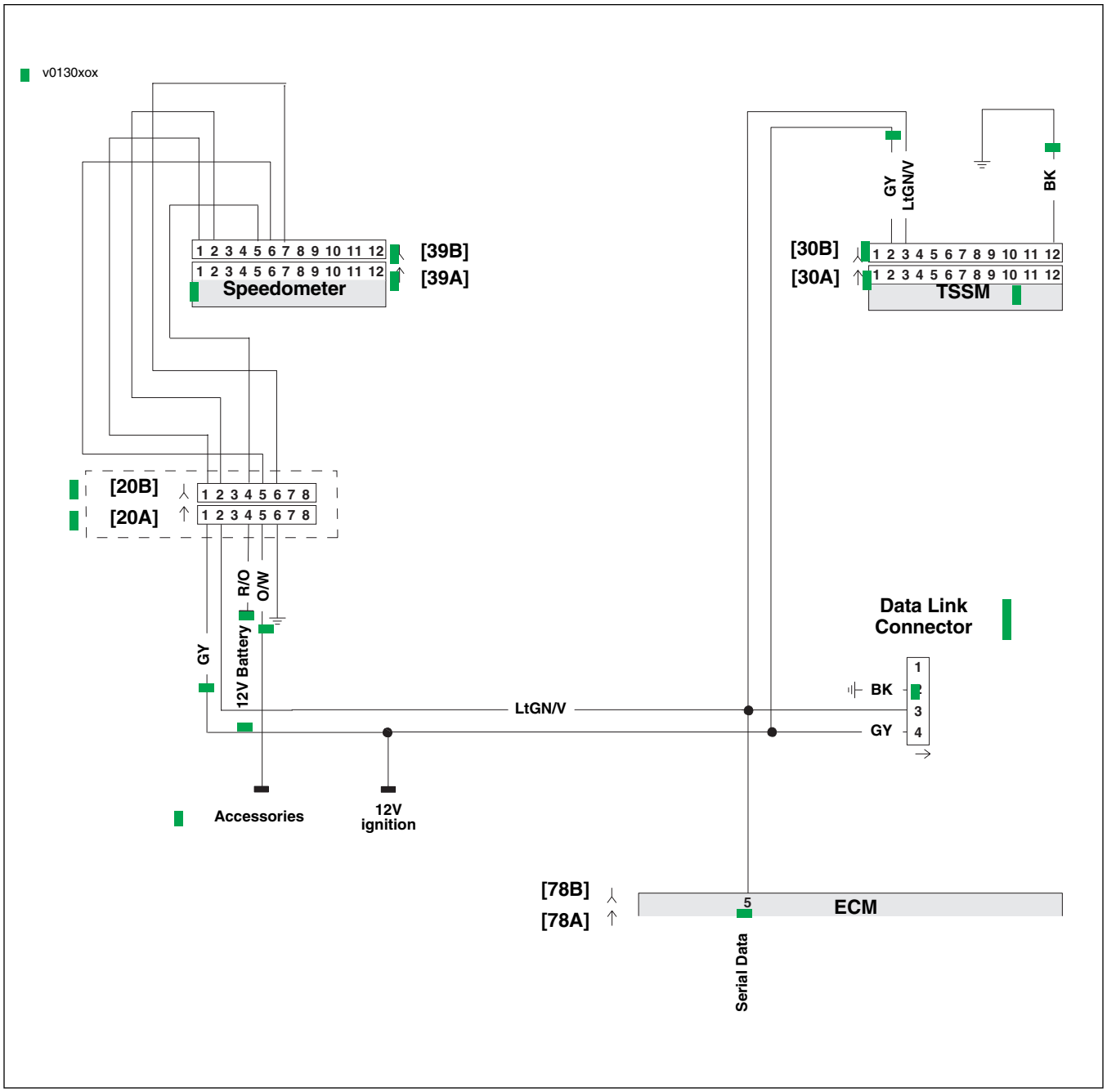


Figure 8-71. Serial Data Circuit

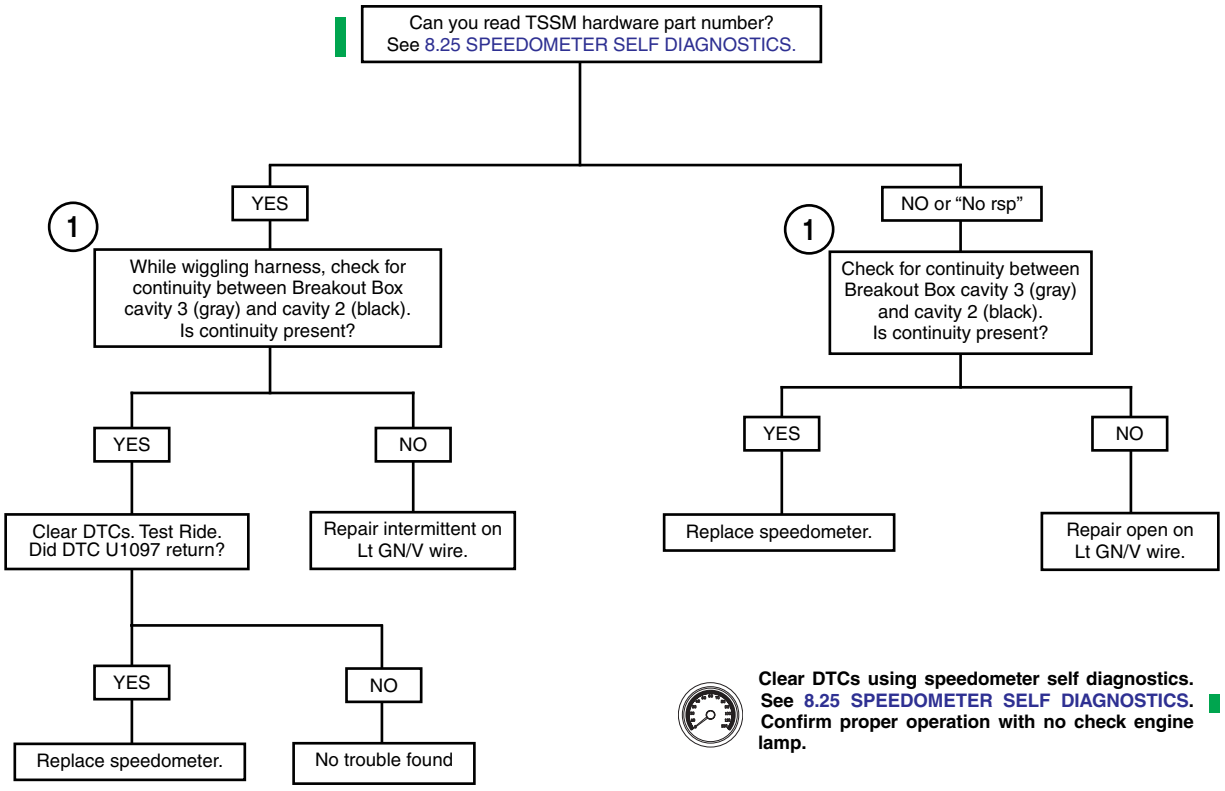
Table 8-43. Wire Harness Connectors in Figure 8-71.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Test 8.35

LOSS OF SPEEDOMETER SERIAL DATA: DTC U1097, U1255

IMPORTANT:
Always start from 8.24 INITIAL DIAGNOSTIC CHECK: TSSM.



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC U1300, U1301 OR “BUS ER” 8.37

GENERAL

Serial Data Low or Serial Data Open/High

See Figure 8-72. The typical serial data voltage range is 0 volts (inactive) to 7 volts (active). Due to the short pulse, voltages will be much lower on a DVOM. In analog mode, a DVOM reading serial data will show continuous voltage when active, typically 0.6-0.8 volts. The range for acceptable operations is 0-7.0 volts.

Table 8-44. Code Description

DTC	DESCRIPTION
U1300	Serial data low
U1301	Serial data open/high

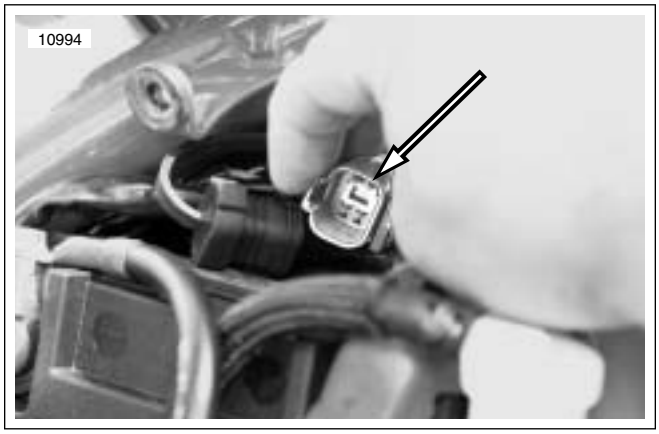


Figure 8-72. Data Link Connector [91A]

DIAGNOSTICS

Diagnostic Tips

- If serial data is shorted, these diagnostic trouble codes (DTCs) will automatically cause the check engine lamp to illuminate. The odometer will read “Bus Er” in this condition.
- Diagnostic trouble codes P1009 and P1010 may accompany DTCs U1300 and U1301.

Diagnostic Notes

- If a U1300, U1301 or “BUS Er” is present, perform diagnostic procedures listed in 8.47 STARTS, THEN STALLS.

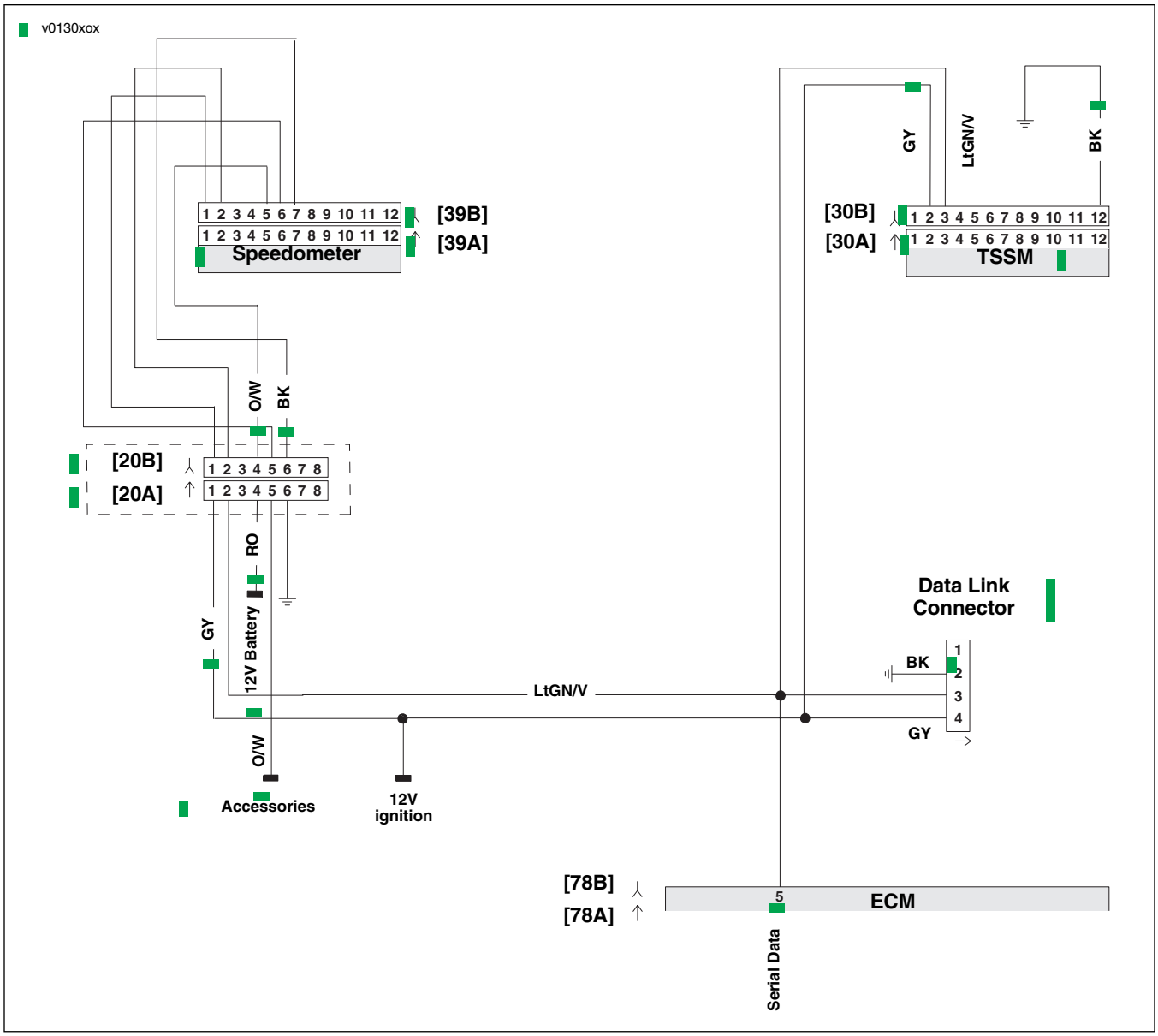


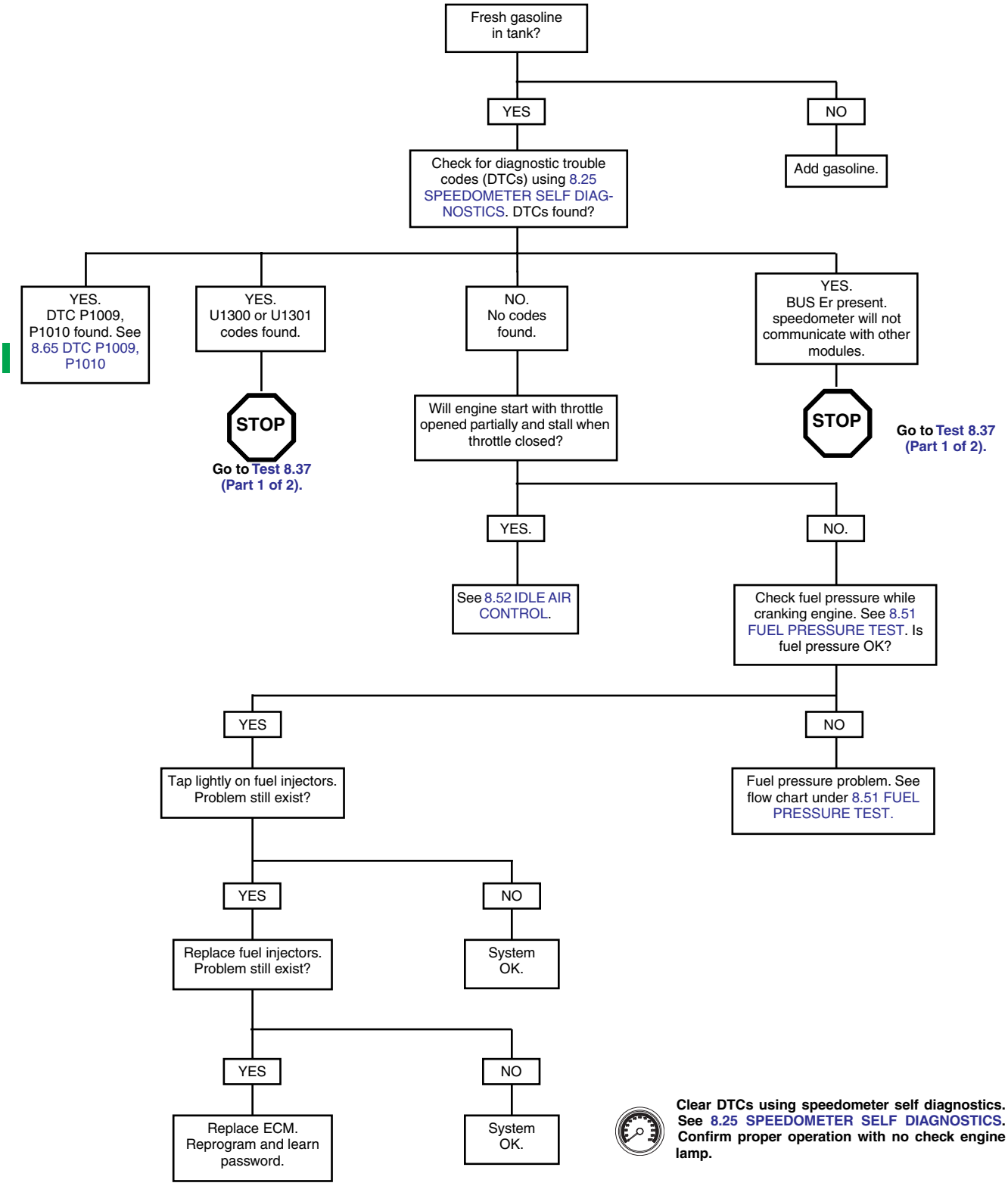
Figure 8-73. Serial Data Circuit

Table 8-45. Wire Harness Connectors in Figure 8-73.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Mini-Deutsch	Under left side cover
[30]	TSSM	12-place Deutsch	Under electrical caddie cover
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under right side cover

Test 8.37 (Part 1 of 2)

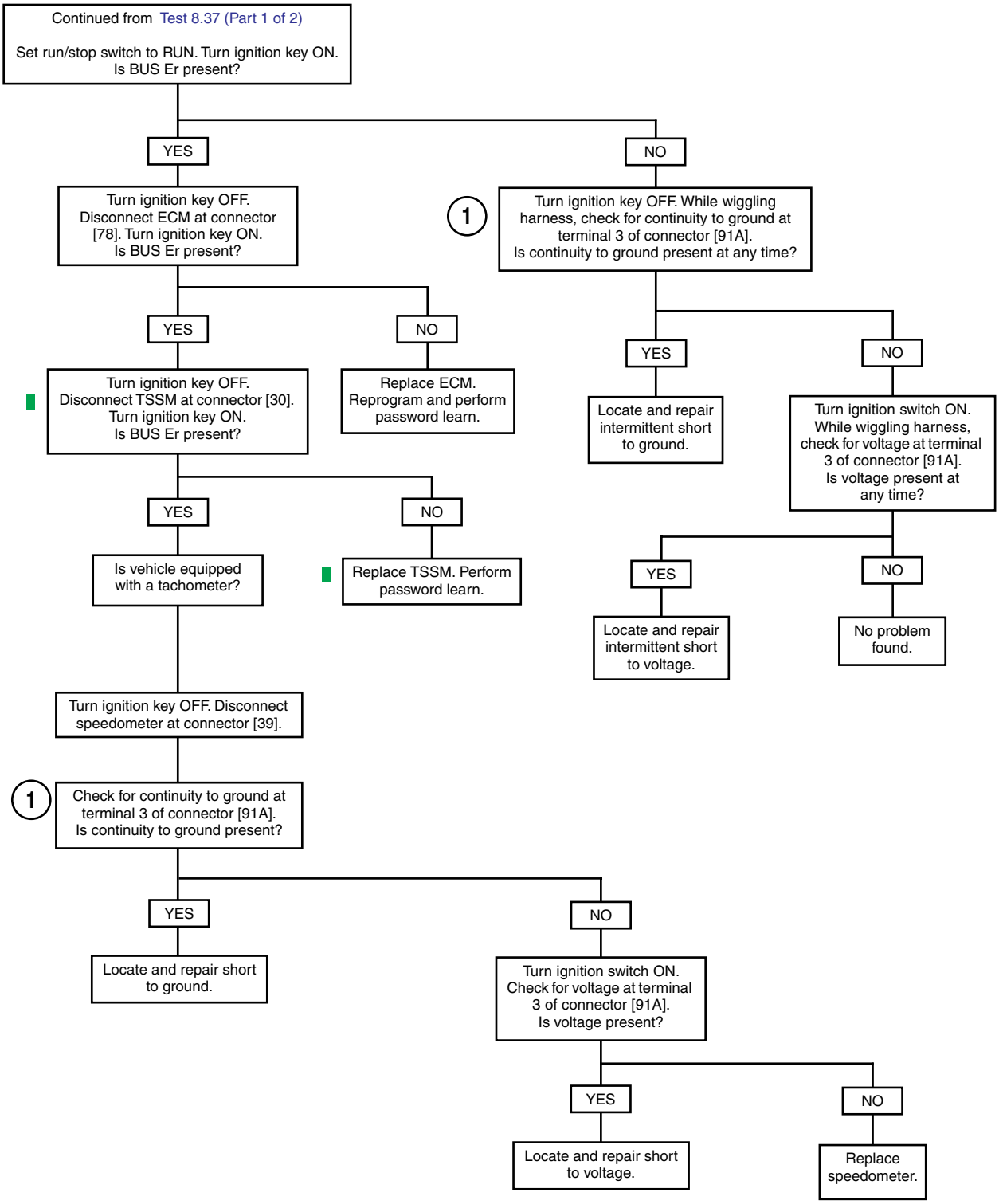
STARTS, THEN STALLS: DTC U1300, U1301



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.37 (Part 2 of 2)

STARTS, THEN STALLS: DTC U1300, U1301



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

PASSWORD LEARN 8.38

GENERAL

If the ECM or TSSM is faulty, follow the instructions in the VRSC Service Manual for ECM or TSSM replacement. Then, to determine if password learn is necessary, refer to Table 8-46.

Table 8-46. Password Learn

DEVICE REPLACED	IS PASSWORD LEARN NECESSARY?
ECM	Yes
TSSM	Yes

PASSWORD LEARNING

To perform password learning procedure, refer to Table 8-47. When finished, continue with all instructions under 8.18 TSSM VEHICLE DELIVERY.

Always perform all appropriate instructions under 8.18 TSSM VEHICLE DELIVERY after TSSM replacement or removal.

IMPORTANT NOTE

Do not forget to enter a personal code for TSSM vehicles. If a code is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.

Table 8-47. Setting TSSM and ECM/ICM Password

NO.	ACTION	CONFIRMATION	NOTES
	Ignition must be turned off for at least 15 seconds.	With ignition turned off, Check Engine Lamp and Security Lamp will be off.	
1	Install **new** TSSM or ECM. Perform all steps under 8.18 TSSM VEHICLE DELIVERY.		
2	Set **RUN/OFF** switch to **RUN.**		
3	Turn **IGN** key **ON.**	Verify Check Engine Lamp and Security Lamp illuminate and then turn off.	TSSM enables starter relay.
4	Attempt normal start **one** time.	Engine starts and stalls. Check Engine Lamp illuminates and stays on.	Password has not been learned. ECM/ICM sets DTC P1009.
5	Wait ten seconds. Security lamp will illuminate and stay on.	Security Lamp illuminates.	ECM/ICM enters Password Learning mode for ten minutes. Do not cycle ignition switch or interrupt vehicle power or Password Learn will be unsuccessful.
6	Wait until Security Lamp turns off.		This takes ten minutes.
7	Quickly (within two seconds) turn **IGN** key OFF-**ON.**		ECM must not be allowed to shutdown.
8	Wait until Security Lamp turns off.		This takes ten minutes.
9	Quickly (within two seconds) turn **IGN** key OFF-**ON.**		ECM must not be allowed to shutdown.
10	Wait until Security Lamp turns off.		This takes ten minutes.
11	Quickly (within two seconds) turn **IGN** key OFF-**ON.**		ECM must not be allowed to shutdown.
12	Turn **IGN** key **OFF. Wait 15 seconds before turning IGN on.** Turn **IGN** switch **ON** and start engine to confirm successful Password Learn procedure. Clear diagnostic trouble codes.		
13	Perform all steps under 8.18 TSSM VEHICLE DELIVERY.		

GENERAL

The TSSM system uses batteries in the key fob and siren. These are the only parts requiring periodic maintenance.

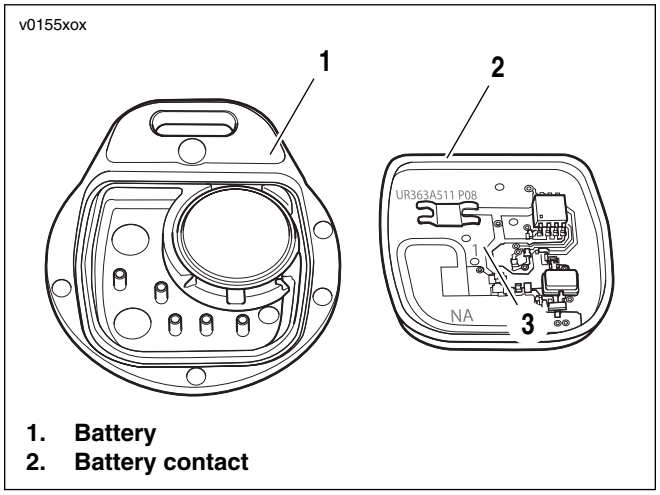
KEY FOB

Schedule

Replace the key fob battery every 2 years.

Battery Replacement

1. Open the key fob case.
   a. Place a thin blade between the 2 halves of the case.
   b. Slowly twist the blade.
2. See Figure 8-74. Replace battery (1).
   a. Remove the original battery.
   b. Install a **new** battery with the positive (+) side down. Use a Panasonic® 2032 or equivalent.
3. See Figure 8-75. Align case and circuit board as shown. Snap case halves together.
4. While standing next to the motorcycle, press and hold the key fob button for 10-15 seconds until the security system responds with two turn signal flashes/siren chirps.



1. Battery
2. Battery contact

Figure 8-74. Open Key Fob Case (typical)

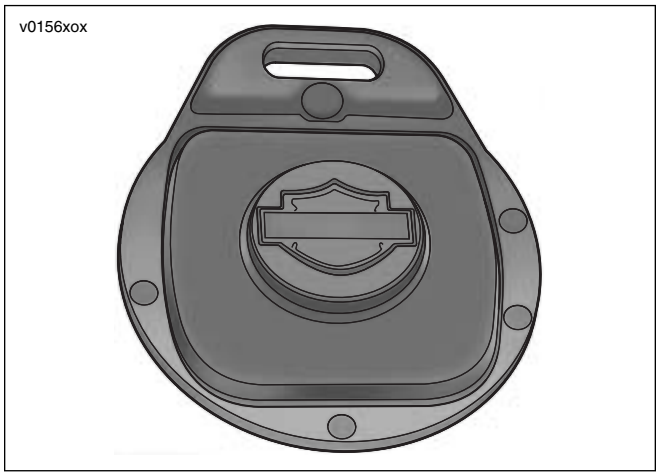


Figure 8-75. Key Fob Assembly (typical)

SIREN

Schedule

The siren's internal 9 volt battery is rechargeable and does not need to be replaced on a regular basis. Battery life under normal conditions is approximately three to six years.

NOTE

The internal siren battery may not charge if the vehicle's battery is less than 12.5 volts.

Battery Replacement

1. Disarm system and remove siren.
2. See Figure 8-76. Remove battery cover (1).
   a. Place the siren module on a flat and sturdy table with the potted section (area with epoxy covering circuit board) facing up and towards you.
   b. Position a knife blade at a 45 degree angle to the long side of the siren case. Insert the knife blade between the siren case and battery cover at one of the two accessible corners of the battery cover. Keep the blade slightly higher towards the battery cover as this helps keep the blade away from the battery seal.
   c. Slowly twist the blade towards the battery cover and the cover will pop off.

NOTE

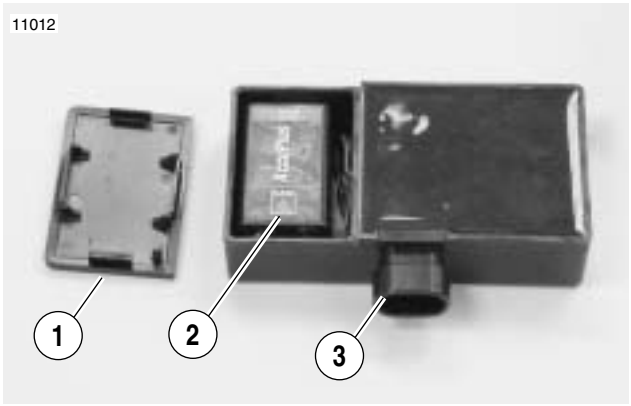
*For protection against corrosion, battery terminals and battery clip are covered with a special grease. Do not wipe away this substance. Apply all available existing grease to terminals on **new** battery.*

3. See Figure 8-77. Replace battery by removing old battery from polarized battery clip. Install a **new** 9 volt nickel metal hydride battery. See VRSCSE2 Parts Catalog for correct part number.

NOTE

Only a nickel metal hydride nine-volt battery should be used in the siren.

4. See Figure 8-76. Reinstall battery cover (1).
   a. Carefully replace the rubber seal.
   b. Align battery cover (1) with case placing round corners on cover away from connector [142A]. Snap cover into place.
5. Install siren and check operation. If siren is working properly, it will respond with two chirps after receiving the arm command.



1. **Cover**
2. **Battery**
3. **Connector [142A]**

Figure 8-76. Siren Battery Compartment

Figure 8-77. Siren Battery

Table 8-48. Connector Locations

CONNECTOR NO.	DESCRIPTION	TYPE	LOCATION
[5]	Main fuse	Spade terminals	Under right side cover
[18]	Right rear turn signal	2-place Multilock	Under outer rear fender
[19]	Left rear turn signal	2-place Multilock	Under outer rear fender
[20]	Speedometer	8-place Mini-Deutsch	Left side cover
[22]	Right hand controls	6-place Deutsch	Under left side cover
[24]	Left hand controls and horn	6-place Deutsch	Under left side cover
[29]	Position lamp (HDI)	2-place Mini-Deutsch	Under left side cover
[30]	Turn signal/security module	12-place Deutsch	Under passenger seat
[31]	Front turn signals	6-place Multilock	Under handlebar cover
[33]	Ignition key switch	3-place Packard	Back of ignition switch
[38L]	Low beam lamp	2-place Amp	Back of headlamp
[38H]	High beam lamp	2-place Amp	Back of headlamp
[39]	Speedometer	12-place Mini-Deutsch	Back of speedometer
[45]	License plate lamp	3-place Multilock	Under outer rear fender
[46]	Voltage regulator to stator	3-place Packard	Under left trim cover
[65]	Vehicle speed sensor (VSS)	3-place Deutsch	Above rear rocker box
[77]	Voltage regulator to main harness	1-place Deutsch	Behind radiator cover
[78]	Electronic control module (ECM)	36-place Packard	Under left side cover
[79]	Crank position sensor (CKP)	2-place Mini-Deutsch	Under left trim cover
[80]	Manifold air pressure sensor (MAP)	3-place Packard	Front intake passage
[83 F]	Front plug top coil	3-place Packard	On top of front rocker box
[83 R]	Rear plug top coil	3-place Packard	On top of rear rocker box
[84]	Front injector	2-place Packard	Throttle body
[85]	Rear injector	2-place Packard	Throttle body
[87]	Idle air control (IAC)	4-place Packard	Below air cleaner assembly
[88]	Throttle position sensor (TP)	3-place Packard	Front of throttle body
[89]	Intake air temperature sensor (IAT)	2-place Packard	Under airbox
[90]	Engine coolant sensor (ECT)	2-place Packard	Water pump housing
[91]	Data link connector	4-place Deutsch	Under left side cover
[93]	Tail lamp	4-place Multilock	Under outer rear fender
[95]	Purge solenoid	2-place Packard	Below seat
[97 T]	Cooling fan	2-place Multilock	Under left trim cover
[97 B]	Cooling fan	2-place Multilock	Under left trim cover
[108]	Tachometer	3-place Mini-Deutsch	Left side cover
[120]	Oil pressure switch	Post terminal	Crankcase between cylinders
[122]	Horn	Spade terminals	Between cylinders, left side
[128A]	Starter solenoid coil	2-place Amp	Under left side cover
[61]	Starter relay	5-place Amp	Under airbox cover, in fuse block
[62]	System relay	5-place Amp	Under airbox cover, in fuse block

Table 8-48. Connector Locations

CONNECTOR NO.	DESCRIPTION	TYPE	LOCATION
[62]	Fan relay	5-place Amp	Under airbox cover, in fuse block
[141]	Fuel pump and sender	3-place Mini-Deutsch	Top of fuel tank
[142]	Security siren (optional)	3-place Packard	Electrical panel behind fender extension
[145]	Engine harness	12-place Mini-Deutsch	Below air cleaner assembly
-	Fuse block	Spade terminals	Under airbox cover
-	Rear stoplight switch	Spade terminals	Behind transmission
-	Neutral switch	Post terminals	Bottom rear of crankcase
-	Harness grounds (2)	Ring terminals	Front and rear cam covers

GENERAL

The engine management system consists of the following components:

- Electronic control module (ECM).
- Crank position sensor (CKP).
- Manifold absolute pressure sensor (MAP).
- Intake air temperature sensor (IAT).
- Engine coolant temperature sensor (ECT).
- Idle air control (IAC).
- Throttle position sensor (TP).
- Vehicle speed sensor (VSS).
- Factory-installed turn signal security module (TSSM). This includes an integrated bank angle sensor (BAS).
- Fan relay.
- System relay.
- Ignition (plug top) coils.
- Purge solenoid (California models only).

The ECM is mounted ahead of the battery behind the left side cover. It computes the spark advance for proper ignition timing and fuel control based on sensor inputs (from CKP, MAP, IAT and TP sensor) and controls the low-voltage circuits for the ignition coils and injectors. The Scanalyzer can access the data received by and stored in the ECM.

The ECM contains all of the solid state components used in the ignition system. The dwell time for the ignition coil is also calculated in the microprocessor and is dependent upon battery voltage. The programmed dwell is an added feature to give adequate spark at all speeds. (The ECM has added protection against transient voltages, continuous reverse voltage protection, and damage due to jump starts.) The ECM is fully enclosed to protect it from vibration, dust, water or oil. This unit is a non-repairable item. If it fails, it must be replaced.

The crank position sensor (CKP) is located on the left front of the lower crankcase half. The CKP generates an AC signal which is sent to the ECM where it is used to reference engine position (TDC) and speed. It functions by taking readings off the 22 teeth on the alternator rotor (two teeth are missing to establish a reference point).

The MAP sensor is located at the rear intake port. The MAP sensor monitors the intake manifold pressure (vacuum) and sends the information to the ECM where the module adjusts the spark and fuel timing advance curves for optimum performance.

The bank angle sensor is within the turn signal/turn signal security module. If the vehicle lean angle exceeds 45 degrees for one second, the fuel pump is shut off. Once the sensor is tripped, the motorcycle must be uprighted, turned off and then on again before the engine can be restarted. This is communicated across the data bus.

Front and rear coils fire each spark plug independently (one cylinder at a time - no wasted spark). The coil also has an extra terminal to monitor current on the coil secondary circuit. This is used for knock detection and combustion diagnostics.

The ignition system gives a spark near top dead center for starting. At RPM and loads above this, the system gives a spark advance that varies between 0° and 50°.

The IAT, ECT and TP sensors are used to provide information to the ECM to fine tune spark and fuel delivery. The engine coolant temperature (ECT) sensor also controls the cooling fan relay that provides 12vdc to the fans. The VSS is used as an input for idle speed control.

The purge solenoid (California models only) allows vapors from the charcoal canister to flow to the throttle body. The timing and amount of solenoid opening depends on engine speed, vehicle speed, engine temperature and throttle position.

NOTE

On models not equipped with a purge solenoid, a resistive plug (Part No. 72529-01) is installed in the purge solenoid connector [95B] to prevent an error message being generated.

TROUBLESHOOTING

See the diagnostic charts that follow for troubleshooting information.

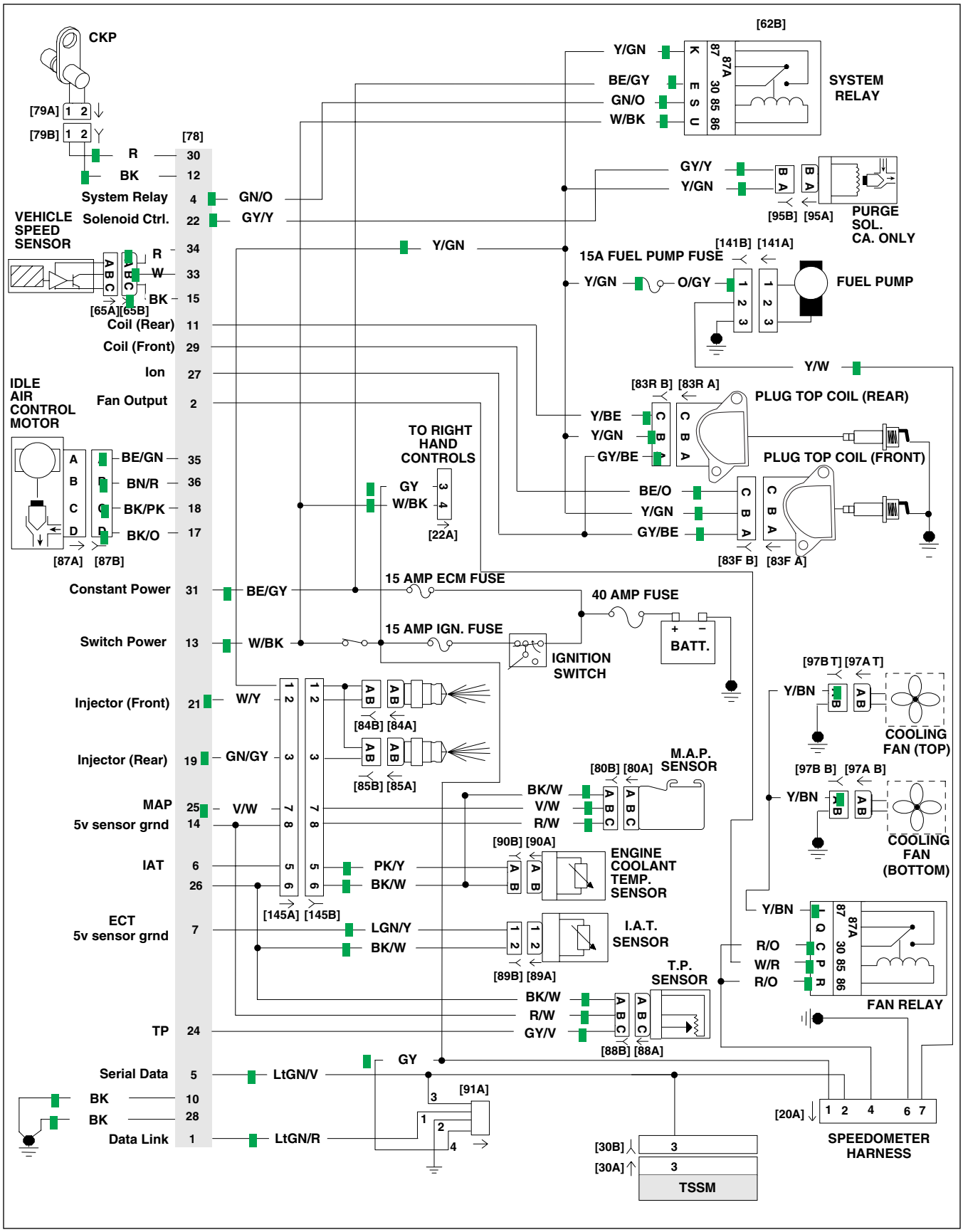


Figure 8-78. EFI System Circuit

DIAGNOSTIC INTRODUCTION 8.41

SYSTEM PROBLEMS

All system problems fall into at least one of three general categories.

No Start

The engine cranks over freely, but will not start. This does not include situations where the engine will not crank, such as a security disabled starter, dead battery, etc. This condition assumes that all obvious checks (fuel in tank, etc.) have been made.

Poor Performance

The engine starts but there are performance problems. These problems may include poor fuel economy, rough idle, engine misfire, engine hesitation, severe spark knock, etc.

Check Engine Lamp

See Figure 8-79. The check engine lamp indicates the ECM has determined a fault condition exists. There may also be starting or performance problems.

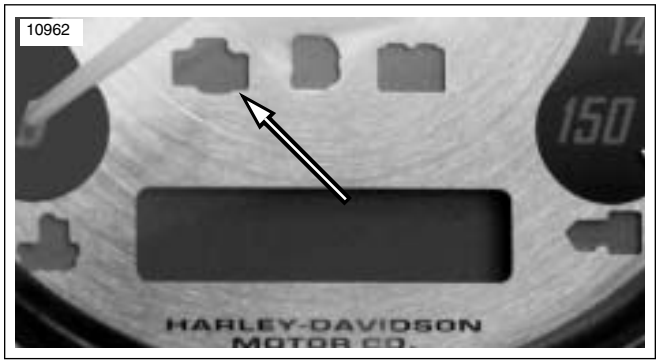


Figure 8-79. Check Engine Lamp

RESOLVING PROBLEMS

To resolve system problems, five basic steps are involved. In order of occurrence, they are:

1. Check for trouble codes by observing check engine lamp. See 8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES.
2. Diagnose system problems. This involves using special tools and the diagnostic flow charts in this section.
3. Correct problems through the replacement and/or repair of the affected components.
4. After repairs are performed, the work must be validated. This involves clearing the trouble codes and confirming proper vehicle operation as indicated by the behavior of the check engine lamp.

BREAKOUT BOX: ECM 8.42

GENERAL

The BREAKOUT BOX (Part No. HD-43876) connects to the main harness. Used in conjunction with a DVOM, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects

NOTE

See wiring diagrams for ECM terminal functions.

INSTALLATION

1. Remove left side cover.
2. See Figure 8-80. Depress latch on connector [78B].
3. Attach Breakout Box (1) to connector.
   a. Attach connector from Breakout Box to ECM connector.
   b. Attach connector from the wiring harness to connector on Breakout Box.

REMOVAL

1. Depress latch on ECM connection.
2. Detach Breakout Box connector from ECM connector.
3. Detach Breakout Box connector from wiring harness.
4. Reattach ECM connector to wiring harness.
5. Install side cover.

RESOLVING PROBLEMS

To resolve system problems, five basic steps are involved. In order of occurrence, they are:

1. Check for trouble codes by observing check engine lamp. See 8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES.
2. Diagnose system problems. This involves using special tools and the diagnostic flow charts in this section.
3. Correct problems through the replacement and/or repair of the affected components.
4. After repairs are performed, the work must be validated. This involves clearing the trouble codes and confirming proper vehicle operation as indicated by the behavior of the check engine lamp.

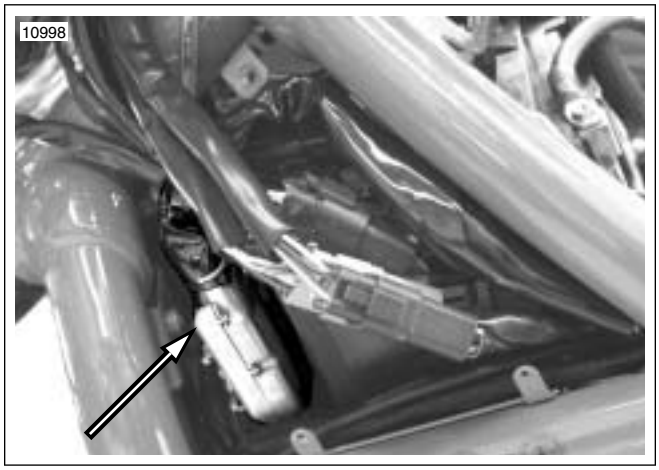


Figure 8-80. ECM Latch Connector

WIGGLE TEST 8.43

GENERAL

The wiggle test indicates the presence of intermittants in a wiring harness. Depending upon the availability of diagnostic tools, either version of this test may be used.

PROCEDURE

Using DVOM (Part No. HD-39978)

1. See Figure 8-81. Connect DVOM to wiring harness between the suspect connections. When diagnosing ECM connections, use a BREAKOUT BOX (Part No. HD-43876) to simplify the procedure. See 8.42 BREAKOUT BOX: ECM.
2. Set DVOM to read voltage changes.
3. Start motorcycle engine and run at idle.
4. Shake or wiggle harness to detect intermittants. If intermittants are present, radical voltage changes will register on the DVOM.

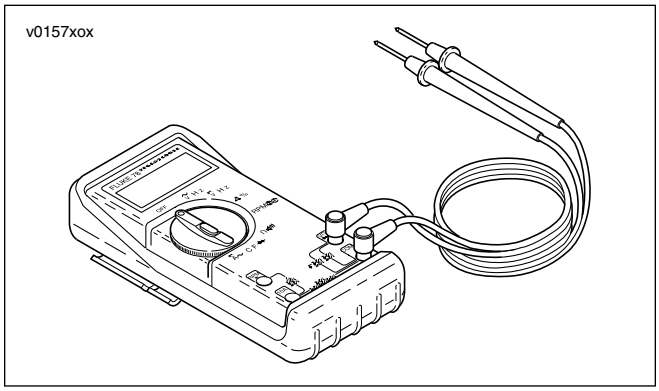


Figure 8-81. Fluke 78 Multimeter (DVOM) (Part No. HD-39978)

INITIAL DIAGNOSTIC CHECK 8.44

GENERAL

To locate faulty circuits or other system problems, follow the diagnostic flow charts in this section. For a systematic approach, always begin with 8.44 INITIAL DIAGNOSTIC CHECK. Read the general information and then work your way through the flow chart box by box.

Diagnostic Notes

If a numbered circle appears adjacent to a flow chart box, then more information is offered in the diagnostic notes. Many diagnostic notes contain supplemental information, descriptions of various diagnostic tools or references to other parts of the manual where information on the location and removal of components may be obtained.

Circuit Diagram/Wire Harness Connector Table

When working through a flow chart, refer to the illustrations, the associated circuit diagram and the wire harness connector table as necessary. The wire harness connector table for each circuit diagram identifies the connector number, description, type and general location.

In order to perform most diagnostic routines, a Breakout Box and a DVOM are required. See 8.42 BREAKOUT BOX: ECM.

To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

INITIAL DIAGNOSTICS

General Information

The diagnostic check is an organized approach to identifying a problem caused by an electronic control system malfunction.

Diagnostic Tips

- If Speedometer reads “BUS Er” with the ignition key turned ON (engine stop switch at RUN with the engine off), check data bus for an open or short to ground. between data link connector [91A] terminal 3 and ICM connector [10B] terminal 12 (corroborated models), ECM connector [78B] terminal 5 (EFI models), TSSM connector [30B] terminal 3, speedometer connector [39B] terminal 2 or tachometer (if equipped) connector [108B] terminal 2.
- Check for an open diagnostic test terminal between data Terminal 3 and ECM. With ignition key turned ON, transmit data should be typically 0.6-0.8 volts. The range of acceptable operation is 0-7.0 volts.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the diagnostic check flow charts.

1. Compare engine behavior to symptoms tables.
   a. Starts hard. Refer to Table 8-50.
   b. Hesitates, stumbles, surges, misfires and/or sluggish performance. Refer to Table 8-51.
   c. Engine exhaust emits black smoke or fouls plugs. Refer to Table 8-52.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probes and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 8.42 BREAKOUT BOX: ECM.

All EFI diagnostic codes are listed in Table 8-53.

Other Codes

See INITIAL DIAGNOSTIC CHECK TSSM for any codes related to the turn signal security module (TSSM).

See INITIAL DIAGNOSTIC CHECK SPEEDOMETER for any codes related to the instrument module (IM).

Table 8-49. Typical Scan Values for Engine Data

ITEM	MIN. VALUE	MAX. VALUE	HOT IDLE
MAP sensor	10 kPa	104 kPa	9.1-10.6 in. Hg 31-36 kPa
	0 volts	5.1 volts	1.1-1.4 volts
TP sensor	0	100	0%
	0.2 volts	4.8 volts	0.2-0.8 volts
IAC pintle	0	150	20-50 steps
RPM (non-adjustable)	0	9000	1300
ECT sensor	Ambient	302° F (150° C)	208-217° F (98-103° C)
	0.0 volts	5.1 volts	1.5-1.7 volts
IAT sensor	Ambient	248° F (120° C)	68-120° F (20-49° C)
	0.0 volts	5.1 volts	2.2-3.7 volts
INJ PW front	0	50 mS	1.6-2.3 mS
INJ PW rear	0	50 mS	1.6-2.3 mS
Advance front	0	50°	8-10°
Advance rear	0	50°	8-10°
VSS	0	136/140**	0 MPH
Battery voltage	10 volts	15 volts	13.4-14.5 volts
ENG RUN	off	run	Run
Idle RPM	1300	1600	1300
Purge solenoid	0%	100%	0%
Fan relay	off 208° F (98° C) and lower	on 217° F (103° C) and higher	depends on coolant temperature

NOTE

Hot idle specifications are with stock exhaust, the engine operating at 1300 RPM and an engine temperature of approximately 212° F (100° C). Idle settings are controlled by the ECM and cannot be changed.

Table 8-50. Engine Starts Hard

CAUSE	SOLUTION
Battery discharged	See charging system trouble-shooting in this section.
Spark plugs	8.53 MISFIRE AT IDLE OR UNDER LOAD.
Spark plug boots	8.53 MISFIRE AT IDLE OR UNDER LOAD.
Ignition coil	8.53 MISFIRE AT IDLE OR UNDER LOAD.
Valve sticking	See Section 3 in the appropriate VRSC Service Manual.
Water or dirt in fuel system	Drain and refill with fresh fuel.
Loss of battery power to ECM terminal 31*	See 8.46 NO ECM POWER

* Codes will not clear (although they appear to).

** 136 MPH (218.8 KPH) for domestic models using 28 tooth sprocket. 140 MPH (225.3 KPH) for HDI models using 30 tooth sprocket.

Table 8-51. Engine Performance Problems

CAUSE	SOLUTION
Manifold leak (When manifold leak is large enough, IAC will close to 0 and a P0505 DTC will set.)	See VRSC Service Manual, Intake Leak Test. A low IAC count may also indicate an air leak.
MAP sensor plugged or not operating properly	8.55 DTC P0107, P0108.
Water or dirt in fuel system	Drain and refill with fresh fuel.
Spark plugs	8.53 MISFIRE AT IDLE OR UNDER LOAD.
Throttle plate not opening fully	See throttle cable adjustment in the appropriate VRSC Service Manual.
Low fuel pressure	8.51 FUEL PRESSURE TEST.
Cooling system fan(s) inoperative	8.50 FAN OPERATION CHECK.

Table 8-52. Engine Exhaust Emits Black Smoke or Fouls Plugs

CAUSE	SOLUTION
Clogged air filter	See AIR CLEANER FILTER in the appropriate VRSC Service Manual
MAP sensor plugged or not operating properly	8.55 DTC P0107, P0108.

Table 8-53. Diagnostic Trouble Codes (DTC) and Fault Conditions

RANKING	DTC	STATUS	FAULT CONDITION	SOLUTION
1	P0605	Current	ECM flash error	8.64 DTC P0603, P0605
2	P0605	Historic	ECM flash error	8.64 DTC P0603, P0605
3	P0603	Current	ECM EEPROM error	8.64 DTC P0603, P0605
4	P0603	Historic	ECM EEPROM error	8.64 DTC P0603, P0605
5	U1300	Current	ECM serial data low	8.47 STARTS, THEN STALLS
6	U1301	Current	ECM serial data open/high	8.47 STARTS, THEN STALLS
7	U1300	Current	TSSM serial data low	8.47 STARTS, THEN STALLS
8	U1301	Current	TSSM serial data open/high	8.47 STARTS, THEN STALLS
9	U1300	Current	Serial data low	8.47 STARTS, THEN STALLS
10	U1301	Current	Serial data open/high	8.47 STARTS, THEN STALLS
11	U1064	Current	Loss of /TSSM serial data-at ECM	8.67 DTC U1064, U1255 AT ECM
12	U1016	Current	Loss of all ECM serial data-at TSSM	8.35 DTC U1016, U1255 AT TSSM
13	U1097	Current	Loss of speedometer serial data-at TSSM	8.35 DTC U1016, U1255 AT TSSM
14	U1255	Current	Missing response-at TSSM	8.15 DTC U1064, U1255 AT SPEEDOMETER
15	U1064	Current	Loss of /TSSM serial data-at speedometer	8.15 DTC U1064, U1255 AT SPEEDOMETER
16	U1016	Current	Loss of all ECM serial data-at speedometer	8.14 DTC U1016, U1255 AT SPEEDOMETER
17	U1255	Current	Missing response-at speedometer	8.36 DTC U1097, U1255 AT TSSM
18	P1003	Current	System relay contacts open	8.49 SYSTEM RELAY CHECK
19	P1002	Current	System relay coil high/shorted	8.49 SYSTEM RELAY CHECK
20	P1001	Current	System relay coil open/low	8.49 SYSTEM RELAY CHECK
21	P1004	Current	System relay contacts closed	8.49 SYSTEM RELAY CHECK
22	P1009	Current	Incorrect password	8.65 DTC P1009, P1010
23	P1010	Current	Missing password	8.65 DTC P1009, P1010
24	P0373	Current	CKP sensor intermittent	8.60 DTC P0373, P0374
25	P0374	Current	CKP sensor synch error	8.60 DTC P0373, P0374
26	P0122	Current	TP sensor open/low	8.58 DTC P0122, P0123
27	P0123	Current	TP sensor high	8.58 DTC P0122, P0123
28	P0107	Current	MAP sensor open/low	8.55 DTC P0107, P0108
29	P0108	Current	MAP sensor high	8.55 DTC P0107, P0108
30	P0117	Current	ET sensor voltage low	8.57 DTC P0117, P0118
31	P0118	Current	ET sensor open/high	8.57 DTC P0117, P0118
32	P0112	Current	IAT sensor voltage low	8.56 DTC P0112, P0113
33	P0113	Current	IAT sensor open/high	8.56 DTC P0112, P0113
34	P1351	Current	Front ignition coil open/low	8.66 DTC P1351, P1352, P1354, P1355
35	P1354	Current	Rear ignition coil open/low	8.66 DTC P1351, P1352, P1354, P1355
36	P1352	Current	Front ignition coil high/shorted	8.66 DTC P1351, P1352, P1354, P1355
37	P1355	Current	Rear ignition coil high/shorted	8.66 DTC P1351, P1352, P1354, P1355
38	P1357	Current	Front cylinder combustion intermittent	8.54 COMBUSTION ABSENT/INTERMITTENT
39	P1358	Current	Rear cylinder combustion intermittent	8.54 COMBUSTION ABSENT/INTERMITTENT
40	P0261	Current	Front injector open/low	8.59 DTC P0261, P0262, P0263, P0264
41	P0263	Current	Rear injector open/low	8.59 DTC P0261, P0262, P0263, P0264
42	P0262	Current	Front injector high	8.59 DTC P0261, P0262, P0263, P0264
43	P0264	Current	Rear injector high	8.59 DTC P0261, P0262, P0263, P0264

Table 8-53. Diagnostic Trouble Codes (DTC) and Fault Conditions

RANKING	DTC	STATUS	FAULT CONDITION	SOLUTION
44	P0562	Current	Battery voltage low	8.63 DTC P0562, P0563
45	P0563	Current	Battery voltage high	8.63 DTC P0562, P0563
46	P0501	Current	VSS sensor low	8.62 DTC P0501, P0502
47	P0502	Current	VSS sensor high	8.62 DTC P0501, P0502
48	P1651	Current	Check engine light open/low	8.25 SPEEDOMETER SELF DIAGNOSTICS
49	P1652	Current	Check engine light high	8.25 SPEEDOMETER SELF DIAGNOSTICS
50	P1653	Current	Tachometer low	8.25 SPEEDOMETER SELF DIAGNOSTICS
51	P1654	Current	Tachometer high	8.25 SPEEDOMETER SELF DIAGNOSTICS
52	P1356	Current	Rear cylinder no combustion	8.54 COMBUSTION ABSENT/INTERMITTENT
53	P1353	Current	Front cylinder no combustion	8.54 COMBUSTION ABSENT/INTERMITTENT
54	P0444	Current	Purge control open/low	8.61 DTC P0444, P0445
55	P0445	Current	Purge control high	8.61 DTC P0444, P0445
56	P1481	Current	Fan output open/low	8.50 FAN OPERATION CHECK
57	P1482	Current	Fan output high	8.50 FAN OPERATION CHECK
58	P0505	Current	Loss of idle speed control	8.52 IDLE AIR CONTROL
59	B1135	Current	Accelerometer fault	8.34 DTC B1135
60	B1134	Current	Starter output high	8.33 DTC B1134
61	B1121	Current	Left turn output fault	8.30 TURN SIGNAL ERRORS
62	B1122	Current	Right turn output fault	8.30 TURN SIGNAL ERRORS
63	B0563	Current	Battery voltage high	8.31 DTC B0563
64	B1131	Current	Alarm output low	8.32 DTC B1131, B1132
65	B1132	Current	Alarm output high	8.32 DTC B1131, B1132
66	B1141	Current	Ignition switch open/low	8.30 TURN SIGNAL ERRORS
70	B1006	Current	Accessory line overvoltage	8.12 DTC B1006, B1007
71	B1007	Current	Ignition line overvoltage	8.12 DTC B1006, B1007
72	B1008	Current	Trip switch closed	8.13 DTC B1008
73	U1300	Historic	ECM serial data low	8.47 STARTS, THEN STALLS
74	U1301	Historic	ECM serial data open/high	8.47 STARTS, THEN STALLS
75	U1300	Historic	TSSM serial data low	8.47 STARTS, THEN STALLS
76	U1301	Historic	TSSM serial data open/high	8.47 STARTS, THEN STALLS
77	U1300	Historic	IM serial data low	8.47 STARTS, THEN STALLS
78	U1301	Historic	IM serial data open/high	8.47 STARTS, THEN STALLS
79	U1064	Historic	Loss of /TSSM serial data-at ECM	8.15 DTC U1064, U1255 AT SPEEDOMETER
80	U1016	Historic	Loss of all ECM serial data-at TSSM	8.15 DTC U1064, U1255 AT SPEEDOMETER
81	U1096	Historic	Loss of IM serial data-at TSSM	8.36 DTC U1097, U1255 AT TSSM
82	U1255	Historic	Missing response-at TSSM	8.15 DTC U1064, U1255 AT SPEEDOMETER
83	U1064	Historic	Loss of /TSSM serial data-at IM	8.15 DTC U1064, U1255 AT SPEEDOMETER
84	U1016	Historic	Loss of all ECM serial data-at IM	8.35 DTC U1016, U1255 AT TSSM
85	U1255	Historic	Missing response-at IM	8.36 DTC U1097, U1255 AT TSSM
86	P1003	Historic	System relay contacts open	8.49 SYSTEM RELAY CHECK
87	P1002	Historic	System relay coil high/shorted	8.49 SYSTEM RELAY CHECK
88	P1001	Historic	System relay coil open/low	8.49 SYSTEM RELAY CHECK
89	P1004	Historic	System relay contacts closed	8.49 SYSTEM RELAY CHECK
90	P1009	Historic	Incorrect password	8.65 DTC P1009, P1010
91	P1010	Historic	Missing password	8.65 DTC P1009, P1010
92	P0373	Historic	CKP sensor intermittent	8.60 DTC P0373, P0374
93	P0374	Historic	CKP sensor synch error	8.65 DTC P1009, P1010

Table 8-53. Diagnostic Trouble Codes (DTC) and Fault Conditions

RANKING	DTC	STATUS	FAULT CONDITION	SOLUTION
94	P0122	Historic	TP sensor open/low	8.58 DTC P0122, P0123
95	P0123	Historic	TP sensor high	8.58 DTC P0122, P0123
96	P0107	Historic	MAP sensor open/low	8.55 DTC P0107, P0108
97	P0108	Historic	MAP sensor high	8.55 DTC P0107, P0108
98	P0117	Historic	ET sensor voltage low	8.57 DTC P0117, P0118
99	P0118	Historic	ET sensor open/high	8.57 DTC P0117, P0118
100	P0112	Historic	IAT sensor voltage low	8.56 DTC P0112, P0113
101	P0113	Historic	IAT sensor open/high	8.57 DTC P0117, P0118
102	P1351	Historic	Front ignition coil open/low	8.66 DTC P1351, P1352, P1354, P1355
103	P1354	Historic	Rear ignition coil open/low	8.66 DTC P1351, P1352, P1354, P1355
104	P1352	Historic	Front ignition coil high/shorted	8.66 DTC P1351, P1352, P1354, P1355
105	P1355	Historic	Rear ignition coil high/shorted	8.66 DTC P1351, P1352, P1354, P1355
106	P1357	Historic	Front cylinder combustion intermittent	8.54 COMBUSTION ABSENT/INTERMITTENT
107	P1358	Historic	Rear cylinder combustion intermittent	8.54 COMBUSTION ABSENT/INTERMITTENT
108	P0261	Historic	Front injector open/low	8.59 DTC P0261, P0262, P0263, P0264
109	P0263	Historic	Rear injector open/low	8.59 DTC P0261, P0262, P0263, P0264
110	P0262	Historic	Front injector high	8.59 DTC P0261, P0262, P0263, P0264
111	P0264	Historic	Rear injector high	8.59 DTC P0261, P0262, P0263, P0264
112	P0562	Historic	Battery voltage low	8.63 DTC P0562, P0563
113	P0563	Historic	Battery voltage high	8.63 DTC P0562, P0563
114	P0501	Historic	VSS sensor low	8.62 DTC P0501, P0502
115	P0502	Historic	VSS sensor high	8.62 DTC P0501, P0502
116	P1651	Historic	Check engine light open/low	8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES
117	P1652	Historic	Check engine light high	8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES
118	P1653	Historic	Tachometer low	8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES
119	P1654	Historic	Tachometer high	8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES
120	P1356	Historic	Rear cylinder no combustion	8.54 COMBUSTION ABSENT/INTERMITTENT
121	P1353	Historic	Front cylinder no combustion	8.54 COMBUSTION ABSENT/INTERMITTENT
122	P0444	Historic	Purge control open/low	8.61 DTC P0444, P0445
123	P0445	Historic	Purge control high	8.61 DTC P0444, P0445
124	P1481	Historic	Fan output open/low	8.50 FAN OPERATION CHECK
125	P1482	Historic	Fan output high	8.50 FAN OPERATION CHECK
126	P0505	Historic	Loss of idle speed control	8.52 IDLE AIR CONTROL
127	B1135	Historic	Accelerometer fault	8.34 DTC B1135
128	B1134	Historic	Starter output high	8.33 DTC B1134
129	B1121	Historic	Left turn output fault	8.30 TURN SIGNAL ERRORS
130	B1122	Historic	Right turn output fault	8.30 TURN SIGNAL ERRORS
131	B0563	Historic	Battery voltage high	8.31 DTC B0563
132	B1131	Historic	Alarm output low	8.32 DTC B1131, B1132
133	B1132	Historic	Alarm output high	8.32 DTC B1131, B1132
134	B1141	Historic	Ignition switch open/low	8.30 TURN SIGNAL ERRORS
138	B 1006	Historic	Accessory line overvoltage	8.12 DTC B1006, B1007
139	B 1007	Historic	Ignition line overvoltage	8.12 DTC B1006, B1007
140	B 1008	Historic	Trip switch closed	8.13 DTC B1008

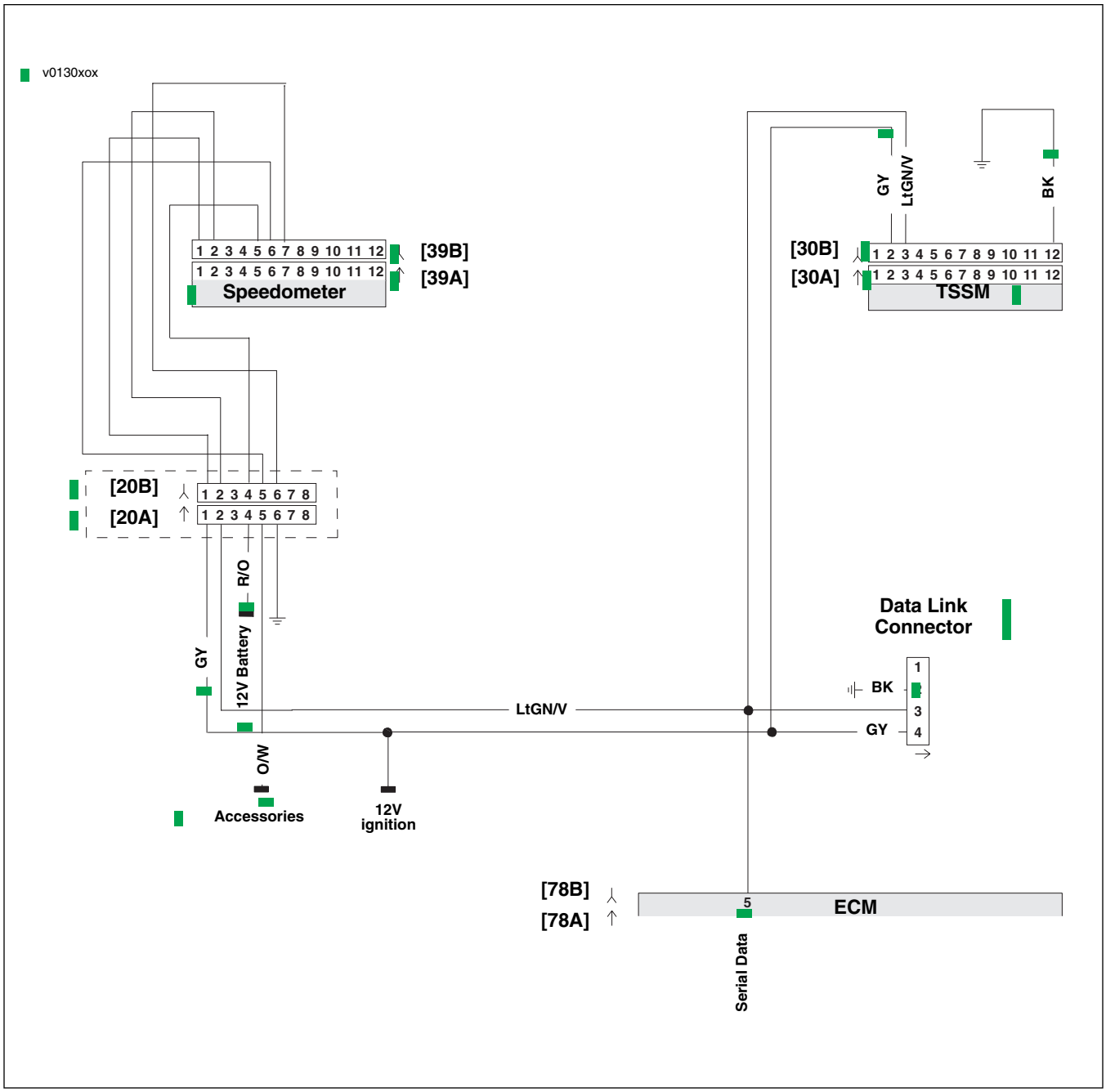
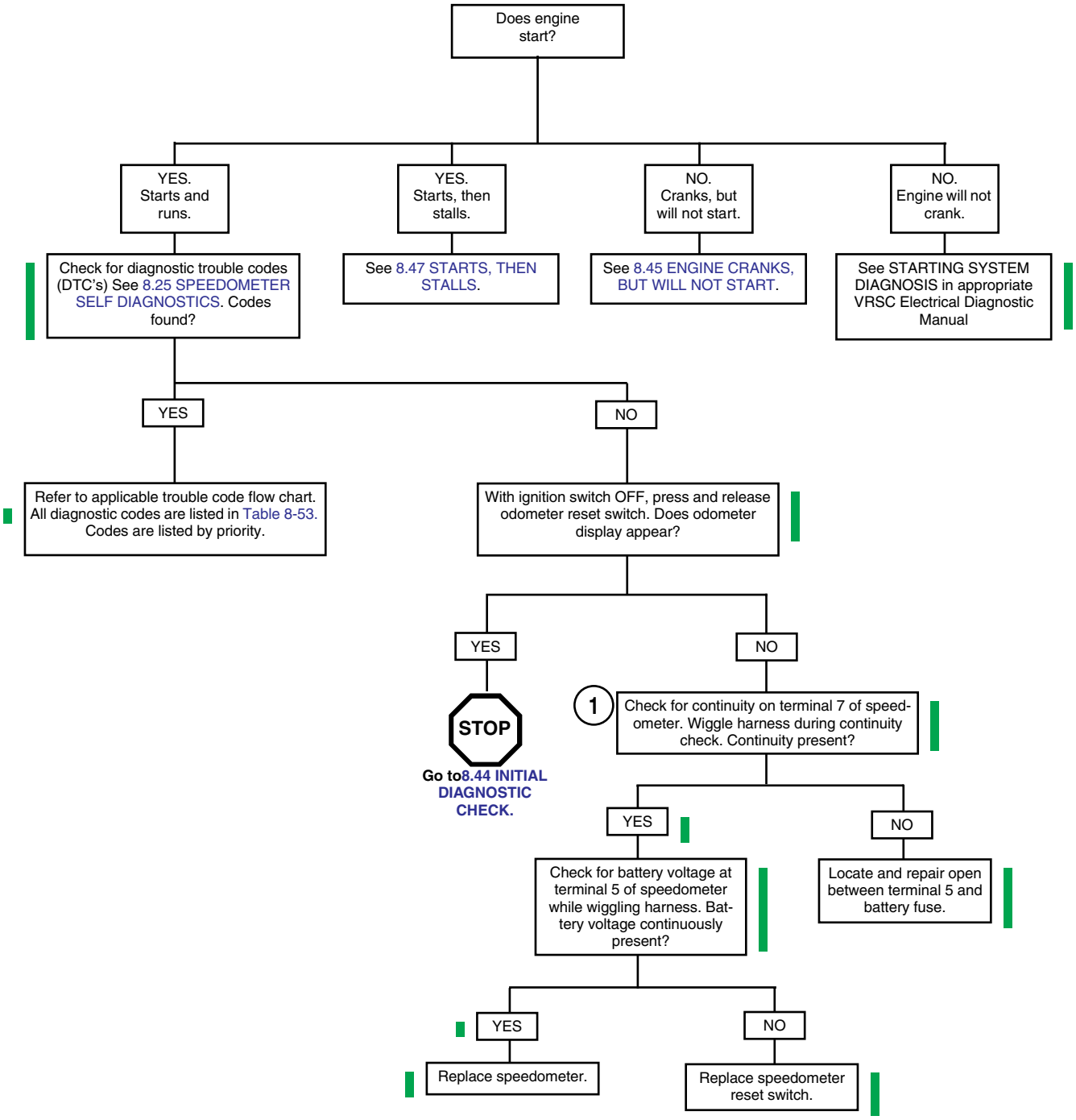


Figure 8-82. Serial Data Circuit

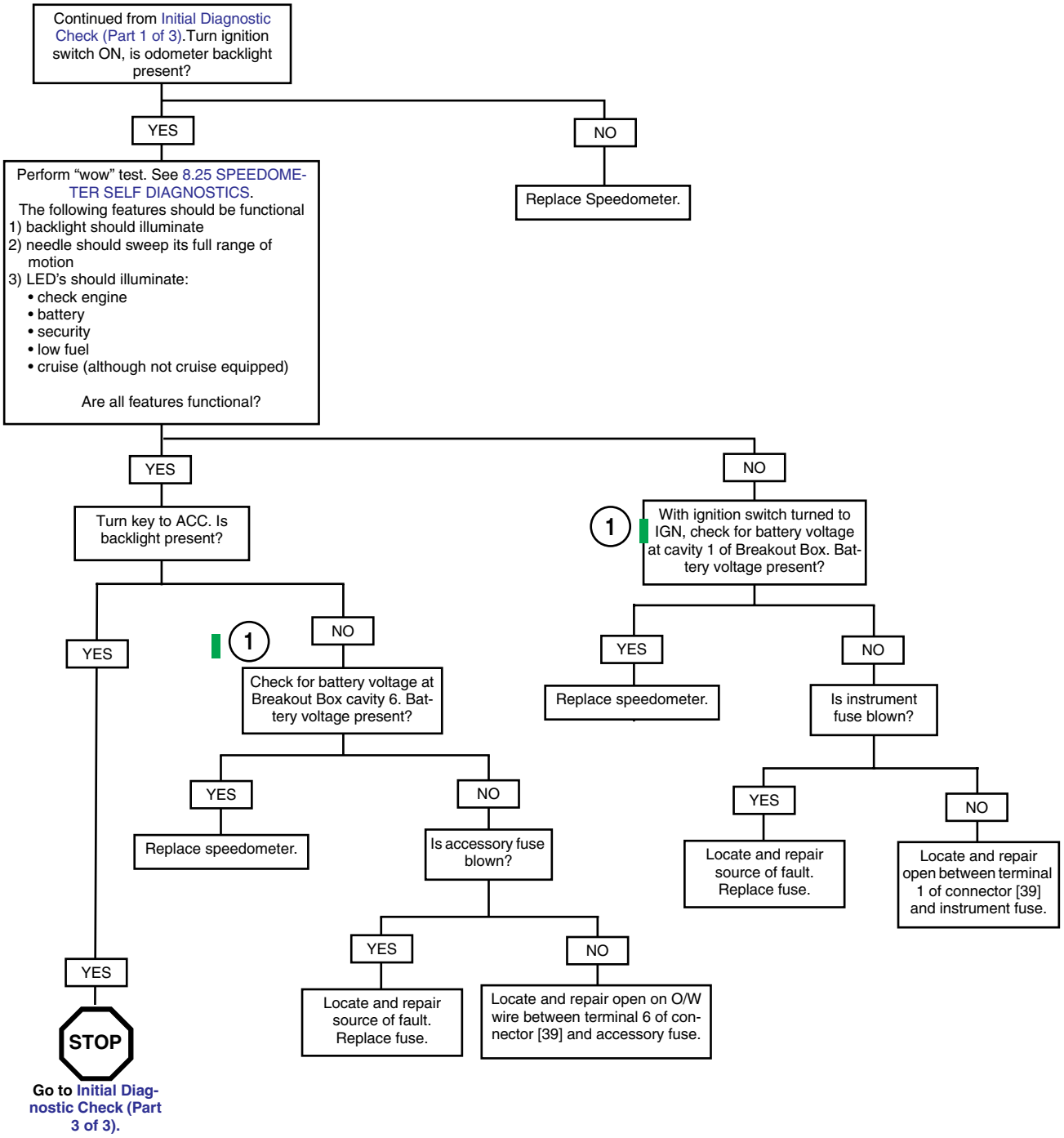
Table 8-54. Wire Harness Connectors in Figure 8-82.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Initial Diagnostic Check 8.44 (Part 1 of 3)

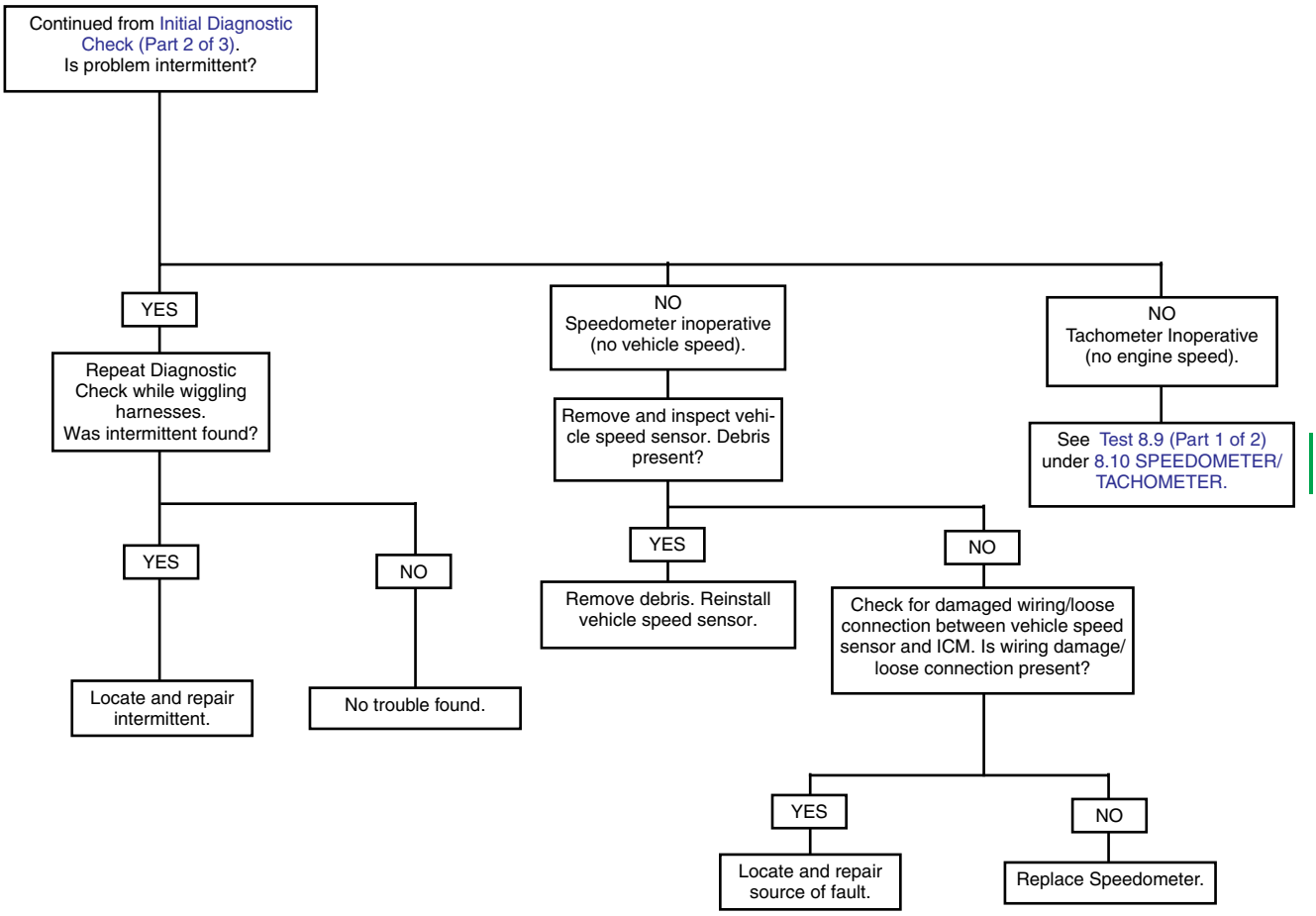


Initial Diagnostic Check 8.44 (Part 2 of 3)



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Initial Diagnostic Check 8.44 (Part 3 of 3)



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

ENGINE CRANKS, BUT WILL NOT START 8.45

GENERAL

If the starter will not crank the engine, the problem is not EFI related. Refer to SECTION 1-STARTING & CHARGING or SECTION 3 TSSM.

Self diagnostics can be used to retrieve trouble codes. See SPEEDOMETER SELF DIAGNOSTICS.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. Check for trouble codes. See 8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES
2. Check the condition of the battery. Perform a voltage test and recharge if below 12.60V. Check battery connections and perform load test. Replace the battery if necessary. See BATTERY in the appropriate VRSC Service Manual.
3. Typically, when IAC is not functioning, the engine will not start unless throttle is opened and the engine will stall when throttle is closed.
4. See Figure 8-84. Plug IGNITION COIL CIRCUIT TEST ADAPTER (Part No. HD-44687) and FUEL INJECTOR TEST LAMP (Part No. HD-34730-2C) into Breakout Box Terminals 13 and 11. Start engine. If lamp flashes, no problem is found. Repeat for Breakout Box cavities 13 and 29.
5. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probe and patch cord.

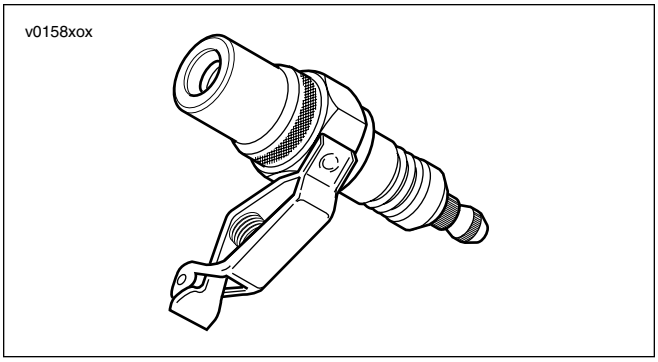


Figure 8-83. Spark Tester

Figure 8-84. Ignition Coil Circuit Test

6. Connect BREAKOUT BOX (Part No. HD-43876). See 8.42 BREAKOUT BOX: ECM.
7. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404) gray terminal probes and patch cords.

⚠WARNING

Any open spark around gasoline or other combustibles may result in fire or explosion. Thoroughly wipe up any spilled fuel and dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

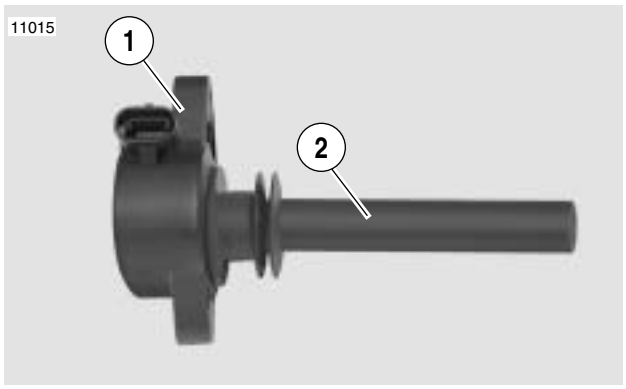
8. Remove both plug top coils and spark plugs.

NOTE

Engine will not spark with both spark plugs removed. When checking for spark, use SPARK TESTER (Part No. HD-26792) with both plugs installed.

   a. Visually check condition of plugs.
   b. Reinstall spark plugs.
   c. See Figure 8-83. Attach plug top coil to SPARK TESTER (Part No. HD-26792). Clip tester to ground.
   d. While cranking engine, look for spark. Repeat procedure on other cylinder.

9. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), brown socket probe and patch cord.



1. **Plug top coil**
2. **Boot**

Figure 8-85. Plug Top Coil

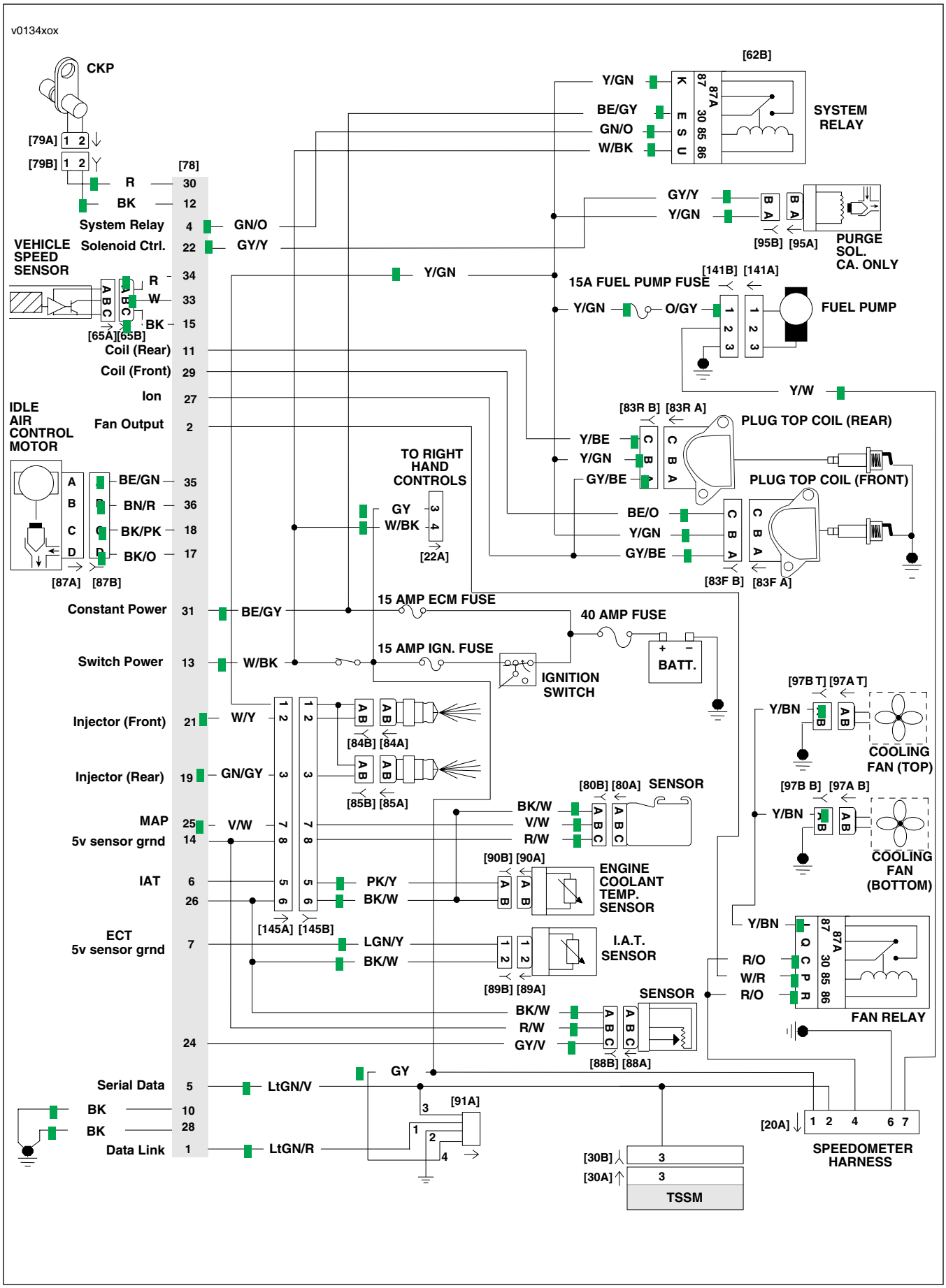


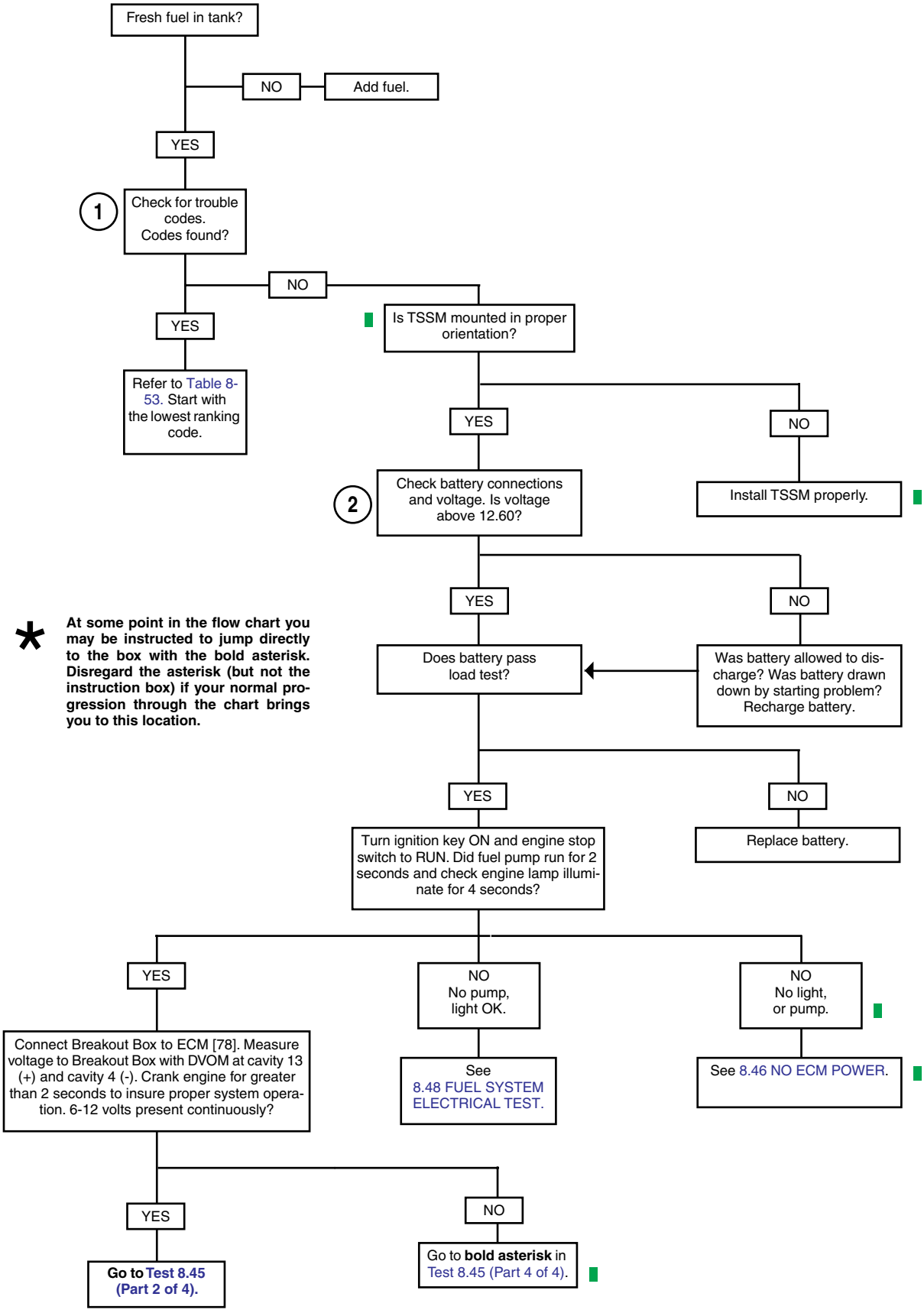
Figure 8-86. EFI Circuit Diagram

Table 8-55. Wire Harness Connectors in Figure 8-86.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar switch (black)	6-place Deutsch	under left side cover
[78]	ECM	36-place Packard	under left side cover
[79]	CKP sensor	2-place Mini-Deutsch	under crankcase
[83F]	Front plug top coil	3-place Packard	on top of front rocker box
[83R]	Rear plug top coil	3-place Packard	on top of rear rocker box
[91]	Data link	4-place Deutsch	under left side cover
[145]	Engine harness	12-place Deutsch	under air cleaner

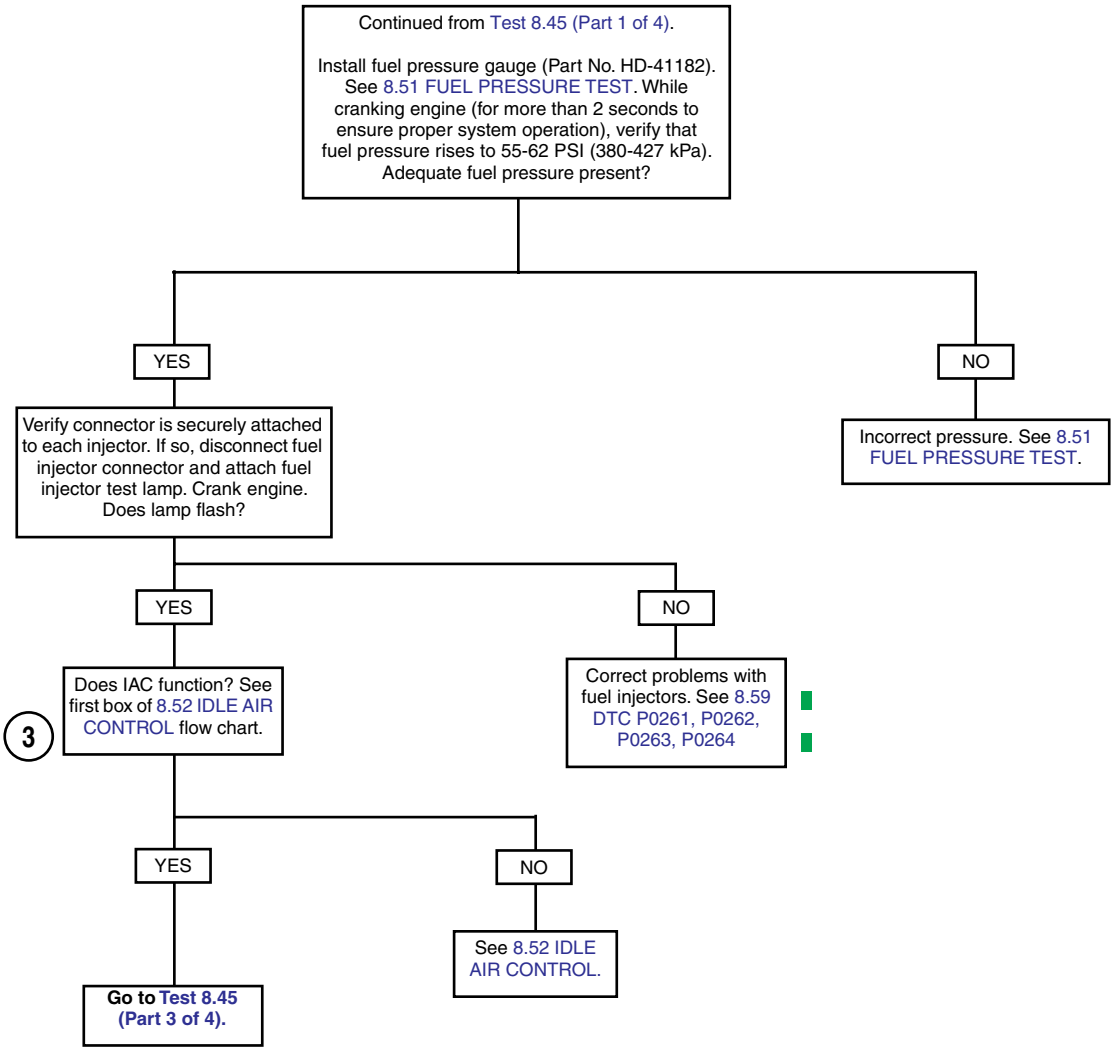
Test 8.45 (Part 1 of 4)

ENGINE CRANKS, BUT WILL NOT START



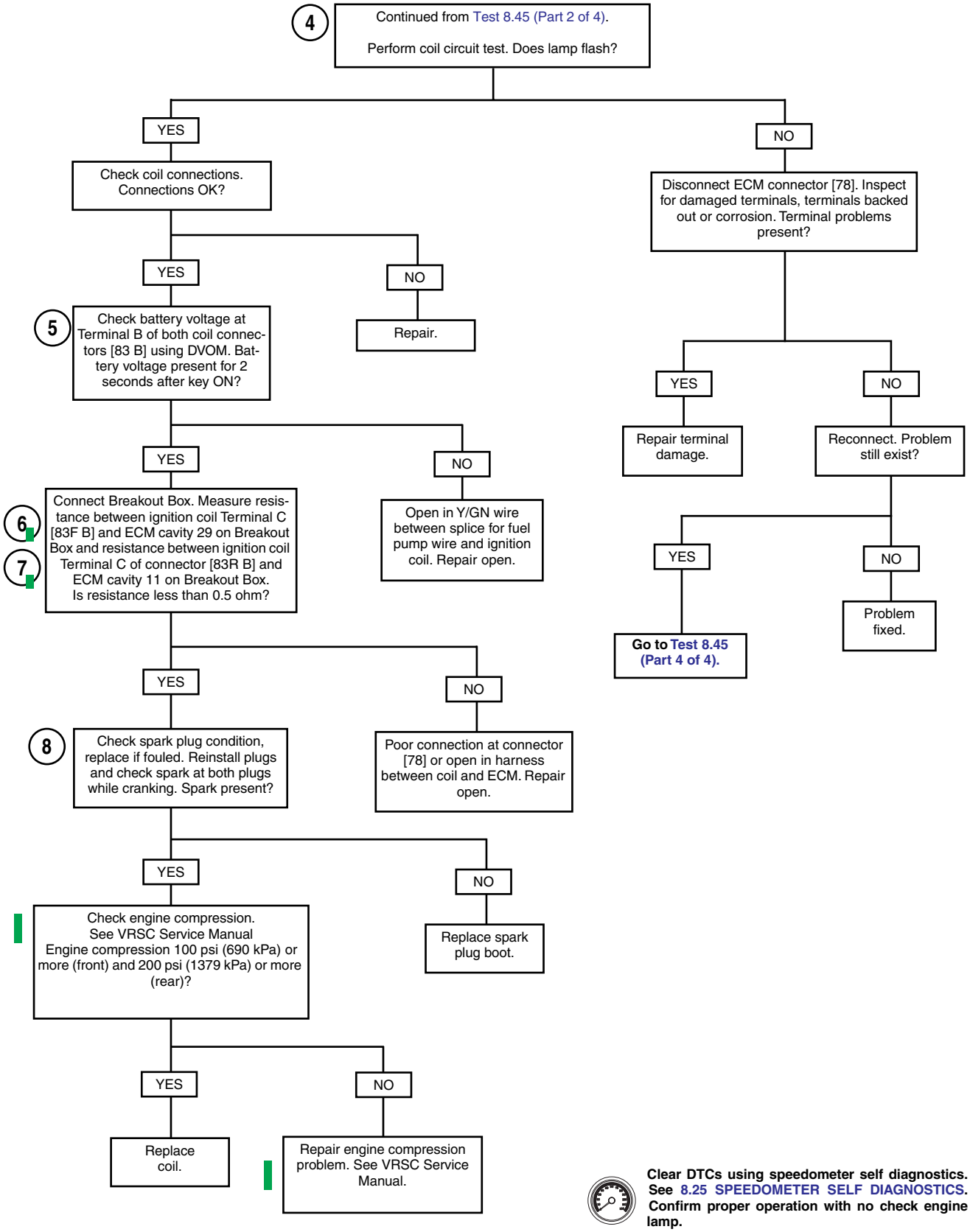
Test 8.45 (Part 2 of 4)

ENGINE CRANKS, BUT WILL NOT START



Test 8.45 (Part 3 of 4)

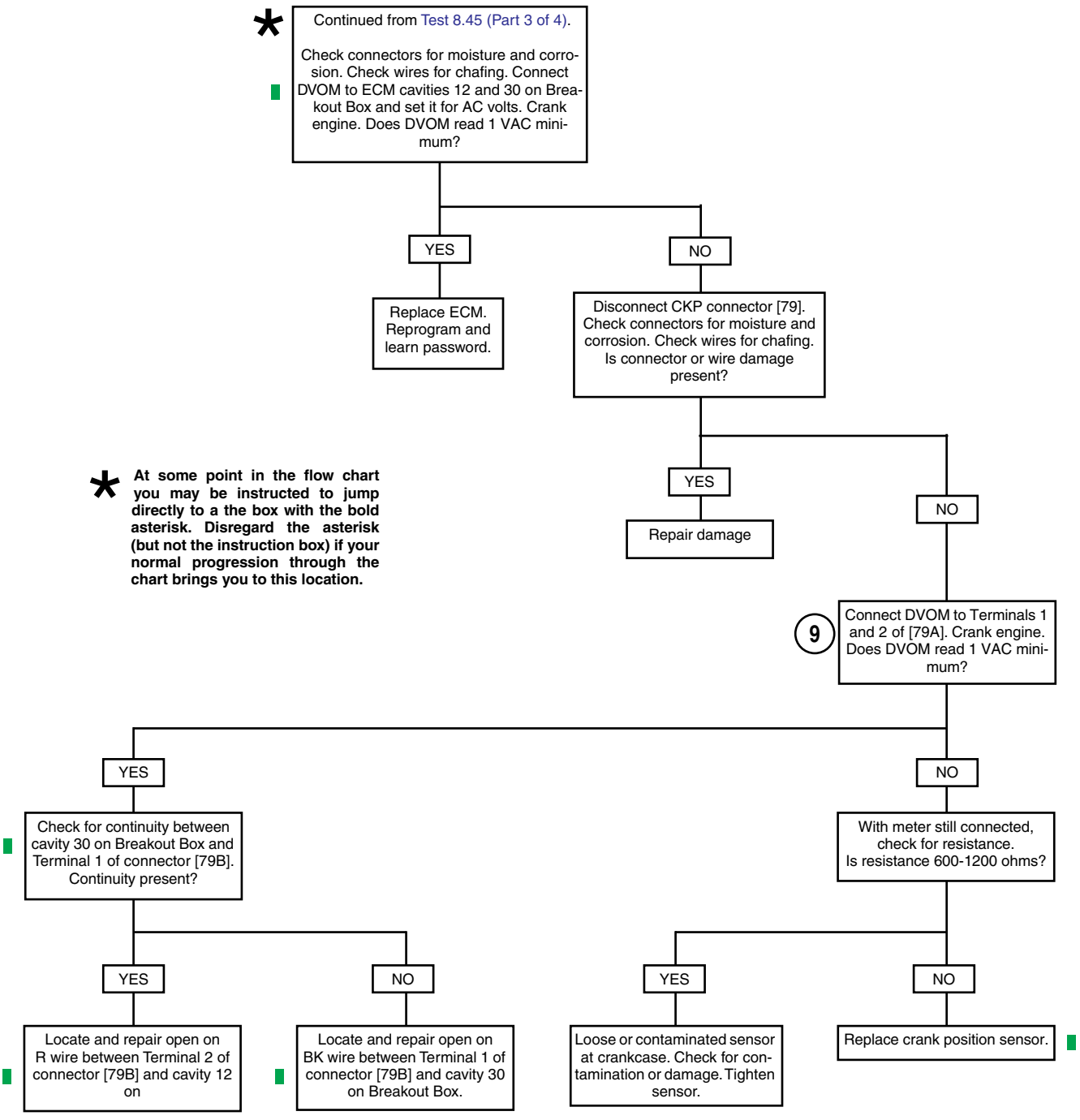
ENGINE CRANKS, BUT WILL NOT START



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.45 (Part 4 of 4)

ENGINE CRANKS, BUT WILL NOT START



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

NO ECM POWER 8.46

GENERAL

No Spark/No Check Engine Lamp at Key ON

Constant power is supplied to the ECM through terminal 31. The ECM turns on when power is applied to terminal 13 of connector [78]. The ECM goes through an initialization sequence every time power is removed and re-applied to terminal 13. The only visible part of this sequence is the check engine lamp. Upon key ON, the check engine lamp and security lamp will illuminate for 4 seconds and then (if parameters are normal) go out.

If battery power is absent at ECM terminal 31:

- DTCs cannot be cleared. Tool will show them as cleared but will be present next time ignition key is cycled.
- ECM cannot be re-flashed.
- Vehicle will run but IAC will not reset eventually leading to idle speed or hard starting problems.

NOTE

The key ON sequence also activates the idle air control motor. If power from terminal 31 is disrupted (blown fuse, etc.) always turn the key OFF wait 10 seconds then turn the key ON to reset the motor to the default position.

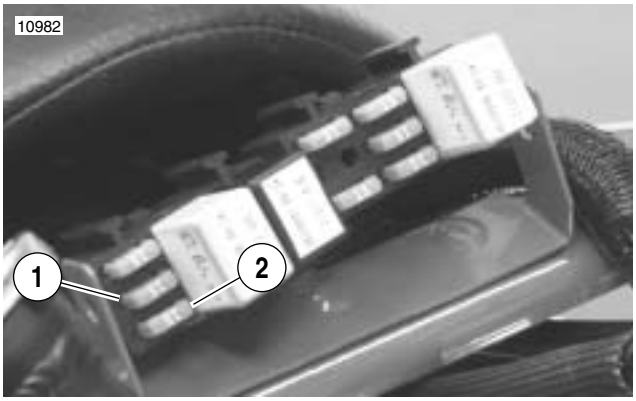
DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. Connect BREAKOUT BOX (Part No. HD-43876). See 8.42 BREAKOUT BOX: ECM.
2. Connect BREAKOUT BOX (Part No. HD-42682) to connector [22] using ADAPTERS (HD-42962).

Figure 8-87. Fuse Block Location



1. **ECM fuse**
2. **Ignition fuse**

Figure 8-88. Ignition and ECM Fuse

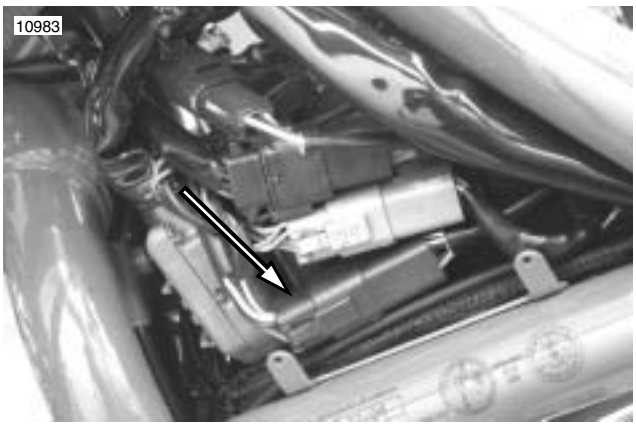


Figure 8-89. Right Hand Control Connector [22] - Under Left Side Cover

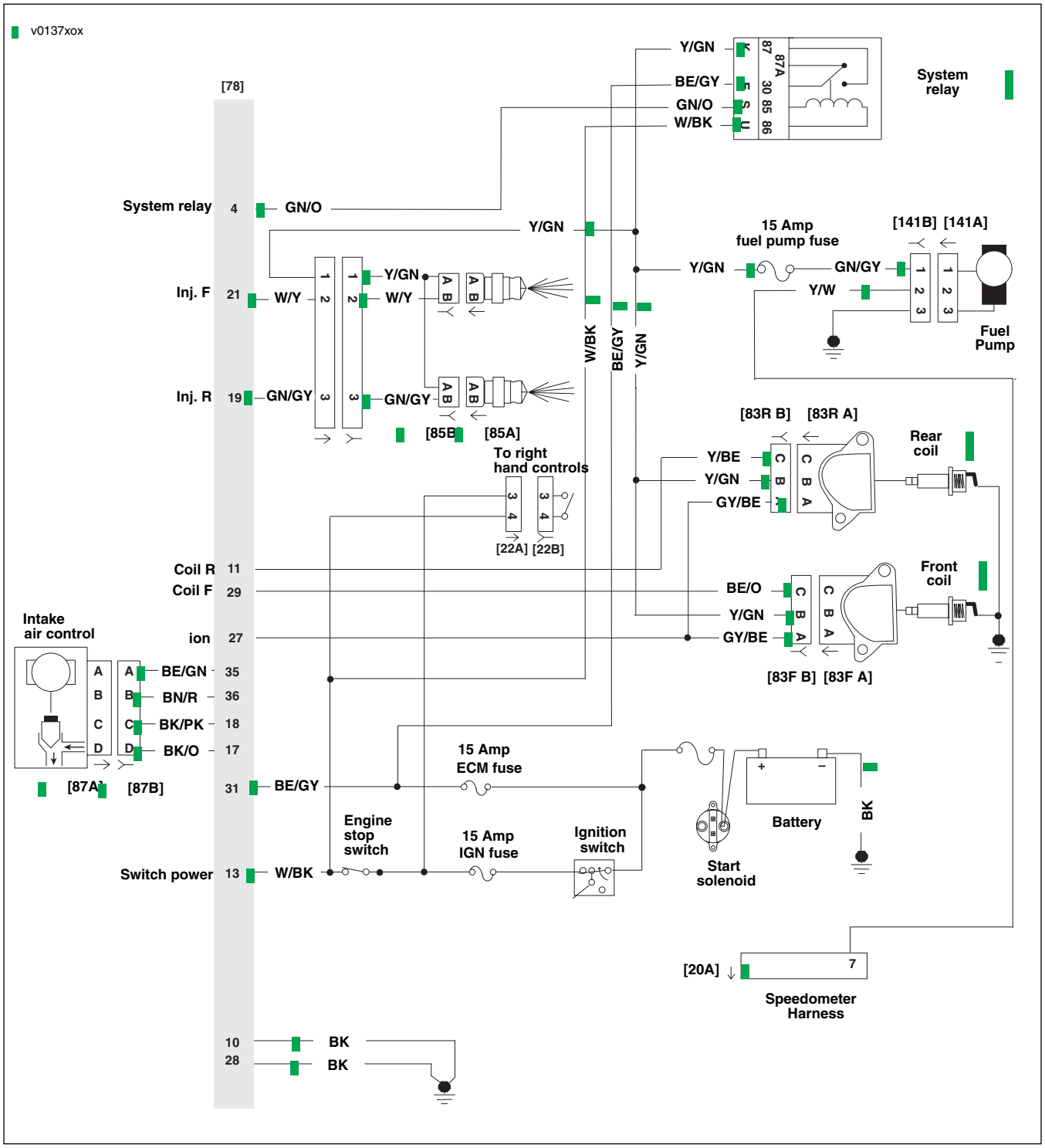


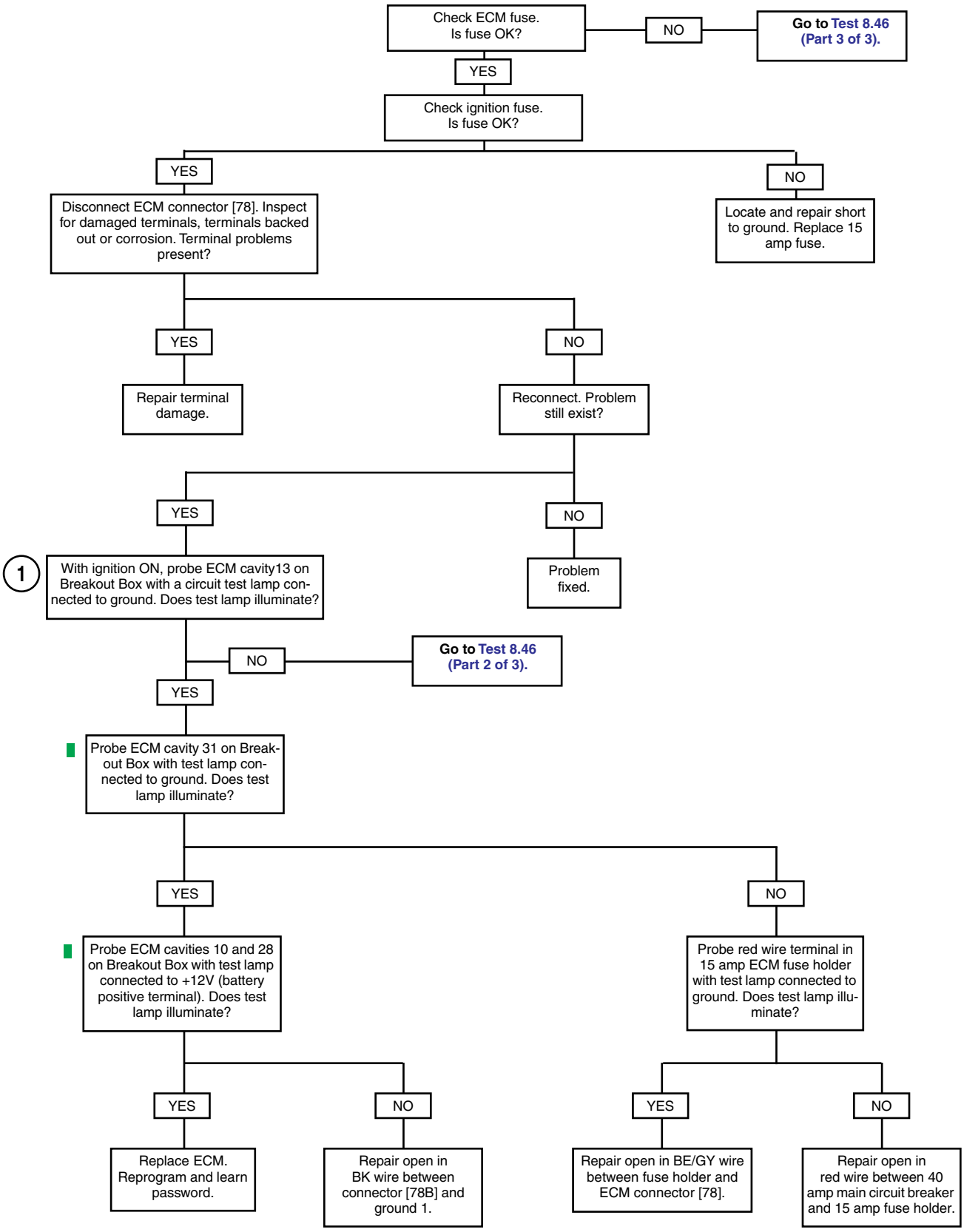
Figure 8-90. ECM Power Circuit Diagram

Table 8-56. Wire Harness Connectors in Figure 8-90.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar switch (black)	6-place Deutsch	Under left side cover
[78]	ECM	36-place Packard	Under left side cover
GND 1	ECM ground	Ring terminal	Rear cylinder head
	Fuse block	Fuse block	Under airbox cover

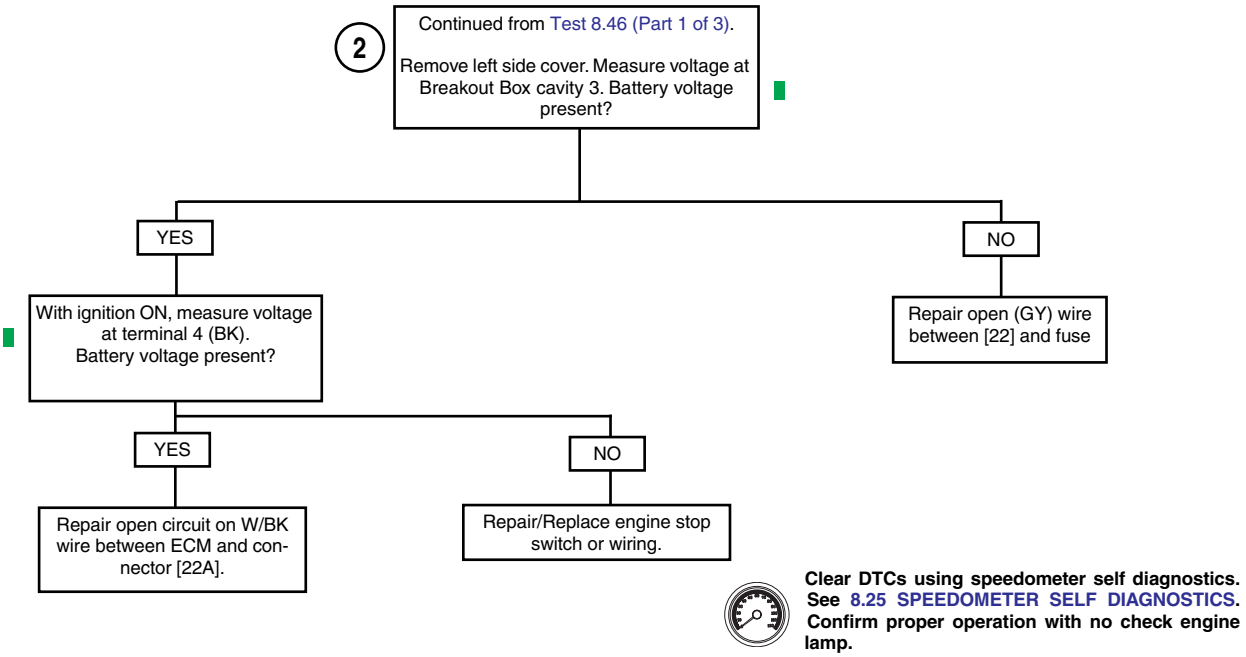
Test 8.46 (Part 1 of 3)

NO ECM POWER



Test 8.46 (Part 2 of 3)

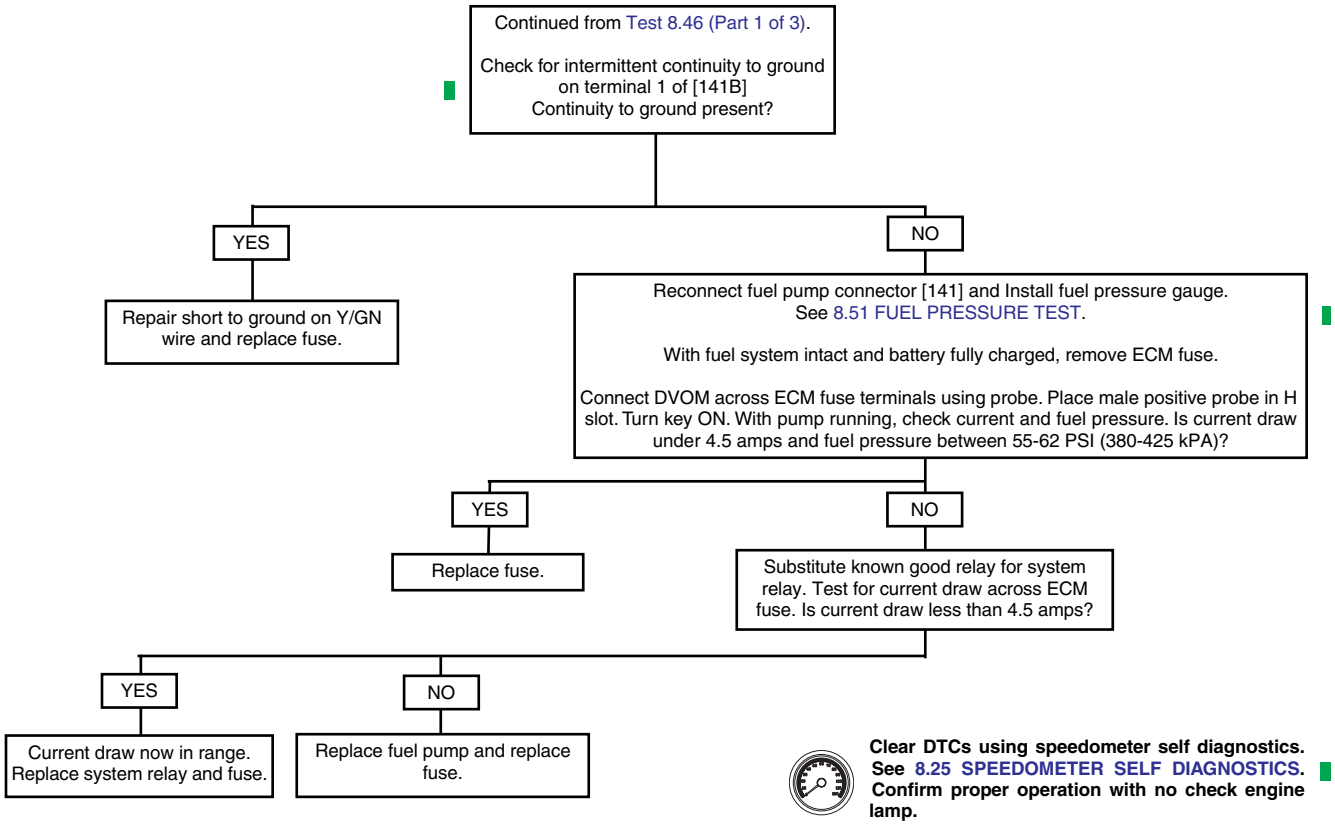
NO ECM POWER



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.46 (Part 3 of 3)

NO ECM POWER



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

STARTS, THEN STALLS 8.47

GENERAL

Diagnostic Trouble Codes U1300, U1301: Serial Data Failure

See Figure 8-91. The typical serial data voltage range is 0 volts (inactive) to 7 volts (active). Due to the short pulse, voltages will be much lower on a DVOM. In analog mode, a DVOM reading serial data will show continuous voltage when active, typically 0.6-0.8 volts. The range for acceptable operations is 0-7.0 volts.

NOTE

Problems in the fuel system or idle air control system may also create this symptom.

Table 8-57. Code Description

DTC	DESCRIPTION
U1300	Serial data low
U1301	Serial data open/high

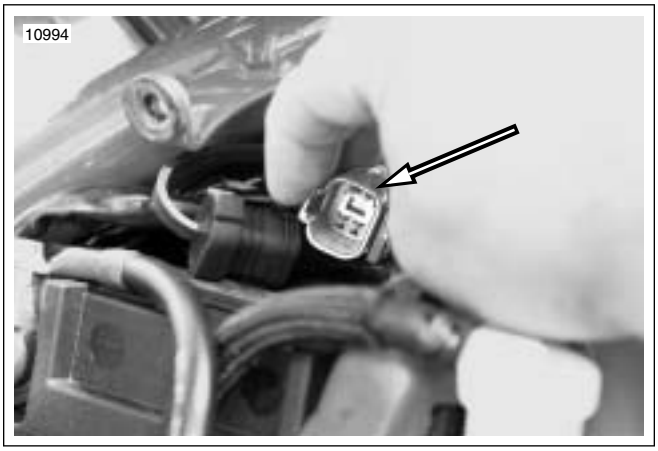


Figure 8-91. Data Link Connector [91A]

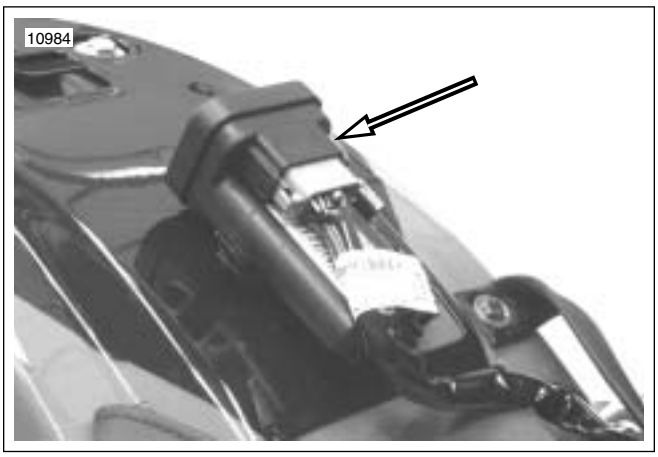


Figure 8-92. TSSM (typical)

DIAGNOSTICS

Diagnostic Tips

- If serial data is shorted, these codes will automatically trip the check engine light.
- DTCs P1009 and P1010 may accompany DTCs U1300 and U1301.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. Check for trouble codes. See 8.23 CHECKING FOR DIAGNOSTIC TROUBLE CODES.
2. Connect BREAKOUT BOX (Part No. HD-43876). See 8.42 BREAKOUT BOX: ECM.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probes and patch cord.
4. Historic code U1300 would have been set. Clear historic codes.

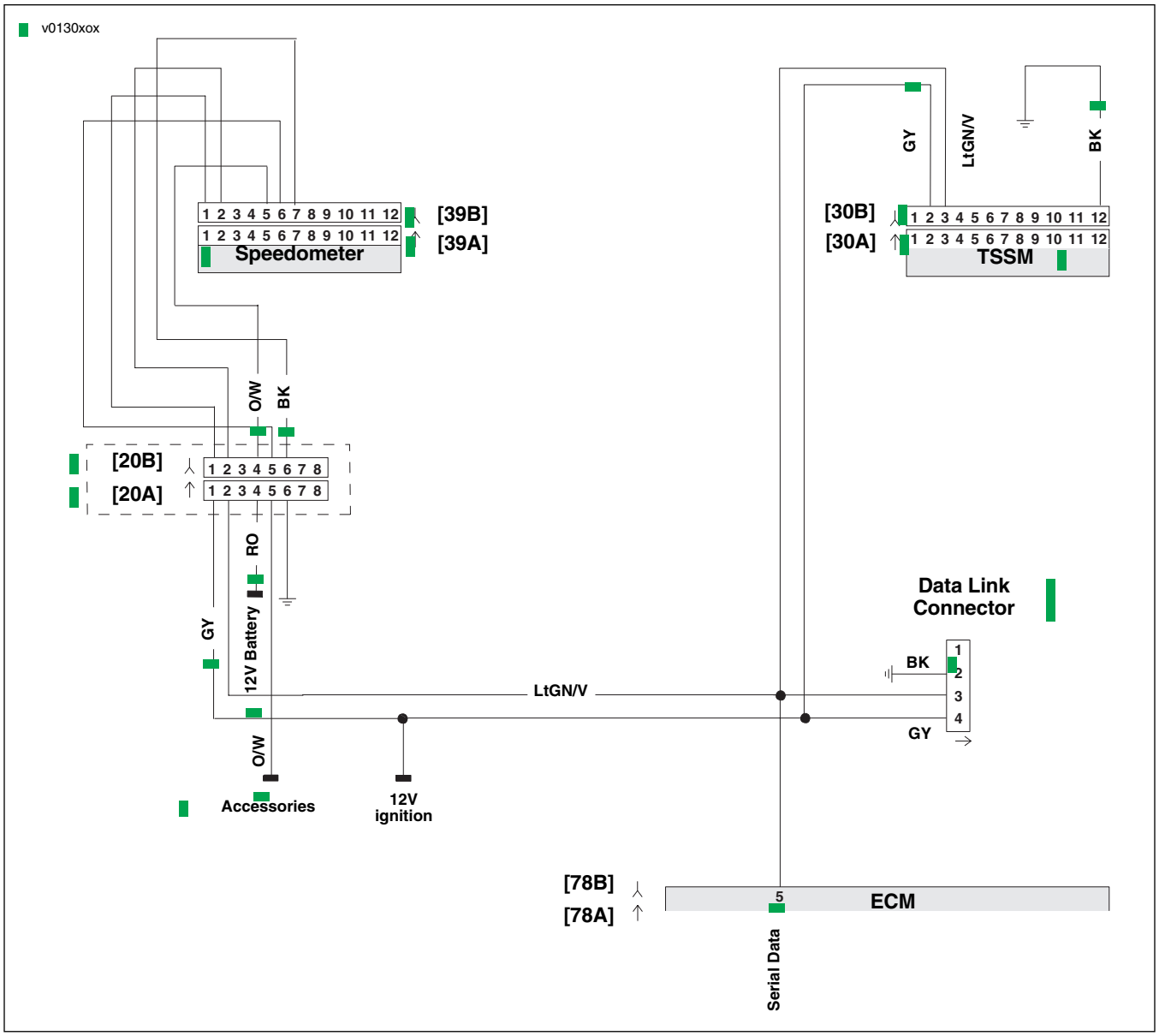


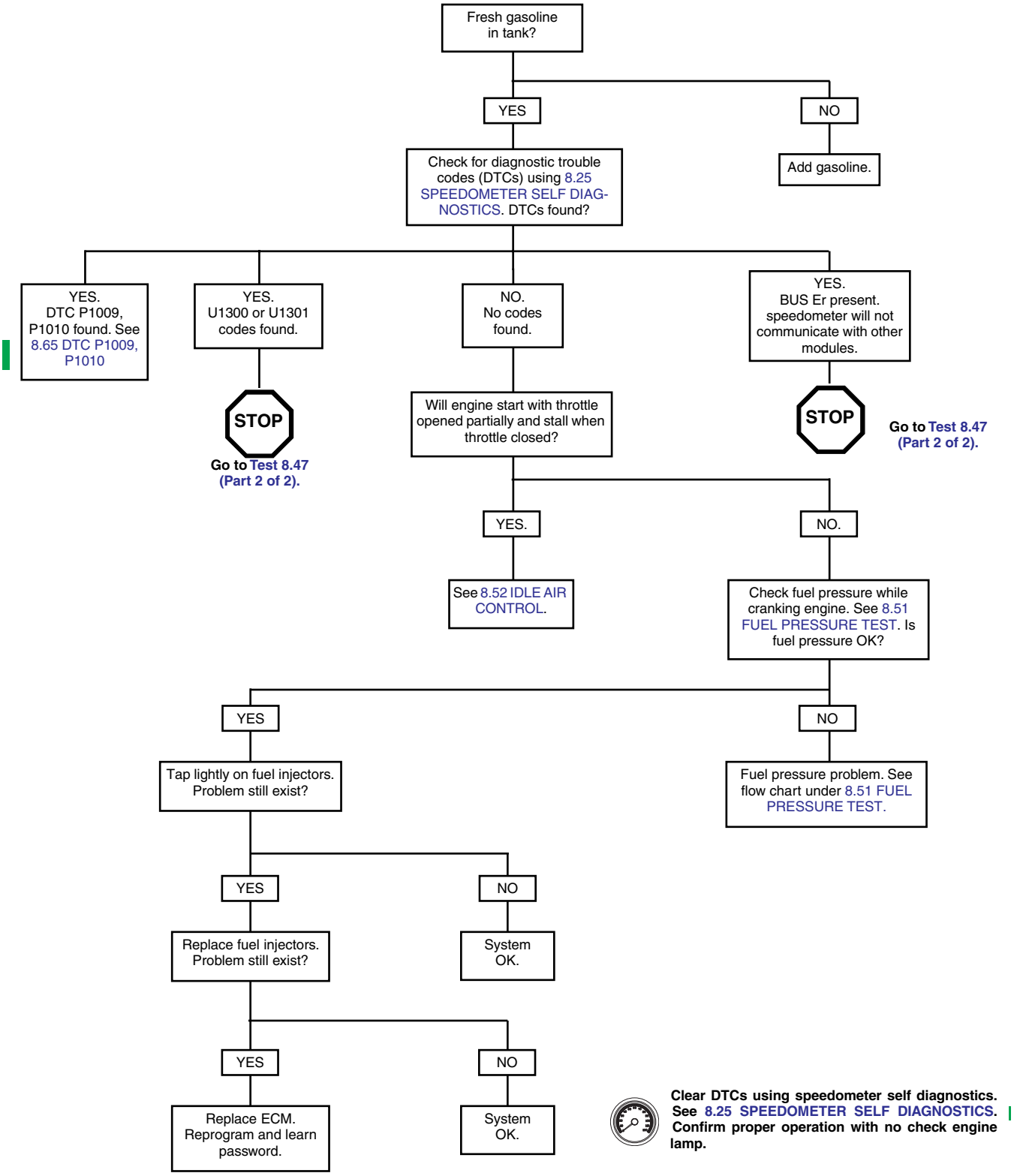
Figure 8-93. Serial Data Circuit

Table 8-58. Wire Harness Connectors in Figure 8-93.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Instruments	12-place Mini-Deutsch	Under left side cover
[30]	TSSM	12-place Deutsch	Under electrical caddie cover
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Test 8.47 (Part 1 of 2)

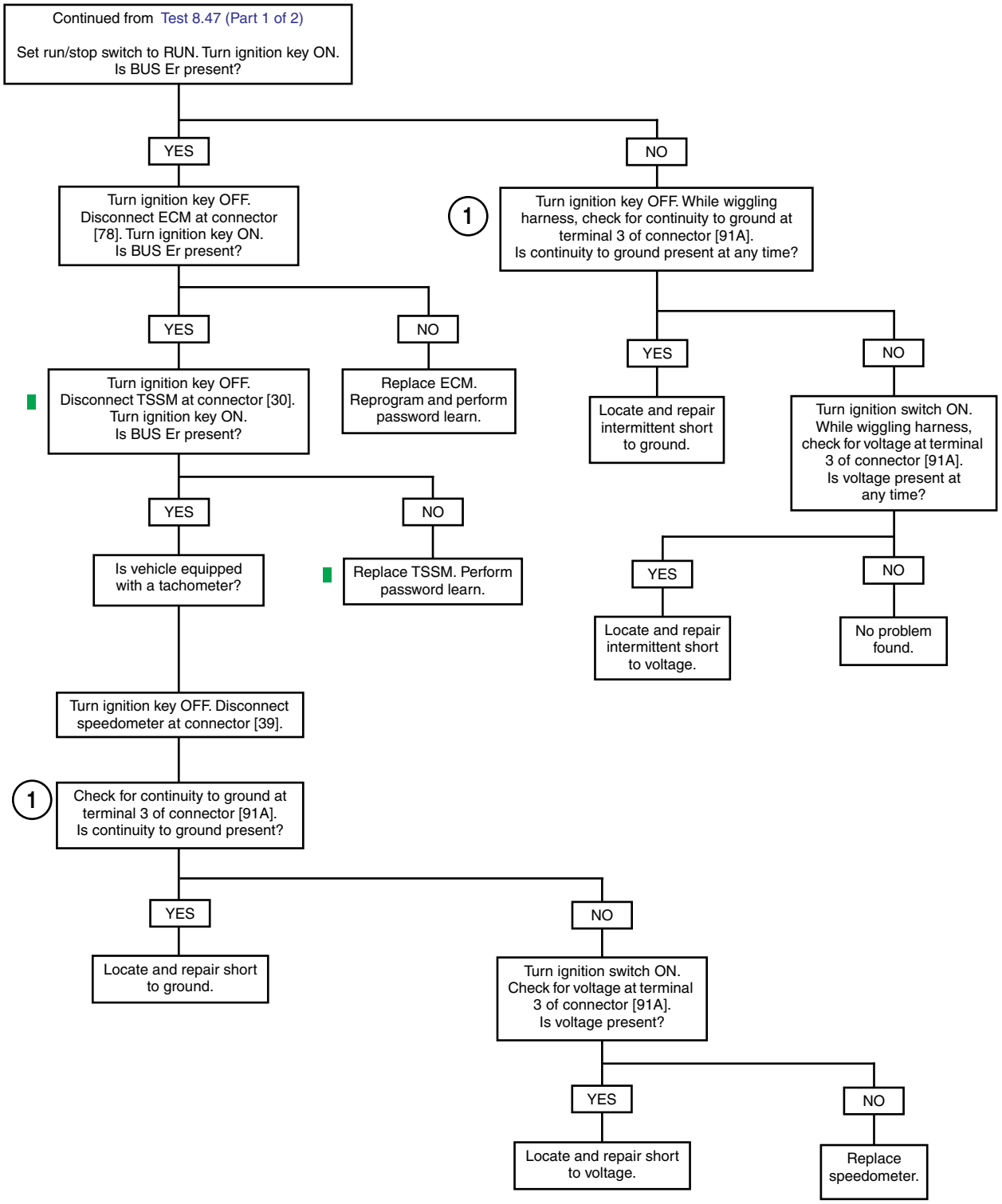
STARTS, THEN STALLS: DTC U1300, U1301



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.47 (Part 2 of 2)

STARTS, THEN STALLS: DTC U1300, U1301



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

FUEL SYSTEM ELECTRICAL TEST 8.48

GENERAL

With the ignition key ON and the engine stop switch at RUN, the ECM will energize the system relay to complete the circuit to the in-tank fuel pump. It will remain on as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses from the CKP. If there are no reference pulses, the ECM will de-energize the system relay within 2 seconds after ignition is ON or engine has stalled, or immediately after the ignition is shut OFF.

The fuel pump delivers fuel to the injectors then to the pressure regulator. The regulator controls system pressure. Excess fuel flow is returned to the fuel tank through the pressure regulator.

See Figure 8-94. When the engine is stopped, the pump can be turned on by applying battery voltage to terminal 1 and ground to terminal 3 of the fuel pump connector [141A]. The fuel pump connector is located on top of the fuel tank.

Improper fuel system pressure may contribute to one or all of the following symptoms.

- Engine cranks, but won't run.
- Engine cuts out (may feel like ignition problems).
- Hesitation, loss of power and poor fuel economy.

NOTE

After turning ignition OFF, you must wait 10 seconds before turning the ignition back ON to get the fuel pump to prime. This time out period is necessary for the fuel pump and IAC to reset.

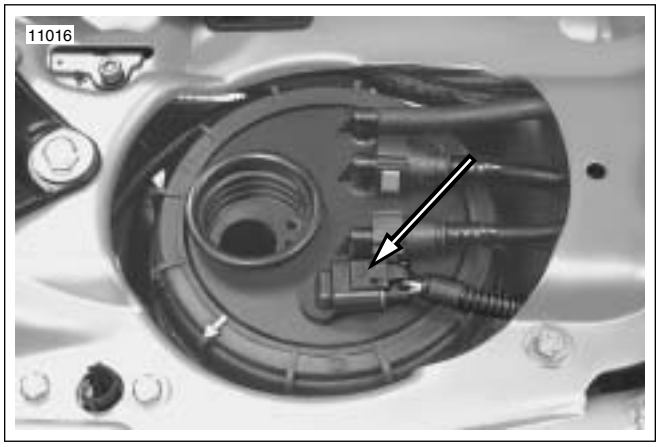


Figure 8-94. Fuel Pump Connector [86]

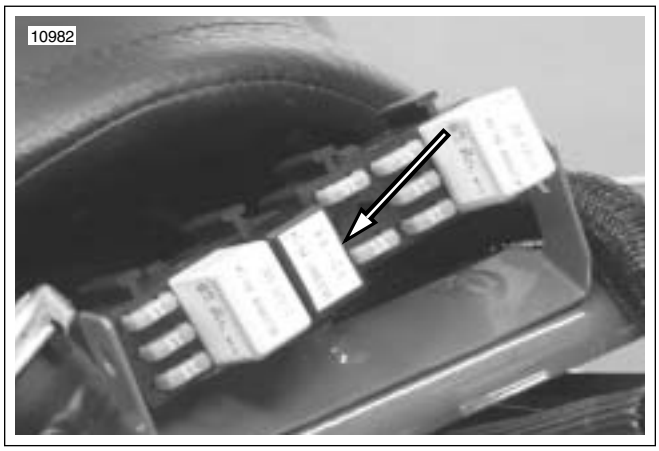


Figure 8-95. System Relay

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the flow charts.

1. Turns on fuel pump if wiring is OK. If pump runs, problem is in basic fuel delivery.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), brown terminal probe and patch cord.
3. See RELAYS in the VRSC Service Manual. This test checks for a short to ground in the system relay harness circuit.
4. See FUEL INJECTORS or IGNITION COIL in the VRSC Service Manual.
5. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple terminal probe and patch cord.
6. Connect BREAKOUT BOX (Part No. HD-43876). See 8.42 BREAKOUT BOX: ECM.

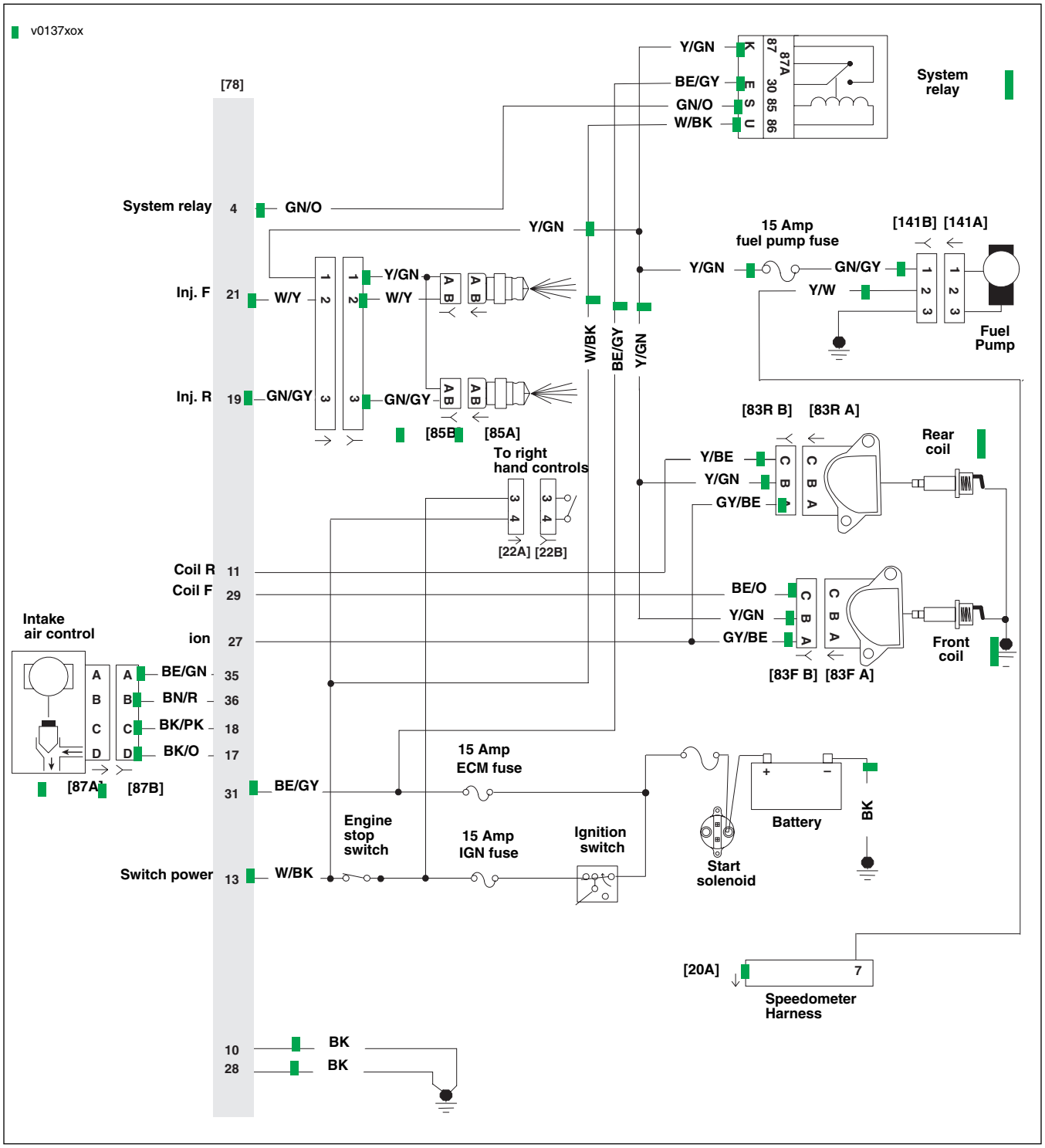


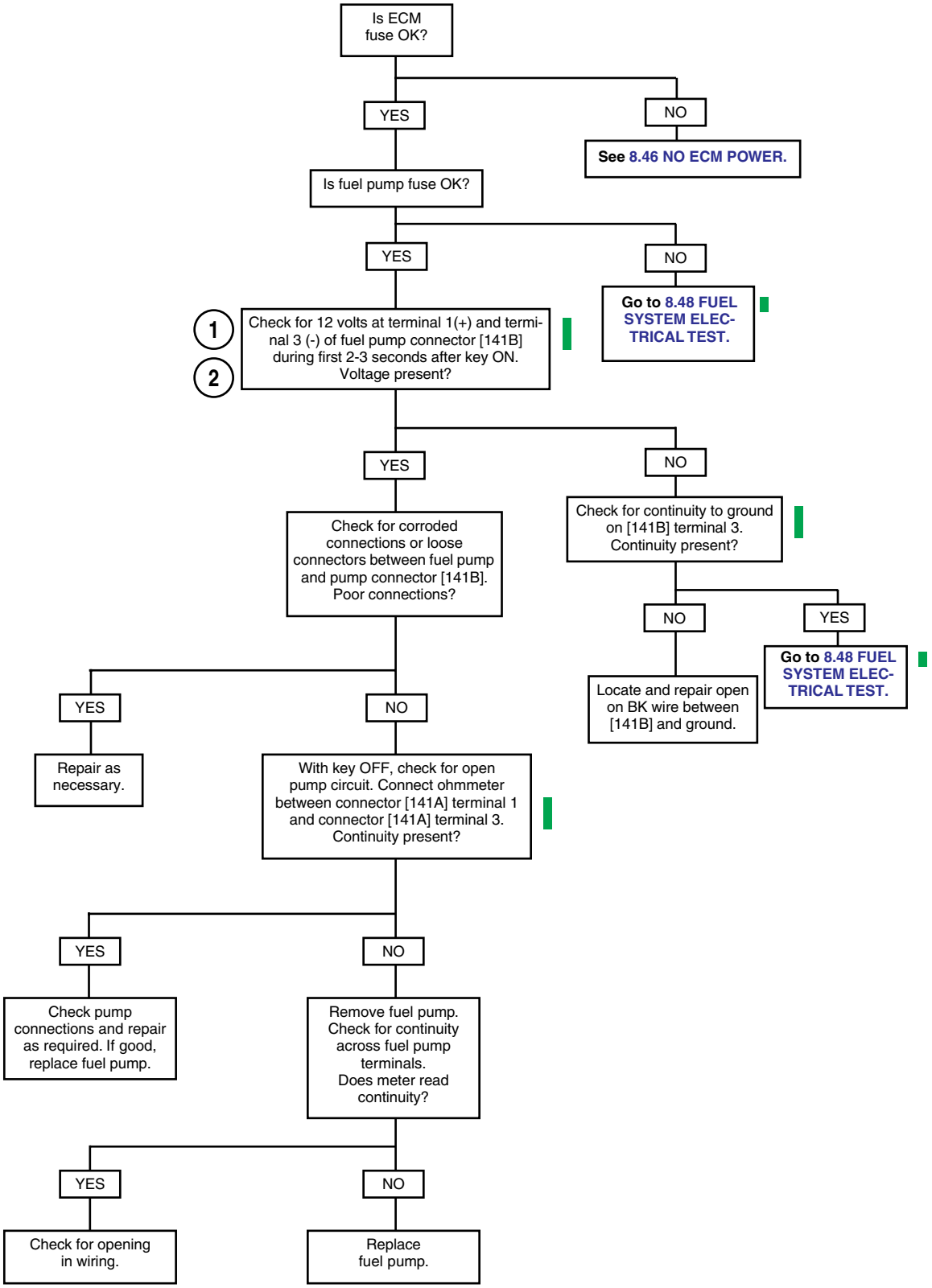
Figure 8-96. Fuel Pump Circuit

Table 8-59. Wire Harness Connectors in Figure 8-96.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[141]	Fuel pump	3-place Packard	Under seat
[145]	Engine harness	12-place Deutsch	Under air cleaner
[22]	Right handlebar switch (Black)	6-place Deutsch	Under left side cover

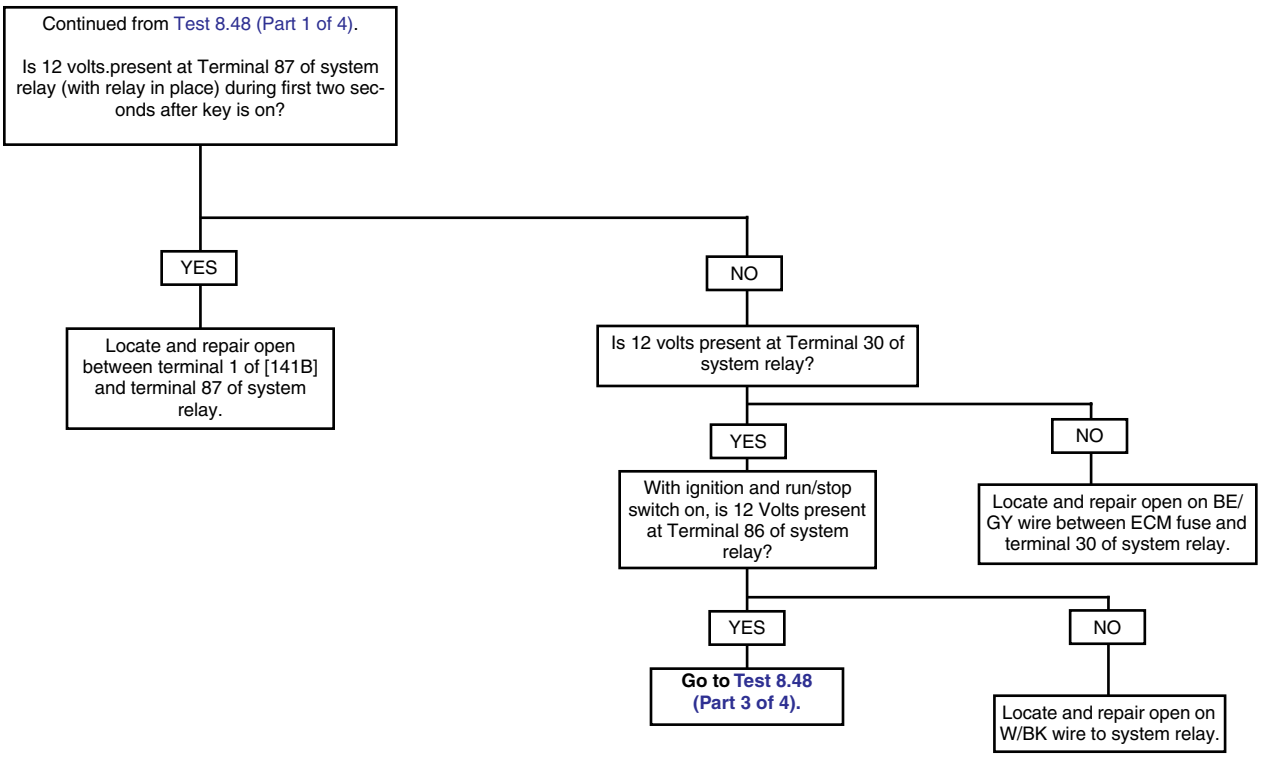
Test 8.48 (Part 1 of 4)

FUEL SYSTEM ELECTRICAL TEST



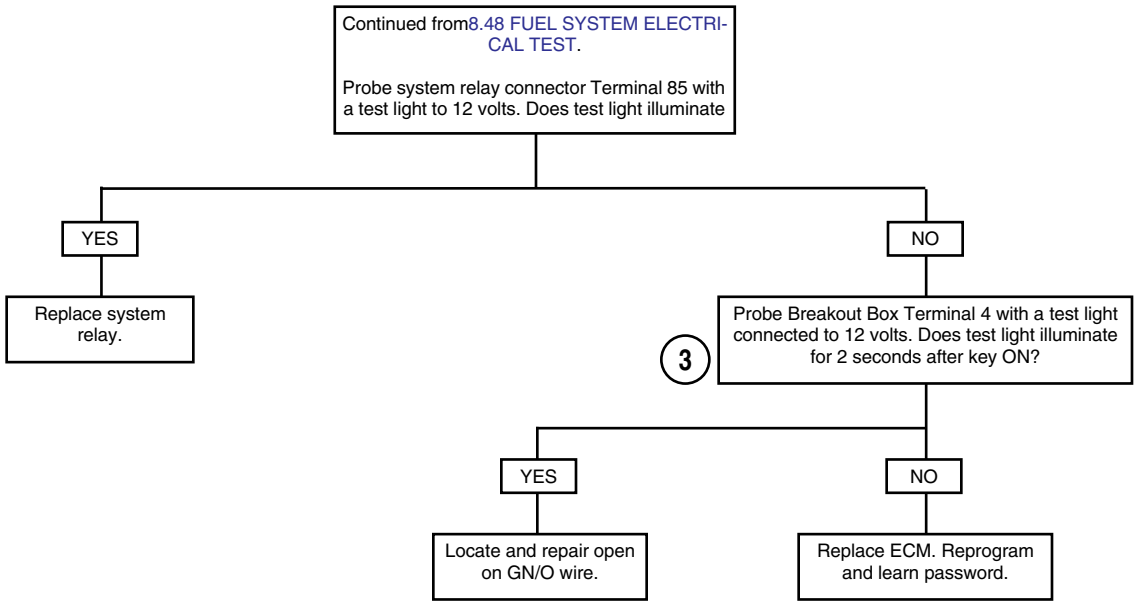
Test 8.48 (Part 2 of 4)

FUEL SYSTEM ELECTRICAL TEST



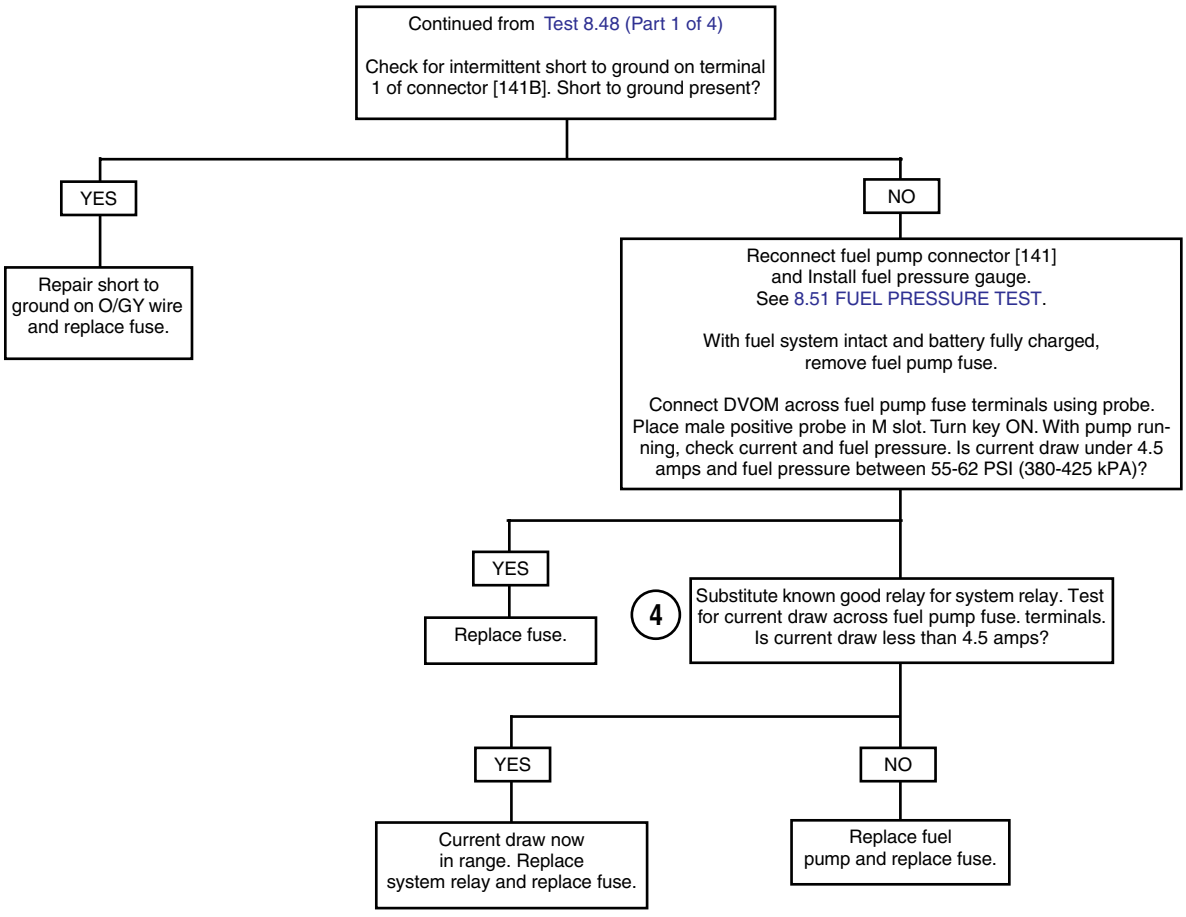
Test 8.48 (Part 3 of 4)

FUEL SYSTEM ELECTRICAL TEST



Test 8.48 (Part 4 of 4)

FUEL SYSTEM ELECTRICAL TEST



SYSTEM RELAY CHECK 8.49

GENERAL

System Relay

See Figure 8-97. With the ignition key ON and the engine stop switch at RUN, the ECM will energize the system relay to complete the circuit to the in tank fuel pump, ignition coils and injectors. they will remain powered as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses from the CKP. If there are no reference pulses, the ECM will de-energize the system relay within 2 seconds after ignition is ON or engine has stalled, or immediately after the ignition is shut OFF.

Table 8-60. Code Description

DTC	DESCRIPTION
P1001	System relay coil open/low
P1002	System relay coil high/shorted
P1003	System relay contacts open
P1004	System relay contacts closed

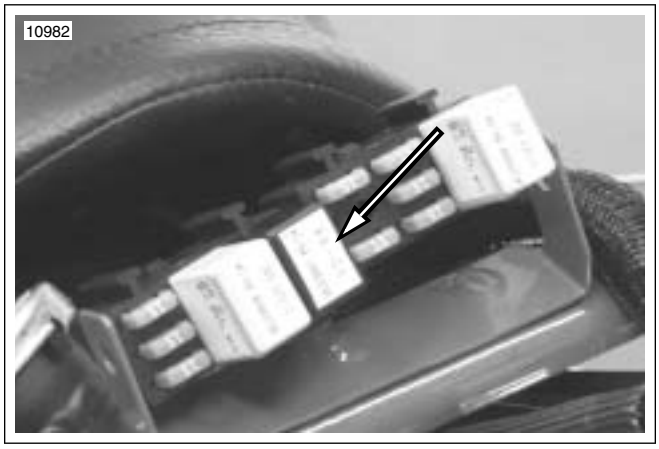


Figure 8-97. System Relay

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the flow charts.

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), red terminal probe and patch cord to relay and gray terminal probe and patch cord to the coil connectors [83B].
2. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 8.42 BREAKOUT BOX: ECM.

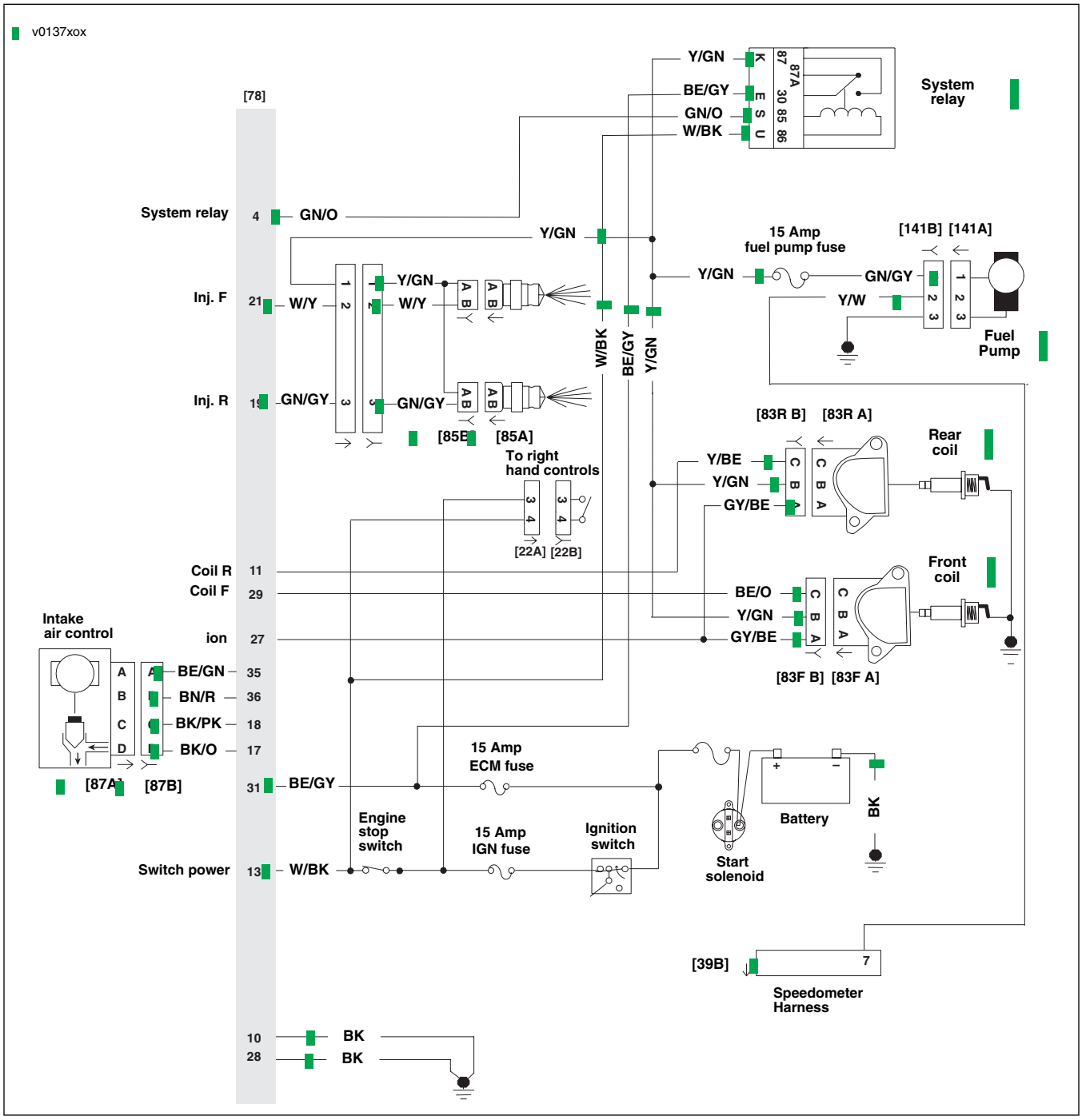


Figure 8-98. System Relay Circuit

Table 8-61. Wire Harness Connectors in Figure 8-98.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar switch (black)	6-place Deutsch	Under left side cover
[62]	System relay	fuse block	Under airbox cover
[78]	ECM	36-place Packard	Under left side cover
[83F]	Front plug top coil	3-place Packard	On top of front rocker box
[83R]	Rear plug top coil	3-place Packard	On top of rear rocker box
[145]	Engine harness	12-place Deutsch	Under air cleaner

Test 8.49 (Part 1 of 3)

SYSTEM RELAY: DTC P1001, P1003

With relay in, check for battery voltage at Terminal 87 of system relay during first 2-3 seconds after key ON.
Battery voltage (10-13 volts) present for 2-3 seconds after key ON?

YES

System relay OK. With relay out, measure resistance between Terminal 87 of the system relay and coil connector [83B] of both coils.
Is resistance less than 0.5 ohm?

1

YES

Recheck connections. Wiggle harness while repeating test. Repair intermittent.

NO

Find and repair connection or open on Y/GN wire.

NO.
No voltage or voltage always present.

Check for 10-13 volts at Terminal 30 of the system relay.
Voltage present?

YES

With ignition ON, check for 10-13 volts at Terminal 86 of the system relay.
Voltage present?

YES

2

Measure resistance between terminal 85 of system relay and cavity 4 on Breakout Box.
Is resistance less than 0.5 ohm?

YES

Check for continuity to ground on cavity 4 on Breakout Box.
Continuity present?

YES

Repair short to ground.

NO

Replace system relay. Does fuel pump run for the first 2 seconds after key ON?

YES

System OK.

NO

Replace ECM. Reprogram and learn password.

NO

Locate and repair open.

NO

Was ignition fuse blown?

YES

Repair short to ground and replace ignition fuse.

NO

Find and repair open on W/BK wire between connector [22] and relay.

NO

Check for continuity to ground on BE/GY wire.
Continuity present?

YES

Repair short to ground and replace ECM fuse.

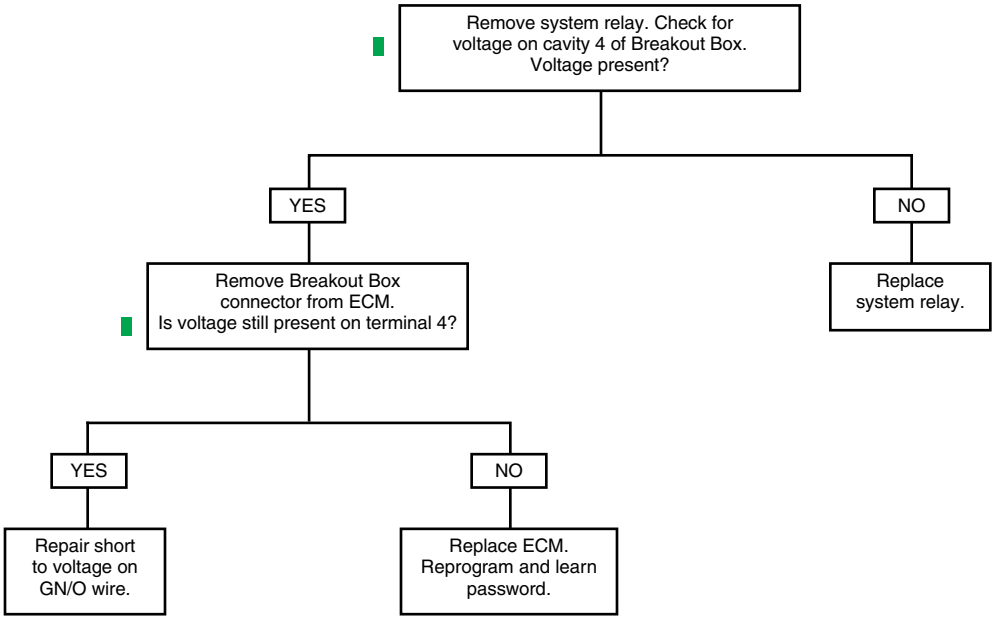
NO

Find and repair open between fuse and relay.

Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS Confirm proper operation with no check engine lamp.

Test 8.49 (Part 2 of 3)

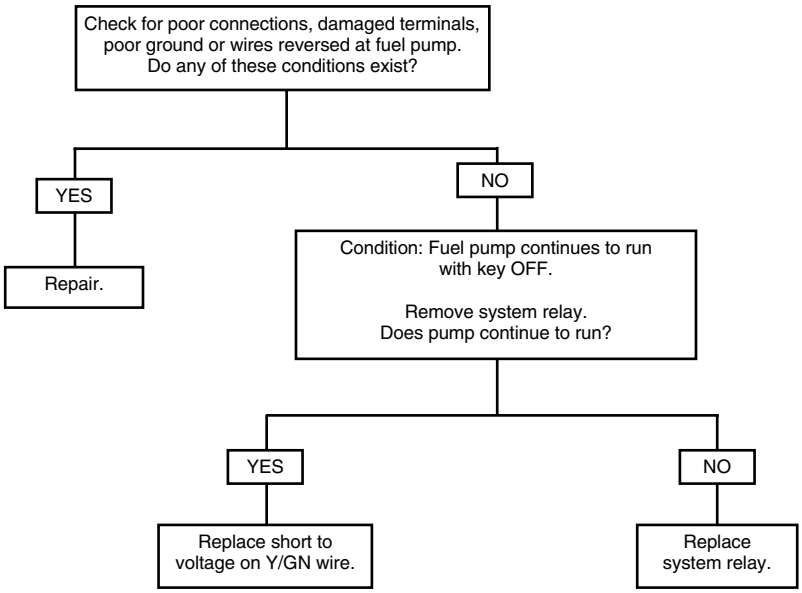
SYSTEM RELAY: DTC P1002



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.49 (Part 3 of 3)

SYSTEM RELAY: DTC P1004



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

FAN OPERATION CHECK 8.50

GENERAL

Fan Relay

See Figure 8-99. The ECM will energize the fan relay when coolant temperature rises to 217° F (103° C) and shut off when coolant temperature falls to 208° F (98° C). The ECM may continue this function for up to one minute when engine is off if engine temperature is above 208° F (98° C)

Table 8-62. Code Description

DTC	DESCRIPTION
P1481	Fan relay coil open/low
P1482	Fan relay coil high

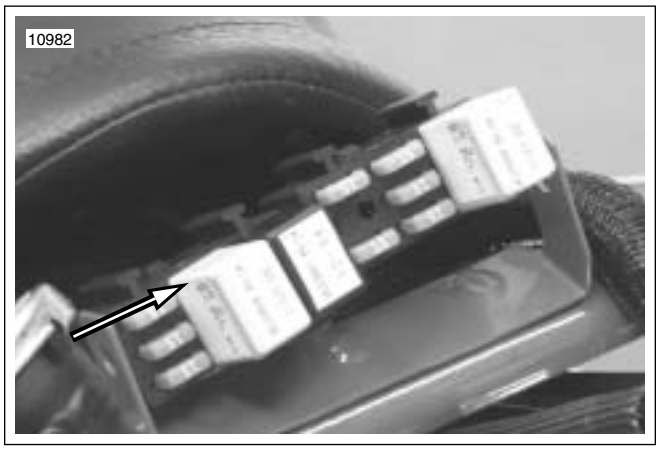


Figure 8-99. Fan Relay

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the flow charts.

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probe and patch cord.
2. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 8.42 BREAKOUT BOX: ECM

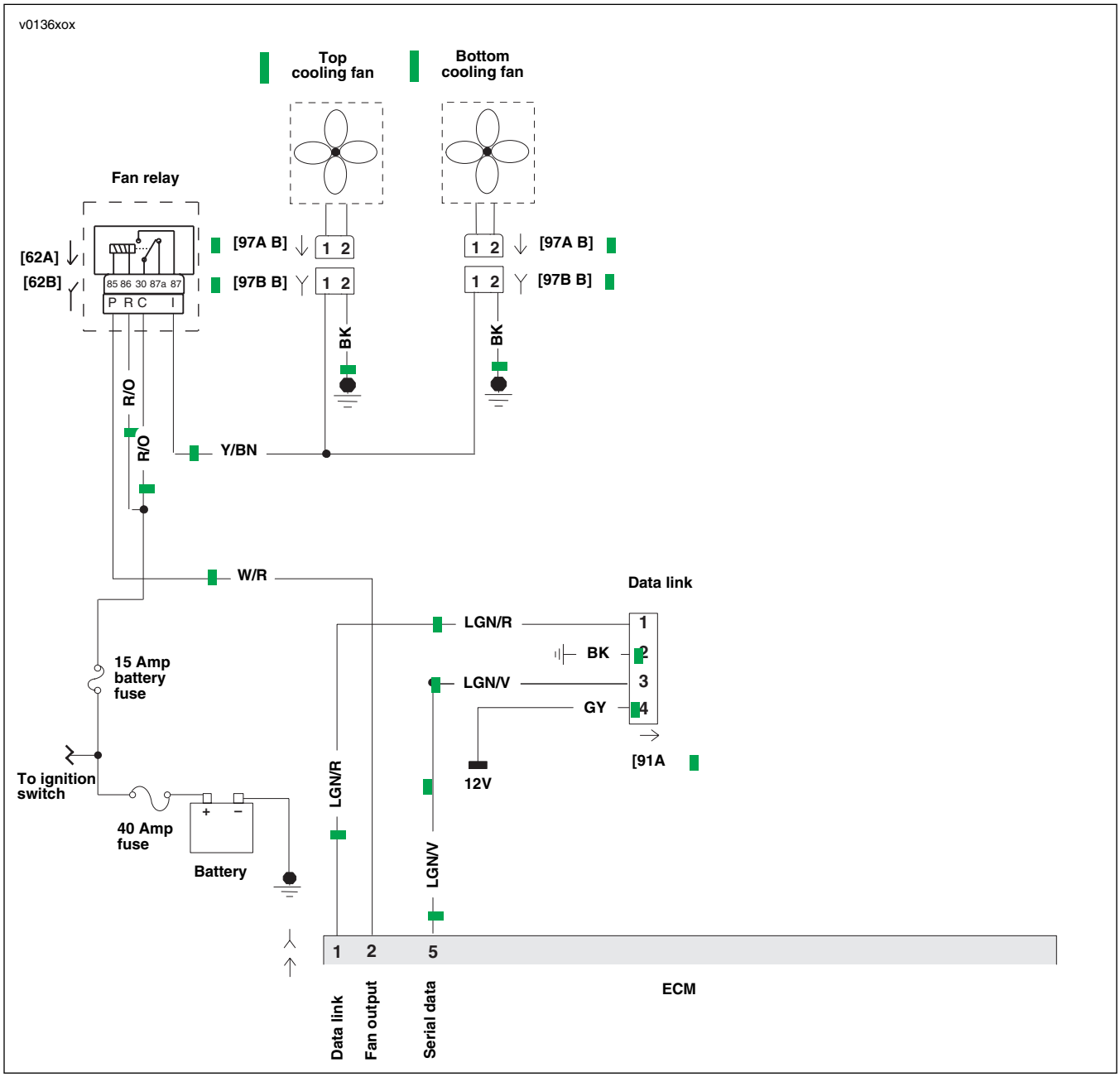


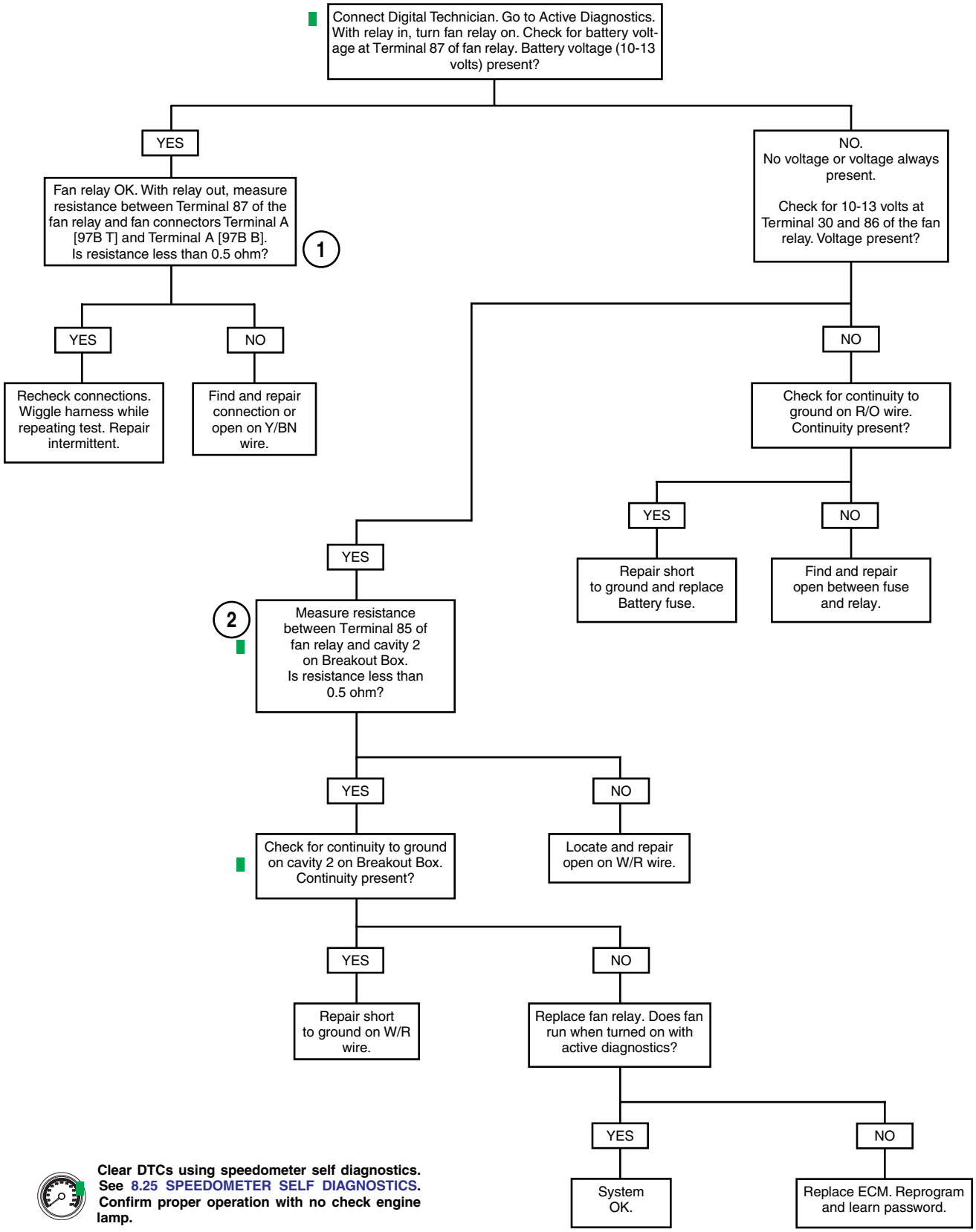
Figure 8-100. Fan Relay Circuit

Table 8-63. Wire Harness Connectors in Figure 8-100.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[62]	Fan relay	Fuse block	Under airbox cover
[97 T]	Top cooling fan	2-place Multilock	Behind radiator
[97 B]	Bottom cooling fan	2-place Multilock	Behind radiator

Test 8.50 (Part 1 of 2)

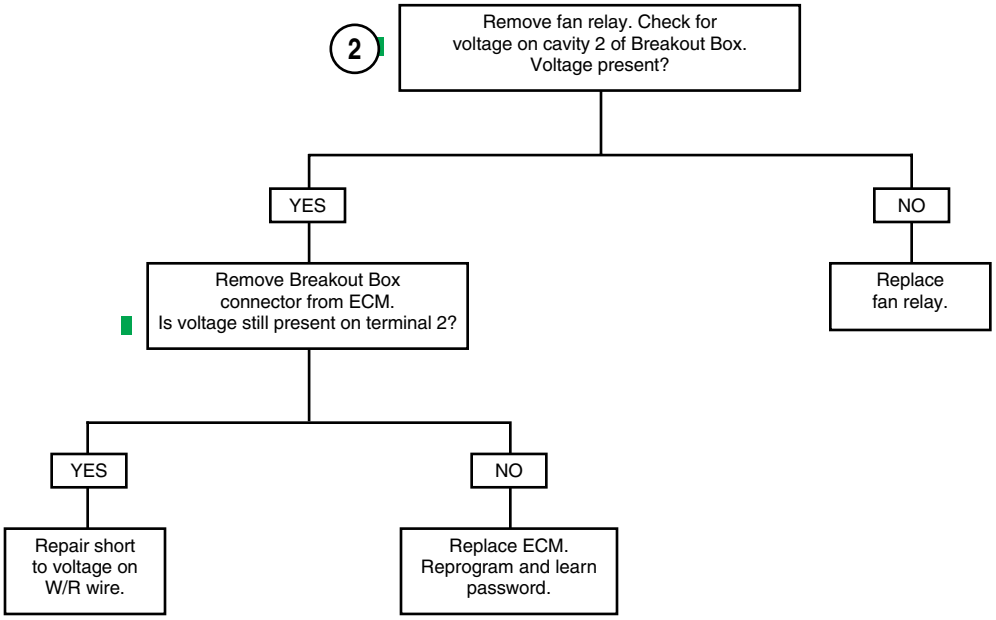
FAN OPERATION CHECK: DTC P1481 OR NO CODES



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.50 (Part 2 of 2)

FAN OPERATION CHECK: DTC P1482 OR NO CODES



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

FUEL PRESSURE TEST 8.51

GENERAL

The fuel pump is located in the fuel tank. It delivers fuel to the fuel metering assembly. The fuel metering assembly contains the fuel injectors and the pressure regulator, where the system pressure is controlled. Excess fuel pressure is returned to the fuel tank by a return line. The ECM controls the system relay that supplies 12 vdc to the fuel pump.

When the engine is stopped, the pump can be turned on by applying battery voltage to terminal 1 and ground to terminal 3 of the fuel pump connector [141A].

Improper fuel system pressure may contribute to one of the following conditions:

- Cranks, but won't run.
- Cuts out (may feel like ignition problem).
- Hesitation, loss of power or poor fuel economy.

TESTING

The fuel pressure gauge (0-100 PSI) allows for fuel injector and fuel system pressure diagnosis.

PART NO.	SPECIALTY TOOL
HD-41182	Fuel pressure gauge
26338-68	1/8 in. pipe thread 90° (right angle) elbow

1. See Figure 8-101. Disconnect fuel pump connector [141] from top of fuel tank.
2. Start the engine and allow the vehicle to run.
3. When engine stalls, operate the starter for 3 seconds to remove any remaining fuel from the fuel lines. Turn ignition key off.
4. See Figure 8-102. Insert a 1/8 in. pipe thread 90° degree (right angle) elbow (1) between the fuel valve (2) and the Schrader valve adapter (3).
5. See Figure 8-103. Remove protective cap from Schrader valve in fuel metering assembly.
6. Verify that the fuel valve and air bleed petcock on the Fuel Pressure Gauge (HD-41182) are closed.

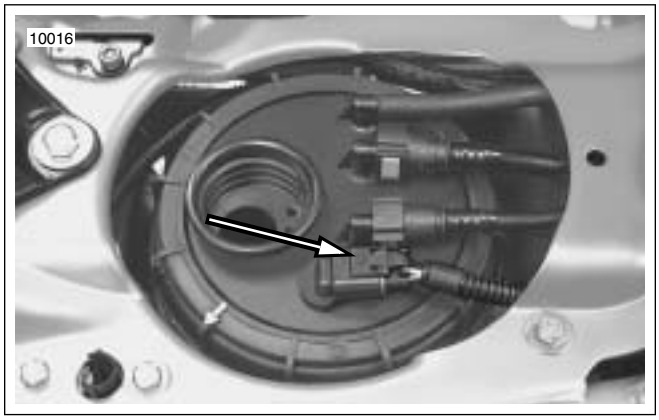
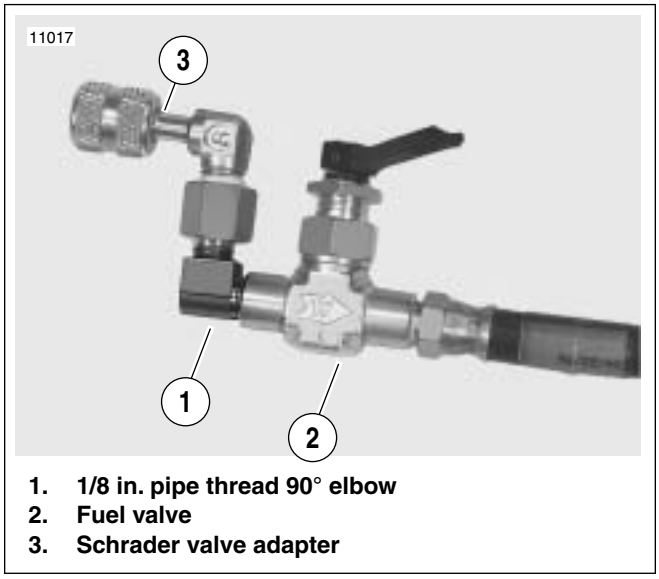


Figure 8-101. Fuel Pump Connector [141]



1. **1/8 in. pipe thread 90° elbow**
2. **Fuel valve**
3. **Schrader valve adapter**

Figure 8-102. Fuel Pressure Gauge Valves

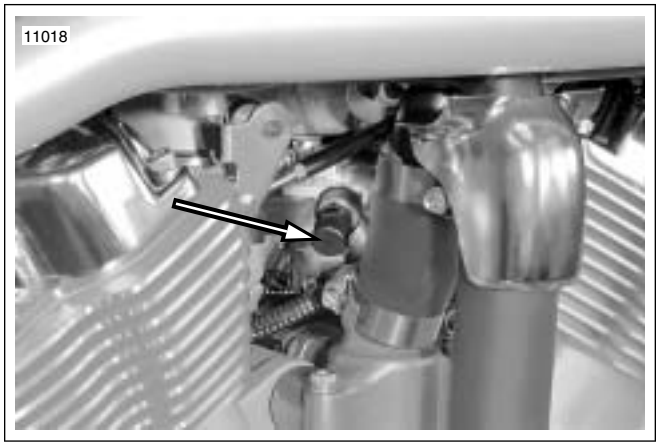


Figure 8-103. Schrader Valve Location

7. Connect fuel pressure gauge to Schrader valve. Reconnect connector [141].
8. Start and idle engine to pressurize the fuel system. Open the fuel valve to allow the flow of fuel down the hose of the pressure gauge.
9. Position the clear air bleed tube in a suitable container and open and close the air bleed petcock to purge the gauge and hose of air. Repeat this step several times until only solid fuel (without bubbles) flows from the air bleed tube. Close the petcock.
10. Open and close throttle to change engine speed. Note the reading of the pressure gauge. Fuel pressure should remain steady at 380-425 CPA (55-62) psi.
11. Turn the engine off. Open the air bleed petcock to relieve the fuel system pressure and purge the pressure gauge of gasoline.

⚠WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

12. Remove fuel pressure gauge from the Schrader valve in fuel metering assembly. Install protective cap over Schrader valve.

Figure 8-104. Fuel Pressure Gauge Installed

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the flow chart.

1. If the regulator is faulty, see VRSC SERVICE MANUAL.
2. If fuel system has pressure, but it is less than specification, check for the following conditions.
   a. The amount of fuel to the injectors is within limits, but pressure is too low. Also, hard starting cold and overall poor performance condition may exist.
   b. Restricted fuel flow causing pressure drop. However, if pressure drop occurs only when driving, engine may surge and lose power as pressure begins to drop rapidly.
3. This condition may be identified when the fuel level is low and the fuel pump turned on for the first 2 seconds after key ON. A ringing sound can be heard as the high pressure fuel is sprayed against the inside wall of the fuel tank.

Test 8.51

FUEL PRESSURE TEST

Install fuel pressure gauge. See TESTING under 8.51 FUEL PRESSURE TEST.

Start and idle engine.

Open and close throttle to change engine speed. Does fuel pressure remain steady at 55-62 PSI (380-425 kPa)?

- YES — Steady pressure.
  - No trouble found. Review symptoms.
- NO — Low pressure.
  - (2) Check for restricted fuel filter or pump inlet screen. Are filter and screen OK?
    - YES
      - (1) (3) Check for restricted pressure line or flex hose between Schrader and test gauge. If lines are OK, check for:

        Faulty fuel pump.

        Leak inside tank caused by faulty coupling hose or connection, such as hose at filter or pump.

        Faulty fuel pressure regulator.
    - NO
      - Replace filter or clean pump inlet screen. Retest.
- NO — High pressure.
  - (1) Inspect return line to fuel tank for damage or obstructions. If OK, replace faulty fuel pressure regulator.

IDLE AIR CONTROL 8.52

GENERAL

IAC Operation

The ECM controls engine idle speed by moving the idle air control (IAC) to open or close a passage around the throttle plates. It does this by sending voltage pulses to the proper motor winding of the IAC. This causes the pintle to move in or out of the IAC a given distance for each pulse received.

- To increase idle speed, the ECM retracts the pintle, allowing more air to flow through the throttle body.
- To decrease idle speed, the ECM extends the pintle, allowing less air to flow through the throttle body.

The IAC position can be measured in steps. Use the Data Monitor Display (DIGITALTECHNICIAN - see your dealer) to check this measurement.

- A high number of steps represents a fully retracted pintle and open passage around throttle plate. This correlates with an increase in the amount of air flowing through the throttle body.
- Zero steps represents a fully extended pintle. A zero reading indicates an abnormal condition in which the pintle has been fully extended and has consequently closed the passage around throttle plate.

Each time the ignition is turned off, the ECM resets the IAC by sending enough pulses to extend the pintle and effectively close the throttle body. The fully extended value is the ECM reference point. A given number of steps are then calculated by the ECM for use in setting the proper idle speed and IAC position.

NOTE

Idle speed is controlled by the ECM and can not be adjusted.

Diagnostic Trouble Code P0505: Loss of Idle Speed Control

Loss of idle speed control will result if the idle RPM is ±200 from preset idle speed and IAC motor is at zero or maximum for greater than 5 seconds. This code may occur with others for a multiple code situation. Resolve the other codes first to correct.

Table 8-64. Code Description

DTC	DESCRIPTION
P0505	Loss of idle speed control

DIAGNOSTICS

Diagnostic Tips

Engine idle speed can be adversely affected by the following:

- A loss of idle speed control does not necessarily imply the IAC actuator or wiring has failed. It can be caused by a number of conditions such as an intake air leak, improperly adjusted throttle linkage or a misfiring cylinder.
- Leaking injectors will cause fuel imbalance and poor idle quality due to different air/fuel ratios in each cylinder. To check for leaky injectors, first remove the airbox and air filter. See AIRBOX AND AIR FILTER in the VRSC Service Manual. Then, with the throttle wide open, turn key ON for 2 seconds and then OFF for 2 seconds five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores. See FUEL INJECTORS in the VRSC Service Manual.
- Vacuum leaks. To check for vacuum leaks, spray water around the throttle body seals while idling the engine. If RPM changes, replace seals. A leak can also be indicated by a low IAC count on the Scanalyzer Data Monitor.
- Contaminated fuel.
- TPS reading of greater than 1% (possible throttle cable out of adjustment) or battery voltage reading of less than 9 volts or a vehicle speed sensor (VSS) greater than 0 will disable idle speed control.
- If there is a loss of battery power at ECM terminal 31, vehicle will start but IAC pintle will not reset at key OFF. Eventually pintle will be out of position causing performance problems.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. When the engine is stopped, the IAC pintle extends and then retracts to a fixed “Park” position for increased airflow and idle speed during the next engine start sequence. This key OFF reset procedure takes 10 seconds to perform.
2. Test lamp behavior may follow two patterns. The color of the lights is not relevant to IAC operation.
   a. **Normal behavior:** At key ON, test lights will alternately flash and then remain steady on to confirm ECM signals. At key OFF lights alternately flash and go out after 10 second reset procedure.
   b. **Problem indicated:** One or more lights fail to illuminate during key ON/key OFF cycle.

NOTE

There is a remote possibility that one of the circuits is shorted to voltage which would have been indicated by a steady light. Disconnect ECM and turn the ignition ON. Probe terminals to check for this condition.

3. Connect BREAKOUT BOX (Part No. HD-43876) to EFI wire harness only, leaving ECM disconnected. See 8.42 BREAKOUT BOX: ECM.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probe and patch cord.
5. Repair faulty ECM connection or replace ECM. If ECM requires replacement, see ECM in the VRSC Service Manual.

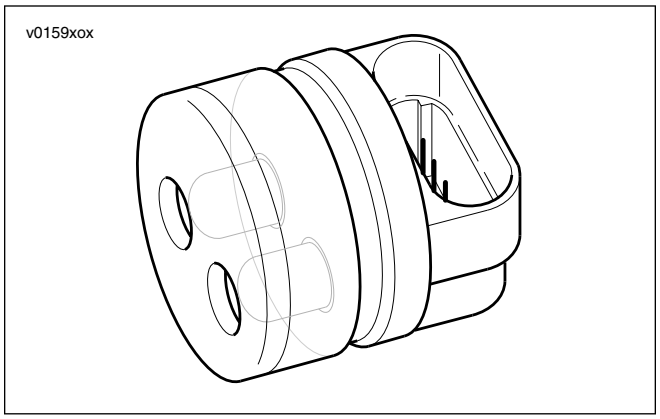


Figure 8-105. IAC Test Lamp (Part No. HD-41199-3)

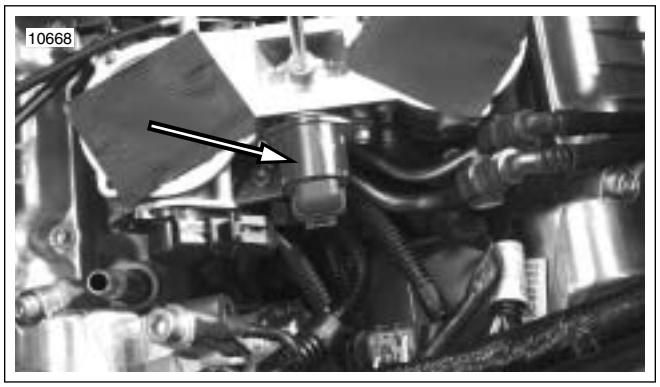


Figure 8-106. IAC

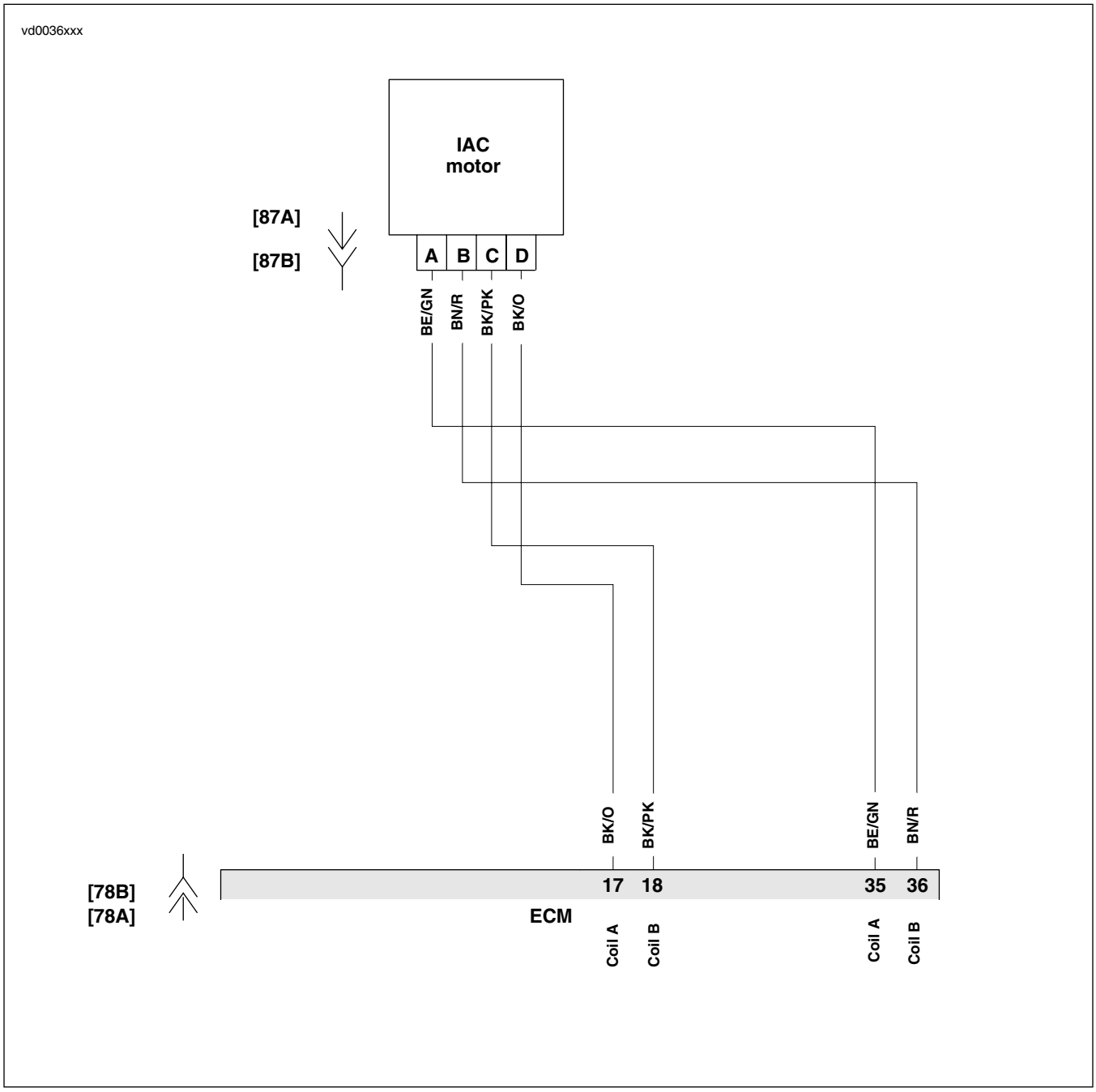


Figure 8-107. IAC Circuit

Table 8-65. Wire Harness Connectors in Figure 8-107.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Behind left side cover
[87]	IAC	4-place Packard	Below air cleaner assembly

Test 8.52 (Part 1 of 2)

IDLE AIR CONTROL: DTC P0505

Remove air cleaner cover and element. Is throttle valve completely closed?

- NO → Lubricate and adjust throttle cables.
- YES → Monitor IAC pintle for 10 seconds after turning ignition OFF. Does pintle extend and then retract during 10 second key OFF reset procedure? (1)
  - YES → Check intake manifold for leaks. See VRSC Service Manual, Intake Leak Test.
    - YES → Repair intake leak.
    - NO → Check fuel pressure. See 8.51 FUEL PRESSURE TEST.
  - NO → Remove airbox. Disconnect IAC and connect test lamp. See Figure 8-105.

    Turn ignition key ON for 2 seconds, then turn ignition key OFF for 10 seconds. (2)
    - Problem indicated. → Remove test lamp. Connect Breakout Box to connector [78B] leaving ECM disconnected. Check terminal 31 for battery voltage. Battery voltage present?
      - NO → Go to 8.46 NO ECM POWER.
      - YES → Using DVOM, measure resistance between IAC connector [87B] and Breakout Box. (3)

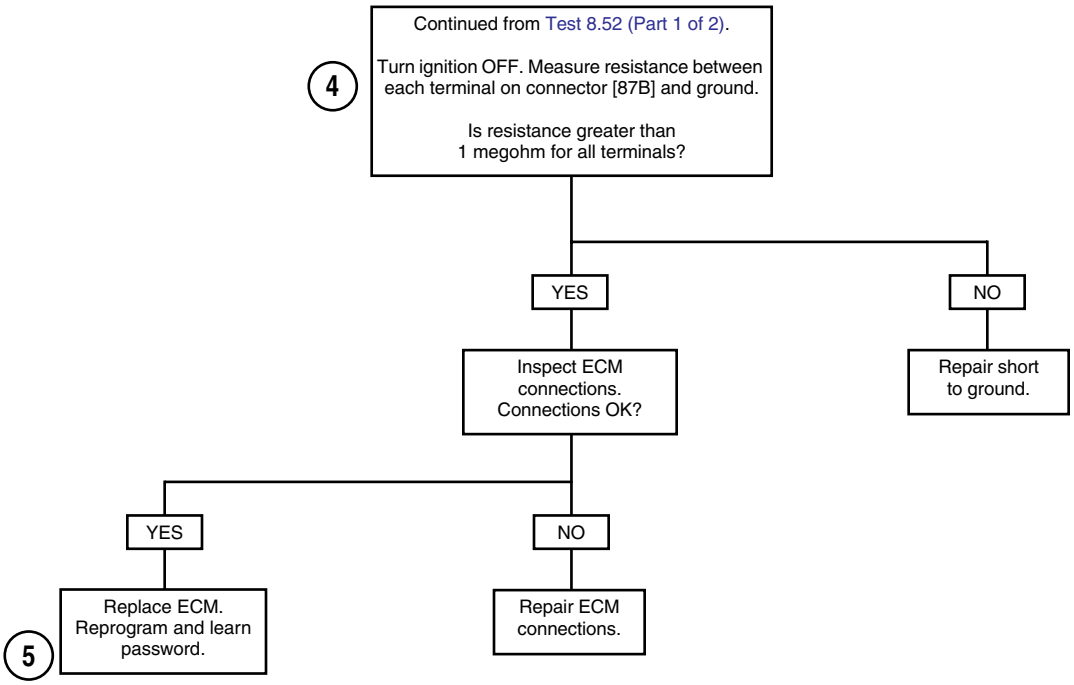
IAC	WIRE COLOR	ECM
A	BE/GN	to 35
B	BN/R	to 36
C	BK/PK	to 18
D	BK/O	to 17

        Does each wire measure 0.5 ohms or less? (4)
        - NO → Repair poor connection at connectors [87B] or [78B] or repair open wire in harness.
        - YES → Turn ignition ON. With ECM still disconnected, check voltage on all four terminals at connector [87B]. Is voltage present? (4)
          - YES → Repair short to voltage.
          - NO → **Go to Test 8.52 (Part 2 of 2).**
    - Normal behavior. → Repair faulty IAC connection or IAC assembly.

Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.52 (Part 2 of 2)

IDLE AIR CONTROL: DTC P0505



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

MISFIRE AT IDLE OR UNDER LOAD 8.53

GENERAL

Misfire at Idle or Under Load

- Battery condition and connections may also cause misfires. See BATTERY in the VRSC Service Manual for more information.
- Fuel system problems may also cause misfires. Consult 8.51 FUEL PRESSURE TEST and then refer to symptom tables under 8.44 INITIAL DIAGNOSTIC CHECK.
- Mechanical problems with the engine may cause misfires. See Section 3 of the VRSC Service Manual for more information.
- Vehicle modifications including intake and exhaust changes may cause misfires.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

⚠WARNING

Any open spark around gasoline or other combustibles may result in fire or explosion. Thoroughly wipe up any spilled fuel and dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

1. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 8.42 BREAKOUT BOX: ECM.
2. See Figure 8-108. A SPARK TESTER (Part No. HD-26792) must be used to verify adequate secondary voltage (25,000 volts) at the spark plug.

NOTE

Engine will not spark with both spark plugs removed. When checking for spark, use SPARK TESTER (Part No. HD-26792) with both plugs installed.

   a. Turn ignition key OFF.
   b. See Figure 8-108. Attach plug top coil to SPARK TESTER (Part No. HD-26792). Clip tester to ground.
   c. While cranking engine, watch for spark to jump tester gap on leads.
   d. Reinstall and repeat procedure on other coil.

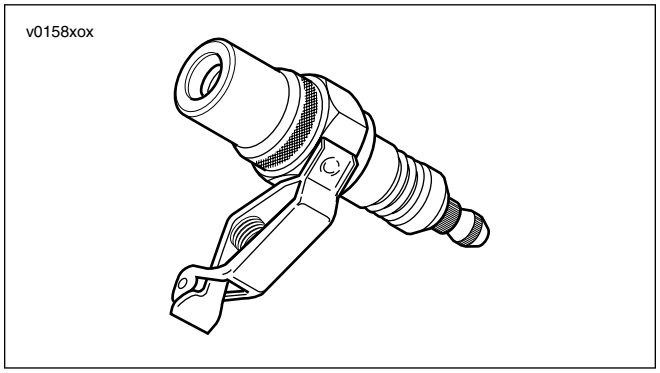
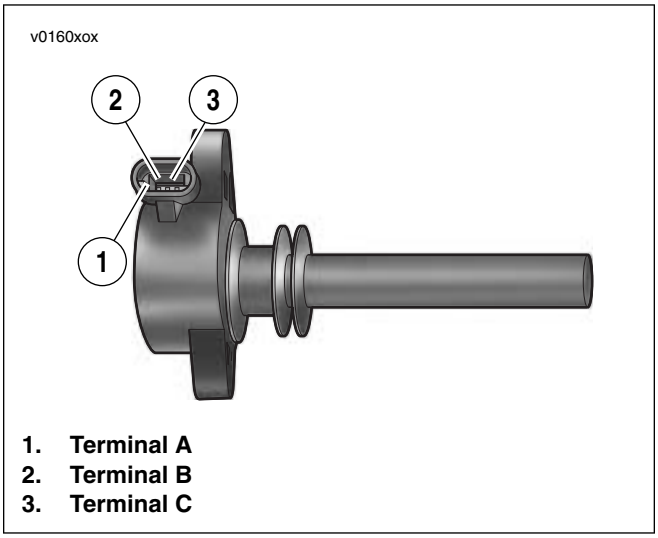


Figure 8-108. Spark Tester

3. See Figure 8-109. Perform plug top coil resistance test.
   a. Remove plug top coil.
   b. Using an ohmmeter, touch probes to coil terminals referred to in Table 8-66.
   c. If coil primary is out of range or coil secondary is below range, replace coil.
   d. If coil secondary is above specified range, remove boot and recheck coil. If coil readings are within specifications, replace boot. If coil secondary readings are still above specifications, replace coil.
   e. Reinstall and repeat procedure on other coil.
4. This test can also be performed by substituting a known good coil for one causing the no spark condition. The coil does not require full installation to be functional. Verify faulty coil by performing resistance test. See IGNITION COIL in the VRSC Service Manual.
5. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), red terminal probe and patch cord to relay and gray terminal probe and patch cord to the coil connector [83B].
6. Refer to appropriate VRSC Electrical Diagnostics manual for more information on voltage drop testing.

Table 8-66. Plug Top Coil

COIL	SPECIFICATION
Primary terminal B to terminal C	0.3-0.5 ohms
Secondary terminal A to plug end of boot	3500-4500 ohms
Plug top coil boot	less than 5 ohms



1. **Terminal A**
2. **Terminal B**
3. **Terminal C**

Figure 8-109. Plug Top Coil

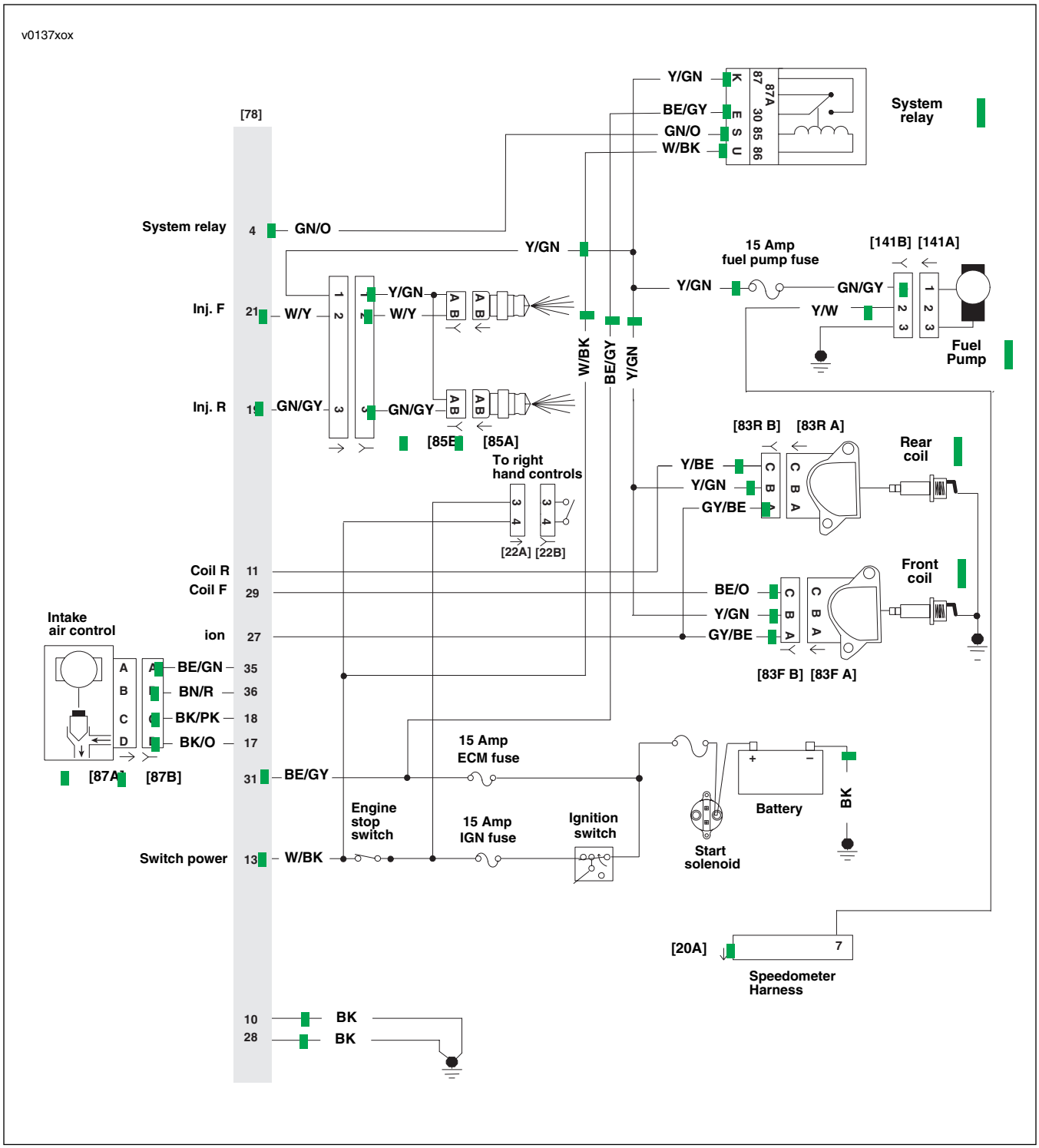


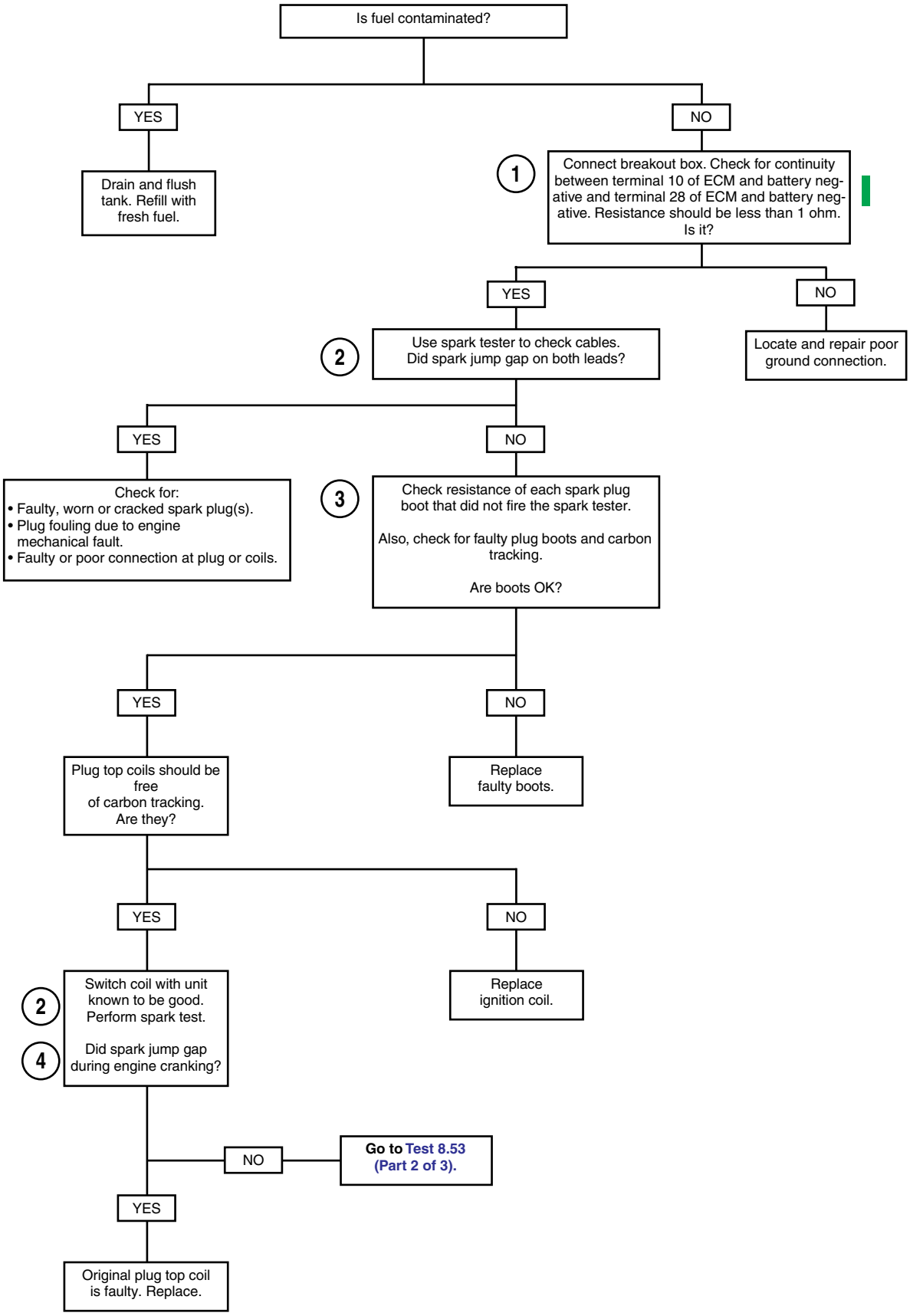
Figure 8-110. Ignition Coil Circuit Diagram

Table 8-67. Wire Harness Connectors in Figure 8-110.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[83F]	Front plug top coil	3-place Packard	On top of front cam cover
[83R]	Rear plug top coil	3-place Packard	On top of rear cam cover
[145]	Engine harness	12-place Deutsch	Under air cleaner

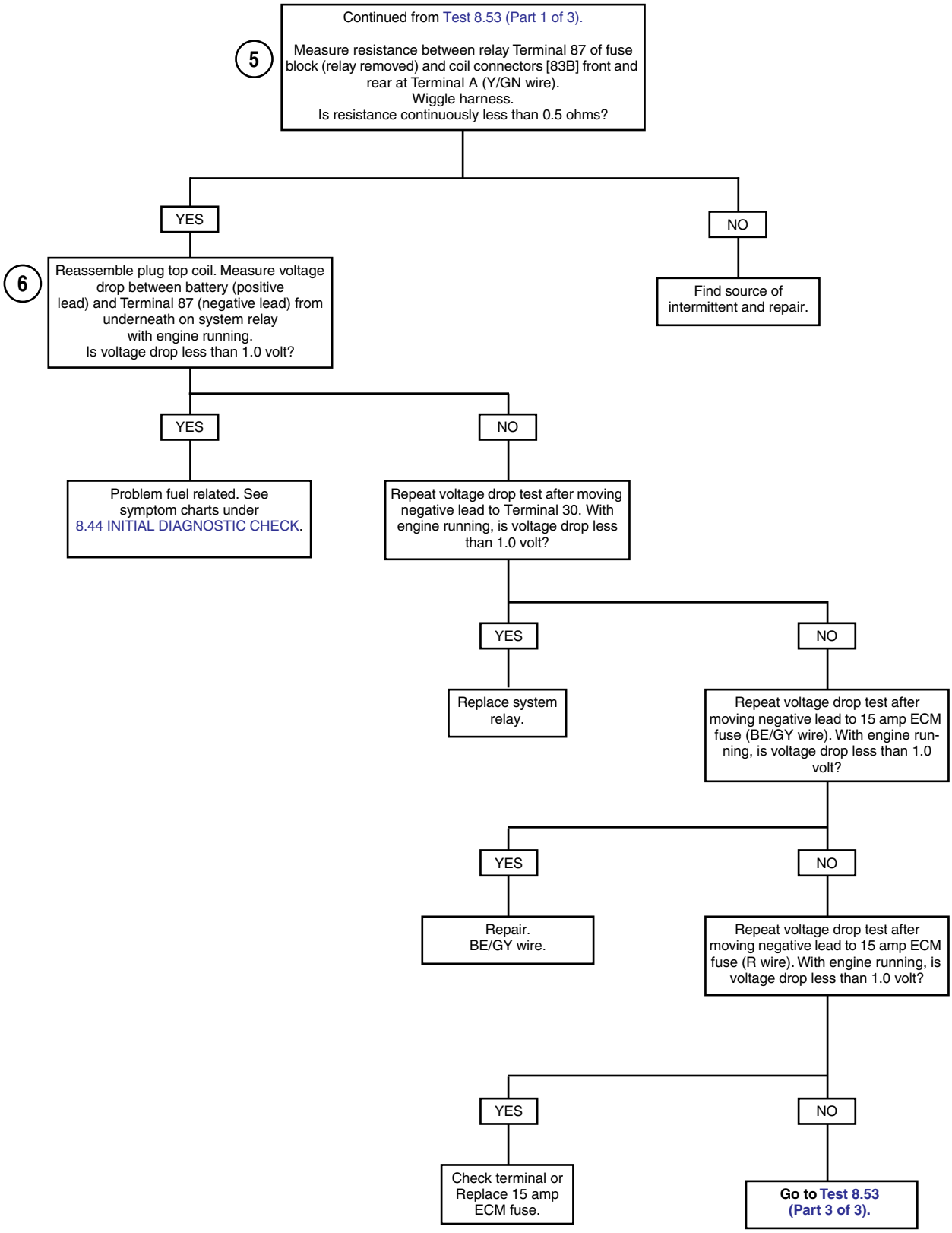
Test 8.53 (Part 1 of 3)

MISFIRE AT IDLE OR UNDER LOAD



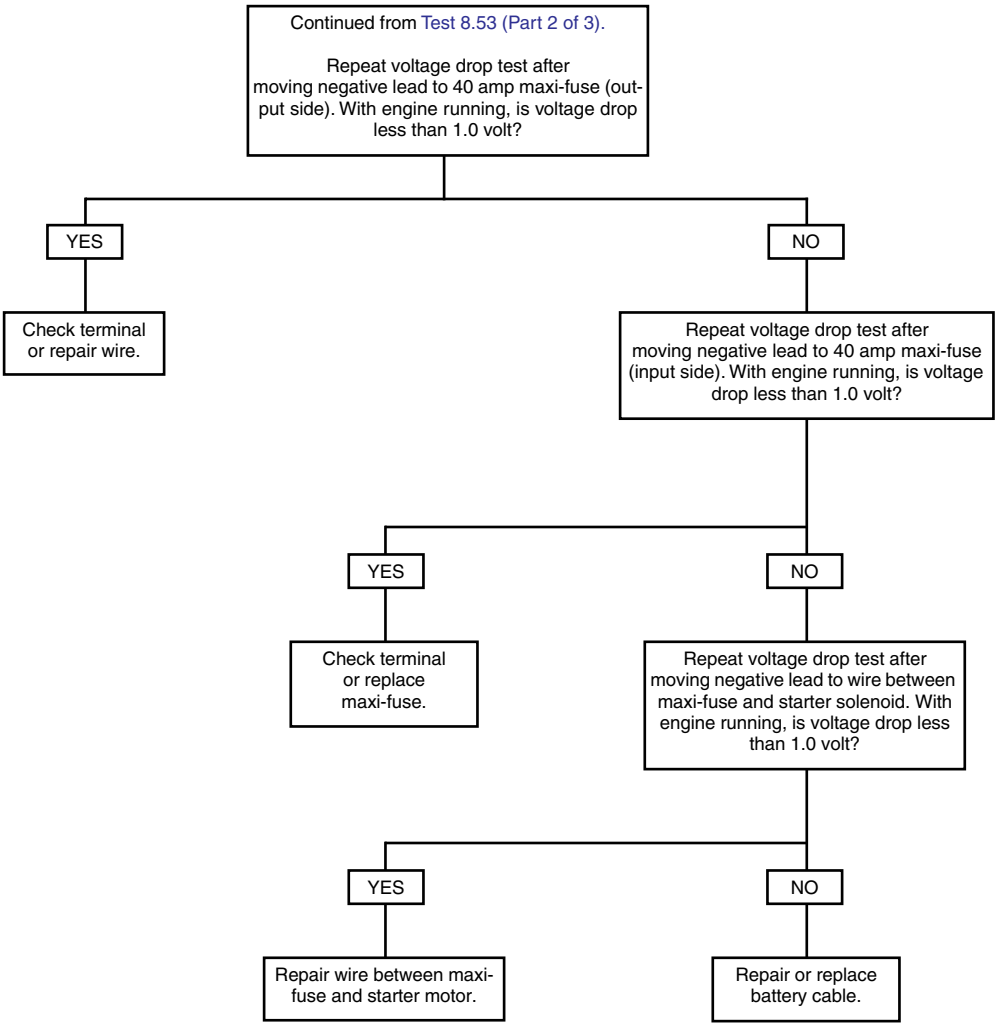
Test 8.53 (Part 2 of 3)

MISFIRE AT IDLE OR UNDER LOAD



Test 8.53 (Part 3 of 3)

MISFIRE AT IDLE OR UNDER LOAD



COMBUSTION ABSENT/INTERMITTENT 8.54

GENERAL

Diagnostic Trouble Codes P1353, P1356, 1357, 1358: No Combustion

See Figure 8-111. A feedback voltage signal in the secondary ignition circuit (terminal A) detects the presence of combustion each time a cylinder fires on ECM terminal 27. For diagnostic purposes, this signal is only analyzed at high speed and load where it may be easily measured. Failure to detect combustion at high speed and load means one of following conditions is true.

- Cylinder is truly misfiring.
- There is a lack of continuity in the ignition coil secondary circuit.

Table 8-68. Code Description

DTC	DESCRIPTION
P1353	Front cylinder no combustion
P1356	Rear cylinder no combustion
P1357	Front cylinder combustion intermittent
P1358	Rear cylinder combustion intermittent

Table 8-69. Plug Top Coil

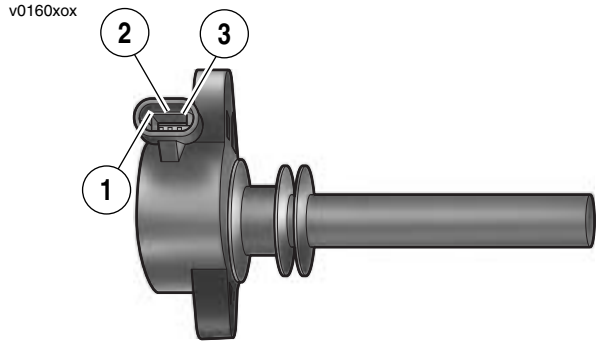
COIL	SPECIFICATION
Primary terminal B to terminal C	0.3-0.5 ohms
Secondary terminal A to plug end of boot	3.5-4.5K ohms
Plug top coil boot	< 5 ohms

DIAGNOSTICS

Diagnostic Notes

The reference number below correlates with the circled numbers on the Test flow charts.

1. Perform plug top coil resistance test.
   a. Remove plug top coil.
   b. Using an ohmmeter, touch probes to coil terminals referred to in Table 8-69.
   c. If coil primary is out of range or coil secondary is below range, replace coil.
   d. If coil secondary is above specified range, remove boot and recheck coil. If coil readings are within specifications, replace boot. If coil secondary readings are still above specifications, clean the coil terminals and repeat resistance test. If resistance is still high after cleaning terminals, replace plug top coil.
   e. An infinite ohms (∞ or no continuity) resistance value indicates an open circuit (a break in the coil winding). Replace plug top coil.
   f. Reinstall and repeat procedure on other coil.
2. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 8.42 BREAKOUT BOX: ECM.



1. **Terminal A**
2. **Terminal B**
3. **Terminal C**

Figure 8-111. Plug Top Coil

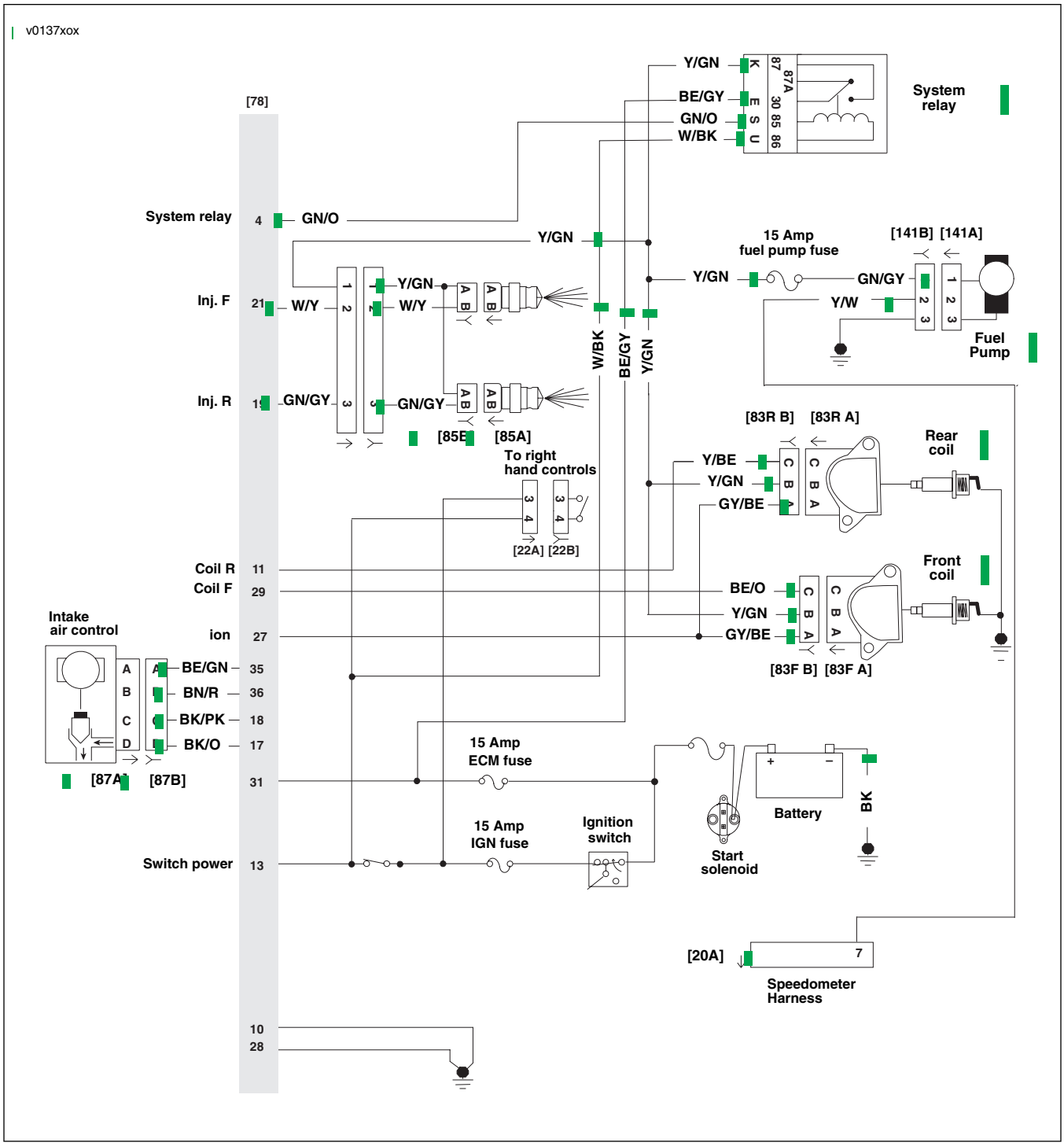


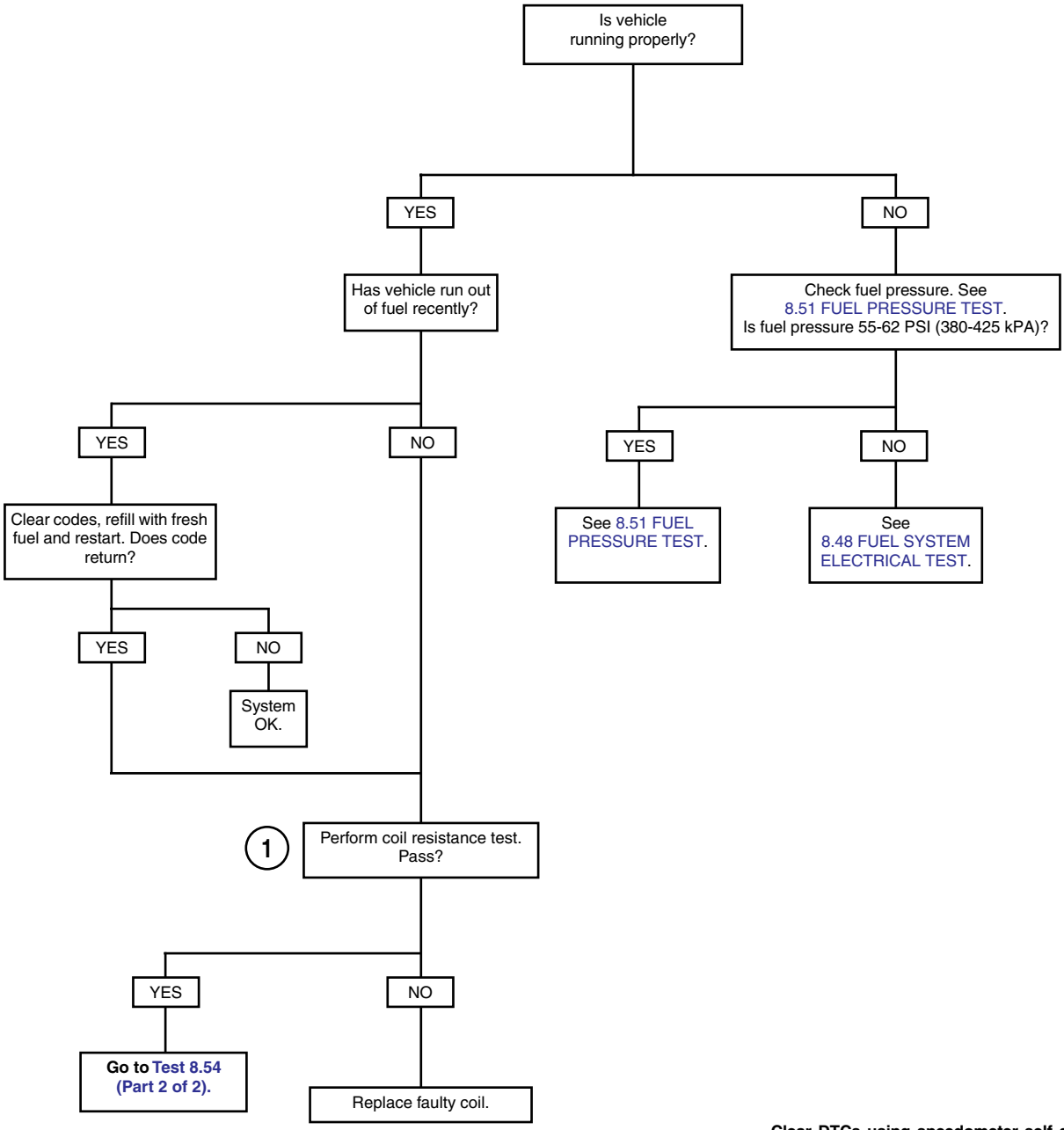
Figure 8-112. Secondary Ignition Circuit Diagram

Table 8-70. Wire Harness Connectors in Figure 8-112.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Behind left side cover
[83F]	Front plug top coil	3-place Packard	On top of front cam cover
[83R]	Rear plug top coil	3-place Packard	On top of rear cam cover
[145]	Engine harness	12-place Deutsch	Under air cleaner

Test 8.54 (Part 1 of 2)

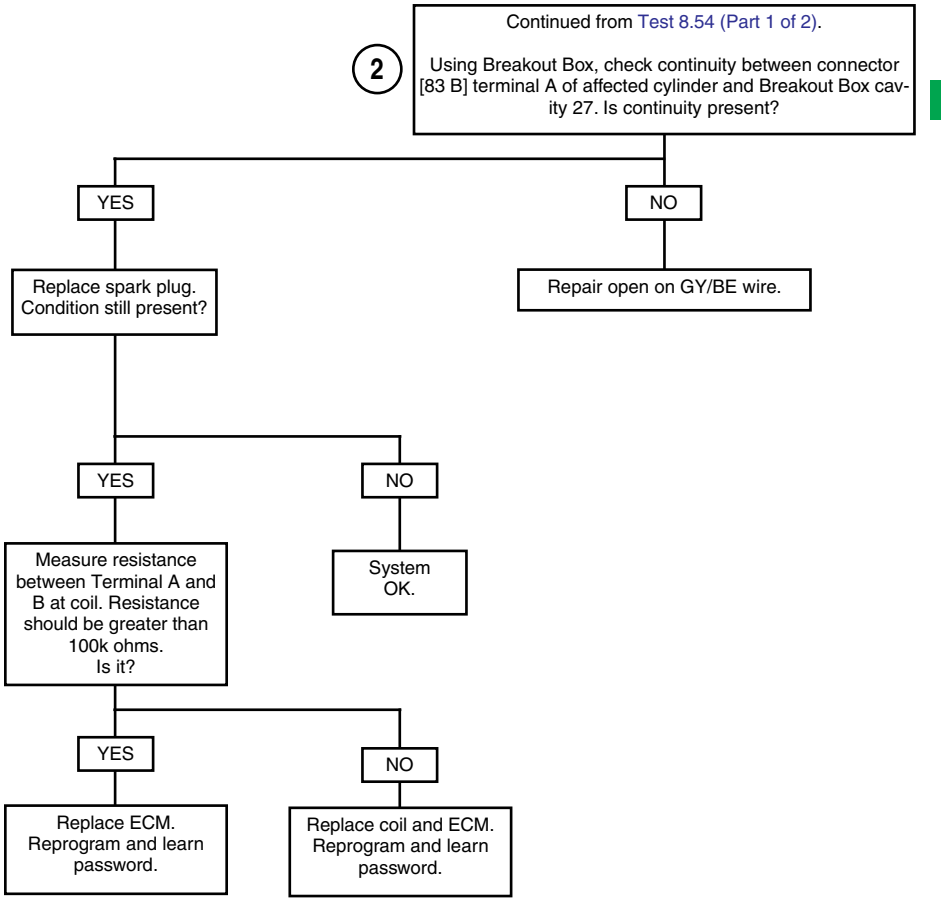
COMBUSTION ABSENT: DTC P1353, P1356, 1357, 1358



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.54 (Part 2 of 2)

COMBUSTION ABSENT: DTC P1353, P1356, 1357, 1358



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC P0107, P0108 8.55

GENERAL

MAP Sensor

See Figure 8-113. The manifold absolute pressure sensor (MAP sensor) is supplied 5 volts from the ECM (terminal 14) and sends a signal back to the ECM (terminal 25). This signal varies in accordance with engine vacuum and atmospheric barometric pressure. Changes in barometric pressure are influenced by weather and altitude.

Table 8-71. Code Description

DTC	DESCRIPTION
P0107	MAP sensor open/low
P0108	MAP sensor high

DIAGNOSTICS

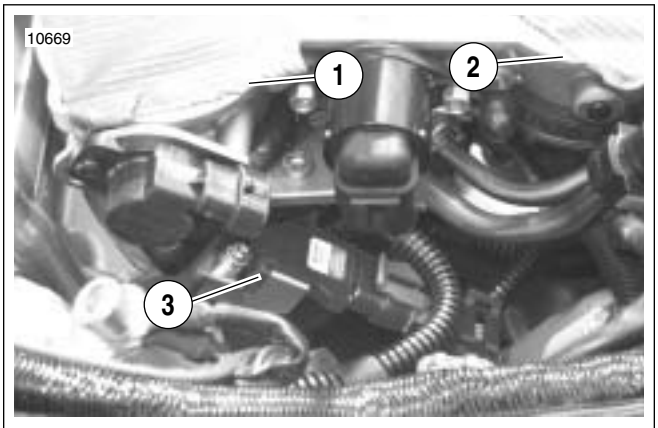
Diagnostic Tips

- These codes will set if the MAP sensor signal is out of range. Code P0108 can only be detected with the engine running.

NOTE

Use caution not to over-pump vacuum pump during MAP sensor output check as sensor damage may result.

- MAP sensor output check. Using the VACUUM PUMP (Part No. HD-23738), apply a vacuum to the pressure port of the MAP sensor. The signal voltage should lower as the vacuum is applied.
- The MAP and TP sensors are connected to the same reference line (+5V Vref). If the reference line goes to ground or open, multiple codes will be set (DTC P0107, P0108, P0122, P0123).



1. **Front intake**
2. **Rear intake**
3. **MAP sensor**

Figure 8-113. MAP Sensor (throttle body removed)

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 8.42 BREAKOUT BOX: ECM.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probes and patch cords.

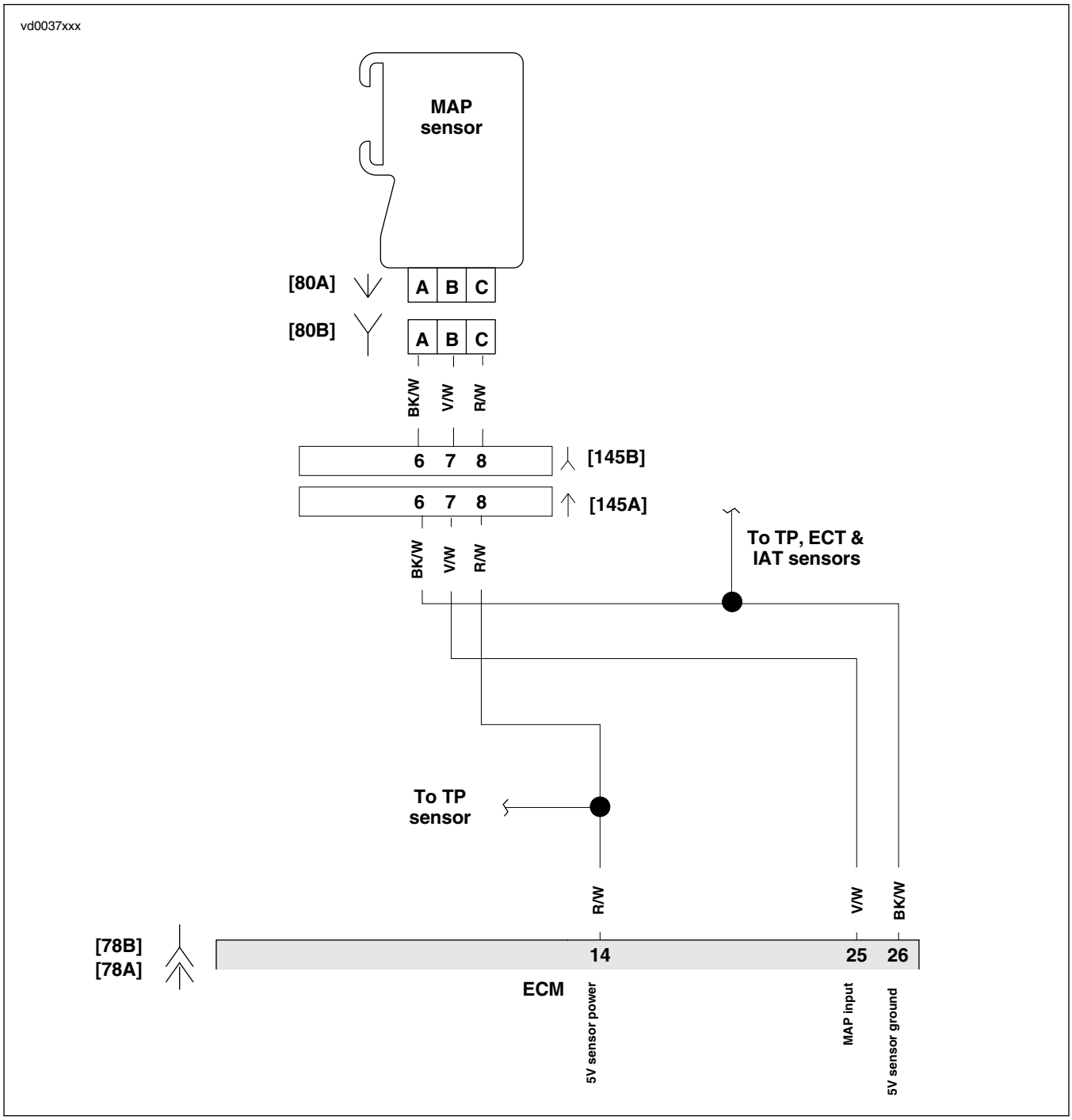


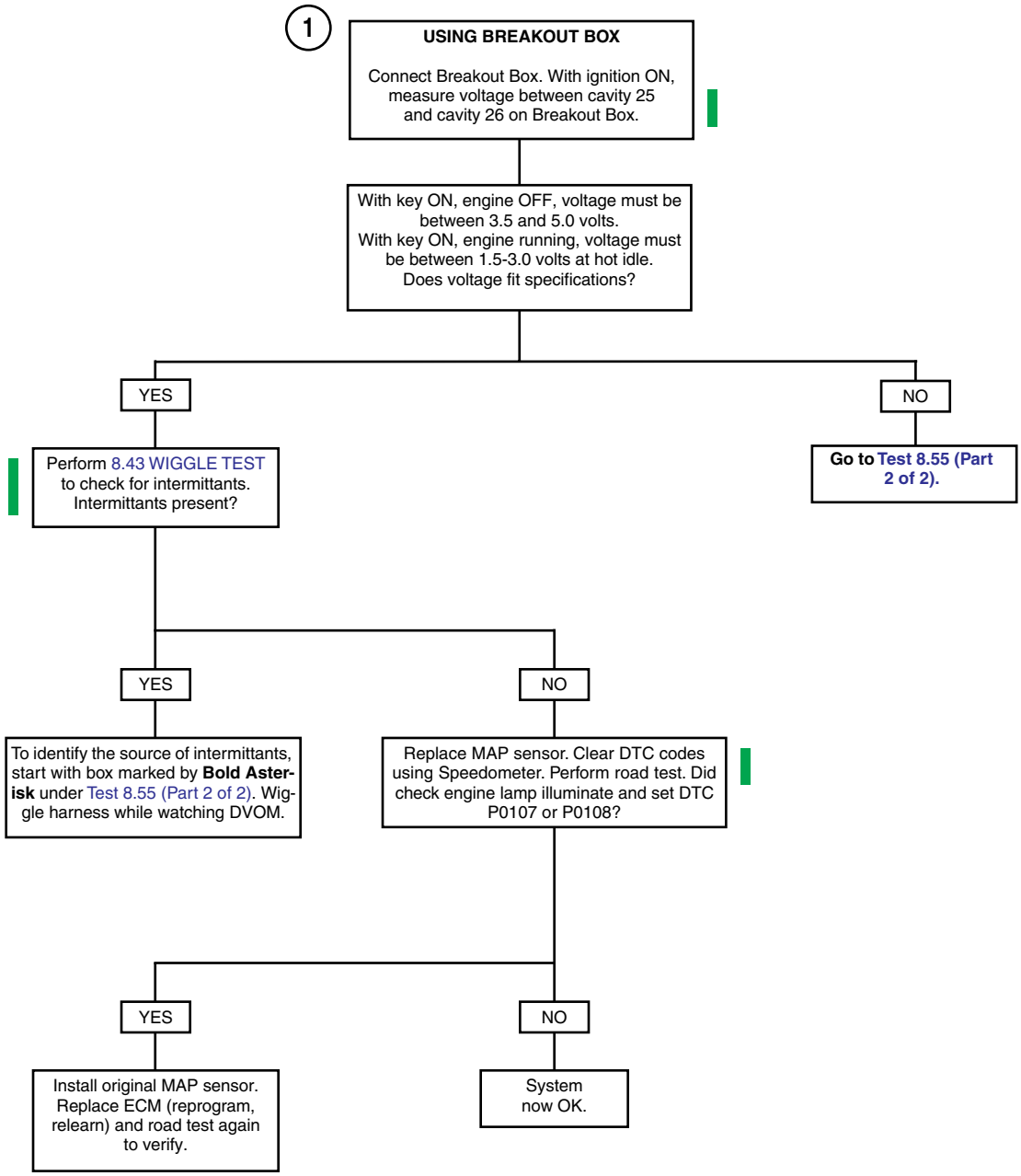
Figure 8-114. MAP Sensor Circuit

Table 8-72. Wire Harness Connectors in Figure 8-114.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[80]	MAP sensor	3-place Packard	Front intake passage
[145]	Engine harness	12-place Deutsch	Under air cleaner

Test 8.55 (Part 1 of 2)

MAP SENSOR: DTC P0107, P0108

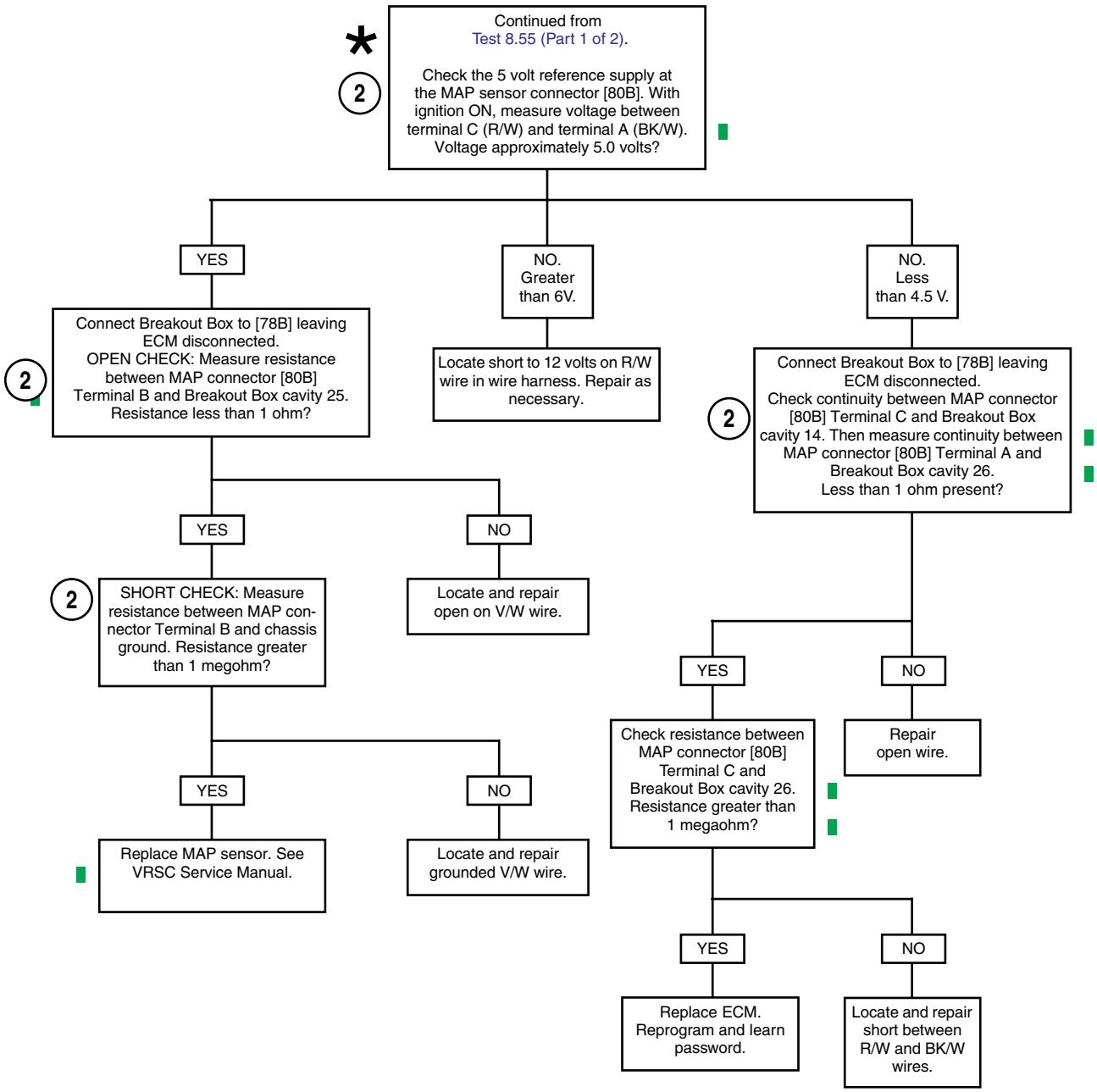


Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

* **At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Test 8.55 (Part 2 of 2)

MAP SENSOR: DTC P0107, P0108



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

*** At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

GENERAL

IAT Sensor

The ECM supplies and monitors a voltage signal (terminal 7) to one side of the intake air temperature sensor (IAT sensor). The other side of the IAT sensor is connected to a common sensor ground, which is also connected to the ECM (terminal 26).

The IAT sensor is a thermistor device, meaning that at a specific temperature, it will have a specific resistance across its terminals. As this resistance varies, so does the voltage (terminal 7).

- At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on terminal 7.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5 volts.

The ECM monitors this voltage to compensate for various operating conditions.

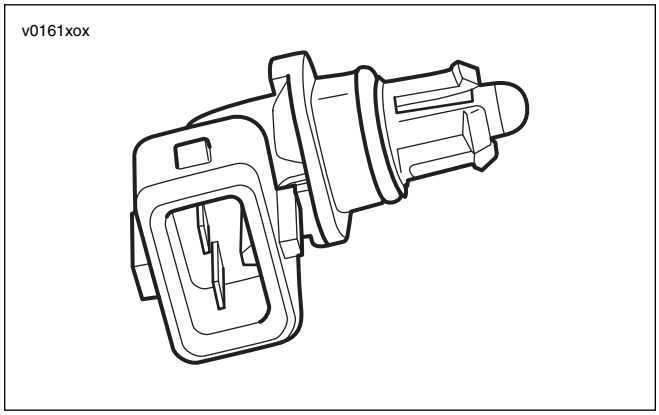


Figure 8-115. IAT sensor

Table 8-73. Code Description

DTC	DESCRIPTION
P0112	IAT sensor voltage low
P0113	IAT sensor open/high

Table 8-74. IAT Sensor Table

TEMP °C	RESISTANCE	VOLTAGE	TEMP °F
-20	15701	**4.8**	-4
-10	9539	**4.6**	14
0	5959	**4.3**	32
10	3820	**4.0**	50
20	2509	**3.6**	68
25	2051	**3.4**	77
30	1686	**3.2**	86
40	1157	**2.7**	104
50	810	**2.3**	122
60	578	**1.9**	140
70	419	**1.5**	158
80	309	**1.2**	176
90	231	**1.0**	194
100	176	**0.8**	212

DIAGNOSTICS

Diagnostic Tips

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation.

Check the following conditions:

- **Poor connection:** Inspect ECM and harness connector [78] for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform 8.43 WIGGLE TEST to locate intermittants:** If connections and harness check out OK, use the Scanalyzer to check the intake air temperature reading while moving related connectors and wiring harness. If the failure is induced, the intake air temperature display will change.
- **Shifted sensor:** Refer to Table 8-74. This table may be used to test the intake air temperature sensor at various temperature levels in order to evaluate the possibility of a shifted (out-of-calibration) sensor which may result in driveability problems.

NOTE

All voltage and resistance values are approximate (±20%). Measure IAT sensor resistance between ECM Terminal 7 and system ground (ECM Terminal 26).

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. Connect BREAKOUT BOX (Part No. HD-43876) to EFI wire harness **only** (leave ECM disconnected). See 8.42 BREAKOUT BOX: ECM.
2. If the engine has not been operated for 1 hour, the measured resistance should be very close to the measured resistance across the ECT sensor which is terminals 6 and 26 on the Breakout Box. Scanalyzer values (using Data Monitor Mode) will be approximately the same if code is historic. Current code will read default value.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probes and patch cords.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple socket probes and patch cords.
5. Replace IAT sensor. See VRSC Service Manual.

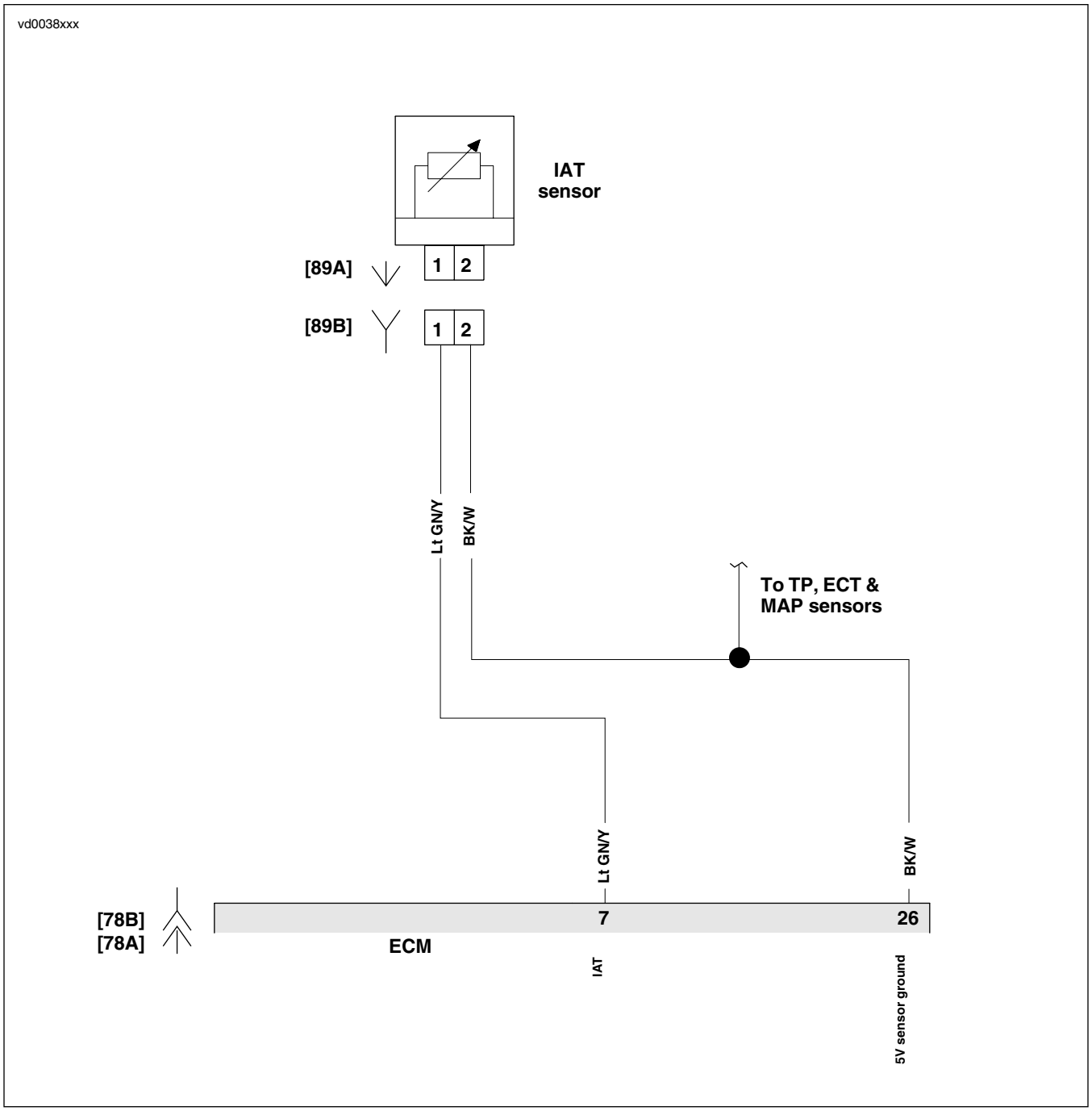


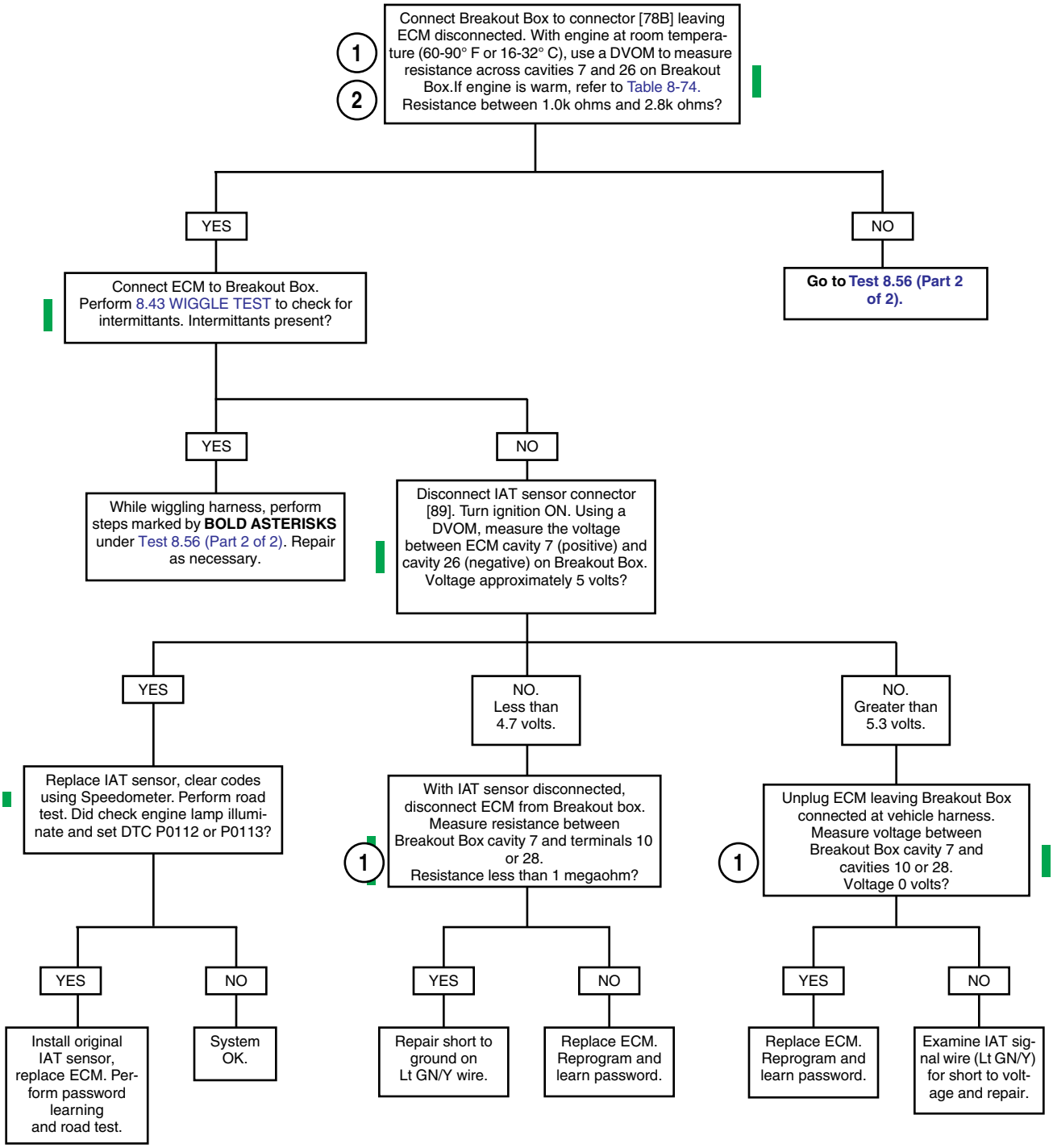
Figure 8-116. IAT Sensor Circuit

Table 8-75. Wire Harness Connectors in Figure 8-116.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[89]	IAT sensor	2-place Packard	Under airbox cover
[145]	Engine harness	12-place Deutsch	Under air cleaner

Test 8.56 (Part 1 of 2)

IAT SENSOR: DTC P0112, P0113

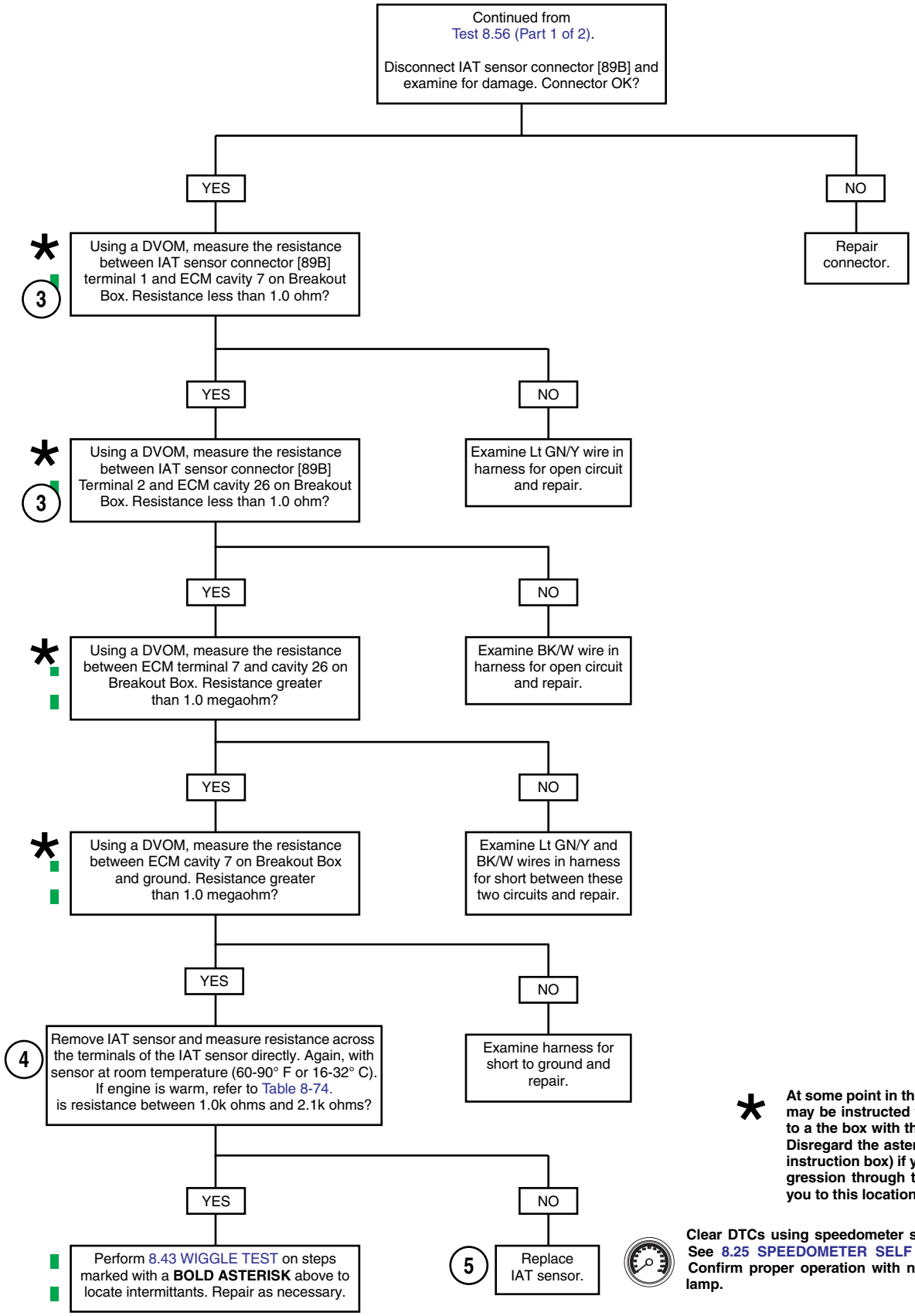


***** **At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.56 (Part 2 of 2)

IAT SENSOR: DTC P0112, P0113



* **At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC P0117, P0118 8.57

GENERAL

ECT Sensor

The ECM supplies and monitors a voltage signal (terminal 6) to one side of the engine coolant temperature sensor (ECT sensor). The other side of the ECT sensor is connected to a common sensor ground, which is also connected to the ECM (terminal 26).

The ECT sensor is a thermistor device, which means that at a specific temperature it will have a specific resistance across its terminals. As this resistance varies, so does the voltage on terminal 6.

- At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on terminal 6.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5 volts.

The ECM monitors this voltage to compensate for various operating conditions. The ECM also uses the sensor input as a reference for determining IAC pintle position.

Table 8-76. Code Description

DTC	DESCRIPTION
P0117	ECT sensor voltage low
P0118	ECT sensor open/high

Table 8-77. ECT Sensor Table

TEMP °C	RESISTANCE	VOLTAGE*	TEMP °F
-20	28582	4.4	-4
-10	16120	4.1	14
0	9399	3.6	32
10	5658	3.0	50
20	3511	2.4	68
25	2800	2.1	77
30	2240	1.8	86
40	1465	1.4 **or** 4.1	104
50	980	1.0 **or** 3.7	122
60	671	3.3	140
70	469	2.9	158
80	334	2.5	176
90	242	2.1	194
100	178	1.7	212

* Between 40-50°C the ECM changes scaling. Voltages for ECT sensor will shift scales in that range. This provides proper sensor resolution for all temperatures.

DIAGNOSTICS

Diagnostic Tips

Once the engine is started, the ECT voltage should rise steadily.

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation.

Check the following conditions:

- **Poor connection:** Inspect ECM harness connector [78] for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform 8.43 WIGGLE TEST to locate intermittants:** If connections and harness check out OK, use a DVOM to check the ECT voltage reading while moving related connectors and wiring harness. If the failure is induced, the engine coolant temperature display will change.
- **Shifted sensor:** Refer to Table 8-77. This table may be used to test the engine temperature sensor at various temperature levels in order to evaluate the possibility of a shifted (out-of-calibration) sensor which may result in driveability problems.

NOTE

All voltage and resistance values are approximate (±20%). Measure ECT sensor resistance between ECM Terminal 6 and system ground (ECM Terminal 26).

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. Connect BREAKOUT BOX (Part No. HD-43876) to EFI wire harness **only** (leave ECM disconnected). See 8.42 BREAKOUT BOX: ECM.
2. If engine has not been operated for 1 hour, the measured resistance should be very close to the measured resistance across the IAT sensor which is cavities 7 and 26 on the Breakout Box. Scanalyzer values (using Data Monitor Mode) will be approximately the same if code is historic. Current code will read default value.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probes and patch cords.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray socket probes and patch cords.
5. Replace ECT sensor. See VRSC Service Manual.

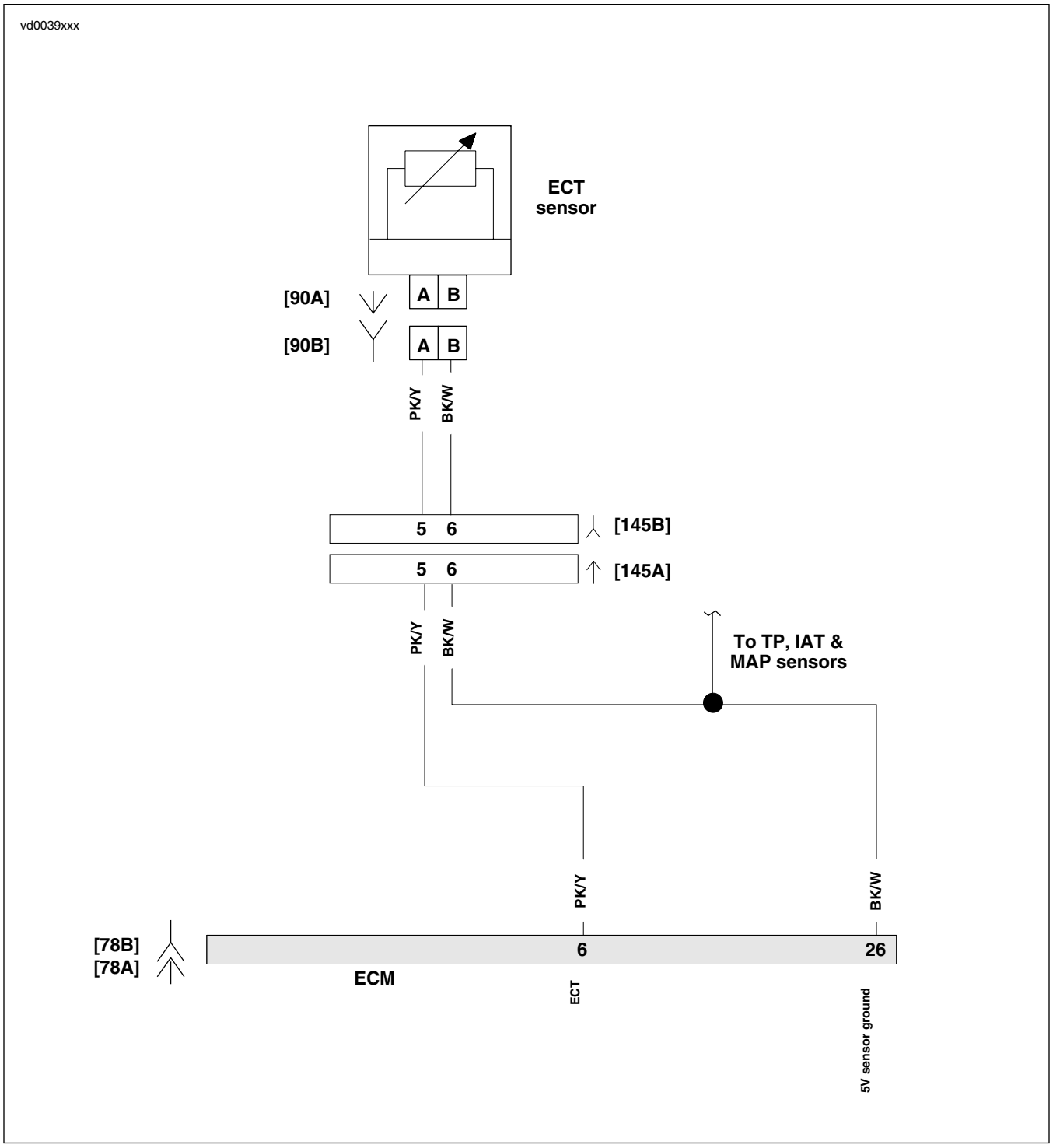


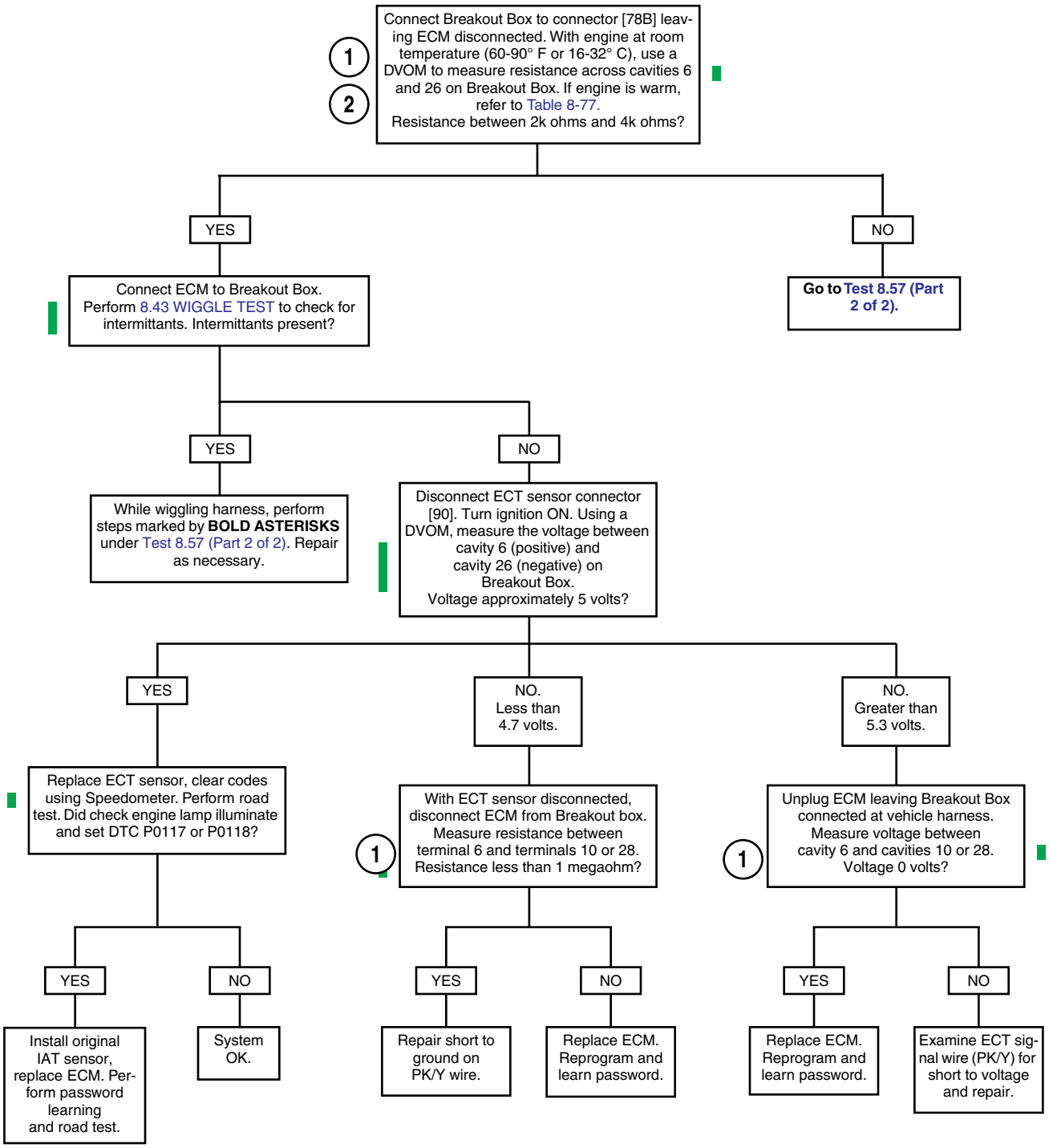
Figure 8-117. ECT Sensor Circuit

Table 8-78. Wire Harness Connectors in Figure 8-117.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[90]	ECT sensor	2-place Packard	Water pump housing
[145]	Engine harness	12-place Deutsch	Under air cleaner

Test 8.57 (Part 1 of 2)

ECT SENSOR: DTC P0117, P0118

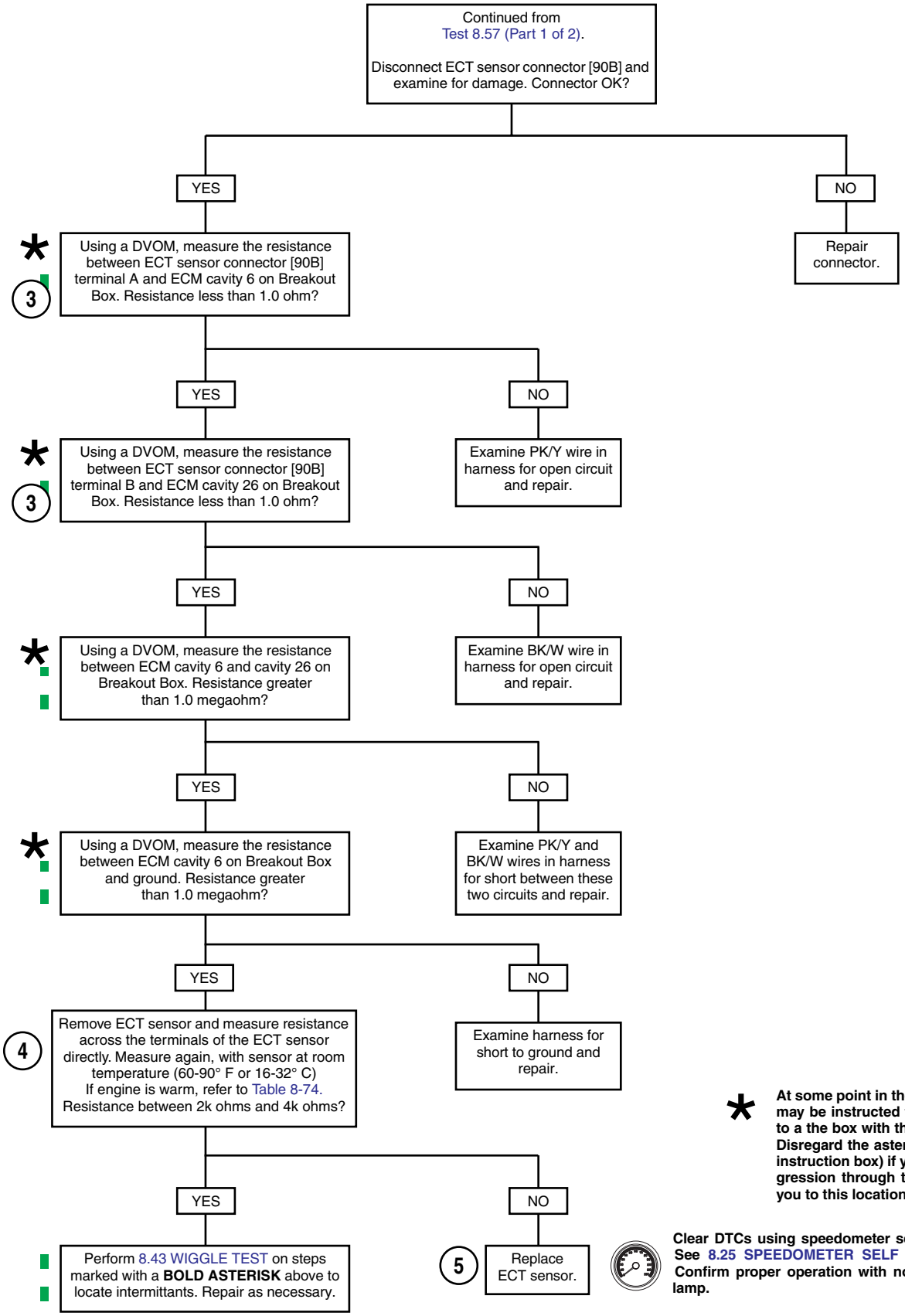


Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

* **At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Test 8.57 (Part 2 of 2)

ECT SENSOR: DTC P0117, P0118



*** At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC P0122, P0123 8.58

GENERAL

TP Sensor

The ECM supplies a 5 volt signal (terminal 14) to the throttle position sensor (TP sensor). The TP sensor sends a signal back to the ECM (terminal 24). The returned signal varies in voltage according to throttle position.

- At idle (closed throttle), the signal is typically in the range of 0.20-0.80 volts.
- At wide open throttle, the signal is normally 4.0-4.9 volts.

A code P0122 or P0123 will set if the TP sensor voltage signal does not fall within the acceptable range.

Table 8-79. Code Description

DTC	DESCRIPTION
P0122	TP sensor open/low
P0123	TP sensor high

DIAGNOSTICS

Diagnostic Tips

The DVOM reads throttle position in volts. Voltage should increase at a steady rate as the throttle is moved from idle to wide open. A short to ground or open on the GY/V or R/W wires also will result in a DTC P0122. A short to ground or open on the R/W wire (+5v REF) sets multiple codes as described below.

NOTE

The MAP and TP sensors are both connected to the same reference line (+5v Vref). If the line goes to ground or open, multiple trouble codes will be set, that is, diagnostic trouble codes P0107, P0108 and P0122 or P0123. Start with the trouble code having the lowest ranking value.

Check for the following conditions:

- **Poor Connection:** Inspect ECM harness connector [78B] for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform 8.43 WIGGLE TEST to locate intermittants:** If connections and harness check out OK, monitor TP sensor voltage using a DVOM while moving related connectors and wiring harness. If the failure is induced, the TP sensor display will change.
- **TP sensor scaling:** Observe the TP sensor voltage display while opening the throttle with engine stopped and ignition key ON. Display should vary from closed throttle TP sensor voltage (when throttle is closed) to greater than 4.0 volts (when throttle is held wide open). As the throttle is **slowly** moved, the voltage should change gradually without spikes or low voltages being observed.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. Connect a BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM before measuring voltage. See 8.42 BREAKOUT BOX: ECM.
   a. Use a DVOM to measure voltage, take reading across cavity 24 (positive lead) and cavity 26 (negative lead) on Breakout Box.
2. Replace TP sensor.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probes and patch cords.

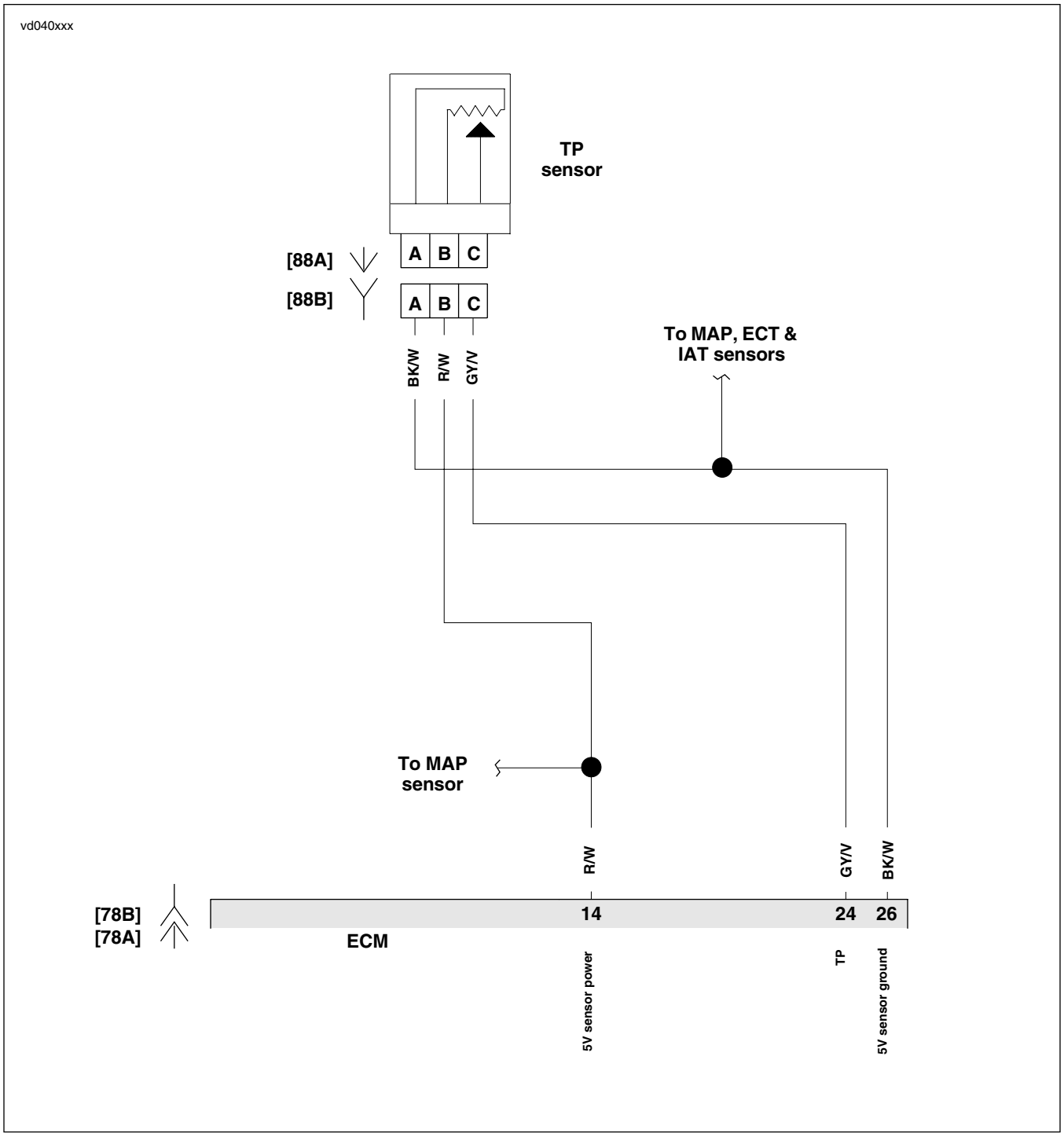


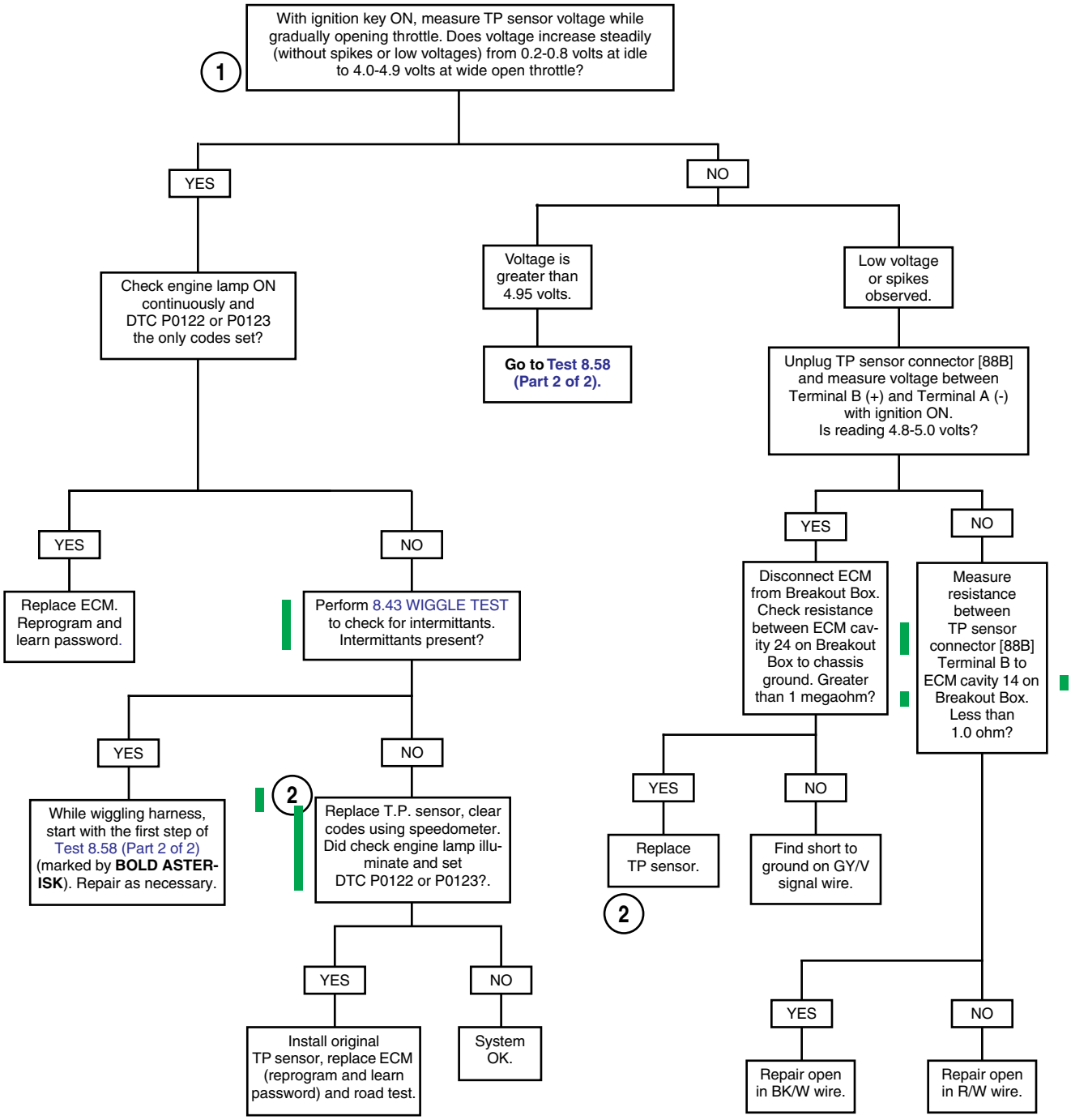
Figure 8-118. TP Sensor Circuit

Table 8-80. Wire Harness Connectors in Figure 8-118.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[88]	TP sensor	3-place Packard	Front of throttle body

Test 8.58 (Part 1 of 2)

TP SENSOR: DTC P0122, P0123

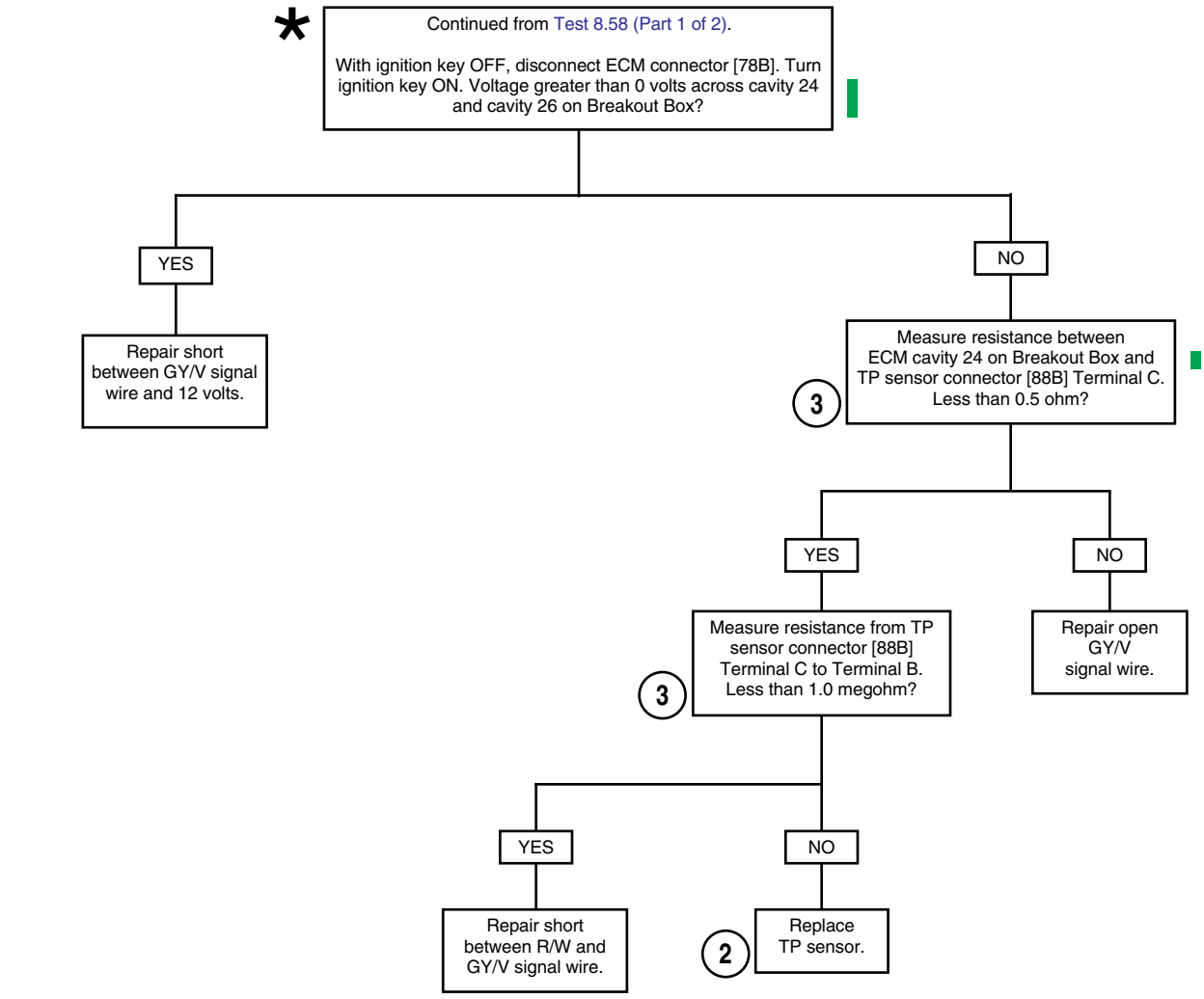


Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

*** At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Test 8.58 (Part 2 of 2)

TP SENSOR: DTC P0122, P0123



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

*** At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

DTC P0261, P0262, P0263, P0264 8.59

GENERAL

Fuel Injectors

The fuel injectors are solenoids that allow pressurized fuel into the intake tract. The injectors are timed to the engine cycle and triggered sequentially. The power for the injectors comes from the system relay. The system relay also provides power for the fuel pump and the ignition coils. The ECM provides the path to ground to trigger the injectors.

NOTE

ECM fuse and system relay failures or wiring harness problems will cause 12 volt power to be lost to both injectors, ignition coils and fuel pump.

Table 8-81. Code Description

DTC	DESCRIPTION
P0261	Front injector open/low
P0262	Front injector high
P0263	Rear injector open/low
P0264	Rear injector high

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. See VRSC Service Manual for all service information.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple terminal probe and patch cord.
3. Connect a BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM. See 8.42 BREAKOUT BOX: ECM.

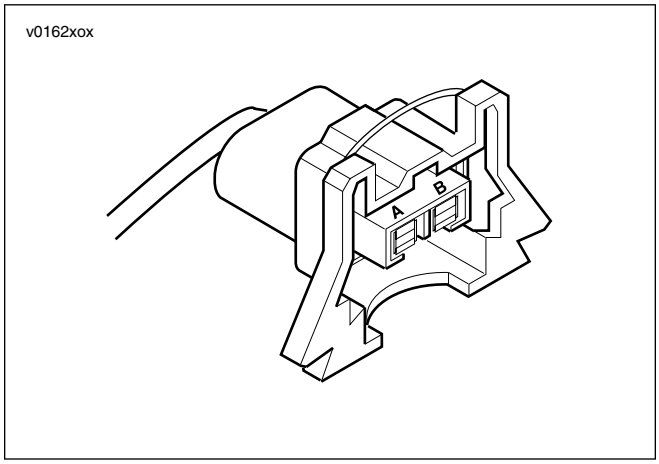


Figure 8-119. Fuel Injector Connector

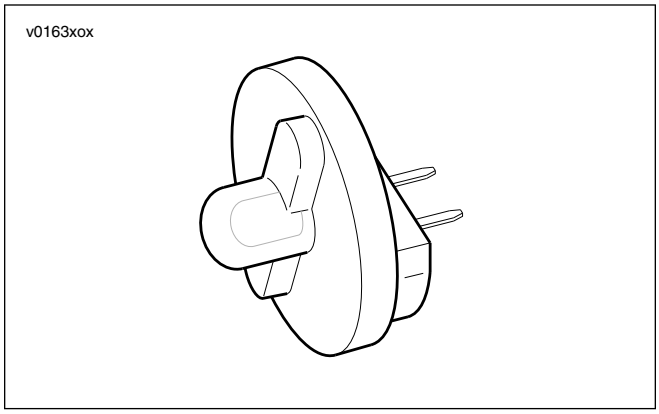


Figure 8-120. Fuel Injector Test Lamp (Part No. HD-34730-2C)

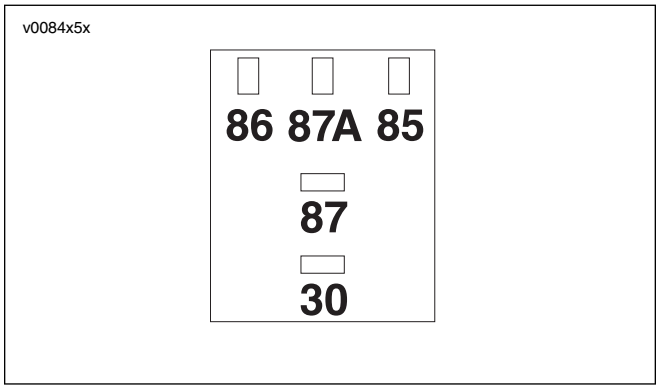


Figure 8-121. Relay Terminals

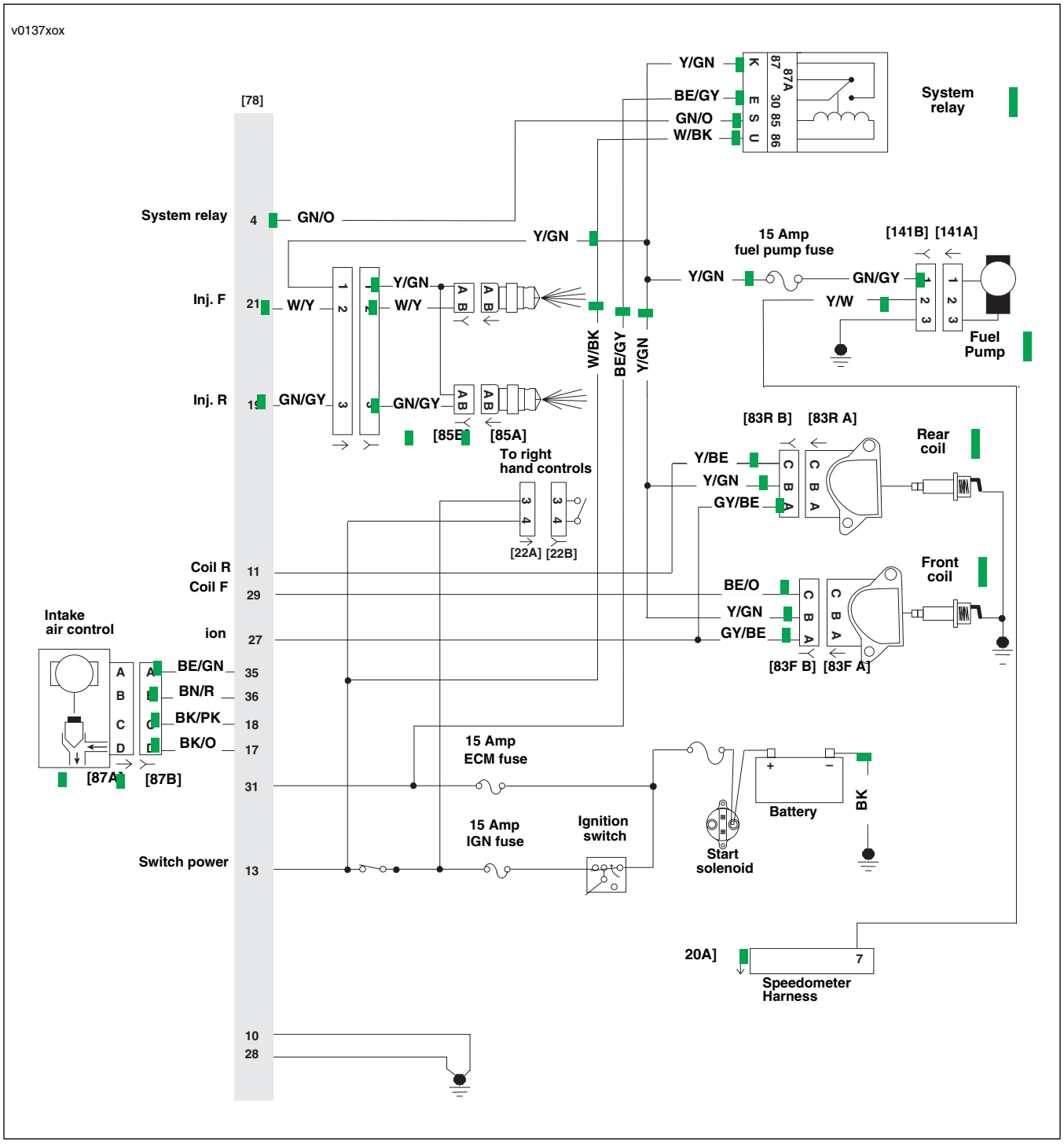


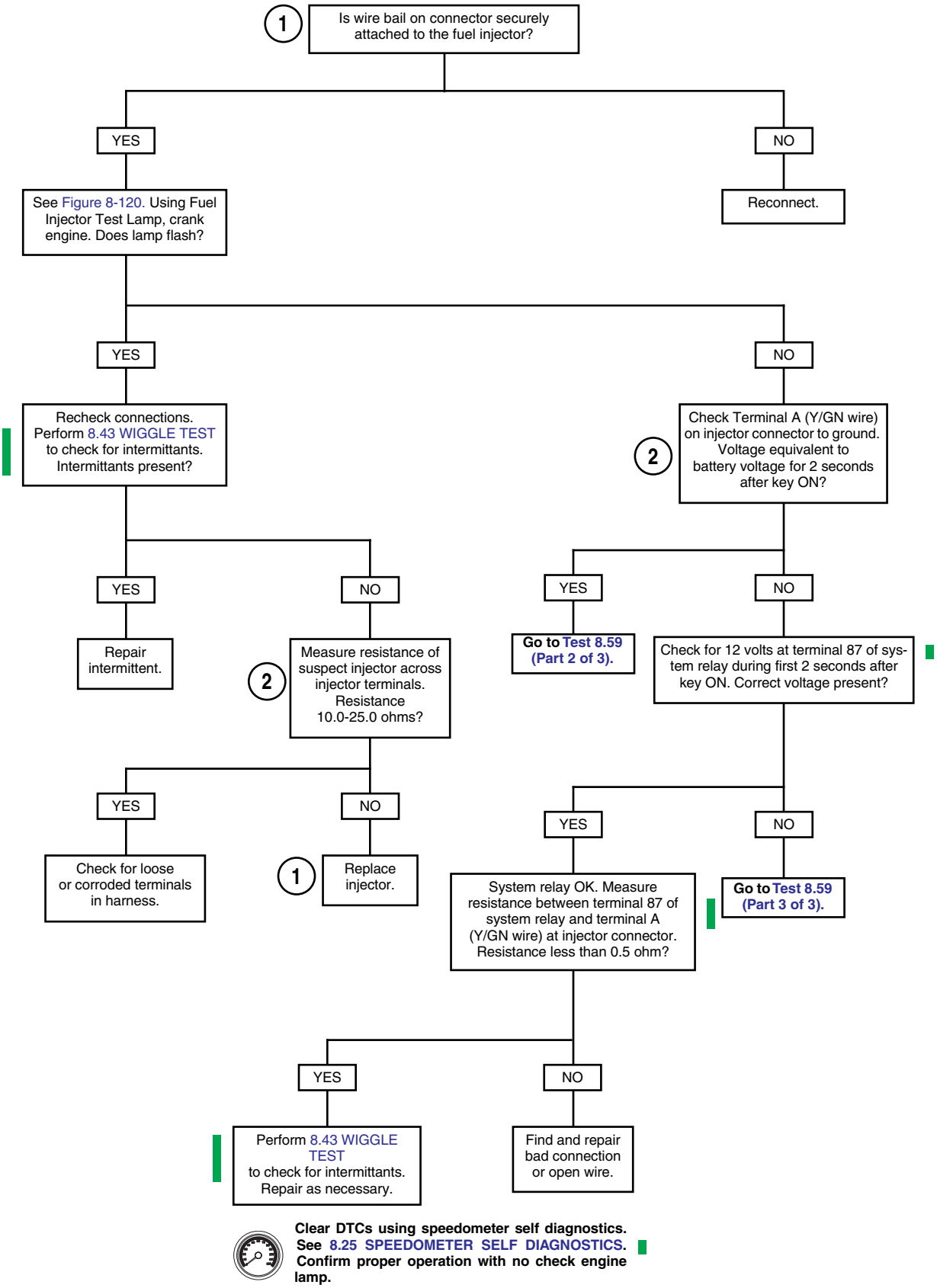
Figure 8-122. Fuel Injectors Circuit

Table 8-82. Wire Harness Connectors in Figure 8-122.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[84]	Front injector	2-place Packard	Throttle body
[85]	Rear injector	2-place Packard	Throttle body
[145]	Engine harness	12-place Deutsch	Under air cleaner

Test 8.59 (Part 1 of 3)

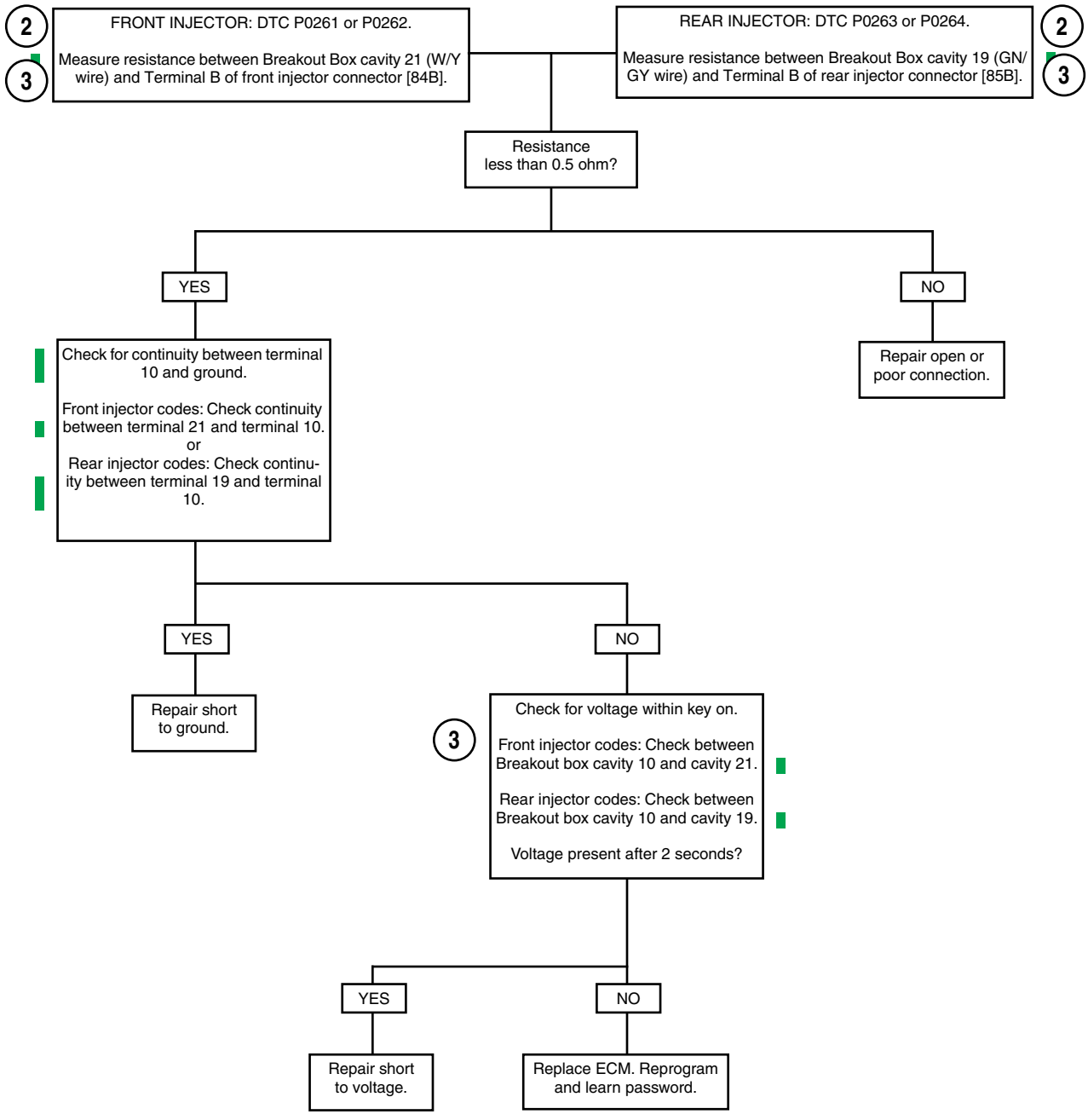
FUEL INJECTORS: DTC P0261, P0262, P0263, P0264



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.59 (Part 2 of 3)

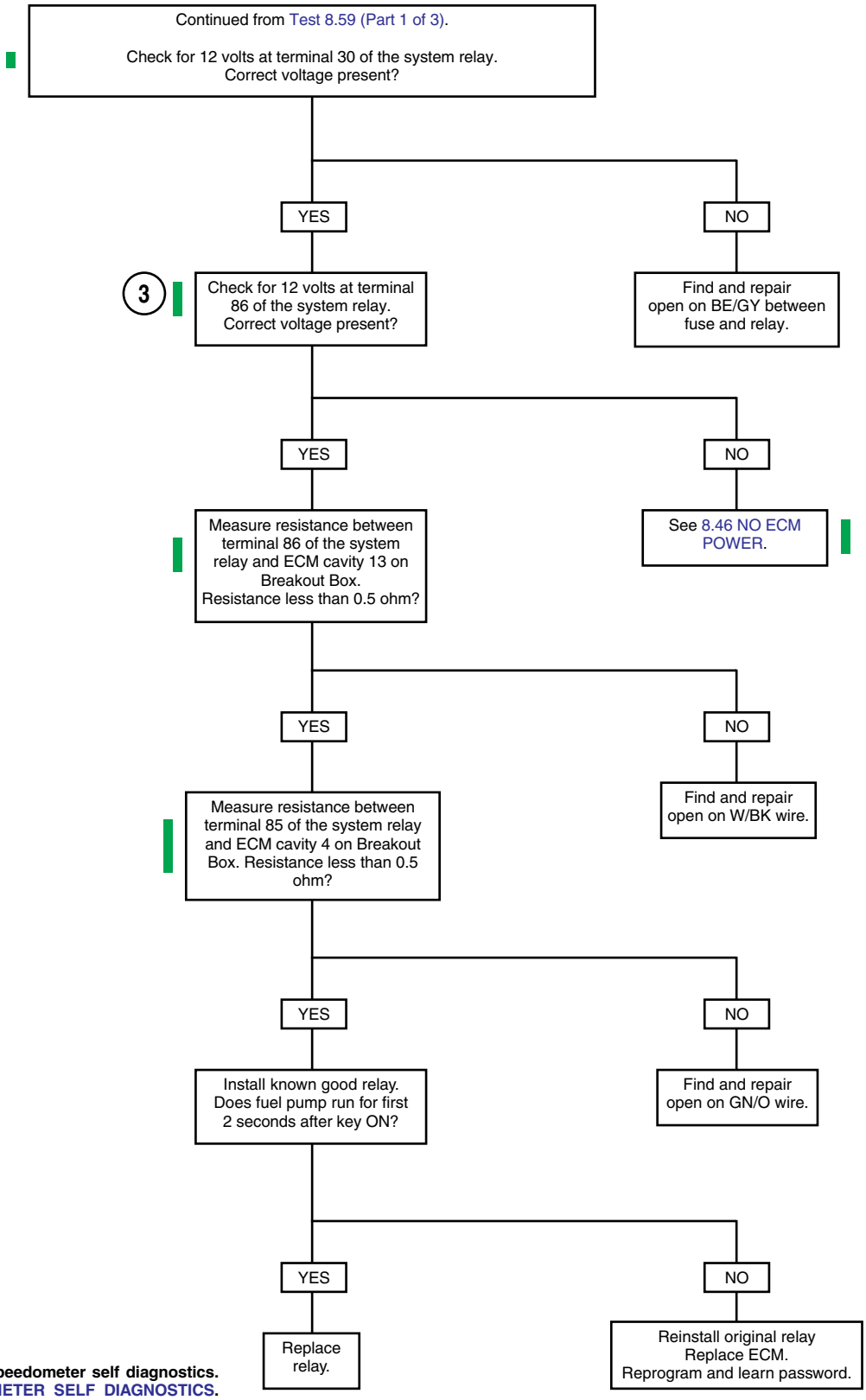
FUEL INJECTORS: DTC P0261, P0262, P0263, P0264



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.59 (Part 3 of 3)

FUEL INJECTORS: DTC P0261, P0262, P0263, P0264



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC P0373, P0374 8.60

GENERAL

CKP Sensor

If the crank position sensor (CKP sensor) signal is weak or absent, diagnostic trouble codes P0373 or P0374 will be set.

NOTE

If signal is not detected or cannot synchronize (DTC P0374), engine will not start.

Table 8-83. Code Description

DTC	DESCRIPTION
P0373	CKP sensor intermittent
P0374	CKP sensor synch error

DIAGNOSTICS

Diagnostic Tips

- Engine must be cranked for more than five seconds without CKP signal to set code.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow chart.

1. Connect BREAKOUT BOX (Part No. HD-43876) to ECM wire harness **only** (leave ECM disconnected). See 8.42 BREAKOUT BOX: ECM.
2. One megaohm is very high resistance. Some meters will read ∞, OL, etc.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), brown socket probes and patch cords.
4. For testing purposes, install sensor without running wiring along normal path. Disconnect and route wiring properly if system is now OK.

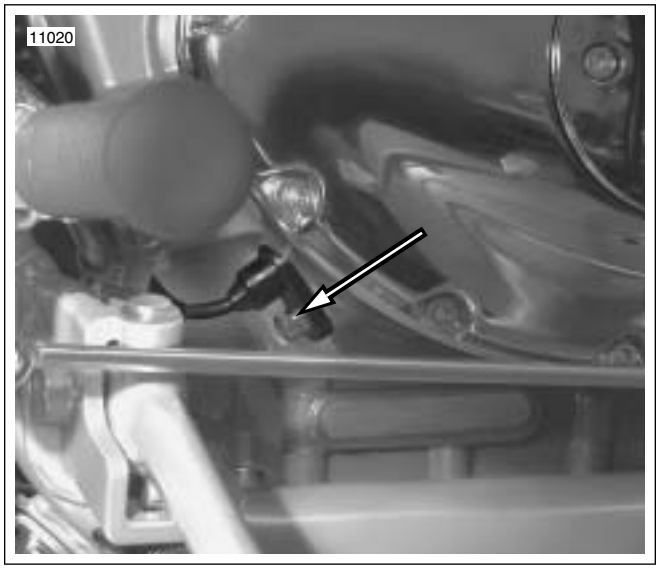


Figure 8-123. CKP Sensor (typical)

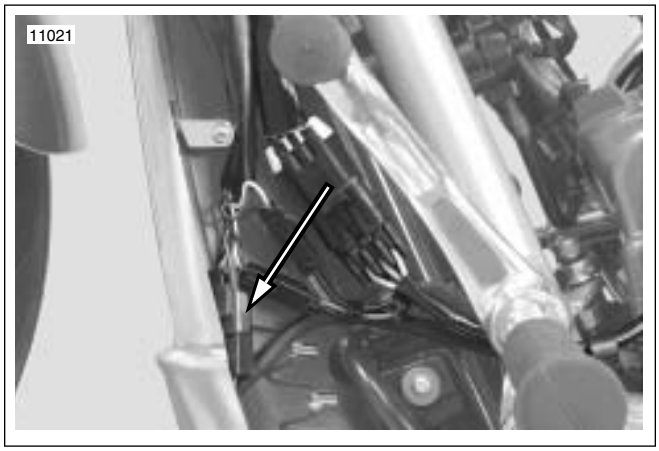


Figure 8-124. CKP Sensor Connector Location (typical)

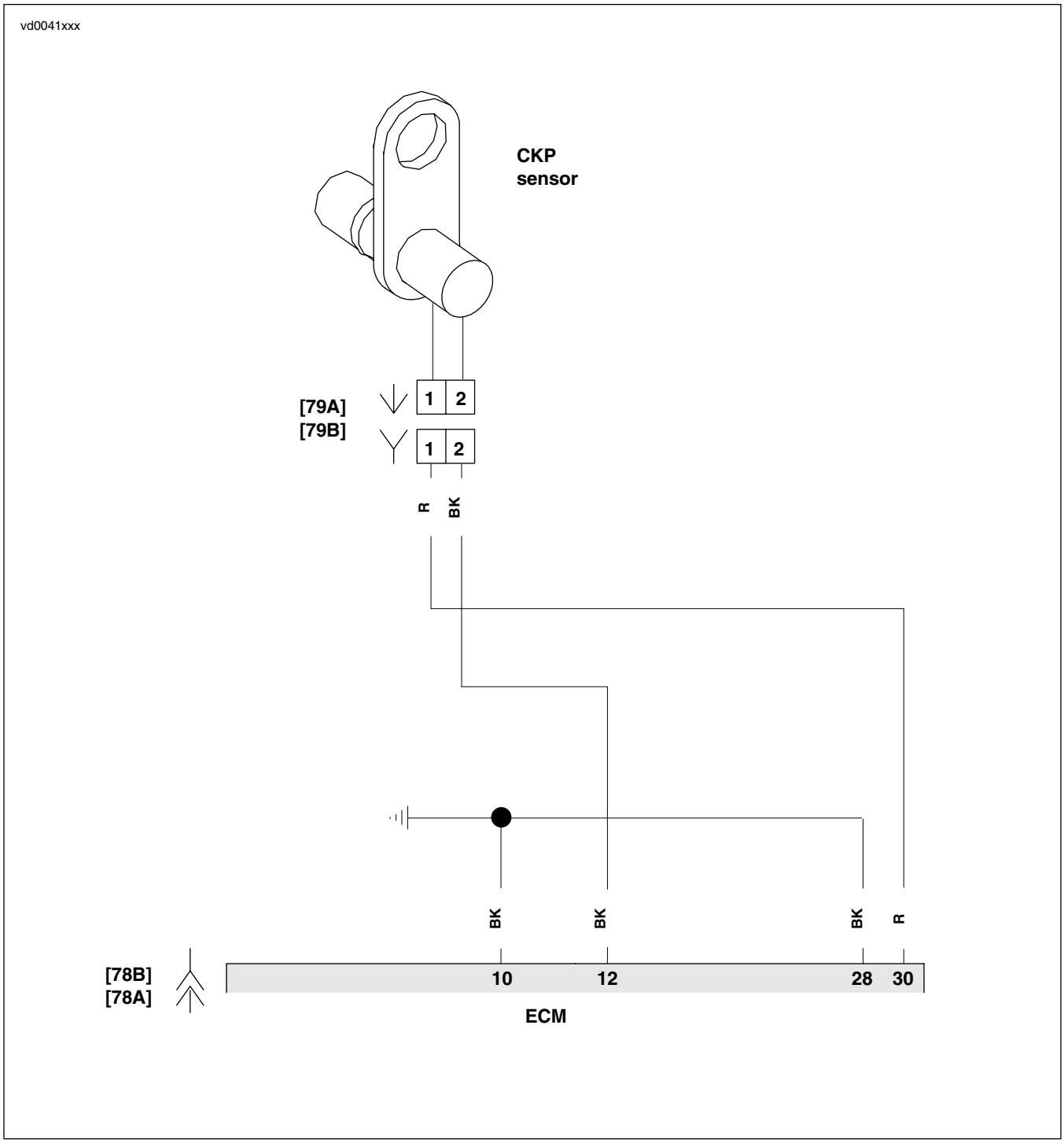


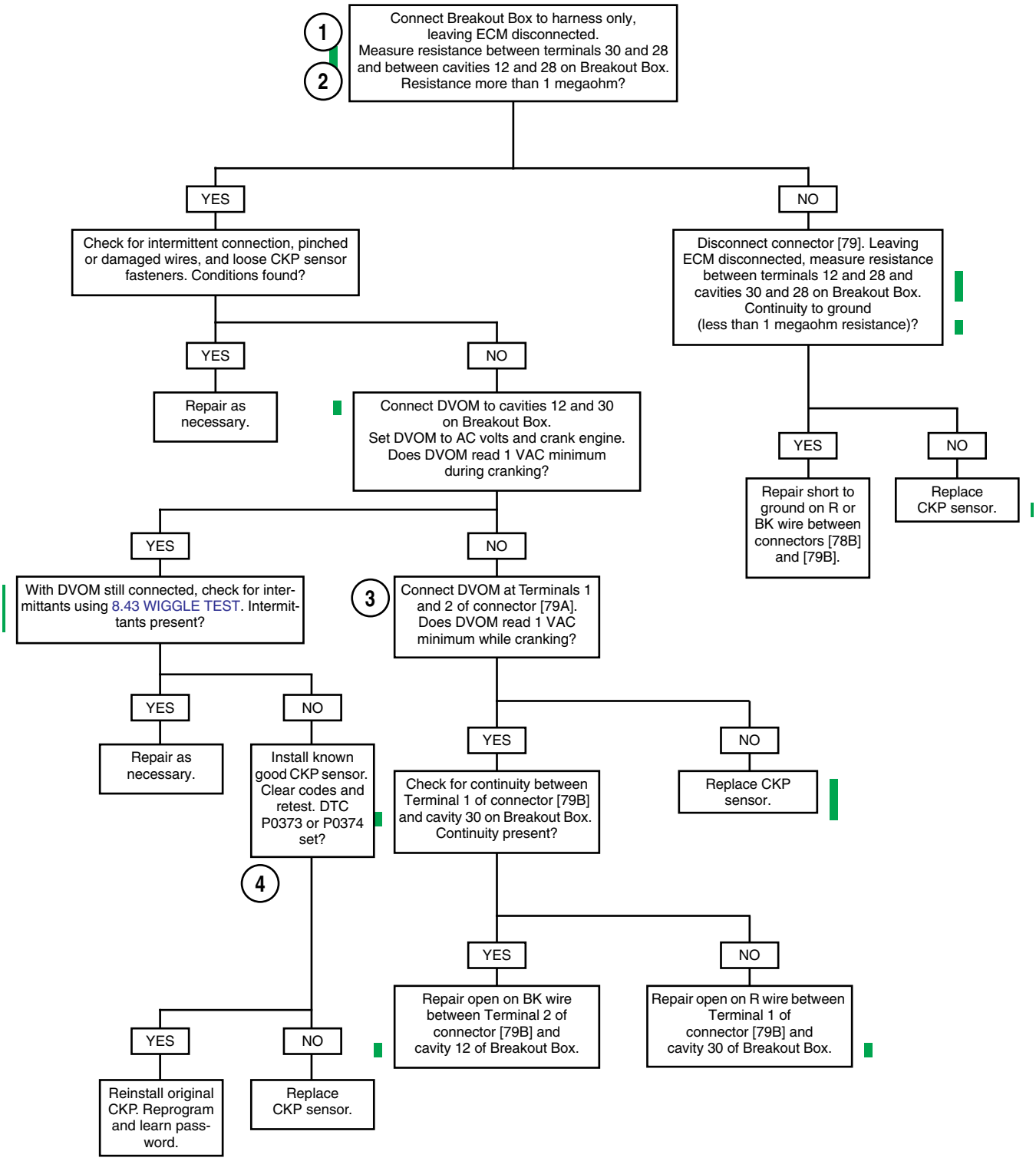
Figure 8-125. CKP Circuit

Table 8-84. Wire Harness Connectors in Figure 8-125.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[79]	CKP sensor	2-place Mini-Deutsch	Under left trim cover

Test 8.60

CKP SENSOR: DTC P0373, P0374



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC P0444, P0445 8.61

GENERAL

Purge Solenoid (CA Models Only)

The purge solenoid allows vapors to escape back into the throttle body. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed or low vehicle speed. The power for the purge solenoid comes from the system relay. The system relay also provides power for the injectors, fuel pump and the ignition coil. The ECM provides the path to ground to trigger the purge solenoid.

NOTE

- *System fuse and system relay failures or wiring harness problems will cause 12 volt power to be lost to both injectors, ignition coils, fuel pump and purge solenoid.*
- *See Figure 8-127. A P0444 DTC can be set on non-California models if resistive plug is removed from connector [95B] or plug is faulty.*

Table 8-85. Code Description

DTC	DESCRIPTION
P0444	Purge solenoid open/low
P0445	Purge solenoid high

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. See VRSC Service Manual for all service information.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple terminal probes and patch cord to BREAKOUT BOX and gray socket probes and patch cord to FUEL INJECTOR TEST LAMP (Part No. HD-34730-2C). See Figure 8-120.
3. Connect a BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM. See 8.42 BREAKOUT BOX: ECM.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple terminal probe and patch cord.

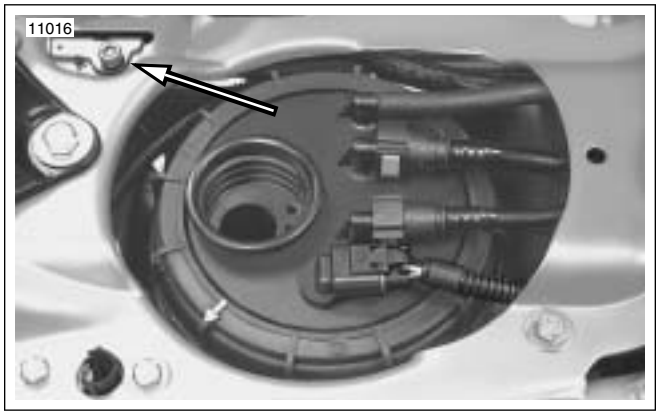


Figure 8-126. Purge Solenoid Mount

Figure 8-127. Resistive Plug

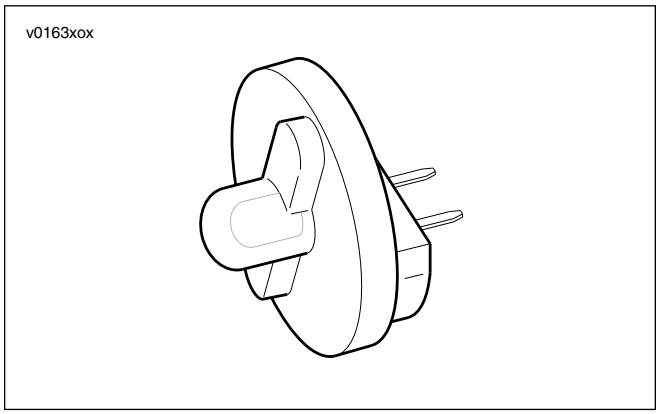


Figure 8-128. Test Lamp (Part No. HD-34730-2C)

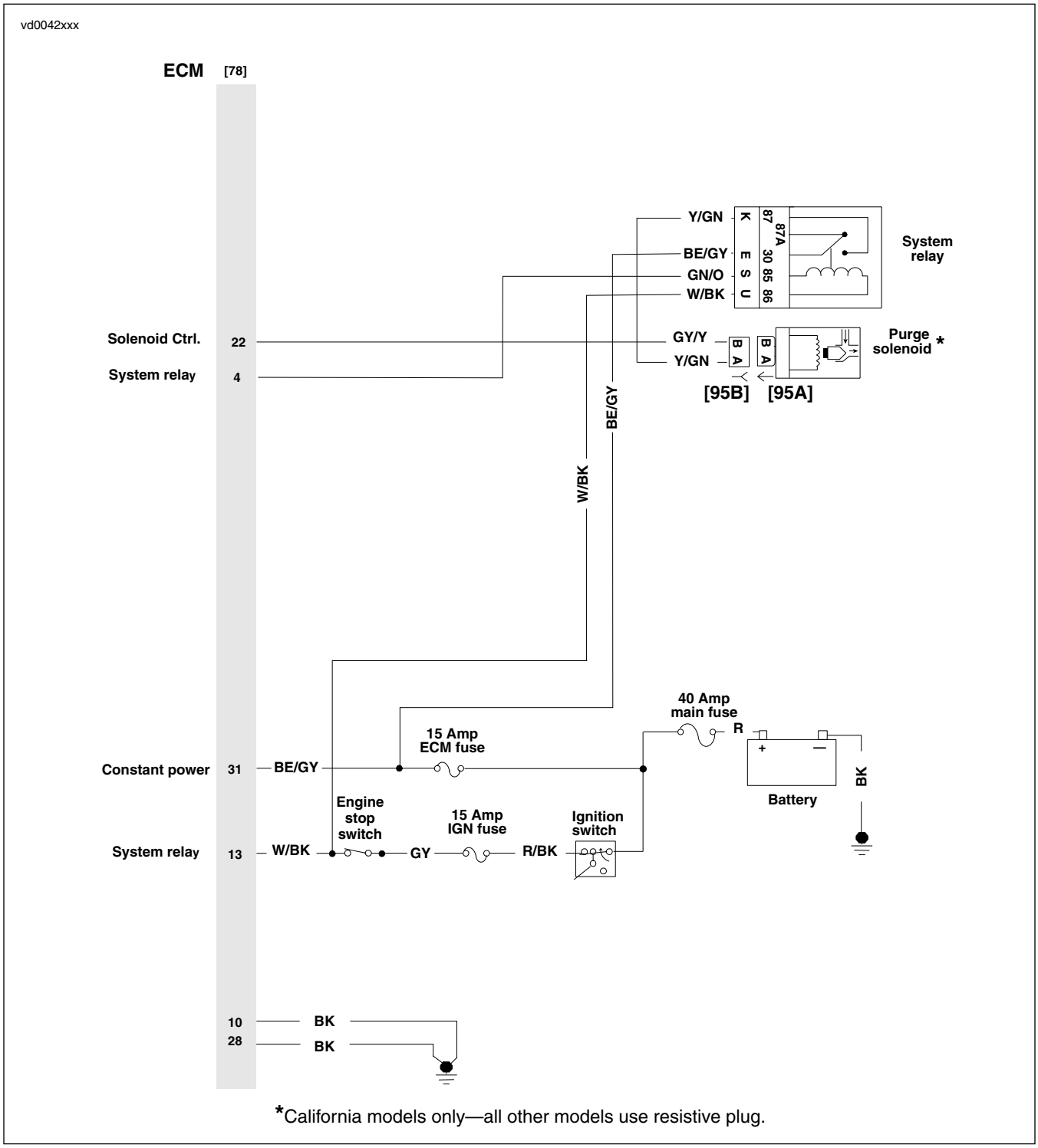


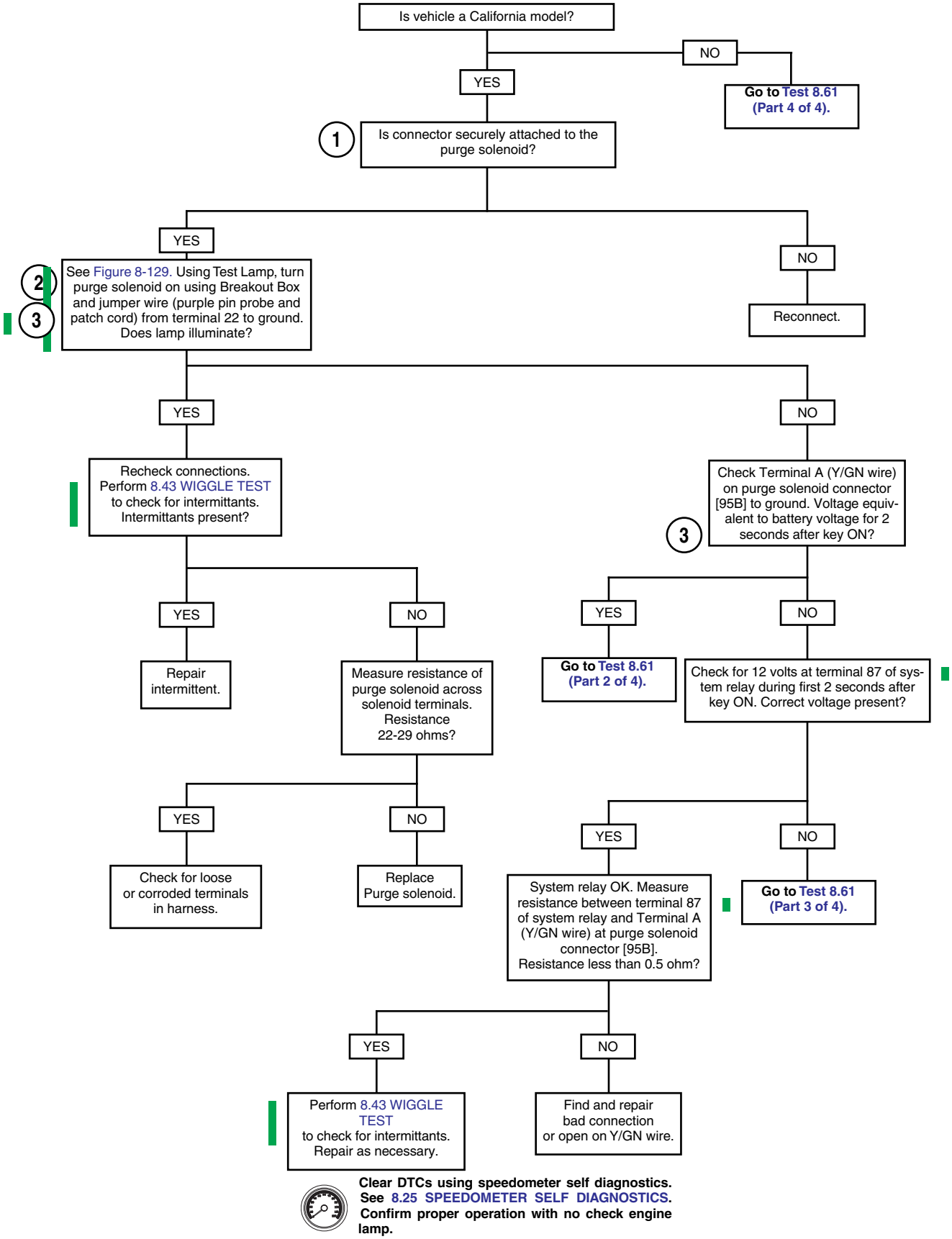
Figure 8-129. Purge Solenoid Circuit

Table 8-86. Wire Harness Connectors in Figure 8-129.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[95]	Purge Solenoid	2-place Packard	Below seat

Test 8.61 (Part 1 of 4)

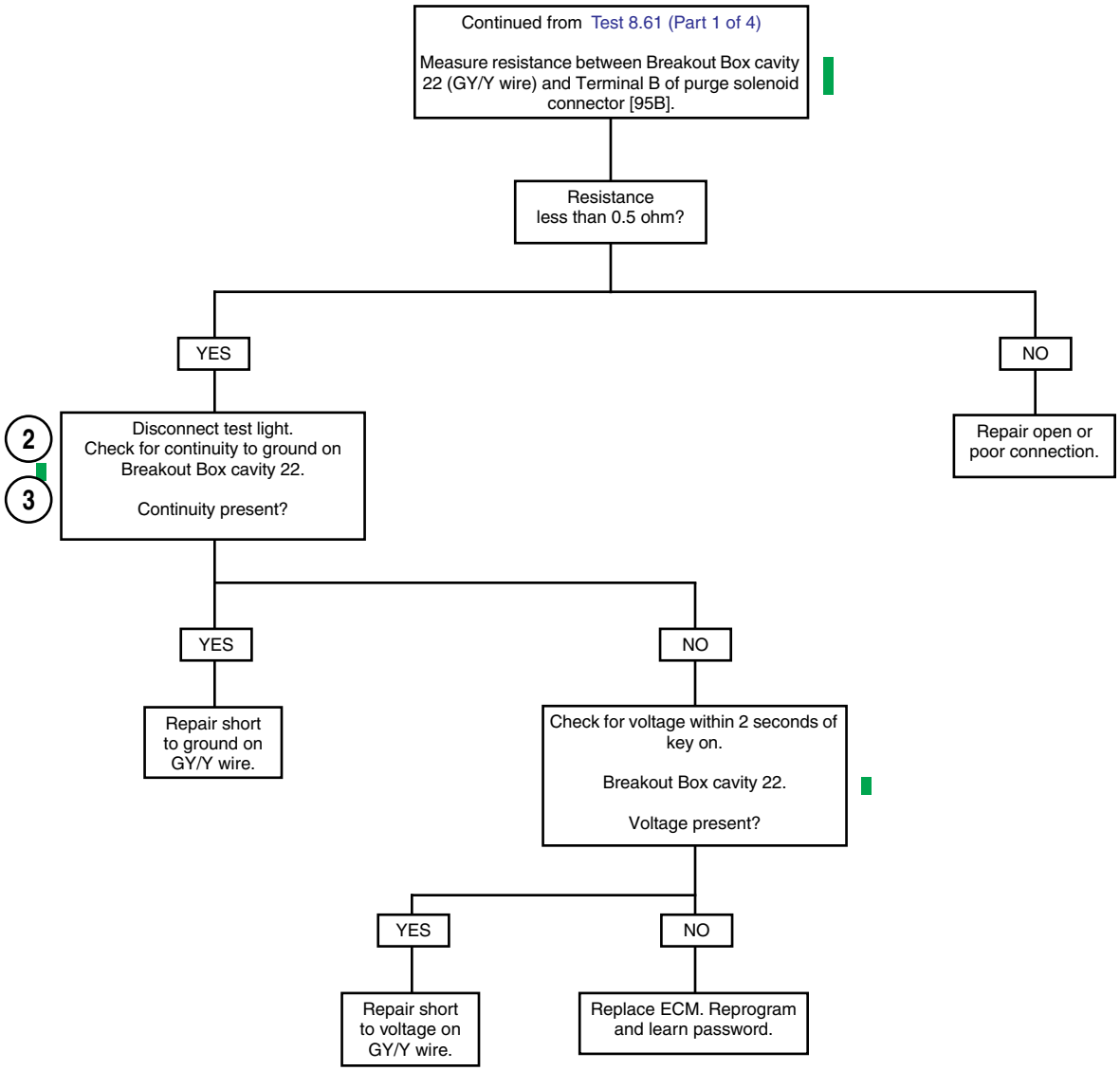
PURGE SOLENOID P0444, P0445



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.61 (Part 2 of 4)

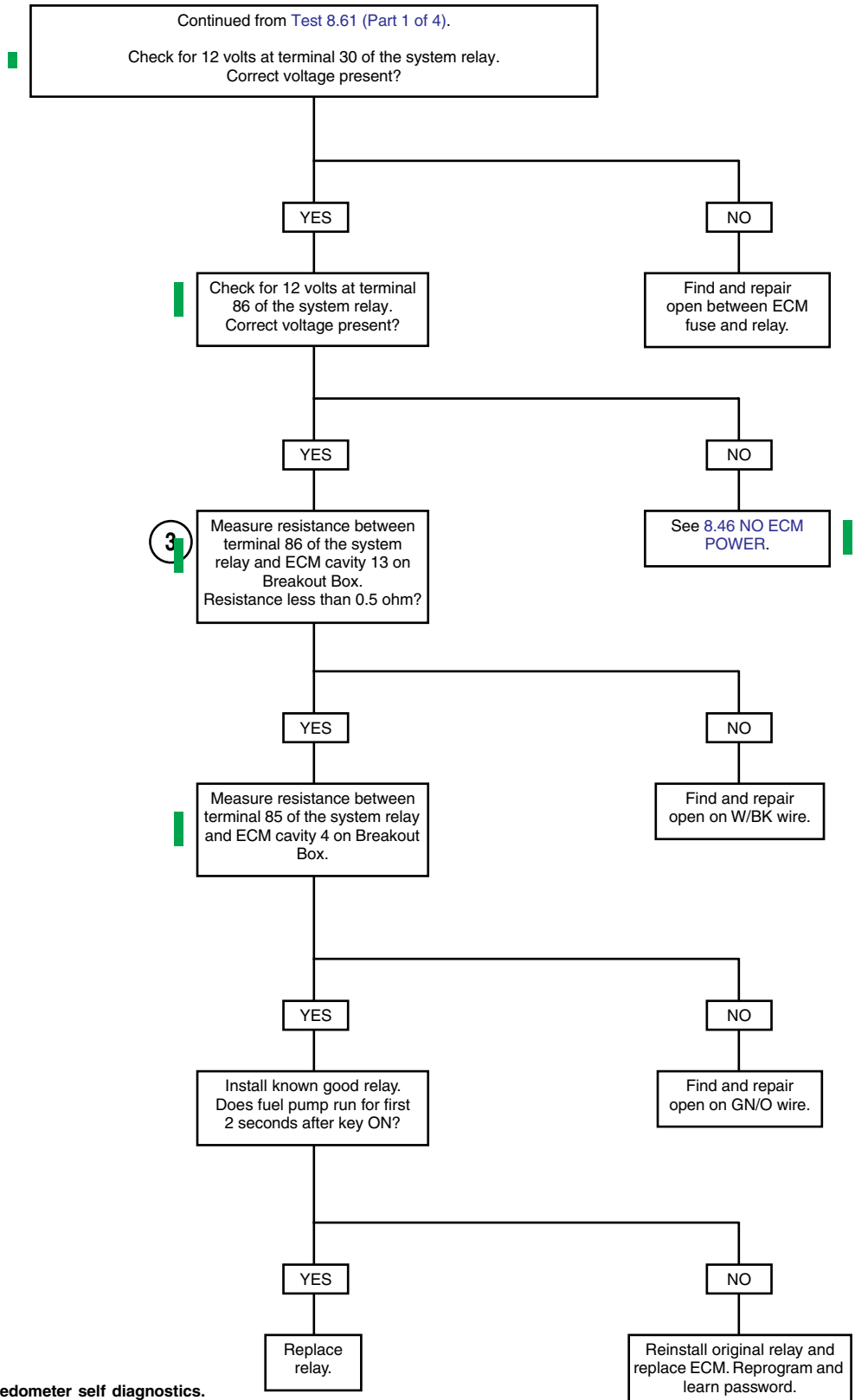
PURGE SOLENOID P0444, P0445



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.61 (Part 3 of 4)

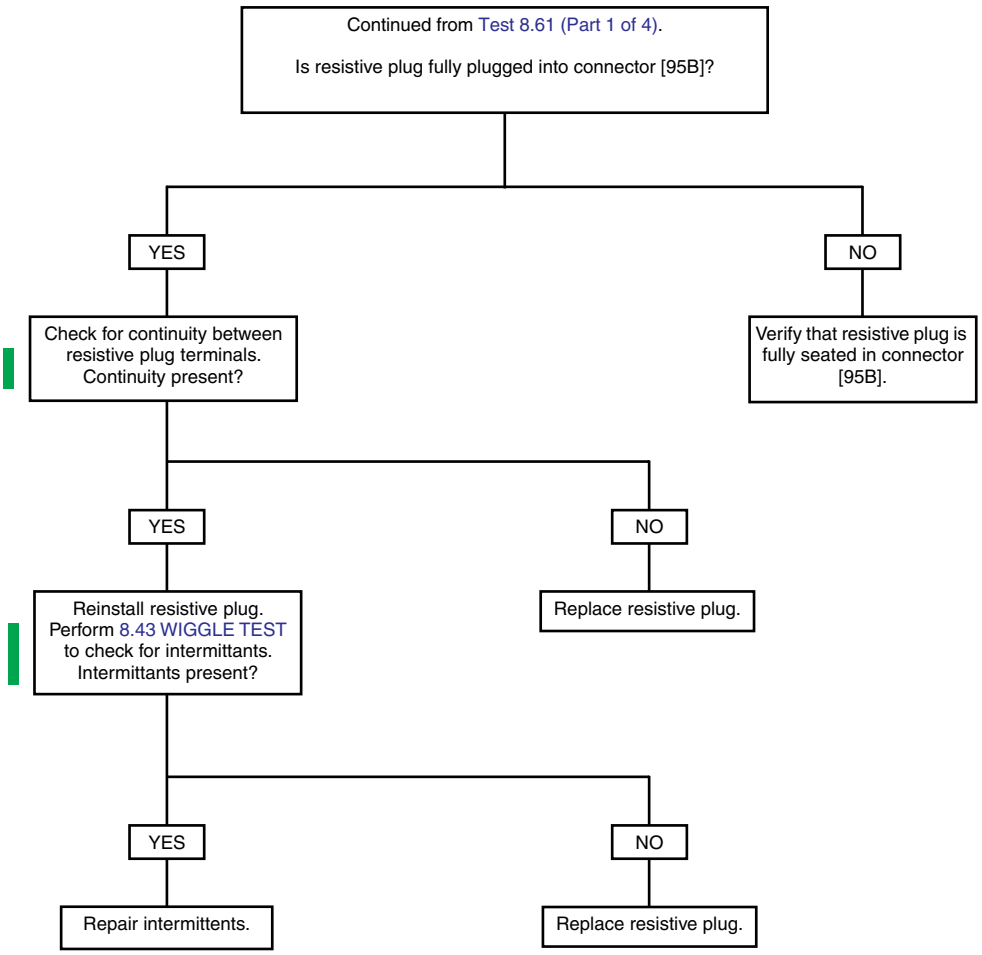
PURGE SOLENOID P0444, P0445



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.61 (Part 4 of 4)

PURGE SOLENOID P0444, P0445



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC P0501, P0502 8.62

GENERAL

Vehicle Speed Sensor

See Figure 8-130. The vehicle speed sensor is powered and monitored by the ECM. The ECM processes the vehicle speed signal and transmits this signal to the TSSM and Speedometer through serial data.

NOTE

Vehicle speed is input to the idle air control system. Therefore problems with the vehicle speed signal can lead to improper operation of the idle air control.

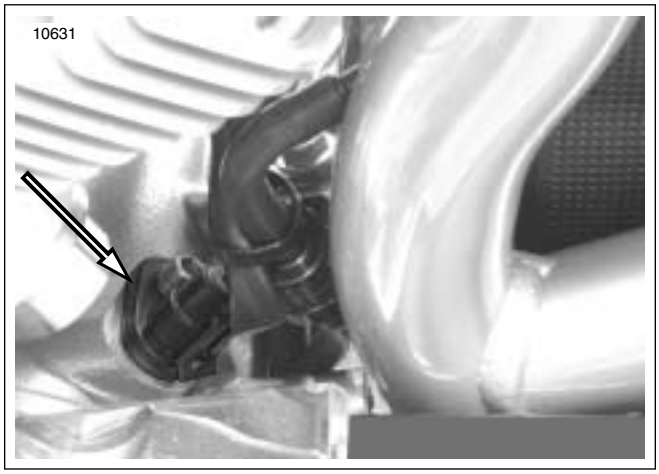


Figure 8-130. Vehicle Speed Sensor

Table 8-87. Code Description

DTC	DESCRIPTION
P0501	VSS sensor low
P0502	VSS sensor high/open

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. The Speedometer has a built-in diagnostic mode. See 8.25 SPEEDOMETER SELF DIAGNOSTICS.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probe and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 8.42 BREAKOUT BOX: ECM.

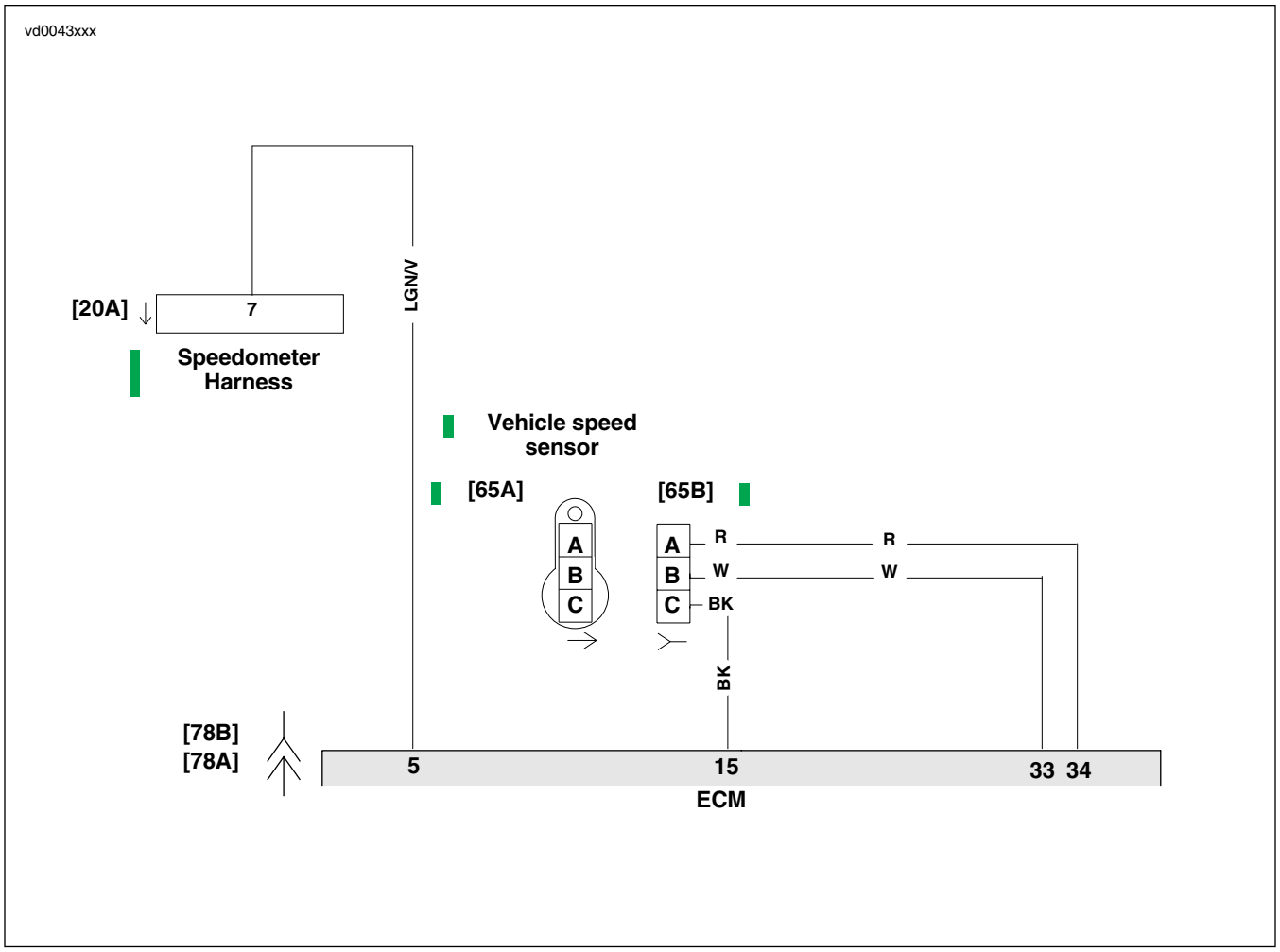


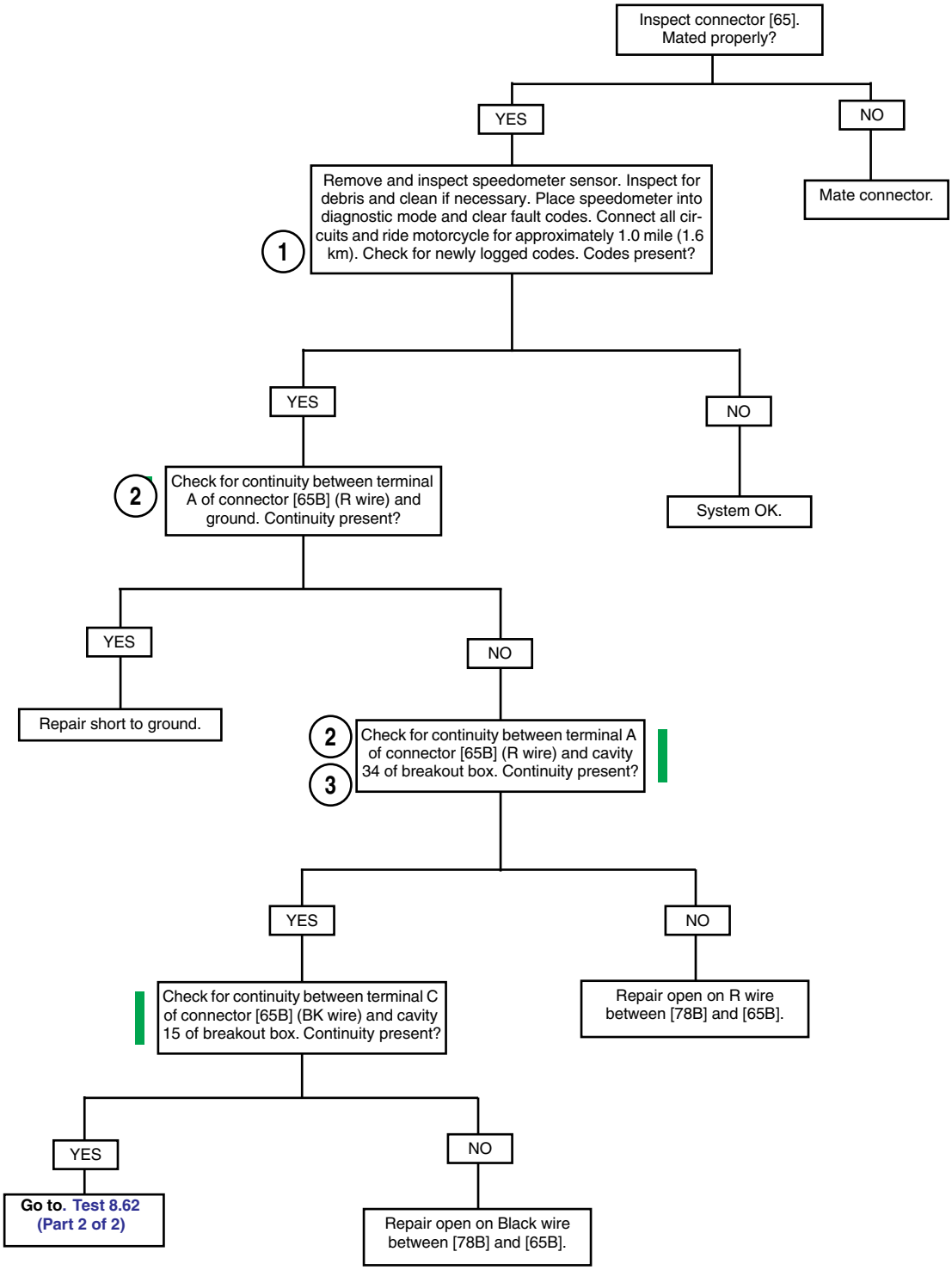
Figure 8-131. Vehicle Speed Sensor Circuit

Table 8-88. Wire Harness Connectors in Figure 8-131.

NO.	DESCRIPTION	TYPE	LOCATION
[39]	Speedometer	12-place Mini-Deutsch	Under handlebar cover
[65]	Vehicle speed sensor	3-place Packard	At vehicle speed sensor
[78]	ECM	36-place Packard	Under left side cover

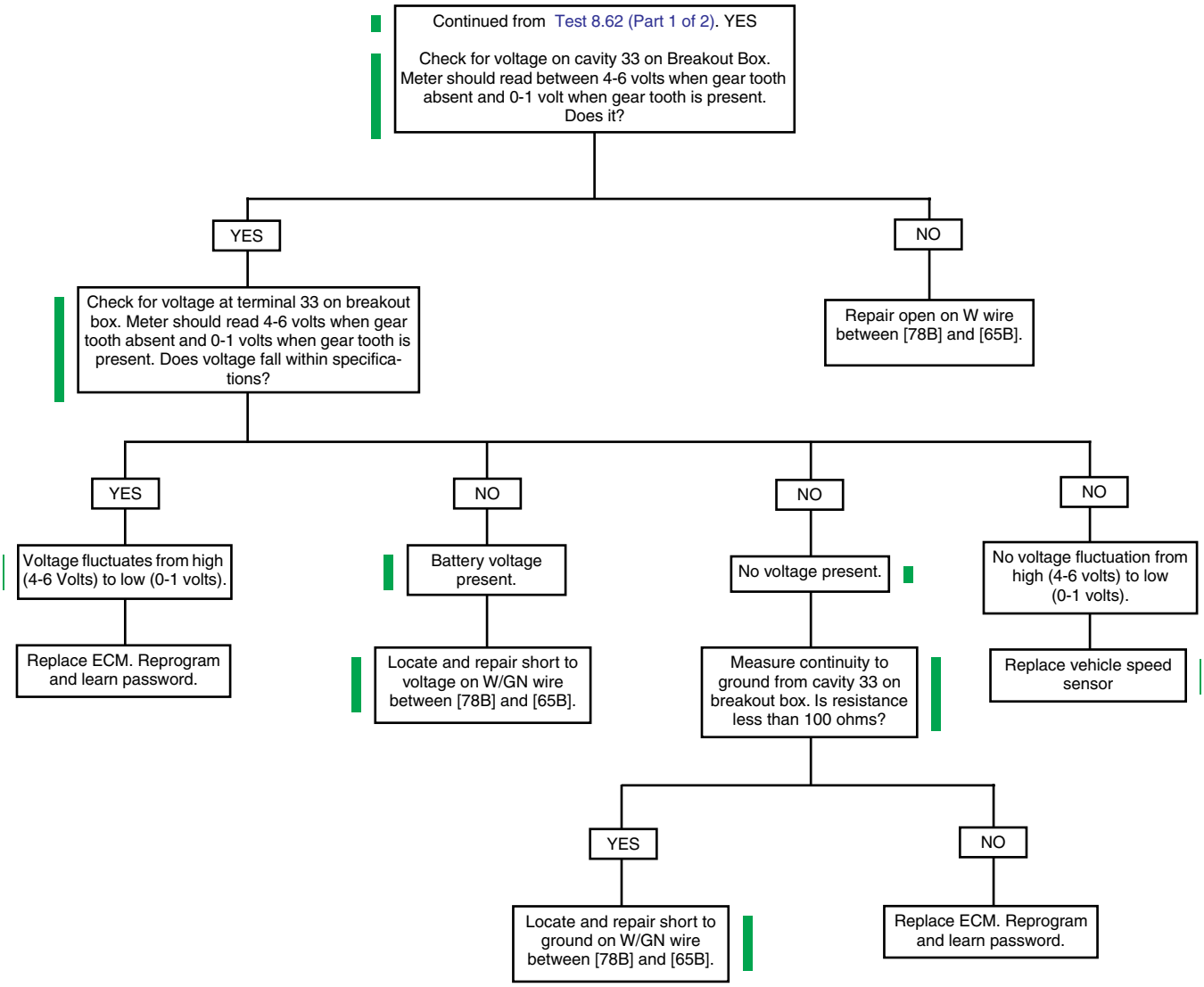
Test 8.62 (Part 1 of 2)

VEHICLE SPEED SENSOR: DTC P0501, P0502



Test 8.62 (Part 2 of 2)

VEHICLE SPEED SENSOR: DTC P0501, P0502



DTC P0562, P0563 8.63

GENERAL

Battery Voltage

See Figure 8-132. Battery voltage is monitored by the ECM (terminal 13). If the battery voltage fails to meet normal operating parameters, a code is set.

- Code P0562 is displayed when battery positive voltage is less than 11.0 volts at 2000 RPM for longer than 5 seconds.
- Code P0563 is displayed when battery positive voltage is greater than 16.0 volts for more than 4 seconds.

NOTES

- *Warm idle speed will be automatically increased if battery voltage is low at idle.*
- *Speedometer or TSSM problems may also set a battery voltage diagnostic code P0563.*

Table 8-89. Code Description

DTC	DESCRIPTION
P0562	Battery voltage low
P0563	Battery voltage high

DIAGNOSTICS

Diagnostic Tips

- Low voltage generally indicates a loose wire, corroded connections, battery and/or a charging system problem.
- A high voltage condition may be caused by a faulty voltage regulator.

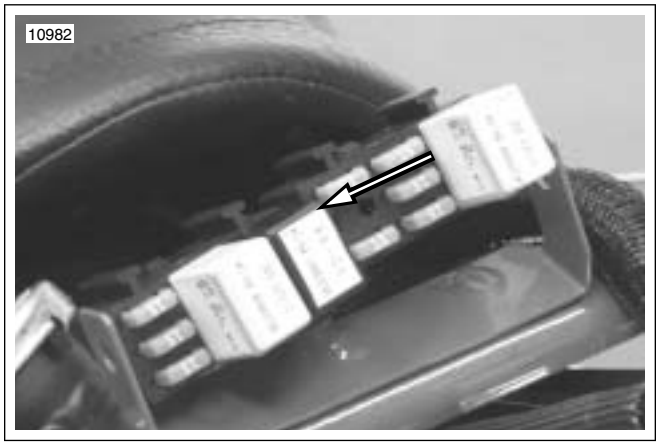


Figure 8-132. System Relay

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. Was battery allowed to discharge? Was battery drawn down by a starting problem?
   a. **Yes.** Charge battery.
   b. **No.** See charging system troubleshooting.
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 8.42 BREAKOUT BOX: ECM.
3. This checks for voltage drops in the ignition module circuit.
   a. Place (+) probe to battery positive terminal.
   b. Place (-) probe to W/BK terminal on Breakout Box.
4. Connect BREAKOUT BOX (Part No. HD-42682) using ADAPTERS (HD-45325).
5. Problem is most likely the ground connection at the frame.

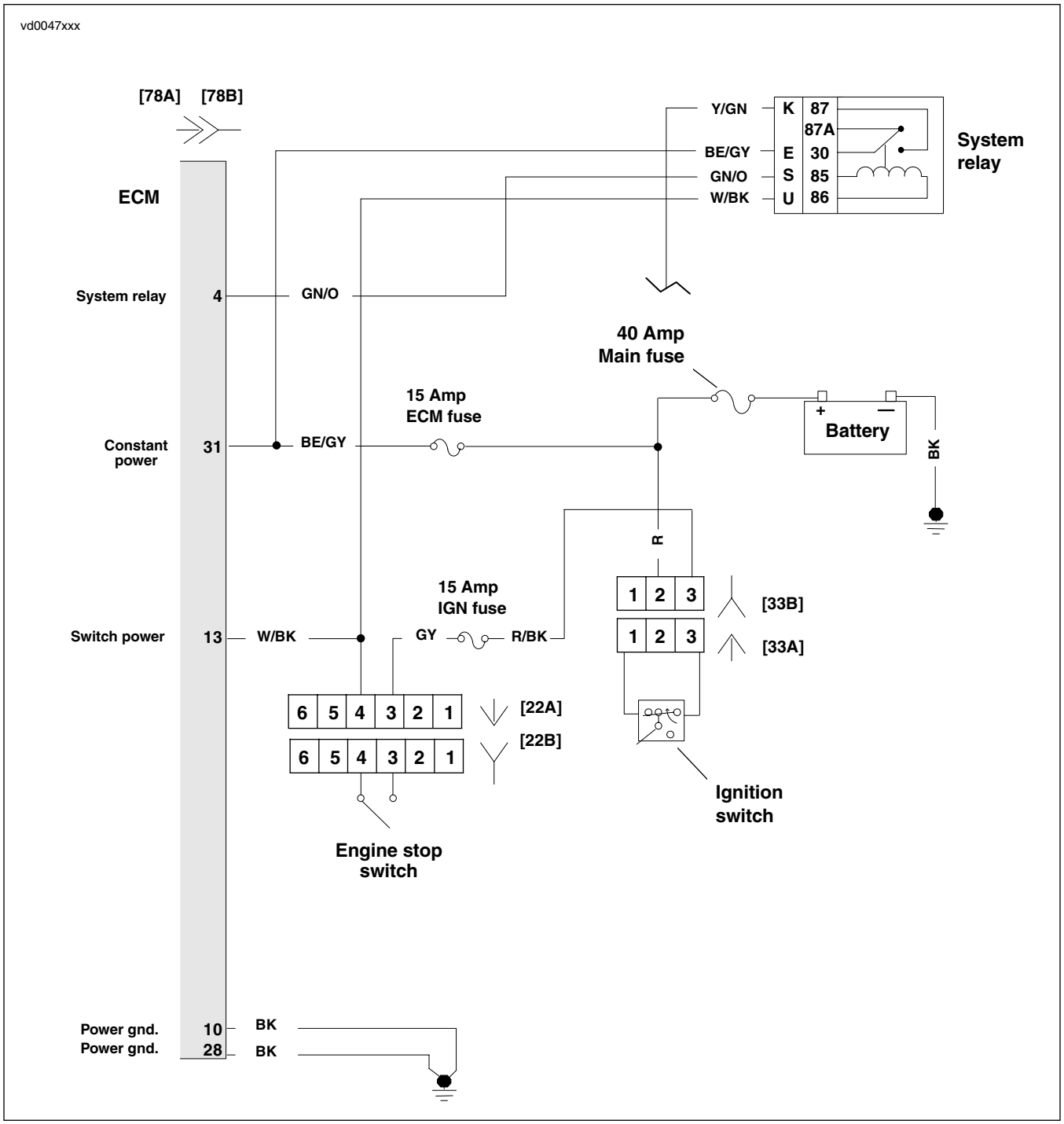


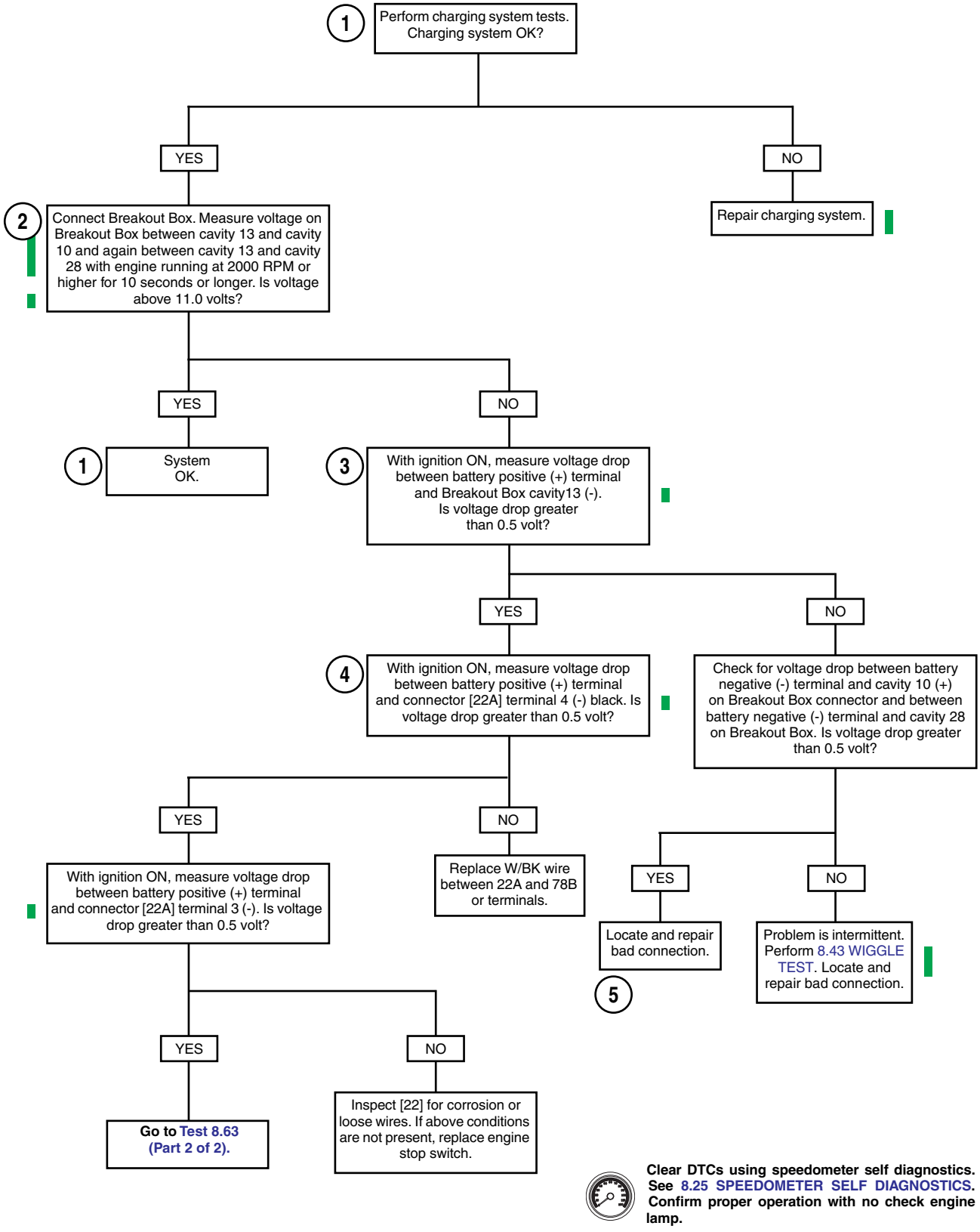
Figure 8-133. Battery Voltage Circuit Diagram

Table 8-90. Wire Harness Connectors in Figure 8-133.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar switch (black)	6-place Deutsch	Under left side cover
[78]	ECM	36-place Packard	Under left side cover

Test 8.63 (Part 1 of 2)

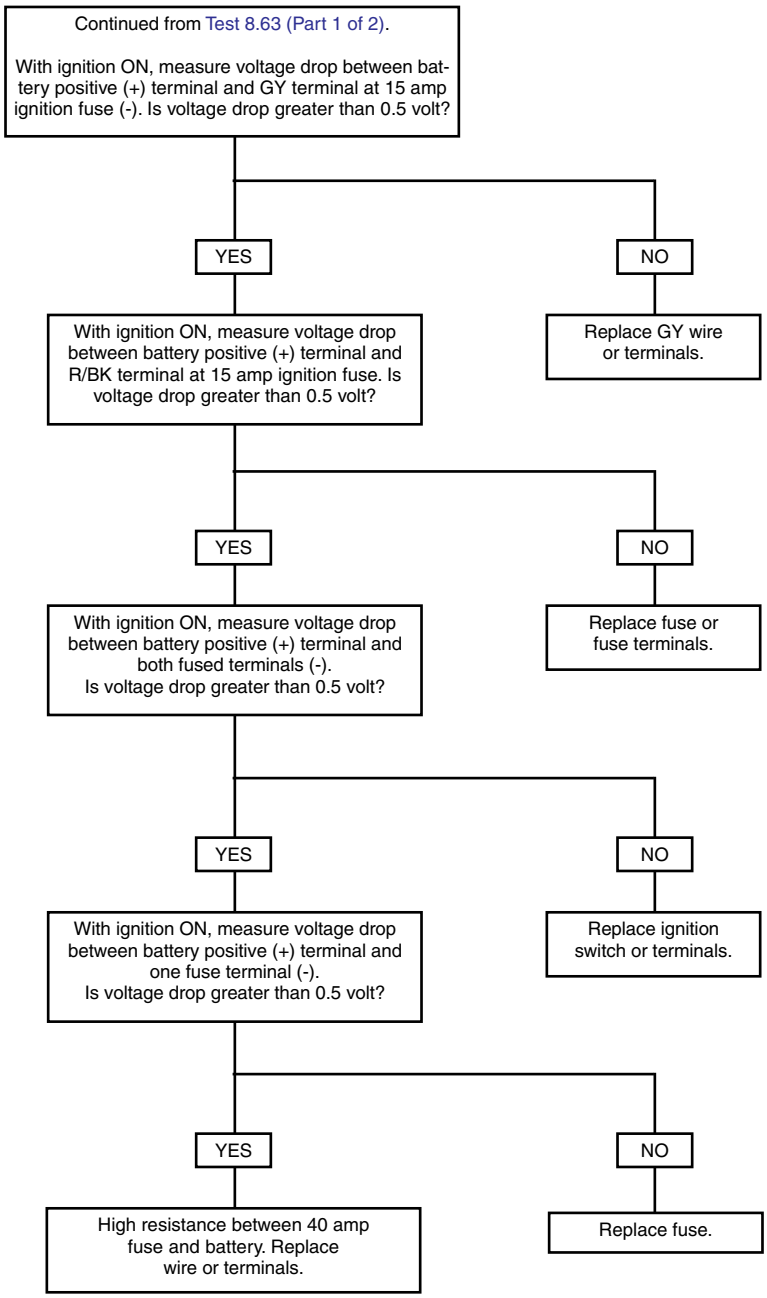
BATTERY VOLTAGE: DTC P0562, P0563



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.63 (Part 2 of 2)

BATTERY VOLTAGE: DTC P0562, P0563



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC P0603, P0605 8.64

GENERAL

ECM Failure

Refer to Table 8-91. The codes listed indicate a failure which requires replacement of the ECM. See the appropriate VRSC Service Manual for replacement information.

NOTE

After replacing ECM; reprogram, perform password learning procedure and clear codes. ECM must be reprogrammed using a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750). See you dealer. Password learn procedure must also be performed. See PASSWORD LEARN.

Table 8-91. Code Description

DTC	DESCRIPTION
P0603	ECM EEPROM error
P0605	ECM flash error

DIAGNOSTICS

These codes are set under two conditions.

- If DTC P0603 or P0605 occur during normal operation, replace ECM. reprogram and learn password.
- If DTC P0603 or P0605 occur during or after reprogramming, perform the following:

DTC P0603 Test

1. Clear codes using speedometer self diagnostics.
2. Power down the vehicle. Wait 10 seconds.
3. Turn ignition ON.
4. Replace ECM if codes appear again.

DTC P0605 Test

1. Clear codes using speedometer self diagnostics.
2. Power down the vehicle.
3. Attempt to reprogram ECM using correct calibration.
4. Restart vehicle. If code appears again, replace ECM.

DTC P1009, P1010 8.65

GENERAL

Password Problem

The ECM and TSSM exchange passwords during operation. An incorrect password or missing password will set a diagnostic code.

NOTE

If the TSSM is not connected to the wiring harness, the vehicle will not start.

Table 8-92. Code Description

DTC	DESCRIPTION
P1009	Incorrect password
P1010	Missing password

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

1. DTC P1009 may be set if a recent ECM or TSSM replacement did not follow the correct password assignment procedure. See 8.39 TSSM MAINTENANCE for details.
2. See the VRSC Service Manual for TSSM replacement. See TSSM section of this document for the password learning routine (Scanalyzer menu refers to this function as “module replacement”).
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probes and patch cord.
4. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 8.42 BREAKOUT BOX: ECM.

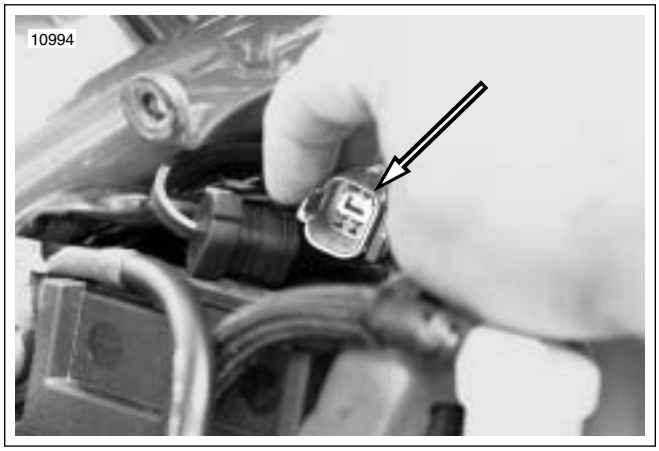


Figure 8-134. Data Connector [91A]

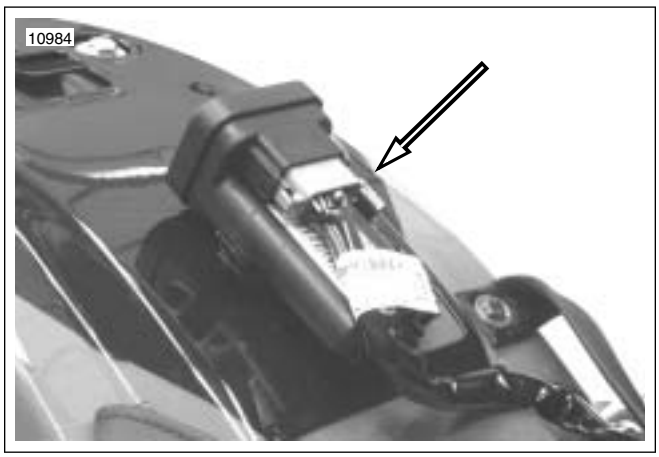


Figure 8-135. TSSM (typical)

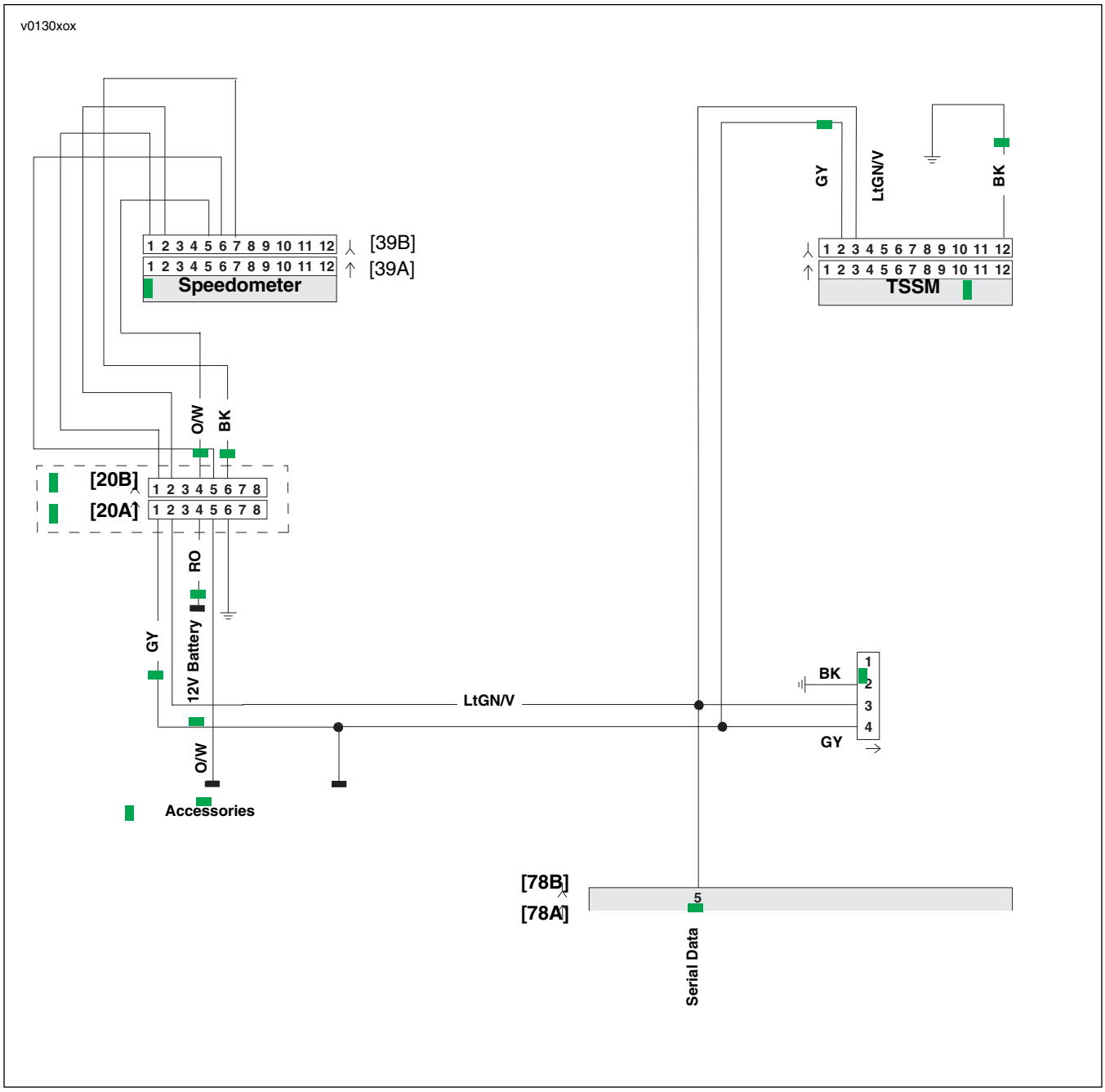


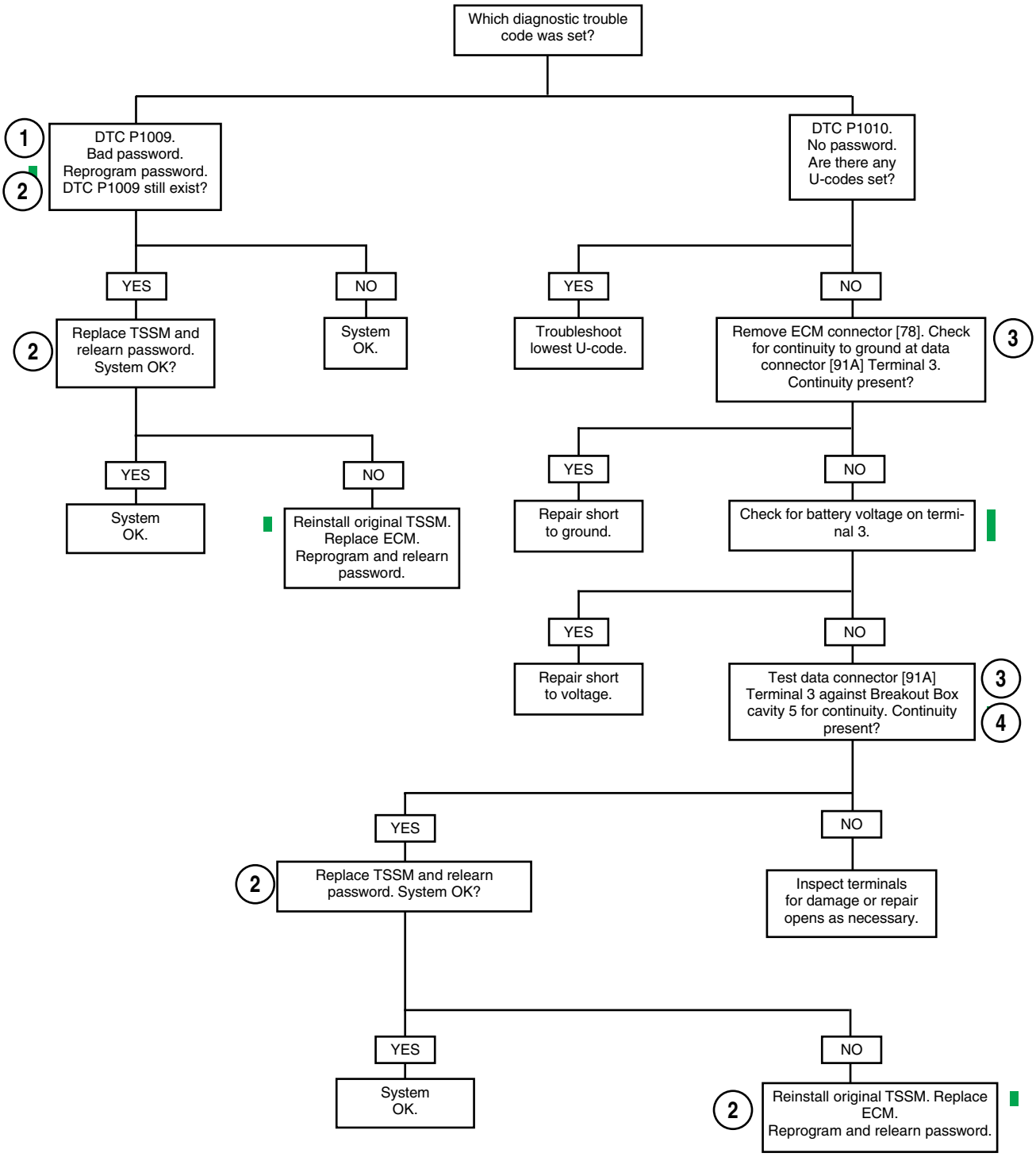
Figure 8-136. Serial Data Circuit

Table 8-93. Wire Harness Connectors in Figure 8-136.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Test 8.65

PASSWORD PROBLEM: DTC P1009, P1010



DTC P1351, P1352, P1354, P1355 8.66

GENERAL

Ignition Coil

Ignition coil codes will set if an ignition coil primary voltage is out of range. This could occur if there is an open coil or loss of power to a coil. If front and rear codes are set simultaneously, it is likely a coil power failure or a coil failure.

The coils receive power from the system relay at the same time that the fuel pump and injectors are activated. The system relay is active for the first 2 seconds after the ignition is turned ON and then shuts off until RPM is detected from the CKP sensor, at which time it is reactivated. The ECM is responsible for turning on the system relay by providing the ground to activate the relay, which in turn powers the coil.

Table 8-94. Code Description

DTC	DESCRIPTION
P1351	Front ignition coil open/low
P1352	Front ignition coil high/shorted
P1354	Rear ignition coil open/low
P1355	Rear ignition coil high/shorted

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow charts.

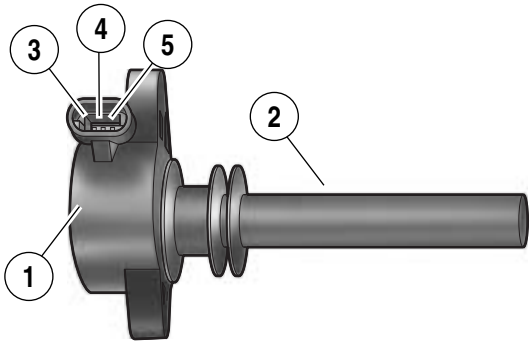
1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probes and patch cord.

CAUTION

Gently connect test lamp to connector [83B]. Forcefully inserting test lamp will result in ignition connector terminal damage.

2. See Figure 8-137. Plug IGNITION COIL CIRCUIT TEST ADAPTER (Part No. HD-44687) and FUEL INJECTOR TEST LAMP (Part No. HD-34730-2C) into Breakout Box. Note that cranking the engine with test lamp in place of the ignition coil can sometimes cause a DTC P1351, P1352, P1354 or P1355. This condition is normal and does not by itself indicate a malfunction.
3. Connect BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM. See 8.42 BREAKOUT BOX: ECM.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), grey socket probes and patch cords.

Figure 8-137. Ignition Coil Circuit Test



1. **Plug top coil**
2. **Boot**
3. **Feedback signal terminal (ion sense)**
4. **Power**
5. **Coil driver**

Figure 8-138. Plug Top Coil

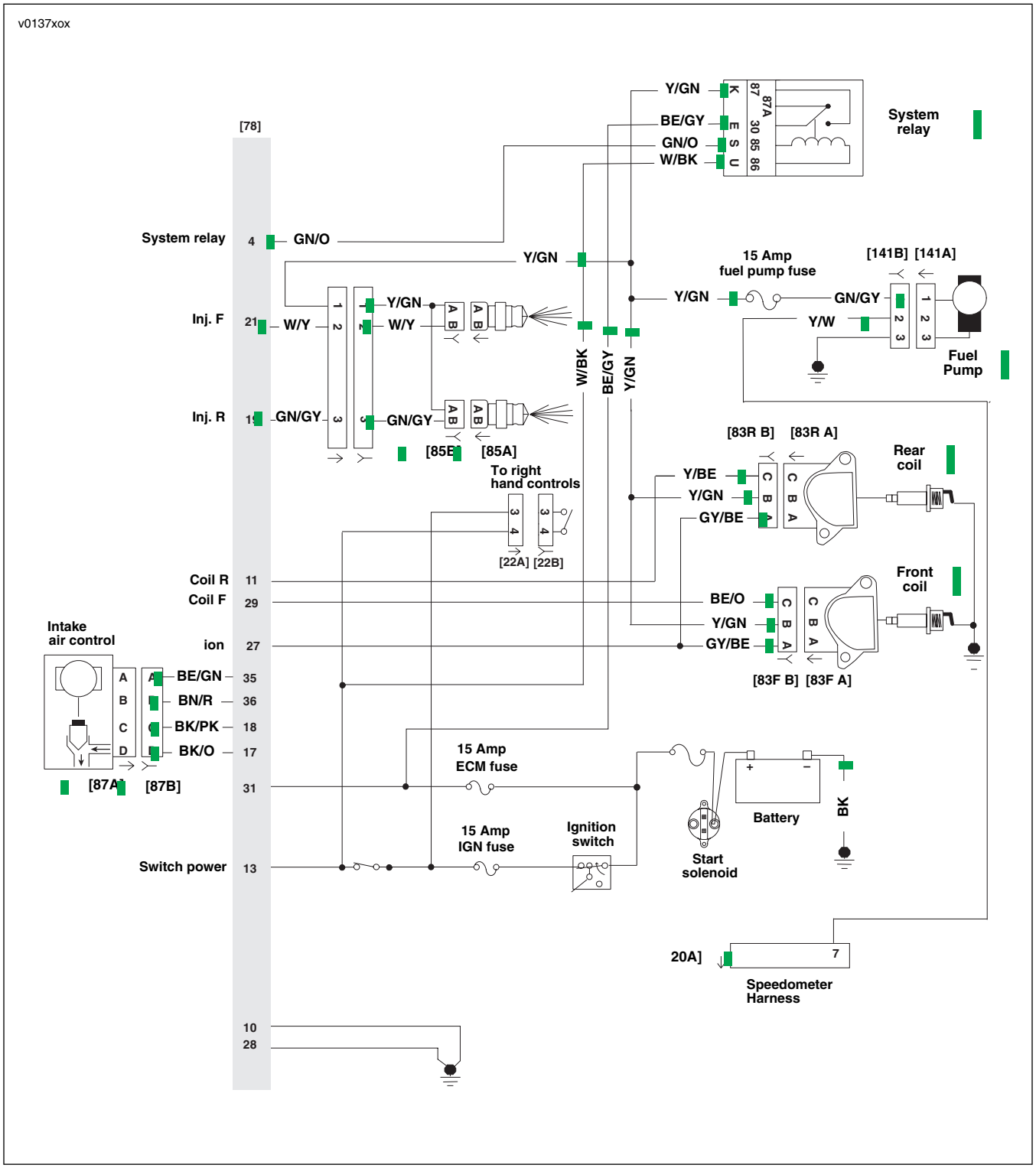


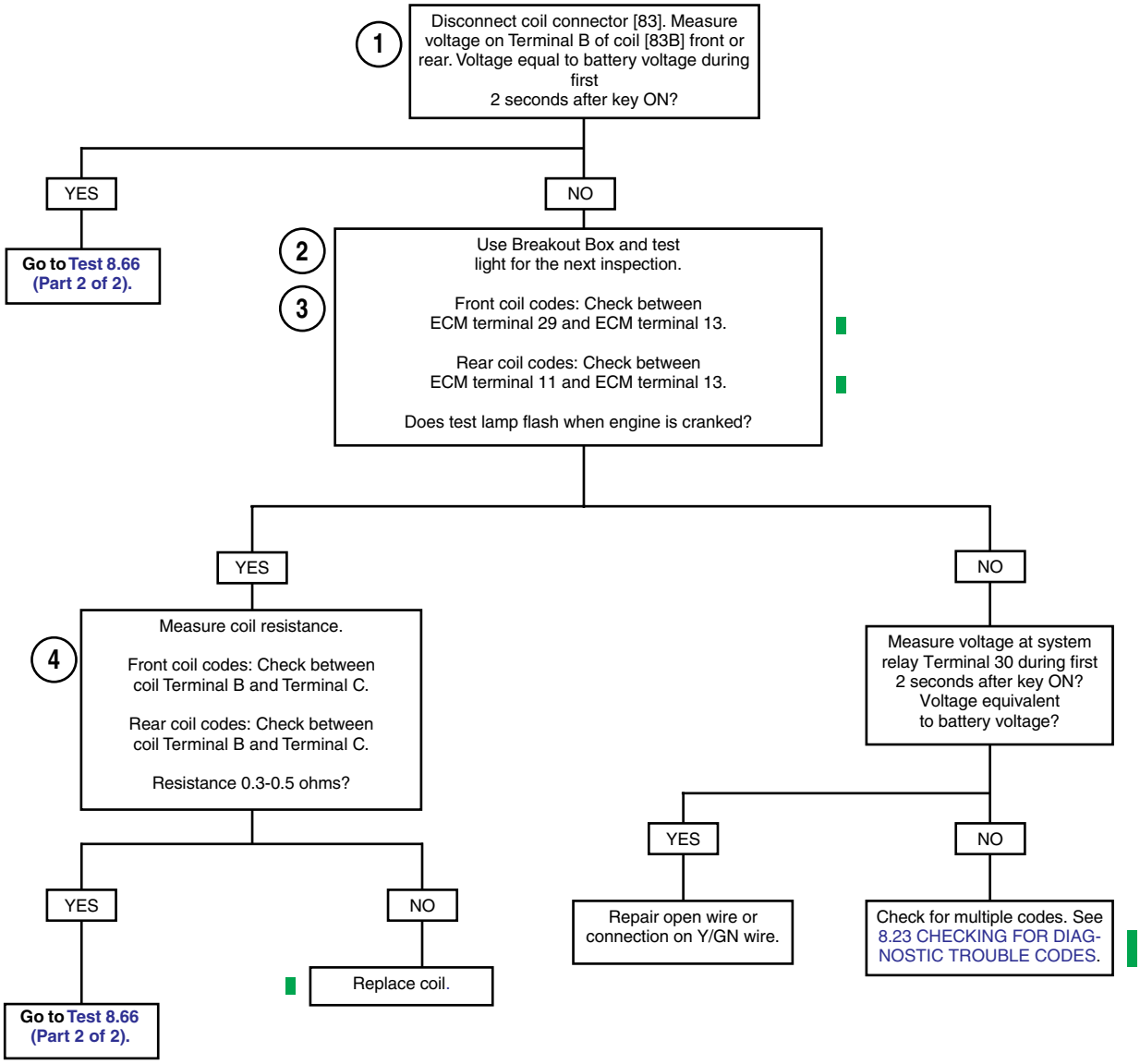
Figure 8-139. Ignition Coil Circuit

Table 8-95. Wire Harness Connectors in Figure 8-139.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	Under left side cover
[83F]	Front plug top coil	3-place Packard	On top of front cam cover
[83R]	Rear plug top coil	3-place Packard	On top of rear cam cover

Test 8.66 (Part 1 of 2)

IGNITION COIL: DTC P1351, P1352, P1354, P1355



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

Test 8.66 (Part 2 of 2)

IGNITION COIL: DTC P1351, P1352, P1354, P1355

Continued from Test 8.66 (Part 1 of 2).

Using Breakout Box, measure resistance between ECM and coil terminals as follows.

DTC	COIL TERMINAL	BREAK-OUT BOX TERMINAL
P1351/ P1352	C (BE/O wire)	29
P1353/ P1354	C (Y/BE wire)	11

1
3

Resistance less than 0.5 ohms?

YES

Perform 8.43 WIGGLE TEST to check for intermittants. Intermittants present?

YES

Repair intermittent.

NO

Check for continuity to ground.

Front coil codes: Check Breakout Box cavity 29.

Rear coil codes: Check Breakout Box cavity 11.

Continuity present?

YES

Repair short to ground.

NO

Check for voltage.

Front coil codes: Check Breakout Box cavity 29.

Rear coil codes: Check Breakout Box cavity 11.

Voltage present?

YES

Repair short to voltage.

NO

Replace ECM. Reprogram and learn password.

NO

Repair open wire or connection.

Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC U1064, U1255 AT ECM 8.67

GENERAL

Loss of TSSM Serial Data

The serial data connector provides a means for the ECM, Speedometer and TSSM to communicate their current status. When all operating parameters on the serial data link are within specifications, a state of health message is sent between the components. A DTC U1064 indicates that the TSSM is not receiving this state of health message.

Table 8-96. Code Description

DTC	DESCRIPTION
U1064	Loss of TSSM serial data (state of health)
U1255	Missing message at TSSM

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 8.67 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 8.42 BREAKOUT BOX: ECM.
2. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness and TSSM. See 8.26 BREAKOUT BOX: TSSM.

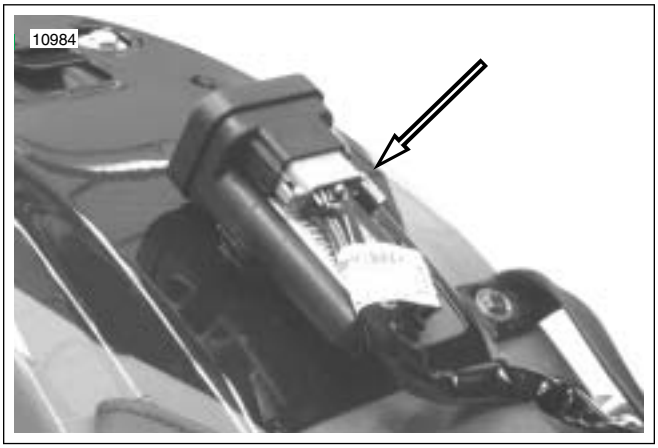
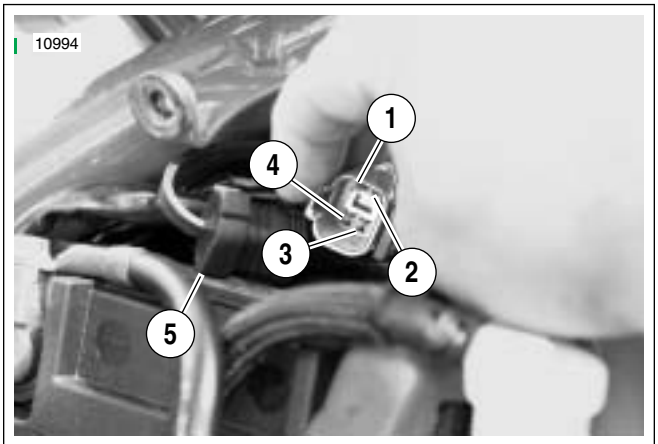


Figure 8-140. TSSM (typical)



1. **Terminal 1: flash terminal (Lt. GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**
5. **Protective cap**

Figure 8-141. Data Connector Terminals [91A]

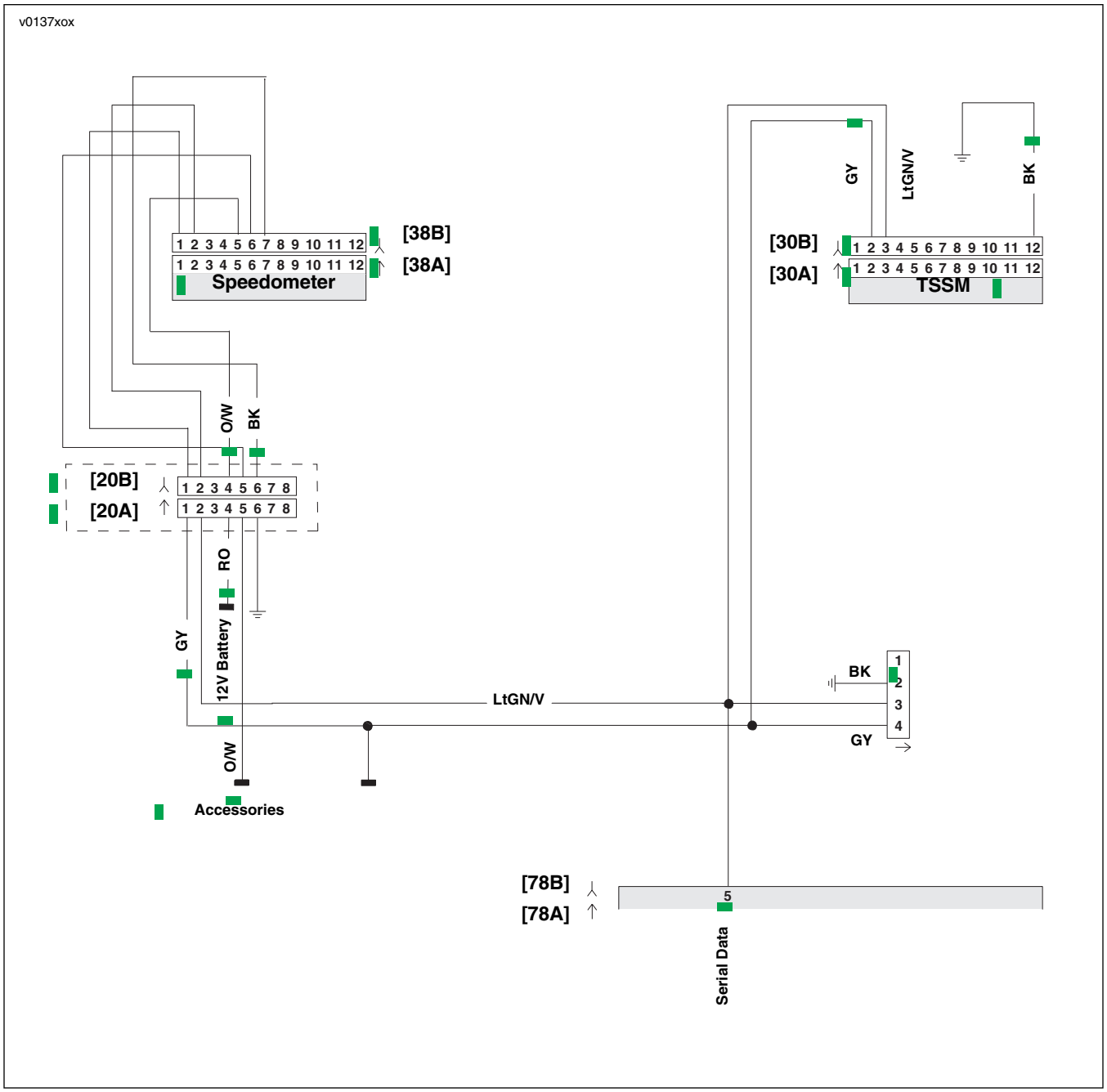


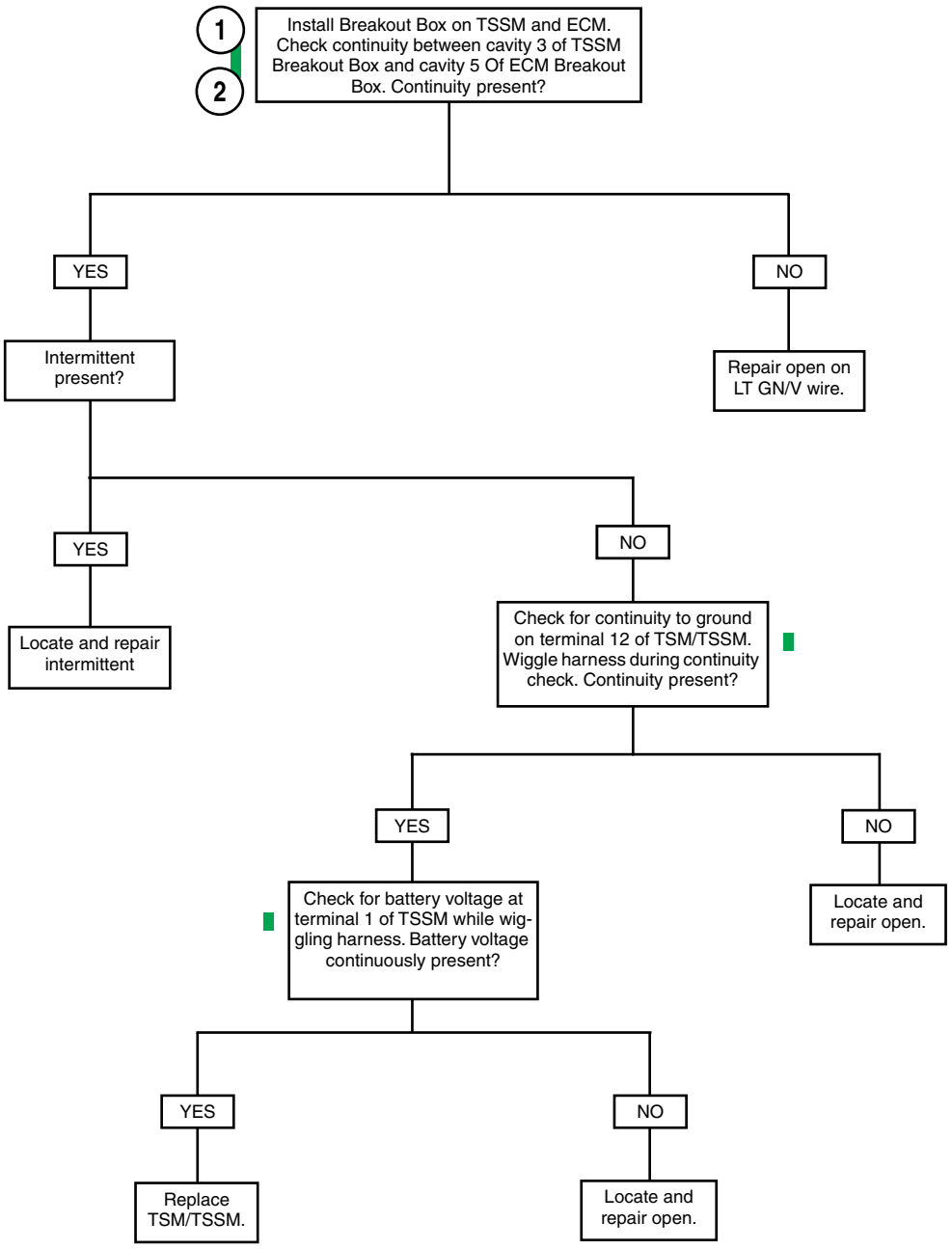
Figure 8-142. TSSM/ECM Circuit

Table 8-97. Wire Harness Connectors in Figure 8-142.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Test 8.67

LOSS OF TSSM SERIAL DATA: DTC U1064, U1255



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

DTC U1097, U1255 AT ECM 8.68

GENERAL

Loss of Speedometer Serial Data

The serial data connector provides a means for the Speedometer, ECM and TSSM to communicate their current status. When all operating parameters on the serial data link are within specifications, a state of health message is sent between the components. A DTC U1097 indicates that the IM is not capable of sending this state of health message.

Table 8-98. Code Description

DTC	DESCRIPTION
U1097	Loss of all Speedometer serial data (state of health)
U1255	Missing message at IM

DIAGNOSTICS

NOTE

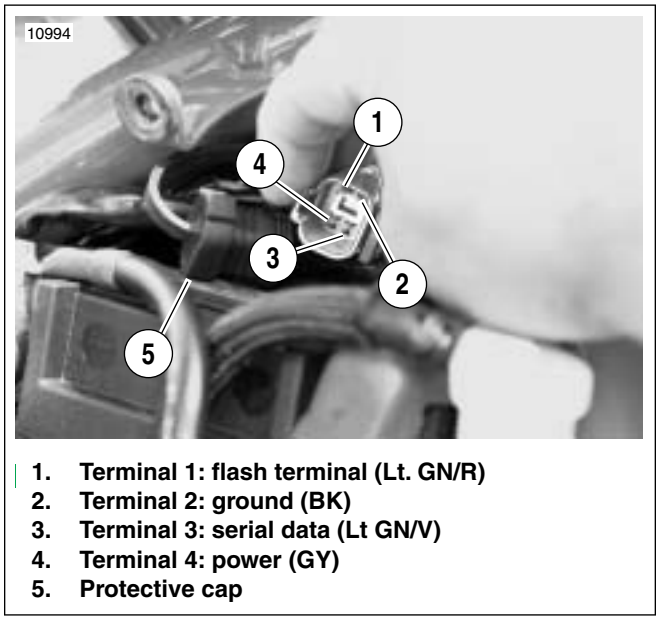
If code is historic and not current, wiggle wire harness while performing voltage and continuity tests to identify intermittents.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test flow chart.

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness connector [78B] Leave ECM [78A] disconnected. See 8.42 BREAKOUT BOX: ECM.
2. Connect Breakout Box (Part No. HD-42682) (black) to wire harness connector [39B] using SPEEDOMETER HARNESS ADAPTER (Part No. HD-46601). Leave speedometer [39A] disconnected. See 8.11 BREAKOUT BOX: SPEEDOMETER.

Figure 8-143. ECM Connector



1. **Terminal 1: flash terminal (Lt. GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**
5. **Protective cap**

Figure 8-144. Data Connector Terminals

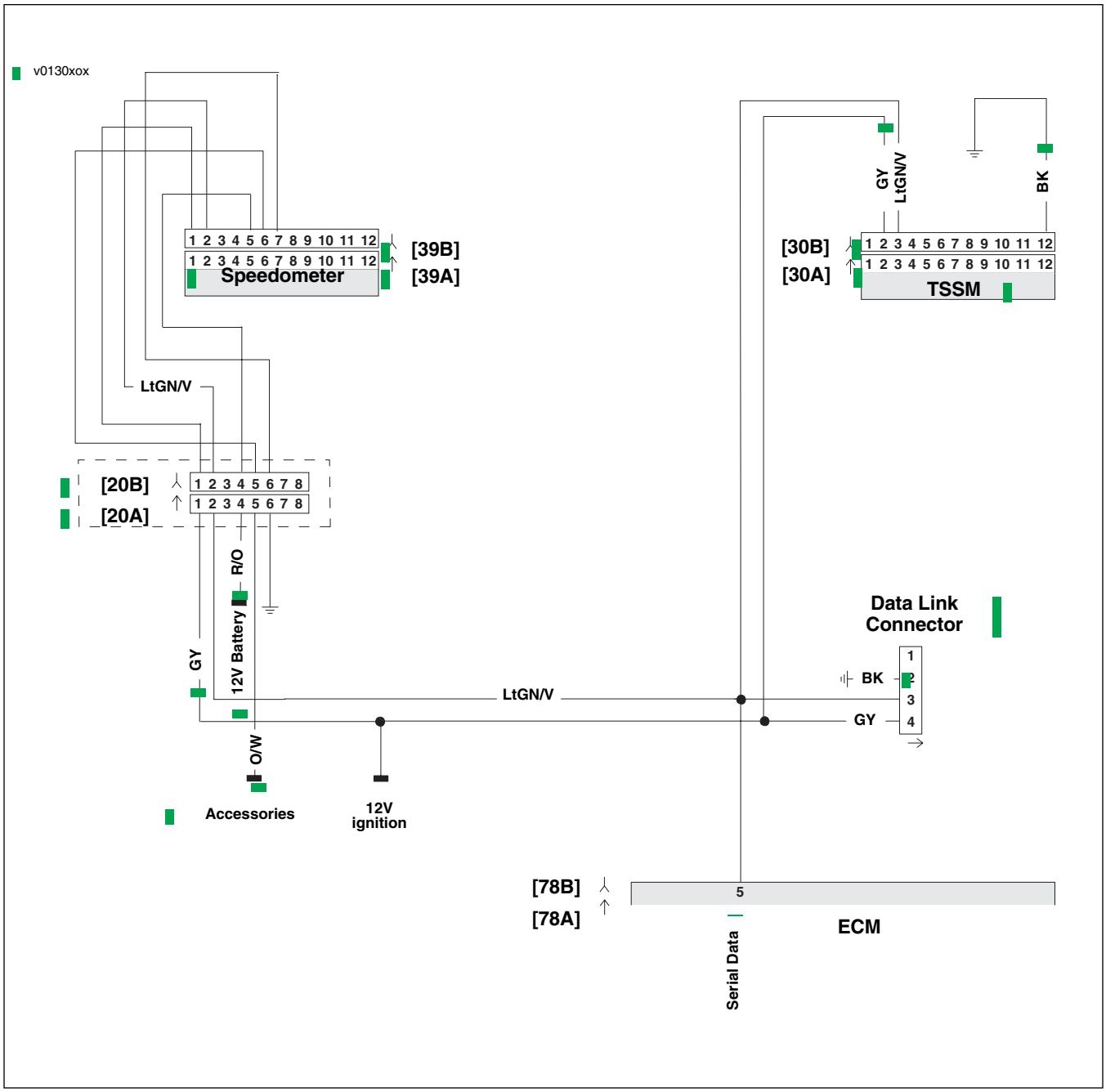


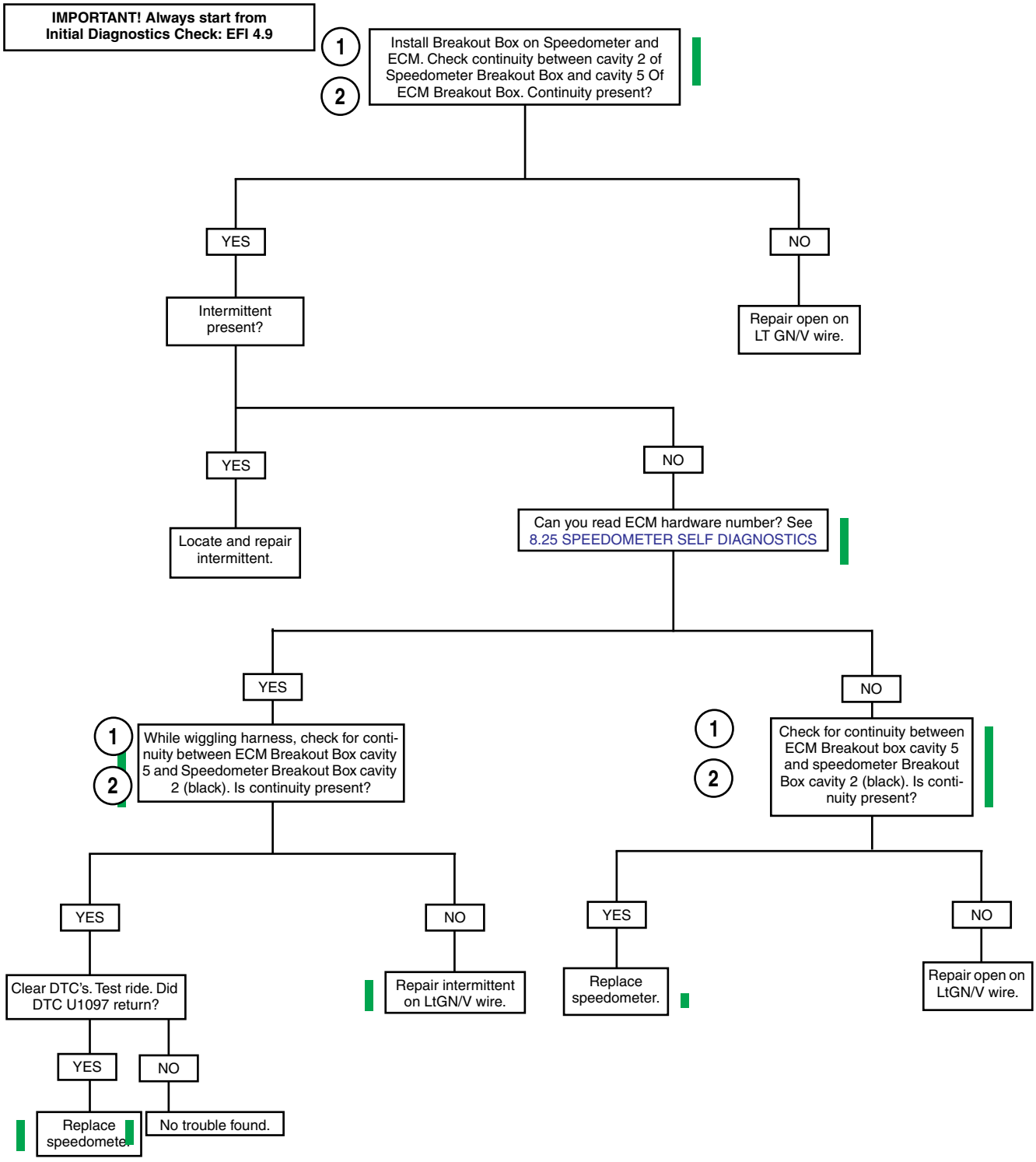
Figure 8-145. Serial Data Circuit

Table 8-99. Wire Harness Connectors in Figure 8-145.

NO.	DESCRIPTION	TYPE	LOCATION
[20]	Gauges	8-place Deutsch	Under air box cover
[30]	TSSM	12-place Deutsch	Under passenger seat
[39]	Speedometer	12-place Packard	Back of speedometer
[78]	Electronic control module (ECM): EFI models	36-place Packard	Under left side cover
[91]	Data link connector	4-place Deutsch	Under left side cover

Test 8.68

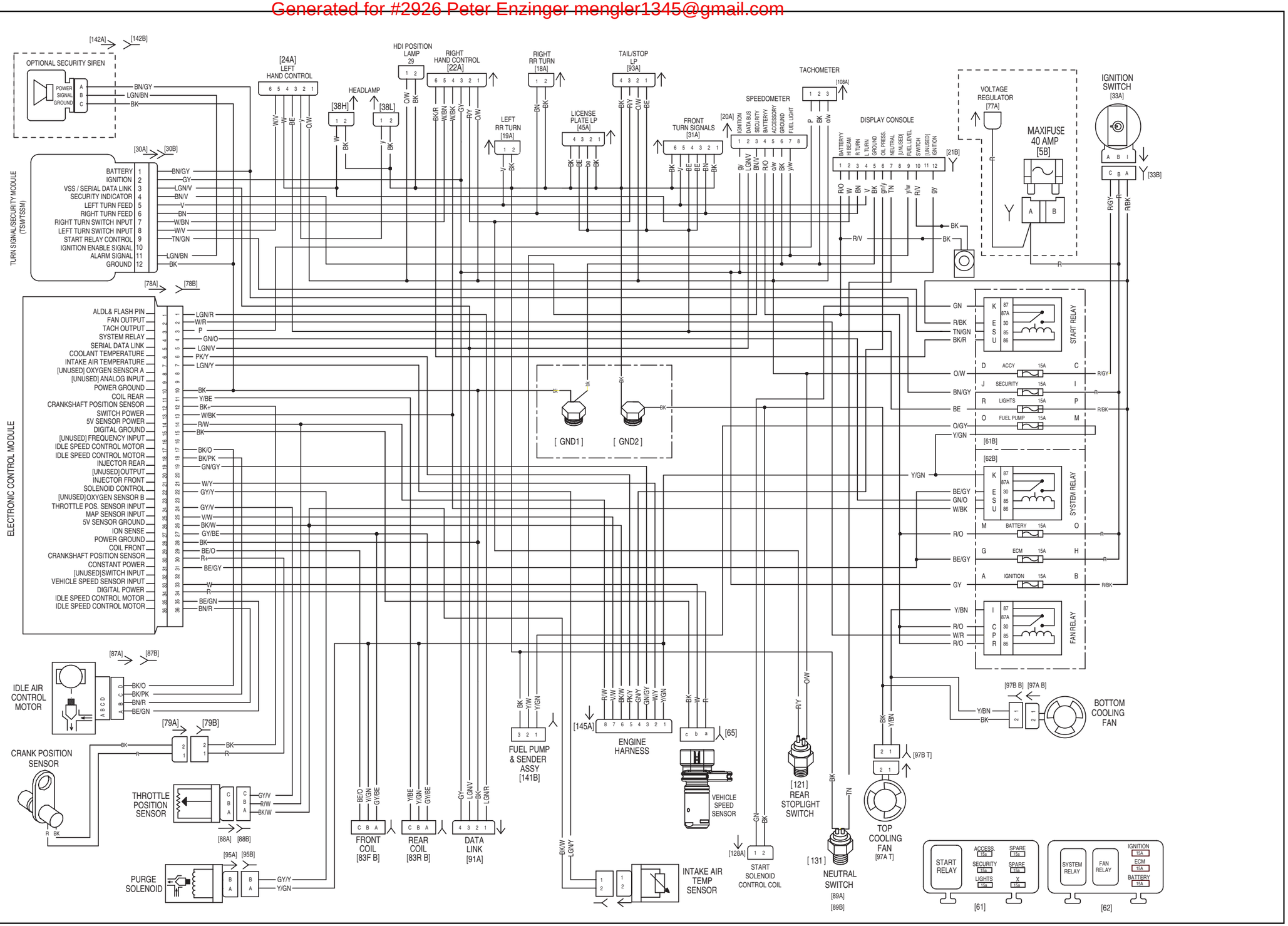
LOSS OF SPEEDOMETER SERIAL DATA: DTC U1097, U1255



Clear DTCs using speedometer self diagnostics. See 8.25 SPEEDOMETER SELF DIAGNOSTICS. Confirm proper operation with no check engine lamp.

NOTES

vd0104xxx

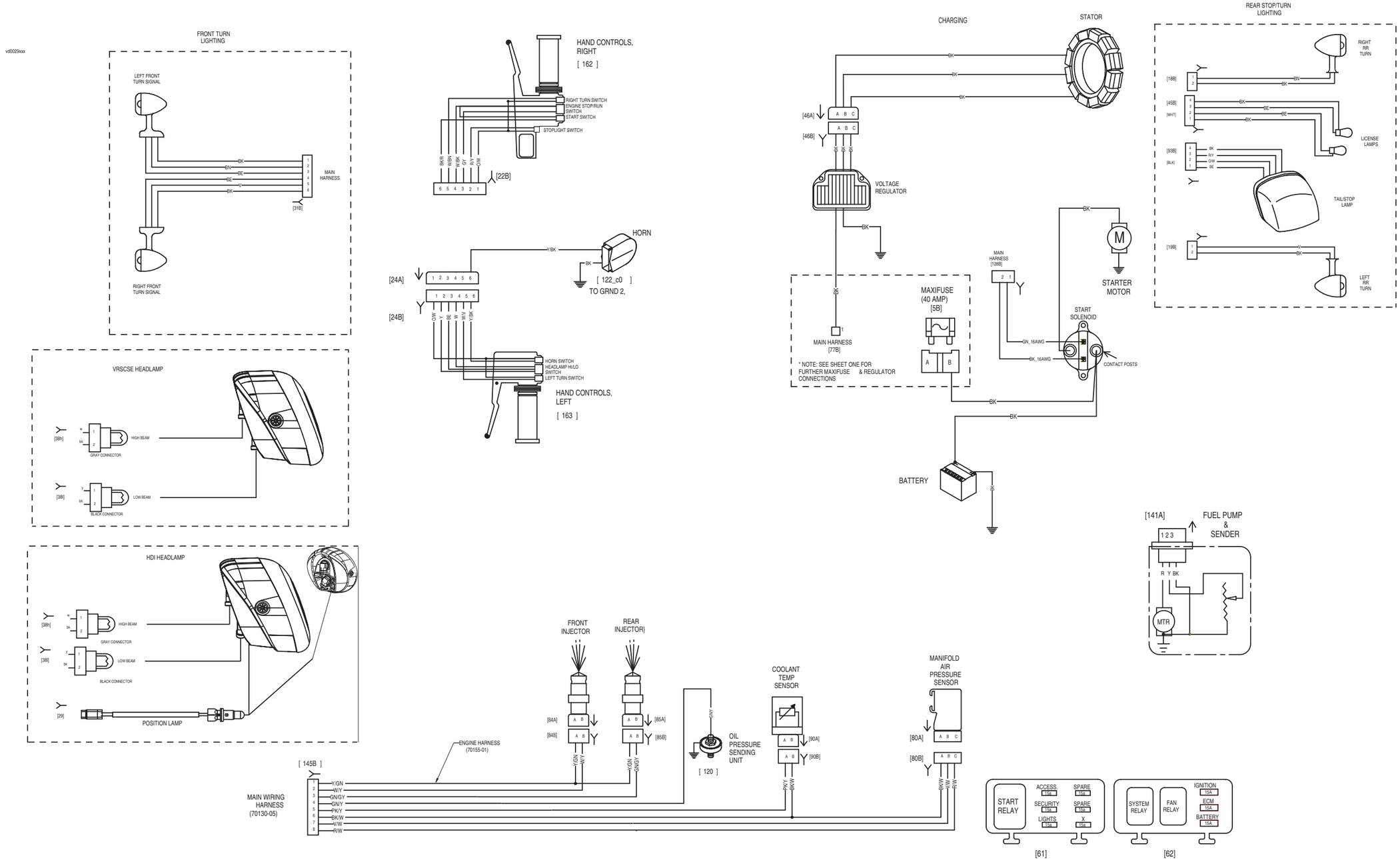


2006 VRSCSE2 MODEL, MAIN HARNESS: PAGE 1 OF 2

2006 VRSCSE2 MODEL, MAIN HARNESS: PAGE 1 OF 2

2006 VRSCSE2 MODEL, MAIN HARNESS: PAGE 1 OF 2

vd0029xxx



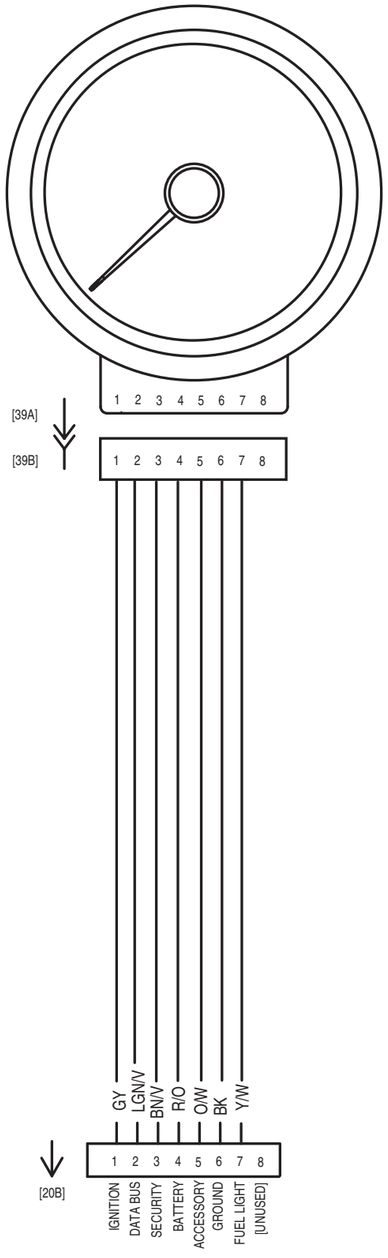
2006 VRSCSE2 MODEL, MAIN HARNESS: PAGE 2 OF 2

2006 VRSCSE2 MODEL, MAIN HARNESS: PAGE 2 OF 2

2006 VRSCSE2 MODEL, MAIN HARNESS: PAGE 2 OF 2

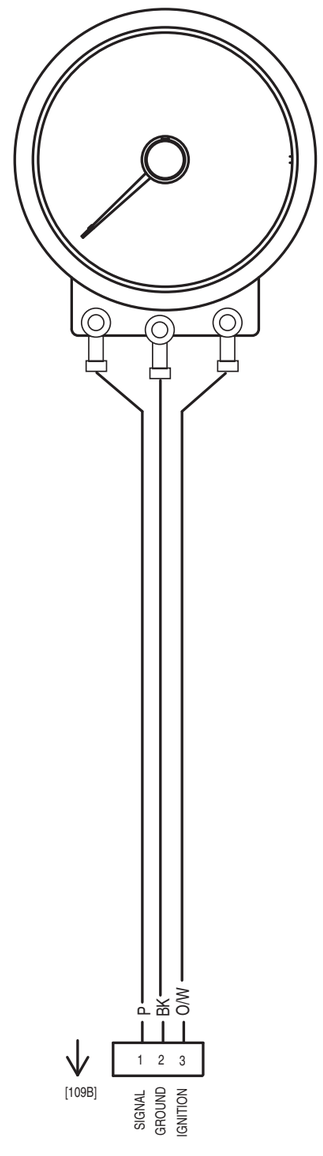
vd0101x1x

SPEEDOMETER

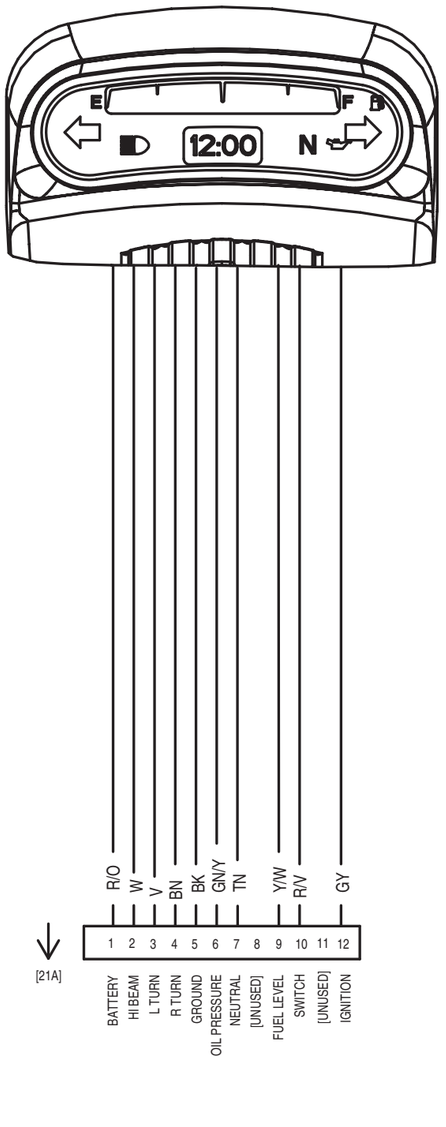


vd0101x1x

TACHOMETER



DISPLAY CONSOLE

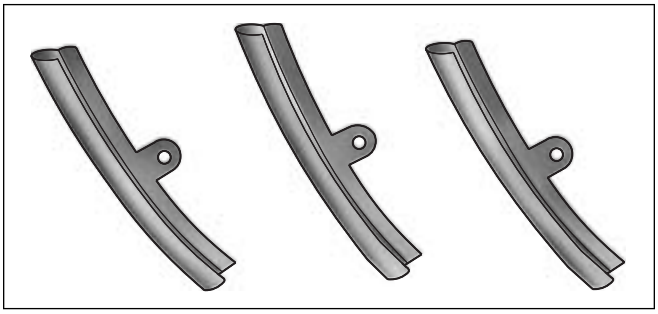


2006 VRSCSE2 MODEL, INSTRUMENTS AND SUB-HARNESSES: PAGE 1 OF 1

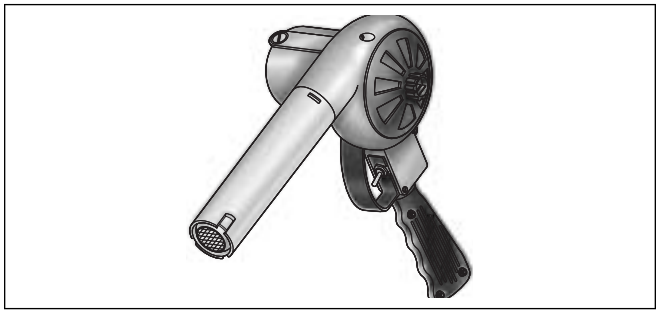
2006 VRSCSE2 MODEL, INSTRUMENTS and SUB-HARNESSES: PAGE 1 OF 2

2006 VRSCSE2 MODEL, INSTRUMENTS AND SUB-HARNESSES: PAGE 1 OF 2

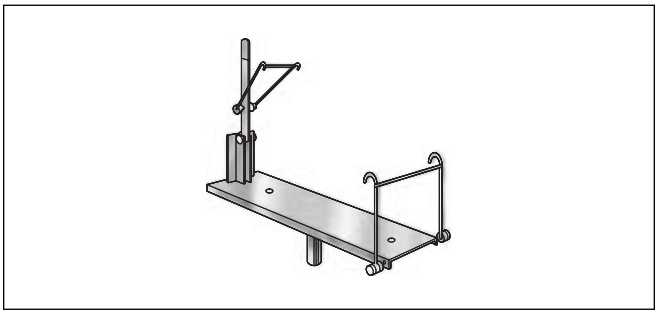
APPENDIX A–TOOLS A.1



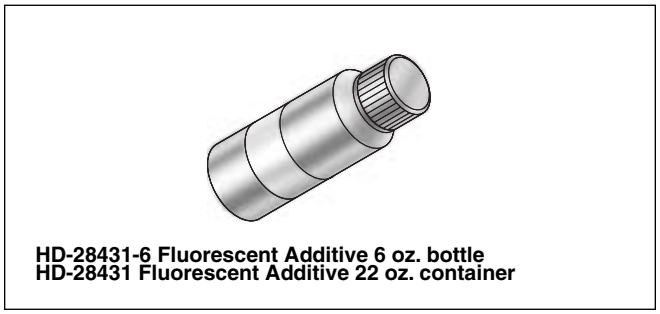
Part No. HD-01289 Rim Protectors



Part No. HD-25070 Robinair Heat Gun

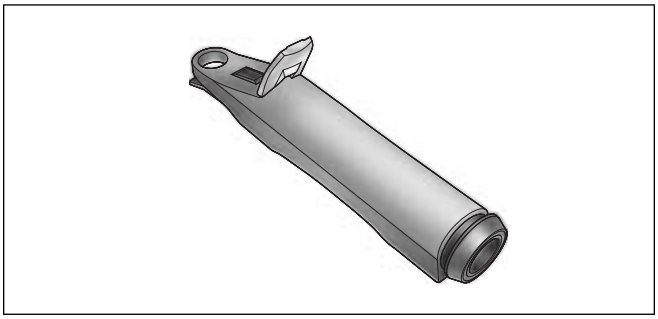


Part No. HD-21000 Tire Spreader

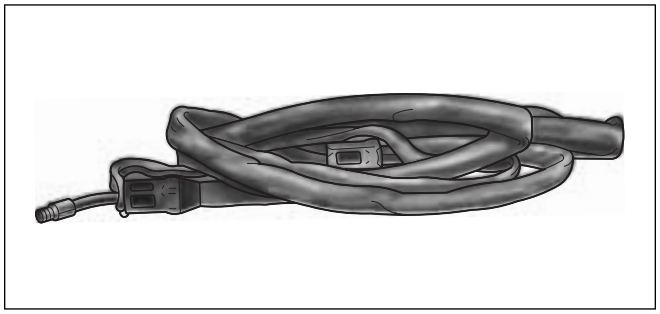


HD-28431-6 Fluorescent Additive 6 oz. bottle
HD-28431 Fluorescent Additive 22 oz. container

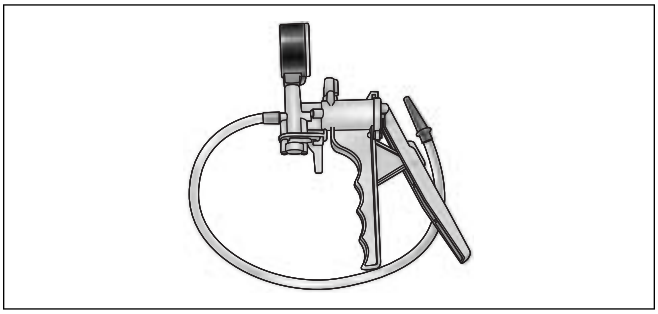
Part No. HD-28431B Black Light Fluorescent Additive. Used with HD-35457, HD-47183, HD-47184.



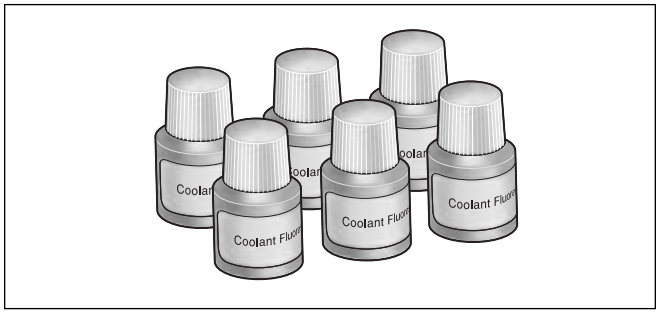
Part No. HD-23688 Coolant Tester - Fahrenheit
Part No. HD-26568 Coolant Tester - Centigrade



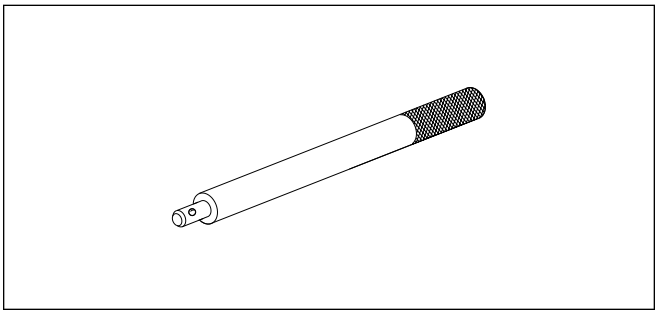
Part No. HD-28700 Tire Bead Expander



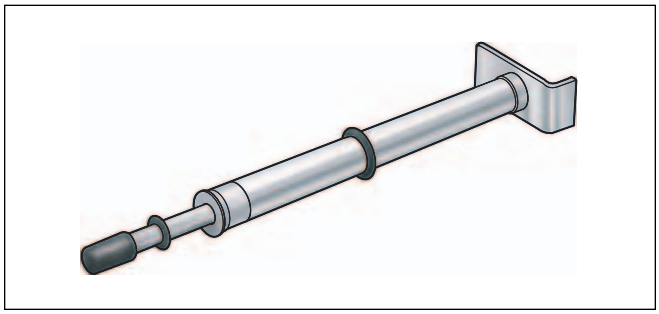
Part No. HD-23738 Vacuum Pump



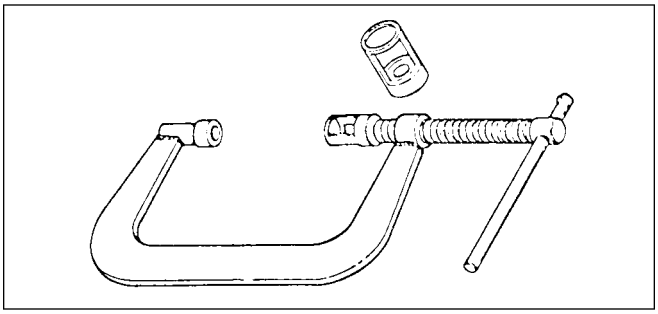
Part No. HD-29545-6 Coolant Leak Dye



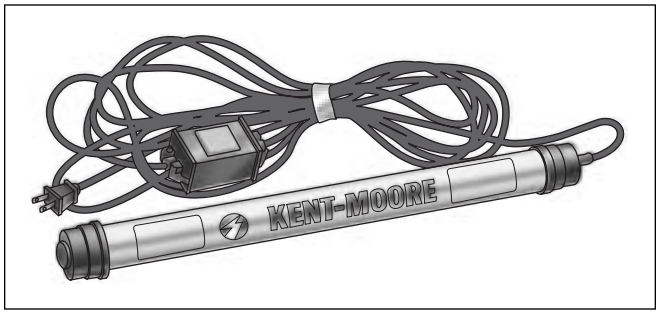
Part No. HD-33416 Universal Driver Handle



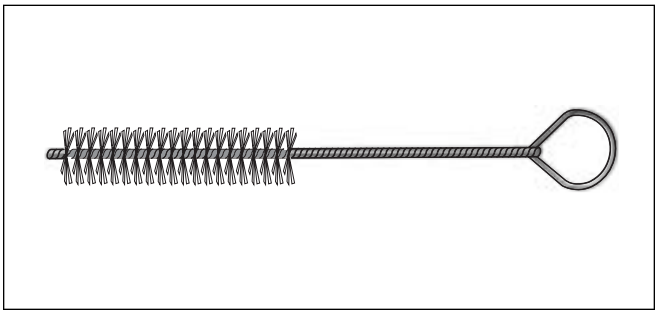
Part No. HD-35381A Belt Tension Gauge



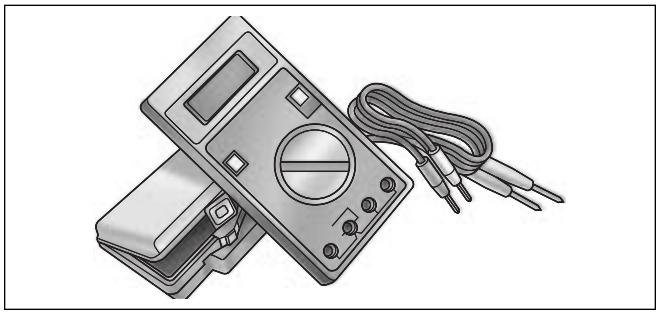
Part No. HD-34736B Valve Spring Compressor



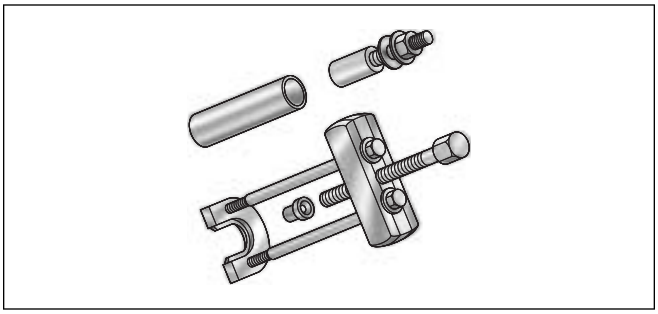
Part No. HD-35457 Black Light Leak Detector



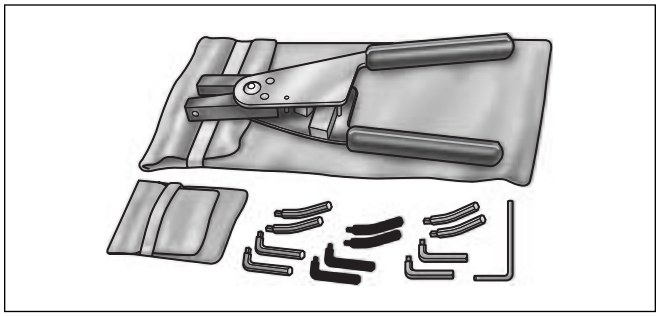
Part No. HD-34751A Nylon Valve Guide Cleaning Brush



Part No. HD-35500C Digital Multimeter (Fluke 23)

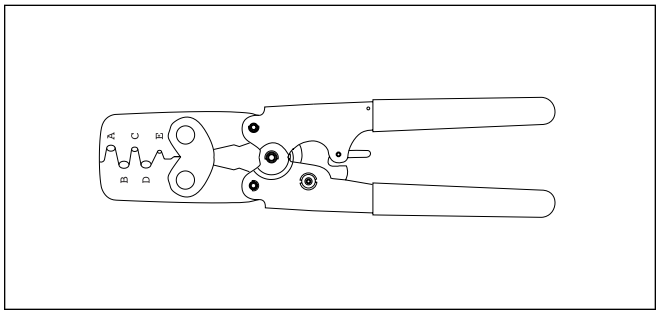


Part No. HD-34902B Mainshaft Primary Bearing Race Remover And Installer

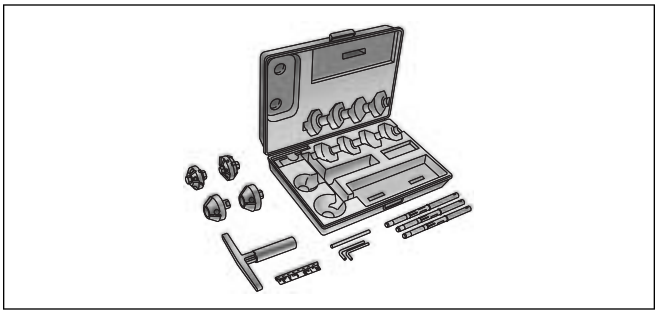


Part No. HD-35518 Internal/External Retaining Ring Pliers

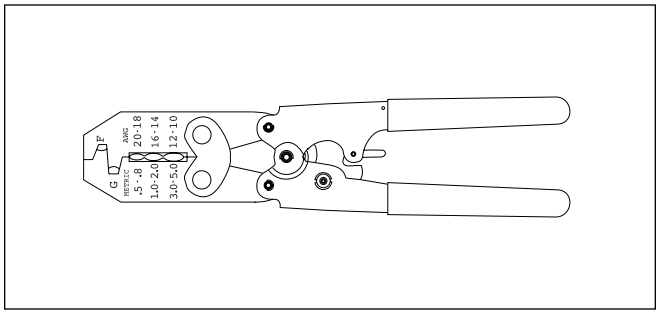
Part No. HD-35667A Cylinder Leakdown Tester



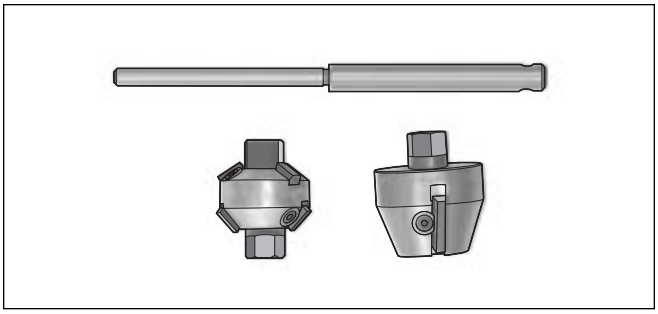
Part No. HD-38125-7 Packard Terminal Crimp Tool



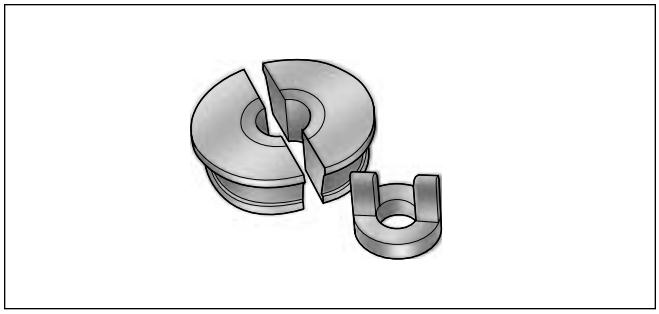
Part No. HD-35758B Neway Valve Seat Cutter Set



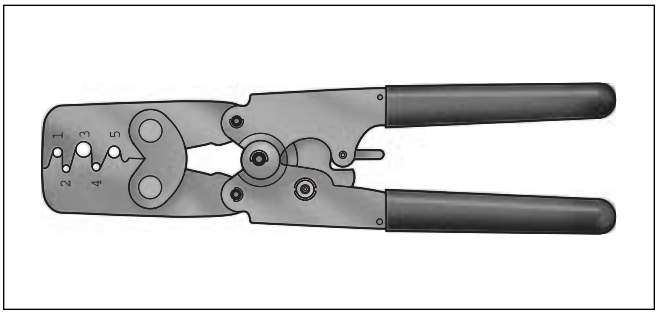
Part No. HD-38125-8 Packard Terminal Crimp Tool



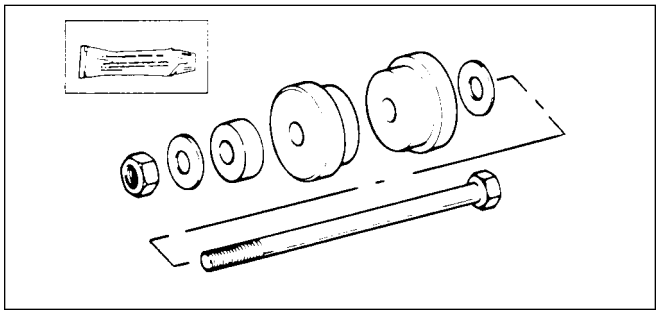
Part No. HD-3575850-50 Neway Valve Seat Cutter Set



Part No. HD-39301A Steering Head Bearing Race Remover. Used with HD-33416.

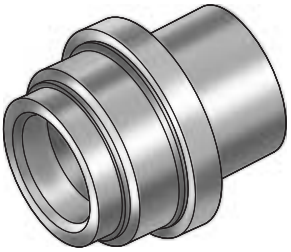


Part No. HD-38125-6 Packard Terminal Crimp Tool

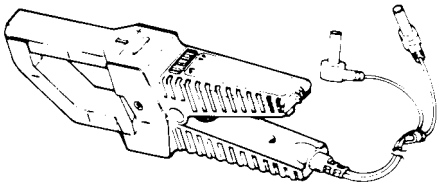


Part No. HD-39302 Steering Head Bearing Race Installer

Part No. HD-39565 Engine Sound Probe

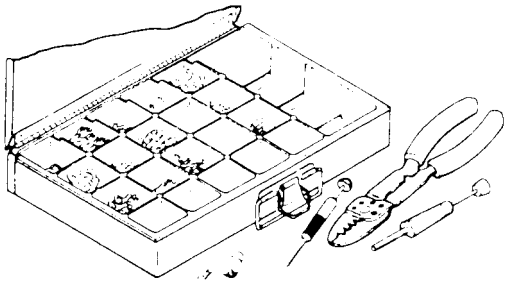


Part No. HD-39782-13 (Intake Seat) Cylinder Head Support Stand Adapter



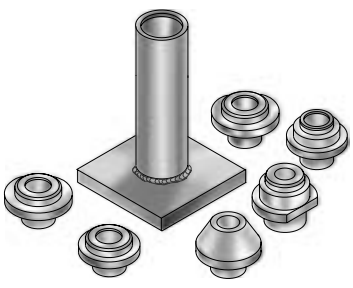
Part No. HD-39617 Inductive Amp Probe. Used with HD-35500B.

Part No. HD-39782-14 (Exhaust Seat) Cylinder Head Support Stand Adapter

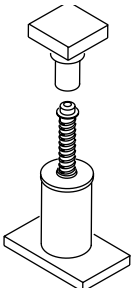


Part No. HD-39621 Electrical Terminal Repair Kit

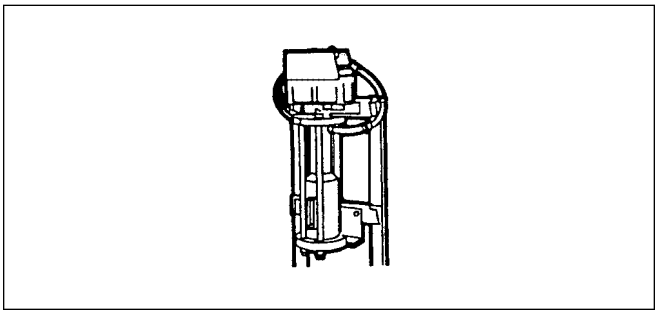
Part No. HD-39786 Cylinder Head Holding Fixture



Part No. HD-39782 Cylinder Head Support

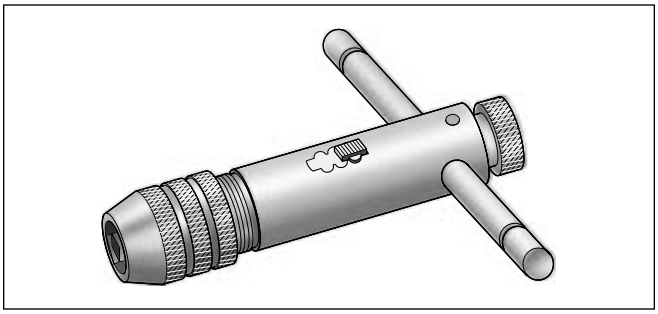


Part No. HD-39800 Oil Filter Crusher (Small)

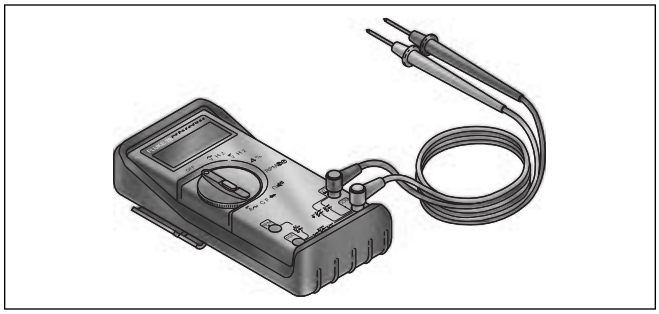


Part No. HD-39823 25 Ton Oil Filter Crusher

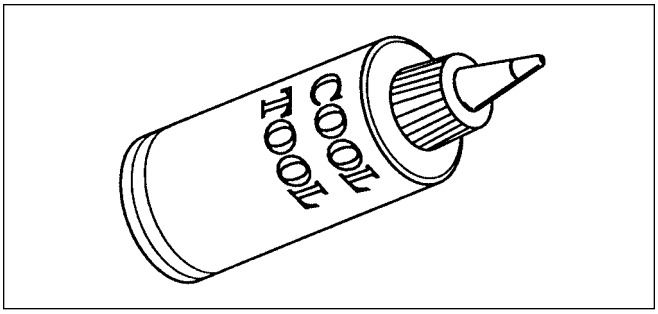
Part No. HD-39969 Ultra-Torch UT-100



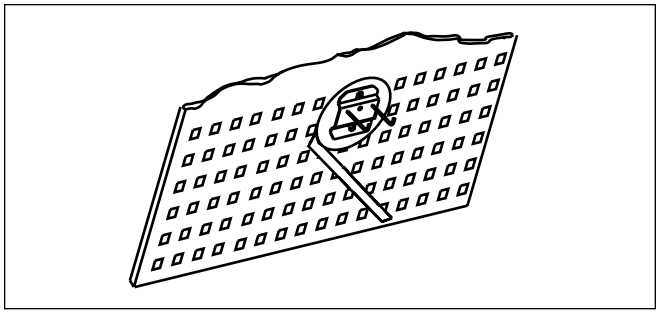
Part No. HD-39847 Universal Ratcheting Tap/Reamer Handle



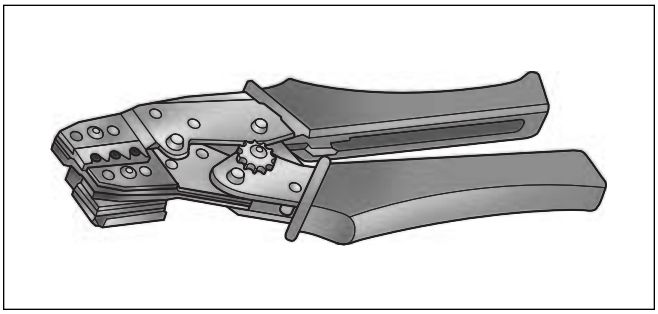
Part No. HD-39978 Multi-Meter (FLUKE 78)



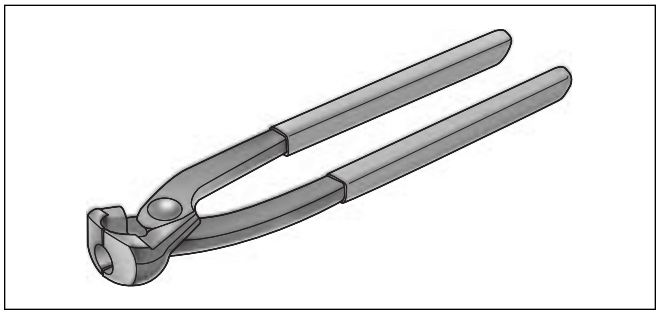
Part No. HD-39964 Reamer Lubricant (Cool Tool)



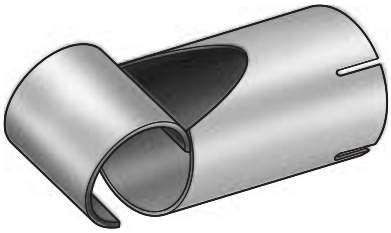
Part No. HD-41025A Tool Organization System



Part No. HD-39965 Deutsch Terminal Crimp Tool

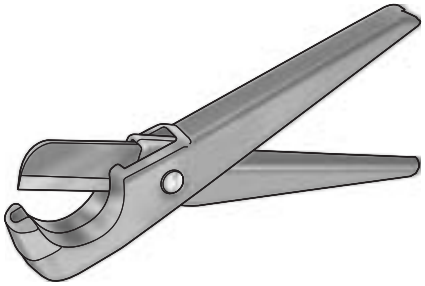


Part No. HD-41137 Hose Clamp Pliers



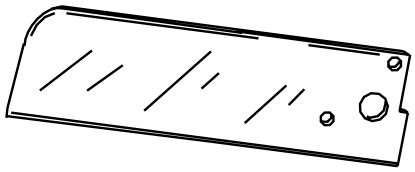
Part No. HD-41183 Robinair Heat Gun Shrink Tool Attachment (used with HD-25070)

Part No. HD-41354 Speedometer Tester

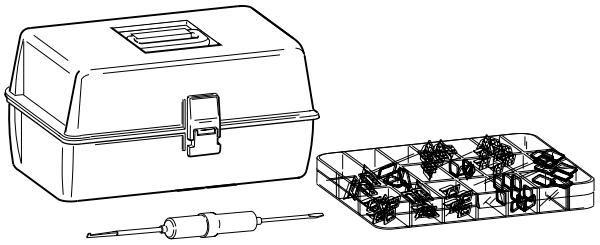


Part No. HD-41185 Hose Cutting Tool

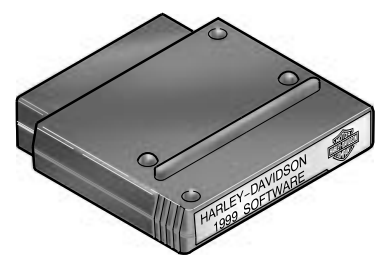
Part No. HD-41404A Harness Connector Test Kit



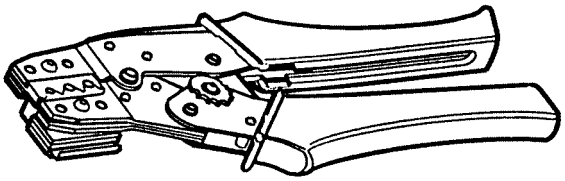
Part No. HD-41185-1 Hose Cutter Blade



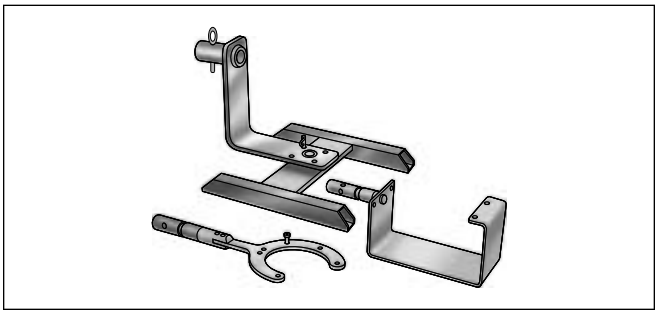
Part No. HD-41475 Deutsch Connector Service Kit Includes HD-41475-100



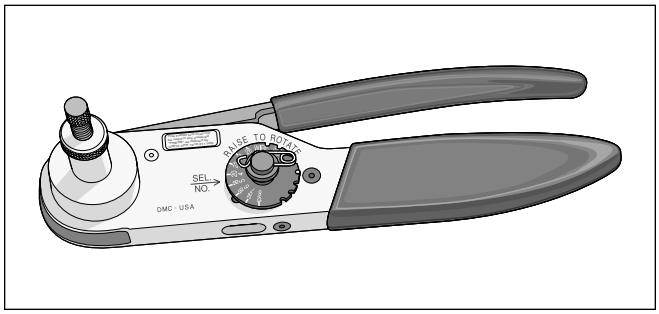
Part No. HD-41325-95C Scanalyzer Cartridge



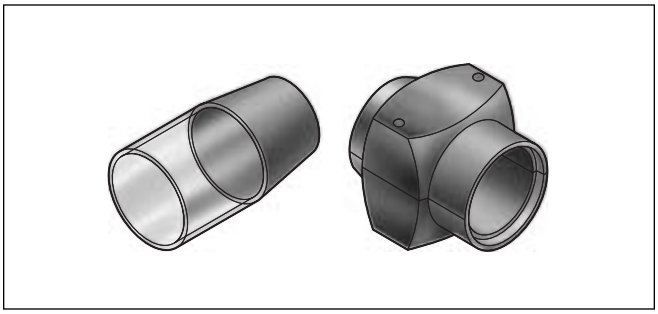
Part No. HD-41609 Amp Multilock Electrical Crimp Tool



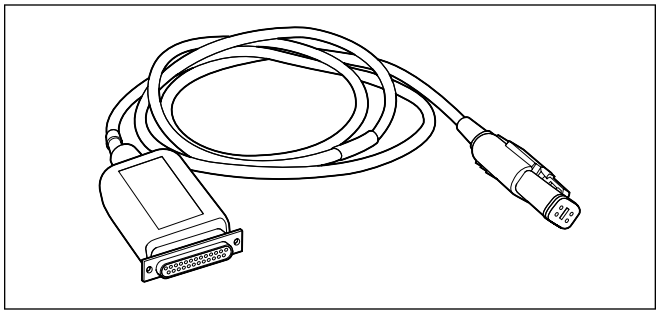
Part No. HD-42310 Engine Stand



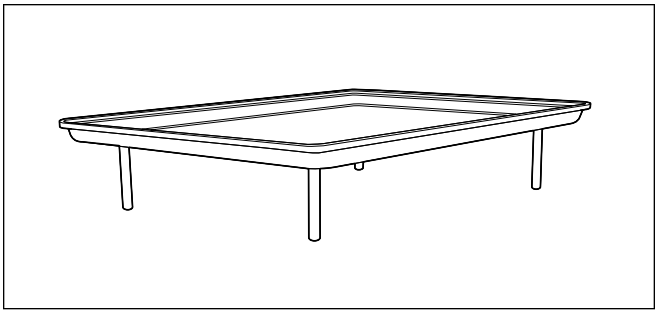
Part No. HD-42879 Deutsch Solid Barrel Contact Crimp Tool



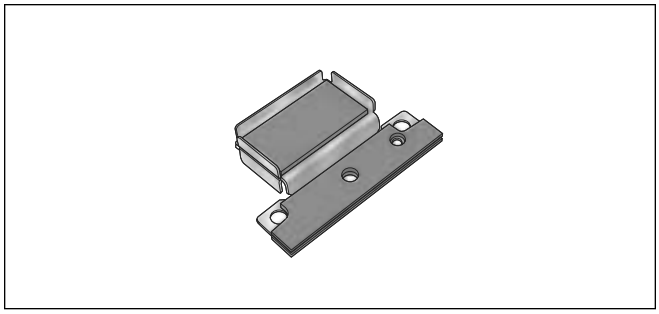
Part No. HD-42571 Fork Seal Driver



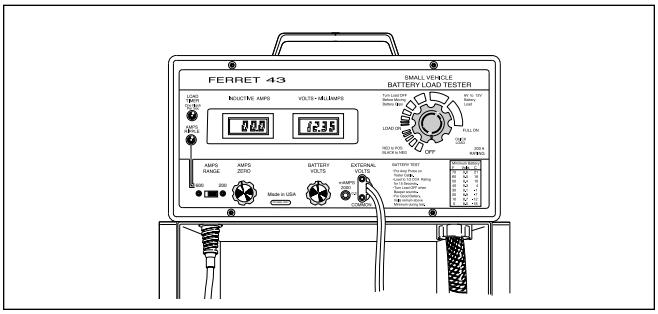
Part No. HD-42921A Scanalyzer Cable



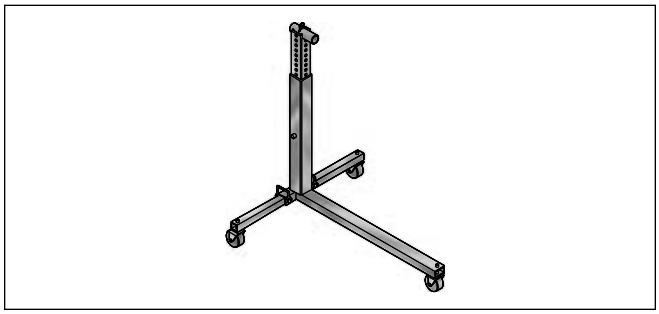
Part No. HD-42310-150 Drip Tray. Used with HD-42310.



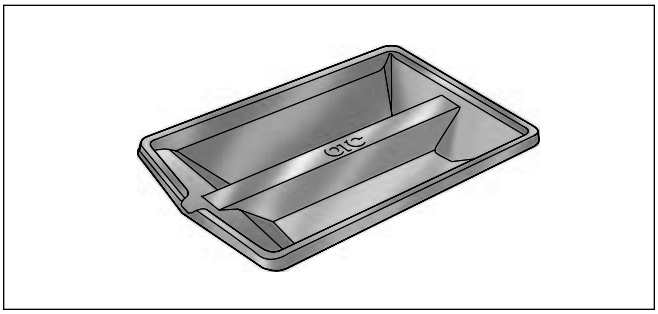
Part No. HD-43293A Brake Caliper Piston Remover



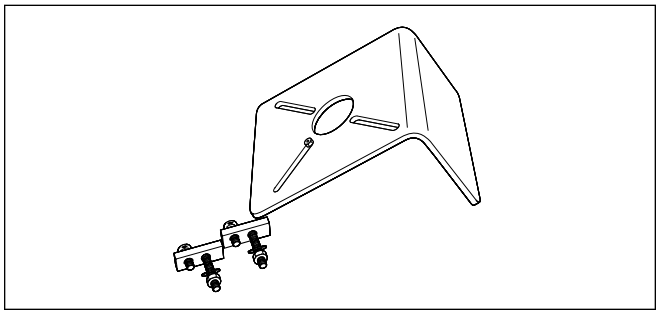
Part No. HD-42376 Battery /Charging System Load Tester



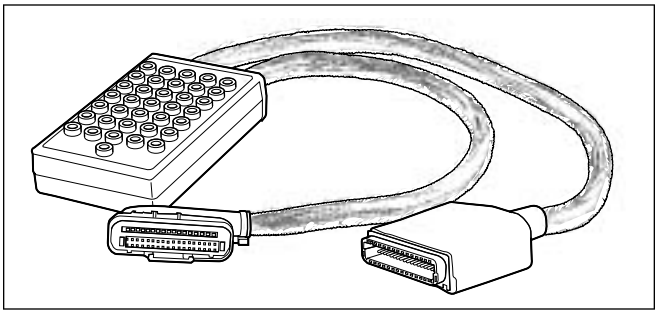
Part No. HD-43646A Rolling Engine Stand



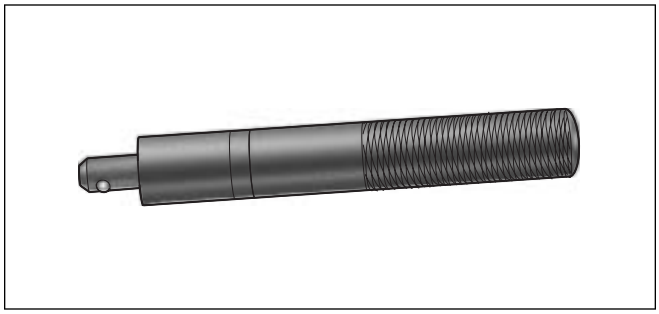
Part No. HD-43636-10 Drip Pan Use with HD-43636-10



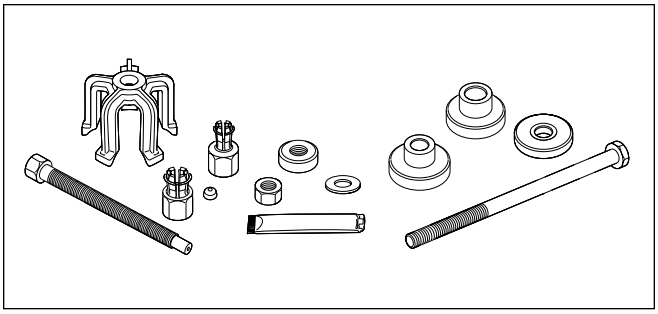
Part No. HD-44358 Rowe Flywheel Fixture



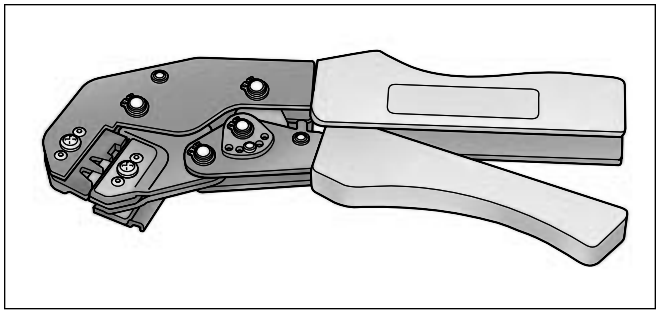
Part No. HD-43876 Breakout Box



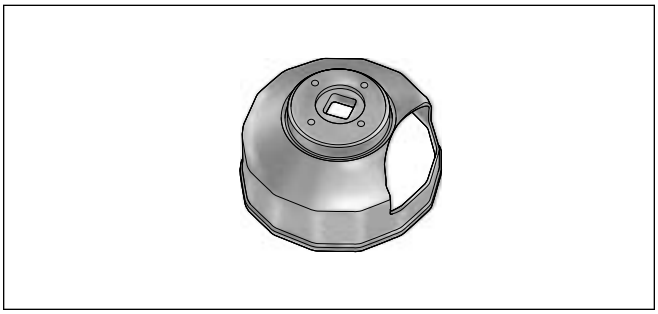
Part No. HD-44567 Universal Driver (7-inch)



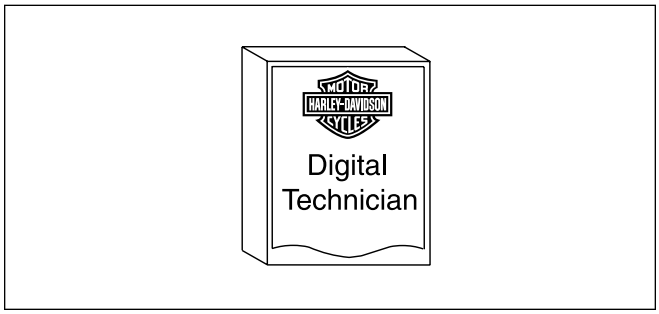
Part No. HD-44060 Wheel Bearing Remover



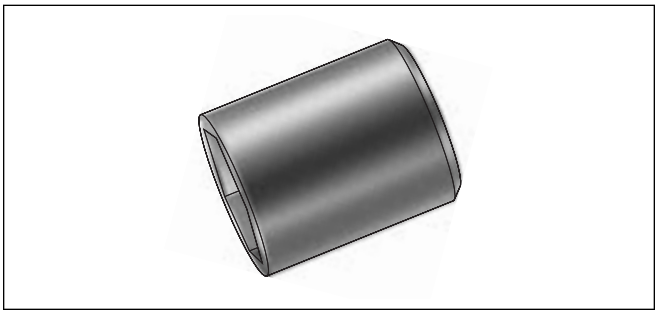
Part No. HD-44695 Electrical Crimp Tool



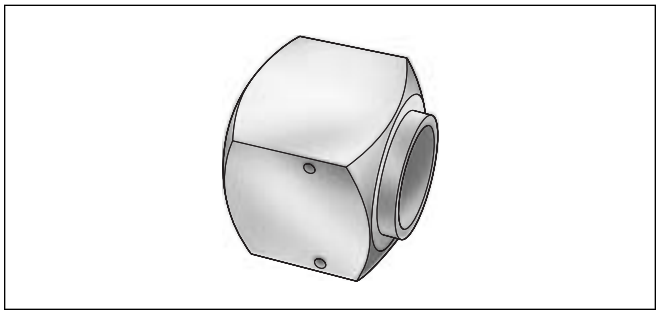
Part No. HD-44067 Oil Filter Remover



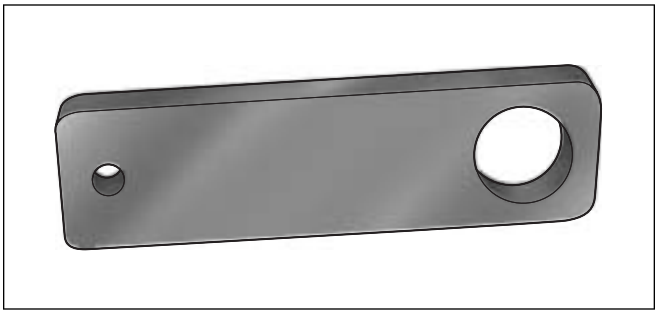
Part No. HD-44750-P50 (non-touch screen)
or HD-44750-P29 (touch screen)
Digital Technician



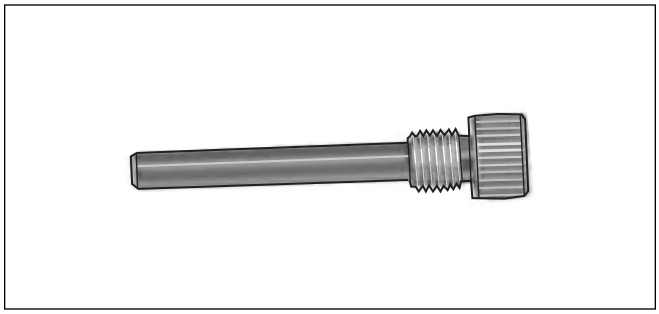
Part No. HD-45300 Oil Pressure Sending Unit Remover/Installer



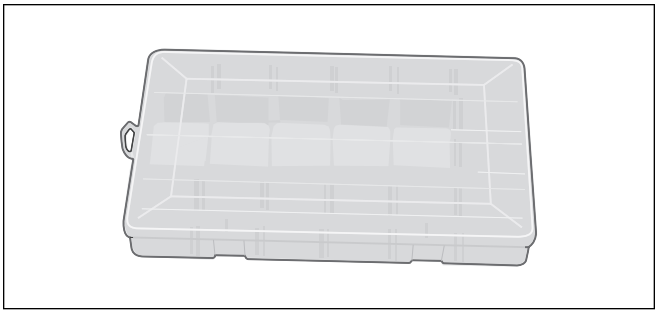
Part No. HD-45305 Fork Seal Driver



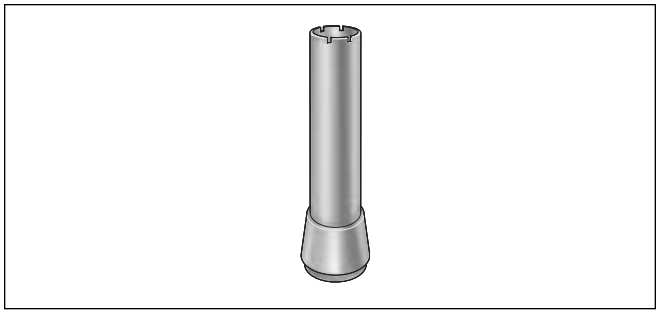
Part No. HD-45301 Transmission Assembly Retainer



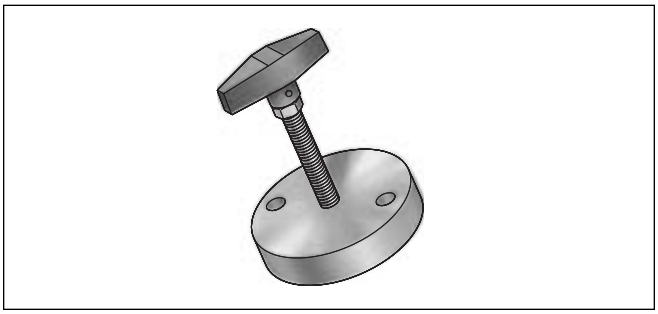
Part No. HD-45306 Crankshaft Locking Pin



Part No. HD-45303 Shim Storage Case

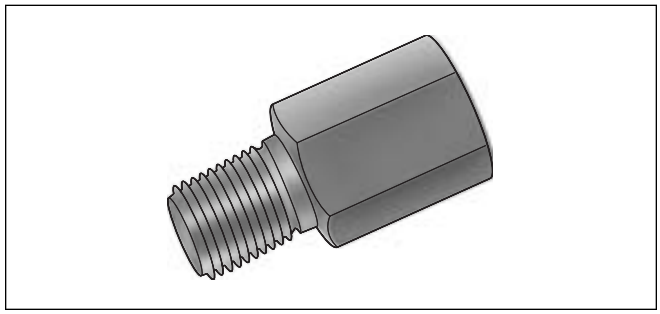


Part No. HD-45307 Thermostat Remover/Installer

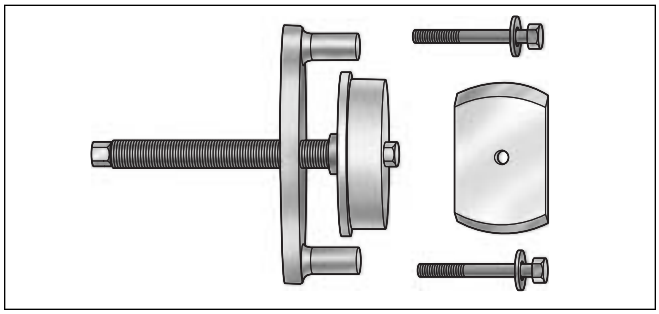


Part No. HD-45304 Alternator Stator/Cover Remover/ Installer

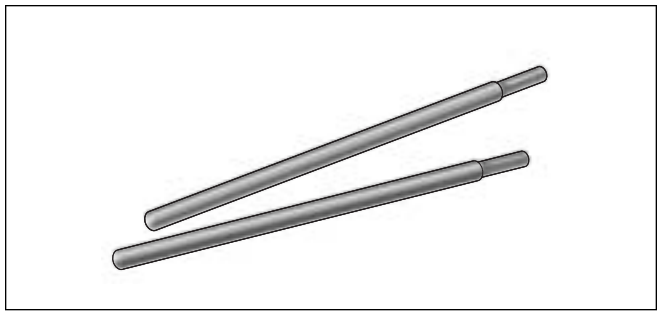
Part No. HD-45308 Oil Pressure Gauge



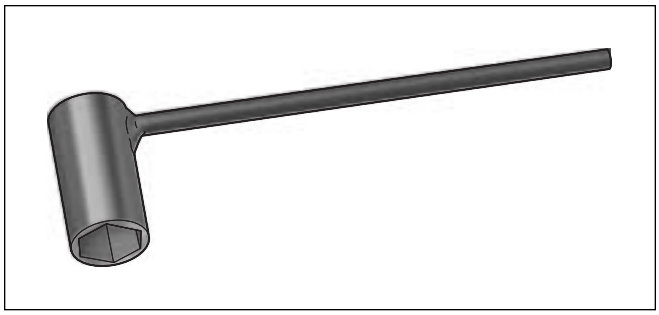
Part No. HD-45309 Oil Pressure Gauge Adapter



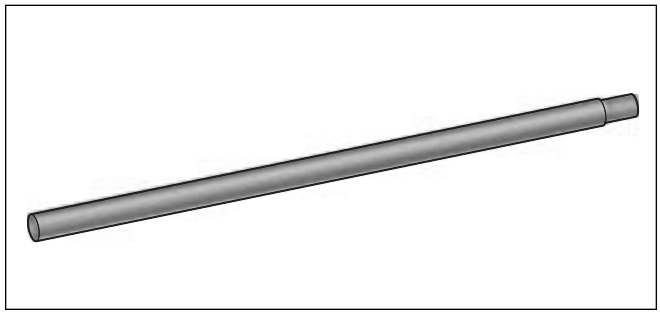
Part No. HD-45313A Cylinder Liner Remover/Installer



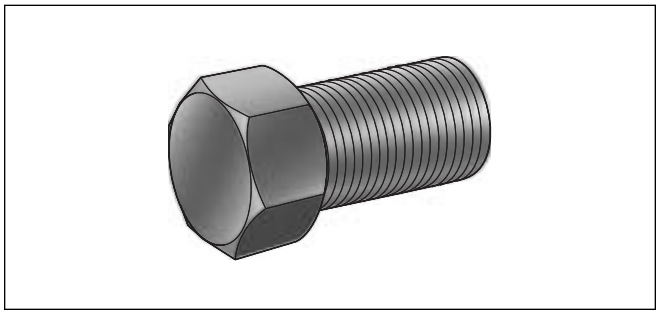
Part No. HD-45310 Lower Crankcase Alignment Dowels



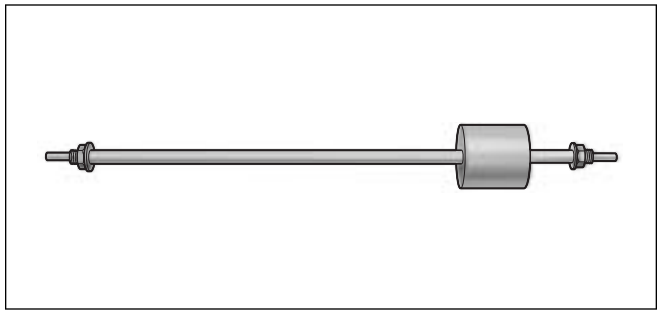
Part No. HD-45314A Crankshaft Rotating Wrench



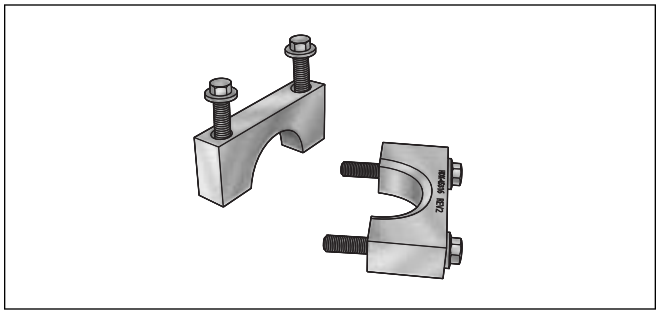
Part No. HD-45311 Counterbalancer Alignment Pin



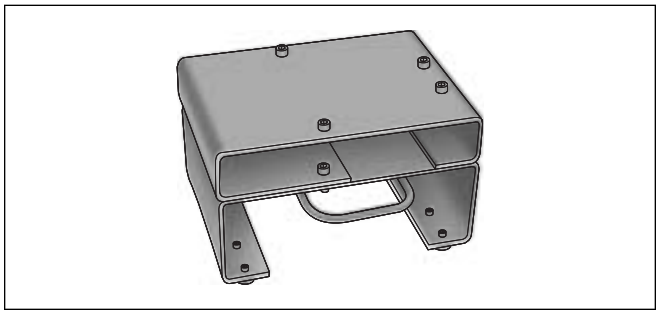
Part No. HD-45315 Alternator Rotor Remover



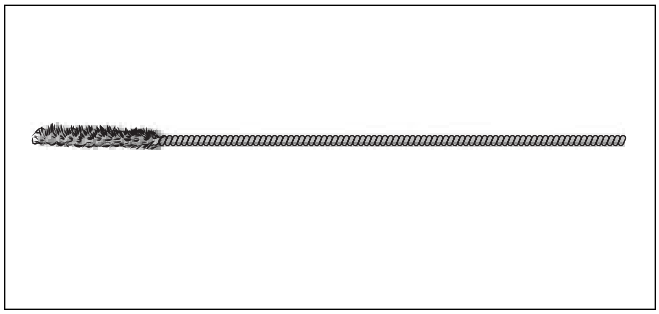
Part No. HD-45312 Cam Chain Tensioner/Guide Pin Remover/Installer



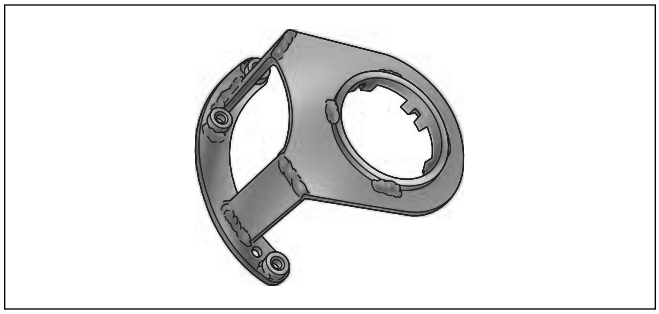
Part No. HD-45316 Crankshaft Assembly Retainer



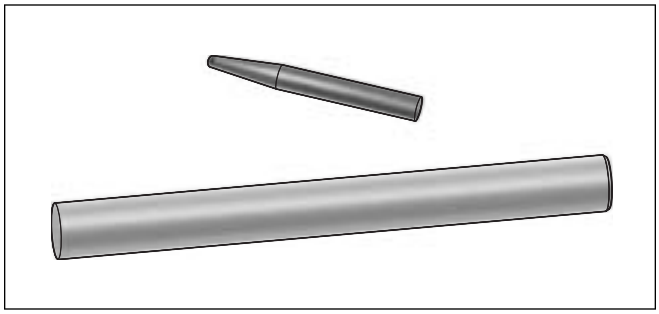
Part No. HD-45317 Engine Assembly Support Fixture (shown with HD-45317-10 spacer)



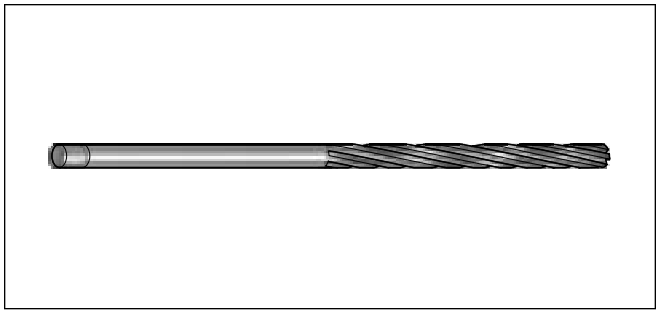
Part No. HD-45321 Valve Flex Hone



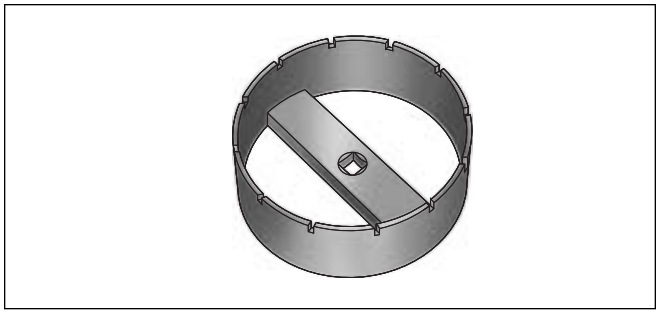
Part No. HD-45318 Clutch Hub Holder



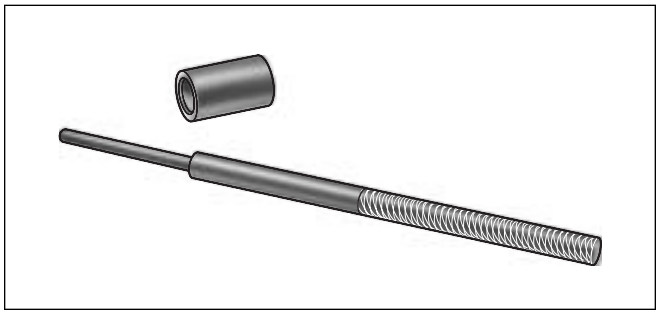
Part No. HD-45322 Valve Guide Sealer Installer



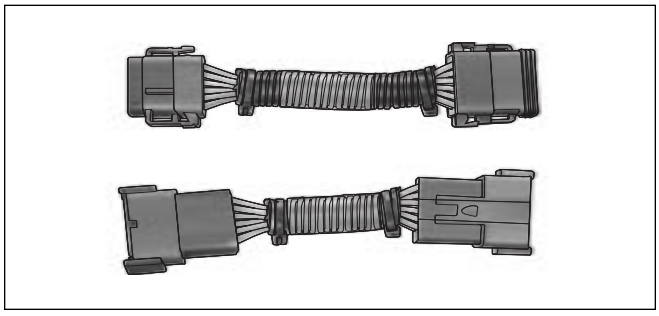
Part No. HD-45319 Valve Guide Reamer



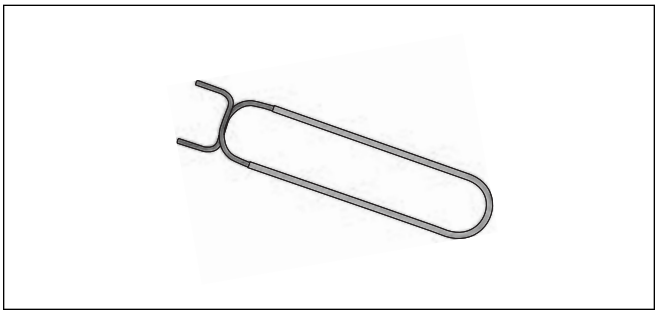
Part No. HD-45324 Fuel Cap Remover/Installer



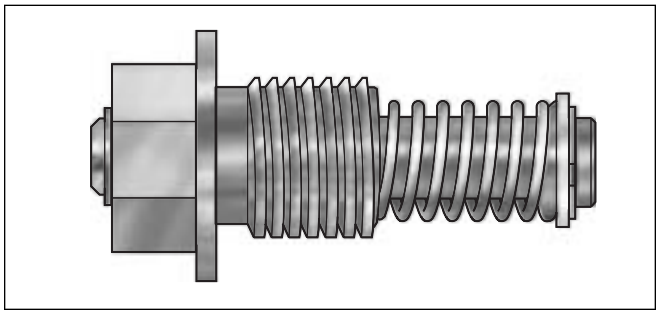
Part No. HD-45320 Valve Guide Remover/Installer



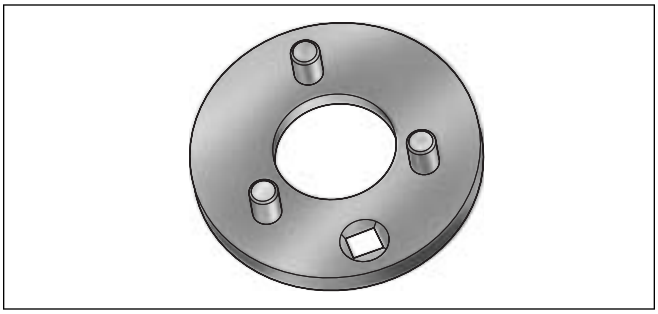
Part No. HD-45325 Jumper Harness



Part No. HD-45326 Primary Chain Tensioner Retainer

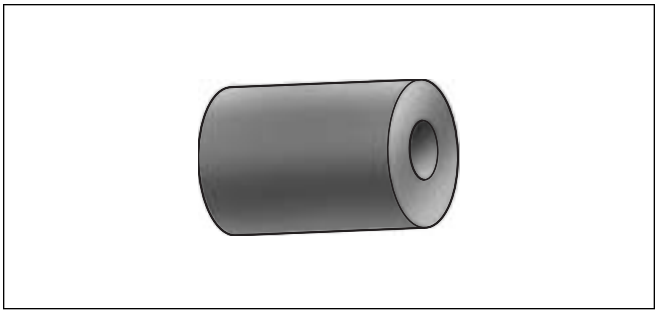


Part No. HD-45334 Secondary Chain Measuring Tool

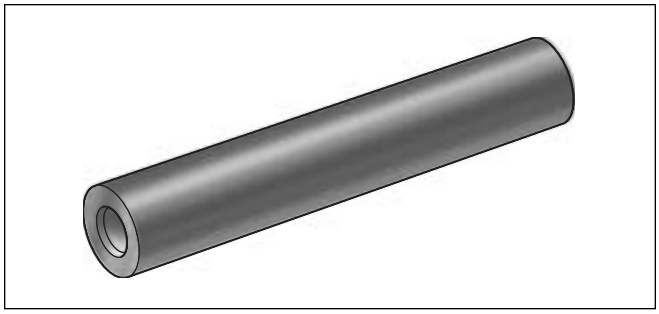


Part No. HD-45331-A Final Drive Sprocket Flange Locking Tool

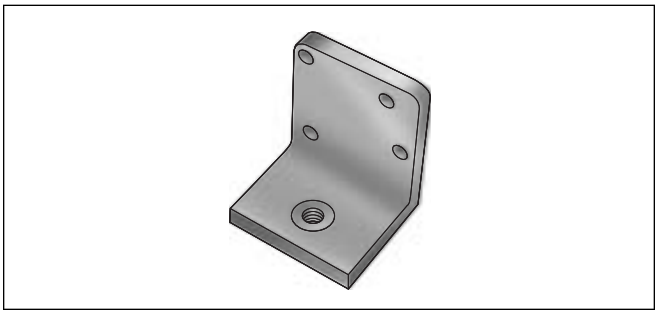
Part No. HD-45335 Coolant System Pressure Tester



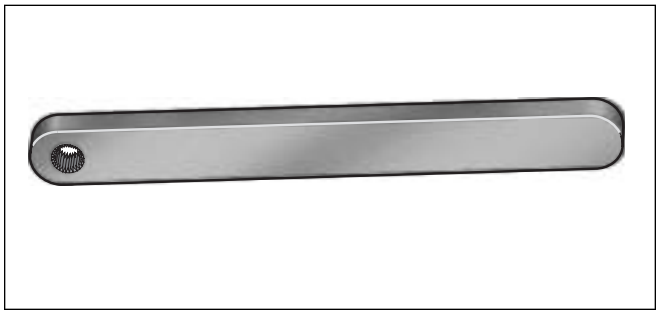
Part No. HD-45332 Final Drive Sprocket Locking Device Installer



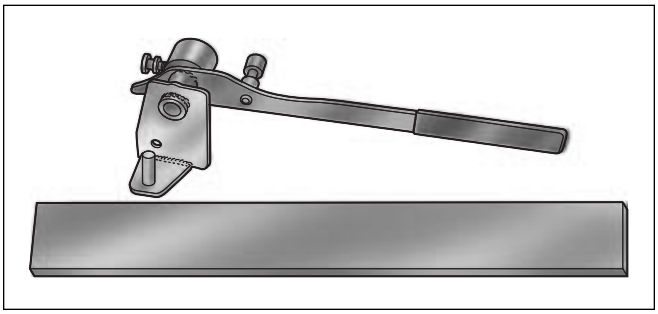
Part No. HD-45337 Shift Shaft Seal Installer



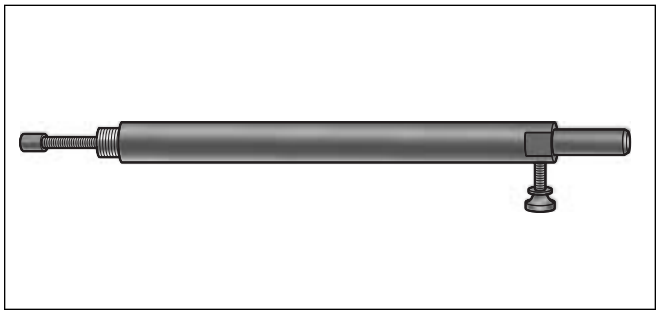
Part No. HD-45333 Cylinder Head Holder



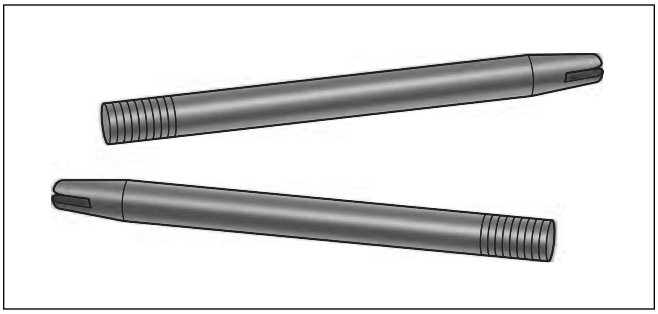
Part No. HD-45338 Shift Lever Substitute



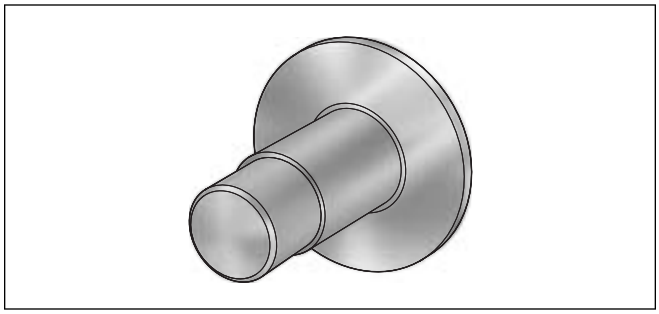
Part No. HD-45339 Shift Mechanism/Detent Retractor



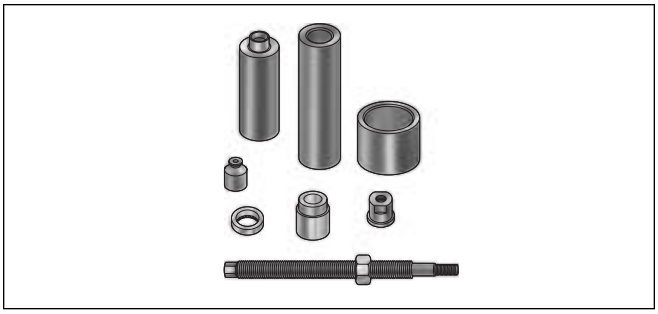
Part No. HD-45653 Top Dead Center Positioning Tool



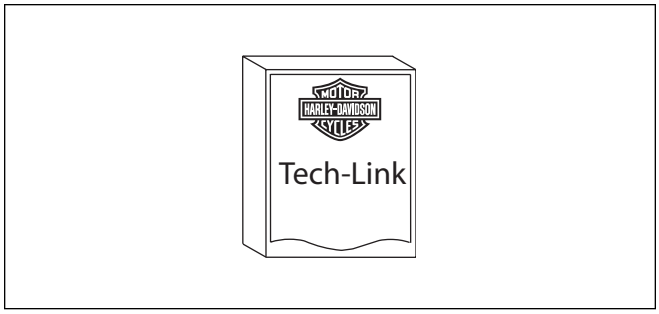
Part No. HD-45340 Gasket Alignment Dowels



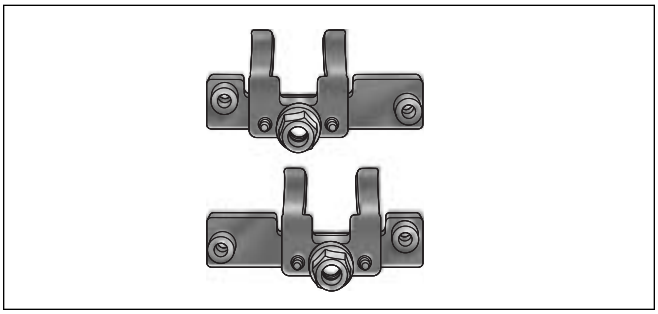
Part No. HD-45654 Clutch Disc Aligning Spacer



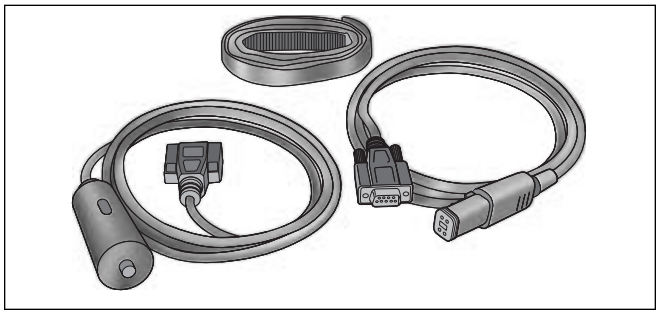
Part No. HD-45490 Balancer Bearing Remover/Installer Tools



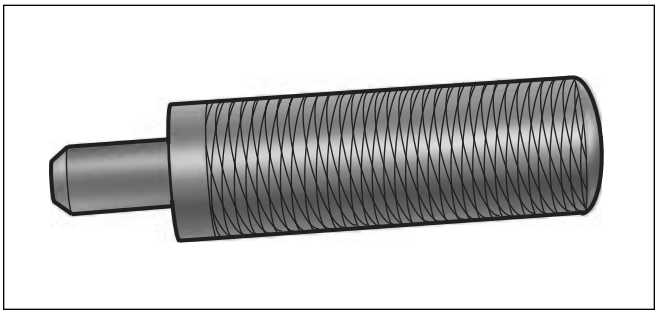
Part No. HD-45830 Tech. Link



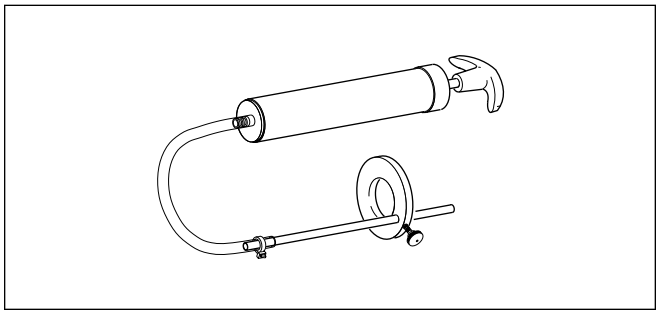
Part No. HD-45491 Tappet Compressing Tool



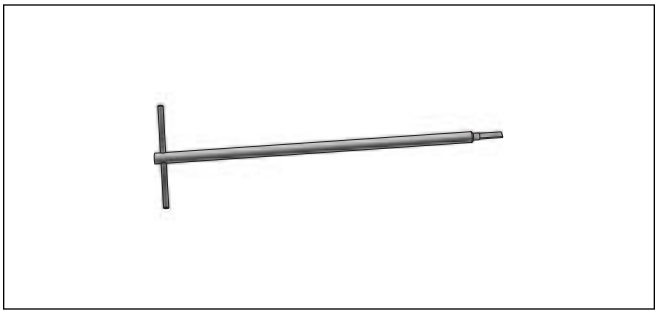
Part No. HD-45835 Road Test Kit



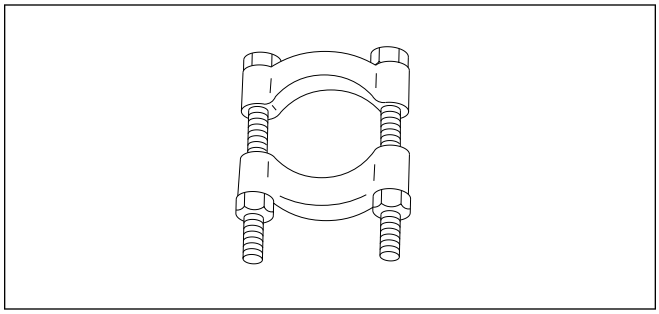
Part No. HD-45907 Universal Driver (4-inch)



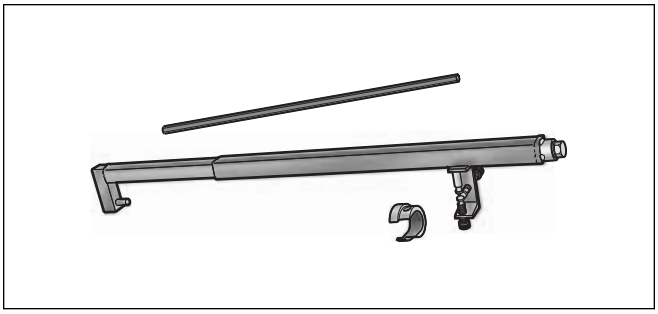
Part No. HD-59000B Fork Oil Level



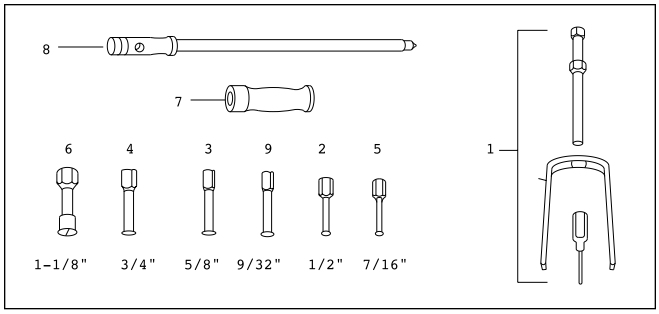
Part No. HD-45961 Ignition Switch



Part No. HD-95637-46A Wedge Attachment for Claw Puller. Used with HD-95635-46.

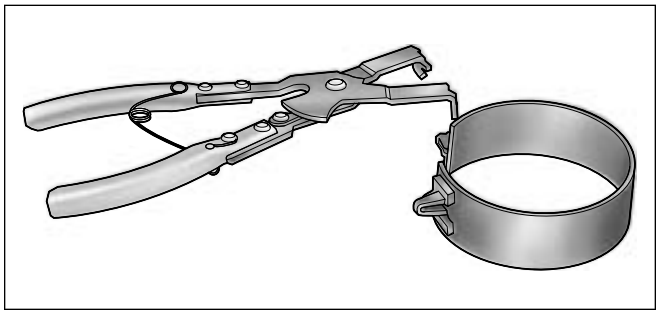


Part No. HD-45966 Fork Spring Compressor

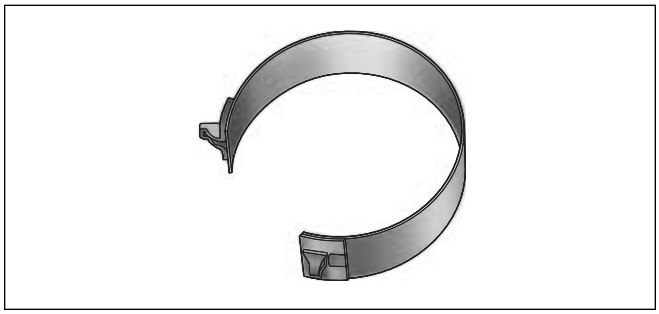


Part No. HD-95760-69A Bushing/Bearing Puller Tool Set. Set includes items 1-7. Items 8 (HD-95769-69), 9 (HD-95770-69) and 10 (HD-95771-69) are optional.

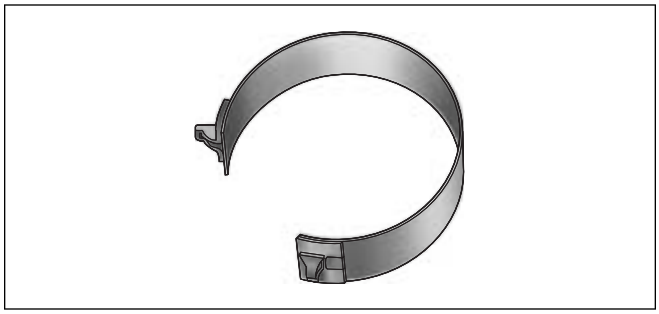
Part No. HD-47652 Inner Fork Nut Remover/Installer



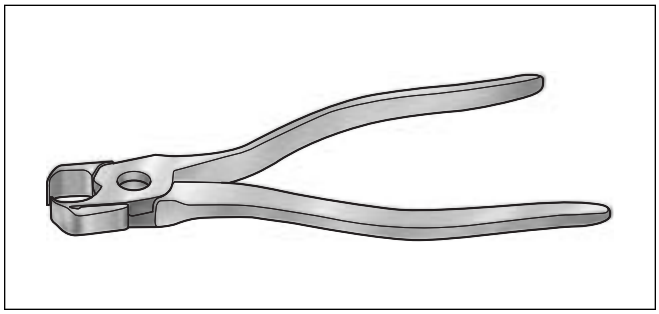
Part No. HD-96333-51E Piston Ring Compressor Used with Band HD-96333-105 and Band HD-96333-106



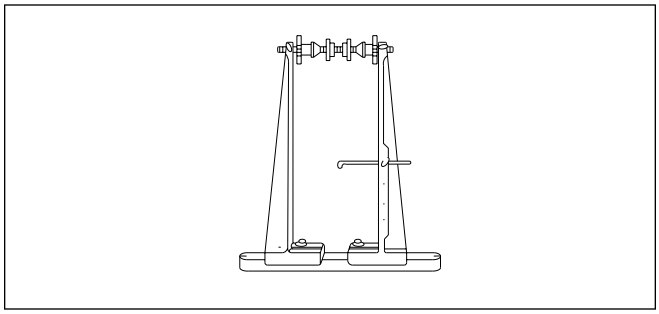
Part No. HD-96333-105 Piston Ring Compressor



Part No. HD-96333-106 Piston Ring Compressor



Part No. HD-97087-65B Hose Clamp Pliers



Part No. HD-99500-80 Wheel Truing and Balancing Stand

NOTES

APPENDIX B-WIRING
AMP MULTILOCK ELECTRICAL CONNECTORS B.1

REMOVING SOCKET/PIN TERMINALS

1. Remove connector from the retaining device, either attachment or rosebud clip.
2. Depress the button on the socket terminal side of the connector (plug) and pull apart the pin and socket halves.
3. Bend back the latch slightly and free one side of secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access terminals in chambers of connector housing.
4. Looking in the terminal side of the connector (opposite the secondary lock), take note of the cavity next to each terminal.
5. See Figure B-1. With the flat edge against the terminal, insert the pick tool (Snap-on TT600-3) into the cavity until it stops. Pivot the end of the pick away from the terminal (locktab is inside housing) and gently tug on wire to pull terminal from chamber. Do not tug on the wire until the tang is released or the terminal will be difficult to remove. A “click” is heard if the tang is engaged but then inadvertently released. Repeat the step without releasing the tang.

NOTE

- *If pick tool is not available, a push pin/safety pin may be used instead.*
- *An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-41609) is used to install Amp Multilock pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions on the next page.*

INSTALLING SOCKET/PIN TERMINALS

NOTE

For wire location purposes, numbers are stamped into the secondary locks of both the socket and pin housings. See Figure B-2.

1. From the secondary lock side of the connector, insert the terminal into its respective numbered chamber until it snaps in place. For proper fit, the slot in the terminal must face the tang in the chamber.

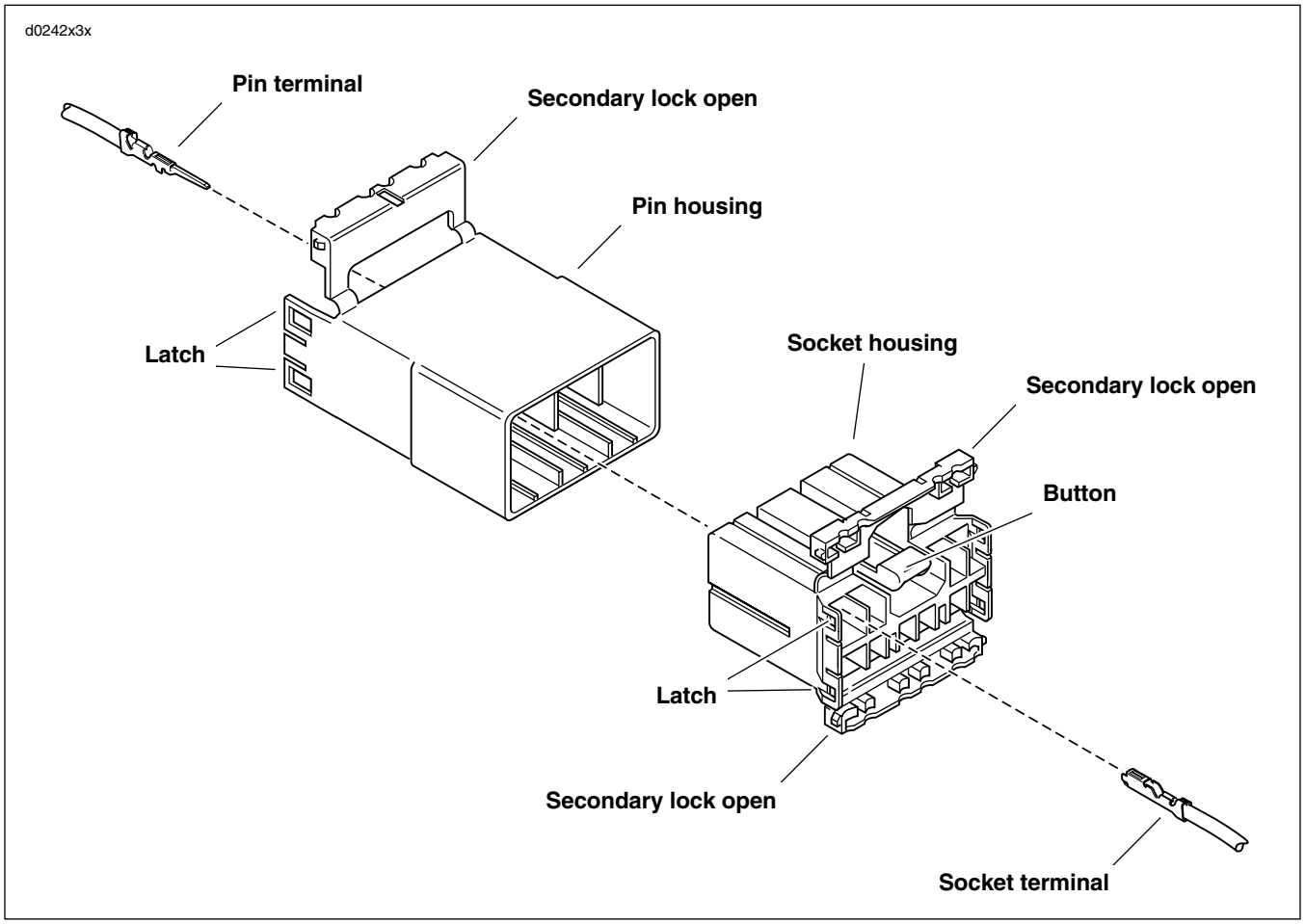


Figure B-1. 10-Place Amp Multilock Connector

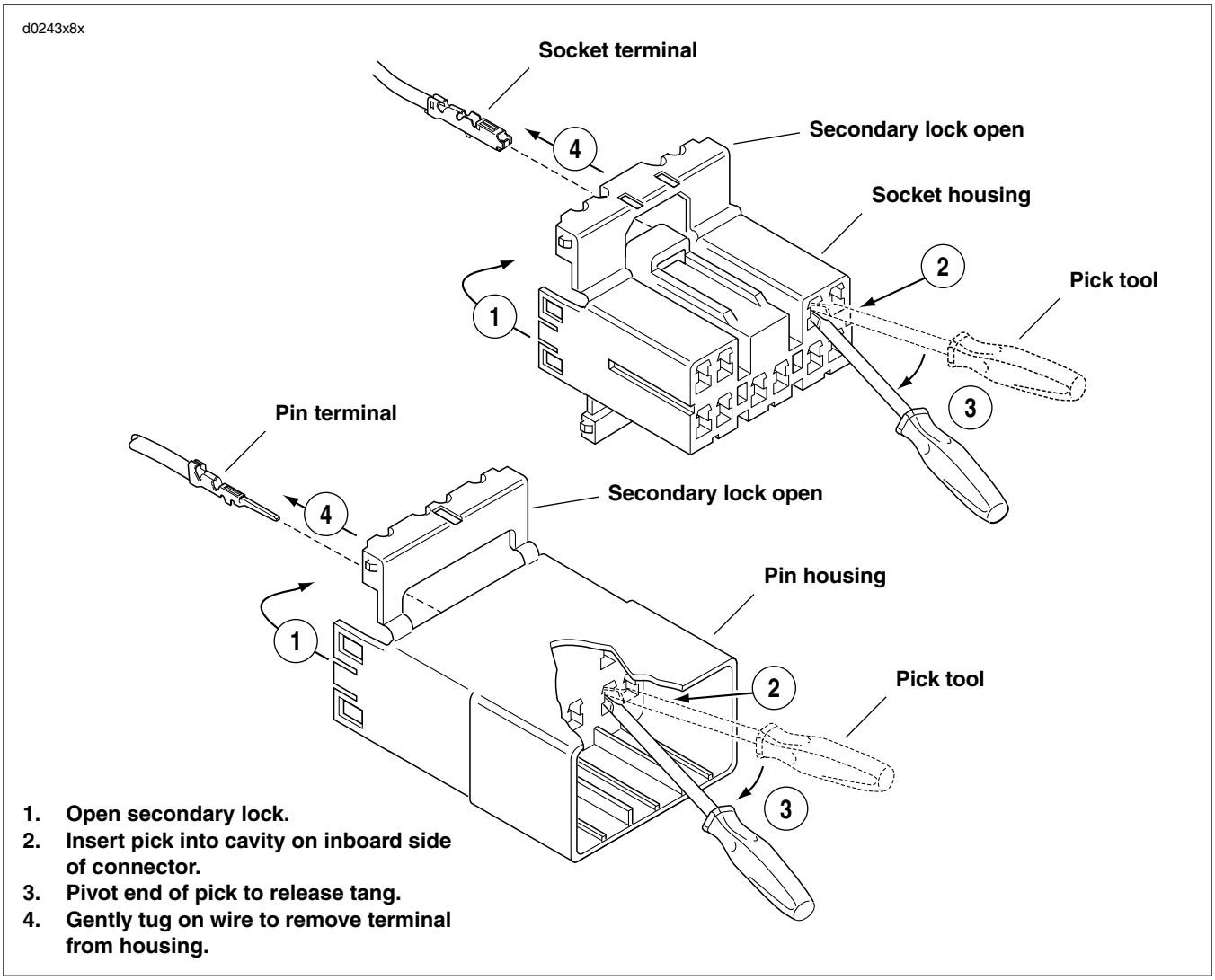


Figure B-2. Release Tang and Back Out Terminals

NOTES

- *See Figure B-3. The tang in the chamber engages the slot to lock the terminal in position.*
- *On the pin side of the connector, tangs are positioned at the bottom of each chamber, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward.*
- *On the socket side, tangs are at the top of each chamber, so the socket terminal slot (on the same side as the crimp tails) must face upward.*
- *Up and down can be determined by the position of the release button (used to separate the pin and socket halves). Consider the button to always be on top of the connector.*

2. Gently tug on wire end to verify that the terminal is locked in place and will not back out of chamber.
3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.
4. Insert the socket housing (plug) into the pin housing (receptacle) until it snaps in place.
5. Install connector on retaining device, either attachment or rosebud clip.

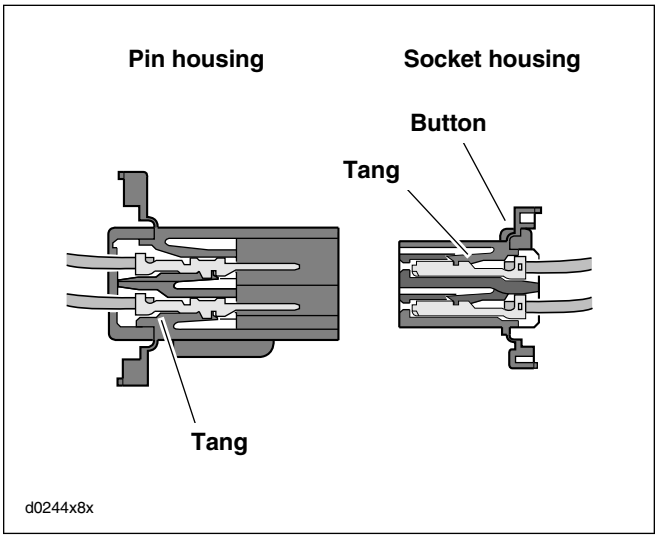


Figure B-3. Multilock Connector Cutaway View

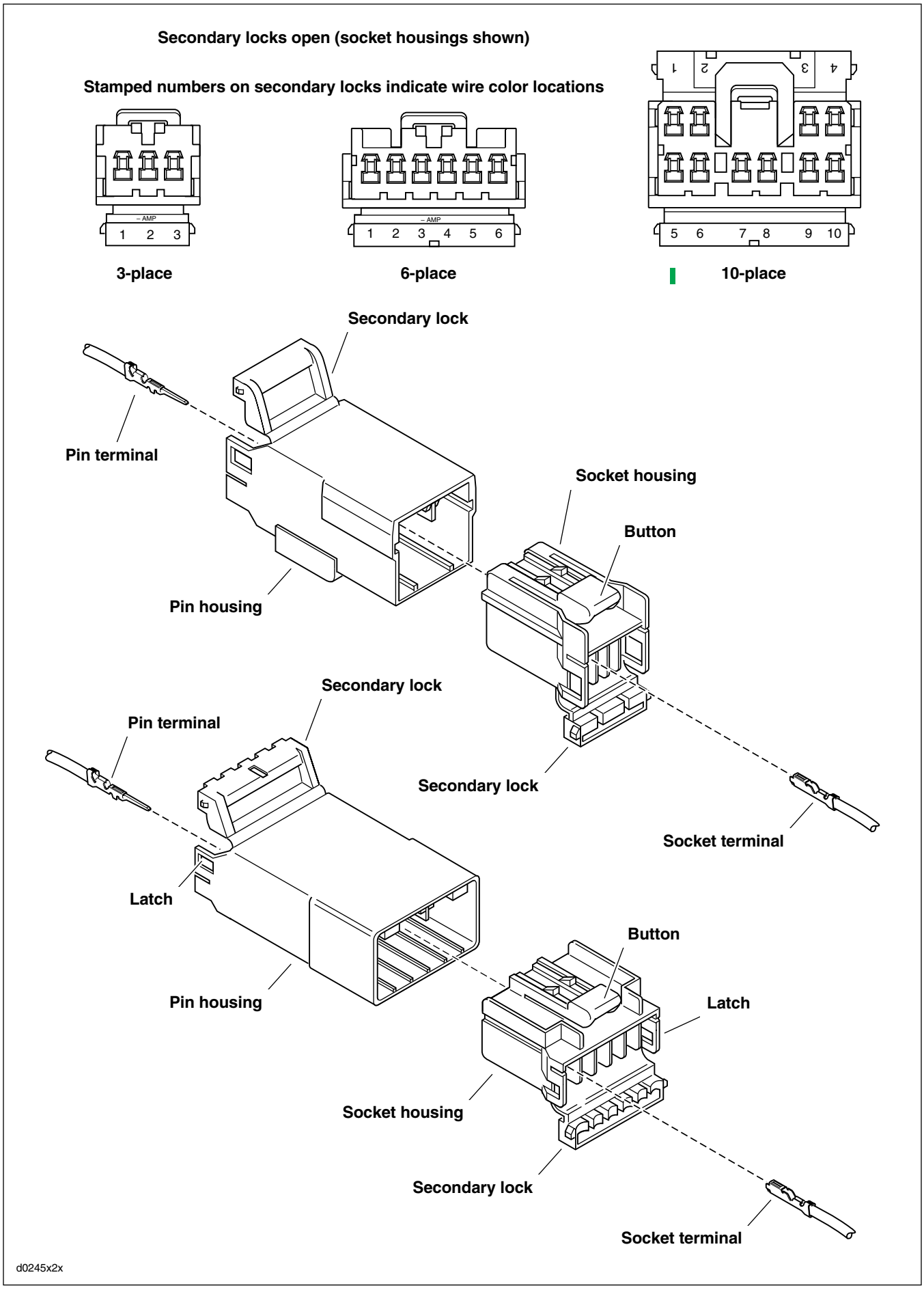


Figure B-4. 3-Place and 6-Place Amp Multilock Connectors

CRIMPING INSTRUCTIONS

1. Squeeze the handles to cycle the crimp tool (Part No. HD-41609) to the fully open position.
2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward, insert contact (socket/pin) through locking bar, so that the closed side of the contact rests on the front nest (concave split level area of the crimp tool). See Figure B-3.
3. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.
4. Strip lead removing 5/32 in. (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.
6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.

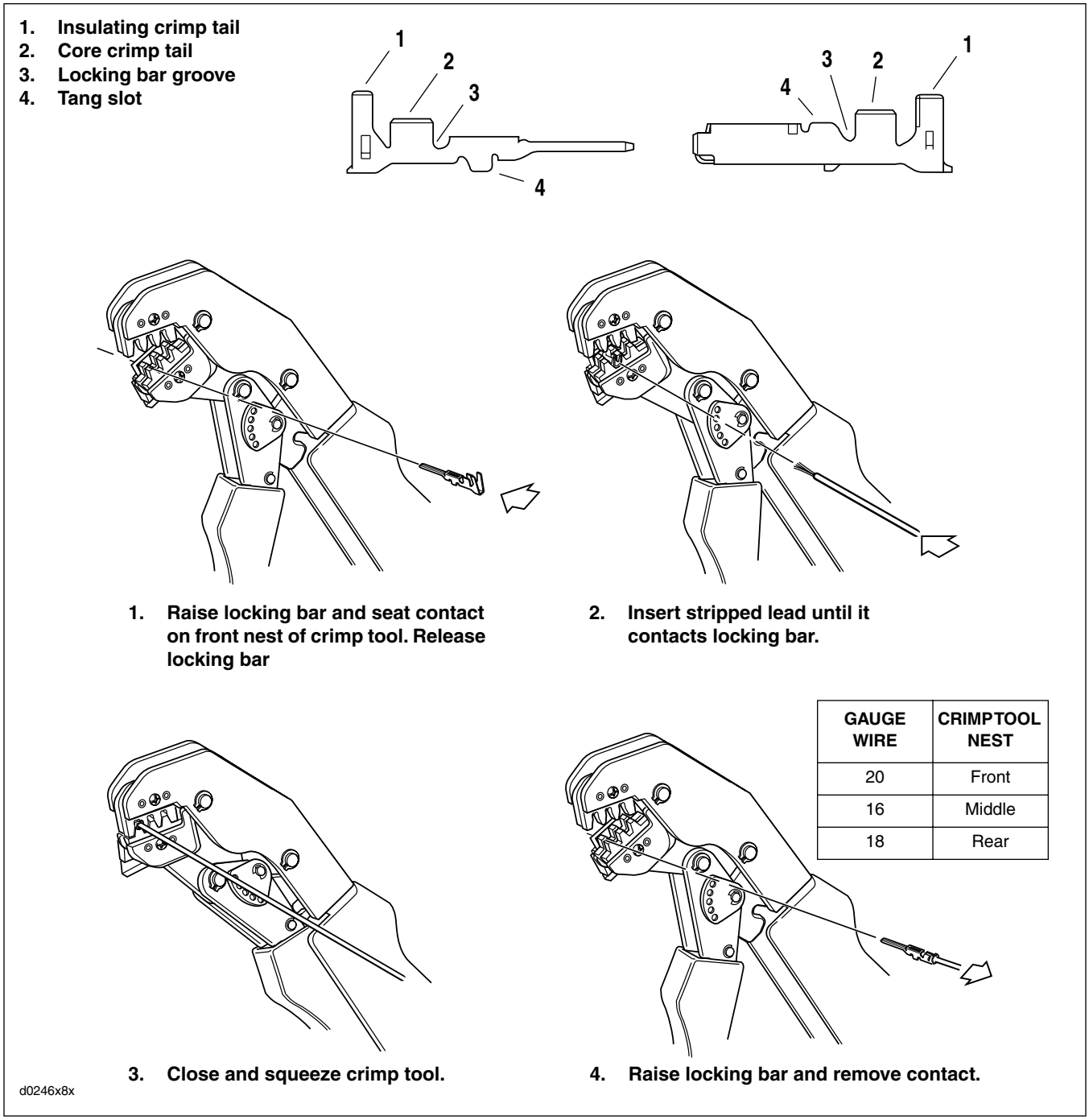


Figure B-5. Amp Multilock Crimping Procedure

DEUTSCH ELECTRICAL CONNECTORS B.2

GENERAL

Deutsch Connectors feature a superior seal to protect electrical contacts from dirt and moisture in harsh environments. The connector also provides superior pin retention.

See Figure B-8. This 12-pin connector illustrates the various parts of the Deutsch connector. The following instructions may be followed for all 2-pin through 12-pin Deutsch connectors.

Socket housing: alignment tabs and/or external latch, secondary locking wedge, internal seal, wire seal, seal pin.

NOTE

Seal pins or plugs are installed in the wire seals of unused pin and socket locations. If removed, seal pins must be replaced to maintain the integrity of the environmental seal.

Pin housing: alignment grooves and/or external latch cover, attachment clip, secondary locking wedge, wire seal, seal pin.

REMOVING/DISASSEMBLING

Attachment clips are attached to the pin housings of most connectors. The clips are then attached to T-studs on the motorcycle frame. T-studs give positive location to electrical connectors and wire harness. Consistent location reduces electrical problems and improves serviceability.

1. Push the connector to disengage small end of slot on attachment clip from T-stud. Lift connector off T-stud.
2. Depress the external latch(es) on the socket housing side and use a rocking motion to separate the pin and socket halves. Two-, three-, four- and six-pin Deutsch connectors have one external latch, while eight- and twelve-pin connectors have two, both of which must be pressed simultaneously to separate the connector halves.

NOTE

With few exceptions, the socket housing can always be found on the accessory side, while the pin side of the connector is connected to the wiring harness.

REMOVING/INSTALLING SOCKETS

1. See Figure B-7. Remove the secondary locking wedge. Insert the blade of a small screwdriver between the socket housing and locking wedge in line with the groove (in line with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up.
2. See Figure B-8. Gently depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

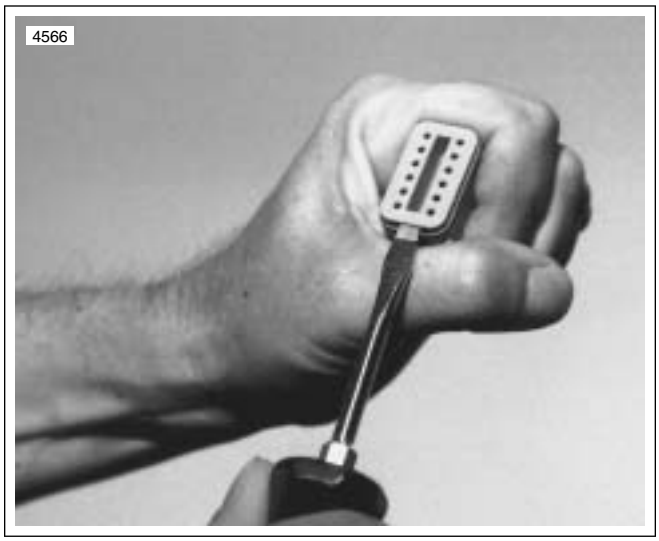


Figure B-6. Remove Secondary Locking Wedge

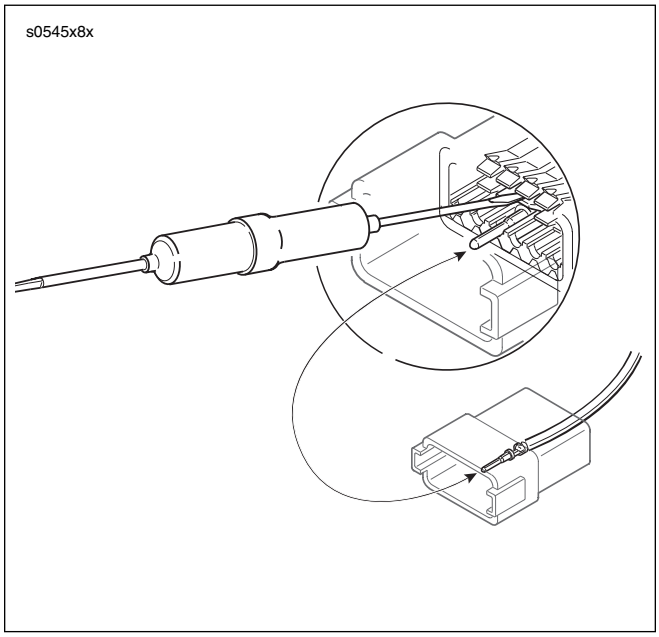


Figure B-7. Depress Terminal Latches/Back Out Pins

NOTE

*An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-39965) is used to install Deutsch pin and socket terminals on wires. If **new** terminals must be installed, follow the instructions included with the crimping tool or see Crimping Instructions in this section.*

Fit rear wire seal into back of socket housing, if removed. Grasp socket approximately 1.0 in. (25.4 mm) behind the contact barrel. Gently push sockets through holes in wire seal into their respective chambers. Feed socket into chamber until it “clicks” in place. Verify that socket will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.

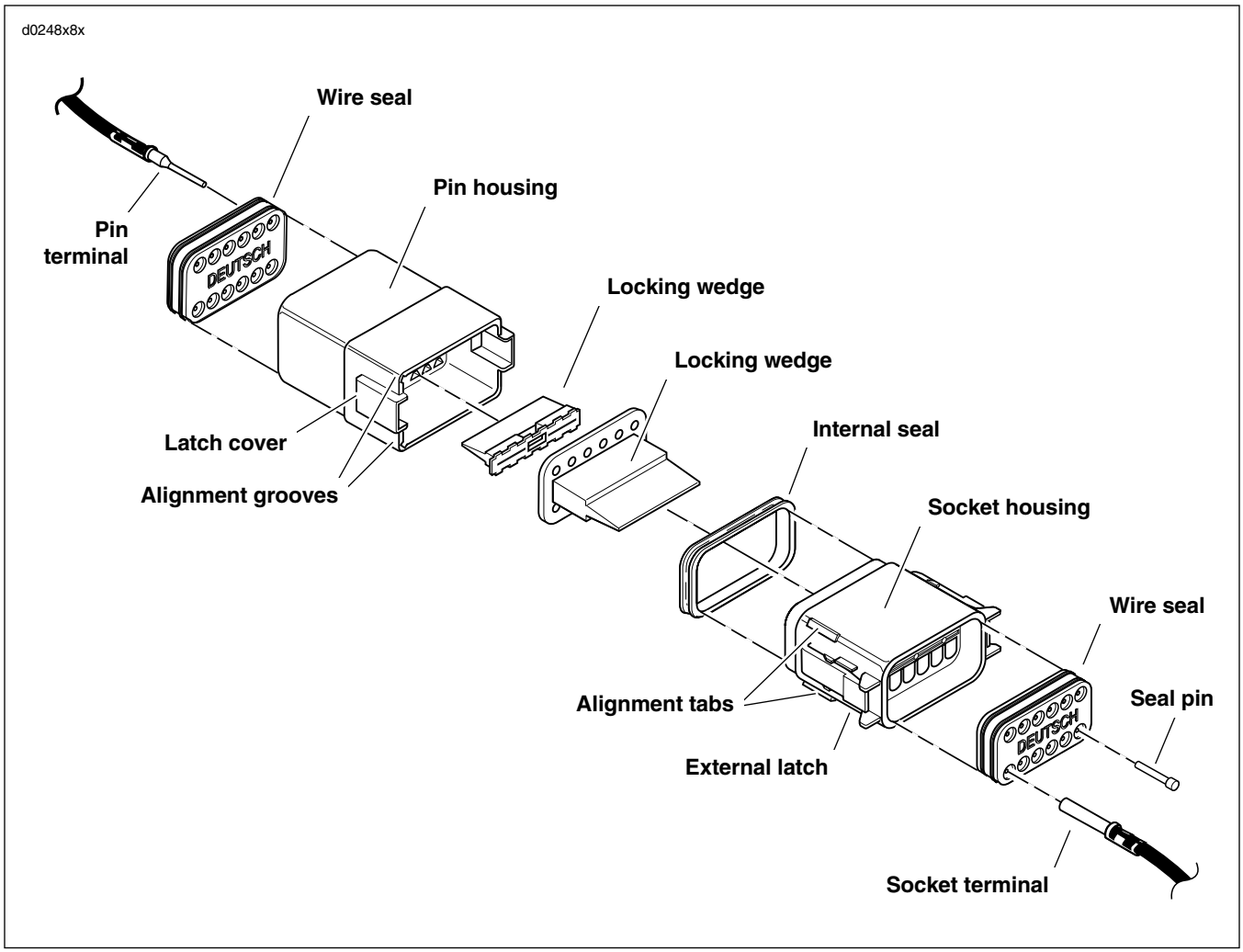


Figure B-8. 12-pin Deutsch Connector (Exploded View)

3. Install internal seal on lip of socket housing, if removed. Insert tapered end of secondary locking wedge into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

NOTES

- *While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure B-9.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

REMOVING/INSTALLING PINS

1. Remove the secondary locking wedge. Use the hooked end of a stiff piece of mechanics wire a needle nose pliers, or a suitable pick tool (Part No. HD-41475-100). See Figure B-10.
2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

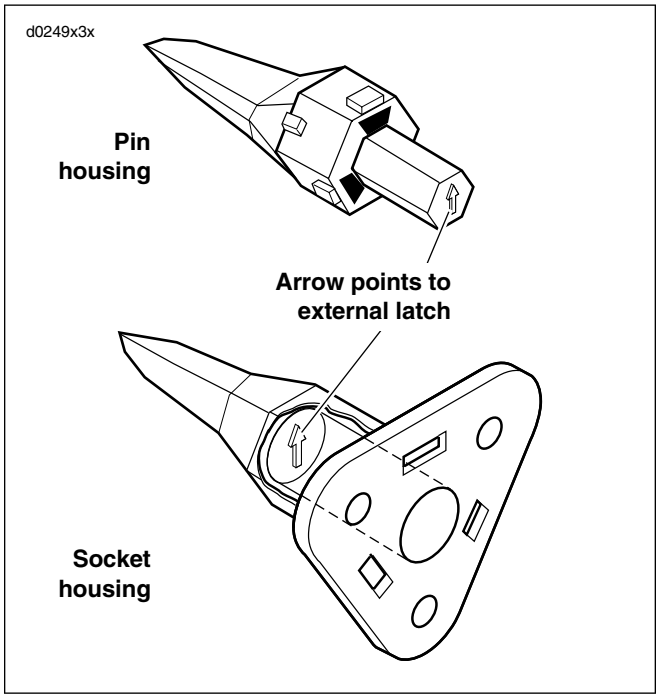


Figure B-9. Depress Terminal Latches/Back Out Pins

NOTE

*An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-39965) is used to install Deutsch pin and socket terminals on wires. If **new** terminals must be installed, see Crimping Instructions in this section.*

3. Fit wire seal into back of pin housing. Grasp crimped pin approximately 1.0 in. (25.4 mm) behind the contact barrel. Gently push pins through holes in wire seal into their respective numbered locations. Feed pin into chamber until it “clicks” in place. Verify that pin will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.
4. Insert tapered end of secondary locking wedge into pin housing and press down until it snaps in place. The wedge fits in the center groove within the pin housing and holds the terminal latches tightly closed.

NOTES

- *While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure B-9.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

ASSEMBLING/INSTALLING

1. Insert socket housing into pin housing until it snaps in place. Two-, three-, four- and six-pin Deutsch connectors have one external latch on the socket half of the connector. To fit the halves of the connector together, the latch on the socket side must be aligned with the latch cover on the pin side.

   For those connectors with two external latches (8-pin and 12-pin), a different system is used to prevent improper assembly. Align the tabs on the socket housing with the grooves on the pin housing. Push the connector halves together until the latches “click.” If latches do not click (latch), press on one side of the connector until that latch engages, then press on the opposite side to engage the other latch.

NOTE

*Deutsch connectors are color coded for location purposes. Those connectors associated with **left** side accessories, such as the front and rear **left** turn signals, are **gray**. All other connectors, including those associated with right side accessories, are black.*

If it should become necessary to replace a plug or receptacle, please note that the 8-pin and 12-pin gray and black connectors are not interchangeable. Since location of the alignment tabs differ between the black and gray connectors, plugs or receptacles must be replaced by those of the same color. If replacing both the socket and pin halves, then the black may be substituted for the gray, and vice versa. The socket and pin halves of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.

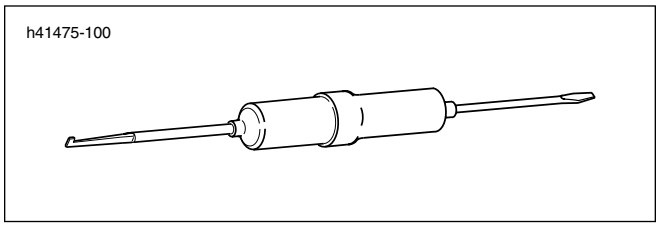


Figure B-10. Deutsch Connector Pick Tool (Part No. HD-41475-100)

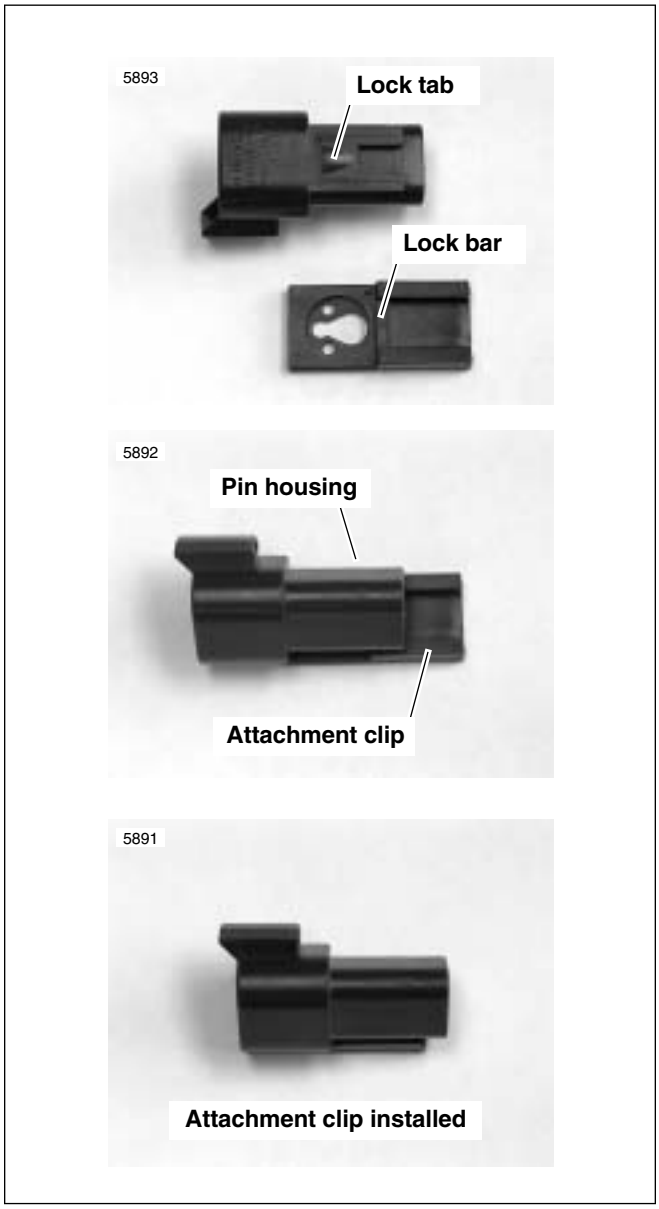


Figure B-11. Attachment Clip Installation

2. See Figure B-11. Fit the attachment clip to the pin housing, if removed. Place large end of slot on attachment clip over T-stud on frame. Push assembly forward to engage small end of slot.

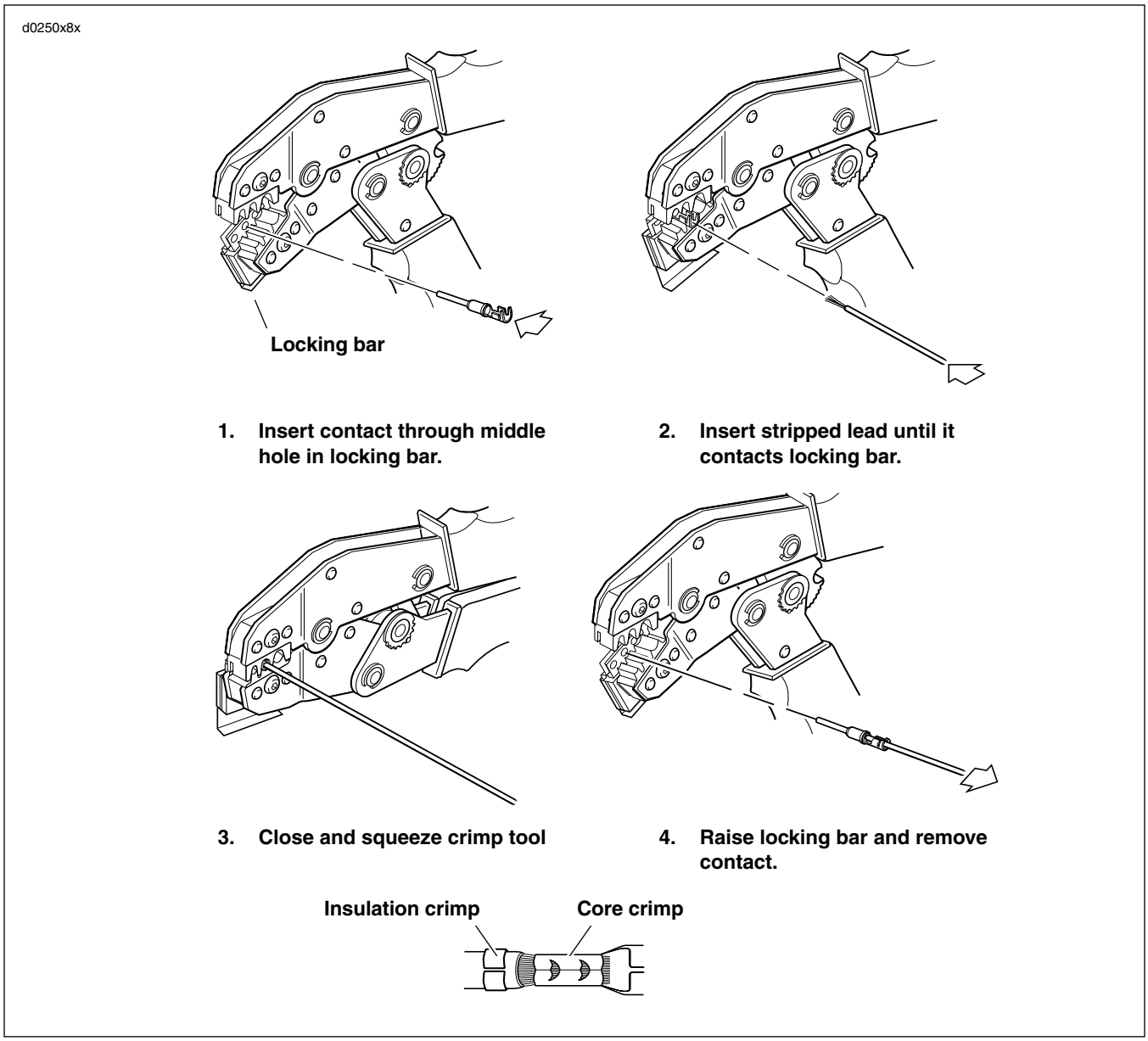


Figure B-12. Deutsch Crimping Procedure

CRIMPING INSTRUCTIONS

1. See Figure B-12. Squeeze the handles to cycle the crimp tool to the fully open position.
2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward and the rounded side of the contact barrel resting on the concave split level area of the crimp tool, insert contact (socket/pin) through middle hole of locking bar.
3. Release locking bar to lock position of contact. If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the contact so that the tails face straight upward. When correctly positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.
4. Strip lead removing 5/32 in. (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.
6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.

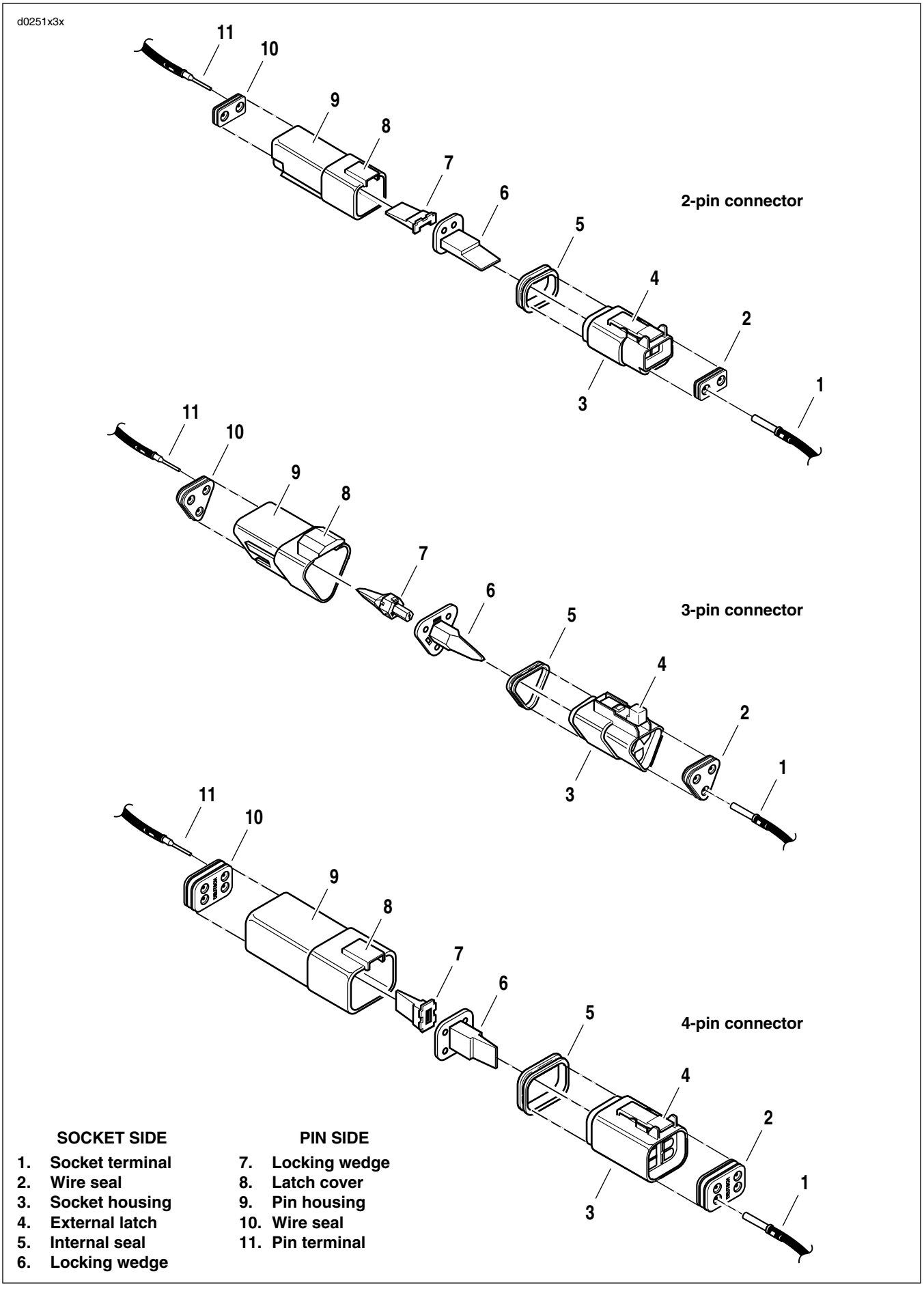


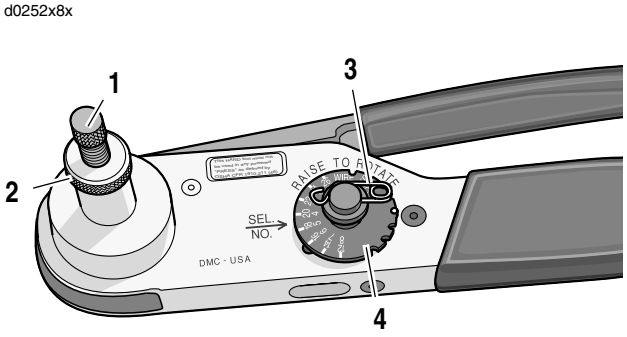
Figure B-13. 2-Pin, 3-pin and 4-pin Deutsch Connectors

MINI-DEUTSCH CONNECTORS B.3

GENERAL

For Size 20, 16 and 12 Contacts Wire Range 26-12 AWG

Mini-Deutsch connectors make use of a solid barrel contact without crimp tails. As a result, a special TERMINAL CRIMP TOOL (Part No. HD-42879) is needed to install pin and socket terminals on wires.



1. **Adjusting screw**
2. **Locknut**
3. **Locking pin**
4. **Selector knob**

Figure B-14. Deutsch Solid Barrel Contact Crimp Tool (Part No. HD-42879)

CRIMPING INSTRUCTIONS

1. Squeeze the handles to cycle the crimp tool to the fully open position.
2. See Figure B-14. Remove locking pin (3) from selector knob (4).
3. See Figure B-15. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with “SEL. NO.” arrow.
4. Loosen knurled locknut and turn adjusting screw clockwise (in) until it stops.
5. Turn tool over and drop contact into indentor cover hole with the wire end out.
6. Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indentor cover. Tighten knurled locknut.
7. See Figure B-16. Slowly squeeze handles of crimp tool until contact (2) is centered between indentor points (3).

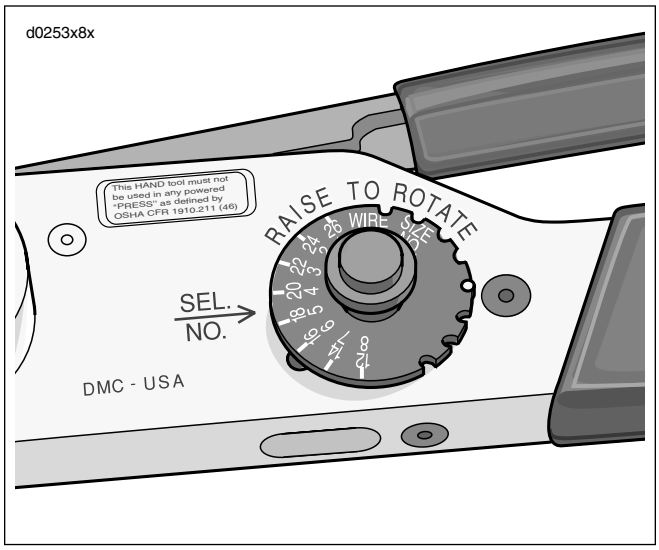


Figure B-15. Selector Knob

1. **Indentor cover**
2. **Contact**
3. **Indentor points**

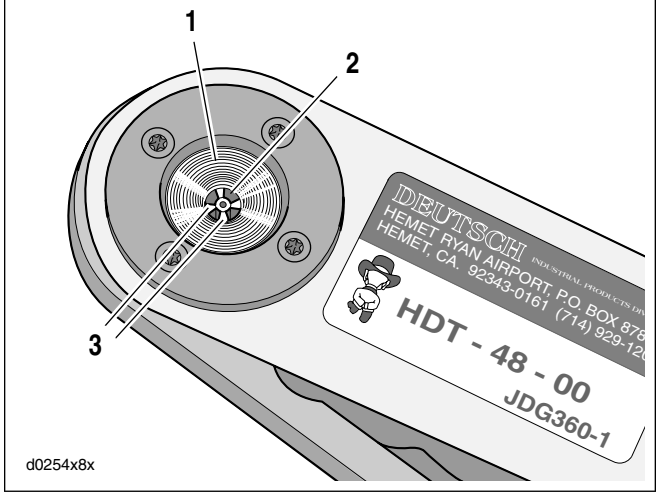


Figure B-16. Indentor Points

8. Strip wire lead removing 1/4 in. (6.3 mm) of insulation.
9. See Figure B-17. Insert bare wire strands into contact barrel.
10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
11. Remove crimped contact from indentor.
12. Inspect the quality of the crimp. Verify that all wire strands are in crimp barrel.

NOTE

Tool must be readjusted when changing contact size/type.

13. Install pin to lock position of selector knob.

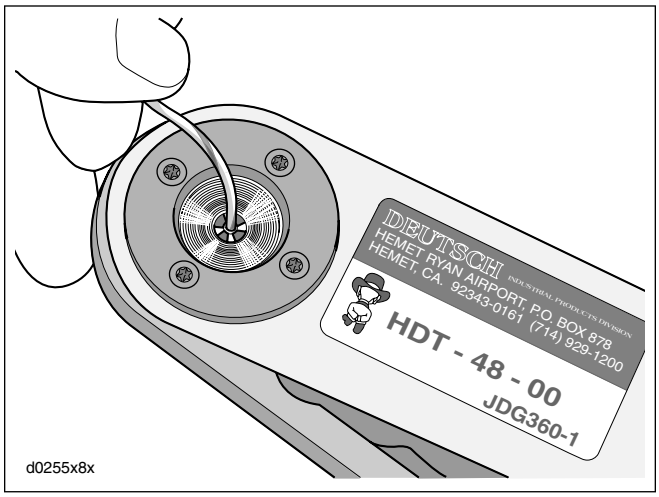


Figure B-17. Contact Barrel

SEALED BUTT SPLICE CONNECTORS B.4

INSTALLATION

Butt splicing may be a necessary procedure for the replacement of some components.

1. Strip 3/8 in. (9.5 mm) of insulation off the ends of the wires.
2. Compress the handles of the Packard Crimp Tool (HD-38125-8) until the ratchet automatically opens.
3. See Table B-1. Since the size of the connectors varies with the gauge of the wire, always used the correct components when creating sealed splices.
4. See Figure B-18. Determine the correct dye or nest for the crimping operation. Match the color or gauge wire marked on the butt splice connector with the corresponding crimp cavity on the crimp tool.
5. Gently apply pressure to the handles until the crimper lightly secures one side of the metal insert inside the butt splice connector. The connector must be crimped in two stages; one side then the other.
6. See Figure B-19. Feed the wire into the butt splice connector until the stripped end contacts the wire stop inside the metal insert.
7. Squeeze the handles of the crimp tool until tightly closed. The tool automatically opens when the crimping sequence is complete.
8. Repeat steps 5, 6, and 7 on the other side of the butt splice connector.

NOTE

If adjacent wires are being spliced, stagger the splices so that the butt splice connectors are spaced at different positions along the length of the wires.

⚠WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
- Avoid heat toward any electrical system component other than the connectors on which heat shrink work is being performed.
- Always keep hands away from tool tip area and heat shrink attachment.

9. Using the UltraTorch UT-100 (Part No. HD-39969), Robinair Heat Gun (Part No. HD-25070) with heat shrink attachment (Part No. HD-41183) or other suitable radiant heating device, heat the crimped splice to encapsulate the butt splice connection. Apply heat from the center of the crimp out to each end until the meltable sealant exudes out both ends of the connector.

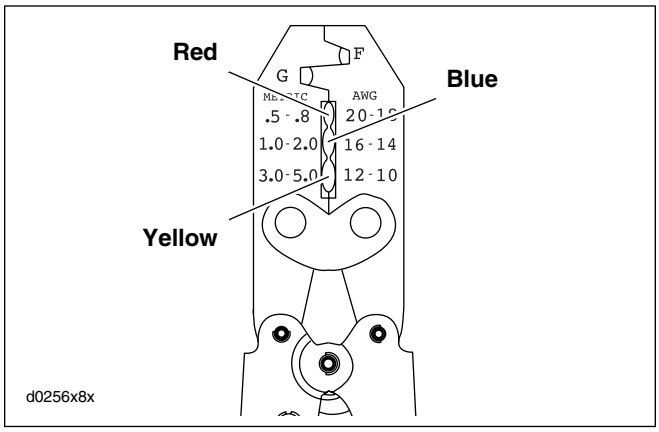


Figure B-18. Packard Crimp Tool (Part No. HD-38125-8)

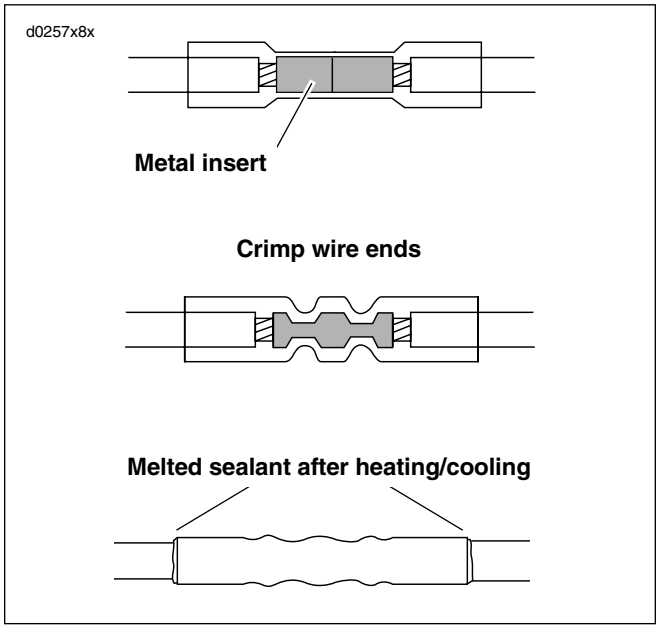


Figure B-19. Installing Sealed Butt Splice Connectors

Table B-1. Common Sealed Splices

GAUGE WIRE	CONNECTOR COLOR	PART NO.
18-20	Red	70585-93
14-16	Blue	70586-93
10-12	Yellow	70587-93

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

10. Heat the center of the splice until the crimp indentations disappear and the tubing assumes a smooth cylindrical appearance.

PACKARD ELECTRICAL CONNECTORS B.5

GENERAL

From a servicing standpoint, there are two basic types of Packard electrical connectors, those with pull-to-seat terminals and those with push-to-seat terminals.

Look into the mating end of the connector. If it appears that the terminal can be extracted from this side, then it is probably the pull-to-seat type.

At least one Packard pull-to-seat terminal can be easily recognized by the presence of a locking ear. The ear engages a slot in the connector housing and prevents the terminal from being removed from the wire end side of the connector. The ear also acts as a strain relief in the event that the wires are pulled and further inhibits movement of the terminal inside the chamber.

Unlike most connectors, where the terminals are pulled out the wire end of the connector, to remove the terminals from the pull-to-seat connectors, the terminal is pushed out the mating end of the connector. Once a **new** terminal is crimped onto the end of the wire, the wire is pulled to draw the terminal back inside the chamber of the connector housing.

Two types of Packard pull-to-seat electrical connectors are used. One type has an external latch to lock the pin and socket halves together, while the other makes use of a wireform. See Figure B-20. The manner in which the terminals are picked differs between these two types of connectors, as further described below.

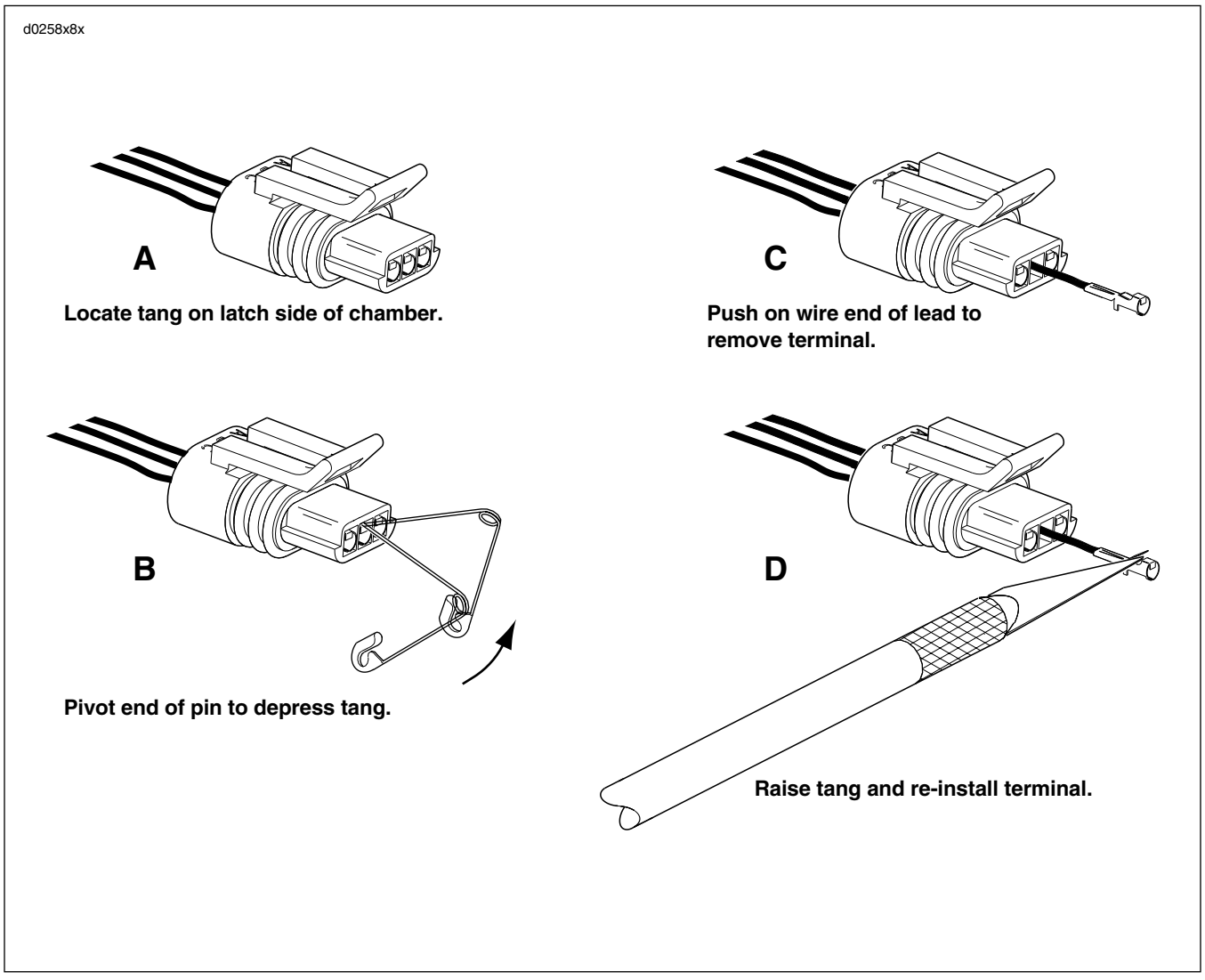


Figure B-20. Packard Connectors

PULL-TO-SEAT TERMINALS

Removing External Latch Type

To remove a pull-to-seat terminal from connectors with external latches, proceed as follows:

1. Remove the connector from the retaining device, if present.
2. Bend back the external latch(es) slightly and separate the pin and socket halves of the connector.
3. To free a pull-to-seat terminal from the connector housing, first look into the mating end of the connector to find the locking tang. See A in Figure B-20. The tangs are always positioned in the middle of the chamber and are on the same side as the external latch. On those connectors with locking ears, the tang is on the side opposite the ear.
4. At a slight angle, gently insert the point of a one inch safety pin down the middle of the chamber (about 1/8 inch) and pivot the end of the pin toward the terminal body. When a click is heard, remove the pin and repeat the procedure. See B in Figure B-20. The click is the sound of the tang returning to the locked position as it slips from the point of the pin. Pick at the tang in this manner until the clicking stops and the pin seems to slide in at a slightly greater depth than it had previously. This is an indication that the tang has been depressed.

NOTES

- *On those terminals that have been extracted on a previous occasion, no clicking sound may be heard when the pin is pivoted to depress the tang, but proceed as if the clicking is audible and then push on the wire end of the lead to check if the terminal is free.*
- *When picking multiple terminals, the end of the pin may become malleable. For best results, continue the procedure with a new safety pin.*

5. Remove the pin and push on the wire end of the lead to extract the terminal from the mating end of the connector. See C in Figure B-20. If necessary, pull back the conduit and remove the wire seal at the back of the connector to introduce some slack in the wires.

NOTE

*A series of Packard Electrical Terminal Crimp Tools are available to install Packard pin and socket terminals on wires. If **new** terminals must be installed, see Crimping Instructions.*

Installing External Latch Type

NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

1. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body. See D in Figure B-20.
2. Gently pull on the lead at the wire end of the connector to draw the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Push on the lead to verify that the terminal is locked in place.
4. Push the pin and socket halves of the connector together until the latches “click.”

PUSH-TO-SEAT TERMINALS

Removing Push-to-Seat Terminals

Like most connectors, Packard push-to-seat terminals are pulled out the wire end of the connector. To remove a push-to-seat terminal, proceed as follows:

1. Remove the connector from the retaining device, if present.
2. Bend back the external latch(es) slightly and separate the pin and socket halves of the connector.

NOTE

Both the Ignition Light/Key Switch and the Main Power connectors are provided with secondary locks. The secondary lock, which may be molded onto the connector or exist as a separate piece, aids in terminal retention. Secondary locks must be opened (or removed) before the terminals can be extracted from the connector housing.

3. Open or remove the secondary lock. **Ignition Switch:** Bend back the latch slightly and free one side of the secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access the terminals in the chambers of the connector housing.
4. Looking in the mating end or terminal side of the connector (opposite the secondary lock), take note of the larger cavity next to each terminal.
5. Insert the pick (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick toward the terminal to depress the locking tang. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat the step if the terminal is still locked in place.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions.

Installing Push-to-Seat Terminals

NOTE

For wire location purposes, alpha characters are stamped onto the secondary locks or onto the wire end of the connector housing.

1. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body.
2. Push the lead into the chamber at the wire end of the connector. A click is heard when the terminal is properly seated.
3. Gently tug on the wire end to verify that the terminal is locked in place and will not back out of the chamber.
4. Close or install the secondary lock. **Ignition Switch:** Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.
5. Push the pin and socket halves of the connector together until the latches “click.”
6. Install connector on retaining device, if present.

CRIMPING INSTRUCTIONS

1. Strip wire lead removing 5/32 in. (4 mm) of insulation.
2. Compress handles until ratchet automatically opens.

NOTE

Always perform core crimp before insulation/seal crimp.

3. Determine the correct dye or nest for the core crimp by checking with the appropriate crimp table.

NOTE

When the word “TIP” appears in the Crimp Table, use the tip of the tool specified to perform the core crimp procedure. See Figure B-21.

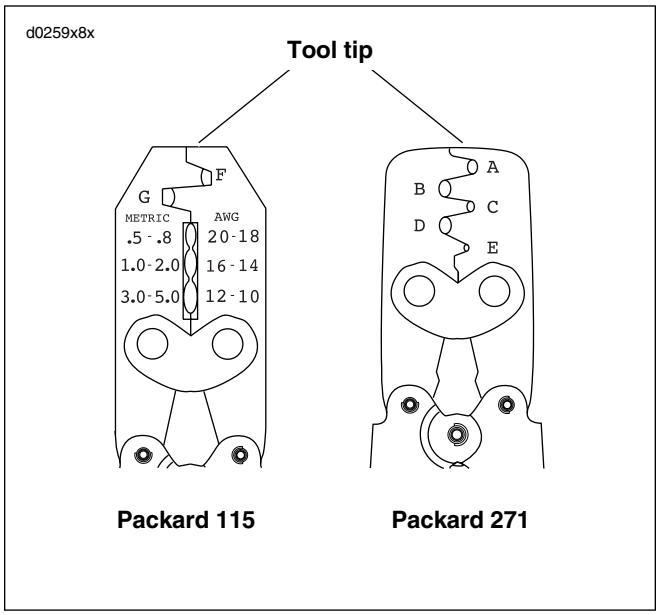
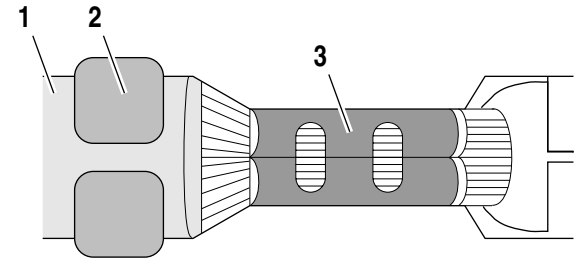


Figure B-21. Packard Terminal Crimp Tools

Table B-2. Packard Terminal Crimp Tools

SPECIFICATION	PACKARD 115	PACKARD 271
Part No.	HD-38125-8	HD-38125-7
Type of Crimp	Non-sealed terminals, butt splices	Non-sealed terminals
Dye/nests	F-G	A-E

4. Lay the back of the core crimp tails on the appropriate nest. Be sure the core crimp tails are pointing towards the forming jaws.
5. Gently apply pressure to handles of tool until crimpers slightly secure the core crimp tails.
6. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation or seal material.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
8. Determine the correct dye or nest for the insulation/seal crimp.
9. Lay the back of the insulation/seal crimp tails on the appropriate nest. Be sure the insulation/seal crimp tails are pointing towards the forming jaws.
10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
11. See Figure B-22. Inspect the quality of the core (3) and insulation/seal (2) crimps. Distortion should be minimal.



1. Insulation
2. Insulation crimp
3. Core crimp

Figure B-22. Inspect Core and Insulation/Seal Crimps

PACKARD ECM CONNECTOR B.6

DISASSEMBLY

1. See Figure B-23. Depress tabs (3) on the sides of connector and remove clear plastic cover (4).
2. Remove cable strap (2).
3. See Figure B-24. Pry three tabs (1) to separate connector halves.
4. Push on desired wire (2) from back of connector to expose wire terminal.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard socket terminals on wires. If new terminals must be installed, see CRIMPING INSTRUCTIONS.

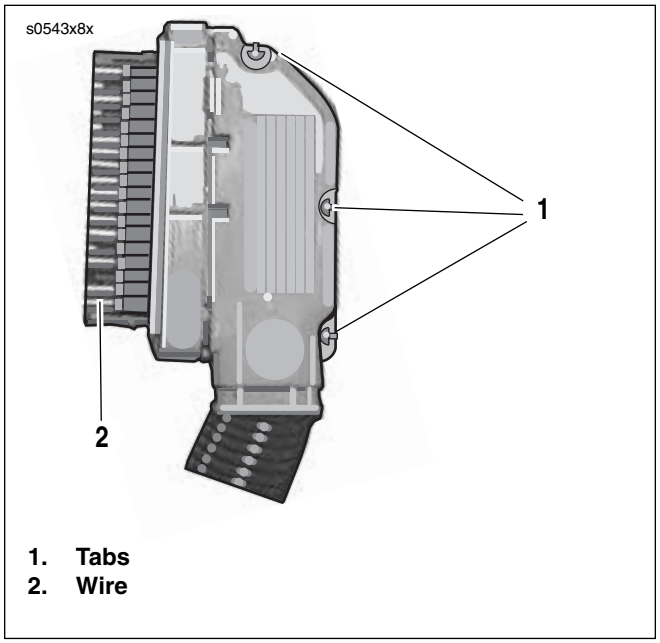
ASSEMBLY

1. Push wire into correct hole until terminal is seated.

NOTE

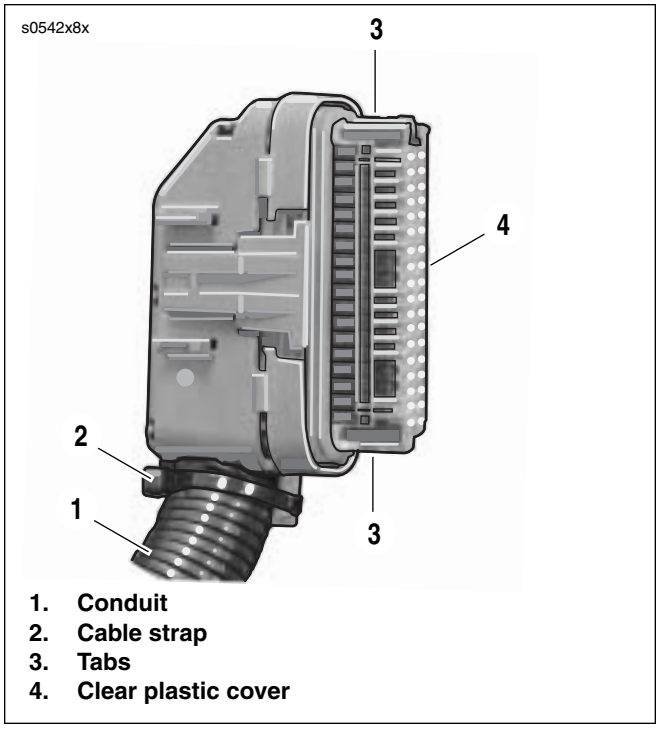
In next step be sure wires are not pinched while mating connector halves.

2. See Figure B-23. Mate connector halves making sure wires are not pinched and end of wire conduit (1) is inside connector halves.
3. Install new cable strap on end of connector.
4. Install clear plastic cover over terminals.



1. **Tabs**
2. **Wire**

Figure B-24. Connector Tabs



1. **Conduit**
2. **Cable strap**
3. **Tabs**
4. **Clear plastic cover**

Figure B-23. ECM Connector

CRIMPING INSTRUCTIONS

1. Strip wire lead removing 5/32 in. (4 mm) of insulation.
2. Compress handles until ratchet automatically opens.

NOTE

Always perform core crimp before insulation/seal crimp.

3. Determine the correct dye or nest for the core crimp by checking with the appropriate crimp table.

NOTE

When the word "TIP" appears in the Crimp Table, use the tip of the tool specified to perform the core crimp procedure. See Figure B-21.

4. Lay the back of the core crimp tails on the appropriate nest. Be sure the core crimp tails are pointing towards the forming jaws.
5. Gently apply pressure to handles of tool until crimpers slightly secure the core crimp tails.
6. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation or seal material.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
8. Determine the correct dye or nest for the insulation/seal crimp.
9. Lay the back of the insulation/seal crimp tails on the appropriate nest. Be sure the insulation/seal crimp tails are pointing towards the forming jaws.
10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
11. See Figure B-22. Inspect the quality of the core (3) and insulation/seal (2) crimps. Distortion should be minimal.

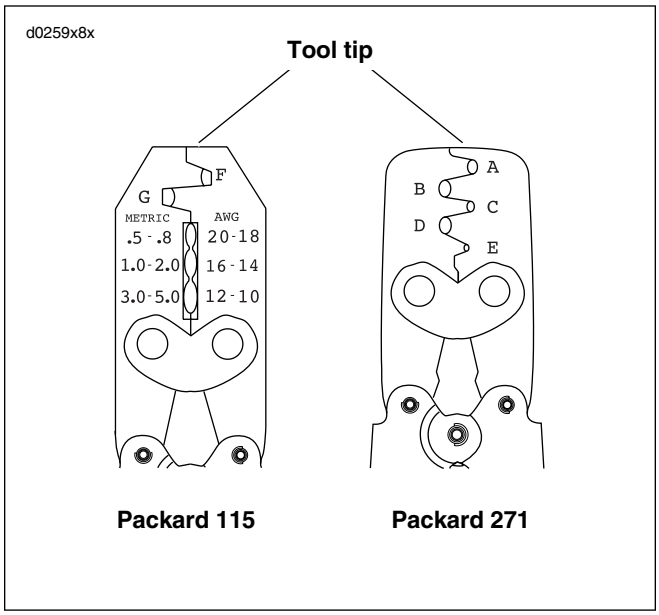


Figure B-25. Packard Terminal Crimp Tools

Table B-3. Packard Terminal Crimp Tools

SPECIFICATION	PACKARD 115	PACKARD 271
Part No.	HD-38125-8	HD-38125-7
Type of Crimp	Non-sealed terminals, butt splices	Non-sealed terminals
Dye/nests	F-G	A-E

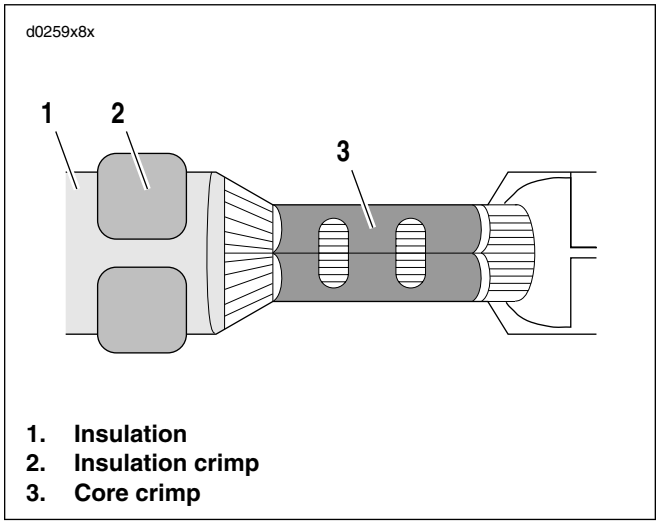


Figure B-26. Inspect Core and Insulation/Seal Crimps

CONNECTOR LOCATIONS B.7

Table B-4. Connector Locations

CONNECTOR NO.	DESCRIPTION	TYPE	LOCATION
[5]	main fuse	spade terminals	under right side cover
[18]	right rear turn signal	2-place Multilock	under outer rear fender
[19]	left rear turn signal	2-place Multilock	under outer rear fender
[22]	right hand controls	6-place Deutsch	under left side cover
[24]	left hand controls and horn	6-place Deutsch	under left side cover
[29]	position lamp (HDI)	2-place Mini-Deutsch	under left side cover
[30]	turn signal/security module	12-place Deutsch	under passenger seat
[31]	front turn signals	6-place Multilock	under left side cover
[33]	ignition key switch	3-place Packard	back of ignition switch
[38L]	low beam lamp	2-place Amp	back of headlamp
[38H]	high beam lamp	2-place Amp	back of headlamp
[39]	instrument module (IM)	12-place Mini-Deutsch	under handlebar cover
[45]	license plate lamp	3-place Multilock	under outer rear fender
[46]	voltage regulator to stator	3-place Packard	under left trim cover
[65]	vehicle speed sensor (VSS)	3-place Deutsch	above rear rocker box
[77]	voltage regulator to main harness	1-place Deutsch	behind radiator cover
[78]	electronic control module (ECM)	36-place Packard	under left side cover
[79]	crank position sensor (CKP)	2-place Mini-Deutsch	under left trim cover
[80]	manifold air pressure sensor (MAP)	3-place Packard	front intake passage
[83 F]	front plug top coil	3-place Packard	on top of front rocker box
[83 R]	rear plug top coil	3-place Packard	on top of rear rocker box
[84]	front injector	2-place Packard	throttle body
[85]	rear injector	2-place Packard	throttle body
[87]	idle air control (IAC)	4-place Packard	below air cleaner assembly
[88]	throttle position sensor (TP)	3-place Packard	front of throttle body
[89]	intake air temperature sensor (IAT)	2-place Packard	upper airbox
[90]	engine coolant sensor (ECT)	2-place Packard	water pump housing
[91]	data link connector	4-place Deutsch	under left side cover
[93]	tail lamp	4-place Multilock	under outer rear fender
[95]	purge solenoid	2-place Packard	below seat
[97 T]	cooling fan	2-place Multilock	under left trim cover
[97 B]	cooling fan	2-place Multilock	under left trim cover
[120]	oil pressure switch	post terminal	crankcase between cylinders
[122]	horn	spade terminals	between cylinders, left side
[128A]	starter solenoid coil	spade terminals	behind radiator-left side
[61]	starter relay	5-place Amp	under air box cover, in fuse block
[62]	system relay	5-place Amp	under air box cover, in fuse block
[62]	fan relay	5-place Amp	under air box cover, in fuse block
[141]	fuel pump and sender	3-place Mini-Deutsch	top of fuel tank

Table B-4. Connector Locations

CONNECTOR NO.	DESCRIPTION	TYPE	LOCATION
[142]	security siren (optional)	3-place Packard	electrical panel behind fender extension
[145]	engine harness	12-place Mini-Deutsch	below air cleaner assembly
-	fuse block	spade terminals	under air box cover
-	rear stoplight switch	spade terminals	behind transmission
-	neutral switch	post terminals	bottom rear of crankcase
-	harness grounds (2)	ring terminals	front and rear cam covers

INDEX TO WIRING DIAGRAMS B.8

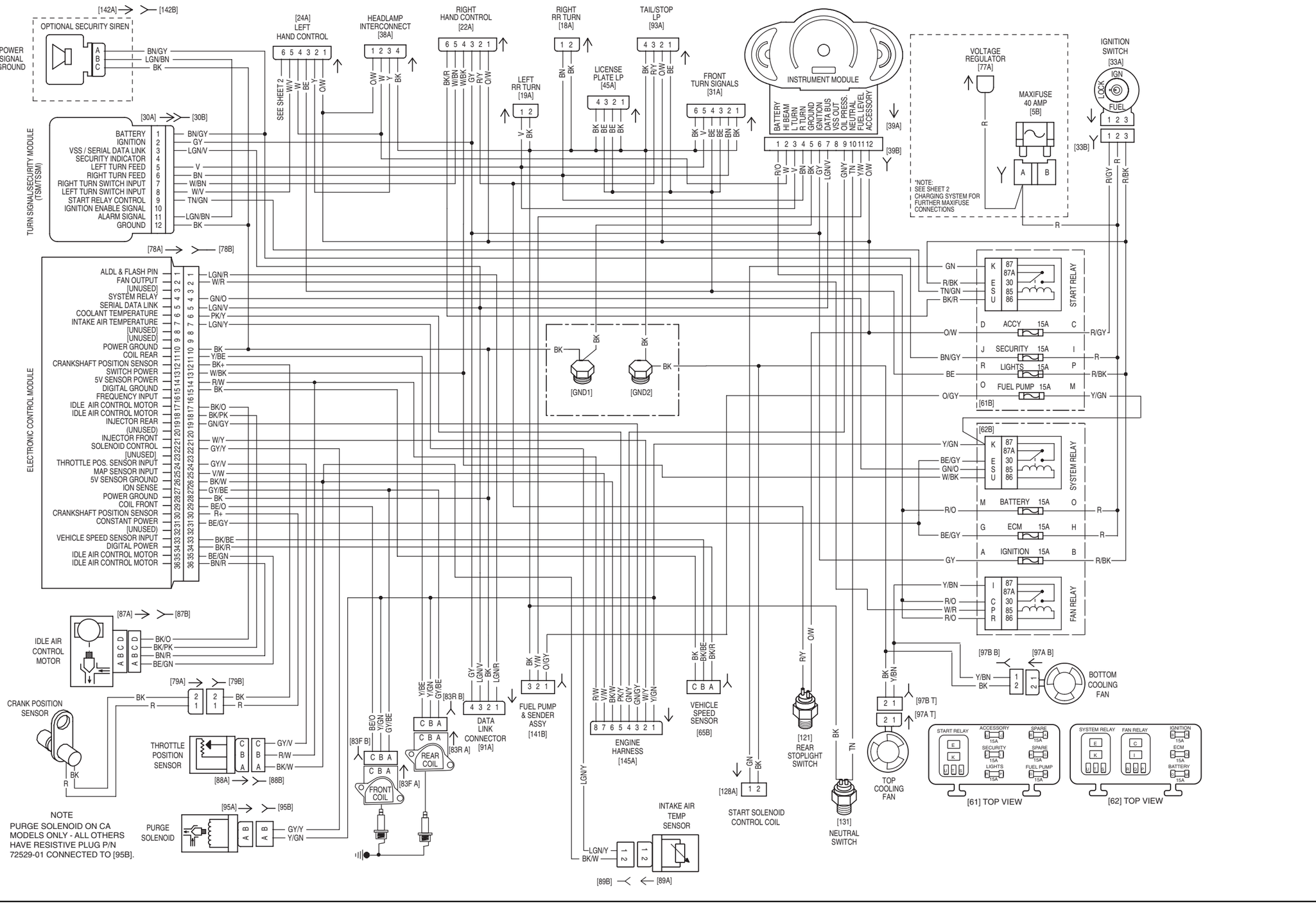
Table B-5. Wiring Diagrams

Table B-6. Wiring Color Codes

CODE	COLOR	CODE	COLOR
BE	Blue	PK	Pink
BK	Black	R	Red
BN	Brown	TN	Tan
GN	Green	V	Violet
GY	Grey	W	White
LT GN	Light green	Y	Yellow
O	Orange		

NOTES

vd0017x1x

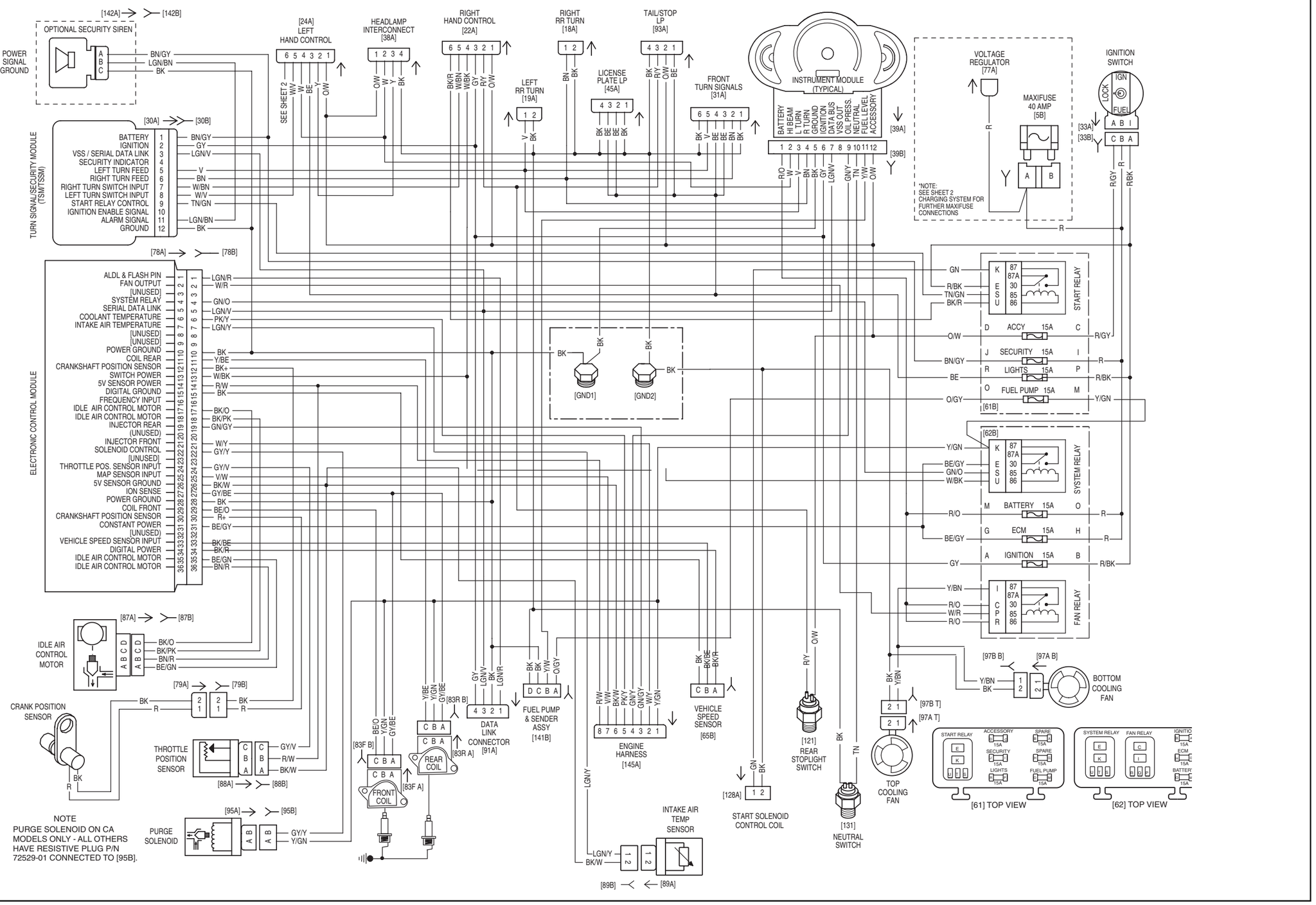


2006 VRSCA/VRSCD MODEL, MAIN HARNESS: PAGE 1 OF 2

2006 VRSCA/VRSCD MODEL, MAIN HARNESS: PAGE 1 OF 2

2006 VRSCA/VRSCD MODEL, MAIN HARNESS: PAGE 1 OF 2

vd0094x1x 94x1x



2006 VRSCR MODEL, MAIN HARNESS: PAGE 1 OF 2

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2006 VRSCR MODEL, MAIN HARNESS: PAGE 1 OF 2

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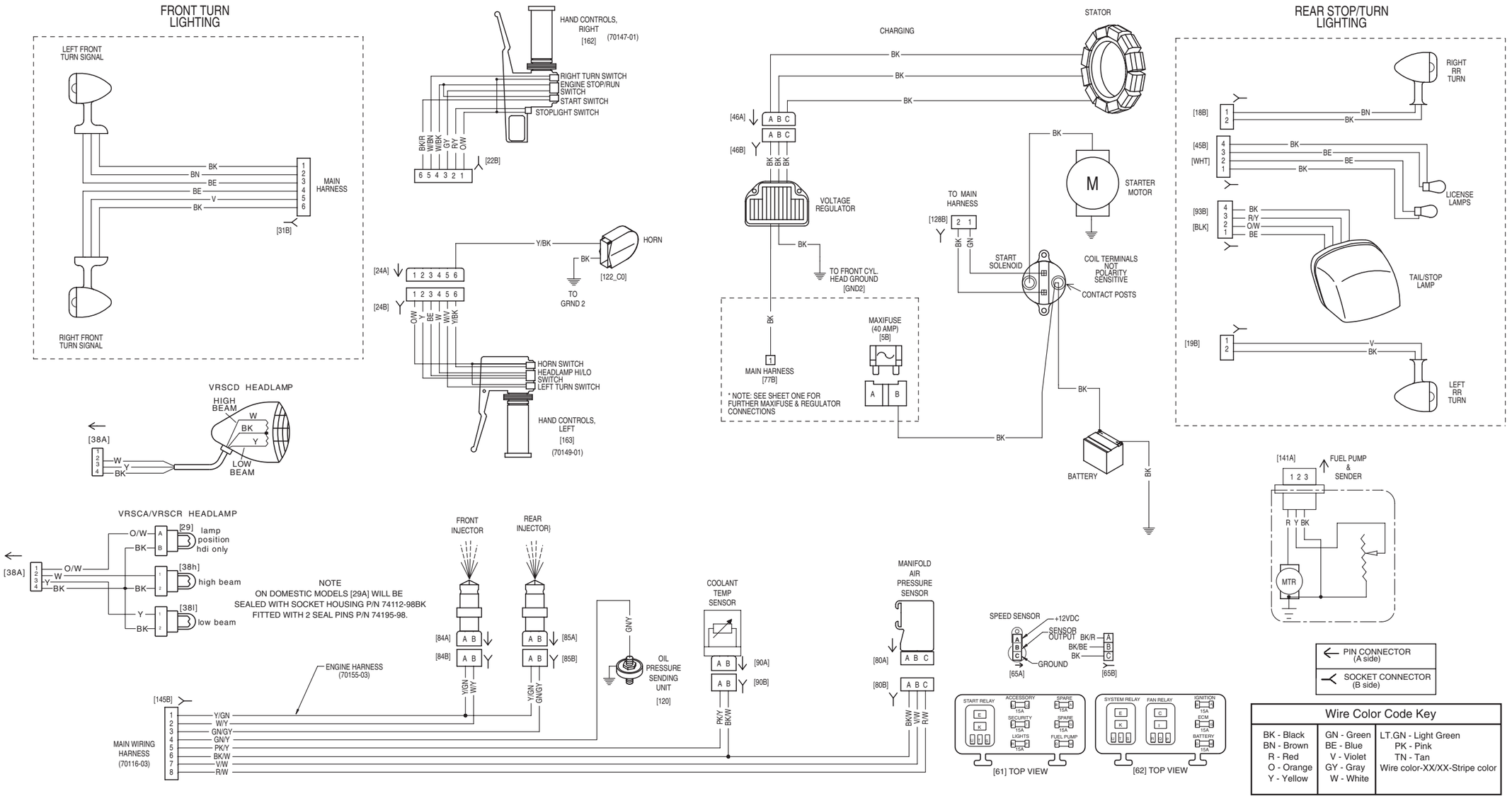
vd0018x1x



Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

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2006 VRSCA/VRSCD MODEL, MAIN HARNESS: PAGE 2 OF 2

2006 VRSCA/VRSCD MODEL, MAIN HARNESS: PAGE 2 OF 2

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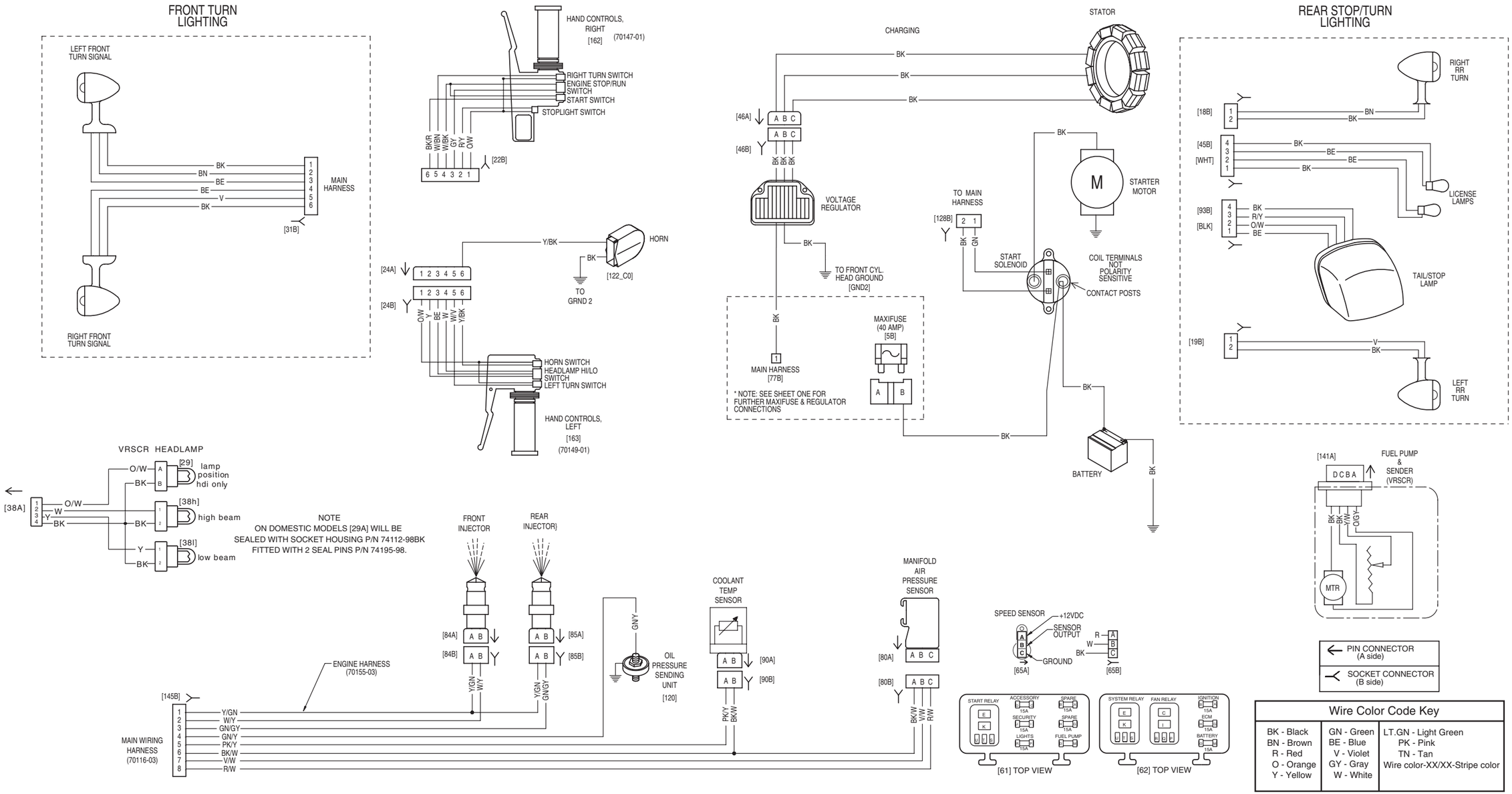
vd0095x1x

vd0018xx



Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

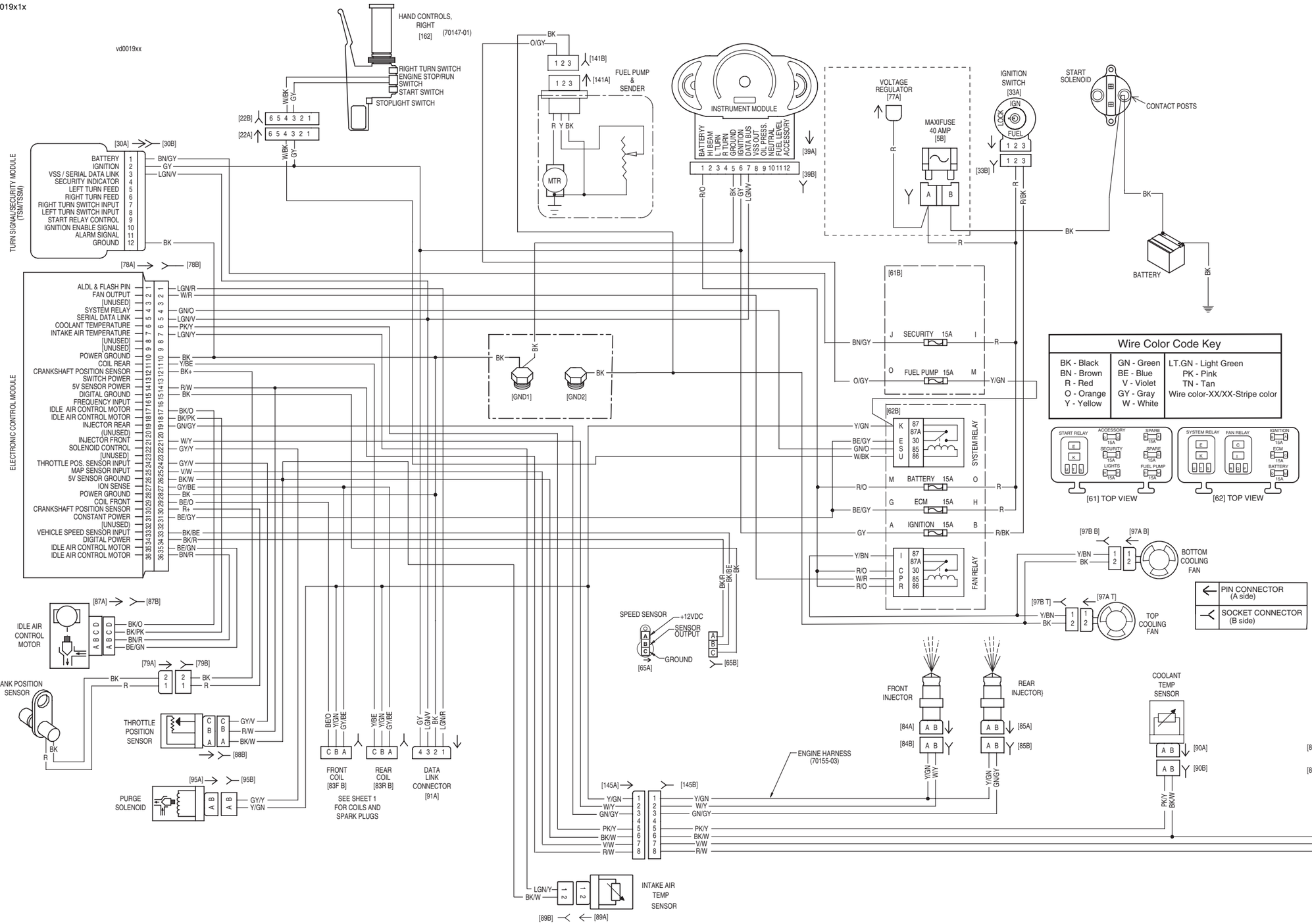
2006 VRSCR MODEL, MAIN HARNESS: PAGE 2 OF 2

2006 VRSCR MODEL, MAIN HARNESS: PAGE 2 OF 2

2006 VRSCR MODEL, MAIN HARNESS: PAGE 2 OF 2

vd0019x1x

vd0019xx



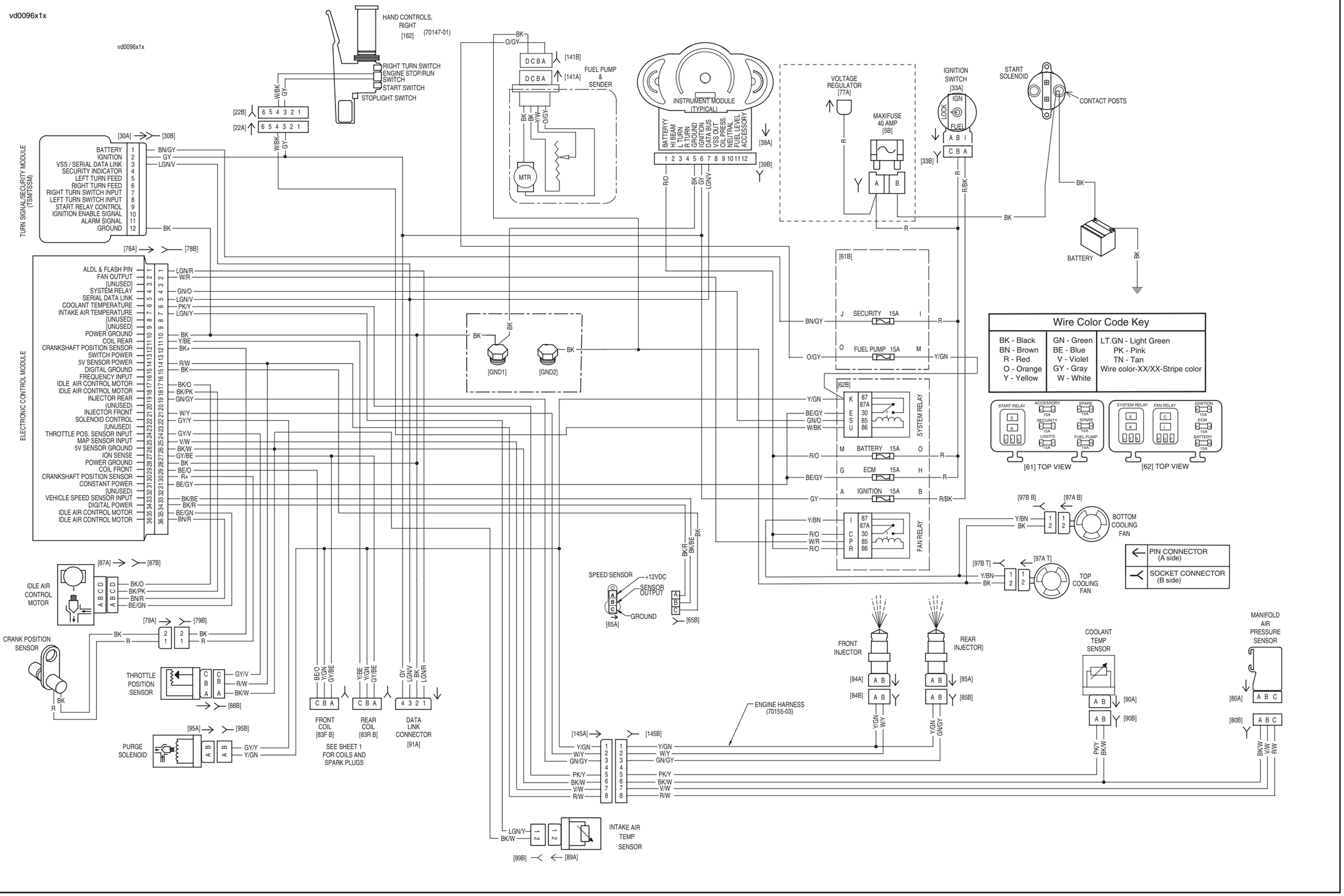
2006 VRSCA/VRSCD MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

vd0096x1x

vd0096x1x



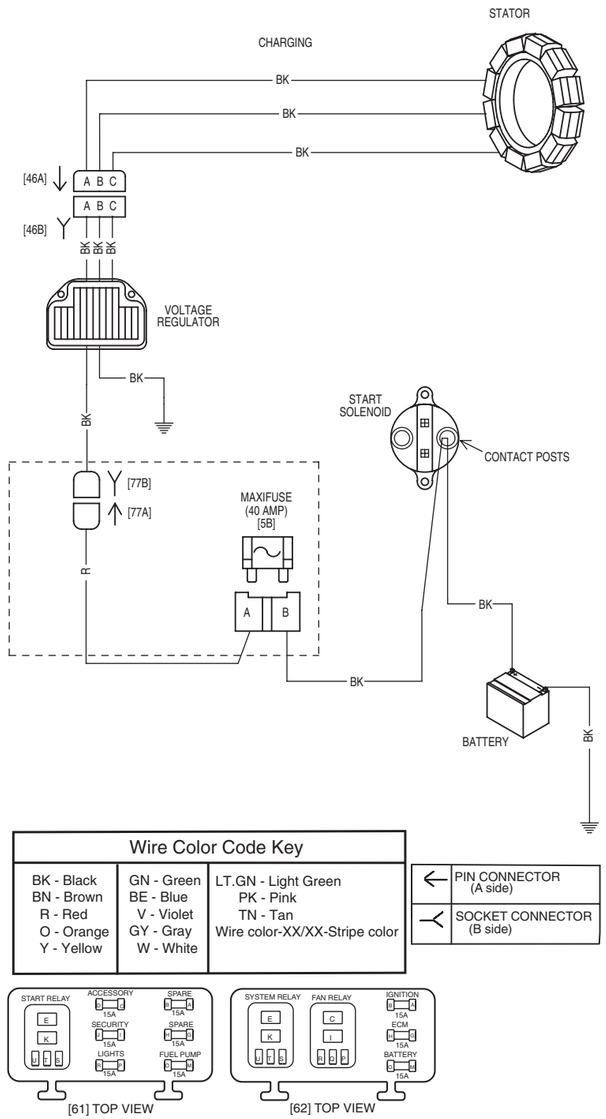
2006 VRSCR MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

vd0097xxx

vd0097xxx



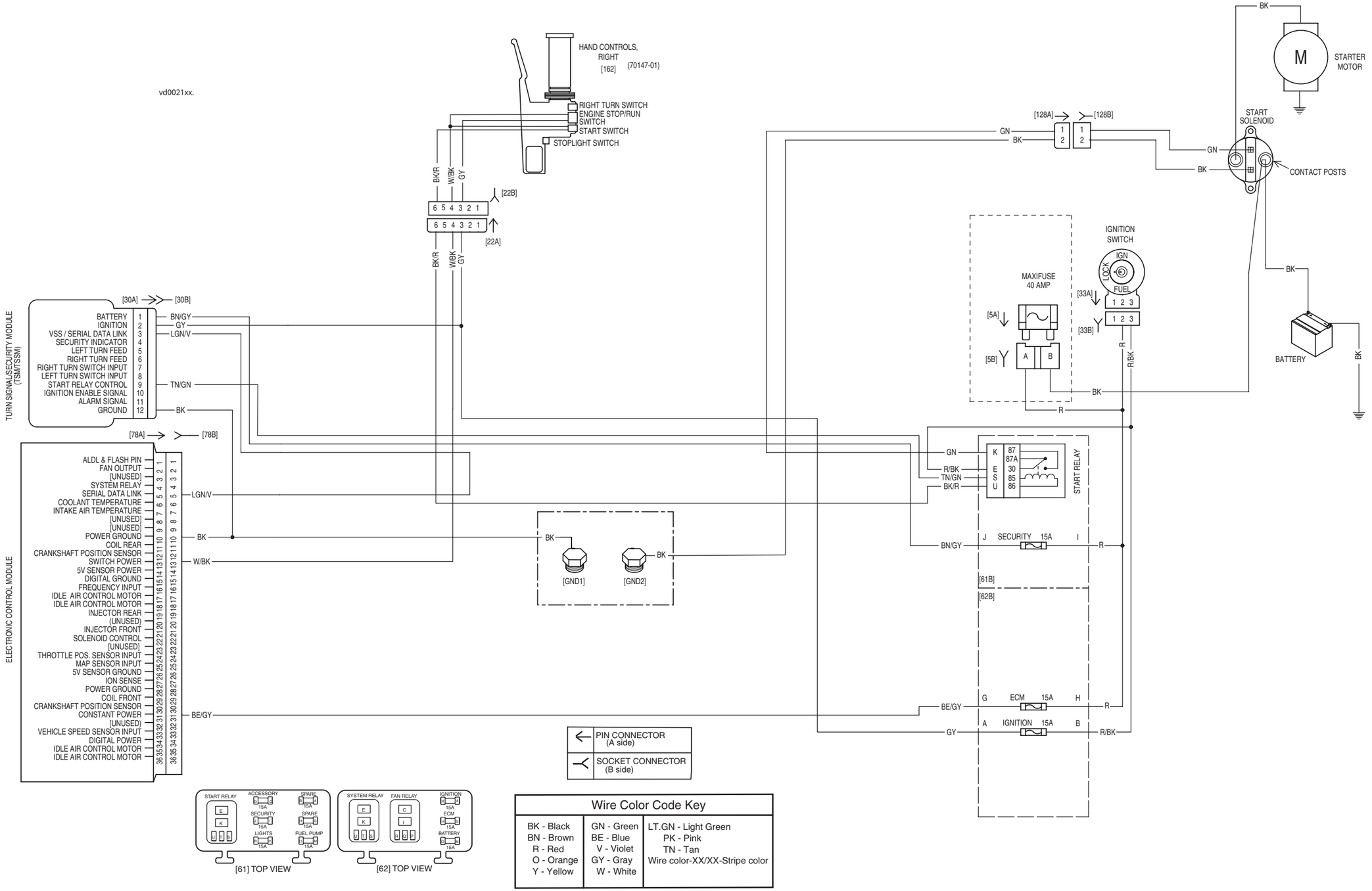
2006 VRSC (ALL) MODEL, CHARGING CIRCUIT: PAGE 1 OF 1

2006 VRSC (ALL), CHARGING CIRCUIT: PAGE 1 OF 1

2006 VRSC (ALL), CHARGING CIRCUIT: PAGE 1 OF 1

vd0021xxx

vd0021xx.



Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

2006 VRSCA/VRSCD MODEL, STARTING CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, STARTING CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, STARTING CIRCUIT: PAGE 1 OF 1

vd0098xxx

vd0098xxx

HAND CONTROLS, RIGHT [162] (70147-01)
RIGHT TURN SWITCH
ENGINE STOP/RUN SWITCH
START SWITCH
STOPLIGHT SWITCH
BK/R
W/BK
GY
[22B]
[22A]
6 5 4 3 2 1

BK
M
STARTER MOTOR
START SOLENOID
CONTACT POSTS
[128A]
[128B]
GN
BK
1 2

IGNITION SWITCH
LOCK
IGN
FUEL
A B I
C B A
[33A]
[33B]
MAXIFUSE 40 AMP
[5A]
[5B]
A
B
R
R/BK
BATTERY

TURN SIGNAL/SECURITY MODULE (TSM/TSSM)
[30A] [30B]
BATTERY 1
IGNITION 2
VSS / SERIAL DATA LINK 3
SECURITY INDICATOR 4
LEFT TURN FEED 5
RIGHT TURN FEED 6
RIGHT TURN SWITCH INPUT 7
LEFT TURN SWITCH INPUT 8
START RELAY CONTROL 9
IGNITION ENABLE SIGNAL 10
ALARM SIGNAL 11
GROUND 12
BN/GY
GY
LGN/V
TN/GN
BK

ELECTRONIC CONTROL MODULE
[78A] [78B]
ALDL & FLASH PIN
FAN OUTPUT
[UNUSED]
SYSTEM RELAY
SERIAL DATA LINK
COOLANT TEMPERATURE
INTAKE AIR TEMPERATURE
[UNUSED]
[UNUSED]
POWER GROUND
COIL REAR
CRANKSHAFT POSITION SENSOR
SWITCH POWER
5V SENSOR POWER
DIGITAL GROUND
FREQUENCY INPUT
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
INJECTOR REAR
(UNUSED)
INJECTOR FRONT
SOLENOID CONTROL
[UNUSED]
THROTTLE POS. SENSOR INPUT
MAP SENSOR INPUT
5V SENSOR GROUND
ION SENSE
POWER GROUND
COIL FRONT
CRANKSHAFT POSITION SENSOR
CONSTANT POWER
[UNUSED]
VEHICLE SPEED SENSOR INPUT
DIGITAL POWER
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
LGN/V
BK
W/BK
BE/GY

[GND1] [GND2]

GN
R/BK
TN/GN
BK/R
K
E
S
U
87
87A
30
85
86
START RELAY
BN/GY
J SECURITY 15A I
[61B]
[62B]
BE/GY
G ECM 15A H
GY
A IGNITION 15A B
R
R/BK

PIN CONNECTOR (A side)
SOCKET CONNECTOR (B side)

START RELAY
ACCESSORY 15A
SPARE 15A
SECURITY 15A
SPARE 15A
LIGHTS 15A
FUEL PUMP 15A
[61] TOP VIEW

SYSTEM RELAY
FAN RELAY
IGNITION 15A
ECM 15A
BATTERY 15A
[62] TOP VIEW

Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

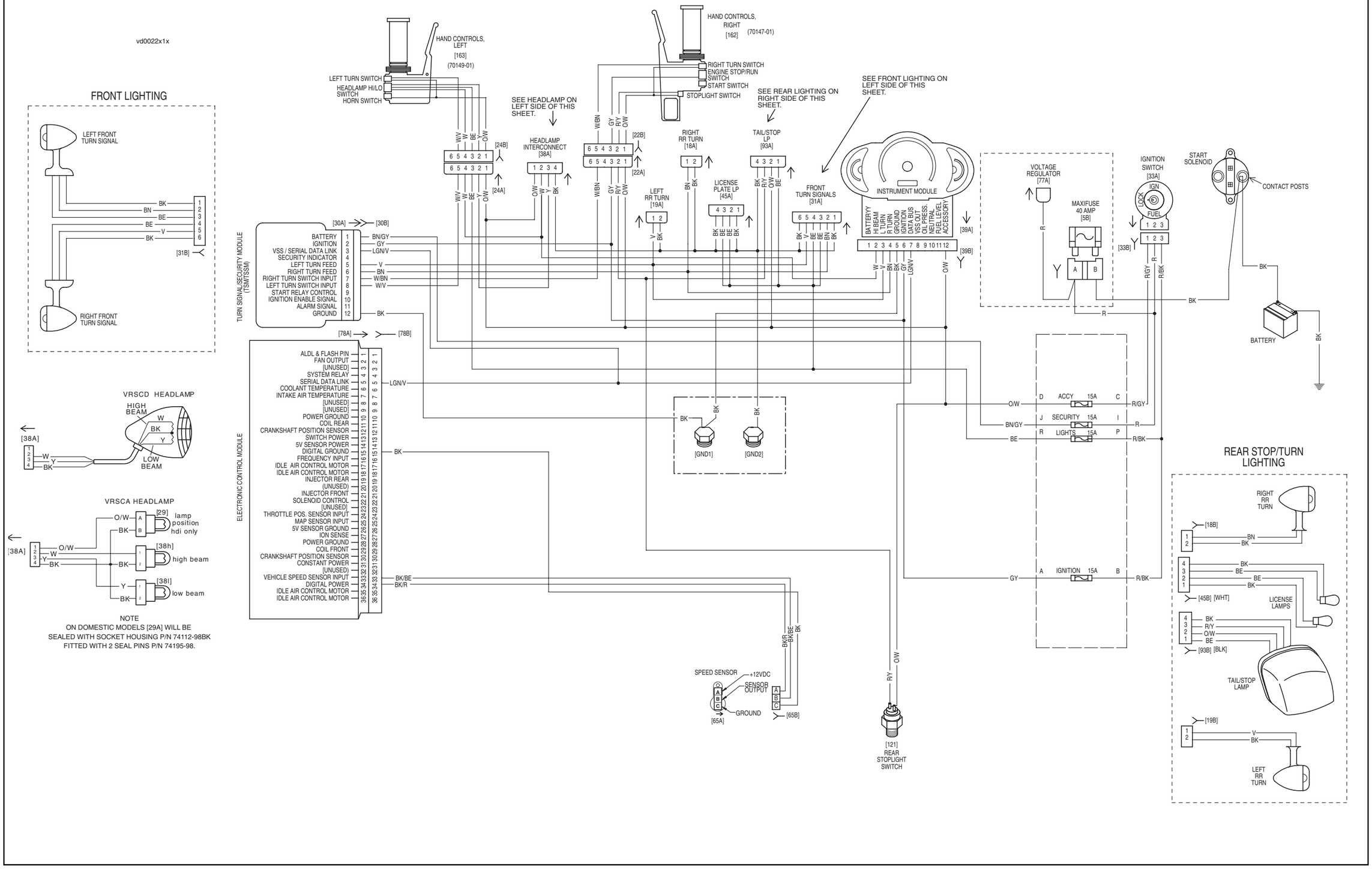
2006 VRSCR MODEL, STARTING CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, STARTING CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, STARTING CIRCUIT: PAGE 1 OF 1

vd0022xxx

vd0022x1x



2006 VRSCA/VRSCD MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

vd0099x1x

vd0099x1x

FRONT LIGHTING

LEFT FRONT TURN SIGNAL

RIGHT FRONT TURN SIGNAL

BK
BN — BE
BE
V
BK
[31B]

VRSCR HEADLAMP

[38A]
O/W
W
Y
BK

[29] lamp position hdi only
[38h] high beam
[38l] low beam

NOTE
ON DOMESTIC MODELS [29A] WILL BE SEALED WITH SOCKET HOUSING P/N 74112-98BK FITTED WITH 2 SEAL PINS P/N 74195-98.

HAND CONTROLS, LEFT [163] (70149-01)
LEFT TURN SWITCH
HEADLAMP HI/LO SWITCH
HORN SWITCH

HAND CONTROLS, RIGHT [162] (70147-01)
RIGHT TURN SWITCH
ENGINE STOP/RUN SWITCH
START SWITCH
STOPLIGHT SWITCH

SEE HEADLAMP ON LEFT SIDE OF THIS SHEET.
SEE REAR LIGHTING ON RIGHT SIDE OF THIS SHEET.
SEE FRONT LIGHTING ON LEFT SIDE OF THIS SHEET.

HEADLAMP INTERCONNECT [38A]
RIGHT RR TURN [18A]
LEFT RR TURN [19A]
LICENSE PLATE LP [45A]
TAIL/STOP LP [93A]
FRONT TURN SIGNALS [31A]
INSTRUMENT MODULE (TYPICAL)
BATTERY
HI BEAM
L TURN
R TURN
GROUND
DIGITAL BUS
VSS OUT
OIL PRESS.
NEUTRAL
FUEL LEVEL
ACCESSORY

VOLTAGE REGULATOR [77A]
MAXIFUSE 40 AMP [5B]
IGNITION SWITCH [33A]
START SOLENOID
CONTACT POSTS
BATTERY

TURN SIGNAL/SECURITY MODULE (TSM/TSSM)
[30A] [30B]
BATTERY 1 — BN/GY
IGNITION 2 — GY
VSS / SERIAL DATA LINK 3 — LGN/V
SECURITY INDICATOR 4
LEFT TURN FEED 5 — V
RIGHT TURN FEED 6 — BN
RIGHT TURN SWITCH INPUT 7 — W/BN
LEFT TURN SWITCH INPUT 8 — W/V
START RELAY CONTROL 9
IGNITION ENABLE SIGNAL 10
ALARM SIGNAL 11
GROUND 12 — BK

ELECTRONIC CONTROL MODULE
[78A] [78B]
ALDL & FLASH PIN
FAN OUTPUT
[UNUSED]
SYSTEM RELAY
SERIAL DATA LINK — LGN/V
COOLANT TEMPERATURE
INTAKE AIR TEMPERATURE
[UNUSED]
[UNUSED]
POWER GROUND — BK
COIL REAR
CRANKSHAFT POSITION SENSOR
SWITCH POWER
5V SENSOR POWER
DIGITAL GROUND
FREQUENCY INPUT
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
INJECTOR REAR
(UNUSED)
INJECTOR FRONT
SOLENOID CONTROL
[UNUSED]
THROTTLE POS. SENSOR INPUT
MAP SENSOR INPUT
5V SENSOR GROUND
ION SENSE
POWER GROUND
COIL FRONT
CRANKSHAFT POSITION SENSOR
CONSTANT POWER
[UNUSED]
VEHICLE SPEED SENSOR INPUT — BK/BE
DIGITAL POWER — BK/R
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR

[GND1] [GND2]

SPEED SENSOR
+12VDC
SENSOR OUTPUT
GROUND
[65A] [65B]

[121] REAR STOPLIGHT SWITCH

D ACCY 15A C — O/W — R/GY
J SECURITY 15A I — BN/GY — R
R LIGHTS 15A P — BE — R/BK
A IGNITION 15A B — GY — R/BK

REAR STOP/TURN LIGHTING

RIGHT RR TURN
[18B] BN BK
[45B] [WHT] BK BE BE BK
LICENSE LAMPS
[93B] [BLK] BK R/Y O/W BE
TAIL/STOP LAMP
[19B] V BK
LEFT RR TURN

2006 VRSCR MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

v0023xxx

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TURN SIGNAL/SECURITY MODULE (TSM/TTSSM)

[30A] [30B]

BATTERY	1	BN/GY
IGNITION	2	LGN/V
VSS / SERIAL DATA LINK	3	
SECURITY INDICATOR	4	
LEFT TURN FEED	5	
RIGHT TURN FEED	6	
RIGHT TURN SWITCH INPUT	7	
LEFT TURN SWITCH INPUT	8	
START RELAY CONTROL	9	
IGNITION ENABLE SIGNAL	10	
ALARM SIGNAL	11	
GROUND	12	BK

ELECTRONIC CONTROL MODULE

[78A] [78B]

ALDL & FLASH PIN	1	
FAN OUTPUT	2	
[UNUSED]	3	
SYSTEM RELAY	4	
SERIAL DATA LINK	5	LGN/V
COOLANT TEMPERATURE	6	
INTAKE AIR TEMPERATURE	7	
[UNUSED]	8	
[UNUSED]	9	
POWER GROUND	10	BK
COIL REAR	11	
CRANKSHAFT POSITION SENSOR	12	
SWITCH POWER	13	
5V SENSOR POWER	14	
DIGITAL GROUND	15	BK
FREQUENCY INPUT	16	
IDLE AIR CONTROL MOTOR	17	
IDLE AIR CONTROL MOTOR	18	
INJECTOR REAR	19	
(UNUSED)	20	
INJECTOR FRONT	21	
SOLENOID CONTROL	22	
[UNUSED]	23	
THROTTLE POS. SENSOR INPUT	24	
MAP SENSOR INPUT	25	
5V SENSOR GROUND	26	
ION SENSE	27	
POWER GROUND	28	
COIL FRONT	29	
CRANKSHAFT POSITION SENSOR	30	
CONSTANT POWER	31	BE/GY
[UNUSED]	32	
VEHICLE SPEED SENSOR INPUT	33	BK/BE
DIGITAL POWER	34	BK/R
IDLE AIR CONTROL MOTOR	35	
IDLE AIR CONTROL MOTOR	36	

INSTRUMENT MODULE

[39A]

BATTERY	1
HI BEAM	2
L TURN	3
R TURN	4
GROUND	5
IGNITION	6
DATA BUS	7
VSS OUT	8
OIL PRESS.	9
NEUTRAL	10
FUEL LEVEL	11
ACCESSORY	12

[39B]

R/O BK LGN/V GN/Y TN Y/W O/W

*NOTE: SEE SHEET 2 CHARGING SYSTEM FOR FURTHER MAXIFUSE CONNECTIONS

MAXIFUSE 40 AMP [5B]

IGNITION SWITCH [33A]

IGN LOCK FUEL

[33B]

START SOLENOID

CONTACT POSTS

BATTERY

BK

R

R/GY

O/W D ACCY 15A C R/GY

BN/GY J SECURITY 15A I R

P

R/O M BATTERY 15A O R

BE/GY G ECM 15A H R

[GND1] [GND2]

PIN CONNECTOR (A side)

SOCKET CONNECTOR (B side)

Wire Color Code Key

BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe
Y - Yellow	W - White	

[61] TOP VIEW

[62] TOP VIEW

START RELAY ACCESSORY 15A SPARE 15A SECURITY 15A SPARE 15A LIGHTS 15A FUEL PUMP 15A

SYSTEM RELAY FAN RELAY

[24A] 1 2 3 4 5 6

[24B] 1 2 3 4 5 6

O/W Y/BK

O/W

Y/BK BK HORN

TO GRND 2

[122_C0]

HORN SWITCH
HEADLAMP HI/LO SWITCH
LEFT TURN SWITCH

HAND CONTROLS, LEFT
[163]
(70149-01)

SPEED SENSOR +12VDC SENSOR OUTPUT GROUND

[65A] [65B]

BK/R BK/BE BK

[141B] Y/W BK

[141A] 1 2 3

FUEL PUMP & SENDER

R Y BK

MTR

BK TN

[131] NEUTRAL SWITCH

[145A] [145B]

GN/Y GN/Y GN/Y

OIL PRESSURE SENDING UNIT
[120]

ENGINE HARNESS (70155-03)

2006 VRSCA/VRSCD MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

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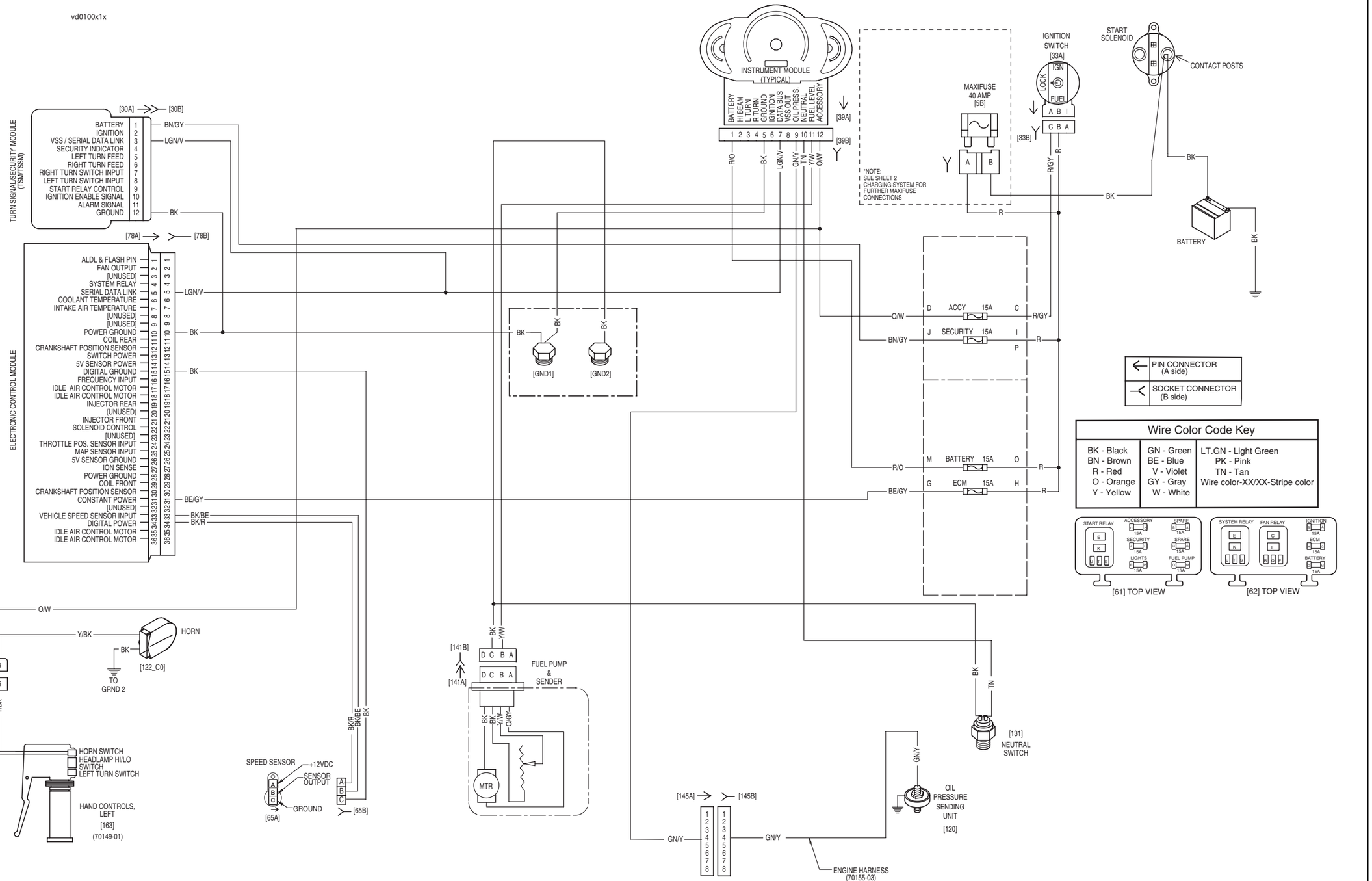
vd0100x1x

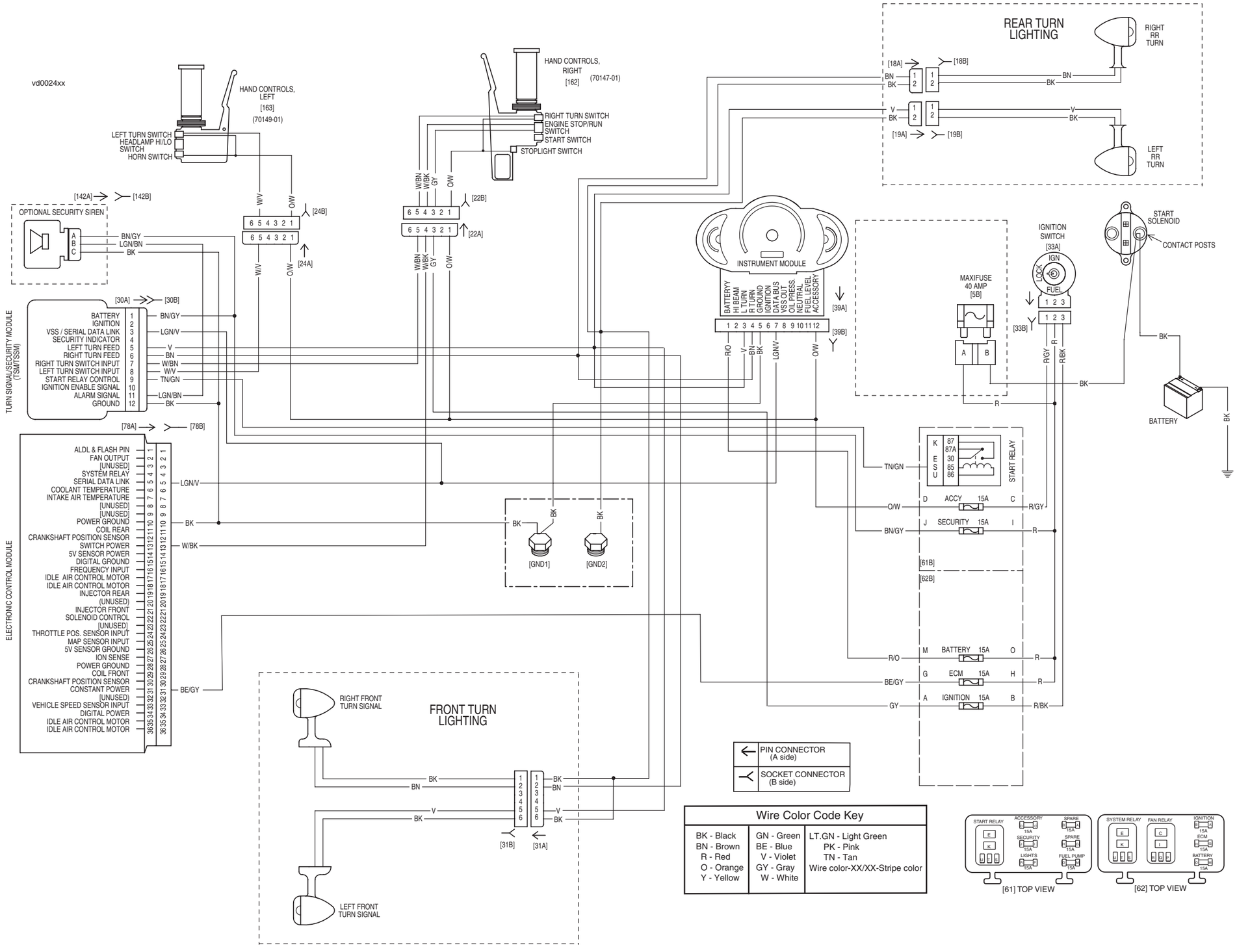


2006 VRSCR MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

vd0024xxx



2006 VRSCA/VRSCD MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

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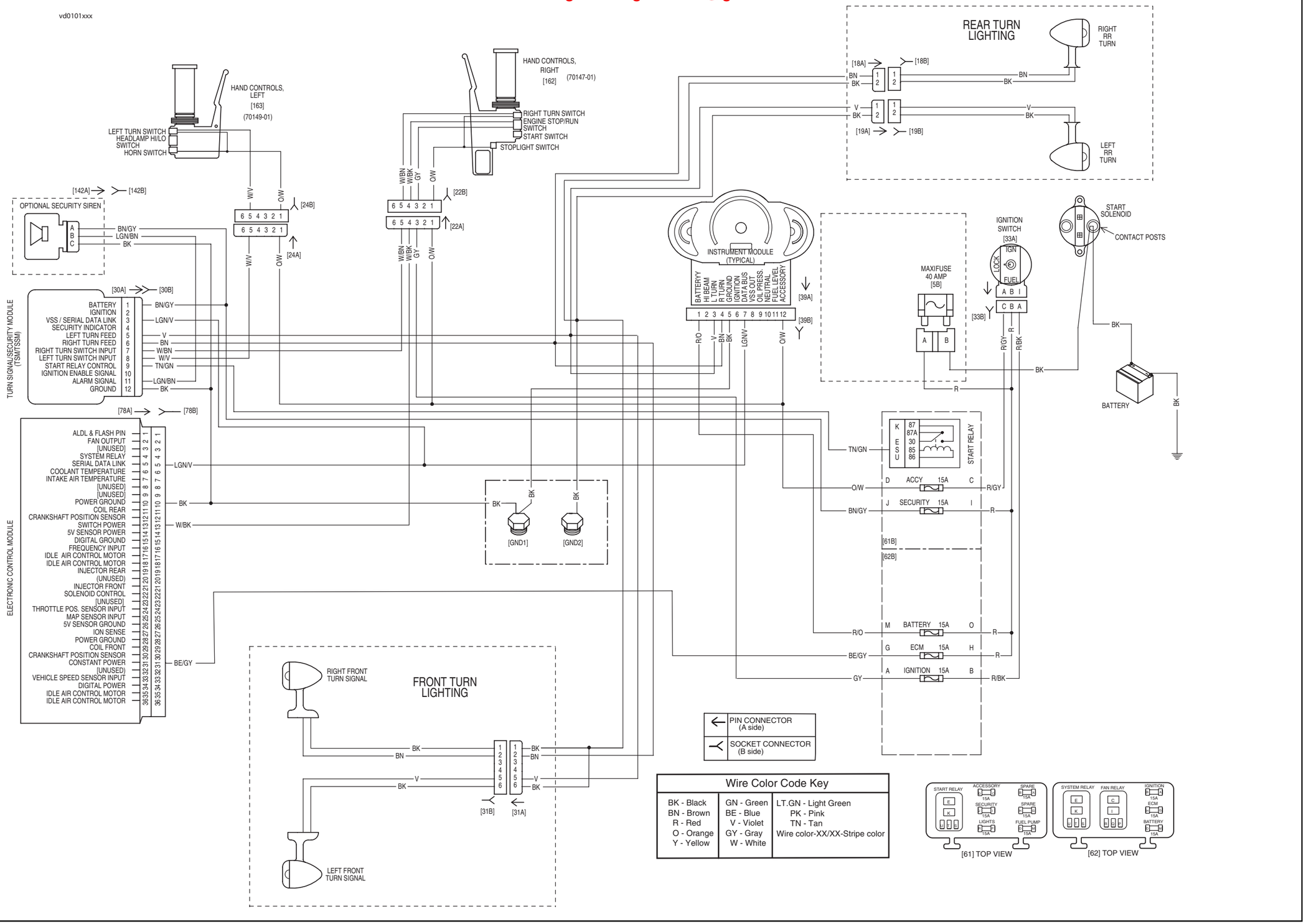
vd0101xxx



2006 VRSCR MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

APPENDIX C: CONVERSIONS C.1

Table C-1. Linear Conversion Table

MILLIMETERS to INCHES (mm x 0.03937 = inches)								INCHES to MILLIMETERS (inches x 25.40 = mm)							
mm	in.	mm	in.	mm	in.	mm	in.	in.	mm	in.	mm	in.	mm	in.	mm
.1	.0039	25	.9842	58	2.283	91	3.582	.001	.025	.6	15.240	1 15/16	49.21	3 5/16	84.14
.2	.0078	26	1.024	59	2.323	92	3.622	.002	.051	5/8	15.875	2	50.80	3 3/8	85.72
.3	.0118	27	1.063	60	2.362	93	3.661	.003	.076	11/16	17.462	2 1/16	52.39	3.4	86.36
.4	.0157	28	1.102	61	2.401	94	3.701	.004	.102	.7	17.780	2.1	53.34	3 7/16	87.31
.5	.0197	29	1.142	62	2.441	95	3.740	.005	.127	3/4	19.050	2 1/8	53.97	3 1/2	88.90
.6	.0236	30	1.181	63	2.480	96	3.779	.006	.152	.8	20.320	2 3/16	55.56	3 9/16	90.49
.7	.0275	31	1.220	64	2.519	97	3.819	.007	.178	13/16	20.638	2.2	55.88	3.6	91.44
.8	.0315	32	1.260	65	2.559	98	3.858	.008	.203	7/8	22.225	2 1/4	57.15	3 5/8	92.07
.9	.0354	33	1.299	66	2.598	99	3.897	.009	.229	.9	22.860	2.3	58.42	3 11/16	93.66
1	.0394	34	1.338	67	2.638	100	3.937	.010	.254	15/16	23.812	2 5/16	58.74	3.7	93.98
2	.0787	35	1.378	68	2.677	101	3.976	1/64	.397	1	25.40	2 3/8	60.32	3 3/4	95.25
3	.1181	36	1.417	69	2.716	102	4.016	.020	.508	1 1/16	26.99	2.4	60.96	3.8	96.52
4	.1575	37	1.456	70	2.756	103	4.055	.030	.762	1.1	27.94	2 7/16	61.91	3 13/16	96.84
5	.1968	38	1.496	71	2.795	104	4.094	1/32	.794	1 1/8	28.57	2 1/2	63.50	3 7/8	98.42
6	.2362	39	1.535	72	2.834	105	4.134	.040	1.016	1 3/16	30.16	2 9/16	65.09	3.9	99.06
7	.2756	40	1.575	73	2.874	106	4.173	.050	1.270	1.2	30.48	2.6	66.04	3 15/16	100.01
8	.3149	41	1.614	74	2.913	107	4.212	.060	1.524	1 1/4	31.75	2 5/8	66.67	4	101.6
9	.3543	42	1.653	75	2.953	108	4.252	1/16	1.588	1.3	33.02	2 11/16	68.26	4 1/16	102.19
10	.3937	43	1.693	76	2.992	109	4.291	.070	1.778	1 5/16	33.34	2.7	68.58	4.1	104.14
11	.4331	44	1.732	77	3.031	110	4.331	.080	2.032	1 3/8	34.92	2 3/4	69.85	4 1/8	104.77
12	.4724	45	1.772	78	3.071	111	4.370	.090	2.286	1.4	35.56	2.8	71.12	4 3/16	106.36
13	.5118	46	1.811	79	3.110	112	4.409	.1	2.540	1 7/16	36.51	2 13/16	71.44	4.2	106.68
14	.5512	47	1.850	80	3.149	113	4.449	1/8	3.175	1 1/2	38.10	2 7/8	73.02	4 1/4	107.95
15	.5905	48	1.890	81	3.189	114	4.488	3/16	4.762	1 9/16	39.69	2.9	73.66	4.3	109.22
16	.6299	49	1.929	82	3.228	115	4.527	.2	5.080	1.6	40.64	2 15/16	74.61	4 5/16	109.54
17	.6693	50	1.968	83	3.268	116	4.567	1/4	6.350	1 5/8	41.27	3	76.20	4 3/8	111.12
18	.7086	51	2.008	84	3.307	117	4.606	.3	7.620	1 11/16	42.86	3 1/16	77.79	4.4	111.76
19	.7480	52	2.047	85	3.346	118	4.645	5/16	7.938	1.7	43.18	3.1	78.74	4 7/16	112.71
20	.7874	53	2.086	86	3.386	119	4.685	3/8	9.525	1 3/4	44.45	3 1/8	79.37	4 1/2	114.30
21	.8268	54	2.126	87	3.425	120	4.724	.4	10.160	1.8	45.72	3 3/16	80.96	4 9/16	115.89
22	.8661	55	2.165	88	3.464	121	4.764	7/16	11.112	1 13/16	46.04	3.2	81.28	4.6	116.84
23	.9055	56	2.205	89	3.504	122	4.803	1/2	12.700	1 7/8	47.62	3 1/4	82.55	4 5/8	117.47
24	.9449	57	2.244	90	3.543	123	4.842	9/16	14.288	1.9	48.26	3.3	83.82	4 11/16	119.06

FLUID CONVERSIONS C.2

UNITED STATES SYSTEM

Unless otherwise specified, **all fluid volume measurements in this Service Manual are expressed in United States (U.S.) units-of-measure.** See below:

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) = 128 fl. oz. (U.S.)

METRIC SYSTEM

Fluid volume measurements in this Service Manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (mL). Should you need to convert from U.S. units-of-measure to metric units-of-measure (or vice versa), refer to the following:

- fluid ounces (U.S.) x 29.574 = milliliters
- pints (U.S.) x 0.473 = liters
- quarts (U.S.) x 0.946 = liters
- gallons (U.S.) x 3.785 = liters
- milliliters x 0.0338 = fluid ounces (U.S.)
- liters x 2.114 = pints (U.S.)
- liters x 1.057 = quarts (U.S.)
- liters x 0.264 = gallons (U.S.)

BRITISH IMPERIAL SYSTEM

Fluid volume measurements in this Service Manual do not include the British Imperial (Imp.) system equivalents. The following conversions exist in the British Imperial system:

- 1 pint (Imp.) = 20 fluid ounces (Imp.)
- 1 quart (Imp.) = 2 pints (Imp.)
- 1 gallon (Imp.) = 4 quarts (Imp.)

Although the same unit-of-measure terminology as the U.S. system is used in the British Imperial (Imp.) system, the actual volume of each British Imperial unit-of-measure differs from its U.S. counterpart. The U.S. fluid ounce is larger than the British Imperial fluid ounce. However, the U.S. pint, quart, and gallon are smaller than the British Imperial pint, quart, and gallon, respectively. Should you need to convert from U.S. units to British Imperial units (or vice versa), refer to the following:

- fluid ounces (U.S.) x 1.042 = fluid ounces (Imp.)
- pints (U.S.) x 0.833 = pints (Imp.)
- quarts (U.S.) x 0.833 = quarts (Imp.)
- gallons (U.S.) x 0.833 = gallons (Imp.)
- fluid ounces (Imp.) x 0.960 = fluid ounces (U.S.)
- pints (Imp.) x 1.201 = pints (U.S.)
- quarts (Imp.) x 1.201 = quarts (U.S.)
- gallons (Imp.) x 1.201 = gallons (U.S.)

VALVE TAPPET SHIMS D.1

Table D-1. Case 1 Valve Tappet Shims

Part No.	Shim Thickness
H-D 18696-01K	1.825 mm
H-D 18697-01K	1.850 mm
H-D 18698-01K	1.875 mm
H-D 18699-01K	1.900 mm
H-D 18700-01K	1.925 mm
H-D 18701-01K	1.950 mm
H-D 18702-01K	1.975 mm
H-D 18666-01K	2.000 mm
H-D 18624-01K	2.025 mm
H-D 18667-01K	2.050 mm
H-D 18625-01K	2.075 mm
H-D 18668-01K	2.100 mm
H-D 18626-01K	2.125 mm
H-D 18669-01K	2.150 mm
H-D 18627-01K	2.175 mm
H-D 18670-01K	2.200 mm
H-D 18628-01K	2.225 mm
H-D 18628-01K	2.250 mm
H-D 18629-01K	2.275 mm
H-D 18672-01K	2.300 mm
H-D 18630-01K	2.325 mm
H-D 18673-01K	2.350 mm
H-D 18631-01K	2.375 mm
H-D 18674-01K	2.400 mm

Table D-2. Case 2 Valve Tappet Shims

Part No.	Shim Thickness
H-D 18632-01K	2.425 mm
H-D 18675-01K	2.450 mm
H-D 18638-01K	2.475 mm
H-D 18676-01K	2.500 mm
H-D 18639-01K	2.525 mm
H-D 18677-01K	2.550 mm
H-D 18655-01K	2.575 mm
HD 18678-01K	2.600 mm
H-D 18656-01K	2.625 mm
H-D 18679-01K	2.650 mm
H-D 18657-01K	2.675 mm
H-D 18680-01K	2.700 mm
H-D 18658-01K	2.725 mm
H-D 18681-01K	2.750 mm
H-D 18659-01K	2.775 mm
H-D 18682-01K	2.800 mm
H-D 18692-01K	2.825 mm
H-D 18683-01K	2.850mm
H-D 18693-01K	2.875 mm
H-D 18684-01K	2.900 mm
H-D 18694-01K	2.925 mm
H-D 18685-01K	2.950 mm
H-D 18695-01K	2.975 mm
H-D 18686-01K	3.000 mm

NOTES

HOME

VALVE LASH CALCULATION WORKSHEET 1 D.2

V.I.N.	
Technician	
Date	
Intake lash	0.22 mm ± 0.025 (0.0087 in. ± 0.00098)
Exhaust lash	0.32 mm ± 0.025 (0.0126 in. ± 0.00098)

NOTE

- ***Valve numbers correspond to the "cast-in" number in the cylinder head casting located at each valve tappet.***
- ***Always measure shim, never trust bin location or etched size.***
- ***Photocopy this form for use on each valve lash adjustment.***

Cylinder	Valve Number	Valve Type	Initial Lash Measurement	Installed Shim Measurement	Valve Lash Upper Limit mm (in.)	Valve Lash Lower Limit mm (in.)	NEW SHIM LOWER LIMIT Calculate Columns (1)+(2)-(3)	NEW SHIM UPPER LIMIT Calculate Columns (1)+(2)-(4)	DESIRED SHIM SIZE Calculate Columns $\frac{(L)+(U)}{2}=(S)$	Shim Size Chosen (closest to column S)	Final Lash Reading
			(1)	(2)	(3)	(4)	(L)	(U)	(S)		
Front	1	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	2	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	3	Intake			0.245 (0.0096)	0.195 (0.0078)					
	4	Intake			0.245 (0.0096)	0.195 (0.0078)					
			(1)	(2)	(3)	(4)	(L)	(U)	(S)		
Rear	5	Intake			0.245 (0.0096)	0.195 (0.0078)					
	6	Intake			0.245 (0.0096)	0.195 (0.0078)					
	7	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	8	Exhaust			0.345 (0.0135)	0.295 (0.0117)					

NOTES

HOME

VALVE LASH CALCULATION WORKSHEET 2 D.3

V.I.N.	
Technician	
Date	
Intake lash	0.22 mm ± 0.025 (0.0087 in. ± 0.00098)
Exhaust lash	0.32 mm ± 0.025 (0.0126 in. ± 0.00098)

NOTE

- ***Valve numbers correspond to the "cast-in" number in the cylinder head casting located at each valve tappet.***
- ***Always measure shim, never trust bin location or etched size.***
- ***Photocopy this form for use on each valve lash adjustment.***

Cylinder	Valve Number	Valve Type	Initial Lash Measurement	Installed Shim Measurement	Valve Lash Upper Limit mm (in.)	Valve Lash Lower Limit mm (in.)	NEW SHIM LOWER LIMIT Calculate Columns (1)+(2)-(3)	NEW SHIM UPPER LIMIT Calculate Columns (1)+(2)-(4)	DESIRED SHIM SIZE Calculate Columns $\frac{(L)+(U)}{2}=(S)$	Shim Size Chosen that is closest to column (S)	Final Lash Reading
			(1)	(2)	(3)	(4)	(L)	(U)	(S)		
Front	1	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	2	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	3	Intake			0.245 (0.0096)	0.195 (0.0078)					
	4	Intake			0.245 (0.0096)	0.195 (0.0078)					
			(1)	(2)	(3)	(4)	(L)	(U)	(S)		
Rear	5	Intake			0.245 (0.0096)	0.195 (0.0078)					
	6	Intake			0.245 (0.0096)	0.195 (0.0078)					
	7	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	8	Exhaust			0.345 (0.0135)	0.295 (0.0117)					

NOTES

APPENDIX E-GLOSSARY E.1

ACRONYM OR ABBREVIATION	DESCRIPTION
A	Amperes
AC	Alternating Current
ACC	Accessory
ACR	Automatic Compression Release
AGM	Absorbed Glass Mat (battery)
AMP	Ampere
AWG	American Wire Gauge
B+	Battery voltage
BAS	Bank Angle Sensor
BTDC	Before Top Dead Center
C	Celsius (Centigrade)
CA	California
CAL	Calibration
CC	Cubic Centimeters
CCA	Cold Cranking Amps
CKP	Crankshaft Position
cm	Centimeter
CV	Constant Velocity
DC	Direct Current
DLC	Data Link Connector
DOM	Domestic
DTC	Diagnostic Trouble Code
DVOM	Digital Volt Ohm Meter
ECM	Electronic Control Module
ECT	Engine Coolant Temperature
EEPROM	Electrically Erasable Programmable Read Only Memory
EFI	Electronic Fuel Injection
ET	Engine Temperature
EVAP	Evaporative Emissions Control System
F	Fahrenheit
ft-lbs	Foot-Pounds
fl oz.	Fluid Ounce
g	Gram
GAL	Gallon
GAWG	Gross Axle Weight Rating
GND	Ground (electrical)
GVWR	Gross Vehicle Weight Rating
HDI	Harley-Davidson International
Hg	Mercury
IAC	Idle Air Control
IAT	Intake Air Temperature
ICM	Ignition Control Module
ID	Inside Diameter
IGN	Ignition Light/Key Switch

ACRONYM OR ABBREVIATION	DESCRIPTION
IM	Instrument Module
In.	Inch
INJ PW	Injector Pulse Width
in-lbs	Inch-Pounds
Kg	Kilogram
Km	Kilometer
kPa	Kilopascal
km/hr	Kilometers Per Hour
L	Liter
LCD	Liquid Crystal Display
LED	Light Emitting Diode
mA	Milliampere
MAP	Manifold Absolute Pressure
ml	milliliter
mm	millimeter
MPH	Miles Per Hour
ms	millisecond
Nm	Newton-Meter
N/A	Not Applicable
no.	number
O2	oxygen
OD	Outside Diameter
OEM	Original Equipment Manufacturer
oz	Ounce
P&A	Parts and Accessories
PN	Part Number
PSI	Pounds Per Square Inch
RES	Reserve
RPM	Revolutions Per Minute
SCFH	Cubic Feet per Hour at Standard Conditions
TDC	Top Dead Center
TP	Throttle Position
TSM	Turn Signal Module
TSSM	Turn Signal/Security Module
V	Volt
VAC	Volts of Alternating Current
VDC	Volts of Direct Current
VIN	Vehicle Identification Number
VSS	Vehicle Speed Sensor

Table Of Contents

SUBJECT **PAGE NO.**

GENERAL 1.1

SERVICING A NEW MOTORCYCLE

⚠WARNING

Perform the service and maintenance operations as indicated in the regular service interval table. Lack of regular maintenance at the recommended intervals can affect the safe operation of your motorcycle, which could result in death or serious injury. (00010a)

Service operations to be performed before customer delivery are specified in the applicable model year PREDELIVERY AND SETUP MANUAL.

The performance of new motorcycle initial service is required to keep warranty in force and to ensure proper emissions systems operation. See 1600 km (1000 mile) MAINTENANCE under 1.2 MAINTENANCE SCHEDULE for details.

SHOP PRACTICES

Repair Notes

NOTES

- *General maintenance practices are given in this section.*
- *Repair = Disassembly/Assembly.*
- *Replace = Removal/Installation.*

All special tools and torque values are noted at the point of use.

All required parts or materials can be found in the appropriate PARTS CATALOG.

Safety

Safety is always the most important consideration when performing any job. Be sure you have a complete understanding of the task to be performed. Use common sense. Use the proper tools. Protect yourself and bystanders with approved eye protection. Don't just do the job – do the job safely.

Removing Parts

Always consider the weight of a part when lifting. Use a hoist whenever necessary. Do not lift heavy parts by hand. A hoist and adjustable lifting beam or sling are needed to remove some parts. The lengths of chains or cables from the hoist to the part should be equal and parallel and should be positioned directly over the center of the part. Be sure that no obstructions will interfere with the lifting operation. Never leave a part suspended in mid-air.

⚠WARNING

Always check the capacity rating and condition of hoists, slings, chains or cables before use. Failure to do so can lead to an accident which could result in death or serious injury.

Always use blocking or proper stands to support the part that has been hoisted. If a part cannot be removed, verify that all bolts and attaching hardware have been removed. Check to see if any parts are in the way of the part being removed.

When removing hoses, wiring or tubes, always tag each part to ensure proper installation.

Cleaning

If you intend to reuse parts, follow good shop practice and thoroughly clean the parts before assembly. Keep all dirt out of parts; the unit will perform better and last longer. Seals, filters and covers are used in this vehicle to keep out environmental dirt and dust. These items must be kept in good condition to ensure satisfactory operation.

Clean and inspect all parts as they are removed. Be sure all holes and passages are clean and open. After cleaning, cover all parts with clean lint-free cloth, paper or other material. Be sure the part is clean when it is installed.

Always clean around lines or covers before they are removed. Plug, tape or cap holes and openings to keep out dirt, dust and debris.

Disassembly/Assembly

Always assemble or disassemble one part at a time. Do not work on two assemblies simultaneously. Be sure to make all necessary adjustments. Recheck your work when finished. Be sure that everything is done.

Operate the vehicle to perform any final check or adjustments. If all is correct, the vehicle is ready to go back to the customer.

REPAIR AND REPLACEMENT PROCEDURES

Hardware and Threaded Parts

Install helical thread inserts when inside threads in castings are stripped, damaged or not capable of withstanding specified torque.

Replace bolts, nuts, studs, washers, spacers and small common hardware if missing or in any way damaged. Clean up or repair minor thread damage with a suitable thread chaser.

Replace all damaged or missing lubrication fittings.

Use Teflon pipe sealant on pipe fitting threads.

Wiring, Hoses and Lines

Replace hoses, clamps, electrical wiring, electrical switches or fuel lines if they do not meet specifications.

Instruments and Gauges

Replace broken or defective instruments and gauges. Replace dials and glass that are so scratched or discolored that reading is difficult.

Bearings

Anti-friction bearings must be handled in a special way. To keep out dirt and abrasives, cover the bearings as soon as they are removed from the package.

Wash bearings in a non-flammable cleaning solution. Knock out packed lubricant inside by tapping the bearing against a wooden block. Wash bearings again. Cover bearings with clean material after setting them down to dry. Never use compressed air to dry bearings.

Coat bearings with clean oil. Wrap bearings in clean paper.

Be sure that the chamfered side of the bearing always faces the shoulder (when bearings installed against shoulders). Lubricate bearings and all metal contact surfaces before pressing into place. Only apply pressure on the part of the bearing that makes direct contact with the mating part. Install bearings with numbered side facing out.

Always use the proper tools and fixtures for removing and installing bearings.

Bearings do not usually need to be removed. Only remove bearings if necessary.

Bushings

Do not remove a bushing unless damaged, excessively worn or loose in its bore. Press out bushings that must be replaced.

When pressing or driving bushings, be sure to apply pressure in line with the bushing bore. Use a bearing/bushing driver or a bar with a smooth, flat end. Never use a hammer to drive bushings.

Inspect the bushing and the mated part for oil holes. Be sure all oil holes are properly aligned.

Gaskets

Always discard gaskets after removal. Replace with **new** gaskets. Never use the same gasket twice. Be sure that gasket holes match up with holes in the mating part.

Lip Type Seals

Lip seals are used to seal oil or grease and are usually installed with the sealing lip facing the contained lubricant. Seal orientation, however, may vary under different applications.

Seals should not be removed unless necessary. Only remove seals if required to gain access to other parts or if seal damage or wear dictates replacement.

Leaking oil or grease usually means that a seal is damaged. Replace leaking seals to prevent overheated bearings.

Always discard seals after removal. Do not use the same seal twice.

O-rings (Preformed Packings)

Always discard O-rings after removal. Replace with **new** O-rings. To prevent leaks, lubricate the O-rings before installation. Apply the same type of lubricant as that being sealed. Be sure that all gasket, O-rings and seal mating surfaces are thoroughly clean before installation.

Gears

Always check gears for damaged or worn teeth.

Lubricate mating surfaces before pressing gears on shafts.

Shafts

If a shaft does not come out easily, check that all nuts, bolts or retaining rings have been removed. Check to see if other parts are in the way before using force.

Shafts fitted to tapered splines should be very tight. If shafts are not tight, disassemble and inspect tapered splines. Discard parts that are worn. Be sure tapered splines are clean, dry and free of burrs before putting them in place. Press mating parts together tightly.

Clean all rust from the machined surfaces of new parts.

Part Replacement

Always replace worn or damaged parts with **new** parts.

CLEANING

Part Protection

Before cleaning, protect rubber parts (such as hoses, boots and electrical insulation) from cleaning solutions. Use a grease-proof barrier material. Remove the rubber part if it cannot be properly protected.

Cleaning Process

Any cleaning method may be used as long as it does not result in parts damage. Thorough cleaning is necessary for proper parts inspection. Strip rusted paint areas to bare metal before repainting.

Rust or Corrosion Removal

Remove rust and corrosion with a wire brush, abrasive cloth, sand blasting, vapor blasting or rust remover. Use buffing crocus cloth on highly polished parts that are rusted.

TOOL SAFETY

Air Tools

- Always use approved eye protection equipment when performing any task using air-operated tools.
- On all power tools, use only recommended accessories with proper capacity ratings.
- Do not exceed air pressure ratings of any power tools.
- Bits should be placed against work surface before air hammers are operated.
- Disconnect the air supply line to an air hammer before attaching a bit.
- Never point an air tool at yourself or another person.
- Protect bystanders with approved eye protection.

Wrenches

- Never use an extension on a wrench handle.
- If possible, always pull on a wrench handle and adjust your stance to prevent a fall if something lets go.
- Never cock a wrench.
- Never use a hammer on any wrench other than a STRIKING FACE wrench.
- Discard any wrench with broken or battered points.
- Never use a pipe wrench to bend, raise or lift a pipe.

Pliers/Cutters/Prybars

- Plastic- or vinyl-covered pliers handles are not intended to act as insulation; don't use on live electrical circuits.
- Don't use pliers or cutters for cutting hardened wire unless they were designed for that purpose.
- Always cut at right angles.
- Don't use any prybar as a chisel, punch or hammer.

Hammers

- Never strike one hammer against a hardened object, such as another hammer.
- Always grasp a hammer handle firmly, close to the end.
- Strike the object with the full face of the hammer.
- Never work with a hammer which has a loose head.
- Discard hammer if face is chipped or mushroomed.
- Wear approved eye protection when using striking tools.
- Protect bystanders with approved eye protection.

Punches/Chisels

- Never use a punch or chisel with a chipped or mushroomed end; dress mushroomed chisels and punches with a file.
- Hold a chisel or a punch with a tool holder if possible.
- When using a chisel on a small piece, clamp the piece firmly in a vise and chip toward the stationary jaw.
- Wear approved eye protection when using these tools.
- Protect bystanders with approved eye protection.

Screwdrivers

- Don't use a screwdriver for prying, punching, chiseling, scoring or scraping.
- Use the right type of screwdriver for the job; match the tip to the fastener.
- Don't interchange POZIDRIV®, PHILLIPS® or REED AND PRINCE screwdrivers.
- Screwdriver handles are not intended to act as insulation; don't use on live electrical circuits.
- Don't use a screwdriver with rounded edges because it will slip – redress with a file.

Ratchets and Handles

- Periodically clean and lubricate ratchet mechanisms with a light grade oil. Do not replace parts individually; ratchets should be rebuilt with the entire contents of service kit.
- Never hammer or put a pipe extension on a ratchet or handle for added leverage.
- Always support the ratchet head when using socket extensions, but do not put your hand on the head or you may interfere with the action of its reversing mechanism.
- When breaking loose a fastener, apply a small amount of pressure as a test to be sure the ratchet's gear wheel is engaged with the pawl.

Sockets

- Never use hand sockets on power or impact wrenches.
- Select the right size socket for the job.
- Never cock any wrench or socket.
- Select only impact sockets for use with air or electric impact wrenches.
- Replace sockets showing cracks or wear.
- Keep sockets clean.
- Always use approved eye protection when using power or impact sockets.

Storage Units

- Don't open more than one loaded drawer at a time. Close each drawer before opening up another.
- Close lids and lock drawers and doors before moving storage units.
- Don't pull on a tool cabinet; push it in front of you.
- Set the brakes on the locking casters after the cabinet has been rolled to your work space.

MAINTENANCE SCHEDULE 1.2

Table 1-1. Regular Service Intervals for VRSC Models

ITEM SERVICED	PROCEDURE	1000 mi 1600 km	5000 mi 8000 km	10,000 mi 16,000 km	15,000 mi 24,000 km	20,000 mi 32,000 km	25,000 mi 40,000 km	NOTES
Engine oil and filter	Replace	X	X	X	X	X	X	
Oil lines and brake system	Inspect for leaks	X	X	X	X	X	X	1
Air cleaner	Inspect, service as required	X	X	X	X	X	X	
Tires	Check pressure, inspect tread	X	X	X	X	X	X	
Clutch fluid	Check level and condition	X	X	X	X	X	X	
Rear belt and sprockets	Inspect, adjust belt	X	X	X	X	X	X	1
Throttle, brake and clutch controls	Check, adjust and lubricate	X	X	X	X	X	X	1
Jiffy stand	Inspect and lubricate	X	X	X	X	X	X	1
Brake fluid	Check levels and condition	X	X	X	X	X	X	5
Brake pads and discs	Inspect for wear	X	X	X	X	X	X	
Spark plugs	Inspect		X		X		X	
	Replace			X		X		
Electrical equipment and switches	Check operation	X	X	X	X	X	X	
Front fork oil		Replace every 30,000 miles (48,000 km)						1
Steering head bearings	Adjust	X				X		1, 2
Rear fork bearings		Inspect every 30,000 miles (48,000 km)						1
Valve lash	Adjust	Adjust every 12,000 miles (19312 km)						1, 4
Cooling system	Inspect; check clamps for tightness, check coolant freeze point	X		X		X		1
Coolant		Replace every 30,000 miles (48,000 km).						1
Radiator	Clean	X	X	X	X	X	X	
Critical fasteners	Check tightness	X		X		X		1
Battery	Check battery and clean connections							3
Road test	Verify component and system functions	X	X	X	X	X	X	

NOTES:

1. Should be performed by an authorized Harley-Davidson dealer, unless you have the proper tools, service data and are mechanically qualified.
2. Disassemble, lubricate and inspect every 30,000 miles (48,000 km).
3. Perform annually.
4. Could vary with frequency of operation and riding style.
5. Change D.O.T. 4 and flush brake system every two years.

FIRST SCHEDULED MAINTENANCE

- A Harley-Davidson dealer should perform the first scheduled service listed in the Owner's Manual. See the Maintenance and Lubrication section in your Owner's Manual for more information.

Table 1-2. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Engine oil and filter	Drain plug torque	35 Nm (25.8 ft-lbs)
	Oil capacity	4.7 L (5.0 qt.) with filter
	Oil Level	Bike upright, unscrew dipstick, wipe off and screw back in. Unscrew and verify level.
	Filter	Hand tighten 2/3-1 full turn after gasket contact
	Black filter part number	63793-01K
Radiator and coolant	Drain plug torque	2.3-2.8 Nm (21-24 **in-lbs**)
	System capacity	2.4 L (2.54 qt.)
Clutch adjustment	Free play at adjuster screw	Hydraulic
	Bleeder Screw Torque	9-11 Nm (80-100 **in-lbs**)
	Free play at hand lever	4 mm (5/32 in.)
	Clutch inspection cover torque	6-10 Nm (53-88 **in-lbs**)
Transmission lubricant	Lubricant level	Wet sump engine with integral transmission, wet clutch. See engine oil.
Tire condition and pressure	Pressure for solo rider	Front: 36 psi (2.5 bar) Rear: 36 psi (2.5 bar)
	Pressure for rider and passenger	Front: 36 psi (2.5 bar) Rear: 40 psi (2.8 bar)
	Wear	Replace tire if 1/32 in. (0.8 mm) or less of tread pattern remains
Steering head bearings	Lubricant for steering head bearings	SPECIAL PURPOSE GREASE Part No. 99857-97 (14 oz. cartridge)
Brake fluid reservoir level	D.O.T. 4 hydraulic brake fluid	99953-99A (12 oz.)
	Proper fluid level front	5 mm (13/64 in.) from the top
	Proper fluid level rear	12.7 mm (0.5 in.) below gasket surface
	Master cylinder reservoir cover torque	0.8-1.2 Nm (7-11 **in-lbs**)
Brake pad linings and discs	Minimum brake pad thickness	Wear indicator lines in pad material must be visible
	Minimum brake disc thickness	4.5 mm (0.177 in.)
Drive belt	Upward measurement force applied at midpoint of top belt strand	10 lb. (4.5 kg)
	VRSCA/VRSCD Belt deflection with no rider on motorcycle	6 mm (0.236 in.)
	VRSCR Belt deflection with no rider on motorcycle	10 mm (0.393 in.)
Air cleaner	Air cleaner velocity stack screw torque	6 Nm (53 **in-lbs**)
	Air cleaner cover wing nut torque	Turn wing nut 2.5-3 turns after contact

Table 1-2. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Throttle cables	Lubricant	SUPER OIL Part No. 94968-85TV (1/4 fl. oz.)
	Handlebar clamp screw torque	60-80 **in-lbs** (6.8-9.0 Nm)
	Handlebar switch housing screw torque	35-45 **in-lbs** (4-5 Nm)
Spark plugs	Type	10R12A
	Gap	0.89 mm (0.035 in.)
	Torque	23 Nm (17 ft-lbs) with anti-seize applied to threads
Engine idle speed	Idle speed	1150-1250 RPM
Front fork oil	Type	HYDRAULIC FORK OIL (TYPE E) Part No. 99884-80 (16 oz.)
Battery	Lubricant	ELECTRICAL CONTACT LUBRICANT Part No. 99861-02 (1 oz.)
	Battery terminal torque	60-96 **in-lbs** (6.8-10.9 Nm)

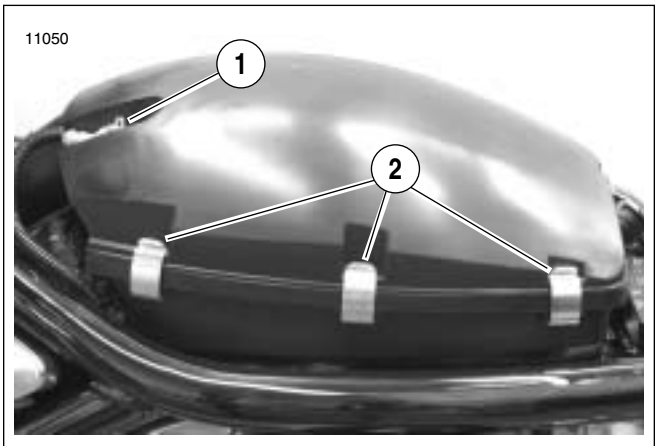
AIRBOX AND AIR FILTER 1.3

REMOVAL

1. Open seat.
2. See Figure 1-1. Remove airbox cover by turning bailhead fastener 1/4 turn counterclockwise (CCW). Pull airbox cover away from locating holes.

Figure 1-1. Airbox Cover

3. See Figure 1-2. Remove IAT connector (1) by pushing down on bail wire to unlock. Airbox top is retained by eight clips (2), three per side, one at the rear and one in the front under the snorkel. Disconnect clips and remove airbox top.



1. **IAT connector [89]**
2. **Retaining clips**

Figure 1-2. Air Filter Top

4. See Figure 1-3. Remove wing nut securing filter cap and air filter.

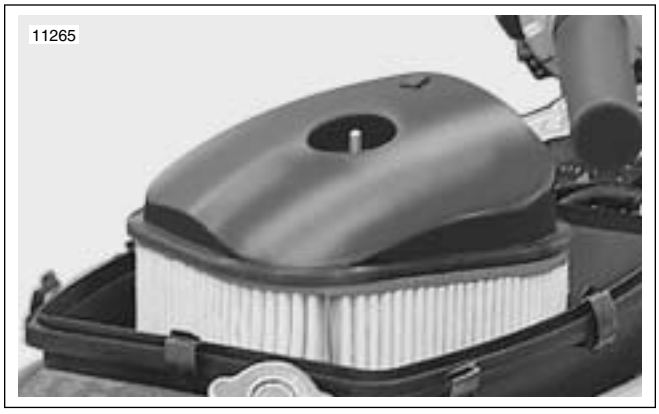
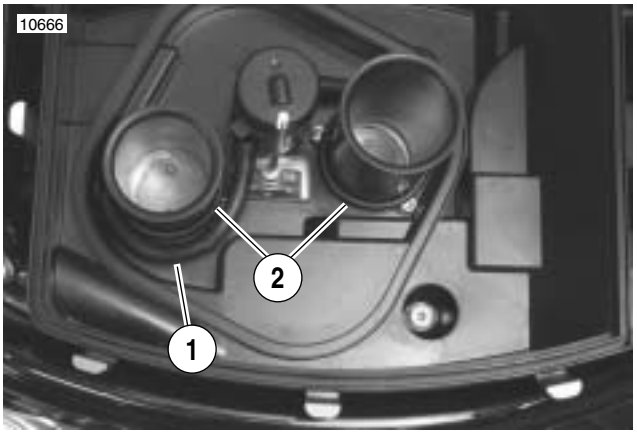


Figure 1-3. Air Filter (typical)

5. See Figure 1-4. Disconnect breather hose (1). Slide o-ring (2) up the velocity stack body to access the three retaining fasteners. Remove the velocity stacks.



1. **Breather hose**
2. **o-rings**

Figure 1-4. Velocity Stacks (typical)

6. Gently lift the air filter bottom. Front breather hose is a press-fit and will disconnect, rear breather has a worm clamp holding hose to air filter bottom. Loosen clamp and remove air filter bottom.

CAUTION

Cover the injector intakes with duct tape to prevent objects from falling down the injector bore. Do NOT use shop cloths or objects that could damage the injector butterflies. (00212a)

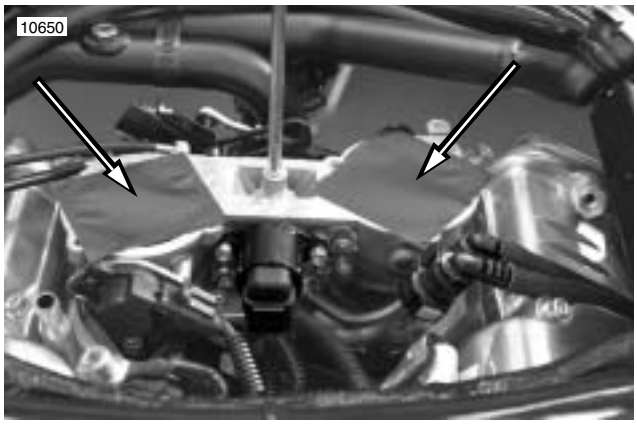


Figure 1-5. Airbox Removed (Injector intakes shown by arrows)

INSTALLATION

1. Remove tape from throttle body intakes.
2. See Figure 1-6. Inspect and replace bottom airbox gasket if damaged. Check gasket position on air filter bottom. Gasket is located by three alignment pins on mating surface.

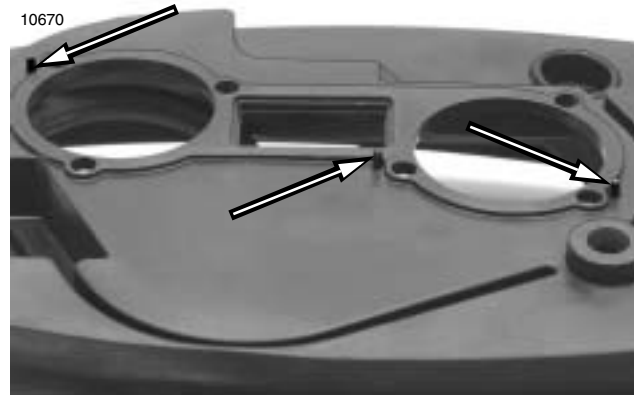


Figure 1-6. Air Filter Gasket Alignment Pins (3)

3. Place air filter bottom over throttle body and attach rear breather hose with hose clamp.
4. Align air filter bottom with front breather hose and press firmly in position.

NOTE

Velocity stacks have a mark at the bottom flange between two of the fastener locations. Align the mark with the corresponding mark on the air filter bottom.

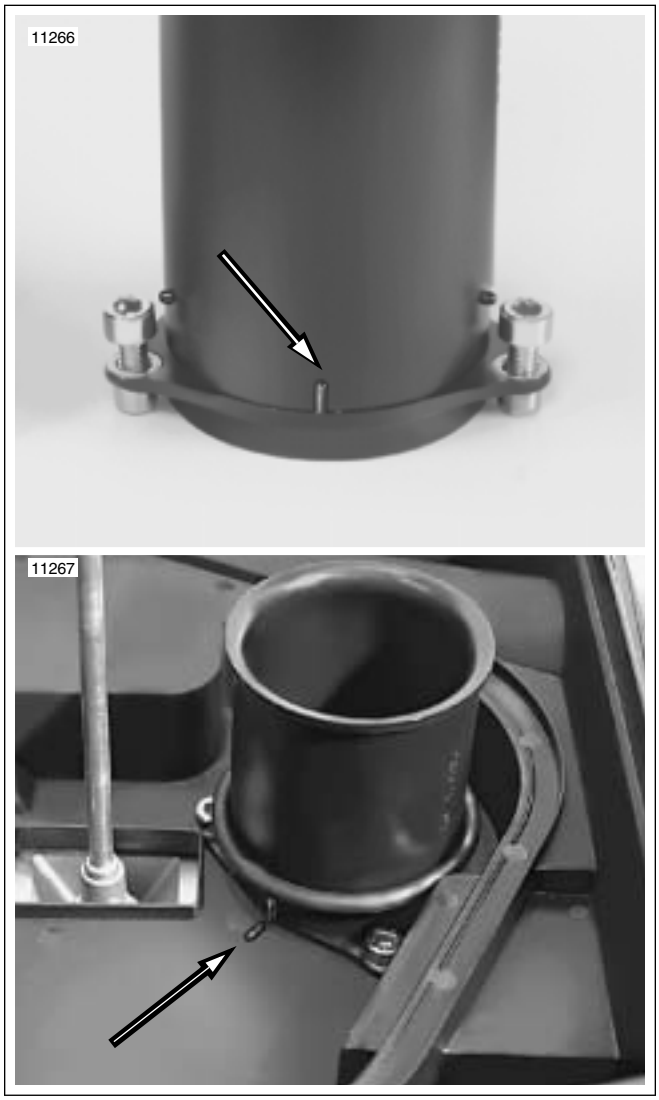


Figure 1-7. Velocity Stack Alignment Marks

5. Align index marks and install velocity stacks, longest in front. Tighten fasteners to 6 Nm (53 **in-lbs**).
6. Slide o-rings down the velocity stack body until they contact the three fasteners.

NOTE

The o-rings retain the velocity stack fasteners when assembling airbox.

7. Attach the breather hose.
8. Place air filter element in air filter bottom.
9. Align air filter cap and fasten with wing nut. Turn wing nut 2.5-3 turns after contact.
10. Position air filter top over bottom section with snorkel between frame tubes at the steering neck.
11. Fasten clips along each side and clip at rear.

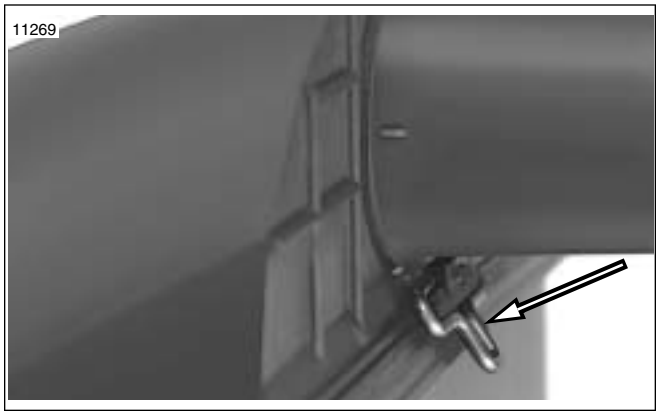
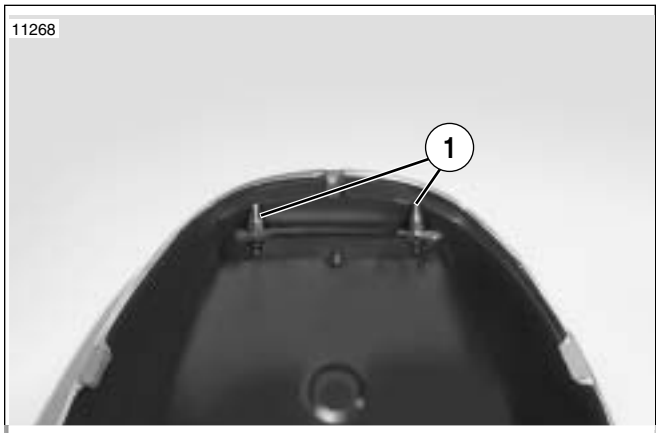
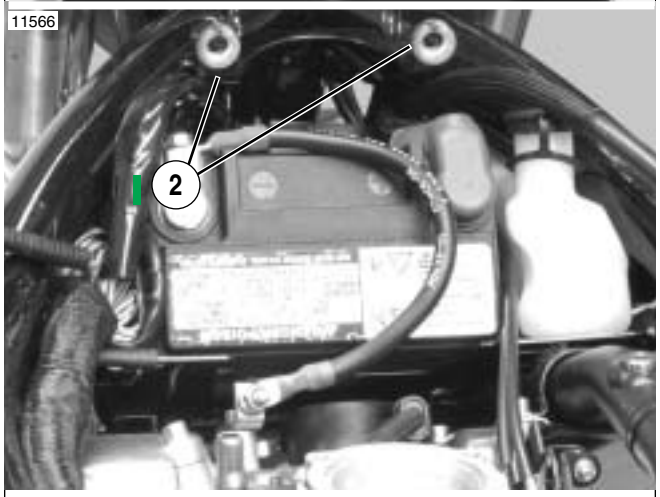


Figure 1-8. Front Airbox Clip

12. See Figure 1-8. Front clip under snorkel is attached to top section and must be fastened over the lip on the air filter bottom.
13. See Figure 1-2. Attach IAT connector.
14. See Figure 1-9. Position the airbox cover with the locating pins (1) in the holes (2) on the frame tabs.
15. See Figure 1-1. Turn bailhead fastener 1/4 turn clockwise.





1. Locating pins
2. Frame tab holes

Figure 1-9. Airbox Cover (typical)

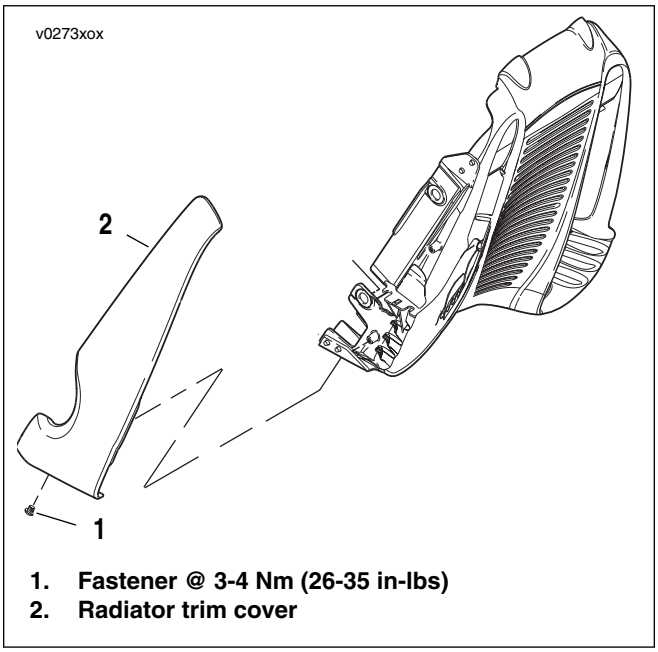
RADIATOR SIDE COVERS (VRSCA/VRSCD) 1.4

REMOVAL

CAUTION

The radiator side covers are delicate and should not be forced into or from mounted position. Use care when removing and installation to avoid damage.

1. Remove maxi-fuse.



1. **Fastener @ 3-4 Nm (26-35 in-lbs)**
2. **Radiator trim cover**

Figure 1-10. Removing Radiator Covers (VRSCA shown)

2. See Figure 1-10. Remove lower radiator side cover fastener (1) and remove gently remove cover (2) from radiator by pulling downward and out on bottom of side cover to release bottom of side cover from front radiator cover.
3. Gently lift side cover upward to remove upper mounting tab from front radiator cover.

INSTALLATION

1. See Figure 1-12. Position top of radiator side cover on radiator front cover and gently slide side cover into position.
2. Insert lower radiator side cover fastener and tighten to 3-4 Nm (26-35 **in-lbs**).

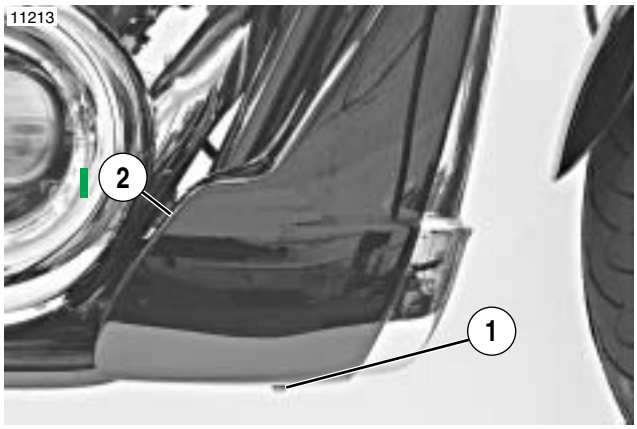
RADIATOR SIDE COVERS (VRSCR) 1.5

REMOVAL

CAUTION

The radiator side covers are delicate and should not be forced into or from mounted position. Use care when removing and installation to avoid damage.

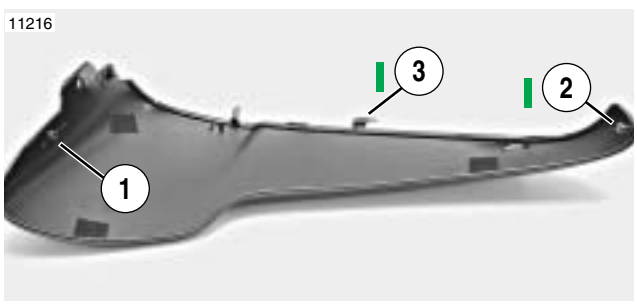
1. Remove maxi-fuse.



1. **Lower radiator side cover fastener**
2. **Radiator side cover**

Figure 1-11. Lower Radiator Side Cover Fastener (right side shown)

2. See Figure 1-11. Remove lower radiator side cover fastener.



1. **Bottom mounting pin**
2. **Top mounting pin**
3. **Latching tab**

Figure 1-12. Radiator Side Cover (inside view)

3. See Figure 1-12. Radiator side cover is held in place by a bottom mounting pin (1), top mounting pin (2) and latching tab (3). Remove radiator side covers as follows:
   a. See Figure 1-13. Grasp bottom of radiator side cover and pull down gently to disengage bottom mounting pin from bottom mounting hole located in radiator front cover.
   b. See Figure 1-13 While supporting radiator side cover, grasp top of side cover and pull up gently to disengage top mounting pin from mounting hole in front cover.

Figure 1-13. Bottom Mounting Hole

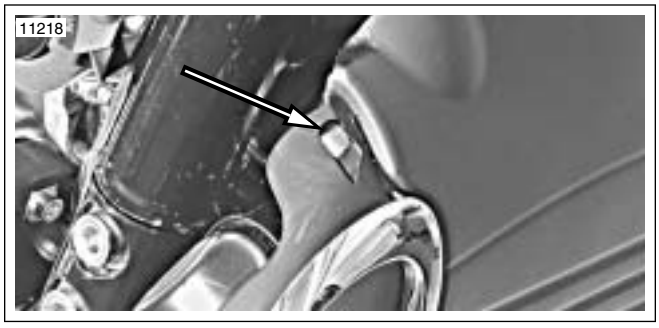


Figure 1-14. Top Mounting Hole

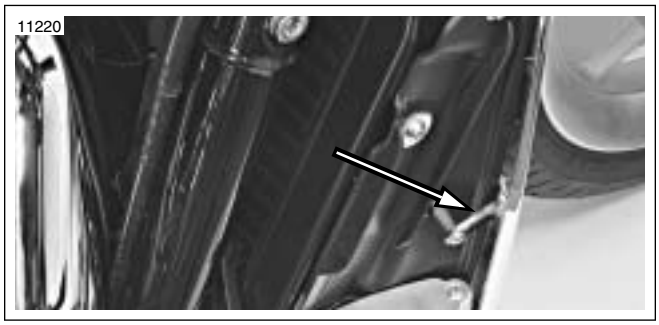


Figure 1-15. Tab Mounting Lip

   c. Slide radiator side cover down gently to disengage latching tab from mounting lip in radiator front cover.
   d. Set radiator side cover aside.

INSTALLATION

1. See Figure 1-12. Position radiator side cover on radiator front cover and gently slide side cover upward until latching tab fits into tab mounting lip.
   a. See Figure 1-14. Engage top mounting pin of radiator side cover into top mounting hole of radiator front cover.
   b. See Figure 1-13. Engage lower mounting pin of radiator side cover into bottom mounting hold of radiator front cover.
   c. See Figure 1-11. Install radiator side cover fastener and tighten to 3-4 Nm (27-35 **in-lbs**).

CHECKING COOLANT LEVEL IN OVERFLOW BOTTLE

1. See Figure 1-16. Remove fastener at upper corner of right side cover and remove cover.

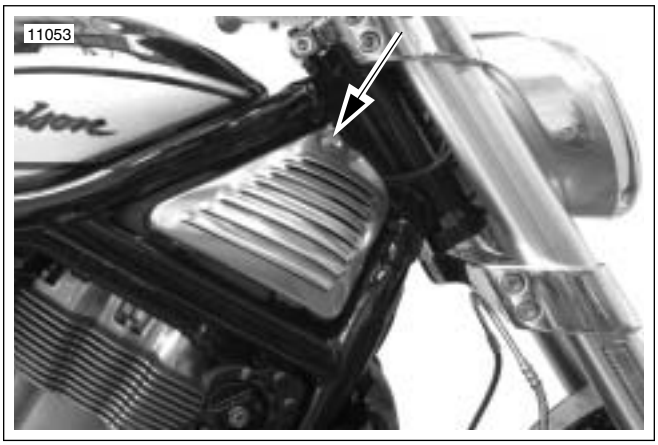


Figure 1-16. Removing Fastener and Cover to Check Coolant Level (typical)

WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

CAUTION

Use ONLY Genuine Harley-Davidson Extended Life Antifreeze & Coolant. Use of other coolants/mixtures may lead to engine damage. (00179a)

2. See Figure 1-17. Check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line on tank, remove cap from tank by using pull tab and add Harley-Davidson, FULLY FORMULATED ANTIFREEZE until fluid level reaches COLD FULL line.

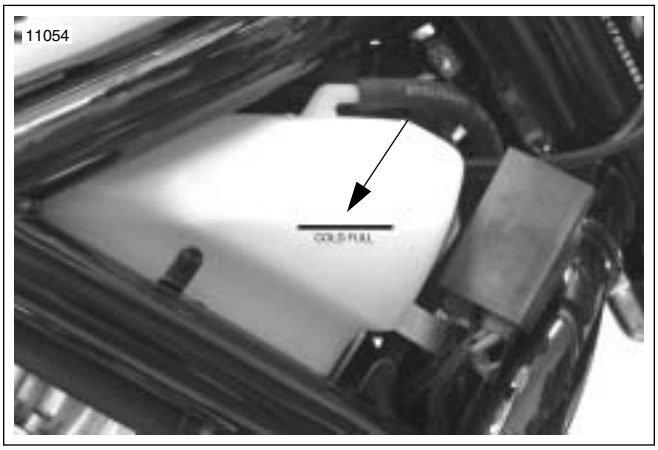


Figure 1-17. Cold Full Line On Overflow Bottle

CHECK FOR COOLANT IN SYSTEM

Coolant may be visible in the overflow bottle but not present in the rest of the cooling system. To ensure coolant is present:

1. Remove air filter top. See 1.3 AIRBOX AND AIR FILTER.

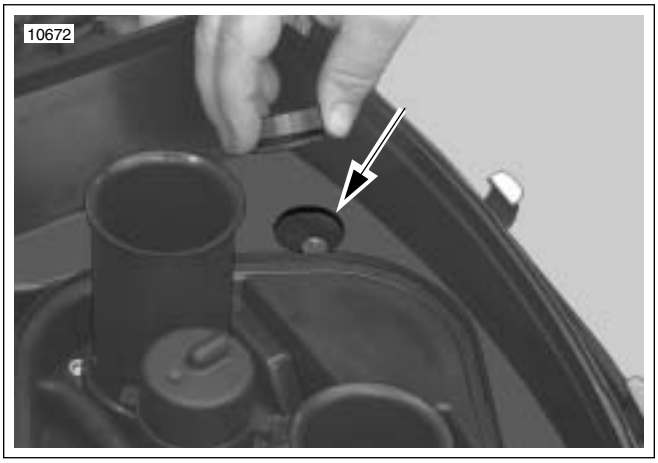


Figure 1-18. Cooling System Air Bleed Plug

2. See Figure 1-18. Remove cooling system air bleed plug.
3. Gently squeeze vertical water pump coolant hose on right side of engine.
4. Coolant should be visible in the air bleed hole. If coolant is not visible, see 6.3 ENGINE COOLANT.

CHECKING AND ADDING OIL

CAUTION

Oil level cannot be accurately measured on a cold engine. For preride inspection with the motorcycle upright (not leaning on jiffy stand) on level ground, the oil should register approximately at the midpoint of the cross-hatch area on the dipstick when the engine is cold. Do NOT add oil to bring the level to the FULL mark on a COLD engine. (00186a)

NOTE

This engine has a wet sump, an integral transmission, gear driven primary drive and wet clutch. This design allows engine oil in the sump to be used to lubricate the engine, transmission and primary drive. The clutch and primary drive are located on the right side of the engine.

Cold Engine Oil Level Check

Check engine oil level with engine **COLD** as follows:

1. Stand motorcycle upright (not leaning on jiffy stand) on a level surface.
2. See Figure 1-19. Unscrew the oil filler cap (with attached dipstick) by turning the filler cap counterclockwise. Remove the filler cap and dipstick and wipe the dipstick clean.
3. Screw the filler cap into the engine. Make sure the cap is fully seated on the crankcase.
4. See Figure 1-20. Remove the filler cap again and check the oil level on the dipstick.
5. See Figure 1-20. If the oil level is below the midpoint of the cross-hatch area on the dipstick, add enough Harley-Davidson oil to bring the level up to the midpoint of the cross-hatch area shown.

CAUTION

Do NOT operate the engine when the oil level is below the add mark on the dipstick at operating temperature. Engine damage will result. (00187a)

Hot Engine Oil Level Check

Check engine oil level with **engine at normal operating temperature as follows:**

1. Stop engine and allow oil to drain into sump for **about three minutes.**
2. Stand motorcycle upright (not leaning on jiffy stand) on a level surface.
3. See Figure 1-19. Unscrew filler cap (with attached dipstick) located at front of engine on left side. Remove filler cap and dipstick and wipe dipstick clean.
4. Screw filler cap into engine. Make sure cap is fully seated on crankcase.

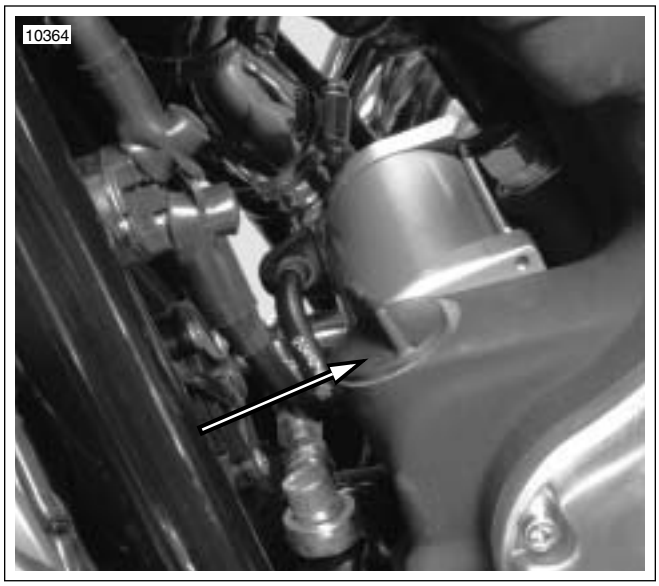


Figure 1-19. Dipstick/Filler Cap

5. See Figure 1-19. Remove filler cap and check oil level on dipstick.

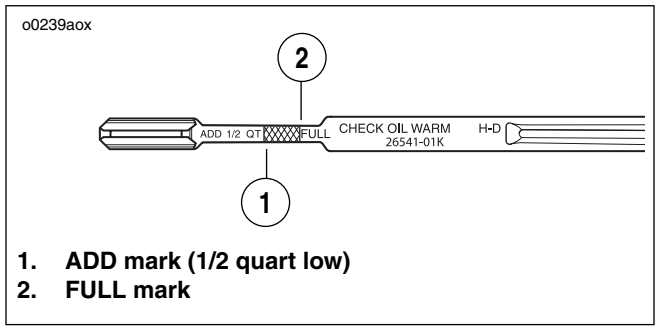
CAUTION

To avoid over-filling the oil sump, wait approximately three minutes after adding oil before checking the oil level with the dipstick. An over-filled sump can cause engine damage. (00188a)

6. If oil level is below FULL mark on the cross-hatched band of the dipstick, add enough Harley-Davidson oil to bring level up to the FULL mark. Observe CAUTION stated below.

CAUTION

Do not allow hot oil level to fall below Add/Fill mark on dipstick. Doing so can result in equipment damage and/or equipment malfunction. (00189a)



1. ADD mark (1/2 quart low)
2. FULL mark

Figure 1-20. Dipstick

NOTE

Cross hatched band of dipstick indicates 0.47 liter (1/2 quart) of Harley-Davidson oil.

CHANGING OIL AND FILTER

PART NO.	SPECIALTY TOOL
HD-44067	Oil filter wrench

Change engine oil and filter:

- At the first scheduled service interval.
- At every 8000 km (5000 mile) service interval thereafter.
- When storing or removing the motorcycle for the season.

NOTES

- *If the motorcycle is ridden hard, under dusty conditions, or in cold weather, the oil and filter should be changed more often.*
- *VRSC models are shipped from the factory with Harley-Davidson Motor Oil.*
- *VRSC models come equipped from the factory with a premium 10 micron synthetic media oil filter. These are the only recommended replacement filters.*

1. Ride motorcycle until engine is warmed up to normal operating temperature.
2. See Figure 1-19. Remove the oil filler plug/dipstick on left side.
3. See Figure 1-21. Remove the engine oil drain plug at front of oil pan on left side. Allow oil to drain into a suitable container.

NOTE

Lower radiator mounting bracket can be loosened and moved forward slightly to improve access to oil filter.

4. Remove the oil filter using the OIL FILTER WRENCH. Clean the oil filter mount flange of any old gasket material.
5. See Figure 1-23. Lube the gasket on **new** oil filter with engine oil and install **new** filter. Hand tighten oil filter 2/3 to 1 turn after gasket contacts filter mounting surface.
6. See Figure 1-21. Install oil drain plug.
   a. Inspect oil drain plug for damage. Replace if required. Wipe any foreign material from plug.
   b. Install drain plug. Tighten to 35 Nm (25.8 ft-lbs).
7. See Figure 1-19. Select the grade of oil for the lowest temperature expected before next oil change. Refer to Table 1-3.

NOTE

The position of the motorcycle when draining oil affects the amount of residual oil in the crankcase. Do not overfill.

Figure 1-21. Oil Drain Plug (typical)

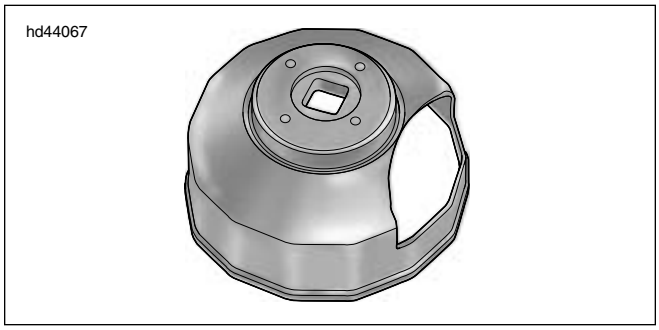


Figure 1-22. Oil Filter Wrench (HD-44067)

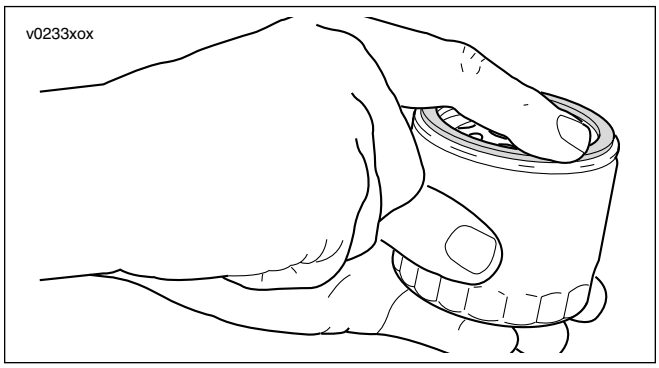


Figure 1-23. Lubing New Oil Filter

8. Fill engine and perform a cold engine oil level check until oil level indicates a level on the cross-hatched band of the dipstick. See Cold Engine Oil Level Check under 1.7 ENGINE OIL AND FILTER.

NOTE

Maximum capacity of oil system is 4.7 liters (5 quarts).

9. Start engine and carefully check for oil leaks around drain plug and oil filter.
10. Perform a complete hot engine oil level check. See Hot Engine Oil Level Check in 1.7 ENGINE OIL AND FILTER

Table 1-3. Recommended Engine Oils

Harley-Davidson Type	Viscosity	Harley-Davidson Rating	Lowest Ambient Temperature	Cold Weather Starts Below 50˚ F (10˚ C)
HD Multi-grade	SAE 10W40	HD 360	Below 40˚ F (4˚ C)	Excellent
HD Multi-grade	SAE 20W50	HD 360	Above 40˚ F (4˚ C)	Good

BATTERY MAINTENANCE 1.8

GENERAL

⚠WARNING

Batteries contain sulfuric acid, which could cause severe burns to eyes and skin. Wear a protective face shield, rubberized gloves and protective clothing when working with batteries. KEEP BATTERIES AWAY FROM CHILDREN. (00063)

⚠WARNING

Never remove warning label attached to top of battery. Failure to read and understand all precautions contained in warning, could result in death or serious injury. (00064a)

All AGM (absorption glass mat) batteries are permanently sealed, maintenance-free, valve-regulated, lead/calcium and sulfuric acid batteries. The batteries are shipped pre-charged and ready to be put into service. Do not attempt to open these batteries for any reason.

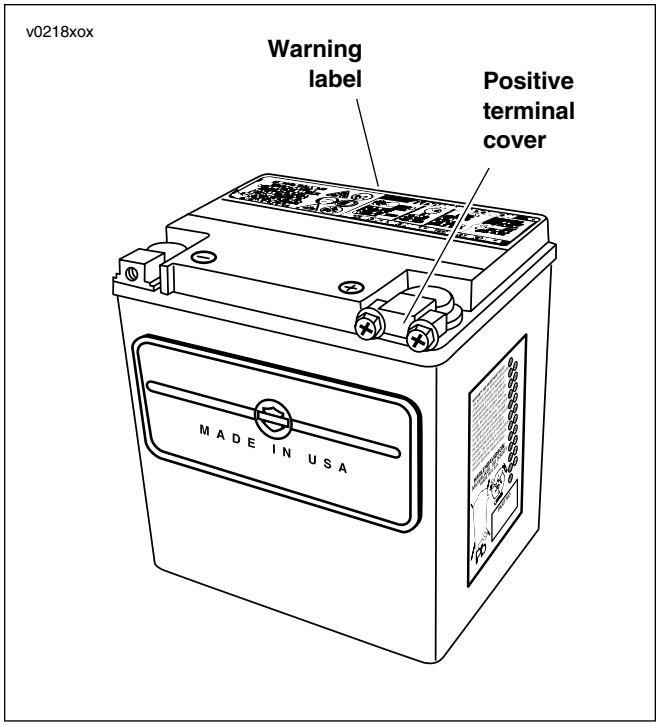


Figure 1-24. Battery

NOTE
See 8.10 BATTERY for charging and testing information.

Table 1-4. Battery Electrolyte Antidotes

CONTACT	SOLUTION
External	Flush with water.
Internal	Drink large quantities of milk or water, followed by milk of magnesia, vegetable oil or beaten eggs. Call doctor immediately.
Eyes	Flush with water. Get immediate medical attention.

Figure 1-25. Battery Warning Label

DISCONNECTION/REMOVAL

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove airbox. See 1.3 AIRBOX AND AIR FILTER.

CAUTION

Cover the injector intakes with duct tape to prevent contaminates/objects from falling down the injector bore. do NOT use shop cloths or objects that could damage the injector butterflies. (00212a)

3. Cover injector intakes (injector bore).

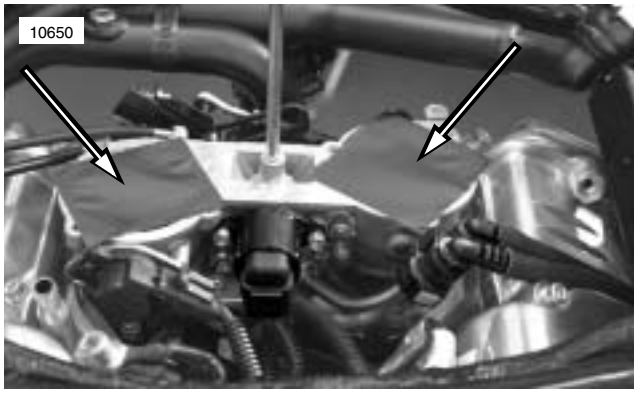


Figure 1-26. Cover Injector Intakes (shown by arrows)

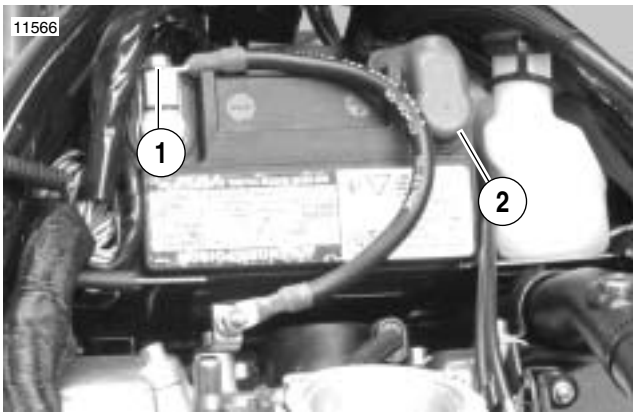
⚠WARNING

Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)

4. See Figure 1-27. Remove negative battery terminal bolt (1), lift up boot, and remove positive battery terminal bolt (2).
5. Stretch battery strap up and over airbox grommet bracket.
6. Remove battery and release tension on battery strap.
7. Check the voltage of the battery to make sure it is 12.7 V. If the open circuit (disconnected) voltage reading is below 12.7 V, refer to Table 8-7., and charge battery at rate and time specified.

NOTE

The engine is equipped with an ACR (automatic compression release) so a smaller battery provides adequate starting current.



1. Negative battery terminal bolt
2. Positive battery terminal bolt (located under boot)

Figure 1-27. Battery (12 amp-hour) (typical) (VRSCA shown)

INSTALLATION/CONNECTION

CAUTION

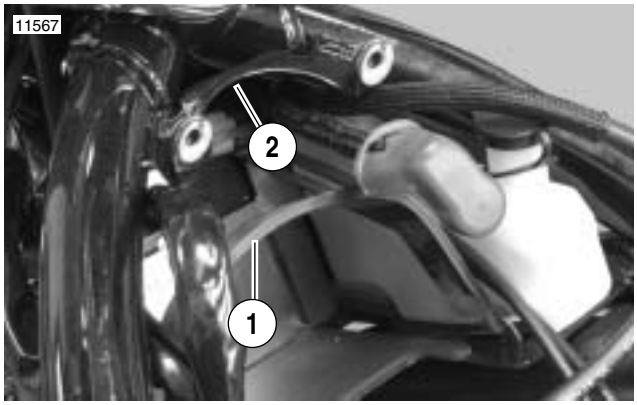
Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)

CAUTION

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

⚠WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)



1. **Hold-down strap**
2. **Bracket**

Figure 1-28. Stretch Hold-Down Strap Over Bracket (typical) (VRSCA shown)

1. See Figure 1-28. Stretch rubber hold-down strap (1) over airbox grommet bracket (2).
2. See Figure 1-27. Install battery with negative terminal on left side. Move hold-down strap over battery case.
3. Attach positive battery cable first. Tighten terminal bolt (2) to 6.8-10.9 Nm (60-96 **in-lbs**).
4. Attach negative battery cable and tighten terminal bolt (1) to 6.8-10.9 Nm (60-96 **in-lbs**).

NOTE

Battery must sit flat on bottom of tray pad. Verify that battery does not sit on front edge of tray pad.

5. Remove covering over throttle bodies.
6. Install airbox. See 1.3 AIRBOX AND AIR FILTER.
7. Install maxi-fuse and side cover.
8. Close seat.

STORAGE

⚠WARNING

Store the battery out of the reach of children. Inadequate safety precautions could result in death or serious injury.

CAUTION

Do not allow battery to completely discharge. The electrolyte in a discharged battery will freeze. The more discharged a battery is, the more easily it can freeze and crack the battery case. (00218a)

If the motorcycle is be stored with the security system armed, connect a Battery Tender Plus! Automatic Battery Charger (Part No. 99863-93TA) to maintain battery charge.

If the motorcycle is to be stored with the battery installed, a Battery Tender unavailable, and with the security system ***not*** armed, remove the right side cover and the maxi-fuse. See 8.5 MAXI-FUSE.

If the motorcycle will not be operated for several months, such as during the winter season, remove the battery from the motorcycle and fully charge. See 8.10 BATTERY.

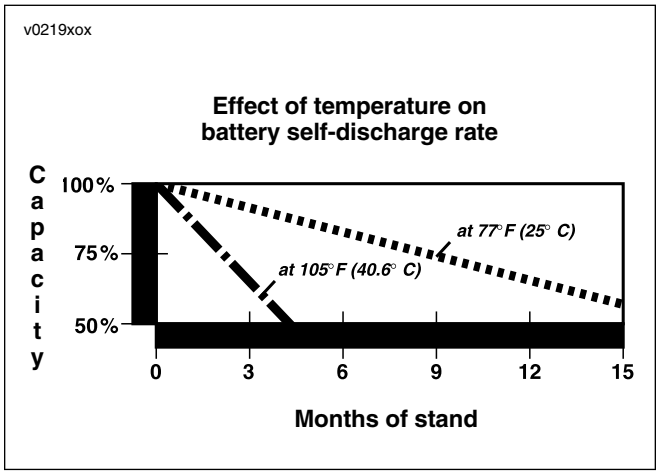


Figure 1-29. Battery Self-Discharge Rate

See Figure 1-29. Self-discharge is a normal condition and occurs continuously at a rate that depends on the ambient temperature and the battery's state of charge. Batteries discharge at a faster rate at higher ambient temperatures. To reduce the self-discharge rate, store battery in a cool (not freezing), dry place.

Charge the battery every month if stored at temperatures below 60˚ F (16˚ C). Charge the battery more frequently if stored in a warm area above 60˚ F (16˚ C).

NOTE

The Battery Tender Plus! Automatic Battery Charger (Part No. 99863-93TA) may be used to maintain battery charge for extended periods of time without risk of overcharging or boiling.

When returning a battery to service after storage, refer to the instructions under 8.10 BATTERY.

FLUID INSPECTION

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

1. See Figure 1-30. Check level in rear brake master cylinder reservoir. Level should be 12.7 mm (0.5 in.) below the gasket surface.
   a. Remove cooling system side cover fastener on underside of side cover.
   b. Swing out lower section and lift to unhook from top of assembly.
   c. View fluid level through sight window at rear of reservoir.

CAUTION

To prevent dirt from entering the master cylinder reservoir, thoroughly clean the cover before removal.

2. See Figure 1-32. Check level in front brake master cylinder reservoir. Level should be at 5 mm (1/5 in.) below the gasket surface.
3. Install gaskets and covers. Tighten reservoir cover screws to 0.8-1.2 Nm (7-11 **in-lbs**).

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

4. Front brake hand lever and rear brake foot pedal must have a firm feel when applied. If not, bleed system using only D.O.T. 4 BRAKE FLUID. See 1.10 BLEEDING BRAKES.

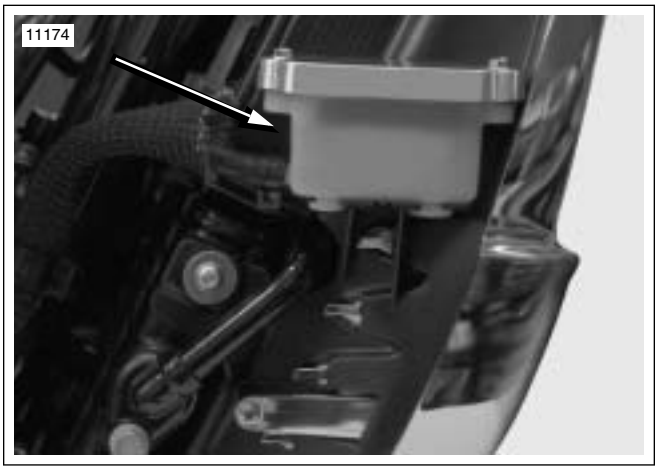


Figure 1-30. Rear Brake Master Cylinder Reservoir (typical) (VRSCA shown)

Figure 1-31. Rear Brake Fluid Reservoir Sight Gauge (reservoir removed from motorcycle) (typical)

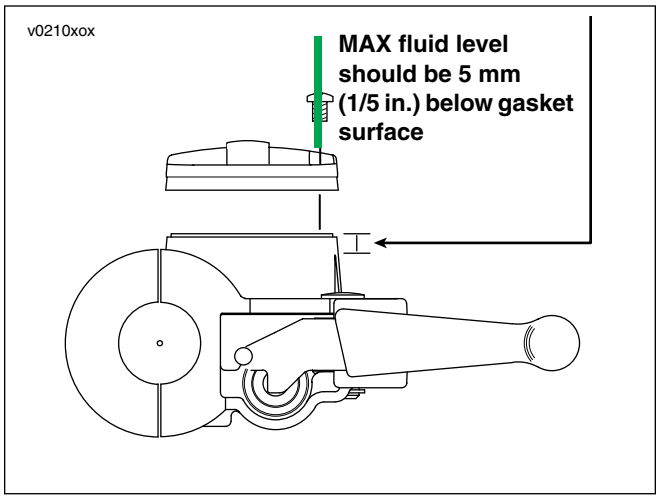


Figure 1-32. Front Brake Master Cylinder Reservoir

REAR BRAKE PEDAL

Pedal Adjustment

Rear brake pedal is non-adjustable.

BLEEDING BRAKES 1.10

GENERAL

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

Front brake hand lever and rear brake foot pedal must have a firm feel when brakes are applied. If not, bleed system as described.

BLEEDING BRAKES

NOTE

Hydraulic brake fluid bladder-type pressure equipment can be used to fill brake master cylinder through the bleeder valve. Remove master cylinder reservoir cover so that system cannot pressurize. Do not use pressure bleeding equipment when the hydraulic system is sealed with master cylinder reservoir cover and gasket in place.

1. Bleed front and rear brakes separately. Remove bleeder valve cap. Install end of a length of clear plastic tubing over caliper bleeder valve. Place opposite end in a clean container.
   a. Front brake bleeder valve-see Figure 1-33.
   b. Rear brake bleeder valve-see Figure 1-34.
2. Stand motorcycle upright. Clean and remove covers to master cylinder reservoir.
3. Add D.O.T. 4 BRAKE FLUID to master cylinder reservoir.
   a. Front brake master cylinder reservoir: Fluid level should be at MAX LEVEL. See 2.20 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
   b. Rear brake master cylinder reservoir: Fluid level should be 12.7 mm (0.5 in.) below reservoir's gasket surface. See 2.23 REAR BRAKE RESERVOIR (VRSCD/VRSCR).

NOTE

Do not fill above the rear brake reservoir above the top of the sight window at the rear of the reservoir.

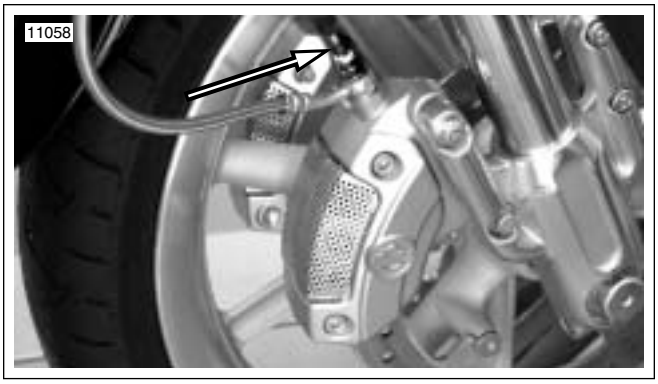


Figure 1-33. Front Brake Bleeder Valve

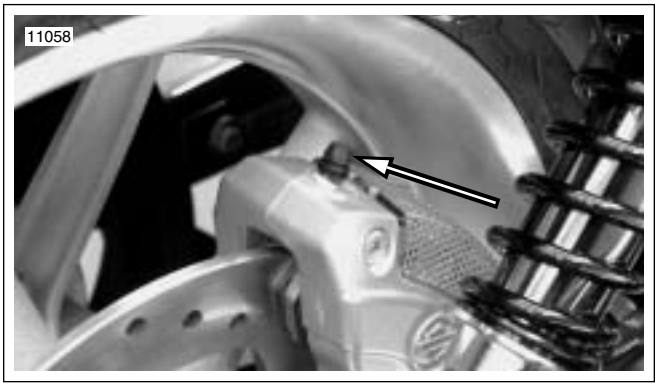


Figure 1-34. Rear Brake Bleeder Valve

4. Depress and hold brake lever/pedal to build up hydraulic pressure.
5. Open bleeder valve slowly about 1/2-turn counterclockwise; brake fluid will flow from bleeder valve and through tubing. When brake lever/pedal has moved its full range of travel, close bleeder valve (clockwise). Allow brake lever/pedal to return slowly to its released position.
6. Repeat steps 4 and 5 until all air bubbles are purged.

NOTE

Check fluid lever in master cylinder during process. Do not allow master cylinder to run dry. Refill as necessary.

7. Remove clear plastic tubing and tighten bleeder valve to 9.0-11.0 Nm (80-97 **in-lbs**). Install bleeder valve cap.
8. Verify master cylinder fluid level.

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

9. Attach cover to rear brake reservoir. Tighten screws on cover to 0.8-1.2 Nm (7-11 **in-lbs**).

BRAKE PADS AND DISCS 1.11

INSPECTION

Brake Pads

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (0011a)

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

See Figure 1-37. Replace brake pads if brake pad friction material on either the front or rear caliper is worn to service limit (wear indicator lines no longer visible). Always replace both pads in a caliper as a set.

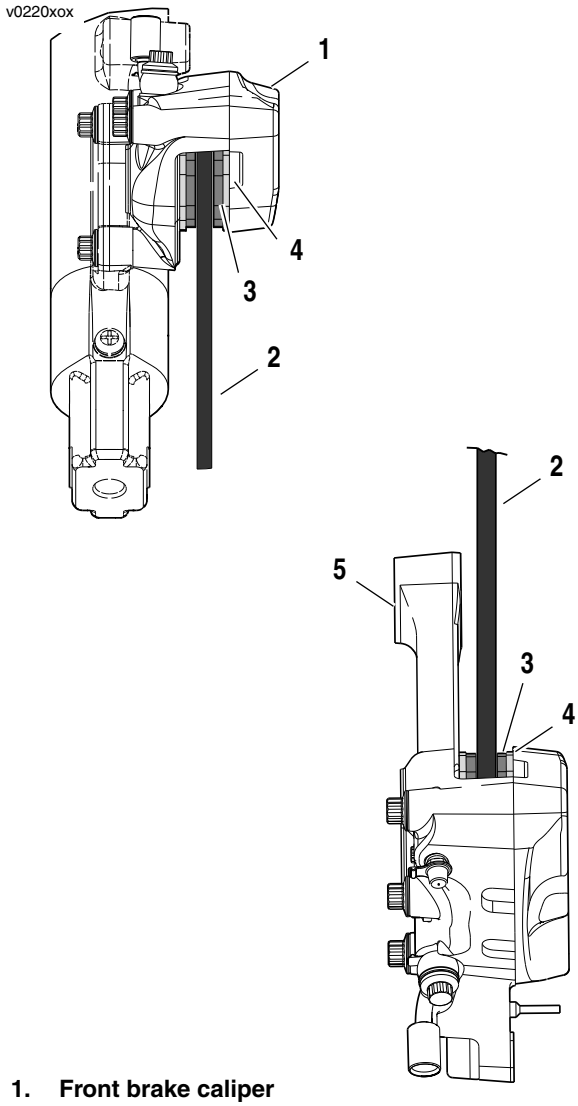
When checking the brake pads and discs, inspect the brake hoses for correct routing and any signs of damage.

Brake Disc Thickness

The minimum brake disc (2) thickness is stamped on the side of the disc. Replace disc if badly scored.

Brake Disc Lateral Runout and Warpage

Maximum brake disc lateral runout and warpage is 0.3 mm (0.012 in.).



1. **Front brake caliper (viewed from below)**
2. **Brake disc**
3. **Brake pads**
4. **Backing plate**
5. **Rear brake caliper (viewed from above)**

Figure 1-35. Brake Pad Areas of Inspection (typical)

BRAKE PAD REPLACEMENT

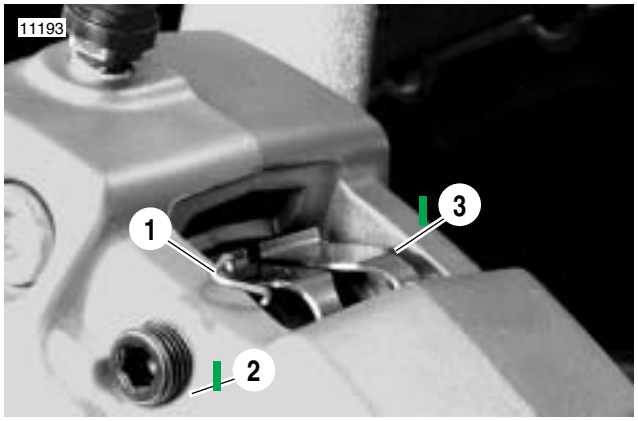
Rear Brake Caliper

1. Remove right rear upper shock bolt and pivot shock absorber away to provide necessary clearance for performing rear brake service. See 2.44 REAR SHOCK ABSORBERS (VRSCA/VRSCD), or 2.45 REAR SHOCK ABSORBERS (VRSCR) for proper procedure.
2. Remove rear master cylinder reservoir cap. As pistons are pushed back into the caliper, fluid level may rise more than 12.7 mm (1/2 in.). You may have to remove fluid to allow for this.
3. Gently pry the pads back. Use steady pressure to prevent scoring the brake disc. Pry between the pad and the brake disc in order to push the caliper pistons back into their bores.
4. See Figure 1-36. Remove screen cover by pulling single prong side first, caliper pin retainer clip, and caliper pin (6 pt/5 mm). Inspect caliper pin and caliper pin clip for damage or wear. Replace as necessary.
5. Using index finger, pull downward on at rear of pad directly below two-pronged side of brake pad spring to free pads from caliper. Note the pad's original orientation for replacement purposes.

NOTE

If brake pad spring needs to be replaced, it is necessary to remove caliper from motorcycle. Make sure brake pad spring is seated completely for proper brake pad installation.

6. Inspect brake pad spring for wear or damage and replace as necessary.



1. **Caliper pin retainer clip (always facing outward)**
2. **Caliper pin**
3. **Brake pad spring**

Figure 1-36. Rear Caliper Pad Clip and Pin (6 pt/ 5 mm) (caliper cover removed for photo clarity)

WARNING

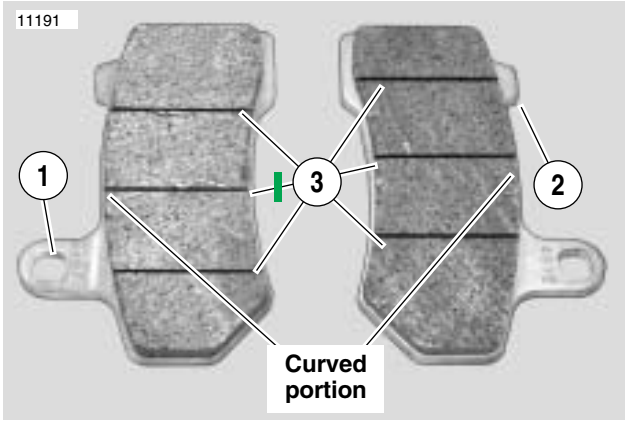
Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

7. See Figure 1-37. Install **new** brake pads using the same orientation as the pads previously removed. Curved portion of pad must face upward. Insert square locator tab first and then pivot pin side tab upward until pad seats.
8. Verify pads have been correctly installed and seated in caliper
   a. Install **new** pad pin (provided in set) and tighten to 8.5-11.5 Nm (75-102 **in-lbs**).
   b. Install **new** caliper pin retaining clip (provided in set) with clip facing outward.
   c. Install two pronged side of screen cover on caliper first (two pronged side faces pin side of caliper), followed by snapping the single pronged side in.
9. Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads. If the front wheel is off the ground, rotate wheel to check for excessive brake pad drag.

WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

10. Check brake fluid level in master cylinder. Push diaphragm in cover gasket in toward cover and fill to proper level if necessary using D.O.T. 4 BRAKE FLUID. Install master cylinder reservoir cap. Tighten reservoir cap screws to 0.7-0.9 Nm (6-8 **in-lbs**).



1. **Pin side tab on backing plate**
2. **Single square locator tab on backing plate**
3. **Wear indicator lines**

Figure 1-37. Brake Pad Orientation

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

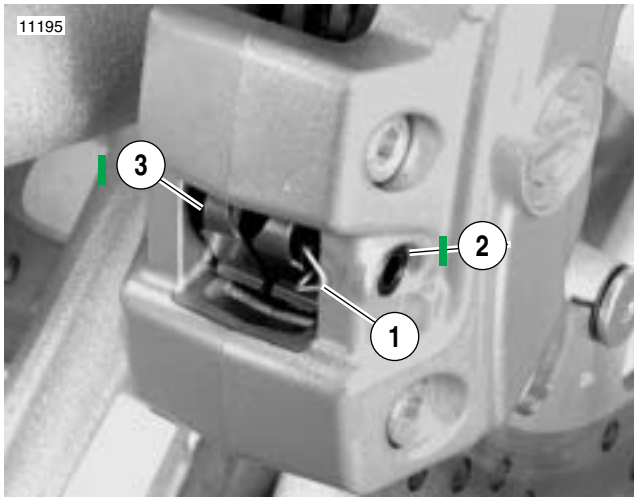
11. Install shock absorber per procedure in 2.44 REAR SHOCK ABSORBERS (VRSCA/VRSCD), or 2.45 REAR SHOCK ABSORBERS (VRSCR).
12. Test brake system.
    a. Turn ignition switch ON. Pump brake pedal to verify operation of the brake lamp.
    b. Test ride the motorcycle. If the brakes feel spongy, bleed the system. See 1.10 BLEEDING BRAKES.

NOTE

Avoid making hard stops for the first 160 km (100 miles). This allows the new pads to become conditioned to the brake disks.

Front Brake Caliper

1. Remove the front master cylinder reservoir cap. As the pistons are pushed back into the caliper, fluid level may rise more than 5.0 mm (1/5 in). You may have to remove fluid to allow for this.



1. **Caliper pin retainer clip**
2. **Caliper pin**
3. **Brake pad spring**

Figure 1-38. Front Brake Caliper (Right Side Shown with screen cover removed)

2. Gently pry the pads back. Use steady pressure to prevent scoring the brake disc. Pry between the pad and the brake disc in order to push the caliper pistons back into their bores.
3. See Figure 1-38. Remove screen cover by pulling single prong side first, then caliper pin retainer clip, and caliper pin (6 pt/5 mm). Inspect caliper pin and caliper pin clip for damage or wear. Replace as necessary.
4. Using index finger, pull downward on at rear of pad directly below two-pronged side of brake pad spring to free pads from caliper. Note the pad's original orientation for replacement purposes.

NOTE

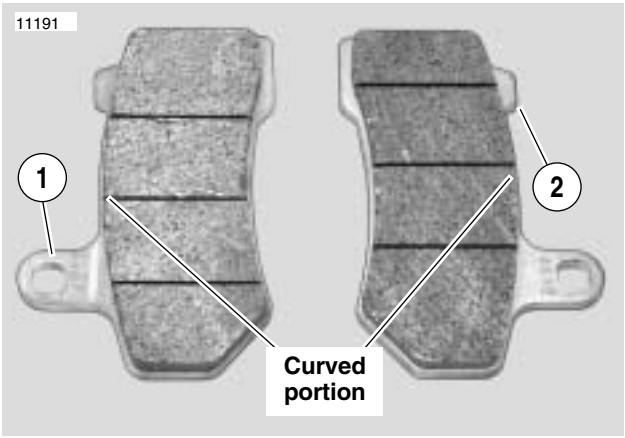
If brake pad spring needs to be replaced, it is necessary to remove caliper from motorcycle. Make sure brake pad spring is seated completely for proper brake pad installation.

5. Inspect brake pad spring for wear or damage and replace as necessary.

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

6. See Figure 1-39. Install **new** brake pads using the same orientation as the pads previously removed. Curved portion of pad must face upward. Insert square locator tab first and then pivot pin side tab upward until pad seats.



1. **Pin side tab on backing plate**
2. **Single square locator tab on backing plate**

Figure 1-39. Brake Pad Orientation

   a. Install **new** pad pin (provided in set) and tighten to 8.5-11.5 (75-102 **in-lbs**).

   b. Install **new** caliper pin retainer clip (provided in set) with clip facing outwards.

7. Verify pads have been correctly installed and seated in caliper.
8. Install two pronged side of screen cover on pin side of caliper first, followed by snapping the single pronged side in.

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

9. Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads. If the front wheel is off the ground, rotate wheel to check for excessive brake pad drag.
10. Check brake fluid level in master cylinder. Fill to proper level if necessary using D.O.T. 4 BRAKE FLUID. Install master cylinder reservoir cap. Tighten reservoir cap screws to 0.8-1.2 Nm (7-11 **in-lbs**).

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

11. Test brake system.

    a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.

    b. Test ride the motorcycle. If the brakes feel spongy, bleed the system. See 1.10 BLEEDING BRAKES.

NOTE

*Avoid making hard stops for the first 160 km (100 miles). This allows the **new** pads to become conditioned to the brake discs.*

TIRES

WARNING

Match tires, tubes, air valves and caps to the correct wheel rim. Contact a Harley-Davidson dealer. Mismatching can result in damage to the tire bead, allow tire slippage on the rim or cause tire failure, which could result in death or serious injury. (00023a)

- **In addition, using tires other than those specified may adversely affect motorcycle handling.**
- **Inner tubes must not be used in radial tires and radial tires must not be used on laced (wire spoked) wheels.**
- **Tubeless tires are used on all Harley-Davidson cast and disc wheels.**
- **Tire sizes are molded on the tire sidewall. Inner tube sizes are printed on the tube.**

Check tire pressure and tread:

- As part of the pre-ride inspection.
- At every scheduled service interval.

1. Inspect each tire for punctures, cuts, and breaks.
2. Inspect each tire for wear. See TIRE REPLACEMENT under 2.26 TIRES. Replace tires before they reach the tread wear indicator bars.

NOTE

Missing indicator wear bars represent less than 0.8 mm (1/32 in.) tread pattern depth remaining.

WARNING

Do not inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)

3. Check for proper front and rear tire pressures when tires are cold. Refer to Table 1-5. Adjust pressure if required.

WHEEL BEARINGS

Service wheel bearings:

- Inspect any time the wheels are removed.
- Replace when bearings exceed end play service wear limit of 0.051 mm (0.002 in.).

Check wheel bearings and axle spacers for wear and corrosion. Excessive play or roughness indicates worn bearings. Replace bearings in sets only. See 2.31 SEALED WHEEL BEARINGS.

Table 1-5. Tire Pressures

DUNLOP TIRES ONLY		SOLO RIDER		RIDER & ONE PASSENGER	
MODEL	TIRE	PSI	kPA	PSI	kPA
ALL	Front	36	248	36	248
	Rear	38	262	40	276

CLUTCH 1.13

GENERAL

The clutch is hydraulically actuated. A hand lever actuated master cylinder creates pressure in a clutch fluid line that activates a secondary clutch actuator mounted in the engine right side cover. The secondary clutch actuator piston extends and contacts the clutch release bearing to release the clutch.

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

CHECKING CLUTCH FLUID LEVEL

Though the sight gauge in the side of the reservoir will indicate a low clutch fluid level when the gauge is clear.

⚠WARNING

Check that no lubricant gets on rear tire, wheel or brakes when changing fluid. Traction can be adversely affected, which could result in loss of control of the motorcycle and death or serious injury. (00047a)

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

1. Stand motorcycle upright and square handlebars to level clutch reservoir.

CAUTION

Do not overfill clutch reservoir. Clutch fluid volume increases with clutch wear and can damage seals causing damage to clutch or clutch system.

2. Verify that fluid level is at FILL LEVEL marked on ledge on rear inside wall of reservoir.
3. If necessary, add D.O.T. 4 BRAKE FLUID, (HD-99953-99A) to master cylinder reservoir. Fluid level should not exceed FILL LEVEL.
4. Tighten reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).

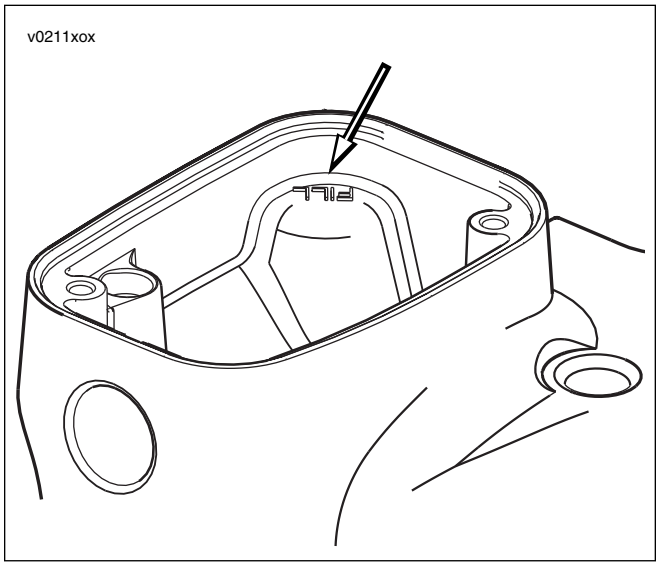


Figure 1-40. Fill Level (reservoir cover removed)

BLEEDING CLUTCH FLUID LINE 1.14

PROCEDURE

⚠WARNING

Check that no lubricant gets on rear tire, wheel or brakes when changing fluid. Traction can be adversely affected, which could result in loss of control of the motorcycle and death or serious injury. (00047a)

CAUTION

Do NOT allow dirt or debris to enter the clutch master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation of the clutch and equipment damage. (00205a)

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

NOTE

When filling an empty clutch fluid line, a Snap-on BASIC VACUUM BRAKE BLEEDER with a fitting that mates to the secondary clutch actuator bleeder screw threads can be used to initially draw the fluid down the clutch line.

1. Stand motorcycle upright and square handlebars to level clutch reservoir. Remove reservoir cover.

CAUTION

Do not overfill clutch reservoir. Clutch fluid volume increases with clutch wear and can damage seals causing damage to clutch or clutch system.

2. If necessary, add D.O.T. 4 BRAKE FLUID, (HD-99953-99A) to master cylinder reservoir. Initial fluid level should not exceed FILL LEVEL.

⚠CAUTION

Loosen banjo bolt only enough to allow air bubbles to escape. Clutch fluid under pressure can squirt a steady stream several feet.

3. While holding reservoir cover in place:
   a. Pump clutch hand lever 5 times.
   b. Hold clutch hand lever against handlebar.
   c. Hold shop towel under fitting and loosen banjo bolt.
   d. Watch banjo fitting for air bubbles.
   e. Retighten banjo fitting.
   f. Release hand lever.
4. Fill reservoir to FILL LEVEL and repeat the previous step three times or more until only a steady flow of clutch fluid escapes banjo fitting and fluid level in reservoir is at FILL LEVEL with motorcycle in an upright position.
5. Remove secondary clutch actuator cover.
6. Cover exhaust with towel and place a suitable pan under right side case to catch excess clutch fluid.

7. While holding reservoir cover in place:
   a. Pump clutch hand lever 5 times.
   b. Hold clutch hand lever against handlebar.
   c. Loosen secondary clutch actuator bleed screw.
   d. Watch bleed screw for air bubbles.
   e. Tighten bleeder screw.
   f. Release hand lever.
8. Fill reservoir to FILL LEVEL and repeat the previous step three times or more until only a steady flow of clutch fluid escapes bleeder screw and fluid level in reservoir is at FILL LEVEL with motorcycle in an upright position.

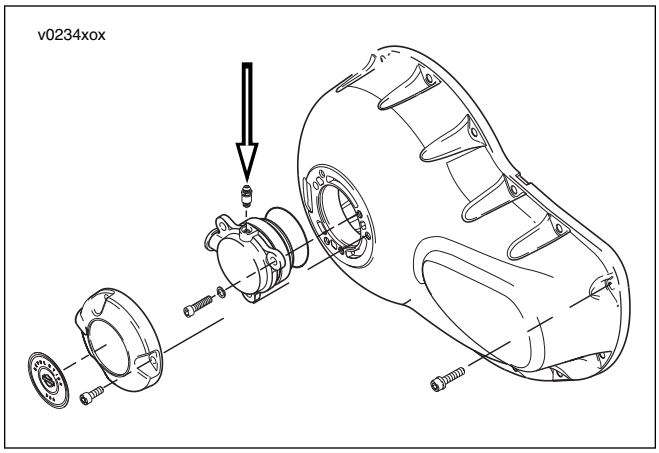


Figure 1-41. Secondary Clutch Actuator Bleed Screw

CAUTION

Do not overfill clutch reservoir. Clutch fluid volume increases with clutch wear and can damage seals causing damage to clutch or clutch system.

9. Test pressure by squeezing clutch hand lever.

NOTE

If continued repetition of procedure does not build pressure in line and maintain FILL LEVEL, there is a leak in the clutch system. If the leak is not visible, remove and check the secondary clutch actuator boot for leakage.

10. Tighten fasteners as follows:
    a. Reservoir banjo bolt to 23-31 Nm (17-23 ft-lbs).
    b. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
    c. Bleed screw to 9-11 Nm (80-100 **in-lbs**).
    d. Secondary clutch actuator cover fasteners to 6-10 Nm (53-88 **in-lbs**).
11. Test ride motorcycle. Incorrect pressure can cause:
    a. Dragging clutch.
    b. Hard shifting.

REAR BELT DEFLECTION 1.15

INSPECTION

PART NO.	SPECIALTY TOOL
HD-35381	Belt tension gauge

Check rear belt deflection:

- As part of the pre-ride inspection.
- At every scheduled service interval.

NOTE

Customers may purchase belt tension gauge from an authorized Harley-Davidson dealer.

CAUTION

Setting tension without using BELT TENSION GAUGE typically results in loose belts. Loose belts will fail due to ratcheting (jumping a tooth) which causes tensile cord crimping and breakage.

1. See Figure 1-42. Check rear belt tension with motorcycle cold, standing upright, transmission in NEUTRAL and no rider on motorcycle.
2. See Figure 1-44. Using BELT TENSION GAUGE (HD-35381), apply 4.5 kg (10 lbs) of force upward.
3. Verify that the drive belt deflects 6 mm for VRSCA and VRSCD models and 10 mm for VRSCR models.

NOTE

Belt deflection window on the debris deflector is graduated in 2 mm increments.

Figure 1-42. Belt Tension Gauge (HD-35381)

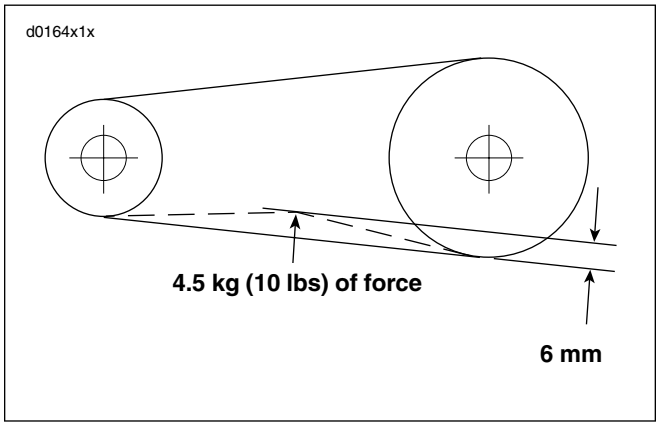


Figure 1-43. Checking Belt Deflection (VRSCA,VRSCD)

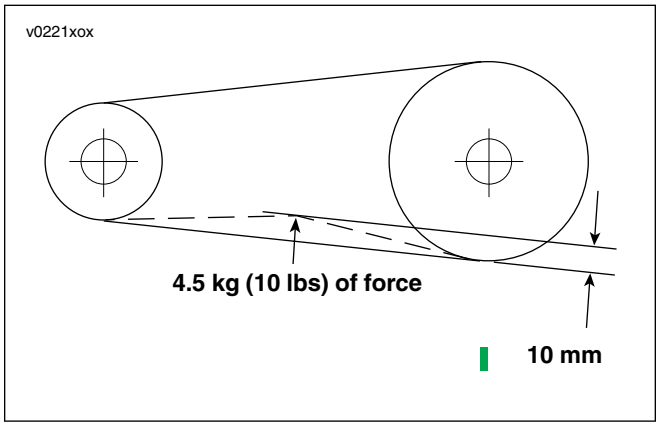


Figure 1-44. Checking Belt Deflection (VRSCR)

4. If belt adjustment is necessary, see Figure 1-45. Remove snap ring (1) and loosen axle nut (2) on right side of motorcycle.

NOTE

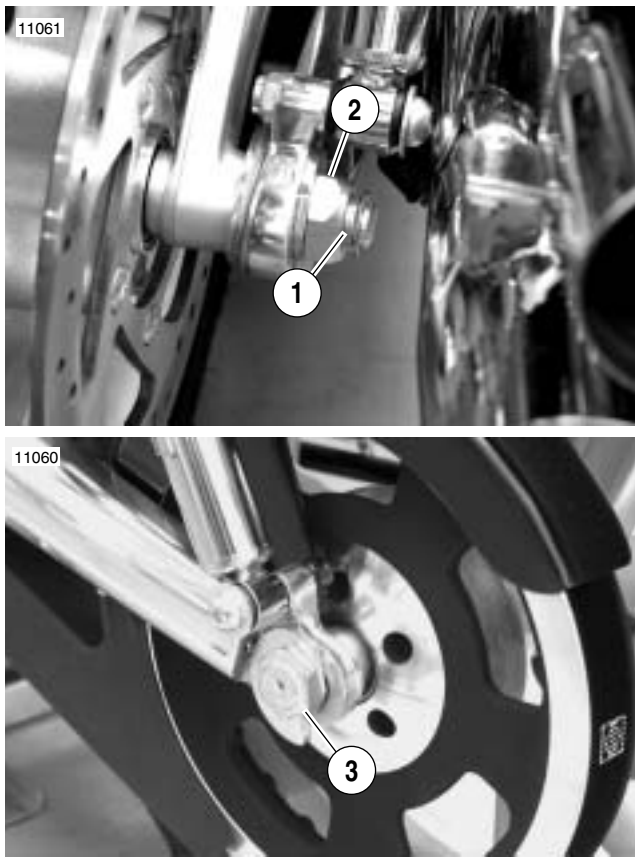
The left cam is welded to the axle and the right cam is keyed to the axle. Clockwise rotation of axle will tighten belt. Counterclockwise rotation will loosen belt.

5. Adjust belt tension on left side by turning the axle adjustment eccentric (3) until the specification in step 2 is achieved.

⚠WARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)

6. Tighten axle nut (2).
   a. Tighten axle nut (2) to 190-203 Nm (140-150 ft-lbs).
   b. Install snap ring (1).



1. **Snap ring (right side)**
2. **Axle nut (right side)**
3. **Adjustment eccentric (left side)**

Figure 1-45. Axle Adjusters (typical)

DRIVE BELT AND WHEEL SPROCKET 1.16

GENERAL

NOTE

When a drive belt is replaced for any reason other than stone damage, it is recommended that the transmission and rear sprockets also be replaced to increase the longevity of the new drive belt. In the case of stone damage, inspect sprockets for damage and replace as required.

CLEANING

Keep dirt, grease, oil, and debris off the belt and sprockets.

Clean the belt with a rag which is slightly damp with a light cleaning agent.

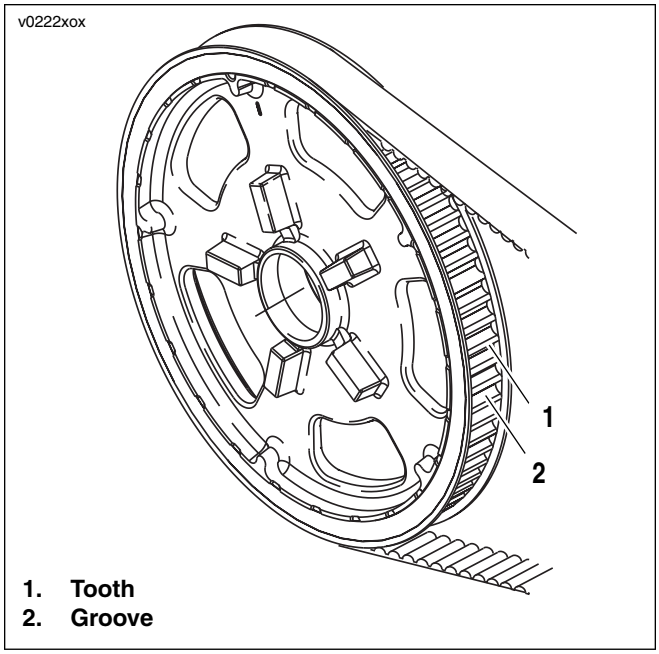
INSPECTION

Sprocket

NOTE

If chrome chips or gouges in wheel sprocket are large enough to be harmful, they will leave a pattern on the belt face.

1. See Figure 1-46. Inspect each tooth (1) of rear sprocket for:
   a. Major tooth damage.
   b. Large chrome chips with sharp edges.
   c. Gouges caused by hard objects.
   d. Excessive loss of chrome plating (see step 2).
2. To check if chrome plating has worn off, drag a scribe or sharp knife point across the bottom of a groove (2) (between two teeth) with medium pressure.
   a. If scribe or knife point slides across groove without digging in or leaving a visible mark, chrome plating is still good.
   b. If scribe or knife points digs in and leaves a visible mark, it is cutting the bare aluminum. A knife point will not penetrate the chrome plating.
3. Replace rear sprocket if major tooth damage or loss of chrome exists.



1. Tooth
2. Groove

Figure 1-46. Rear Sprocket (typical)

Drive Belt

See Figure 1-47. Inspect drive belt for:

- Cuts or unusual wear patterns.
- Outside edge bevelling (8). Some bevelling is common, but it indicates that sprockets are misaligned.
- Outside ribbed surface for signs of stone puncture (7). If cracks/damage exists near edge of belt, replace belt immediately. Damage to center of belt will require belt replacement eventually, but when cracks extend to edge of belt, belt failure is imminent.
- Inside (toothed portion) of belt for exposed tensile cords (normally covered by nylon layer and polyethylene layer). This condition will result in belt failure and indicates worn transmission sprocket teeth. Replace belt and transmission sprocket.
- Signs of puncture or cracking at the base of the belt teeth. Replace belt if either condition exists.
- Replace belt if conditions 2, 3, 6 or 7 (on edge of belt) exist. See 1.15 REAR BELT DEFLECTION.

NOTE

Refer to Table 1-6. Condition 1 may develop into 2 or 3 over time. Condition 1 is not grounds for replacing the belt, but it should be watched closely before condition 2 develops which will require belt replacement.

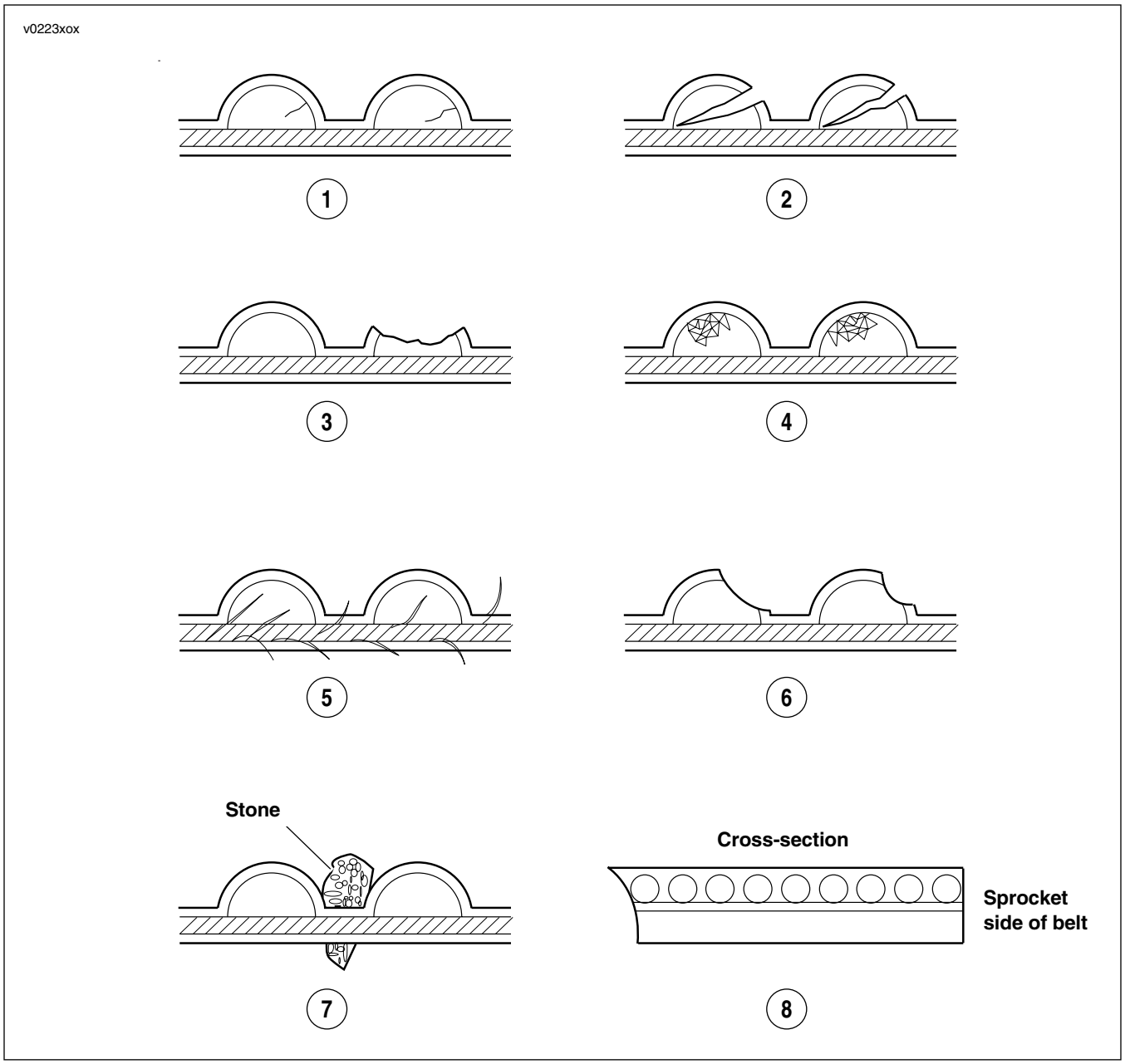


Figure 1-47. Drive Belt Wear Patterns

Table 1-6. Drive Belt Wear Analysis

PATTERN	CONDITION	REQUIRED ACTION
1	Internal tooth cracks (hairline)	OK to run, but monitor condition
2	External tooth cracks	Replace belt
3	Missing teeth	Replace belt
4	Chipping (not serious)	OK to run, but monitor condition
5	Fuzzy edge cord	OK to run, but monitor condition
6	Hook wear	Replace belt
7	Stone damage	Replace belt if damage is on the edge
8	Bevel wear (outboard edge only)	OK to run, but monitor condition

DRIVE BELT REPLACEMENT 1.17

REPLACEMENT

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. See Figure 1-49. Remove drive sprocket cover (6) fasteners (9) and washers (8). Grommets (7) and bushings (10) should stay with cover (6).
3. See Figure 1-49. Loosen locking bolts (5) holding drive sprocket (3) to drive sprocket flange (4).
4. Block motorcycle underneath frame so weight of motorcycle is off of rear wheel.
5. Remove fastener holding lower debris deflector to rear fork. Pull debris deflector rearward off of rubber grommet. See 2.43 BELT GUARD/DEBRIS DEFLECTOR.
6. Loosen left lower shock bolt out until belt guard is free and pull belt guard rearward off of rubber grommets.
7. Remove axle retaining ring and loosen axle nut and adjuster from right side of axle.
8. Relieve belt tension by rotating axle adjusters.

CAUTION

Polished aluminum wheels can be scratched or damaged when slid out of and into the rear fork. Exercise caution to avoid dragging wheel and sprocket surfaces against rear fork components.

9. Remove shock bolt and swing shock up and out of the way.
10. See Figure 1-49. Slip drive belt (2) off wheel sprocket (1) and drive sprocket (3).
11. Inspect both drive and wheel sprocket for indicators of wear, misalignment, and damage. See 1.16 DRIVE BELT AND WHEEL SPROCKET.

NOTE

When a drive belt is replaced for any reason other than stone damage, it is recommended that the drive and wheel sprockets also be replaced to increase the longevity of the new drive belt. In the case of stone damage, inspect sprockets for damage and replace as required.

NOTE

Do not remove the drive sprocket flange nut.

12. Remove locking bolts (5) from drive sprocket. Discard bolts (5).
13. Rotate drive sprocket (3) to fit spoke pattern of flange (4) and remove sprocket (3).

NOTE

*Make sure threads are free of old thread lock material before installing **new** locking bolts.*

14. Install drive sprocket (3) by matching spokes of drive sprocket to open spaces of drive sprocket flange (4) and rotate drive sprocket (3) to align sprocket bolt holes behind mounting flange (4) bolt holes.
15. Install and tighten three **new** locking bolts (5) to 88-102 Nm (65-75 ft-lbs).

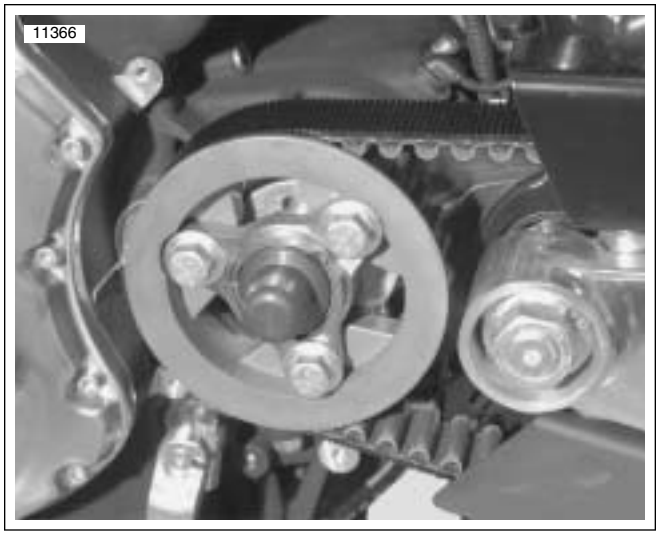
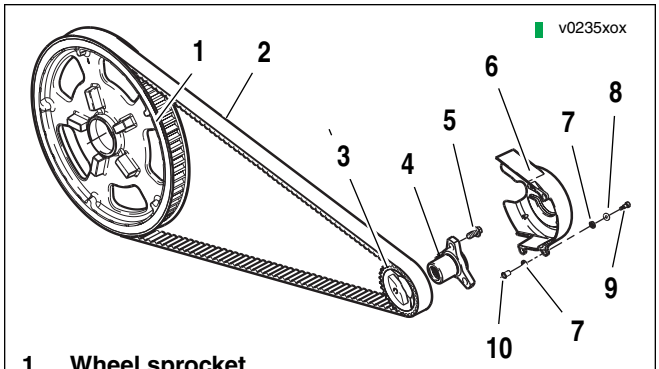


Figure 1-48. Drive Sprocket



1. **Wheel sprocket**
2. **Drive belt**
3. **Drive sprocket**
4. **Drive sprocket flange**
5. **Locking bolts**
6. **Drive sprocket cover**
7. **Grommet (2)**
8. **Washer**
9. **Fastener**
10. **Bushing**

Figure 1-49. Sprocket and Belt Components

16. Remove the rear wheel and replace the wheel sprocket. See 2.30 REAR WHEEL.

17. See Figure 1-49. Fit replacement belt (2) around drive sprocket (3) and over wheel sprocket (1).

18. Rotate axle adjusters to seat drive belt on sprockets. Tighten axle nut to hold in place.

19. Slide belt guard slots onto rubber grommet.

20. Thread shock mount bolt into belt guard and tighten shock mount bolt. See 2.44 REAR SHOCK ABSORBERS (VRSCA/VRSCD). See 2.45 REAR SHOCK ABSORBERS (VRSCR).

21. Slide debris deflector slots on to its corresponding rubber grommet. Install debris deflector fastener and tighten to 6-10 Nm (53-88 **in-lbs**).

22. Measure belt guard to drive sprocket clearance.

23. If clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.

24. Verify axle alignment and check belt deflection. See 1.15 REAR BELT DEFLECTION.

25. Use a wrench to rotate rear axle adjuster until drive belt deflection is within specifications.

⚠WARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)

26. Tighten axle nut to 190-203 Nm (140-150 ft-lbs).

27. Install snap ring.

28. Install belt drive sprocket cover (6). Tighten cover fasteners (9) to 6-10 Nm (53-88 **in-lbs**).

29. Install maxi-fuse and right side cover.

REAR SHOCK PRELOAD

PART NO.	SPECIALTY TOOL
HD-94700-52C	Spanner wrench

The rear shock absorber springs can be adjusted for motorcycle load. A spanner wrench is required for this adjustment.

⚠ WARNING

Be sure both shock absorbers are adjusted to same preload position. Improper adjustment can adversely affect stability and handling, which could result in death or serious injury. (00036a)

The rear shock absorber springs can be adjusted to five positions to compensate for various loads.

- For heavy loads, the springs should be compressed.
- For lighter loads, the springs should be extended.

See Figure 1-50. To adjust the rear shock absorber, turn spring adjusting cam to desired position with SPANNER WRENCH (HD-94700-52C). Both spring adjusting cams must be adjusted to the same position.

Figure 1-50. Rear Shock Adjustment (typical) (VRSCA shown)

STEERING HEAD BEARINGS (VRSCA, VRSCD) 1.19

ADJUSTMENT (FALL-AWAY)

1. Support motorcycle in an upright position so the front end is completely suspended and the vehicle is level.
2. Remove all accessory weight and P&A parts, such as a windshield, or any part that may influence the way the front end swings.

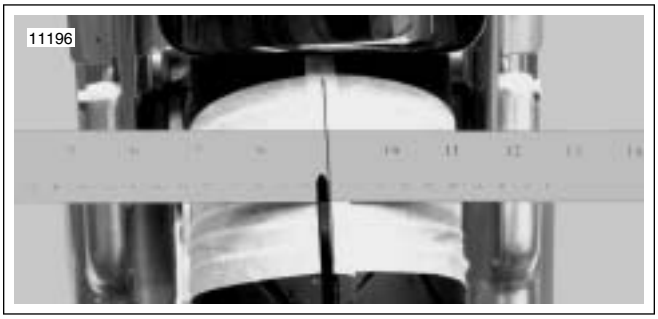


Figure 1-51. Fall-Away Measurement

3. See Figure 1-51. Place masking tape on front tire. Tape ruler over taped area on front tire and draw a line on the masking tape even with the ruler center.
4. Install a pointer so the base is stationary on the floor and the pointer indicates the center of the ruler. The front end should be straight ahead, however the balance point may be slightly off center.

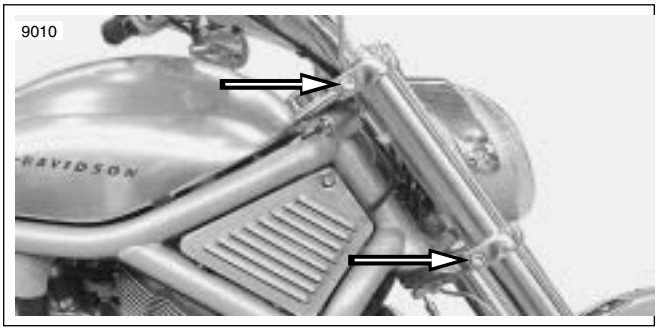


Figure 1-52. Pinch Bolts

5. See Figure 1-52. Loosen fork stem bracket pinch bolts.
6. Check steering fall-away.
   a. Tap the tire on one side until the front end begins to “fall-away.” Record mark on ruler.
   b. Tap the tire on the opposite side until the front end begins to “fall-away.” Record mark on ruler.
   c. Measure distance between marks or subtract reading at one mark from reading at other.
7. The distance between the “fall-away” marks must be 51-102 mm (2.0-4.0 in.). Tighten or loosen adjuster nut until the measurement is within limits.
   a. See Figure 1-53. Remove fork stem cap, bend down the fork stem lockwasher tabs, and loosen fork stem nut.
   b. If the distance is more 102 mm (4.0 in.) loosen adjusting nut.
   c. If it is less than 51 mm (2.0 in.), tighten the adjusting nut.

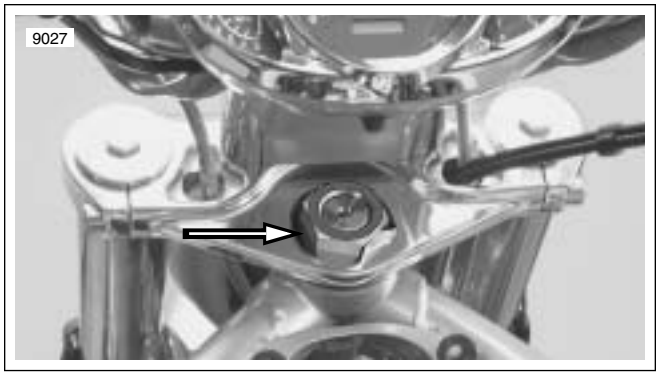


Figure 1-53. Steering Head Fork Stem Nut

NOTE

Tighten fork stem nut to 61-74.5 Nm (45-55 ft-lbs) each time fall-away is checked.

If adjustment seems to have no impact, check to see if fork tubes are stuck in clamps. If necessary, strike triple clamps with a dead blow hammer to free. Retest steering head bearing tension after freeing forks.

Figure 1-54. Tighten Steering Head

8. Tighten fork stem bracket pinch bolts to 41-47 Nm (30-35 ft-lbs).
9. Repeat the “fall-away” procedure to be sure the adjustment is correct.
10. When fall-away is within 51-102 mm (2.0-4.0 in.) bend up the fork stem lock washer tab and reinstall fork stem cap.

STEERING HEAD BEARINGS (VRSCR) 1.20

ADJUSTMENT (FALL-AWAY)

1. Support motorcycle in an upright position so the front end is completely suspended and the vehicle is level.
2. Remove all accessory weight and P&A parts, such as a windshield, or any part that may influence the way the front end swings.

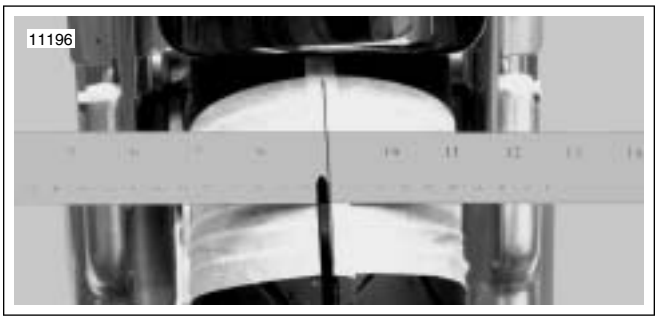


Figure 1-55. Fall-Away Measurement

3. See Figure 1-55. Place masking tape on front tire. Tape ruler over taped area on front tire and draw a line on the masking tape even with the ruler center.
4. Install a pointer so the base is stationary on the floor and the pointer indicates the center of the ruler. The front end should be straight ahead, however the balance point may be slightly off center.

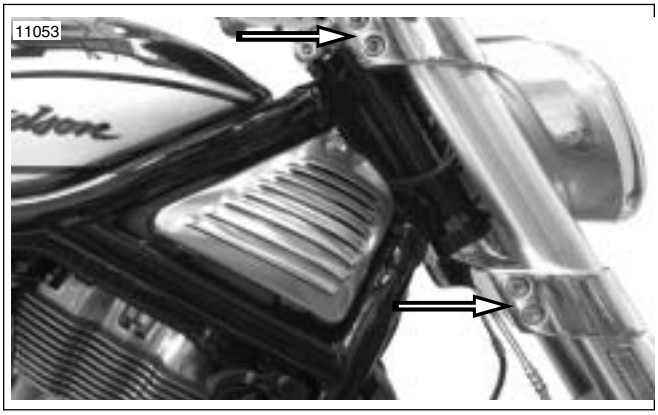
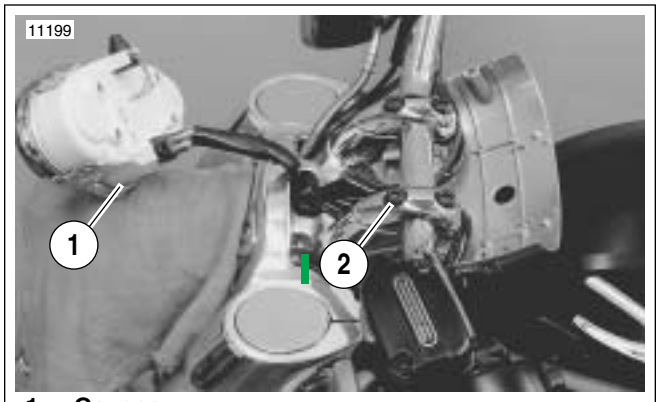


Figure 1-56. Triple Clamp Pinch Bolts

5. See Figure 1-56. Loosen triple clamp pinch bolts.
6. Check steering fall-away.
   a. Tap the tire on one side until the front end begins to "fall-away." Record mark on ruler.
   b. Tap the tire on the opposite side until the front end begins to "fall-away." Record mark on ruler.
   c. Measure distance between marks or subtract reading at one mark from reading at other.

Figure 1-57. Gauge Cluster Fasteners



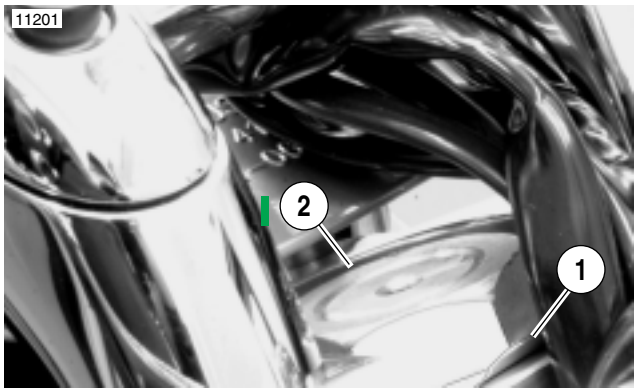
1. Gauges
2. Riser mounting bolts

Figure 1-58. Gauges Removed From Cluster

7. The distance between the "fall-away" marks must be 51-102 mm (2.0-4.0 in.). Tighten or loosen adjuster nut (located under fork stem nut) until the measurement is within limits.
   a. Remove air box cover.
   b. See Figure 1-57. Remove fasteners from gauge cluster
   c. See Figure 1-58. Remove gauge cluster cover and remove gauges from bottom of gauge cluster mount.
   d. Remove riser mounting bolts and lift handlebars out of risers.
   e. Loosen triple clamp pinch bolts.
   f. See Figure 1-59. Bend down the fork stem lock washer tabs (1), and loosen fork stem nut (2).
   g. If the distance is more 102 mm (4.0 in.) loosen adjusting nut located beneath the fork stem nut.
   h. If it is less than 51 mm (2.0 in.), tighten the adjusting nut located beneath the fork stem nut.

NOTE

Tighten fork stem nut (2) to 61-75 Nm (45-55 ft-lbs) and place handlebars back in risers in rider position with fasteners finger tight each time fall-away is checked before the final tightening procedure.



1. **Fork stem lock washer**
2. **Fork stem nut**

Figure 1-59. Fork Stem Lock Washer and Nut (front view)

NOTE

If adjustment seems to have no impact, check to see if fork tubes are stuck in clamps. If necessary, strike triple clamps with a dead blow hammer to free. Retest steering head bearing tension after freeing forks.

8. Install triple clamp pinch bolts. See 2.39 FRONT FORK (VRSCR) for procedure.
9. Repeat the “fall-away” procedure to be sure the adjustment is correct.
10. When fall-away is within 51-102 mm (2.0-4.0 in.)
    a. Torque fork stem nut, bend sides of fork stem lock washer tab to lock nut in place.
    b. Install handlebars and gauge cluster.
    c. Install air box cover.
11. Verify that fall-away is within specifications after the final tightening procedure. If fall-away is not in spec, repeat procedure.

SPARK PLUG AND COIL 1.21

GENERAL

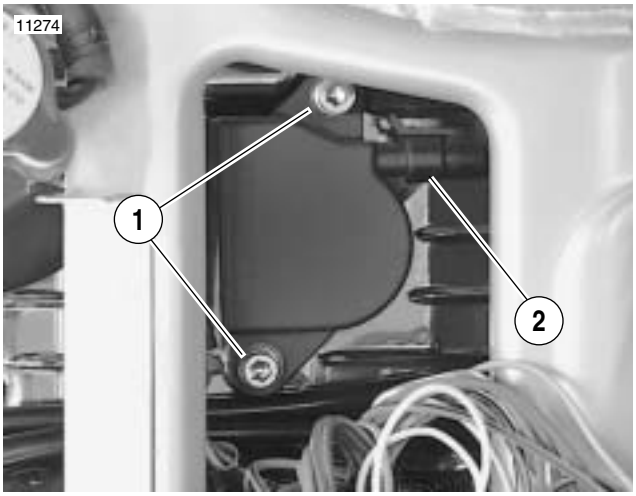
The spark plugs have been carefully selected for the performance characteristics of the VRSC engine. Use only **10R12A** spark plugs in the VRSC engine.

CAUTION

Use only Harley-Davidson spark plugs made for the VRSC. Use of other spark plugs can affect the running characteristics of the engine and could result in serious engine damage.

REMOVAL/INSPECTION

1. After the engine has cooled to room temperature remove airbox assembly. See 1.3 AIRBOX AND AIR FILTER.
2. Lift fuse block off the retaining bracket and move to side.
3. See Figure 1-60. Remove rear coil fasteners (1).
4. Detach connector (2) [83R] at rear coil, [83F] at front coil.
5. Pull coil and boot assembly straight up to disconnect spark plug.
6. Using a spark plug socket with plug retaining sleeve, remove rear spark plug.
7. Remove battery for access to front spark plug. See 1.8 BATTERY MAINTENANCE.
8. Remove front plug following steps 3 through 6.



1. **Fasteners**
2. **Connector [83R]**

Figure 1-60. Rear Cylinder Coil (typical)

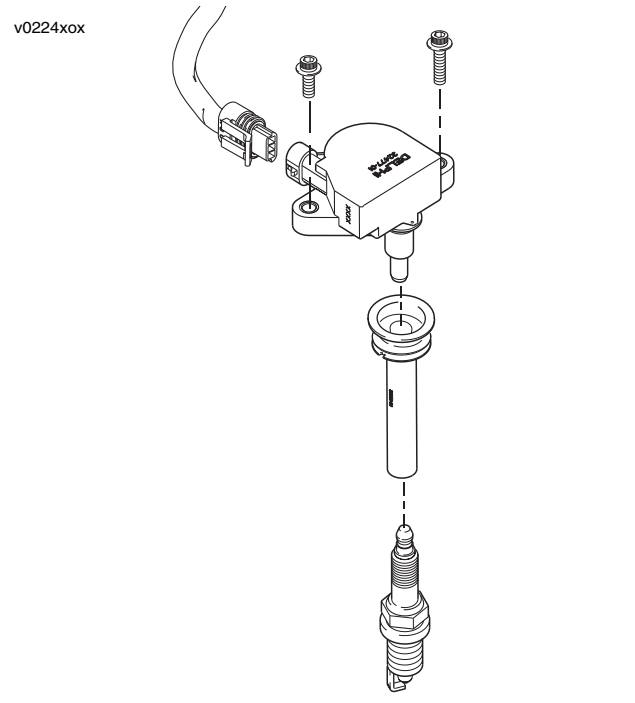


Figure 1-61. Plug Top Coil

9. See Figure 1-62. Compare your observations of the plug deposits with the descriptions provided.

   a. A wet, black and shiny deposit on plug base, electrodes and ceramic insulator tip indicates an oil fouled plug. The condition may be caused by one or more of the following: worn pistons, worn piston rings, worn valves, worn valve guides, worn valve seals, a weak battery or a faulty ignition system.

   b. A dry, fluffy or sooty black deposit indicates an air-fuel mixture that is too rich, engine idling for excessive periods of time and/or enrichener usage for excessive periods of time.

   c. A light brown, glassy deposit indicates an overheated plug. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes and is caused by an air-fuel mixture that is too lean, a hot-running engine, valves not seating or improper ignition timing. The glassy deposit on the spark plug is a conductor when hot and may cause high-speed misfiring. A plug with eroded electrodes, heavy deposits or a cracked insulator must be replaced.

   d. A plug with a white, yellow, tan or rusty brown powdery deposit indicates balanced combustion. Clean off spark plug deposits at regular intervals.

10. If the plugs require cleaning between tune-ups, proceed as follows:

    a. Degrease firing end of spark plug using ELECTRICAL CONTACT CLEANER. Dry plug with compressed air.

    b. Use a thin file to flatten spark plug electrodes. A spark plug with sharp edges on its electrodes requires 25-40% less firing voltage than one with rounded edges.

    c. If the plugs cannot be cleaned, replace with No. **10R12A** spark plugs.

11. Check electrode gap with a wire-type feeler gauge. Bend the outside of the electrode so only a slight drag on the gauge is felt when passing it between electrodes. Proper gap measurement is 0.89 mm (0.035 in.).

12. Check condition of threads on cylinder head and plug. If necessary to remove deposits, apply penetrating oil and clean out with a thread chaser.

Figure 1-62. Typical Spark Plug Deposits

INSTALLATION

1. Apply LOCTITE® ANTI-SEIZE to plug threads. Install and tighten to 23 Nm (17 ft-lbs).
2. Install coil and boot assembly over spark plug with wiring connector facing rear of motorcycle.
3. Insert coil fasteners with long fastener used on left side. Tighten to 9.7 Nm (86 **in-lbs).**
4. Connect connectors [83R] and [83F].
5. Install battery. See 1.8 BATTERY MAINTENANCE.
6. Install airbox assembly. See 1.3 AIRBOX AND AIR FILTER.

CABLE, LINE AND FRAME INSPECTION 1.22

GENERAL

Inspect and lubricate the front brake lever, clutch hand lever, throttle control cables, and jiffy stand.

CABLES AND HAND LEVERS

Inspect and lubricate throttle cables. See 1.23 THROTTLE CABLES for throttle cables.

Use SUPER OIL (Part No. HD-94968-85TV) for hand levers.

JIFFY STAND

Clean and lubricate the jiffy stand.

If service is on muddy or dusty roads, clean and lubricate at shorter intervals.

FUEL SYSTEM LINES AND FITTINGS

1. Inspect the fuel system lines.
2. Check the fuel system lines and fittings for leaks.
3. See Figure 1-63. Check fuel system lines for chafing against frame components.

HYDRAULIC LINES

1. Inspect hydraulic brake fluid lines and clutch fluid lines for leaks.
2. Check inside clear plastic tubing over braided lines for leakage inside tubing.

Figure 1-63. Fuel Line Inspection Points (typical)

THROTTLE CABLES 1.23

INSPECTION

⚠WARNING

Never route throttle cable over the battery. Fire due to short circuit could occur and cause death or serious injury. Throttle cables must be routed alongside battery, between hold down strap and coolant overflow bottle. (00224a)

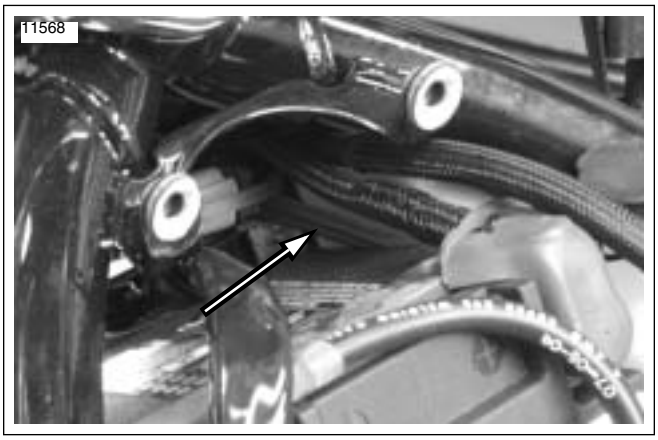


Figure 1-64. Cable Routing

LUBRICATION

1. See Figure 1-65. Turn the cable adjusters (2, 4) and jam nuts (3) as short as they will go.
2. Remove two screws (1) to separate the upper handlebar housing from the lower housing.
3. Use a screwdriver to rotate each ferrule and remove cable from the throttle grip.
4. Slide the throttle grip off the handlebar.
5. Apply a light coat of graphite to the handlebar and reinstall throttle grip.
6. Put one or two drops of SUPER OIL (Part No. HD-94968-85TV) into the housing of each cable.
7. Remove the airbox cover and the airbox and inspect cable routing. See 1.3 AIRBOX AND AIR FILTER.
8. Install the airbox and airbox cover. See 1.3 AIRBOX AND AIR FILTER.
9. Assembling the handlebar housing and tighten both screws (1) to 4.0-5.1 Nm (35-45 **in-lbs**).

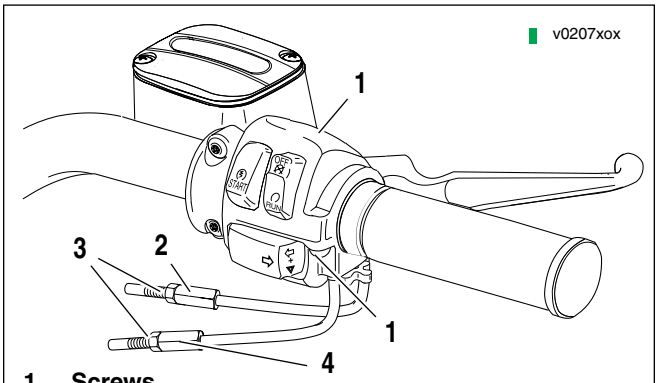
ADJUSTMENT

1. See Figure 1-65. Turn the cable adjusters (2, 4) and jam nuts (3) as short as they will go. Both cables should have zero adjustment at the start of this procedure.
2. Point the front wheel straight ahead.
   a. Rotate the throttle grip wide open and hold it there.
   b. Turn the throttle cable adjuster (2), lengthening the sleeve, until the throttle cam just touches the cam stop.
   c. Tighten the throttle cable adjuster (2) an additional 2 to 3 full turns.
3. Turn the front wheel full right.
4. Turn the idle cable adjuster (4), lengthening the sleeve until the cable housing just touches the bottom of the pocket retainer on the throttle body linkage.

⚠WARNING

Check that the throttle control operates freely without binding. Irregular or sticking throttle response could cause a loss of control, leading to an accident which could result in death or serious injury.

5. Check adjustment.
   a. Rotate the throttle grip and release to be sure the cable returns sharply to idle position. If the cable does not return to idle, turn idle cable adjuster (4), shortening the sleeve until correct adjustment is reached.
   b. Verify that the throttle operates without binding.
   c. Verity sufficient free play.
6. Tighten both jam nuts (3).



1. **Screws**
2. **Throttle cable adjuster**
3. **Jam nuts**
4. **Idle cable adjuster**

Figure 1-65. Throttle Cable Adjusters

LASH MEASURMENT

Part No.	Specialty Tool
HD-45314	Crankshaft rotating wrench

1. Remove airbox assembly. See 1.3 AIRBOX AND AIR FILTER.
2. Remove battery. See 1.8 BATTERY MAINTENANCE.

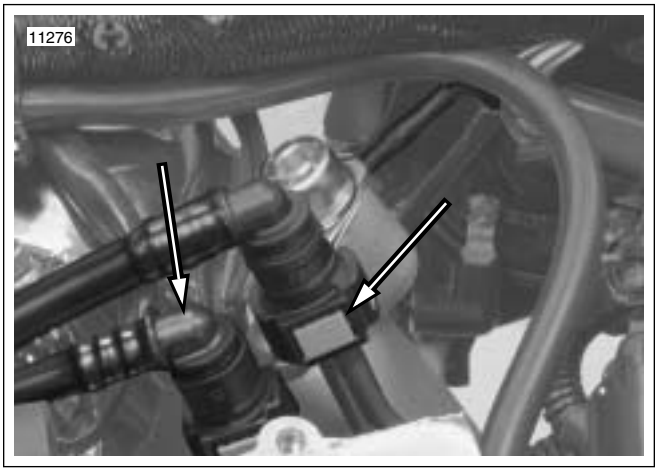
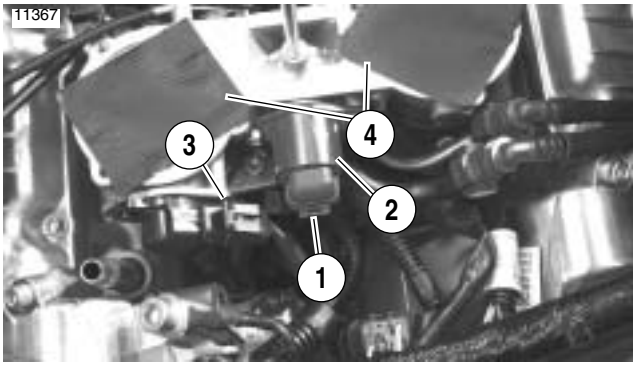


Figure 1-66. Fuel Line

3. See Figure 1-66. Remove fuel lines.
   a. At the fuel rail, disconnect pressure fuel line and return fuel line by pressing blue buttons with thumb and first finger.
   b. Remove fittings at the fuel tank.
   c. Pull fuel lines away from the throttle body.
   d. Remove ground wires.
4. Remove front and rear coils. See 1.21 SPARK PLUG AND COIL.
5. Disconnect idle air control (IAC) connector [87B] from throttle body.
6. Disconnect throttle position (TP) sensor connector [88B] from throttle body.



1. **IAC sensor connector [87B]**
2. **Idle air control (IAC)**
3. **Throttle position (TP) sensor connector [88B]**
4. **Injector intakes (covered)**

Figure 1-67. Throttle Body Electrical Connectors

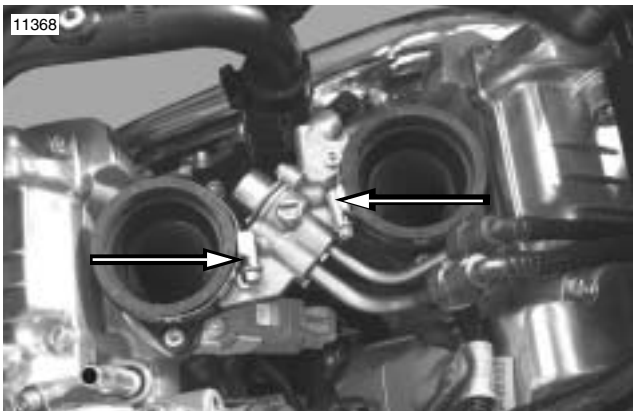
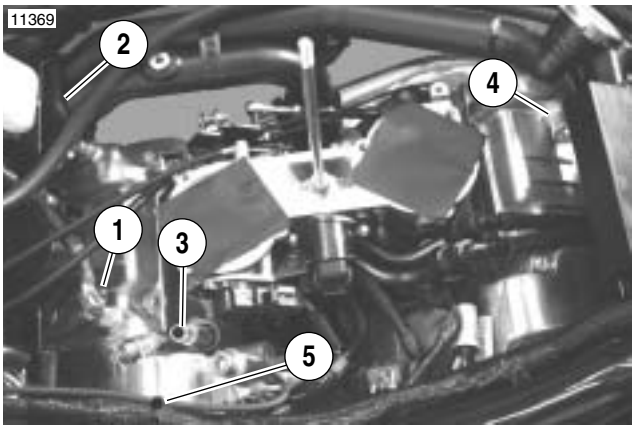


Figure 1-68. Intake Clamps, Throttle Body Removed



1. **Ground strap**
2. **Radiator hose P-clamp**
3. **Front cylinder breather tube**
4. **Rear cylinder breather tube**
5. **Cable strap**

Figure 1-69. Upper Engine

7. See Figure 1-68. Loosen clamps at each intake and lift throttle body straight up.

NOTE

Observe the position of the clamps for reassembly.

8. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine.
9. Cover intake openings to prevent objects from falling into intake bore.
10. See Figure 1-69. Remove ground strap at cam cover.
11. Remove p-clamp (2) retaining radiator hoses.
12. Remove front (3) and rear (4) breather hoses.
13. Remove main harness cable straps (5) along left side of frame.
14. See Figure 1-70. Remove vapor valve from t-stud from VRSCA models only.
15. See Figure 1-71. Loosen all cam cover fasteners in reverse order of torque sequence.

NOTE

There are holes and openings in the frame and battery box area that, with the use of a ball end hex tool, will allow access to the cam cover fasteners. Suggest using Snap-on Tool #FABLM5E.

16. Support engine with jack under oil pan.
17. See Figure 1-72. Loosen front engine mount bolt and retract jack to allow the engine to drop down approximately 13 mm (1/2 in.).

NOTE

It may be necessary to loosen drive belt, and loosen exhaust at rear support bracket to allow the engine to drop sufficiently.

CAUTION

Do not allow dowels from cam cover to drop into the engine. If this should occur, they must be retrieved or serious engine damage will result.

18. Remove fasteners from small cam cover and remove from left side.
19. Remove all remaining fasteners from cam cover.
20. Gently pry up cover and gasket. Remove cam cover by lifting up and over cam drive sprockets and removing from right side of motorcycle.

NOTES

- *It may be necessary to manipulate or move radiator hoses to allow front cam cover removal.*
- *It may be necessary to remove breather hose fitting from rear cam cover to gain additional clearance.*

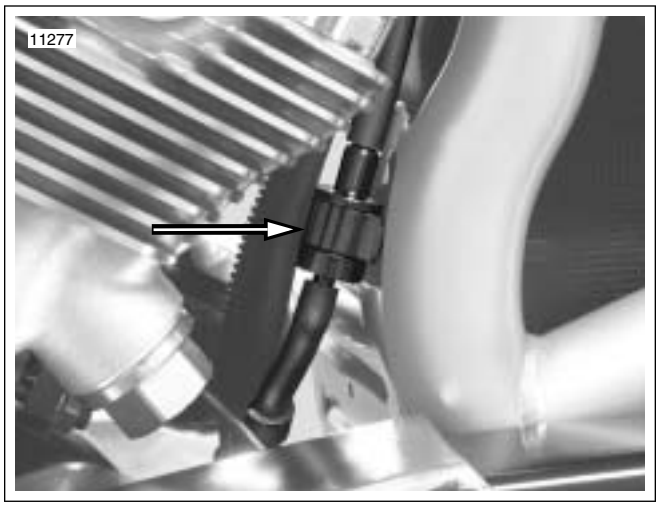


Figure 1-70. Vapor Valve (VRSCA shown)

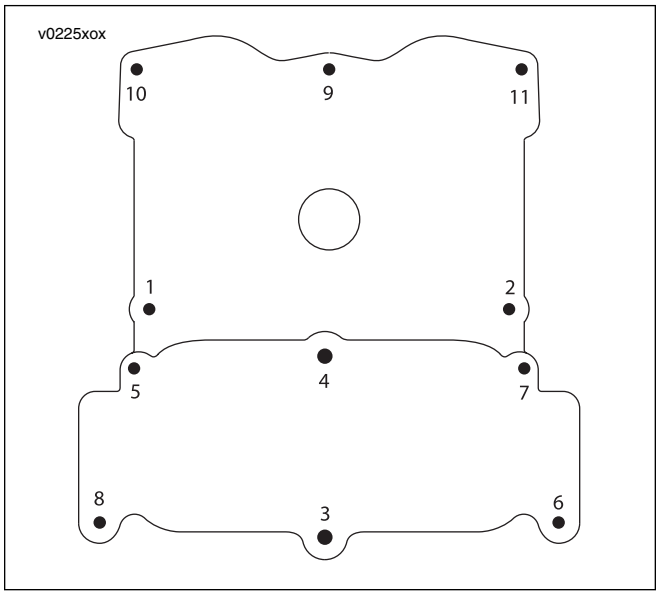


Figure 1-71. Cam Cover Torque Sequence

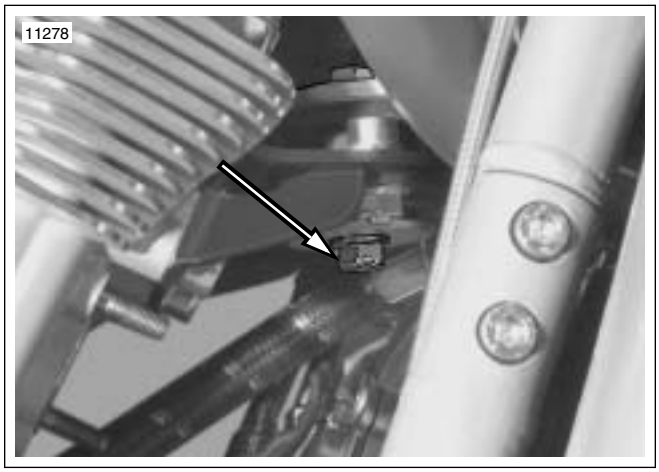


Figure 1-72. Front Engine Mount Bolt

21. Remove spark plugs. See 1.21 SPARK PLUG AND COIL.

NOTE

Spark plugs are only removed to allow the engine to be rotated easily. Spark plugs should be re-installed and torqued immediately after lash is set and before assembly begins.

22. Remove alternator derby cover to access 36 mm rotor nut.

CAUTION

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c)

23. Using CRANKSHAFT ROTATING WRENCH (HD-45314) rotate the engine toward front cylinder (direction of operation) until nose of camshaft intake and exhaust are at the 2 o'clock and 10 o'clock position as shown in Figure 1-74.
    a. When adjusting the front cylinder the cam lobes will be at the base circle position on the tappet as shown in Figure 1-74.
    b. When adjusting the rear cylinder the cam lobes will be at the base circle position on the tappet as shown in Figure 1-75.

NOTE

See Figure 1-76. When the cam covers are off the heads, always inspect the ACR (automatic compression release). The pivot pin must be secure and the rocker arm must rotate back and forth freely around the pin.

Figure 1-73. Correct Engine Rotation

Figure 1-74. Front Cylinder Cam Lobe Position

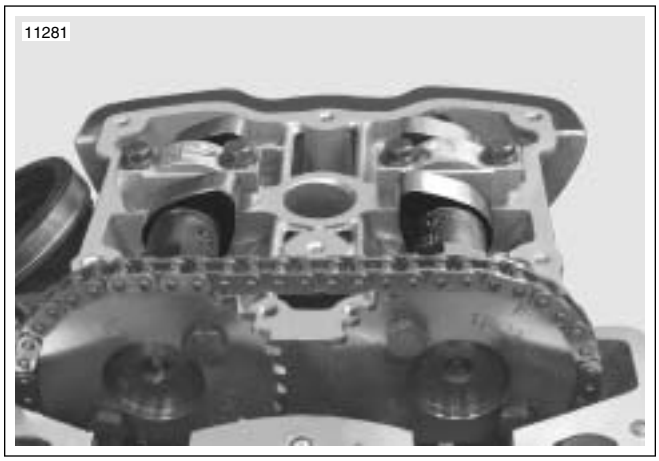


Figure 1-75. Rear Cylinder Cam Lobe Position

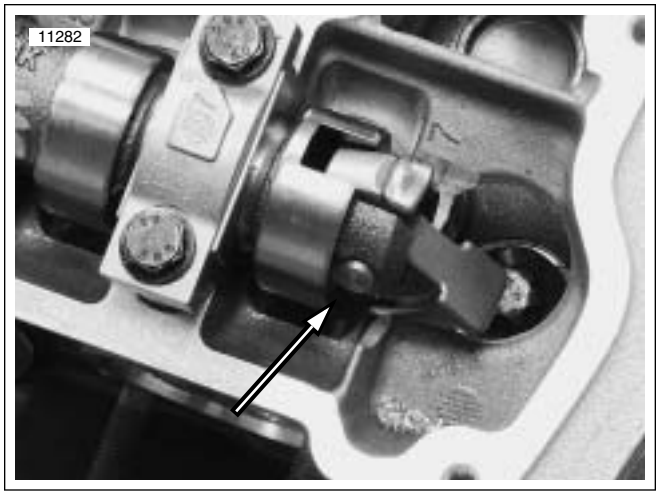


Figure 1-76. ACR (automatic compression release) Pivot

24. See Figure 1-77. Use blade style metric feeler gauges to measure the gap (lash) between the cam and tappet.

NOTES

- *An angle blade feeler gauge set (HD-47181) is available and may increase the reliability of the readings.*
- *A valve lash calculation worksheet is provided in Appendix D to record the valve lash data. Use this sheet to determine the correct shim selection. Incorrect lash adjustment can cause serious engine damage.*

25. Copy the D.2 VALVE LASH CALCULATION WORKSHEET 1. in Appendix D.

Figure 1-77. Measuring Valve Lash

Table 1-7. Valve Lash Specifications

		MM	IN.
Intake	Max	0.245	0.0096
	Min	0.195	0.0078
Exhaust	Max	0.345	0.0135
	Min	0.295	0.0117

26. Gage the lash for exhaust and intake valves and record selected blade thickness in the “Initial Lash Measurement” column of the valve lash calculation worksheet.

27. Repeat valve lash measurements on other cylinder head and record initial lash measurements.

28. Compare measurements to “Valve Lash Upper Limit” column and “Valve Lash Lower Limit” column. A valve requires lash adjustment if:

    a. Measurement is larger than “Valve Lash Upper Limit.”

    b. Measurement is smaller than “Valve Lash Lower Limit.”

NOTE

If cam caps are removed, install and finger tighten before applying torque.

29. If all valves are within specification, verify cam timing before reassembly. See VERIFY CAM TIMING in 1.24 VALVE LASH.

30. If cam timing is correct, install spark plugs, install cam covers and front engine mount according to the instructions in the following procedure. See LASH ADJUSTMENT in 1.24 VALVE LASH.

31. If valve lash must be adjusted, verify cam timing before disassembly. See VERIFY CAM TIMING in 1.24 VALVE LASH.

CAUTION

Fasteners or objects dropped into engine during disassembly/assembly must be retrieved or severe engine damage will result.

VERIFY CAM TIMING

PART NO.	SPECIALTY TOOL
HD-45653	TDC positioning tool
HD-45306	Crankshaft locking pin
HD-45314	Crankshaft rotating wrench

1. See Figure 1-78. Install TDC POSITIONING TOOL (HD-45653) in front spark plug hole.

CAUTION

Never insert a foreign object, such as a screwdriver in the spark plug hole. Engine damage can result.

2. See Figure 1-79. Remove plug from timing hole.

CAUTION

Rotate engine toward front cylinder only. Do not rotate engine toward rear cylinder, as engine damage can result. (00409c).

3. Using CRANKSHAFT ROTATING WRENCH (HD-45314) rotate the engine counterclockwise (CCW) (direction of operation) and observe exhaust cam lobe. Note when exhaust valve is closing (TDC Tool will start to extend as valve closes) and engine is approaching TDC.
4. Verify that the TDC POSITIONING TOOL is fully extended and front piston is at TDC.
5. See Figure 1-79. Insert CRANKSHAFT LOCKING PIN (HD-45306). The CRANKSHAFT LOCKING PIN should insert flush with engine case. If necessary, gently rock crankshaft using CRANKSHAFT ROTATING WRENCH (HD-45314) to lock engine at exact TDC.
6. See Figure 1-80. Note position of cam sprocket gear marks and cam lobe positions. At front cylinder TDC, timing is correct when:
   a. The front exhaust and intake cam gear marks (2, 3) are aligned.
   b. The front exhaust and intake cam lobes (6, 7) are positioned as illustrated.
   c. The rear intake and exhaust cam gear marks (4, 5) are aligned.
   d. The rear intake and exhaust cam lobes (8, 9) are positioned as illustrated.

NOTE

Copper colored links (1) are only used in installation of cam chains. They may not appear in the positions illustrated.

7. If cam timing is incorrect, see 3.20 CAM DRIVE.
8. If cam timing is correct, Remove CRANKSHAFT LOCKING PIN.
9. Install engine timing plug in timing hole. Tighten to 23 Nm (17 ft-lbs).

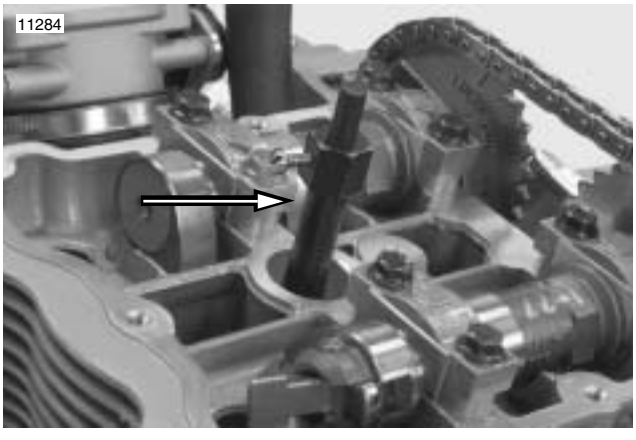
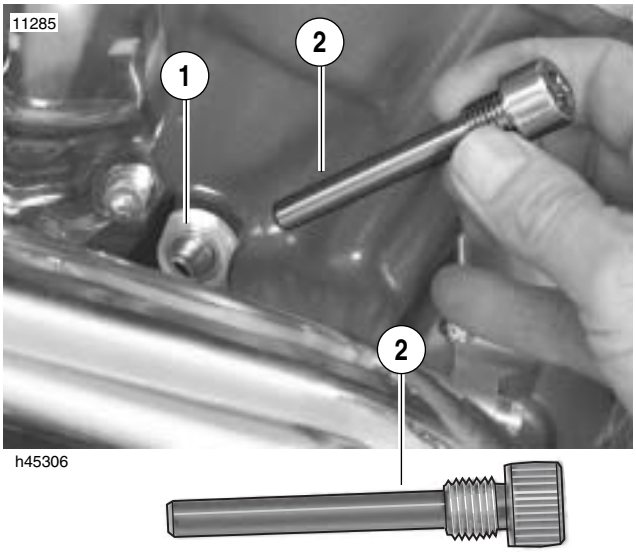
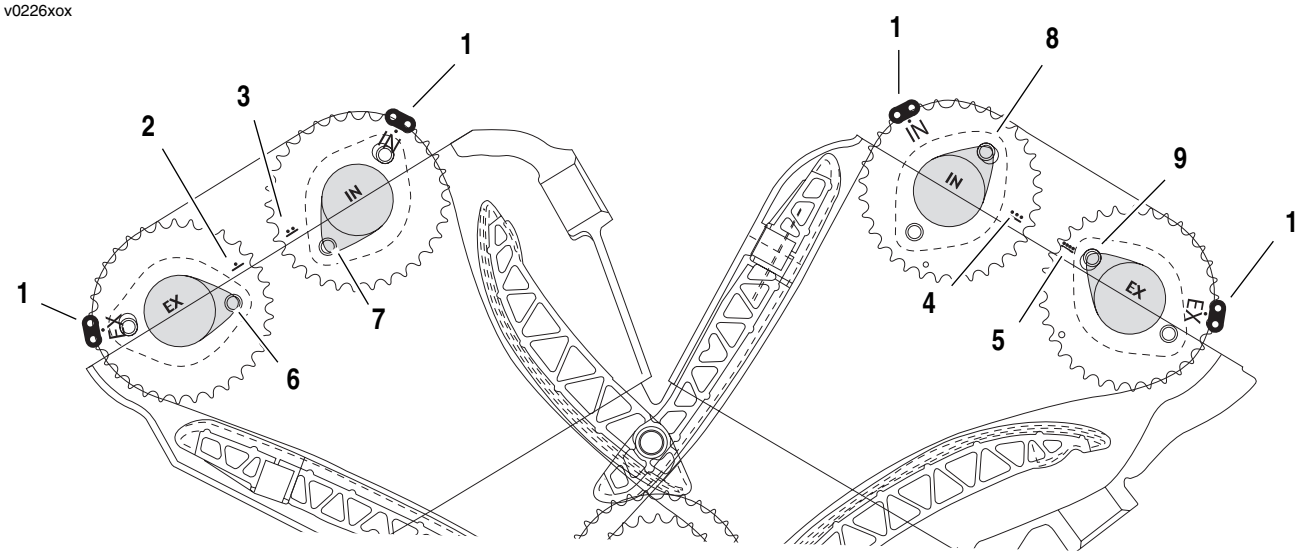


Figure 1-78. Top Dead Center Positioning Tool (HD-45653)



1. Timing hole
2. Locking pin

Figure 1-79. Crankshaft Locking Pin (HD-45306).



NOTE

Even though the timing is correct, the copper links may not appear in the positions illustrated. The copper links are used only in the installation of cam chains.

1. **Copper links (may not appear where illustrated)**
2. **Front exhaust alignment mark (single dot and line)**
3. **Front intake alignment mark (two dots and line)**
4. **Rear intake alignment mark (three dots and line)**
5. **Rear exhaust alignment mark (four dots and line)**
6. **Front exhaust cam lobe position**
7. **Front intake cam lobe position**
8. **Rear intake cam lobe position**
9. **Rear exhaust cam lobe position**

Figure 1-80. TDC Cam Timing Orientation

LASH ADJUSTMENT

PART NO.	SPECIALTY TOOL
HD-45314	Crankshaft rotating wrench
HD-45340	Gasket alignment tool

1. See Figure 1-81. Using CRANKSHAFT ROTATING WRENCH (HD-45314), rotate the toward front cylinder (direction of operation) to position front cylinder cam lobes at 10 o'clock and 2 o'clock.

2. See Figure 1-82. Clean oil from cam drive gear and chain link. Make a reference mark on chain and cam drive gear, both intake and exhaust, as shown.

NOTE

Copper colored links are for initial assembly of complete cam drive system.

3. See Figure 1-83. Remove secondary cam chain tensioner.

CAUTION

NEVER rotate engine with secondary cam chain tensioner removed. Engine damage and/or loss of correct timing will occur.

NOTE

Do not remove cam drive gear bolts. It is not necessary for the lash adjustment.

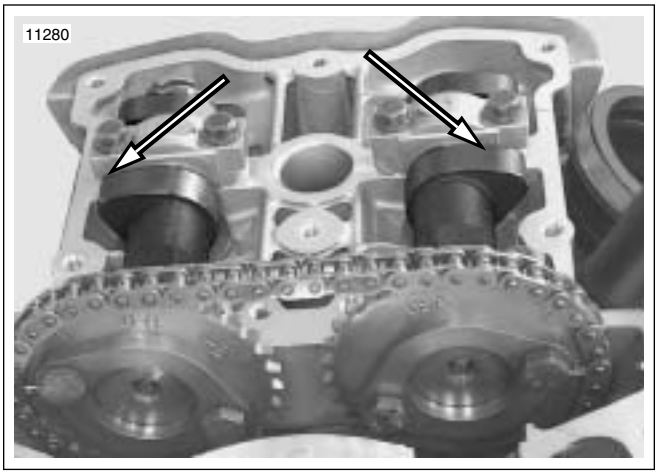


Figure 1-81. Front Cylinder 10 and 2 O'clock Cam Lobe Position

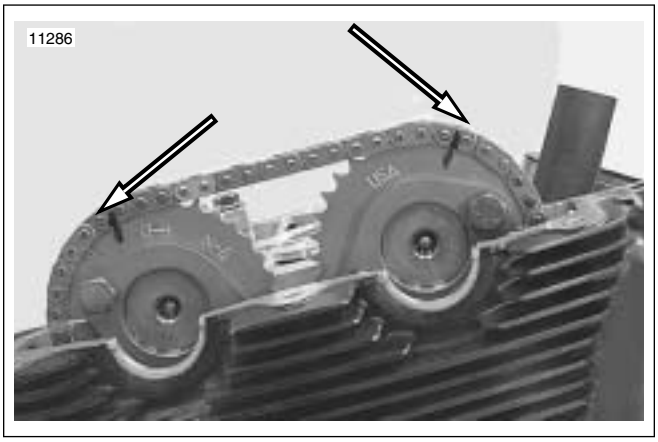


Figure 1-82. Reference Mark Cam Gear and Chain Link

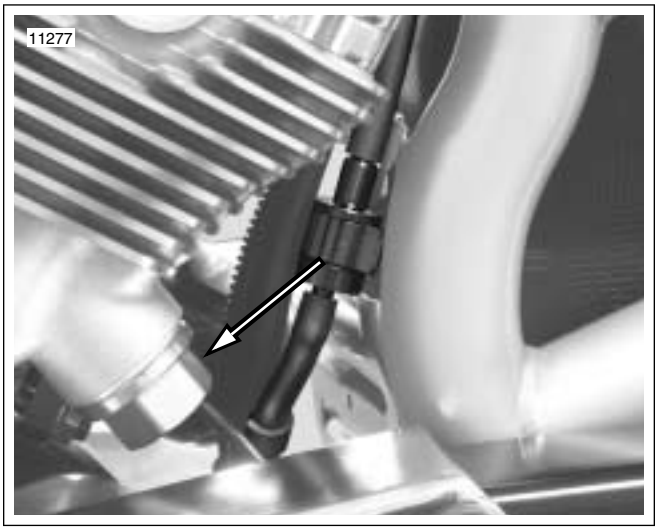


Figure 1-83. Secondary Cam Chain Tensioner

4. See Figure 1-84. Remove cam journal fasteners and caps from the cam needing adjustment.

NOTE

Remove and adjust only one camshaft at a time.

5. See Figure 1-85. Carefully move cam and drive gear aside. Keep cam drive gear and chain engaged.

NOTE

Handle chain and cam assembly carefully so as not to remove reference marks.

6. Carefully remove tappet. Oil film will usually cause shim to adhere to the under side of the tappet. Take care that shim does not dislodge and fall into engine. To remove tappet, use of a strong magnet is suggested. This will keep shim and tappet together during removal.

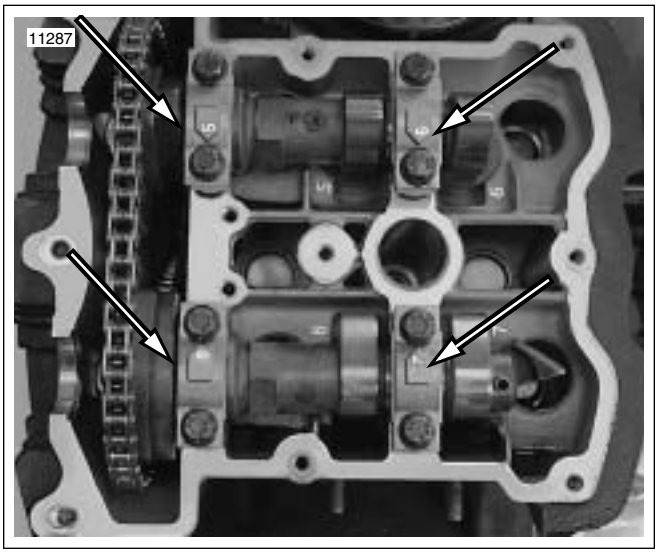


Figure 1-84. Cam Journal Caps

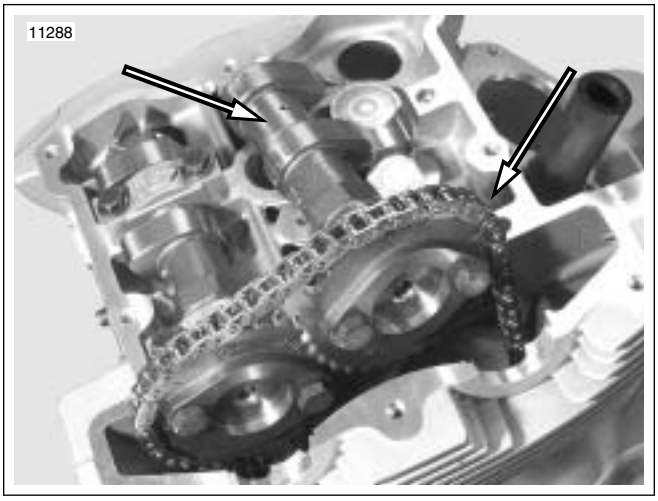


Figure 1-85. Move Cam Aside With Chain Engaged

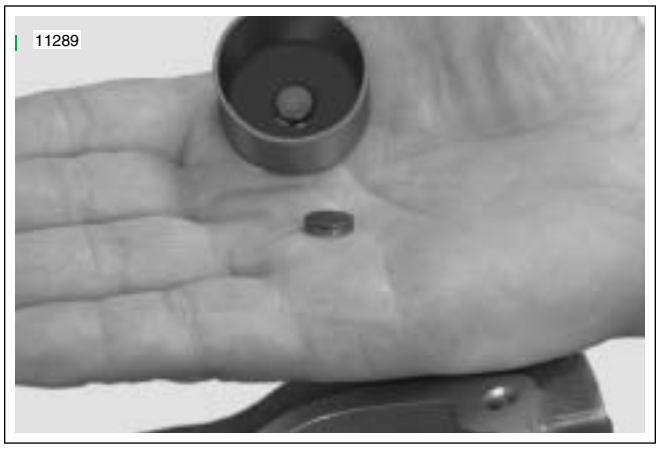
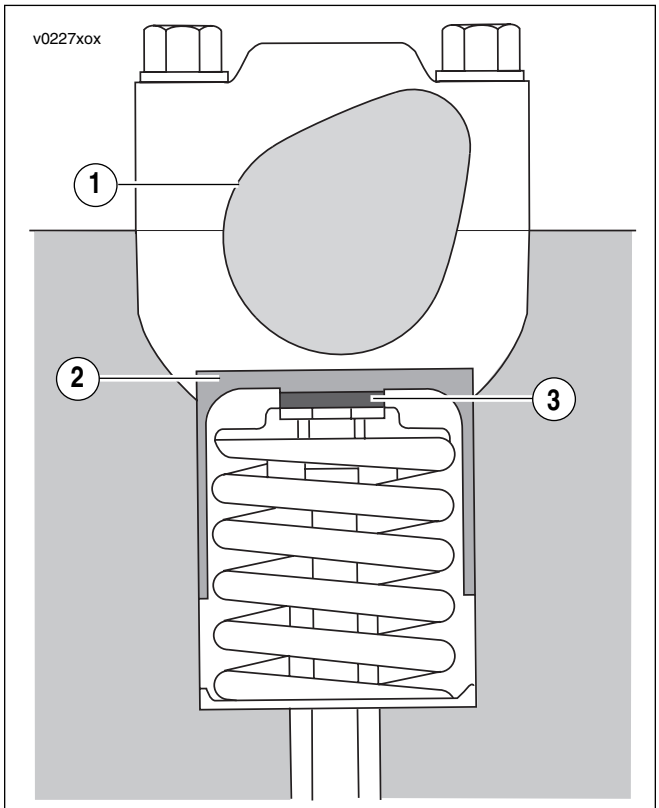


Figure 1-86. Tappet And Shim



1. **Cam shaft**
2. **Tappet**
3. **Shim**

Figure 1-87. Cam, Tappet, Shim Orientation

7. Use a micrometer to measure the thickness of the removed shim. Record measurement in the “Installed Shim Measurement” column on valve lash calculation worksheet. See D.2 VALVE LASH CALCULATION WORKSHEET 1.

CAUTION

Only use genuine Harley-Davidson shims for adjusting valve lash. Do not use typical shim stock. Shim stock can dislodge and cause severe engine damage.

8. Calculate and record on the valve lash calculation worksheet the “New Shim Lower Limit” and the “New Shim Upper Limit.”

9. Calculate and record “Desired Shim Size.”

10. Select and record the “Closest Shim Size” replacement shim. Refer to Table D-1. Case 1 Valve Tappet Shims and Table D-2. Case 2 Valve Tappet Shims.

11. Always confirm **new** shim thickness with micrometer. Record for reference.

12. See Figure 1-89. Position **new** shim in spring retainer pocket. Use a magnet to position the shim and carefully push into place with finger.

13. Reinstall tappet.

14. If the initial lash measurement of the remaining valve exceeds the upper or lower valve lash limits, preform the lash adjustment on the remaining valve.

15. See Figure 1-82. Install cam in alignment with **new** reference marks on drive chain and cam drive gear. Note **new** reference marks from step 2.

16. See Figure 1-90. Cam journal caps are numbered. Install cam journal caps with corresponding number on head, arrow pointing to center of head. Lubricate cam journal and journal cap with oil before placing in position.

17. Tighten cam bearing caps to 9.7 Nm (86 **in-lbs**).

18. Review the valve lash calculation worksheet and make adjustments to the valves activated by the opposite cam if necessary.

CAUTION

NEVER rotate engine with secondary cam chain tensioner removed. Engine damage and/or loss of correct timing will occur.

19. When second cam has been set aside, the valve lash adjusted, and the cam reinstalled, install secondary cam chain tensioner.

Figure 1-88. Measure Shim

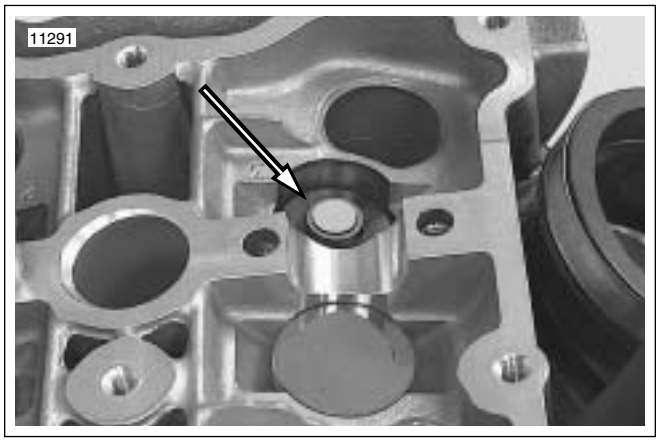


Figure 1-89. Position Shim

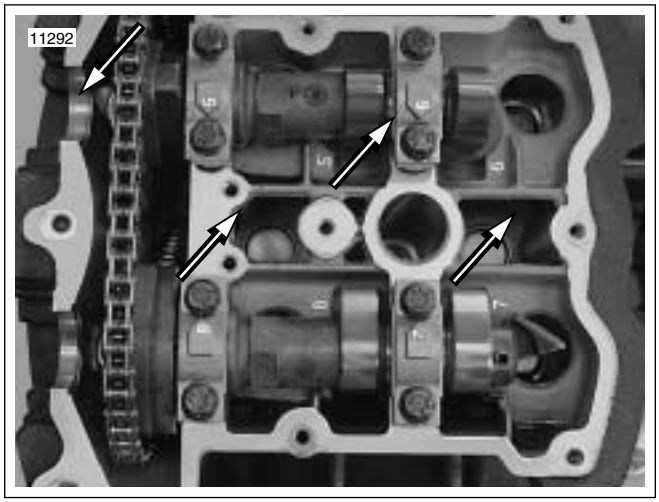


Figure 1-90. Cam Journal Cap Reference Numbers

20. Rotate engine two complete revolutions (counter-clockwise, direction of rotation) until cam lobes return to 10 o'clock and 2 o'clock position.

21. Re-measure valve lash of all front cylinder cams and record "Final Lash Reading" on the worksheet.

22. Review the worksheet for the rear cylinder valves and make adjustments as needed.

23. See Figure 1-75. Turn engine over to position rear cylinder cams at the 2 o'clock and 10 o'clock position and repeat the procedures for the rear cylinder.

24. After lash adjustment is complete, verify cam timing on both cylinders. See VERIFY CAM TIMING in 1.24 VALVE LASH.

25. When lash adjustment is verified install and tighten spark plugs to 23 Nm (17 ft-lbs).

26. Clean cam cover and install **new** gasket.

27. See Figure 1-91. Use cable straps (1) to help retain gasket as shown.

28. See Figure 1-94. Insert GASKET ALIGNMENT TOOL (HD-45340) into small hole in cylinder head next to spark plug hole.

29. See Figure 1-93. Apply a thin bead of silicone along both half-moon shaped recesses in cylinder head. Cam cover gasket must stay in place, a small amount of sealer, lightly applied will help.

30. Carefully install cam cover and gasket. Cable straps will allow the cam bore plug to be moved horizontally to clear cam drive gears.

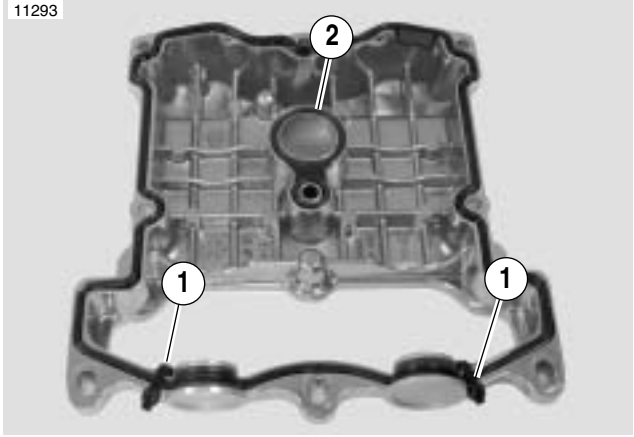
31. Visually check to ensure spark plug hole gasket (2) is in place.

NOTE

See Figure 1-92. The seal of the spark plug hole gasket is correct when the tapered edge of the gasket is in the cam cover and the double lipped side of the rings is facing out to mate with the flat of the cylinder head.

32. Remove cable straps.

33. Place small cam cover in position on large cam cover.



1. Cable strap
2. Spark plug hole gasket

Figure 1-91. Cam Cover Gaskets

Figure 1-92. Spark Plug Hole Gasket (double lipped side)

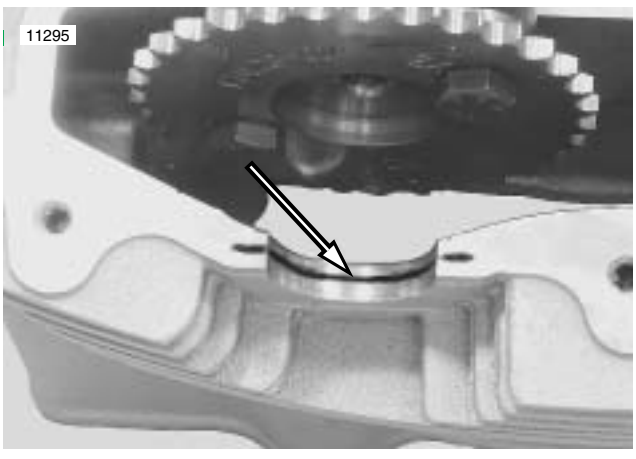


Figure 1-93. Silicone Bead Pattern in Head Recesses

34. See Figure 1-95. Insert fasteners in cam cover and tighten to 9.7 Nm (86 **in-lbs**) in sequence.
35. See Figure 1-72. Tighten front engine mount fastener to 38 Nm (28 ft-lbs).
36. Position the main harness along the left side of the frame and install cable straps.
37. Install front cylinder and rear cylinder breather hoses.
38. Install p-clamp around the right side radiator hoses and tighten fastener to 9.7 Nm (86 **in-lbs**).
39. Connect ground strap to cam cover. Tighten to 9.7 Nm (86 **in-lbs**).
40. See Figure 1-96. Orient intake clamps as shown.
41. Install throttle body and tighten clamps.
42. See 1.21 SPARK PLUG AND COIL. Install coils.
43. Attach the idle speed control (IAC) connector.
44. Attach the throttle position (TP) sensor.
45. Attach fuel lines.
    a. Insert fuel lines from injector back under frame and connect to fuel tank.
    b. Push connector onto fuel tank elbow until a “click” is heard.
    c. Install right angle connectors on rigid lines from injector. Push until a “click” is heard.
46. Install battery. See 1.8 BATTERY MAINTENANCE.
47. Install airbox assembly. See 1.3 AIRBOX AND AIR FILTER.

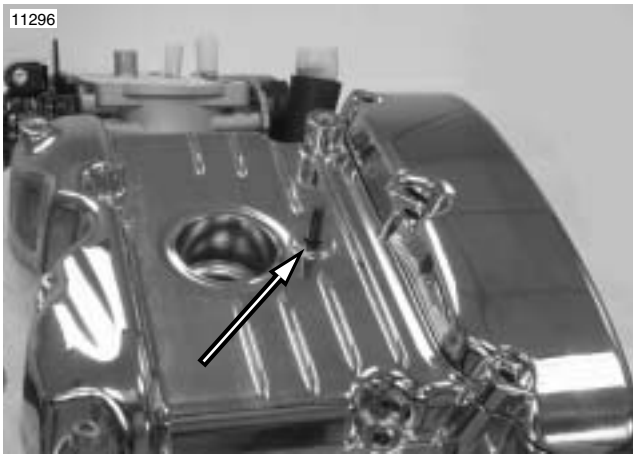


Figure 1-94. Gasket Alignment Tool (H-D-45340)

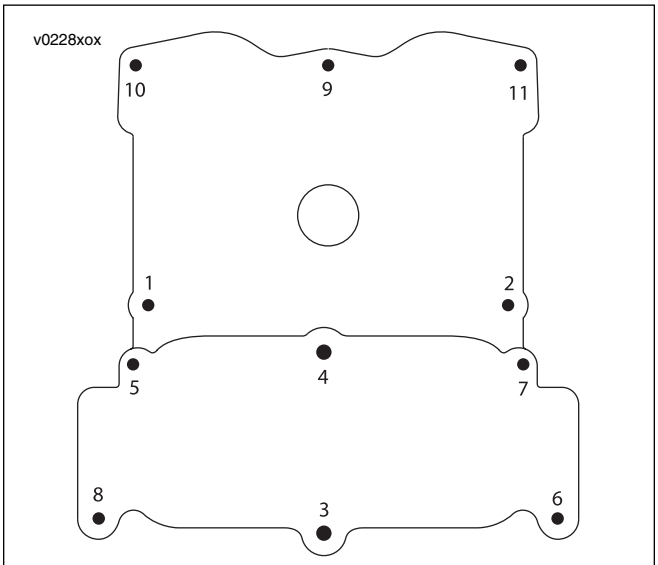


Figure 1-95. Cam Cover Torque Sequence

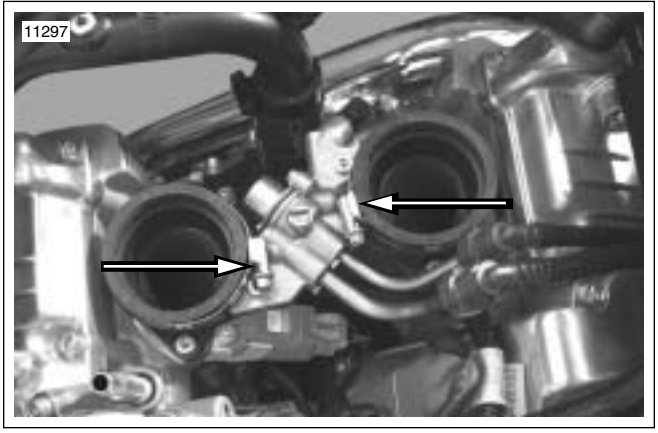


Figure 1-96. Intake Clamps, Throttle Body Removed

SECONDARY CAM CHAIN 1.25

GENERAL

On high mileage engines with good oil pressure, if there is a noise at start-up which goes away, check secondary cam chain wear. Before beginning procedure, note if the rattle is heard during engine start-up.

ADJUSTMENT

PART NO.	SPECIALTY TOOL
HD-45314	Crankshaft rotating wrench
HD-45334	Secondary cam chain measurement tool

1. Support engine with a scissors jack under the frame at the fuel tank.
2. Remove the right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
3. Open seat.
4. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

5. Disconnect negative battery cable.
6. Remove air filter top and air filter. See 1.3 AIRBOX AND AIR FILTER.
7. Remove the horn. See 8.29 HORN.
8. Remove the derby cover from the left side crankcase cover.

CAUTION

Turn the engine crankshaft counterclockwise only. Turning it clockwise could cause the cam chain to jump over the cam sprocket.

9. To position the front piston to adjust the secondary cam chain:
   a. See Figure 1-97. Install CRANKSHAFT ROTATING WRENCH (HD-45314).
   b. Hold the throttle wide open and watch front cylinder intake valve through intake port.
   c. Turn crankshaft counterclockwise to open valve fully and then to close the valve.
   d. When the front cylinder intake valve is seated, turn crankshaft an additional 1/4 turn (90˚) counterclockwise.

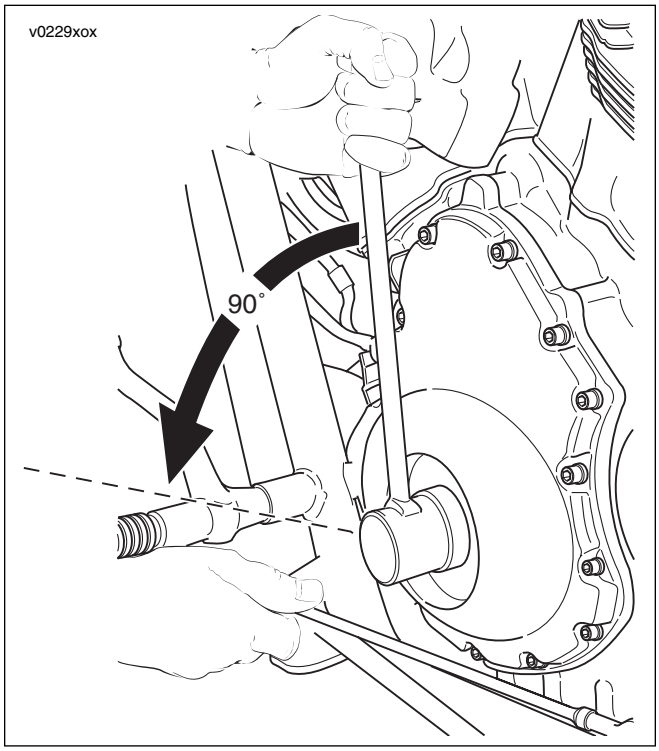


Figure 1-97. Positioning Piston

CAUTION

Never rotate the engine without the secondary cam chain tensioner installed. Cam timing could be changed, causing engine damage.

NOTE

Do not use the sealing washer from the secondary cam chain tensioner when installing the SECONDARY CAM CHAIN MEASUREMENT TOOL (HD-45334).

10. Remove the secondary cam chain tensioner.
11. See Figure 1-98. install SECONDARY CAM CHAIN MEASUREMENT TOOL. Thread-in the tool until it is seated against the cylinder head.
12. Note the number of grooves showing on the tool.
13. Remove the SECONDARY CAM CHAIN MEASUREMENT TOOL.
14. From the table, select the number of shims necessary for correct secondary cam chain tension. Refer to Table 1-8.

NOTE

If a start-up rattle is present, add 1 or 2 shims to the tensioner. If there is no start-up rattle, do not add shims to the tensioner.

Table 1-8. Tensioner Shims

Grooves	Shims Required
4	1*
3	2*
2	3
1	4

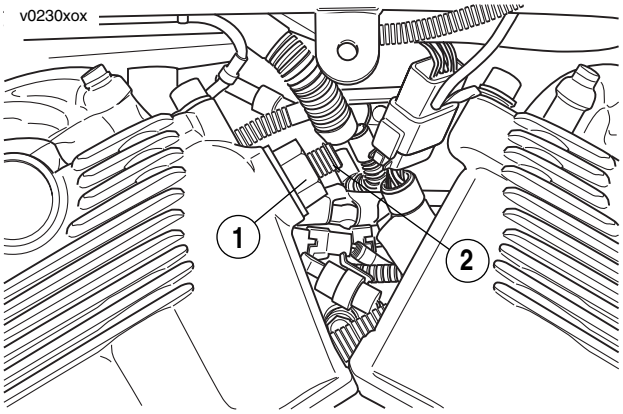
* Do not add shims if start-up rattle is not heard.

15. See Figure 1-99. Wrap cardboard or heavy cloth around thick shaft on plunger (1). Gently twist while pulling to remove plunger (1) from tensioner (3).
16. Apply a thin film of Harley-Davidson Motorcycle Oil 20W50 to selected shims (2) and plunger (1).
17. Seat number of selected shims (2) and plunger (1) in tensioner (3).
18. Lubricate tensioner seal (4) with Harley-Davidson Motorcycle Oil 20W50.
19. Install front cylinder secondary cam chain tensioner. Tighten to 100 Nm (74 ft-lbs).

CAUTION

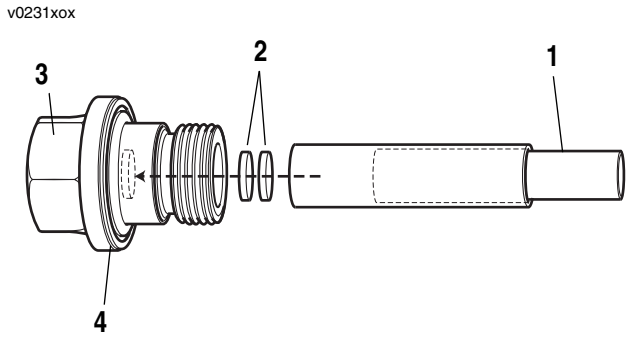
Turn the engine crankshaft counterclockwise only. Turning it clockwise could cause the cam chain to jump over the cam sprocket. Cam timing could be changed, causing engine damage.

20. To position rear cylinder to adjust secondary cam chain:
    a. See Figure 1-97. Install CRANKSHAFT ROTATING WRENCH (HD-45314).
    b. Hold throttle wide open and watch rear cylinder intake valve through intake port.
    c. Turn crankshaft counterclockwise to open valve fully and then close intake valve.



1. **Secondary cam chain measurement tool**
2. **Visible grooves**

Figure 1-98. Secondary Cam Chain Measurement Tool Installed in Front Cylinder



1. **Plunger**
2. **Shims (as required)**
3. **Secondary cam chain tensioner**
4. **Seal**

Figure 1-99. Secondary Cam Chain Tensioner

21. When rear cylinder intake valve is seated, turn crankshaft an additional 1/4 turn (90˚) counterclockwise (CCW).

NOTE

Do not use the sealing washer from the secondary cam chain tensioner when installing the SECONDARY CAM CHAIN MEASUREMENT TOOL (HD-45334).

22. See Figure 1-98. Remove rear cylinder secondary cam chain tensioner and install SECONDARY CHAM CHAIN MEASUREMENT TOOL. Thread-in the tool until it is seated against cylinder head.
23. Note the number of grooves showing on tool.
24. Remove SECONDARY CAM CHAIN MEASUREMENT TOOL.
25. Refer to Table 1-8. From the table, select the number of shims necessary for correct secondary cam chain tension.

NOTE

If a start-up rattle was noticed, 1 or 2 shims are added to the tensioner. If there was no start-up rattle, do not add 1 or 2 shims to the tensioner.

26. See Figure 1-99. Wrap cardboard or heavy cloth around thick shaft on plunger (1). Gently twist while pulling to remove plunger (1) from tensioner (3).
27. Apply a thin film of Harley-Davidson Motorcycle Oil 20W50 to selected shims (2) and plunger (1).
28. Seat number of selected shims (2) and plunger (1) in tensioner (3).
29. Lubricate tensioner seal (4) with Harley-Davidson Motorcycle Oil 20W50.
30. Install rear cylinder secondary cam chain tensioner. Tighten to 100 Nm (74 ft-lbs).
31. Install the horn. See 8.29 HORN.
32. Connect negative battery cable.
33. Install air filter and air filter top. See 1.3 AIRBOX AND AIR FILTER.
34. Install airbox cover.
35. Install the right side cover and maxi-fuse.
36. Turn ignition switch to FUEL and close seat. Then turn ignition switch to LOCK.

HEADLAMP ALIGNMENT 1.26

INSPECTION

⚠WARNING

The automatic-on headlamp feature provides increased visibility for riders. Be sure headlamp is on at all times. Low visibility of rider can result in death or serious injury. (00030a)

Check headlamp for proper height and lateral alignment:

- When the new owner takes delivery of the motorcycle.
- When there is a change in load (adding luggage, etc.).

1. Verify correct front and rear tire pressure. See 1.12 TIRES AND WHEELS.
2. Place motorcycle on level floor (or pavement) in an area with minimum light.
3. See Figure 1-100. Position motorcycle 7.6 m (25 ft) away from a screen or wall. Measure the vertical distance from center of headlamp to floor, and draw a horizontal line (A) on screen or wall at same height above floor.
4. Load vehicle with rider, passenger (if normally present) and any cargo. Weight will compress vehicle suspension slightly.
5. Stand motorcycle upright with both tires resting on floor and with front wheel held in straight alignment (directly forward).
6. See Figure 1-101. Turn ignition switch ON. Set handlebar headlamp switch to HI beam position.
7. Check light beam for alignment.
   a. The main beam, which is a broad, flat pattern of light, should be centered equally above and below the horizontal line.
   b. The main beam of light should also be directed straight ahead. Properly adjusted headlamps project an equal area of light to right and left of center.
   c. Adjust headlamp alignment if necessary.

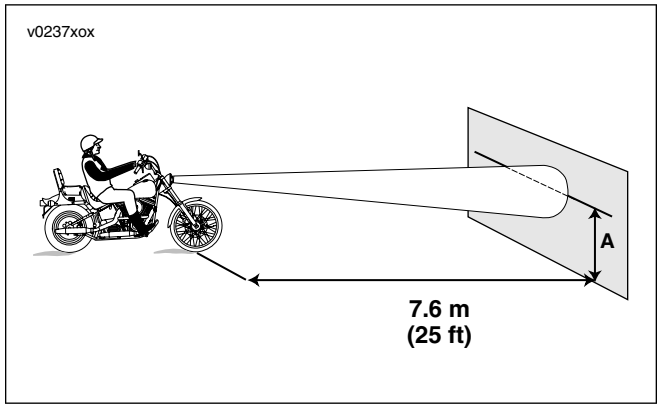


Figure 1-100. Headlamp Alignment

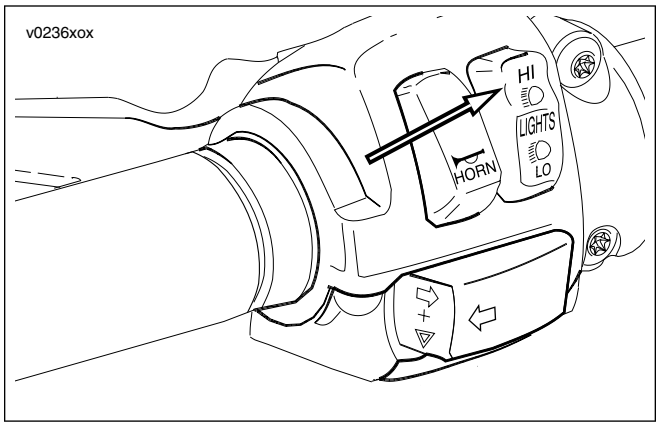


Figure 1-101. Headlamp Switch

ADJUSTMENT

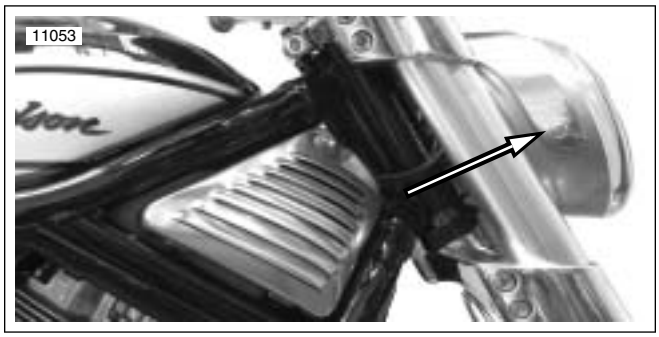


Figure 1-102. Headlamp Alignment Fastener (VRSCA, VRSCR)

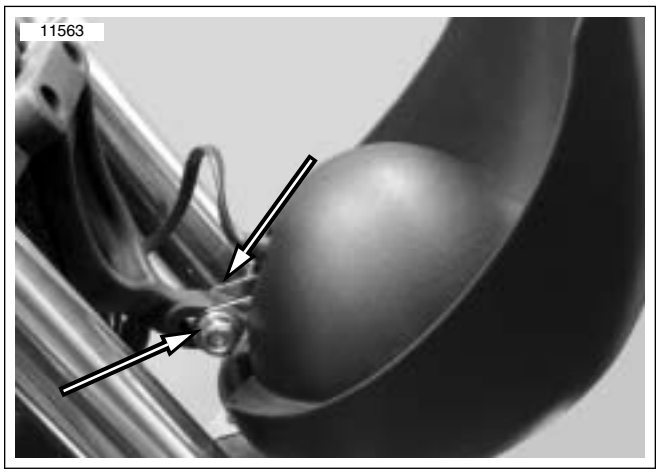


Figure 1-103. Headlamp Alignment Fastener (VRSCD)

1. See Figure 1-102. Loosen fasteners slightly so headlamp is still snug.
2. Adjust accordingly and tighten fasteners.
3. Verify adjustments.

CRITICAL FASTENERS 1.27

INSPECTION

Refer to Table 1-9. Tighten all critical fasteners, except head bolts, to service manual specifications. Replace any damaged or missing hardware.

Table 1-9. Critical Fasteners

SYSTEM	FASTENER	TORQUE	
Hand controls	Upper and lower switch housings	4.0-5.1 Nm	35-45 **in-lbs**
	Clutch lever handlebar clamp	8.0-9.0 Nm	70-80 **in-lbs**
	Master cylinder handlebar clamp	8.0-9.0 Nm	70-80 **in-lbs**
Brakes	Banjo bolts	23-29 Nm	17-22 ft-lbs
	Lower brake caliper mounting pin	38.0-51.5 Nm	28-38 ft-lbs
	Brake disc screws, front	23-31 Nm	17-23 ft-lbs
	Brake disc screws, rear	41-53 Nm	30-39 ft-lbs
	Reservoir screws	0.8-1.2 Nm	7-11 **in-lbs**
Axle nuts	Front axle	67.8-75 Nm	50-55 ft-lbs
	Rear axle	190-203 Nm	140-150 ft-lbs
Front fork/handlebars (VRSCA/VRSCD)	Lower fork pinch bolts	44 Nm	32 ft-lbs
	Upper bracket pinch bolts	44 Nm	32 ft-lbs
Front fork/handlebars (VRSCR)	Lower fork pinch bolts	special procedure	
	Upper bracket pinch bolts	special procedure	
Frame	Lower frame rail bolts	61-75 Nm	45-55 ft-lbs
Rear shock absorbers (VRSCA/VRSCD)	Lower shock absorber bolts	41-68 Nm	31-50 ft-lbs
	Upper shock absorber bolts	41-68 Nm	31-50 ft-lbs
Rear shock absorbers (VRSCR)	Lower shock absorber bolts (with LOCTITE®)	41-68 Nm	31-50 ft-lbs
	Upper shock absorber bolts (with LOCTITE®)	115-125 Nm	85-92 ft-lbs

GENERAL

⚠WARNING

The troubleshooting section of this manual is a guide to diagnose problems. Read the appropriate sections of this manual before performing any work. Improper repair and/or maintenance could result in death or serious injury.

The following check list of possible operating troubles and their probable causes will be helpful in keeping a motorcycle in good operating condition. More than one of these conditions may be causing the trouble and all should be carefully checked.

NOTES

- *For further troubleshooting information see the VRSC Electrical Diagnostic Manual.*
- *For troubleshooting the cooling system, review the check list of operating troubles 6.2 COOLANT FLOW.*

ENGINE

Starter Motor Does Not Operate or Does Not Turn Engine Over

1. Ignition switch not in ON position.
2. Engine run switch in OFF position.
3. Maxi-fuse not in place.
4. Discharged battery, loose or corroded connections (solenoid chatters).
5. Starter control circuit, relay, or solenoid faulty.
6. Electric starter shaft pinion gear not engaging or overrunning clutch slipping.
7. Crankshaft locking pin is in place.

Engine Turns Over But Does Not Start

1. Fuel tank empty.
2. Fouled spark plugs.
3. Discharged battery, loose or broken battery terminal connections.
4. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

5. Loose wire connection at coil, battery, or plug between ignition module or ECM.
6. Ignition timing incorrect due to faulty coil, ignition module, ECM or sensors.
7. Bank Angle Sensor tripped and ignition switch not cycled OFF then ON.
8. Fuel filter clogged.
9. Sticking or damaged valve.

Starts Hard

1. Spark plugs in bad condition or have improper gap or are partially fouled.
2. Battery nearly discharged.
3. Loose wire connection at one of the battery terminals, coil, or plug between ECM or ignition module.
4. Water or dirt in fuel system.
5. Intake air leak.
6. Fuel tank vent hose and vapor valve plugged, or fuel line closed off, restricting fuel flow.
7. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

8. Ignition not functioning properly (possible sensor failure).
9. Faulty ignition coil.
10. Valves sticking or valves too tight.
11. Rotor key sheared.

Starts But Runs Irregularly or Misses

1. Spark plugs in bad condition or partially fouled.
2. Spark plug gap too close or too wide.
3. Faulty ignition coil, module, or sensor.
4. Battery nearly discharged.
5. Damaged wire or loose connection at battery terminals, coil, or plug between ignition sensor and module.
6. Intermittent short circuit due to damaged wire insulation.
7. Water or dirt in fuel system or filter.
8. Fuel tank vent system plugged or closed off.
9. Air leak at intake manifold or air filter.
10. MAP sensor inoperative.
11. Loose or dirty ignition module or ECM connector at crankcase.
12. Faulty Sensor(s): Manifold Absolute Pressure (MAP), or Crank Position (CKP).
13. Incorrect valve timing.
14. Weak or broken valve springs.
15. Damaged intake or exhaust valve.

A Spark Plug Fouls Repeatedly

1. Fuel mixture too rich.
2. Incorrect spark plug for the kind of service.
3. Piston rings badly worn or broken.
4. Valve guides or seals badly worn.

Pre-Ignition or Detonation (Knocks or Pings)

1. Fuel octane rating too low.
2. Faulty spark plugs.
3. Incorrect spark plug for the kind of service.
4. Excessive carbon deposit on piston head or in combustion chamber.
5. Ignition timing advanced due to faulty sensor inputs (MAP, CKP).
6. Air leak

Overheating

1. Insufficient oil supply or oil not circulating.
2. Insufficient air flow over engine.
3. Heavy carbon deposit.
4. Ignition timing retarded due to faulty sensor(s): Manifold Absolute Pressure (MAP) and/or Crank Position (CKP).
5. Leaking valve.
6. Radiator dirty, plugged.
7. Insufficient coolant supply.
8. Vent hose crimped.
9. Air in cooling system.

Valve Train Noise

1. Low oil pressure caused by oil feed pump not functioning properly or oil passages obstructed.
2. Valve sticking in guide.
3. Chain tensioning spring or shoe worn.
4. Cam timing incorrect.
5. Secondary cam tensioner out of range.

Excessive Vibration

1. Wheels and/or tires worn or damaged.
2. Engine/transmission/rear wheel not aligned properly.
3. Upper engine mounting bracket loose/broken or mounting bracket pre-loaded.
4. Ignition timing advanced due to faulty sensor inputs (MAP, CKP)/poorly tuned engine.
5. Internal engine problem.
6. Broken frame.
7. Engine counterbalancer out of time or bearing failed.
8. Exhaust system binding or hitting frame.

Check Engine Light Illuminates During Operation

Fault detected. See the VRSC Electrical Diagnostic Manual.

LUBRICATION SYSTEM

Engine Uses Too Much Oil Or Smokes Excessively

1. Restricted breather operation.
2. Restricted oil filter.
3. Piston rings badly worn or broken.
4. Valve guides or seals worn.
5. Oil diluted with gas.

Engine Leaks Oil From Cases, Hoses, Etc.

1. Loose parts.
2. Imperfect seal at gaskets, washers, etc.
3. Restricted breather hose to air filter.
4. Restricted oil filter.
5. Porosity.

Low Oil Pressure

1. Oil underfilled.
2. Faulty low oil pressure switch.
3. Oil pump o-ring damaged or missing.
4. Bypass valve stuck in open position.
5. Oil diluted with gas.
6. Open in oiling circuit.

High Oil Pressure

1. Overfilled with oil.
2. Bypass valve stuck in closed position.

ELECTRICAL SYSTEM

NOTE

For diagnostic information see the VRSC Electrical Diagnostic Manual.

Alternator Does Not Charge

1. Voltage regulator/rectifier module not grounded.
2. Engine ground wire loose or broken.
3. Faulty regulator-rectifier module.
4. Loose or broken wires in charging circuit.
5. Faulty stator and/or rotor.

Alternator Charge Rate Is Below Normal

1. Weak or damaged battery.
2. Loose connections.
3. Faulty regulator-rectifier module.
4. Faulty stator and/or rotor.

Speedometer Operates Erratically

1. Contaminated speedometer sensor (remove sensor and clean off metal particles).
2. Loose connections.

TRANSMISSION

Shifts Hard

1. Clutch dragging slightly.
2. Shifter return spring (inside transmission) bent or broken.
3. Bent shifter rod.
4. Shifter forks (inside transmission) sprung.
5. Corners worn off shifter clutch dogs (inside transmission).
6. Hydraulic clutch circuit not bled correctly.

Jumps Out Of Gear

1. Shifter rod improperly adjusted.
2. Shifter drum (inside transmission) damaged.
3. Shifter engaging parts (inside transmission) badly worn and rounded.
4. Shifter forks bent.
5. Damaged gears.

Clutch Slips

1. Insufficient clutch spring tension.
2. Worn friction discs.

Clutch Drags Or Does Not Release

1. Lubricant level too high in primary chaincase.
2. Clutch spring tension.
3. Clutch discs warped.
4. Clutch spacer missing or installed backwards.

Clutch Chatters

1. Friction discs worn or warped.
2. Steel discs worn or warped.

HANDLING

Irregularities

1. Improperly loaded motorcycle. Non-standard equipment on the front end such as heavy radio receivers, extra lighting equipment or luggage tends to cause unstable handling.
2. Damaged tire(s) or improper front-rear tire combination.
3. Irregular or peaked front tire tread wear.
4. Incorrect tire pressure. See 1.12 TIRES AND WHEELS.
5. Shock absorber not functioning normally.
6. Loose wheel axle nuts. Tighten to recommended torque specification.
7. Excessive wheel hub bearing play.
8. Rear wheel out of alignment with frame and front wheel.
9. Steering head bearings improperly adjusted. Correct adjustment and replace pitted or worn bearings and races. See 1.19 STEERING HEAD BEARINGS (VRSCA, VRSCD), or 1.20 STEERING HEAD BEARINGS (VRSCR).
10. Tire and wheel unbalanced.
11. Rims and tires out-of-round or eccentric with hub.
12. Rims and tires out-of-true sideways.
13. Rear fork loose on pivot shaft.

BRAKES

Brake Does Not Hold Normally

1. Master cylinder reservoir low on fluid.
2. Brake system contains air bubbles.
3. Master or wheel cylinder piston worn or parts damaged.
4. Brake pads contaminated with grease or oil.
5. Brake pads badly worn.
6. Brake disc badly worn or warped.
7. Brake drags –brake pedal and master cylinder piston not returning completely.
8. Brake fades due to heat build up – brake pads dragging or excessive braking.

Table Of Contents

CHASSIS 2

SPECIFICATIONS 2.1

Table 2-1. Dimensions (VRSCA)

ITEM	MM	IN
Wheel base	1714.5	67.5
Overall length	2377.4	93.6
Overall width	914.9	36.0
Road clearance	127.0	5.0
Overall height	1193.8	47.0
Saddle height (laden w/180 lb rider)	660.4	26.0

Table 2-2. Dimensions (VRSCD)

ITEM	MM	IN
Wheel base	1699.8	66.9
Overall length	2363	93.0
Overall width	924.8	36.4
Road clearance	127.0	5.0
Overall height	1168.4	46.0
Saddle height (laden w/180 lb rider)	660.4	26

Table 2-3. Dimensions (VRSCR)

ITEM	MM	IN
Wheel base	1697	66.8
Overall length	2380	93.7
Overall width	823	32.4
Road clearance	170	6.7
Overall height	1237	48.7
Saddle height (laden w/180 lb rider)	762	30

Table 2-4. Weights (VRSCA)

ITEM	KG	LBS
Shipping weight	272	600
GVWR	481	1060
GAWR - front	169	372
GAWR - rear	312	688

Table 2-5. Weights (VRSCD)

ITEM	KG	LBS
Shipping weight	276	607
GVWR	481	1060
GAWR - front	169	372
GAWR - rear	312	688

Table 2-6. Weights (VRSCR)

ITEM	KG	LBS
Shipping weight	280	618
GVWR	481	1060
GAWR - front	169	372
GAWR - rear	312	688

NOTE

Gross Vehicle Weight Rating (GVWR) (maximum allowable loaded vehicle weight) and corresponding Gross Axle Weight Ratings (GAWR) are given on a label located on the left front frame cross tube.

Table 2-7. Fluid Capacities (VRSCA)

ITEM	LITERS	U.S.
Fuel tank total	14.0	3.7 gal
Oil tank w/filter	4.7	5.0 qts
Coolant	2.4	2.54 qts

Table 2-8. Fluid Capacities (VRSCD)

ITEM	LITERS	U.S.
Fuel tank total	14.0	3.7 gal
Oil tank w/filter	4.7	5.0 qts
Coolant	2.4	2.54 qts

Table 2-9. Fluid Capacities (VRSCR)

ITEM	LITERS	U.S.
Fuel tank total	18.9	5 gal
Oil tank w/filter	4.7	5.0 qts
Coolant	2.4	2.54 qts

Table 2-10. Wheel/Brake Disc/Tire Runout

RUNOUT	MM	IN
Wheel - rim lateral	1.02	0.040
Wheel - rim radial	0.76	0.030
Front brake disc - lateral	0.3	0.012
Rear brake disc - lateral	0.3	0.012
Tire - lateral	1.52	0.060
Tire - radial	2.29	0.090

Table 2-11. Tires

WHEEL	DUNLOP SPORTMAX™ SIZE
Front	120/70ZR-19
Rear	180/55ZR-18

⚠WARNING

Do not inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)

Table 2-12. Tire Pressures

DUNLOP TIRES (ONLY)	FRONT		REAR	
	kPa	PSI	kPa	PSI
Solo rider	248	36	262	38
Rider & passenger	248	36	276	40

⚠WARNING

Match tires, tubes, air valves and caps to the correct wheel rim. Contact a Harley-Davidson dealer. Mismatching can result in damage to the tire bead, allow tire slippage on the rim or cause tire failure, which could result in death or serious injury. (00023a)

NOTE

See 1.12 TIRES AND WHEELS for important information regarding tires.

⚠WARNING

Use only Harley-Davidson approved tires. See a Harley-Davidson dealer. Using non-approved tires can adversely affect stability, which could result in death or serious injury. (00024a)

- Use tubeless tires on all Harley-Davidson disc wheels.
- Do not use inner tubes in radial tires.
- Always use the correct size tires. Tire sizes are molded on the tire sidewall.

TORQUE VALUES 2.2

ITEM	TORQUE		NOTES
Auxiliary volume fasteners	23 Nm	17 ft-lbs	page 2-13
Belt drive sprocket cover fasteners	6-10 Nm	53-88 **in-lbs**	page 2-25
Belt guard grommet bolt	6-10 Nm	53-88 **in-lbs**	page 2-114
Brake disc bolts, front	21-31 Nm	16-23 ft-lbs	page 2-72
Brake disc bolts, rear	41-53 Nm	30-38 ft lbs	page 2-77
Clutch fluid line flare nut	9-13 Nm	80-115 **in-lbs**	page 2-45
Compensator bowl screws	61-75 Nm	45-55 ft-lbs	page 2-77
Coolant air bleed plug	9-11 Nm	80-97 **in-lbs**	page 2-26
Cross member fasteners	20-26 Nm	15-19 ft-lbs	page 2-25
Debris deflector fastener	6-10 Nm	53-88 **in-lbs**	page 2-114
Debris deflector	6-10 Nm	53-88 **in-lbs**	page 2-78
Drive sprocket cover	6-10 Nm	53-88 **in-lbs**	page 2-13
Drive sprocket locking bolts	88-102 Nm	65-75 ft-lbs	page 2-25
Engine mount bracket	34-41 Nm	25-30 ft-lbs	page 2-10
Engine mount double threaded studs	34-41 Nm	25-30 ft-lbs	page 2-10
Engine mount to bracket	34-41 Nm	25-30 ft-lbs	page 2-10
Engine mounting bolt thru travel limiting washer	34-41 Nm	25-30 ft-lbs	page 2-10
Exhaust clamp nut	32-37 Nm	24-27 ft-lbs	page 2-13
Exhaust flange hex-nuts	8-12 Nm	71-106 **in-lbs**	page 2-13
Exhaust system support pin	23 Nm	17 ft-lbs	page 2-13
Fender bracket to front fork bolts	20-26 Nm	15-19 ft-lbs	page 2-91
Fender bracket to front fork bolts	20-26 Nm	15-19 ft-lbs	page 2-92
Fender fasteners w/grabstrap	8-12 Nm	71-106 **in-lbs**	page 2-128
Fender support bracket	34-41 Nm	25-30 ft-lbs	page 2-129
Footrest axle retaining bolt	11-17 Nm	9-12 ft-lbs	page 2-31
Footrest support mounting bolts	19-27 Nm	14-20 ft-lbs	page 2-31
Fork stem nut	61-75 Nm	45-55 ft-lbs	page 2-111
Fork tube caps	22-58 Nm	16-43 ft-lbs	page 2-98
Front axle holder pinch bolts	16 Nm	11 ft-lbs	page 2-72
Front axle nut	68-75 Nm	50-55 ft-lbs	page 2-72

ITEM	TORQUE		NOTES
Front brake caliper top mounting bolt	38-52 Nm	28-38 ft-lbs	page 2-50
Front brake hose bracket bolt	6-10 Nm	53-89 **in-lbs**	page 2-111
Front brake master cylinder banjo bolt	23-31 Nm	17-23 ft-lbs	page 2-48
Front engine mount	34-41 Nm	25-30 ft-lbs	page 2-10
Front engine mount	34-41 Nm	25-30 ft-lbs	page 2-9
Front fender bracket fasteners	4.1 -6.8 Nm	36-60 **in-lbs**	page 2-91
Front fender bracket fasteners	4.1 -6.8 Nm	36-60 **in-lbs**	page 2-92
Grabstrap	11-17 Nm	97-150 **in-lbs**	page 2-125
Grabstrap	11-17 Nm	97-150 **in-lbs**	page 2-127
Handlebar (VRSCB) clamp fasteners	16-20 Nm	144-180 **in-lbs**	page 2-66
Handlebar bolts	41-47 Nm	31-35 ft-lbs	page 2-64
Handlebar bolts	41-47 Nm	31-35 ft-lbs	page 2-66
Handlebar bolts	41-47 Nm	31-35 ft-lbs	page 2-67
Handlebar clamp screws	8-9 Nm	71-80 **in-lbs**	page 2-40
Headlamp mounting bracket bolts	11-18 Nm	9-13 ft-lbs	page 2-64
Heat shield screws	10 Nm	88 **in-lbs**	page 2-13
Inner fender fasteners	20-26 Nm	15-19 ft-lbs	page 2-129
Jiffy stand anchor	7-9 Nm	62-79 **in-lbs**	page 2-28
Lower frame rail bolts	61-75 Nm	45- 55 ft-lbs	page 2-24
Lower handlebar cover	6-10 Nm	54-88 **in-lbs**	page 2-64
Lower muffler fasteners	23 Nm	17 ft-lbs	page 2-13
Master cylinder clamp screw	38-72 Nm	28-53 ft-lbs	page 2-48
Mud flap stud plate fasteners	8-12 Nm	70-106 **in-lbs**	page 2-129
Oil drain plug	35 Nm	25 ft-lbs	page 2-18
P-clamp	6-10 Nm	53-88 **in-lbs**	page 2-25
Pillion mounting bolt	11-17 Nm	97-150 **in-lbs**	page 2-125
Pillion mounting bolt	11-17 Nm	97-150 **in-lbs**	page 2-127
Pipe clamp	6.5 Nm	57 **in-lbs**	page 2-25
Pipe connecting clamp	6-10 Nm	53-88 **in-lbs**	page 2-25
Pivot shaft nut	61-75Nm	45-55 ft-lbs	page 2-122
Radiator drain plug	2.3-2.8 Nm	21-24 **in-lbs**	HAND TIGHTEN, page 2-20
Radiator hose clamps	3-4 Nm	27-35 **in-lbs**	page 2-25
Rear axle nut	129 Nm-142 Nm	95-105 ft-lbs	page 2-25
Rear brake reservoir cover screws	0.7-0.9 Nm	6-8 **in-lbs**	page 2-55
Rear caliper banjo bolt	23-31 Nm	17-23 ft-lbs	page 2-62
Rear engine mount bracket	34-41 Nm	25-30 ft-lbs	page 2-17

ITEM	TORQUE		NOTES
Rear master cylinder banjo bolt	23-31 Nm	17-23 ft-lbs	page 2-55
Rear master cylinder cartridge retaining nut	41-54 Nm	30-40 ft-lbs	page 2-55
Seat latch	6-10 Nm	53-88 **in-lbs**	page 2-123
Seat pipe screw	12-18 Nm	106-159 **in-lbs**	page 2-98
Secondary clutch actuator cover	6-10 Nm	53-88 **in-lbs**	page 2-45
Secondary clutch actuator	10 Nm	88 **in-lbs**	page 2-45
Shift linkage to foot shift lever bolt	9-15 Nm	7-11 ft-lbs	page 2-31
Shifter arm clamp bolt	14-16 Nm	11-12 ft-lbs	page 2-25
Shifter linkage to shifter arm bolt	9-15 Nm	80-132 **in-lbs**	page 2-25
Shock mount bolts	41-68 Nm	31-50 ft-lbs	page 2-115
Shock mount bolts	41-68 Nm	31-50 ft-lbs	page 2-117
Solenoid bracket nuts	6-10 Nm	53- 88 **in-lbs**	page 2-8
Solenoid cable terminal ring	6-10 Nm	53-88 **in-lbs**	page 2-25
Stabilizer link to frame tab	34-41 Nm	25-30 ft-lbs	page 2-90
Stabilizer to frame tab	34-41 Nm	25-30 ft-lbs	page 2-8
Throttle body clamps	1.25 Nm	11 **in-lbs**	page 2-26
Throttle housing screws	4-5 Nm	35-45 **in-lbs**	page 2-37
Top handlebar cover fasteners	1.3-1.9 Nm	12-16 **in-lbs**	page 2-64
Top radiator mounting nuts	19-27 Nm	15-20 ft-lbs	page 2-25
Turn signal and license plate bracket	8-12 Nm	71-106 **in-lbs**	page 2-129
Upper muffler clamp	65 Nm	48 ft-lbs	page 2-13
Upper muffler fasteners	23 Nm	17 ft-lbs	page 2-13
Valve stem nut	1.4-1.7 Nm	12-15 **in-lbs**	page 2-85

VEHICLE IDENTIFICATION NUMBER: VIN 2.3

GENERAL

See Figure 2-1. The full 17 digit serial, or Vehicle Identification Number (V.I.N.) is stamped on the right side of the steering head and on a label located on the right side down tube.

An abbreviated V.I.N. is stamped on the left side crankcase at the base between the cylinders.

Sample V.I.N. as it appears on the steering head: **1HD1HAZ176K800000**
Sample abbreviated V.I.N. as it appears on the left crankcase: **HAZ6800000**

NOTE

Always give the full 17 digit Vehicle Identification Number when ordering parts or making any inquiry about your motorcycle.

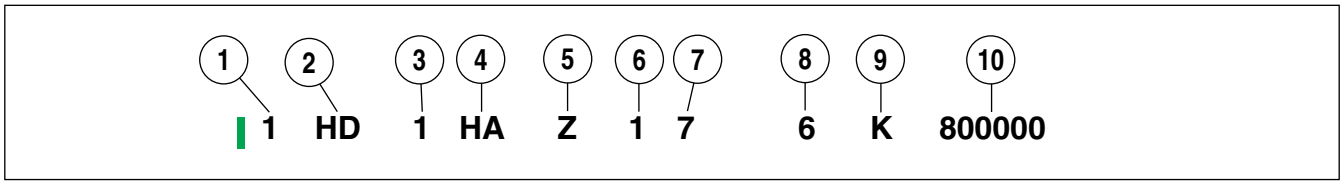


Figure 2-1. VRSC Vehicle Identification Number (typical)

Table 2-13. Harley-Davidson 2006 VRSC Model V.I.N. Description

ITEM	DESCRIPTION	POSSIBLE VALUES
1	Market destination	1=Originally manufactured for sale within the United States 5=Originally manufactured for sale outside of the United States
2	Manufacturer	HD=Harley-Davidson
3	Motorcycle type	1=Heavyweight motorcycle 901 cc and larger
4	Model	see VRSC Model V.I.N. Codes table
5	Engine type	Z=Revolution, 1130cc liquid-cooled, fuel injected A=Revolution, 1130cc liquid-cooled, fuel injected, 105 HP HDI Only
6	Introduction date	1=Regular 2=Mid-year 3=California/regular 4=Cosmetic changes and/or special introductory date 5=California/cosmetic changes and/or special introductory date 6=California/mid-year
7	VIN check digit	Can be 0-9 or X
8	Model year	6=2006
9	Plant of manufacture	K=Kansas City, MO. USA
10	Sequential number (last 6 digits)	varies

Table 2-14. 2006 VRSC Model V.I.N. Codes

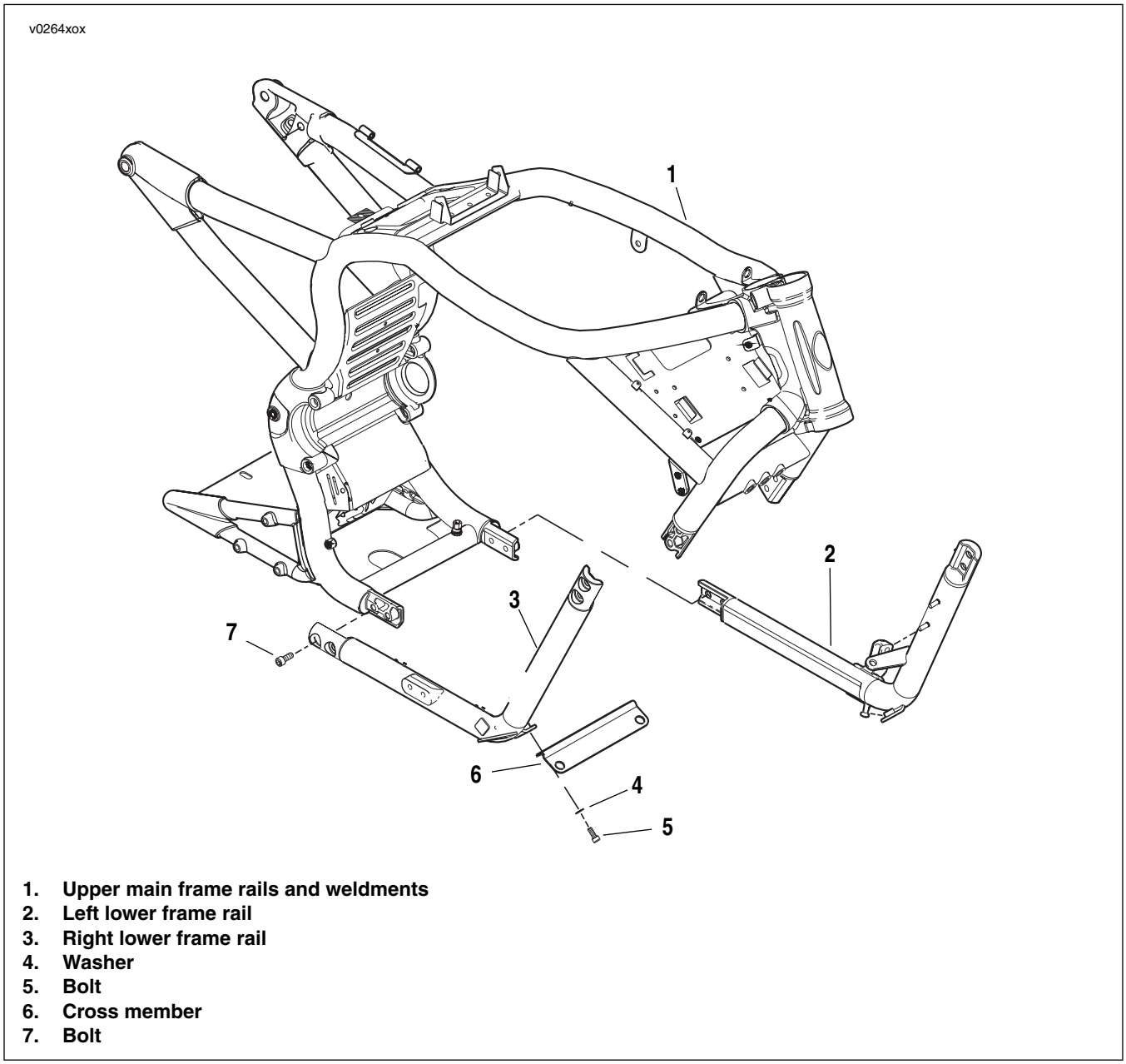
CODE	MODEL NAME
HA	VRSCA
HC	VRSCR
HD	VRSCD

FRAME/LOWER FRAME RAILS 2.4

GENERAL

The steel upper hydroformed main rails, joined with stamped sheet metal weldments for the steering head, seat, rear fork pivots, fuel tank shield, and rear fender, are bolted to left and right lower frame rails that complete the frame perimeter.

The rider footrests and foot controls are mounted on the lower frame near the rear fork pivot. The passenger footrests are mounted on the rear frame rails next to the fuel tank.



1. **Upper main frame rails and weldments**
2. **Left lower frame rail**
3. **Right lower frame rail**
4. **Washer**
5. **Bolt**
6. **Cross member**
7. **Bolt**

Figure 2-2. Steel Perimeter Frame and Bolt-on Lower Frame Rails (typical)

REMOVAL

1. Support motorcycle under fuel tank frame weldment and/or lock wheels so that frame rails and/or engine can be removed.
2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
3. Open seat.
4. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.

⚠ WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

5. Disconnect negative battery cable.
6. See Figure 2-2. Remove two cross member bolts (5) and washers (4). Pull bottom of radiator assembly forward with cross member or remove the radiator assembly as required. See 6.8 RADIATOR/OIL COOLER.
7. Remove clutch fluid line from clips on right lower frame rail. See 2.18 CLUTCH FLUID LINE.
8. Remove starter solenoid bracket nuts and remove starter solenoid from right lower frame rail. See 5.5 STARTER SOLENOID.
9. Remove engine mount stabilizer link from frame rail bracket. See 2.5 FRONT ENGINE MOUNT.

NOTE

Maintain stabilizer link length for reinstallation. Do not loosen jam nuts on stabilizer link.

10. Remove bolts (7) holding on the right and left lower frame rails (2, 3). Remove the frame rails.

INSTALLATION

1. See Figure 2-2. Install left and right lower frame rails (2, 3) and finger tighten mounting bolts (7).
2. Using clips, attach clutch fluid line to right lower frame rail. See 2.18 CLUTCH FLUID LINE.
3. Attach the engine mount stabilizer link to the frame tab. Tighten to 34-41 Nm (25-30 ft-lbs). See 2.5 FRONT ENGINE MOUNT.
4. Attach starter solenoid bracket to right lower frame rail with nuts. Tighten to 6-10 Nm (53-88 **in-lbs**).
5. Reinstall radiator/oil cooler assembly as required or pull radiator/oil cooler assembly into position and install and finger tighten cross member mounting bolts (5) and washers (4). Tighten cross member bolts (5) to 20-26 Nm (15-19 ft-lbs). See 6.8 RADIATOR/OIL COOLER.
6. Tighten lower frame rail bolts (7) to 61-75 Nm (45-55 ft-lbs).
7. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
8. Reinstall airbox cover.
9. Install maxi-fuse and right side cover.

FRONT ENGINE MOUNT 2.5

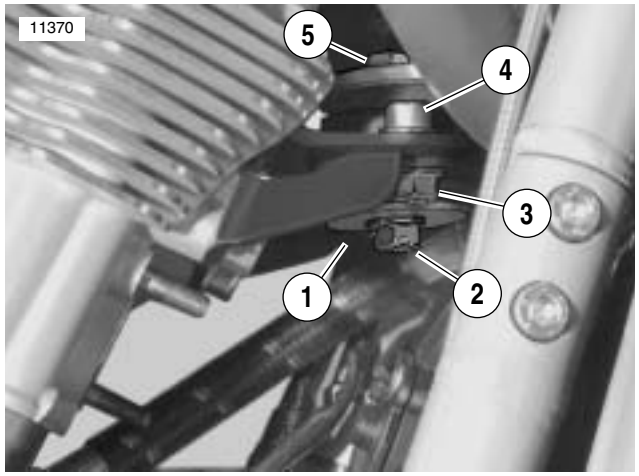
REPLACEMENT

1. Support engine with a scissors jack under the oil pan.
2. Remove the right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
3. Open seat.
4. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

5. Disconnect negative battery cable.
6. See Figure 2-3. Loosen and remove nut (2) and travel limiting washer (1) from center mounting bolt (5).
7. Loosen and remove nuts (3) from engine mount bolts (4) (Left side requires using a 8 mm ball Allen with a 2 in. extension).
8. By lifting up the center mounting bolt (5) slightly, the engine mount pivots down and out away from the fan shroud.
9. Install **new** engine mount and left and right engine mounting bolts (4).
10. Install travel limiting washer (1) and center mounting bolt nut (2).
11. Tighten all fasteners to 34-41 Nm (25-30 ft-lbs).
12. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
13. Reinstall airbox cover.
14. Close seat.
15. Install maxi-fuse and right side cover.



1. **Travel limiting washer**
2. **Center mounting bolt nut**
3. **Engine mount bolt nut**
4. **Engine mount bolt and washer**
5. **Center mounting bolt**

Figure 2-3. Engine Mount (exhaust removed for clarity)

FRONT ENGINE MOUNT ASSEMBLY 2.6

REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Open seat.
3. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

4. Disconnect negative battery cable.
5. Remove radiator assembly as required. See 6.8 RADIATOR/OIL COOLER.
6. See Figure 2-4. Loosen and remove double threaded studs (11) that hold front engine mount bracket (3) to frame.
7. Remove bolts (10) that hold front engine mount bracket (4) to engine and work assembly out of frame between two lower frame rails.
8. Loosen and remove stabilizer link hold down bolt (12) to lower frame rail bracket.
9. Loosen and remove bolt (16), spacer (17) and stabilizer link (15) from front of engine case.

NOTE

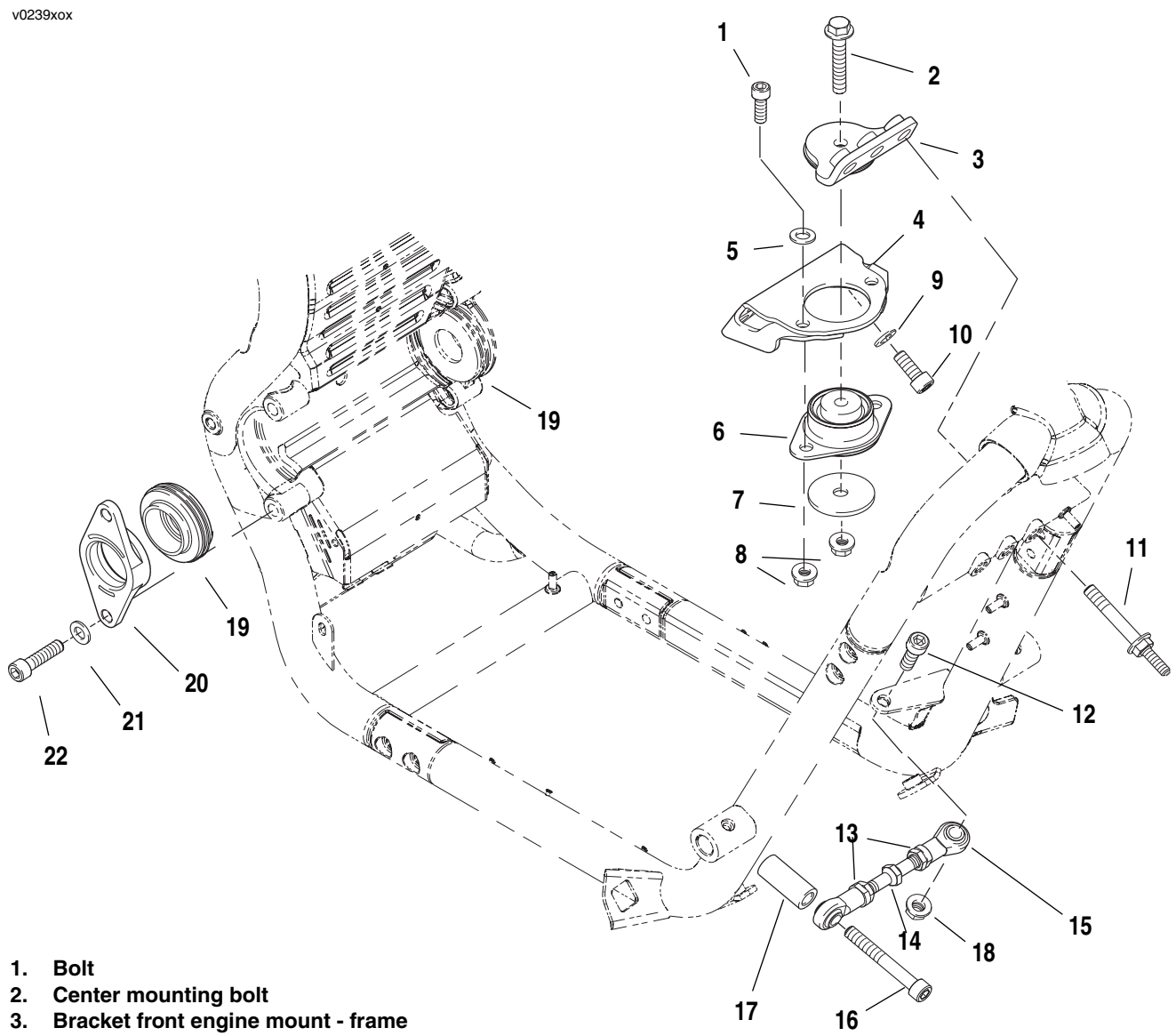
Maintain stabilizer link length for a correctly aligned reinstallation. Do not loosen jam nuts and turn rod ends.

DISASSEMBLY AND ASSEMBLY

1. See Figure 2-4. Loosen and remove nut (8) from center mounting bolt (2) holding engine mount (6), travel limiting washer (7) and the two brackets (3, 4) together.
2. Remove two bolts (1) holding engine mount (6) to engine mount bracket (4). Remove engine mount (6).
3. Inspect for worn or damaged parts, replace as necessary.
4. Align engine mount bolt (2) through the frame bracket (4) and the engine mount (6) with the flange of the engine mount under the engine bracket and the large end up through the engine bracket. Slide on the travel limiting washer (7) and loosely install the flanged hex-nut (8).
5. Install and tighten fasteners (1), washers (5) and nuts (8) holding engine mount (6) to bracket to 34-41 Nm (25-30 ft-lbs).

INSTALLATION

1. See Figure 2-4. Start, but do not tighten bolts (10) and washers (9) fastening engine mount bracket (4) to engine cylinder head.
2. Attach frame bracket to frame with double threaded studs.
3. Alternately tighten and loosen engine mount bolts (10) and the two threaded studs (11). Tighten the engine bolts (10) and the two threaded studs (11) to 34-41 Nm (25-30 ft-lbs).
4. Tighten center mounting bolt (2) and travel limiting washer to 34-41 Nm (25-30 ft-lbs)
5. Insert bolt through stabilizer link (15) and spacer (17) and thread into engine crankcase. Tighten bolt to 34-41 Nm (25-30 ft-lbs).
6. Install frame end of stabilizer link (15) to frame bracket. Tighten to 34-41 Nm (25-30 ft-lbs).
7. Reinstall radiator assembly. See 6.8 RADIATOR/OIL COOLER.
8. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
9. Install airbox cover.
10. Close seat
11. Install maxi-fuse and right side cover.



1. Bolt
2. Center mounting bolt
3. Bracket front engine mount - frame
4. Bracket front engine mount - engine
5. Washer
6. Front engine mount
7. Washer - travel limiting
8. Nut
9. Washer
10. Bolt
11. Double threaded stud
12. Bolt
13. Jam nut
14. Fixed nut
15. Stabilizer Link
16. Bolt
17. Spacer
18. Nut
19. Rear engine mount
20. Bracket - rear engine mount
21. Washer
22. Fasteners

Figure 2-4. Engine Mounts (typical) (VRSCA shown)

EXHAUST SYSTEM (VRSCA) 2.7

REMOVAL

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
2. See Figure 2-7. Loosen upper muffler clamp (11).

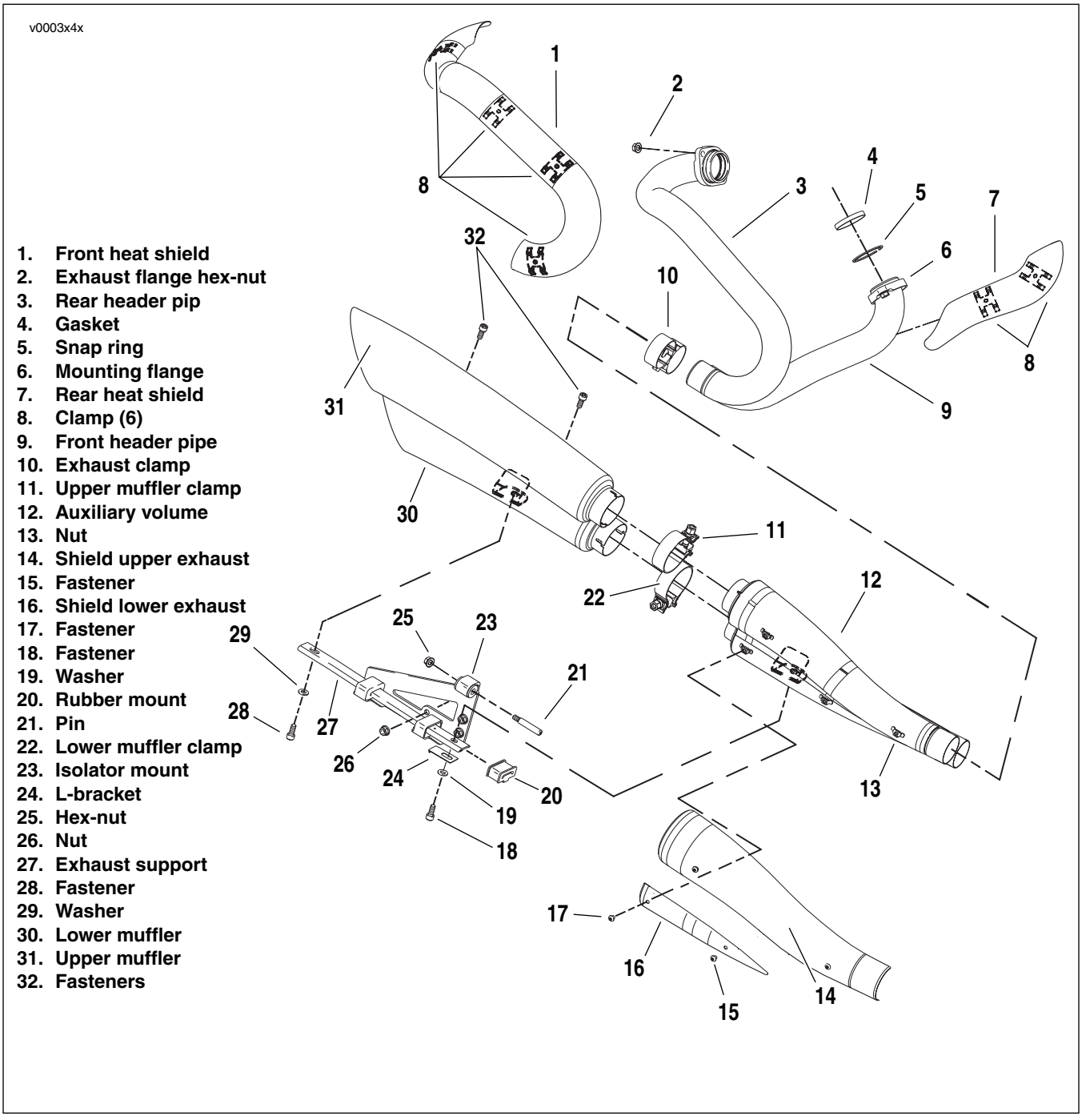


Figure 2-5. Exhaust System

3. Remove the two fasteners (32) holding the upper muffler (31) to the bottom muffler (30).
4. Slide upper muffler rearward to disconnect from the auxiliary volume (12).
5. Remove both heat shields (1, 7) from front and rear header pipes. It's not necessary to remove the heat shield (14) from the auxiliary volume (12).
6. Remove the auxiliary volume fastener (18) and the lower muffler fastener (28) from the lower part of the exhaust support bracket. Save the L-bracket (24) found under the exhaust support.

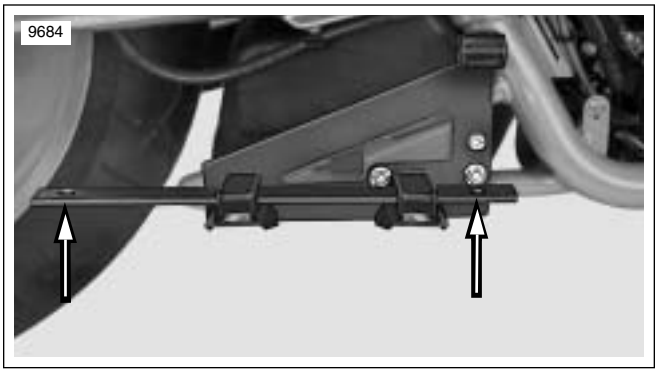


Figure 2-6. Exhaust Support Fastener Locations (exhaust system removed)

NOTE

Remove the left side drive sprocket cover for easier access to rear cylinder lower exhaust flange bolt.

7. Remove flanged hex-nuts (2) holding exhaust flange to front and rear cylinders.
8. Remove hex-nut (25) and pin (21) on exhaust support bracket.
9. Remove header pipes with the auxiliary volume and lower muffler attached. Lift and adjust assembly until header pipes slide out and away from the cylinder heads.

NOTE

To maintain the alignment of these components, keep the lower muffler, the auxiliary volume, the exhaust clamp, and the front and rear header pipes firmly connected.

INSTALLATION

NOTE

Do not torque fasteners until required to do so by the following installation instructions. Hand tightening each fastener will pull the exhaust system into a position that will allow the crush of the exhaust gaskets during the torquing sequence to to draw the exhaust system up to the engine.

1. Install **new** exhaust header gaskets.
2. See Figure 2-7. Gently lift the lower muffler, auxiliary volume, and header pipe assembly into position.

NOTE

A second technician may be required to hold the header pipes when aligning the exhaust header flanges with the studs in the cylinder heads.

3. Slip both front and rear header flanges over the studs in the cylinder heads. Thread hex-nuts (2) on header flange studs. Do not tighten.
4. Install support pin (21) in isolator mount (23) on the exhaust support. Thread on the hex-nut (25). Do not tighten.
5. Hold a 1/2 in. spacer between the frame rail and the header pipe exhaust clamp.
6. Thread in the lower muffler fastener (28) through the exhaust support.
7. Thread in the auxiliary volume fastener (18) through the L-bracket (24) and the exhaust support. Do not tighten.
8. Torque the pin hex-nut to 23 Nm (17 ft-lbs).
9. Place clamp (11) on upper muffler (31). Slide muffler over upper opening of auxiliary volume (12). Position clamp with compression fastener to inboard with tightening nut upward.
10. Thread upper muffler fasteners (32) into the lower muffler (30). Do not tighten.
11. Torque the fasteners to the indicated torque in the following order:
    a. Upper muffler clamp - 65 Nm (48 ft-lbs).
    b. Upper muffler fasteners - 23 Nm (17 ft-lbs).
    c. Lower muffler and auxiliary volume fasteners to support bracket - 23 Nm (17 ft-lbs).
    d. Exhaust flange hex-nuts - 8-12 Nm (71-106 **in-lbs**).
12. Check the tightness of the exhaust clamp by tightening the clamp nut to 32-37 Nm (24-27 ft-lbs).
13. Reinstall front and rear heat shields. Tighten the heat shield fasteners to 10 Nm (88 **in-lbs**).
14. If removed, reinstall drive sprocket cover. Tighten to 6-10 Nm (53-88 **in-lbs**).
15. Reinstall the maxi-fuse and the right side cover.

EXHAUST SYSTEM (VRSCD/VRSCR) 2.8

REMOVAL

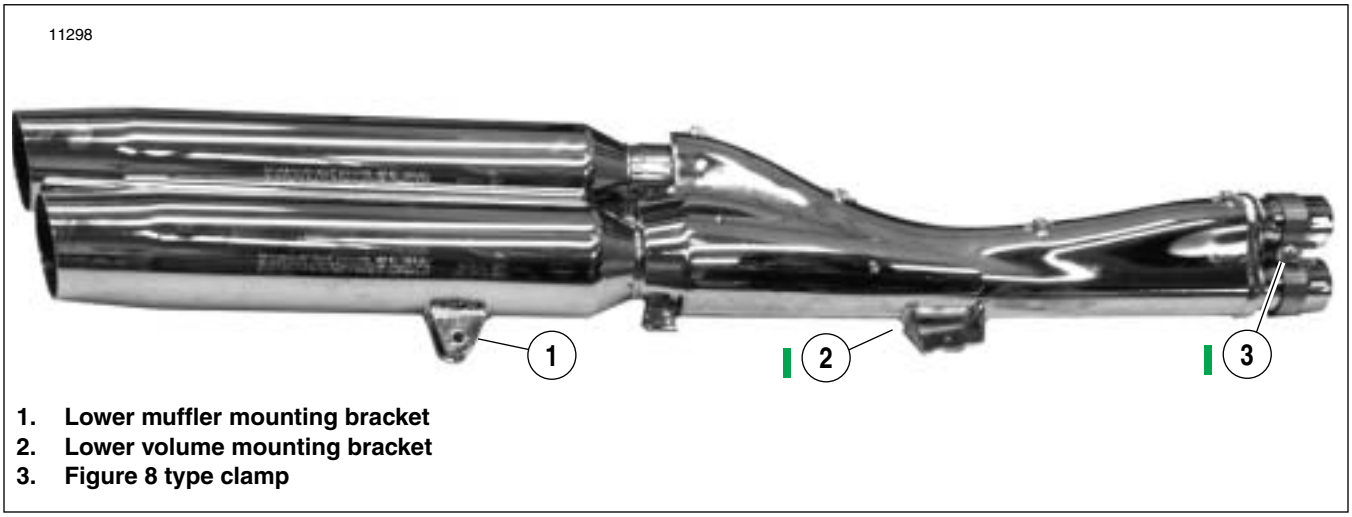
WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

NOTE

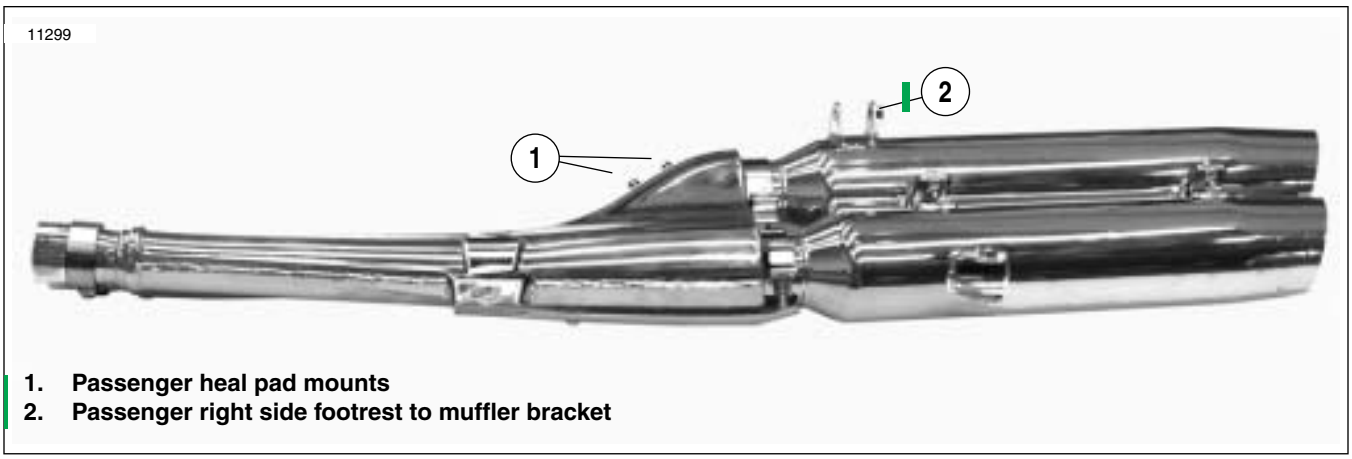
The exhaust system can be removed as a complete unit from the primary tubes back. It is not necessary to remove the heat shields or passenger footrest pad from muffler assembly.

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
2. See Figure 2-7. Loosen figure 8 type clamp (3).
3. Remove passenger right side footrest assembly. See 2.14 FOOTRESTS/FOOT CONTROLS (VRSCD/VRSCR).
4. See Figure 2-9. Remove exhaust bracket fastener from passenger right side footrest.
5. Holding exhaust system firmly, use an up and down motion at the back of the mufflers while pulling exhaust system back and away from primary tubes until exhaust system is free from motorcycle.
6. See Figure 2-10. Note lower support fastener locations. It is not necessary to remove this bracket from motorcycle.



1. **Lower muffler mounting bracket**
2. **Lower volume mounting bracket**
3. **Figure 8 type clamp**

Figure 2-7. Exhaust System Front View
(exhaust system removed shown with heat shields removed for clarity)



1. **Passenger heal pad mounts**
2. **Passenger right side footrest to muffler bracket**

Figure 2-8. Exhaust System Rear View
(exhaust system removed shown with heat shields removed for clarity)

INSTALLATION

⚠WARNING

Before installing exhaust system, verify brake hose between rear brake master cylinder and reservoir is installed securely into frame clips and no clamps are missing or damaged. Failure to verify can cause brake hose to contact hot exhaust system which can result in loss of control of motorcycle and result in death or serious injury.

⚠WARNING

If for any reason, heat shields or heat shield fasteners were removed from exhaust system, they must be replaced with new fasteners containing lock patch and tightened properly. Failure to do so can result in the heat shield coming loose and interfering with rear brake pedal operation which can cause loss of vehicle control and death or serious injury.

⚠WARNING

If thin metal band is removed for any reason from front of volume heat shield, it must be replaced with a new band. Failure to replace band may result in heat shield making contact with rear brake lever which can result in death or serious injury.

NOTE

A second technician may be required to hold the primary header tubes while guiding exhaust system onto motorcycle.

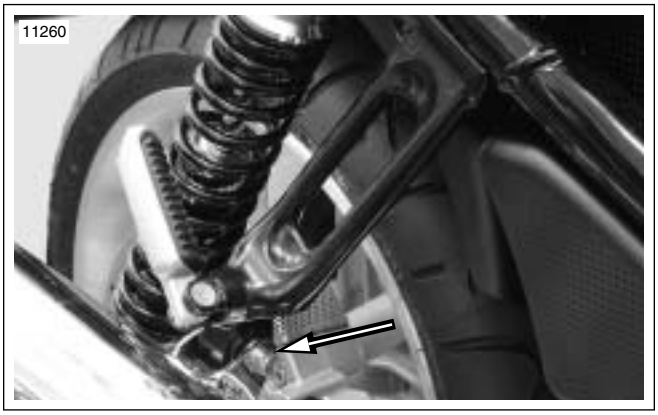


Figure 2-9. Right Side Passenger Footrest to Exhaust Bracket Fastener

1. Verify brake hose between master cylinder and reservoir is completely seated in retainer clips along lower frame tube Replace any damaged or missing clips and verify that brake hose is as far inboard of frame tube as possible.
2. Gently lift the exhaust system assembly into position.
3. Have assistant guide the pipes from the muffler assembly into the primary header tubes. Make sure heat shield on muffler assembly fits over heat shield on primary header tubes.
4. See Figure 2-10. Install all fasteners loosely. Do not tighten at this time.

Figure 2-10. Exhaust Lower Support Fastener Location (exhaust system removed for photo clarity)

5. Install passenger footrest and bracket assembly. See 2.14 FOOTRESTS/FOOT CONTROLS (VRSCD/VRSCR).
6. Tighten lower muffler mounting fastener to 19-27 Nm (14-20 ft-lbs) and lower volume mounting fasteners to 19-27 Nm (14-20 ft-lbs).
7. Tighten figure 8 clamp to 30-34 Nm (22-25 ft-lbs).

⚠WARNING

Check clearance between bottom of exhaust and frame of motorcycle. There should be a measured clearance no less than 5.7 mm (7/32 in). Clearance less than this can result n damage to the rear brake reservoir to master cylinder hose which can cause loss of vehicle control and death or serious injury.

8. Check clearance between frame and exhaust system. Clearance should be no less than 5.7 mm (7/32 in). If adjustment is necessary, loosen primary header tubes, all mounting fasteners and reposition exhaust system and check clearance again.
9. Confirm thin metal band around front of heat shield is securely in place.

PRIMARY HEADER TUBES

Removal

If it is necessary to remove primary header tubes, first perform steps necessary to remove rear part of exhaust system.

1. Remove fasteners holding primary header tubes to cylinder heads.
2. Remove primary header tubes from cylinder heads and discard old gaskets.

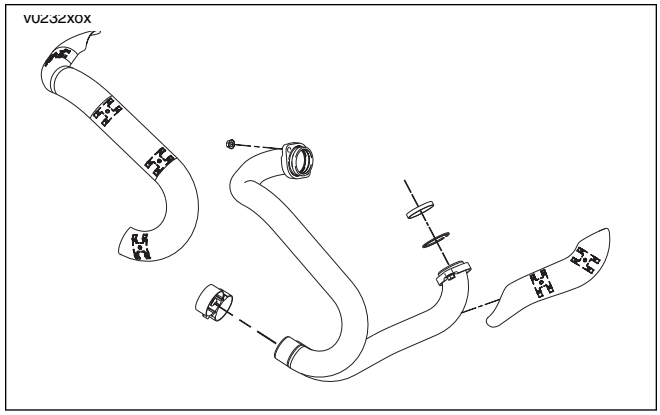


Figure 2-11. Primary Header Tubes

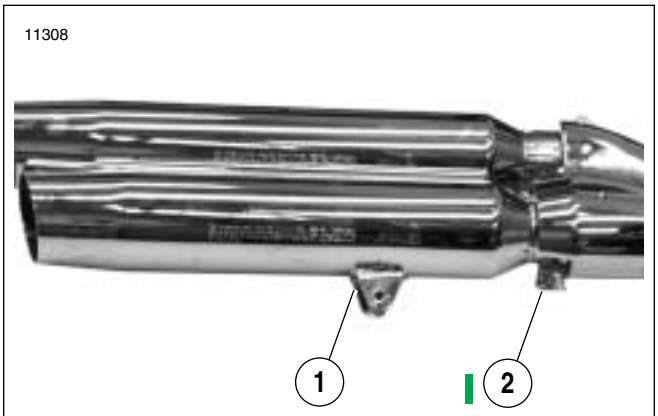
Installation

1. Install **new** primary header tube mounting gaskets.
2. Install primary header tubes to cylinder heads and install fasteners. Do not tighten at this time.
3. Install complete exhaust system and perform alignment checks to verify clearance between exhaust and frame tube.
4. Tighten primary header tube to cylinder head fasteners to 8-12 Nm (71-106 **in-lbs**).

MUFFLERS

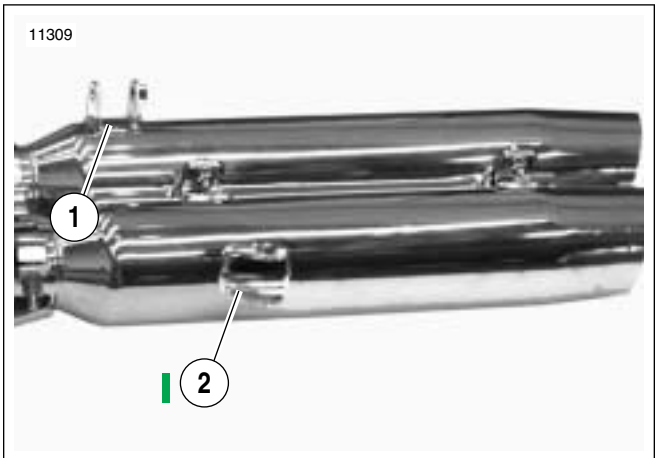
Removal

1. Remove lower muffler by doing the following:
   a. Loosen lower muffler clamp.
   b. Remove fastener from lower muffler to bracket.
   c. Holding muffler firmly, use an up and down motion at the back of the muffler while pulling muffler back and away from exhaust system until muffler is free from motorcycle.
2. Remove upper muffler by doing the following:
   a. Loosen upper muffler clamp.
   b. Remove fastener from upper muffler to footpeg bracket.
   c. Holding muffler firmly, use an up and down motion at the back of the muffler while pulling muffler back and away from exhaust system until muffler is free from motorcycle



1. Lower muffler bracket
2. Lower muffler clamp

Figure 2-12. Lower Clamp and Bracket Locations



1. Upper muffler bracket
2. Upper muffler clamp

Figure 2-13. Upper Clamp and Bracket Locations

Installation

1. Install lower muffler by doing the following:
   a. Put muffler clamp in place for installation.
   a. Holding muffler firmly, use an up and down motion at the back of the muffler while pushing muffler onto existing exhaust system until muffler is in place.
   b. Install fastener from lower muffler to bracket.
   c. Tighten muffler clamp to 30-34 Nm (22-25 ft-lbs).
2. Install upper muffler by doing the following:
   a. Put muffler clamp in place for installation.
   a. Holding muffler firmly, use an up and down motion at the back of the muffler while pushing muffler onto existing exhaust system until muffler is in place.
   b. Install fastener from upper muffler to footpeg bracket.
   c. Tighten muffler clamp to 30-34 Nm (22-25 ft-lbs).

REAR ENGINE MOUNTS 2.9

REMOVAL

PART NO.	SPECIALTY TOOL
HD-45317	Engine assembly support fixture
HD-45317-10	Engine support fixture spacer (VRSCR ONLY)

1. Support motorcycle under fuel tank frame weldment and lock the front wheel so that the engine can be removed.

NOTE

To provide clearance and alignment, locate a scissors style jack under the fuel tank frame extensions to raise or lower the motorcycle throughout the procedure.

2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
3. Open seat.
4. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

5. Disconnect negative battery cable.

NOTE

If performing this procedure on a VRSCR model, use HD-45317-10 with HD-45317.

6. WIth ENGINE ASSEMBLY SUPPORT FIXTURE (HD-45317) positioned under engine, remove engine from motorcycle and roll far enough from frame to remove left rear engine mount. See 2.10 ENGINE REPLACEMENT.
7. See Figure 2-4. Remove fasteners (22) holding right rear engine mount bracket (20) to the frame.
8. Remove both rear engine mounts (19) with left and right pivot shaft spacers. See 2.46 REAR FORK.
9. Clean as necessary the right rear engine mount frame weldment, and the rear engine mount bracket.

INSTALLATION

1. See Figure 2-4. Install left rear engine mount (19) in left side frame weldment.
2. Install pivot shaft spacer in left rear engine mount. See 2.46 REAR FORK.
3. Orient flanged side of right rear engine mount (19) toward outside of the rear engine mount bracket (20), and thread fasteners (22) with narrow washers (21) through rear engine mount bracket into frame bosses.
4. Install pivot shaft spacer in right engine mount.
5. Tighten mounting bolts (22) to 34-41 Nm (25-30 ft-lbs).

NOTE

The left and right rear fork pivot shaft spacers are inserted into the engine mounts. Verify that the pivot shaft spacers are in position before installation of the pivot shaft.

6. Reinstall engine. See 2.10 ENGINE REPLACEMENT.
7. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
8. Install airbox cover.
9. Close seat
10. Reinstall maxi-fuse and right side cover.

ENGINE REPLACEMENT 2.10

GENERAL

Removal and replacement of the engine may be required for either replacement engines or for engine overhaul.

REMOVAL

PART NO.	SPECIALTY TOOL
HD-42317-10	Engine support fixture spacer (VRSCR ONLY)
HD-45317	Engine assembly support fixture

1. See Figure 2-14. On a table lift with a lift side extension, position a scissors jack under the fuel tank.

NOTE

To provide clearance and alignment, locate a scissors style jack under the fuel tank frame extensions to raise or lower the motorcycle throughout the procedure.

⚠WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

2. Open seat.
3. Purge fuel supply line of high pressure gasoline.
   a. Disconnect fuel module connector from top plate.
   b. In neutral, start engine and allow engine to run.
   c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.
4. Place a suitable container under engine, loosen oil drain plug and drain oil.
5. Install and tighten oil drain plug to 35 Nm (25 ft-lbs).
6. Allow engine to cool.
   a. For replacement engines, leave oil filter threaded into its mounting plate.
   b. For engine overhaul, remove oil filter as necessary.

NOTE

Dispose of oil in accordance with local regulations.

7. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
8. Remove air filter cover. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

9. See Figure 2-15. Disconnect negative (1) and positive (2) battery cables from battery.

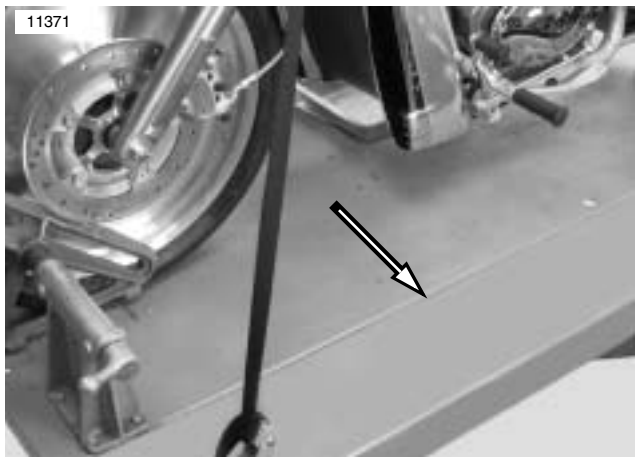
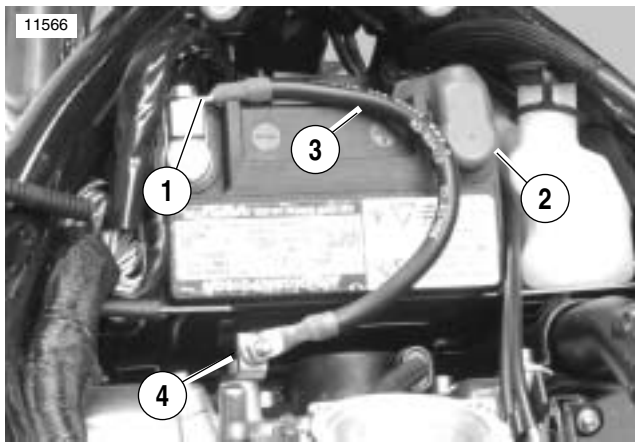


Figure 2-14. Lift Side Extension (typical)



1. **Negative battery cable at battery**
2. **Positive battery cable at battery (under boot)**
3. **Negative battery cable**
4. **L-bracket with negative battery cable**

Figure 2-15. Battery Cable Connections (typical)

10. Remove air filter top, air filter, breather hose, velocity stacks, and air filter bottom. Unscrew threaded air filter hold down rod from throttle body. See 1.3 AIRBOX AND AIR FILTER.
11. At the fuel rail, disconnect pressure fuel line and return fuel line by pressing blue buttons with thumb and first finger.
12. See Figure 2-15. Disconnect copper L-bracket (4) with negative battery cable (3) from front cylinder head.
13. See Figure 2-17. Remove fastener on rear cylinder head and remove GND 1 (8), GND 2 (9) and horn ground wire (10). Replace fastener.
14. Remove fastener on front cylinder head and remove regulator ground (3). Replace fastener.
15. Separate wiring connectors from horn. Unbolt and remove horn from rubber grommet on frame. See 8.29 HORN.
16. Separate:
    a. Front (2) and rear coil connectors [83F, 83R].
    b. Main engine connector [45] (7).
    c. Throttle position sensor [88] (4).
    d. Idle air control actuator [87] (5).
17. For a California model, pull the purge solenoid hose (6) off throttle body.
18. Perform throttle body procedure:
    a. For a replacement engine, loosen throttle cable adjustor jam nuts. Turn throttle cable adjuster until cable is as short as possible. Remove throttle cable housings from guides at the throttle body and remove cable barrels from throttle cam. See 2.15 THROTTLE CABLES.
    b. See Figure 2-16. For engine overhaul, loosen clamps at each intake and lift throttle body straight up. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine. Cover intake openings to prevent objects from falling into intake bore.

NOTE

For replacement engines, the engine wiring harness is left attached to the engine. The engine wiring harness will include connectors to the manifold air pressure sensor [80], the intake air temperature sensor [89], the coolant temperature sensor [90], the oil pressure sending unit [120], and both fuel injectors [84] [85].

19. Remove exhaust system. See 2.8 EXHAUST SYSTEM (VRSCD/VRSCR).
20. Remove lower left and right side radiator covers. See 6.8 RADIATOR/OIL COOLER.
21. See Figure 2-18. Separate:
    a. Crank position sensor connector [79] (3).
    b. Top and bottom cooling fan connectors [97T] [97B] (2).
    c. Stator-to-regulator connector [46] (1).
    d. Wiring frame clip (4).

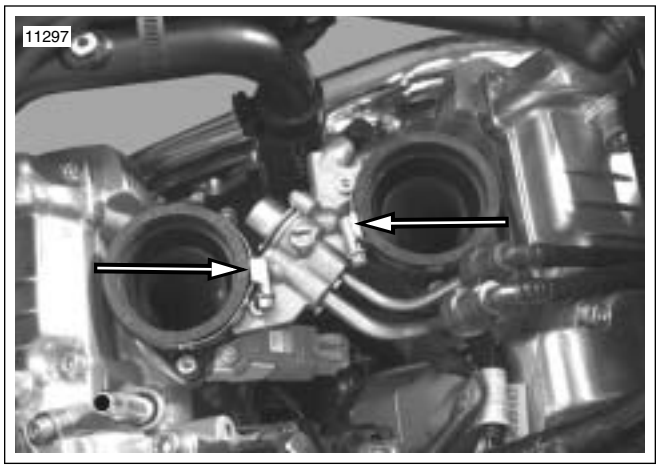


Figure 2-16. Intake Clamps (throttle body removed)

NOTE

Note the position of the clamps for assembly.

22. See Figure 2-19. Cover front fender with a shop towel or protective cover. On right side, pull rear brake fluid reservoir from radiator cover.
23. Remove two fasteners and washers (2) on each side of radiator cover and remove radiator cover. The radiator cover includes two chrome inlet bezels.
24. Place a suitable container under radiator and open pressure cap.
25. See Figure 2-19. Loosen but do not remove radiator drain plug. Orient radiator drain plug so that slot in threads is open to container.

⚠WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

26. Loosen radiator cap and allow coolant to drain from the radiator.
27. See Figure 2-20. Place a suitable container under engine and remove front engine coolant drain plug. Allow remaining coolant to drain from engine.
28. Install front engine drain plug and tighten to 9.7 Nm (86 **in-lbs**)

NOTE

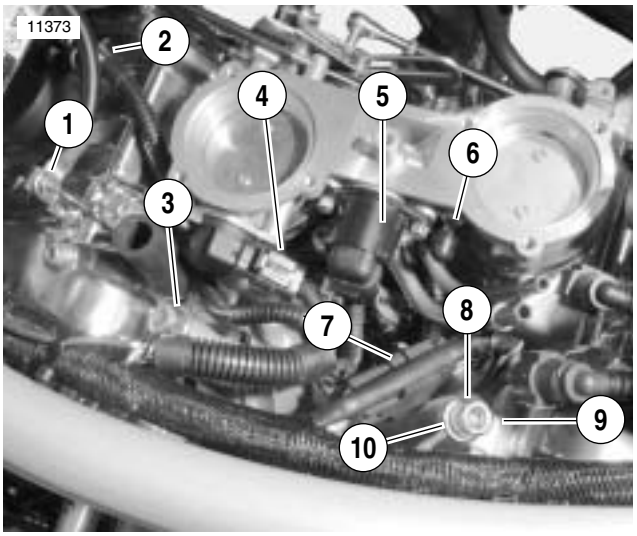
With the motorcycle in normal orientation, there is no need to remove the rear engine coolant drain plug.

29. Hand tighten radiator drain plug.

NOTE

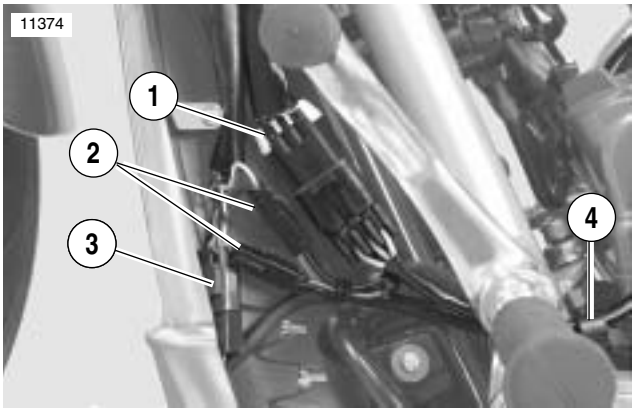
*Correct torque on the radiator drain plug is 2.3-2.8 Nm (21-24 **in-lbs**). See 6.3 ENGINE COOLANT.*

30. Use a long thin screwdriver (Snap-on Part No. SDD1410) to loosen worm drive clamps on radiator hoses.



1. **Negative battery cable copper L-bracket**
2. **Front cylinder coil connector**
3. **Regulator ground**
4. **Throttle position sensor connector [88]**
5. **Idle air control actuator connector [87]**
6. **Purge solenoid fitting**
7. **Main engine connector [45]**
8. **GND 1**
9. **GND 2**
10. **Horn ground wire**

Figure 2-17. Wiring Connections (typical)



1. **Stator-to-regulator connector [46]**
2. **Top & bottom fan power connectors [97T] [97B]**
3. **Crank position sensor connector [79]**
4. **Wiring frame clip**

Figure 2-18. Left Side Wiring Connectors (typical)

31. Loosen and remove cross member fasteners holding the bottom of the radiator/oil cooler assembly on both sides.
32. Put radiator/oil cooler assembly forward at the bottom. Separate oil lines from crankcase (oil in) and oil filter (oil out) fittings. See 6.7 OIL LINE FITTINGS.
33. Remove radiator/oil cooler assembly. See 6.8 RADIATOR/OIL COOLER.
34. Remove engine coolant pipes. See 6.6 COOLANT PIPES AND HOSES.

NOTE

Dispose of antifreeze in accordance with local regulations.

35. Remove drive sprocket cover.

NOTE

Remove debris deflector/belt guard, if required, for clearance. See 2.43 BELT GUARD/DEBRIS DEFLECTOR.

36. See Figure 2-21. Loosen retaining bolts (3) holding drive sprocket (1) to sprocket mounting flange.

NOTE

Do not remove the output shaft flange nut (4).

37. Remove snap ring and loosen rear wheel axle nut. Move wheel forward and slip belt off wheel sprocket. Pull belt off of drive sprocket.
38. See Figure 2-21. Remove retaining bolts (3) from drive sprocket. Discard bolts (3).
39. Rotate sprocket (1) to fit spoke pattern of mounting flange (2) and remove sprocket (1).
40. Remove secondary clutch actuator cover and secondary clutch actuator. See 2.19 SECONDARY CLUTCH ACTUATOR.

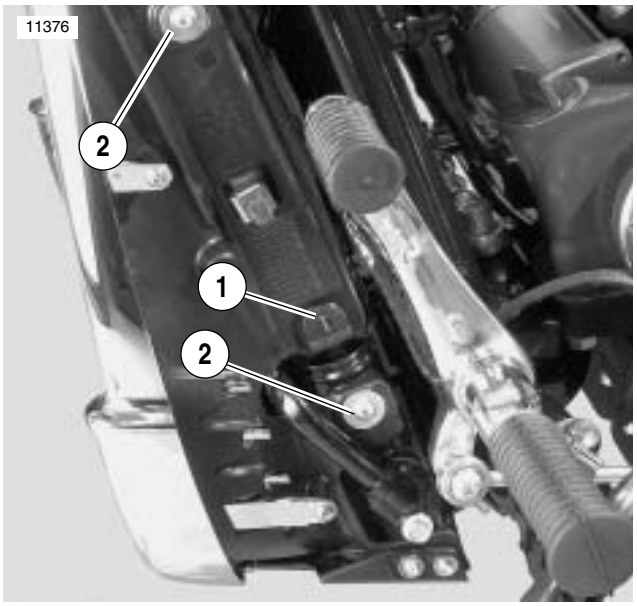
NOTE

It is not necessary to loosen flare nut or to remove clutch fluid line from the secondary clutch actuator. Allow secondary clutch actuator to hang from clutch fluid line.

41. At front of engine, pull back solenoid cable protective boot from starter post and loosen and remove nut. Remove solenoid cable terminal ring. See 5.4 STARTER.
42. Remove nuts holding starter solenoid to frame and pull solenoid off of frame studs. See 5.5 STARTER SOLENOID.

NOTE

To avoid strain on solenoid green and black wire leads, locate connector under left side cover and press on release square to separate connector halves.



1. **Drain plug**
2. **Cover fastener and washer**

Figure 2-19. Radiator Cover Left Side (typical)

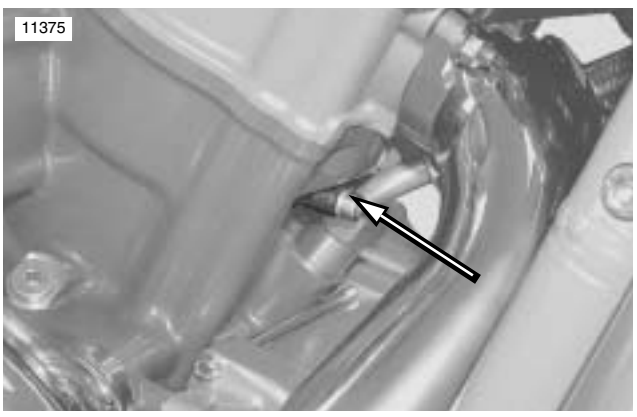
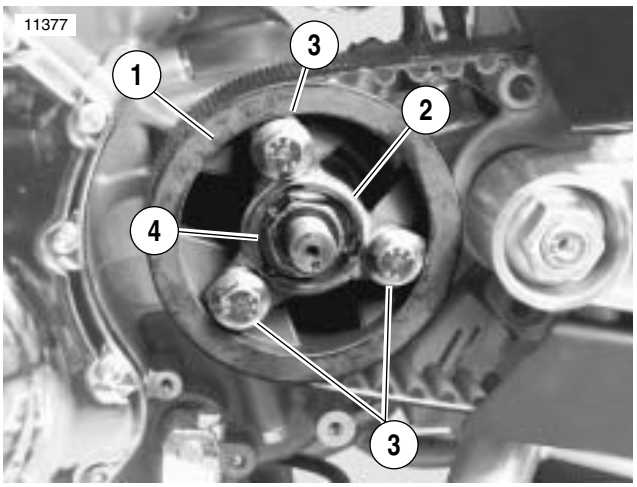


Figure 2-20. Front Cylinder Coolant Drain Plug



1. **Drive sprocket**
2. **Sprocket mounting flange**
3. **Retaining bolt**
4. **Drive sprocket flange nut**

Figure 2-21. Drive Sprocket

NOTE

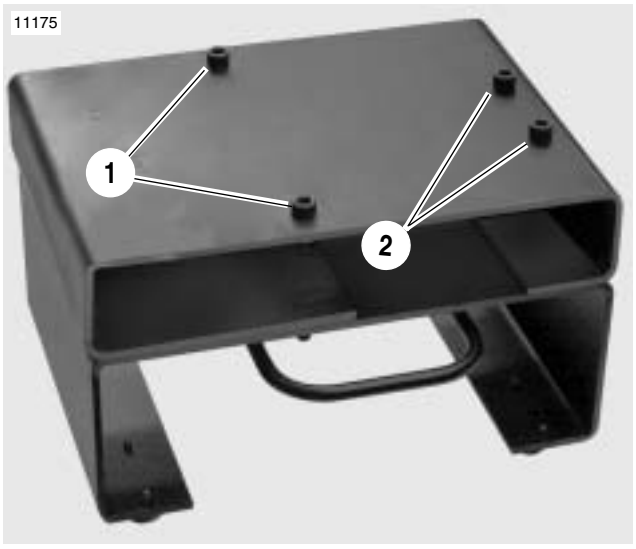
If performing this procedure on a VRSCR model, use HD-45317-10 with HD-45317.

43. See Figure 2-22. Jack up motorcycle and position ENGINE ASSEMBLY SUPPORT FIXTURE (Part No. HD-45317)under engine. Align the two hex socket-head bolts (2) at rear of fixture with mounting screw detents at bottom rear of oil pan. Align the two separated hex head bolts (1) on each side of front of fixture with corresponding mounting screw detents on sides of oil pan. Using scissors jack, lower motorcycle until engine oil pan screw detents rest on hex socket-head bolts.
44. Remove nut and travel limiting washer from center engine mount bolt. Remove center mounting bolt.
45. Remove fasteners holding front engine mount bracket to engine.
46. Remove upper radiator studs securing frame engine mount bracket to frame. Pull front engine mount assembly forward through frame rails.
47. Remove stabilizer link bolt from frame bracket. See 2.5 FRONT ENGINE MOUNT.

NOTE

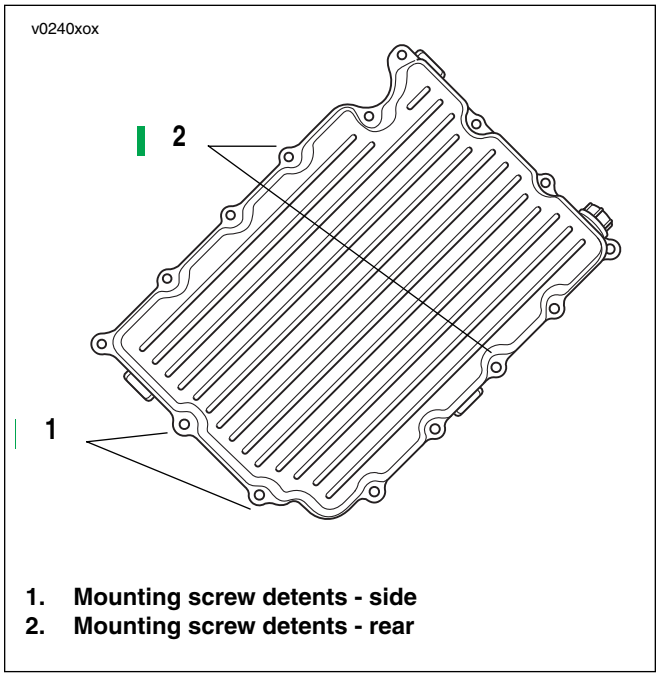
Maintain stabilizer link length for reinstallation. Do not loosen jam nuts on stabilizer link.

48. Remove rear fork pivot nut and slide out pivot shaft. Rear fork can be left in place.
49. Loosen fasteners holding rear engine mount bracket. See 2.9 REAR ENGINE MOUNTS.
50. Remove shifter linkage from engine shifter arm on transmission.
51. Remove engine ground cable from frame.
52. Remove lower left frame rail and stabilizer link attached. See 2.4 FRAME/LOWER FRAME RAILS.



1. **Hex socket-head bolt- side**
2. **Hex socket-head bolt- rear**

Figure 2-22. Engine Assembly Support Fixture Alignment (shown with ENGINE SUPPORT FIXTURE SPACER (HD-45317-10) (VRSCR ONLY)



1. **Mounting screw detents - side**
2. **Mounting screw detents - rear**

Figure 2-22. Engine Assembly Support Fixture Alignment (shown with ENGINE SUPPORT FIXTURE SPACER (HD-45317-10) (VRSCR ONLY)

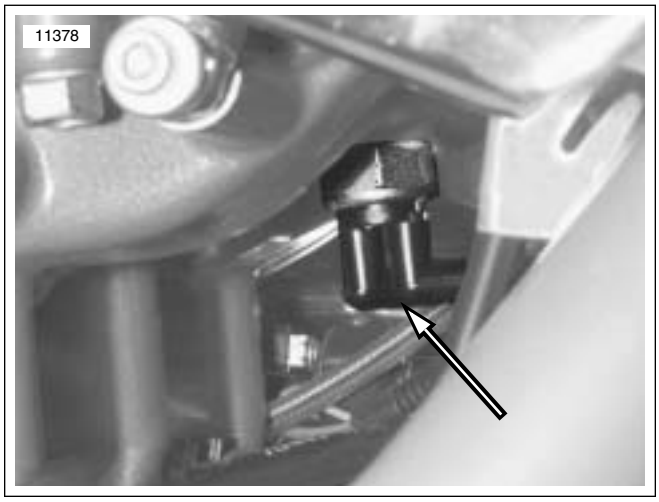


Figure 2-23. Neutral Light Sender Connectors [131]

CAUTION

Do not push on the engine to move the engine. Support the engine and pull on the fixture handles. Failure to transport engine properly can result in engine falling from stand and causing injury or damage to engine.

53. With engine resting in ENGINE ASSEMBLY SUPPORT FIXTURE (HD-43517), gently pull on handles to work engine partially out of left side of frame.
54. See Figure 2-23. Pull connectors to neutral light sender [131] under drive sprocket.

NOTE

The neutral light sender stays in the engine.

55. Pull purge solenoid hose off of charcoal canister (California models only).
56. See Figure 2-24. Pull connectors from stoplamp switch [121] for VRSCA models.
57. See Figure 2-25. Pull connectors from stoplamp switch [121] for VRSCD, VRSCR models.
58. Pull electrical harness to stoplamp switch and purge solenoid hose (California models only) through top of the cavity in engine cases.
59. See Figure 2-26. Disconnect vehicle speed sensor wire from connector [65] at top of frame under relay block and pull wire and connector down out of frame.

NOTE

The vehicle speed sensor and wire connector [65] stay attached to the engine.

60. With fixture handles, pull engine out of frame onto left side extension.
61. See Figure 2-27. Engine may be secured with straps for hoisting.

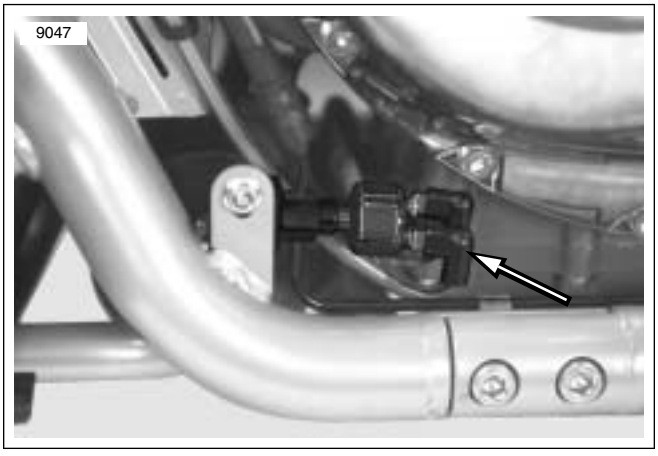


Figure 2-24. Stoplamp Switch Connectors (VRSCA) [121]

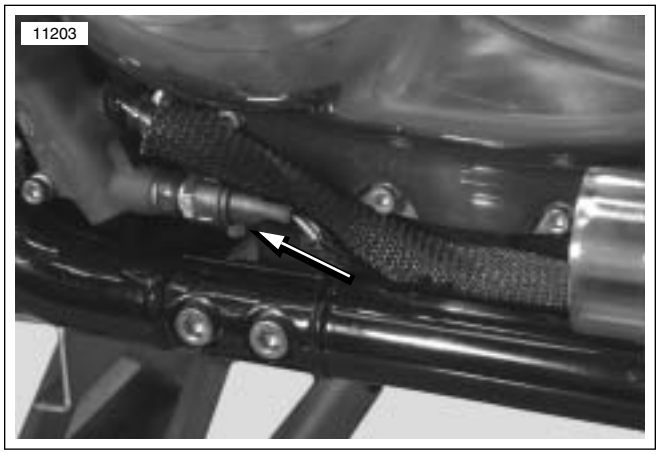


Figure 2-25. Stoplamp Switch Connectors (VRSCD, VRSCR) [121]

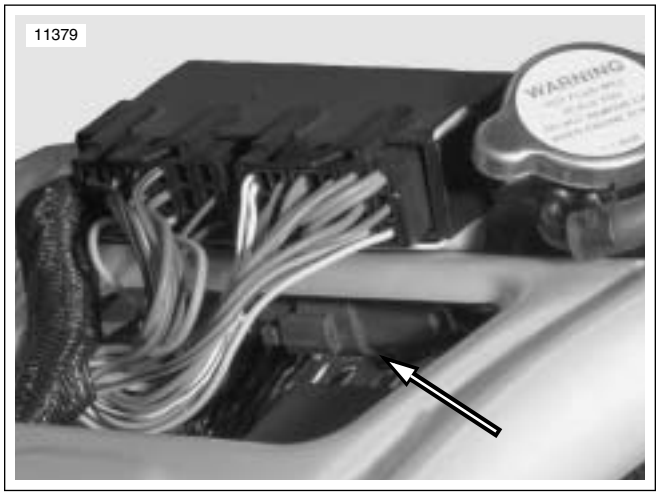


Figure 2-26. Vehicle Speed Sensor Connector [65]

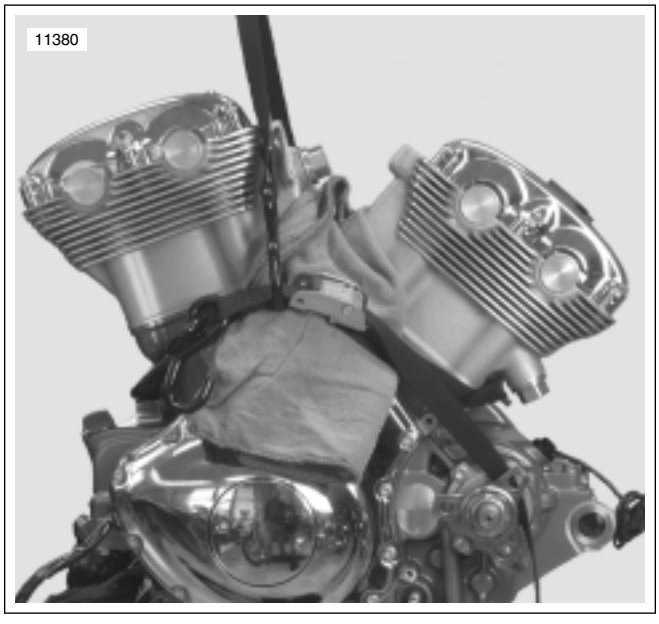


Figure 2-27. Engine Strapped for Hoisting

INSTALLATION

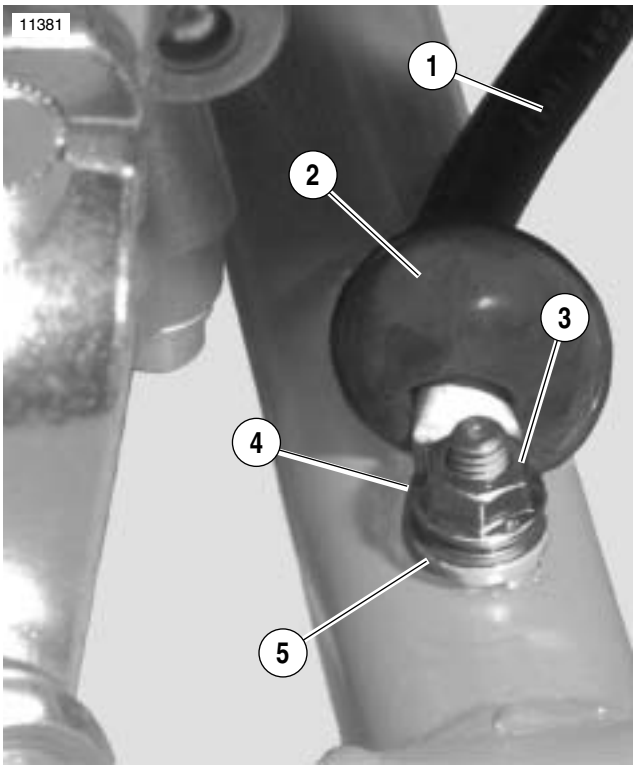
PART NO.	SPECIALTY TOOL
HD-45317	Engine assembly support fixture

1. Verify VIN of replacement engine.
2. Check replacement/overhauled engine for:
   a. Vehicle speed sensor and wiring.
   b. Neutral sending switch.
   c. Ground cable.
3. Verify that engine wiring harness is connected to:
   a. Manifold air pressure sensor [80].
   b. Intake air temperature sensor [89].
   c. Coolant temperature sensor [90].
   d. Oil pressure sending unit [120].
   e. Injector connectors [84, 85].
4. Check oil filter tightness. See 1.3 AIRBOX AND AIR FILTER.
5. Install rear engine mount in left side frame weldment. Pull engine partially into frame capturing left rear engine mount.

NOTE

The left rear fork pivot shaft spacer is inserted into the engine mount. Verify that the pivot shaft spacer is in position before installing the pivot shaft.

6. With engine oil pan screw detents resting on hex socket-head bolts of the ENGINE ASSEMBLY SUPPORT FIXTURE (HD-45317), pull engine into frame with fixture handles.
7. Thread stoplamp electrical wires and connectors and purge solenoid hose (California models only) through cavity in engine cases.
8. See Figure 2-25. Push on stoplamp switch wires.
9. Push purge solenoid hose onto charcoal canister (California models only).
10. See Figure 2-28. Fasten ground cable (1) terminal ring (4) with washer (5) to frame. Tighten to 6-10 Nm (53-88 **in-lbs**) and reinstall rubber boot.
11. See Figure 2-23. Push on neutral light sender wires.
12. See Figure 2-26. Thread vehicle speed sender connector [65] wire up through frame and connect to wiring harness.
13. Install rear engine mounting bracket and engine mount to right side frame weldment. Thread mounting bolts with narrow washers through bracket into frame bosses.
14. Raise or lower frame with scissor jack to align pivot shaft bores of rear fork to rear engine mounts and engine case mounting bosses. Apply LOCTITE® ANTI-SEIZE and slide in rear fork pivot shaft.
15. Apply LOCTITE® 243 (blue) to threads of pivot shaft nut.
16. Install upper engine mounting bracket to engine with fasteners and engine mounting bracket to frame with double threaded studs.
17. Install left frame rail with stabilizer link.



1. **Ground cable**
2. **Boot (pulled back from nut)**
3. **Nut**
4. **Terminal ring**
5. **Washer**

Figure 2-28. Ground Cable Installation

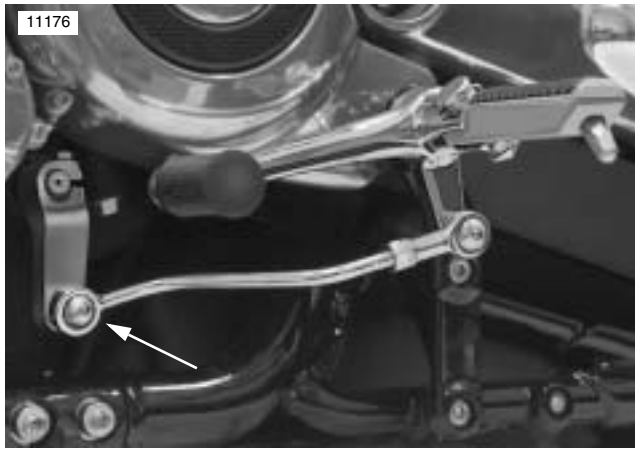
18. Assemble spacer and stabilizer link and thread into crankcase.
19. Tighten fasteners in following order:
    a. Pivot shaft nut to 61-75 Nm (45-55 ft-lbs).
    b. Rear engine mount bracket fasteners (including stabilizer link fasteners) to 34-41 Nm (25-30 ft-lbs).
    c. Front engine mount fasteners to 34-41 Nm (25-30 ft-lbs).
    d. Lower frame rail fasteners to 61-75 Nm (45-55 ft-lbs).
    e. Engine crankcase end of stabilizer link to 34-41 Nm (25-30 ft-lbs).

20. See Figure 2-29. Install shifter arm perpendicular to frame rail for correct operation. Tighten clamp bolt to 14-16 Nm (11-12 ft-lbs).
21. If removed, attach shifter linkage to shifter arm and tighten to 9-15 Nm (80-132 **in-lbs**).
22. Install starter solenoid to frame posts. If separated, mate black and green wire lead connectors [128].
23. Install solenoid cable terminal ring to starter post.
24. Tighten solenoid fasteners to the following torques:
    a. Solenoid cable terminal ring to starter post to 6-10 Nm (53-88 **in-lbs**).
    b. Starter solenoid to frame posts to 6-10 Nm (53- 88 **in-lbs**).
    c. Install secondary clutch actuator onto clutch cover.
25. Install exhaust system. See 2.8 EXHAUST SYSTEM (VRSCD/VRSCR).
26. Install drive sprocket by matching spokes of drive sprocket to open spaces of mounting flange and rotating sprocket to align sprocket bolt holes behind mounting flange bolt holes.
27. Install and tighten three **new** locking bolts to 88-102 Nm (65-75 ft-lbs).
28. Route drive belt over wheel sprocket and drive sprocket.
29. If removed, install and belt guard and debris deflector. See 2.43 BELT GUARD/DEBRIS DEFLECTOR.
30. Adjust drive belt. See 1.15 REAR BELT DEFLECTION.

⚠WARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)

31. Tighten axle nut to 190-203 Nm (140-150 ft-lbs) and install snap ring.
32. Install belt drive sprocket cover. Tighten cover fasteners to 6-10 Nm (53-88 **in-lbs**). If necessary, install debris deflector and belt guard.
33. Install engine coolant pipes and hoses. Fasten p-clamp to cylinder head, pipe clamp, and worm drive clamps to both coolant pipe hoses. See 6.6 COOLANT PIPES AND HOSES.



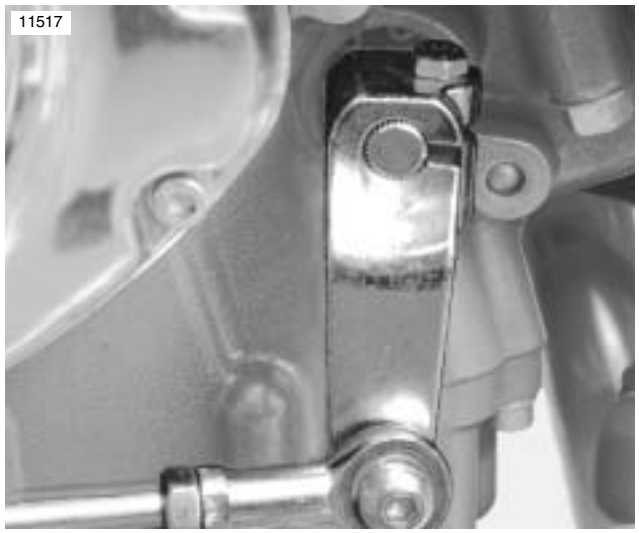


Figure 2-29. Shifter Arm Perpendicular to Frame Rail (VRSCD, VRSCR top, VRSCA bottom)

34. Fit radiator/oil cooler assembly to top mounting studs. Fit coolant out and in hoses to radiator beaded pipes. See 6.8 RADIATOR/OIL COOLER.
35. Install oil line quick connects to crankcase and oil filter mount oil fittings. See 6.7 OIL LINE FITTINGS.
36. Push radiator/oil cooler assembly mounting pins and grommets into cross member. Thread cross member mounting bolts into frame.

NOTE

Route hose to remote rear brake reservoir behind brake pedal above the clevis pin before installing cross member. Be sure remote hose is not pinched during installation of radiator/oil cooler assembly and cross member.

37. Tighten cooling system fasteners:
    a. Cross member fasteners to 20-26 Nm (15-19 ft-lbs).
    b. Top mounting flange nuts to 19-27 Nm (15-20 ft-lbs).
    c. Pipe clamp to 6.5 Nm (57 **in-lbs**).
    d. Pipe connecting clamp to 6-10 Nm (53-88 **in-lbs**).
    e. P-clamp to 6-10 Nm (53-88 **in-lbs**).
    f. Hose worm drive clamps to 3-4 Nm (27-35 **in-lbs**).
    g. Install clutch actuator cover.
38. Route drain hose to overflow bottle.
39. Install radiator cover. See 6.8 RADIATOR/OIL COOLER.

40. See Figure 2-18. Connect:
    a. Crank position sensor connector [79] (3).
    b. Top and bottom cooling fan connectors [97T] [97B] (2).
    c. Stator to voltage regulator connector [46] (1).
    d. Wiring frame clip (4).
41. Push rear brake fluid reservoir onto radiator cover and install both lower radiator trim covers. See 6.8 RADIATOR/OIL COOLER.
42. Install throttle body/cables:
    a. For replacement engines: Insert throttle cable barrels into throttle cam, route cable around throttle cam and insert cable housing in cable guides. Adjust cables. See 1.23 THROTTLE CABLES.
    b. For engine overhaul: Install throttle body and tighten clamps to 1.25 Nm (11 **in-lbs**).
43. See Figure 2-17. Connect:
    a. Front (2) and rear coils [83F] [83R].
    b. Main engine harness [45] (7).
    c. Throttle position sensor [88] (4).
    d. Idle speed control actuator [87] (5).
    e. Regulator ground (3).
44. Install horn to rubber grommet and bracket on engine. Connect horn wire to main harness. See 8.29 HORN.
45. Connect GND 2 (9), GND 1 (8) and horn ground wire (10) to rear engine cylinder head.
46. Connect negative battery copper L-bracket and cable to front cylinder head.
47. Install air filter bottom, velocity stacks, O-rings, breather hose, threaded air filter hold down rod, and air filter. See 1.3 AIRBOX AND AIR FILTER.
48. Fill engine with oil. See CHANGING OIL AND FILTER under 1.7 ENGINE OIL AND FILTER.
49. Open radiator air bleed plug and fill cooling system with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through coolant pressure cap. See 6.3 ENGINE COOLANT.
50. Tighten radiator air bleed plug to 9-11 Nm (80-97 **in-lbs**).

⚠WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

51. Connect positive battery cable to battery, cover with boot and then connect negative battery cable to battery. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
52. With the spark plugs removed, use the starter to turn the engine over to prime the engine with oil. The engine oil pressure indicator lamp should not illuminate. See 3.5 OIL PRESSURE.
53. Install air filter, air filter top and airbox cover.
54. Close seat
55. Install maxi-fuse and right side cover.
56. Test ride motorcycle and adjust as required.

JIFFY STAND (VRSCA/VRSCD) 2.11

CLEANING

WARNING

The jiffy stand locks when placed in the full forward (down) position with vehicle weight on it. If the jiffy stand is not in the full forward (down) position with vehicle weight on it, the vehicle can fall over which could result in death or serious injury. (00006a)

WARNING

Always park motorcycle on a level, firm surface. An unbalanced motorcycle can fall over, which could result in death or serious injury. (00039a)

WARNING

Be sure jiffy stand is fully retracted before riding. If jiffy stand is not fully retracted, it can contact the road surface causing a loss of vehicle control, which could result in death or serious injury. (00007a)

1. Block motorcycle underneath frame so both wheels are raised off ground.
2. See Figure 2-35. Inspect leg stop and lock slot in jiffy stand weldment. If covered or plugged with dirt, wipe dirt off with a shop towel and spray catch and mating surface with LOCTITE® AEROSOL ANTI-SEIZE.
3. Move jiffy stand leg forward and back while spraying anti-seize to infuse LOCTITE® AEROSOL ANTI-SEIZE into mating parts.
4. Lubricate jiffy stand with LOCTITE® LUBRIPLATE.
5. Check condition of rubber bumper.

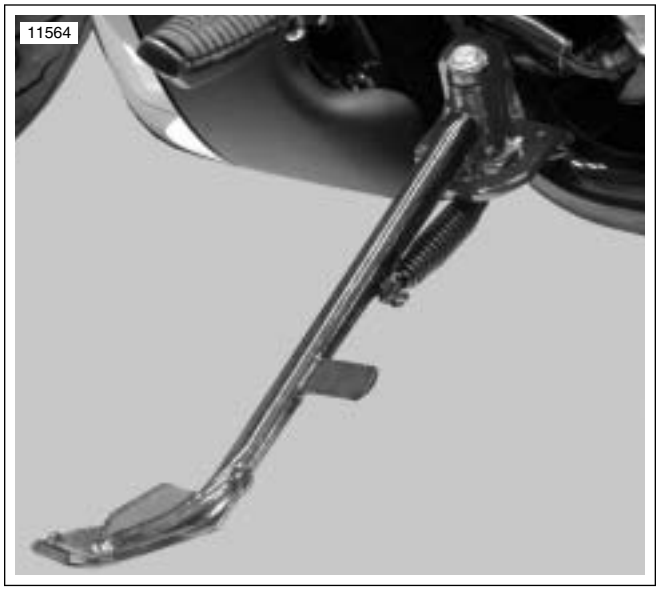


Figure 2-30. Jiffy Stand

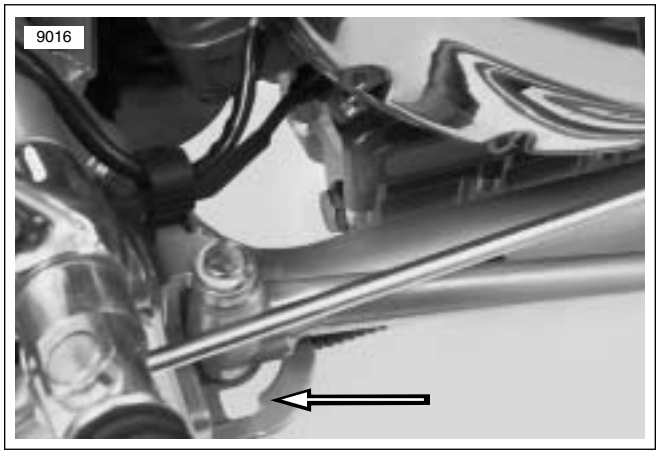


Figure 2-31. Jiffy Stand Catch and Lock Slot

REMOVAL

⚠WARNING

Failure to support motorcycle with proper blocking equipment could result in death or serious injury.

1. Block motorcycle underneath frame so both wheels are raised off ground. Jiffy stand should be able to move through its full range of travel without the weight of motorcycle resting on it.
2. See Figure 2-33. Remove cotter pin (3) from clevis pin (2).

⚠WARNING

Wear gloves and protective eyeglasses (or face shield) when performing the following procedure. The jiffy stand spring tension could cause the spring, attached components and/or hand tools to fly outward at great speed and could cause death or serious injury.

3. With leg in the retracted position, detach spring (6) from jiffy stand leg (5), and anchor (7).
4. Remove clevis pin (2) by gently tapping on pin from bottom to drive pin up through mounting bracket.
5. Pull out jiffy stand leg and remove upper and lower bushings.
6. Loosen and remove the anchor (7).
7. Remove rubber bumper (1), if necessary.

NOTE

Jiffy stand brackets can be replaced by replacing the left lower frame rail. See 2.4 FRAME/LOWER FRAME RAILS.

INSTALLATION

⚠WARNING

Wear gloves and protective eyeglasses (or face shield) when performing the following procedure. The jiffy stand spring tension could cause the spring, attached components and/or hand tools to fly outward at great speed and could cause death or serious injury.

1. See Figure 2-33. Apply LOCTITE® 243 (blue) to anchor (7). Install and tighten anchor to 7-9 Nm (62-79 **in-lbs**).
2. Apply LOCTITE® AEROSOL ANTI-SEIZE to both bushings (4) and install bushings in position for a retracted leg.
3. Orient leg retracted in mounting bracket, and install **new** clevis pin (2) through the upper bushing (4), leg (5), and lower bushing (4).
4. Install **new** cotter pin (3).
5. Attach spring (6) to the anchor and to jiffy stand leg (5). When properly installed, spring open hook on anchor faces outward and open hook on jiffy stand leg faces down when jiffy stand leg is extended.
6. Replace rubber bumper (1) if required.
7. Check that jiffy stand operates correctly before supporting the weight of the motorcycle on the leg.

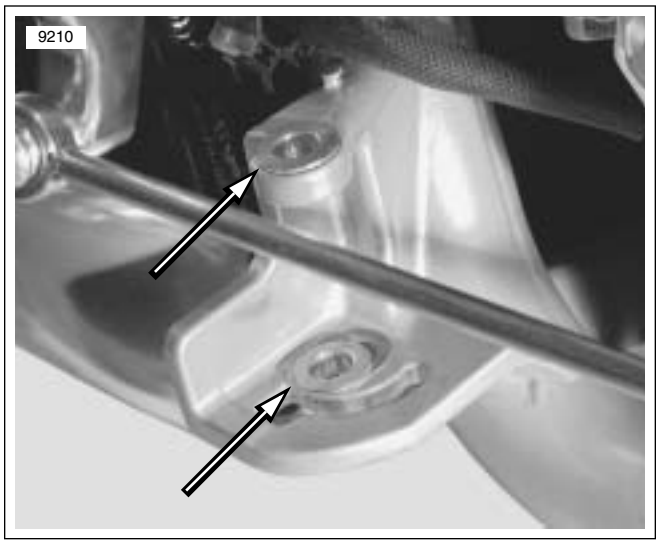
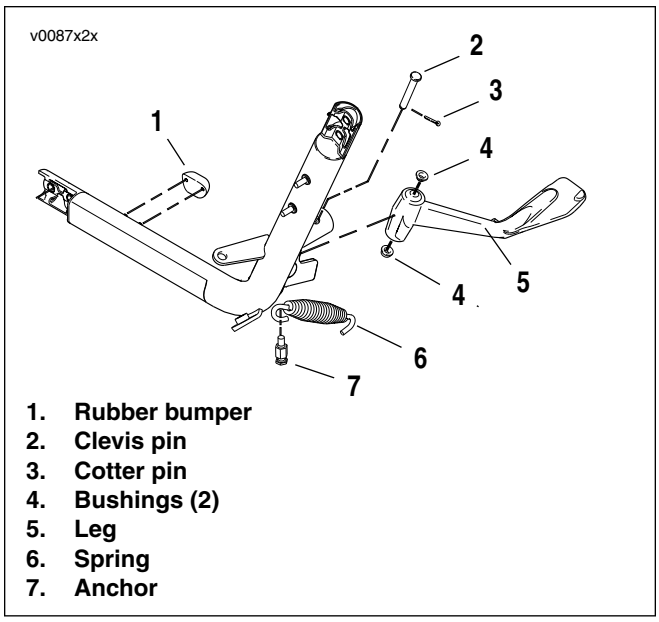


Figure 2-32. Bushings in Retracted Position



1. **Rubber bumper**
2. **Clevis pin**
3. **Cotter pin**
4. **Bushings (2)**
5. **Leg**
6. **Spring**
7. **Anchor**

Figure 2-33. Jiffy Stand Components (typical)

JIFFY STAND (VRSCR) 2.12

CLEANING

⚠WARNING

The jiffy stand locks when placed in the full forward (down) position with vehicle weight on it. If the jiffy stand is not in the full forward (down) position with vehicle weight on it, the vehicle can fall over which could result in death or serious injury. (00006a)

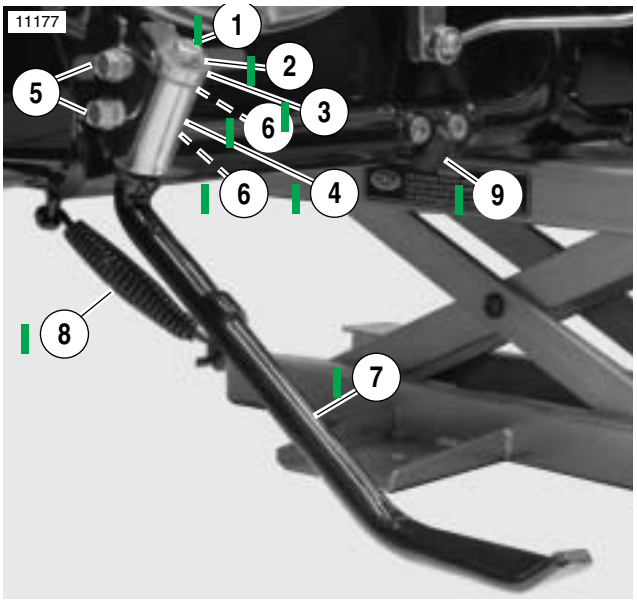
⚠WARNING

Always park motorcycle on a level, firm surface. An unbalanced motorcycle can fall over, which could result in death or serious injury. (00039a)

⚠WARNING

Be sure jiffy stand is fully retracted before riding. If jiffy stand is not fully retracted, it can contact the road surface causing a loss of vehicle control, which could result in death or serious injury. (00007a)

1. Block motorcycle underneath frame so both wheels are raised off ground.
2. See Figure 2-35. Inspect jiffy stand catch and lock slot in jiffy stand weldment. If covered or plugged with dirt, wipe dirt off with a shop towel and spray catch and mating surface with LOCTITE® AEROSOL ANTI-SEIZE.
3. Move jiffy stand forward and back while spraying anti-seize to infuse LOCTITE® AEROSOL ANTI-SEIZE into mating parts.
4. Lubricate jiffy stand with LOCTITE® LUBRIPLATE.
5. Check condition of rubber bumper.



1. **Fastener**
2. **Washer**
3. **Jiffy stand catch**
4. **Jiffy stand bracket**
5. **Bracket fasteners (2)**
6. **Bracket nuts (2)**
7. **Jiffy stand**
8. **Spring**
9. **Rubber Bumper**

Figure 2-34. Jiffy Stand

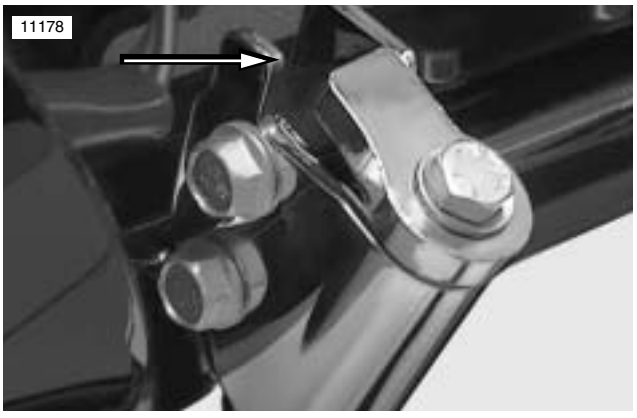


Figure 2-35. Jiffy Stand Catch and Lock Slot

REMOVAL

⚠WARNING

Failure to support motorcycle with proper blocking equipment could result in death or serious injury.

1. Block motorcycle underneath frame so both wheels are raised off ground. Jiffy stand should be able to move through its full range of travel without the weight of motorcycle resting on it.
2. See Figure 2-34. Remove spring (8).

⚠WARNING

Wear gloves and protective eyeglasses (or face shield) when performing the following procedure. The jiffy stand spring tension could cause the spring, attached components and/or hand tools to fly outward at great speed and could cause death or serious injury.

3. Remove fastener (1) and washer (2) and remove jiffy stand (7) from jiffy stand bracket (4).
4. Remove bracket fasteners (5) and bracket nuts (6) from jiffy stand bracket and remove jiffy stand bracket from frame.
5. Remove rubber bumper (9), if necessary.

NOTE

Jiffy stand frame mounting boss can be replaced by replacing the left lower frame rail. See 2.4 FRAME/LOWER FRAME RAILS.

INSTALLATION

⚠WARNING

Wear gloves and protective eyeglasses (or face shield) when performing the following procedure. The jiffy stand spring tension could cause the spring, attached components and/or hand tools to fly outward at great speed and could cause death or serious injury.

1. See Figure 2-34. Install jiffy stand bracket (4) and insert jiffy stand fasteners (5) and nuts (6). Tighten to 20-26 Nm (15-19 ft-lbs).
2. Insert jiffy stand (7) from bottom of jiffy stand bracket and install washer (2) and install fastener (1). Tighten to 20-26 Nm (15-19 ft-lbs).
3. Orient jiffy stand to retracted position and install spring (8).
4. Verify proper operation and locking of jiffy stand before applying weight of motorcycle.

FOOTRESTS/FOOT CONTROLS (VRSCA) 2.13

RIDER FOOTRESTS

Removal

1. With motorcycle in neutral, remove fastener from shift linkage to foot shift lever.
2. See Figure 2-36. Remove retaining ring (1) from clevis pin (4) holding left side footrest (3) to footrest axle (7). Remove clevis, footrest, and spring washer (5).

NOTE

Shift lever toe peg unthreads from shift lever. Remove and replace as required.

3. Remove retaining bolt (9) holding left side footrest axle (7) to frame. Remove footrest axle (7) and foot shift lever (8).
4. Remove left side radiator cover.
5. Remove the cotter key from the clevis pin connecting brake pedal (10) to master cylinder brake rod.
6. Cover outside face of clevis pin with cardboard and using a large pliers, squeeze pin until pin shoulder pops out of interference fit in the clevis. Remove clevis pin and brake rod.
7. Remove retaining ring (1) from clevis pin (4) holding right side footrest (3) to footrest axle (7). Remove clevis, footrest, and spring washer.
8. Remove retaining bolt (9) holding right side footrest axle (7) to frame. Pull footrest axle (7) from frame and rear brake pedal (10).

Installation

1. See Figure 2-36. Install left side footrest axle (7) and foot shift lever (8). Tighten retaining bolt to 11-17 Nm (9-12 ft-lbs).
2. Install fastener holding shift linkage to foot shift lever (8). Tighten to 9-15 Nm (7-11 ft-lbs).

⚠WARNING

Footpegs must fold upward and rearward. This will allow footpeg to fold, if by accident, it strikes ground surface when making a sharp turn. Failure to set footpeg to the proper fold-up angle could result in death or serious injury.

3. Orient footrest (3) to fold upwards on contact with ground.
4. Install clevis pin (4) through left side footrest axle (7), footrest (3), and spring washer (5). Secure with a **new** retaining ring (1).
5. Install right side footrest axle (7) through rear brake pedal (10). Using LOCTITE® 243 (blue), thread in and tighten retaining bolt to 11-17 Nm (9-12 ft-lbs).
6. Install clevis pin (4) through right side footrest axle (7), footrest (3), and spring washer (5). Secure with a **new** retaining ring (1).
7. Install clevis pin through rear brake pedal clevis and master cylinder brake rod.
8. Cover the face of clevis pin and clevis with cardboard. Holding the brake pedal (10) firmly, tap on a rod to seat shoulder of clevis pin into clevis. Install **new** cotter pin.

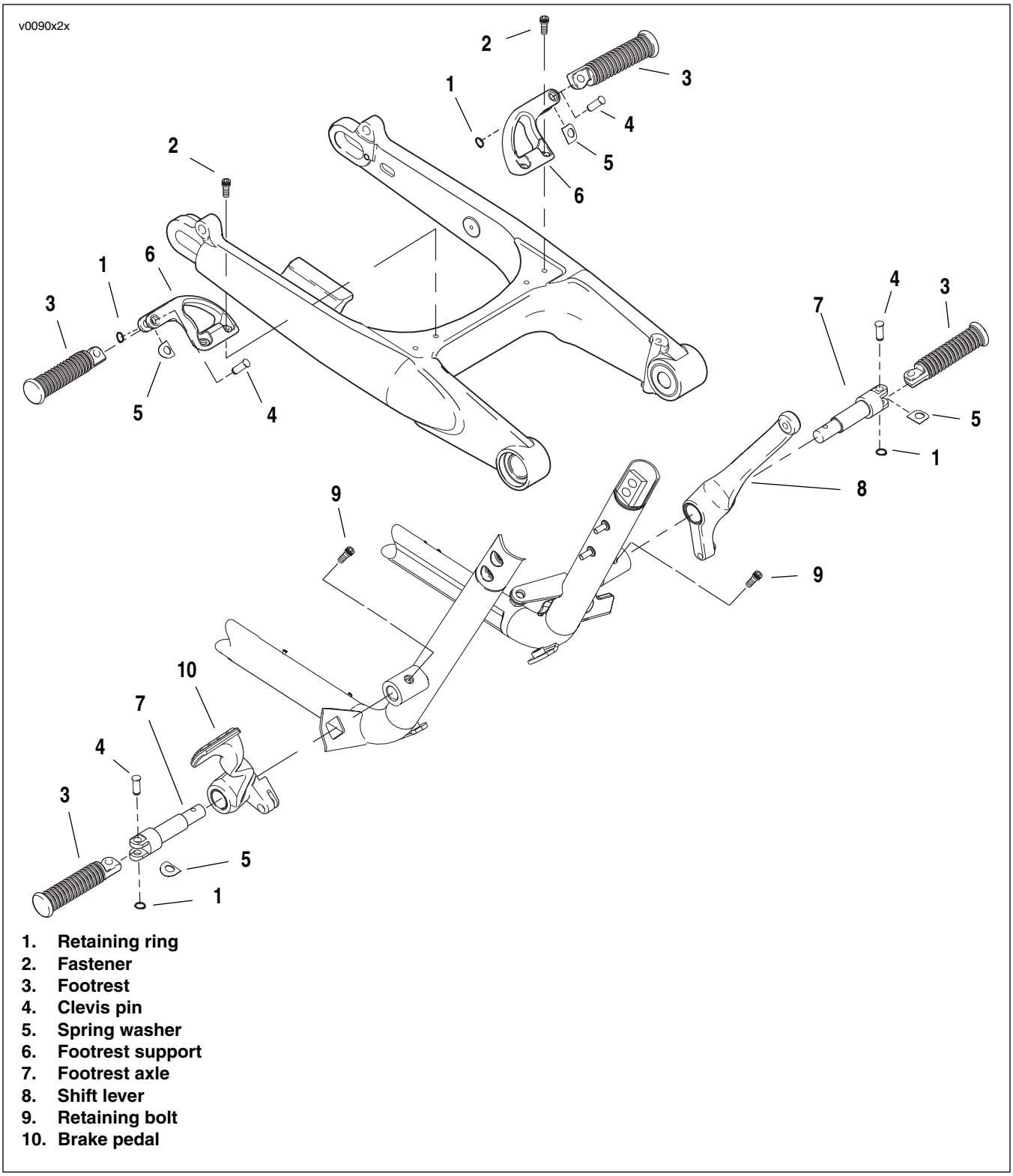
PASSENGER FOOTRESTS

Removal

1. See Figure 2-36. Remove the retaining ring (1) from the clevis pin (4) holding the footrest (3) to the footrest support (6). Remove the clevis pin, footrest, and spring washer (5).
2. Loosen and remove the two fasteners (2) holding the footrest support (6) to the rear fork. Remove the footrest support.
3. Repeat for opposite side passenger footrest assembly.

Installation

1. See Figure 2-36. Mount the footrest support (6) to the rear fork. Tighten the two fasteners (2) to 19-27 Nm (14-20 ft-lbs).
2. Orient footrest (3) to fold upwards on contact with ground.
3. Install clevis pin (4) through the support (6), footrest (3), and spring washer (5). Secure with a **new** retaining ring (1).
4. Repeat for the opposite side passenger footrest assembly.



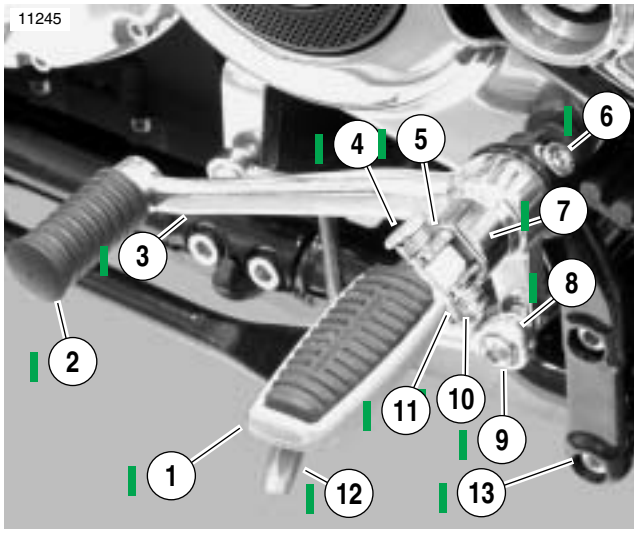
1. Retaining ring
2. Fastener
3. Footrest
4. Clevis pin
5. Spring washer
6. Footrest support
7. Footrest axle
8. Shift lever
9. Retaining bolt
10. Brake pedal

Figure 2-36. Rider and Passenger Foot Rests

RIDER FOOTRESTS

Rider Left Side Footrest and Control Removal

1. Remove maxi-fuse and place motorcycle in neutral.



1. **Footrest**
2. **Shift lever toe peg**
3. **Shift lever**
4. **Clevis pin**
5. **Spring**
6. **Capscrew**
7. **Footrest bracket**
8. **Shift linkage**
9. **Capscrew**
10. **Retaining clip**
11. **Washer**
12. **Wear peg**
13. **Frame bracket**

Figure 2-37. Left Footrest and Control assembly

2. See Figure 2-37. To remove left side footrest (1), remove retaining clip (10), washer (11), clevis pin (4) and remove footrest from footrest bracket (7).

NOTES

Shift lever toe peg unthreads from shift lever. Remove and replace as required.

Do not disturb the adjustment on the shift linkage during disassembly or assembly to ensure proper shifting.

Wear peg unthreads from end of footrest. Remove and replace as required.

3. To remove footrest and control as a unit, remove capscrew (9), disconnect shift linkage (8), remove capscrew (6) and remove footrest/control assembly from motorcycle.

Rider Left Side Footrest and Control Installation

1. See Figure 2-37. To install left side footrest, (1), insert footrest into footrest bracket (7), insert clevis pin (4), install washer (11), spring (5), and **new** retaining clip (10).
2. To install footrest and control as a unit, insert footrest/control assembly into frame bracket (13) apply LOCTITE® 243 and install capscrew (6) tighten to 30-35 Nm (22-26 ft-lbs).
3. Attach shift linkage (8) to shift lever (3), apply LOCTITE® 243 and install capscrew (9). Tighten to 9-15 Nm (7-11 ft-lbs).

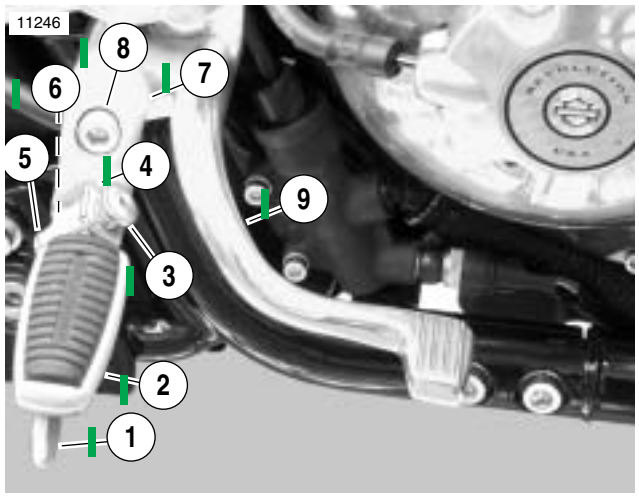
⚠WARNING

Footpegs must fold upward and rearward. This will allow footpeg to fold, if by accident, it strikes ground surface when making a sharp turn. Failure to set footpeg to the proper fold-up angle could result in death or serious injury.

4. Verify footpeg function
5. Verify shifting.
6. Install maxi-fuse.

Rider Right Side Footrest and Control Removal

1. Remove maxi-fuse and place motorcycle in neutral.



1. **Wear peg**
2. **Footrest**
3. **Clevis pin**
4. **Spring**
5. **Retaining clip**
6. **Washer**
7. **Footrest bracket**
8. **Capscrew**
9. **Brake pedal**

Figure 2-38. Right Footrest and Control Assembly

2. See Figure 2-38. To remove right side footrest, remove retaining clip (5), washer (6), clevis pin (3) and spring (4). Pull footrest (2) from footrest bracket (7).

NOTE

Wear peg unthreads from end of footrest. Remove and replace as required.

3. See Figure 2-39. Remove master cylinder brake pedal clip
4. Remove footrest and control as a unit by removing capscrew (7) from footrest bracket (8).
5. Slowly pull footrest/control assembly away from motorcycle working master cylinder rod free from brake pedal (9).

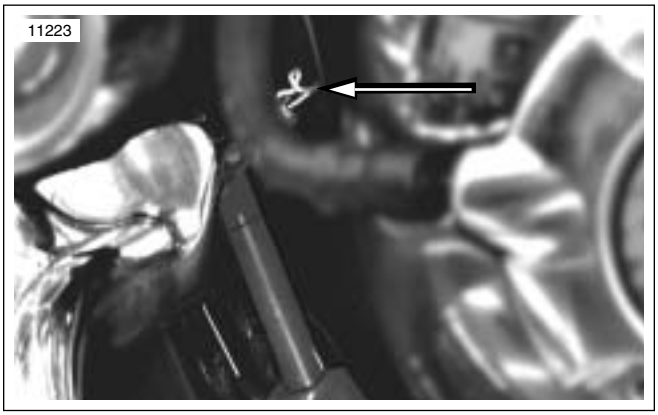


Figure 2-39. Master Cylinder Brake Pedal Clip

Rider Right Side Footrest and Control Installation

1. See Figure 2-38. To install right side footrest, (2), insert footrest into footrest bracket (7), insert clevis pin (3), install washer (6), spring (4) and **new** retaining clip (5).
2. To install footrest and control as a unit, position brake pedal (9) to motorcycle and insert master cylinder rod into brake pedal.
3. See Figure 2-39. Install master cylinder brake pedal clip.

NOTE

Make sure master cylinder brake clip is completely seated.

4. See Figure 2-38. Install footrest assembly with footrest bracket (7) to motorcycle. Apply 243 LOCTITE® and install capscrew (8). Tighten to 34-41 Nm (25-30 ft-lbs).

⚠WARNING

Footpegs must fold upward and rearward. This will allow footpeg to fold, if by accident, it strikes ground surface when making a sharp turn. Failure to set footpeg to the proper fold-up angle could result in death or serious injury.

5. Verify footpeg function.
6. Verify brake pedal function.
7. Install maxi-fuse.

PASSENGER FOOTRESTS

Passenger Left Side Footrest Removal

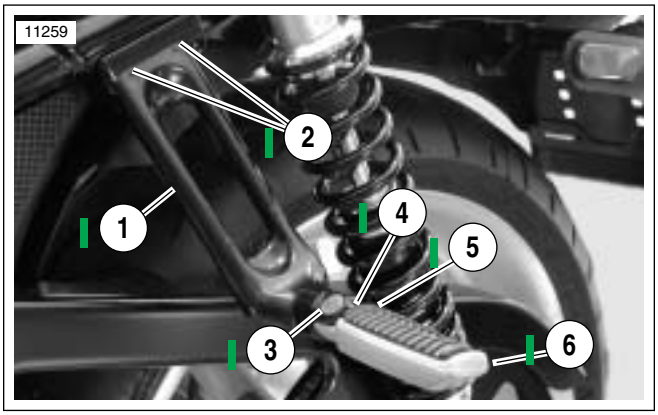
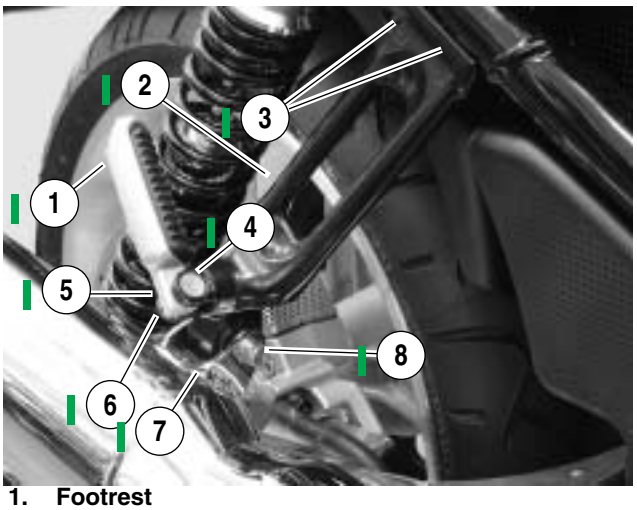


Figure 2-40. Left Aide Footrest Assembly

1. See Figure 2-40. To remove left side footrest, remove retaining clip (5), clevis pin (3), spring washer (4), and footrest (6).
2. To remove left side footrest bracket, remove socket head capscrews (2) and remove bracket (1).

Passenger Right Side Footrest Removal



1. **Footrest**
2. **Footrest bracket**
3. **Socket head capscrews (2)**
4. **Clevis pin**
5. **Spring washer**
6. **Retaining clip**
7. **Exhaust system bracket**
8. **Socket head capscrew**

Figure 2-41. Right Side Footrest Assembly

1. See Figure 2-41. To remove right side footpeg, remove retaining clip (6), clevis pin (4), spring washer (5), and footrest (1).
2. Remove socket head capscrews (3) socket head capscrew (8) to remove footrest bracket (2).

Passenger Left Side Footrest Installation

1. See Figure 2-40. Install left side footrest bracket (1) to frame using socket head capscrews (2). Tighten to 55-70 Nm (41-52 ft-lbs).
2. Install left side footrest (6), spring washer (4), clevis pin (3), and **new** retaining clip (5).

Passenger Right Side Footrest Installation

1. See Figure 2-41. Install right side footrest bracket (2) using socket head capscrews (3). Tighten to 55-70 Nm (44-52 ft-lbs).
2. Install socket head capscrew (8) securing passenger footrest bracket (2) to exhaust system bracket (7). Tighten to 19-27 Nm (14-20 ft-lbs).
3. Install right side footrest (1), spring washer (5), clevis pin (4), and **new** retaining clip (6).

THROTTLE CABLES 2.15

REMOVAL/DISASSEMBLY

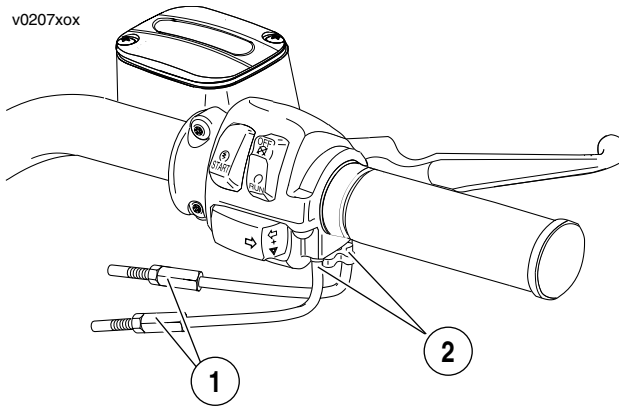
1. See Figure 2-42. Loosen cable adjuster jam nuts (1). Screw throttle cable adjuster until it is a short as possible.
2. Remove screws that hold handlebar housing together to separate the upper and lower housings.
3. Use a screwdriver to rotate cable ferrules in throttle grip notches. Remove cables from notches on inboard side of throttle grip and remove cables from throttle grip and lower housing.
4. Remove airbox. See 1.3 AIRBOX AND AIR FILTER.
5. Remove throttle cable housings from guides at throttle body and remove cable barrels from throttle cam.
6. See Figure 2-43. Pull cables from housing by placing a drop of oil on retaining ring that holds cable in housing, then firmly pull bent tubing portion of cable out of housing using a rocking motion.

CLEANING AND INSPECTION

WARNING

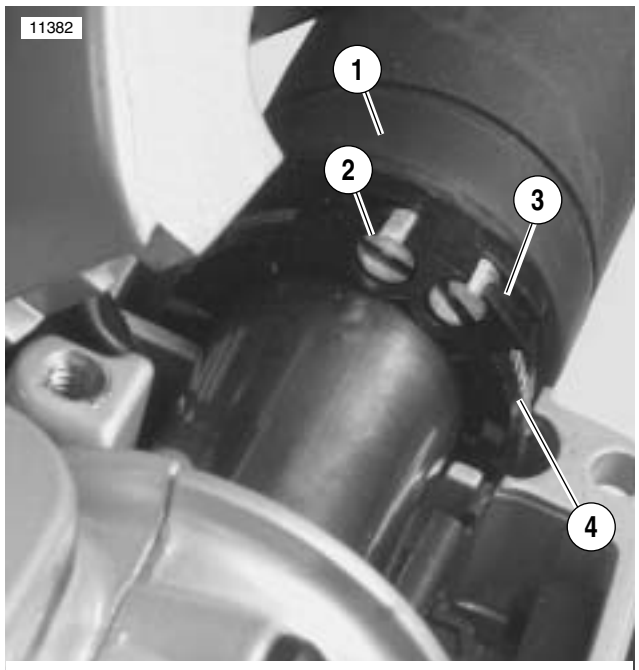
Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

1. Wash all components in non-flammable cleaning solvent. Blow parts dry with low pressure compressed air.
2. Replace control cables if frayed, kinked or bent.
3. Put one or two drops of oil into housing of each cable.



1. **Adjuster jam nuts**
2. **Inserts**

Figure 2-42. Handlebar Throttle Control



1. **Throttle grip**
2. **Ferrule**
3. **Groove**
4. **Idle cable (gold insert, rear hole)**

Figure 2-43. Throttle Cable Attachment (typical)

ASSEMBLY AND INSTALLATION

1. Apply a light coating of graphite to handlebar and inside surface of housings.
2. See Figure 2-43. Attach control cable assemblies to lower housing.
   a. Push silver insert of the cable housing into hole in front of tension adjuster screw. Snap in retaining ring.
   b. Push gold insert of idle cable housing into hole at rear of tension adjuster screw. Snap in retaining ring.
   c. Install adjusting screw, spring and friction pad in lower housing if they were removed.
3. Position throttle grip on the handlebar. Place lower housing on throttle grip.
4. Fit ferrules (2) over cable balls. Slide ferrules into throttle notches and rotate so cables fit grooves (3) in throttle grip.
5. Fasten upper housing to lower housing using two screws. Tighten to 4-5 Nm (35-45 **in-lbs**).
6. Route throttle cables through right side hole in upper fork clamp and behind radiator cover along side battery.

⚠WARNING

Never route throttle cable over the battery. Fire due to short circuit could occur and cause death or serious injury. Throttle cables must be routed alongside battery, between hold down strap and coolant overflow bottle. (00224a)

7. Insert throttle cable barrels on throttle cam and fit cables into guides.

⚠WARNING

Do not tighten throttle friction adjustment screw to the point where the engine will not return to idle automatically. Over-tightening can lead to loss of vehicle control, which could result in death or serious injury. (00031b)

8. Adjust cables for correct throttle opening and closing. See 1.23 THROTTLE CABLES.
9. Install airbox. See 1.3 AIRBOX AND AIR FILTER.

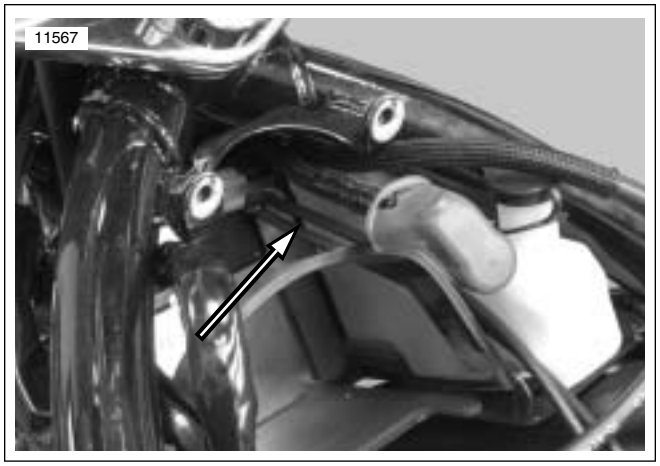


Figure 2-44. Throttle Cable Routing (typical)

CLUTCH MASTER CYLINDER/RESERVOIR 2.16

GENERAL

The clutch is hydraulically actuated. Squeezing the clutch hand lever causes the clutch master cylinder to apply pressure via the clutch fluid in the clutch line to the secondary clutch actuator mounted to the engine right side cover. The secondary clutch actuator piston extends and contacts the clutch release bearing which disengages the clutch.

A bleeder screw at the secondary clutch actuator allows bleeding air from the clutch lines. D.O.T. 4 BRAKE FLUID is used in the clutch system.

Check the clutch fluid level in the clutch fluid reservoir on left handlebar. If the sight gauge is dark, the fluid level in the reservoir is above the sight gauge prism and the reservoir is full. If the sight gauge appears clear, the fluid level is below the sight gauge prism and the fluid level should be checked. Fluid level should be level with the internal shelf marked FILL LEVEL with the motorcycle upright.

CAUTION

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

REMOVAL

1. While holding turn signal locknut underneath clutch lever/master cylinder assembly, unthread mirror (counterclockwise). Remove mirror and turn signal.
2. Remove electrical controls.

CAUTION

To prevent dirt and other contaminants from entering the master cylinder reservoir, thoroughly clean the cover before removal.

3. See Figure 2-45. Loosen, but do not remove, screws (10) with flat washers (9) that detach handlebar clamp (8) from clutch master cylinder/reservoir.
4. Loosen both screws (3) on cover (1) to relieve pressure in master cylinder reservoir.

⚠WARNING

Be sure no clutch fluid gets on tires, wheels or brakes when draining fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00295a)

NOTE

Place a large cup under the banjo fitting. Hydraulic fluid will begin draining from the reservoir as the banjo bolt is removed.

CAUTION

Damaged banjo bolt surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing clutch line components.

5. Slowly loosen banjo bolt (6) and allow clutch fluid from reservoir to drain into cup.

NOTE

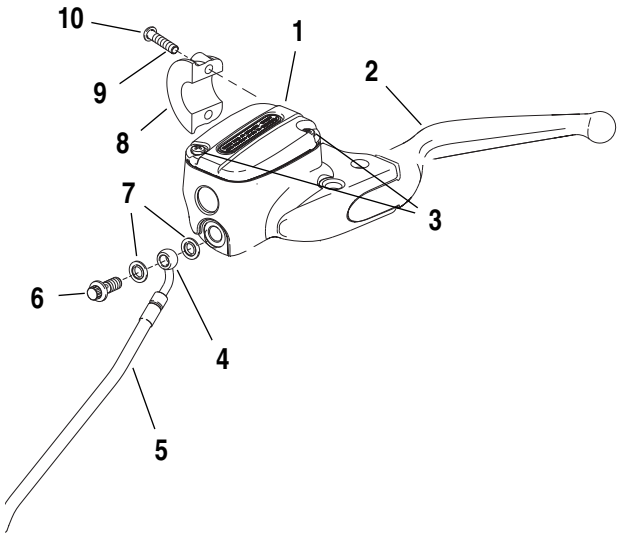
Dispose of clutch fluid in accordance with local regulations.

6. Remove banjo bolt (6) and two copper washers (7) to disconnect fitting of hydraulic clutch fluid line (5) from clutch reservoir and master cylinder. Discard copper washers.

NOTE

To prevent the rest of the clutch fluid from draining from the clutch line and secondary clutch actuator, support the banjo fitting and clutch fluid line upright. Plug the banjo bolt hole with a finger to transfer the assembly to a workbench without spilling clutch fluid.

7. Remove handlebar clamp screws and take clamp and clutch master cylinder/reservoir assembly to a workbench.



1. **Cover**
2. **Clutch hand lever**
3. **Cover hold down screws**
4. **Banjo fitting**
5. **Clutch fluid line**
6. **Banjo bolt**
7. **Copper washers**
8. **Handlebar clamp**
9. **Washer**
10. **Clamp screw**

Figure 2-45. Clutch Master Cylinder/Reservoir

DISASSEMBLY

CAUTION

To prevent dirt and other contaminants from entering the master cylinder reservoir, thoroughly clean the cover before removal.

1. Drain additional clutch fluid from master cylinder/reservoir.
2. Remove screws securing master cylinder cover. Remove cover and gasket. Turn housing upside down to remove remaining clutch fluid from reservoir.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

3. Remove retaining ring from pivot pin groove.

NOTE

To take the piston spring load off the pin and remove the pivot pin, gently force the clutch lever toward the piston (as if operating the clutch).

4. Remove pivot pin through top of housing. Remove and save pivot pin and clutch lever.
5. See Figure 2-46. Using a toothpick or small screwdriver, gently pry outer edge of piston boot (1) out of piston bore.
6. Remove piston (2) and spring (4).

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

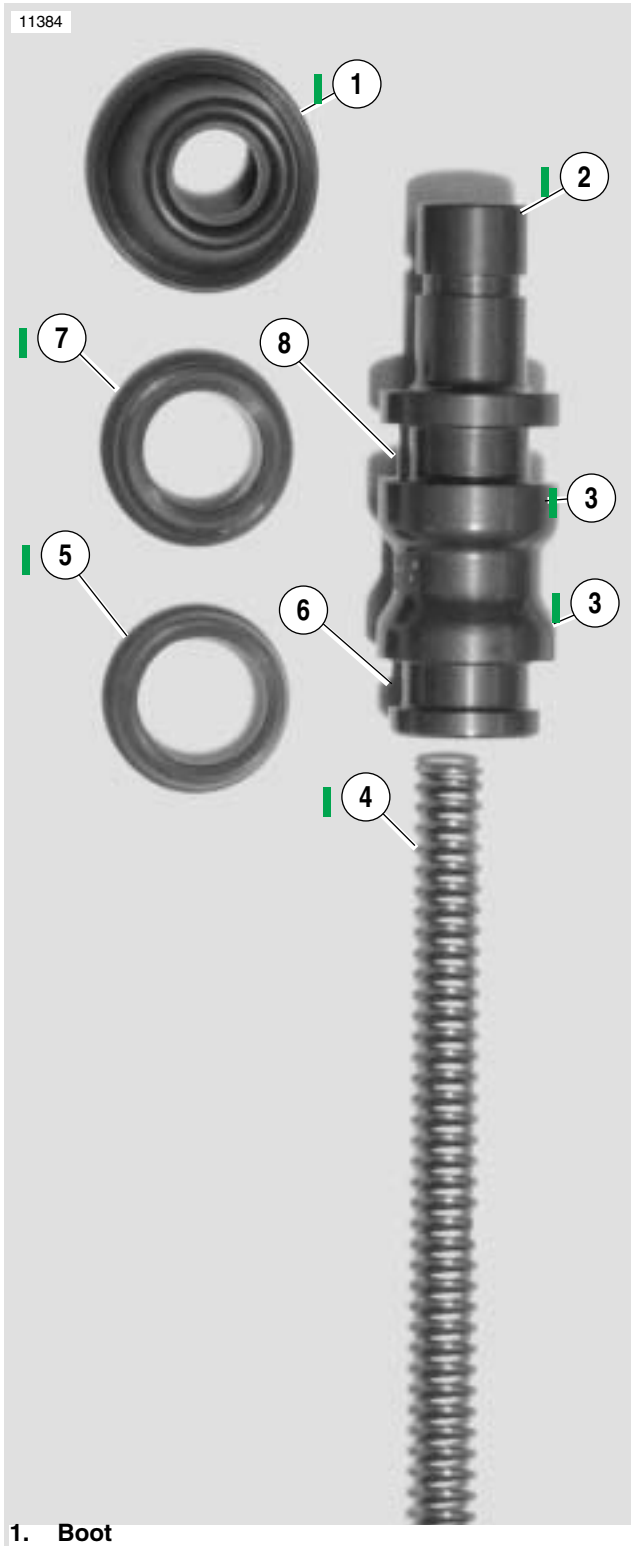
CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

NOTE

Do not use a wire or sharp instrument to clean drilled oil passages.

7. Inspect cylinder housing bore for scoring, pitting or corrosion. Also check outlet port for damage. Replace housing if necessary.
8. Inspect the cover, sight glass, and gasket for cuts, tears or general deterioration.



1. **Boot**
2. **Piston**
3. **Shoulder**
4. **Spring**
5. **Primary cup**
6. **Groove - primary cup**
7. **Secondary cup**
8. **Groove - secondary cup**

Figure 2-46. Clutch Master Cylinder Components

ASSEMBLY

To rebuild clutch master cylinder, use the components found in the SERVICE PARTS KIT No. 46244-01.

1. See Figure 2-46. Lightly lubricate inside of primary cup (5) and fit over lip on spring end of piston (2) so the closed end (small ID) contacts evenly with the shoulder (3) in primary cup grove (6).
2. Lightly lubricate inside of secondary cup (7) (steep taper from center to outside diameter) and fit over the lip on outboard end of piston (2) so that flared end is open toward the shoulder (3) of the secondary cup groove (8).
3. Install boot (1), large sealing ID first, on piston (2) until seal on smaller ID fits snugly into thin groove in piston.

NOTE

See Figure 2-47. The flared ends of the primary cup and the secondary cup face the spring end of the piston.

4. Using lubricant in SERVICE PARTS KIT (Part No. 46244-01) thoroughly coat outside diameters of primary and secondary cups. Coat master cylinder piston bore.
5. With tapered end out, install spring (4) into opening on inboard side of piston assembly.
6. Align and install piston assembly into bore. Firmly press on flat end of piston, compressing spring, until the entire assembly slides into cylinder bore.

NOTE

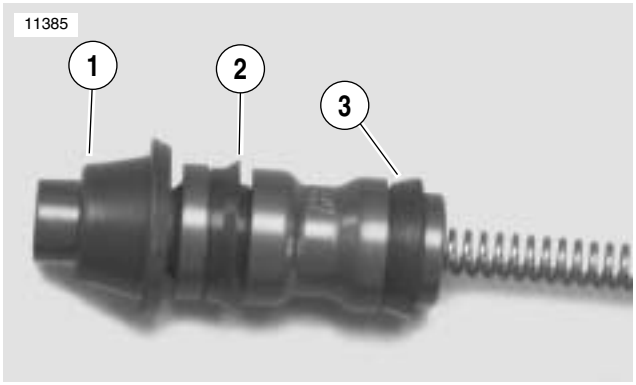
When fitting the piston sealing boot, be careful not to tear, perforate or damage the piston sealing boot.

7. Compress piston until it is even with the end of bore. Using a small dull bladed screwdriver or similar tool, gently work around sealing edges of boot until entire circumference of boot is seated in cylinder bore groove.
8. If cover gasket and/or sight glass replacement is necessary. Proceed as follows:
   a. From inboard side, push sight glass toward top of cover until free.
   b. Pull rubber gasket from cover.
   c. Fit nipple of **new** gasket into hole of cover aligning gasket and cover thru holes.
   d. From bottom of gasket, push flat end of sight glass through nipple until top of glass is flush with top of gasket. Verify that glass is square in bore. If lubrication is necessary, use clean D.O.T. 4 BRAKE FLUID.
9. Install cover with gasket on master cylinder reservoir. Install two screws to fasten the cover to reservoir, but do not tighten.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

10. To install existing clutch hand lever, install clutch hand lever, pivot pin, and a **new** retaining ring.
11. To install a replacement clutch hand lever, See 2.17 CLUTCH HAND LEVER.



1. **Boot in piston groove**
2. **Secondary cup flare**
3. **Primary cup**

Figure 2-47. Assembled Cups and Piston

INSTALLATION

1. See Figure 2-45. Attach master cylinder/reservoir to handlebars with handlebar clamp (8). Orient lever to rider position and tighten two clamp screws (10) to 8-9 Nm (71-80 **in-lbs**).
2. Attach banjo fitting (4) of clutch fluid line to master cylinder with **new** copper washers. Install electrical controls.
3. Remove secondary clutch actuator cover and loosen bleeder screw.
4. Fill reservoir with D.O.T. 4 BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleeder screw. Finger tighten bleed screw.
5. Bleed clutch line. See 1.14 BLEEDING CLUTCH FLUID LINE.
6. Verify that fluid level in clutch fluid reservoir is at FILL LEVEL with motorcycle upright.

NOTE

Clutch fluid volume increases with clutch wear. Do not overfill clutch reservoir.

7. Verify pressure by squeezing clutch hand lever.
8. Tighten fasteners as follows:
   a. Banjo bolt (6) to 17-20 Nm (13-14 ft-lbs).
   b. Bleeder screw to 9-11 Nm (80-97 **in-lbs**).
   c. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
   d. Secondary clutch actuator cover mounting bolts to 6-10 Nm (53-88 **in-lbs**).

⚠WARNING

Check for proper turn signal lamp operation before riding motorcycle. Visibility is a major concern for motorcyclists. Failure to have proper lamp operation could result in death or serious injury.

9. Install rear view mirror and turn signals.
10. Test ride motorcycle.

CLUTCH HAND LEVER 2.17

REMOVAL

1. Remove retaining ring from pivot pin.
2. Remove pivot pin.
3. Slide lever free from clutch master cylinder housing.

INSTALLATION

1. See Figure 2-48. Slide bushing cups (3) onto pins of roller with cup flanges against roller.

NOTE

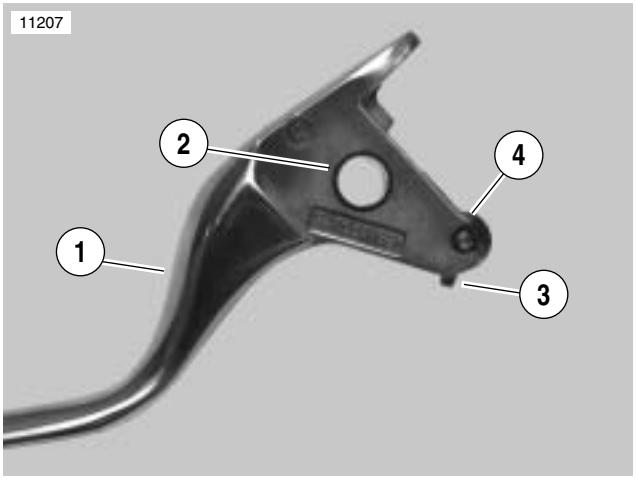
Be careful when handling the bushing cups. The bushing cups are hard plastic and can be easily broken.

2. With connector bow (3) portion of the bushing cups parallel with groove in clutch handle, snap roller pin (4) with the bushing cups installed into clutch lever roller groove. If bushing is positioned correctly, roller/bushing assembly will install with a snap and will be held securely.
3. Lightly grease pivot bushing (2) and install into clutch hand lever (1) pivot hole. Position bushing until it is flush with both sides of lever.

NOTE

If the clutch master cylinder/reservoir is full of clutch fluid under pressure, it may be necessary to apply force to the hydraulic piston (in the clutch hand lever mount) in order to align the clutch hand lever and to allow the pivot pin to be inserted.

4. Orient clutch lever in lever mounting bracket. Insert pivot pin from top and tap into place.
5. Install retaining ring on pivot pin.



1. Clutch hand lever
2. Pivot bushing installed
3. Bushing cups connector bow
4. Roller pin

Figure 2-48. Clutch Hand Lever

CLUTCH FLUID LINE 2.18

REMOVAL

Inspect the clutch fluid line for wear, damage, and leaks. Replace if necessary.

1. Remove secondary clutch actuator cover from left side clutch cover.

⚠WARNING

Be sure no clutch fluid gets on tires, wheels or brakes when draining fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00295a)

2. Place a suitable container under secondary clutch actuator. Loosen flare nut and allow clutch fluid to drain from clutch line.

NOTE

Dispose of clutch fluid in accordance with local regulations.

3. Remove banjo bolt and two copper washers to disconnect fitting of hydraulic clutch fluid line from clutch reservoir and master cylinder. Discard washers.
4. See Figure 2-49. Remove clutch fluid line from clips on frame.
5. Carefully thread banjo fitting end of clutch line out through upper triple clamp. Thread flare nut end of clutch line out through bottom of motorcycle and remove clutch line through front down tubes.

INSTALLATION

1. Route clutch line banjo fitting up through upper triple clamp, then route line behind steering head over to right frame rail and along inside of rail under engine and back up between bottom frame rails to loop out and forward to secondary clutch actuator mounted on clutch cover.
2. Thread in and finger tighten flare nut fastening clutch fluid line to secondary clutch actuator.
3. Attach banjo fitting of the clutch fluid line to master cylinder with **new** copper washers.
4. Reinstall all clutch line clips in corresponding locations along frame.

⚠WARNING

Be sure no clutch fluid gets on tires, wheels or brakes when adding fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00294a)

CAUTION

Do NOT allow dirt or debris to enter the clutch master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation of the clutch and equipment damage. (00205a)

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

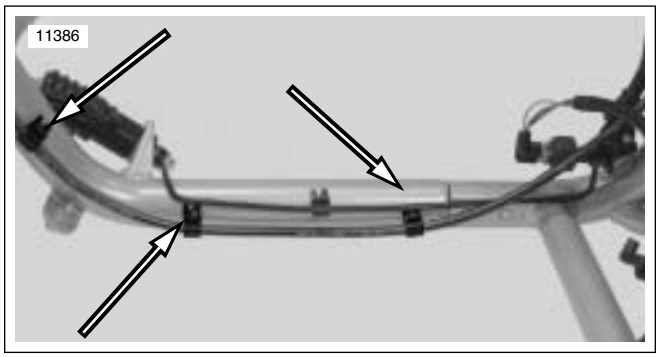


Figure 2-49. Clutch Fluid Line Clips (typical) (VRSCA shown)

5. Remove secondary clutch actuator cover and loosen bleeder screw.
6. Fill reservoir with D.O.T. 4 BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleeder screw. Finger tighten bleed screw.

NOTE

A Snap-on BASIC VACUUM BRAKE BLEEDER with a fitting that mates to the bleed screw threads can be used to draw the fluid down the clutch line.

7. Bleed clutch line. See 1.14 BLEEDING CLUTCH FLUID LINE.
8. Verify that fluid level in clutch fluid reservoir is at FILL LEVEL with motorcycle upright.

NOTE

Clutch fluid volume increases with clutch wear. Do not overfill clutch reservoir.

9. Test pressure by squeezing clutch hand lever.

10. Tighten fasteners as follows:
    a. Banjo bolt (6) to 23-31 Nm (17-23 ft-lbs).
    b. Clutch line flare nut to 9-13 Nm (80-115 **in-lbs).**
    c. Bleeder screw to 9-11 Nm (80-100 **in-lbs**).
    d. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
    e. Secondary clutch actuator cover mounting bolts to 6-10 Nm (53-88 **in-lbs**).
11. Test ride motorcycle.

SECONDARY CLUTCH ACTUATOR 2.19

REMOVAL

1. Remove secondary clutch actuator cover.
2. See Figure 2-50. Remove mounting bolts (2) holding secondary clutch actuator (4) to clutch cover.

CAUTION

The piston in the secondary clutch actuator is under pressure. Squeezing the clutch hand lever could push the piston out of its housing requiring the clutch actuator to be rebuilt.

3. See Figure 2-51. Inspect O-ring (2). Replace if necessary and re-install actuator.

NOTE

Dispose of clutch fluid in accordance with local regulations.

4. See Figure 2-50. If condition indicates replacement of secondary actuator:
   a. Place a suitable container under secondary clutch actuator (4). Loosen flare nut (5) and allow clutch fluid to drain from clutch line (1).
   b. Remove flare nut and remove actuator.
   c. Remove bleeder screw and drain remaining clutch fluid.

DISASSEMBLY

1. See Figure 2-52. Pull off boot (7), piston (6), seal (5), and spring (4) from housing (1). Slip O-ring (3) off housing.
2. Clean with denatured alcohol or D.O.T. 4 BRAKE FLUID only.

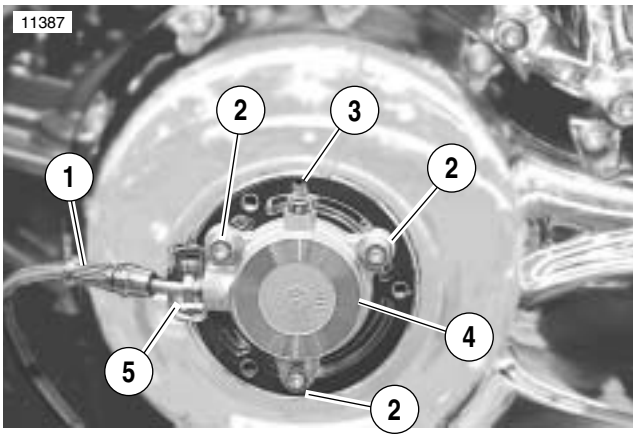
WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

3. Use air hose to clean inlet and bleeder ports.
4. Inspect cylinder housing bore for scoring, pitting or corrosion. Inspect inlet and bleeder ports. Replace housing if necessary.

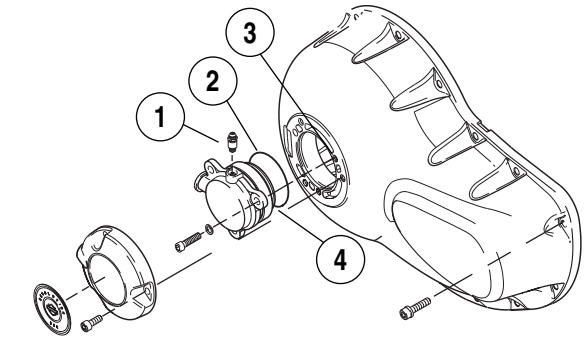
ASSEMBLY

1. See Figure 2-52. Coat cylinder bore, piston, O-ring, boot, and bleeder screw with lubricant from service kit.
2. Orient a **new** seal (5) with square split lip toward rider side of actuator and fit to piston (6).
3. Insert spring into cylinder bore and insert piston into cylinder bore. Compress and guide seal lip as piston is pressed into bore.
4. Install a **new** O-ring (3) into groove at base of secondary clutch actuator housing (1).
5. Fit boot (7) to piston (6) and push edge of boot over machined lip around housing (1).
6. Fit **new** O-ring (3) to bleeder screw (2) and loosely install into housing.



1. **Clutch fluid line**
2. **Mounting bolts**
3. **Bleeder screw**
4. **Secondary clutch actuator**
5. **Flare nut**

Figure 2-50. Secondary Clutch Actuator Installed



1. **Bleeder screw**
2. **O-ring**
3. **Clutch release bearing**
4. **Secondary clutch actuator piston**

Figure 2-51. Secondary Clutch Actuator

INSTALLATION

1. Install clutch fluid line flare nut to secondary clutch actuator. Tighten to 9-13 Nm (80-115 **in-lbs**).
2. Loosen bleeder screw.

⚠WARNING

Be sure no clutch fluid gets on tires, wheels or brakes when draining fluid. Traction can be adversely affected, which could result in loss of control and death or serious injury. (00295a)

⚠CAUTION

Do NOT allow dirt or debris to enter the clutch master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation of the clutch and equipment damage. (00205a)

CAUTION

The piston in the secondary clutch actuator is under pressure. Squeezing the clutch hand lever could push the piston out of its housing requiring the clutch actuator to be rebuilt.

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

3. Fill reservoir with D.O.T. 4 BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleeder screw. Tighten bleeder screw.

NOTE

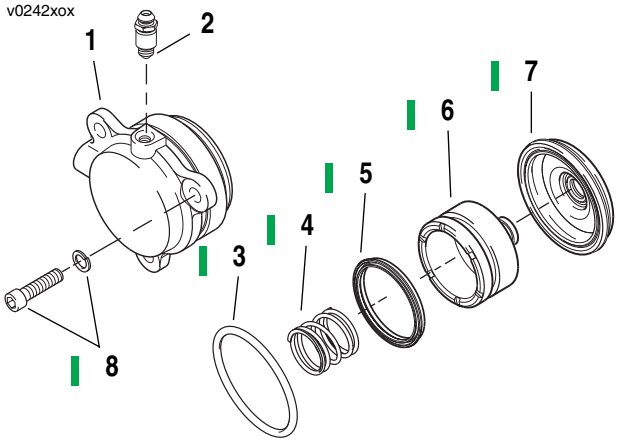
When filling an empty clutch fluid line, a Snap-on BASIC VACUUM BRAKE BLEEDER with a fitting that mates to the bleeder screw threads can be used to initially draw the fluid down the clutch line with little or no air in the line.

4. Bleed clutch fluid line. See 1.14 BLEEDING CLUTCH FLUID LINE.
5. Tighten fasteners as follows:
   a. Banjo bolt to 23-31 Nm (17-23 ft-lbs).
   b. Bleeder screw to 9-11 Nm (80-100 **in-lbs**).
   c. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
6. Determine sufficient piston travel.

NOTE

Insufficient piston travel may indicate a fluid or pressure leak somewhere in the actuator, clutch fluid line, or clutch master cylinder.

7. Press secondary clutch actuator into its mounting flange on crankcase cover. Install fasteners and tighten to 10 Nm (88 **in-lbs**).
8. Install secondary clutch actuator cover. Tighten to 6-10 Nm (53-88 **in-lbs**).



1. **Secondary clutch actuator housing**
2. **Bleeder screw**
3. **O-ring**
4. **Spring**
5. **Seal**
6. **Piston**
7. **Boot**
8. **Mounting bolts and washers**

Figure 2-52. Secondary Clutch Actuator Components

FRONT BRAKE MASTER CYLINDER/RESERVOIR 2.20

REMOVAL AND DISASSEMBLY

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

NOTE

Master cylinders designed for dual disc (two caliper) operation have an 15 mm (19/32 in.) bore.

1. Open bleeder nipple caps on front brake calipers. Install clear plastic tubing over each caliper bleeder valve, while placing free ends in a suitable container. Open bleeder valves about 1/2-turn. Pump brake hand lever to drain brake fluid from reservoir. Close bleeder valve. See 1.10 BLEEDING BRAKES.

CAUTION

Damaged banjo bolt surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

2. Remove banjo bolt and two copper washers to disconnect fitting of hydraulic brake line from front brake master cylinder. Discard washers.

CAUTION

Do not remove the master cylinder assembly without first placing a 4 mm (5/32 inch) thick cardboard insert between the brake lever and master cylinder body. Removal without the insert may result in damage to the rubber boot and plunger of the front stoplight switch.

3. See Figure 2-53. Place cardboard insert (2) between brake lever and reservoir housing.
4. See Figure 2-54. Remove screw (21) to detach handlebar clamp (20) from master cylinder reservoir (6).

⚠WARNING

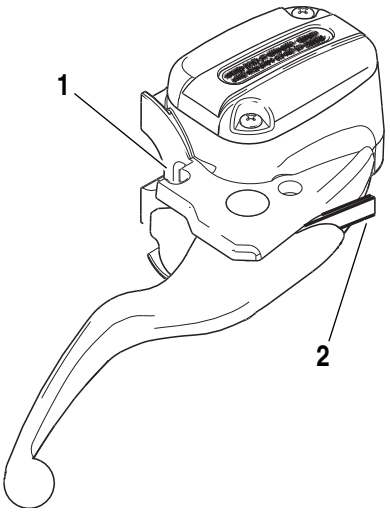
Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

5. Remove retaining clip (10) from pivot pin (7) and remove brake hand lever (9) from master cylinder.
6. Remove push rod (19), dust cover (18) and retainer clip (17).
7. Remove piston (15) and spring (11) from master cylinder bore.

CAUTION

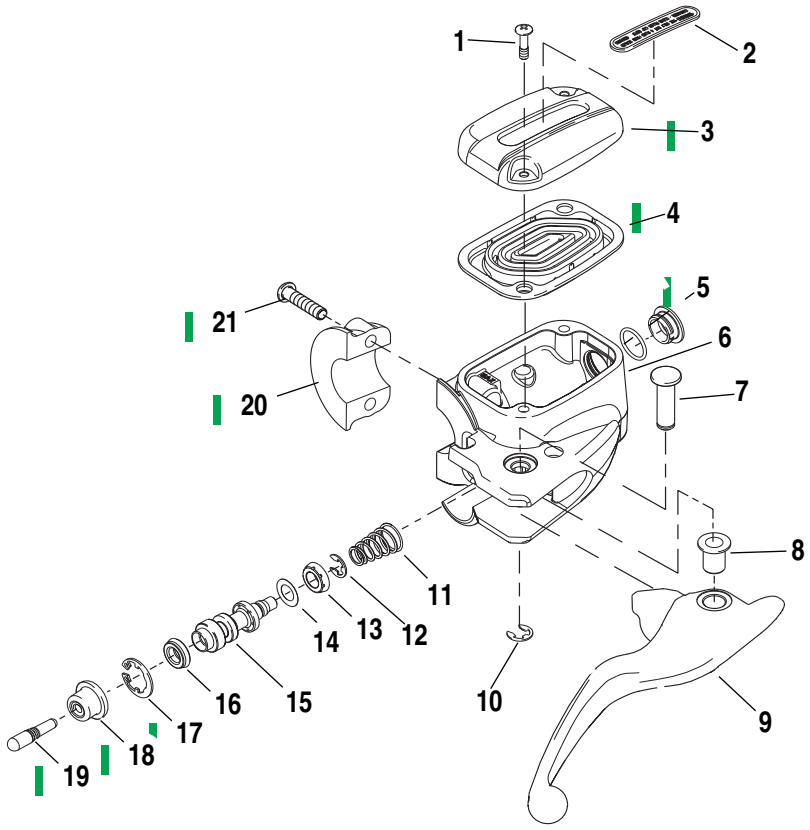
To prevent dirt and other contaminants from entering the master cylinder reservoir, thoroughly clean the cover before removal.

8. Remove both screws (1), cover (3) and cover gasket (4).



1. Groove
2. 4 mm (5/32 in.) thick cardboard insert

Figure 2-53. Front Brake Master Cylinder and Reservoir



1. Screw (2)
2. Label (D.O.T. 4)
3. Cover
4. Gasket
5. Sight glass and retaining clip
6. Master cylinder reservoir
7. Pivot pin
8. Bushing
9. Brake hand lever
10. Retaining clip
11. Spring
12. Retaining clip
13. Primary seal
14. Washer
15. Piston
16. Secondary seal
17. Retaining clip
18. Dust cover
19. Push rod
20. Handlebar clamp
21. Screw (2)

* Parts 11-16 are included in kit as an assembly.

Figure 2-54. Front Brake Master Cylinder

CLEANING AND INSPECTION

1. Always assemble master cylinder using **new** parts from repair kit.

⚠WARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

2. Clean all parts with denatured alcohol or D.O.T. 4 BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe dry with a clean, lint free cloth.

⚠WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

3. Blow out drilled passages and bore with a clean air supply. Do not use a wire or similar instrument to clean drilled passages in bottom of reservoir.
4. Carefully inspect all parts for wear or damage and replace as necessary.
5. Inspect piston bore in master cylinder housing for scoring, pitting or corrosion. Replace master cylinder if any of these conditions are found.
6. Inspect outlet port that mates with brake line fitting. If any scratches, dents or other damage is found on this critical sealing surface, replace housing.
7. Inspect cover, sight glass and gasket for cuts, tears or general deterioration. If gasket and/or sight glass replacement is necessary, proceed as follows:
   a. From inboard side, push sight glass (5) out of casting.
   b. Pull rubber gasket (4) from cover (3).

NOTE

Cover gasket is unidirectional and will only fit properly one way. Verify correct installation before completing assembly.

   c. Fit **new** gasket into cover, aligning gasket and cover thru holes.

ASSEMBLY

To rebuild front brake master cylinder, use the components found in the SERVICE PARTS KIT.

1. Install **new** rear master cylinder kit. Kit includes: primary seal, secondary seal, piston valve, and spring as an assembly.

NOTE

Apply a drop of grease (supplied with brake kit) to each end of push rod before installation. DO NOT use this grease on master cylinder internal parts.

2. Press down on piston and spring assembly into the cylinder bore and install retaining clip (17) Retaining clip must be completely seated in groove on outlet side of piston bore. Install dust cover (18) and push rod (19).
3. Install cover (3) with gasket (4) on master cylinder reservoir. Install two screws (1) to fasten the cover to reservoir. Do not tighten screws at this time.
4. Install bushing (8) in brake hand lever (9) and align hole in brake hand lever with hole in master cylinder reservoir (6). From top of assembly, slide pivot pin (7) through reservoir and hand lever.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

5. Install retaining clip (10) in pivot pin groove. Verify that retaining clip is completely seated in groove and verify proper function of master cylinder assembly.

INSTALLATION

CAUTION

Do not install the master cylinder assembly without first placing the 4 mm (5/32 in.) thick cardboard insert (or cable strap eyelet) between the brake pedal and lever bracket. Installation without the insert may result in damage to the rubber boot and plunger of the front stoplight switch.

1. See Figure 2-55. Position brake lever/master cylinder assembly inboard of switch housing assembly engaging tab (2) on lower switch housing (1) in groove (3) at top of brake lever bracket (4).
2. Align holes in handlebar clamp with those in master cylinder housing and start both screws with flat washers. Position for rider posture. Beginning with top screw, tighten to 8-9 Nm (71-80 **in-lbs**).

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)

3. Lubricate **new** copper washers with D.O.T. 4 BRAKE FLUID. Position **new** copper washers on each side of hydraulic brake line fitting. Insert bolt through washers and fitting. Thread banjo bolt into master cylinder housing and tighten to 23-24 Nm (17-21 ft-lbs).
4. Install length of clear plastic tubing over caliper bleeder valve, if removed. Place free end of tube in a clean container.
5. Stand the motorcycle upright so that master cylinder is level. Remove master cylinder cover.

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

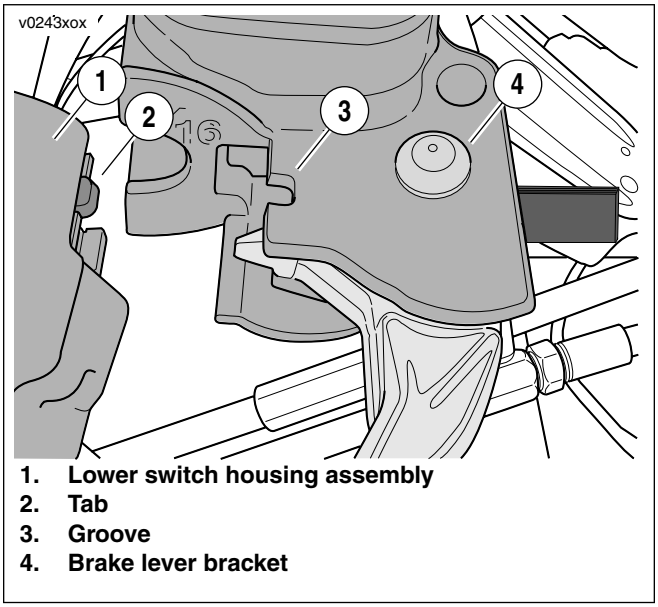
D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

6. Add D.O.T. 4 BRAKE FLUID to master cylinder reservoir until fluid level is 5.0 mm (13/64 in.) from top. Do not reuse old brake fluid. Use only D.O.T. 4 BRAKE FLUID from a sealed container.

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

7. Bleed brake system. See 1.10 BLEEDING BRAKES.



1. **Lower switch housing assembly**
2. **Tab**
3. **Groove**
4. **Brake lever bracket**

Figure 2-55. Master Cylinder and Brake Lever To Handlebar Switch Housing (typical)

⚠WARNING

A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)

8. Verify operation of master cylinder relief port. Actuate brake hand lever with cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
9. Install gasket and cover on master cylinder. Tighten cover screws to 0.8-1.2 Nm (7-11 **in-lbs**).

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

10. Test brake system.
    a. Turn ignition switch ON. Pump brake hand lever to verify operation of brake lamp.
    b. Test ride motorcycle. If the brakes feel spongy, bleed the system again. See 1.10 BLEEDING BRAKES.

NOTE

A sight glass enables the rider to visually check the brake fluid level without removing the master cylinder cover. When the reservoir is full, the sight glass is dark. As the fluid level drops, the glass lightens up to indicate this condition to the rider.

FRONT BRAKE CALIPERS 2.21

REMOVAL

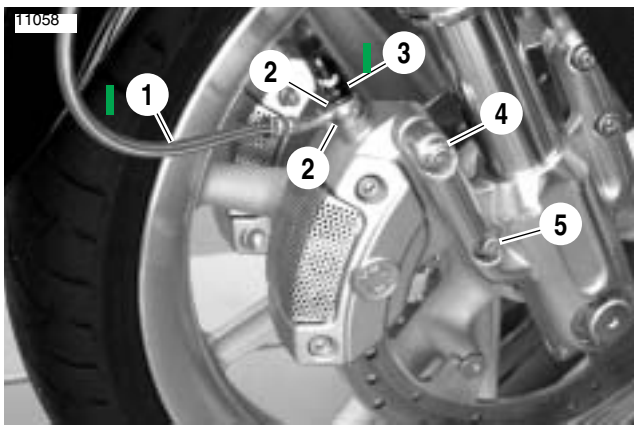
NOTE

If only replacing brake pads, see 1.11 BRAKE PADS AND DISCS.

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)

1. Drain master cylinder reservoir using a suction device.
2. See Figure 2-56. Remove banjo bolt (3) and both copper washers (2) to detach front brake line (1) from caliper. Discard washers.
3. Remove both upper (4) and lower (5) mounting bolts. Lift caliper upward to remove from brake disc.
4. Repeat for opposite side caliper.



1. **Front brake line**
2. **Copper washer**
3. **Banjo bolt**
4. **Upper mounting bolt**
5. **Lower mounting bolt**

Figure 2-56. Front Brake Caliper Mounting (VRSCR shown)

INSTALLATION

1. See Figure 2-56. Attach calipers to fork legs.
   a. Place caliper over brake disc with bleeder valve facing upwards.
   b. Loosely install upper mounting bolt (4) into top hole on fork leg.
   c. Install lower mounting bolt (5) into bottom hole on fork leg. Tighten bottom mounting bolt to 43-52 Nm (32-38 ft-lbs).
   d. Final tighten the top mounting bolt to 43-52 Nm (32-38 ft-lbs).

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)

2. Lubricate **new** copper washers (2) with D.O.T. 4 BRAKE FLUID. Connect the brake line (1) to caliper using two **new** copper washers (2) and banjo bolt (3). Tighten to 23-24 Nm (17-21 ft-lbs).
3. Repeat for opposite side caliper.

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

4. Remove cover from front brake master cylinder. Fill master cylinder with D.O.T. 4 BRAKE FLUID. Verify that fluid level is at FILL LEVEL when the motorcycle is level.
5. Tighten cover screws to 0.8-1.2 Nm (7-11 **in-lbs**).

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

6. Bleed brake system and tighten bleeder valve. See 1.10 BLEEDING BRAKES.

⚠WARNING

A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)

7. Verify proper operation of the master cylinder relief port. Actuate the brake lever with the cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
8. Push diaphragm back in if extended and install gasket and cover on reservoir. Tighten to 0.8-1.2 Nm (7-11 **in-lbs**).

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

9. Test brake system.
   a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
   b. Test ride motorcycle. If brakes feel spongy, bleed the system again. See 1.10 BLEEDING BRAKES.

NOTE

Avoid making hard stops for the first 100 miles (160 km). This allows the new pads to become conditioned to the brake discs.

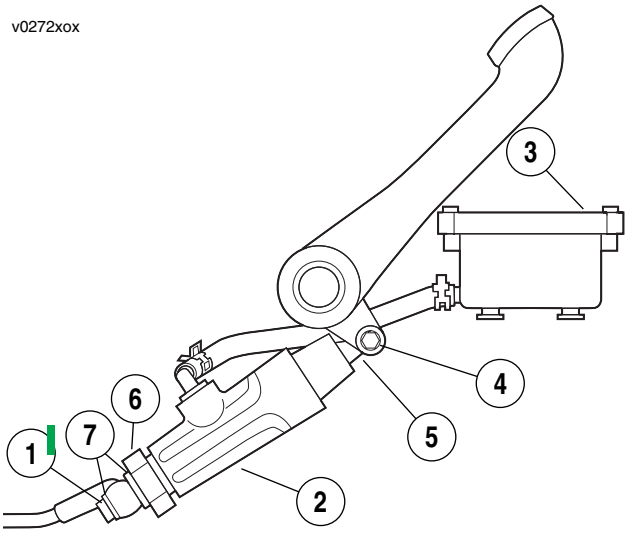
REAR BRAKE MASTER CYL./RESERVOIR (VRSCA) 2.22

REMOVAL

CAUTION

Damaged banjo bolt surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove radiator right side cover.
3. See Figure 2-57. With a suitable container under the master cylinder, remove the banjo bolt (1). Discard the two steel/rubber washers (7).
4. Remove the clip from the clevis pin (4).
5. Cover the outside face of clevis pin (4) with cardboard and using a large pliers, squeeze the pin until the pin shoulder pops out of its interference fit with the clevis. Remove the clevis pin.
6. Remove the brake rod (5) from the clevis.
7. Pull remote reservoir from slot on radiator cover.
8. Remove jam nut (6) to free master cylinder from mounting bracket.
9. Remove master cylinder with the remote reservoir.



1. **Banjo bolt**
2. **Master cylinder**
3. **Remote reservoir**
4. **Clevis pin**
5. **Push rod**
6. **Jam nut**
7. **Steel/rubber washers**

Figure 2-57. Rear Brake Master Cylinder & Reservoir

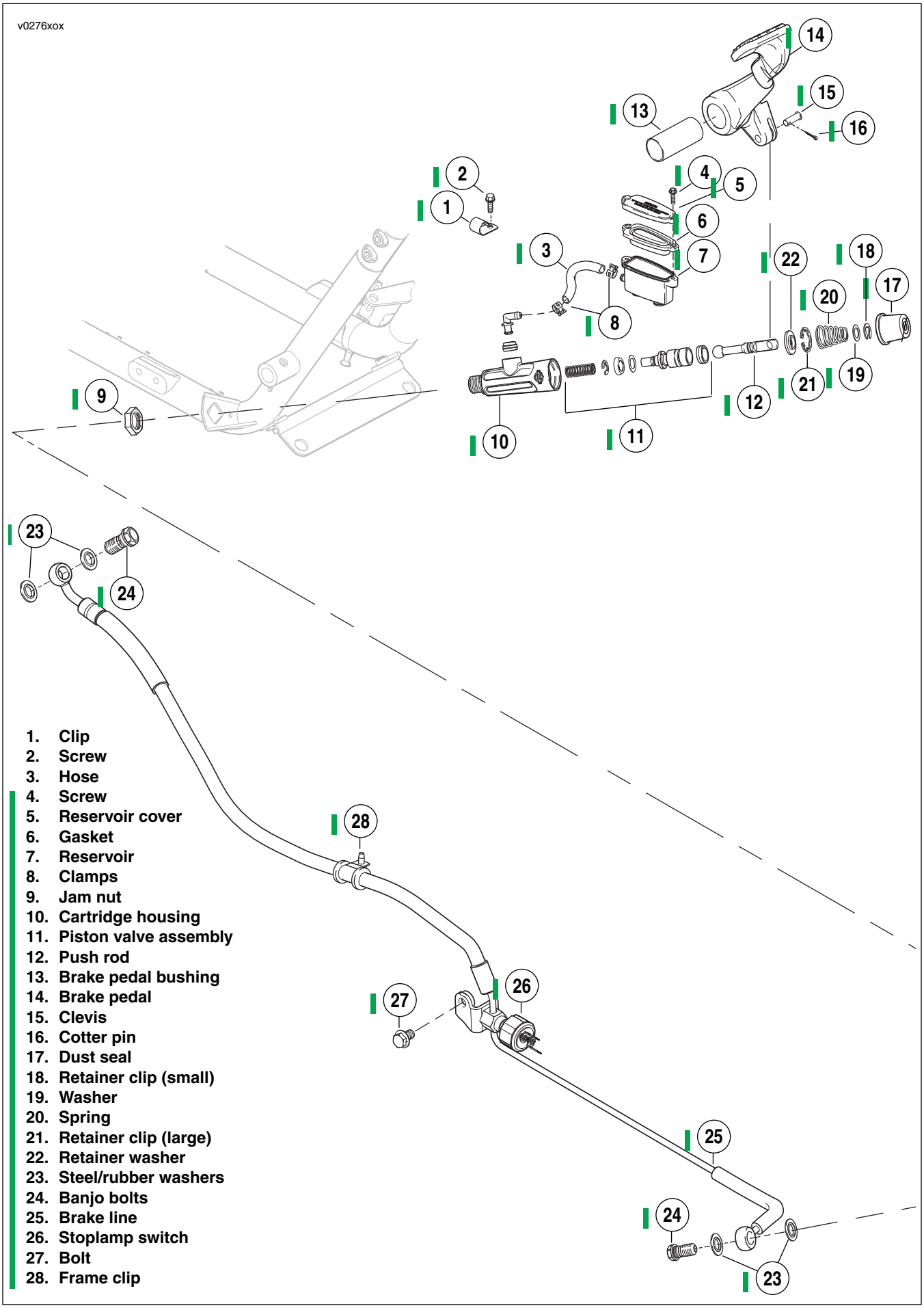


Figure 2-58. Rear Brake Master Cylinder/Reservoir

DISASSEMBLY

⚠CAUTION

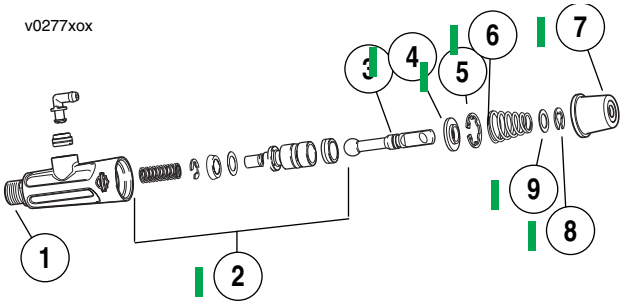
Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

1. See Figure 2-58. Remove reservoir cover (5) and gasket (6).



1. **Cartridge housing (shown w/elbow and o-ring)**
2. **Piston valve assembly (see VRSC parts manual)**
3. **Push rod**
4. **Retainer washer**
5. **Retainer clip (large)**
6. **Spring**
7. **Dust seal**
8. **Retainer clip (small)**
9. **Washer**

Figure 2-59. Master Cylinder Components

2. Over suitable container, use HOSE CLAMP PLIERS (HD-41137), to remove hose clamps (9) from reservoir hose (3). Drain reservoir (7) and hose.
3. Thoroughly clean exterior of master cylinder assembly with denatured alcohol.
4. Gently pull dust seal (17) from cartridge housing (10).

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

5. See Figure 2-59. Using hand pressure, push down on spring (6) and remove small retainer clip (8), washer (9) and remove spring.
6. Using hand pressure, push in push rod (3). Using a snap ring pliers, remove large retainer clip (5) and retainer washer (4).
7. Remove push rod (3).
8. Remove piston valve assembly (2) from cartridge housing (1).

CLEANING AND INSPECTION

⚠WARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

1. Clean all rubber parts using denatured alcohol. Check dust boot for cuts or tears. Replace as necessary.
2. Inspect threads on the cartridge body. Replace if threads are damaged.
3. Inspect spring for cracks or broken coils. Replace as necessary.
4. Wipe bore of cartridge housing with D.O.T. 4 BRAKE FLUID.
5. Inspect reservoir cover gasket for cuts, tears or general deterioration. Replace as necessary.

ASSEMBLY

To rebuild rear brake master cylinder, use the components found in the SERVICE PARTS KIT.

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

1. See Figure 2-59. Lubricate inner bore of cartridge housing (1) with D.O.T.4 brake fluid.
2. Install **new** piston valve assembly (2) from service parts kit.
3. Lay down a clean shop cloth and stand cartridge housing upright.

NOTE

Apply a small drop of grease to each end of push rod before assembly. DO NOT use this grease on internal master cylinder parts.

4. Insert ball end of push rod (3) into piston valve assembly (2). Using hand pressure, push down to compress spring. Install washer (4) retainer washer (4), and larger retainer clip (5) using snap ring pliers into groove of cartridge housing.
5. Verify larger retainer clip has seated in groove of cartridge housing body.
6. Using hand pressure, push down on spring (6) and install small washer (9) and small retainer clip (8), locking small retainer clip into groove on push rod.
7. Verify small retainer clip has seated properly into groove on push rod.
8. Install dust seal (7) over push rod and seat base of dust seal into bore of cartridge housing until base of seal is below bore opening.
9. Test function of master cylinder assembly. Check for binding or excessive drag when pushing down on push rod.

INSTALLATION

1. See Figure 2-58. Route remote reservoir (7) and hose (3) behind rear brake pedal (14). Press reservoir mounting studs into slots on radiator cover.
2. Fit square on bottom of master cylinder cartridge housing (10) into square hole of mounting bracket.
3. See Figure 2-57. Install the clevis pin (4) through the brake pedal clevis and master cylinder push rod (5).
4. Cover the face of clevis pin (16) and clevis with cardboard. Holding the brake pedal firmly, tap on a rod to seat shoulder of clevis pin into clevis. Install **new** clip.
5. Apply LOCTITE® 243 (blue) to threads of jam nut (6). Thread jam nut (10) on cartridge housing and tighten to 41-54 Nm (30-40 ft-lbs).

NOTE

To avoid leakage, verify that the banjo bolt, brake line fitting and master cylinder bore are completely clean.

6. Lubricate **new** steel/rubber washers (7) with D.O.T. 4 BRAKE FLUID. Position **new** steel/rubber washers on each side of brake line. Insert the banjo bolt (1) through washers and fitting. Tighten to 23-31 Nm (17-23 ft-lbs).
7. Stand the motorcycle upright so that the reservoir is in a level position. Clean and remove reservoir cover.

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

8. See Figure 2-60. Add D.O.T. 4 BRAKE FLUID to the master cylinder reservoir until the fluid level is 12.7 mm (1/2 in.) below top of reservoir and is visible in sight window at rear of reservoir. Use only D.O.T. 4 BRAKE FLUID from a sealed container.

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

9. Bleed brake system. See 1.10 BLEEDING BRAKES.
10. Install gasket and cover on master cylinder. Tighten cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
11. Reinstall radiator side cover.
12. Reinstall maxi-fuse and right side cover.

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

13. Test brake system.
    a. Turn ignition switch ON. Pump brake foot pedal to verify operation of brake lamp.
    b. Test ride motorcycle. If the brakes feel spongy, bleed the system again. See 1.10 BLEEDING BRAKES.

Figure 2-60. Rear Brake Reservoir Sight Window (removed from motorcycle)

REAR BRAKE RESERVOIR (VRSCD/VRSCR) 2.23

REMOVAL

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

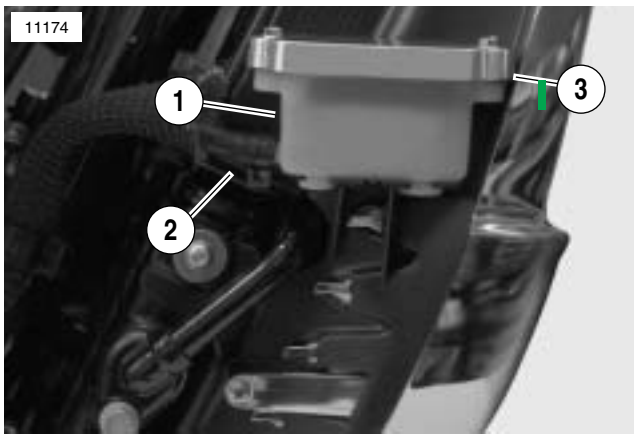
CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

NOTE

When removing/replacing rear brake master cylinder or reservoir, DO NOT disturb the placement of the brake fluid supply line. Brake line placement is critical and it must remain positioned in on the inboard side of the frame rails.

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove radiator right side cover.
3. See Figure 2-61. Place a suitable container under the master cylinder reservoir (1) and remove reservoir cover.
4. Carefully slide reservoir out of mount and drain brake fluid.
5. Remove reservoir hose (2) from reservoir.



1. **Rear brake reservoir**
2. **Remove reservoir hose**
3. **Reservoir cover**

Figure 2-61. Rear Brake Reservoir

INSTALLATION

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

1. See Figure 2-61. Connect reservoir hose to reservoir and install clamp.
2. Carefully slide reservoir into it's mount.
3. Bleed rear brakes. See 1.10 BLEEDING BRAKES.
4. Install radiator side cover. See 1.4 RADIATOR SIDE COVERS (VRSCA/VRSCD), or 1.5 RADIATOR SIDE COVERS (VRSCR).
5. Install maxi-fuse and right side cover.

REAR BRAKE MASTER CYLINDER (VRSCD, VRSCR) 2.24

REMOVAL

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

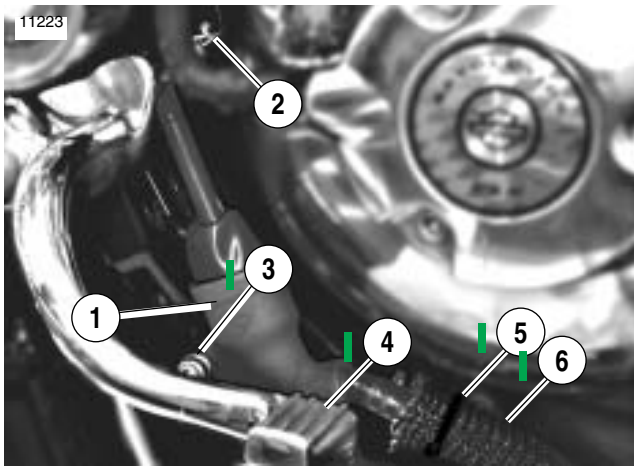
CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

NOTE

When removing/replacing rear brake master cylinder or reservoir, DO NOT disturb the placement of the brake fluid supply line. Brake line must remain positioned in on the inboard side of the frame rails. Note position of tie wrap. If tie wrap must be removed, mark location and install exactly as removed.

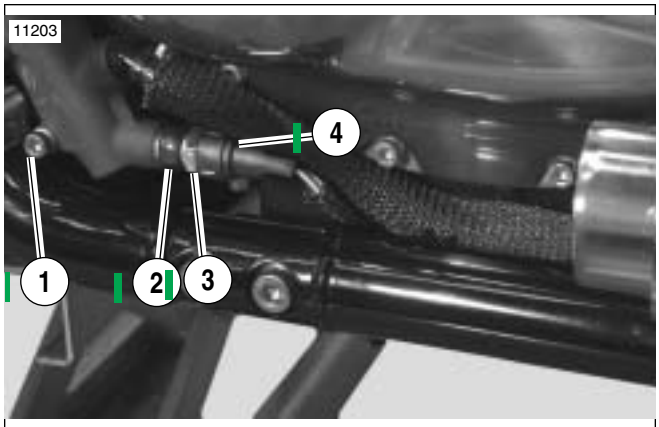
1. Drain master cylinder reservoir using a suction device.
2. Remove exhaust system. See 2.8 EXHAUST SYSTEM (VRSCD/VRSCR).
3. Remove right side rider foot control. See 2.14 FOOTRESTS/FOOT CONTROLS (VRSCD/VRSCR).



1. **Master cylinder**
2. **Master cylinder brake pedal clip**
3. **Upper master cylinder fastener**
4. **Brake pedal**
5. **Tie wrap**
6. **Brake hose with heat sheathing**

Figure 2-62. Rear Brake Master Cylinder and Clevis Pin Location

4. See Figure 2-62. Remove master cylinder brake pedal clip (2).



1. **Lower master cylinder fastener**
2. **Brake line and washers**
3. **Brake light switch**
4. **Brake light switch connector**

Figure 2-63. Brake Light Switch

NOTE

Protect painted areas for removal of brake line.

5. See Figure 2-63. Remove brake light switch connector (4), brake line and washers (2) from bottom of master cylinder.
6. See Figure 2-62. Remove brake hose with heat sheathing (6) and clamp.
7. Remove upper and lower master cylinder fasteners.
8. Remove master cylinder form motorcycle.

DISASSEMBLY

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

1. Thoroughly clean exterior of master cylinder assembly with denatured alcohol.
2. See Figure 2-64. Remove pivot (13) by loosening set-screw (14) and remove dust seal (12).

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

3. Using hand pressure, push down on spring (9) and remove small retaining clip (11) and washer (10) and remove spring.
4. Using hand pressure, push in push rod (8) and remove large retaining clip (7) using a snap ring pliers.
5. Remove push rod.
6. Remove piston valve (4) containing primary seal (3) and secondary seal (5) from master cylinder body (1).

1. **Master cylinder body (shown with hose attached)**
2. **Spring**
3. **Primary seal**
4. **Piston valve**
5. **Secondary seal**
6. **Retaining washer**
7. **Retaining clip (large)**
8. **Push rod**
9. **Spring**
10. **Washer**
11. **Retainer clip (small)**
12. **Dust seal**
13. **Pivot**
14. **Set Screw**

Figure 2-64. Rear Brake Master Cylinder/Reservoir (shown with supply hose attached)

CLEANING AND INSPECTION

WARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

1. Clean all parts using denatured alcohol. Check dust boot for cuts or tears. Replace as necessary.
2. Inspect threads and bore in master cylinder body, inspect springs for cracks or broken coils, and inspect master cylinder internal parts. Replace if damaged.
3. Wipe bore of master cylinder body with D.O.T. 4 BRAKE FLUID.

ASSEMBLY

To rebuild rear brake master cylinder, use components found in the SERVICE PARTS KIT.

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

1. See Figure 2-64. Lubricate inner bore of master cylinder body with D.O.T. 4 BRAKE FLUID.
2. Install **new** master cylinder repair kit (kit includes primary seal (3), secondary seal (5), piston valve (4), and spring (2).
3. Lay down a clean shop cloth and stand master cylinder assembly upright.

NOTE

Apply a drop of grease (supplied with kit) to each end of push rod before assembly. DO NOT use this grease on master cylinder internal parts.

4. See Figure 2-64. Insert ball end of push rod (8) into piston valve (4). Using hand pressure, push down to compress spring. Install washer (6) with cupped end toward spring and large retaining ring (7) into groove of master cylinder body bore.
5. Verify large retaining ring has seated in notches in master cylinder body.
6. Insert spring (9) into master cylinder body bore.
7. Using hand pressure, push down on spring and install small washer (10) and small retaining clip (11), locking small retaining clip into groove on push rod (8).
8. Verify small retaining clip has seated properly on push rod shaft.
9. Install dust seal (12) over shaft of push rod (8) and seat base of dust seal into bore of master cylinder body until base of seal is below bore opening.
10. Remove set screw (14) from pivot (13). Place a drop of LOCTITE® 242 on threads of set screw and install set screw into pivot.
11. Install pivot (13) on push rod end (8) and tighten set screw to 2-2.7 Nm (18-24 **in-lbs**).
12. Test operation of master cylinder. Check for binding or excessive drag when pushing down on push rod.

INSTALLATION

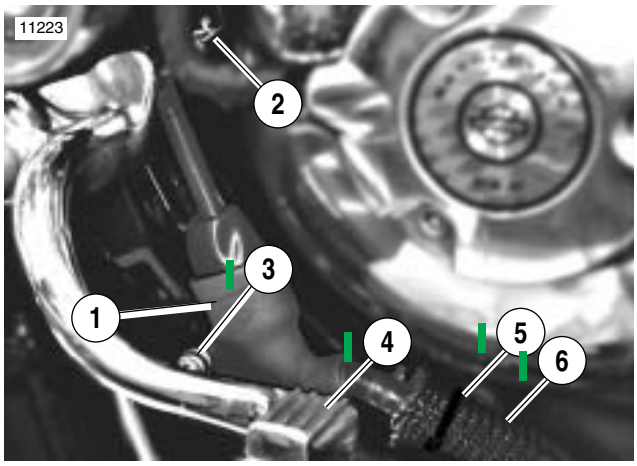
⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

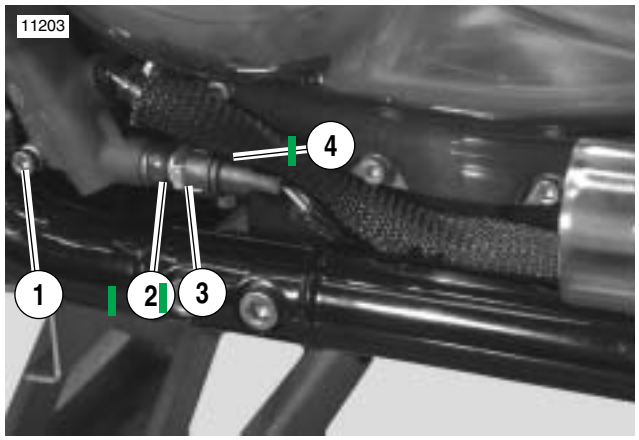
1. Install master cylinder to motorcycle and install upper and lower master cylinder fasteners. Tighten to 8-12 Nm (7-11 ft-lbs).



1. **Master cylinder**
2. **Master cylinder brake pedal clip**
3. **Upper master cylinder fastener**
4. **Brake pedal**
5. **Tie wrap**
6. **Brake hose**

Figure 2-65. Rear Brake Master Cylinder and Clevis Pin Location

2. See Figure 2-66. Install brake line (2) with new washers, install brake light switch (3), and tighten to 23-26 Nm (17-19 ft-lbs).
3. See Figure 2-65. Install brake hose (6) and clamp.
4. Install right side rider foot control. See 2.14 FOOT-RESTS/FOOT CONTROLS (VRSCD/VRSCR).



1. **Lower master cylinder fastener**
2. **Brake line and washers**
3. **Brake light switch**
4. **Brake light switch connector**

Figure 2-66. Brake Light Switch

⚠CAUTION

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

5. Test brake system.
   a. Turn ignition switch ON. Pump brake hand lever to verify operation of brake lamp.
   b. Test ride motorcycle. If the brakes feel spongy, bleed the system again. See 1.10 BLEEDING BRAKES.

REAR BRAKE CALIPER 2.25

REMOVAL

NOTE

If only replacing brake pads, do not remove rear brake caliper. Should pad replacement be necessary, see 1.11 BRAKE PADS AND DISCS.

1. Drain master cylinder brake reservoir using a suction device.
2. Remove saddlebag if necessary to gain access to rear brake caliper.

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)

3. Remove banjo bolt and both copper washers to detach rear brake line from caliper. Discard washers.
4. With motorcycle supported from underneath, remove axle nut and rear axle adjuster. Pull axle from the left side through right side rear fork arm and caliper only. Do not pull axle all the way out. See 2.30 REAR WHEEL.
5. Lift rear caliper away from axle and rear fork.

INSTALLATION

1. Place caliper on rear axle with notch inside rear fork weldment. Verify that rubber bumper is contacting underside of the caliper weldment for the full length of bumper. Install rear axle and check drive belt tension. See 2.30 REAR WHEEL.

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and caliper bore are clean and undamaged before assembly. (00321a)

2. Lubricate **new** copper washers with D.O.T. 4 BRAKE FLUID. Connect brake line to caliper using two **new** washers and banjo bolt. Tighten to 23-26 Nm (17-19 ft-lbs).

⚠CAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00353a)

CAUTION

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

3. Remove radiator side cover to access master cylinder. See 2.23 REAR BRAKE RESERVOIR (VRSCD/VRSCR). Remove cover from rear brake master cylinder. Fill master cylinder with D.O.T. 4 BRAKE FLUID. Verify that fluid level is at the FILL LEVEL boss when the motorcycle is level.

⚠WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

4. Bleed brake system. See 1.10 BLEEDING BRAKES.
5. Install radiator side cover.

⚠WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

6. Test brake system.
   a. Turn ignition switch ON. Pump brake foot pedal to verify operation of brake lamp.
   b. Test ride motorcycle. If brakes feel spongy, bleed the system again. See 1.10 BLEEDING BRAKES.

NOTE

*Avoid making hard stops for the first 100 miles (160 km). This allows the **new** pads to become conditioned to the brake discs.*

HANDLEBARS (VRSCA) 2.26

REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove rear view mirrors and turn signals.
3. Remove throttle cables from throttle control. See 2.15 THROTTLE CABLES.
4. Remove front brake master cylinder/reservoir, turn signal assembly, and throttle control from right handlebar. See 2.20 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
5. Remove switch housing from right handlebar. See 8.17 RIGHT HANDLEBAR SWITCH.
6. Cut clip holding wiring harness to right handlebar.
7. Remove clutch master cylinder/reservoir, turn signal assembly from left handlebar. See 2.16 CLUTCH MASTER CYLINDER/RESERVOIR.
8. Remove switch housing from left handlebar. See 8.18 LEFT HANDLEBAR SWITCH.
9. Cut clip holding wiring harness to left handlebar.
10. See Figure 2-67. To free lower end of top handlebar cover, loosen mounting bolts (3) holding headlamp bracket (2) to upper triple clamp (1).
11. See Figure 2-68. Without removing cover, remove fasteners (7) holding top handlebar cover (2) and instrument bezel (1) to lower handlebar cover (6).

CAUTION

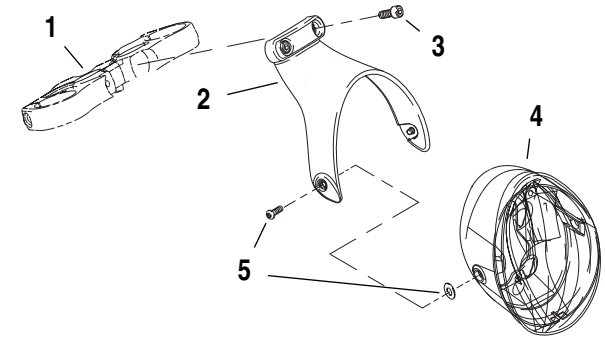
See Figure 2-68. Snap and hook at bottom of bezel holding top cover to lower handlebar cover can be damaged if forced during removal or installation.

12. From headlamp bracket end of cover, gently tilt top handlebar cover (2) and instrument bezel (1) up and back to remove cover and bezel.

NOTE

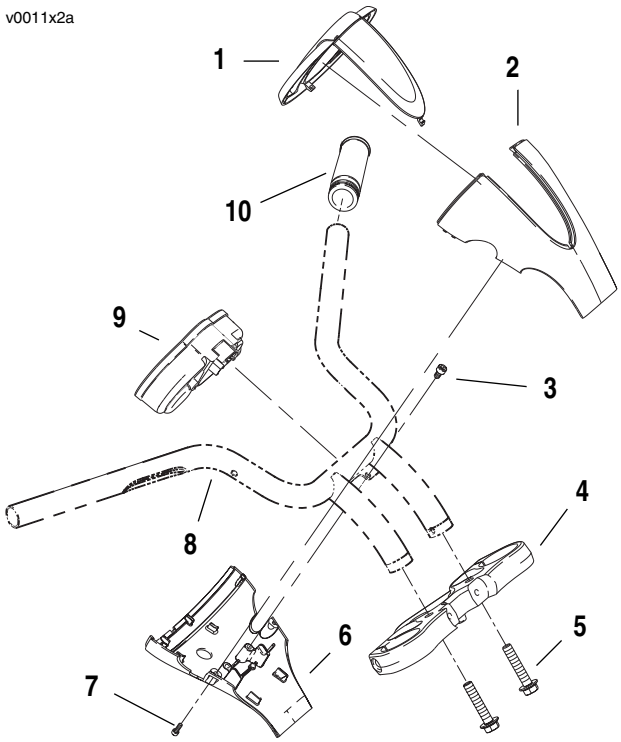
Bezel can remain snapped to upper handlebar cover.

13. Remove wiring harness connector to instrument cluster (9) and remove instrument cluster.
14. Remove fasteners (7) holding lower handlebar cover (6) to handlebars (8).
15. If necessary, remove the handgrip (10).
16. Remove fasteners (5) holding handlebars to upper triple clamp (4). Remove handlebars.



1. **Upper triple clamp**
2. **Headlamp bracket**
3. **Mounting bolt**
4. **Headlamp assembly**
5. **Headlamp assembly fastener and washer**

Figure 2-67. Headlamp Bracket and Headlamp Assembly



1. **Instrument bezel**
2. **Top handlebar cover**
3. **Lower cover fasteners**
4. **Upper triple clamp**
5. **Handlebar fasteners**
6. **Lower handlebar cover**
7. **Top cover fasteners**
8. **Handlebar**
9. **Instrument cluster**
10. **Handgrip**

Figure 2-68. Handlebar Assembly

INSTALLATION

1. See Figure 2-68. Mount handlebars (8) on upper triple clamp (4). Tighten handlebar fasteners (5) to 41-47 Nm (31-35 ft-lbs).
2. Mount lower handlebar cover (6) to handlebar (8). Tighten fasteners (3) to 6-10 Nm (53-88 **in-lbs**).
3. Mount instrument cluster (9). Connect wiring harness to instrument cluster.

CAUTION

Snap holding bottom of bezel and top cover to lower handlebar cover can be damaged if forced during removal or installation.

4. Orient instrument bezel and fit bezel hook over tab on lower handlebar cover. Gently tilt bezel (1) and top handlebar cover (2) until bezel hook snaps onto tab.
5. Fit top cover (2) under headlamp bracket. Bezel edge should fit snugly to grooved rim of lower and upper cover.
6. Install fasteners (7) that hold top handlebar cover (2), instrument bezel (1), and capture instrument cluster (9). Tighten fasteners to 1.3-1.9 Nm (12-16 **in-lbs**).
7. See Figure 2-67. Tighten headlamp bracket (2) fasteners (3) to 11-18 Nm (9-13 ft-lbs).
8. Install left handgrip:
   a. Using emery cloth, rough grip end of left handlebar.

NOTE

Before applying adhesive, clean the left handlebar with acetone.

   b. Apply LOCTITE PRISM PRIMER (770) to inside of **new** handgrip. Remove any excess PRIMS PRIMER with a clean cloth. Wait two minutes for PRISM PRIMER to set before attempting the next step.
   c. Apply LOCTITE PRISM SUPERBONDER (411) to inside of handgrip. Install handgrip on left handlebar.

NOTE

SUPERBONDER will set in four minutes and be fully cured in 24 hours.

9. Install left turn signal assembly, front brake master cylinder/reservoir, and brake hand lever, and throttle control handgrip. See 2.20 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
10. Install a **new** clip to hold the wiring harness to the left handlebar.
11. Install left handlebar switch housing. See 8.18 LEFT HANDLEBAR SWITCH.
12. Install throttle cable to throttle control handgrip. See 2.15 THROTTLE CABLES.
13. Install right turn signal assembly, clutch master cylinder/reservoir, and clutch hand lever assembly. See 2.16 CLUTCH MASTER CYLINDER/RESERVOIR.
14. Install a **new** clip to hold wiring harness to the right handlebar.
15. Install right handlebar switch housing. See 8.17 RIGHT HANDLEBAR SWITCH.
16. Install rear view mirrors and turn signals.
17. Install maxi-fuse and right side cover.

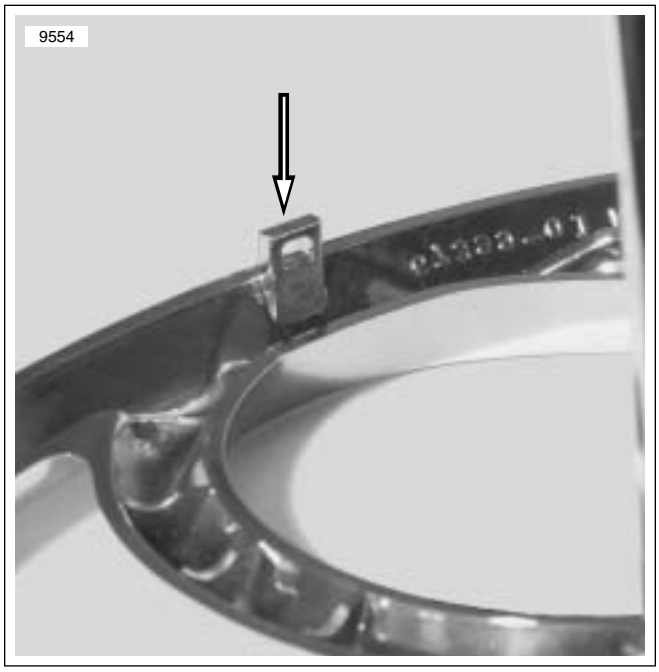


Figure 2-69. Bezel Hook

HANDLEBARS (VRSCD) 2.27

REMOVAL

1. Loosen headlamp adjuster and lower headlamp/nacelle assembly to allow for procedure. See 1.26 HEADLAMP ALIGNMENT.
2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
3. Remove rear view mirrors and turn signals.
4. Remove throttle cables from throttle control. See 2.15 THROTTLE CABLES.
5. Remove front brake master cylinder/reservoir, turn signal assembly, and throttle control from right handlebar. See 2.20 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
6. Remove switch housing from right handlebar. See 8.17 RIGHT HANDLEBAR SWITCH.
7. Cut clip holding wiring harness to right handlebar.
8. Remove clutch master cylinder/reservoir, turn signal assembly from left handlebar. See 2.16 CLUTCH MASTER CYLINDER/RESERVOIR.
9. Remove switch housing from left handlebar. See 8.18 LEFT HANDLEBAR SWITCH.
10. Cut clip holding wiring harness to left handlebar.
11. Remove the instrument cluster from the handlebar top clamp. See 8.22 InSTRUMENT CLUSTER (VRSCD).
12. See Figure 2-71. Supporting the handlebars (3), loosen and remove the 4 fasteners (1) holding the top clamp (2).
13. Remove the handlebars (3).
14. If necessary, remove the handgrip.
15. If necessary, loosen and remove the two fasteners (5) securing riser (4) to upper fork clamp and remove the riser (4).

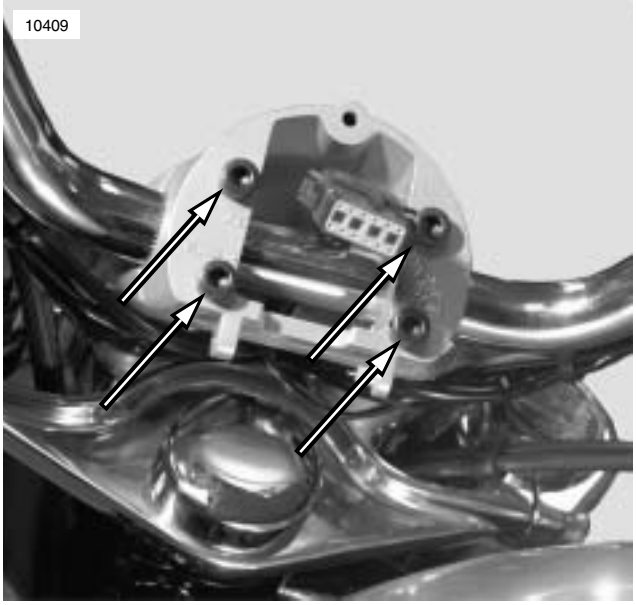
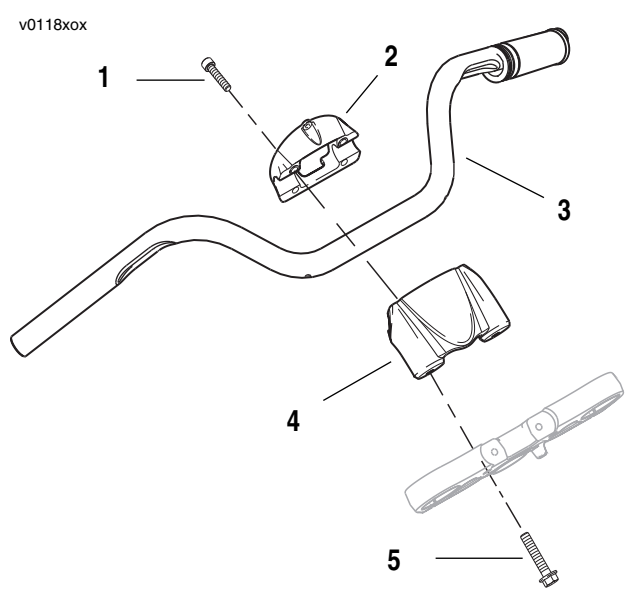


Figure 2-70. Handlebar Top Clamp Fasteners



1. **Top clamp fastener**
2. **Top clamp**
3. **Handlebar**
4. **Riser**
5. **Fastener**

Figure 2-71. Top Clamp, Handlebar, and Riser

INSTALLATION

1. Install cast riser on upper triple clamp (4). Tighten fasteners to 41-47 Nm (31-35 ft-lbs).
2. Mount handlebar on riser with top clamp. Thread in and tighten fasteners to hold handlebar.
3. Center handlebars. Verify that equal amounts of knurled areas on handlebar protrude from sides of upper handlebar clamp.
4. Figure 2-71. Position handlebars for rider posture and hold in position.
5. Tighten two front fasteners until cast-in spacers of upper clamp contact handlebar lower clamp.
6. Tighten rear fasteners to 16-20 Nm (144-180 **in-lbs**).
7. Final tighten front fasteners to 16-20 Nm (144-180 **in-lbs**). Slight gap between upper and lower clamps should exist at rear.
8. Install instrument cluster. See 8.22 InSTRUMENT CLUSTER (VRSCD).
9. If removed, install left handgrip:
   a. Using emery cloth, rough grip end of left handlebar.

NOTE

Before applying adhesive, clean the left handlebar with acetone.

   b. Apply LOCTITE PRISM PRIMER (770) to inside of **new** handgrip. Remove any excess PRISM PRIMER with a clean cloth. Wait two minutes for PRISM PRIMER to set before attempting the next step.
   c. Apply LOCTITE PRISM SUPERBONDER (411) to inside of handgrip. Install handgrip on left handlebar.

NOTE

SUPERBONDER will set in four minutes and be fully cured in 24 hours.

10. Install left turn signal assembly, front brake master cylinder/reservoir, and brake hand lever, and throttle control handgrip. See 2.20 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
11. Install a **new** clip to hold the wiring harness to the left handlebar.
12. Install left handlebar switch housing. See 8.18 LEFT HANDLEBAR SWITCH.
13. Install throttle cable to throttle control handgrip. See 2.15 THROTTLE CABLES.
14. Install right turn signal assembly, clutch master cylinder/reservoir, and clutch hand lever assembly. See 2.16 CLUTCH MASTER CYLINDER/RESERVOIR.
15. Install a **new** clip to hold wiring harness to the right handlebar.
16. Install right handlebar switch housing. See 8.17 RIGHT HANDLEBAR SWITCH.
17. Install rear view mirrors and turn signals.

HANDLEBARS (VRSCR) 2.28

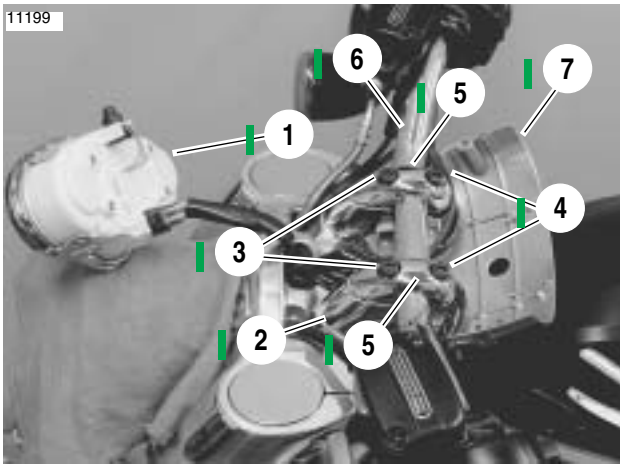
REMOVAL

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove air box cover. See 1.3 AIRBOX AND AIR FILTER.
3. See Figure 2-72. Remove and retain two instrument cluster cover fasteners (one per side) and remove instrument cluster cover.
4. See Figure 2-73. Place a shop towel over headlamp bucket to protect finish. Carefully lift instrument cluster (1) from lower handlebar cover and rest instrument cluster on shop towel.
5. Remove right handlebar switch housing from handlebar. See 8.17 RIGHT HANDLEBAR SWITCH
6. Remove front brake master cylinder/reservoir. See 2.20 FRONT BRAKE MASTER CYLINDER/RESERVOIR
7. Remove left handlebar switch housing from handlebar. See 8.18 LEFT HANDLEBAR SWITCH
8. Remove clutch master cylinder reservoir. See 2.16 CLUTCH MASTER CYLINDER/RESERVOIR.
9. If necessary, remove handgrips.
10. Remove any wire ties or cable clips necessary to remove handlebars.
11. Remove front fasteners (3) and rear fasteners (4) holding handlebar to upper triple clamp. Remove upper handlebar clamps (5) and remove handlebar (6) from lower handlebar clamps (2).

Figure 2-72. Instrument Cluster Cover Fasteners

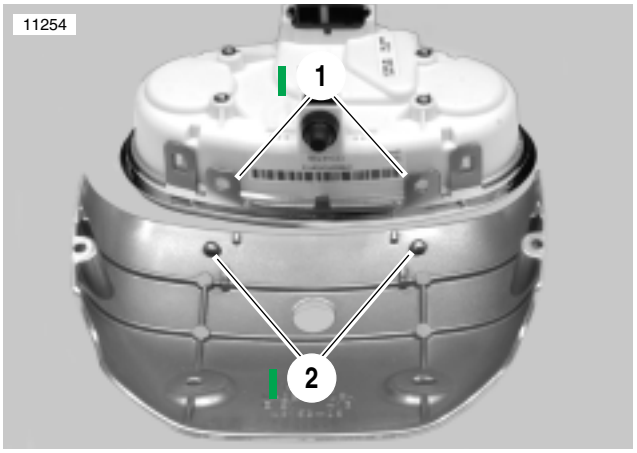
INSTALLATION

1. See Figure 2-73. Install handlebar (6) in lower handlebar clamps (2). Install upper handlebar clamps (5) and install front (3) and rear (4) handlebar fasteners. Position handlebars to original location and tighten to 41-47 Nm (31-35 ft-lbs).
2. See Figure 2-74. Mount instrument cluster in lower handlebar cover by matching up instrument cluster locating tabs (1) with lower instrument cluster cover locators (2).
3. Fit top cover over instrument cluster. Bezel edge and upper locating tabs should fit snugly into upper cover.



1. **Instrument cluster**
2. **Lower handlebar clamps (2)**
3. **Front fasteners**
4. **Rear fasteners**
5. **Upper handle bar clamps**
6. **Handlebar**
7. **Lower handlebar cover**

Figure 2-73. Handlebar Assembly



1. **Instrument cluster locating tabs**
2. **Lower handlebar cover locators**

Figure 2-74. Instrument Cluster and Lower Handlebar Cover (removed from motorcycle for photo clarity)

4. See Figure 2-74.. Install instrument cluster cover fasteners. Tighten fasteners to 1.3-1.9 Nm (12-16 **in-lbs**).

5. If removed, Install handgrips:
   a. Using emery cloth, score both grip ends of handlebar where handgrips will be installed.

NOTE

Before applying adhesive, clean handlebar with acetone.

   b. Apply LOCTITE® PRISM PRIMER (770) to inside of **new** handgrip. Remove any excess PRIMS PRIMER with a clean cloth. Wait two minutes for PRISM PRIMER to set before attempting the next step.
   c. Apply LOCTITE® PRISM SUPERBONDER (411) to inside of handgrip. Install handgrip on handlebar. Repeat procedure for other side.

NOTE

SUPERBONDER will set in four minutes and be fully cured in 24 hours.

6. Install front brake master cylinder/reservoir, and brake hand lever, and throttle control handgrip. See 2.20 FRONT BRAKE MASTER CYLINDER/RESERVOIR.
7. Install left handlebar switch housing. See 8.18 LEFT HANDLEBAR SWITCH.
8. Install clutch master cylinder/reservoir, and clutch hand lever assembly. See 2.16 CLUTCH MASTER CYLINDER/RESERVOIR.
9. Install **new** clips or wire ties to replace any removed earlier to hold wiring harnesses to handlebar.
10. Install right handlebar switch housing. See 8.17 RIGHT HANDLEBAR SWITCH.
11. Install maxi-fuse, right side cover, and air box cover.

FRONT WHEEL 2.29

GENERAL

Maximum tire mileage and good handling qualities are directly related to wheel and tire care. Wheels and tires should be inspected regularly for wear. If handling problems occur, check 1.28 TROUBLESHOOTING for possible causes.

Preliminary Inspection - Brake Discs

1. Measure brake disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
2. If warped, replace disc. Maximum allowable lateral runout of a spring washer mounted brake disc is 0.3 mm (0.012 in.).
3. If scored, replace disc.

Preliminary Inspection - Wheel/Tire

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. Inspect tire for wear and wear pattern. Replace tire as necessary.
3. Inspect air valve. Replace as necessary.
4. Inspect wheel bearing end play and service bearings if necessary. If end play is 0.051 mm (0.002 in.) or more, replace the wheel bearings. See 2.31 SEALED WHEEL BEARINGS.

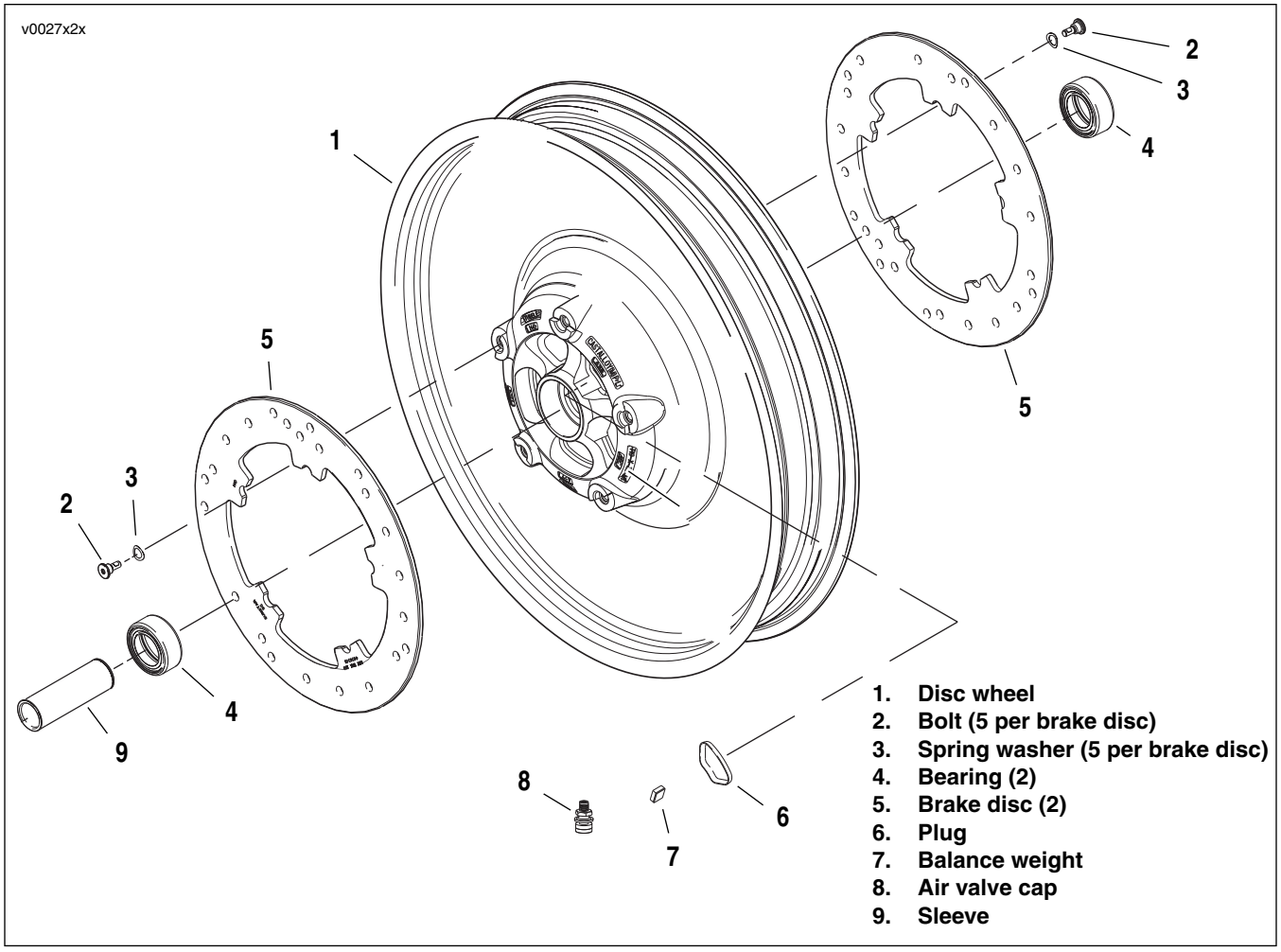


Figure 2-75. Front Wheel Components (typical)

REMOVAL

1. Block motorcycle underneath frame so front wheel is off the ground.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

2. Remove right side cover and maxi-fuse.
3. See Figure 2-76. Remove both upper and lower mounting bolts to remove brake caliper assembly.
4. Support calipers using a rubber bungee cord. Be careful not to scratch fender or fork slider finish.
5. Repeat to remove opposite caliper.

NOTE

Do not operate front brake lever with the front wheel removed or the caliper piston may be forced out of piston bore.

6. See Figure 2-78. Loosen pinch bolt (2) in right side axle holder (4).
7. Insert screwdriver or steel rod through hole in axle (1) on right side. While holding axle stationary, remove axle nut (5).
8. Pull axle out while retaining the left and right inner wheel spacers (3).
9. Remove wheel assembly from forks.

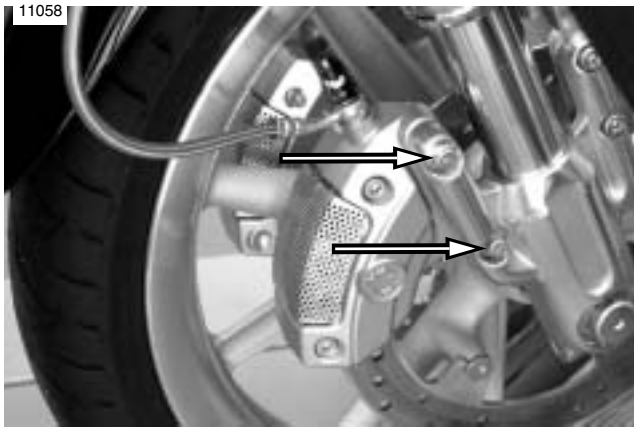
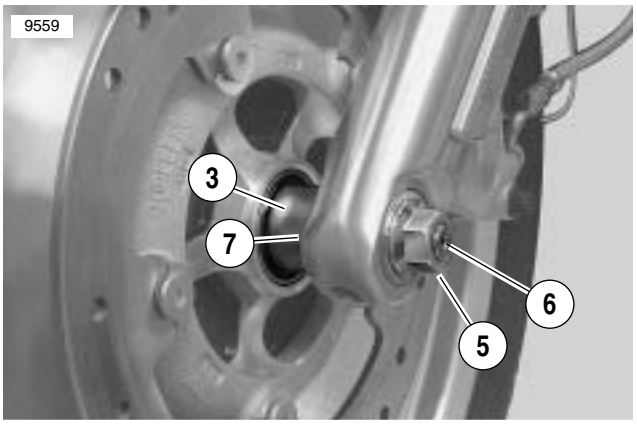
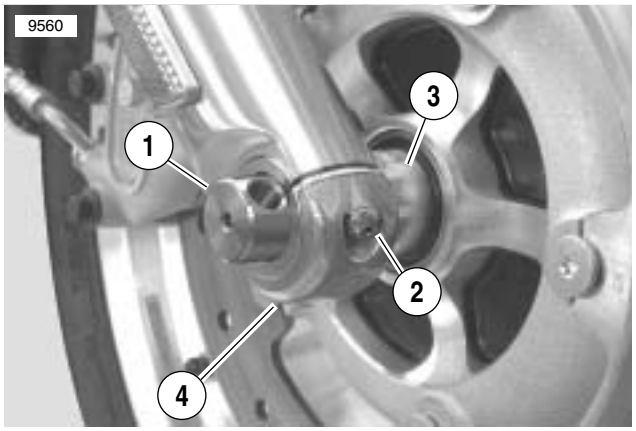


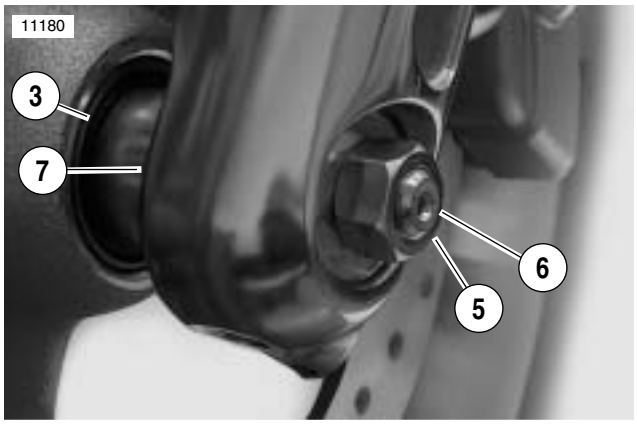
Figure 2-76. Caliper Mounting Bolts (typical) (VRSCR shown)

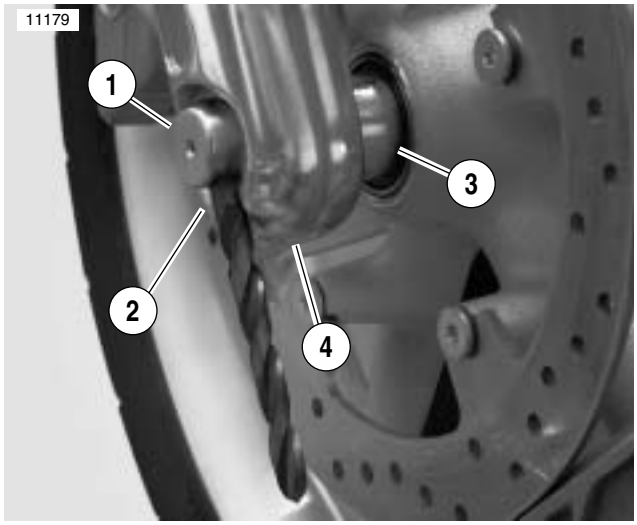




1. **Axle**
2. **Pinch bolts (screws)**
3. **Left and right inner wheel spacer**
4. **Axle holder (right side only)**
5. **Axle nut**
6. **Bolt**
7. **Spring washer**

Figure 2-77. Front Wheel Mounting (VRSCA/VRSCD)





1. **Axle**
2. **Pinch bolt (screw)**
3. **Left and right inner wheel spacer**
4. **Axle holder (right side only)**
5. **Axle nut**
6. **Bolt**
7. **Spring washer**

Figure 2-78. Front Wheel Mounting (VRSCR)

DISASSEMBLY

NOTE

See 2.33 TIRES to service tire or valve stem assembly.

1. Remove spacers from left and right sides.
2. If tire replacement is necessary, remove tire and valve stem. See 2.33 TIRES.
3. If wheel bearing replacement is necessary, remove the sleeve and press out the sealed wheel bearings. See 2.31 SEALED WHEEL BEARINGS.
4. If it is necessary to remove brake discs and if wheel is to be assembled with same discs, mark both wheel and discs, so they can be installed in their original locations.
5. See Figure 2-75. If removing brake discs (5), remove five bolts (2) and spring washers (3) securing brake disc to the wheel (1). Repeat procedure to remove disc on opposite side of wheel. Discard bolts and spring washers.

CLEANING AND INSPECTION

1. Thoroughly clean all parts in solvent.
2. Inspect all parts for damage or excessive wear.

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

3. Inspect brake discs. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc. Also replace discs if warped or badly scored. See 1.11 BRAKE PADS AND DISCS.

NOTE

Minimum thickness is measured from backing plate.

4. Inspect brake pads. Minimum brake pad thickness is 0.4 mm (0.016 in.). See 1.11 BRAKE PADS AND DISCS.

ASSEMBLY

⚠WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

NOTE

Always install first of two bearings on the side opposite the valve stem side of the wheel.

1. If sealed wheel bearings must be serviced, always replace bearings as a complete set. See 2.31 SEALED WHEEL BEARINGS.

⚠WARNING

Do not inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)

2. If necessary, mount tire, valve stem and balance wheel assembly as required. See 2.33 TIRES.
3. Verify that wheel and tire are true. See 2.33 TIRES and 2.32 DISC RIM RUNOUT.

⚠WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

4. See Figure 2-75. If necessary, install brake discs in their original positions. Verify that brake disc is clean.
   a. On left side of wheel, install five **new** bolts (2) and five **new** spring washers (3) to attach left brake disc. Tighten bolts to 22-33 Nm (16-24 ft-lbs).
   b. On right side of wheel, install five **new** bolts (2) and five **new** spring washers (3 to attach right brake disc. Tighten bolts to 22-23 Nm (16-24 ft-lbs).
5. After wheel is balanced, apply a coat of LOCTITE® ANTI-SEIZE LUBRICANT to entire surface of right side bearing race.

INSTALLATION

NOTE

Drill bit shown in illustrations is used ONLY for axle nut tightening procedure. Right side fork leg alignment should follow written procedure.

1. Apply a liberal coat of LOCTITE® ANTI-SEIZE LUBRICANT to the axle.
2. See Figure 2-80. Place wheel and spacers into front fork and install axle (5). Verify that axle spacers on right and left side are properly installed.
3. Thread on the axle nut. Insert drill bit, screwdriver or steel rod through hole in axle on right side of vehicle. While holding axle stationary, tighten axle nut to 68-75 Nm (50-55 ft-lbs).
4. Pull fork leg so that it just contacts the inner wheel spacer and then tighten axle holder pinch bolt (2) to 55-65 Nm (41-48 ft-lbs). Ensure that gap between the axle holder (3) and the fork slider (1) is equal at front and rear of axle holder.
5. Remove drill bit, screwdriver or steel rod from axle hole.

⚠WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

6. Install the brake caliper to the fork legs.
   a. Loosely install long mounting bolt into top hole on fork leg.
   b. Install short mounting bolt into bottom hole on fork leg. Tighten bottom mounting bolt to 43-52 Nm (32-38 ft-lbs).
   c. Final tighten top mounting bolt to 43-52 Nm (32-38 ft-lbs).
7. Repeat steps 6-7 to install brake caliper on other side of wheel.

⚠WARNING

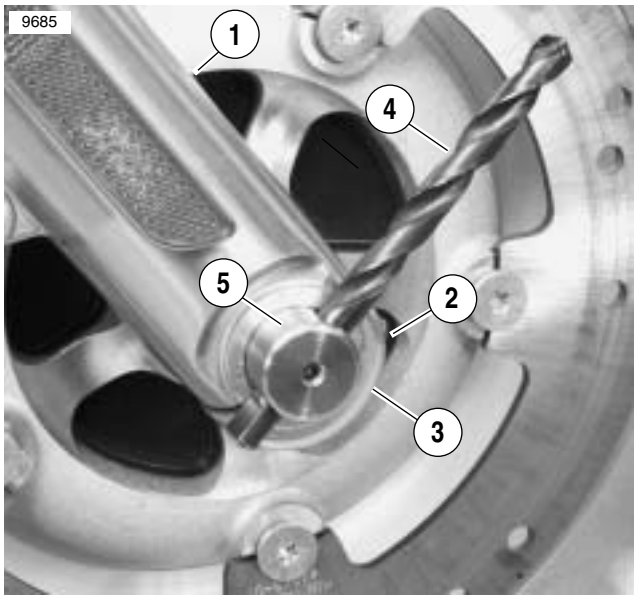
Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)

8. Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads.

⚠WARNING

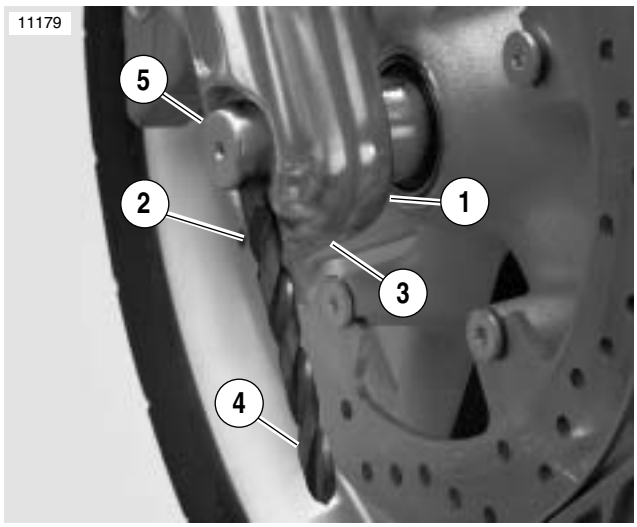
After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

9. Reinstall maxi-fuse and right side cover.



1. Fork slider
2. Axle holder pinch bolt
3. Axle holder
4. Drill bit, screwdriver or steel rod
5. Axle

Figure 2-79. Aligning Fork to Wheel (VRSCA/VRSCD)



1. Fork slider
2. Axle holder pinch bolt
3. Axle holder
4. Drill bit, screwdriver or steel rod
5. Axle

Figure 2-80. Aligning Fork to Wheel (VRSCR)

REAR WHEEL 2.30

GENERAL

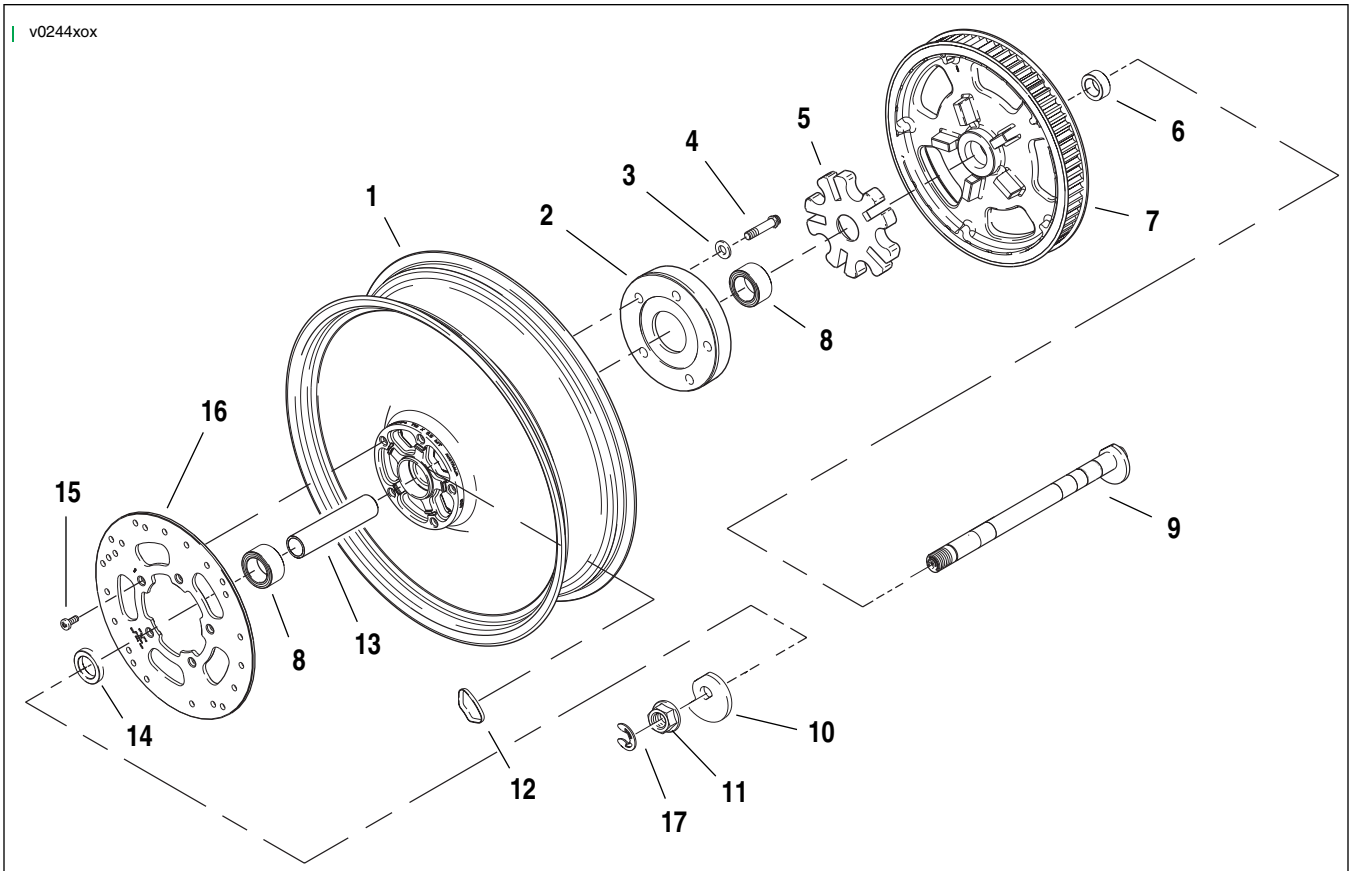
Maximum tire mileage and good handling qualities are directly related to care given wheels and tires. Wheels and tires should be inspected regularly for wear. If handling problems occur, check 1.28 TROUBLESHOOTING for possible causes.

Preliminary Inspection - Brake Disc

1. Measure brake disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
2. Replace disc if warped. Maximum allowable runout of a rear brake disc is 0.3 mm (0.012 in.).
3. If scored, replace disc.

Preliminary Inspection - Wheel/Tire

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. Inspect tire for wear and wear pattern. Remove wheel assembly and replace tire as necessary. See 2.33 TIRES.
3. Inspect air valve. Replace as necessary.
4. Inspect wheel bearing end play and service bearings if necessary. If end play is 0.051 mm (0.002 in.) or more, replace the wheel bearings. See 2.31 SEALED WHEEL BEARINGS.



1. **Disc wheel**
2. **Compensator bowl**
3. **Lockwasher (5)**
4. **Screw**
5. **Cushion compensator**
6. **Left side spacer (2)**
7. **Sprocket assembly (w/bearings)**
8. **Bearing (2)**
9. **Axle**
10. **Rear axle adjuster**
11. **Axle nut**
12. **Plug**
13. **Sleeve**
14. **Right side spacer**
15. **Fasteners (5)**
16. **Brake disc**
17. **Snap ring**

Figure 2-81. Rear Wheel Components (typical)

REMOVAL

1. Block motorcycle underneath frame so weight of motorcycle is off of rear wheel.

NOTE

A scissors style jack will allow you to raise or lower the motorcycle at different points throughout the procedure to provide both clearance and alignment during removal and installation.

2. Remove right side cover and maxi-fuse.
3. See Figure 2-82. Remove fasteners holding lower debris deflector (4) to rear fork. Remove debris deflector.
4. If necessary, remove fasteners holding belt guard (1) to rear fork. Back lower shock bolt (2) out until belt guard is free and remove belt guard. Shock bolt retaining threads are integral to belt guard. Leave shock bolt in place to maintain alignment.
5. See Figure 2-83. Remove snap ring (2), axle nut (1) and adjuster (4) from right side of axle.
6. Relieve belt tension by rotating axle adjusters.

CAUTION

Support rear tire from underneath during removal. Failure to support rear tire may cause damage to the motorcycle as the axle is removed.

7. Tap axle towards left side until rear brake caliper is free.
8. Slide rear caliper up off of brake disc towards front of motorcycle. Using a bungee cord, secure caliper to right side shock. Be sure rubber bumper stays with caliper.
9. Remove axle. Identify and set aside right and left spacers, right side axle adjuster, axle nut, and snap ring.

CAUTION

Polished aluminum wheels can be scratched or damaged when slid out of and into the rear fork. Exercise caution to avoid dragging wheel and sprocket surfaces against rear fork components.

10. Move wheel forward and slip belt off sprocket. Adjust height of the scissors jack to allow removing wheel assembly without damaging components.

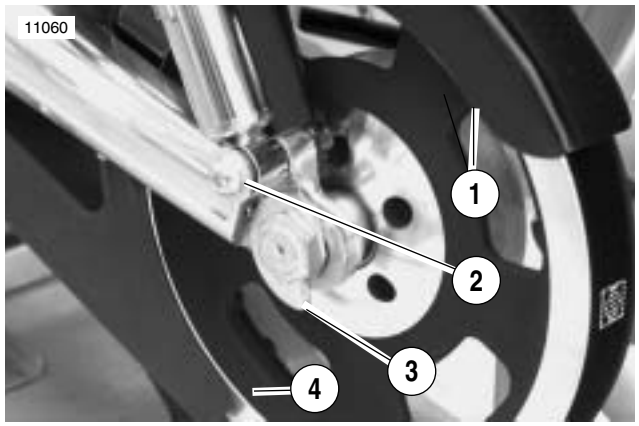
NOTE

Note the height of the license plate bracket. Pulling the rear wheel can break off the reflector brackets.

11. Pull wheel and drive belt sprocket assembly from rear fork.

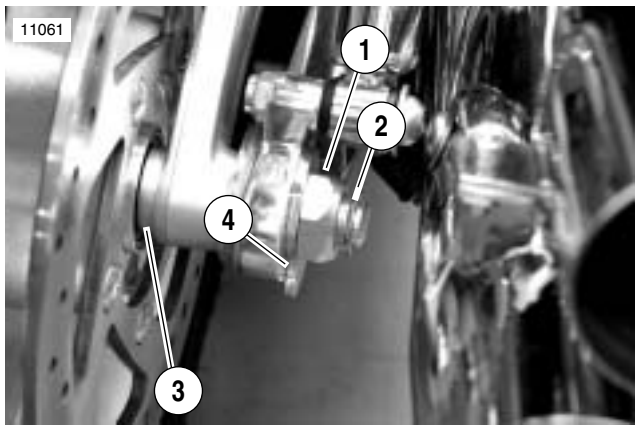
NOTE

Do not operate rear brake pedal with the rear wheel removed or the caliper piston may be forced out of piston bores. Reseating the piston requires disassembly of the caliper.



1. **Belt guard**
2. **Lower shock bolt**
3. **Left side axle adjuster**
4. **Debris deflector**

Figure 2-82. Rear Axle: Left Side (typical)



1. **Axle nut**
2. **Snap ring**
3. **Right side spacer**
4. **Right side axle adjuster**

Figure 2-83. Rear Axle: Right Side (typical)

DISASSEMBLY

1. See Figure 2-84. Pull sprocket out of rubber compensator cushion (1) and compensator bowl (4) mounted to disc wheel.
2. Pull compensator spacer (2) and compensator cushion (1) from compensator bowl (4) mounted to disc wheel.
3. If tire replacement is necessary, remove tire and valve stem. See 2.33 TIRES.

NOTE

If drive sprocket bearing surface is rough or if bearing is leaking grease, replace bearing in CLEANING AND INSPECTION procedures.

4. See Figure 2-81. If necessary, remove screws (4) and lockwashers (3) holding compensator bowl (2) to disc wheel (1). Remove compensator bowl (2).
5. If necessary, remove fasteners (15) that hold brake disc (16) to disc wheel (1) and remove brake disc (16).

CLEANING AND INSPECTION

1. Clean all parts in solvent and inspect all parts for damage or excessive wear.

NOTE

The wheels are aluminum and do not have a protective coating. Damage from harsh chemicals, acid based wheel cleaners, brake dust and lack of maintenance can occur. Use HARLEY-DAVIDSON WHEEL & TIRE CLEANER (Part No. 94658-98) to clean the wheels and tires and then use HARLEY GLOSS (Part No. 94627-98) to protect the aluminum wheel surfaces.

2. Inspect rear belt. See 1.16 DRIVE BELT AND WHEEL SPROCKET.
3. Inspect sprocket bearing. If bearing surface is rough or if bearing was leaking grease, replace sprocket bearing as follows:
   a. Supporting hub inside compensator dogs. use a suitable drift to press bearing out of sprocket hub.
   b. Lubricate the bearing bore in the sprocket hub.
   c. Supporting hub from cosmetic side in such a manner as to not damage machined surface, use a suitable drift to press in a **new** bearing. To avoid damaging bearing, drift should press on outside race of bearing.
4. Inspect compensator cushion for missing chunks or excessive debris beyond normal wear marks. Replace if necessary.
5. Inspect brake disc. Replace disc if warped or badly scored. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
6. If sealed wheel bearings must be serviced, see 2.31 SEALED WHEEL BEARINGS

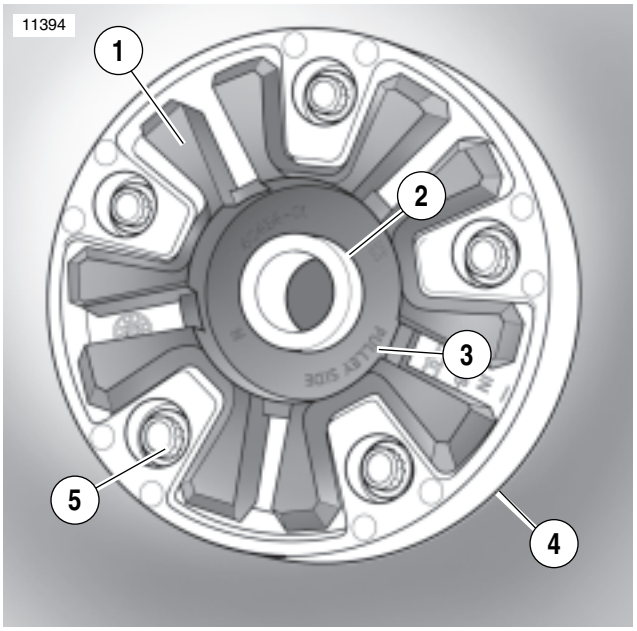
⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

7. Inspect brake pads, calipers, and brake lines. Replace pads and service calipers and brake lines as required. See 1.11 BRAKE PADS AND DISCS.

ASSEMBLY

1. If necessary, mount tire, valve stem and balance wheel assembly as required. See 2.33 TIRES.
2. Install brake disc, if removed, on valve stem side of wheel.
   a. Apply a drop of LOCTITE® 242 to the five bolts that hold on rear brake disc.
   b. Thread in and alternately tighten to 41-53 Nm (30-38 ft-lbs).
3. Install compensator bowl. Thread in screws and helical spring lockwashers. Tighten to 61-75 Nm (45-55 ft-lbs).
4. Verify that wheel and tire are true and balanced. See 2.32 DISC RIM RUNOUT and 2.33 TIRES.
5. After wheel is balanced, apply LOCTITE® ANTI-SEIZE LUBRICANT to entire surface of left side (compensator bowl) bearing race only.
6. See Figure 2-84. Lubricate compensator cushion (1) with a detergent spray like Windex™ and install compensator cushion. Be sure the PULLEY SIDE legend (3) is facing out.
7. Install the compensation spacer (2) with the grooved end in the cushion (1).
8. Insert sprocket dogs into compensator cushion to mate sprocket to rear wheel.



1. **Compensator cushion**
2. **Compensator spacer**
3. **PULLEY SIDE legend**
4. **Compensator bowl**
5. **Screws and helical spring lockwashers**

Figure 2-84. Compensator Cushion in Compensator Bowl

INSTALLATION

1. Install wheel into rear fork.
2. Slide drive belt over drive sprocket.
3. Slide brake calipers over front brake disc between brake pads. Lubricate rubber bumper with a detergent spray and slide slot in the caliper over brake anchor weldment on rear fork. Be sure rubber bumper is in place under weldment.
4. Coat axle liberally with LOCTITE® ANTI-SEIZE LUBRICANT and install.
   a. From left side, carefully insert axle through rear fork, left side spacer, drive sprocket, compensator cushion, into wheel assembly.
   b. Continue sliding axle through wheel assembly hub sleeve, right side spacer, brake caliper, and left rear fork. Center right side spacer on wheel bearing to allow axle to pass through. Axle is fully installed when left side cam is tight against rear fork.
   c. Slip on right side axle adjuster. Right side axle adjuster will only fit in a manner that matches position of left side eccentric.
   d. Coat flange of axle nut with LOCTITE® ANTI-SEIZE LUBRICANT and thread on and finger tighten axle nut.

⚠WARNING

Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)

5. Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads.
6. Verify axle alignment and then check belt deflection. See 1.15 REAR BELT DEFLECTION.
7. Use a wrench to rotate rear axle adjuster until drive belt deflection is within specifications.

⚠WARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)

8. Tighten axle nut to 190-203 Nm (140-150 ft-lbs).
9. Install snap ring.
10. If belt guard was removed, slide belt guard slots onto rubber grommets. Install shock mount bolt into belt guard. See 2.44 REAR SHOCK ABSORBERS (VRSCA/VRSCD), or 2.45 REAR SHOCK ABSORBERS (VRSCR)
11. Slide debris deflector slots on to its corresponding rubber grommet. Install debris deflector bolt and tighten bolt to 6-10 Nm (53-88 **in-lbs**).
12. Measure belt guard to drive sprocket clearance.
13. If clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.
14. Install maxi-fuse and right side cover.

SEALED WHEEL BEARINGS 2.31

GENERAL

Inspection for lateral end play, removal, and installation procedures for sealed wheel bearings are the same for both the front wheel and the rear wheel.

INSPECTION: LATERAL END PLAY

1. Block motorcycle underneath frame so wheel is raised off ground.
2. See Figure 2-85. Mount a magnetic base dial indicator to brake disc with dial's contact point on end of axle.
3. To check for lateral end play, turn wheel through several rotations, then move wheel side to side.
   a. If end play is less than service wear limit of 0.051 mm (.002 in.), bearing passes inspection.
   b. If end play exceeds service wear limit or feels rough, remove wheel and replace both wheel bearings.

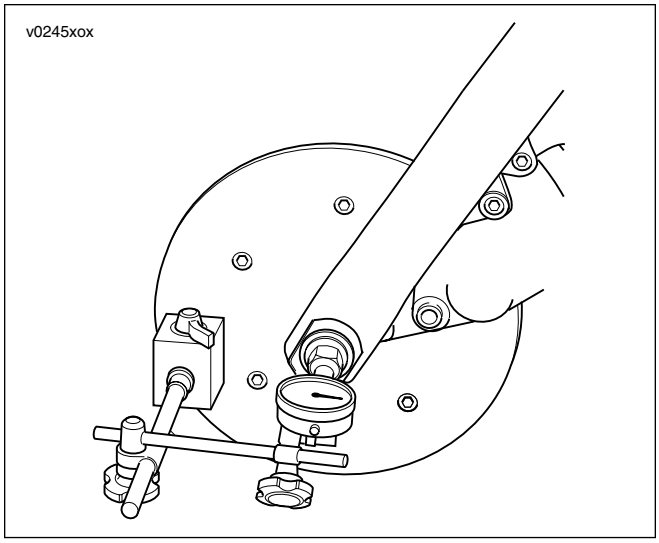
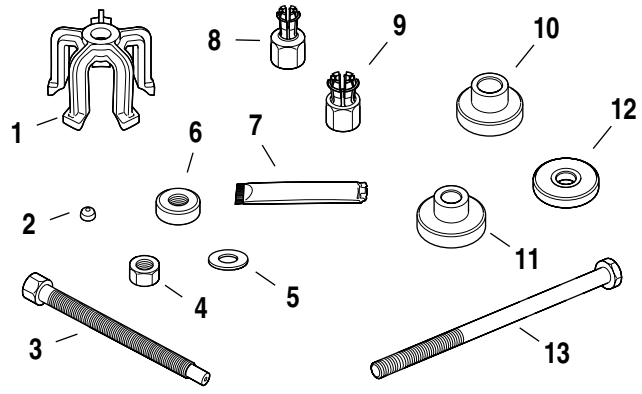


Figure 2-85. Measuring Lateral End Play (Front Wheel) (typical)



Parts 1-7 common to removal/installation.
Parts 8-9 used for removal only.
Parts 10-13 used for installation only.

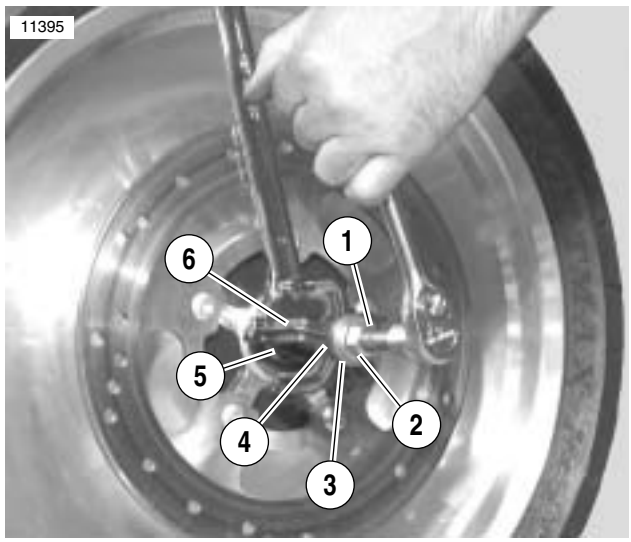
NO.	DESCRIPTION	PART NO.
1	Bridge	HD-44060-5
2	Steel ball	12547
3	Forcing screw	HD-44060-4
4	Nut	10210
5	Washer	12004
6	Nice bearing	RS25100-200
7	Lubricant	J-23444A
8	Collet, 3/4 in.	HD-44060-3
9	Collet, 1.0 in.	HD-44060-7
10	Pilot, 1.0 in.	HD-44060-8
11	Pilot, 3/4 in.	HD-44060-6
12	Support plate	HD-44060-1
13	Threaded rod	280856

Figure 2-86. HD-44060 Wheel Bearing Tools

REMOVAL

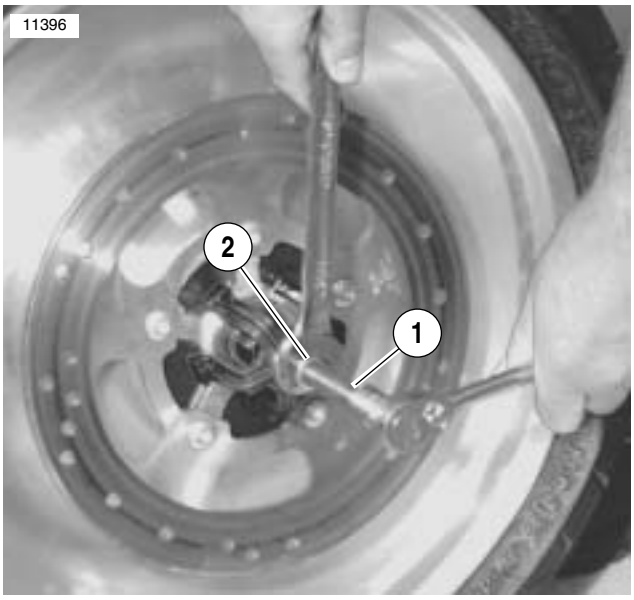
PART NO.	SPECIALTY TOOL
HD-44060	Wheel bearing installer/remover

1. Remove wheel. See 2.30 REAR WHEEL and 2.29 FRONT WHEEL.
2. See Figure 2-87. Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060) and assemble tools required for bearing removal.
   a. Sparingly apply graphite lubricant to threads of forcing screw (1) to prolong service life and ensure smooth operation.
   b. Install nut (2), washer (3) and Nice bearing (4) on screw. Insert assembly through hole in bridge (6).
   c. Drop ball bearing inside collet (5). Fasten collet and ball bearing to forcing screw (1).
3. Hold end of forcing screw (1) and turn collet (5) to expand edges of collet.
4. See Figure 2-88. When expanded collet has gripped bearing edges, hold end of forcing screw (1) and turn nut (2) to remove bearing from wheel.
5. Remove spacer from inside wheel hub.
6. Repeat procedure for opposite side bearing. Discard all bearings upon removal.



1. **Forcing screw**
2. **Nut**
3. **Washer**
4. **Nice bearing**
5. **Collet with ball bearing inside**
6. **Bridge**

Figure 2-87. Gripping Bearing (typical)



1. **Forcing screw**
2. **Nut**

Figure 2-88. Removing Bearing (typical)

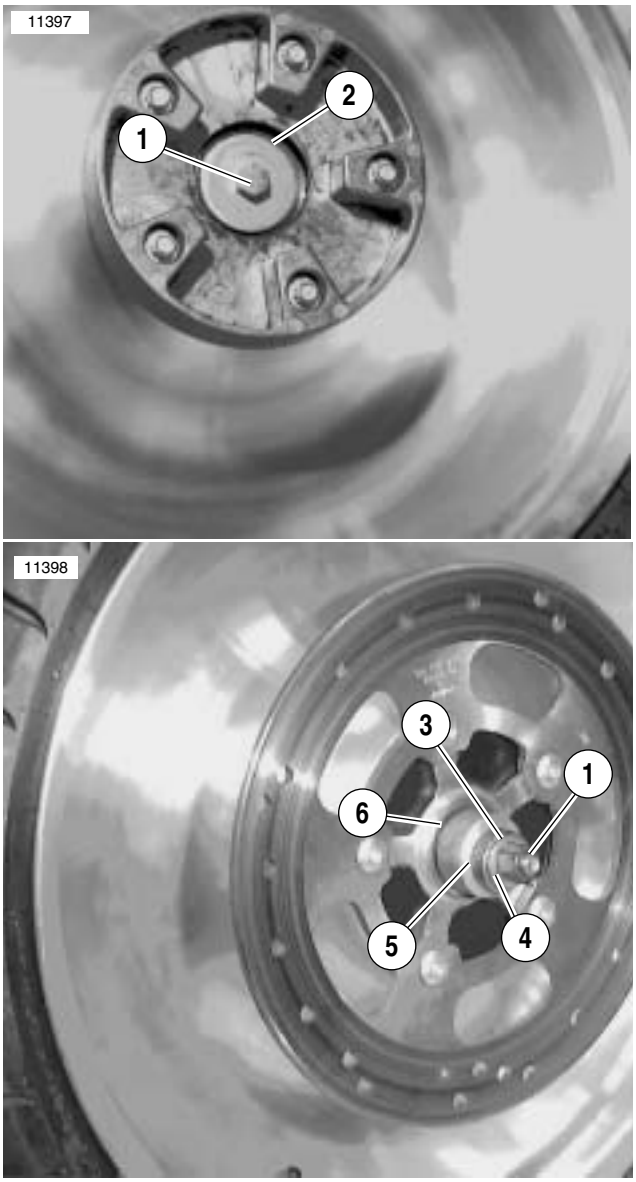
INSTALLATION

PART NO.	SPECIALTY TOOL
HD-44060	Wheel bearing installer/remover

NOTE

On a front wheel, install bearing on the left side first. On a rear wheel, install bearing on the brake disc or right side first.

1. Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060) and assemble tools required for bearing installation.
   a. Sparingly apply graphite lubricant to threads of a draw down bolt or a suitable threaded rod with double locking nuts to prolong service life and ensure smooth operation.
   b. See Figure 2-89. Place threaded rod (1) through support plate (2).
   c. Insert assembly through wheel.
   d. Place the **new** bearing on threaded rod (1) with lettered side outward.
   e. Install pilot (6), Nice bearing (5), washer (4) and nut (3) over rod.
2. Hold hex end of threaded rod (1) and turn nut (3) to install bearing. Bearing will be fully seated when nut can no longer be turned. Remove tool.
3. Install spacer sleeve inside wheel hub.
4. Reverse tool and install opposite side bearing.



1. **Threaded rod**
2. **Support plate**
3. **Nut**
4. **Washer**
5. **Nice bearing**
6. **Pilot**

Figure 2-89. Installing Wheel Bearing (typical)

DISC RIM RUNOUT 2.32

GENERAL

Disc wheels should be checked for lateral and radial runout before installing a new tire or tube.

Table 2-15. Rim Runout Maximums

RUNOUT	MM	IN
Lateral	1.02	0.040
Radial	0.76	0.030

LATERAL RUNOUT

See Figure 2-90. Install arbor in wheel hub and place wheel in WHEEL TRUING STAND (Part No. HD-95599-80). To check rim lateral runout, place a gauge rod or dial indicator near rim bead. Spin wheel. If lateral runout exceeds 1.02 mm (0.040 in.), replace wheel.

PART NO.	SPECIALTY TOOL
HD-95599-80	Wheel truing stand

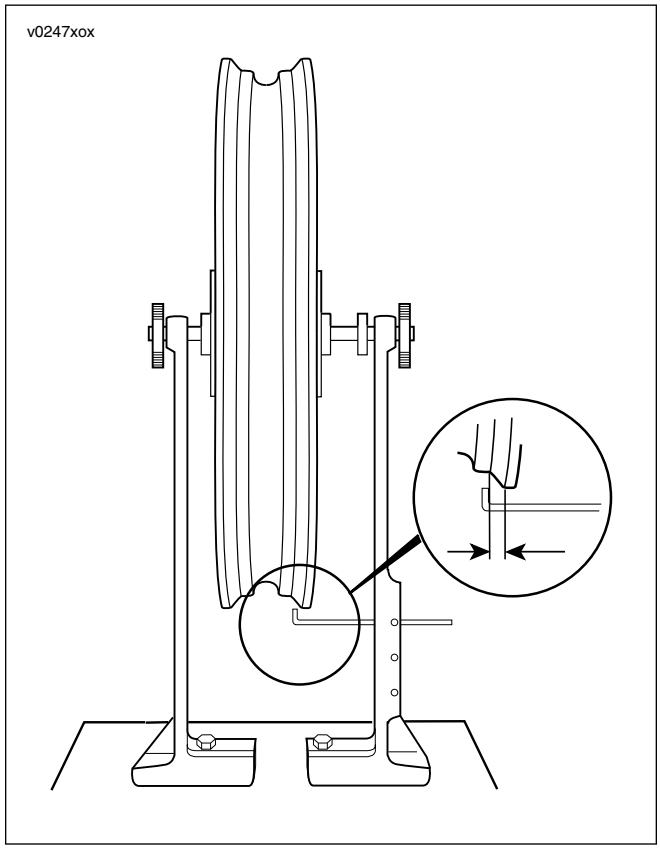


Figure 2-90. Rim Lateral Runout

RADIAL RUNOUT

See Figure 2-91. Spin wheel to check for radial runout. Replace wheel if rim radial runout exceeds 0.76 mm (0.030 in.).

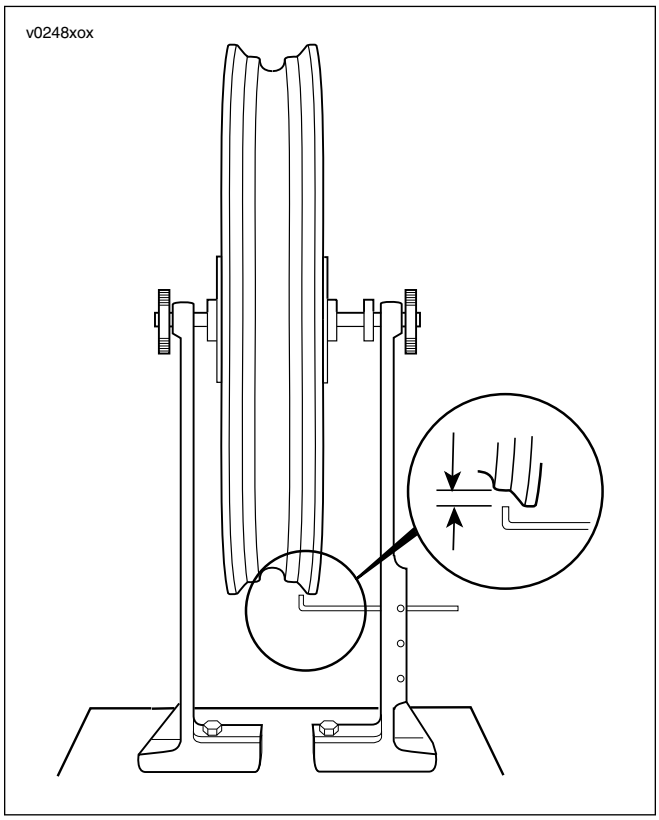


Figure 2-91. Rim Radial Runout

TIRES 2.33

GENERAL

Tires should be inspected for punctures, cuts, breaks, and wear at least weekly.

New tires should be stored in a horizontal tire rack. Avoid stacking new tires in a vertical stack. The weight of the stack compresses the tires and closes down the beads.

⚠WARNING

Replace punctured or damaged tires. In some cases, small punctures in the tread area may be repaired from within the demounted tire by a Harley-Davidson dealer. Speed should NOT exceed 50 mph (80 km/h) for the first 24 hours after repair, and the repaired tire should NEVER be used over 80 mph (130 km/h). Failure to follow this warning could result in death or serious injury. (00015a)

Tubeless tires may be repaired in the tread area only if the puncture is 6.4 mm (1/4 in.) or smaller. All repairs must be made from inside the tire.

Acceptable repair methods include a patch and plug combination, chemical or hot vulcanizing patches or head-type plugs. When repairing tires, use TIRE SPREADER (Part No. HD-21000) to spread the tire sidewalls.

⚠WARNING

Never repair a tire with less than 1.6 mm (1/16 in.) tread depth. Inadequate tread depth can cause an accident which could result in death or serious injury.

DEMOUNTNG TIRES

1. Remove wheel from motorcycle. See 2.29 FRONT WHEEL, and/or 2.30 REAR WHEEL. Remove drive sprocket from a rear wheel.
2. Deflate tire. Use a valve core tool to remove valve core from valve stem.

⚠WARNING

Read the operating manual for the manufacturer and model of tire machine used. Failure to follow operational procedures or to heed any cautions/warnings in the manual for the tire machine could result in death or serious injury. (00283a)

3. See Figure 2-92. Use a pneumatic bead breaker to loosen bead. Rotate wheel and apply bead breaker at several points along circumference of the rim until entire bead drops into rim well.

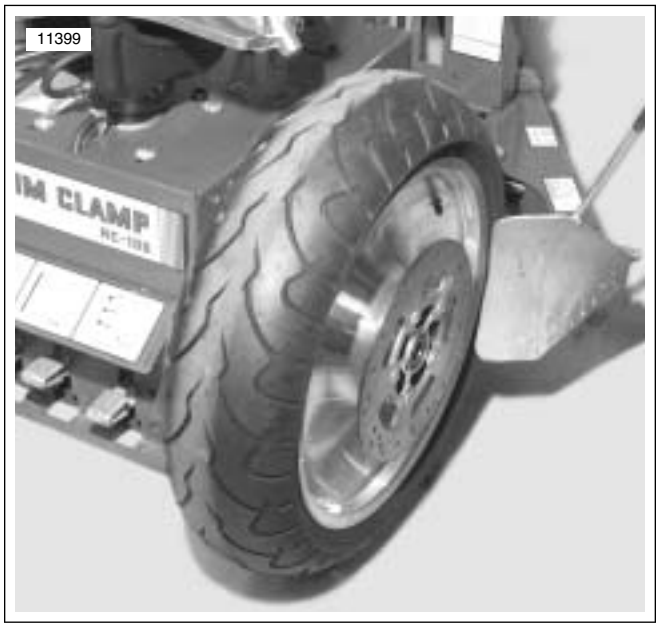


Figure 2-92. Pneumatic Bead Breaker

4. Install wheel onto jaws of tire machine. Lubricate tire bead with soap solution.
5. Fit wedge over rim of wheel.
6. See Figure 2-93. Pull bead up over rim in one spot and fit bead to wedge. Spin wheel to draw full length of bead over rim and off wheel. Do not use excessive force when starting bead over rim.

Figure 2-93. Tire Machine Pulling Bead Off Rim

CAUTION

Follow the tire machine manufacture's recommendation for the correct placement of the bead on the mandrel. Incorrect mounting may damage the bead and ruin the tire.

7. If necessary, repeat for opposite bead and remove tire from wheel.

CLEANING AND INSPECTION

1. Clean inside of rim. If rim is dirty or corroded, clean with a stiff wire brush.
2. Wheels should be checked for lateral and radial runout before installing a new tire or tube. See 2.32 DISC RIM RUNOUT.
3. Inspect tire for wear. Measure tread depth.

PART NO.	SPECIALTY TOOL
HD-21000	Tire spreader

4. Use TIRE SPREADER (HD-21000) and inspect inside of tire for wear and damage.

TIRE REPLACEMENT

See Figure 2-94. Tire wear indicator bars will appear on tire tread surfaces when 1/32 inch (0.8 mm) or less of tire tread remains. Arrows on tire sidewalls pinpoint location of wear bar indicators. Always remove tires from service before they reach the tread wear indicator bars (1/32 of an inch/0.8 mm tread pattern depth remaining).

New tires are needed if any of the following conditions exist.

1. Tire wear indicator bars become visible on the tread surfaces.
2. Tire cords or fabric become visible through cracked sidewalls, snags or deep cuts.
3. A bump, bulge or split in the tire.
4. Puncture, cut or other damage to the tire that cannot be repaired.

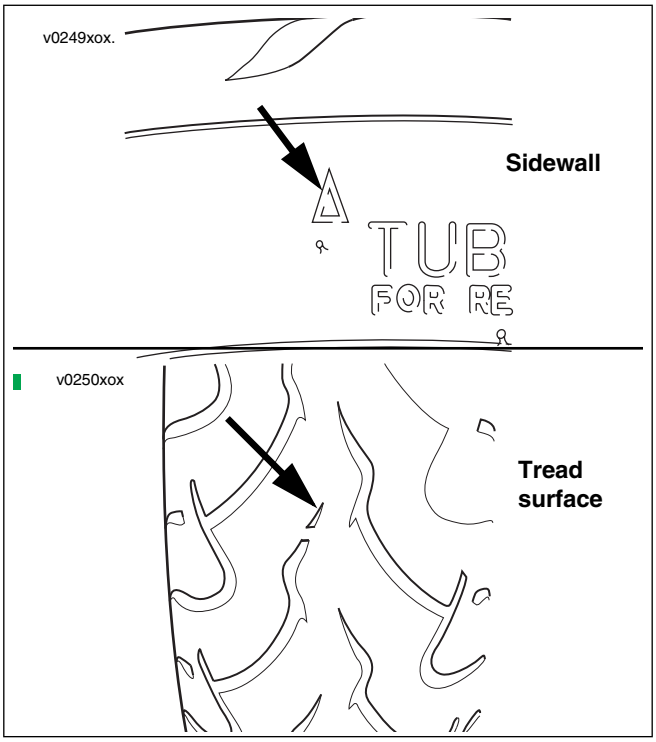


Figure 2-94. Tire Wear Indicators for VRSC

MOUNTING TIRES

⚠WARNING

Only install original equipment tire valves and valve caps. A valve, or valve and cap combination, that is too long or too heavy can strike adjacent components and damage the valve, causing rapid tire deflation. Rapid tire deflation can cause loss of vehicle control, which could result in death or serious injury. (00281a)

NOTE

New radial tires are extremely stiff and tires stored near the bottom of a tire stack may take a compressed set.

NOTE

Warm radial tires mount easier than cold tires. Prior to mounting, store new tire in a warm area and/or in sun light. Tire temperature should not exceed 48° C (120° F).

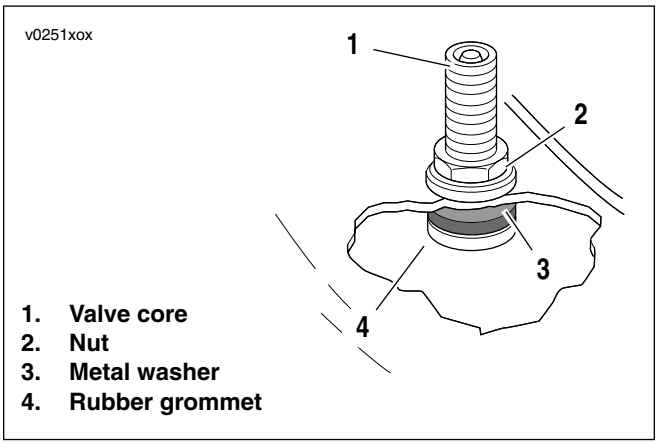


Figure 2-95. Valve Stem (typical)

1. See Figure 2-95. Replace damaged or leaking valve stems.

NOTE

Leaving the valve core out of the valve stem will allow a sufficient volume of air to inflate the radial tire to seat the beads on the rim.

   a. Insert valve stem with rubber grommet (4) in place into rim hole.
   b. Install metal washer (3) over valve stem.
   c. Install nut (2). Tighten to 1.4-1.7 Nm (12-15 **in-lbs**).

2. Thoroughly lubricate bead on both sides of tire with a rubber lubricant. Lubricate inside diameter of bead and side wall. Lubricate rim flanges and safety hump on wheel.

⚠WARNING

Read the operating manual for the manufacturer and model of tire machine used. Failure to follow operational procedures or to heed any cautions/warnings in the manual for the tire machine could result in death or serious injury. (00283a)

3. With rim installed in pneumatic tire machine jaws, orient tire with rotational arrow pointing in direction of forward rotation. Push one side off bottom bead into rim well and walk the bottom bead around until it is completely in the rim well.

NOTE

The tire has a colored dot on sidewall, it is a balance mark and should be located next to valve stem hole.

4. Position yellow dot at valve stem and starting 180 degrees opposite valve stem, mount top bead to shoe of pneumatic tire machine.

5. Rotate wheel to pull bead into rim well. Remove wheel from tire machine.

⚠WARNING

Do not exceed manufacturer's recommended pressure to seat beads. Exceeding recommended bead seat pressure can cause tire rim assembly to burst, which could result in death or serious injury. (00282a)

6. Center tire to wheel and inflate tire to trial seat bead on the rim. Identify any spot around rim where bead does not seat correctly before deflating the tire.

7. While inflating a second time, press down on sidewall opposite spot where bead did not seat during first inflation.

8. Continue to deflate and inflate tire while by pressing on side of tire opposite any spot on tire where bead is not seating. Continue procedure until tire is centered all the way around rim.

9. Install a **new** valve core and adjust air pressure as required to match recommended pressures. See 1.12 TIRES AND WHEELS.

10. Check tire for both radial and lateral runout. See TIRE RUNOUT in 2.33 TIRES.

11. Balance tire as required. See 2.33 TIRES.

12. Clean wheel and rim of any rubber lubricant or soap used in mounting tire.

NOTE

Lubricants or detergents can cause corrosion on the motorcycle's wheel if not removed immediately after mounting and balancing a tire.

TIRE RUNOUT

Mounted tires should be checked for both lateral and radial tire runout.

Table 2-16. Tire Runout Maximums

RUNOUT	MM	IN
Lateral	2.29	0.090
Radial	2.03	0.080

Lateral Runout

1. See Figure 2-96. Check tire runout by turning wheel on axle, measuring tire lateral runout.

NOTE

Be sure bead is properly seated on rim. Deflate and reseat tire if necessary.

2. Maximum tire lateral runout is 1.52 mm (0.060 in.). If tire tread runout exceeds 1.52 mm (0.060 in.), remove tire from rim and check wheel rim lateral runout to see if rim is at fault. See 2.32 DISC RIM RUNOUT.
3. If rim lateral runout is less than 0.76 mm (0.030 in.), tire is at fault and should be replaced. If rim lateral runout is more than 0.76 mm (0.030 in.), correct by replacing disc wheel.

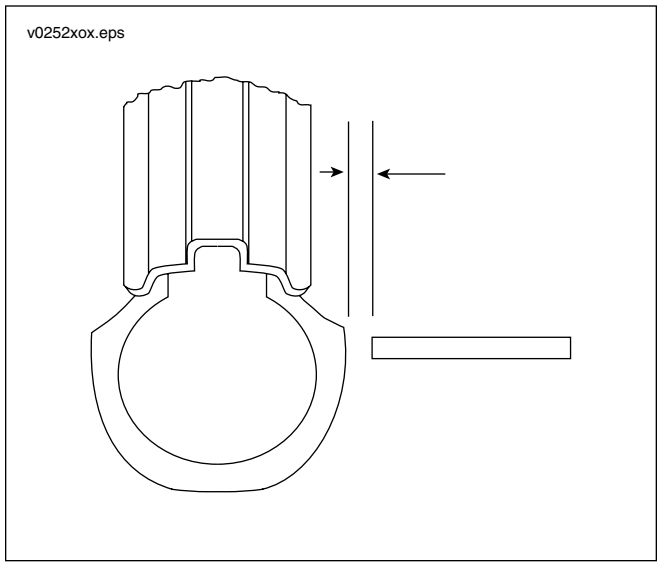


Figure 2-96. Lateral Tire Runout

Radial Runout

1. See Figure 2-97. With a tire centered and mounted on the rim, check runout by turning wheel on axle, measuring amount of radial displacement from a fixed point near the tire.

NOTE

Make sure bead is properly seated on rim. Deflate and reseat tire if necessary.

2. Maximum tire tread runout is 2.29 mm (0.090 in.). If tire tread runout exceeds 2.29 mm (0.090 in.), remove tire from rim and check rim radial runout to see if rim is at fault. See 2.32 DISC RIM RUNOUT.
3. If rim radial runout is less than 0.76 mm (0.030 in.), tire is at fault and should be replaced. If rim radial runout is more than 0.76 mm (0.030 in.), correct by replacing wheel.

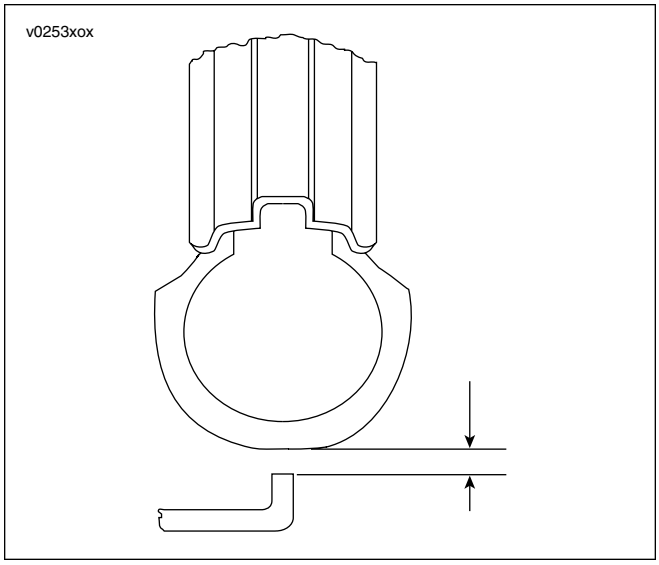


Figure 2-97. Radial Tire Runout

WHEEL BALANCING

Wheels must be balanced to improve handling and reduce vibration, especially at high road speeds.

PART NO.	SPECIALTY TOOL
HD-95599-80	Wheel truing stand

Static balancing using WHEEL TRUING STAND (HD-95599-80) will produce satisfactory results.

Dynamic balancing, utilizing a wheel spinner, should be used to produce finer tolerances for best high speed handling characteristics. Follow the instructions supplied with the balance machine you are using.

Cast aluminum wheels require the special self adhesive balance weights listed below.

Table 2-17. Balance Weights

COLOR	GRAMS	OZ.
Silver (HD-95595-84)	7	0.25
Black (HD-95594-84)	7	0.25

1. Use a balancing machine to determine amount of balance weight required to bring wheel within 7 g (0.25 oz.) at 97 km/h (60 mph).

NOTES

- *The maximum weight permissible to accomplish balance is 99 g (3.5 oz.) total weight applied on the rim.*
- *Self adhesive wheel weights should be applied to the flat surface of the rim in increments of 7 g (0.25 oz.).*
- *If 28 g (1.0 oz.) or more weight must be added at one location, split the amount so that half is applied to each side of the rim.*

2. To apply self adhesive wheel weights, make sure that area of application is completely clean, dry, and free of oil and grease.
3. Remove paper backing from weight and apply 3 drops of LOCTITE® SUPERBONDER 420 to the adhesive side of weight.
4. Place weight on rim, press firmly in place and hold for 10 seconds. Wheel should not be used for 8 hours to allow adhesive to cure completely.
5. Recheck balance. Repeat procedures as necessary.

WHEEL ALIGNMENT 2.34

GENERAL

The alignment of the front wheel to the rear wheel is set at the factory. There are no adjustments for alignment. Alignment is maintained with quality components and with correct assembly procedures.

The stabilizer link between the engine and the frame is a horizontal engine locator only. The stabilizer link is **not** to be used to adjust the horizontal alignment of the rear wheel. See 2.6 FRONT ENGINE MOUNT ASSEMBLY.

Verification of front wheel to rear wheel alignment can be used to determine the cause of an ill-handling motorcycle or of a vibration/noise in the front engine mount.

INSPECTION

Before following the verification procedure, after engine removal and replacement, or after service that requires removing and replacing the front motor mounts or the rear fork and engine mounts, always inspect the front and rear engine mounts, the stabilizer link, the rear tire to the fender mounting hardware clearance and the lower left crankcase to frame rail clearance.

Front Engine Mount

1. Verify condition and torque of the front engine mount. Visually inspect for wear, damage or improper installation. Replace hardware as necessary.
2. Replace the rubber mount if there are any signs of bulging, cracking, or shearing. See 2.5 FRONT ENGINE MOUNT.

Rear Engine Mounts and Rear Fork Pivot

1. Verify condition and torque of the mounting hardware. Visually inspect for wear, damage or improper installation. Replace hardware as necessary.
2. Examine rubber rear engine mounts to be sure there is no twisting or binding. Replace as required. See 2.9 REAR ENGINE MOUNTS.

Engine Stabilizer Link

1. Verify condition and torque of the mounting hardware.
2. Visually inspect for wear, damage or improper installation. Replace hardware as necessary. See 2.6 FRONT ENGINE MOUNT ASSEMBLY.

Clearances

1. The rear wheel and tire must have adequate clearance through its suspension travel.
2. The engine crankcase should have a minimum 3.18 mm (0.125 in.) clearance from the lower left hand frame rail.

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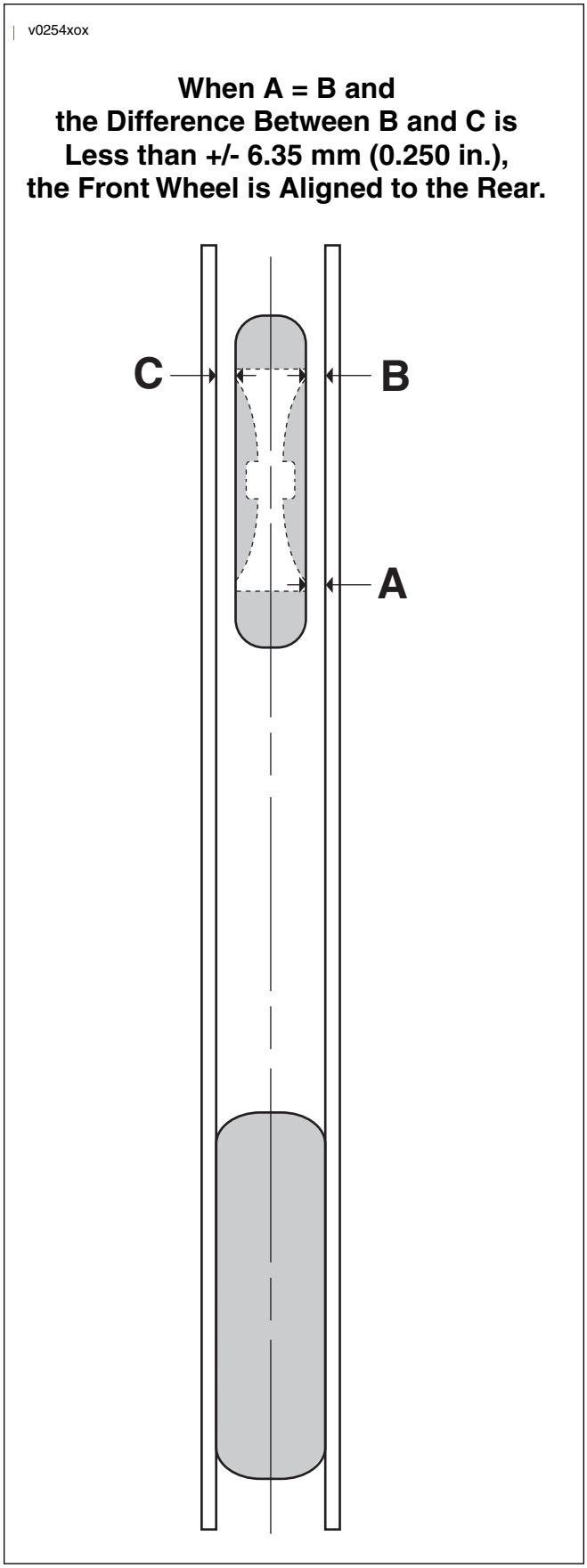


Figure 2-98. Wheel Alignment

VERIFICATION

⚠WARNING

Check vehicle alignment according to following procedures. Incorrect alignment can adversely affect stability and handling, which could result in death or serious injury. (00287a)

1. Verification of wheel alignment requires that the motorcycle meet specifications for the following components:
   a. Wheels. See 2.32 DISC RIM RUNOUT.
   b. Tires. See 1.12 TIRES AND WHEELS.
   c. Steering head bearing “fall-away.” See 1.19 STEERING HEAD BEARINGS (VRSCA, VRSCD), or 1.20 STEERING HEAD BEARINGS (VRSCR)
   d. Belt deflection. See 1.15 REAR BELT DEFLECTION.
2. Place the motorcycle on a center stand to support the vehicle and lift the rear wheel off the ground.
   a. Place scissors jack under fuel tank mount with clearance for alignment bars.
   b. Do **NOT** support engine on oil sump. The engine must be free to shift slightly in its mounts.
   c. Be sure the motorcycle is as level as possible.
3. Identify the rear tire clearance to the rear fender and mounting hardware. The tire should appear to be centered and move through its travel without hitting other components.
4. Install a set of straightedges or alignment bars on both the left and right side of motorcycle alongside the front and rear tires.
   a. Both alignment bars should firmly contact the rear tire at two points on both sides of the tire.
   b. Use clamps or bungee cords to hold the bars in place. Tension should be equal to avoid spreading or pinching the bars.
   c. Verify that the bars are parallel by comparing the measurements between the bars at both ends.
5. See Figure 2-98. Straighten the front forks. From the front wheel rim, measure to the bar on one side of the motorcycle at the rear of the rim (A) and at the front of the rim (B) (two points). Straighten the front forks until the two measurements are equal (A = B).
6. See Figure 2-99. Measure vertical alignment by placing an inclinometer vertically on front and rear brake discs. Front and rear lean angles should be equal within +/- 1/2 degree.
7. See Figure 2-98. On the other side of the motorcycle, measure from the alignment bar to the front wheel rim (C) and compare measurement to that of the opposite side (B - C).
   a. If opposing side measurements (B - C) are within +/- 6.35 mm (0.250 in.), the front and rear wheel are **in** alignment.
   b. If the difference in opposing side measurements (B - C) is more than +/- 6.35 mm (0.250 in.), the front and rear wheel are **out** of alignment.

Figure 2-99. Measuring Vertical Alignment (typical)

CENTERING ENGINE

1. Verify wheel alignment. See 2.34 WHEEL ALIGNMENT.
2. See Figure 2-100. If the front and rear wheels are out of alignment, loosen and remove the engine stabilizer link from the tab on the frame. This allows the engine to center itself to the front and rear engine mounts.
3. Repeat alignment verification:
   a. See Figure 2-98. To straighten the front wheel, measure from the front wheel rim to the bar on one side at two points (A, B) along the wheel rim. Straighten the front wheel until the measurements are the same (A = B).
   b. Measure the front and rear brake disc vertical lean angles. The angles should be within +/- 1/2 degree.
   c. On the other side, measure the from the rim to the bar (C) and compare (B - C) to the measurement from the opposite side. The measurements must be within +/- 6.35 mm (0.250 in.).
   d. Check the left lower engine case to frame rail clearance. It should be at least 3.18 mm (0.125 in.).
   e. Identify clearance between the rear tire and the rear fender mounting hardware. The tire should appear to be centered and move through its suspension travel without hitting other components.

CAUTION

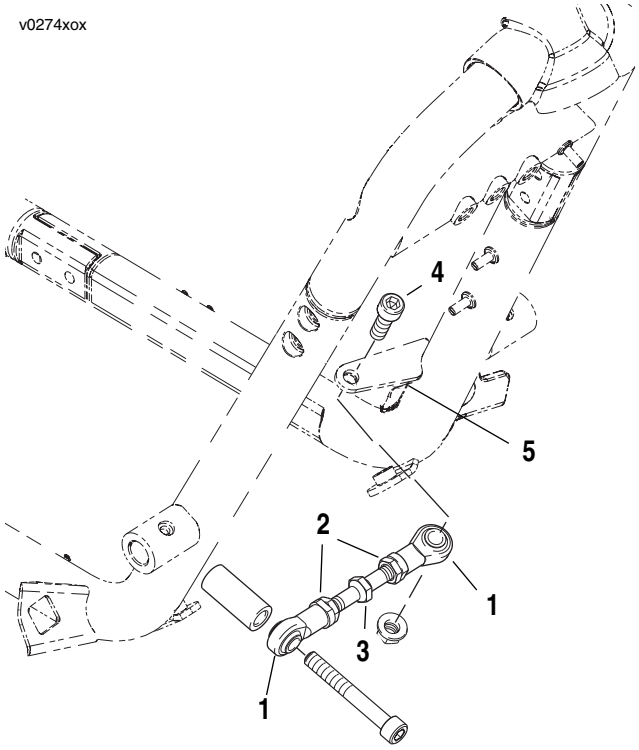
Lengthening or shortening the stabilizer link can put stress on the crankcase mounting boss. The stress may break or crack the crankcase mounting boss after light impact.

4. See Figure 2-100. The stabilizer link fastener (4) should fit freely through the ball end of the link (1) and the frame tab (5). If it does not, loosen lock nuts (2) on the ball ends (1) and use adjusting nut (3) and rod to adjust length of stabilizer link until stabilizer link bolt fits freely through ball end (1) of stabilizer link and frame tab (5).
5. Tighten stabilizer link to frame tab fastener (4) to 34-41 Nm (25-30 ft-lbs).

NOTE

If installing the stabilizer link causes interference between the rear tire and fender mounting hardware or the lower left crankcase and frame rail, the stabilizer link can be shorten or lengthened a short distance while fastened to frame tab and crankcase. Rotate the adjusting nut and rod (no more than two turns) to provide clearance. It is recommended to never turn the adjusting nut and rod more than two turns in or out with the stabilizer link fastened to the crankcase and the frame tab.

6. Tighten lock nuts (2) on stabilizer link ball ends (1).



1. **Ball ends**
2. **Lock nuts**
3. **Adjusting nut**
4. **Stabilizer link to frame tab fastener @ 34-41 Nm (25-30 ft-lbs)**
5. **Frame tab**

Figure 2-100. Engine Stabilizer Link

FRONT FENDER: (VRSCA/VRSCD) 2.35

REMOVAL

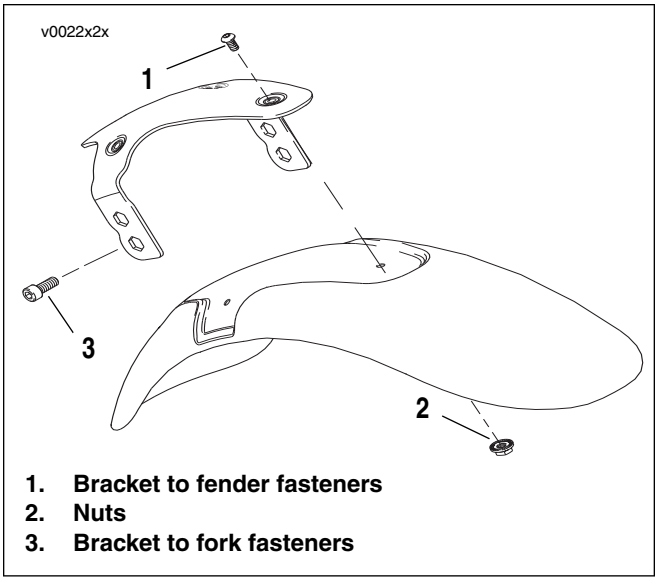
NOTE

Be careful lifting fenders out of forks or you may scratch the paint. If necessary, cover fender with a clean shop rag to prevent damage.

1. See Figure 2-101. Remove fasteners (3) from front fork and remove fender and bracket.
2. Remove fasteners (1, 2) that hold bracket to fender and separate bracket and fender.

INSTALLATION

1. See Figure 2-101. Attach fender to fender bracket. Tighten fasteners (1, 2) to 4.1-6.8 Nm (36-60 **in-lbs**).
2. Position fender and bracket in front fork and secure with fasteners (3). Tighten to 20-26 Nm (15-19 ft-lbs).



1. Bracket to fender fasteners
2. Nuts
3. Bracket to fork fasteners

Figure 2-101. Front Fender

FRONT FENDER (VRSCR) 2.36

REMOVAL

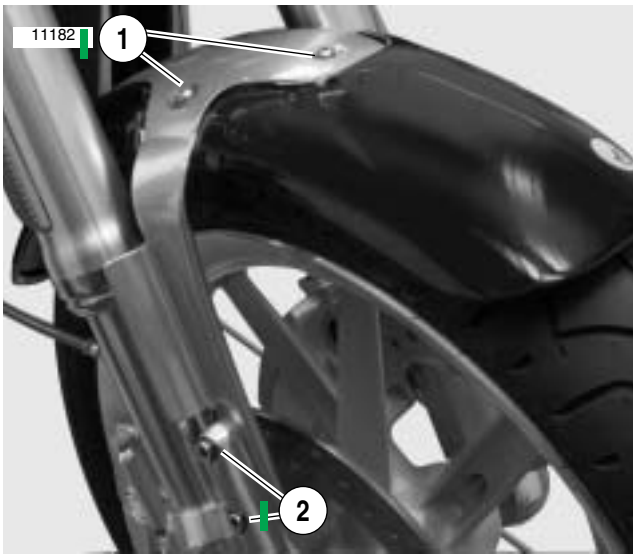
NOTE

Be careful lifting fenders out of forks or you may scratch the paint. If necessary, cover fender with a clean shop rag to prevent damage.

1. See Figure 2-102. Remove fasteners (1) from front fork and remove fender and bracket.
2. Remove fasteners (2) that hold bracket to fender and separate bracket and fender.

INSTALLATION

1. See Figure 2-102. Attach fender to fender bracket. Tighten fasteners (1, 2) to 4.1-6.8 Nm (36-60 **in-lbs**).
2. Position fender and bracket in front fork and secure with fasteners. Tighten to 20-26 Nm (15-19 ft-lbs).



1. Bracket to fender fasteners
2. Bracket to fork fasteners

Figure 2-102. Front Fender

FORK CAPS (VRSCR) 2.37

GENERAL

The fork caps are designed to help keep dirt and debris from building up in the recessed ares in the upper triple clamp. These caps are equipped with a spring devise to help hold them in place when installed.

See Figure 2-103. to see bottom of fork cap showing spring. Note that fork caps are unidirectional and have a letter F and an arrow identifiers to indicate front of motorcycle.

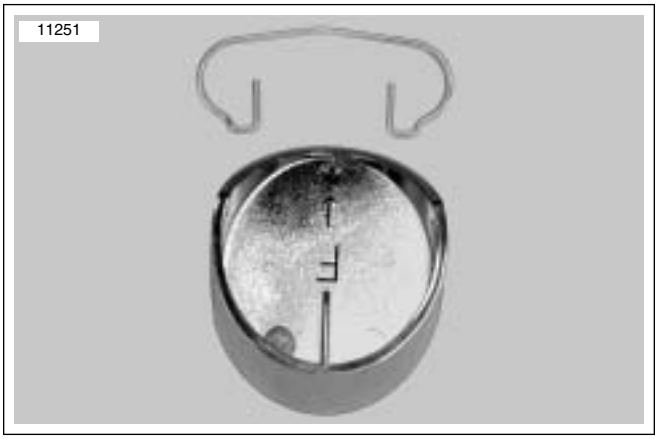


Figure 2-103. Fork Cap Inverted With Spring Removed

REMOVAL

⚠WARNING

Completely clean excess lock patch from pinch bolt threads. Tap bolt holes and blow bolt hole threads clean with compressed air. Failure to properly clean these threads will cause improper torque readings upon assembly and can result in loss of vehicle control, death or serious injury.

NOTE

Upper triple clamp pinch bolts must be removed to perform this procedure.

1. Remove upper fork pinch bolt from upper triple clamp.

Figure 2-104. Insert Wrench

2. See Figure 2-104. Insert an 1/8 inch allen wrench between gap at rear of upper triple clamp while angling wrench upward until it touches fork cap.
3. Push wrench in completely until wrench bottoms.
4. Release upward pressure on wrench and allow wrench to rest on top on spring.
5. Apply a small amount of downward pressure and slowly pull wrench out from fully inserted position until wrench stops making contact with spring.

NOTE

Repeat step 5 a few times until familiar with approximate location of spring in cap.

6. At point where wrench loses contact with spring, stop and regain contact of spring with tip of allen wrench.
7. Push against spring while gently prying cap upward from fork with fingernails.

INSTALLATION

See Figure 2-105. Note location of notch. There is one notch per side of upper triple clamp.

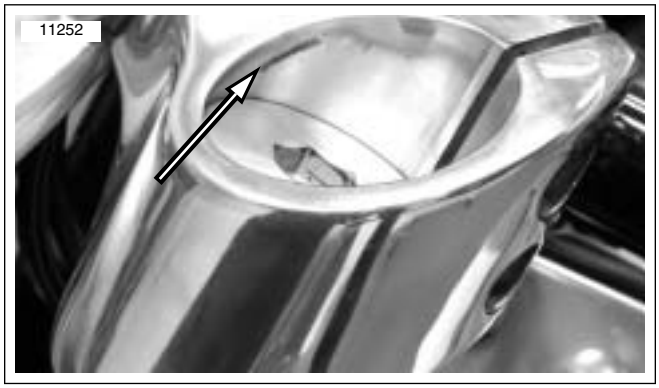


Figure 2-105. Notch In Upper Triple Clamp

Figure 2-106. Install Fork Cap

1. See Figure 2-106. Set cap on top of triple clamp and while applying downward pressure with fingers, push spring in with allen wrench.
2. With first side of cap installed, gently press spring in on opposite side of cap and cap will sit flush in triple clamp.
3. See 2.39 FRONT FORK (VRSCR). Install lock patch on triple clamp pinch bolts and install. Tighten pinch bolts per procedure to 44 Nm (32.5 ft-lbs).

FRONT FORK (VRSCA/VRSCD) 2.38

REMOVAL

1. Support motorcycle so front end is off floor and forks are fully extended.
2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
3. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.
4. Remove negative battery cable.
5. Remove both front brake calipers. See 2.21 FRONT BRAKE CALIPERS.
6. Remove front wheel. See 2.29 FRONT WHEEL.
7. Remove front fender bracket with the front fender. See 2.35 FRONT FENDER: (VRSCA/VRSCD).
8. See Figure 2-110. On one side, first loosen pinch bolt (5) on top triple clamp (4).
9. Break loose but do not remove fork tube cap (17).
10. Loosen pinch bolts (5) on bottom triple clamp (14) and pull fork tube and slider assembly (10) from triple clamp.
11. Repeat procedure for opposite fork tube and slider assembly (10).

DISASSEMBLY

PART NO.	SPECIALTY TOOL
HD-41177	Fork tube holder

1. See Figure 2-107. Clamp fork tube and slider assembly in FORK TUBE HOLDER (HD-41177) and mount in vise.
2. See Figure 2-110. While internal components are still under tension and less prone to rotate, break loose but do not completely unthread seat pipe screw (35). On right fork tube and slider assembly, remove axle holder (36) to access seat pipe screw.

⚠WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

3. Remove fork tube cap (17) and o-ring (18).
4. Remove the long spring collar (21).
5. Remove from FORK TUBE HOLDER and invert fork over a suitable container. Allow fork to drain. Extend and retract slider several times to push oil out of internal components. The washer (22), and spring (23) will fall out of fork tube.

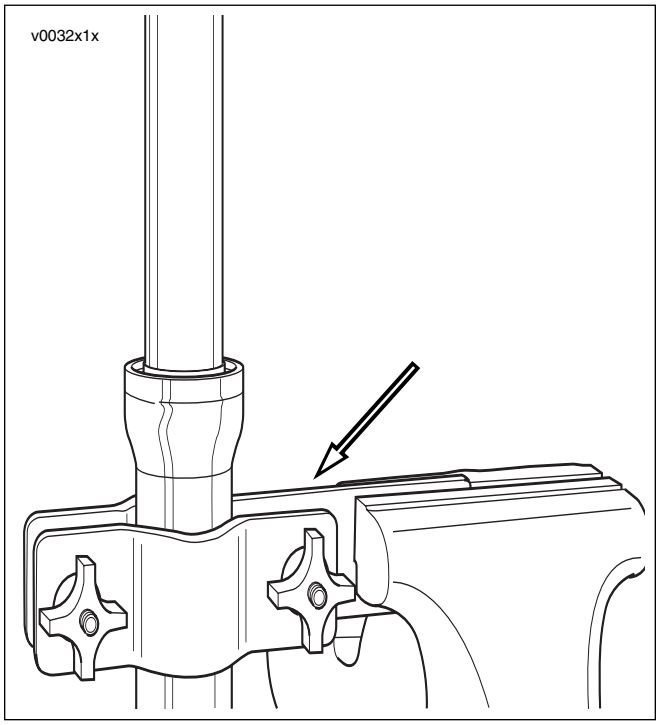


Figure 2-107. Fork Tube Holder (HD-41177) (mounted vertically to slider)

6. Clamp fork tube in holder. Mount FORK TUBE HOLDER (HD-41177) horizontally in vise.

7. Remove slider cover (27) from slider by inserting brass drift into notch in slider and lightly tapping cover.

8. Compress stopper ring (29) and remove stopper ring from groove in top of slider bore.

⚠WARNING

The VRSC models have a preloaded fork spring. The seat pipe is under spring pressure. Always wear proper eye protection when disassembling the fork tube and slider assembly. Disassemble the fork tube and slider assemblies carefully. The springs can force parts from the fork tube or slider unexpectedly, which could result in death or serious injury.

9. Remove seat pipe screw (35) and washer (34) from bottom of slider (33). Retain the seat pipe screw and washer.

10. Withdraw slider (33) from fork tube (19) until bushing guide (32) contacts bushing (20) on fork tube. Busing guide (32) is a slight interference fit in slider.

11. Using the slider as a slide hammer, hit the bushing with the bushing guide with a quick continuous stroke until slider is pulled free of the fork tube.

12. Drain the slider and allow the stop oil lock piece (26) to fall free.

NOTE

If replacing the slider only, the components remaining in the fork tube can be left assembled and the fork re-assembled from ASSEMBLY procedures step 5.

13. If still attached to seat pipe, remove stop oil lock piece (26) from the lower end of seat pipe.

14. Remove seat pipe (24) piston and ring assembly.

15. Remove rebound spring (23).

16. Remove oil seal (30), seal spacer (31), and bushing guide (32).

17. Repeat procedure for opposite fork tube and slider assembly (10).

CLEANING AND INSPECTION

1. Thoroughly clean and inspect each part. If inspection shows that any parts are bent, broken or damaged, those parts should be repaired or replaced.

2. Inspect fork tube bushing and slider guide bushing and replace as required.

3. Always replace oil seals and o-rings.

4. Check dust cover where it rubs on fork tube. The dust cover should present a good continuous seal and not show excessive wear.

5. Check the fork tube where it rubs on dust cover. The tube should show a bright, shining surface, free of scoring or abrasions.

6. If springs are broken, replace springs.

7. If a fork tube or slider is bent or damaged, replace it.

8. Replace all other worn or damaged components as necessary.

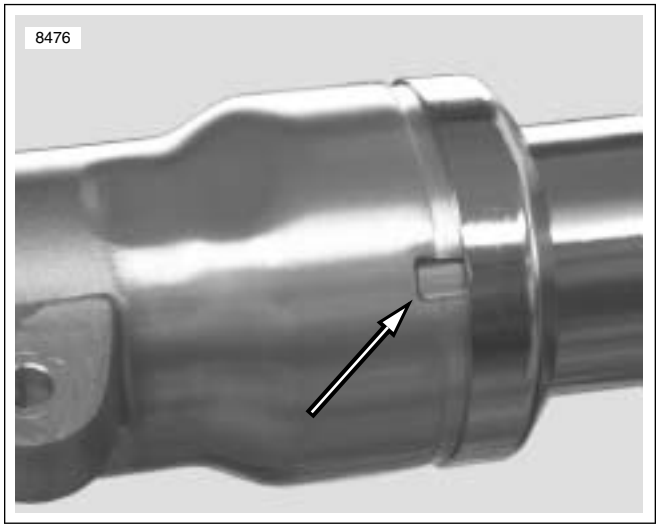


Figure 2-108. Notch in Slider

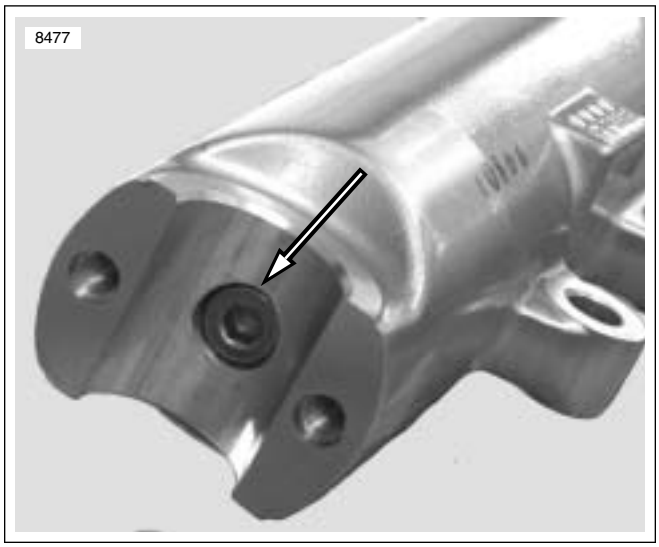
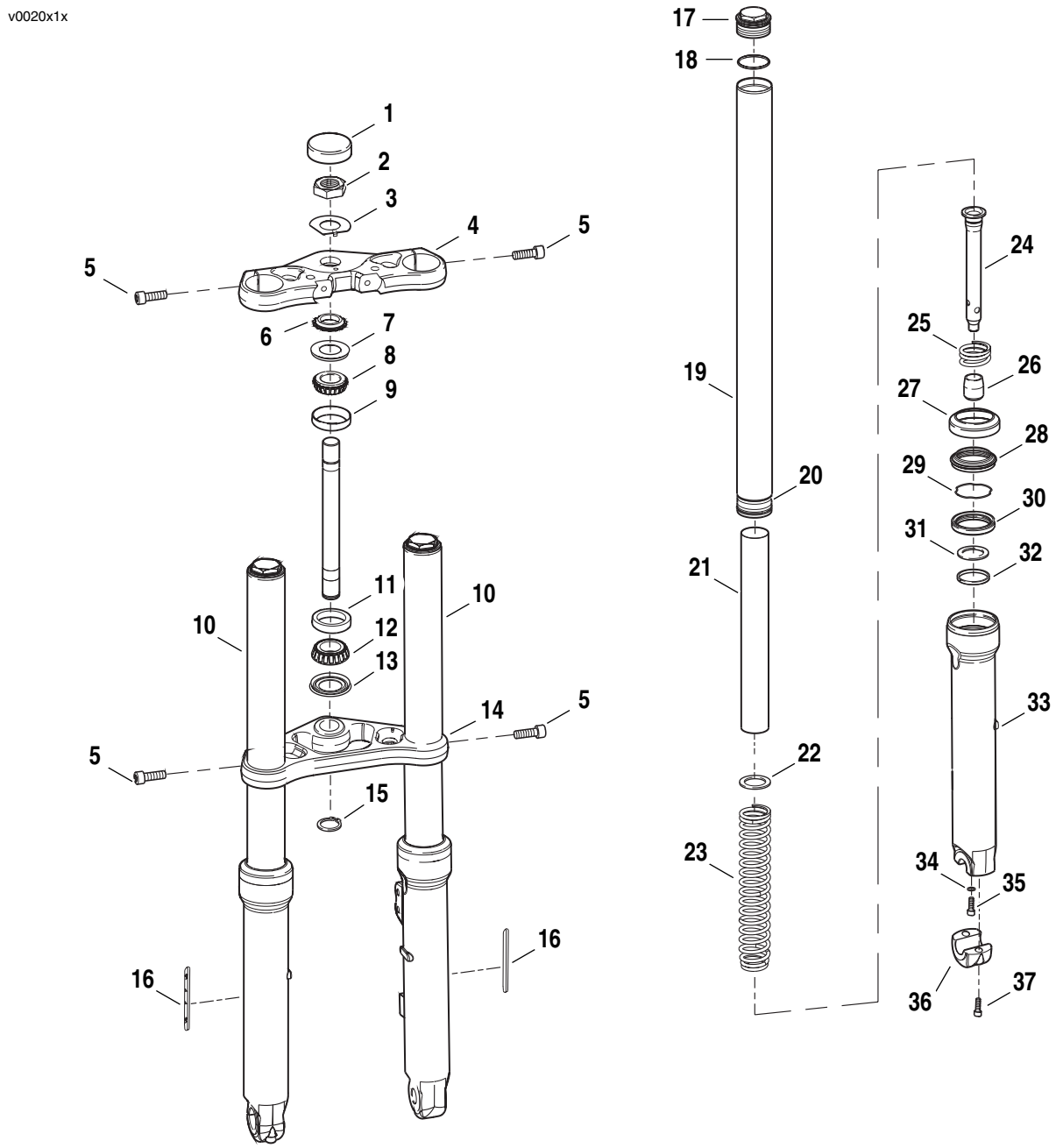


Figure 2-109. Seat Pipe Screw (right fork assembly)



1. Cap - fork stem
2. Nut - fork stem
3. Lockwasher - fork stem nut
4. Top triple clamp
5. Pinch bolts
6. Adjusting nut - upper
7. Seal
8. Roller bearing
9. Bearing cup
10. Fork tube and slider assembly (right & left)
11. Bearing cup
12. Tapered roller bearing
13. Seal
14. Bottom triple clamp
15. Retaining ring
16. Reflector
17. Fork tube cap
18. O-ring
19. Fork tube (right & left)
20. Bushing
21. Spring collar
22. Washer
23. Rebound spring
24. Seat pipe
25. Spring
26. Stop oil lock piece
27. Slider cover
28. Dust shield
29. Stopper ring
30. Oil seal
31. Seal spacer
32. Bushing guide
33. Slider
34. Washer
35. Seat pipe screw
36. Axle holder
37. Axle holder screw

Figure 2-110. Front Fork/Steering Head Components

ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-41177	Fork tube holder
B-45305	Fork seal driver
HD-59000A	Pro-level oil gauge

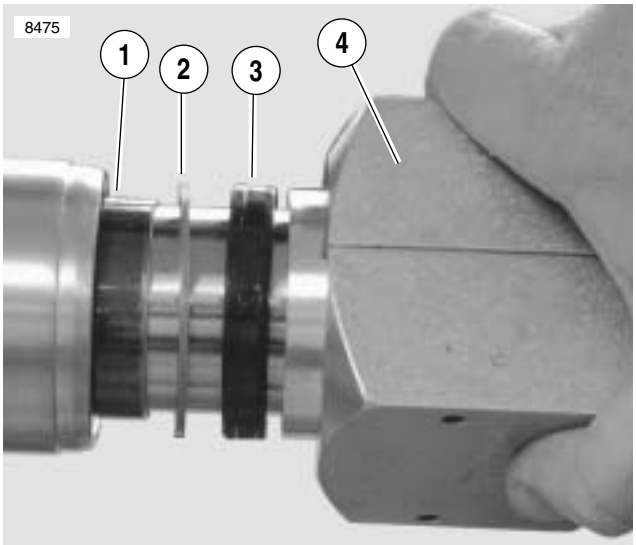
1. See Figure 2-110. Insert seat pipe and piston assembly (24) with the rebound spring (23) into fork tube (19).
2. Slide bushing guide (32) down to bushing (20) on fork tube (19). Follow with spacer (31), oil seal (30), stopper ring (29), dust shield (28) and slider cover (27).
3. Install fork tube into FORK TUBE HOLDER (HD-41177) mounted horizontally in a vise.
4. Fit stop oil lock piece (26) onto seat pipe (24).
5. See Figure 2-111. Side seat pipe back into fork tube until seat pipe is centered in tube.
6. See Figure 2-110. Gently install slider (33) onto fork tube (19) and bushing (20).
7. Thread seat pipe screw (35) and washer (34) into seat pipe (24) through bottom of slider (33). Draw fastener into seat pipe but do not torque.
8. Verify action of fork by sliding slider up and down fork tube.
9. Assemble the FORK SEAL DRIVER (Part No. B-45305) over fork tube in front of oil seal.

NOTE

Chamfered lips on oil seal MUST face towards oil in fork.

10. See Figure 2-112. Holding FORK SEAL DRIVER (4) together assemble in the following order. Tap oil seal (3), spacer (2) and bushing guide (1) into slider bore.

Figure 2-111. Seat Pipe Centered in Fork Tube



1. **Bushing guide**
2. **Spacer**
3. **Oil seal (chamfered lips must face oil)**
4. **Fork seal driver**

Figure 2-112. Assembled Fork Seal Driver

11. See Figure 2-110. Install stopper ring (29) into groove in top of oil seal.
12. Push dust shield (28) against oil seal and stopper ring
13. Rotate slider cover to match any removal burrs to notch in slider and snap slider cover (27) into place.
14. Move slider through its full range of travel several times to verify alignment. Then, pulling down on slide to apply downward force on rebound spring (23), tighten seat pipe screw to 12-18 Nm (106-159 **in-lbs**).
15. Re-position fork tube in FORK TUBE HOLDER (HD-41177) vertically. With slider tube compressed, fill the fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80) until it is approximately 85 mm (3.3 in.) from top of fork tube.
16. Slowly pump slider 8 to 10 times to exhaust air from assembly. Fully compress slider to determine oil level.

NOTE

Fork oil level is measured from top of fork tube, with spacer and spring removed and fork fully compressed.

17. Using the PRO-LEVEL OIL GAUGE (HD-59000A), adjust the oil level to 85 mm (3.3 in.) from top of fork tube.
18. Pull out the slider (33) and install the rebound spring (23) in the fork tube with the tightly wound end at the bottom.
19. Install the washer (22) and spring collar (21).

⚠WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

20. With a **new** o-ring, install and tighten fork tube caps to 22-58 Nm (16-43 ft-lbs).

NOTE

To prevent cross threading fork tube caps, use caution when threading in the caps with the spring compressed.

21. Repeat for opposite fork tube and slider assembly.

INSTALLATION

1. See Figure 2-113. Insert fork tube and slider assemblies through lower triple clamp and upper triple clamp. fork tubes should project above upper triple clamp 6.4-9.7 mm (0.25-0.38 in.). Tighten pinch bolts to 41-47 Nm (31-34 ft-lbs).
2. Install front fender and bracket. See 2.35 FRONT FENDER: (VRSCA/VRSCD).
3. Install front brake caliper hydraulic lines and install front brake calipers. See 2.21 FRONT BRAKE CALIPERS.
4. Install front wheel and align the wheel to the forks. See 2.29 FRONT WHEEL.
5. Adjust fall-away. See 1.19 STEERING HEAD BEARINGS (VRSCA, VRSCD) or 1.20 STEERING HEAD BEARINGS (VRSCR).
6. Replace negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
7. Replace airbox cover
8. Replace maxi-fuse and right side cover.

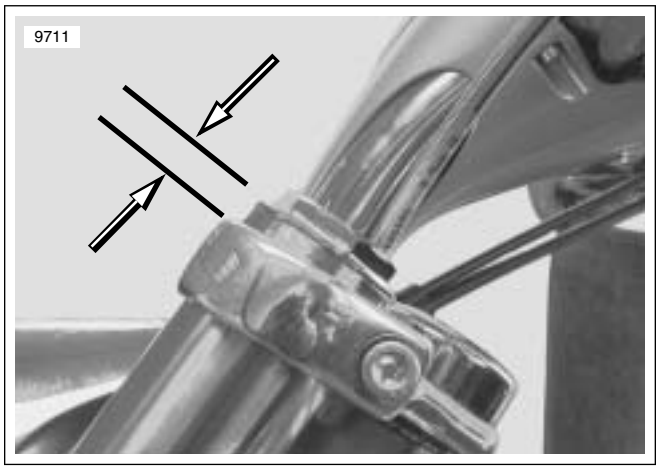


Figure 2-113. Fork Tube Projection (6.4-9.7 mm)

FRONT FORK (VRSCR) 2.39

REMOVAL

1. Support motorcycle so front end is off floor and forks are fully extended.
2. Remove right side cover and MAXI-FUSE. See 8.5 MAXI-FUSE
3. Remove front fender. See 2.36 FRONT FENDER (VRSCR).
4. Remove front wheel. See 2.29 FRONT WHEEL.
5. Remove caliper mounting fasteners. See 2.21 FRONT BRAKE CALIPERS.

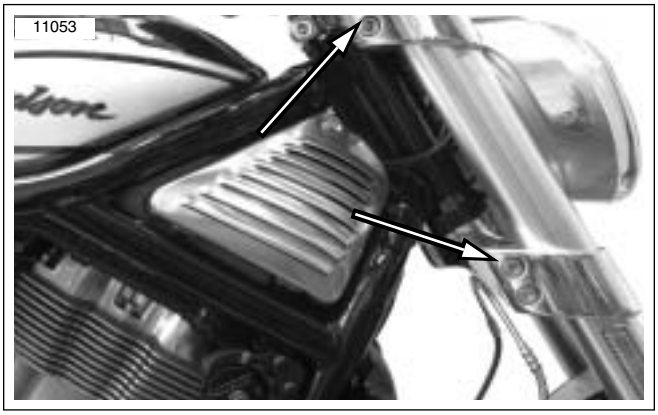


Figure 2-114. Fork Clamp Fasteners

⚠WARNING

Completely clean excess lock patch from pinch bolt threads. Tap bolt holes and blow bolt hole threads clean with compressed air. Failure to properly clean these threads will cause improper torque readings upon assembly and can result in loss of vehicle control, death or serious injury.

NOTE

Anytime fork pinch bolts are loosened or removed for any reason, the following procedure must be used. The fork tube installation process is extremely critical and must follow this procedure with no exceptions.

*Fork pinch bolts must be thoroughly cleaned of all lockpatch material. Triple clamp bolt holes must be tapped with a bottoming tap and blown clear with compressed air to remove excess lockpatch material. If bolts can not be completely cleaned, it is required that **new** fork pinch bolts (P/N 4534M) be installed and triple clamp bolt holes still completely cleaned using a bottoming tap, without exception.*

6. See Figure 2-114. Remove upper and lower fork clamp pinch bolts.
7. Using a soft wedged object such as wood, insert wedge in triple clamps (in areas shown by arrows) to relieve clamping pressure on fork tubes.
8. Remove fork from upper and lower fork clamps.
9. Remove chrome triple clamp caps. See 2.37 FORK CAPS (VRSCR).
10. Repeat steps 6 through 9 for other side.

DISASSEMBLY

Left Side

PART NO.	SPECIALTY TOOL
HD-41177	Fork tube holder
HD-45966	Fork Compressing Tool

⚠WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

NOTE

When using FORK SPRING COMPRESSING TOOL be sure not to bind the outer fork tube on the tool.

NOTE

FORK SPRING COMPRESSING TOOL (HD-45966) comes with a cup and screw that are for FLT models only and not to be used with this fork assembly.

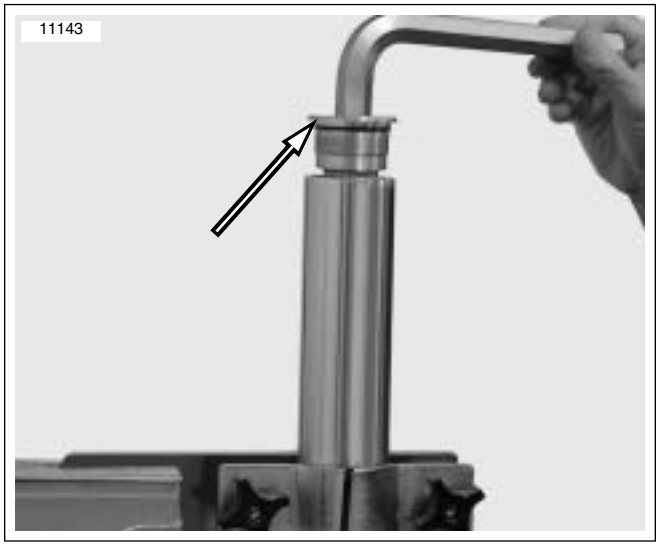


Figure 2-115. Clamp Fork and Remove Fork Cap

1. See Figure 2-115. Using FORK TUBE HOLDER (HD-41177), mount fork assembly in vise.
2. Remove fork cap.
3. See Figure 2-116. Compress fork using Fork Compressing Tool (HD-45966).

NOTE

Note position of retaining nut with shoulder of nut facing away from fork cap. Be sure to install in the same manner.

4. See Figure 2-117. Remove keeper and loosen retaining nut, and fork cap from cartridge assembly.
5. Remove fork compressing tool.

Figure 2-116. Compress Fork Assembly

1. **Fork cap**
2. **Retaining nut**
3. **Keeper**

Figure 2-117. Remove Keeper

Figure 2-118. Remove Collar, and Spring Assembly

NOTE

Coil windings tighten at bottom of spring. Be sure to install in this manner.

6. See Figure 2-118. Remove collar and spring from fork assembly.
7. Remove fork from vise and drain fork oil into a suitable container by tipping fork upside down and stroke cartridge plunger to remove excess fork oil.

CAUTION

Always use soft jaws for bench vise when placing any fork components into vise. failure to do so can damage components.

Figure 2-119. Remove Fastener and Copper Washer

8. See Figure 2-119. Place fork slider into bench vise with soft-jaws and remove fastener and copper washer from bottom of fork assembly.

Figure 2-120. Cartridge Assembly

9. Remove fork from vise.

10. See Figure 2-120. Place fork in vise using Fork Tube Holder and remove cartridge assembly from fork slider.

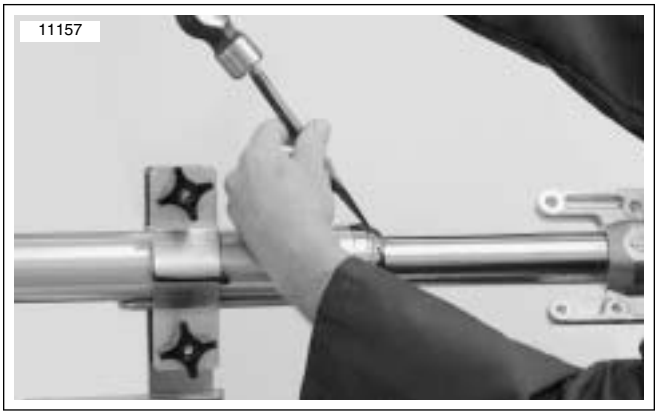
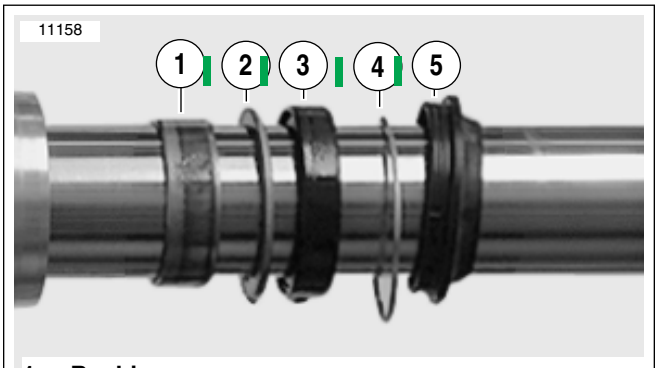


Figure 2-121. Remove Chrome Dust Cover

11. See Figure 2-121. Using a blunt soft object (such as a wood dowel or chisel with duct tape), gently tap chrome dust cover away from seat, remove dust seal, lock ring, fork seal, spacer, and bushing from fork tube. Then, expand fork tube and slider against each other (in a slider-hammer effect) repeatedly to free fork slider from fork tube. Use caution not to damage components.



1. **Bushing**
2. **Spacer**
3. **Fork seal**
4. **Lock ring**
5. **Dust seal**

Figure 2-122. Seal Components

12. See Figure 2-122. Once fork tube and slider are separated, remove dust seal, lock ring, fork seal, spacer, bushing and chrome dust cover (not shown) from fork slider.

Right Side

PART NO.	SPECIALTY TOOL
HD-41177	Fork tube holder
HD-47852	Damper cup remover/installer

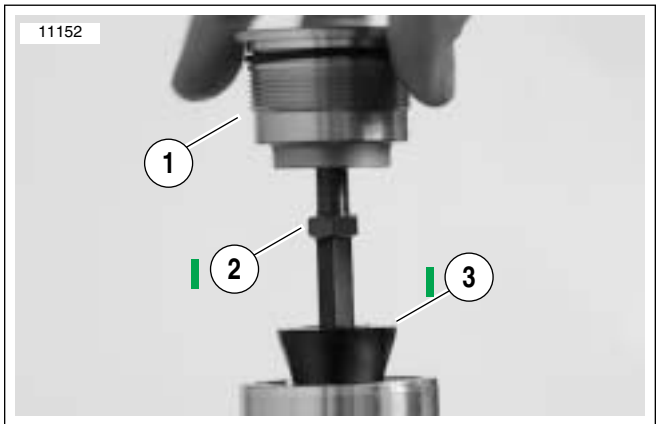
⚠WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

1. See Figure 2-123. Using FORK TUBE HOLDER (HD-41177), mount fork assembly in vise.

Figure 2-123. Clamp Fork and Loosen Fork Cap

2. Loosen fork cap.



1. **Fork cap**
2. **Retaining nut**
3. **Rubber stopper**

Figure 2-124. Remove Fork Cap, Retaining Nut and Rubber Stopper

3. See Figure 2-124. Back retaining nut away from fork cap. Remove fork cap, retainer nut, and rubber stopper from inner fork nut threaded shaft.

NOTE:

Do not fully extend fork assembly. Extending fork will cause oil to leak from bleed hole.

⚠CAUTION

Use caution when removing inner fork nut. Fork is under slight spring pressure. Wear safety glasses to prevent injury.

4. See Figure 2-125. Using Inner Fork Nut Remover/Installer (HD-47852) and remove inner fork nut assembly from fork tube.

Figure 2-125. Inner Fork Nut

NOTE

Note positioning of collar, washer and spring for assembly.

5. See Figure 2-126. Remove collar, washer and spring from fork assembly.
6. Remove fork from vise and drain fork oil into a suitable container by tipping fork upside down and drain excess fork oil into suitable container.

Figure 2-126. Remove Collar, Washer and Spring

7. See Figure 2-127. Using FORK TUBE HOLDER (HD-41177), mount fork assembly in vise.

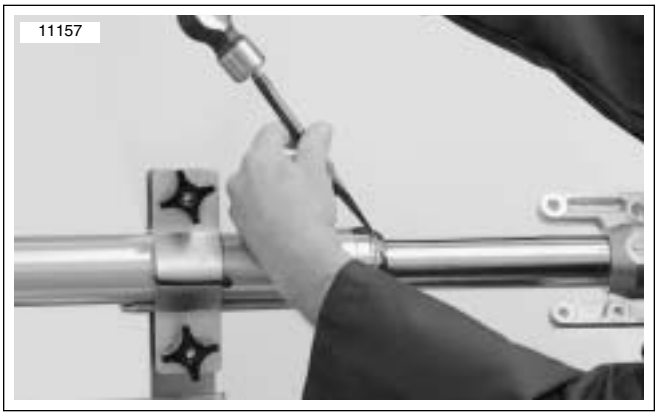
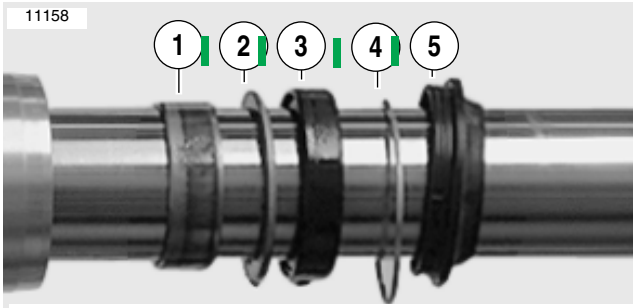


Figure 2-127. Remove Chrome Dust Cover

8. Using a blunt soft object (such as a wood dowel, or chisel with duct tape), gently tap chrome dust cover away from seat, remove dust seal, lock ring, fork seal, spacer, and bushing from fork tube. Then, by expanding fork and slider against each other (in a slider-hammer effect) repeatedly, pull slider free from fork tube. Use caution not to damage components.



1. **Bushing**
2. **Spacer**
3. **Fork seal**
4. **Lock ring**
5. **Dust seal**

Figure 2-128. Seal Components

9. Once fork tube and slider are separated, remove dust seal, lock ring, fork seal, spacer, bushing and chrome dust cover (not shown) from fork slider.

CLEANING AND INSPECTION

1. Thoroughly clean and inspect each part. If inspection shows that any parts are bent, broken or damaged, those parts should be repaired or replaced.
2. Inspect fork tube bushing and slider guide bushing and replace as required.
3. Always replace oil seals and o-rings.
4. Check dust cover there it rubs on fork tube. Dust cover should not show any wear.
5. If springs are broken, replace springs.
6. If a fork tube or slider is bent or damaged, replace it.
7. Replace all other worn or damaged components as necessary.

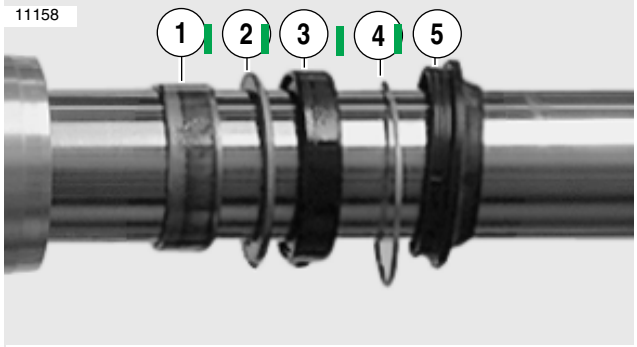
ASSEMBLY

Left side

PART NO.	SPECIALTY TOOL
HD-41177	Fork tube holder
B-45305	Fork seal driver
HD-45966	Fork Compressing Tool
HD-59000A	Pro-level oil gauge

NOTE
Chamfered lips on oil seal MUST face towards oil in fork.

1. See Figure 2-129. Use sleeve from fork seal driver and install chrome dust cover (not shown) and components onto fork slider in order shown.



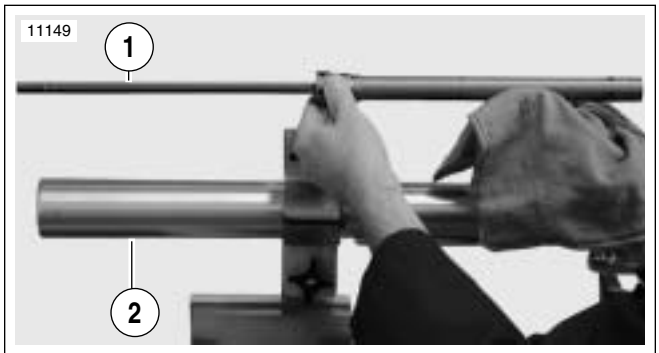
1. **Bushing**
2. **Spacer**
3. **Fork seal (chamfered lips must face towards oil)**
4. **Lock ring**
5. **Dust cap**

Figure 2-129. Fork Tube Shown installed In Order of Installation

2. Lightly coat fork slider and bushing with fork oil and gently install slider into fork tube.

CAUTION

Always use soft jaws for bench vise when placing any fork components into vise. failure to do so can damage components.



1. **Fork cartridge**
2. **Fork tube**

Figure 2-130. Install Fork Cartridge

3. See Figure 2-130. Using FORK TUBE HOLDER (HD-41177), mount fork assembly in vise.
4. Make sure cap (centering plate) is on bottom end of fork cartridge and install fork cartridge (big end first) into fork slider.
5. Remove fork from vise.

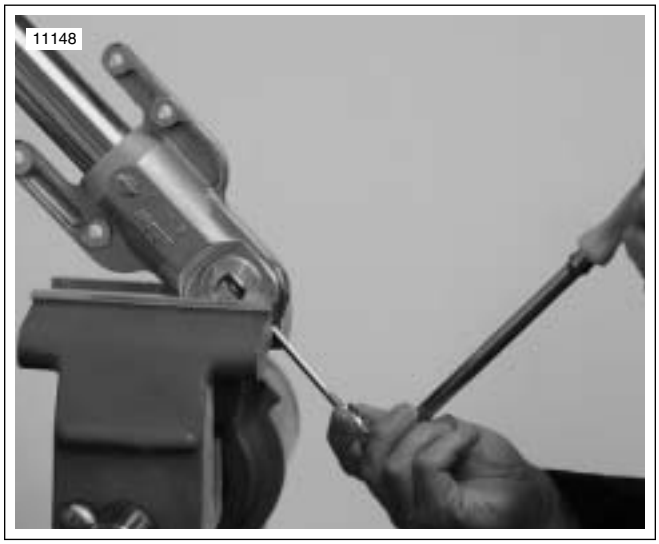


Figure 2-131. Install Fastener and New Copper Washer

6. See Figure 2-131. Using a vise with soft jaws, clamp fork slider in vise. Install **new** fastener and copper washer to hold fork cartridge in place inside fork tube. Tighten to 12-18 Nm (106-159 **in-lbs**).
7. Remove fork from vise.
8. Using FORK TUBE HOLDER (HD-41177), mount fork assembly in vise.
9. See Figure 2-132. Assemble the FORK SEAL DRIVER (Part No. B-45305) over fork slider in front of oil seal with the long end of tool facing seal. Install parts in the following order: bushing, spacer, and drive fork seal into fork tube bore with tool until tool is flush with fork slider.
10. Install lock ring into groove in top of oil seal. Verify lock ring is properly seated by fully extending fork assembly.
11. See Figure 2-133. Remove FORK SEAL DRIVER (B-45305), reverse tool to short side of tool to prepare to install chrome dust cover. Rotate slider cover to match any removal burrs in slider and tap chrome dust cover into place.

Figure 2-132. Install Bushing, Spacer, and Install Fork Seal in Place with Seal Driver (B-45305)

Figure 2-133. Install Chrome Dust Cover

12. Remove fork from vise.

Table 2-18. Type E Fork Oil Levels

MODEL	MM	IN.
VRSCR (left side)	80	3.15

13. Using FORK TUBE HOLDER (HD-41177), mount fork assembly in vise vertically fully compressed.
14. Fill fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80) until it is approximately 50.8 mm (2.0 in.) from top of fork tube. Refer to Table 2-18.

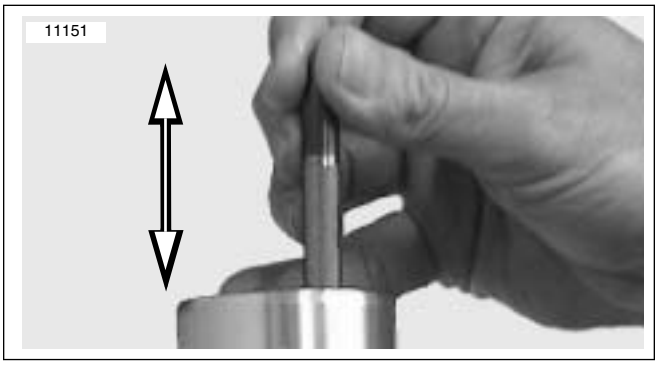


Figure 2-134. Pump Cartridge

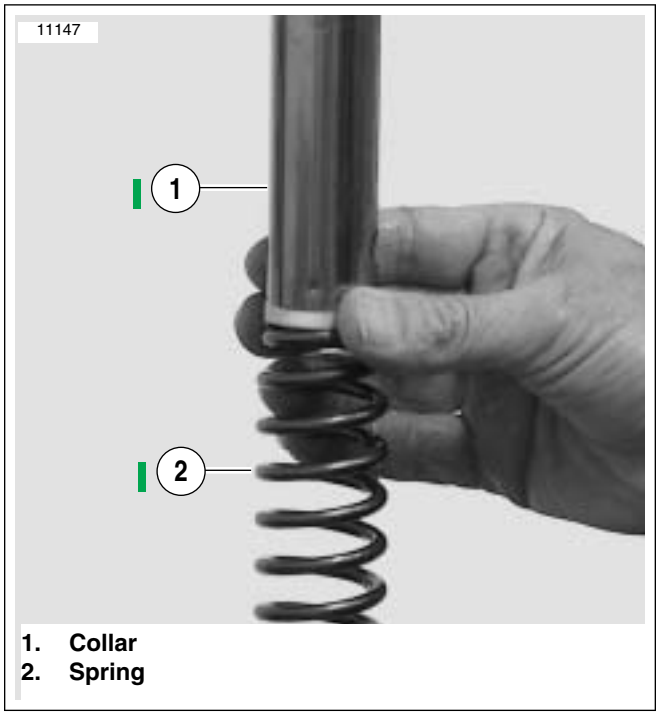
15. See Figure 2-134. Slowly pump cartridge 8 to 10 times to exhaust air from assembly.

Figure 2-135. Measure Fork Oil

NOTE

Fork oil level is measured from top of fork tube, with spacer and spring removed and fork fully compressed.

16. Refer to Table 2-18. Measure oil to specification.
17. See Figure 2-135. Fully compress fork and adjust the oil level to 80 mm (3.15 in.) from top of fork tube using PRO-LEVEL OIL GAUGE (HD-59000A).
18. See Figure 2-136. Fully extend fork and install spring in fork tube with **tightly wound end at bottom,** washer and collar.



1. Collar
2. Spring

Figure 2-136. Collar and Spring Assembly

⚠WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)

19. See Figure 2-137. Compress fork using FORK TUBE COMPRESSOR (HD-41177).
20. Install keeper.

Figure 2-137. Install Keeper

21. Install retainer nut on cartridge rod 10 mm (25/64 in.) from top of rod and install fork cap onto cartridge rod.
22. Thread fork cap into fork and tighten to 30-40 Nm (22-29 ft-lbs).
23. Release tension and remove fork compressing tool.

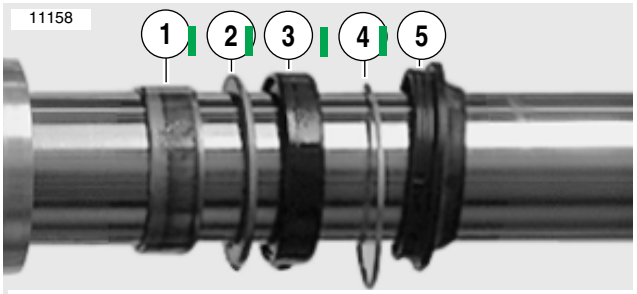
Figure 2-138. Install Fork Cap

24. See Figure 2-138. Install fork cap and tighten to 19.6 Nm (173 **in-lbs**).

Right Side

PART NO.	SPECIALTY TOOL
HD-41177	Fork tube holder
B-45305	Fork seal driver
HD-45966	Fork Compressing Tool
HD47852	Damper cup remover/installer
HD-59000A	Pro-level oil gauge

1. See Figure 2-139. Install chrome dust cover (not shown) and components onto fork slider in order shown.



1. **Bushing**
2. **Spacer**
3. **Fork seal (chamfered lips must face oil)**
4. **Lock ring**
5. **Dust seal**

Figure 2-139. Seal Components

2. Lightly coat fork slider and bushing with fork oil and gently install slider into fork tube.

Figure 2-140. Install Seal Components

NOTE

Chamfered lips on oil seal MUST face towards oil in fork.

3. See Figure 2-140. Assemble the FORK SEAL DRIVER (Part No. B-45305) over fork slider in front of oil seal with the long end of tool facing seal and assemble in the following order: Install bushing, spacer, and drive fork seal into fork tube bore with tool until tool is flush with fork slider.
4. Install lock ring into groove in top of oil seal. Verify lock ring is properly seated by fully extending fork assembly.
5. See Figure 2-141. Remove FORK SEAL DRIVER (B-45305), reverse tool to short side of tool to prepare to install chrome dust cover. Rotate slider cover to match any removal burrs in slider and tap chrome dust cover into place.

Figure 2-141. Install Chrome Dust Cover

6. Remove fork from vise.

Table 2-19. Type E Fork Oil Levels

MODEL	MM	IN.
VRSCR (right side)	122	4.80

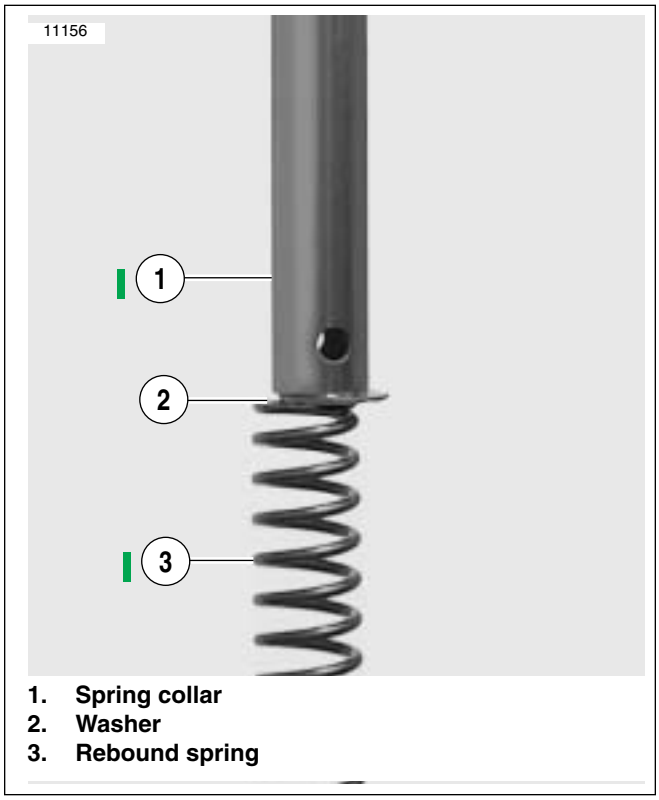
7. Using FORK TUBE HOLDER (HD-41177), mount fork assembly in vise vertically and fully compress fork.
8. Fill fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80) until it is approximately 101.6 mm (4.0 in.) from top of fork tube.
9. Refer to Table 2-19. Measure fork oil specification.

Figure 2-142. Measure Fork Oil

10. Fully extend fork.
11. See Figure 2-143. Install rebound spring in fork tube with **tightly wound end at bottom**, washer, and spring collar.
12. Verify that washer has properly seated on top of spring.
13. See Figure 2-144. Insert inner fork nut and finger tighten.

⚠WARNING

Wear safety glasses or goggles when servicing fork assembly. Do not remove slider tube caps without relieving spring preload or caps and springs can fly out, which could result in death or serious injury. (00297a)



1. **Spring collar**
2. **Washer**
3. **Rebound spring**

Figure 2-143. Collar, Washer and Spring Assembly

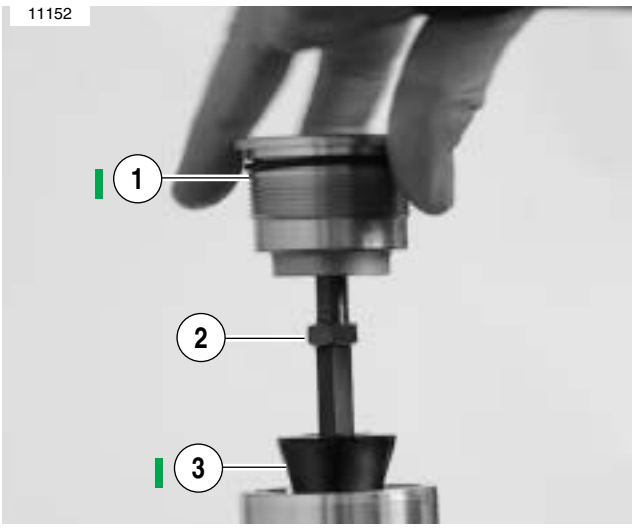
Figure 2-144. Inner Fork Nut

NOTES

To prevent cross threading fork tube damper cups and caps, use caution when threading in the caps with the spring compressed. It may be helpful to use a palm-ratchet during this process.

14. See Figure 2-145. Final tighten inner fork nut and tighten to 98 Nm (72 ft-lbs) using INNER FORK NUT REMOVER/INSTALLER (HD-47852).
15. See Figure 2-146. Install rubber stopper, followed by retainer nut (retainer nut must be installed 10 mm from top of threaded shaft).
16. Install fork cap and tighten to 30-40 Nm (22-29 ft-lbs) while holding retainer nut with wrench.
17. Using a torque wrench, tighten fork cap to 19.6 Nm (173 **in-lbs**).

Figure 2-145. Hand Tighten



1. Fork cap
2. Retainer nut
3. Rubber stopper

Figure 2-146. Install Rubber Stopper, Retainer Nut and Fork Cap

INSTALLATION

⚠WARNING

Completely clean excess lock patch from pinch bolt threads. Tap bolt holes and blow bolt hole threads clean with compressed air. Failure to properly clean these threads will cause improper torque readings upon assembly and can result in loss of vehicle control, death or serious injury.

NOTE

Anytime fork pinch bolts are loosened or removed for any reason, the following procedure must be used. The fork tube installation process is extremely critical and must follow this procedure with no exceptions.

*Bolt holes in both upper and lower triple clamp clamps **must be tapped** using a bottoming tap and blown clean with compressed air to remove excess lockpatch material. It is recommended that **new** fork pinch bolts (P/N 4534M) be installed.*

If new bolts are not readily available, use a wire grinder wheel to remove all remaining lockpatch from original bolts, wash bolts in clean solvent and dry thoroughly.

Fork tube depth measurement is also critical and must match the opposite side exactly to ensure proper vehicle operation, reliability and performance.

1. Identify left and right side fork assemblies.
2. Insert fork assembly from the bottom triple clamp upward through the top triple clamp.
3. Remove wedges installed in triple clamp clamps during removal process.

NOTE

Fork tube depth should be measured at the front of the upper triple clamp surface. This will hold fork in place for measurement.

4. See Figure 2-147. Measure depth from top front of triple clamp to top front of fork assembly. Both sides must be exactly the same and measure 1.7 mm (0.070 in).

Figure 2-147. Fork Tube Depth Measurement Location

⚠WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

5. Verify fork tube depth measurement is 1.7 mm (0.070 in).

NOTE

If new bolts are not readily available, use a wire grinder wheel to remove all remaining lockpatch from original bolts, wash bolts in clean solvent and dry thoroughly. Apply two drops of LOCTITE® 262 to the first 1/4" of the end threads. Install screws in triple clamp clamps.

6. Install **new** pinch bolts (P/N 4534M) with lockpatch.
7. Install fork caps. See 2.37 FORK CAPS (VRSCR).
8. Using a torque wrench, tighten pinch bolts in the following sequence.
   a. Tighten top bolt in upper triple clamp to 44 Nm (32.5 ft-lbs).
   b. Tighten lower bolt in upper triple clamp to 44 Nm (32.5 ft-lbs).
   c. Final tighten top bolt in upper triple clamp to 44 Nm (32.5 ft-lbs).
   d. Final tighten lower bolt in upper triple clamp to 44 Nm (32.5 ft-lbs).
   e. Tighten top bolt in lower triple clamp to 44 Nm (32.5 ft-lbs).
   f. Tighten lower bolt in lower triple clamp to 44 Nm (32.5 ft-lbs).
   g. Final tighten top bolt in lower triple clamp to 44 Nm (32.5 ft-lbs).
   h. Final tighten lower bolt in lower triple clamp to 44 Nm (32.5 ft-lbs).
9. Repeat for other side of fork.
10. Install front fender and bracket. See 2.36 FRONT FENDER (VRSCR).
11. Install front brake caliper hydraulic lines and install front brake calipers. See 2.21 FRONT BRAKE CALIPERS.
12. Install front wheel and align the wheel to the forks. See 2.29 FRONT WHEEL.
13. Install negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
14. Install airbox cover.
15. Install maxi-fuse and right side cover.

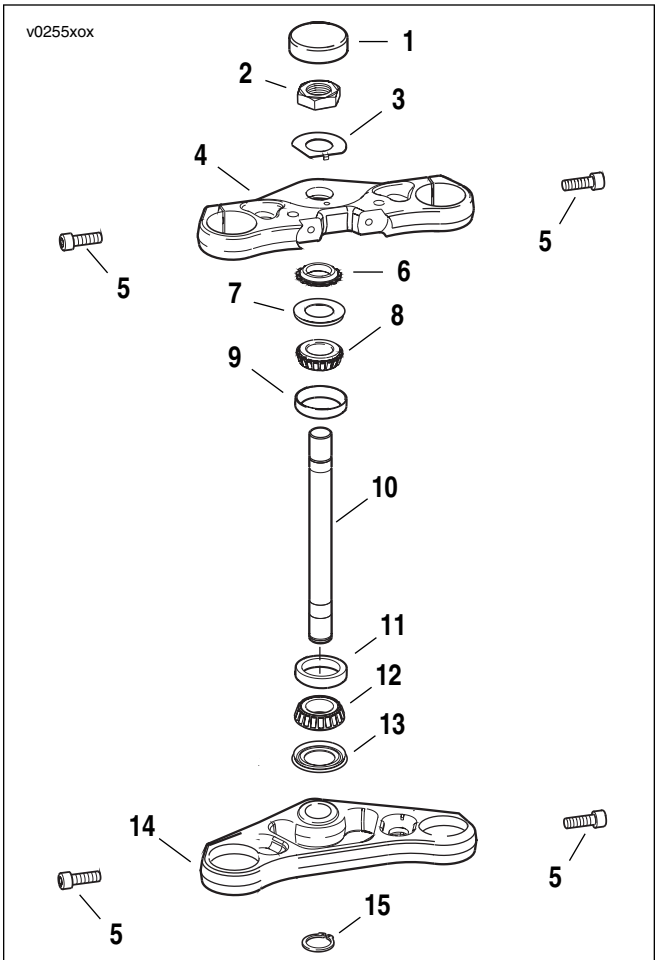
STEERING HEAD 2.40

REMOVAL

NOTE

If bearing races are removed, the bearings cannot be reused–they must be replaced. See CLEANING AND INSPECTION in 2.40 STEERING HEAD.

1. Support motorcycle so front end is off floor and forks are fully extended.
2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
3. Remove headlamp and headlamp bracket. See 8.12 HEADLAMP (VRSCA/VRSCR), or 8.13 HEADLAMP (VRSCD)
4. Remove both front brake calipers. See 2.21 FRONT BRAKE CALIPERS.
5. Remove front wheel. See 2.29 FRONT WHEEL.
6. Remove front fender bracket with front fender. See 2.35 FRONT FENDER: (VRSCA/VRSCD), or 2.36 FRONT FENDER (VRSCR).
7. Loosen but do not remove fork tube caps.
8. See Figure 2-148. Loosen all pinch bolts on top and bottom tripe clamps and pull fork tubes from triple clamps. See 2.38 FRONT FORK (VRSCA/VRSCD), or 2.39 FRONT FORK (VRSCR).
9. Remove brake hose bracket from the bottom of fork stem (10) and bracket.
10. Remove fork stem cap (1). Bend lockwasher (3) tab away from fork stem nut (2). Remove fork stem nut.
11. Lift handlebars from steering head with upper triple clamp (4) attached. Be careful not to pinch or kink control cables.
12. Remove adjusting nut (6), seal (7), and upper bearing (8) out of bearing race.
13. Pull fork stem (10) and lower triple clamp (14) from bottom of steering head.



1. **Cap**
2. **Nut**
3. **Lockwasher**
4. **Upper triple clamp**
5. **Pinch bolt**
6. **Adjusting nut**
7. **Seal**
8. **Upper bearing**
9. **Bearing cup**
10. **Fork stem**
11. **Bearing cup**
12. **Lower bearing**
13. **Seal**
14. **Lower triple clamp**
15. **Retaining ring**

Figure 2-148. Steering Head (typical) (VRSCA shown)

CLEANING AND INSPECTION

1. Check upper and lower bearing races in steering head. If they are pitted or grooved, replace bearings and races in sets.
2. Check roughness of bearings by turning them in race. Replace bearings if they do not turn freely and smoothly.

CAUTION

Always replace both races and bearings even if one race and bearing appear to be good. Mismatched bearing components may lead to excessive wear and the need for premature bearing replacement.

Lower Fork Stem Bearing

PART NO.	SPECIALTY TOOL
HD-95637-46A	Universal wedge attachment

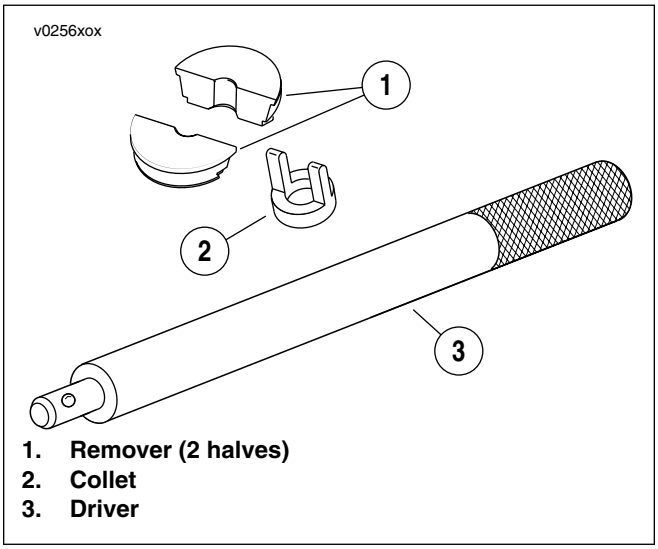
1. See Figure 2-149. Assemble a bearing puller using a using a UNIVERSAL WEDGE ATTACHMENT (HD-95637-46A), two lengths of threaded rod, washers, nuts, a cross clamp or bridge, and a forcing screw and a washer or protective cap.
2. Turn forcing screw to remove bearings and seal from lower triple clamp.

Steering Head Bearing Race

PART NO.	SPECIALTY TOOL
HD-33416	Universal driver handle
HD-39301-A	Steering head bearing race remover

1. See Figure 2-150. With the tapered side down, seat STEERING HEAD BEARING RACE REMOVER (HD-393201-A) on upper bearing race leaving a gap in middle and with lower lip of removers capturing bottom edge of bearing race.
2. Install collet on driver.
3. Insert UNIVERSAL DRIVER HANDLE (HD-33416) at bottom of steering head tube, and while holding remover tool on race, center collet in gap between remover halves. Tap driver to remove upper race.
4. Reverse tool and repeat procedure to remove lower bearing race.

Figure 2-149. Bearing Puller Based on Universal Wedge Attachment (typical) (VRSCA shown)



1. **Remover (2 halves)**
2. **Collet**
3. **Driver**

Figure 2-150. Race Remover Tools (HD-33416 and HD-39301-A)

ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-39302	Steering head bearing race installer

1. Lubricate outside of **new** steering head bearing races with lubricant provided or engine oil.
2. See Figure 2-151. Assemble STEERING HEAD BEARING RACE INSTALLER (HD-39302) and bearing races on tool's draw down bolt through steering head. Orient races so lettered edges are at bottom of steering head bore in steering head.
3. Continue to thread nut on draw down bolt until races fit, and are parallel to steering head bore.
4. Slowly tighten nut while stopping periodically to check for bearing race to steering head parallelism.

⚠WARNING

Use care not to damage the new races' tapered surface. The race should be firmly seated against the shoulder in the bore. If it is loose, the steering head adjustment will become loose, adversely affecting the motorcycle's handling, which may lead to an accident which could result in death or serious injury.

5. When bearing races are fully seated in bore of steering head, pack **new** bearings with HARLEY-DAVIDSON SPECIAL PURPOSE GREASE (HD-99857-97).

CAUTION

Do not use a sleeve that is larger than the inner race of the bearing or bearing cage may be damaged. A damaged bearing cage will require replacement of both the cage and the bearing.

6. Install a **new** lower seal on fork stem.
7. Use sleeve or drift that will contact only inner race of bearing and press lower bearing into place on fork stem.

NOTE

A sleeve (drift) to press on the lower fork stem bearing can be constructed out of thick walled pipe, 22.86 cm (9.0 in.) long with an inside diameter of 25.65 mm (1.010 in.) and an outside diameter of 31.75 mm (1.250 in.).

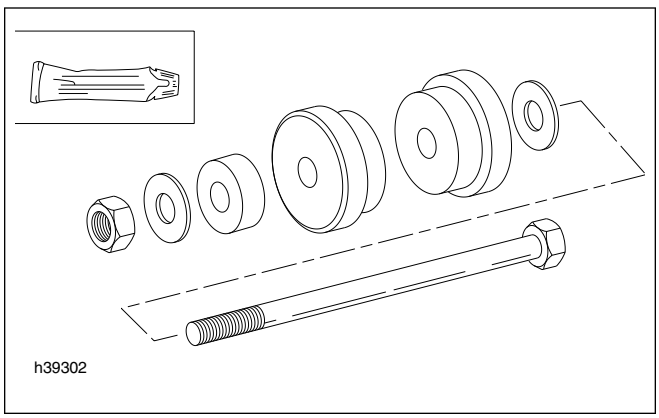


Figure 2-151. Steering Head Bearing Race Installer (HD-39302)

INSTALLATION

1. See Figure 2-148. Insert fork stem (10) and lower triple clamp (14) assembly into frame steering head and install a **new** upper bearing (8) and **new** seal (7). Secure with adjusting nut (6). Tighten adjusting nut until bearings have no noticeable shake. Fork stem must turn freely from side to side.

CAUTION

Overtightening adjusting nut will cause the bearings to wear excessively leading to the need for premature bearing replacement.

2. Install upper triple clamp (4), a **new** lockwasher (3). Be sure pin on lockwasher registers in upper bracket hole.

⚠WARNING

An improperly adjusted fork stem nut may adversely affect handling, which could lead to an accident which could result in death or serious injury.

3. Thread on and finger tighten fork stem nut (2).
4. Fasten brake hose bracket to lower triple clamp (14). Tighten bolt to 6-10 Nm (53-89 **in-lbs**).
5. Install fork tube assemblies into bottom and top triple clamps (4, 14).
6. See Figure 2-147. The fork tube should be recessed in triple clamp approximately 0.070 in. (1.7 mm). Tighten pinch bolts to per appropriate fork rebuild procedure.
7. Install handlebar brackets, handlebars, clutch and brake lever assemblies.
8. Install front fender and bracket. See 2.35 FRONT FENDER: (VRSCA/VRSCD), or 2.36 FRONT FENDER (VRSCR).
9. Install front wheel assembly. See 2.29 FRONT WHEEL.
10. Install right and left front brake calipers. See 2.21 FRONT BRAKE CALIPERS.
11. See Figure 2-148. Adjust steering head bearing fall away. Tighten or loosen adjusting nut (6) until the fall away measurement is within 51-102 mm (2-4 in.). See 2.40 STEERING HEAD.
12. Tighten fork stem nut (2) to 61-75 Nm (45-55 ft-lbs). Bend the lockwasher (3) tab against nut flat.
13. Replace fork stem cap (1).

FORK LOCK (VRSCA/VRSCD) 2.41

GENERAL

To insure that the ignition key and the fork lock key are the same, both locks may need to be changed when one is changed.

REMOVAL

1. Remove the upper triple clamp.
2. See Figure 2-152. Insert ignition key (1) and turn 1/2 way so that plunger (4) rotates in plunger boss (9).
3. Look into the half-moon opening (8) on back of fork lock boss. The slot (5) in plunger (4) should be visible in the opening.

NOTE

If the plunger shot is not visible in the half-moon opening with the key 1/2 way between lock and unlock, the plunger can be rotated with pliers counterclockwise to compress the rotation pin and remove the plunger.

4. Using a thin tool, press in rotation pin (3) through slot (5) in plunger.
5. While pressing rotation pin (3) in, push up through small hole in bottom of plunger boss (9) until plunger (4) holds rotation pin (3) in. Remove tool and continue to push plunger (4) out of plunger boss (9).
6. Use ignition key (1) to pull tumbler (7) out.

INSTALLATION

1. Lightly grease open end of tumbler.

NOTE

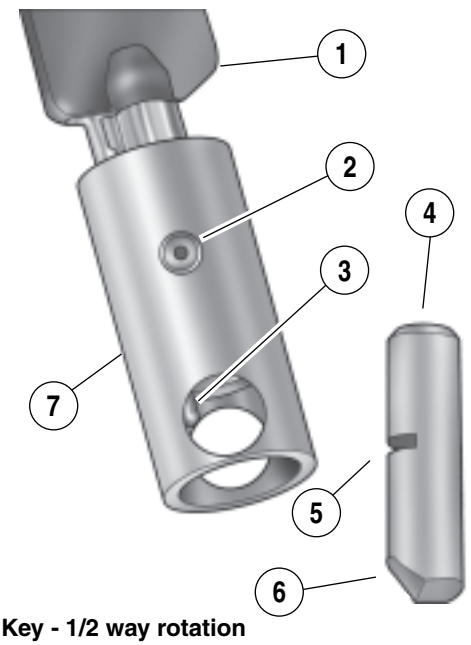
The lock can be installed so that the key will lock the forks with either a counterclockwise or clockwise turn. When the splined retaining key is on top of tumbler, the key will rotate counterclockwise to lock the forks and clockwise to unlock the forks.

2. See Figure 2-154. Slide tumbler (7) into fork lock boss (8) with rotation pin (3) and retaining key (2) at the top of the fork lock boss (8).

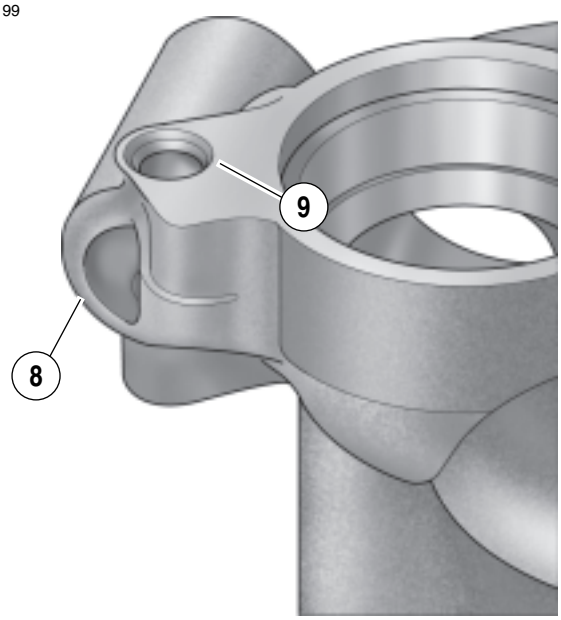
NOTE

The beveled end of the plunger will compress the rotation pin so that the plunger can be slid into place.

3. With the beveled end of plunger (6) facing the rotation pin (3), push the plunger into boss until plunger locks into place.
4. Turn the key from notch to notch. Locking pin should be below fork lock boss in unlocked position and 1/4 inch above boss in locked position.
5. Install upper triple clamp.



1. **Key - 1/2 way rotation**
2. **Retaining key**
3. **Rotation pin - 1/2 way rotation**
4. **Plunger**
5. **Plunger slot**
6. **Plunger bevel**
7. **Tumbler**



8. **Half-moon opening - fork lock boss**
9. **Plunger boss**

Figure 2-152. Fork Lock Components

FORK LOCK (VRSCR) 2.42

GENERAL

To insure that the ignition key and the fork lock key are the same, both locks may need to be changed when one is changed.

REMOVAL

1. Remove complete instrument cluster. See 8.23 InSTRUMENT CLUSTER (VRSCR).
2. See Figure 2-154. Insert ignition key (1) and turn 1/2 way and rotate plunger (4) counterclockwise approximately 1/4 turn.

Figure 2-153. Fork Lock

3. Pull plunger out of tumbler (7).
4. Remove tumbler from triple clamp.

INSTALLATION

1. Lightly grease open end of tumbler.

NOTE

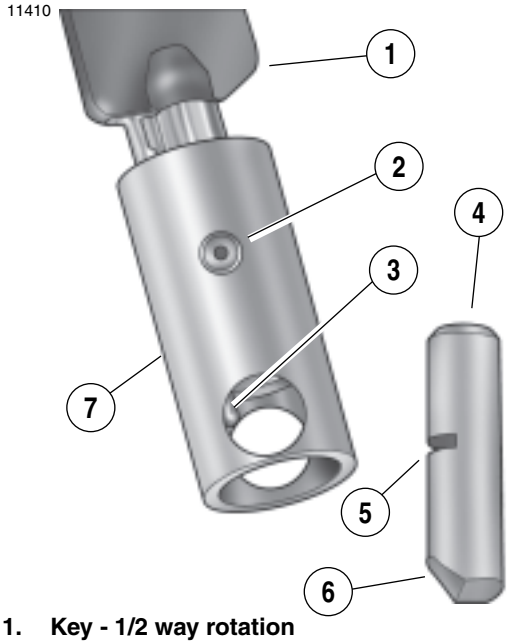
The lock can be installed so that the key will lock the forks with either a counterclockwise or clockwise turn. When the splined retaining key is on top of tumbler, the key will rotate counterclockwise to lock the forks and clockwise to unlock the forks.

2. See Figure 2-154. Slide tumbler (7) into fork lock boss with rotation pin (3) and retaining key (2) at the top of the fork lock boss.

NOTE

The beveled end of the plunger will compress the rotation pin so that the plunger can be slid into place.

3. With the beveled end of plunger (6) facing the rotation pin (3), push the plunger into boss until plunger locks into place.
4. Turn the key from notch to notch. Locking pin should be below fork lock boss in unlocked position and 6.35 mm (1/4 in) above boss in locked position.
5. Install instrument cluster.



1. **Key - 1/2 way rotation**
2. **Retaining key**
3. **Rotation pin - 1/2 way rotation**
4. **Plunger**
5. **Plunger slot**
6. **Plunger bevel**
7. **Tumbler**

Figure 2-154. Fork Lock Components

BELT GUARD/DEBRIS DEFLECTOR 2.43

REMOVAL

Belt Guard

1. See Figure 2-155. Unthread left side lower shock mount bolt from belt guard (1) without removing shock mount bolt from rear fork.
2. Pull belt guard (1) rearward off of side rubber grommet (5) and upper rubber grommet (6). If necessary, remove fasteners (3) holding grommets (5, 6) to rear fork.
3. Inspect rubber grommets (5, 6) on the rear fork and remove the bolts and rubber grommets if necessary.

Debris Deflector

1. See Figure 2-155. Remove fastener (3) and washer (4) from the underside of the rear fork near the rear shock mount.
2. Pull the debris deflector (8) rearward off of the lower rubber grommet (7) and remove the debris guard.
3. Inspect the rubber grommet (7) on the rear fork and remove the bolt and rubber grommet if necessary.

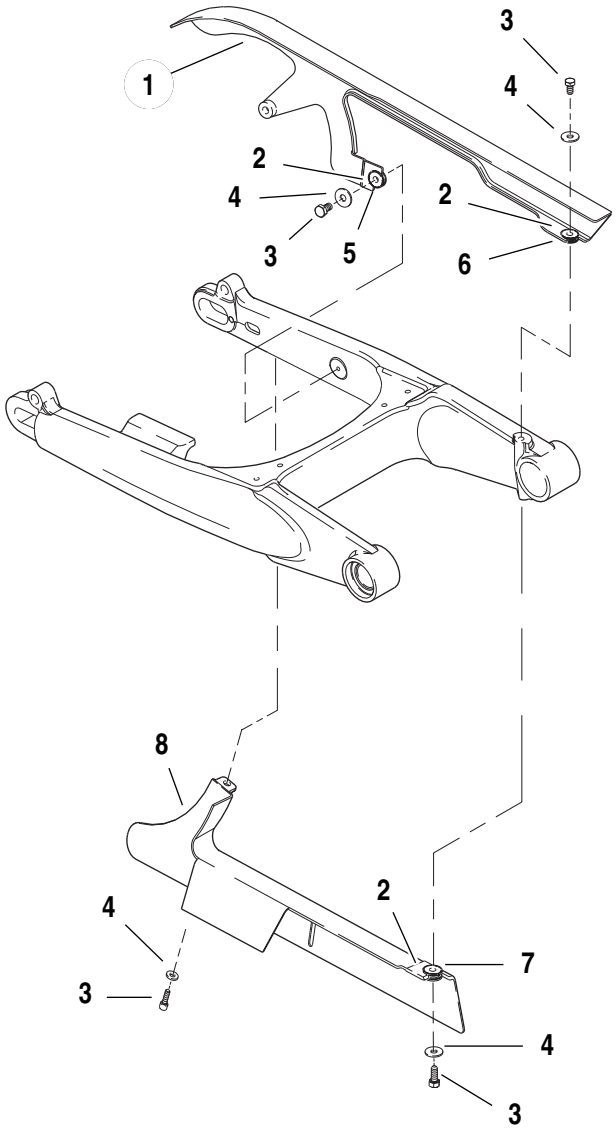
INSTALLATION

Belt Guard

1. See Figure 2-155. If necessary, replace the rubber grommets (5, 6) and bolts. Tighten bolts to 6-10 Nm (53-88 **in-lbs**).
2. Slide the belt guard slots into position on the rubber grommets.
3. Thread lower rear shock mount into thread boss on belt guard. See 2.44 REAR SHOCK ABSORBERS (VRSCA/VRSCD) or 2.45 REAR SHOCK ABSORBERS (VRSCR).
4. Measure guard to drive sprocket clearance.
5. If clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.

Debris Deflector

1. See Figure 2-155. If necessary, replace rubber grommet (7) and fastener (3). Tighten fastener to 6-10 Nm (53-88 **in-lbs**).
2. Slide debris deflector slot (2) into position on the rubber grommet (7).
3. Thread rear fastener (3) and washer (4) through debris deflector (8) into rear fork. Tighten fastener to 6-10 Nm (53-88 **in-lbs**).



1. **Belt guard**
2. **Slot**
3. **Fastener**
4. **Washer**
5. **Side rubber grommet**
6. **Upper rubber grommet**
7. **Lower rubber grommet**
8. **Debris deflector**

Figure 2-155. Belt Guard/Debris Deflector (typical)

REAR SHOCK ABSORBERS (VRSCA/VRSCD) 2.44

REMOVAL

1. Using a suitable lift, support motorcycle under frame until rear tire is slightly off the ground.
2. See Figure 2-156. Remove lower fastener (1), washer (3), and thin height hex-nut (5) attaching right side shock to rear fork.
3. Remove lower bolt (1) and washer (3) from left side shock to rear fork and belt guard. Allow rear tire to rest on ground.
4. Remove top fastener (1) and spacer (2) from left side top shock mount and remove shock. Retain shock mounting nut which passes through fender support and side rail assembly.
5. Remove fastener (1) and spacer (2) from right side top shock mount and remove shock. Retain shock mounting nut which passes through fender support and side rail assembly.

NOTE

The rear shock absorbers on VRSC motorcycles are not repairable. If a shock absorber becomes worn or damaged, it must be replaced as an assembly.

INSTALLATION

1. See Figure 2-156. Insert bolt and spacer (2) through upper shock mounts.
2. Insert shock mounting nuts through left and right fender support and side rails.
3. Thread top shock fasteners (1) through top shock damper spacer (2) into threads of shock mounting nut.
4. Pivot shock absorbers to align lower shock mounts with mounting holes in rear fork.
5. Lift rear fork to meet lower shock mounts.
6. Thread left side lower shock bolt (1) and washer (3) through shock mount and rear fork into belt guard.
7. Thread right side bottom shock mount bolt (1) and washer (3) through bottom shock mount in rear fork into thin height nut (5).
8. Tighten upper and lower shock mount fasteners to 41-68 Nm (31-50 ft-lbs).

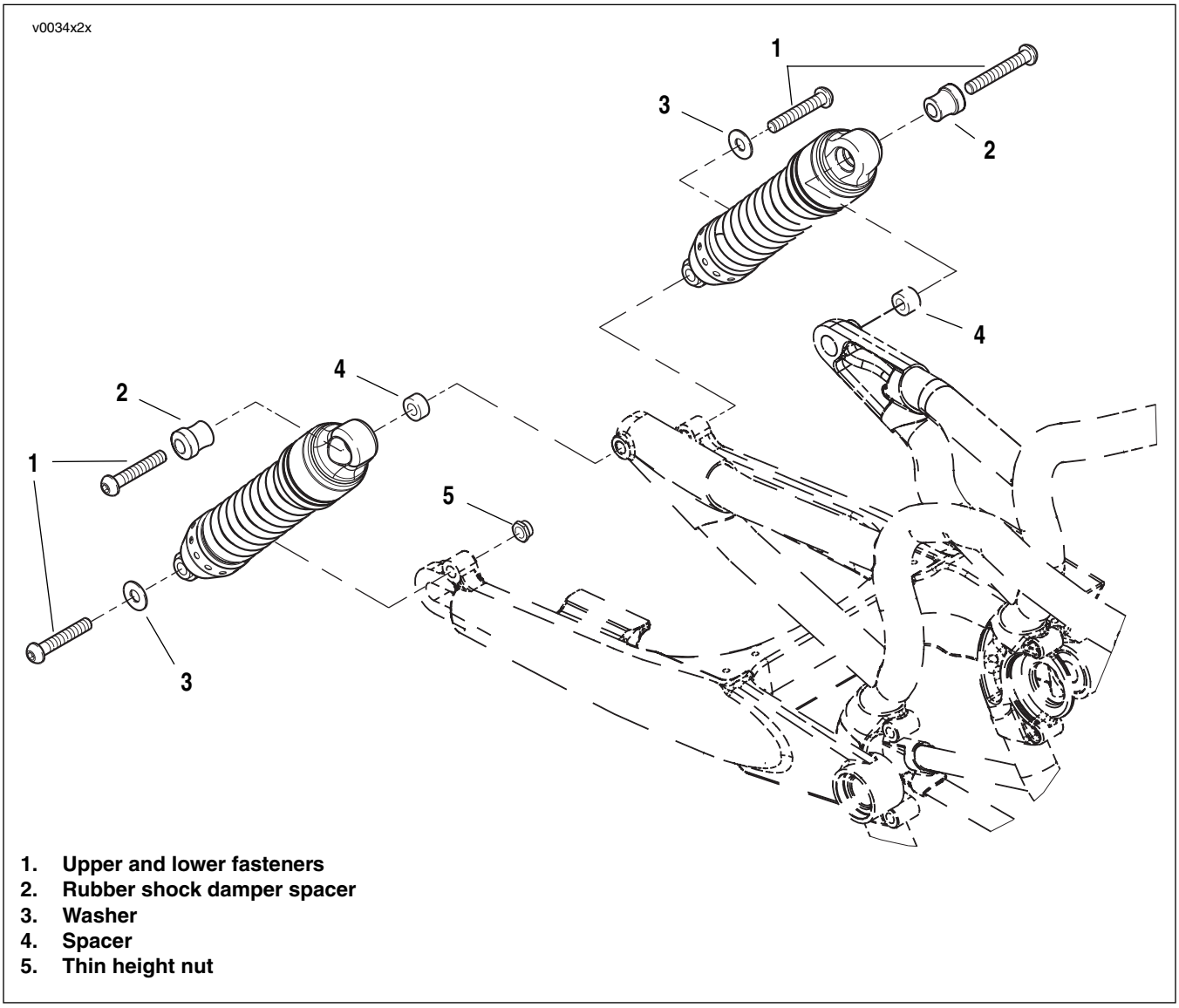
⚠WARNING

Be sure both shock absorbers are adjusted to same pre-load position. Improper adjustment can adversely affect stability and handling, which could result in death or serious injury. (00036a)

9. Verify that preload settings on both shock absorbers are equal. See 1.18 SUSPENSION ADJUSTMENTS.

NOTE

See 1.18 SUSPENSION ADJUSTMENTS for information regarding setting up the suspension for carrying cargo.



1. Upper and lower fasteners
2. Rubber shock damper spacer
3. Washer
4. Spacer
5. Thin height nut

Figure 2-156. Rear Shocks (VRSCA/VRSCD)

REAR SHOCK ABSORBERS (VRSCR) 2.45

REMOVAL

1. Using a suitable lift, support motorcycle under frame until rear tire is slightly off the ground.
2. See Figure 2-157. Remove lower fastener (1), washer (3), and thin height hex-nut (5) attaching right side shock to rear fork.
3. Remove lower bolt (1) and washer (3) from left side shock to rear fork and belt guard. Allow rear tire to rest on ground.
4. Remove top fastener (6) from left side top shock mount and remove shock.
5. Remove fastener (5) from right side top shock mount and remove shock.

NOTE

The rear shock absorbers on VRSCR motorcycles are not repairable. If a shock absorber becomes worn or damaged, it must be replaced as an assembly.

INSTALLATION

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

1. Replace upper shock bolt.
   a. Clean out tapped hole. Run a bottoming tap into the hole and blow hole out with compressed air.
   b. Replace bolts. New bolts must be used.

NOTE

If new bolts are unobtainable in a reasonable timeframe, the original bolt threads must be cleaned off with a wire brush and solvent. After drying bolt with air, apply two drops of LOCTITE®262 approximately 1/4" back from end of free end of bolt. The bolt can then be installed and torqued.

2. See Figure 2-157. Add spacer (3) to upper shock bolts (5) and install bolts.
3. Pivot shock absorbers to align lower shock mounts with mounting holes in rear fork.
4. Lift rear fork to meet lower shock mounts.
5. Coat threads with LOCTITE® 262 and thread left side lower shock bolt (1) and washer (3) through shock mount and rear fork into belt guard.
6. Coat threads with LOCTITE® 262 and thread right side lower shock mount bolt (1) and washer (2) through lower shock mount in rear fork into thin height nut (4).
7. Tighten lower shock mount bolts (1) to 41-68 Nm (31-50 ft-lbs).
8. Tighten upper shock mount bolts (5) to 115-125 Nm (85-92 ft-lbs).

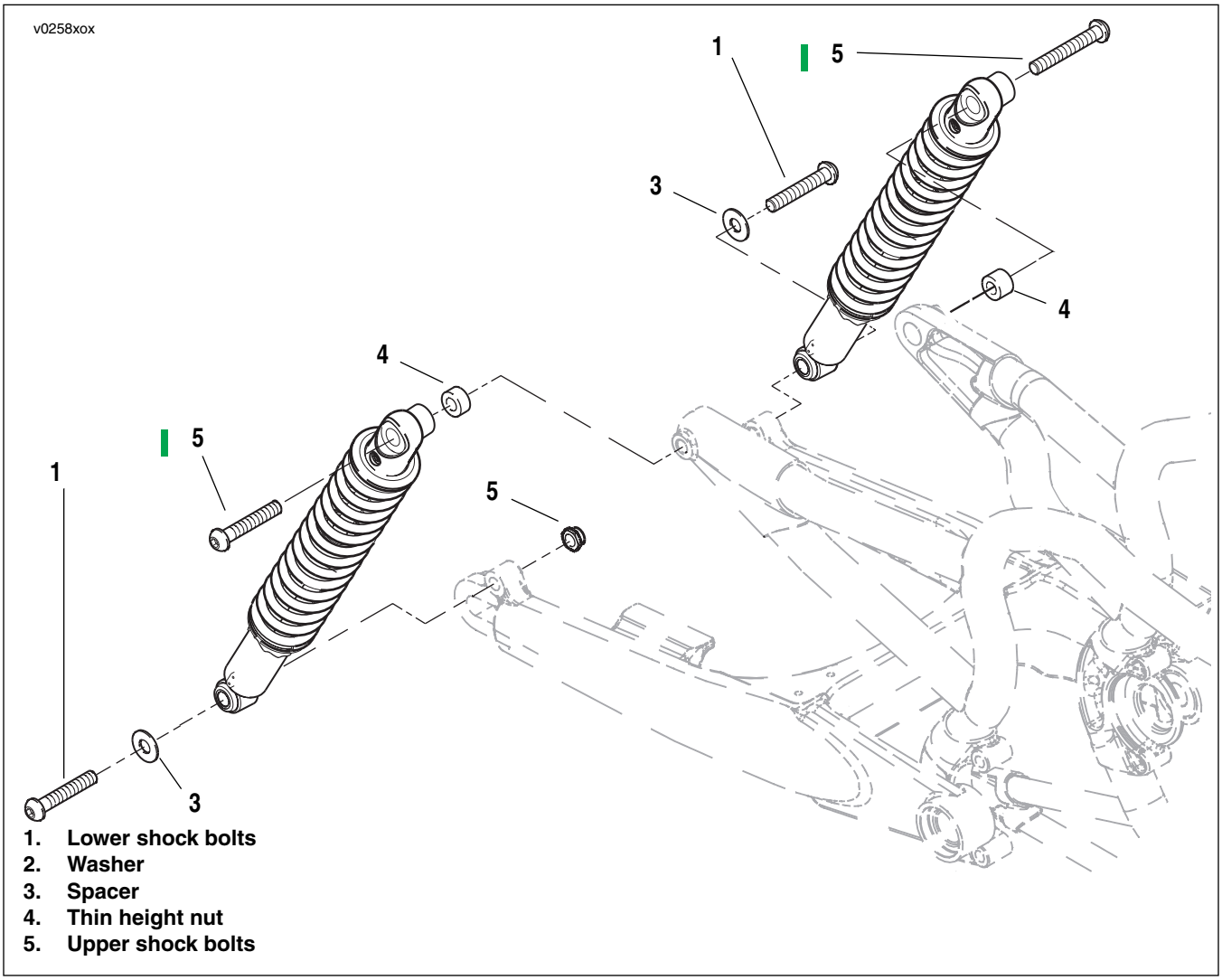
WARNING

Be sure both shock absorbers are adjusted to same preload position. Improper adjustment can adversely affect stability and handling, which could result in death or serious injury. (00036a)

9. Verify that preload settings on both shock absorbers are equal. See 1.18 SUSPENSION ADJUSTMENTS.

NOTE

See 1.18 SUSPENSION ADJUSTMENTS for information regarding setting up the suspension for carrying cargo.



1. Lower shock bolts
2. Washer
3. Spacer
4. Thin height nut
5. Upper shock bolts

Figure 2-157. Rear Shocks (VRSCR)

REAR FORK 2.46

REMOVAL

NOTE

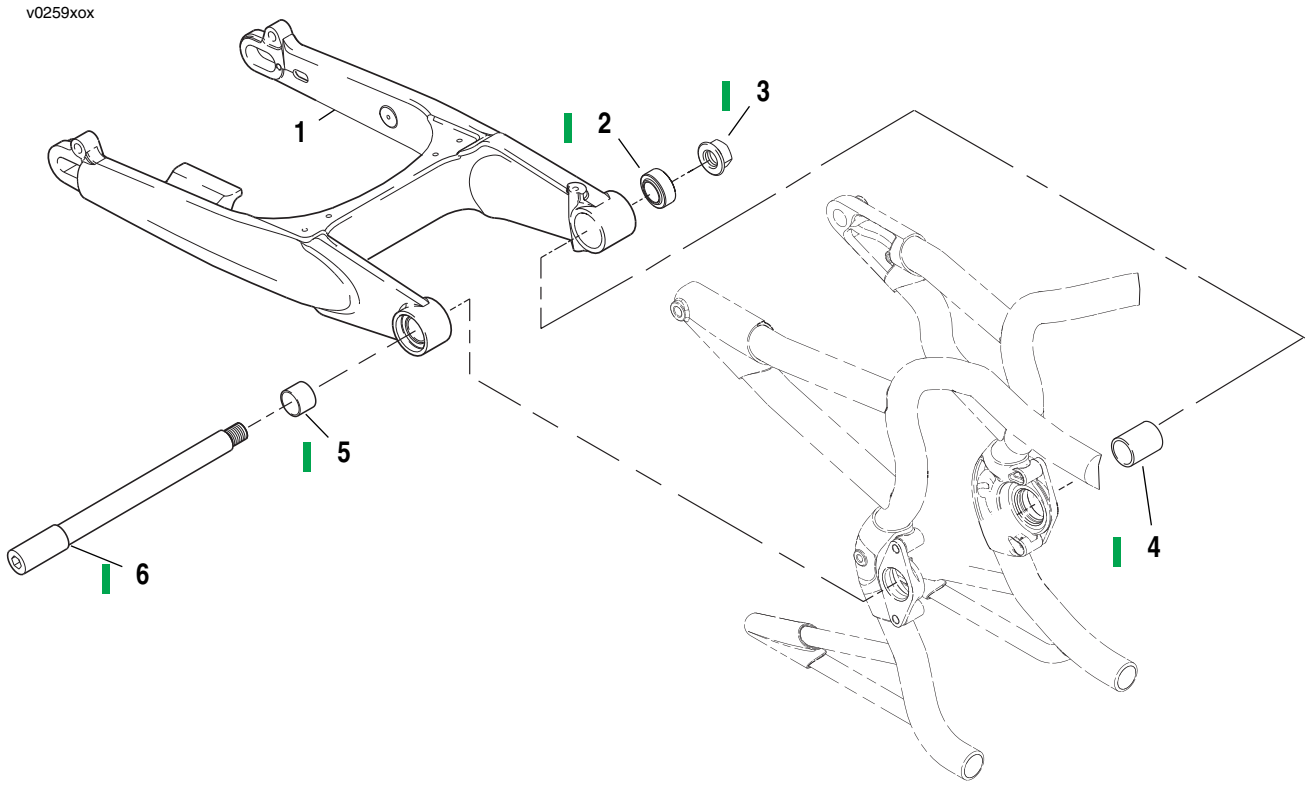
Mark all hardware as it is removed so that it may be returned to its original location.

1. Remove right side cover and maxi-fuse.
2. Remove belt guard and debris deflector. See 2.43 BELT GUARD/DEBRIS DEFLECTOR.
3. Remove rear wheel. See 2.30 REAR WHEEL.
4. Remove rear brake caliper brake fluid line from clips on rear fork. See 2.25 REAR BRAKE CALIPER.
5. Remove left lower rear shock absorber bolt. Remove right rear shock absorber bolt and thin height nut. See 2.44 REAR SHOCK ABSORBERS (VRSCA/VRSCD), or 2.45 REAR SHOCK ABSORBERS (VRSCR).

NOTE

Block or support engine before removing pivot shaft. Pivot bearing (2) will stay with swingarm when swingarm is removed from motorcycle.

6. See Figure 2-158. Remove pivot shaft nut (3).
7. Support rear fork and slide pivot shaft (6) out of rear fork (1). Rear fork can now be removed from frame.



1. **Rear fork**
2. **Left pivot bearing assembly**
3. **Nut**
4. **Left spacer**
5. **Right spacer**
6. **Pivot shaft assembly**

Figure 2-158. Rear Fork (typical)

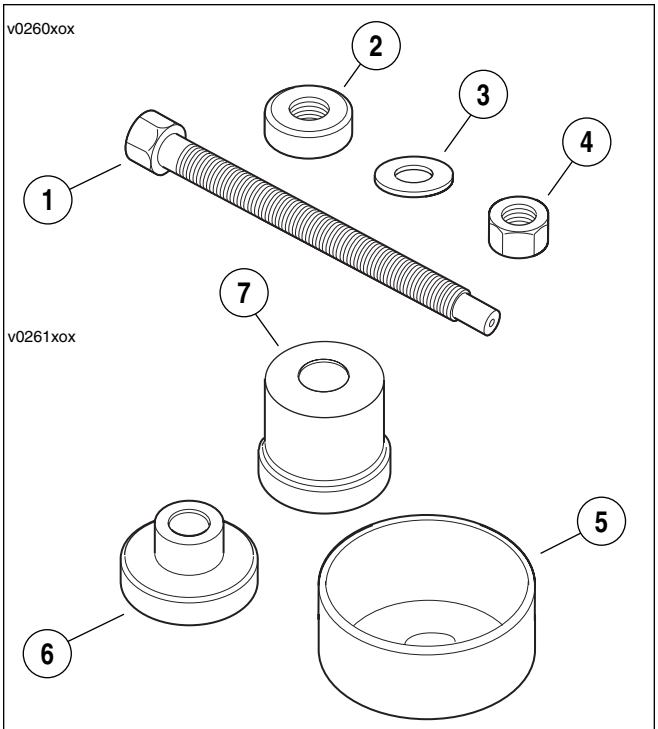
DISASSEMBLY/ASSEMBLY

NOTE

Remove left pivot bearing assembly from fork only if replacement is required. the complete bearing assembly must be replaced as a unit when replacement is necessary. Do not intermix bearing components.

General

The Swingarm Bearing Installation Tool (HD-47175) is used with parts from Wheel Bearing Removal/Replacement Kit (HD-44060-4) as shown in Figure 2-159. Parts used are, Forcing Screw (1), Bearing (2), Washer (3) and Nut (4) to replace the swingarm bearings on all 2005 and later VRSC model motorcycles.



1. **Forcing screw**
2. **Nice bearing**
3. **Washer**
4. **Nut**
5. **Removal cup (HD-47175-1)**
6. **Swingarm bearing remover/installer (HD-47175-2)**
7. **Bushing remover/installer (HD-45175-3)**

Figure 2-159. Parts Used From HD-44060-4 Kit (1-4) and Swingarm Bearing Installation Tool (HD-47175) (5-7)

NOTE

Always remove the bearing/bushing from the inside of swingarm going outward (see arrows). When installing rear bearings/bushings, install from the outside going inward (see arrows).

1. Remove rear swingarm according to appropriate Service Manual.

CAUTION

When mounting swingarm in holding device, protect swingarm to avoid finish damage.

2. Place swingarm assembly on a suitable work surface in suitable holding device.

Left Side Swingarm Bearing Removal

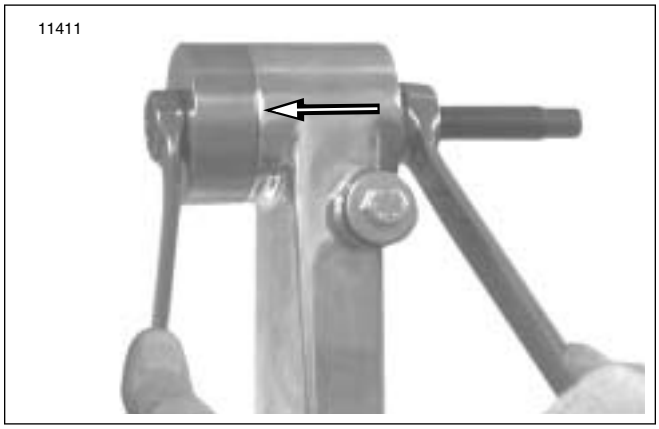


Figure 2-160. Remove Left Side Swingarm Bearing (typical)

1. See Figure 2-160. Position Remover Cup against inner left arm of swingarm with cupped side facing swingarm
2. Install forcing screw through small hole in Remover Cup.
3. Install Swingarm Bearing Remover/Installer, Nice Bearing, washer and nut.
4. Tighten forcing screw until bearing pulls free from swingarm housing.
5. Once bearing has been removed from swingarm, disassemble tool and remove components from swingarm. Discard old swingarm bearing.

Left Side Swingarm Bearing Installation

CAUTION

Do not tighten tool past the point of seating the swingarm bearing or bearing damage can result.

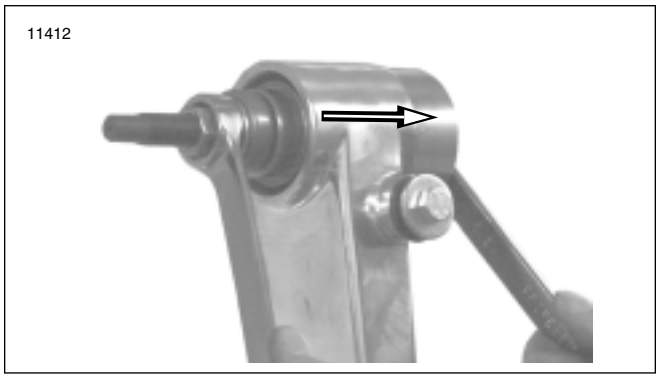


Figure 2-161. Install Left Side Swingarm Bearing (typical)

1. See Figure 2-161. Load **new** swingarm bearing onto swingarm bearing remover/installer and insert into swingarm.

2. Install forcing screw through small hole in Bearing Remover/Installer.
3. Position Remover Cup against inner left arm of swingarm with cupped side facing swingarm.
4. Install bearing and nut.
5. Tighten nut and forcing screw finger tight.

NOTE

When installing bearing, hold the end of the tool without the bearing stationary, and tighten the end with bearing installed.

6. Tighten tool until bearing seats in swingarm housing. DO NOT overtighten.
7. Loosen and remove tool.
8. Check swingarm bearing for free movement.

Right Side Bushing Removal

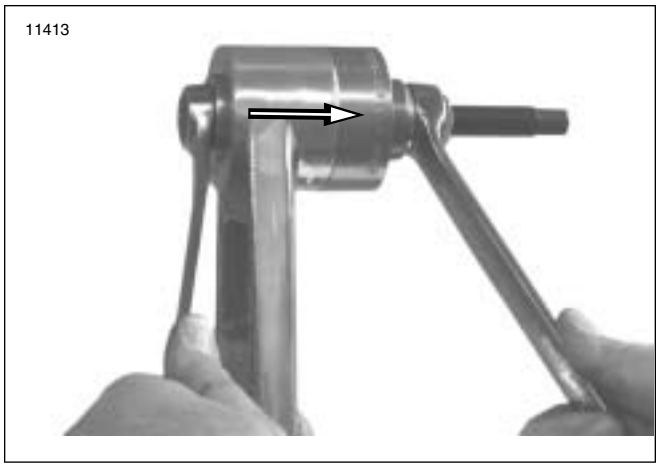


Figure 2-162. Remove Right Side Bushing (typical)

1. See Figure 2-162. Position Removal Cup against outer right arm of swingarm with cupped side facing swingarm
2. Install forcing screw through small hole in remover cup.
3. Install Bushing Remover/Installer, bearing, washer and nut.
4. Tighten forcing screw until bushing pulls free from swingarm housing.
5. Once bushing has been removed from swingarm, disassemble tool and remove components from swingarm. Discard old bushing.

Right Side Bearing Installation

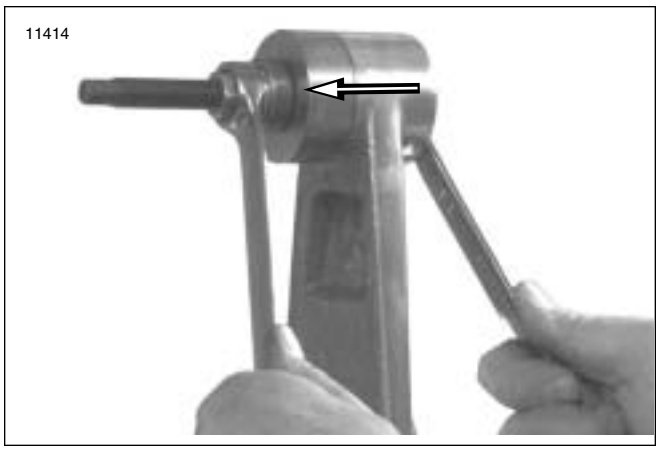


Figure 2-163. Install Right Side Bushing (typical)

1. See Figure 2-163. Load **new** bushing onto bushing remover/installer and insert into outer side of right swingarm.
2. Install forcing screw through small hole in Bushing Remover/Installer.
3. Position Remover Cup against outer left arm of swingarm with cupped side facing swingarm.
4. Install bearing and nut.
5. Tighten nut and forcing screw finger tight.

NOTE

When installing bushing, hold the end of the tool without the bearing stationary, and tighten the end with bearing installed.

6. Tighten tool until bushing is at desired position in swingarm housing.
7. Loosen and remove tool.

NOTE

When installing bushing. tighten tool and begin installation process, stop and back tool off after a few turns and view how far the bushing has been pressed into the swing arm assembly. Bushing should be evenly centered between beveled edges of swingarm casting.

8. Check position of bushing in swingarm housing.

INSTALLATION

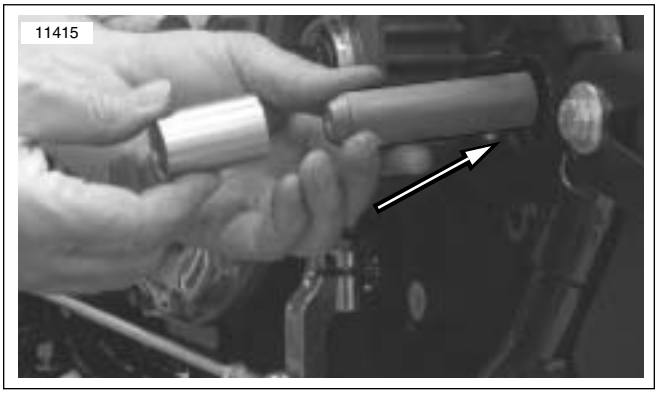


Figure 2-164. Install Swingarm Guide

1. See Figure 2-164. Install Swingarm Guide (HD-47176) into pivot shaft cavity in frame.

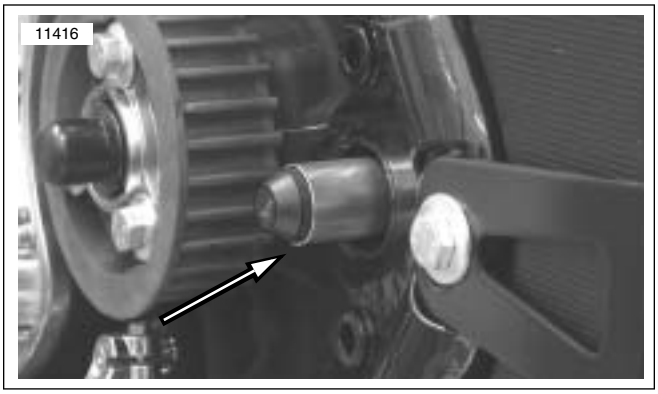


Figure 2-165. Install Left Spacer

2. See Figure 2-165. Slide left-side external swingarm spacer onto Swingarm Guide.

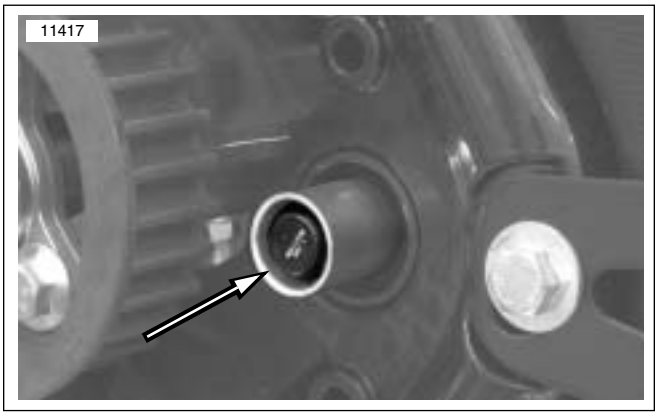


Figure 2-166. Push Guide flush with Spacer

3. See Figure 2-166. Push Swingarm Guide flush with face of left side spacer.

NOTE

When installing rear swingarm and inserting swingarm pivot shaft, swingarm assembly guide will stick to threaded end of pivot shaft via magnet.

4. Install rear swingarm.
5. Slide rear fork assembly into position.
6. Apply a liberal coat of LOCTITE® ANTI-SEIZE LUBRICANT to pivot shaft.
7. See Figure 2-158. From right side, slide pivot shaft (6) through dust seals, rear fork pivot bearing, bushing and engine mounts, spacers.
8. Apply two or three drops of LOCTITE® 243 (blue) to threads of pivot shaft nut. Install and tighten pivot shaft nut to 61-75 Nm (45-55 ft-lbs).

NOTE

Proper pivot shaft tightening is important to maintain rear fork alignment.

9. Check for freedom of rotation of rear fork around bearings and that fork and frame side rails have not been distorted when pivot shaft nut was tightened.
10. Install both rear shock absorbers. See 2.44 REAR SHOCK ABSORBERS (VRSCA/VRSCD), or 2.45 REAR SHOCK ABSORBERS (VRSCR).
11. Install rear brake caliper and clip brake line to rear fork.
12. Install rear wheel.
13. Install belt guard and debris deflector. See 2.43 BELT GUARD/DEBRIS DEFLECTOR.
14. Install maxi-fuse and right side cover.

SEAT LATCH (VRSCA/VRSCD) 2.47

REPLACEMENT

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Unlatch and open seat.
3. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.

⚠ WARNING

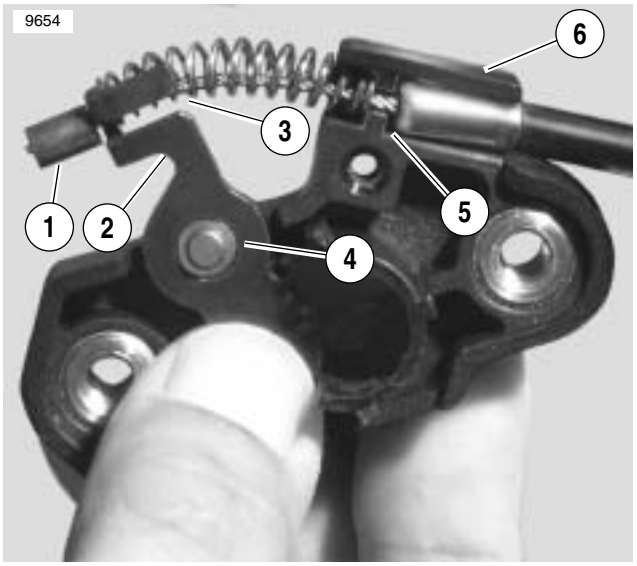
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

4. Disconnect negative battery cable.
5. Remove two fasteners and washers. Pull seat latch mechanism by cable from frame. See 8.6 IGNITION/LIGHT SWITCH (VRSCA/VRSCD).
6. See Figure 2-167. To disconnect seat latch, remove single fastener and remove top plate. Remove cable barrel (1) from rocker (2) and remove cable from cable guide (6).
7. Remove top plate of **new** seat latch.
8. With key switch in FUEL, compress spring over cable and install cable barrel (1) through slot (3) in rocker (2).
9. Hold rocker (2) on pivot (4). Use divider (5) in guide to separate spring from cable sheath. Install top plate.
10. Secure seat latch mechanism to frame with two fasteners and washers. Tighten to 6-10 Nm (53-88 **in-lbs**).
11. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
12. Replace airbox cover.
13. Replace maxi-fuse and side cover.

CAUTION

When closing the seat, make sure the ignition switch is in the FUEL position. If the ignition switch is in any other position when the seat is closed, the seat latch mechanism could be damaged. (00196a)

14. Turn ignition switch to FUEL and close seat. Then turn ignition switch to LOCK.



1. **Cable barrel**
2. **Rocker**
3. **Slot**
4. **Pivot**
5. **Divider**
6. **Cable guide**

Figure 2-167. Seat Latch (top plate removed)

SEAT (VRSCA/VRSCD) 2.48

REMOVAL

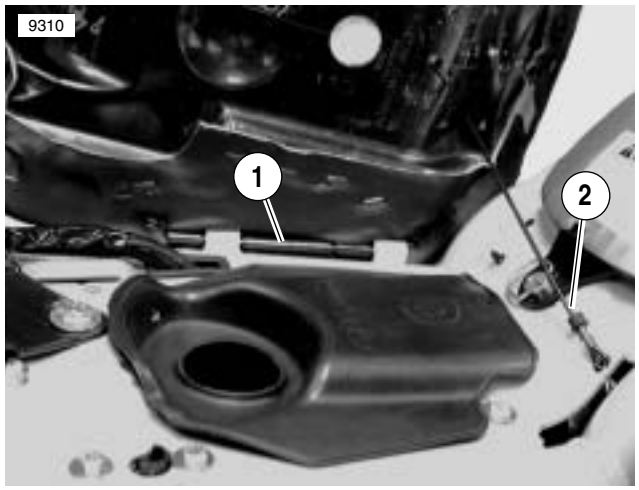
1. Unlock and open seat.
2. See Figure 2-168. Remove seat tether (2) from the hole in frame.
3. Pry hinge clip (1) from seat hinge pins. Slide seat rearward to release hinge pins from bushings on frame.
4. See Figure 2-169. Remove pillion mounting bolt and washer (5). Save bolt and washer for reinstallation. Slide grabstrap (2) forward off pillion.
5. Push pillion forward to release slot on the bottom of pillion from tongue on fender. Lift pillion back and away from motorcycle.
6. If necessary, remove grabstrap.

CLEANING AND INSPECTION

1. Inspect all components for wear or damage.
2. Clean underside of pillion and seat. Clean fender and frame mounting surfaces.

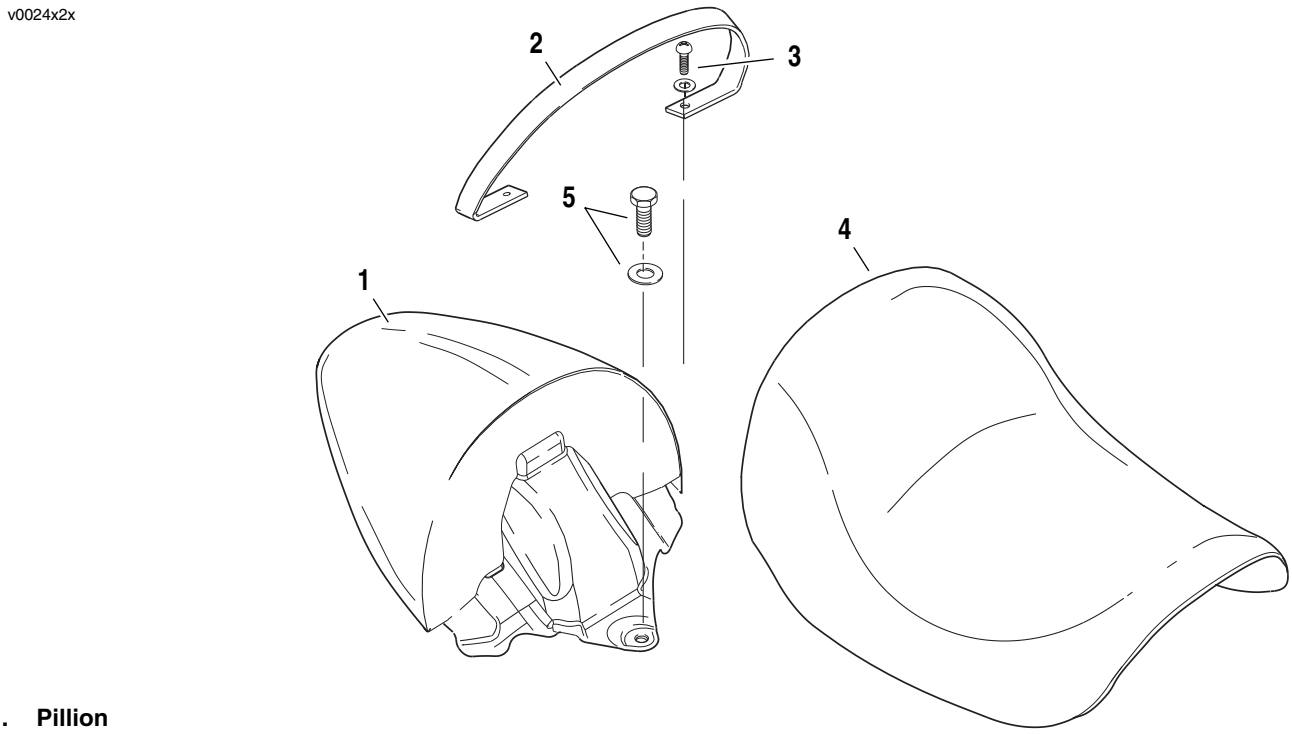
NOTE

Do not use ordinary soap to clean the seat. Thoroughly clean with a quality saddle soap. Once the seat is dry, it can be treated with HARLEY-DAVIDSON LEATHER CARE DRESSING (Part No. 98261-91V).



1. **Hinge clip**
2. **Seat tether**

Figure 2-168. Seat Hinge and Tether



1. **Pillion**
2. **Grabstrap**
3. **Mounting bolt and washer**
4. **Rider's seat**
5. **Pillion mounting bolt and washer**

Figure 2-169. Seat and Pillion

INSTALLATION

1. If necessary, install grabstrap. Tighten to 11-17 Nm (97-150 **in-lbs**).
2. Push pillion toward front of motorcycle until mounting hole in base is approximately 25 mm (1 inch) in front of mounting hole in frame.
3. While applying downward pressure on middle of pillion, slide pillion rearward to fully engage slot on bottom with tongue on top of fender. Push rearward until mounting hole on pillion base is aligned with mounting hole in frame.
4. Install pillion base to frame.Tighten fastener to 11-17 Nm (97-150 **in-lbs**).
5. Install seat. Make sure both seat pins engage their bushings on the frame.
6. Press clip over seat hinge.
7. Install seat tether to hole in frame.

CAUTION

When closing the seat, make sure the ignition switch is in the FUEL position. If the ignition switch is in any other position when the seat is closed, the seat latch mechanism could be damaged. (00196a)

8. Turn ignition switch to FUEL and close seat. Then turn ignition switch to LOCK.

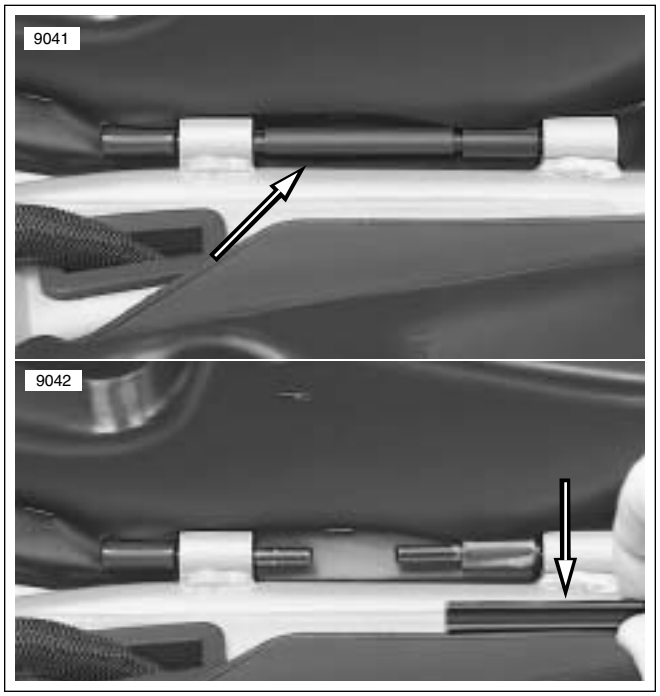


Figure 2-170. Seat Hinge and Clip

SEAT (VRSCR) 2.49

REMOVAL

1. Open seat.
2. See Figure 2-171. Pry hinge clip from seat hinge pins. Slide seat rearward to release hinge pins from bushings on frame.
3. See Figure 2-172. Remove pillion mounting nut and washer (5). Save nut and washer for installation. Slide grab strap forward off pillion.
4. See Figure 2-173. Push pillion forward to release slot on the bottom of pillion from pillion mounting tab (2) on fender. Lift pillion back and away from motorcycle.
5. If necessary, remove grab strap (1).

CLEANING AND INSPECTION

1. Inspect all components for wear or damage.
2. Clean underside of pillion and seat. Clean fender and frame mounting surfaces.

NOTE

Do not use ordinary soap to clean the seat. Thoroughly clean with a quality saddle soap. Once the seat is dry, it can be treated with HARLEY-DAVIDSON LEATHER CARE DRESSING (Part No. 98261-91V).

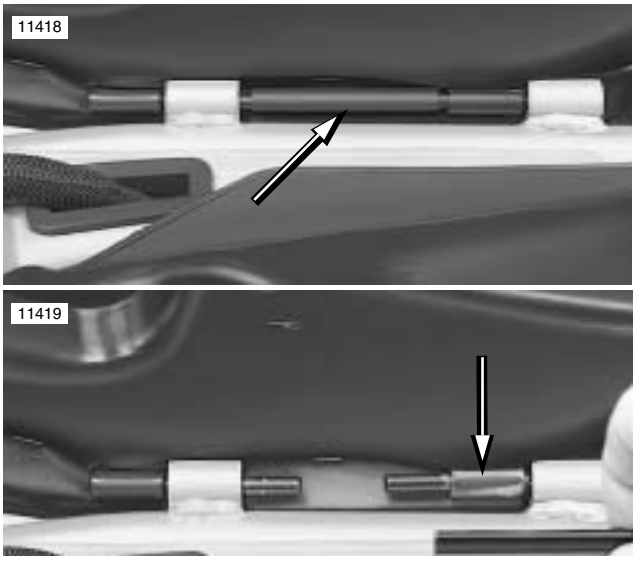
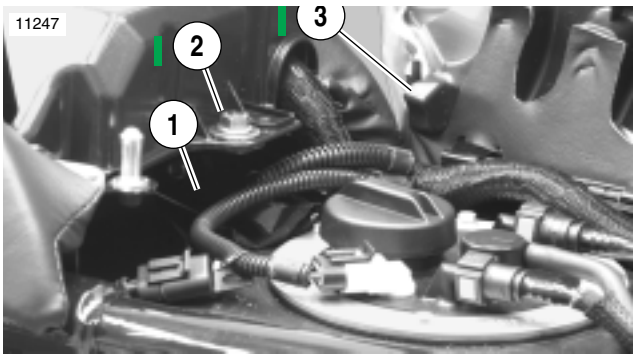
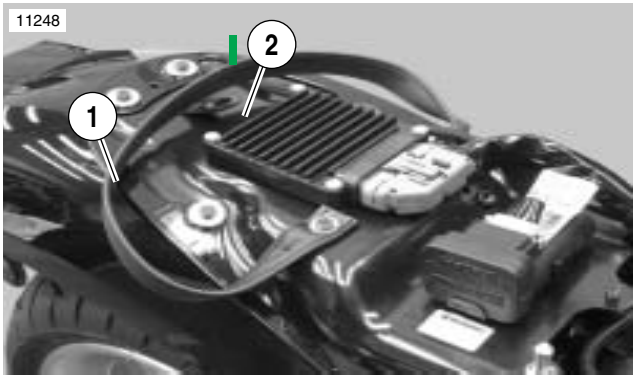


Figure 2-171. Seat Hinge and Clip (typical)



1. **Pillion and rider's seat**
2. **Mounting nut and washer**
3. **Rider seat**

Figure 2-172. Seat and Pillion



1. **Grab strap**
2. **Passenger pillion mounting tab**

Figure 2-173. Grab Strap

INSTALLATION

1. If necessary, install grabstrap. Tighten to 8-12 Nm (72-108 **in-lbs**).
2. Push pillion toward front of motorcycle until mounting hole in base is approximately 25 mm (1 inch) in front of mounting hole in frame.
3. While applying downward pressure on middle of pillion, slide pillion rearward to fully engage slot on bottom with tongue on top of fender. Push rearward until mounting hole on pillion base is aligned with mounting hole in frame.
4. Install pillion base to frame.Tighten fastener to 20-26 Nm (15-19 ft-lbs).
5. Install seat. Make sure both seat pins engage their bushings on the frame.
6. Press clip over seat hinge.
7. Install seat tether to hole in frame.

REAR FENDER/SUPPORTS (VRSCA/VRSCD) 2.50

REMOVAL

WARNING

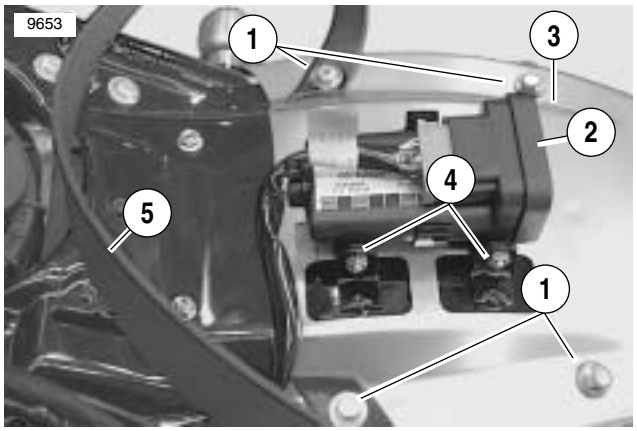
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Disconnect negative battery cable. See 8.10 BATTERY.
3. Remove pillion. See 2.48 SEAT (VRSCA/VRSCD).
4. See Figure 2-174. Remove lock nuts (4) holding turn signal/security module (TSSM) bracket. Thread lock nuts on bracket for use later. Fold module (2) and bracket aside.
5. Remove fasteners (1) holding fender to inner fender. Remove grabstrap (5) and lift fender up from seat end.
6. Separate tail/stop lamp connector [93] and remove fender and stop light assembly.
7. Disconnect:
   a. Left [19] and right [18] rear turn signals.
   b. License plate lamp connector [45].
8. See Figure 2-175. Remove fasteners (3) holding rear turn signal and license plate bracket to inner fender.
9. Remove fasteners (2) holding inner fender to fender support brackets.
10. Remove fasteners mounting inner fender to fender weldment. Remove wiring harness as required and remove inner fender (1).
11. To remove two fender support brackets, use a suitable lift to support motorcycle under frame until rear tire is slightly off ground.
12. Remove upper shock fasteners and capture shock mounting nuts. Lower tire to ground. See 2.44 REAR SHOCK ABSORBERS (VRSCA/VRSCD).
13. See Figure 2-176. Remove two inner bolts fastening support brackets to frame side rails. Remove support brackets.
14. Remove mud flap stud plate and mud flap.
15. Install rear fender and install grabstrap. Tighten to 8-12 Nm (71-106 **in-lbs**).
16. Install turn signal/security module (TSSM) and bracket.
17. Install pillion. See 2.48 SEAT (VRSCA/VRSCD).
18. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
19. Install maxi-fuse and right side cover.

WARNING

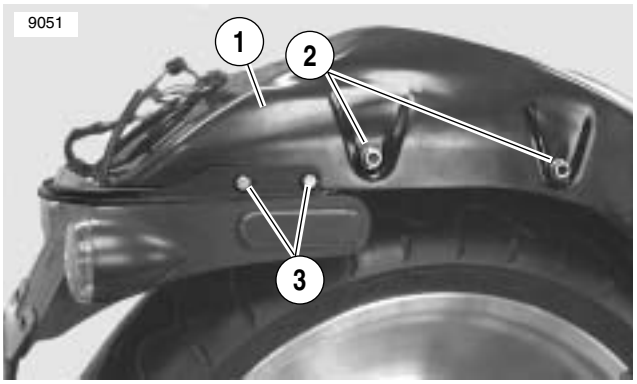
Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

20. Verify turn signal lamp operation.



1. **Fender to inner fender bolts**
2. **TSSM module**
3. **Fender**
4. **TSSM bracket lock nuts**
5. **Grabstrap**

Figure 2-174. Rear Fender Components (under pillion)

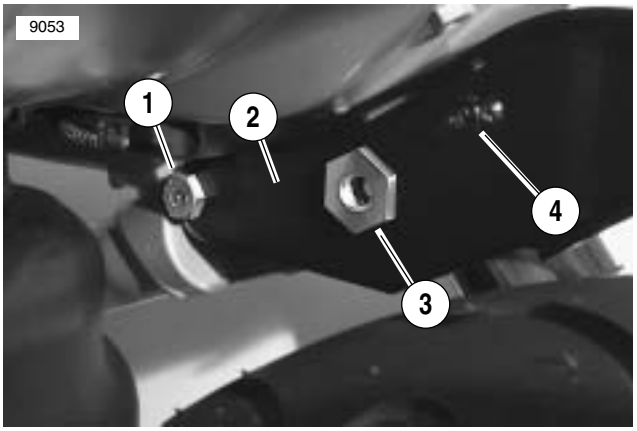


1. **Inner fender**
2. **Inner fender bolts**
3. **Rear turn signal and license bracket bolts**

Figure 2-175. Inner Fender and Rear Turn Signal and License Plate Bracket

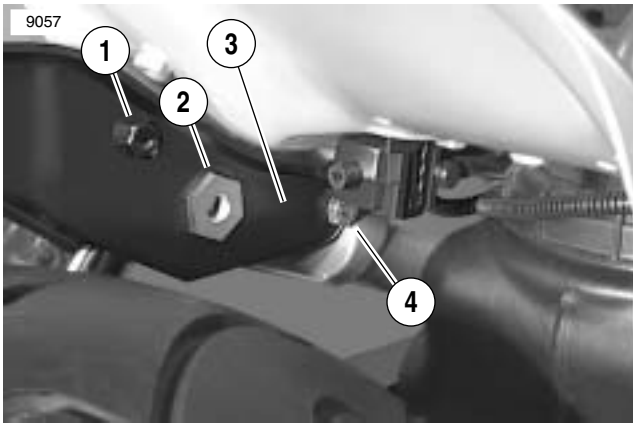
INSTALLATION

1. Install mud flap and stud plate to frame fender weldment. Tighten to 8-12 Nm (70.8-106.2 **in-lbs**).
2. See Figure 2-176. Loosely install both fender support brackets (2). Finger tighten fasteners (1).
3. Insert upper shock mounting nut (3) through support bracket and into frame side rails.
4. Lower motorcycle on rear tire to align rear shock mounting eye with mounting nuts. Install rear shock mounting bolt and spacers. See 2.44 REAR SHOCK ABSORBERS (VRSCA/VRSCD).
5. Tighten fasteners:
   a. Rear shock fasteners - 41-68 Nm (30-50 ft-lbs).
   b. Fender support bracket fasteners - 34-41 Nm (25-30 ft-lbs).
6. Install inner fender. Tighten fasteners to 20-26 Nm (15-19 ft-lbs).
7. Route wiring harness for tail/stop lamp, license plate lamp, and turn signals. Install turn signal and license plate bracket assembly. Tighten to 8-12 Nm (71-106 **in-lbs**).
8. Connect:
   a. Left [19] and right [18] rear turn signals.
   b. License plate lamp connector [45].
   c. Tail/stop lamp connector [93].



1. **Mounting fastener**
2. **Fender support bracket**
3. **Upper shock mounting nut**
4. **Inner fender mounting stud**

Figure 2-176. Right Side Fender Support Bracket



1. **Inner fender mounting stud**
2. **Lower shock mounting nut**
3. **Fender support bracket**
4. **Mounting fastener**

Figure 2-177. Left Side Fender Support Bracket

REAR FENDER (VRSCR) 2.51

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

1. Remove right side cover.
2. Remove maxi-fuse.
3. Open seat

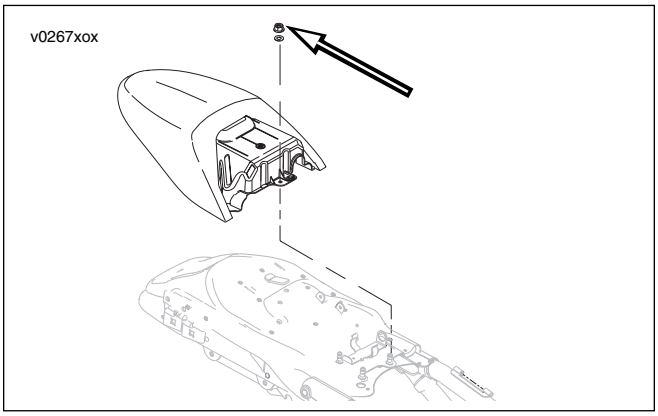


Figure 2-178. Remove Pillion

4. See Figure 2-178. Remove fastener and passenger pillion.

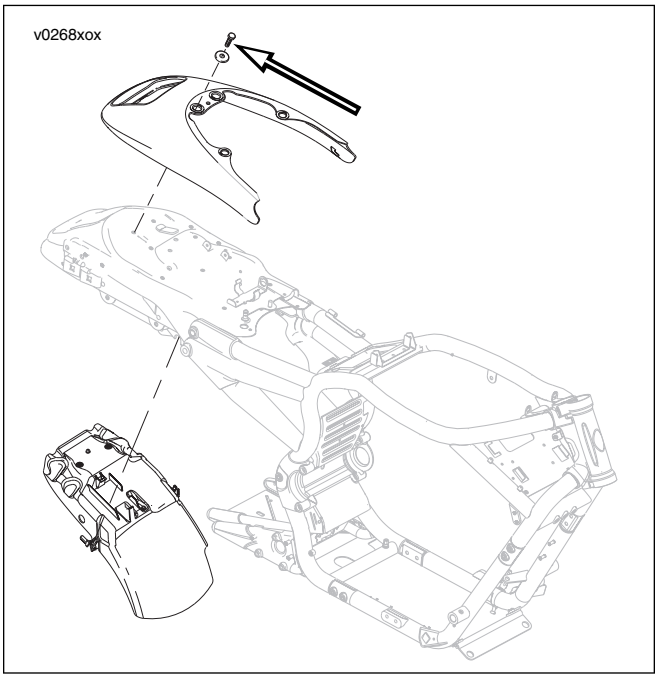


Figure 2-179. Fender Mounting Fasteners

5. See Figure 2-179. Remove four fasteners and washers from fender. Remove fender by sliding back and lifting upward.

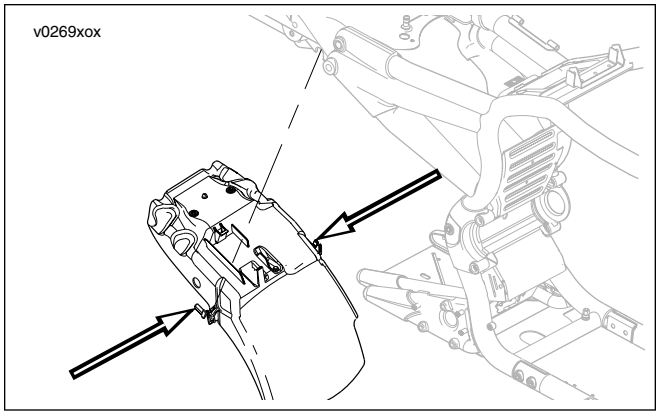


Figure 2-180. Inner Fender Locking Tabs

6. See Figure 2-180. Remove inner fender by first removing two rear ECM mounting bolts, and then gently pulling outward on locking tabs on sides of fender. Inner fender will drop down once released.

INSTALLATION

1. Insert inner fender under rear frame and align fender locking tabs with slots in frame.
2. Push upward and click each side into frame on at a time.
3. Install two rear ECM mounting bolts. Tighten to 6-10 Nm (53-89 **in-lbs**).
4. Install rear fender by sliding tabs on front of rear fender into slots on inner fender locking tabs.
5. Ensure that front fender tabs are latched with inner fender locking tabs and press down gently fender to seat fender against frame.
6. Install four fender fasteners. Tighten fasteners to 4.5-7.5 Nm (40-66 **in-lbs**).
7. Install passenger pillion fastener. Tighten fastener to 20-26 Nm (15-19 ft-lbs).

ENGINE 3

Table Of Contents

SPECIFICATIONS 3.1

Table 3-1. Engine General

ITEM	DATA
Number of cylinders	2
Type	4-cycle, 60°, liquid cooled V-twin
Torque (VRSCA) (domestic model at crank)	100 Nm (74 ft-lbs) @ 7000 rpm
Torque (VRSCD) (domestic model at crank)	109 Nm (80 ft-lbs) @ 7000 rpm
Torque (VRSCR) (domestic model at crank)	109 Nm (80 ft-lbs) @ 7000 rpm
Bore	100 mm (3.94 in.)
Stroke	72 mm (2.835 in.)
Piston displacement (approx.)	1130 cc (69 cubic in.)
Max. engine speed	9000 RPM
Idle speed	1150-1250 RPM
Engine & transmission weight	89.4 kg (197 lbs)

Table 3-2. Oil Pump

ITEM	DATA
Type	Gerotor, internal oil pump, wet sump
Pressure	3-6.5 bar (43-94 psi) at 3000 RPM and normal operating temperature of 70° C (158° F)
Filtration	10 micron media between pump & engine

Table 3-3. Water Pump

ITEM	DATA
Type	Impeller type, thermostat controlled bypass

Table 3-4. Valve Diameter

ITEM	MM	IN
Intake	40.0	1.575
Exhaust	34.5	1.358

Table 3-5. Valve Lash

ITEM		MM	IN
Intake	Max	0.245	0.0096
	Min	0.195	0.0078
Exhaust	Max	0.345	0.0135
	Min	0.295	0.0117

Table 3-6. Cylinder Heads

ITEM	MM	IN
Valve guide in head (tight)	Max 0.051	0.002
	Min 0.022	0.0009
Valve seat in head (tight)	Max 0.100	0.0039
	Min 0.059	0.002
Head gasket surface (flatness)	0.020	0.0008
Valve-to-guide running clearance - intake	Max 0.0585	0.0023
	Min 0.0285	0.0011
Valve-to-guide running clearance - exhaust	Max 0.0685	0.0026
	Min 0.0385	0.0015
Valve guide I.D.	Max 6.015	0.2368
	Min 6.000	0.2362
Valve stem diameter	Intake	
	Max 5.9715	0.2351
	Min 5.9565	0.2345
	Exhaust	
	Max 5.9615	0.2347
	Min 5.9465	0.2341
Valve to guide running clearance	Intake	
	Max 0.0585	0.0023
	Min 0.0285	0.0011
	Exhaust	
	Max 0.0685	0.0027
	Min 0.0385	0.0015
Valve seat to cylinder head press	Max 0.0100	0.0004
	Min 0.0590	0.0023
Valve seat run-out	Max 0.0050	0.0002
Valve seat to guide run-out	Max 0.0200	0.0008
Valve spring free length	Outer	
	Max 45.630	1.797
	Inner	
	Max 43.770	1.723
Valve spring installed height	Outer	
	Max 39.000	1.535
	Inner	
	Max 37.000	1.457
Cylinder head flatness	Max 0.0200	0.0008
Intake valve stem protrusion	Max 44.771	1.762
	Min 44.171	1.739
Exhaust valve stem protrusion	Max 43.893	1.728
	Min 43.293	1.704

Table 3-7. Cylinder Heads (continued)

ITEM	KG	LB
Spring force installed	Outer @ 39 mm (1.535 in.) max	
	Max 20.80	45.86
	Min 18.97	41.88
	Inner @37 mm (1.457 in.) max	
	Max 11.31	24.95
	Min 10.10	22.26
Maximally compressed (intake and exhaust)	Outer	
	Max 66.58	146.80
	Min 60.87	134.22
	Inner	
	Max 34.15	75.31
	Min 31.10	68.57

Table 3-8. Cam Drive

Chain guide wear	Pittings to be smaller than 16 mm in length, Maximum depth of tensioner show wear 0.8 mm.
Sprocket wear	Visual check. No pittings allowed. Lateral wear caused by chain is allowed

Table 3-9. Cam Timing

Intake	106 ± 1°
Exhaust	105 ± 1°
Total intake lift	10.9 mm (0.4291 in.)
Duration intake @1 mm	248°
Total exhaust Lift	9.98 mm (0.3929 in.)
Duration exhaust @ 1 mm	206°

Table 3-10. Piston Ring Gap

ITEM	MM	IN
Top ring gap	Max 0.550	0.022
	Min 0.350	0.014
2nd ring gap	Max 0.600	0.024
	Min 0.400	0.016
Oil control ring gap	Max 0.890	0.035
	Min 0.380	0.015
Top ring side clearance	Max 0.075	0.003
	Min 0.020	0.001
2nd ring side clearance	Max 0.055	0.002
	Min 0.010	0.000

Table 3-11. Crankcase/Cylinder Liner

ITEM	MM	IN
Cylinder liner cover over stand	Max 0.130	0.0051
	Min 0.090	0.0035
Cylinder head deck flatness	Max 0.020	0.0008
	Min 0.000	0.0000

Table 3-12. Connecting Rod/Piston

ITEM	MM	IN
Rod small end bore dia.	Max 22.028	0.8672
	Min 22.018	0.8669
Piston pin diameter	Max 22.000	0.8661
	Min 21.995	0.8659
Running clearance	Max 0.033	0.0013
	Min 0.018	0.0007

Table 3-13. Balance Shaft/Crankcase

ITEM	MM	IN
Balance shaft journal	Max 17.012	0.6698
	Min 17.001	0.6693
Press fit inner race to journal	Max -0.020	- 0.0008
	Min -0.001	- 0.0000
Crankcase balance shaft bearing bore	Max 39.971	1.5737
	Min 39.955	1.5730
Bearing outer race to bearing bore press fit	Max -0.045	- 0.0018
	Min -0.018	- 0.0007

Table 3-14. Connecting Rod Journals

ITEM	MM	IN
Rod bearing journal	Red	
	Max 47.991	1.8894
	Min 47.983	1.8891
	Blue	
	Max 47.983	1.8891
	Min 47.975	1.8888
Rod bearing bore without bearing	Max 51.616	2.0321
	Min 51.600	2.0315
Rod bearing bore with bearing	Red	
	Max 48.052	1.8918
	Min 48.020	1.8906
	Blue	
	Max 48.044	1.8915
	Min 48.012	1.890
Running clearance	Max 0.069	0.0027
	Min 0.029	0.0011
Axial ground play	Max 0.290	0.0114
	Min 0.140	0.0055

Table 3-15. Crankshaft/Crankcase

ITEM	ALTERNATOR SIDE		CLUTCH SIDE	
	MM	IN	MM	IN
Main bearing journal	Blue			
	Max 55.977	2.20382	Max 55.952	2.20283
	Min 55.971	2.20358	Min 55.946	2.20260
	Green			
	Max 55.984	2.20409	Max 55.959	2.20311
	Min 55.977	2.20382	Min 55.952	2.20283
	Red			
	Max 55.990	2.20433	Max 55.965	2.20334
	Min 55.984	2.20410	Min 55.959	2.20312
Main bearing bore	Max 61.019	2.40232		
	Min 61.000	2.40158		
Running clearance	Blue			
	Max 0.059	0.00232	Max 0.059	0.00232
	Min 0.026	0.00103	Min 0.026	0.00103
	Green			
	Max 0.061	0.00240	Max 0.061	0.00240
	Min 0.027	0.00107	Min 0.027	0.00107
	Red			
	Max 0.062	0.00244	Max 0.062	0.00244
	Min 0.029	0.00115	Min 0.029	0.00115
Axial end play	Max 0.060	0.00236		
	Min 0.050	0.00197		

SERVICE WEAR LIMITS 3.2

GENERAL

Wear limits are given here as a guideline for measuring used engine components. Replace components when they exceed values listed here.

Table 3-16. Crankshaft/Crankcase

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Main bearing journal	55.940	2.202
Axial end play	0.300	0.011
Main bearing bore	61.019	2.4023

Table 3-17. Connecting Rod/Piston

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Small end bore diameter	22.050	0.868
Piston pin diameter	21.996	0.866

Table 3-18. Connecting Rod/Crankshaft

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Rod bearing journal	47.970	1.888
Rod bearing bore	51.616	2.0321

Table 3-19. Piston/Cylinder Liner

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Cylinder liner i. d. bore (freestate)	100.085	3.9403
Cylinder liner out-of-round (installed)	0.080	0.0031
Piston major diameter	99.961	3.9354
Running clearance	0.080	0.0031

Table 3-20. Piston Rings

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Top ring gap	0.700	0.0276
2nd ring gap	0.750	0.0295
Oil control ring gap	1.050	0.0413
Top ring side clearance	0.100	0.0039
2nd ring side clearance	0.070	0.0028

Table 3-21. Cylinder Heads

ITEM	REPLACE IF WEAR EXCEEDS	
	MM	IN
Cylinder head flatness	0.100	0.0039
Cylinder head cam bore diameter	26.035	1.0250
Tappet bucket o.d. diameter	30.962	1.2190
Cylinder head bucket bore diameter	31.040	1.2220
Valve guide i.d. diameter	6.040	0.2378
Valve stem deflection	0.08	0.00315
Valve seat width - intake	1.700	0.0669
Valve seat width - exhaust	2.00	0.0787
Valve seat-to-guide runout	0.080	0.0031

TORQUE VALUES 3.3

ITEM	TORQUE		NOTES
Fuel rail into rubber boots	9.7 Nm	85 **in-lbs**	page 3-19
Intake hose clamps	1.25 Nm	11 **in-lbs**	page 3-19
Spark plugs	23 Nm	17 ft-lbs	page 3-19
Coil fasteners	9.7 Nm	85 **in-lbs**	page 3-19
Cam journal caps	9.7 Nm	85 **in-lbs**	page 3-34
Oil pump fasteners	9.7 Nm	85 **in-lbs**	page 3-36
Oil pump cover fasteners	9.7 Nm	85 **in-lbs**	page 3-36
Bypass fastener	35 Nm	25 ft-lbs	page 3-36
Secondary clutch actuator	10 Nm	89 **in-lbs**	page 3-37
Clutch pack spring screws	9.7 Nm	85 **in-lbs**	page 3-46
Clutch hub nut	220 Nm	162 ft-lbs	page 3-49
Clutch side crankcase cover	9.7 Nm	85 **in-lbs**	page 3-49
Secondary clutch actuator	10 Nm	89 **in-lbs**	page 3-49
Secondary clutch actuator cover	6-10 Nm	53-89 **in-lbs**	page 3-49
Secondary clutch actuator	10 Nm	89 **in-lbs**	page 3-51
Main bearing bolts	Special method		page 3-66
Upper and lower input bearing retainer fasteners	23 Nm	17 ft-lbs	page 3-67
Drive sprocket flange seal retainer fasteners	23 Nm	17 ft-lbs	page 3-67
Oil pickup fasteners	9.7 Nm	85 **in-lbs**	page 3-67
Oil pan fasteners	9.7 Nm	85 **in-lbs**	page 3-67
Counterbalancer gear fastener	Special method		page 3-75
Rod caps	27 Nm + 90^{o}	20 ft-lbs + 90^{o}	page 3-84
Primary gear fasteners	Special method		page 3-87
Connecting rod caps	Special method		page 3-94
Oil filter mount fasteners	9.7 Nm	85 **in-lbs**	page 3-95
Primary chain hydraulic tensioner fastener	9.7 Nm	85 **in-lbs**	page 3-97
Triple sprocket fastener	23 Nm	17 ft-lbs	page 3-97
Primary chain fixed tensioner fastener	9.7 Nm	85 **in-lbs**	page 3-97
Head bolts	Special method		page 3-100
5 mm head bolts	9.7 Nm	85 **in-lbs**	page 3-100

ITEM	TORQUE		NOTES
Cam journal caps	9.7 Nm	85 **in-lbs**	page 3-105
Cam chain tensioner	100 Nm	74 ft-lbs	page 3-105

OIL FLOW 3.4

GENERAL

The engine oil serves two purposes. First, the oil lubricates all of the metal to metal parts that are in motion relative to each other. Second, the oil cools the engine, specifically, the pistons.

See Figure 3-1. As the oil is warmed to normal operating temperature, the oil is scavenged from the sump at the screened pick up (1) by the oil pump (2).

The oil pump (2) pressurizes the oil and the pressure maintains the flow of oil through the engine. The oil flows through a bypass valve and through the oil passages to the oil filter (3). If oil pressure exceeds 88 psi, the bypass valve is activated, rerouting oil back through the suction side of the oil pump.

The filtered oil flows into the oil lines up and over the top of the radiator/oil cooler assembly and down to the left side of the oil cooler (4). Flowing across the cooler, the cooled oil is routed up and over the radiator/oil cooler assembly and then down to the oil fitting (5) on the front of the crankcase.

At the crankcase oil fitting, oil is routed to three passages:

1. Oil entering the passage (6) on the water pump side lubricates the right main bearings. The oil flows in a groove in the main bearing then through a drilled hole in the crankshaft to lubricate the rear connecting rod journals.
2. Oil entering the middle passage (7) supplies oil to the front piston jet. The piston jets spray oil to cool the underside of the pistons.
3. See Figure 3-2. Oil entering the cam drive side passage (8) feeds the cam drive side main bearing. The oil flows in a groove in the main bearing then through a drilled hole in the crankshaft to lubricate the front connecting rod bearings.
4. From the cam drive side main bearing, the oil is routed in two directions:
   a. Oil is routed up to the cam drive triple gear bushing (9) where oil is routed along the shaft to the water pump impeller. The oil also flows to front cylinder head through an oil sending unit (10) which shuts off the oil pressure light when oil pressure reaches 13.8-34.5 kPa (2-5 psi). The oil passages continue on to the intake and exhaust cams (13) lubricating the cam journals through grooves in the bearings and to the secondary cam chain tensioner (12).
   b. The second set of passages from the cam drive side main bearings lead the oil flow to the primary cam chain tensioner and up to the secondary cam chain tensioner, the rear cylinder head and the rear intake and exhaust cam journals. From the primary cam chain tensioner the oil also branches to the rear piston jet to cool the underside of the rear piston. The final passages from the cam drive side main bearing routes oil back to the transmission and clutch where the oil lubricates and cools the transmission input and output shafts.
5. See Figure 3-3. Returning oil to the sump (19), the rear cylinder head drains onto the clutch (16) to lubricate primary gear and clutch assembly. Oil from the rear cylinder head also drains on the transmission input and output shaft gearset (16) where gear meshing transfers oil to all gears and then drains into the oil sump (17).
6. The oil in the front cylinder head drains down the cylinder head drain passage (18) to the sump (19).

vrod_02

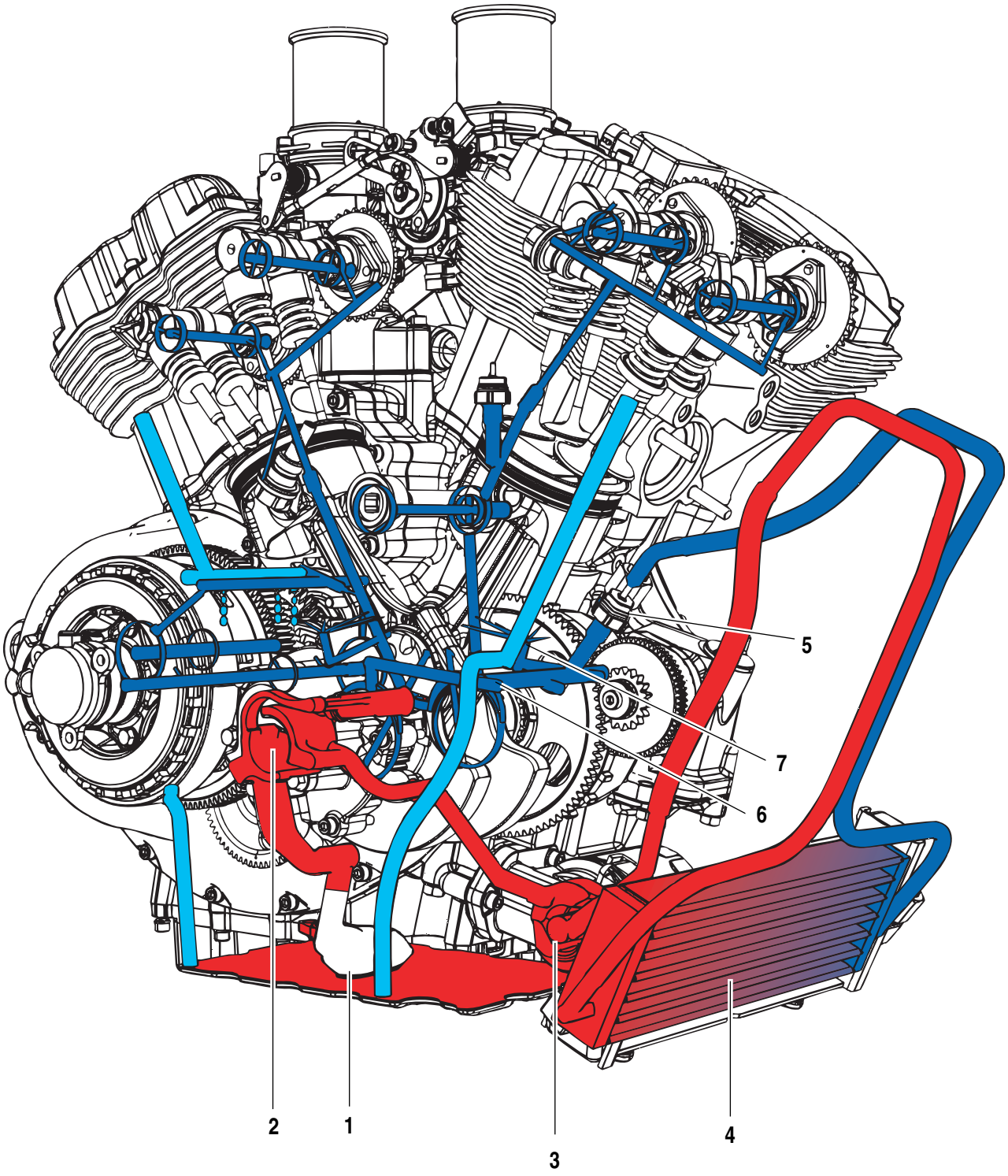


Figure 3-1. Oil Flow A

vrod_03

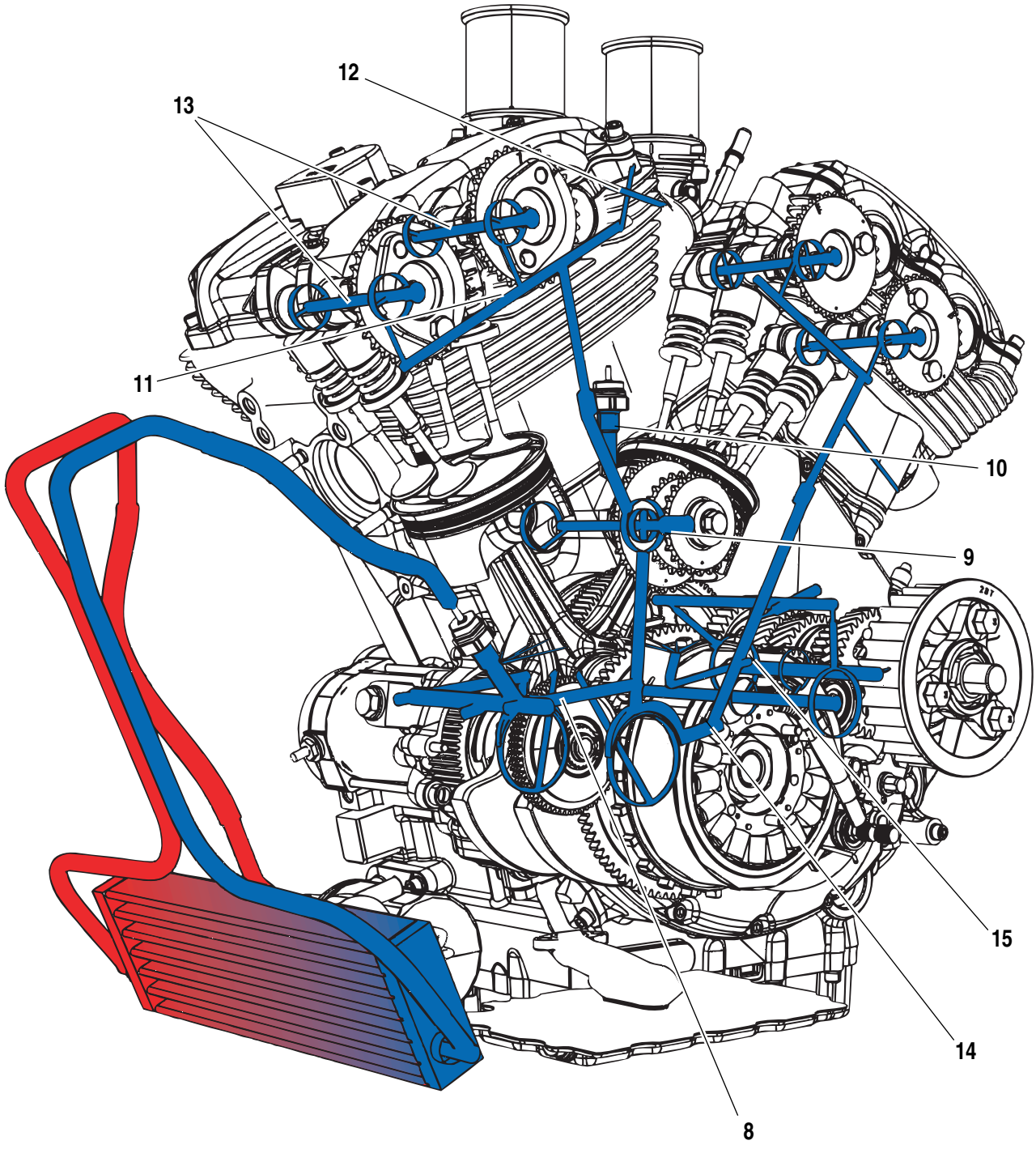
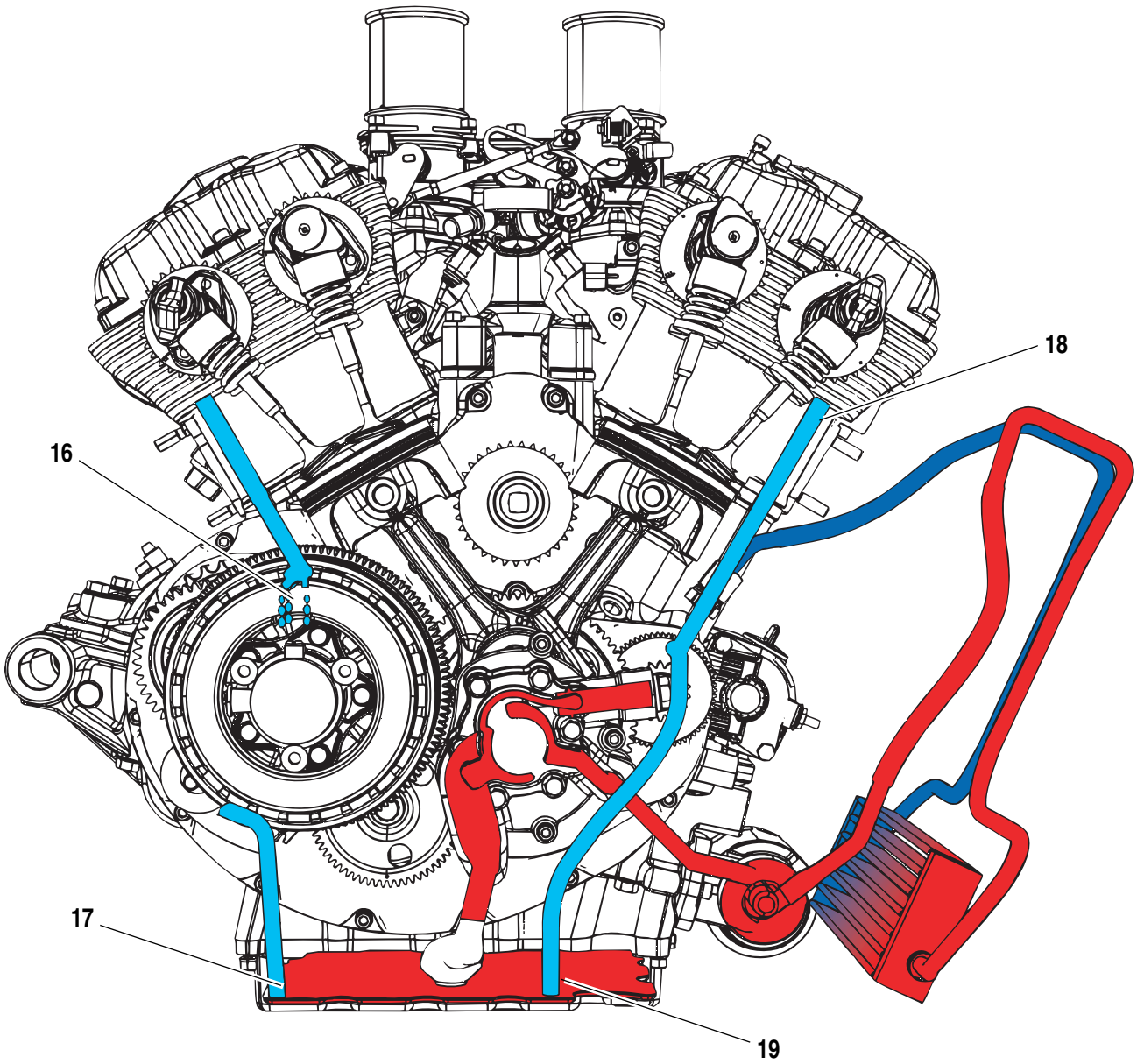


Figure 3-2. Oil Flow B

vrod_01



Red - Hot Oil
Blue - Cooled Oil
Light Blue - Return Oil

Figure 3-3. Oil Flow C

OIL PRESSURE 3.5

OIL PRESSURE INDICATOR LAMP

See Figure 3-4. The red oil pressure indicator lamp illuminates to indicate improper circulation of the engine oil. The lamp illuminates when the ignition is first turned on (before the engine is started), but should be extinguished once the engine is running.

CAUTION

Check the engine oil level if the oil pressure indicator lamp remains illuminated. If the oil level is normal, stop the engine immediately. Do not ride the vehicle until the problem is located and corrected.

If the indicator lamp is not extinguished, it may be the result of a low oil level or diluted oil supply. A defect in the lamp wiring, faulty oil pressure sending unit, damaged oil pump, plugged oil filter element, incorrect oil viscosity, broken or weak spring in the oil pressure relief valve and/or damaged or incorrectly installed o-rings in the engine may also cause the indicator lamp to remain on.

To troubleshoot the problem, always check the engine oil level first. If the oil level is OK, check oil pressure.

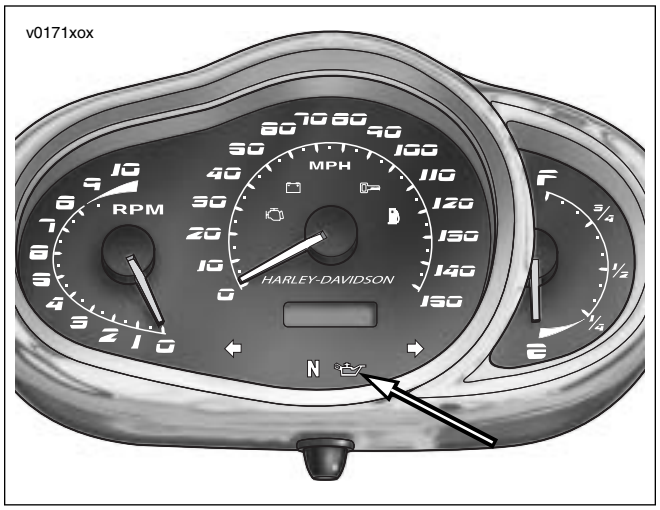


Figure 3-4. Oil Pressure Indicator Lamp (typical) (VRSCR shown)

CHECKING OIL PRESSURE

PART NO.	SPECIALTY TOOL
HD-45308	Oil pressure gauge
HD-45309	Oil pressure gauge adapter

Operating oil pressure is checked as follows:

1. Fill crankcase to proper level.

NOTE

Remove MAP sensor and horn for additional clearance if needed.

2. Remove oil pressure switch from crankcase.
3. Attach OIL PRESSURE GAUGE (HD-45308) to ADAPTER (HD-45309).
4. Install in oil pressure switch mounting hole.

NOTES

- *When checking oil pressure after engine rebuild, unplug fuel pump connector at fuel pump to verify oil pressure before engine starts.*
- *Engine oil should be at normal operating temperature 70° C (158° F) for an accurate reading.*

5. Oil pressure should be 3-6.5 bar (43-94 psi) at 3000 RPM and normal operating temperature of 70° C (158° F).

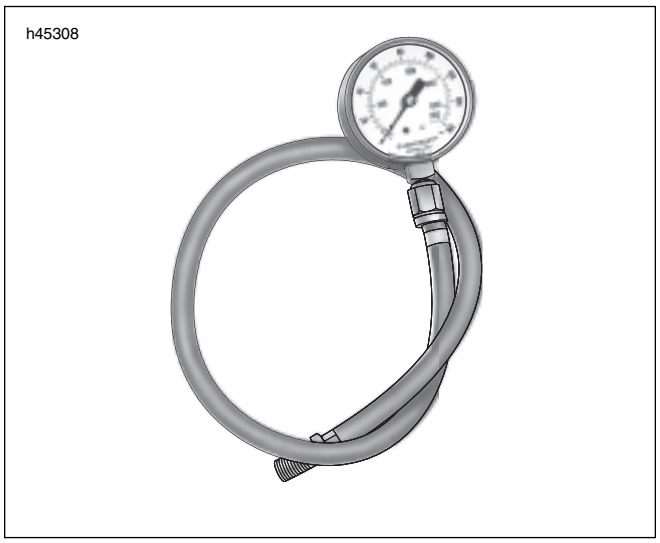


Figure 3-5. Oil Pressure Gauge (HD-45308)

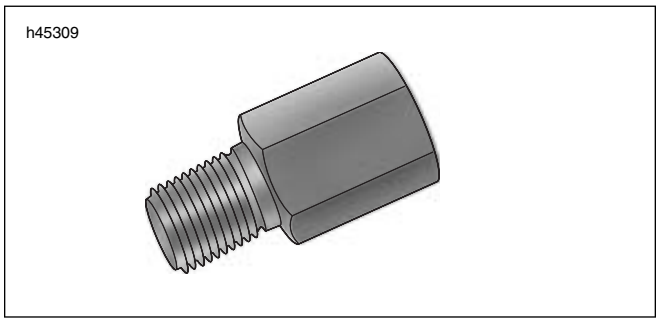


Figure 3-6. Oil Pressure Gauge Adapter (HD-45309)

HOW TO USE THIS SECTION 3.6

TOP END REPAIR

Valve lash adjustment and secondary cam chain adjustment can be done with engine in chassis. Cam drive inspection and some part replacement can be done with the engine in chassis.

For all other top end repairs, the engine must be removed from the chassis. See 2.10 ENGINE REPLACEMENT.

BOTTOM END REPAIR

Bottom end repair can only be done with engine removed from chassis. See 2.10 ENGINE REPLACEMENT.

TYPICAL SYMPTOMS

Symptoms indicating a need for engine repair are often misleading, but generally if more than one symptom is present, possible causes can be narrowed down to make at least a partial diagnosis. An above normal consumption of oil, for example, could be caused by several mechanical faults. But when accompanied by a blue-gray smoke from the exhaust, and when low compression is present, it indicates the rings need replacing. Low compression by itself, however, indicates improperly seated valves, not worn rings.

Certain “knocking” noises may be caused by loose bearings, others by piston slap, a condition where piston or cylinder or both out of tolerance, allowing the piston to slap from front to rear of the cylinder as it moves up and down.

Most frequently, valves, rings, pins, bushings, and bearings need attention at about the same time. If the symptoms can be narrowed down through the process of elimination to indicate that any one of the above components is worn, it is best to give attention to all of the cylinder head and cylinder parts.

DIAGNOSING VALVE TRAIN NOISE

To diagnose and correct noisy valve train components, use the following procedures:

PART NO.	SPECIALTY TOOL
HD-45334	Secondary chain measurement tool

1. Visually inspect camshaft lobes for abnormal wear.
2. If there is noise and engine has low oil pressure, drop oil pan and inspect for metal debris.
3. On high mileage engines with good oil pressure, if there is a noise at start-up which goes away, use SECONDARY CHAIN MEASUREMENT TOOL (HD-45334) to check cam chain wear. See 1.25 SECONDARY CAM CHAIN.
4. Verify valve lash. See 1.24 VALVE LASH.

COMPRESSION TEST

Satisfactory engine performance depends upon a mechanically sound engine. In many cases, unsatisfactory performance is caused by combustion chamber leakage. A compression test can help determine the source of cylinder leakage. Use CYLINDER COMPRESSION GAUGE (Part No. HD-33223-1) that has a screw-in type adapter.

A proper compression test should be performed with the engine at normal operating temperature when possible.

PART NO.	SPECIALTY TOOL
HD-33223-1	Cylinder compression gauge

1. See AIRBOX, BATTERY, and SPARK PLUG REMOVAL.
2. Connect compression tester to front cylinder per manufacturer's instructions.
3. Reinstall battery.
4. Make sure transmission is in neutral. With throttle plates in wide open position, crank engine continuously through 5 to 7 full compression strokes.
5. Note gauge readings at the end of the first and last compression strokes. Record test results.
6. Repeat steps 2 through 5 on rear cylinder.
7. Compare test results to the upper and lower limits posted. Refer to Table 3-22.

Table 3-22. Cylinder Compression

	FRONT		REAR	
	BAR	PSI	BAR	PSI
Upper limit	9.45	137	17.03	247
Mid-range	8.62	125	15.51	225
Lower limit	7.79	113	14.0	203

NOTE

It is normal to have variance in the compression readings when comparing front to rear cylinders. The timing of the automatic compression release (ACR) is different from the front to rear camshaft. This causes variance in compression reading from front to rear when turning the engine over, but has no effect on compression while the engine is running.

8. If compression of a cylinder does not fall within its upper and lower limits, refer to Table 3-23.

Table 3-23. Compression Test Results

TEST RESULTS	DIAGNOSIS
Compression low on first stroke, tends to build up on the following strokes, but does not reach normal. Improves considerably when oil is added to cylinder.	Ring trouble
Compression low on first stroke, does not build up much on following strokes. Does not improve considerably with the addition of oil. Verify valve lash.	Valve trouble
Same results as valve trouble.	Head gasket leak

9. To verify worn piston rings, inject approximately 15 ml (1/2 oz) engine oil into each cylinder and repeat the compression tests on both cylinders. Readings that are considerably higher during the second test indicate worn piston rings.

NOTE

After installing spark plugs, be sure that throttle plate is in the closed position before starting the engine.

CYLINDER LEAKAGE TEST

The cylinder leakage test will pinpoint engine problems including leaking valves, worn, broken or stuck piston rings and blown head gaskets. The cylinder leakage tester applies compressed air to the cylinder at a controlled pressure and volume and measures the percent of leakage from the cylinder.

Use CYLINDER LEAKDOWN TESTER (HD-35667A) and 12 mm adapter and follow the instructions supplied with the tester.

PART NO.	SPECIALTY TOOL
HD-35667A	Cylinder leakdown tester
HD-45314	Crankshaft rotating wrench

1. Run engine to normal operating temperature.
2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
3. Remove inspection cover.
4. Remove airbox cover, air filter top and air filter. See 1.3 AIRBOX AND AIR FILTER.

CAUTION

DO NOT ROTATE ENGINE CLOCKWISE. This is opposite the normal engine operation. Engine damage may result.

5. Hold throttle wide open to observe the front cylinder intake valve through the intake port.

NOTE

Positioning is critical in the next steps for an accurate reading. Make sure that the ACR (automatic compression release) is not contacting the valve to ensure a proper and accurate reading.

6. Turn engine over in direction of operation with CRANKSHAFT ROTATING WRENCH (HD-45314). Open the valve fully, then close. When the intake valve has closed on the valve seat, turn the engine an additional 1/4 turn.
7. Slowly continue to turn the engine an additional 1/8th turn until the automatic compression release deactivates. The front cylinder is now close to TDC.
8. To keep the engine from turning over when air pressure is applied to the cylinder, engage transmission in fifth gear and lock the rear brake and hold engine with CRANKSHAFT ROTATING WRENCH (HD-45314) if needed.

NOTE

Before performing the cylinder leakage test, verify that the tester itself is free from leakage to obtain the most accurate test results. With a soap solution [applied around all tester fittings], connect the cylinder leakdown tester to the compressed air source and look for any bubbles that would indicate leakage from the tester.

9. Following the manufacturer's instructions, perform a cylinder leakage test on the front cylinder. Make a note of the percent of leakage. Leakage greater than 15% indicates internal engine problems.
10. Listen for air leaks at throttle body, exhaust pipe, head gasket and crankcase breather. Air escaping through the throttle body indicates a leaking intake valve. Air escaping through the exhaust pipe indicates a leaking exhaust valve.

NOTE

If air is escaping through valves, measure and adjust valve lash as required. See 1.24 VALVE LASH.

11. Repeat procedure on rear cylinder.

NOTE

After installing spark plugs, be sure that throttle plate is in the closed position before starting the engine.

DIAGNOSING SMOKING ENGINE OR HIGH OIL CONSUMPTION

Perform COMPRESSION TEST or CYLINDER LEAKAGE TEST as described. If further testing is needed, remove suspect head(s) and inspect for the following:

Check Prior to Cylinder Head Removal

1. Crankcase overfilled.
2. Oil carryover.
3. Breather hose restricted.
4. Restricted oil filter.

Check After Cylinder Head Removal

1. Valve guide seals.
2. Valve guide to valve stem clearance.
3. Gasket surface of both head and cylinder.
4. Cylinder head casting's porosity allowing oil to drain into combustion chamber.
5. Piston/ring failure.

STRIPPING MOTORCYCLE FOR SERVICE 3.8

GENERAL

NOTE

If cylinder head, crankcase, or transmission work needs to be performed, engine must be removed from chassis. See 2.10 ENGINE REPLACEMENT.

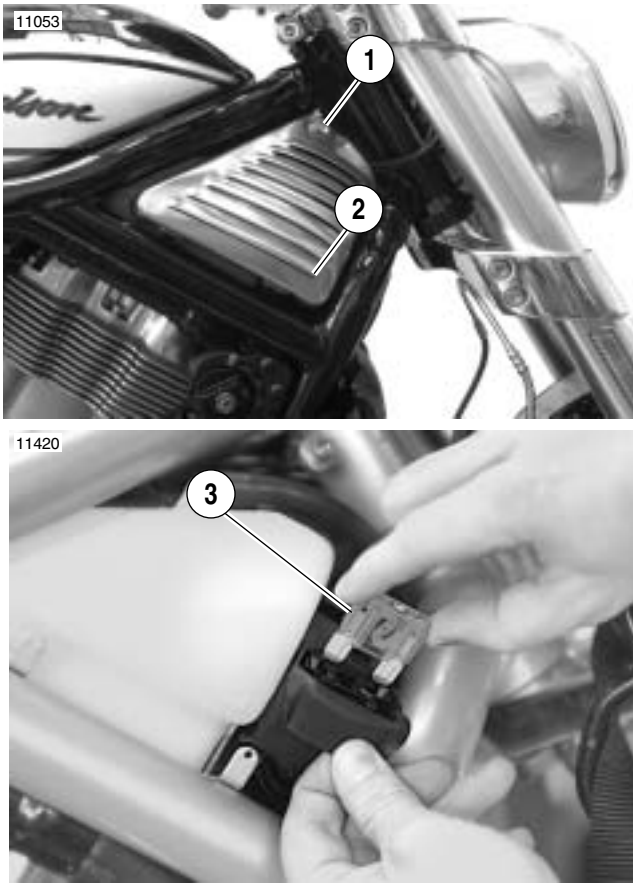
1. If engine is to be removed, position motorcycle on a lift with side extensions.
2. See Figure 3-7. Remove right side cover.
3. Remove maxi-fuse.
4. Remove the engine. See 2.10 ENGINE REPLACEMENT.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

⚠WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)



1. **Fastener**
2. **Side cover**
3. **Maxi-fuse (40 amp)**

Figure 3-7. Maxi-Fuse (typical)

ENGINE CRADLE AND STAND

Prior to engine service, all fluids should be drained from the engine and the engine removed from the chassis.

To support the engine, use ENGINE CRADLE (HD-42310-40) mounted to ENGINE/TRANSMISSION STAND (HD42310) for bench work or to ROLLING ENGINE STAND (HD-43646-A) for floor work.

The engine cradle is bolted to threaded holes in the front and rear of the upper engine case.

PART NO.	SPECIALTY TOOL
HD-42310-100	Cradle locking nut and spacer ring
HD-42310-40	Engine cradle
HD-42310	Engine/transmission stand
HD-43646-A	Rolling engine stand

1. See Figure 3-8. Using fasteners provided, install ENGINE CRADLE (HD-42310-40) to rear of upper engine case.
2. Install fasteners at front of engine.
3. With engine securely strapped, hoist engine and cradle to ENGINE/TRANSMISSION STAND (HD-42310) and slide cradle shaft into post of stand.
4. See Figure 3-9. If mounting to ROLLING ENGINE STAND (HD-43646-A), slide spacer ring from CRADLE LOCKING NUT AND SPACER (HD-42310-100) on cradle shaft before mounting to stand.

NOTE

The spacer ring is used only when securing the cradle to the ROLLING ENGINE STAND (HD-43646-A).

5. Rotate engine and cradle to align holes in cradle shaft to holes in stand post and secure with locking pin.
6. See Figure 3-10. Install fastener and handle from CRADLE LOCKIING NUT AND SPACER RING (HD-42310-100).
7. To access engine components from different angles, remove locking pin, rotate cradle and engine, align holes closest to desired angle and insert locking pin to secure.

CAUTION

Dirt caked on fins and other areas can fall into crankcase bore or stick to subassemblies as parts are removed. Abrasive particles can damage machined surfaces or plug oil passageways. Remove all dirt and particles before disassembly to prevent component damage.

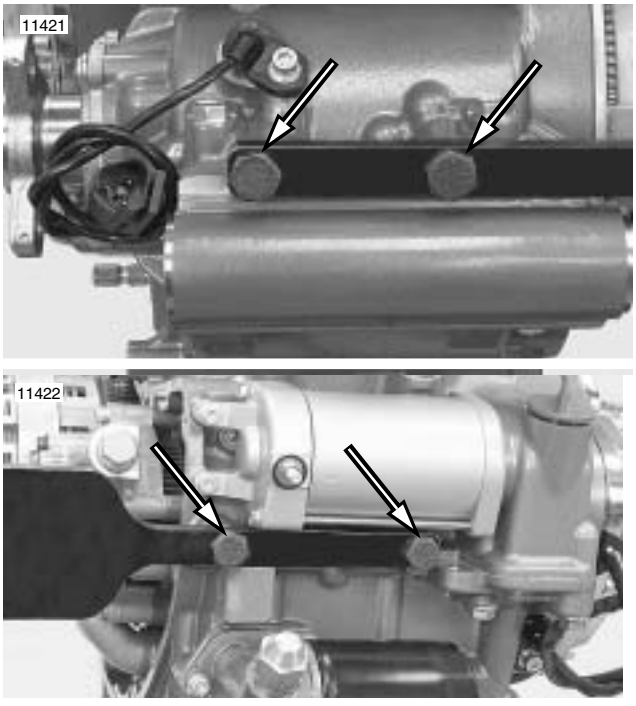


Figure 3-8. Cradle Fasteners in Upper Engine Case

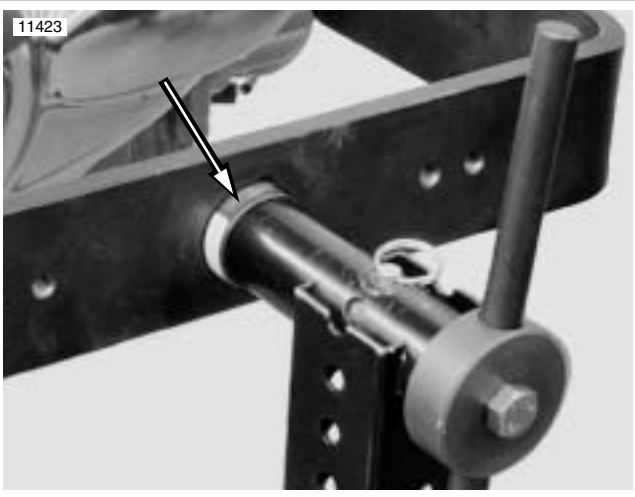


Figure 3-9. Spacer Ring

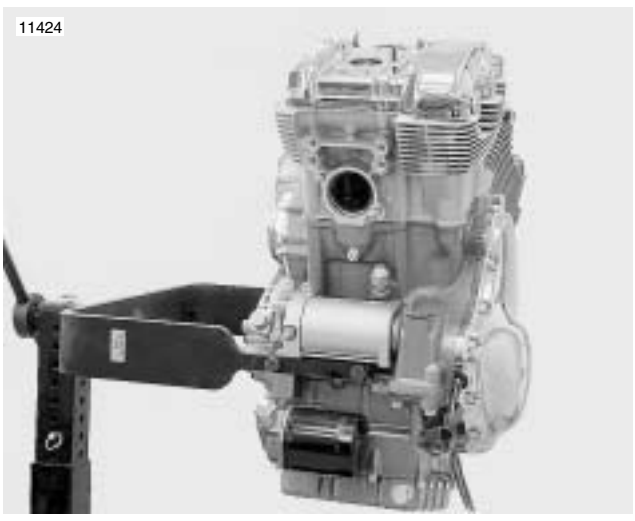


Figure 3-10. Engine in Cradle and Rolling Stand

THROTTLE BODY 3.9

REMOVAL

1. Disconnect the idle speed control (IAC) connector.
2. DIsconnect the throttle position (TP) sensor.
3. See Figure 3-11. Loosen throttle body clamps.
4. Detach throttle body from rubber seals by pulling up with a gentle rocking motion. If engine is in chassis, it is not necessary to disconnect throttle cables. Move throttle body and cables aside and secure away from engine.
5. See Figure 3-12. Remove fuel rail/intake seal fasteners. Bottom nut is captured but should be held with a wrench for removal.
6. See Figure 3-13. Without disturbing the fuel rail, rotate rubber seal from under fuel rail.
7. Remove fastener holding the MAP sensor. Separate connector [80].
8. See Figure 3-15. Pull front injector from front intake runner.
9. With front injector free, swing fuel rail toward cam drive side and pull rear injector from rear intake runner.
10. See Figure 3-14. Unplug connector [84], front injector and connector [85], rear injector.
11. Unplug engine coolant temperature sensor connector [90] and oil pressure sending unit connector [120].
12. Unplug engine harness at connector [145].
13. Disassemble and service fuel rail and fuel injectors. See 4.17 FUEL RAIL/FUEL INJECTORS.

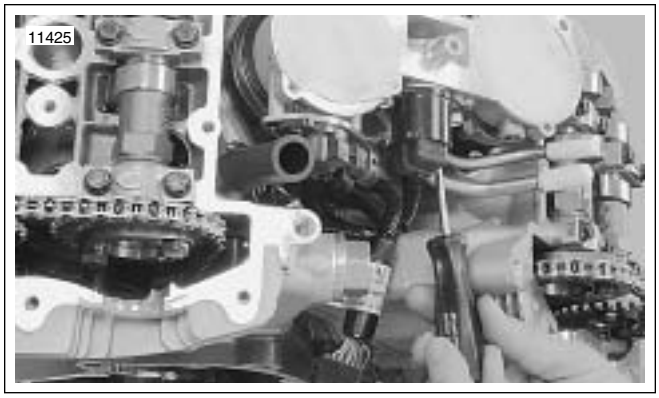


Figure 3-11. Loosen Throttle Body Clamps (typical)

Figure 3-12. Fuel Rail/intake Seal Fasteners (typical)

Figure 3-13. Rubber Seal

Figure 3-14. Fuel Rail with Injectors

INSTALLATION

1. Assemble fuel rail and fuel injectors. See 4.17 FUEL RAIL/FUEL INJECTORS.
2. Connect engine harness at connector [145].
3. Connect engine coolant temperature sensor connector [90] and oil pressure sending unit connector [120].
4. See Figure 3-14. Connect connector [84], front injector and connector [85], rear injector on fuel rail.
5. Supporting fuel rail oriented with fuel tubes toward the left rear, push rear injector into bore in intake runner.
6. Swing fuel rail over and push front injector into intake runner in front cylinder.
7. Rotate rubber boots under fuel rail and install rubber boots over intake runners.
8. Install fasteners through fuel rail into rubber boots. Tighten to 9.7 Nm (86 **in-lbs**).
9. See Figure 3-16. Orient intake clamps as shown.
10. Press throttle body and cables into rubber boots.
11. See Figure 3-17. Tighten intake hose clamps (7) to 1.25 Nm (11 **in-lbs**).
12. See 1.21 SPARK PLUG AND COIL. Install spark plugs and coils. Tighten to:
    a. Tighten spark plugs to 23 Nm (17 ft-lbs).
    b. Tighten coil fasteners to 9.7 Nm (86 **in-lbs)**.
13. Attach the idle speed control (IAC) connector.
14. Attach the throttle position (TP) sensor.
15. Install right angle connectors on rigid fuel lines from fuel rail. Push until audible “click” is heard.

Figure 3-15. Front Injector

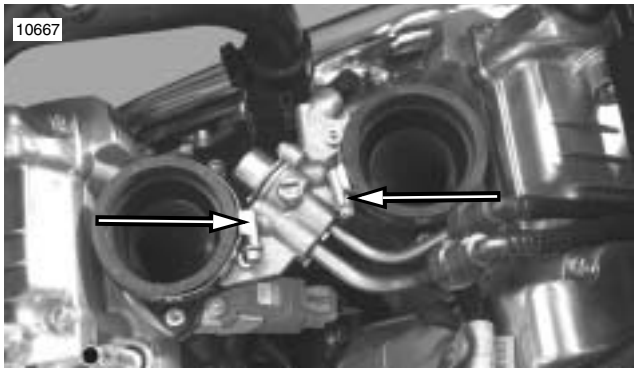
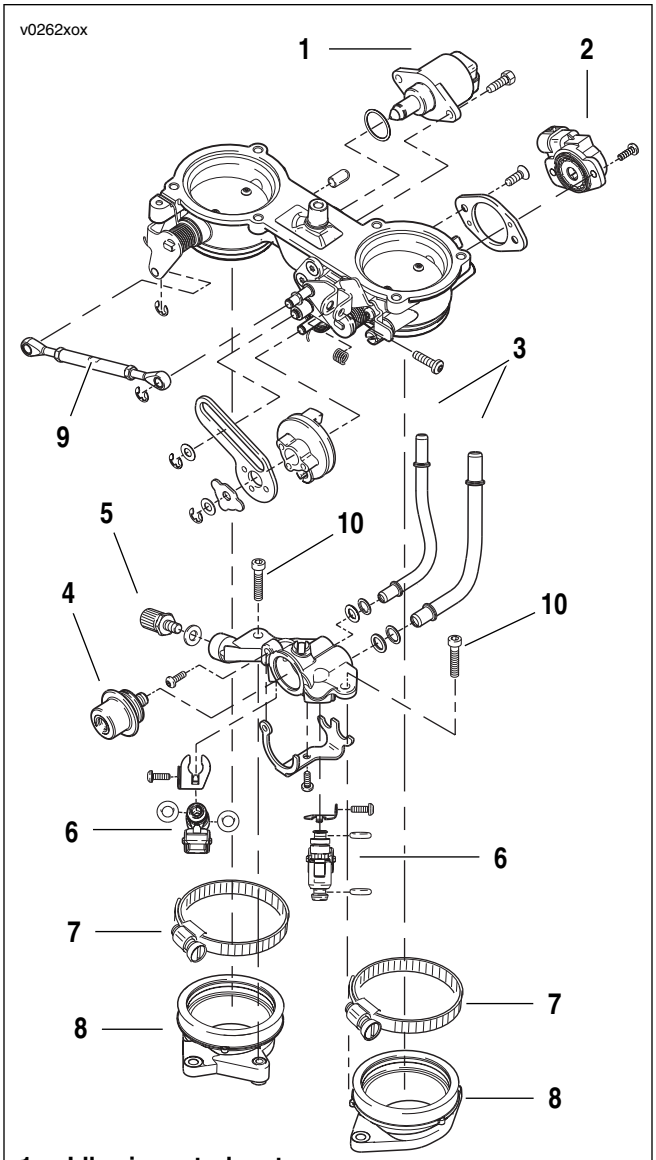


Figure 3-16. Throttle Body Intake Clamps



1. **Idle air control motor**
2. **Throttle position sensor**
3. **Fuel rail**
4. **Fuel pressure regulator**
5. **Fuel pressure check**
6. **Injector**
7. **Hose clamp @ 1.25 Nm (11 in-lbs)**
8. **Rubber boot**
9. **Linkage rod**
10. **Fasteners @ 9.7 Nm (86 in-lbs)**

Figure 3-17. Throttle Body and Fuel Rail

TOP END DISASSEMBLY 3.10

CAM DRIVE REMOVAL

PART NO.	SPECIALTY TOOL
HD-45314	Crankshaft rotating wrench
HD-45653	TDC positioning tool
HD-45306	Crankshaft locking pin
HD-45315	Alternator rotor remover
HD-45491	Tappet compressing tool

1. Remove alternator cover. See 8.8 ALTERNATOR.
2. Remove plug top coils and spark plugs. See 1.21 SPARK PLUG AND COIL.
3. See Figure 3-18. Remove cam cover fasteners in reverse order of torque sequence and remove cam covers.
4. See Figure 3-19. Install TDC POSITIONING TOOL (HD-45653) in front spark plug hole.

CAUTION

Never insert a foreign object, such as a screwdriver, in the spark plug hole. Engine damage can result.

CAUTION

DO NOT ROTATE ENGINE CLOCKWISE. This is opposite the normal engine operation. Engine damage can result.

5. Using CRANKSHAFT ROTATING WRENCH (HD-45314) rotate the engine counter-clockwise (direction of operation). Note when exhaust valve is closing (TDC positioning tool will start to extend as valve closes) and engine is approaching TDC.
6. See Figure 3-20. When the TDC reference tool is fully extended, remove plug from timing hole on right side of engine and insert CRANKSHAFT LOCKING PIN (HD-45306).
7. The crankshaft locking pin should insert flush with engine case. It may be necessary to gently rock the crankshaft using the CRANKSHAFT ROTATING WRENCH (HD-45314) to lock engine at exact TDC.
8. Remove TDC POSITIONING TOOL (HD-45653) and CRANKSHAFT LOCKING PIN (HD-45306).

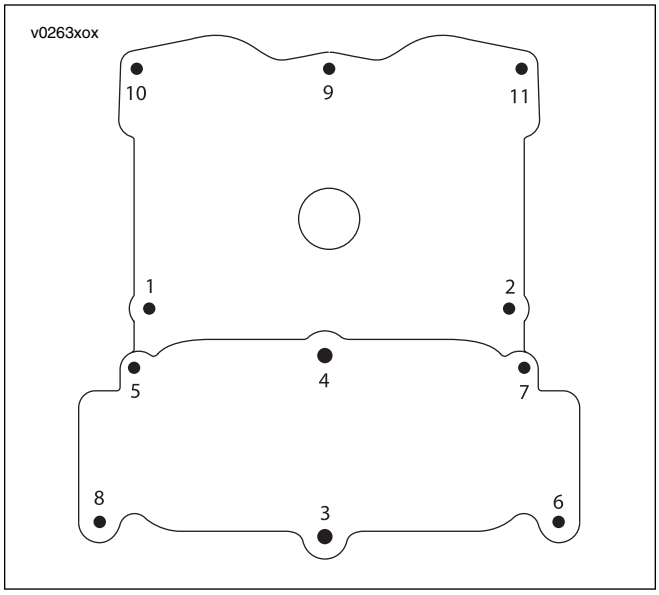


Figure 3-18. Cam Cover Torque Sequence

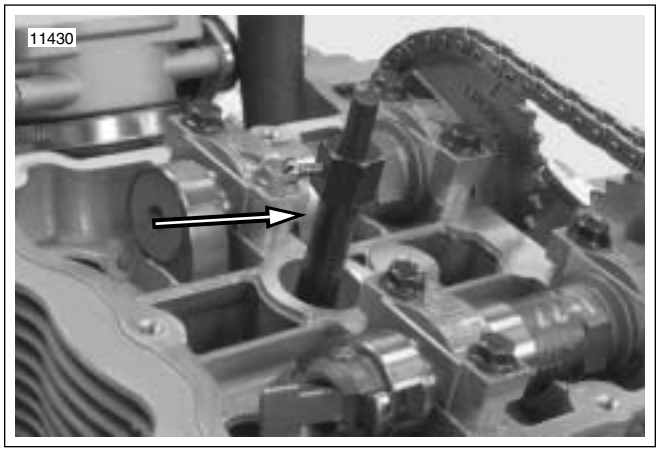


Figure 3-19. Top Dead Center Positioning Tool

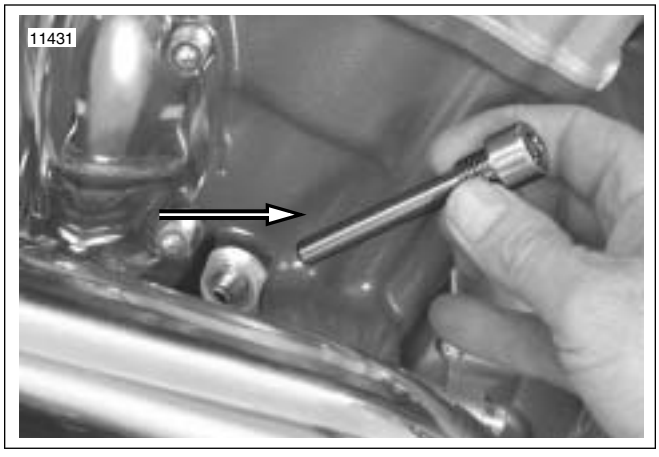


Figure 3-20. Crankshaft Locking Pln

9. See Figure 3-21. Holding 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH (HD-45314), loosen rotor fastener. Air impact tool may be used for REMOVAL ONLY.
10. See Figure 3-22. Holding 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH (HD-45314), loosen starter limiter fastener.
11. See Figure 3-23. Loosen triple sprocket fastener.
12. See Figure 3-24. Install ALTERNATOR ROTOR REMOVER (HD-45315) and finger tighten.
13. Use an impact socket and wrench to tighten the tool removing the rotor and the ball clutch from the crankshaft taper.
14. See Figure 3-25. Remove starter limiter fastener and starter limiter gear assembly.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

15. See Figure 3-26. Remove snap ring from crankshaft.

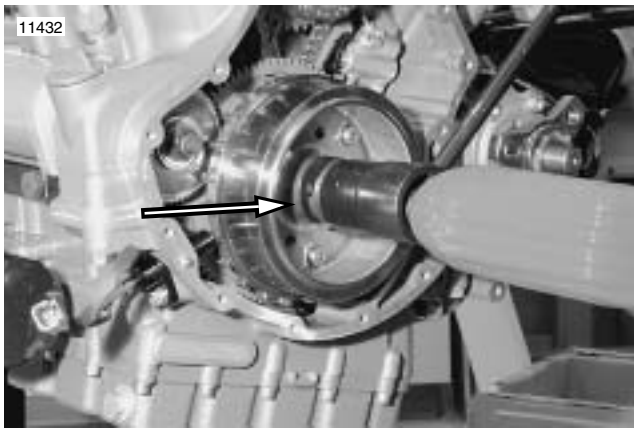


Figure 3-21. Rotor Fastener

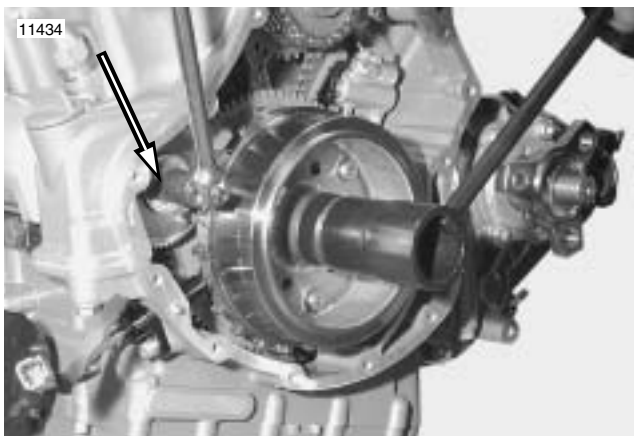


Figure 3-22. Starter Limiter Fastener

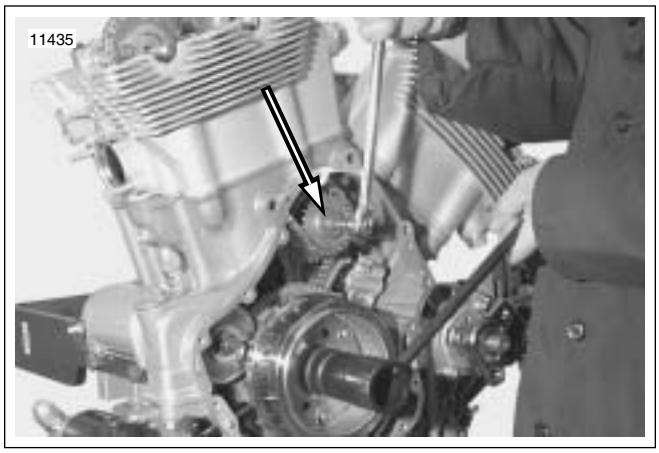


Figure 3-23. Triple Sprocket Fastener

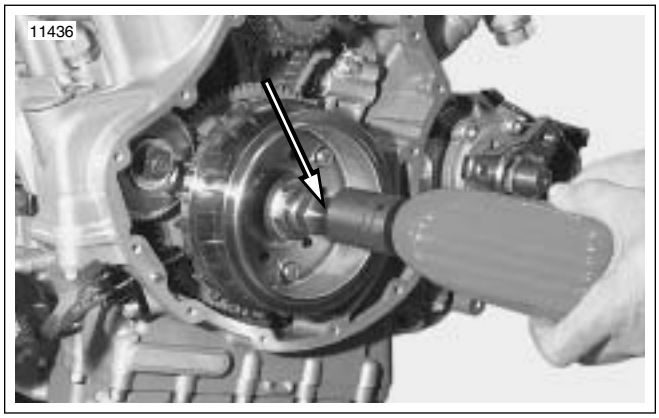


Figure 3-24. Rotor Shell

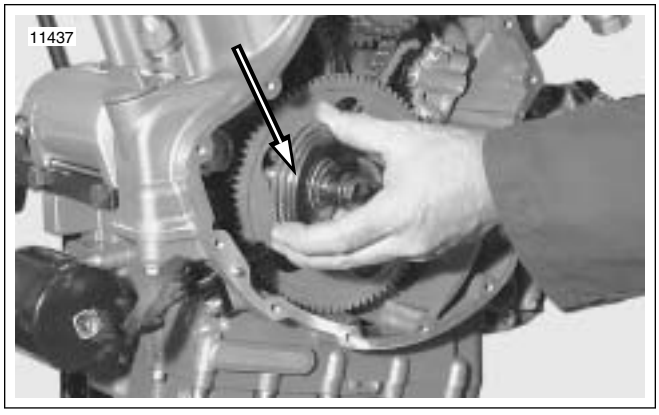


Figure 3-25. Starter Limiter Gear Assembly

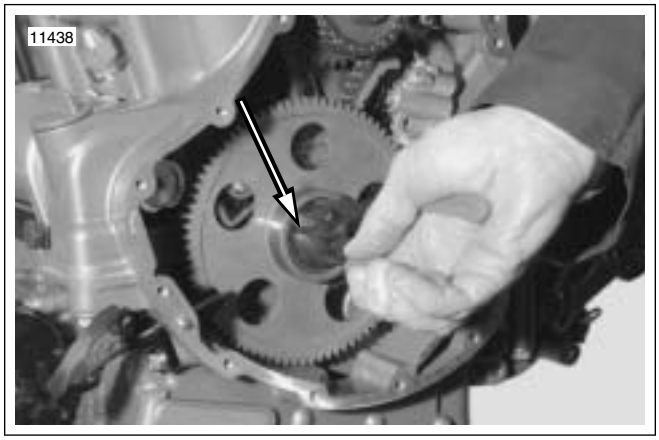


Figure 3-26. Snap Ring

16. See Figure 3-27. Slide snap ring, washer, and ball clutch gear with needle roller and cage assembly off of crankshaft.
17. See Figure 3-28. For this procedure, the front cylinder cams are pre-loaded. Install TAPPET COMPRESSING TOOL (HD-45491) on front cylinder to aid in dissassembly.
    a. Loosen 19 mm nut on tappet compressing tool.
    b. Tools are marked intake and exhaust. Position them accordingly.
    c. Use M6x25 fasteners to secure tools to head.
    d. Tighten 19 mm nut to compress tappets.
18. See Figure 3-29. Remove secondary cam chain tensioner.

Figure 3-27. Snap Ring and Ball Clutch Gear

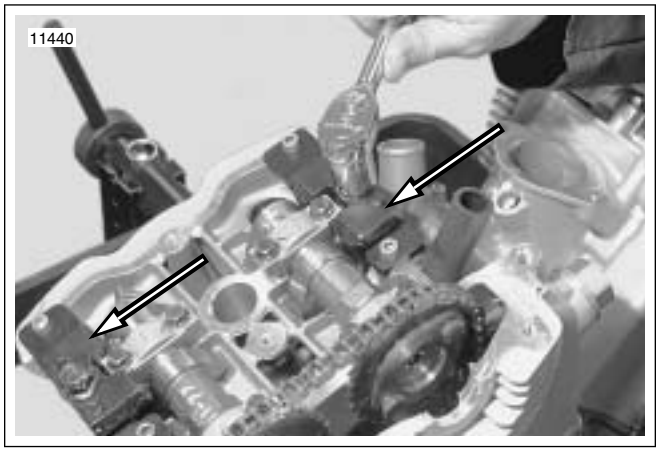


Figure 3-28. Tappet Compressing Tools (HD-45491) (typical)

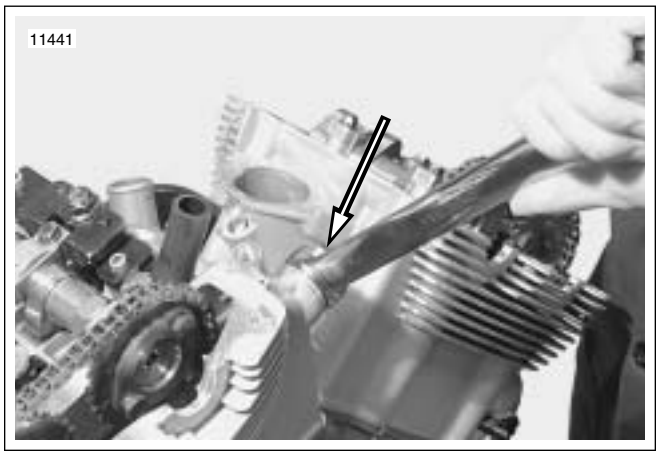
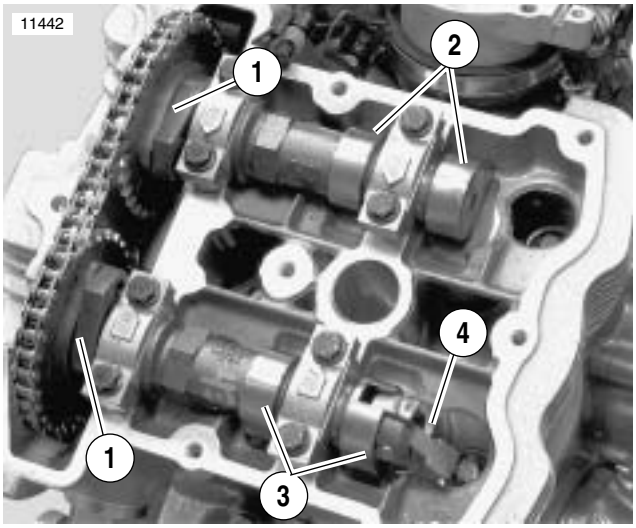


Figure 3-29. Remove Secondary Cam Chain Tensioner (typical)

NOTES

- *Mark or tag chains, front and rear, to match the chains to the front intake and exhaust cam or the rear intake and exhaust cam. The chains are installed with the brass links outboard or on the alternator side.*
- *The front cylinder cams are identified by the spacer boss location on the outside of the cam sprockets. The exhaust cam is the cam with the ACR (automatic compression release) on the end of the cam shaft.*
- *The rear cylinder cams are identified by the spacer boss location on the inside of the cam sprockets. The exhaust cam is the cam with the ACR (automatic compression release) on the end of the cam shaft. See Figure 3-30.*

19. Remove cam bearing caps.
20. See Figure 3-31. Roll chain over cam drive gear. Lift cam and drive gear from head.
21. In this position the rear cams are not preloaded. Remove rear cylinder bearing caps. Disconnect cams from chain.
22. Remove chains.



1. Spacer boss
2. Intake cams
3. Exhaust cams
4. ACR (automatic compression release)

Figure 3-30. Rear Cylinder Cams

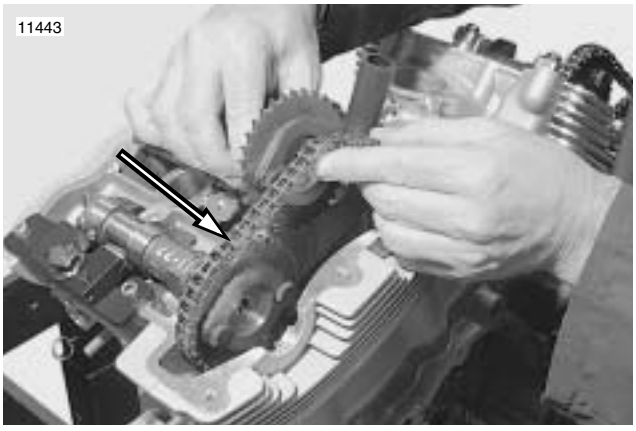


Figure 3-31. Cam Drive Chain (typical)

23. Remove water pump fasteners and cover.
24. See Figure 3-32. Remove water pump housing. Using a soft face hammer, GENTLY tap around edge of housing while exerting outward pressure.
25. See Figure 3-33. Retract primary cam chain tensioner and insert PRIMARY CAM CHAIN TENSIONER RETAINER (HD-45326). Remove primary cam chain tensioner.
26. See Figure 3-34. Remove primary cam chain fixed guide.
27. See Figure 3-35. Remove the triple sprocket fastener.
28. See Figure 3-36. Push triple sprocket/water pump shaft through engine toward the clutch side.
29. Remove triple sprocket and primary cam chain.

Figure 3-32. Removing Water Pump Housing

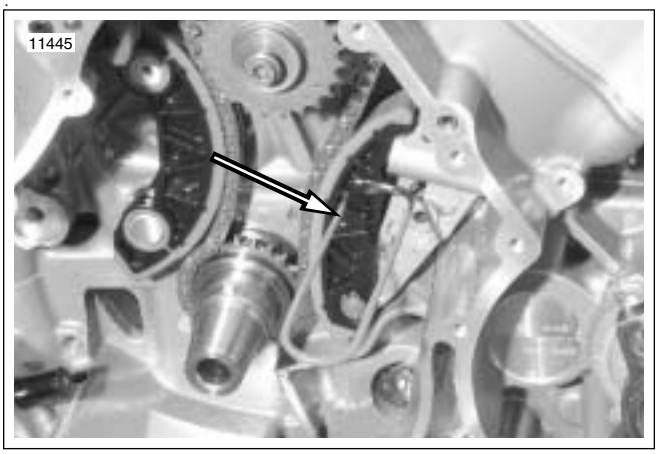


Figure 3-33. Primary Chain Tensioner Retainer (HD-45326)

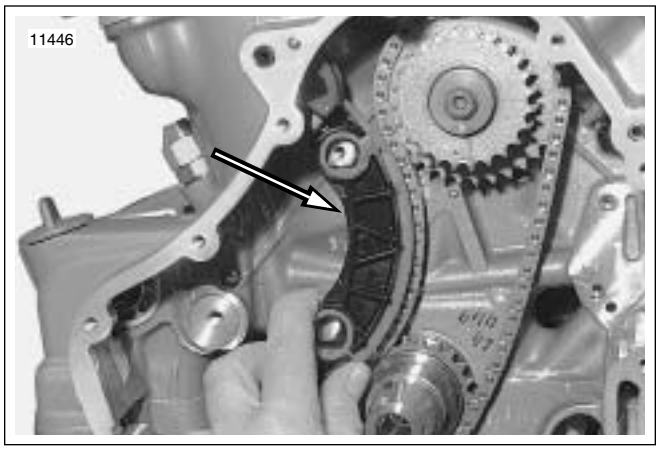


Figure 3-34. Primary Chain Fixed Guide

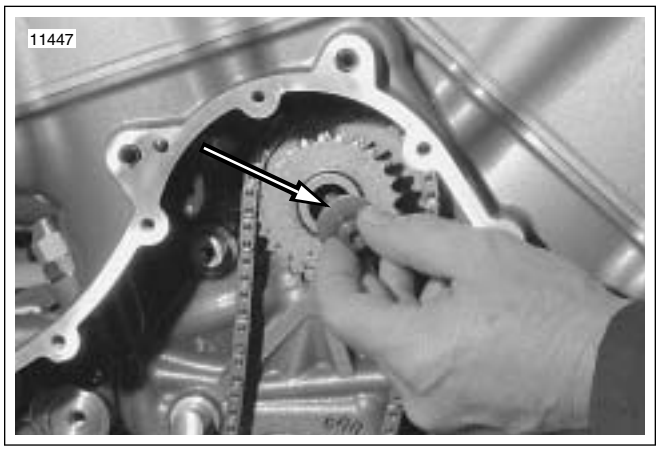


Figure 3-35. Triple Sprocket Fastener

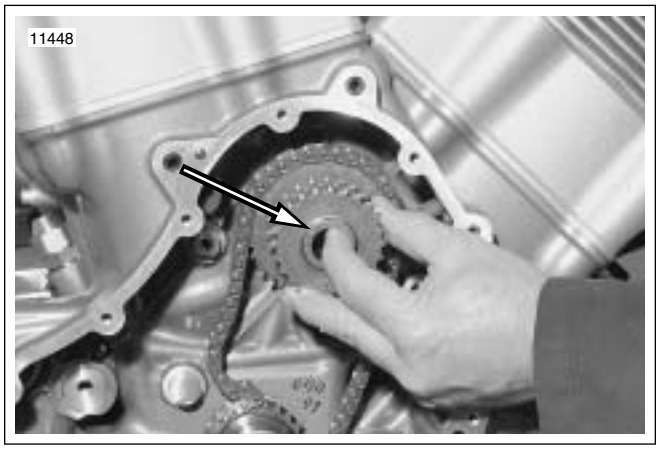


Figure 3-36. Triple Sprocket/Water Pump Shaft

CYLINDER HEAD SERVICE 3.11

REMOVAL AND DISASSEMBLY

PART NO.	SPECIALTY TOOL
HD-39786	Cylinder head holding fixture
HD-45333	Cylinder head holder
HD-45312	Cam chain tensioner guide pin remover/ installer
HD-45491	Tappet compressing tool
HD-34736-B	Valve spring compressor

CAUTION

TAPPET COMPRESSING TOOL (HD-45491) is in place from the cam drive removal process, remove it before proceeding. Removing the head with valves extended could result in damage.

1. See Figure 3-38. Remove seven fasteners retaining head.
   a. Completely remove the three 5mm fasteners (1, 2, 3).
   b. The four main headbolts (4, 5, 6, 7) are external TORX E14. Use Snap-on tool 1MFLE140 to loosen main headbolts in a criss cross pattern until free.
2. Remove the cylinder heads.
3. See Figure 3-37. Use CYLINDER HEAD HOLDING FIXTURE (HD-39786) and CYLINDER HEAD HOLDER (HD-45333) to secure cylinder head for service.

Figure 3-37. Cylinder Head Holder

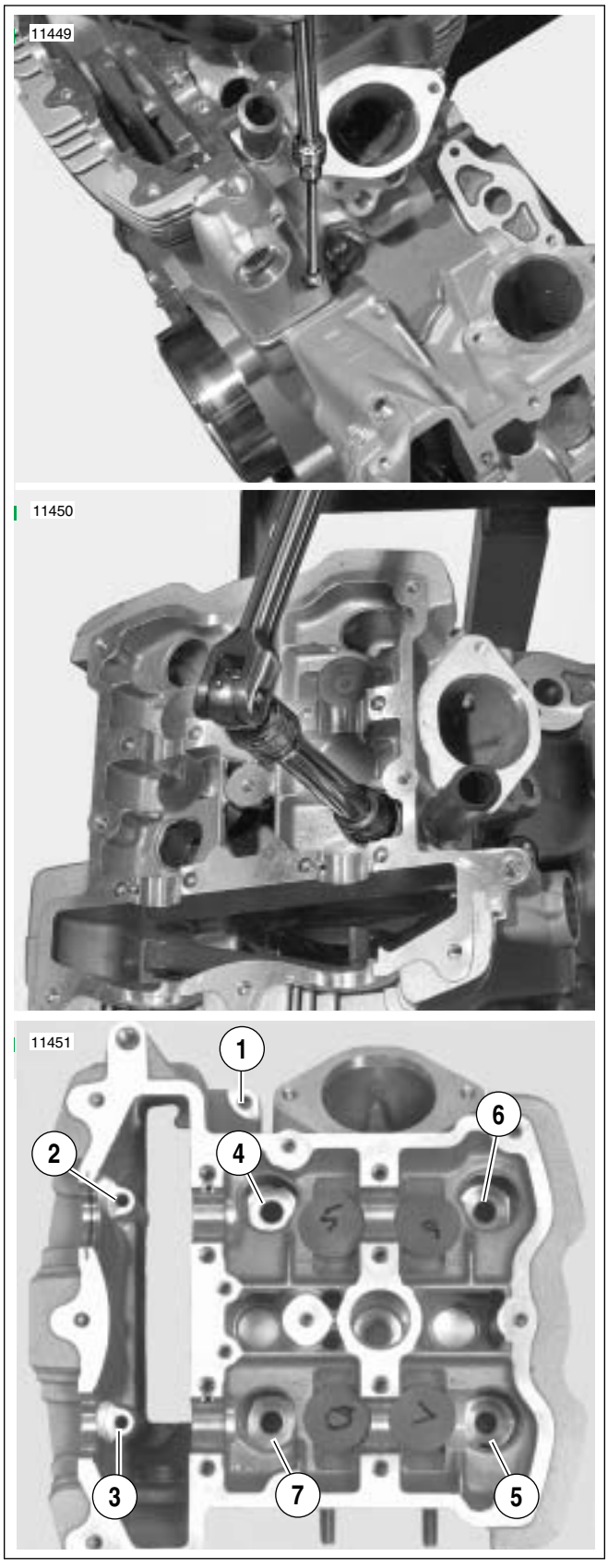


Figure 3-38. Cylinder Head Fasteners

4. See Figure 3-39. Use CAM CHAIN TENSIONER GUIDE PIN REMOVER/INSTALLER (HD-45312) to remove cam chain tensioner pins.
5. See Figure 3-40. Clean oil film from tappets and use marker to number tappets according to the cast in number at each valve. Remove tappets and shims and keep together for assembly in same position.
6. See Figure 3-41. Install VALVE SPRING COMPRESSOR (HD-34736-B). Remove valves, springs and keepers. Keep removed parts organized so they will be assembled in same position.
7. See Figure 3-42. Tightly wound coils are always installed to the bottom.

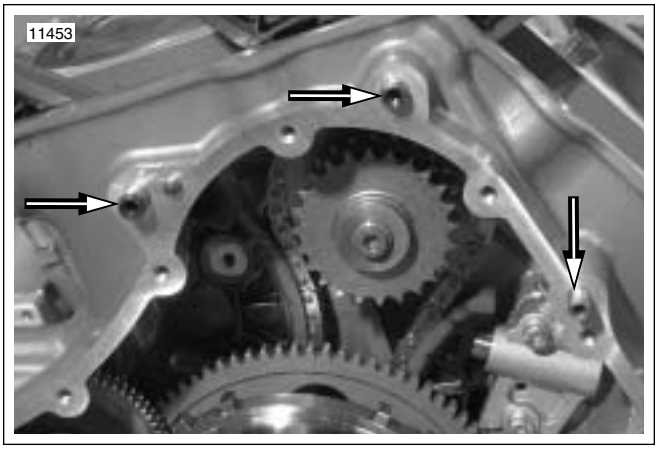


Figure 3-39. Cam Chain Tensioner Guide Pins

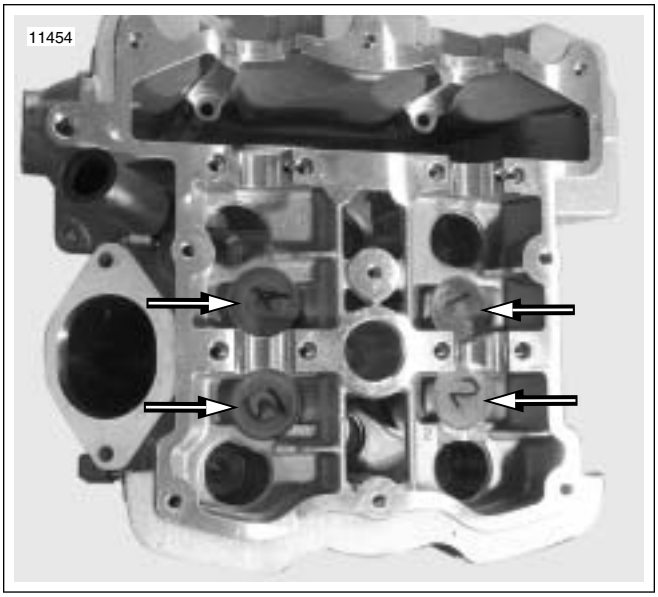


Figure 3-40. Number Tappets

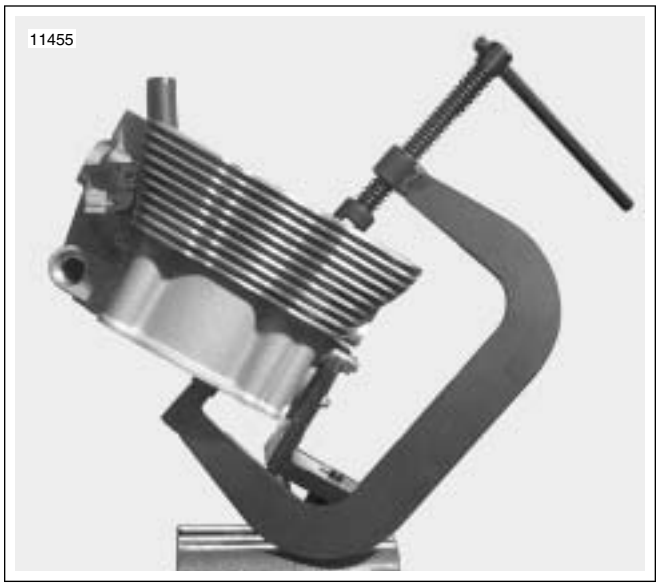


Figure 3-41. Valve Spring Compressor

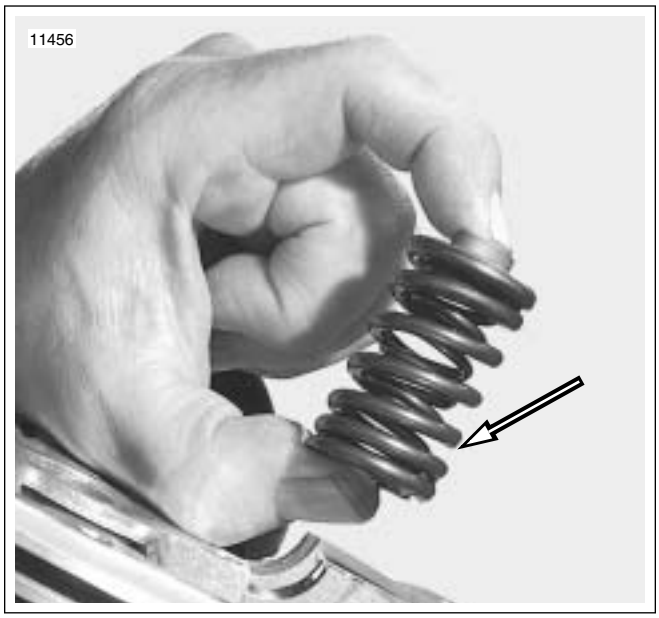


Figure 3-42. Valve Spring Coils

Figure 3-43. Valve Spring Compressor

8. See Figure 3-43. Check valve spring height and compression rate. Replace if spring height or spring rate is not within specification. See 3.1 SPECIFICATIONS.

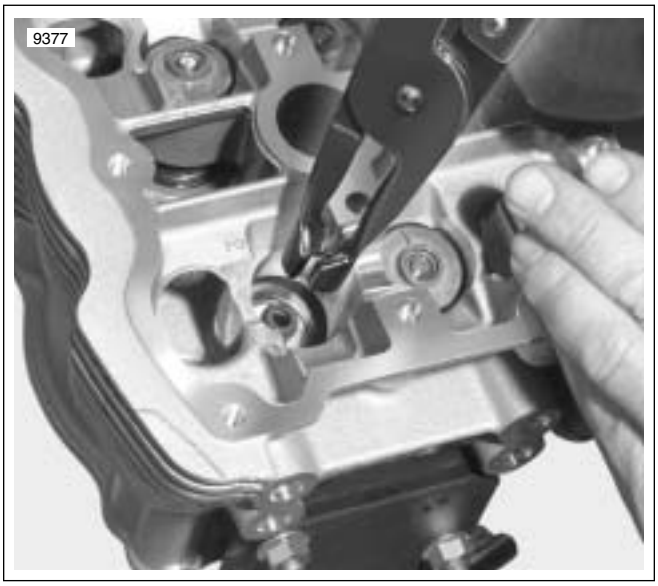


Figure 3-44. Valve Seal

9. See Figure 3-44. Remove valve guide seal with Snap-on tool number YA8230.

10. See Figure 3-45. Measure valve stem diameter and valve guide bore.

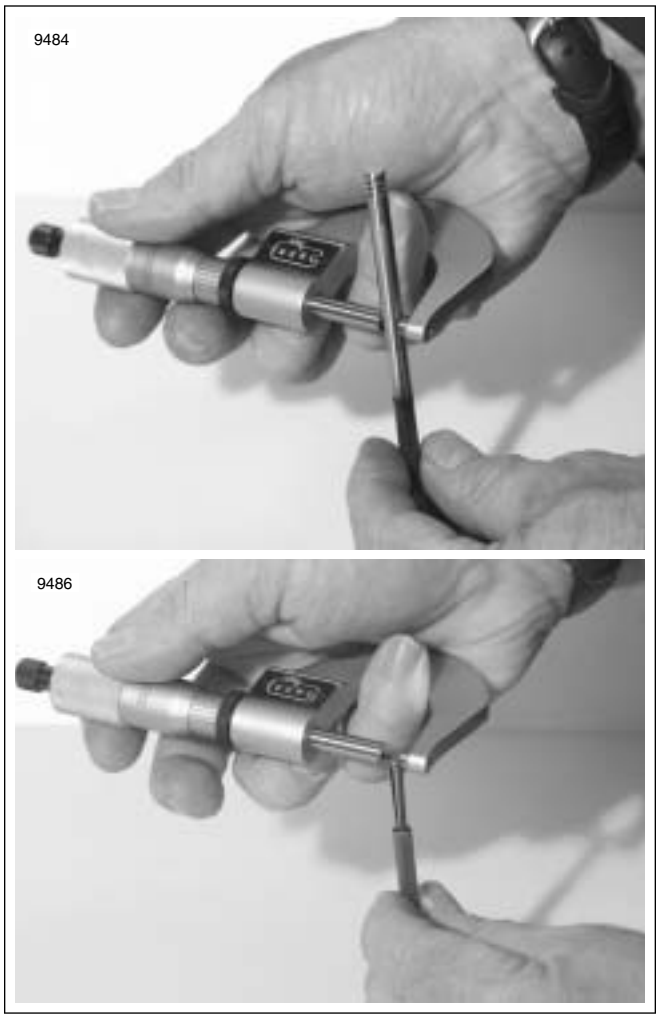


Figure 3-45. Valve Stem and Guide Measurement

11. Subtract the valve stem measurement from the valve guide bore measurement to calculate the running clearance.

12. Refer to Table 3-24. Compare the measurements to the table.

Table 3-24. Valve Guide Running Clearance

Valve Guide		MM	IN
Intake	Min	0.0285	0.0012
	Max	0.0585	0.0023
Exhaust	Min	0.0385	0.0016
	Max	0.0685	0.0026

NOTE

Do not remove valve guides within valve guide running clearance. Refer to Table 3-24.

13. See Figure 3-46. Remove and replace the valve guides that do not meet specifications. Position head for removal of valve guide. Use CYLINDER HEAD SUPPORT STAND (HD-39782) with CYLINDER SUPPORT ADAPTER (HD-39782-13) for intake valves and CYLINDER SUPPORT ADAPTER (HD-39782-14) for exhaust valves.

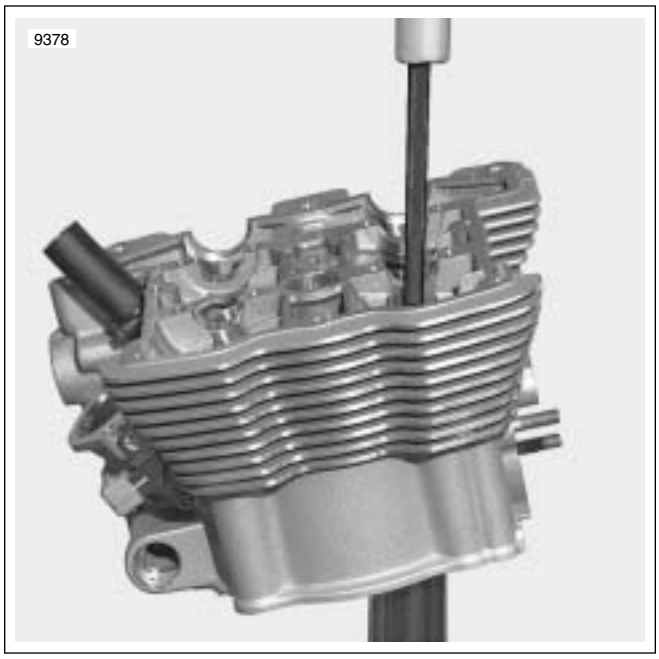


Figure 3-46. Valve Guide Removal (typical)

14. See Figure 3-47. Measure cylinder valve guide bore to determine valve guide diameter needed. Select valve guide no larger than 0.051 mm (0.0020 in.) to 0.022 mm (0.00086 in.) over size of cylinder bore.
15. See Figure 3-48. Use VALVE GUIDE REMOVER/INSTALLER (HD-45320) to install valve guide at correct height.

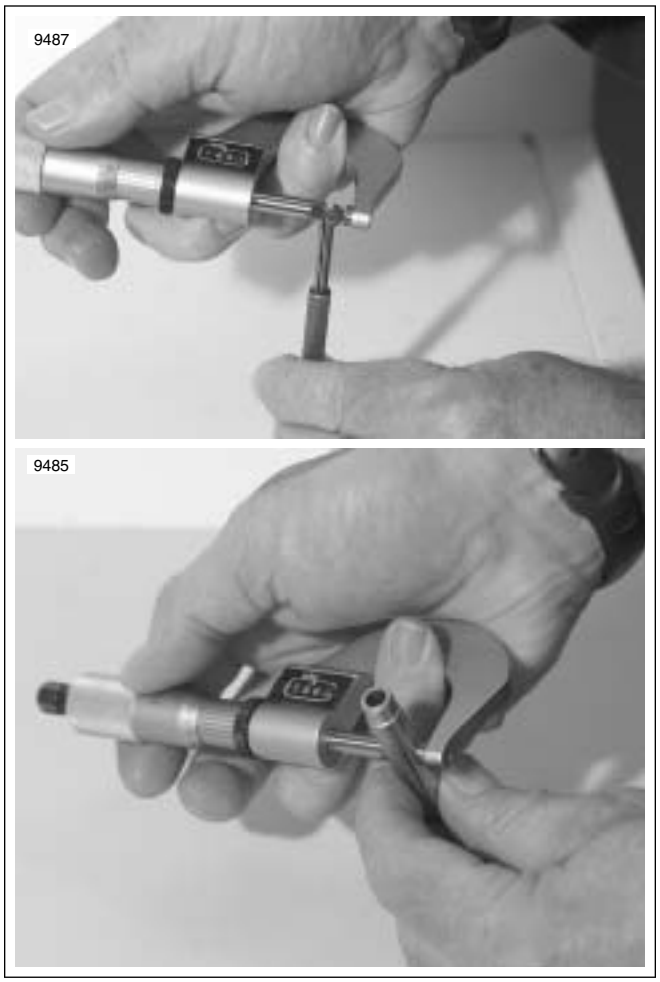


Figure 3-47. Valve Guide Dimensions

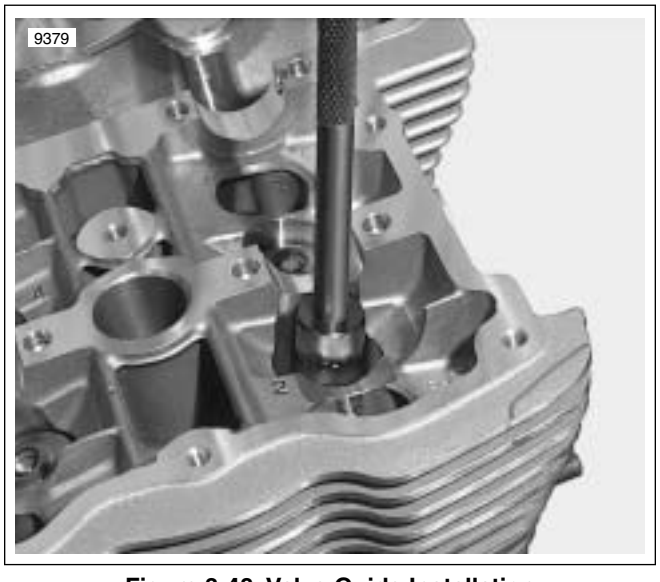


Figure 3-48. Valve Guide Installation

16. See Figure 3-49. Use VALVE GUIDE REAMER (HD-45319) to return installed guide to correct diameter.
17. See Figure 3-50. Use VALVE GUIDE FLEX HONE (HD-45321) to get the correct surface finish for proper valve stem-to-guide fit and lubrication.
18. See Figure 3-51. Clean valve guide with VALVE GUIDE CLEANING BRUSH (HD-34751).
19. See Figure 3-52. Verify stem to guide clearance is correct after reaming.
20. Clean valve stem bore and insert 6 MM PILOT (HD-35758-51) in bore.

NOTE

ALWAYS clean valve stem bore before inserting pilot. Clean bores of all valve guides not replaced as well.

Figure 3-49. Ream Valve Guide

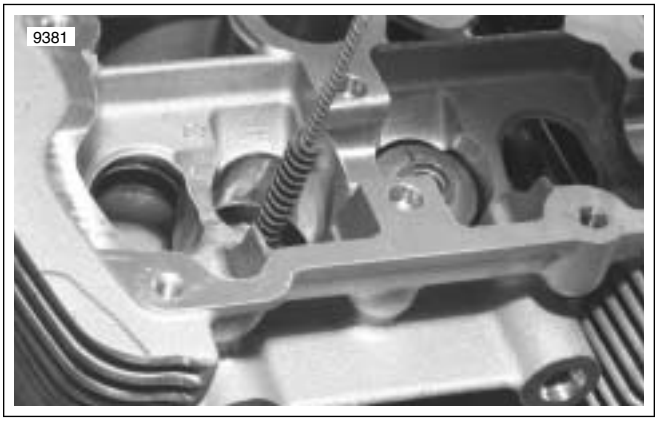


Figure 3-50. Hone Valve Guide

Figure 3-51. Valve Guide Cleaning Brush (HD-34751)

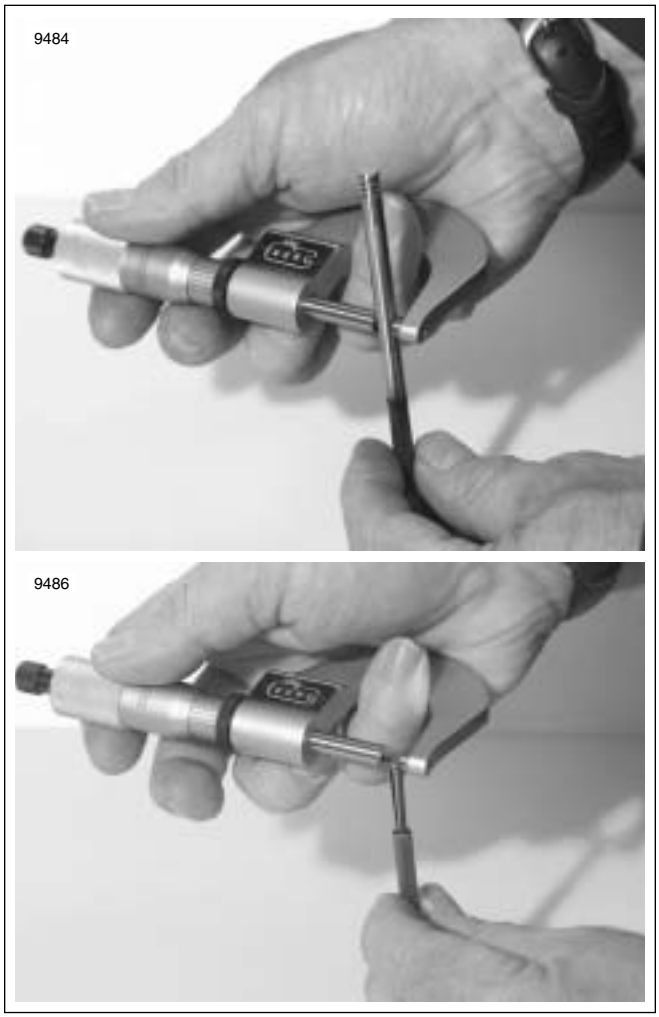


Figure 3-52. Measure Stem to Guide Clearance

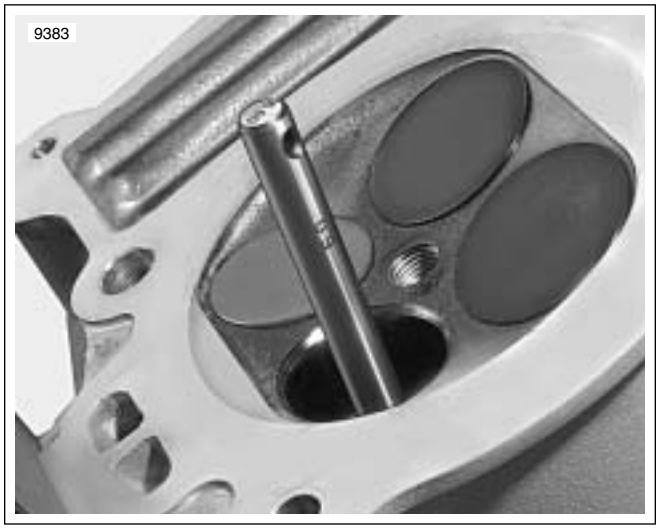


Figure 3-53. 6 mm Pilot (HD-35758-51)

v0075x3x

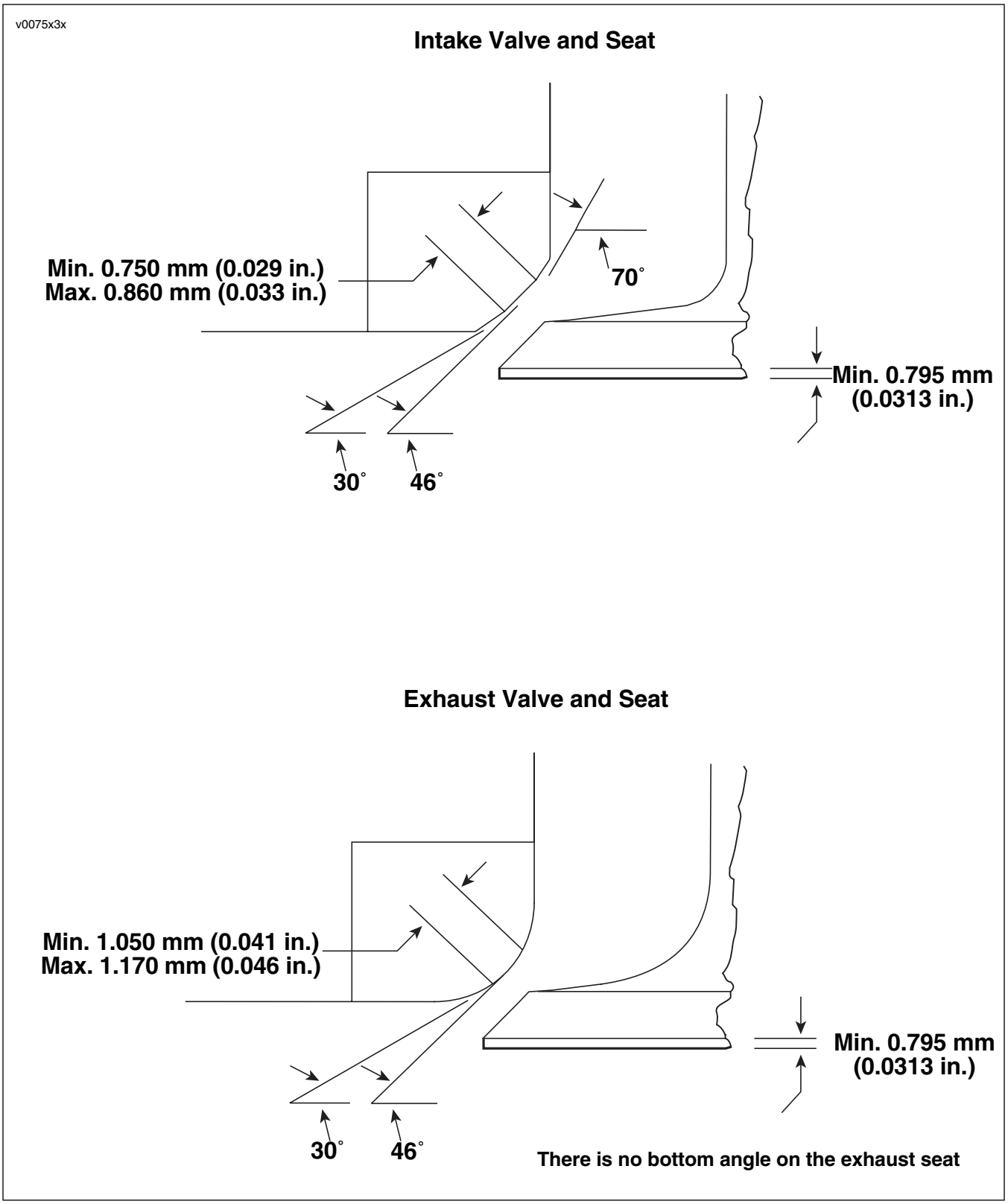


Figure 3-54. Valve and Seat Dimensions

VALVE SEAT REFACING

PART NO.	NEWAY NO.	SPECIALTY TOOL
HD-45333		Cylinder head holder
HD-39786		Cylinder head holding fixture
HD-35758-51		6 mm pilot
HD-35758-53	203	46˚/31˚ Exhaust seat cutter
HD-35758-54	271	70˚ Intake seat cutter
HD-35758-A	622	46˚/31˚ Intake seat cutter
HD-34751		Cleaning brush

NOTE

*Verify correct valve stem to valve guide clearance before refacing. Refer to Table 3-6. If **new** guides must be installed, complete that task before refacing valves and seats.*

NOTE

This procedure is not based on the lapping of valves. The end result is an interference fit between the valve of 45˚ and the valve seat which will be 46˚.

1. See Figure 3-55. Use CYLINDER HEAD HOLDING FIXTURE (HD-39786) and CYLINDER HEAD HOLDER (HD-45333) to secure cylinder head for service.
2. Clean valve seats and valve faces.
3. Insert the valve stem into the valve guide. Push on the bottom of valve until in contacts the valve seat.
4. Measure valve stem protrusion.
   a. Holding valve against seat, measure distance from top of valve stem to face of spring pocket in cylinder head.
   b. Compare measurement to maximum and minimum for exhaust or intake valve. Refer to Table 3-25.

Table 3-25. Valve Stem Protrusion

ITEM	MM	IN
Intake	Max 44.771	1.762
	Min 44.171	1.739
Exhaust	Max 43.893	1.728
	Min 43.293	1.704

   c. If valve stem protrusion is longer than the maximum, replace valve seat or cylinder head as necessary.
   d. If valve stem protrusion is less than the minimum, reface the valve seat until the measurement of valve protrusion is within maximum and minimum specifications.

Figure 3-55. Cylinder Head Holder

5. From the NEWAY VALVE SEAT CUTTER SET (HD-35758-50) use # 622 and cut intake (# 203 for exhaust) valve seat angle to 46˚. Do not remove any more metal than is necessary to clean up the seat (that is, to provide a uniform finish and remove pitting).
6. In order to determine the correct location of the 46˚ valve seat in the head, measure the width of the valve to be used and subtract 1.02 mm (0.040 in.) from that number.
7. Set your dial caliper to the lesser measurement and lock down for quick reference. This is the location of your valve seat.
8. Use a permanent magic marker to highlight the valve seat area that is going to be cut and be sure to highlight all 3 angles. Allow marker to dry before proceeding.

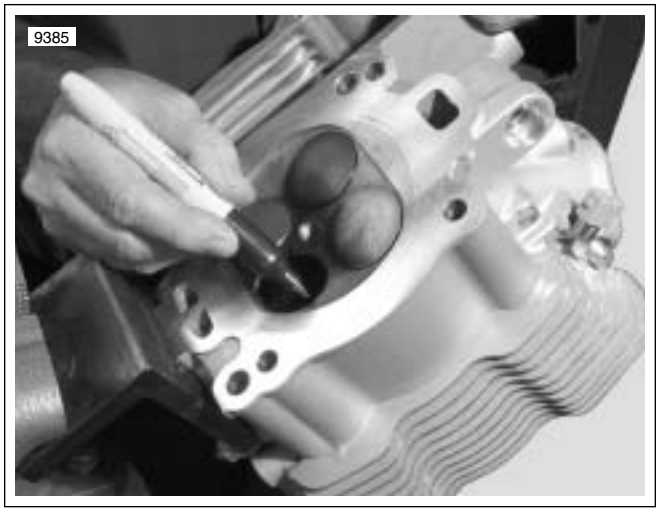


Figure 3-56. Mark Valve Seat

NOTE

Always ensure cutter blades and cutter pilot are clean before beginning the cutting process. The correct cleaning brush is supplied with the Neway tool set. Also ensure the inside of the valve guide is clean by using Kent-Moore CLEANING BRUSH (HD-34751).

9. Choose the cutter pilot that fits properly into the valve guide hole and securely seat the pilot by pushing down and turning using the installation tool supplied in the tool set.
10. Choose the proper 46˚ cutter (intake or exhaust) and gently slide the cutter onto the pilot being careful not to drop the cutter onto the seat.

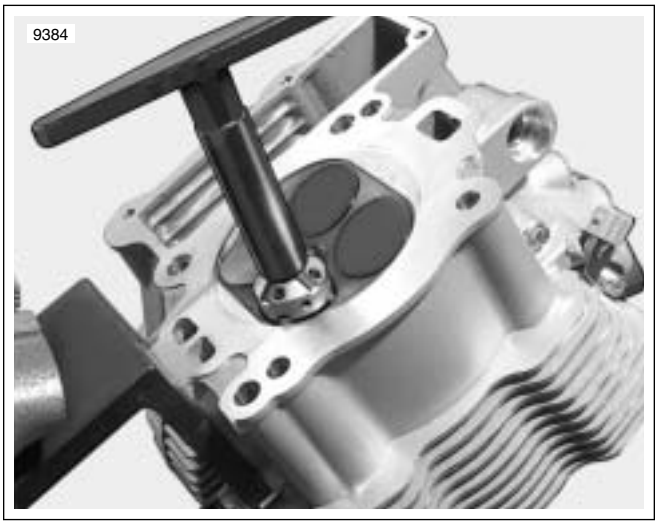


Figure 3-57. Neway Cutter

11. While applying a constant and consistent pressure, remove just enough material to show a complete clean-up on the 46˚ angle.

NOTE

If the width of the clean-up angle is greater on one side of the seat than the other, the guide may need to be replaced due to improper installation.

NOTE

After making the 46˚ cut, if you discover a groove cut completely around the seat this means the blades of the cutter are in alignment and need to be staggered. This is accomplished by loosening all of the blades from the cutter body and moving each blade slightly in it's cradle in opposite directions on the cutter. The tool needed to loosen the blades is supplied in the tool set. A permanent magic marker mark every 90˚ will help in determining where new angles are.

12. Next, with your dial caliper locked to the predetermined setting, measure the 46˚ cut at the outer most edge at the widest point of the circle to determine what cut needs to be made next.
    a. If the 46˚ cut is to high (towards the combustion chamber), use the 31˚ cutter to lower the valve seat closer to the port.
    b. If the 46˚ cut is too low, and the width of the valve seat is too wide, use the 70˚ (intake only) cutter to raise the valve seat or move it away from the port.

NOTE

Due to using the top measurement of our valve seat as a reference point it will usually be necessary to use the 31˚ cutter following the initial 46˚ cut.

NOTE

Do not cut the bottom angle on the exhaust seat.

NOTE

Always highlight the valve seat with the permanent magic marker in order to ensure the location of the 46˚ valve seat.

13. If the location of the valve seat is not correct, repeat steps 6 through 8.
14. When you accomplish a complete clean-up of the 46˚ angle and the width is at least 0.750 mm (0.029 in.) for intake or 1.050 mm (0.041 in.) for exhaust, proceed to the next step.
15. Select the proper 70˚ cutter (for intake) and gently slide the cutter down the cutter pilot to the valve seat. The exhaust does not have a bottom angle.
16. See Figure 3-54. Remove just enough material to provide the proper valve seat width.
17. Remove cutter pilot and wash head thoroughly and dry completely.
18. Repeat the process on any valve seat that needs service.
19. Insert valve to be used in the valve guide and bottom on the valve seat. Positioning the cylinder head port upwards and with slight thumb pressure against the valve, completely fill the port with solvent to verify proper seal between the valve and the valve seat.

NOTE

Hold pressure against the valve for a minimum of 10 seconds. If any leakage occurs, examine the valve seat for irregularities or defects and if necessary repeat the above cutting process.

HEAD ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-45322	Valve guide seal installer
HD-34736-B	Valve spring compressor

1. Thoroughly clean head before beginning assembly.
2. Lubricate valve with Harley-Davidson Motorcycle Oil 20W50 and position in head.
3. See Figure 3-58. Insert lower spring collar.
4. Lubricate valve with Harley-Davidson Motorcycle Oil 20W50 and position in head.
5. See Figure 3-59. Place VALVE GUIDE SEAL INSTALLER (HD-45322) tapered pin over valve stem and position new seal on the tapered pin. Drive seal into position.

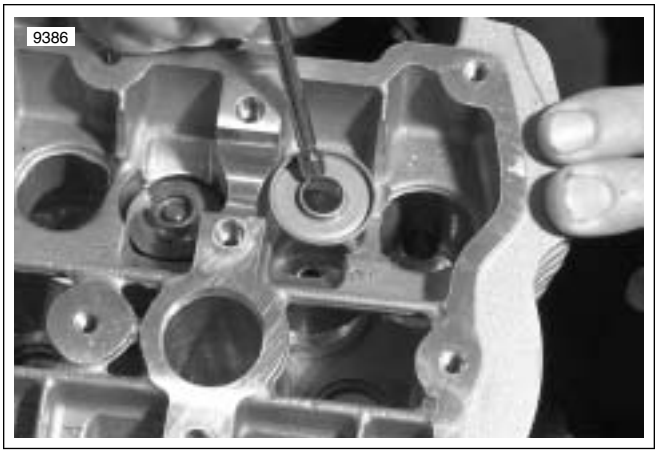


Figure 3-58. Lower Spring Collar

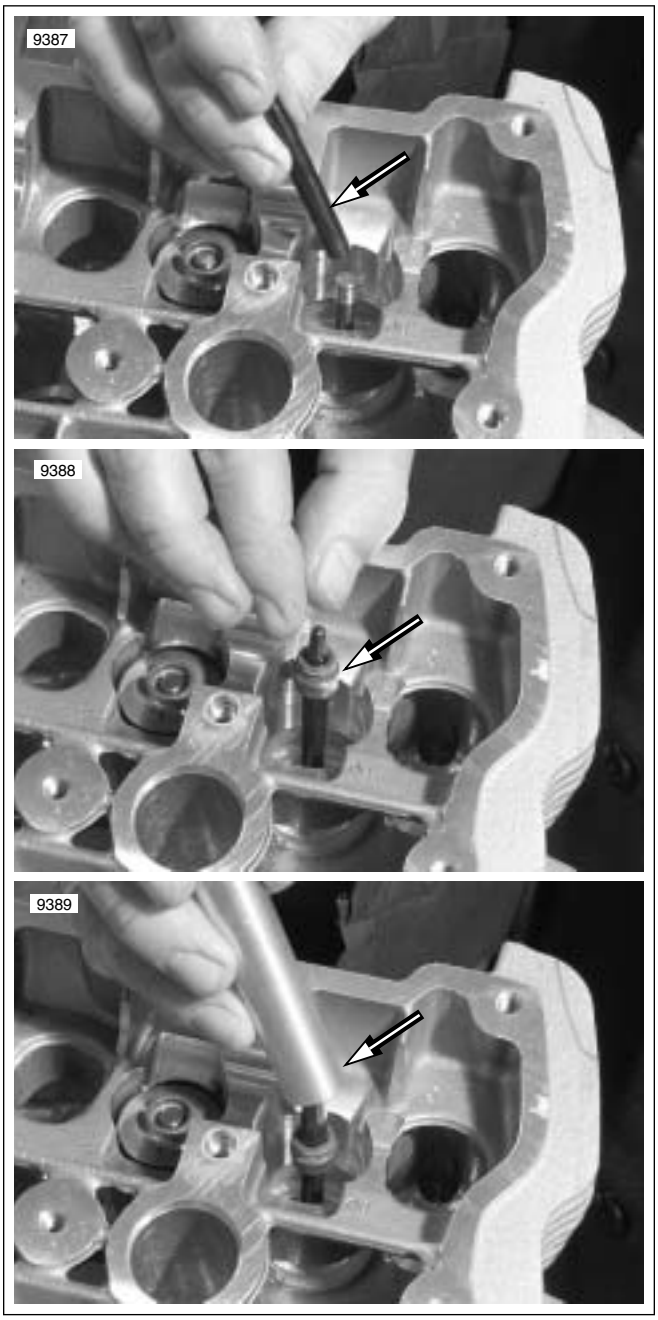


Figure 3-59. Valve Seal Installation

6. See Figure 3-60. Install upper spring collar and valve spring and with tightly wound coils to the bottom.
7. See Figure 3-61. Install VALVE SPRING COMPRESSOR (HD-34736-B) and compress spring to expose valve stem. Apply a light grease around the valve stem to hold keepers in position when relaxing the compressor tool.
8. Install valve keepers and remove compressor tool.
9. Using a micrometer measure and record for reference all valve shims.
10. Install all valve shims in their original location. Use a magnet to position the shim and push into place with finger.
11. Reinstall tappets in their original locations.
12. Lubricate cam journals, lobes, and tappets with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.
13. See Figure 3-62. Install cams and cam journal caps. Tighten cam journal caps to 9.7 Nm (86 **in-lbs**).

NOTE

*To accurately check valve lash, cam journal caps MUST be tightened to 9.7 Nm (86 **in-lbs**).*

14. See Figure 3-63. Using a blade type feeler gauge measure valve lash. See LASH MEASURMENT in 1.24 VALVE LASH and D.2 VALVE LASH CALCULATION WORKSHEET 1.
15. Adjust valve lash as required. See LASH MEASURMENT in 1.24 VALVE LASH.

NOTE

Valve lash can be measured and adjusted before the heads are installed on engine. However, after head installation, valve lash should be measured and adjusted as required.

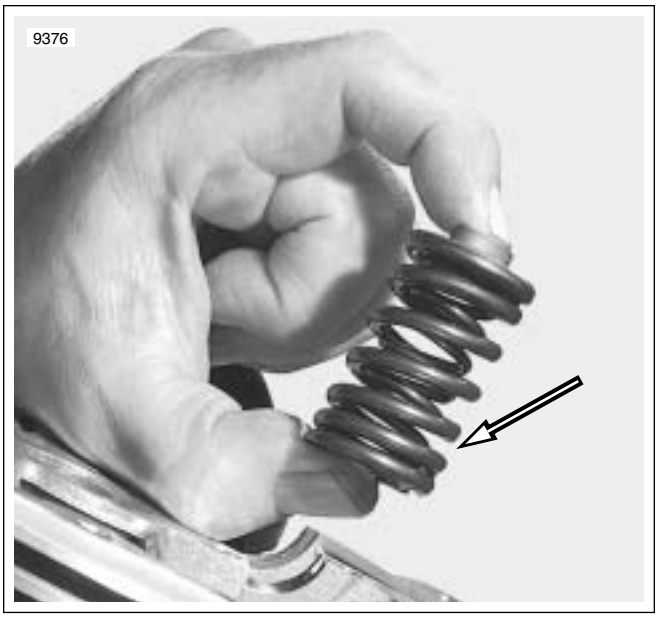


Figure 3-60. Valve Spring Coils

Figure 3-61. Install Valve Keepers

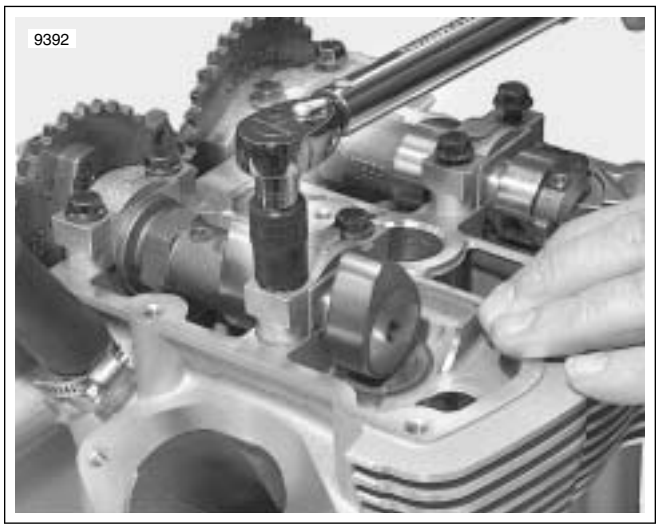


Figure 3-62. Cam Journal Caps @ 9.7 Nm (86 in-lbs)

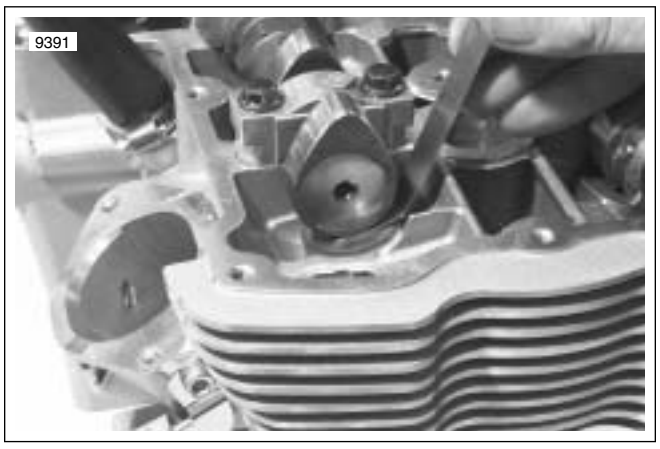


Figure 3-63. Check Valve Lash (typical)

OIL PUMP 3.12

REPLACEMENT

1. See Figure 3-64. With oil pump on engine, loosen bypass fastener and front cover fasteners.
2. See Figure 3-65. Remove three fasteners holding oil pump in case.
3. See Figure 3-66. Remove bypass valve assembly. Examine valve piston and valve piston bore in pump housing. There should be no scoring and valve piston should move freely in the bore without sticking.
4. See Figure 3-67. Examine gerotor. Replace parts showing scoring. Note assembly marks on the gerotor. Marks must be on the same side when assembling.

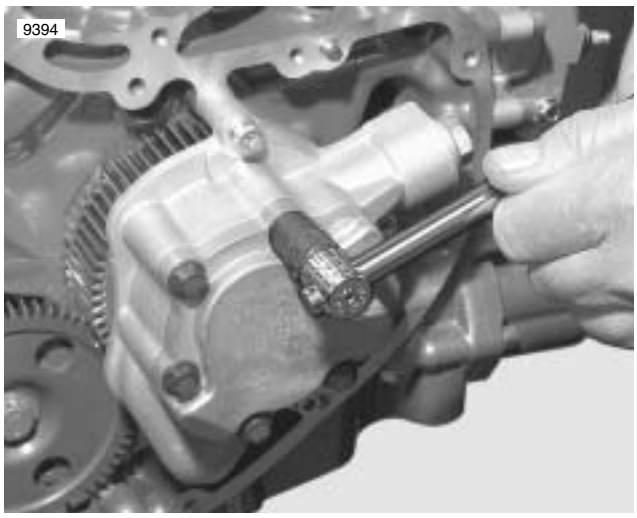


Figure 3-64. Oil Pump Fasteners

Figure 3-65. Remove Oil Pump

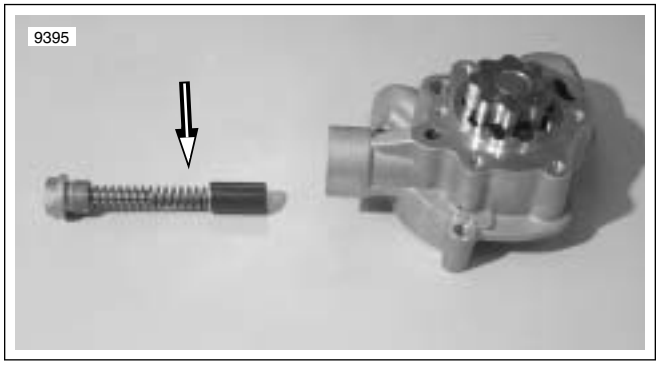


Figure 3-66. Bypass Valve

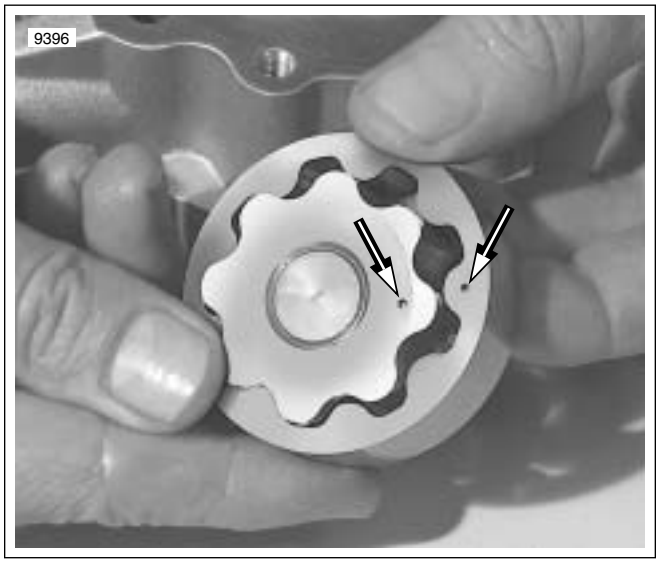


Figure 3-67. Oil Pump Gerotor

5. See Figure 3-68. Thoroughly lubricate during assembly. Pack pump housing with Lubriplate No. 105 (NAPA™ Part No. 765-2651) to insure oil pick-up is immediate.
6. See Figure 3-69. Install **new** o-rings and lubricate with Harley-Davidson Motorcycle Oil 20W50.
7. See Figure 3-70. Install pump in engine. Tighten three fasteners to 9.7 Nm (86 **in-lbs**).
8. See Figure 3-71. Using a crisscross pattern, tighten the oil pump cover fasteners to 9.7 Nm (86 **in-lbs**).
9. Tighten bypass fastener to 35 Nm (25 ft-lbs).

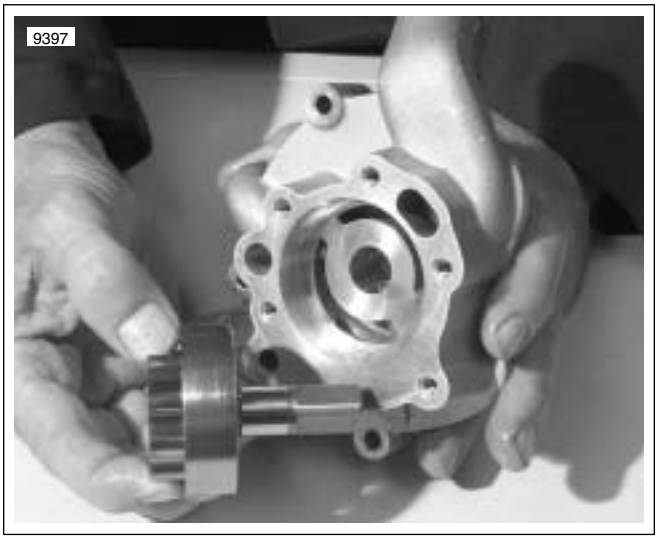


Figure 3-68. Lubricate Assembly

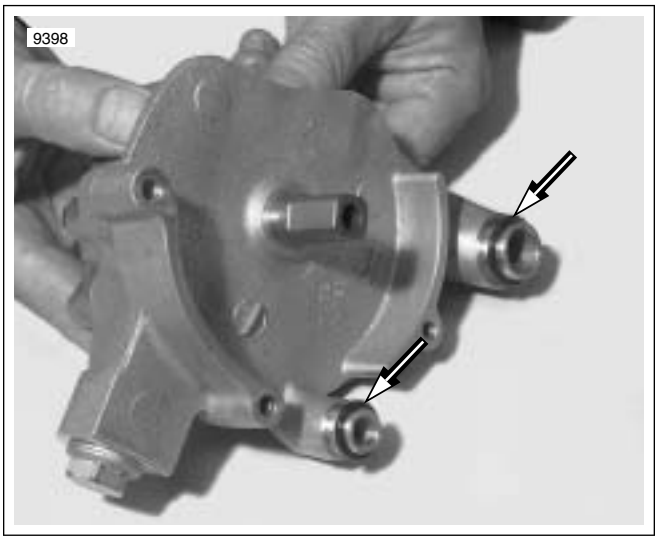


Figure 3-69. Lubricate O-Rings

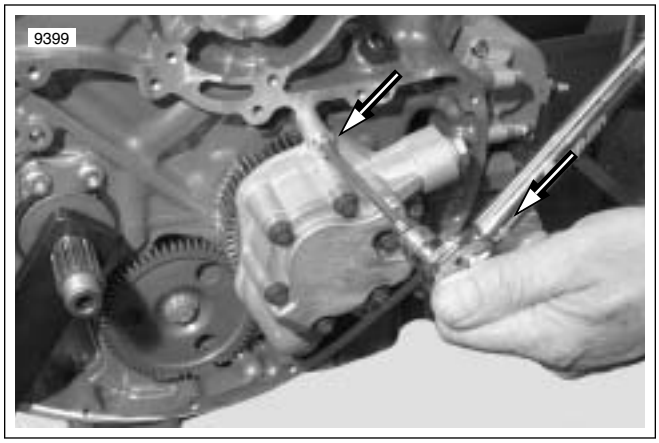


Figure 3-70. Oil Pump Installation @ 9.7 Nm (86 in-lbs)

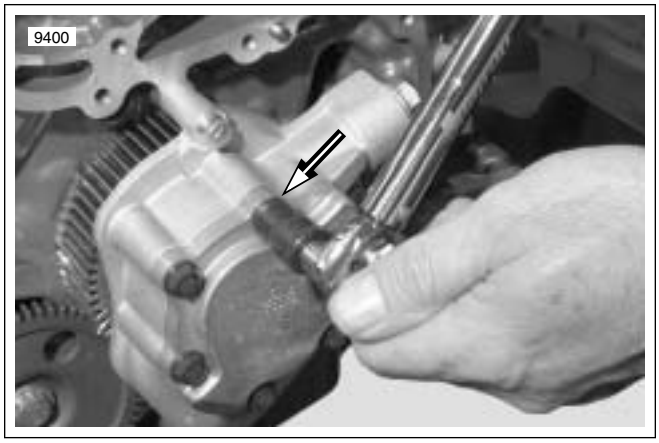


Figure 3-71. Oil Pump Cover @ 9.7 Nm (86 in-lbs)

CLUTCH 3.13

REMOVAL

PART NO.	SPECIALTY TOOL
HD-45318	Clutch hub holder

1. See Figure 3-72. If engine is in chassis, remove secondary clutch actuator cover.
2. Remove three fasteners on secondary clutch actuator and remove from clutch housing. Wrap clutch actuation cylinder with shop towel and secure away from engine.
3. See Figure 3-73. Loosen and remove clutch side crankcase cover fasteners in reverse order of torque sequence.
4. Remove clutch side crankcase cover.

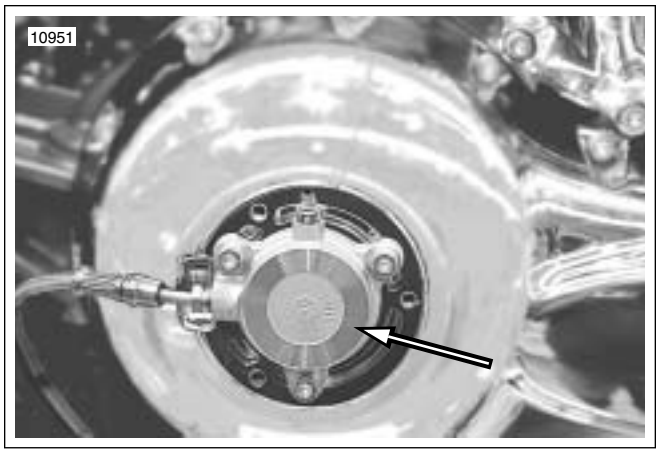


Figure 3-72. Secondary Clutch Actuator

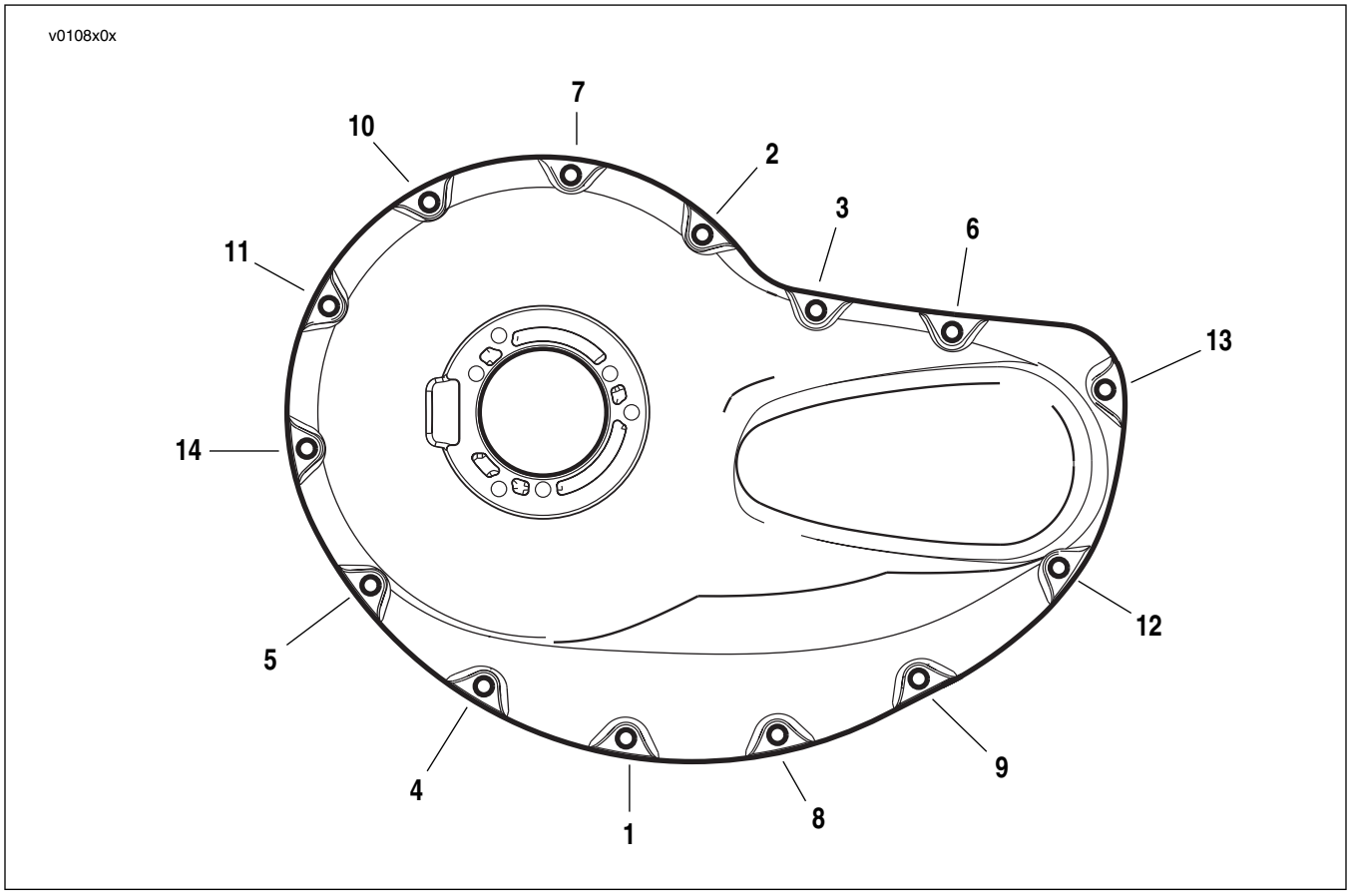


Figure 3-73. Clutch Side Crankcase Cover Torque Sequence @ 9.7 Nm (86 in-lbs)

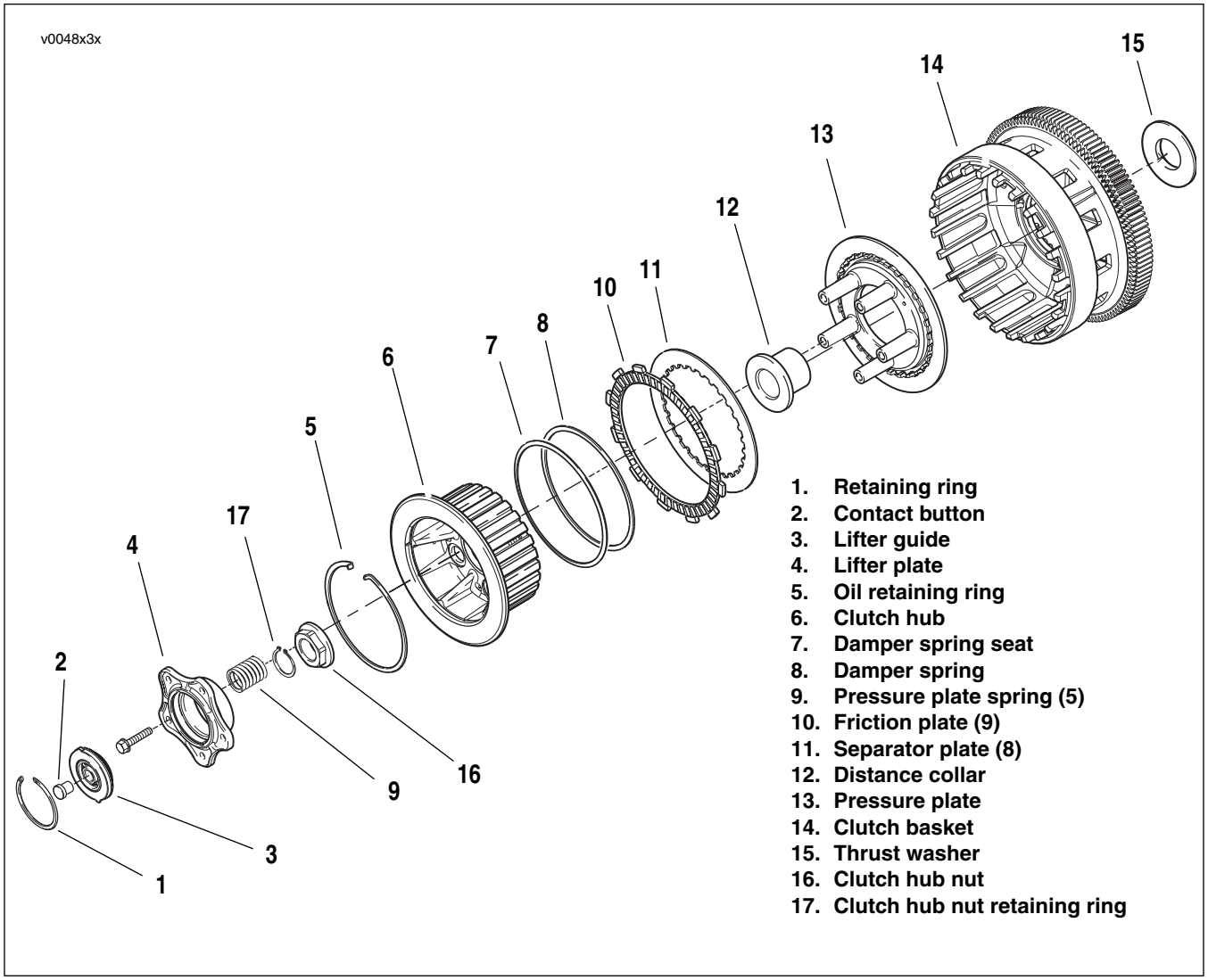


Figure 3-74. Clutch

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

5. See Figure 3-75. Remove retaining ring and lifter guide.

Figure 3-75. Lifter Guide

6. See Figure 3-76. Remove clutch hub nut retaining ring.
7. See Figure 3-74. and Figure 3-77. Remove oil retaining clip (5) for proper tool installation.
8. See Figure 3-78. Install CLUTCH HUB HOLDER (HD-45318). The clutch hub holder can only be installed in one position. The engine case dowel pin must match the hole in the tool.

CAUTION

DO NOT ROTATE ENGINE CLOCKWISE. This is opposite the normal engine operation. Engine damage may result.

9. See Figure 3-79. It may be necessary to rotate engine slightly to properly engage the clutch hub.

CAUTION

When LOCTITE® cannot be broken under normal conditions with conventional methods, apply moderate heat or use an air impact wrench ONLY TO LOOSEN clutch hub mainshaft nut. Failure to do so may result in damaged clutch hub and/or threads.

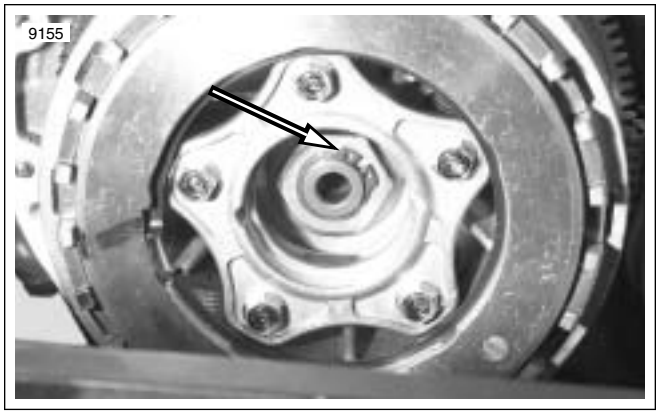


Figure 3-76. Clutch Hub Nut Retaining Ring

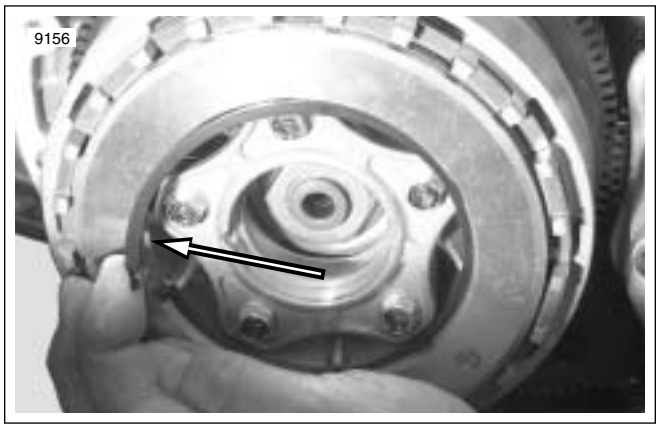


Figure 3-77. Oil Retaining Clip

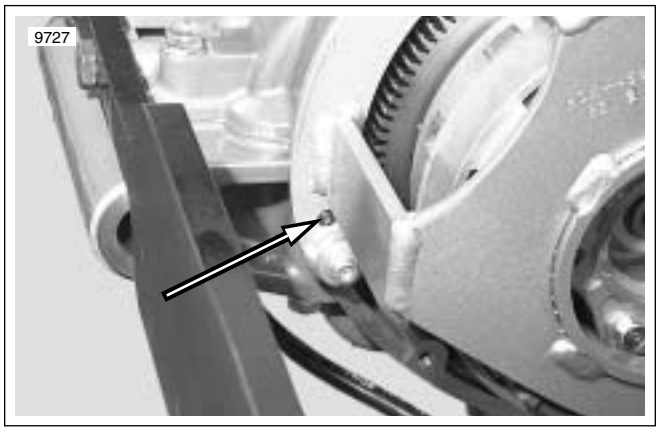


Figure 3-78. Clutch Hub Holder Dowel Pin Position

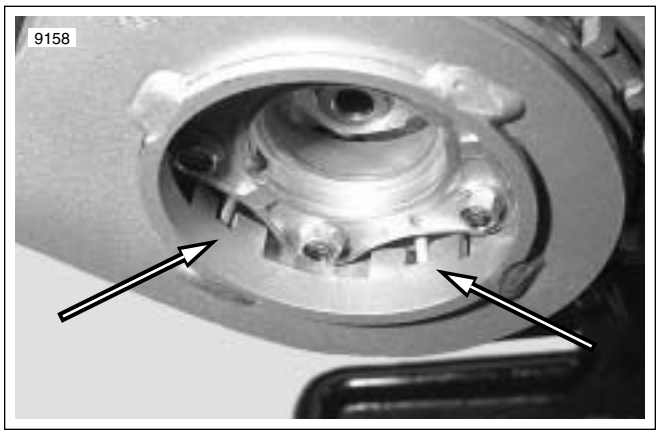


Figure 3-79. Tool and Hub Properly Engaged

⚠WARNING

Use extreme caution when operating propane torch. Read the manufacturer's instructions carefully before use. Do not direct open flame or heat toward any fuel system component. Extreme heat can cause fuel ignition and explosion. Inadequate safety precautions could result in death or serious injury.

CAUTION

When applying heat to the clutch hub mainshaft nut, do so carefully. Excessive heat will damage pressure plate springs.

10. See Figure 3-80. Heat clutch hub nut with a propane torch to loosen LOCTITE®. An air impact can be used to (REMOVAL ONLY) remove nut.
11. See Figure 3-81. Remove clutch hub nut.

NOTE

Clutch hub nut is one-time-use only. Always use a new nut for assembly (Part No. 8008M).

12. Remove CLUTCH HUB HOLDER (HD-45318).
13. See Figure 3-82. Remove clutch assembly.
14. See Figure 3-83. Note position of thrust washer behind the clutch basket.

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Figure 3-80. Heat Clutch Hub Nut

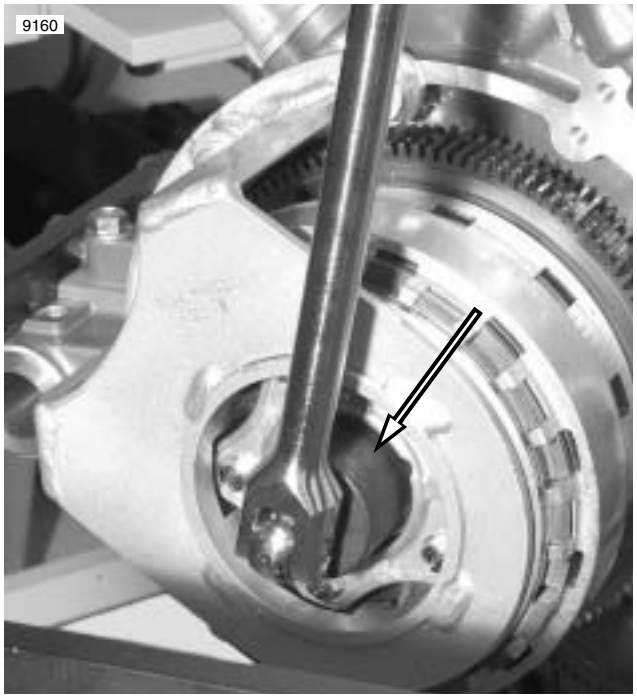


Figure 3-81. Remove Clutch Hub Nut

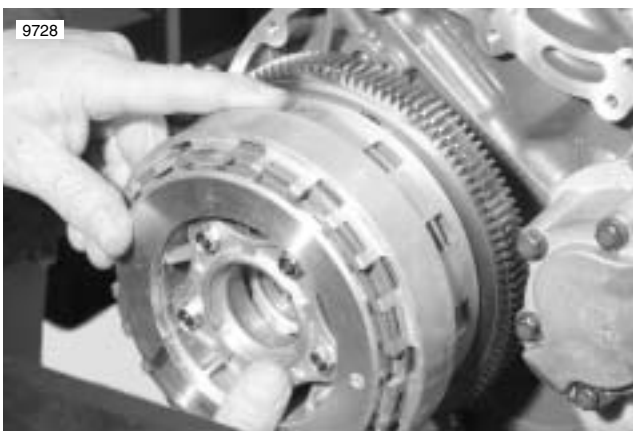


Figure 3-82. Remove Clutch Assembly

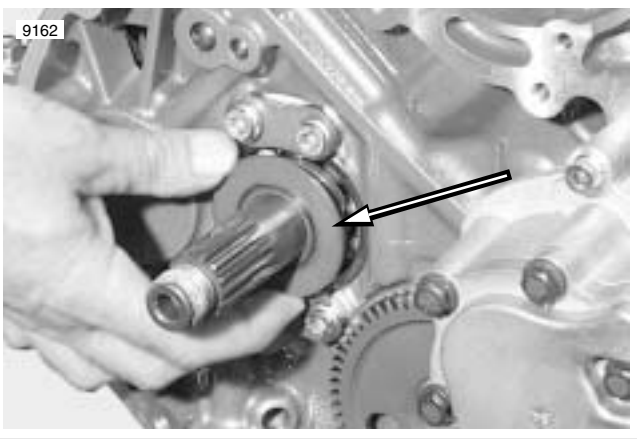


Figure 3-83. Thrust Washer Position

DISASSEMBLY

1. Use a marker to mark clutch basket and clutch pack for assembly.
2. See Figure 3-84. Remove clutch pack from clutch basket.
3. See Figure 3-85. To prevent breaking lifter plate, slowly loosen (2-3 turns at a time) fasteners in a crisscross pattern.
4. See Figure 3-86. Remove clutch springs and measure clutch spring free length.
5. Replace clutch springs if free length is less than 43 mm (1.7 in).
6. Slide hub from the clutch plate. Remove friction plates and steel plates for inspection.

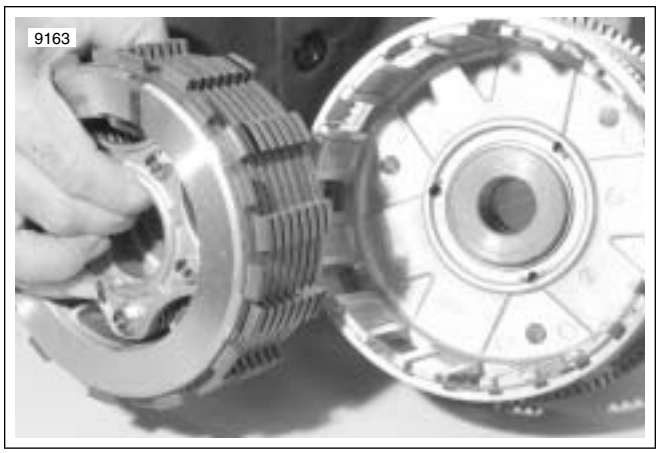


Figure 3-84. Remove Clutch Pack

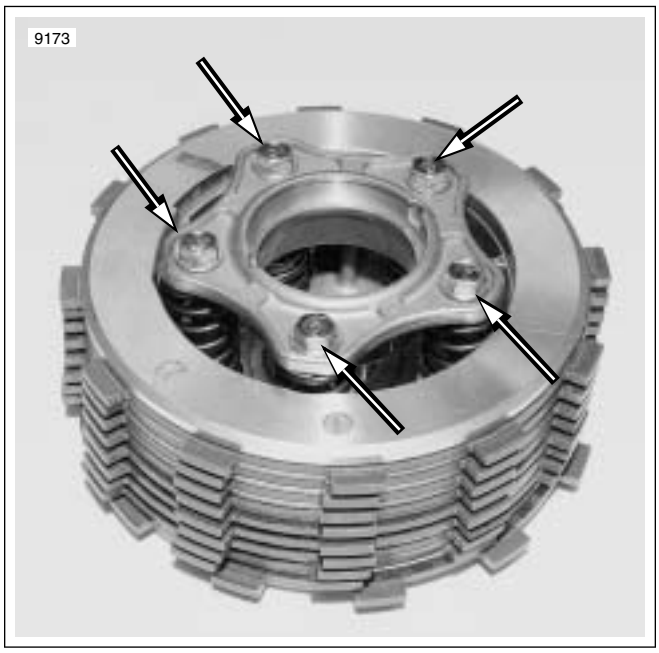


Figure 3-85. Lifter Plate Fasteners

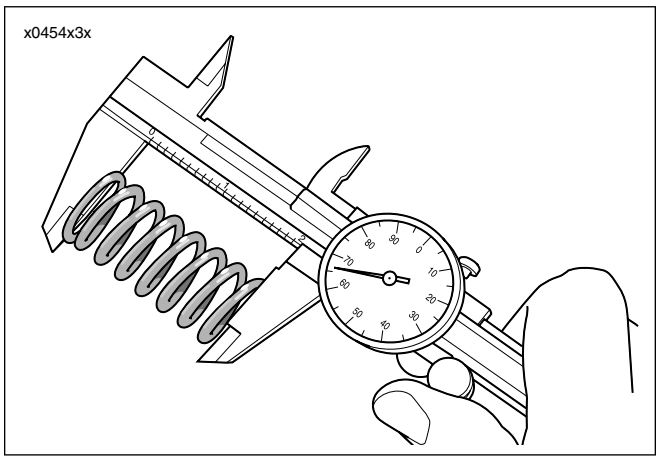


Figure 3-86. Measure Clutch Spring Free Length

CLEANING AND INSPECTION

⚠WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

1. Wash all parts in cleaning solvent, except for friction plates and bearing, if removed. Blow parts dry with low pressure compressed air.
2. Check **friction plates** as follows:
   a. Blow off all lubricant from the friction plates. Do not wipe off with a rag.
   b. Measure the thickness of each plate with a dial caliper or micrometer.
   c. If the thickness of any plate is less than 3.62 mm (0.142 in.), discard all friction plates and replace with an entirely **new** set.
   d. Look for worn or damaged fiber surface material (both sides).

NOTE

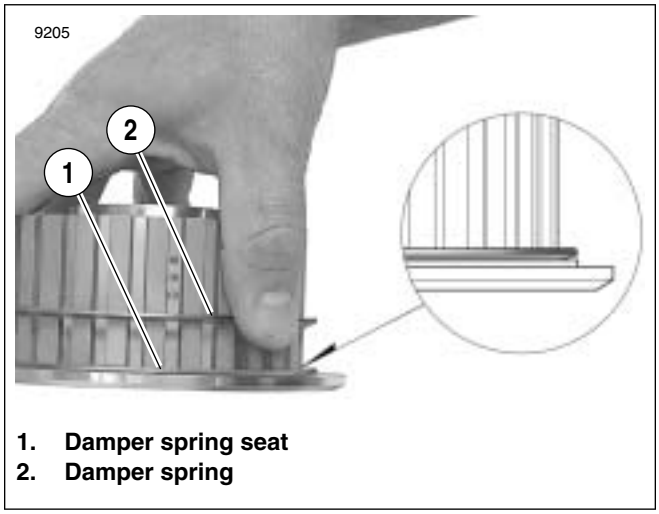
Replace all nine friction plates with an entirely new set if any individual plate shows evidence of wear or damage. Friction plates must be presoaked before installation.

3. Check the **steel plates** as follows:
   a. Discard any plate that is grooved or bluish in color. Blue plates are likely warped or distorted.
   b. Check each plate for distortion. Lay the plate on a precision flat surface. Insert a feeler gauge between the plate and the flat surface in several places. Replace any steel plate that is warped more than 0.15 mm (0.006 in.).
4. Holding the clutch hub, rotate the pressure plate to check bearing for smoothness. Replace the bearing if it runs rough, binds or has any end play.
5. Check the slots that mate with the clutch plates on both the clutch shell and hub. Replace shell or hub if slots are worn or damaged.

ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-45654	Clutch disc aligning spacer
HD-45318	Clutch hub holder

1. See Figure 3-87. Place flat steel damper spring seat on the clutch outer hub. Position the damper spring on the damper spring seat with concave side up.



1. Damper spring seat
2. Damper spring

Figure 3-87. Damper Spring Position

NOTE

New plates should be soaked for 10 minutes in Harley-Davidson Motorcycle Oil 20W50 and assembled wet.

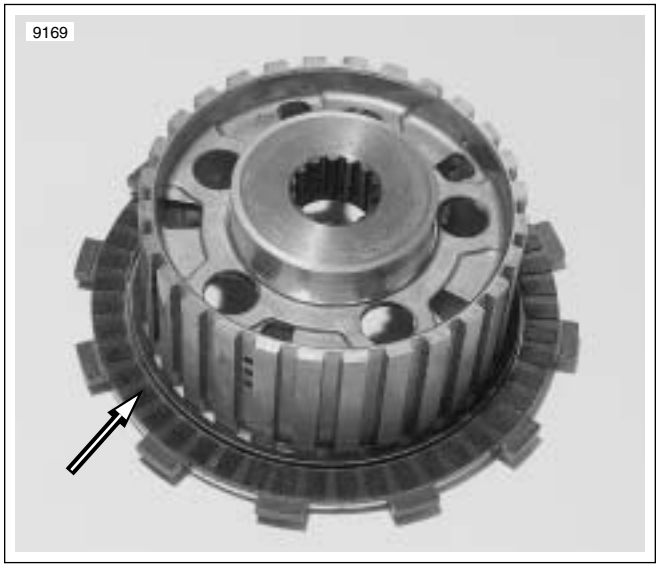


Figure 3-88. Friction Plate

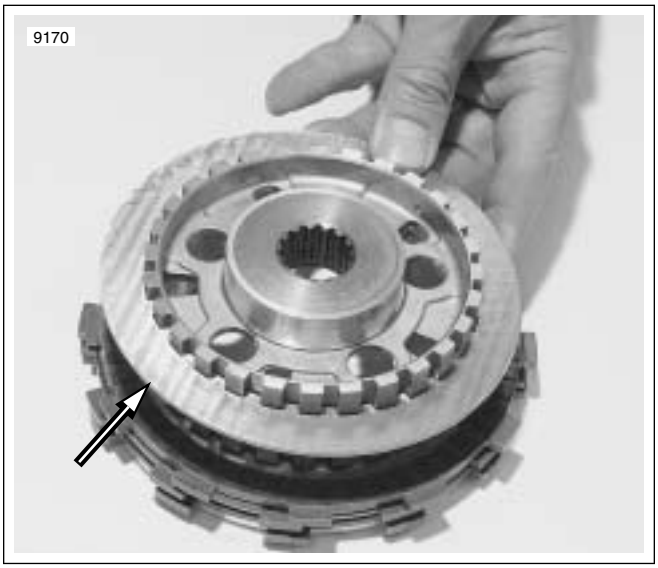


Figure 3-89. Steel Plate

2. See Figure 3-88. See Figure 3-89. Install friction plate first and then a steel plate. Install the remaining plates (9 friction plates and 8 steel plates) in the same manner, alternating between friction plates and steel plates, ending with a friction plate.

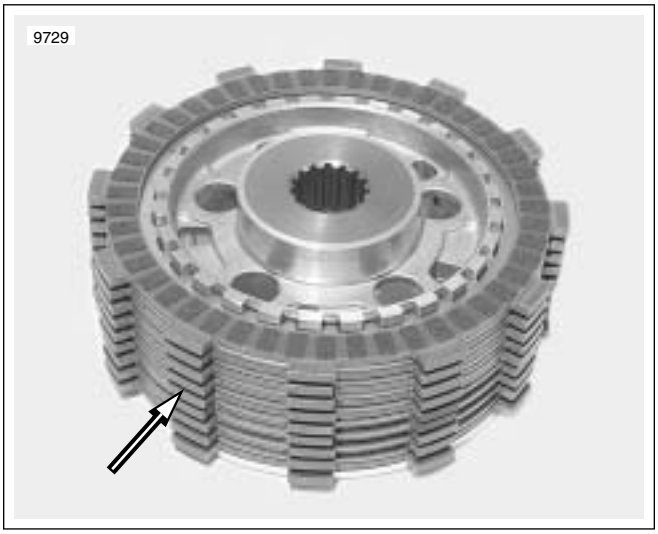


Figure 3-90. Align Friction Plates

3. See Figure 3-90. Align ears on friction plates as shown.

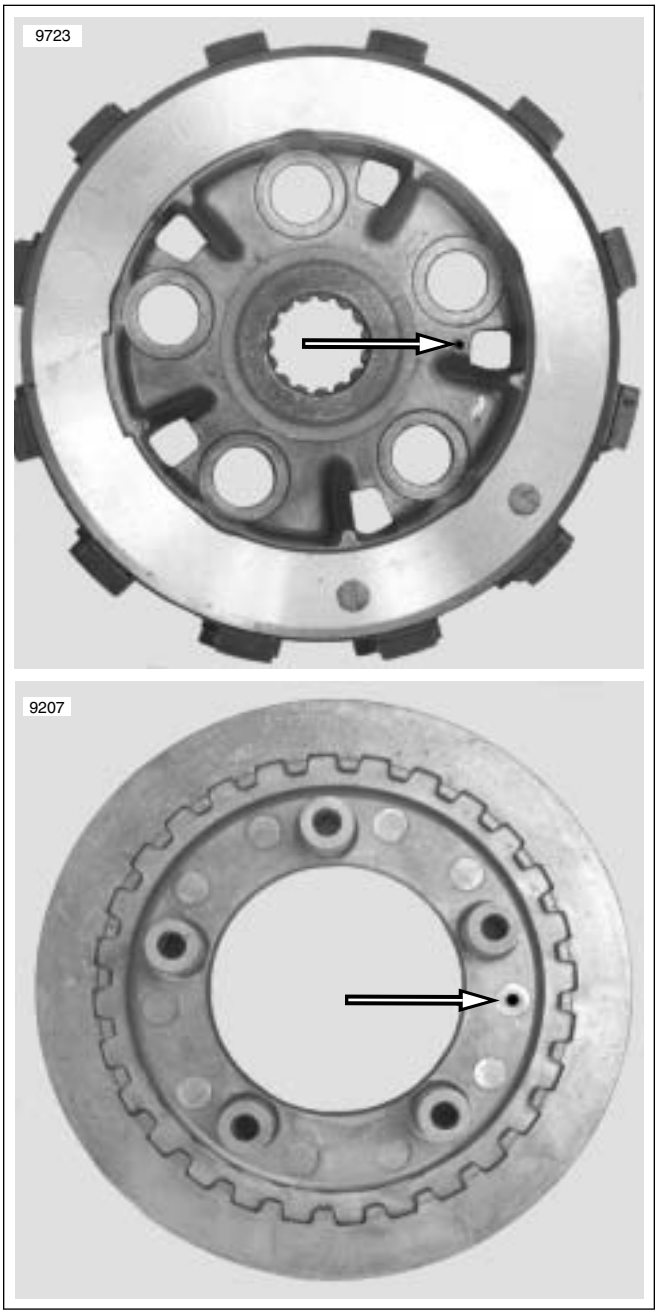


Figure 3-91. Alignment Marks

4. See Figure 3-91. Note the alignment marks on the pressure plate and the clutch outer hub. The outer hub and pressure plate are balanced assemblies and must be aligned correctly.

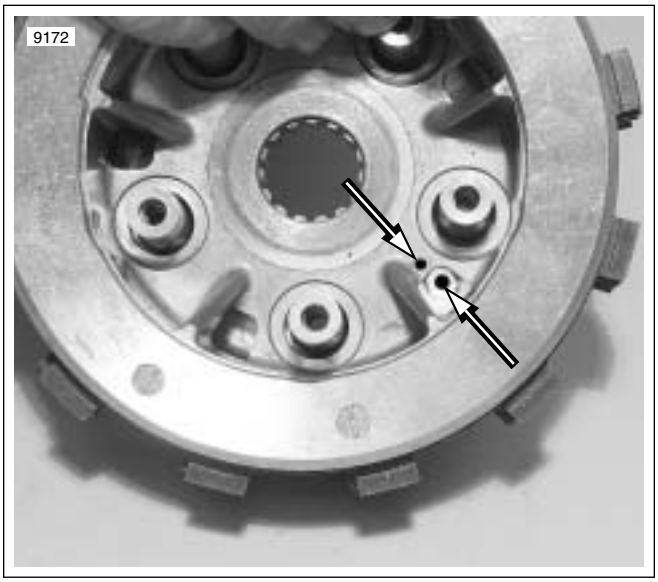
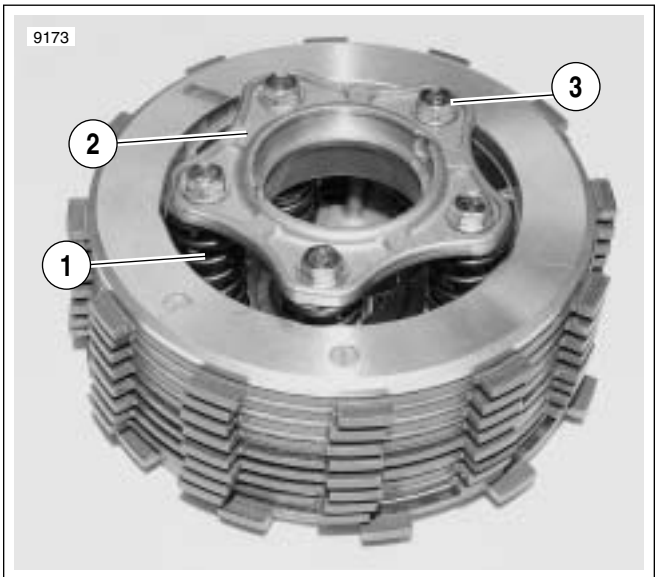


Figure 3-92. Align Clutch Outer Hub and Pressure Plate

5. See Figure 3-92. Assemble the clutch hub (with plates in place) and pressure plate with the marks aligned as shown. Full engagement of hub and pressure plate will only occur if alignment is correct.



1. **Pressure plate springs**
2. **Lifter plate**
3. **Fasteners**

Figure 3-93. Align Clutch Hub and Pressure Plate

6. See Figure 3-93. Install the five pressure plate springs over the threaded bosses on the pressure plate. Position the lifter plate over the springs and install fasteners loose enough to allow the clutch plates to be moved for final alignment.

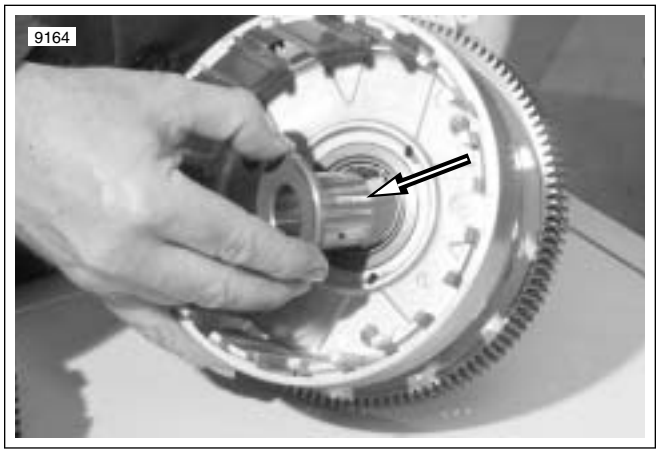


Figure 3-94. Distance Collar

7. See Figure 3-94. Insert distance collar in clutch basket as shown.

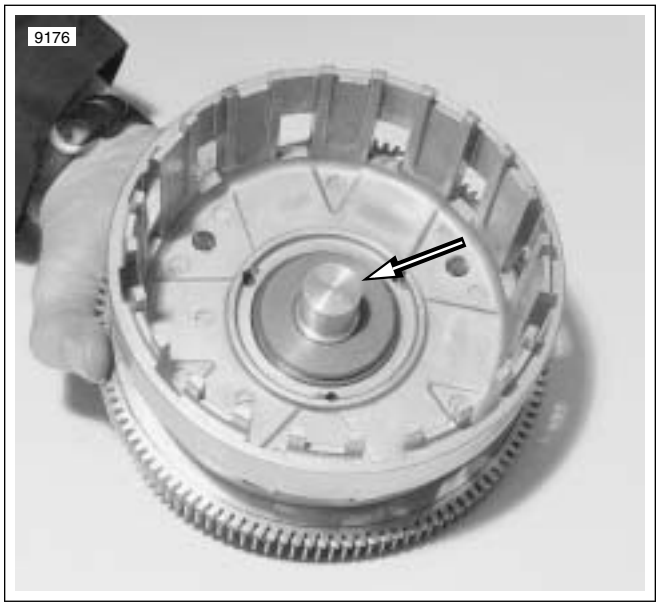


Figure 3-95. Clutch Disc Aligning Spacer (HD-45654)

8. See Figure 3-95. Insert CLUTCH DISC ALIGNING SPACER (HD-45654) from the primary gear side.

Figure 3-96. Insert Clutch Pack in Clutch Basket

9. See Figure 3-96. Align friction plate ears so clutch pack assembly drops into clutch basket under its own weight.

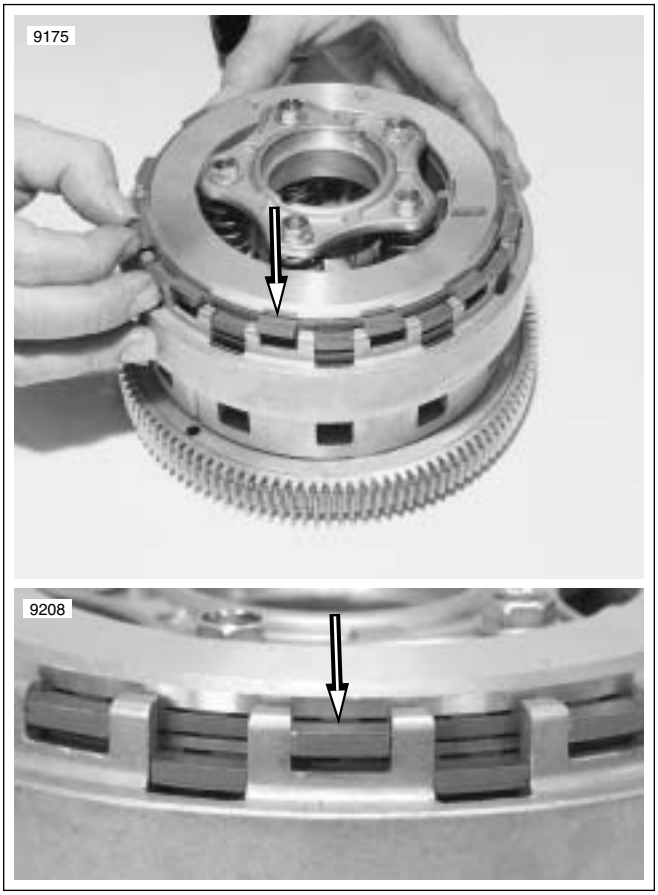


Figure 3-97. Align Friction Plates

10. See Figure 3-97. Top friction plate must be indexed to fit in the top slot of the clutch basket.

Figure 3-98. Spring Screws

11. See Figure 3-98. Using a crisscross pattern, tighten five spring screws to 9.7 Nm (86 **in-lbs**).

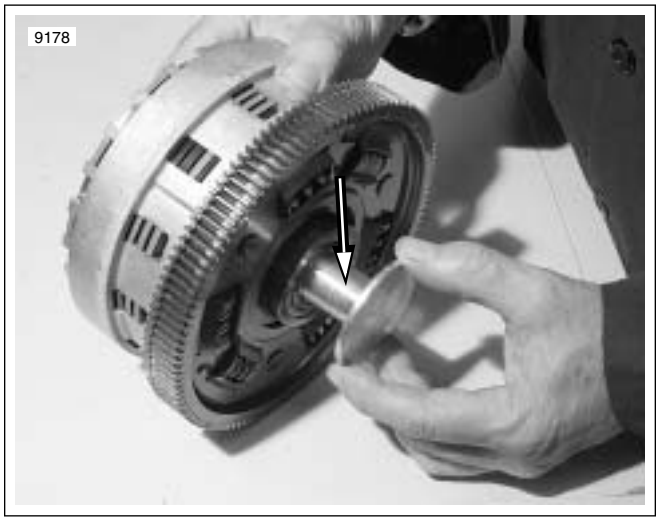


Figure 3-99. Remove Tool HD-45654

12. See Figure 3-99. Remove CLUTCH DISC ALIGNING SPACER (HD-45654).

INSTALLATION

1. See Figure 3-100. Separate clutch pack from the clutch basket.
2. See Figure 3-101. Check position of thrust washer.

NOTE

The tapered side of the thrust washer must be on the crankcase side.

3. See Figure 3-102. Slide clutch basket on to the input shaft.

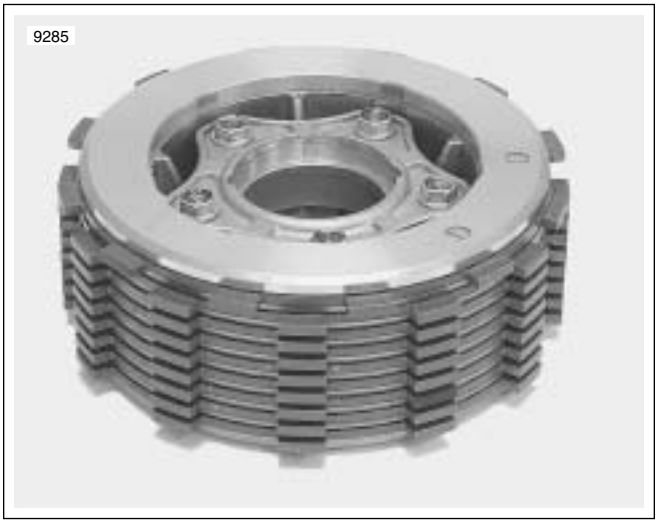


Figure 3-100. Clutch Pack

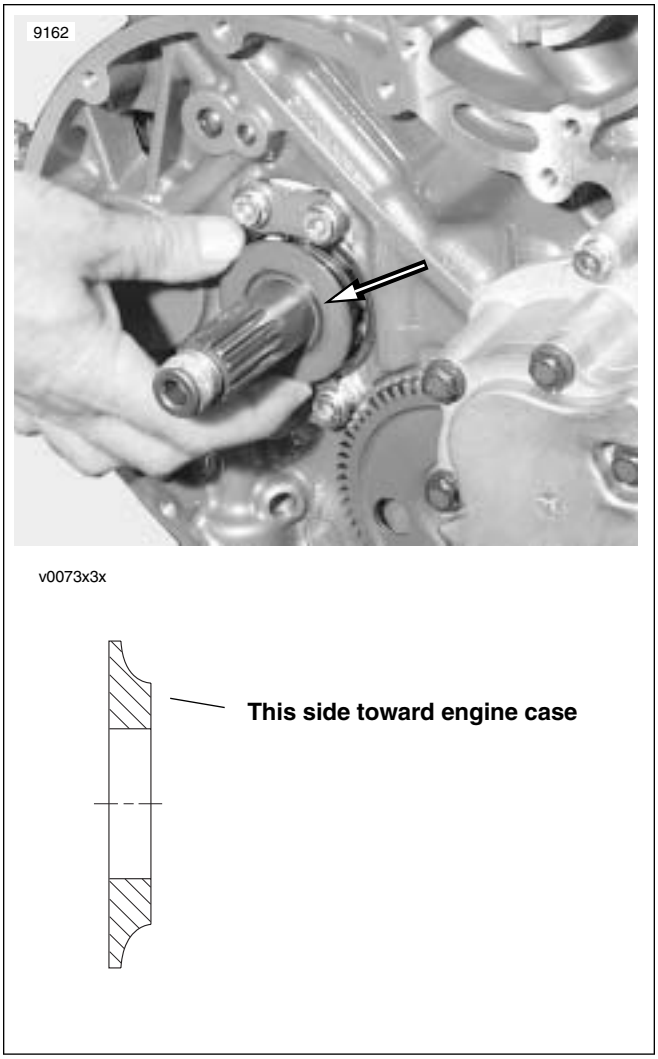


Figure 3-101. Thrust Washer Position

Figure 3-102. Clutch Basket

4. See Figure 3-103. Clutch basket will not go completely into position until the spring loaded backlash gear is aligned. Use a suitable drift pin in hole to align backlash gear.

5. See Figure 3-104. Slide clutch pack into clutch housing. It may be necessary to rotate input shaft to align splines of shaft and outer hub.

6. See Figure 3-78. Install CLUTCH HUB HOLDER (HD-45318). The clutch hub holder can only be installed in one position. The engine case dowel pin must match the hole in the tool.

CAUTION

DO NOT ROTATE ENGINE CLOCKWISE. This is opposite the normal engine operation. Engine damage may result.

7. See Figure 3-79. If necessary, rotate engine slightly to properly engage the clutch hub.

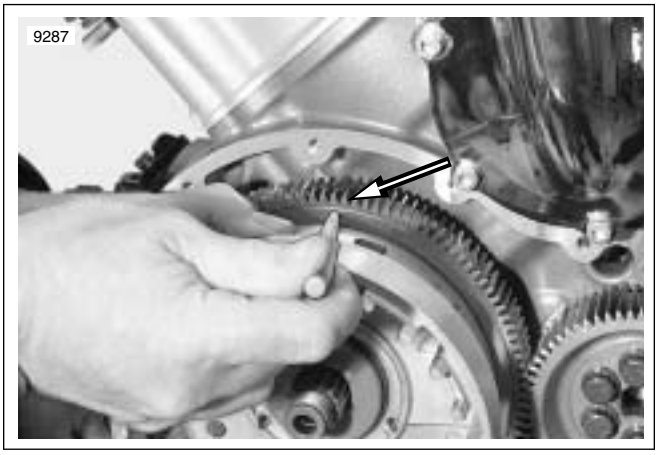


Figure 3-103. Back Lash Gear Alignment

Figure 3-104. Install Clutch Pack

NOTE

*Clutch hub nut is one-time-use only. Always use a **new** nut for assembly.*

8. See Figure 3-105. Install a **new** clutch hub nut and tighten to 220 Nm (162 ft-lbs).

WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

9. Install **new** clutch hub retaining ring.
10. Install oil retaining ring.
11. Install lifter guide and retaining ring.

NOTE

Install Gasket alignment Dowels (HD-45340) to aid in cover installation.

12. See Figure 3-106. Install clutch side crankcase cover. Tighten fasteners in sequence to 9.7 Nm (86 **in-lbs**).
13. Press secondary clutch actuator into its mounting flange on crankcase cover. Install fasteners and tighten to 10 Nm (89 **in-lbs**).
14. Install secondary clutch actuator cover. Tighten to 6-10 Nm (53-89 **in-lbs**).

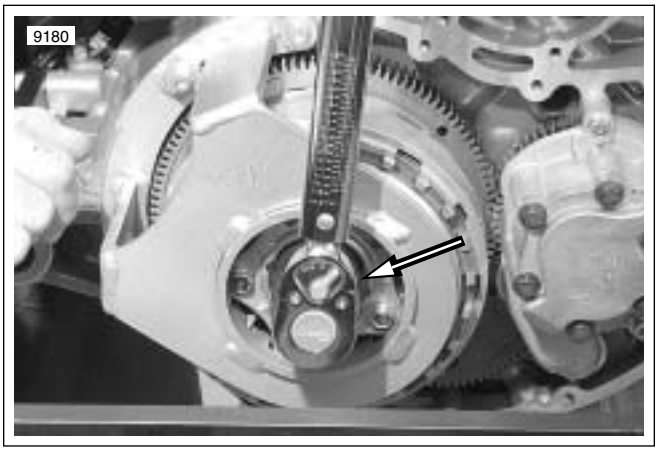


Figure 3-105. Tighten Clutch Hub Nut

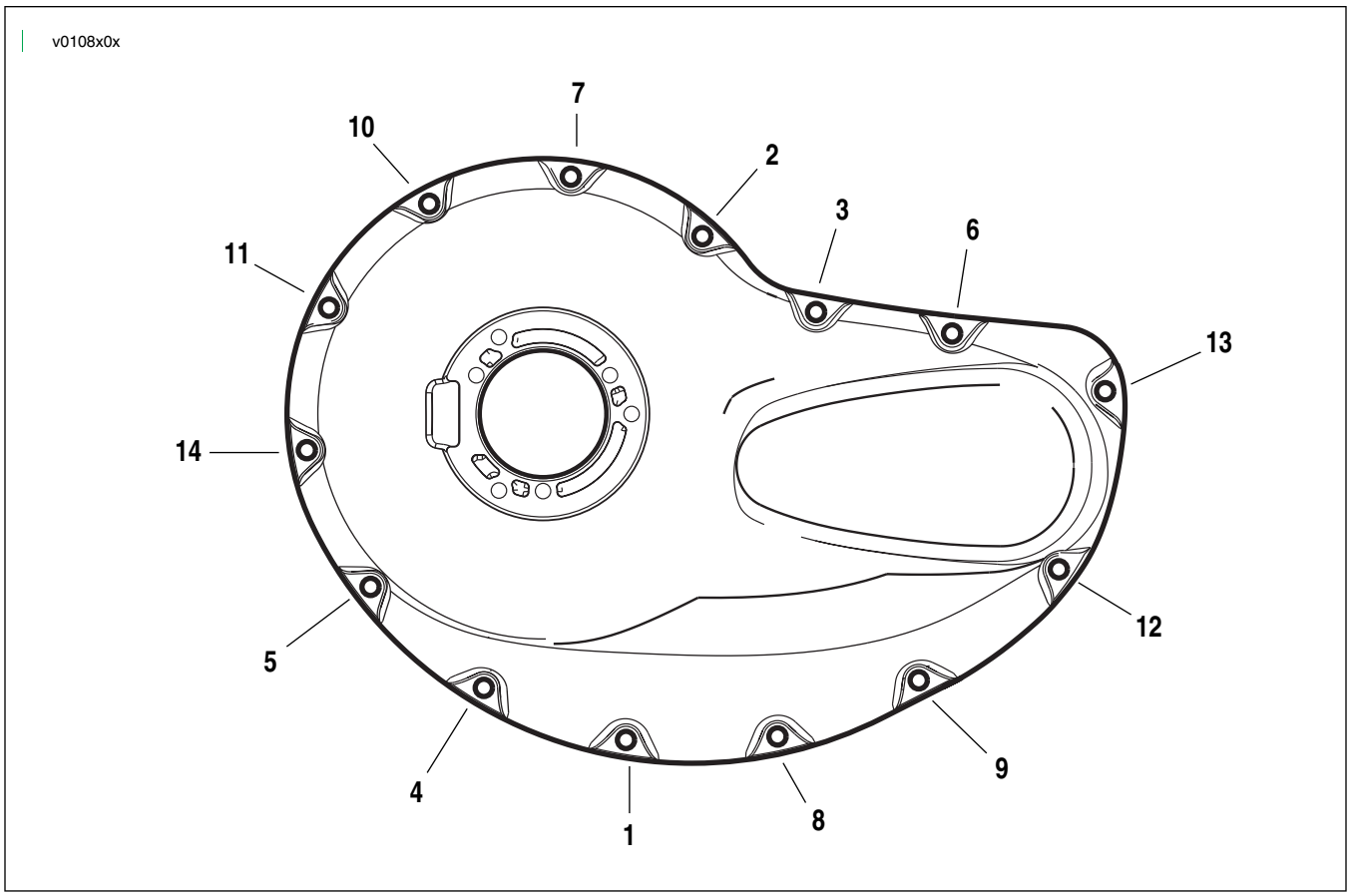


Figure 3-106. Clutch Side Crankcase Cover Torque Sequence @ 9.7 Nm (86 in-lbs)

DISASSEMBLY

PART NO.	SPECIALTY TOOL
HD-45304	Alternator stator cover remover/installer tool
HD-45340	Gasket alignment dowels
HD-45301	Transmission assembly retainer tool

1. Remove inspection cover.
2. See Figure 3-107. Remove the 14 fasteners on the alternator cover in reverse order of torque sequence.
3. Install GASKET ALIGNMENT DOWELS (HD-45340) in two of the alternator cover holes to steady the cover as it is removed.
4. See Figure 3-108. Using the inspection cover fasteners, position the ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL (HD-45304) as shown.
5. See Figure 3-109. Remove the alternator cover.
6. See Figure 3-106. Remove the clutch side crankcase cover fasteners in reverse order of torque sequence.
7. See Figure 3-110. Remove the clutch cover.
8. See Figure 3-111. Remove clutch assembly. See 3.13 CLUTCH.

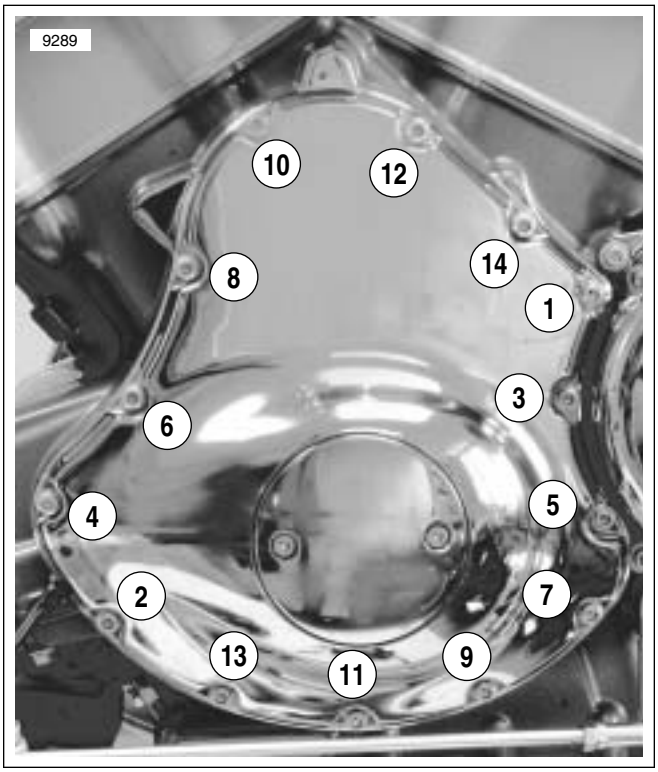


Figure 3-107. Alternator Cover Torque Sequence

Figure 3-108. Position Tool HD-45304

Figure 3-109. Remove Alternator Cover

Figure 3-110. Remove Clutch Cover

Figure 3-111. Remove Clutch Assembly

Figure 3-112. Oil Pump

9. See Figure 3-112. Remove three fasteners holding oil pump in case.
10. Using a 1/2 in. drive extension and breaker bar, rotate engine clockwise until timing marks are aligned.

CAUTION

Do not use COUNTERBALANCE ALIGNMENT PIN to remove or tighten counterbalancer faster. Pin can bend and bind in hole.

11. See Figure 3-113. Hold crankshaft with 1/2 in. drive extension and wrench to loosen counterbalancer drive gear fastener. The gear and fastener can be left in place or removed.

NOTES

- *The counterbalancer gear fastener can only be broken loose before the case halves are separated and the crankshaft is still in place.*
- *If the alternator rotor is to be removed from the crankshaft, the rotor fastener can be broken loose while holding the crankshaft drive gear with a 1/2 in. drive extension and wrench.*
- *If the starter limiter gear is to be removed, the starter limiter fastener can be broken loose while holding the crankshaft drive gear with a 1/2 in. drive extension and wrench.*
- *If the cam drive is to be removed as part of top end disassembly, break loose the cam drive triple sprocket while holding the crankshaft drive gear with a 1/2 in. extension and wrench.*

12. See Figure 3-114. Carefully invert engine. Remove oil pan. Note position of engine ground cable for assembly.
13. See Figure 3-115. Remove oil pickup and gasket/baffle.

Figure 3-113. Crank Held to Loosen Fastener

Figure 3-114. Oil Pan Removal

Figure 3-115. Oil Pickup

14. See Figure 3-116. Loosen, but do not remove, the input bearing retainer fasteners.
15. See Figure 3-117. Install TRANSMISSION ASSEMBLY RETAINER TOOL (HD-45301) on the input shaft.
16. See Figure 3-118. Loosen all four output shaft seal retainer fasteners. Remove the two fasteners from the upper case, leaving the loosened lower case fasteners in place. These fasteners will keep the transmission positioned in the lower crankcase.
17. See Figure 3-119. Remove the 19 case fasteners by first loosening each fastener 1/4 turn in reverse order of torque sequence to slowly relieve torque stress. Once all fasteners have been loosened 1/4 turn then they may be removed in the reverse order of torque sequence.
18. Carefully separate the case halves. Use of a rubber mallet may be necessary to loosen the sealed case halves.

CAUTION

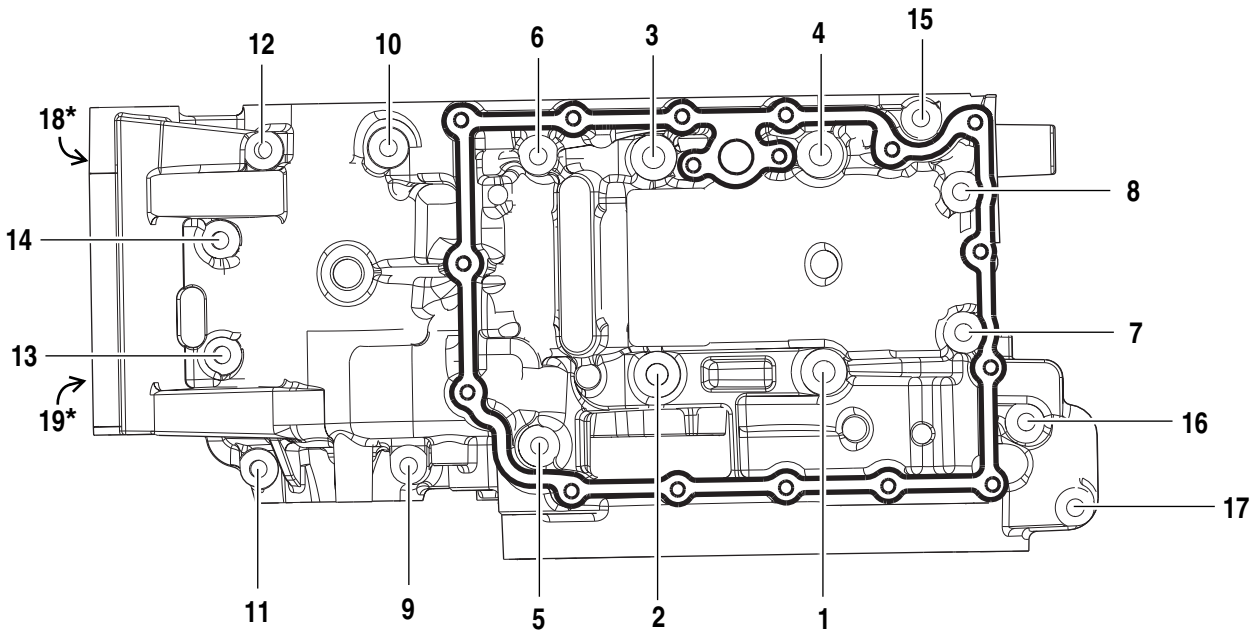
Do not pry on sealing surfaces to separate case halves. Engine damage and/or case leaks may result.

Figure 3-116. Input Bearing Retainer

Figure 3-117. Input Shaft Retainer

Figure 3-118. Drive Sprocket Flange Seal Retainer

v0053x3x



1. M10x150 (Part No. 968M)
2. M10x150 (Part No. 968M)
3. M10x150 (Part No. 968M)
4. M10x150 (Part No. 968M)
5. M8x120 (Part No. 973M)
6. M8x160 (Part No. 972M)
7. M8x90 (Part No. 1025M)
8. M8x90 (Part No. 1025M)
9. M8x120 (Part No. 973M)
10. M8x120 (Part No. 973M)
11. M8x40 (Part No. 970M)
12. M8x90 (Part No. 1025M)
13. M8x40 (Part No. 970M)
14. M8x40 (Part No. 970M)
15. M8x90 (Part No. 1025M)
16. M8x40 (Part No. 970M)
17. M8x40 (Part No. 970M)
18. M8x40 (Part No. 970M) (insert from upper case half)
19. M8x40 (Part No. 970M) (insert from upper case half)

Figure 3-119. Engine Case Torque Sequence

NOTE

Lower case with the transmission gears in place is heavy. Get assistance when lifting lower case.

19. See Figure 3-120. Lift lower case by swing arm pivot housing and oil filter can.

CAUTION

Whenever case halves are separated for service the crankshaft bearings MUST BE REPLACED. Failure to replace bearings will result in engine damage.

20. See Figure 3-121. Remove input shaft. See Figure 3-123. Note the alignment pins (6) on the bearing outer race. If the pins are damaged or missing the bearing must be replaced.

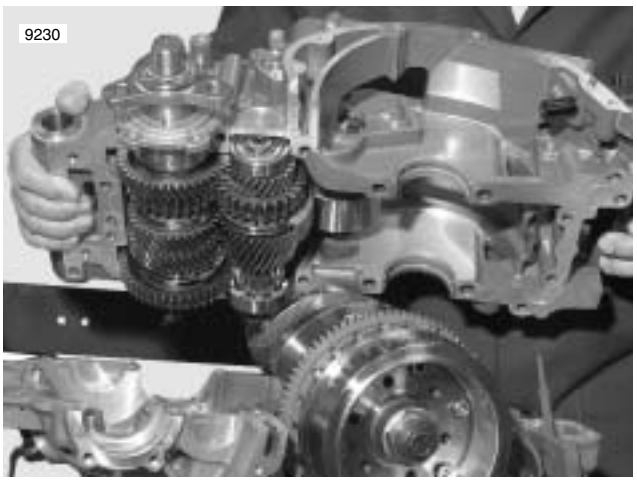


Figure 3-120. Separate Engine Cases

Figure 3-121. Input Shaft

21. Remove two fasteners on drive sprocket flange seal retainer.
22. See Figure 3-122. Remove output shaft.
23. See Figure 3-123. Note the alignment pins (6) on the bearing outer race. If the pins are damaged or missing the bearing must be replaced. See 7.3 OUTPUT SHAFT.

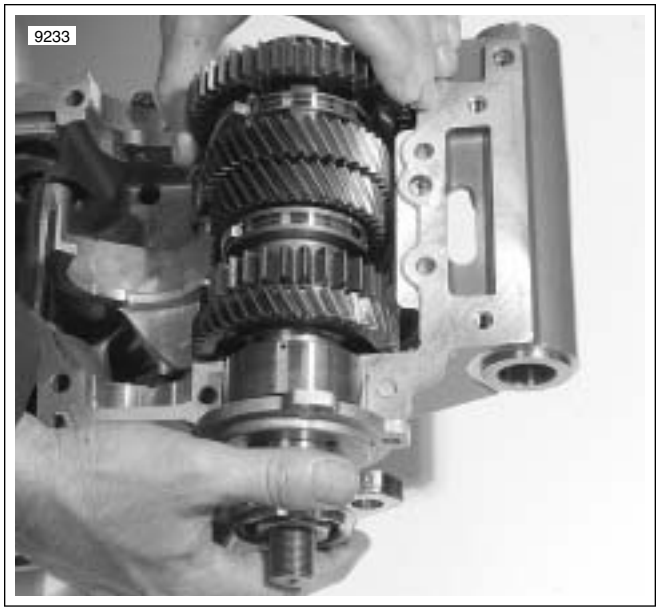
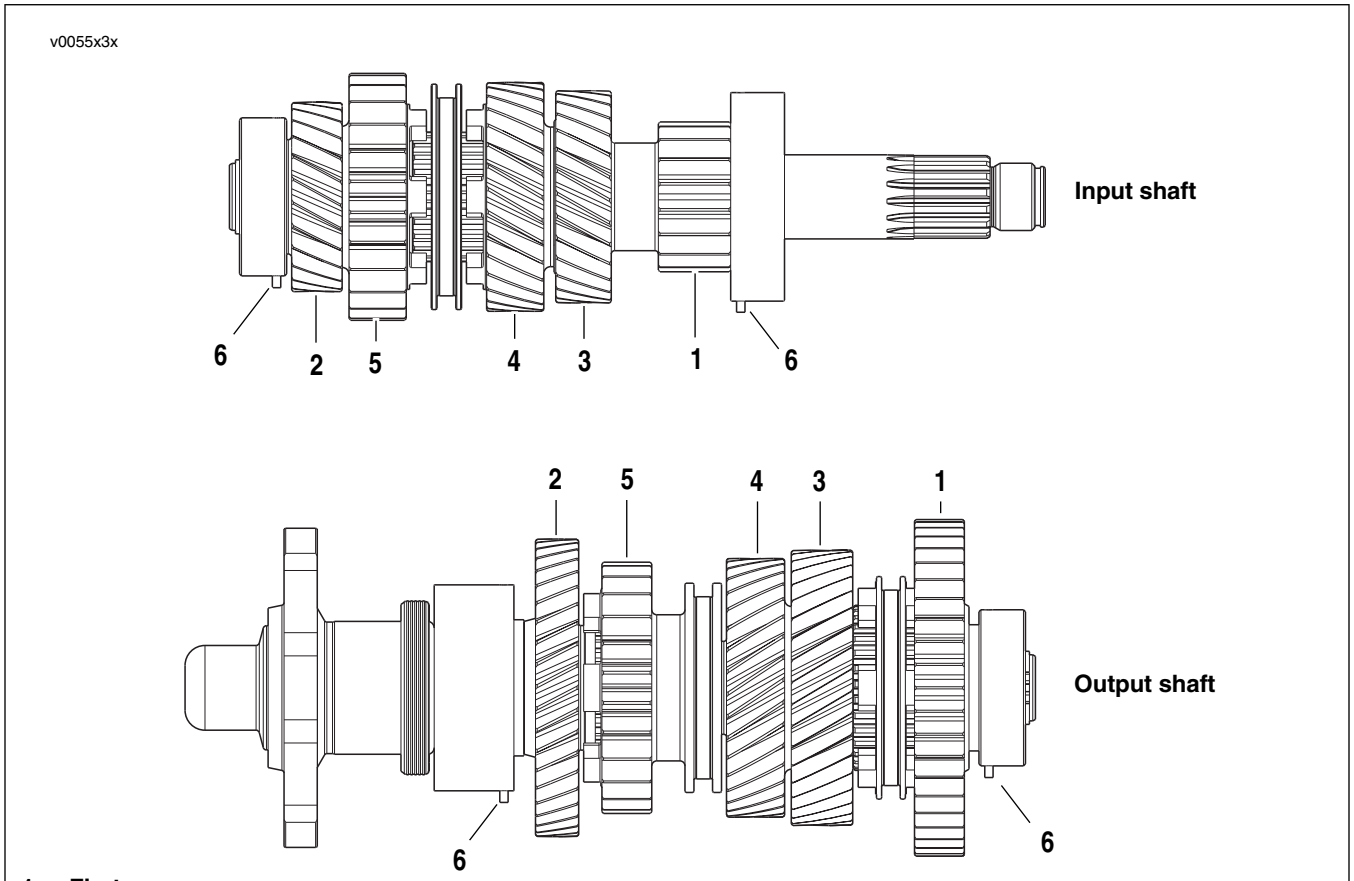


Figure 3-122. Output Shaft



1. **First gear**
2. **Second gear**
3. **Third gear**
4. **Forth gear**
5. **Fifth gear**
6. **Bearing alignment pins**

Figure 3-123. Transmission Input Shaft and Output Shaft Assemblies

Shift Drum Removal

PART NO.	SPECIALTY TOOL
HD-45339	Shift mechanism/detent retractor

1. See Figure 3-124. Remove input shaft bearing retainer to fully expose shifting fork shaft.
2. See Figure 3-125. Remove neutral switch.
3. See Figure 3-126. Using a drift pin, pull shifter fork shaft to edge of case to free shifter forks.

CAUTION

Shafts in the transmission are closely toleranced. Insertion of shafts must be done by hand. NEVER use a hammer or other tool to remove or install shafts. Transmission damage will result if force is used to insert shafts.

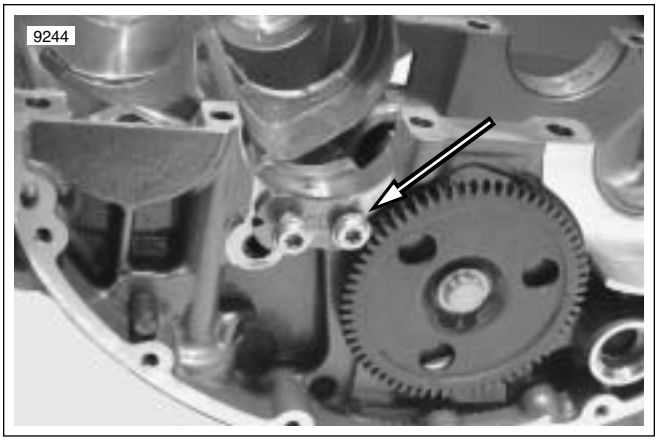


Figure 3-124. Input Shaft Bearing Retainer

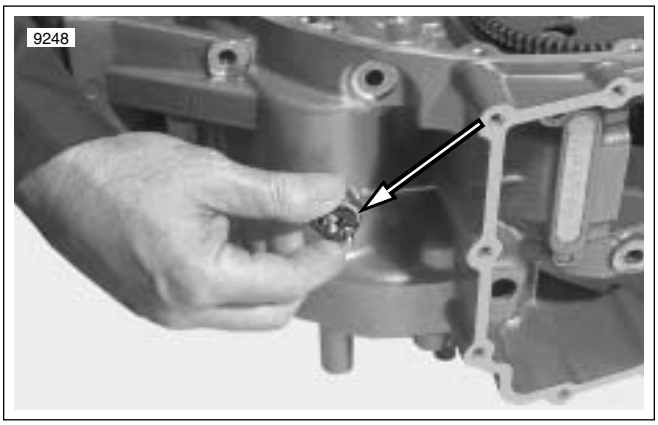


Figure 3-125. Neutral Switch

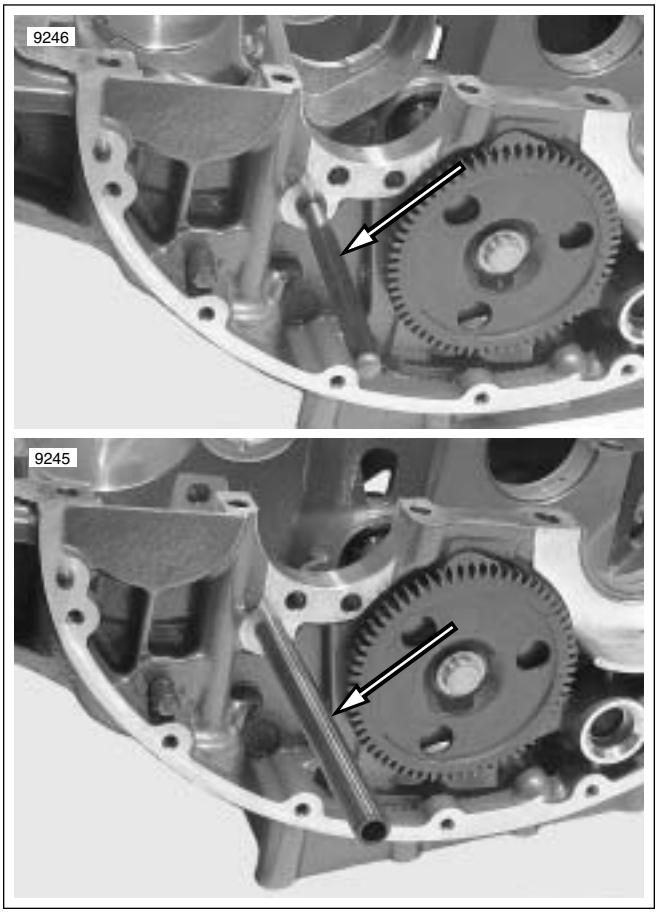


Figure 3-126. Shifter Fork Shaft

4. See Figure 3-127. Use the shifter fork shaft to position the SHIFT MECHANISM/DENTENT RETRACTOR (HD-45339).
   a. Engage the shifter gliding part, tighten brass thumb screw to keep gliding part in retracted position.
   b. Push shifter detent arm spring away from shifting drum star wheel. Lock in place with black knurled thumb screw.
   c. Extract shift drum shaft and remove shift drum.

CAUTION

Always compress shifter pawl gliding part before shift drum detent arm moved out of position. Failure to do so could bend or break shift detent arm assembly tab.

NOTE

If the SHIFT MECHANISM/DENTENT RETRACTOR (HD-45339) is positioned correctly the shift drum will rotate freely.

For shift shaft, or shift shaft seal removal, see 3.17 SHIFT SHAFT AND SEAL.

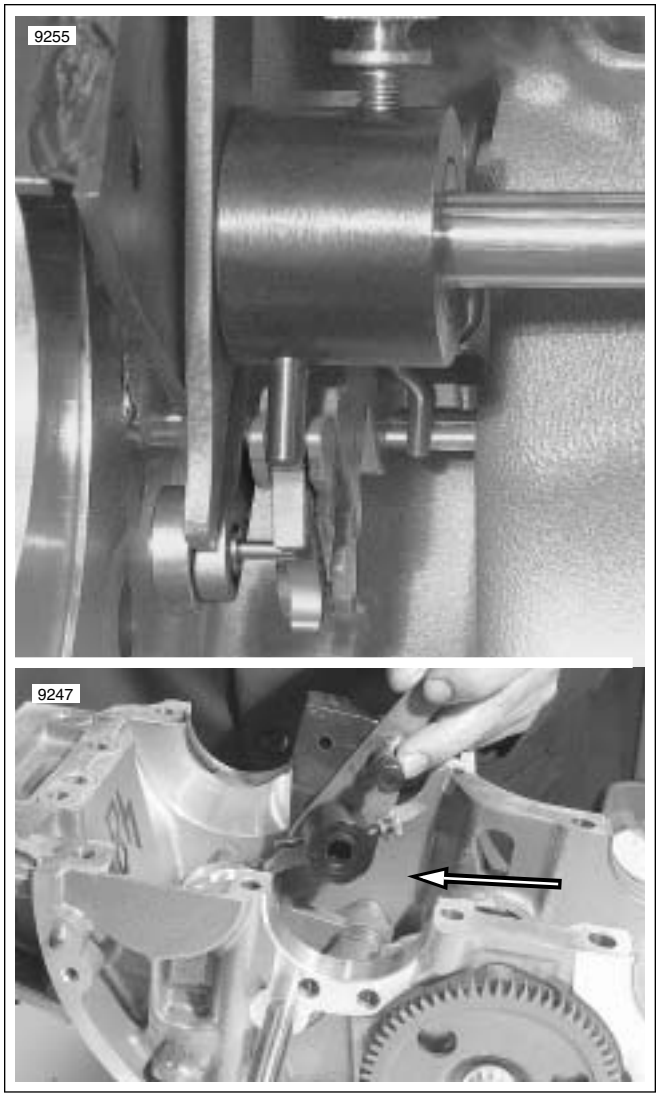


Figure 3-127. Shift Mechanism/Detent Retractor (HD-45339)

ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-45339	Shift mechanism/detent retractor
HD-45338	Shift lever substitute
HD-45301	Transmission assembly retainer
HD-45311	Counterbalance alignment pin
HD-45316	Crankshaft assembly retainer
HD-45306	Crankshaft locking pin
HD-45310	Lower crankshaft alignment dowels

CAUTION

Shafts in the transmission are closely toleranced. Insertion of shafts must be done by hand. NEVER use a hammer or other tool to remove or install shafts. Transmission damage will result if force is used to insert shafts.

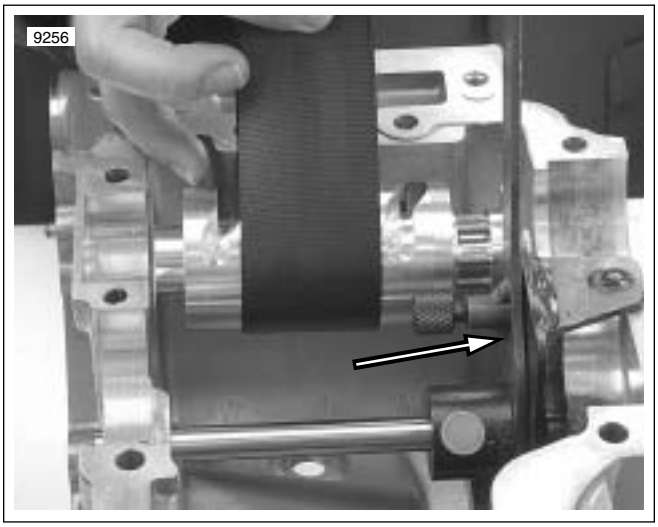


Figure 3-128. Position Shift Drum

1. See Figure 3-128. Use SHIFT MECHANISM/DENTENT RETRACTOR (HD-45339) in reverse of disassembly to compress shifter gliding part and to compress shifting detent arm and spring. Using the nylon strap from the SHIFT MECHANISM/DETENT RETRACTOR (HD-45339), lower the shift drum in place and insert the shift drum shaft.
2. See Figure 3-129. Insert shifter fork shaft through engine case and slide shifter forks in position.
3. See Figure 3-130. Shifter forks must be positioned as shown.
4. See Figure 3-131. Install input shaft bearing retainer loosely in place.

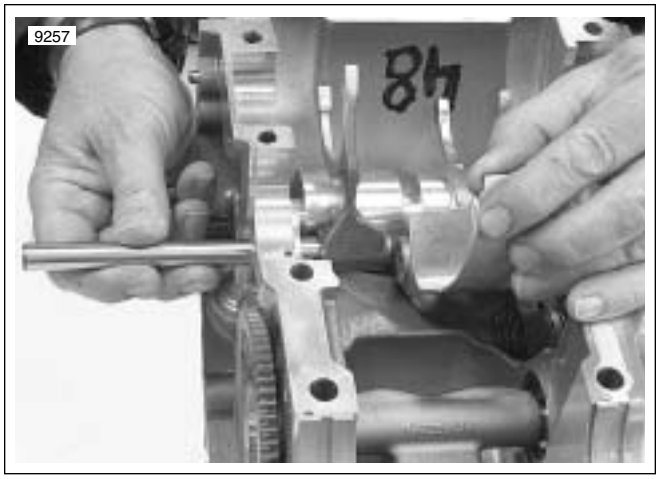


Figure 3-129. Shifter Fork Shaft Installation

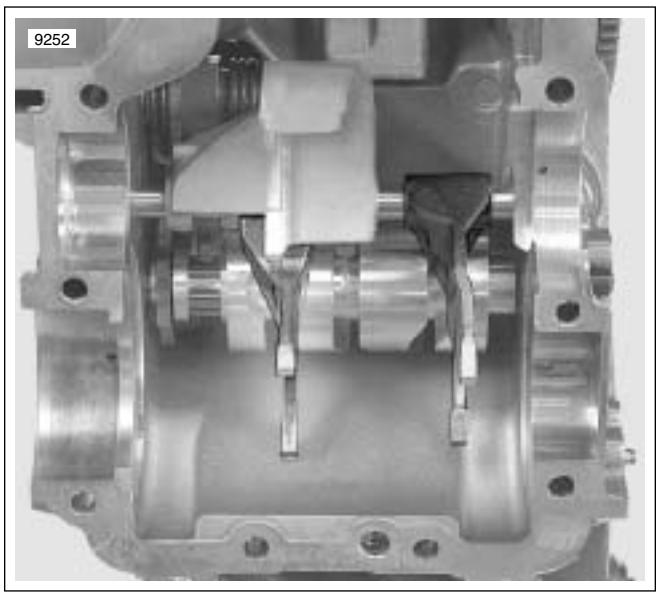


Figure 3-130. Shifter Fork Orientation

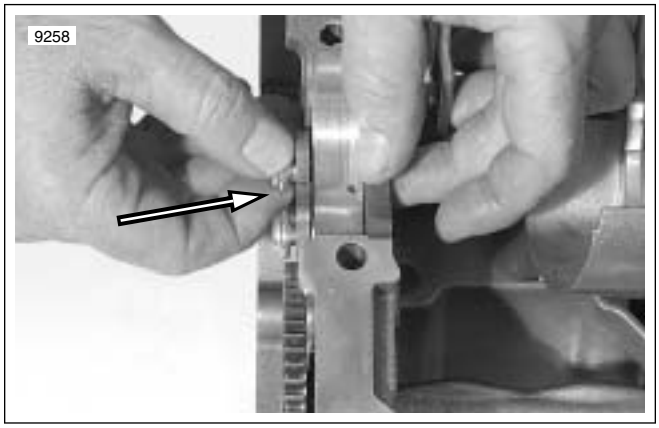


Figure 3-131. Input Shaft Bearing Retainer

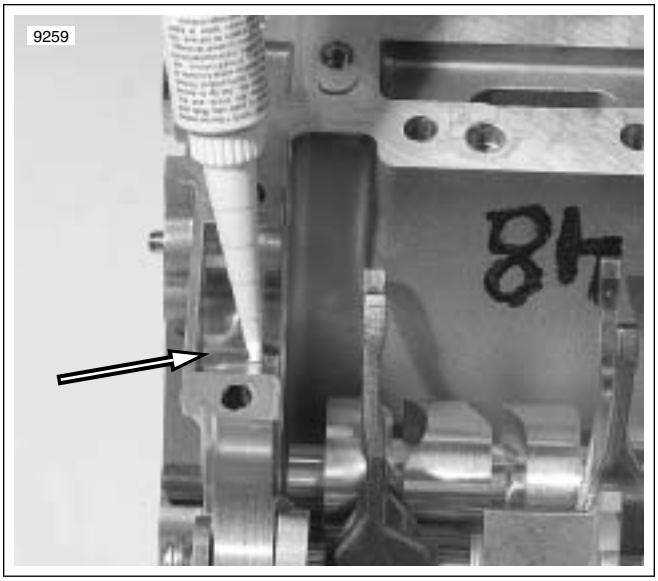


Figure 3-132. Locating Pin Hole

5. See Figure 3-132. A SMALL dab of RTV VRSC crankcase sealer around the output bearing locating pin hole will help to keep bearing from dropping during assembly. THIS IS ONLY DONE ON THE OUTPUT SHAFT FIRST GEAR BEARING.

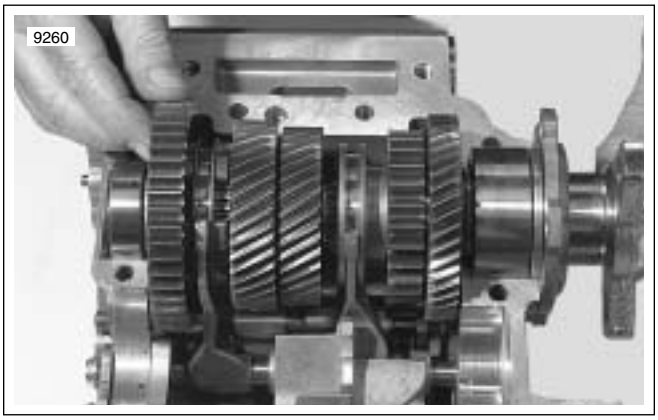


Figure 3-133. Output Shaft

CAUTION

Attempting to assemble engine without the bearing locating pins in the correct position, will cause engine damage.

6. See Figure 3-133. and Figure 3-123. Carefully lower output shaft into case. Inspect to be certain that the alignment pins (6) on the bearing outer race are in the case holes.

NOTE

Output shaft will turn freely when it is in the correct position.

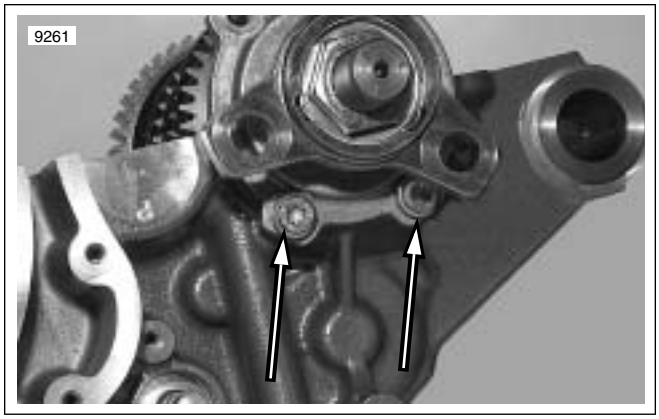


Figure 3-134. Output Shaft Seal Retainer

7. See Figure 3-134. Install two upper case fasteners in drive sprocket seal retainer.

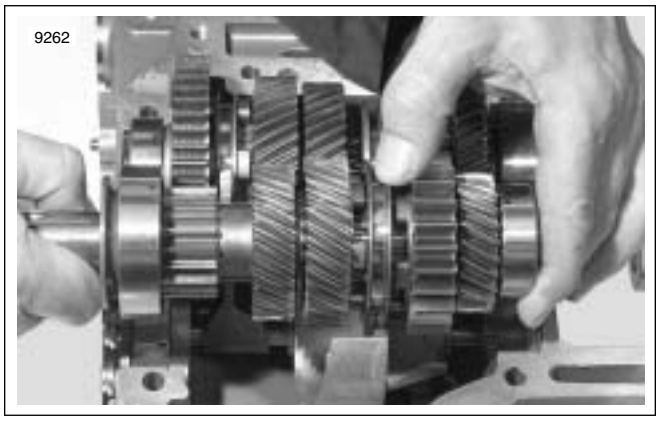


Figure 3-135. Input Shaft

CAUTION

Attempting to assemble engine without the bearing locating pins in the correct position, will cause engine damage.

8. See Figure 3-135. and Figure 3-123. Carefully lower input shaft into case. Inspect to be certain that the alignment pins (6) on the bearing outer race are in the case holes and shifting forks are in the correct location.

9. Use SHIFT LEVER SUBSTITUTE (HD-45338) to dry shift transmission while rotating input and output shaft. Make sure transmission shifts through all gears correctly.

10. Install neutral switch. See 8.25 NEUTRAL SWITCH.

Figure 3-136. Retain Input Shaft

11. See Figure 3-136. Install TRANSMISSION ASSEMBLY RETAINER (HD-45301) on input shaft as shown.

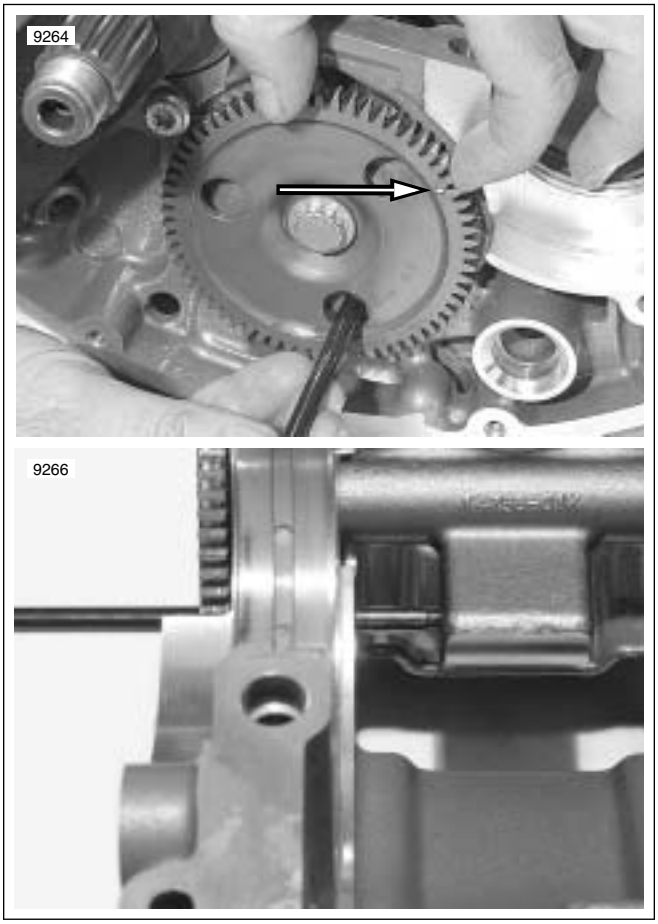


Figure 3-137. Counterbalancer Alignment

12. See Figure 3-137. Install COUNTERBALANCER ALIGNMENT PIN (HD-45311). With the alignment mark in the 2 o'clock position, the case hole and the index hole in the counterbalancer will align.

NOTE

Crankshaft bearings must be replaced every time the cases are split for service. If the cam drive is not being serviced, crankshaft bearings can be replaced without removing the cam drive chain.

13. Replace the crankshaft bearings at this time. See 3.16 CRANKSHAFT BEARING REPLACEMENT.
14. See Figure 3-138. Lubricate crankshaft bearing surfaces, input and output shaft and counterbalancer bearings with Harley-Davidson Motorcycle Oil 20W50. Use Lubriplate No. 105 Assembly Grease (NAPA™ Part No. 765-2651) on bearing shells.

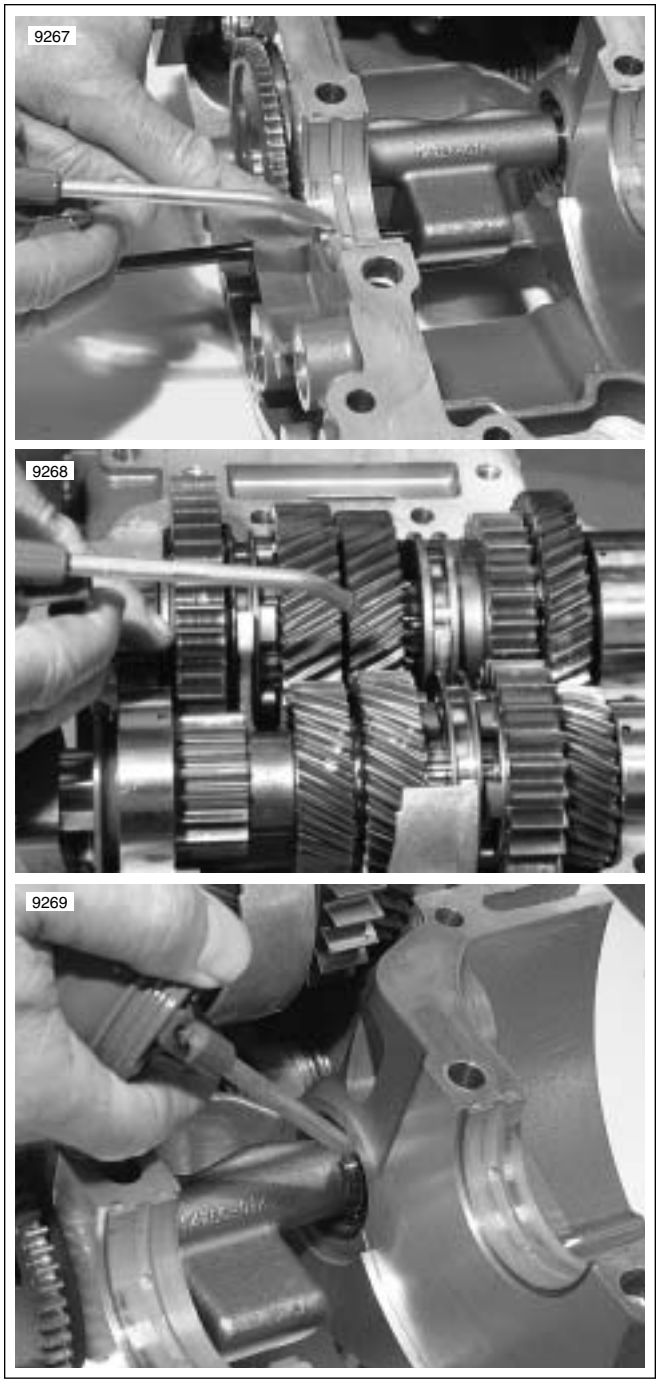


Figure 3-138. Pre-Assembly Lubrication

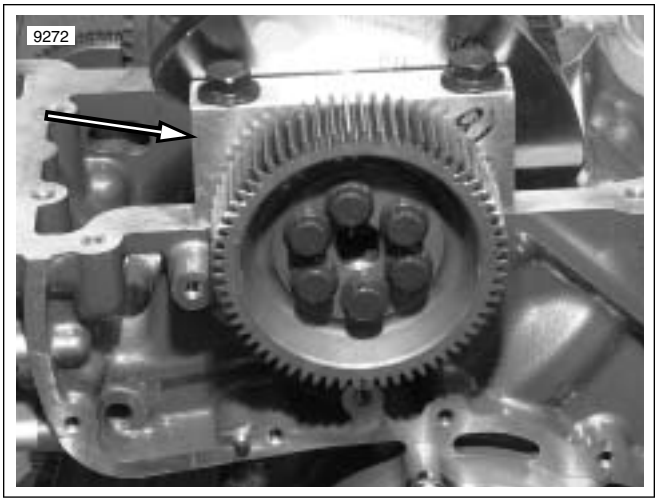


Figure 3-139. Retain Crankshaft Thrust Bearing

15. See Figure 3-139. If engine was not at TDC, position the CRANKSHAFT ASSEMBLY RETAINER (HD-45316) to hold crankshaft thrust bearing half in place while attaining TDC.

CAUTION

DO NOT ROTATE ENGINE CLOCKWISE. This is opposite the normal engine operation. Engine damage may result.

Figure 3-140. Crankshaft Locking Pin (HD-45306)

16. See Figure 3-140. Position the crankshaft assembly at TDC and insert the CRANKSHAFT LOCKING PIN (HD-45306).

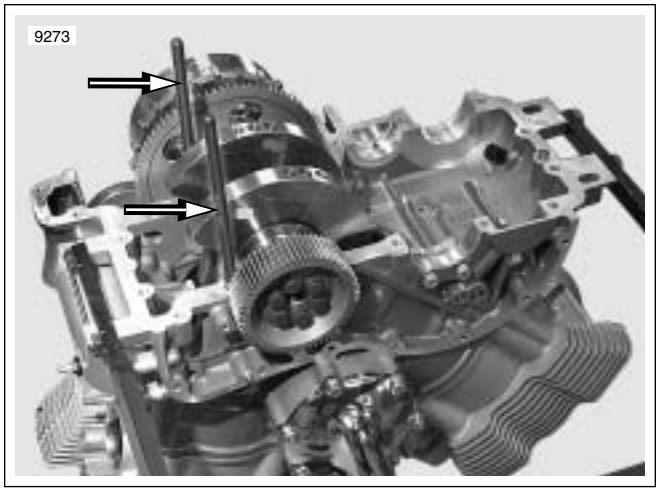


Figure 3-141. Lower Crankcase Alignment Dowels (HD-45310)

17. See Figure 3-141. Install LOWER CRANKCASE ALIGNMENT DOWELS (HD-45310).

NOTE

If dipstick has not been removed, do so at this time.

18. See Figure 3-131. Check that upper crankcase input bearing retainer is loosely in position.

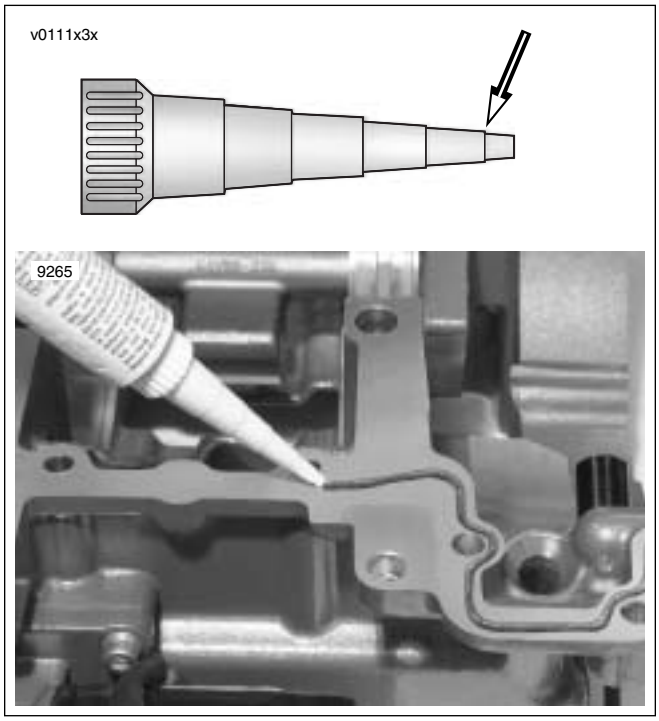


Figure 3-142. Apply Sealant

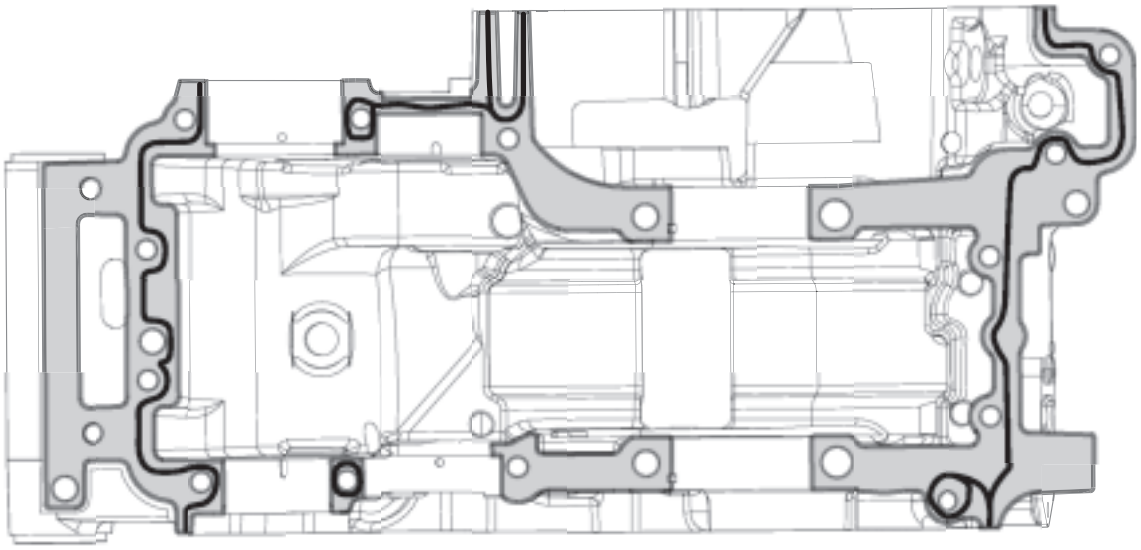
19. See Figure 3-142. See Figure 3-143. Cut VRSC CRANKCASE SEALANT (Part No. 99650-02) applicator tip at first step.

CAUTION

Excess VRSC Crankcase Sealant squeezed into the crankcases during assembly can clog the oil pick up.

20. Adjust speed and pressure to apply a 1 mm (0.04 in.) bead of sealant to the lower case half.

v0054x3x



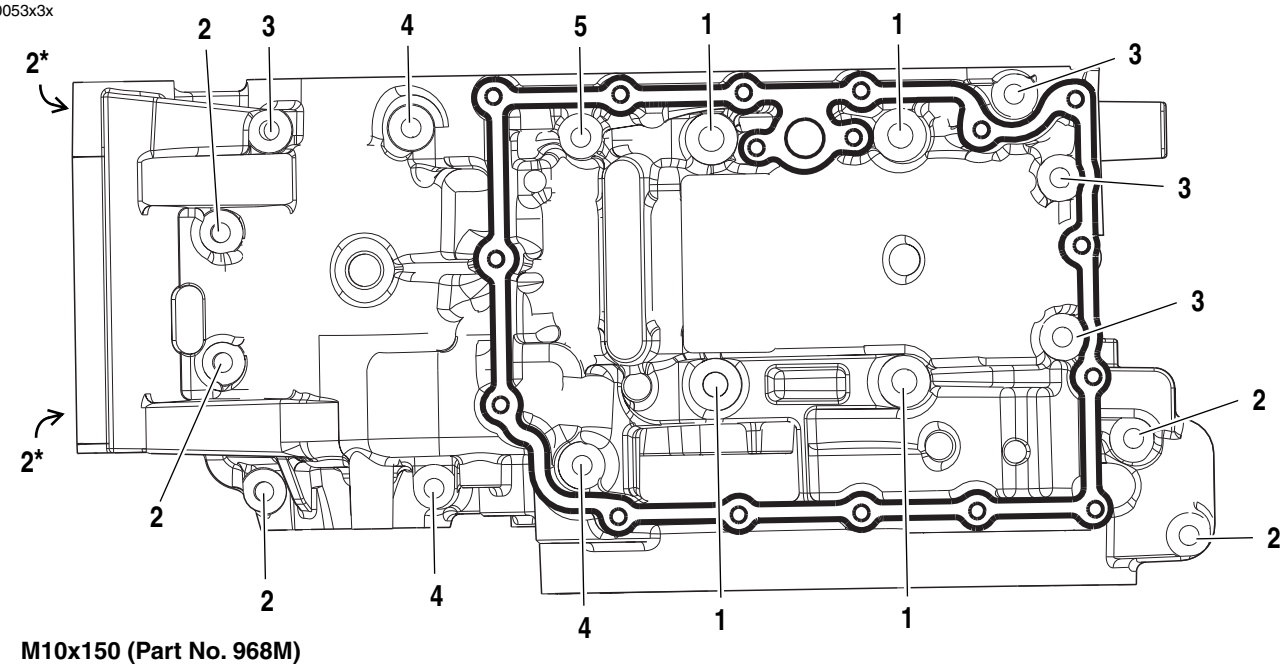
Carefully clean case mating surfaces (gray shaded area).

Apply 1 mm (0.04 in.) VRSC Crankcase Sealant (HD-99650-02) following black line.

Apply sealant only as indicated - DO NOT seal all mating surfaces.

Figure 3-143. Lower Case Sealant Path

v0053x3x



1. **M10x150 (Part No. 968M)**
2. **M8x40 (Part No. 970M)**
3. **M8x90 (Part No. 1025M)**
4. **M8x120 (Part No. 973M)**
5. **M8x160 (Part No. 972M)**

* **Insert from upper case half**

Figure 3-144. Case Fastener Sizes

NOTE

Lower case with the transmission gears in place is heavy. Get assistance when lifting lower case.

21. See Figure 3-145. Position lower case half over the LOWER CRANKCASE ALIGNMENT DOWELS (HD-45310).
22. See Figure 3-146. When the counterbalancer gear and the primary crankshaft gear are close to engagement, remove the COUNTERBALANCER ALIGNMENT PIN (HD-45311).

CAUTION

Confirm the correct alignment of the counterbalancer gear and the primary crankshaft gear timing marks. Engine damage will occur if the counterbalancer gear and the primary crankshaft gear are not correctly timed.

23. See Figure 3-147. Hand position the counterbalancer gear so the timing marks are aligned exactly as shown.
24. See Figure 3-144. Match and thread-in all 19 case fasteners.

Figure 3-145. Lower Case Over Alignment Dowels

Figure 3-146. Lower Case Over Alignment Dowels

Figure 3-147. Marks Aligned

NOTE

The correct torque sequence for the case fasteners requires 2 steps. First, all 19 case fasteners including the 4 main bearing bolts are tighten to 25 Nm (18.4 ft-lbs). Second, the 4 main bearing bolts are backed off one full turn, tightened to 15 Nm and then turned an additional 90°. Use the detailed procedure presented in the following steps. Refer to Table 3-26.

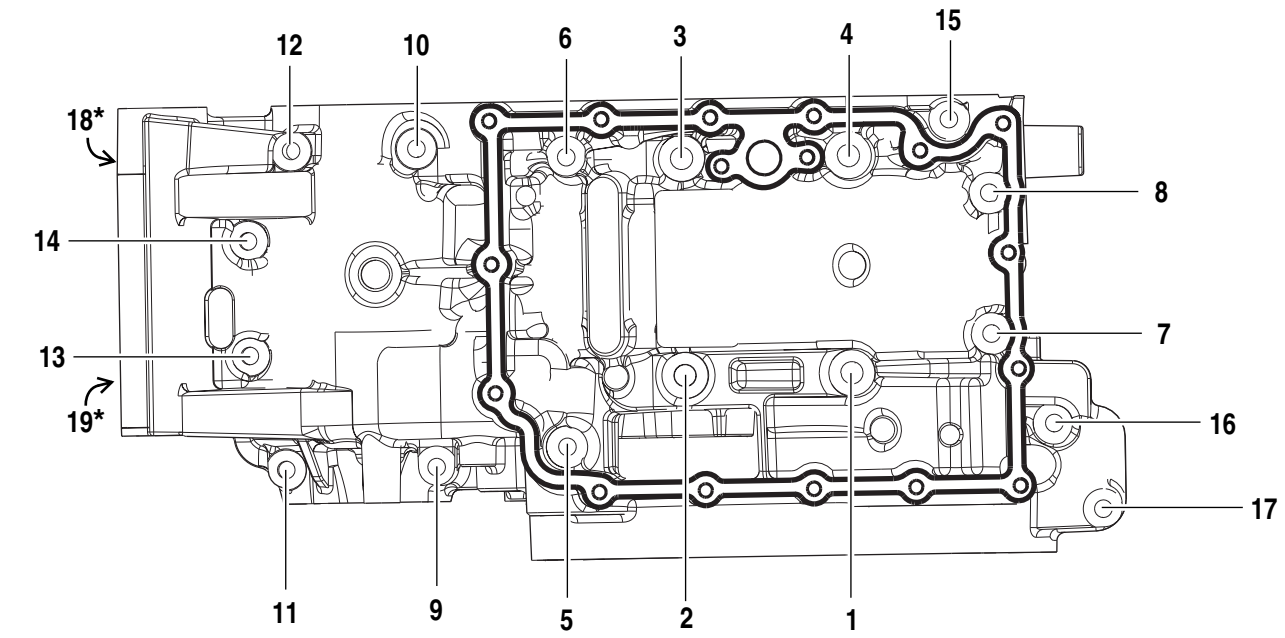
25. See Figure 3-149. Tighten in sequence all 19 case fasteners to 25 Nm (18.4 ft-lbs).
26. Dab a marker next to each torqued fastener as it is tightened.
27. See Figure 3-149. Torque in sequence the 4 M10 x 150 main bearing bolts (1, 2, 3, 4) main bearing bolts in this sequence.
    a. Loosen (counterclockwise) each main bearing bolt (1, 2, 3, 4) one full turn (- 360°).
    b. See Figure 3-149. Torque in sequence each main bearing bolt (1, 2, 3, 4) to 15 Nm (11 ft-lbs).
    c. See Figure 3-148. Position the TORQUE ANGLE GAUGE (Snap-on™ Part No. TA360) per instruction sheet and tighten each bolt an additional quarter turn (+ 90°).

NOTE

The notation for this torque sequence is written: 25 Nm - 360°,15 Nm + 90°.

28. Dab a second mark next to each torqued main bearing bolt to identify which bolts have been tightened with the complete sequence.

Figure 3-148. Torque Angle Gauge



1. **M10x150 (Part No. 968M)**
2. **M10x150 (Part No. 968M)**
3. **M10x150 (Part No. 968M)**
4. **M10x150 (Part No. 968M)**
5. **M8x120 (Part No. 973M)**
6. **M8x160 (Part No. 972M)**
7. **M8x90 (Part No. 1025M)**
8. **M8x90 (Part No. 1025M)**
9. **M8x120 (Part No. 973M)**
10. **M8x120 (Part No. 973M)**
11. **M8x40 (Part No. 970M)**
12. **M8x90 (Part No. 1025M)**
13. **M8x40 (Part No. 970M)**
14. **M8x40 (Part No. 970M)**
15. **M8x90 (Part No. 1025M)**
16. **M8x40 (Part No. 970M)**
17. **M8x40 (Part No. 970M)**
18. **M8x40 (Part No. 970M) (insert from upper case half)**
19. **M8x40 (Part No. 970M) (insert from upper case half)**

Figure 3-149. Engine Case Torque Sequence

Table 3-26. Engine Case Fastener Torque

FASTENER #	TORQUE	
	NM	FT-LBS
1 through 19 (in sequence)	25	18.4
1, 2, 3, 4 (in sequence)	Backoff (-) 360°	
1, 2, 3, 4 (in sequence)	15	11
1, 2, 3, 4 (in sequence)	Tighten (+) 90°	

29. See Figure 3-150. Tighten the upper and lower input bearing retainer fasteners to 23 Nm (17 ft-lbs).
30. See Figure 3-151. Install the lower case two drive sprocket flange seal retainer fasteners and tighten all four drive sprocket flange seal retainer fasteners to 23 Nm (17 ft-lbs).
31. See Figure 3-152. Place **new** oil pan gasket in position. Install oil pickup and fasteners. Tighten to 9.7 Nm (86 **in-lbs**).
32. See Figure 3-153. Install oil pan and fasteners. Tighten to 9.7 Nm (86 **in-lbs**).

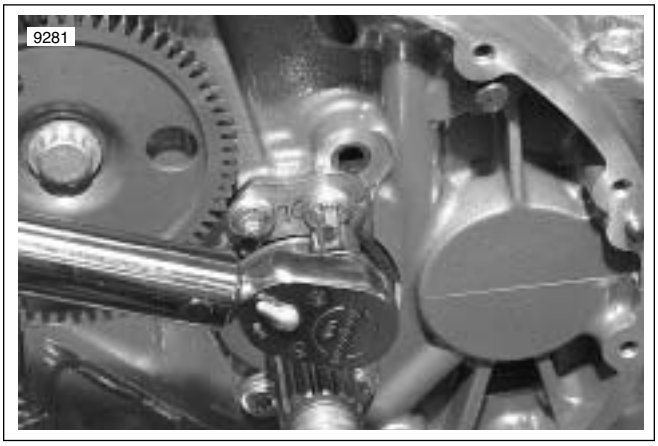


Figure 3-150. Input Bearing Retainer

Figure 3-151. Drive Sprocket Flange Seal Retainer

Figure 3-152. Oil Pickup

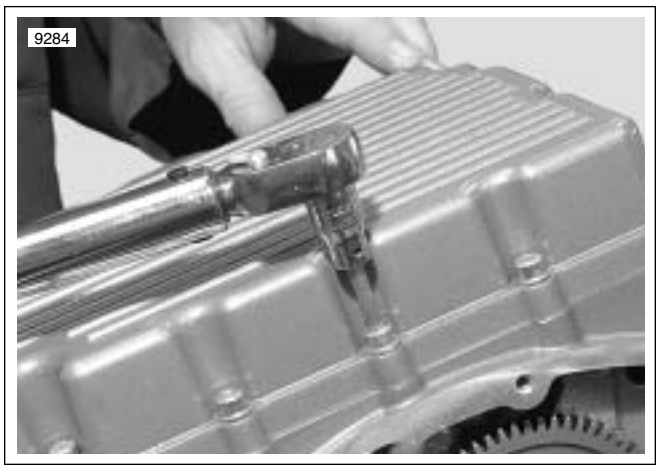


Figure 3-153. Oil Pan

COUNTERBALANCER BEARING REPLACEMENT 3.15

REMOVAL

PART NO.	SPECIALTY TOOL
HD-45311	Counterbalancer alignment pin
HD-45490	Balancer bearing remover/installer tools
HD-46582	Counterbalancer bearing inner race remover and installer
HD-34902-B	End cap only

NOTE

In order to break counterbalancer gear loose, it is necessary to hold the counterbalancer gear with the crankshaft drive gear. Once the fastener is loose, the engine case halves can be separated. See 3.14 UPPER AND LOWER CRANKCASE SERVICE.

1. See Figure 3-154. Before separating the case halves and removing the crankshaft, use a 1/2 in. drive extension and breaker bar to rotate engine clockwise until timing marks are aligned.

CAUTION

Do not use COUNTERBALANCER ALIGNMENT PIN to remove or tighten counterbalancer fastener. Pin can bend and bind in hole.

2. Hold crankshaft with a 1/2 in. drive extension and wrench and loosen counterbalancer gear retaining fastener.

3. See Figure 3-155. Remove fastener and gently pry counterbalancer gear from shaft. Discard gear and fastener.

NOTE

*The counterbalancer gear retaining fastener is one-time-use only. Always use a **new** fastener when installing counterbalancer gear.*

NOTE

Use Snap-on pliers SRPC3890 for removal/installation of the retaining rings.

4. See Figure 3-156. Remove outer retaining ring.

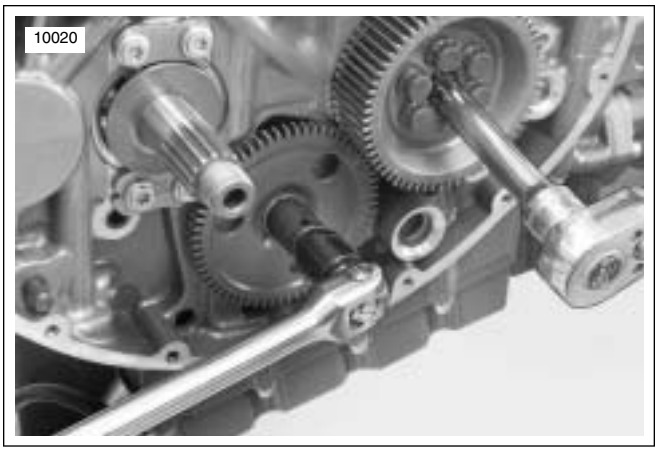


Figure 3-154. Counterbalancer Gear Fastener

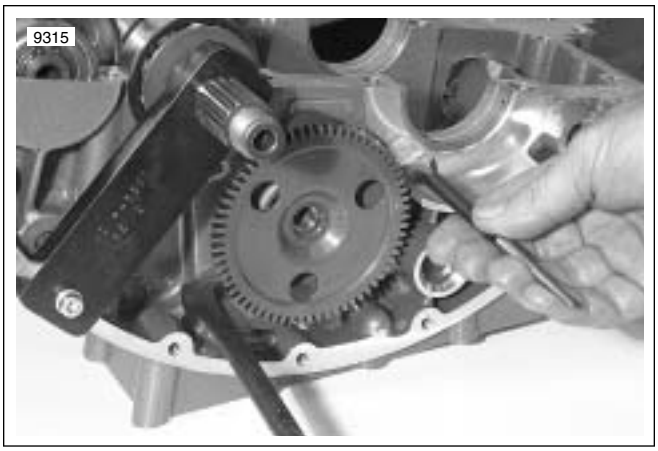


Figure 3-155. Remove Counterbalancer Gear

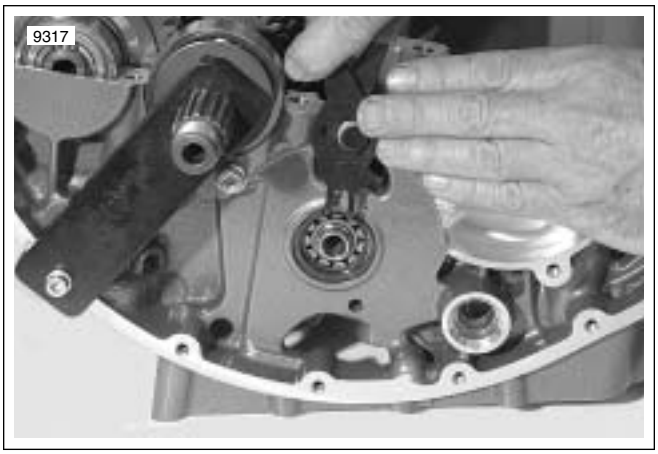


Figure 3-156. Remove Retaining Ring

5. See Figure 3-157. Thread end of BALANCER BEARING REMOVER/INSTALLER TOOLS (HD-45490) into balancer shaft.
6. See Figure 3-158. The counterweight must be rotated and held upright in the position shown to prevent binding against the case. The tool will pull the outboard bearing and balancer through the case. When the bearing is free, remove tool and bearing.
7. See Figure 3-159. Counterbalancer can be removed from engine.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

8. See Figure 3-160. Remove outboard inner retaining ring.

Figure 3-157. Counterbalancer Tool

Figure 3-158. Remove Counterbalancer Outboard Bearing

Figure 3-159. Remove Counterbalancer

Figure 3-160. Outboard Inner Retaining Ring

9. See Figure 3-162. Position the bearing removal insert as shown. Note the position of the flat.
10. See Figure 3-163. Thread puller rod into insert.
11. See Figure 3-164. Hold screw end of puller and turn large nut to remove the bearing.
12. See Figure 3-161. Remove inboard retaining ring.

Figure 3-161. Counterbalancer Inboard Retaining Ring

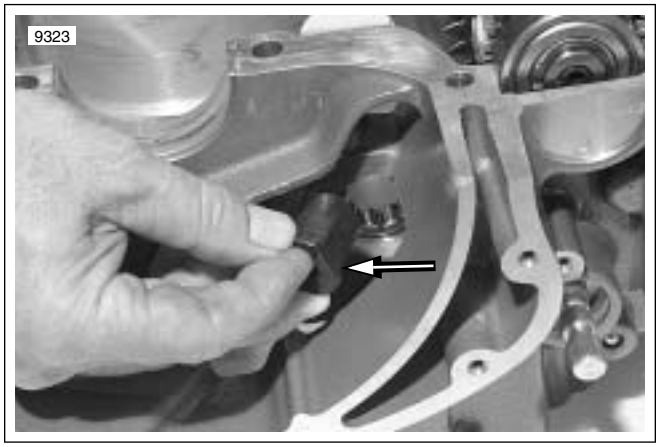


Figure 3-162. Bearing Removal Insert

Figure 3-163. Position Puller

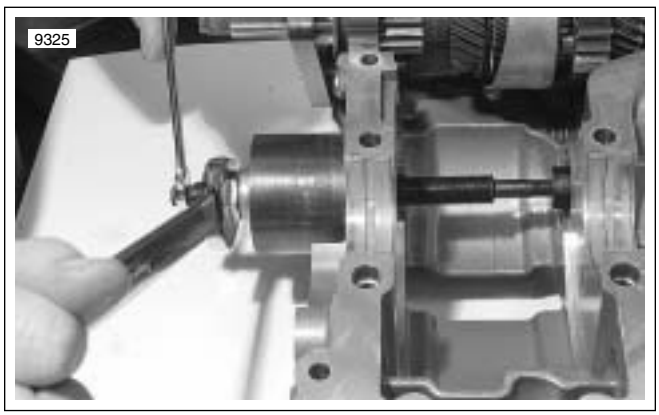


Figure 3-164. Remove Bearing

NOTE

If counterbalancer bearings are being replaced, ALWAYS replace the inner race.

13. See Figure 3-165. Fit the lower half of the COUNTERBALANCER BEARING INNER RACE REMOVER AND INSTALLER (HD-46582) with pin hole over back of inner race. Fit push screw into hole of lower puller half.
14. Position upper puller half around inboard inner bearing race. Slide connecting collar over the halves.
15. See Figure 3-166. Turn push screw to remove inboard bearing inner race.
16. See Figure 3-167. Using an END CAP from HD-34902-B in the outboard end of the counterbalancer shaft, remove the outboard bearing inner race.

Figure 3-165. Counterbalancer Bearing Inner Race Remover and Installer (HD-46582)

Figure 3-166. Remove Bearing Race

Figure 3-167. End Cap from HD-34902-B

INSTALLATION

1. See Figure 3-168. Press **new** inner race of inboard bearing even with the end of the counterbalancer.
2. See Figure 3-169. Press **new** outboard bearing race flush against the shoulder of the balancer.

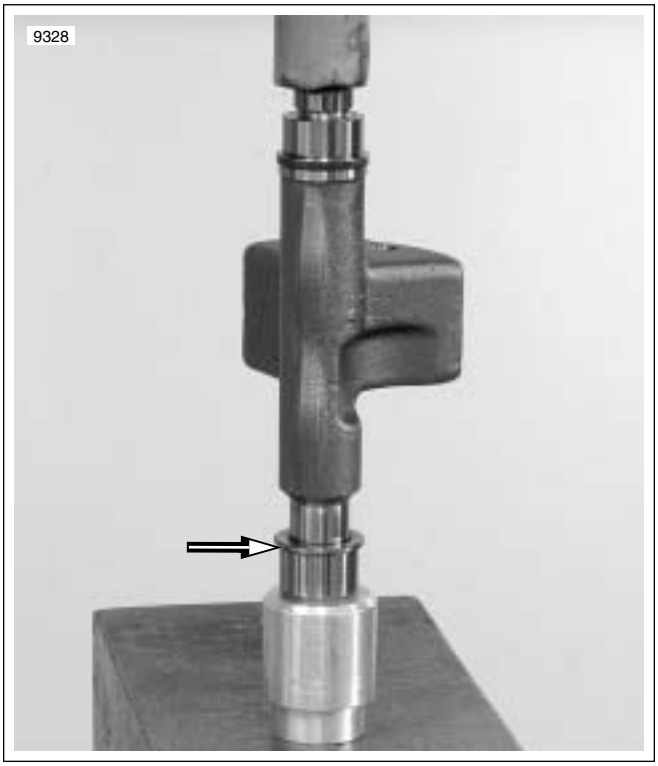


Figure 3-168. Inboard Bearing Race

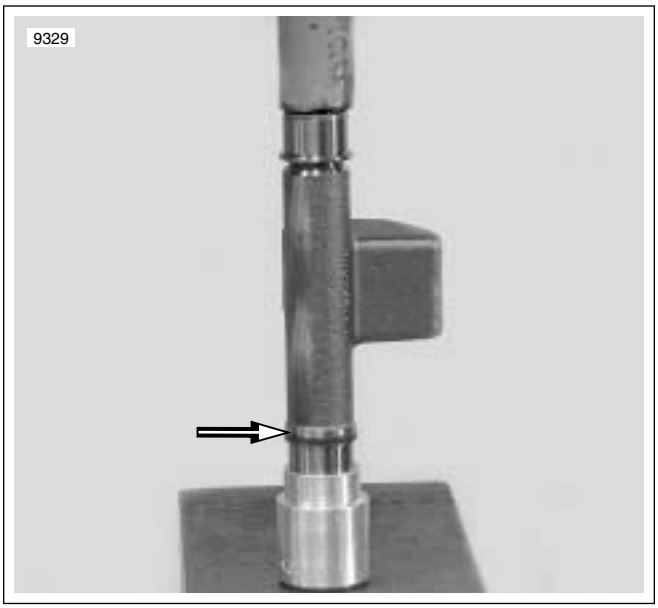


Figure 3-169. Outboard Bearing Race

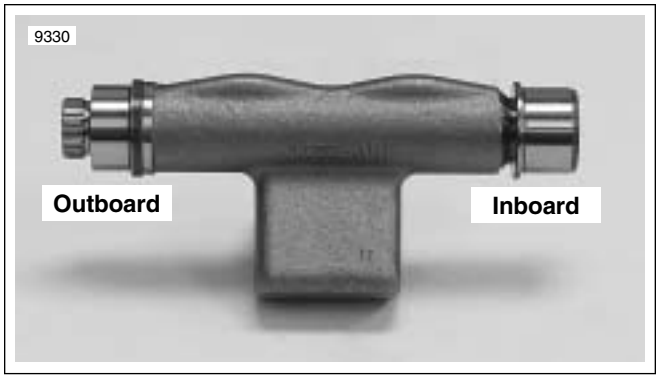


Figure 3-170. Installed Inner Races

3. See Figure 3-170. Inboard bearing race is even with the end of the counterbalancer shaft. Outboard bearing race is fully seated against shoulder of counterbalancer.

NOTE

Use Harley-Davidson Motorcycle Oil 20W50 to thoroughly lubricate bearing surfaces and case bores before bearing installation.

NOTE

When installing bearings, always drive/push against the side of the bearing with the manufactures lettering/part number.

Figure 3-171. Inner Balancer Bearing Installation

4. See Figure 3-171. Using the bearing installer from the BALANCER BEARING REMOVER/INSTALLER TOOLS (HD-45490) drive the inner counterbalancer bearing into the case with a soft faced hammer, until the retaining ring groove is visible.

5. See Figure 3-172. Install inner retaining ring. Be certain retaining ring is fully seated.

6. See Figure 3-173. Install outboard bearing inner retaining ring. Be certain retaining ring is fully seated.

NOTE

Use Harley-Davidson Motorcycle Oil 20W50 to thoroughly lubricate bearing surfaces and case bores before bearing installation process. Use Lubriplate No. 105 Assembly Grease (NAPA Part No. 765-2651) on inner races.

7. See Figure 3-174. Position counterbalancer in case.

NOTE

When installing bearings, always drive/push against the side of the bearing with the manufactures lettering/part number.

8. See Figure 3-175. Start bearing by hand. Insert tapered guide from the BALANCER BEARING REMOVER/INSTALLER TOOLS (HD-45490).

Figure 3-172. Inner Balancer Bearing Installation

Figure 3-173. Outboard Bearing Inner Retaining Ring

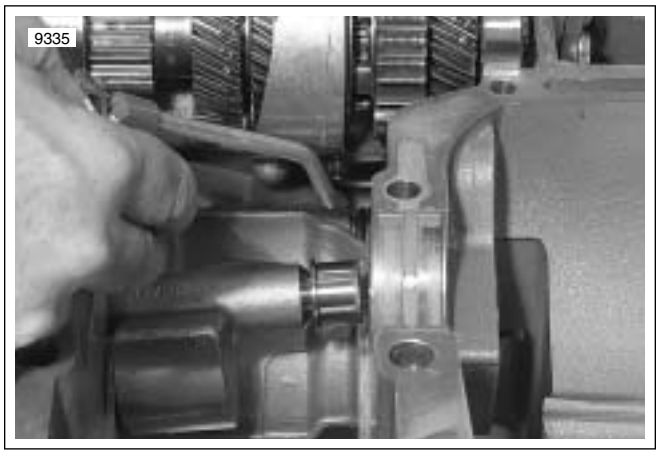


Figure 3-174. Position Counterbalancer

Figure 3-175. Insert Tapered Guide

9. See Figure 3-176. Use the driver from the BALANCER BEARING REMOVER/INSTALLER TOOLS (HD-45490). Drive the bearing in with a soft faced hammer until the retaining ring groove is exposed.

10. See Figure 3-177. Install **new** out board retaining ring. Be certain retaining ring is fully seated in the case groove.

NOTE

The counterbalancer gear can be installed on the balancer shaft with the counterbalancer gear fastener loosely holding the counterbalancer in place. The counterbalancer is either timed to the crankshaft during the assembly of the case halves, or after the case halves have been assembled. See 3.14 UPPER AND LOWER CRANKCASE SERVICE.

11. See Figure 3-178. Position balancer shaft master tooth at 11 o'clock.

12. Insert COUNTERBALANCER ALIGNMENT PIN (HD-45311).

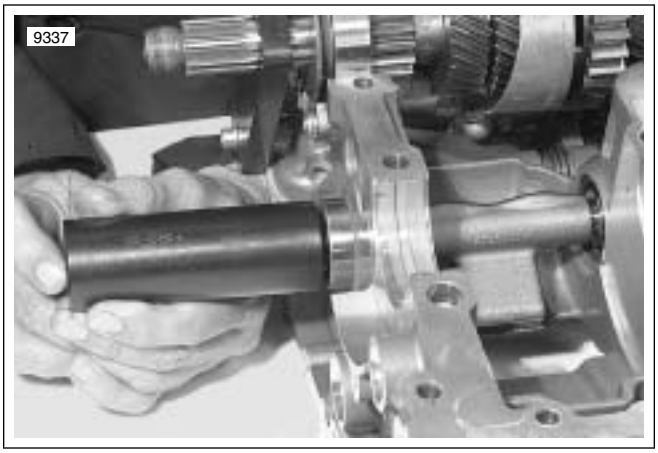


Figure 3-176. Outboard Bearing Installation

Figure 3-177. Outboard Retaining Ring Installation

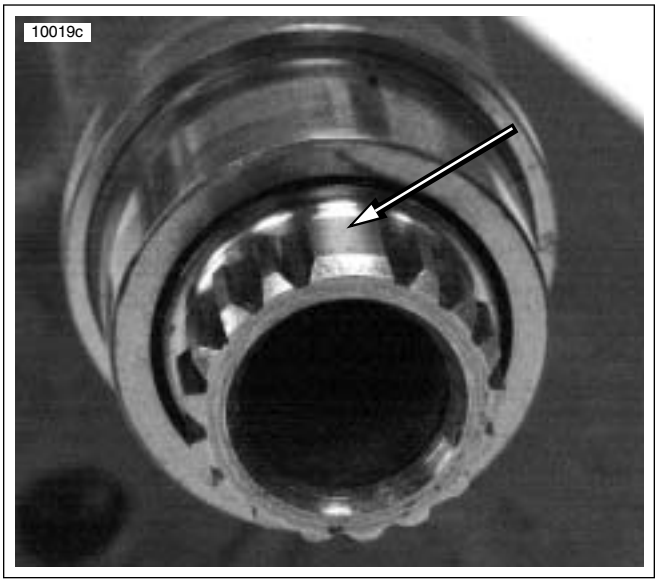


Figure 3-178. Counterbalancer Shaft Master Tooth

13. See Figure 3-180. Position counterbalancer gear with timing marks aligned to crankshaft drive gear.
14. See Figure 3-179. Align the master tooth flat with the corresponding master tooth on the balancer shaft.
15. Gently rock crankshaft until counterbalancer shaft master tooth engages counterbalancer gear master tooth flat and gear slides onto shaft. Gear should seat with hand pressure.

CAUTION

Do not use COUNTERBALANCER ALIGNMENT PIN to remove or tighten counterbalancer fastener. Pin can bend and bind in hole.

16. Remove COUNTERBALANCER ALIGNMENT PIN (HD-45311).
17. Install a **new** counterbalancer gear fastener.
18. See Figure 3-181. Hold crankshaft with 1/2 in. drive extension and wrench while tightening counterbalancer gear fastener to 50 Nm (37 ft-lbs) plus 90˚.

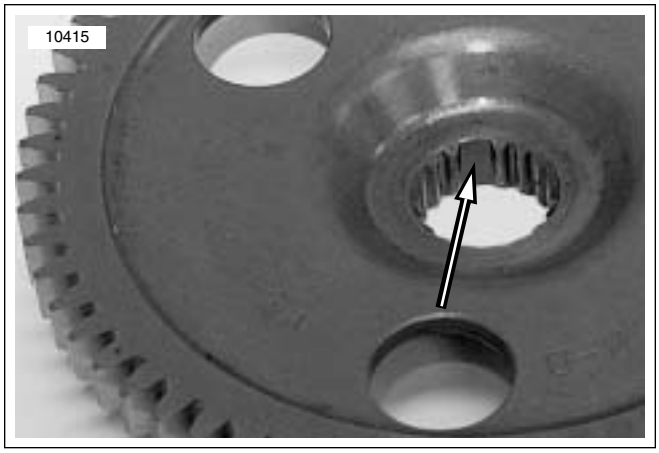


Figure 3-179. Counterbalancer Gear Master Tooth Flat

Figure 3-180. Timing Marks

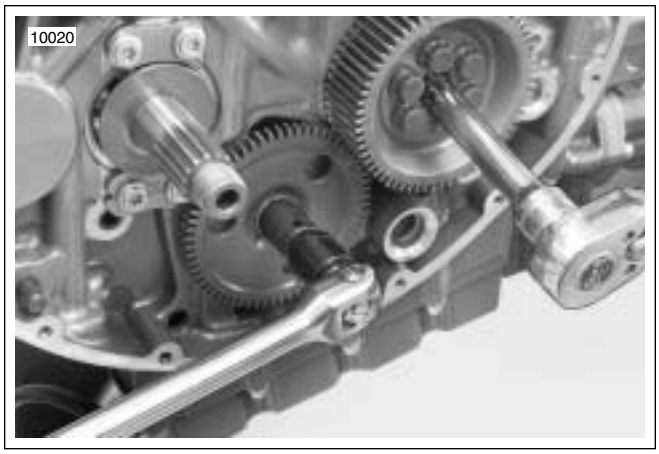


Figure 3-181. Counterbalancer Gear Installation

CRANKSHAFT BEARING REPLACEMENT 3.16

GENERAL

Crankshaft bearings MUST be replaced every time the cases are split for service. If the cam drive is not being serviced, crankshaft bearings can be replaced without removing the cam drive chain.

The alternator side and clutch side crankshaft bearings must be replaced with bearings color coded to match the color code stamped on the counterweight on the clutch side of the crankshaft. To select the correct bearing set, see 3.18 CRANKSHAFT, PISTON AND CYLINDER LINER.

NOTE

A CRANKSHAFT LIFTING TOOL (HD-47180) is available to aid in this procedure.

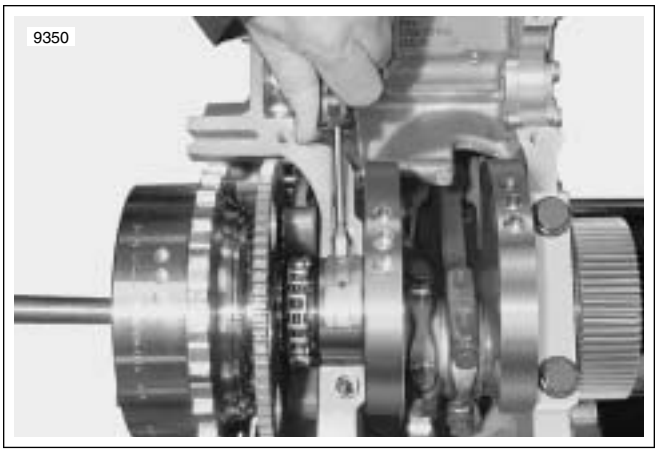


Figure 3-182. Cam Drive Side Bearing Removal

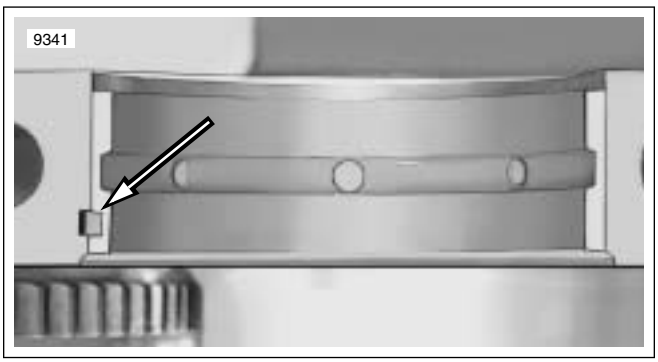


Figure 3-183. Crankshaft Bearing Notch (crankshaft removed for clarity)

ALTERNATOR SIDE

1. See Figure 3-21. Remove rotor bolt from cam drive side.
2. See Figure 3-182. Insert Snap-on # 2050 Prybar in rotor bolt hole.
3. See Figure 3-183. Note the notch in the crankshaft bearing.
4. See Figure 3-182. Gently lift crankshaft to take weight off the bearing.
5. Use a small screwdriver in the notch of the crankcase at the end of the bearing to lever and roll old bearing around crankshaft journal until it can be removed by hand.

NOTE

*Remove and replace one crankshaft bearing at a time. Make sure CRANKSHAFT ASSEMBLY RETAINERS (HD-45316) are loosened. Select **new** bearing. Apply Lubriplate No. 105 Assembly Grease (NAPA Part No. 765-2651) and Harley-Davidson Motorcycle Oil 20W50 to the journal side of the bearing.*

6. Select the alternator side bearing set to match color code on crankshaft counterweight. See 3.18 CRANKSHAFT, PISTON AND CYLINDER LINER.
7. While gently lifting crankshaft with prybar move **new** bearing into position by hand.

CLUTCH SIDE

1. See Figure 3-184. Insert a 10 in. long 1/2 in. drive extension in the square hole of the crankshaft drive gear.
2. See Figure 3-184. Apply gentle upward pressure on the 1/2 in. drive extension. Using a screwdriver on the side opposite the bearing notch, very carefully tap on old bearing until it is exposed enough to be removed by hand.
3. Select the clutch side bearing set to match color code on crankshaft counterweight. See 3.18 CRANKSHAFT, PISTON AND CYLINDER LINER.
4. Select a **new** bearing and apply Harley-Davidson Motorcycle Oil 20W50 to the journal side of the bearing.
5. See Figure 3-185. Position the **new** bearing so the notch rolls into the case last and matches the engine case relief notch.
6. While lifting gently with extension roll bearing into place with finger pressure.

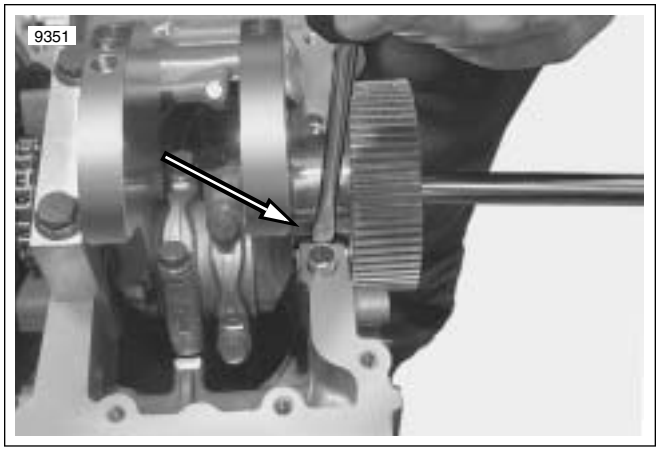


Figure 3-184. Remove Water Pump Side Bearing

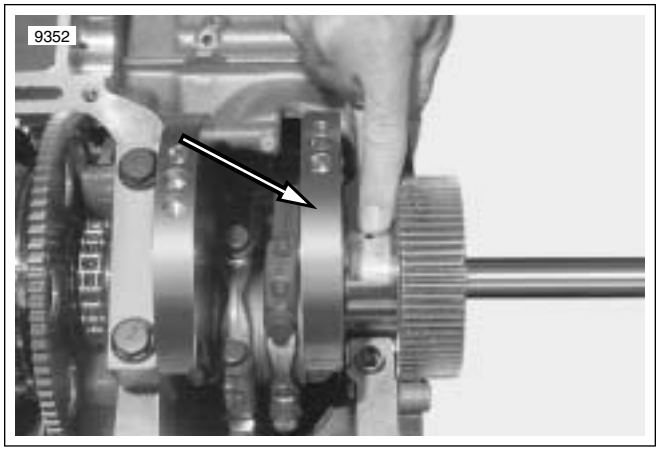


Figure 3-185. Remove Water Pump Side Bearing

SHIFT SHAFT AND SEAL 3.17

GENERAL

This procedure is shown with the engine removed. The shift shaft and seal may be replaced without removing the engine from the chassis.

REMOVAL

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

1. See Figure 3-186. Remove the outer retaining ring (zinc plated).
2. See Figure 3-187. Drill small hole in the shift shaft seal. Thread sheet metal screw into the hole.
3. See Figure 3-188. Gently pry seal from engine case.

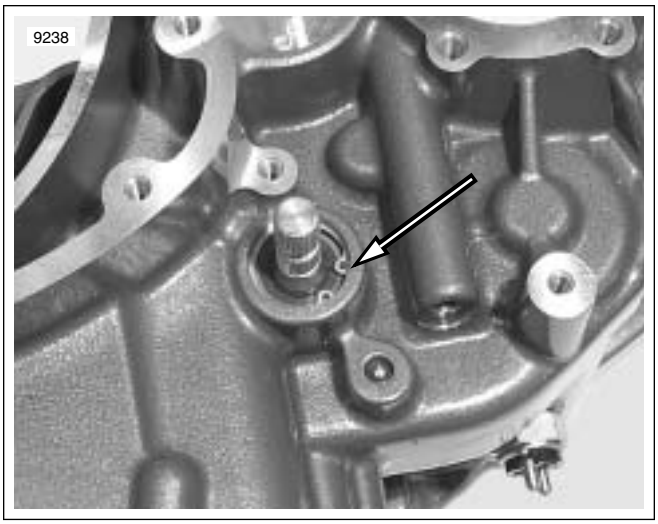


Figure 3-186. Shift Shaft Outer Retaining Ring

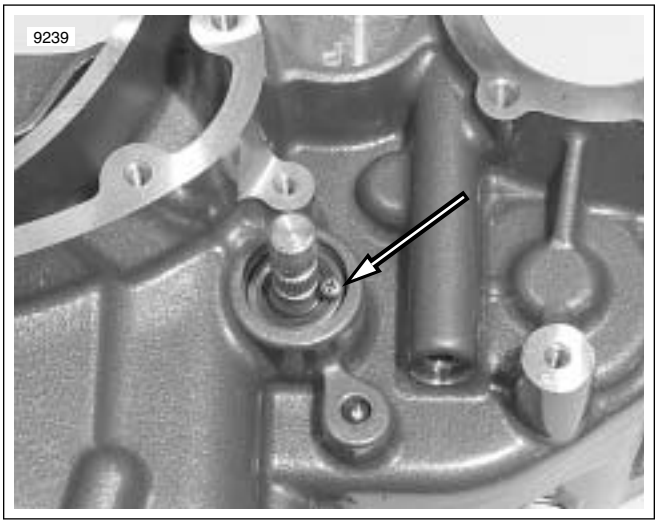


Figure 3-187. Shift Shaft Seal

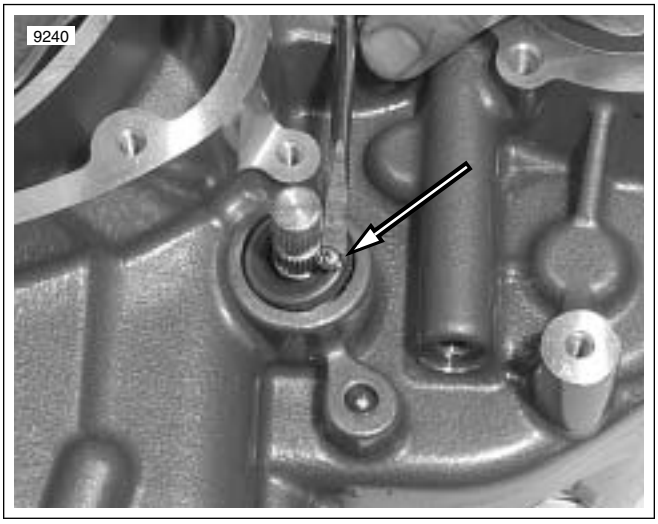


Figure 3-188. Remove Shift Shaft Seal

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

4. See Figure 3-189. With the shaft seal removed, the inner retaining ring (black) is exposed. Remove the retaining ring.
5. Remove shift shaft using hand effort.
6. See Figure 3-190. The shift actuator is spring loaded and will move away from alignment with the case hole when the shift shaft is removed.

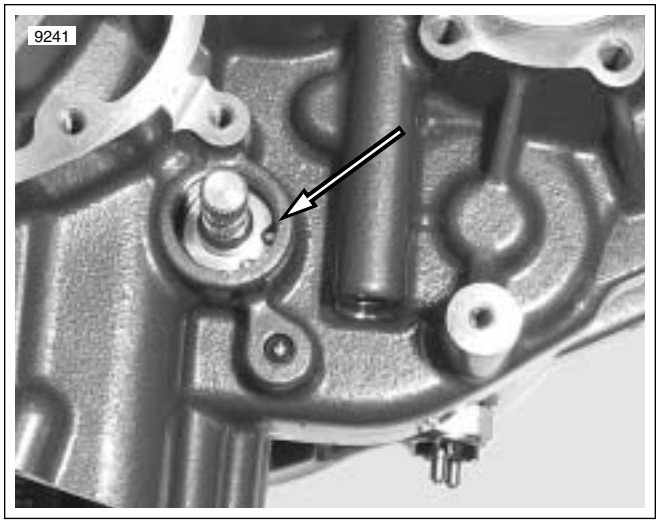


Figure 3-189. Shift Shaft Inner Retaining Ring

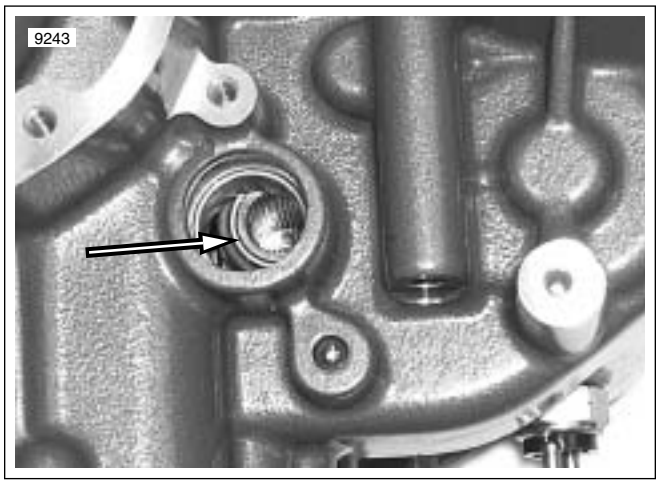


Figure 3-190. Shift Actuator

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-45337	Shift shaft seal installer

1. See Figure 3-191. To insert shift shaft, use leading end of shift shaft to engage the shift actuator. Using hand pressure, center the shift shaft to engage the actuator splines. Seat shift shaft deep enough to expose inner retaining ring groove.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

NOTE

The inner (black) retaining ring and the outer (zinc plated) retaining ring are different in size by 1 mm.

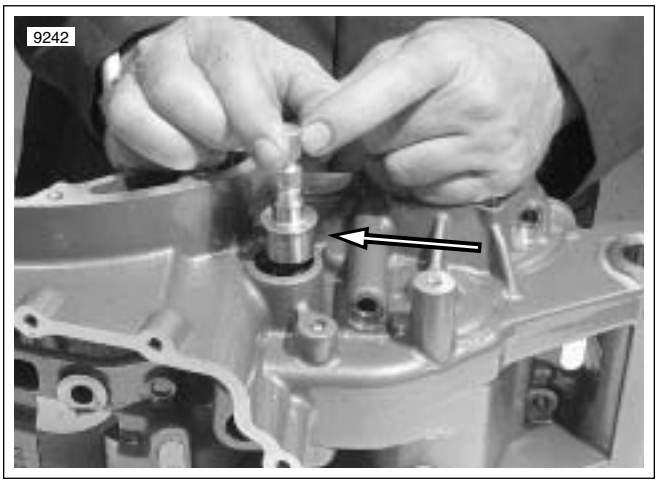


Figure 3-191. Shift Shaft Installation

2. Insert inner retaining ring (black).
3. See Figure 3-192. Lubricate shift shaft seal with Harley-Davidson Motorcycle Oil 20W50 and insert using SHIFT SHAFT SEAL INSTALLER (HD-45337).
4. Install outer retaining ring (zinc plated).

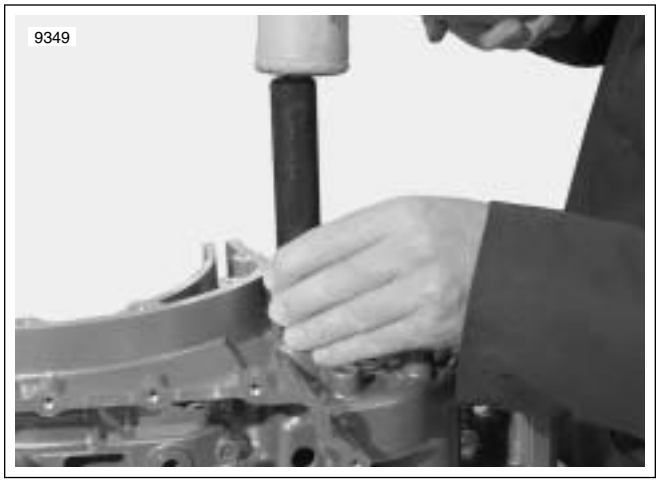


Figure 3-192. Shift Shaft Seal Installation

REMOVAL/INSTALLATION

Remove cam drive, rotor and cylinder heads. Split crankcases. Remove lower crankcase and set aside.

PART NO.	SPECIALTY TOOL
HD-45316	Crankshaft assembly retainer
HD-44358	Flywheel support fixture
HD-45313	Cylinder liner remover/installer
HD-96333-51C	Piston ring compressor
HD-45306	Crankshaft locking pin

1. See Figure 3-193. Install CRANKSHAFT ASSEMBLY RETAINER (HD-45316).

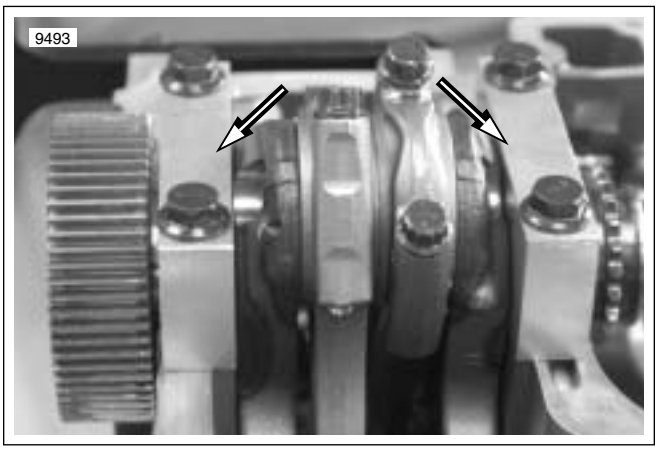


Figure 3-193. Install Crankshaft Assembly Retainers (HD-45316)

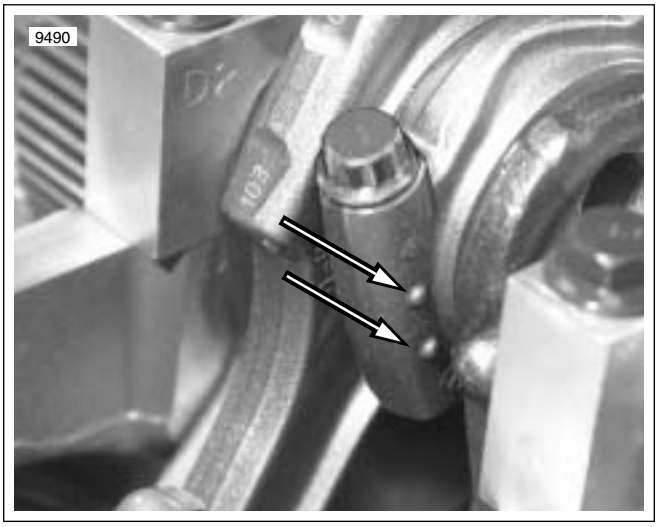


Figure 3-194. Connecting Rod Orientation

2. See Figure 3-194. Note the casting bumps on the connecting rods and caps. The rear cylinder must have the bumps toward the water pump side and the front cylinder toward the cam drive side.

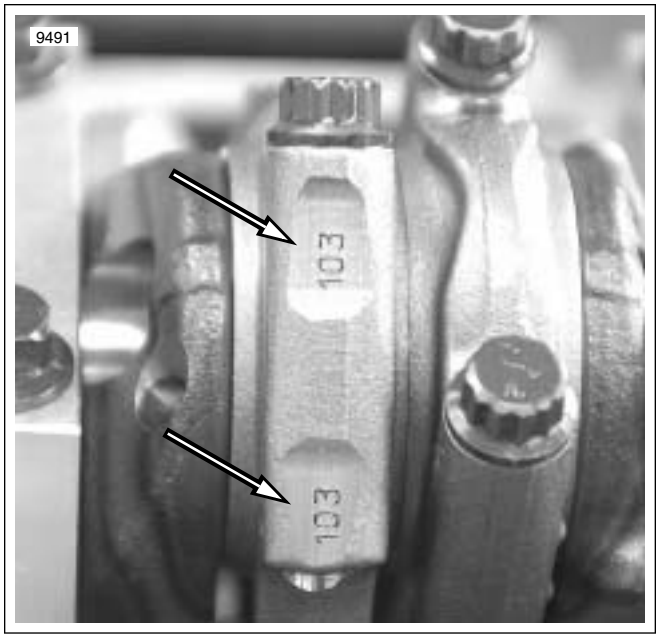


Figure 3-195. Match Rod and Cap

3. See Figure 3-195. Note the numbers on connecting rod and cap. Connecting rods and caps must be used in matched sets.

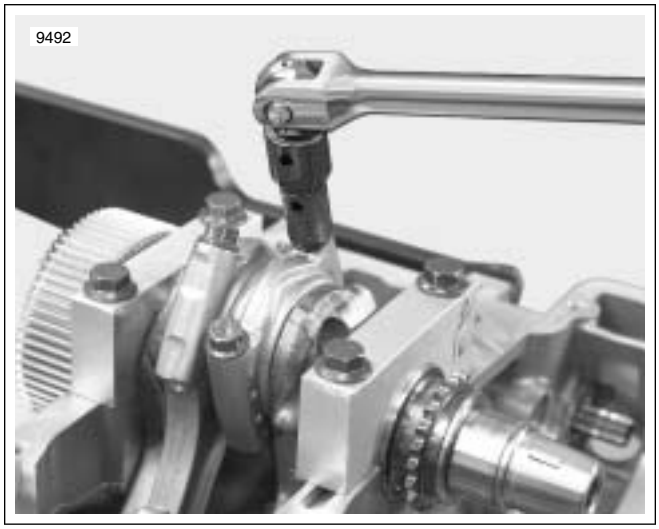


Figure 3-196. Loosen Rod Cap Fasteners

4. See Figure 3-196. Loosen connecting rod caps fasteners.
5. Remove the CRANKSHAFT ASSEMBLY RETAINERS (HD-45316).

Figure 3-197. Remove Rod Caps

6. See Figure 3-197. Inspect connecting rod bearing shells. Look for scoring or discoloration.

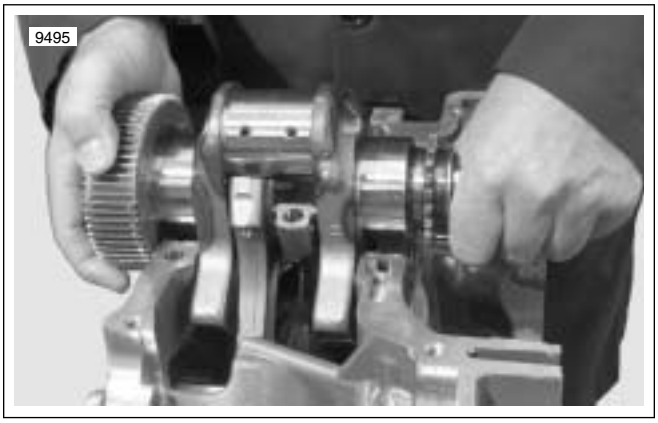


Figure 3-198. Remove Crankshaft

7. See Figure 3-198. Remove crankshaft.

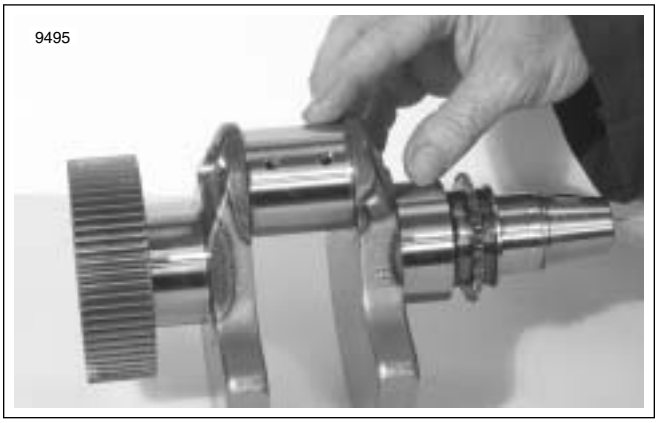


Figure 3-199. Inspect Crankshaft

8. See Figure 3-199. Check journals for scoring, bluing and surface damage. Check main drive gear for wear or missing teeth.

NOTE

Mild bluing around crankshaft journal and sprocket edges is due to heat treating process and is normal. However, metal transfer and bluing on journal surface indicates damage and crankshaft must be replaced.

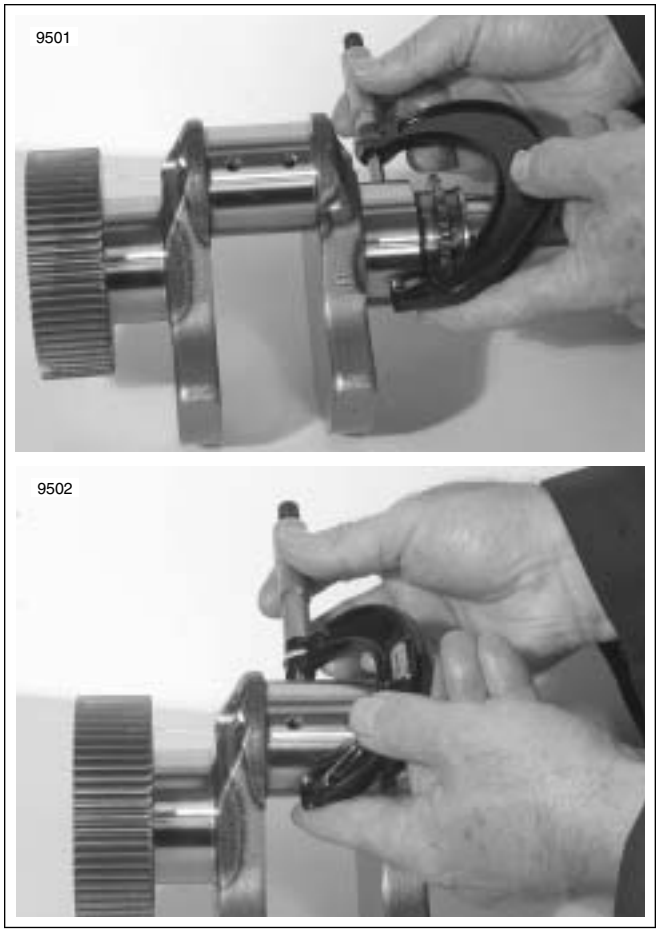


Figure 3-200. Measure Journal

9. See Figure 3-200. Measure crankshaft journals. For crankshaft bearing selection. Refer to Table 3-28.

Figure 3-201. Remove Main Bearing Retainers

10. See Figure 3-201. Remove crankshaft thrust bearings.

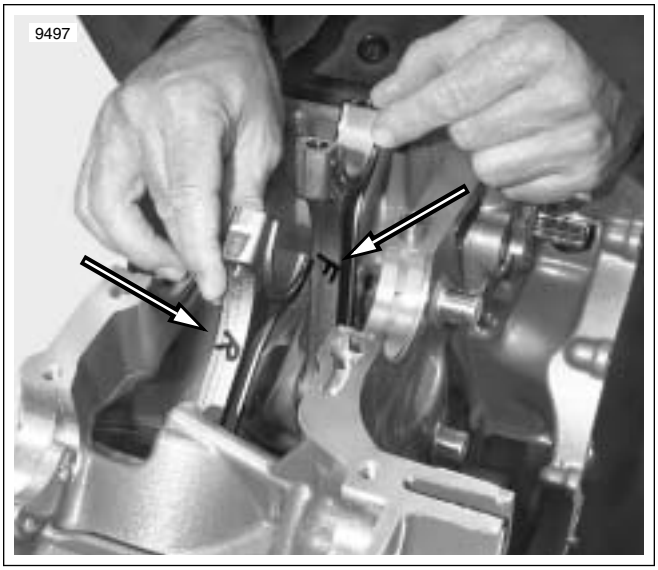


Figure 3-202. Mark Connecting Rods

11. See Figure 3-202. If rods are to be reused, mark them F (front) and R (rear). Rod must be installed in the same position.

Figure 3-203. Bearing Shells

12. See Figure 3-203. Inspect bearing shells for scoring or discoloration.

Figure 3-204. Remove Pistons

13. See Figure 3-204. Carefully push piston and rod out top of cylinder. Avoid contacting piston jet. Do not let the connecting rod contact the cylinder liner wall.

⚠WARNING

Always wear proper eye protection when removing retaining rings. Slippage may propel the ring with enough force to cause eye injury.

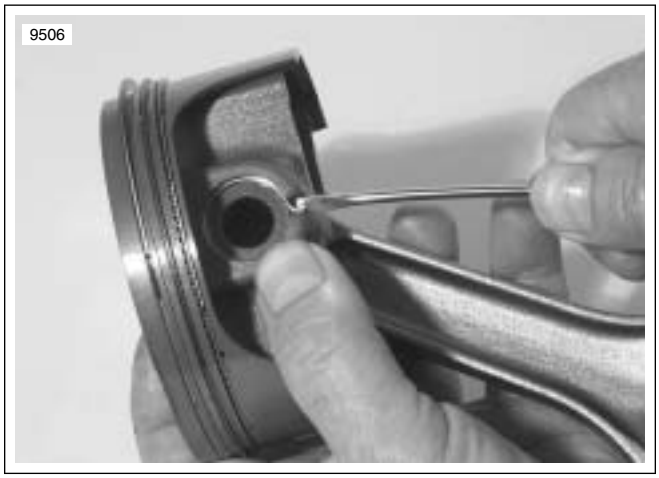


Figure 3-205. Wrist Pin Retaining Rings

14. See Figure 3-205. Remove and discard wrist pin retaining rings. Place small screwdriver under end and twist.

Figure 3-206. Install Rod Caps For Inspection

15. See Figure 3-206. Note rod and cap identifying numbers and casting bumps. Install rod caps and tighten to 27 Nm (20 ft-lbs). Position the Torque Angle Gauge (Snap-on Part No. TA360) per instruction sheet and tighten connecting rod bolts an additional 90°.

NOTE

The notation for this torque sequence is written:

27 Nm + 90°

16. See Figure 3-207. Check big end dimensions with a dial bore gauge. Measurement must be between a maximum of 51.616 mm (2.032 in.) and a minimum of 51.60 mm (2.031 in.).

17. See Figure 3-208. Inspect small end bushing and wrist pin fit. The running clearance should be between a maximum of 0.033 mm (0.001 in.) and a minimum of 0.018 mm (0.0007 in.).

Figure 3-207. Measure Big End

Figure 3-208. Inspect Small End

18. See Figure 3-209. Measure piston diameter on thrust surface. Measurement should be between a maximum of 99.961 mm (3.9354 in.) and a minimum of 99.953 mm (3.9351 in.) at the largest point of the piston thrust surface.

NOTE

Piston size could vary 0.0076 mm (0.0003 in.).

19. See Figure 3-210. EX on piston top goes toward the exhaust valves. Front piston EX will go toward the front of the engine. Rear piston EX will go toward the rear of the engine.

Figure 3-209. Piston Measurement

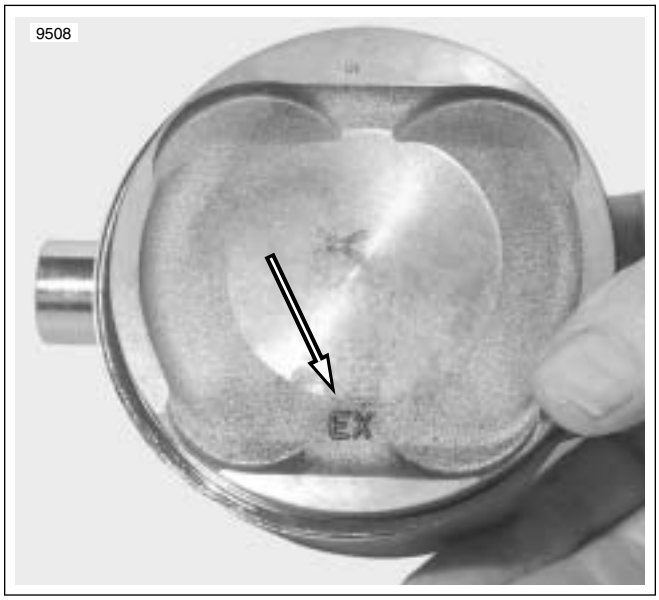


Figure 3-210. Piston Orientation Mark

20. See Figure 3-211. FLYWHEEL SUPPORT FIXTURE (HD-44358) can be modified to hold crankshaft when removing or installing primary drive gear. Open bore of center hole to 59.7 mm (2.350 in.).

21. See Figure 3-212. Remove and discard primary drive gear fasteners.

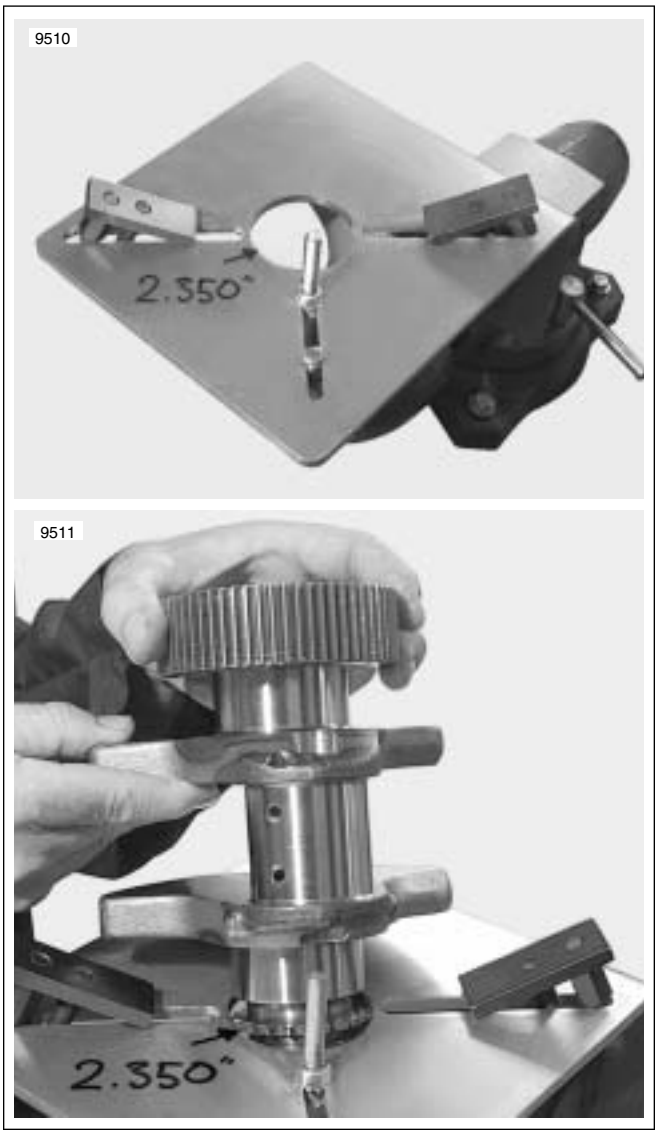


Figure 3-211. Flywheel Support Fixture

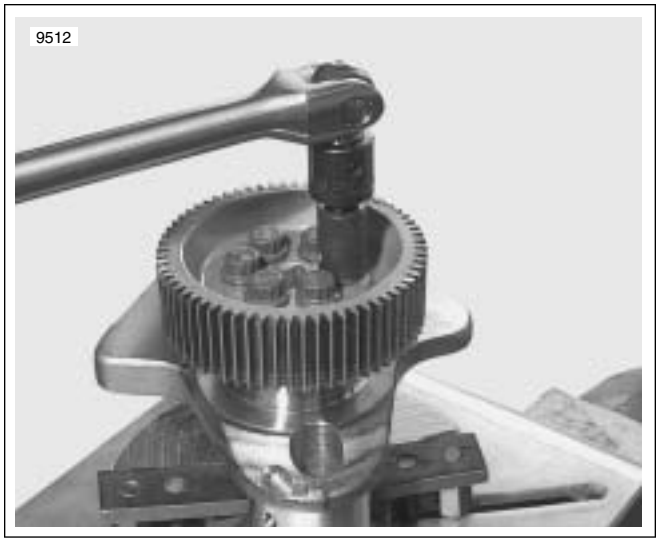


Figure 3-212. Remove Primary Gear

22. See Figure 3-213. Examine primary drive gear. Inspect thrust surfaces for excessive wear or chipping. Note the timing marks on the primary drive gear and the crankshaft. Assemble with the timing mark on the drive gear over the timing mark on the crankshaft.
23. See Figure 3-214. Lubricate **new** primary drive gear fasteners with Harley-Davidson Motorcycle Oil 20W50. Lubricate threads and under head of bolt.
24. See Figure 3-215. Using a crisscross pattern, tighten the primary gear fasteners to 10 Nm (88 **in-lbs**). Position the Torque Angle Gauge (Snap-on Part No. TA360) per instruction sheet and tighten bolt an additional 90°.

Figure 3-213. Primary Gear Timing Marks

Figure 3-214. Installing Primary Gear

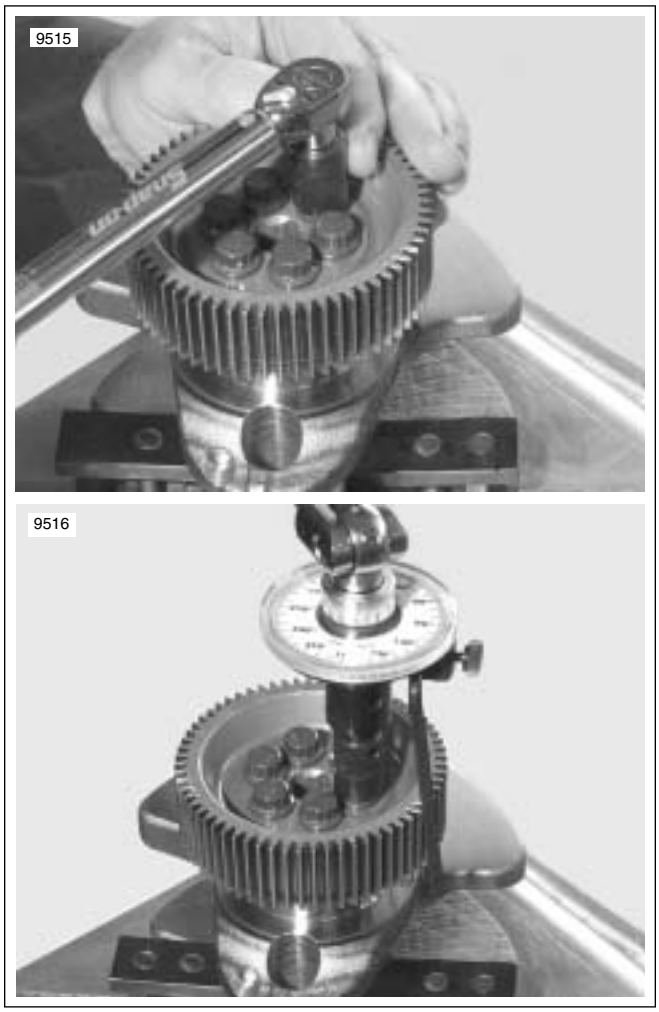


Figure 3-215. Tighten Primary Gear

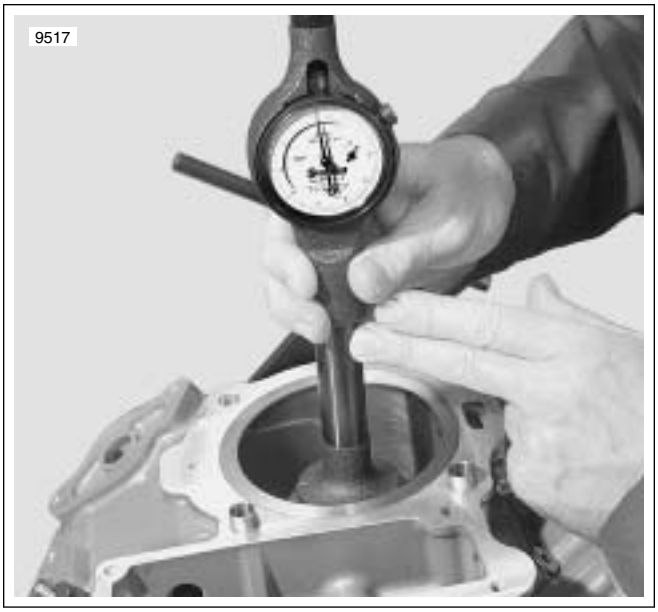


Figure 3-216. Measure Cylinder Bore

25. See Figure 3-216. Using a dial bore gauge, check cylinder concentricity. See specifications for serviceability.

NOTE

If cylinder liner is to be removed, mark liner and crankcase so the liner can be installed in the same position. Pick a convenient feature for reference.

26. See Figure 3-217. Mark case and cylinder liner and install CYLINDER LINER REMOVER/INSTALLER (HD-45313).

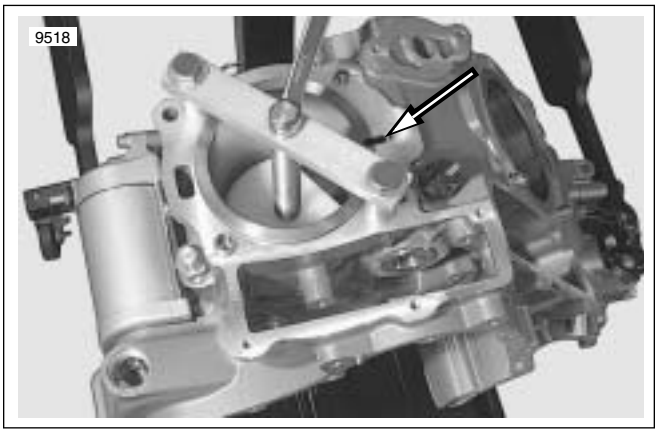


Figure 3-217. Mark Case and Cylinder Liner and Install CYLINDER LINER REMOVER/INSTALLER (HD-45313)

27. See Figure 3-218. According to instruction sheet for CYLINDER LINER REMOVER/INSTALLER (HE-45313), remove liner.

28. See Figure 3-219. Inspect piston jet. Piston jet must fit tight and have no visible damage. If loose or damaged crankcase must be replaced.

29. See Figure 3-220. Carefully clean cylinder liner and step in crankcase. Debris in the step could prevent the cylinder liner from fully seating.

Figure 3-218. Remove Cylinder Liner

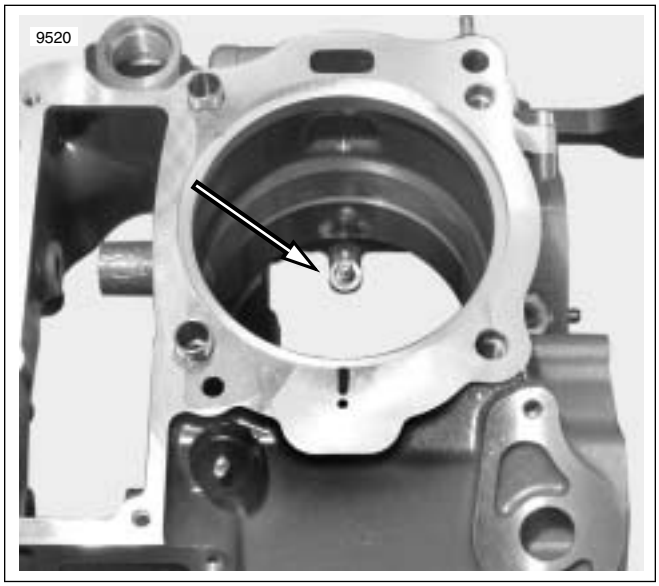


Figure 3-219. Piston Jet

Figure 3-220. Clean Liner and Case Step

Figure 3-221. Lubricate Liner

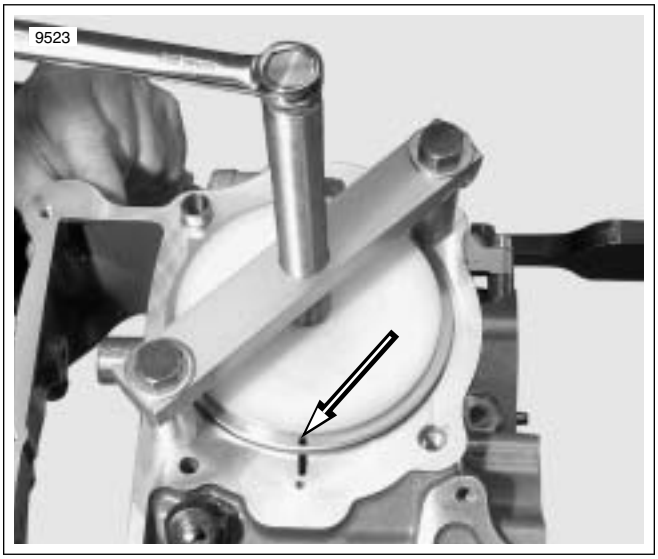


Figure 3-222. Align Case and Cylinder Marks and Insert Liner

30. See Figure 3-221. Lubricate o-rings with Harley-Davidson Motorcycle Oil 20W50 to keep o-rings seated on cylinder.
31. See Figure 3-222. Align case and cylinder marks and insert liner in the case bore. Install CYLINDER LINER REMOVER/INSTALLER (HD-45313) according to instruction sheet and install liner.
32. See Figure 3-223. Check ring end gap by placing ring in cylinder and measure gap using feeler gauges. See specifications for serviceability.
33. See Figure 3-224. Carefully install piston rings. Second compression ring is installed with the mark to the top. When ring set is installed, gaps must be staggered.

NOTE

If engine is to be assembled at this point, make sure all part are cleaned and lubricated appropriately.

⚠WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

34. See Figure 3-225. Install wrist pin and wrist pin retaining rings.

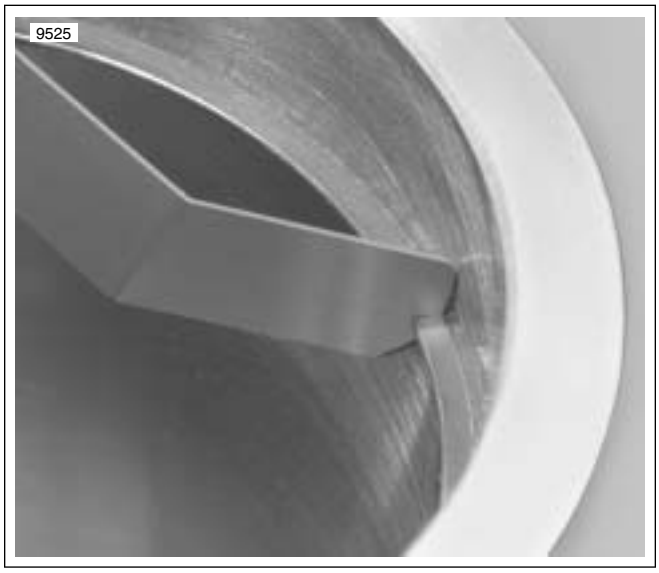


Figure 3-223. Ring End Gap

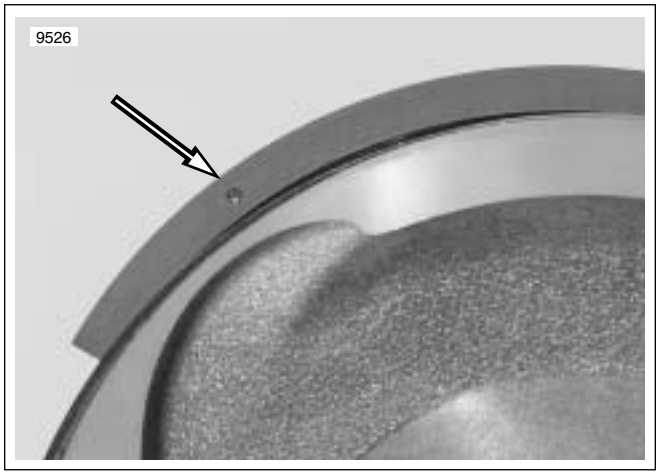


Figure 3-224. Second Compression Ring Top Mark

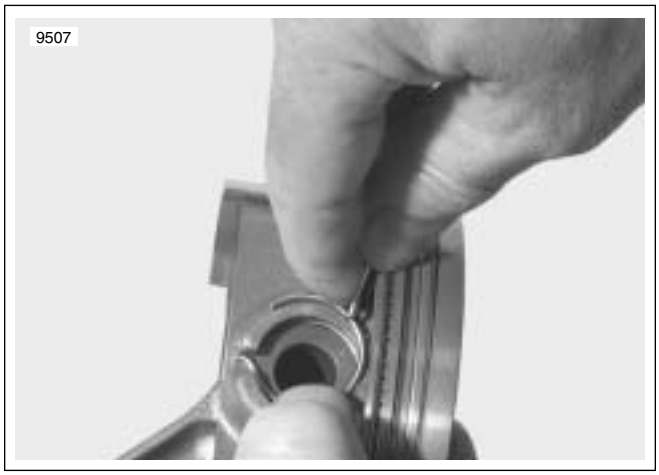


Figure 3-225. Wrist Pins and Retaining Rings

35. See Figure 3-227. To install piston, complete each of the following steps:
    a. LIghtly lubricate inside of PISTON RING COMPRESSOR (HD-96333-51C) and rings and piston skirt with Harley-Davidson Motorcycle Oil 20W50.
    b. See Figure 3-226. Orient the brackets on the compressor ring down (Note arrow on compression ring) toward the crankcase. Orient the squeeze handle parallel to crankcase.

CAUTION

Failure to install pistons correctly oriented will result in engine failure.

    c. Orient piston and connecting rod to crankcase.

NOTE

Correct piston and connecting rod orientation is as follows:

- ***Front cylinder connecting rod and cap bumps to cam drive side of engine***
- ***Rear cylinder connecting rod and cap bumps to water pump side of engine***
- ***EX mark toward the front on front cylinder***
- ***EX mark toward the rear on rear cylinder***

    d. Clamp the PISTON RING COMPRESSOR (HD-96333-51C) around rings and pistons.
    e. Adjust tension on handle to compress rings but still allow piston and rings to slip out of compressor into cylinder bore.

NOTE

If piston jet is damaged, crankcase will have to be replaced.

    f. See Figure 3-219. With free hand inside crankcase, guide rod past piston jet.

CAUTION

Whenever resistance is encountered, stop and examine components. A ring can gouge the cylinder wall when forced.

    g. See Figure 3-227. Using a rubber or wooden mallet handle, very gently tap piston around circumference into bore. Hold constant pressure on the piston ring compressor until rings have entered bore.
    h. When piston and rings are in the bore, move piston up and down the bore to insure rings have not broken during installation.

Figure 3-226. Piston Ring Compressor

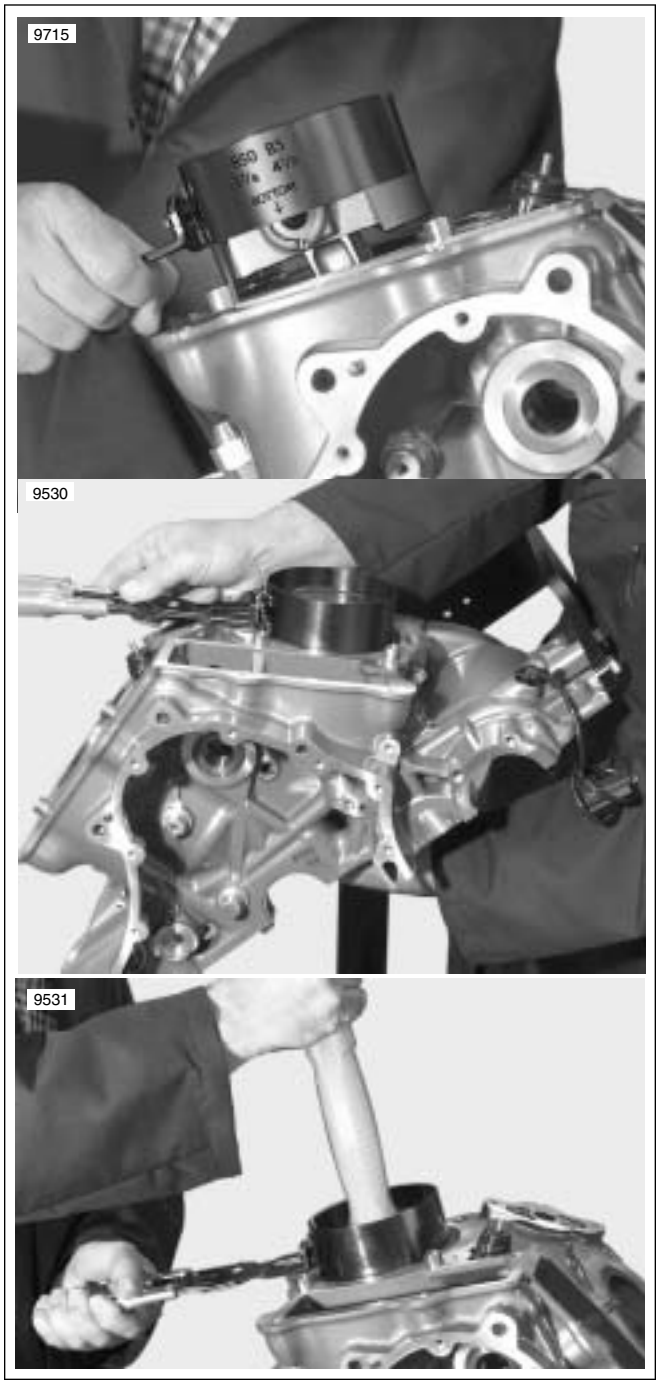


Figure 3-227. Insert Piston

36. Invert engine. Clean connecting rod bore and crank bore making sure its free of oil.
37. See Figure 3-231. Select rod bearing replacement set to match rod bearing journal diameter color code (3) on crankshaft. Refer to Table 3-27.

NOTE

Rod bearing sets (front and rear) are available in two sizes, coded red (R) and blue (B). The rod bearing color code appears on the bearing shell edge.

Table 3-27. Rod Bearing Journal Diameter

COLOR CODE	H-D PART NO.	SPECIFICATION	
Red	24412-01K	Max	47.991 mm
		Min	47.983 mm
Blue	24413-01K	Max	47.983 mm
		Min	47.975 mm

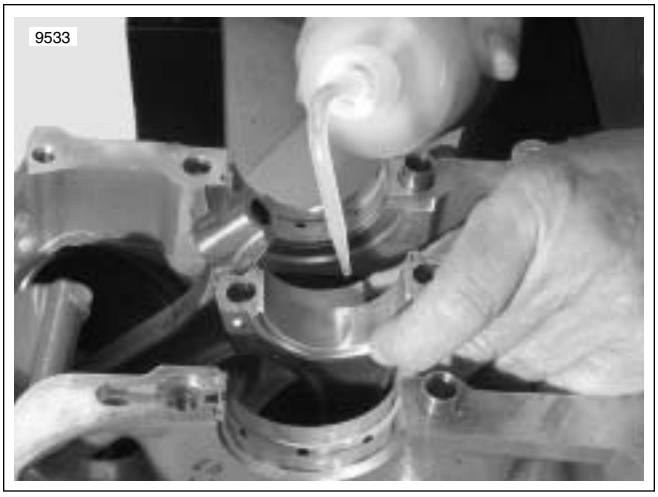


Figure 3-228. Lubricate Bearings

38. See Figure 3-228. Install rod bearings and lubricate bearing surface with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.

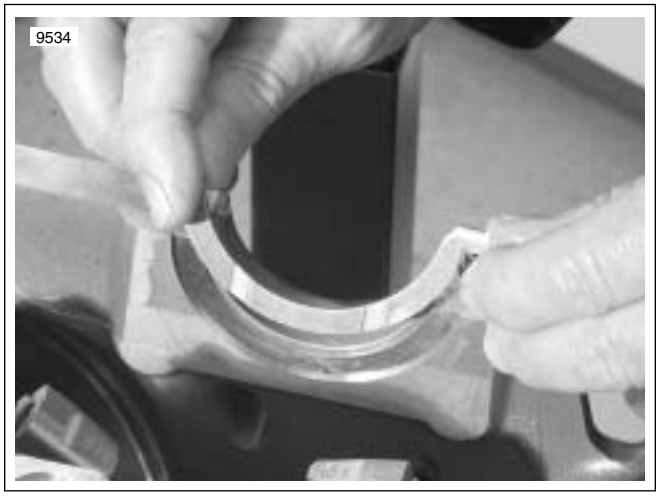


Figure 3-229. Install Thrust Bearing

39. See Figure 3-229. Install thrust bearing. Use a small amount of grease on the back of the bearing to hold in position.
40. See Figure 3-230. Move connecting rods so front connecting rod points to rear, and rear rod points to front of engine.

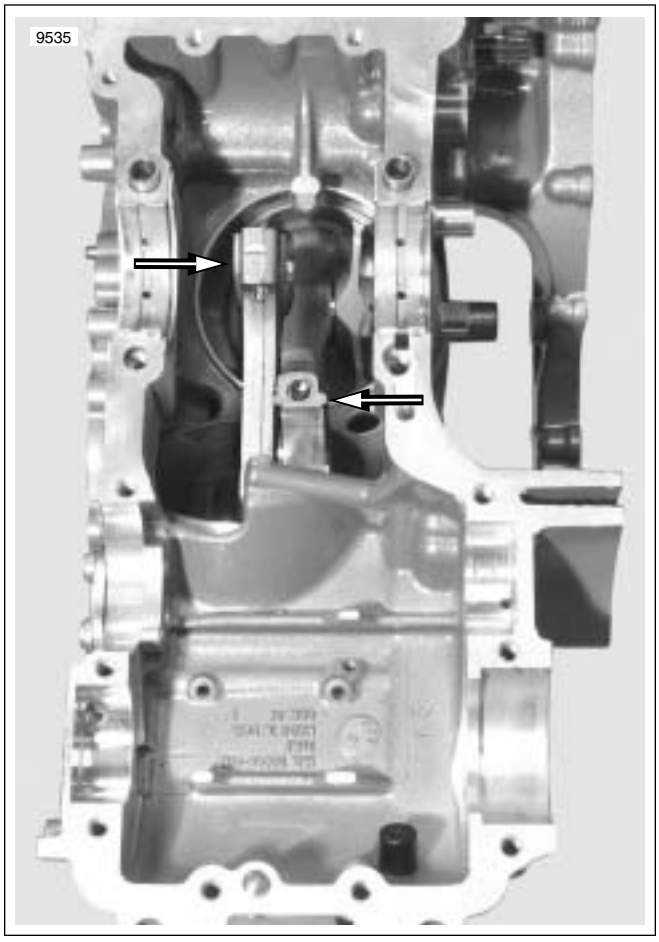
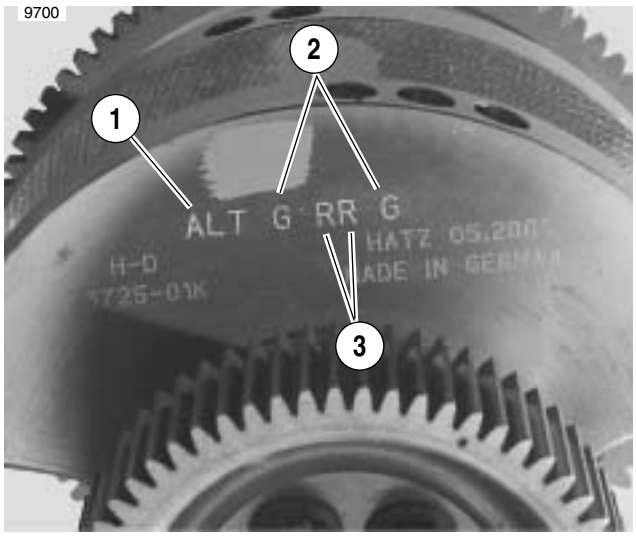


Figure 3-230. Position Connecting Rods



1. **ALT (alternator side)**
2. **G (green main bearing code)**
3. **R (red rod bearing code)**

Figure 3-231. Crankshaft Color Code

41. See Figure 3-231. Crankshaft counter weight is stamped with a color code for main bearing and rod journal replacement sets. Read from left to right, the letter code corresponds to the alternator and clutch side main bearing journals (2) and the front rod and rear rod journals (3).
42. Refer to Table 3-28. Select main bearing set corresponding to color code (2) on crankshaft.

Table 3-28. Main Bearing Journal Diameter

COLOR CODE	H-D PART NO.		ALTERNATOR SIDE	CLUTCH SIDE
Blue	24411-01K	Max	55.977 mm	55.952 mm
		Min	55.971 mm	55.946 mm
Green	24410-01K	Max	55.984 mm	55.959 mm
		Min	55.977 mm	55.952 mm
Red	24409-01K	Max	55.990 mm	55.965 mm
		Min	55.984 mm	55.959 mm

NOTE

Main bearings are available in 3 sets (alternator and clutch side bearings) to fit three sizes of journals. The sets are color coded, blue (B), green (G) and red (R).

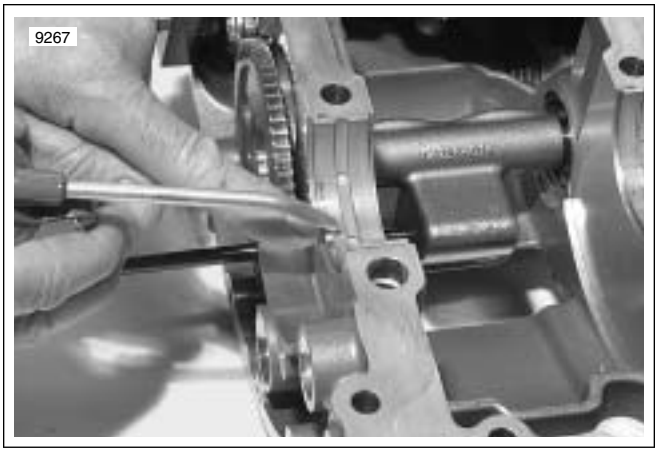


Figure 3-232. Lubricate Crankshaft Bearings

43. See Figure 3-232. Install crankshaft bearings and lubricate bearing surface with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.

Figure 3-233. Install Crankshaft

44. See Figure 3-233. Carefully position crankshaft.
45. See Figure 3-193. When crankshaft is in position install CRANKSHAFT ASSEMBLY RETAINER (HD-45316).

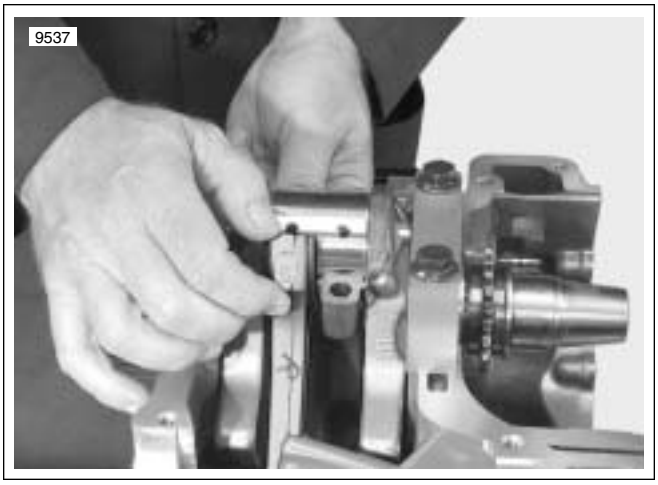


Figure 3-234. Position Connecting Rods

46. See Figure 3-234. Pull piston and rod assembly up to crankshaft journal.
47. See Figure 3-236. Lubricate crankshaft journal, connecting rod cap bearings, connecting rod bolt threads and under head of rod cap bolt with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended for the rod bearings.
48. See Figure 3-235. Install connecting rod caps. Confirm connecting rods and caps have identical numbers and cast bumps are oriented correctly.
    a. Front cylinder connecting rod and cap bumps to cam drive side of engine.
    b. Rear cylinder connecting rod and cap bumps to water pump side of engine.

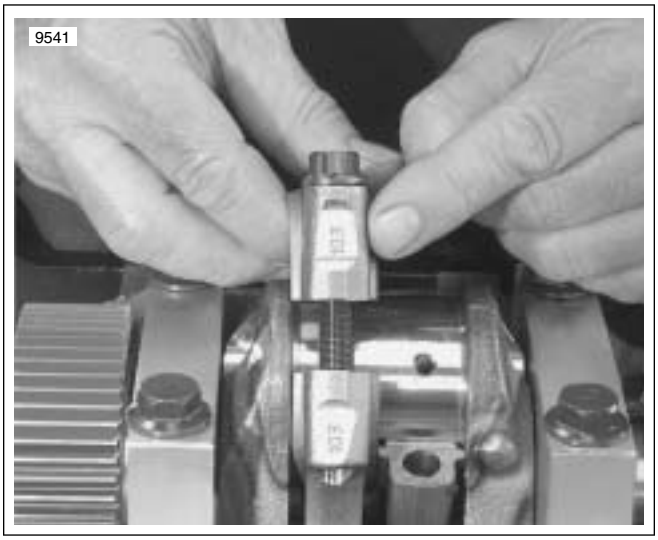


Figure 3-235. Install Connecting Rod Caps

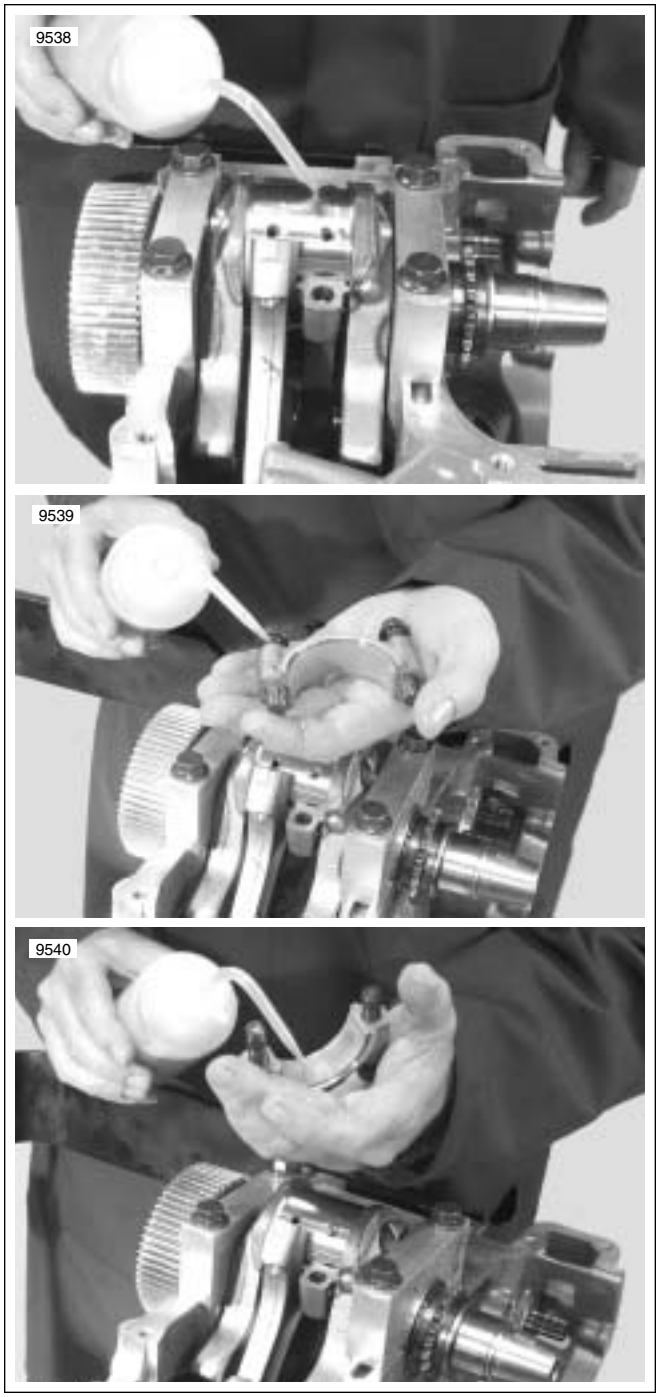


Figure 3-236. Lubricate Crankshaft and Rods

49. See Figure 3-237. Tighten connecting rod caps to 27 Nm (20 ft-lbs).

50. See Figure 3-238. Position the Torque Angle Gauge (Snap-on Part No. TA360) per instruction sheet and tighten connecting rod bolts an additional 90°.

NOTE

The notation for this torque sequence is written:

27 Nm + 90°

CAUTION

DO NOT ROTATE ENGINE CLOCKWISE. This is opposite the normal engine operation. Engine damage may result.

51. When all rod bolts are correctly torqued, turn engine to TDC and insert CRANKSHAFT LOCKING PIN (HD-45306).

52. Continue with appropriate steps under 3.14 UPPER AND LOWER CRANKCASE SERVICE.

Figure 3-237. Install Connecting Rod Caps

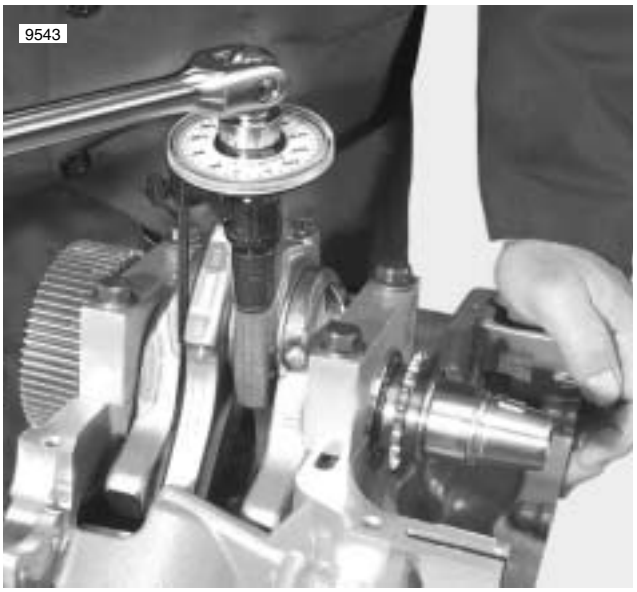


Figure 3-238. Tighten Connecting Rod Caps

OIL FILTER MOUNT 3.19

REMOVAL/INSTALLATION

1. See Figure 3-239. Remove three fasteners and remove oil filter mount.
2. See Figure 3-240. Remove o-ring and discard.
3. Inspect oil passages for debris and dirt. Clean as required.
4. Install **new** o-ring and install oil filter mount.

NOTE

Always replace o-ring when oil filter mount has been removed and/or replaced.

5. Tighten oil filter mount fasteners to 9.7 Nm (86 **in-lbs**).

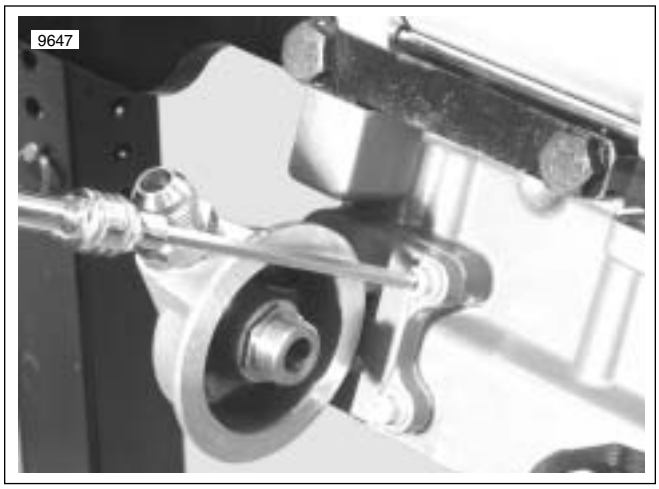


Figure 3-239. Remove Oil Filter Mount Fasteners

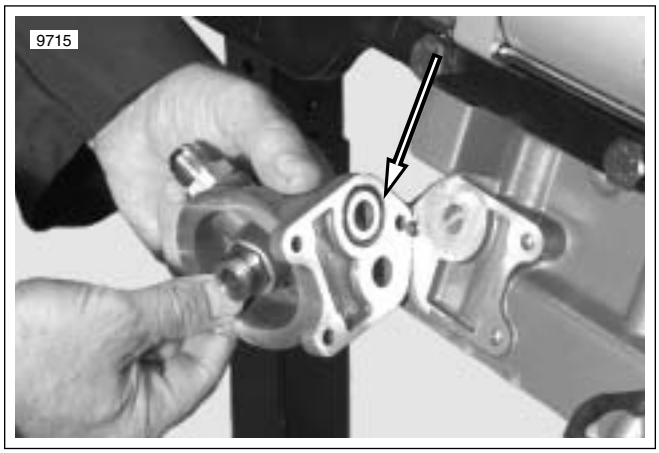


Figure 3-240. Replace O-Ring

ASSEMBLY

1. Rotate the front cylinder piston to TDC. Remove plug from timing hole on right side of engine and insert CRANKSHAFT LOCKING PIN (HD-45306).The CRANKSHAFT LOCKING PIN should insert flush with engine case.
2. See Figure 3-241. Insert water pump shaft through case until flush with case on cam drive side.
3. See Figure 3-242. Position triple gear on water pump shaft and drive chain on crankshaft drive gear. Squeeze drive chain to simulate the chain position with the chain tensioners in place. Walk chain around crankshaft gear to change position.
4. See Figure 3-243. Install primary chain fixed tensioner. Note the flat in the chain tensioner bore and the flat on the mounting shaft in the case.

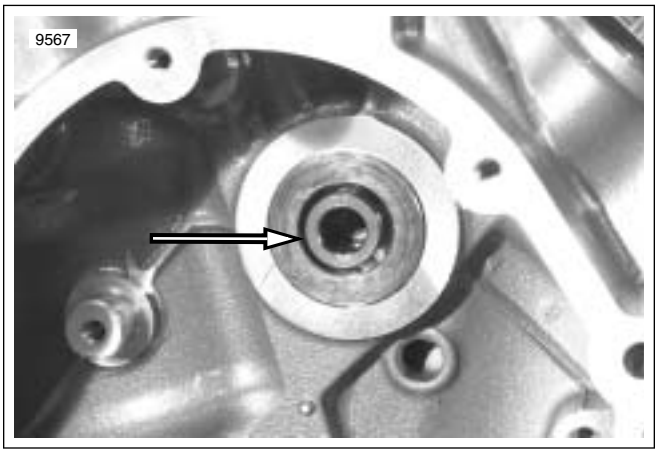


Figure 3-241. Water Pump Shaft

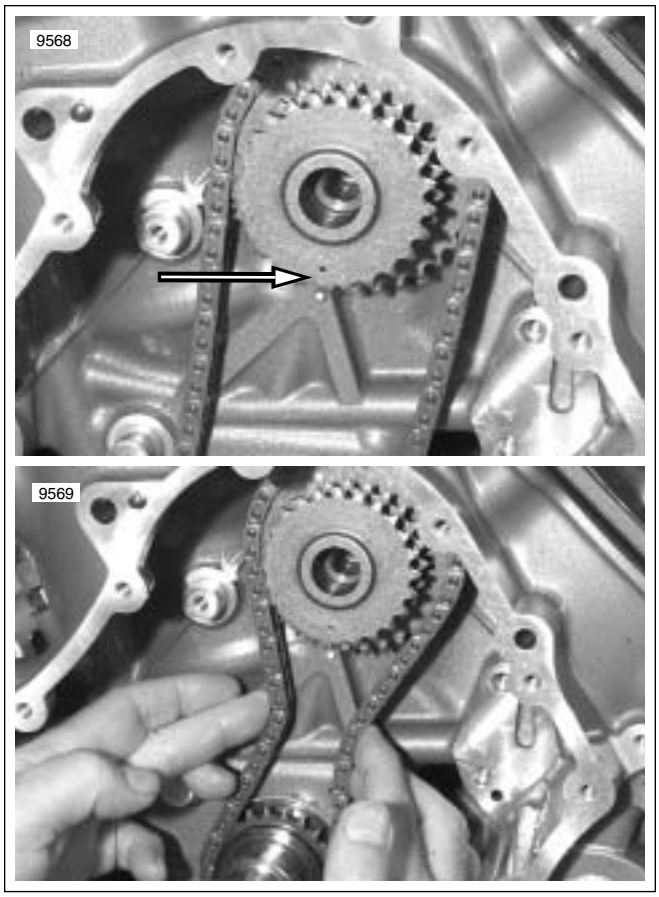


Figure 3-242. Triple Gear Timing Marks

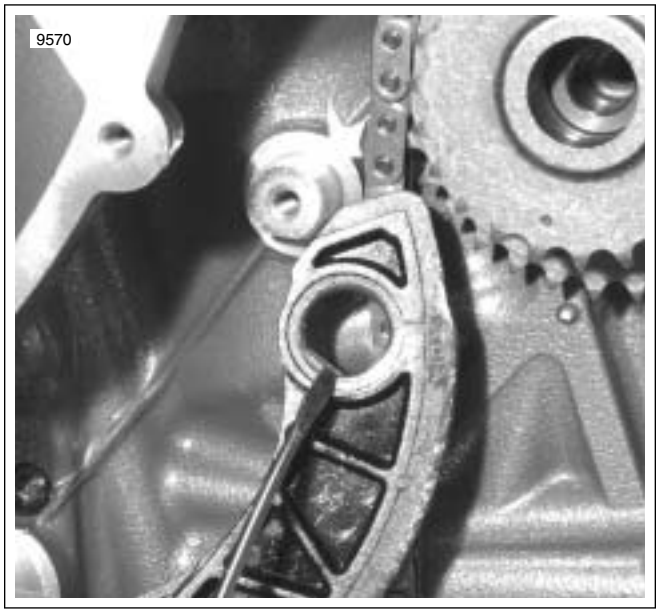


Figure 3-243. Primary Chain Fixed Tensioner

5. See Figure 3-244. Use a small screw driver to help guide the chain over the edge of the primary cam chain fixed tensioner.
6. See Figure 3-245. Retract the chain tensioner and install PRIMARY CAM CHAIN TENSIONER RETAINER (HD-45326).
7. Confirm the position of the timing marks.
8. See Figure 3-246. Install primary chain hydraulic tensioner fastener. Tighten to 9.7 Nm (86 **in-lbs**).
9. See Figure 3-247. Install triple sprocket fastener. Tighten to 23 Nm (17 ft-lbs).
10. See Figure 3-248. Install fastener on primary chain fixed tensioner. Tighten to 9.7 Nm (86 **in-lbs**).
11. See Figure 3-249. Insert 8 mm pin through case and rear cylinder hydraulic cam chain tensioner.

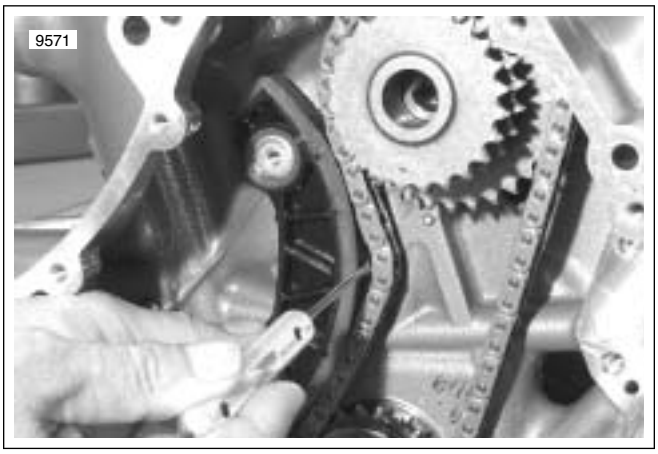


Figure 3-244. Guide Chain Over Tensioner

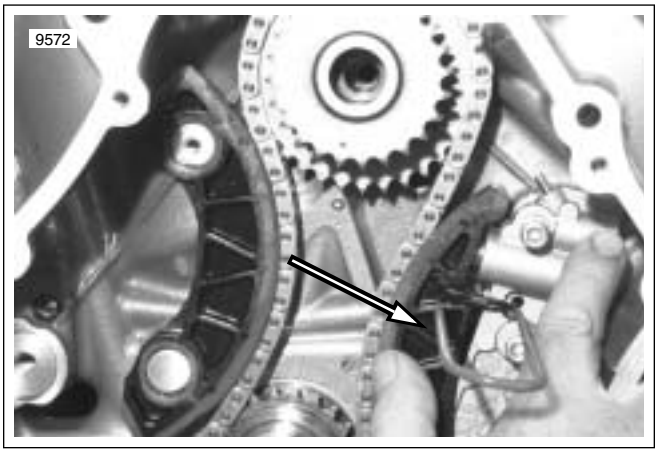


Figure 3-245. Primary Chain Tensioner Retainer

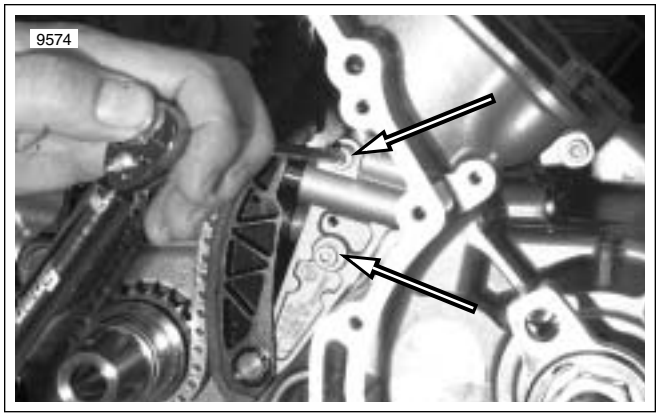


Figure 3-246. Primary Chain Hydraulic Tensioner

Figure 3-247. Triple Sprocket

Figure 3-248. Primary Chain Fixed Tensioner

Figure 3-249. Rear Cylinder Cam Chain Tensioner

12. See Figure 3-250. Front hydraulic and rear fixed cam chain tensioner interlock. Position in case and insert 10 mm pin.
13. See Figure 3-251. Position front cylinder fixed cam chain tensioner and insert 10 mm pin.
14. Install cylinder heads. See 3.21 CYLINDER HEADS.
15. Install and time cams. See 3.22 INSTALLING AND TIMING THE CAMS.

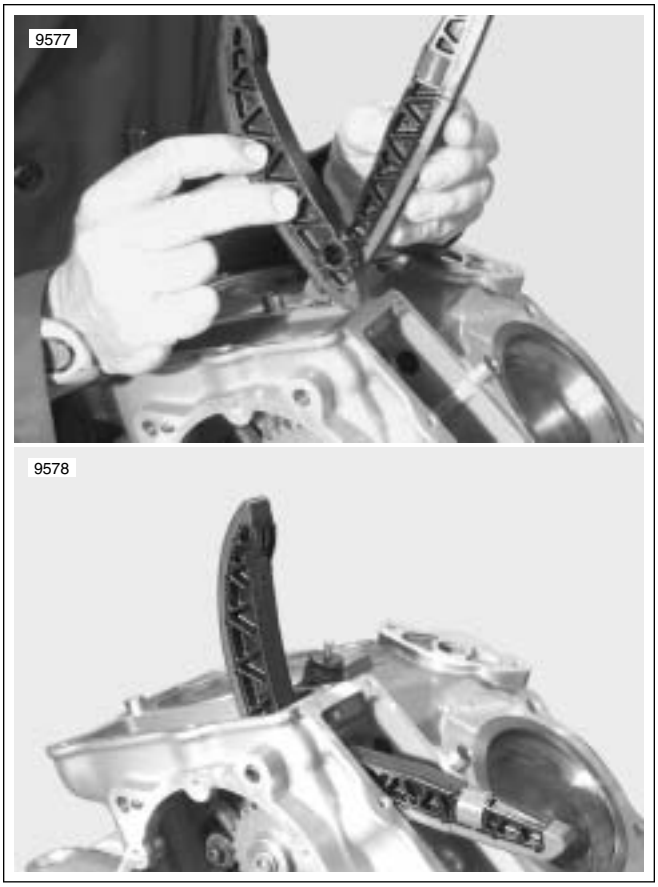


Figure 3-250. Front Hydraulic and Rear Fixed Cam Chain Tensioner

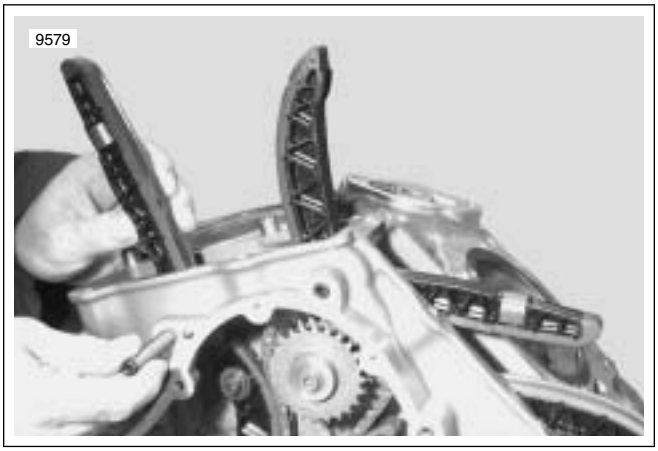


Figure 3-251. Front Cylinder Fixed Cam Chain Tensioner

CYLINDER HEADS 3.21

GENERAL

Cylinder head removal is part of top end disassembly. See 3.10 TOP END DISASSEMBLY.

Clean and examine heads carefully before installation. If heads, values, guides or springs require service, see 3.11 CYLINDER HEAD SERVICE.

If heads have been serviced, remove cam journal caps and cams prior to cylinder head installation. The cams will be re-installed after the heads have been installed and the head bolts torqued to specifications. See 3.22 INSTALLING AND TIMING THE CAMS.

Initial valve lash measurement and adjustment are to be completed as part of cylinder head service. However, after torquing the cylinder head and installing the cam drive and timing the cams, valve lash should be measured and a valve lash calculation worksheet completed. See 1.24 VALVE LASH.

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-45491	Tappet compressing tool

1. Place head gasket on rear cylinder with TOP marking facing up.

NOTE

Note the head gaskets are different for each head and are marked TOP.

2. See Figure 3-252. Make sure tensioner is locked in head as shown.

NOTE

Tensioner position is the same in both rear and front cylinder head.

3. See Figure 3-253. Use Harley-Davidson Motorcycle Oil 20W50 to lubricate the four main head bolts. Lubricate the threads and under the bolt head.

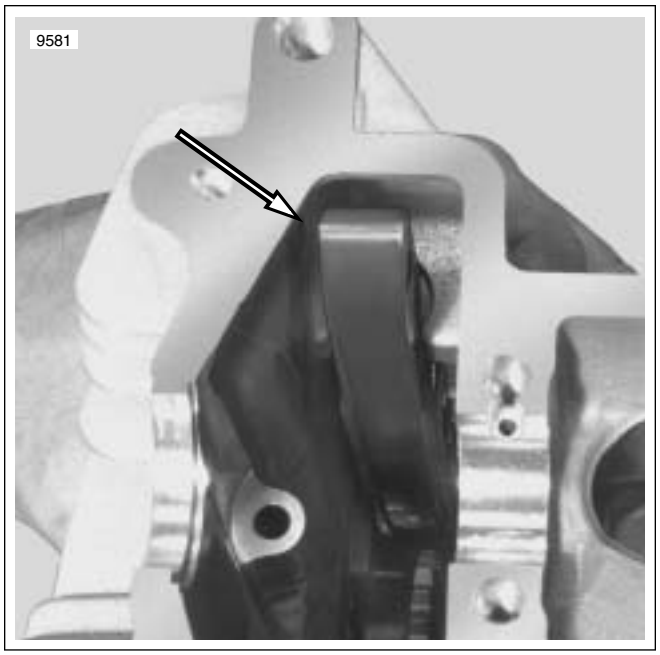


Figure 3-252. Tensioner Position In Cylinder Head

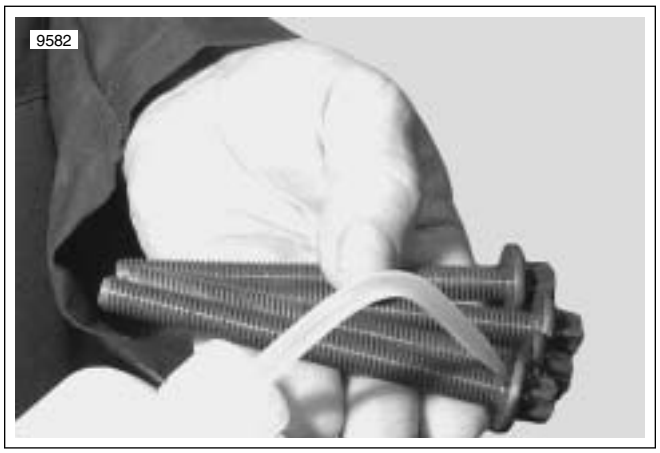


Figure 3-253. Lubricate Head Bolts

4. See Figure 3-254. Tighten four main head bolts in sequence.
   a. See Figure 3-255. Tighten bolts to 35 Nm (25.8 ft-lbs).
   b. Loosen each bolt one full turn (360°).
   c. Tighten bolts to 20 Nm (14.8 ft-lbs).
   d. Position the Torque Angle Gauge (Snap-on Part No. TA360) per instruction sheet and tighten bolt an additional 90°.

NOTE

The notation for this torque sequence is written:
35 Nm - 360°, 20 Nm + 90°.

5. See Figure 3-256. Install 5 mm head bolts. The two long bolts are installed in positions 6 and 7. The short bolt is installed in position 5.
6. Tighten 5 mm head bolts to 9.7 Nm (86 **in-lbs**).

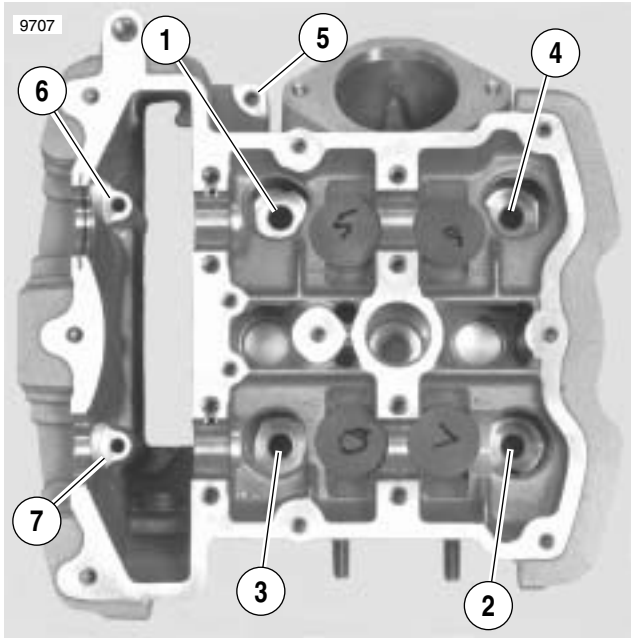


Figure 3-254. Head Bolt Torque Sequence (rear cylinder head)

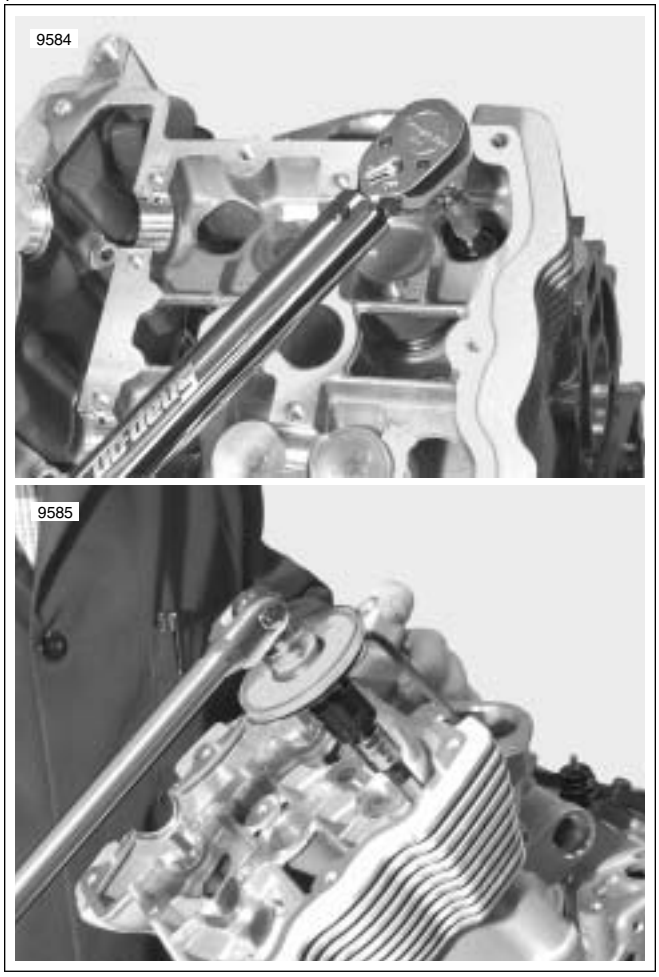


Figure 3-255. Tighten Head Bolts

Figure 3-256. 5 mm Head Fasteners @ 9.7 Nm (86 in-lbs)

INSTALLING AND TIMING THE CAMS 3.22

PROCEDURE

PART NO.	SPECIALTY TOOL
HD-45314	Crankshaft rotating wrench
HD-45653	TDC positioning tool
HD-45306	Crankshaft locking pin
HD-45491	Tappet compressing tool

1. Install TDC POSITIONING TOOL (HD-45653) in front cylinder spark plug hole.

CAUTION

Never insert a foreign object, such as a screwdriver, in the spark plug hole. Engine damage can result.

CAUTION

DO NOT ROTATE ENGINE CLOCKWISE. This is opposite the normal engine operation. Engine damage can result.

2. Using CRANKSHAFT ROTATING WRENCH (HD-45314) rotate the engine counter-clockwise (direction of operation). Note when exhaust valve is closing (TDC positioning tool will start to extend as valve closes) and engine is approaching TDC.
3. When the TDC reference tool is fully extended, remove plug from timing hole on right side of engine and insert CRANKSHAFT LOCKING PIN (HD-45306).
4. The CRANKSHAFT LOCKING PIN should insert flush with engine case. It may be necessary to gently rock the crankshaft using the CRANKSHAFT ROTATING WRENCH (HD-45314) to lock engine at exact TDC.
5. Remove TDC POSITIONING TOOL (HD-45653) from front cylinder spark plug hole.
6. If removed, record shim thickness for reference and install all eight shims in their original location. Use a magnet to position the shim and push into place with finger.
7. Reinstall tappets in their original locations.

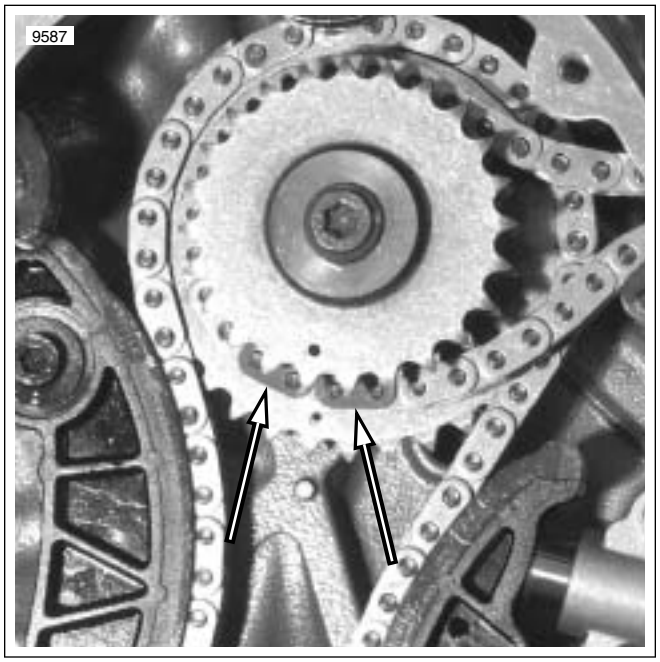


Figure 3-257. Copper Timing Links

NOTES

- *Match front cam chain to front cylinder cams and rear cylinder chain to rear cylinder cams by marks or tags placed during disassembly. The chains are installed with the brass links outboard or on the alternator side. See 3.10 TOP END DISASSEMBLY.*
- *The front cylinder cams are identified by the spacer boss location on the outside of the cam sprockets. The exhaust cam is the cam with the ACR (automatic compression release) on the end of the cam shaft. See Figure 3-258.*
- *The rear cylinder cams are identified by the spacer boss location on the inside of the cam sprockets. See Figure 3-259. The exhaust cam is the cam with the ACR (automatic compression release) on the end of the cam shaft. See Figure 3-260.*

NOTE

- *If cam caps are removed, install and finger tighten before applying torque.*
- *When the cam covers are off the heads, always inspect the ACR components. The pivot pin must be secure and the rocker arm must rotate back and forth freely around the pin.*

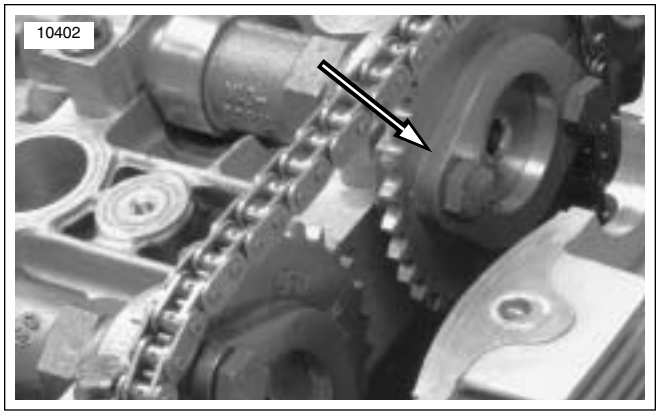


Figure 3-258. Spacer Boss on Outside (front cylinder cam sprocket)

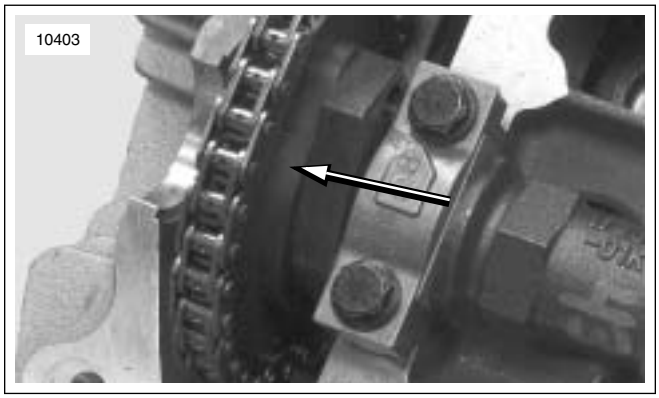


Figure 3-259. Spacer Boss on Inside (rear cylinder cam sprocket)

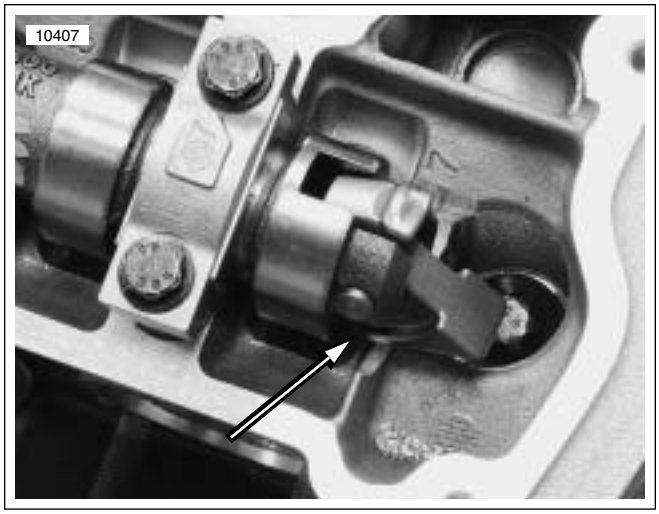
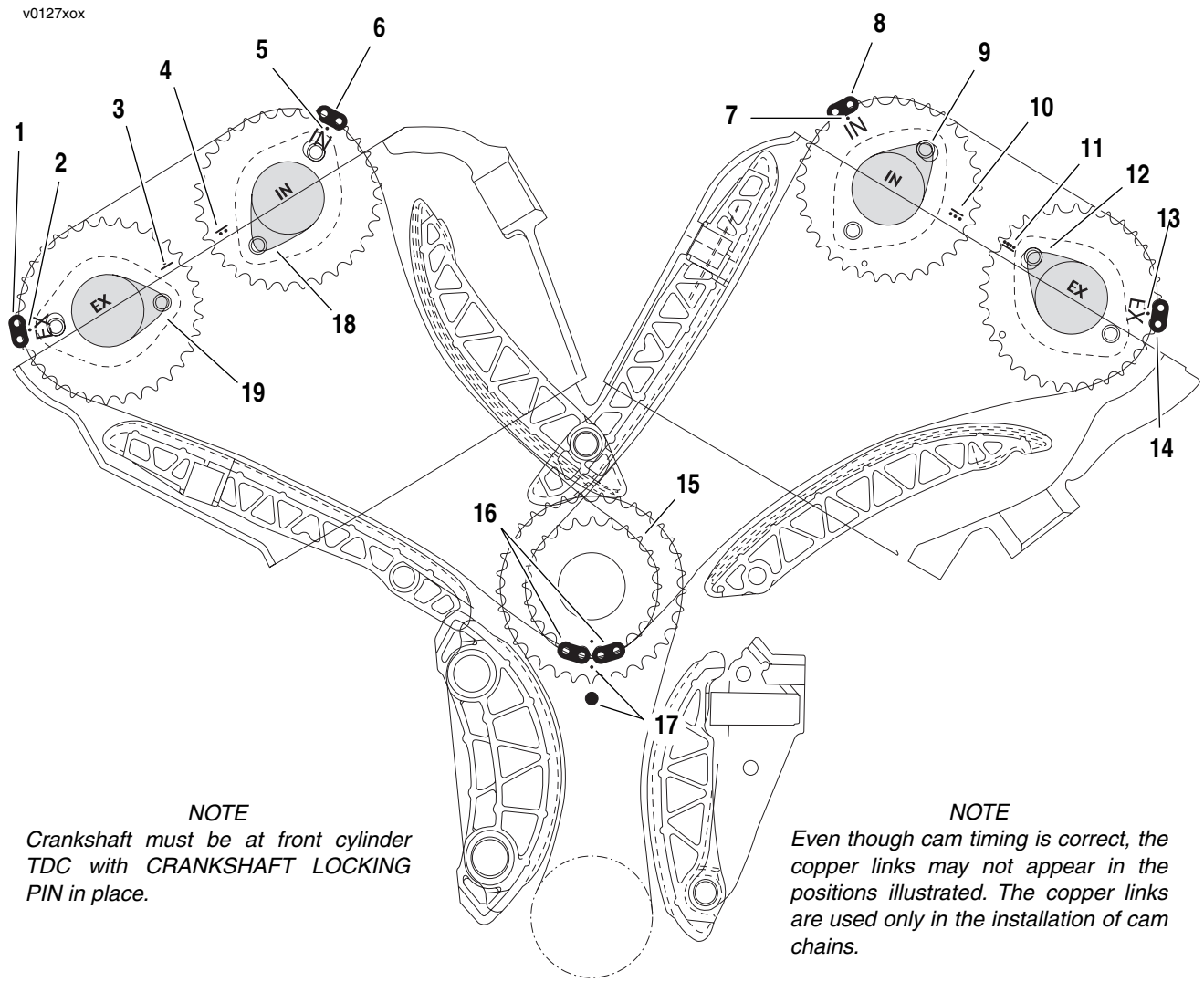


Figure 3-260. ACR (automatic compression release) (exhaust cam)



1. **Front exhaust chain copper link**
2. **Front exhaust EX timing dot**
3. **Front exhaust alignment mark (single dot and line)**
4. **Front intake alignment mark (two dots and line)**
5. **Front intake IN timing dot**
6. **Front intake copper link**
7. **Rear intake IN timing dot**
8. **Rear intake copper link**
9. **Rear intake cam lobe position**
10. **Rear intake alignment mark (three dots and line)**
11. **Rear exhaust alignment mark (four dots and line)**
12. **Rear exhaust cam lobe position**
13. **Rear exhaust EX timing dot**
14. **Rear exhaust chain copper link**
15. **Triple sprocket**
16. **Twin cam drive chain copper links**
17. **Triple sprocket to crankcases alignment marks**
18. **Front intake cam lobe position**
19. **Front exhaust cam lobe position**

Figure 3-261. Cam Drive Timing Marks (secondary cam chain tensioners are not shown)

8. See Figure 3-257. Insert rear cylinder cam drive chain down from the rear head. Wrap chain around middle row of triple sprocket teeth with the copper chain links straddling the triple gear timing marks.

9. See Figure 3-263. Lubricate cam journals, lobes, and tappets with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.

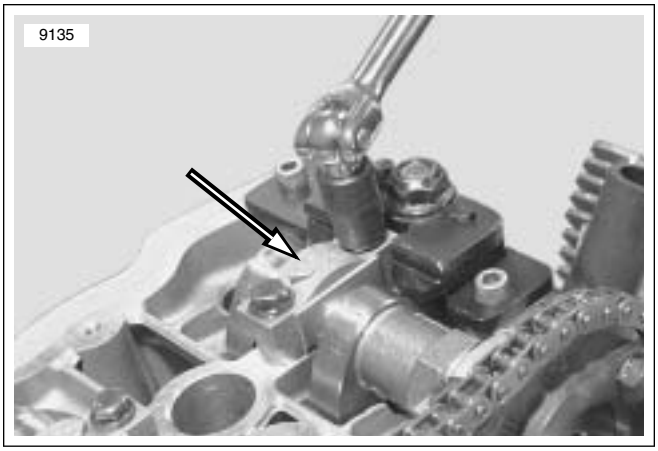


Figure 3-262. Cam Bearing Cap

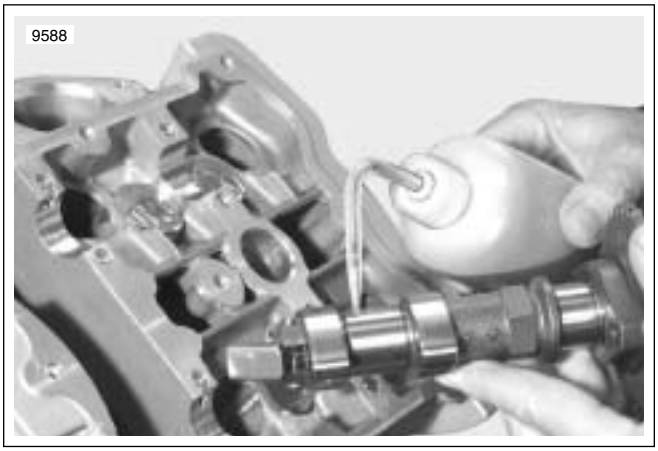


Figure 3-263. Lubricate Cam

10. See Figure 3-261. Insert rear exhaust cam into cylinder head and rotate cam sprocket so single copper link (14) straddles the single dot timing mark labeled as EX (13).
11. Insert rear intake cam into cylinder head and rotate cam sprocket so single copper link (8) straddles the single dot timing mark labeled IN (7).
12. See Figure 3-261. For the rear cylinder, verify that:
    a. The single copper link (8) on the cam drive chain straddle the IN single dot (7) on the intake cam sprocket.
    b. The single copper link (14) on the cam drive chain straddles the EX single dot (13) on the exhaust cam sprocket.
    c. The three dot timing line (10) on the intake cam sprocket is aligned with the four dot timing line (11) on the exhaust cam sprocket.
    d. The rear intake and exhaust cam lobes (9, 12) are positioned as illustrated.
13. See Figure 3-265. Lubricate cam journal caps and fasteners.
14. Cam journal caps are numbered. Install cam journal caps with corresponding number on head, arrow pointing to center of head.
15. Tighten cam journal caps to 9.7 Nm (86 **in-lbs**).
16. See Figure 3-267. Install rear cylinder cam chain tensioner and tighten to 100 Nm (74 ft-lbs).

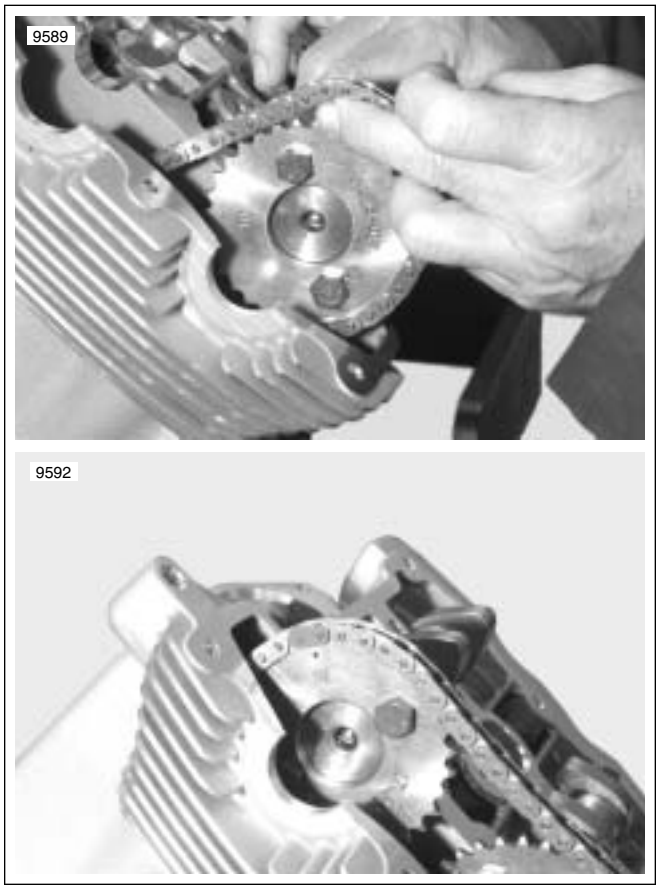


Figure 3-264. Rear Cylinder Cams

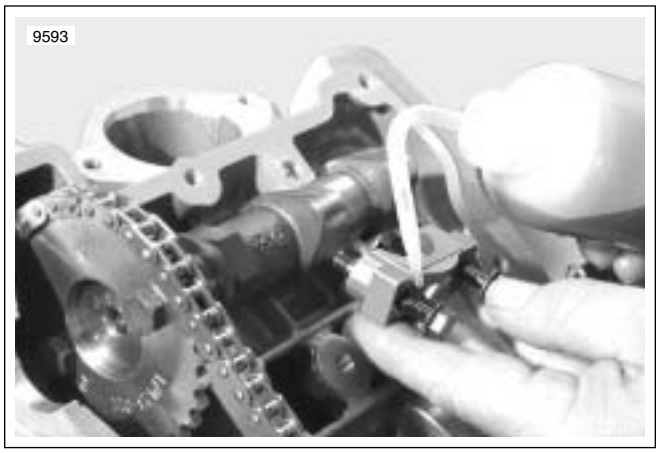


Figure 3-265. Lubricate Journal Caps and Fasteners

CAUTION

NEVER rotate engine with secondary cam chain tensioner removed. Engine damage and/or loss of correct timing will occur.

17. See Figure 3-266. Install TAPPET COMPRESSING TOOL (HD-45491) on front cylinder.
    a. Loosen 19 mm nut on tappet compressing tool.
    b. Using the cam cover fasteners install the tappet compressing tool.
18. Tighten 19 mm nut to compress tappets.
19. See Figure 3-268. Insert front cylinder timing cam drive chain down from the front head. Wrap chain around front row of triple sprocket teeth with the copper chain links straddling the triple gear timing marks.
20. Lubricate cam journals, lobes, and tappets with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.
21. See Figure 3-261. Insert front exhaust cam into cylinder head and rotate cam sprocket so single copper link (1) straddles the single dot timing mark labeled EX (2).

Figure 3-266. Tappet Compressing Tool (typical)

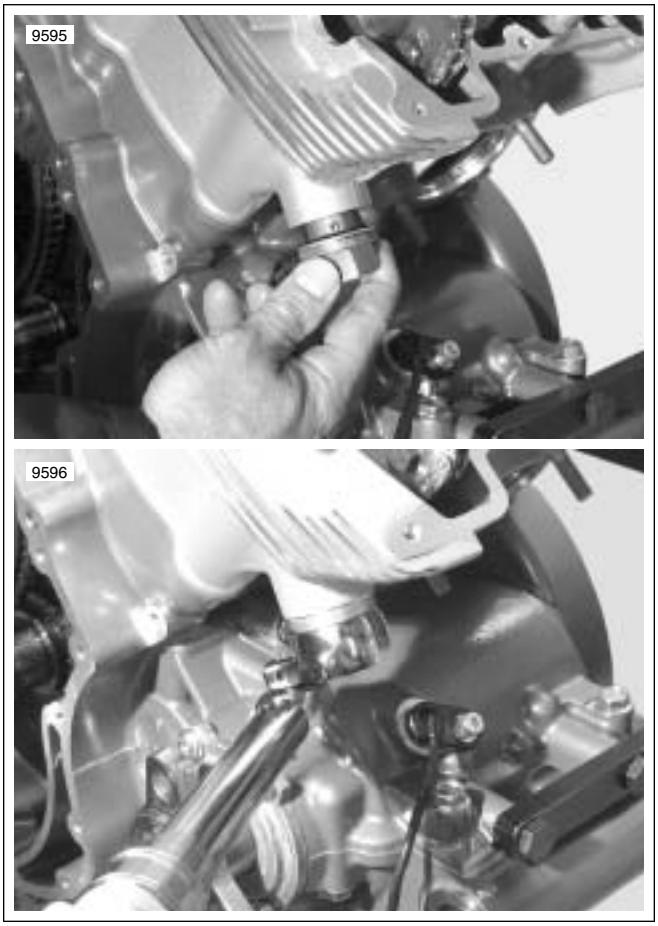


Figure 3-267. Rear Cylinder Cam Chain Tensioner

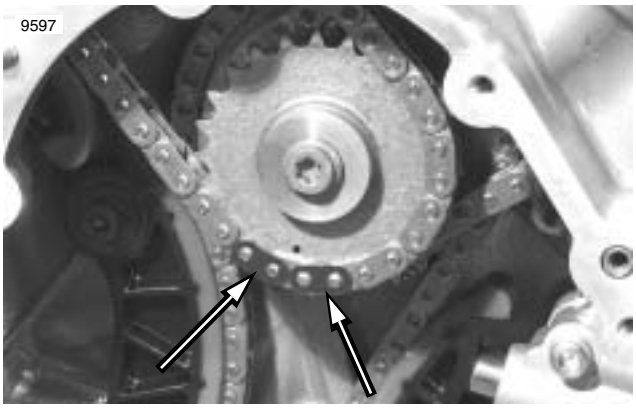


Figure 3-268. Copper Links

22. Insert front intake cam into cylinder head and rotate cam sprocket so single copper link (6) straddles the single dot timing mark labeled IN (5).
23. Install and tighten cam journal caps to 9.7 Nm (86 **in-lbs**).
24. See Figure 3-261. For the rear cylinder, verify that:
    a. The single copper link (6) on the cam drive chain straddle the IN single dot (5) on the intake cam sprocket.
    b. The single copper link (14) on the cam drive chain straddles the EX single dot (13) on the exhaust cam sprocket.
    c. The two dot timing line (4) on the intake cam sprocket is aligned with the one dot timing line (3) on the exhaust cam sprocket.
    d. The front intake and exhaust cam lobes (18, 19) are positioned as illustrated.

NOTE

Compare lobe positions of each cam shaft to Figure 3-261. If timing marks are correct but camshaft lobes are incorrect, the drive sprocket could be installed incorrectly on the camshaft.

25. Remove TAPPET COMPRESSION TOOL.
26. Install front cylinder cam chain tensioner and tighten to 100 Nm (74 ft-lbs).
27. Check valve lash and adjust as necessary. See 1.24 VALVE LASH.
28. Remove CRANKSHAFT LOCKING PIN (HD-45306).
29. Install the engine timing plug and tighten to 23 Nm (17 ft lbs).
30. When lash adjustment is verified install and tighten spark plugs to 23 Nm (17 ft-lbs).

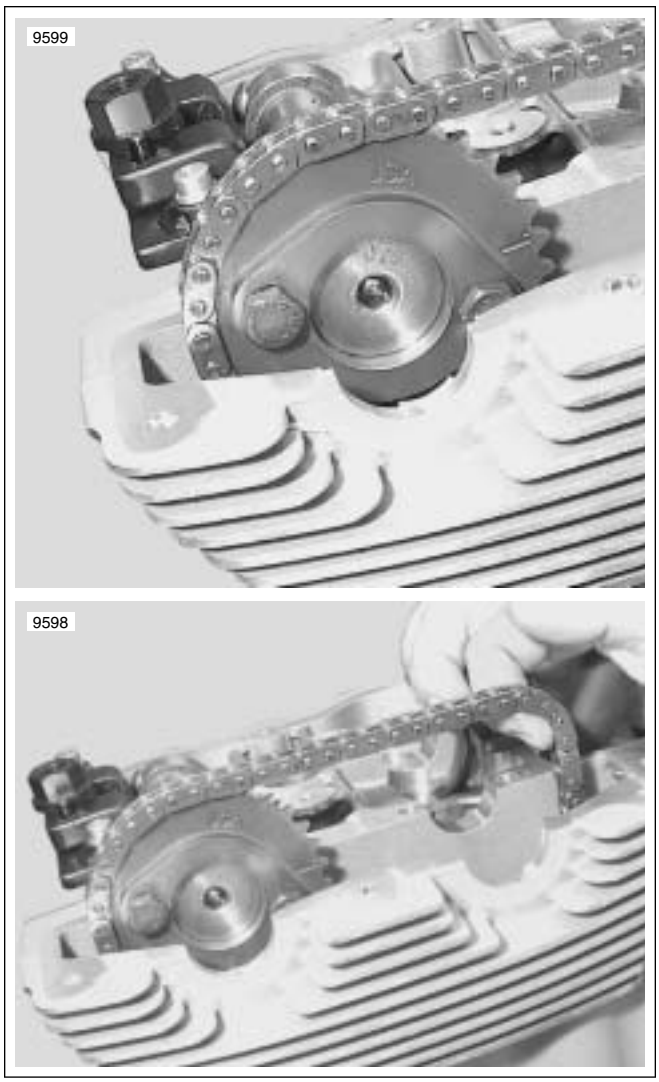


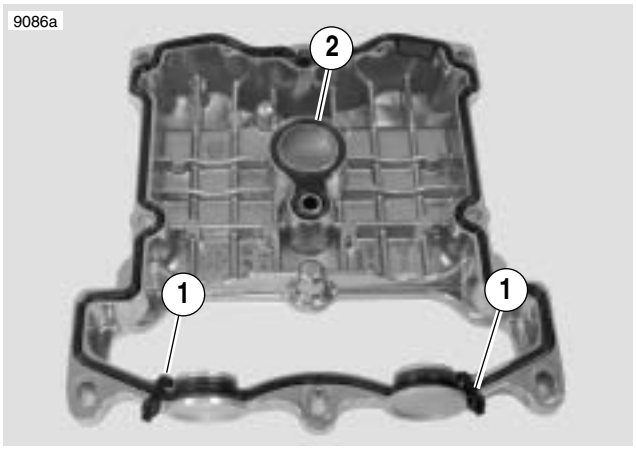
Figure 3-269. Cam Chain Alignment

31. Clean cam covers and install **new** gaskets. The rectangular tab fits in the corresponding knockout around the gasket groove in the head.
32. See Figure 3-270. Use cable straps (1) to help retain gasket as shown.
33. Visually check to ensure spark plug hole gasket (3) is in place.

NOTE

See Figure 3-271. The seal of the spark plug hole gasket is correct when the tapered edge of the gasket is in the cam cover and the double lipped side of the rings is facing out to mate with the flat of the cylinder head.

34. See Figure 3-272. Apply a 1 mm (0.04 in.) bead of silicone along both half-moon shaped recesses in cylinder head. Cam cover gasket must stay in place, a small amount of sealer, lightly applied will help.
35. See Figure 3-270. Carefully install cam cover and gasket. Cable straps will allow the cam bore plug to be moved horizontally to clear cam drive gears.
36. Remove cable straps.
37. Place small cam cover in position.
38. Insert GASKET ALIGNMENT TOOL (HD-45340).
39. See Figure 3-273. Install fasteners in cam cover and tighten to 9.7 Nm (86 **in-lbs**) in sequence.



1. Cable strap
2. Spark plug hole gasket

Figure 3-270. Cam Cover Gaskets

Figure 3-271. Spark Plug Hole Gasket (double lipped side)

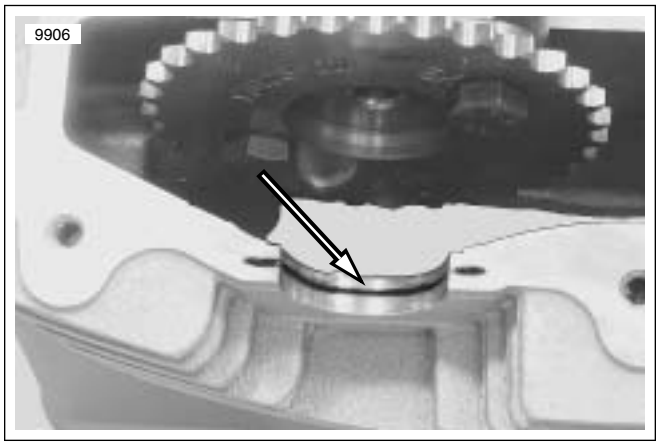


Figure 3-272. Silicone Bead Pattern in Head Recesses

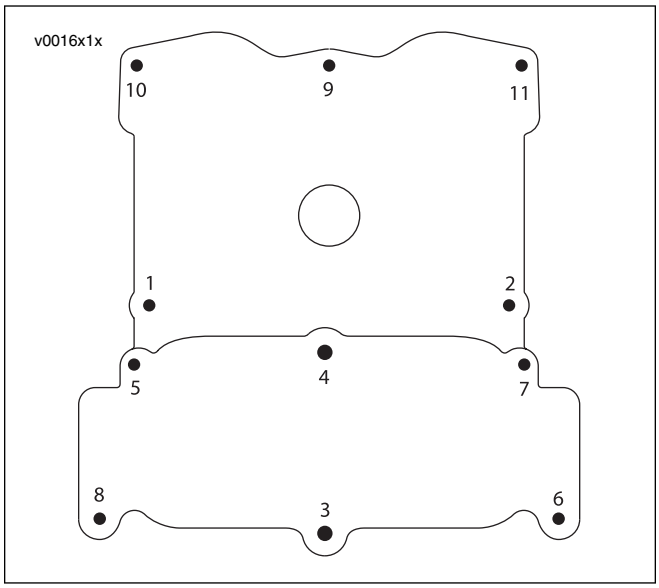


Figure 3-273. Cam Cover Torque Sequence

40. See Figure 3-274. Install needle roller bearing, ball gear, and thrust washer on crankshaft.
41. See Figure 3-275. Snap the retaining ring in place.
42. See Figure 3-276. Install starter limiter gear assembly and starter limiter fastener. Tighten fastener to 46 Nm (34 ft-lbs).
43. Install rotor shell with the integral ball clutch.
44. See Figure 3-277. Hold the 36 mm rotor nut with CRANKSHAFT ROTATING WRENCH (HD-45314) and tighten rotor nut.
    a. Tighten to 82 Nm (60 ft-lbs).
    b. Loosen one full turn.
    c. Tighten to 180 Nm (132 ft-lbs).

NOTE

Check to be certain woodruff key has not slipped out of keyway during assembly.

45. Replace alternator cover. See 8.8 ALTERNATOR.
46. Install oil pump. See 3.12 OIL PUMP.
47. Install clutch and clutch cover. See 3.13 CLUTCH.
48. Install water pump. See 6.5 WATER PUMP.

Figure 3-274. Needle Roller Bearing, Ball Gear, Thrust Washer and Retaining Ring

Figure 3-275. Retaining Ring

Figure 3-276. Starter Limiter Gear and Fastener

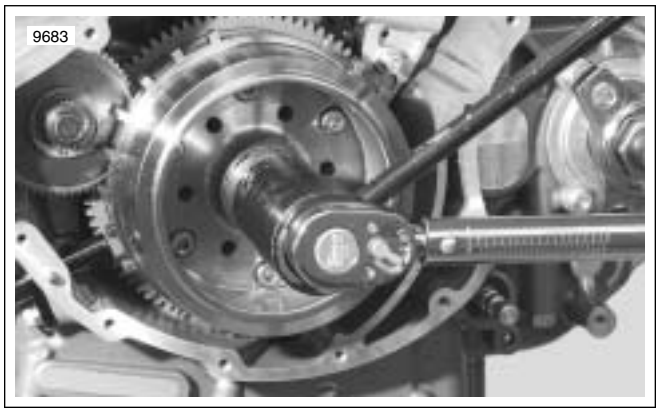


Figure 3-277. Install Rotor Shell

NOTES

Table Of Contents

FUEL SYSTEM 4

SPECIFICATIONS 4.1

Table 4-1. Capacities

FUEL TANK CAPACITY	GALLONS	LITERS
Total (VRSCA/VRSCD)	3.7	14
Total (VRSCR)	5.0	18.9

TORQUE VALUES

ITEM	TORQUE		NOTES
Fuel plate lock ring (VRSCA/VRSCD)	54-61 Nm	40-45 ft-lbs	page 4-4
Fuel tank bracket bolts (All)	40-48 Nm	30-35 ft-lbs	page 4-9
Purge solenoid bolt (All)	6-10 Nm	53-88 **in-lbs**	page 4-12
Mud flap stud plate fasteners (VRSCA/VRSCD)	8-12 Nm	71-106 **in-lbs**	page 4-12
Electronic control module (ECM) mounting bolts	6-10 Nm	53-88 **in-lbs**	page 4-28
Throttle position sensor (TPS) screws	2.0-2.8 Nm	18-25 **in-lbs**	page 4-30
Engine coolant temperature sensor (ECT)	23 Nm	17 ft-lbs	page 4-32
Throttle body clamps	1.25 Nm	11 **in-lbs**	page 4-32
Idle air control (IAC) screws	2.8-4.0 Nm	25-35 **in-lbs**	Use new screws of LOCTITE THREADLOCKER 243, page 4-33
Manifold air pressure sensor (MAP)	6-10 Nm	53-88 **in-lbs**	page 4-35
Fuel rail Schrader valve	6.8-9.6 Nm	60-85 **in-lbs**	page 4-36
Fuel injector clip screws	2.0-2.8 Nm	18-25 **in-lbs**	page 4-37
Fuel pressure regulator clip	2.0-2.8 Nm	18-25 **in-lbs**	page 4-37

Table 4-2. Spark Specifications

IGNITION	DATA
Idle speed	1150 - 1250 RPM
Spark plug size	12 mm
Spark plug gap	0.035 in.
	0.89 mm
Spark plug type	Harley-Davidson No. 10R12A (no substitute)
Ignition coil primary resistance at room temperature	0.3-0.5 ohms
Ignition coil secondary resistance at room temperature	2750-3250 ohms

Table 4-3. Fuse Specifications

ITEM	RATING (AMPERES)
Main fuse	40
Ignition fuse	15
Lighting fuse	15
Accessory fuse	15
Battery fuse	15
Security fuse	15
ECM power fuse	15

NOTE

The fuse labeled “Security” provides basic turn signal functionality on vehicles without a factory-installed security system. Do not remove this fuse or use it as a replacement fuse for other systems.

Table 4-4. Charging Specifications

ITEM	DATA
Battery	12 amp hour/200 CCA
Alternator AC voltage output	16-22 VAC per 1000 RPM
Alternator stator coil resistance	0.1-0.3 ohms
Regulator voltage output @ 3600 rpm	14.4-14.6 volts
Regulator amperes @ 3600 rpm	30-35 amps

FUEL PUMP/FILTER/SENDER ASSEMBLY (VRSCA/VRSCD) 4.2

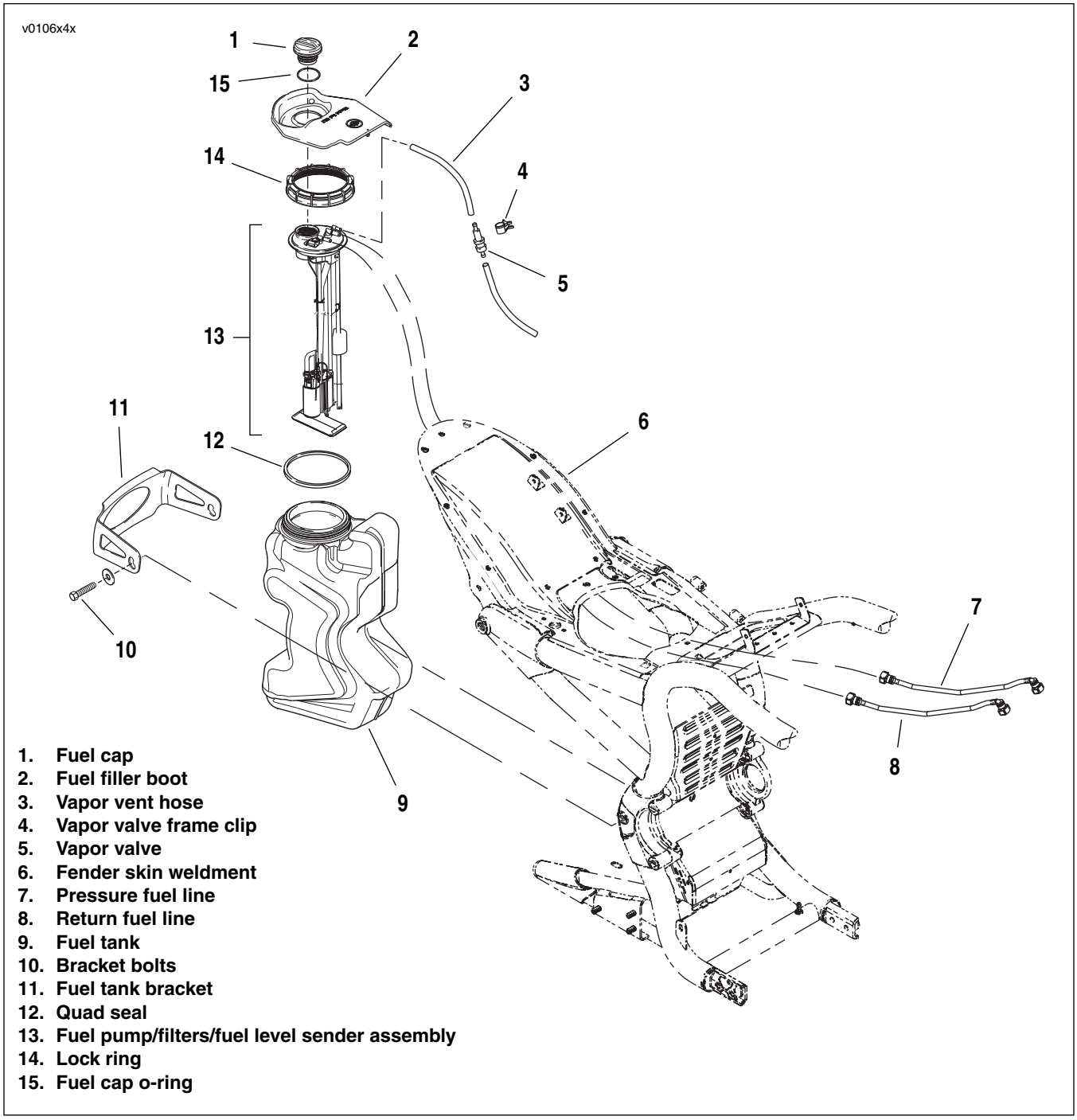
REMOVAL

PART NO.	SPECIALTY TOOL
HD-45324	Fuel cap remover/installer

1. Unlatch and open seat. Remove fuel cap, remove fuel filler boot, and replace fuel cap.

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)



1. **Fuel cap**
2. **Fuel filler boot**
3. **Vapor vent hose**
4. **Vapor valve frame clip**
5. **Vapor valve**
6. **Fender skin weldment**
7. **Pressure fuel line**
8. **Return fuel line**
9. **Fuel tank**
10. **Bracket bolts**
11. **Fuel tank bracket**
12. **Quad seal**
13. **Fuel pump/filters/fuel level sender assembly**
14. **Lock ring**
15. **Fuel cap o-ring**

Figure 4-1. Fuel System

⚠WARNING

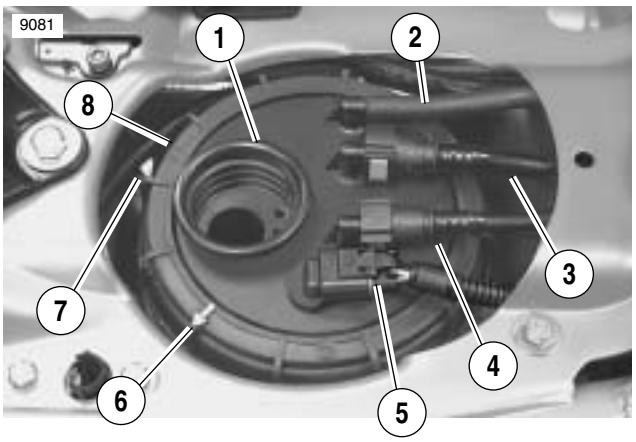
To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

2. Purge the fuel supply line of high pressure gasoline.
   a. See Figure 4-6. Disconnect the fuel pump and sender connector (5) [141] from the top plate (1).
   b. Start the engine and allow the vehicle to run.
   c. When the engine stalls, operate the starter for 3 seconds to remove any remaining fuel from the fuel lines.
3. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
4. Remove airbox. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

5. Disconnect the negative battery cable.
6. Determine how long before the assembly can be re-installed.
   a. If the fuel tank is to be left unattended for any length of time, remove the fuel cap and drain the fuel tank. Use a pump or siphon and an approved gasoline storage container of sufficient capacity.
   b. If the fuel pump/filters/fuel level sender assembly is to be repaired and reinstalled immediately, the open fuel tank can be covered temporarily until the fuel pump/filters/fuel level sender assembly is re-installed.



1. **Top plate**
2. **Vapor vent hose**
3. **Pressure fuel line**
4. **Return fuel line**
5. **Fuel pump & sender connector [141]**
6. **Thread start pointer**
7. **Wiring harness (resistive plug/purge solenoid)**
8. **Lock ring**

Figure 4-2. Fuel Tank Top Plate

⚠WARNING

Gasoline can drain from the fuel line when disconnected from fuel tank. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00260a)

7. See Figure 4-6. At the fuel rail, disconnect the larger pressure fuel line (3) and the smaller return fuel line (4) by pressing blue buttons with thumb and first finger.
8. Disconnect both fuel lines from the fuel tank top plate. Pull the lines out of the rotational path of the lock ring.
9. Use opposite thumbs to push the vapor vent hose (2) off of the outlet tube.

10. Assure that all components are out of the rotational path of the lock ring.

NOTE

Motorcycles not equipped with the H-D Security System will have the siren connector terminated to a cap attached to the wiring harness of the fuel module connector. Pull the siren connector and press the wiring harness out of the way before turning lock ring.

Figure 4-3. Fuel Cap Remover/Installer (HD-45324)

11. See Figure 4-3. Use FUEL CAP REMOVER/INSTALLER (HD-45324) to unthread and lift off the lock ring.

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

12. Lift the fuel pump/filters/fuel level sender assembly out of the fuel tank.

13. Cover the fuel tank opening or drain the fuel tank as required.

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-45324	Fuel cap remover/installer

1. Apply a small dab of silicone gasket sealer at four spots around the bottom side of a **new** quad seal. Install the quad seal onto shoulder of the tank opening. Let the gasket sealer cure for five minutes.

2. See Figure 4-4. Insert fuel pump/filters/fuel level sender assembly into fuel tank. The two side by side tabs (1) on the right underside of the top plate mate to a notch in the collar in the fuel tank allowing the top plate to fall into position and the rubber spacer/bumper (5) on the bottom of the fuel pump/filters/fuel level sender assembly to rest on the bottom of fuel tank.

3. See Figure 4-6. Orient the pointer (6) on the lock ring to point 90 degrees to the left side of the motorcycle. In this position the start of the lock ring threads match the start of the threads on the collar of the opening in the fuel tank. Thread on lock ring. Use FUEL CAP REMOVER/INSTALLER (HD-45324) to tighten the lock ring to 54-61 Nm (40-45 ft-lbs).

4. Mate the fuel pump and sender connector half (5) [141B] while supporting the top plate connector half [141A] with the opposite hand.

NOTE

To avoid bending the connector pins, gently press the socket fuel module connector parallel or straight into the pin fuel module connector on the fuel tank top plate.

5. Install the smaller return fuel line (4) and the larger pressure fuel line (3) while supporting the mating port. Press the lines on until the click is heard that indicates engagement.

⚠WARNING

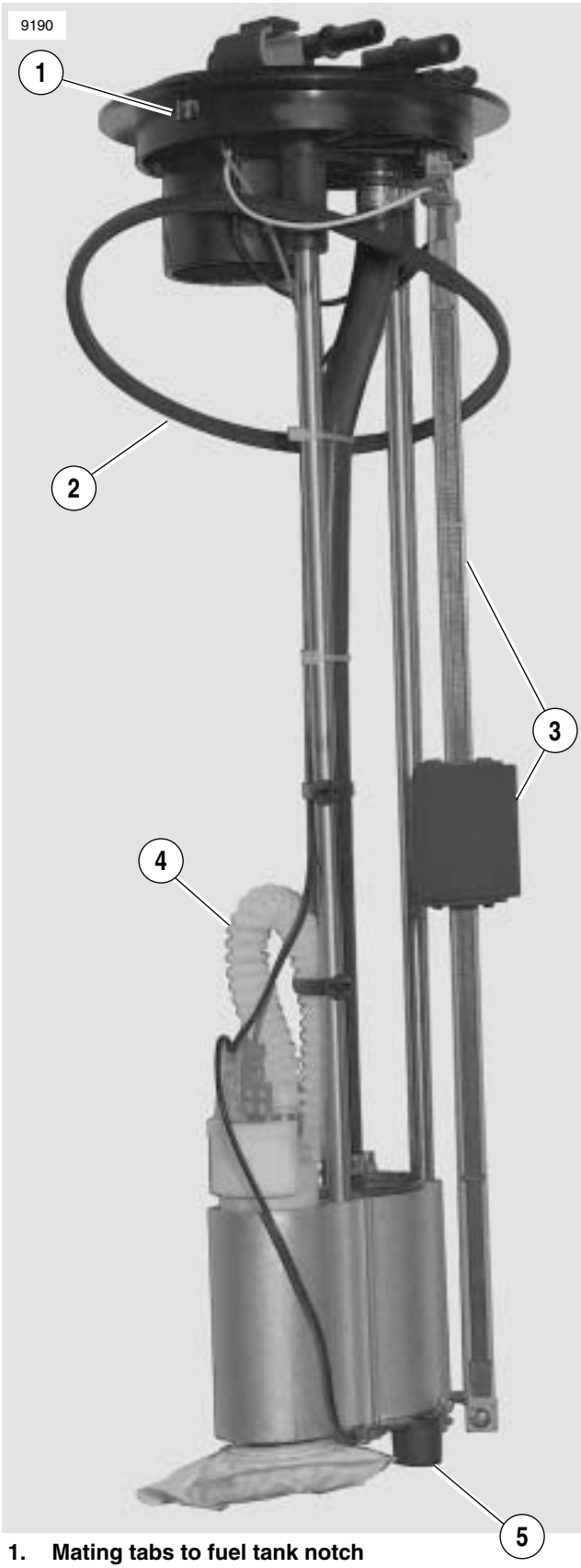
Be sure to connect fuel lines to correct ports and verify fuel lines are properly installed before starting vehicle. Failure to connect fuel lines properly can result in a spray of gasoline when ignition switch is turned on. Gasoline is extremely flammable and explosive which could result in death or serious injury.

6. Attach the pressure (3) and the return (4) fuel lines to the fuel rail.
7. Press on the fuel vapor vent hose (2) while supporting the mating port.
8. Replace fuel filler boot. Fuel as required and replace the fuel cap.

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

9. Connect negative battery cable.
10. Install airbox. See 1.3 AIRBOX AND AIR FILTER.
11. Close and latch seat.
12. Replace the maxi-fuse and right side cover.
13. Check fuel system pressure. See 4.18 FUEL PRESSURE TEST.



1. **Mating tabs to fuel tank notch**
2. **Quad-seal**
3. **Rheostatic slide and fuel level sender float**
4. **Crossover hose**
5. **Rubber spacer/bumper**

Figure 4-4. Fuel Pump/Filter/Sender Assembly

SUCTION SIDE FUEL FILTER

⚠WARNING

Some gasoline will drain from the individual components when disconnected from the fuel pump/filters/fuel level sender assembly. Thoroughly wipe up any spilled fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

See Figure 4-5. The suction side filter (4) filters the fuel as it enters the strained intake of the fuel pump. The suction side filter is replaced at the service interval of 161,000 kilometers (100,000 miles).

PRESSURE SIDE FUEL FILTER

See Figure 4-5. The pressure side filter (2) filters the fuel before it enters the pressure fuel line. The pressure side filter is serviced at a service interval of 161,000 kilometers (100,000 miles) or at anytime the fuel pump is serviced.

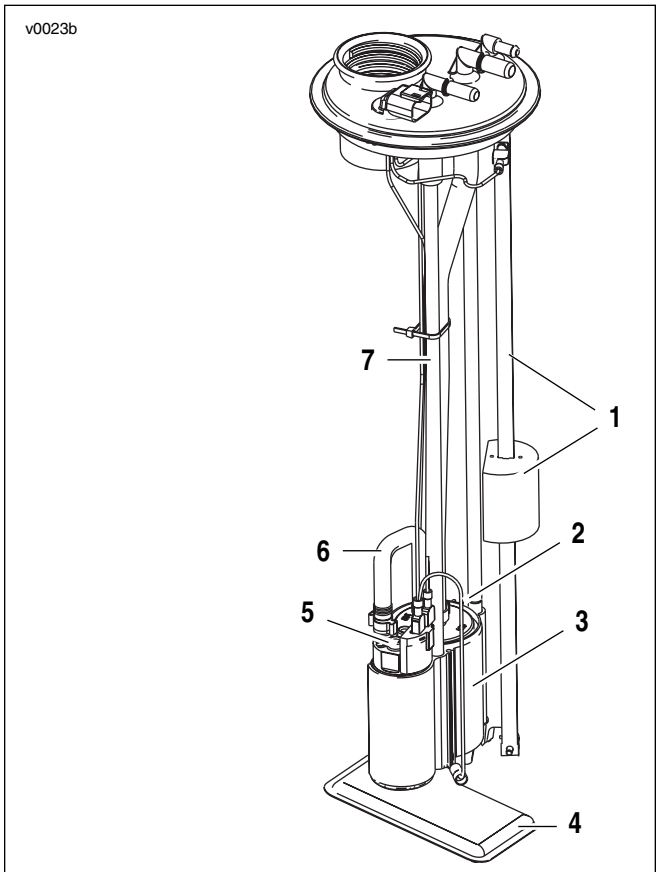
Removal

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

To remove, cut the clamps and disconnect the two hoses (6) from the filter. Press the pressure side filter up and out of the bracket.

Installation

To replace, press a **new** pressure side filter into its bracket up against the bracket stop, replace the fuel crossover hose and the pressure fuel line, and install a **new** clamp over the crossover hose using side of HOSE CLAMP PLIERS (HD-41137).



1. **Sending unit**
2. **Pressure side filter**
3. **Bracket**
4. **Suction side filter**
5. **Fuel pump**
6. **Crossover hose**
7. **Support rod**

Figure 4-5. Fuel Pump/Filters/Fuel Level Sender Assembly

FUEL PUMP

General

The fuel pump pumps fuel from the tank sump and provides filtered, pressurized fuel to the fuel rail. The fuel rail pressure is controlled by a pressure regulator. The injectors receive fuel directly from the fuel rail. The bypass fuel from the pressure regulator is returned to the tank sump via the external fuel return line.

NOTE

Before removing the fuel pump, perform appropriate diagnostics listed in the VRSC Electrical Diagnostic Manual.

Removal

1. See Figure 4-5. Remove the black and red wire leads from the fuel pump (5).
2. Pull the suction side filter off of the inlet port. The retaining ring will remain on the fuel pump.
3. Cut clamp holding crossover hose (6) to pressure side filter and pull fuel crossover hose off pressure side filter.
4. Push fuel pump up and out of its bracket (3).
5. Inspect fuel pump and fuel level sending unit (1) wiring.

CAUTION

Carefully inspect hoses for cuts, tears, holes or other damage. Replace hose if any damage is found. Even the smallest hole can cause a reduction in fuel pressure.

Installation

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

1. See Figure 4-5. Push a **new** fuel pump (5) down into its bracket (3) against the screwed on bracket stop.
2. Route **new** crossover hose (6) on the side of the support rod (7) opposite the fuel level sender float.
3. Install **new** clamps over **new** crossover hose (6) and attach to the pressure side filter using side of HOSE CLAMP PLIERS (HD-41137).
4. If required, replace fuel pump wiring or fuel level sender wiring.

CAUTION

Do not replace the special teflon coated fuel pump wiring with ordinary bulk wire. Ordinary insulation materials may deteriorate when in contact with gasoline.

5. Press the black and red wire leads onto the clips.
6. Press a **new** suction side filter (4) onto the strainer inlet at the bottom of the fuel pump (5).
7. Install fuel pump/filters/fuel level sender assembly into gas tank. See 4.2 FUEL PUMP/FILTER/SENDER ASSEMBLY (VRSCA/VRSCD).
8. After installation of fuel pump/filters/fuel level sender assembly, verify fuel pump operation with a fuel system pressure test. See 4.18 FUEL PRESSURE TEST.

FUEL LEVEL SENDER

WARNING

Some gasoline will drain from the individual components when disconnected from the fuel pump/filters/fuel level sender assembly. Thoroughly wipe up any spilled fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

Removal

1. See Figure 4-9. Remove yellow wire lead and the double black wire leads from the rheostatic slide (3).
2. Inspect and replace as required all fuel level sender wiring.
3. Remove the retaining screw at the bottom of the rheostatic slide (3).
4. Pull the rheostatic slide (3) from its slot in the top plate and remove the fuel level sender float (3).

Installation

1. See Figure 4-9. Slide rheostatic slide with fuel level sender float (3) into notch in top plate. Orient the scale so that the graduated side of the slide faces the fuel level wire connector on the top plate.
2. With the fuel level sender float on the slide (3) so that the half-round side faces out, thread in and tighten the retaining screw into the stop bracket at the bottom of the rheostatic slide (3).
3. Attach the yellow wire lead to the graduated side of the rheostatic slide (3) and the double black lead to the opposite side.
4. Install fuel pump/filters/fuel level sender assembly into gas tank. See 4.2 FUEL PUMP/FILTER/SENDER ASSEMBLY (VRSCA/VRSCD).
5. Verify that the fuel gauge indicates the corresponding fuel level after installing the fuel pump/filters/fuel level sender assembly.

FUEL PUMP/FILTER/SENDER ASSEMBLY (VRSCR) 4.3

REMOVAL

1. Open seat.

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

⚠WARNING

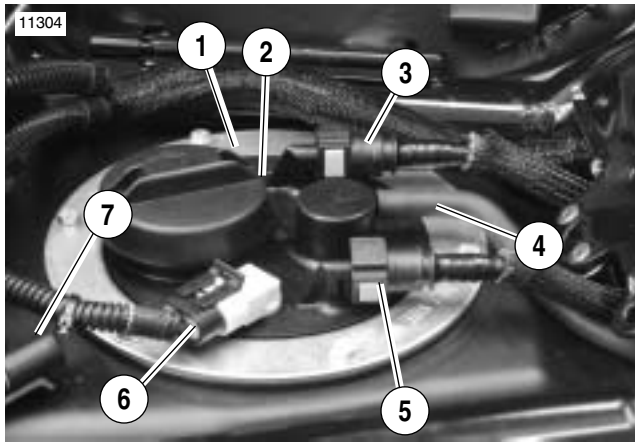
To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

2. Purge the fuel supply line of high pressure gasoline.
   a. See Figure 4-6. Disconnect the fuel pump and sender connector (6) [141] from the top plate (2).
   b. Start the engine and allow the vehicle to run.
   c. When the engine stalls, operate the starter for 3 seconds to remove any remaining fuel from the fuel lines.
3. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
4. Remove airbox. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

5. Disconnect the negative battery cable.
6. Determine how long before the assembly can be reinstalled.
   a. If the fuel tank is to be left unattended for any length of time, remove the fuel cap and drain the fuel tank. Use a pump or siphon and an approved gasoline storage container of sufficient capacity.
   b. If the fuel pump/filters/fuel level sender assembly is to be repaired and reinstalled immediately, the open fuel tank can be covered temporarily until the fuel pump/filters/fuel level sender assembly is reinstalled.



1. **Top plate retaining ring**
2. **Top plate**
3. **Pressure fuel line**
4. **Vapor vent hose**
5. **Return fuel line**
6. **Fuel pump & sender connector [141]**
7. **Wiring harness resistive plug/purge solenoid**

Figure 4-6. Fuel Tank Top Plate

⚠WARNING

Gasoline can drain from the fuel line when disconnected from fuel tank. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00260a)

7. See Figure 4-6. At the fuel rail, disconnect the pressure fuel line (3), return fuel line (5) by pressing blue buttons with thumb and first finger.
8. Disconnect both fuel lines from the fuel tank top plate. Pull the lines out of the rotational path of the lock ring.
9. Use opposite thumbs to push the vapor vent hose (4) off of the outlet tube.

10. Check that all components are out of the path of the retaining ring.

NOTE

Motorcycles not equipped with the H-D Security System will have the siren connector terminated to a cap attached to the wiring harness of the fuel module connector. Pull the siren connector and press the wiring harness out of the way before turning lock ring.

11. See Figure 4-6. Remove six fasteners from top plate retaining ring (1) and remove retaining ring.

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

12. Lift the fuel pump/filters/fuel level sender assembly out of the fuel tank.
13. Cover the fuel tank opening or drain the fuel tank as required.

INSTALLATION

1. See Figure 4-7. Apply a small dab of silicone gasket sealer to the **new** fuel tank cap o-ring. Install the quad seal onto shoulder of the tank opening. Let the gasket sealer cure for five minutes.

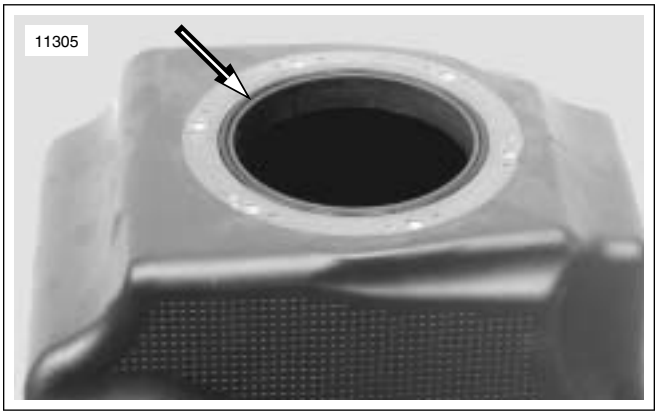


Figure 4-7. Fuel Tank O-ring

2. Insert fuel pump/filters/fuel level sender assembly into fuel tank. Allow the top plate to fall into position and rubber spacer/bumper on bottom of fuel pump/filters/fuel level sender assembly to rest on the bottom of fuel tank.
3. See Figure 4-8. Install top plate retaining ring and fasteners. Tighten to 5-6 Nm (44-53 **in-lbs**).
4. Mate the fuel pump and sender connector half (6)[141B] while supporting the top plate connector half [141A] with the opposite hand.

NOTE

To avoid bending the connector pins, gently press the socket fuel module connector parallel or straight into the pin fuel module connector on the fuel tank top plate.

5. See Figure 4-6. Install the return fuel line and the larger pressure fuel line while supporting the mating port. Press the lines on until the click is heard that indicates engagement.

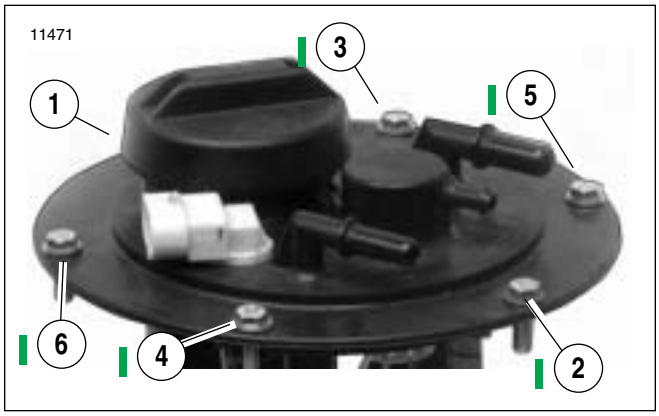


Figure 4-8. Torque Sequence

⚠WARNING

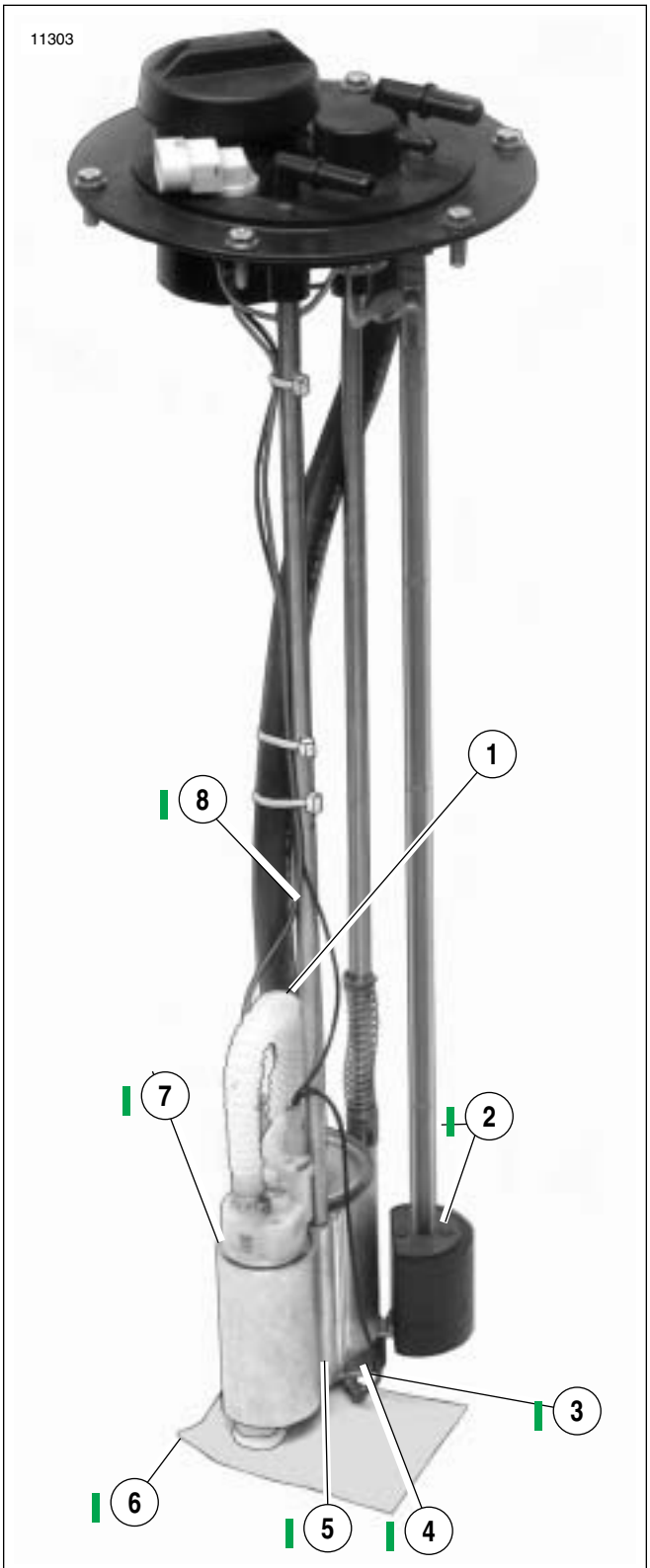
Be sure to connect fuel lines to correct ports and verify fuel lines are properly installed before starting vehicle. Failure to connect fuel lines properly can result in a spray of gasoline when ignition switch is turned on. Gasoline is extremely flammable and explosive which could result in death or serious injury.

6. Press on the fuel vapor vent hose while supporting the mating port.

⚠WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

7. Connect negative battery cable.
8. Install airbox. See 1.3 AIRBOX AND AIR FILTER.
9. Close seat.
10. Replace the maxi-fuse and right side cover.
11. Check fuel system pressure. See 4.18 FUEL PRESSURE TEST.



1. Crossover hose
2. Rheostatic slide and fuel level sender float
3. Rubber spacer/bumper
4. Pressure side filter
5. Bracket
6. Suction side filter
7. Fuel pump
8. Support rod

Figure 4-9. Fuel Pump/Filter/Sender Assembly

SUCTION SIDE FUEL FILTER

⚠WARNING

Gasoline will drain from components when disconnected from the fuel pump/filters/fuel level sender assembly. Gasoline is extremely flammable and highly explosive. Wipe up spilled fuel immediately and dispose of rags in a suitable manner.

See Figure 4-9. The suction side filter filters the fuel as it enters the strained intake of the fuel pump. The suction side filter is replaced at the service interval of 161,000 kilometers (100,000 miles).

PRESSURE SIDE FUEL FILTER

See Figure 4-9. The pressure side filter filters the fuel before it enters the pressure fuel line. The pressure side filter is serviced at a service interval of 161,000 kilometers (100,000 miles) or at anytime the fuel pump is serviced.

Removal

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

To remove, cut the clamps and disconnect the two hoses (6) from the filter. Press the pressure side filter up and out of the bracket.

Installation

To replace, press a **new** pressure side filter into its bracket up against the bracket stop, replace the fuel crossover hose and the pressure fuel line, and install a **new** clamp over the crossover hose using side of HOSE CLAMP PLIERS (HD-41137).

CAUTION

Carefully inspect hoses for cuts, tears, holes or other damage. Replace hose if any damage is found. Even the smallest hole can cause a reduction in fuel pressure.

Installation

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

1. See Figure 4-9. Push a **new** fuel pump down into its bracket against the screwed on bracket stop.
2. Route **new** crossover hose on the side of the support rod opposite the fuel level sender float.
3. Install **new** clamps over **new** crossover hose and attach to the pressure side filter using side of HOSE CLAMP PLIERS (HD-41137).
4. If required, replace fuel pump wiring or fuel level sender wiring.

CAUTION

Do not replace the special teflon coated fuel pump wiring with ordinary bulk wire. Ordinary insulation materials may deteriorate when in contact with gasoline.

5. Press the black and red wire leads onto the clips.
6. Press a **new** suction side filter onto the strainer inlet at the bottom of the fuel pump.
7. Install fuel pump/filters/fuel level sender assembly into gas tank. See 4.3 FUEL PUMP/FILTER/SENDER ASSEMBLY (VRSCR).
8. After installation of fuel pump/filters/fuel level sender assembly, verify fuel pump operation with a fuel system pressure test. See 4.18 FUEL PRESSURE TEST.

FUEL PUMP

General

The fuel pump pumps fuel from the tank sump and provides filtered, pressurized fuel to the fuel rail. The fuel rail pressure is controlled by a pressure regulator. The injectors receive fuel directly from the fuel rail. The bypass fuel from the pressure regulator is returned to the tank sump via the external fuel return line.

NOTE

Before removing the fuel pump, perform appropriate diagnostics listed in the VRSC Electrical Diagnostic Manual.

Removal

1. See Figure 4-9. Remove the black and red wire leads from the fuel pump.
2. Pull the suction side filter off of the inlet port. The retaining ring will remain on the fuel pump.
3. Cut clamp holding crossover hose to pressure side filter and pull fuel crossover hose off pressure side filter.
4. Push fuel pump up and out of its bracket.
5. Inspect fuel pump and fuel level sending unit wiring.

FUEL LEVEL SENDER

⚠WARNING

Gasoline will drain from components when disconnected from the fuel pump/filters/fuel level sender assembly. Gasoline is extremely flammable and highly explosive. Wipe up spilled fuel immediately and dispose of rags in a suitable manner.

Removal

1. See Figure 4-9. Remove yellow wire lead and the double black wire leads from the rheostatic slide.
2. Inspect and replace as required all fuel level sender wiring.
3. Remove the retaining screw at the bottom of the rheostatic slide.
4. Pull the rheostatic slide from its slot in the top plate and remove the fuel level sender float.

Installation

1. See Figure 4-9. Slide rheostatic slide with fuel level sender float into notch in top plate. Orient the scale so that the graduated side of the slide faces the fuel level wire connector on the top plate.
2. With the fuel level sender float on the slide so that the half-round side faces out, thread in and tighten the retaining screw into the stop bracket at the bottom of the rheostatic slide.
3. Attach the yellow wire lead to the graduated side of the rheostatic slide and the double black lead to the opposite side.
4. Install fuel pump/filters/fuel level sender assembly into gas tank. See 4.3 FUEL PUMP/FILTER/SENDER ASSEMBLY (VRSCR)
5. Verify that the fuel gauge indicates the corresponding fuel level after installing the fuel pump/filters/fuel level sender assembly.

FUEL TANK 4.4

REMOVAL

1. Purge the fuel supply line of high pressure gasoline.
   a. Disconnect the fuel module connector from the top plate. See 4.2 FUEL PUMP/FILTER/SENDER ASSEMBLY (VRSCA/VRSCD), or 4.3 FUEL PUMP/FILTER/SENDER ASSEMBLY (VRSCR)
   b. Start the engine and allow the vehicle to run. When the engine stalls, operate the starter for 3 second
2. Remove right side cover.
3. Locate and remove maxi-fuse. See 8.5 MAXI-FUSE.
4. Open seat.
5. Remove the airbox. See 1.3 AIRBOX AND AIR FILTER.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

6. Disconnect the negative battery cable.
7. Remove rear wheel and rear fork. See 2.30 REAR WHEEL and 2.46 REAR FORK.
8. Remove passenger pillion and rear fender.
9. Remove the two fasteners fastening the mud flap plate at rear of voltage regulator. Remove the mud flap by pinching side tabs to disengage from seat pan.
10. Remove fuel cap and fuel filler boot. Replace fuel cap.

WARNING

Gasoline can drain from the fuel line when disconnected from fuel tank. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00260a)

11. See Figure 4-6. At the fuel rail, disconnect the larger pressure fuel line and the smaller return fuel line by pressing blue buttons with thumb and first finger. Then disconnect both fuel lines from the fuel tank top plate.
12. Use opposite thumbs to push the vapor vent hose off of the outlet tube.
13. Unbolt the two bolts and their washers on the bracket that holds the fuel tank against the frame.
14. Remove fuel tank from motorcycle.

WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

15. If the fuel tank is going to be stored prior to service, either drain using a siphon or cap the pressure fuel port, the return fuel port, and the vapor vent port on the fuel tank top plate.

CLEANING AND INSPECTING

1. Drain the fuel tank. Use a common pump or siphon and an approved gasoline storage container of sufficient capacity.
2. Remove fuel pump/filter/fuel level sender assembly from tank.
3. Clean the tank interior with commercial cleaning solvent or a soap and water solution. Shake the tank to agitate the cleaning agent.
4. Flush the tank thoroughly after cleaning and allow it to air dry.

WARNING

Extreme caution should be taken when repairing tanks. If all traces of fuel are not purged, an open flame repair may result in a tank explosion which could result in death or serious injury.

5. Inspect the evaporative emissions system vapor valve line and pressure and return fuel lines for cuts, cracks or holes. Replace lines as needed.
6. Inspect the tank for leaks and other damage. If damaged, replace it.

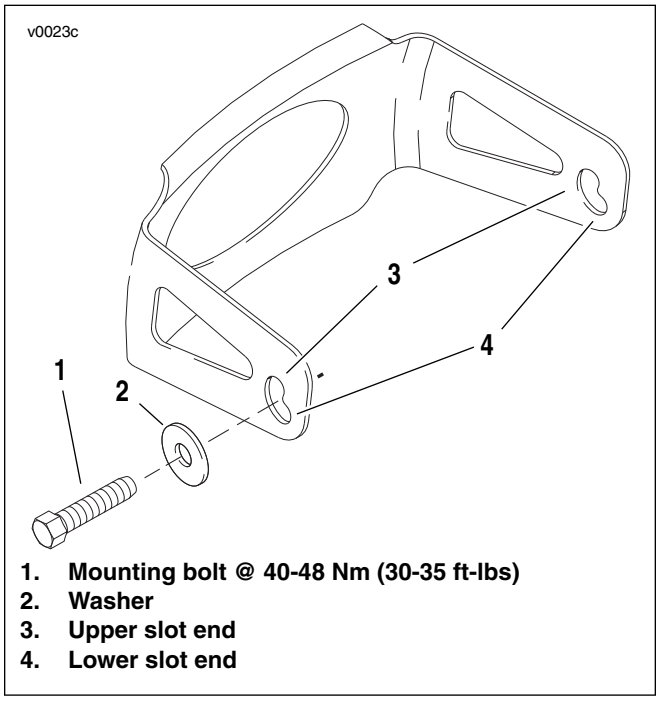
INSTALLATION

1. Position the fuel tank in the frame and position the fuel tank mounting bracket to the frame.
2. See Figure 4-10. Loosely thread in the two mounting bolts and washers through the forward lower slot ends of the bracket into the threaded boss on the frame.
3. Evenly press forward and downward on the bracket against the fuel tank until the mounting bolts slide back and up into the upper slot ends.
4. Tighten the mounting bolts to 40-48 Nm (30-35 ft-lbs).
5. Connect the fuel module connector while supporting the top plate connector half with the opposite hand.
6. See Figure 4-6. Install the smaller return line and the larger pressure line while supporting the mating port. Press the lines on until the click is heard that indicates engagement.
7. Attach the larger pressure line and the smaller return line to the fuel rail.
8. Press on the vapor vent hose while supporting the mating port with the opposite hand.
9. Install mud flap and stud plate.
10. Install rear fender and passenger pillion.
11. Install rear fork. See 2.46 REAR FORK.
12. Install the rear wheel assembly and adjust the drive belt tension. See 2.30 REAR WHEEL.

⚠ WARNING

When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00330a)

13. Fuel the motorcycle as required. Replace the fuel cap.
14. Install airbox. See 1.3 AIRBOX AND AIR FILTER.
15. Connect negative battery cable.
16. Install airbox cover by positioning the airbox cover with the locating pins in the holes on the frame tabs. Turn bail-head fastener 1/4 turn clockwise.
17. Close and latch seat.
18. Replace the maxi-fuse and the side cover.
19. Check fuel system pressure. See 4.18 FUEL PRESSURE TEST.



1. **Mounting bolt @ 40-48 Nm (30-35 ft-lbs)**
2. **Washer**
3. **Upper slot end**
4. **Lower slot end**

Figure 4-10. Fuel Tank Mounting Bracket (typical) (VRSCA shown)

VAPOR VALVE (VRSCA/VRSCD) 4.5

GENERAL

See Figure 4-11. The vapor valve is mounted to the left hand frame rail directly in front of the fuel tank. Hydrocarbon vapors in the fuel tank are vented through a hose to the vapor valve. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.

⚠WARNING

Excessive pressure can build in the fuel tank if vapor valve is not mounted vertically with long fitting to top. Leaks due to excessive pressure can cause a fire or explosion, which could result in death or serious injury. (00265a)

REPLACEMENT

Pull off the upper formed fuel vapor valve hose and the lower hose. Remove the vapor valve from its clip. When installing the vapor valve, place the valve back into the clip with the long necked end at the top.

NOTE

On non-California models, the bottom hose is vented to the atmosphere. On California models, the hose from the vapor valve bottom fitting goes to a evaporative (EVAP) emissions control system. See 4.7 EVAP. EMISSIONS CONTROL: CALIF. (VRSCA/VRSCD).

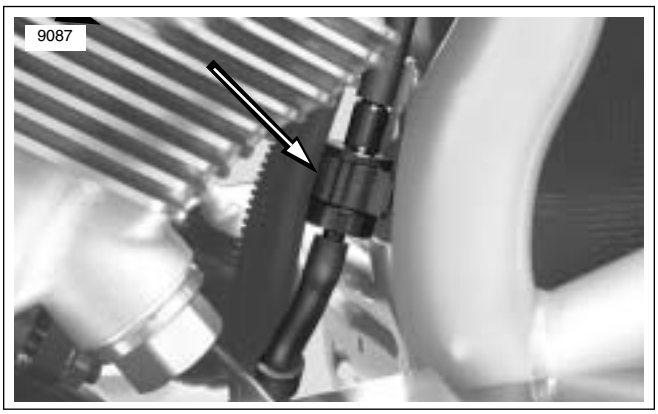


Figure 4-11. Vapor Valve

RESISTIVE PLUG

California models have a purge solenoid to allow hydrocarbon vapor to flow from the charcoal canister to the throttle body.

See Figure 4-12. All non-California models have a resistive plug connected to the purge solenoid connector. The diagnostic system will display the same diagnostic codes whether a resistive plug is in place or the connection is made to a purge solenoid.

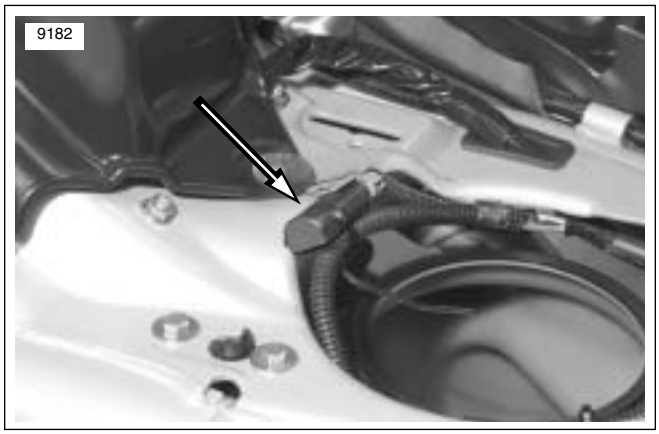


Figure 4-12. Resistive Plug

VAPOR VALVE (VRSCR) 4.6

GENERAL

See Figure 4-13. The vapor valve is mounted in the fuel tank top plate. Hydrocarbon vapors in the fuel tank are vented through the vapor valve and then through the vapor valve hose to the charcoal canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.

REPLACEMENT

The vapor valve is integrated into the fuel tank top plate and is not individually replaceable. If replacement is necessary, the fuel tank top plate must be replaced.

NOTE

On non-California models, the bottom hose is vented to the atmosphere. On California models, the hose from the vapor valve bottom fitting goes to a evaporative (EVAP) emissions control system. See 4.8 EVAP. EMISSIONS CONTROL: CA MODELS (VRSCR).

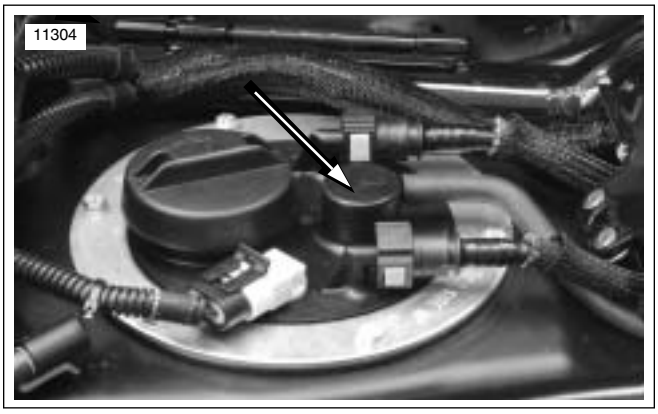


Figure 4-13. Vapor Valve

RESISTIVE PLUG

California models have a purge solenoid to allow hydrocarbon vapor to flow from the charcoal canister to the throttle body.

See Figure 4-14. All non-California models have a resistive plug connected to the purge solenoid connector. The diagnostic system will display the same diagnostic codes whether a resistive plug is in place or the connection is made to a purge solenoid.

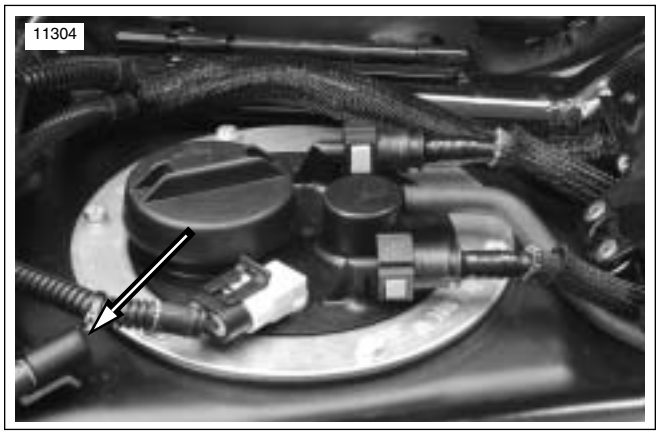


Figure 4-14. Resistive Plug

EVAP. EMISSIONS CONTROL: CALIF. (VRSCA/VRSCD) 4.7

GENERAL

Harley-Davidson motorcycles sold in the state of California are equipped with an evaporative (EVAP) emissions control system. The EVAP system prevents fuel hydrocarbon vapors from escaping into the atmosphere and is designed to meet the California Air Resource Board (CARB) regulations in effect at the time of manufacture.

The EVAP functions in the following manner:

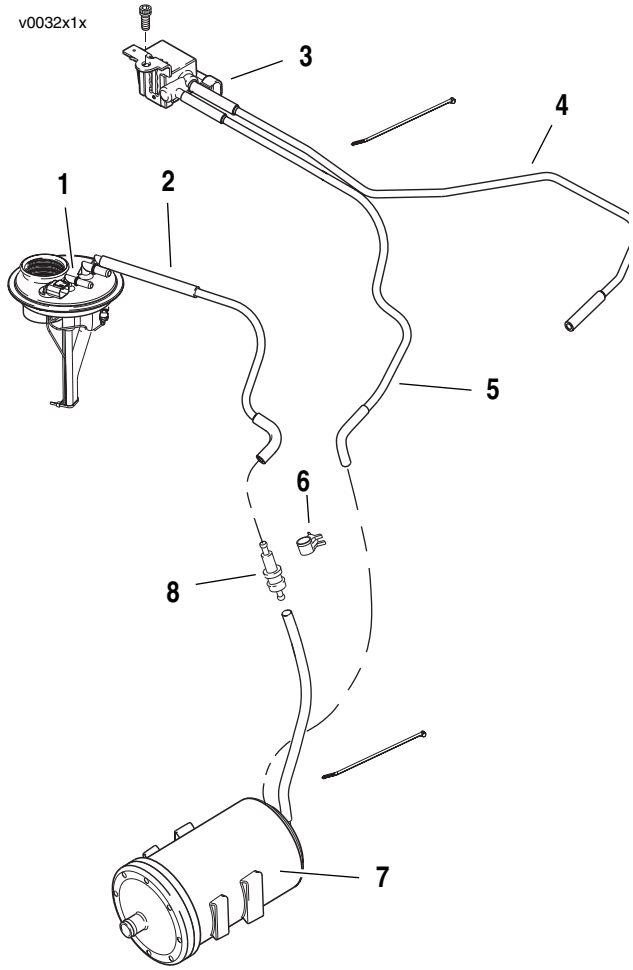
- Hydrocarbon vapors in the fuel tank are directed through the vapor valve and stored in the charcoal canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.
- When the engine is running, intake venturi negative pressure (vacuum) draws off the hydrocarbon vapors from the charcoal canister when the purge solenoid is open. These vapors pass through the intake and are burned as part of normal combustion in the engine. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed, or low vehicle speed.

⚠WARNING

Keep evaporative emissions vent lines away from exhaust and engine. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00266a)

NOTE

The EVAP system has been designed to operate with a minimum of maintenance. Check that all hoses are properly connected, are not pinched or kinked and are routed properly. Improper connections could leak charcoal from canister.



1. **Fuel tank top plate**
2. **Vent hose**
3. **Purge solenoid**
4. **Purge solenoid to throttle body hose**
5. **Canister to purge solenoid hose**
6. **Vapor valve frame clip**
7. **Charcoal canister**
8. **Vapor valve**

Figure 4-15. Evaporative Emissions Control System (VRSCA/VRSCD)

PURGE SOLENOID

The purge solenoid allows hydrocarbon vapor flow from the charcoal canister to the throttle body. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed, or low vehicle speed. The power for the solenoid comes from the system relay. The EVMS provides the path to ground to trigger the purge solenoid.

NOTE

Before removing the purge solenoid, perform diagnostics listed in the VRSC Electrical Diagnostic Manual.

Removal

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

2. Remove the two hex-nuts fastening the mud flap stud plate and the mud flap to the frame fender weldment. Remove the mud flap and the stud plate. See 2.50 REAR FENDER/SUPPORTS (VRSCA/VRSCD).
3. Disconnect the wire connector to the purge solenoid.
4. Gently pull off the charcoal canister to purge solenoid hose.
5. Gently pull off the purge solenoid to throttle body hose.
6. Remove the hold down bolt and the purge solenoid.

Installation

1. Thread the purge solenoid bolt into the threaded fender skin weldment boss and tighten it into the purge solenoid under the fender skin. Tighten to 6-10 Nm (53-88 **in-lbs**).
2. Push on the purge solenoid to throttle body hose.
3. Push on the charcoal canister to purge solenoid hose.
4. Connect the wire connector.
5. Install the mud flap and stud plate to the frame fender weldment. Thread on and tighten the two hex-nuts to 8-12 Nm (71-106 **in-lbs**). See 2.50 REAR FENDER/SUPPORTS (VRSCA/VRSCD).
6. Replace the maxi-fuse and the right side cover.

NOTE

On non-California models the wire connector to the purge solenoid is capped with a resistive plug. However, the diagnostic codes will be the same. See RESISTIVE PLUG in 4.5 VAPOR VALVE (VRSCA/VRSCD).

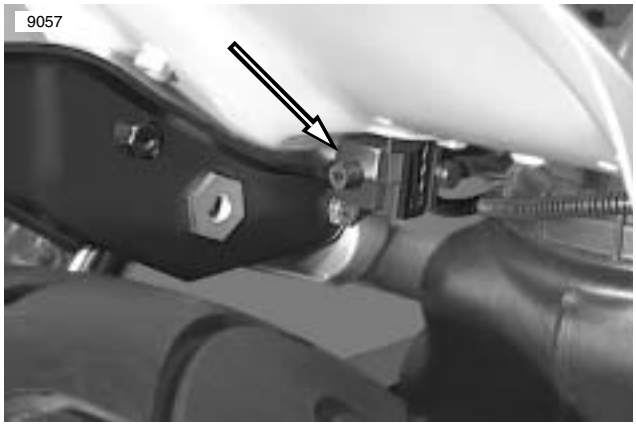


Figure 4-16. Purge Solenoid (mud flap removed)

VAPOR VALVE

WARNING

Excessive pressure can build in the fuel tank if vapor valve is not mounted vertically with long fitting to top. Leaks due to excessive pressure can cause a fire or explosion, which could result in death or serious injury. (00265a)

See Figure 4-11. The vapor valve is mounted to the left hand frame rail directly in front of the fuel tank. See 4.5 VAPOR VALVE (VRSCA/VRSCD).

NOTE

On CA (California) models, the hose from the vapor valve bottom fitting goes to the charcoal EVAP canister.

CHARCOAL CANISTER

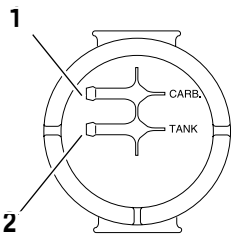
Removal/Inspection

The EVAP charcoal canister is mounted below the swingarm pivot in front of the fuel tank on the shield. It can be accessed from the left side of the motorcycle.

1. See Figure 4-18. Note the two hose connections, CARB (1) and TANK (2), on the left side of the canister. Gently pull the hoses off the charcoal canister.
2. See Figure 4-21. With a screwdriver, press the retention tang (3) in on the bottom of the canister bracket while pressing on the opposite side of the canister. When the bracket on the canister slides just far enough out of the bracket clips (1) to hold the bottom tang in, press in on the top tang (2) and continue to slide the charcoal canister out until it drops free from the bracket clips.
3. Remove charcoal canister.
4. Inspect and replace as required the hose sections to vapor valve.
5. Inspect and replace as required the charcoal canister to purge solenoid hose segments.

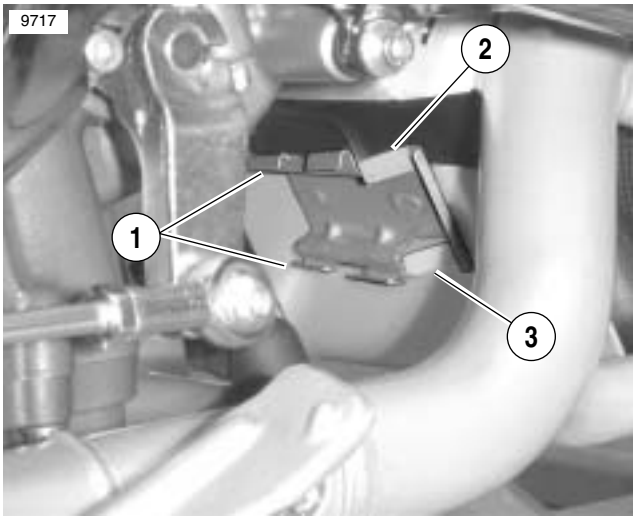
Installation

1. Position the two segments of the brackets on the **new** charcoal canister between the two segments of the canister mounting bracket welded to the frame.
2. See Figure 4-18. Press the canister in toward the bracket until it holds both the upper and lower retention tangs in.
3. Slide the canister into the bracket clips (1) until the tangs (2, 3) snap into place.
4. See Figure 4-17. Attach hoses to left side canister connections (1, 2) as marked.
5. Install **new** EVAP system label on front frame down tube.



1. **Purge hose to canister (CARB)**
2. **Vent hose from vapor valve and fuel tank (TANK)**

Figure 4-17. Charcoal Canister Connections



1. **Bracket clips**
2. **Top retention tang**
3. **Bottom retention tang**

Figure 4-18. Charcoal Canister Mounting Bracket

HOSE ROUTING/REPLACEMENT

NOTE

Record location of cable ties before removal. Install cable ties in same location when installing.

⚠WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

1. Route purge solenoid hoses.
   a. See Figure 4-15. Attach the purge solenoid to throttle body hose (4) to the throttle body.
   b. Route purge solenoid to throttle body hose (4) under frame tube to purge solenoid (3). Install cable ties.
   c. Attach the canister to purge solenoid hose (5) to the purge solenoid.
   d. Route canister to purge solenoid hose (5) to the charcoal canister (7). See Figure 4-17. Attach the hose to the fitting marked CARB (1) on left side of canister. Install cable ties.
2. Route fuel tank vapor vent hoses.
   a. See Figure 4-15. Route fuel tank vent hose (2) along left side of frame to top or long end of the vapor valve (8) clipped on frame tube. Install cable ties. Gently press the hose onto the top plate outlet port and onto the long end of the vapor valve.
   b. See Figure 4-17. Attach short segment of hose to the bottom or short end of the vapor valve and to the fitting marked TANK (2) on left side of the charcoal canister.

EVAP. EMISSIONS CONTROL: CA MODELS (VRSCR) 4.8

GENERAL

Harley-Davidson motorcycles sold in the state of California are equipped with an evaporative (EVAP) emissions control system. The EVAP system prevents fuel hydrocarbon vapors from escaping into the atmosphere and is designed to meet the California Air Resource Board (CARB) regulations in effect at the time of manufacture.

The EVAP functions in the following manner:

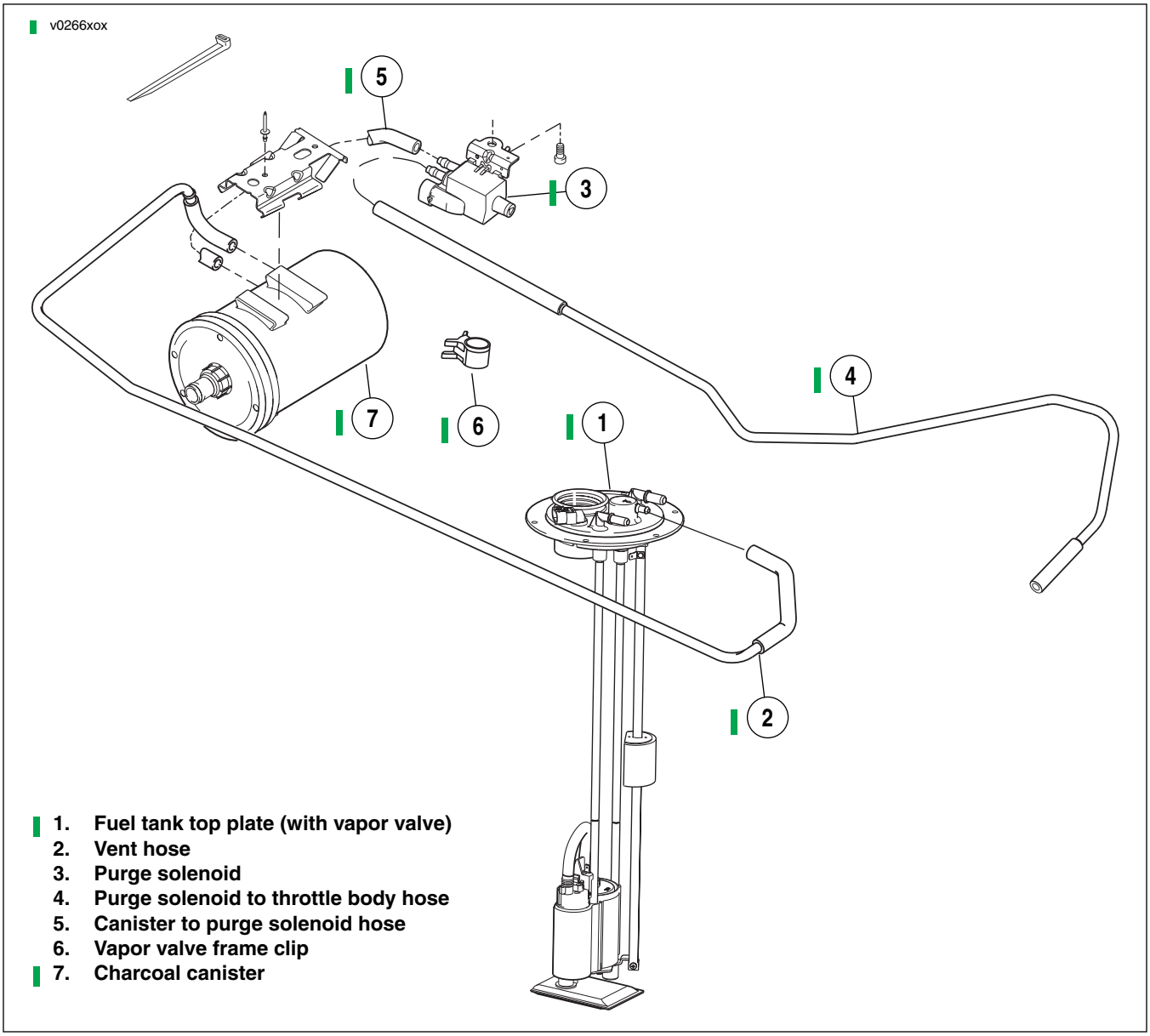
- Hydrocarbon vapors in the fuel tank are directed through the vapor valve and stored in the charcoal canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.
- When the engine is running, intake venturi negative pressure (vacuum) draws off the hydrocarbon vapors from the charcoal canister when the purge solenoid is open. These vapors pass through the intake and are burned as part of normal combustion in the engine. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed, or low vehicle speed.

⚠WARNING

Keep evaporative emissions vent lines away from exhaust and engine. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00266a)

NOTE

The EVAP system has been designed to operate with a minimum of maintenance. Check that all hoses are properly connected, are not pinched or kinked and are routed properly. Improper connections could leak charcoal from canister.



1. **Fuel tank top plate (with vapor valve)**
2. **Vent hose**
3. **Purge solenoid**
4. **Purge solenoid to throttle body hose**
5. **Canister to purge solenoid hose**
6. **Vapor valve frame clip**
7. **Charcoal canister**

Figure 4-19. Evaporative Emissions Control System (VRSCR)

PURGE SOLENOID

The purge solenoid allows hydrocarbon vapor flow from the charcoal canister to the throttle body. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed, or low vehicle speed. The power for the solenoid comes from the system relay. The EVMS provides the path to ground to trigger the purge solenoid.

NOTE

Before removing the purge solenoid, perform diagnostics listed in the VRSC Electrical Diagnostic Manual.

Removal

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

2. Open seat.
3. Remove passenger pillion.
4. Remove rear fender.
5. Remove mud flap under rear fender. See 2.51 REAR FENDER (VRSCR)
6. Disconnect the wire connector to the purge solenoid.
7. Gently pull off the charcoal canister to purge solenoid hose.
8. Gently pull off the purge solenoid to throttle body hose.
9. Remove the hold down bolt and the purge solenoid.

Installation

1. Thread the purge solenoid bolt into the threaded fender skin weldment boss and tighten it into the purge solenoid under the fender skin. Tighten to 6-10 Nm (53-88 **in-lbs**).
2. Push on the purge solenoid to throttle body hose.
3. Push on the charcoal canister to purge solenoid hose.
4. Connect the wire connector.
5. Install mud flap under rear fender.
6. Replace the maxi-fuse and the right side cover.

NOTE

On non-California models the wire connector to the purge solenoid is capped with a resistive plug. However, the diagnostic codes will be the same. See RESISTIVE PLUG in 4.6 VAPOR VALVE (VRSCR).

VAPOR VALVE

⚠WARNING

Excessive pressure can build in the fuel tank if vapor valve is not mounted vertically with long fitting to top. Leaks due to excessive pressure can cause a fire or explosion, which could result in death or serious injury. (00265a)

Figure 4-20. Purge Solenoid (typical) (VRSCA shown)

See Figure 4-13. The vapor valve is mounted to the left hand frame rail directly in front of the fuel tank. See 4.6 VAPOR VALVE (VRSCR).

NOTE

On CA (California) models, the hose from the vapor valve bottom fitting goes to the charcoal EVAP canister.

CHARCOAL CANISTER

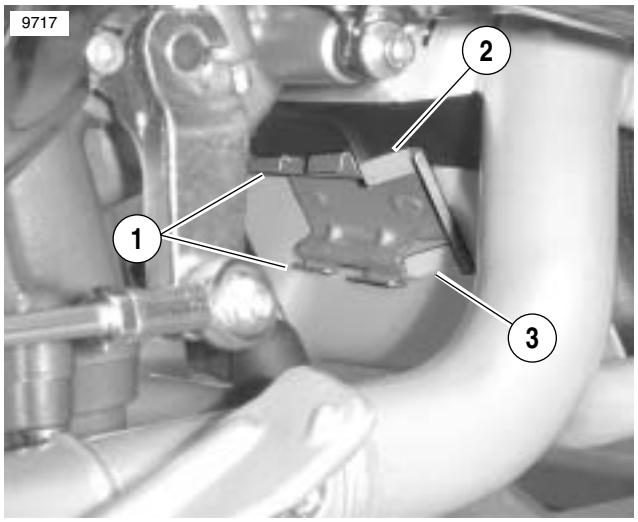
Removal/Inspection

The EVAP charcoal canister is mounted below the rider seat. It can be accessed from the back underside of the motorcycle by removing the mud flap under the rear fender.

1. Label hoses and gently pull the hoses off the charcoal canister.
2. See Figure 4-21. With a screwdriver, press the retention tang (3) in on the bottom of the canister bracket while pressing on the opposite side of the canister. When the bracket on the canister slides just far enough out of the bracket clips (1) to hold the bottom tang in, press in on the top tang (2) and continue to slide the charcoal canister out until it drops free from the bracket clips.
3. Remove charcoal canister.
4. Inspect and replace as required the hose sections to vapor valve.
5. Inspect and replace as required the charcoal canister to purge solenoid hose segments.

Installation

1. Position the two segments of the brackets on the **new** charcoal canister between the two segments of the canister mounting bracket welded to the frame.
2. See Figure 4-21. Press the canister in toward the bracket until it holds both the upper and lower retention tangs in.
3. Slide the canister into the bracket clips (1) until the tangs (2, 3) snap into place.
4. Attach hoses to canister connections as marked before disassembly.
5. Install **new** EVAP system label on front frame down tube.



1. **Bracket clips**
2. **Top retention tang**
3. **Bottom retention tang**

Figure 4-21. Charcoal Canister Mounting Bracket (typical)

HOSE ROUTING/REPLACEMENT

NOTE

Record location of hoses and cable ties before removal. Install hoses and cable ties in same location when installing.

WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

1. Route purge solenoid hoses.
2. Route fuel tank vapor vent hoses.

ELECTRONIC FUEL INJECTION: EFI 4.9

GENERAL

The engine management system consists of the following components:

- Electronic control module (ECM).
- Crank position sensor (CKP).
- Manifold absolute pressure sensor (MAP).
- Intake air temperature sensor (IAT).
- Engine coolant temperature sensor (ECT).
- Idle air control (IAC).
- Throttle position sensor (TP).
- Vehicle speed sensor (VSS).
- Turn signal module (TSM) or optional factory-installed turn signal security module (TSSM). This includes an integrated bank angle sensor (BAS).
- Fan relay.
- System relay.
- Ignition (plug top) coils.
- Purge solenoid (California models only).

The ECM is mounted ahead of the battery behind the left side cover. It computes the spark advance for proper ignition timing and fuel control based on sensor inputs (from CKP, MAP and TP sensor) and controls the low-voltage circuits for the ignition coils and injectors. The Scanalyzer can access the data received by and stored in the ECM.

The ECM contains all of the solid state components used in the ignition system. The dwell time for the ignition coil is also calculated in the microprocessor and is dependent upon battery voltage. The programmed dwell is an added feature to give adequate spark at all speeds. (The ECM has added protection against transient voltages, continuous reverse voltage protection, and damage due to jump starts.) The ECM is fully enclosed to protect it from vibration, dust, water or oil. This unit is a non-repairable item. If it fails, it must be replaced.

The crank position sensor (CKP) is located on the left front of the lower crankcase half. The CKP generates an AC signal which is sent to the ECM where it is used to reference engine position (TDC) and speed. It functions by taking readings off the 22 teeth on the alternator rotor (two teeth are missing to establish a reference point).

The MAP sensor is located on top of the front intake manifold. The MAP sensor monitors the intake manifold pressure (vacuum) and sends the information to the ECM where the module adjusts the spark and fuel timing advance curves for optimum performance.

The bank angle sensor is within the turn signal/turn signal security module. If the vehicle lean angle exceeds 45 degrees, the ignition system is shut off. Once the sensor is tripped, the motorcycle must be uprighted, turned off and then on again before the engine can be restarted. This is communicated across the data link.

Front and rear coils fire each spark plug independently (one cylinder at a time - no wasted spark). The coil also has an extra terminal to monitor current on the coil secondary circuit. This is used for knock detection and combustion diagnostics.

The ignition system gives a spark near top dead center for starting. At rpm and loads above this, the system gives a spark advance that varies between 0° and 50°.

The IAT, ECT and TP sensors are used to provide information to the ECM to fine tune spark and fuel delivery. The engine coolant temperature (ECT) sensor also controls the cooling fan relay that provides 12vdc to the fans. The VSS is used as an input for idle speed control.

The purge solenoid (California models only) allows vapors from the charcoal canister to flow to the throttle body. The timing and amount of solenoid opening depends on engine speed.

NOTE

On models not equipped with a purge solenoid, a resistive plug (Part No. 72529-01) is installed in the purge solenoid connector [95B] to prevent an error message being generated.

TROUBLESHOOTING

See the VRSC Electrical Diagnostic Manual for troubleshooting and diagnostic information.

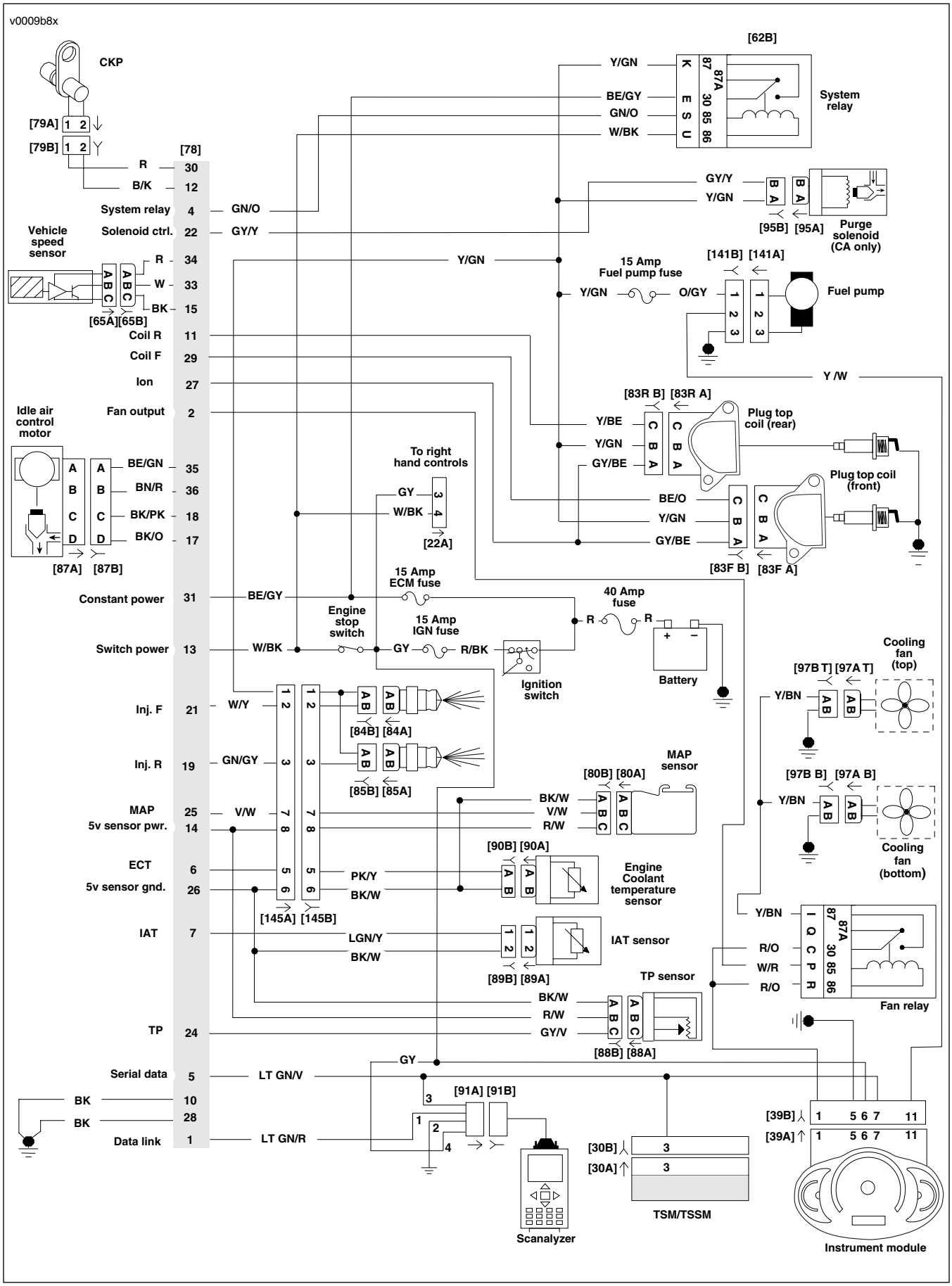


Figure 4-22. EFI System Circuit (VRSCA/VRSCD)

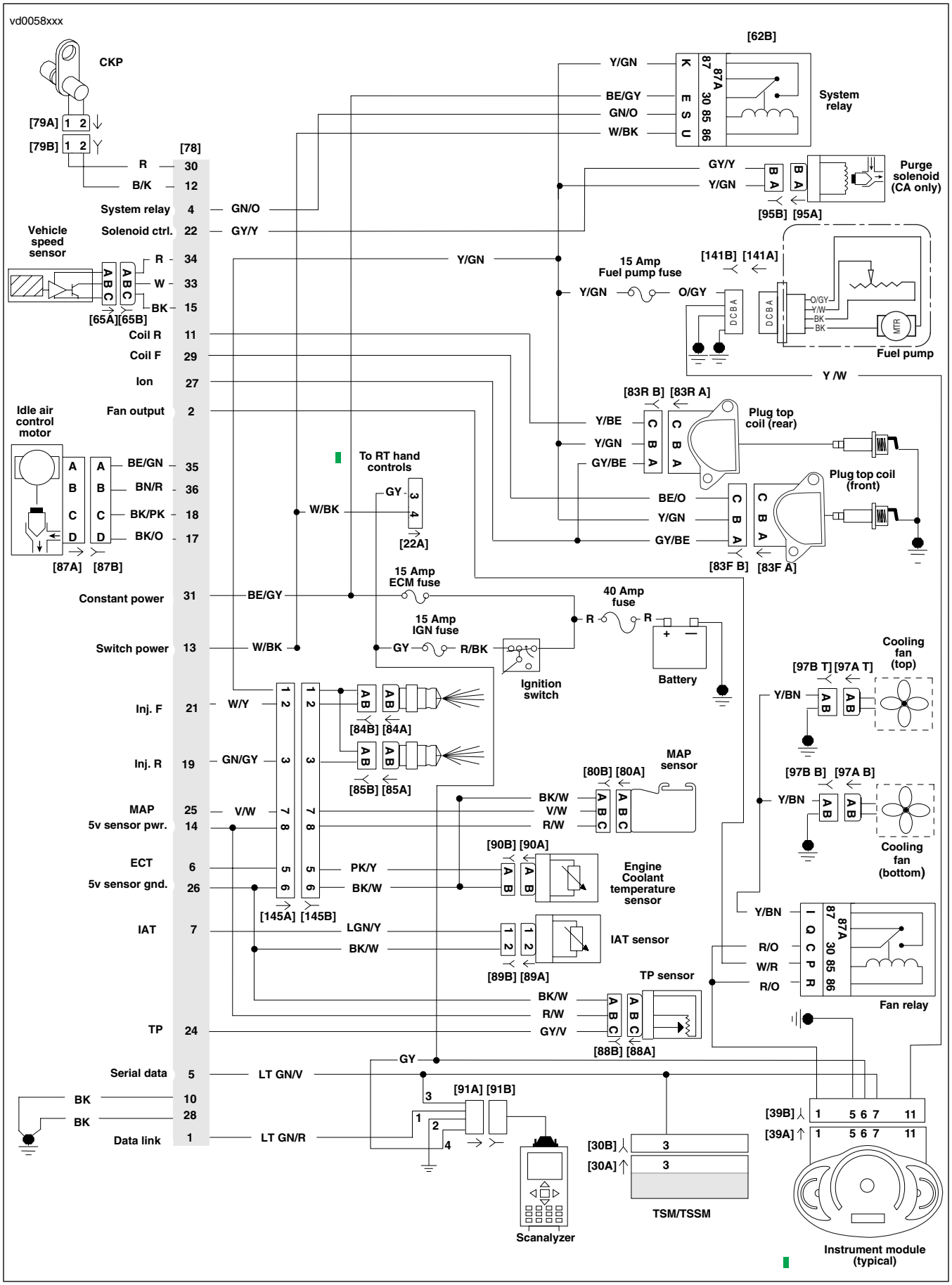


Figure 4-23. EFI System Circuit (VRSCR)

ELECTRONIC CONT. MODULE: ECM (VRSCA/VRSCD) 4.10

GENERAL

The electronic control module (ECM) is mounted under the left side cover. Refer to the VRSC Electrical Diagnostic Manual for information on the function and testing of the electronic control module.

NOTE

The electronic control module cannot be repaired. Replace the unit if it fails.

REMOVAL

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

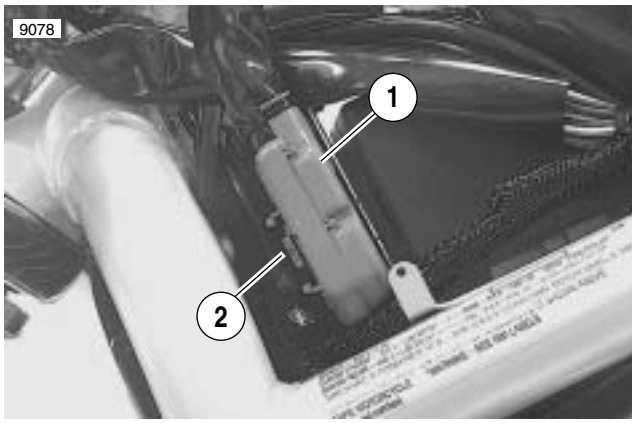
1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove left side cover.
3. See Figure 4-24. Depress latch (2) on ECM connector (1) [78B] and disconnect from ECM.
4. See Figure 4-25. Remove left and right ECM mounting bolts (2, 3).
5. Remove ECM (1) from left side of vehicle.

INSTALLATION

NOTE

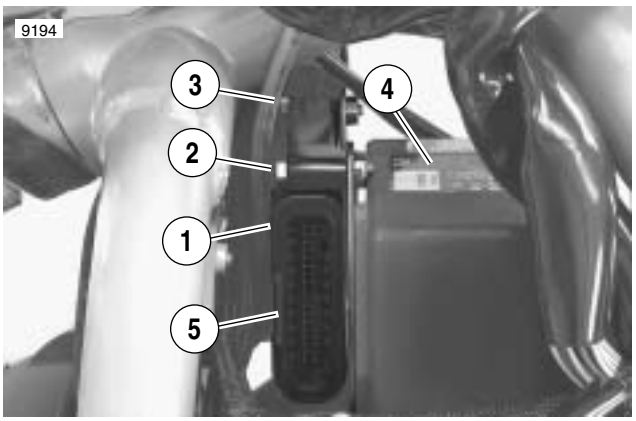
In next step, connector side of ECM should face left side of vehicle and connector tab (4) should face front of vehicle.

1. See Figure 4-25. Put left side ECM mounting bolt (2) into left side ECM mounting hole. Install ECM (1) from left side of vehicle.
2. Loosely thread left side ECM mounting bolt into ECM mounting bracket. Do not tighten.
3. Install right side ECM mounting bolt into right side ECM mounting hole. Tighten left and right bolts to 6.0-10.0 Nm (53.0-88.0 **in-lbs**).
4. See Figure 4-24. Connect ECM connector (1) [78B] to ECM.
5. Install maxi-fuse.
6. Install left and right side covers.



1. **ECM connector [78B]**
2. **Latch**

Figure 4-24. ECM Connector (VRSCA/VRSCD)



1. **ECM**
2. **Left ECM mounting bolt**
3. **Right ECM mounting bolt**
4. **Battery**
5. **Connector tab**

Figure 4-25. ECM Mount

ELECTRONIC CONTROL MODULE: ECM (VRSCR) 4.11

GENERAL

The electronic control module (ECM) is mounted under the left side cover. Refer to the VRSC Electrical Diagnostic Manual for information on the function and testing of the electronic control module.

NOTE

The electronic control module cannot be repaired. Replace the unit if it fails.

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

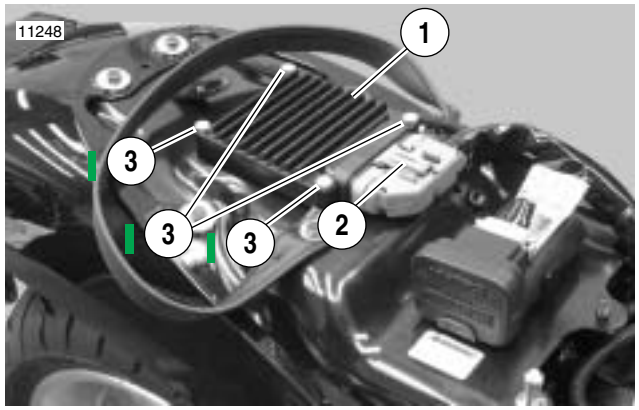
1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. See Figure 4-26. Depress latch (2) on ECM connector (1) [78B] and disconnect from ECM.
3. Remove mounting bolts (3).
4. Remove ECM (1) from vehicle.

INSTALLATION

NOTE

In next step, connector side of ECM should face left side of vehicle and connector tab should face front of vehicle.

1. Install ECM on motorcycle.
2. Loosely install mounting bolts. Tighten to 6.0-10.0 Nm (53.0-88.0 **in-lbs**).
3. See Figure 4-26. Connect ECM connector (1) [78B] to ECM.
4. Install maxi-fuse and install right side cover.



1. **ECM connector [78B]**
2. **Latch**
3. **Mounting bolts**

Figure 4-26. ECM Connector and Mounting Bolts

THROTTLE POSITION SENSOR: TP 4.12

GENERAL

Refer to the VRSC Electrical Diagnostic Manual for information on the function and testing of the throttle position sensor (TP sensor).

REMOVAL

1. Remove airbox and air filter. See 1.3 AIRBOX AND AIR FILTER.

CAUTION

Cover the injector intakes with duct tape to prevent objects from falling down the injector bore. Do NOT use shop cloths or objects that could damage the injector butterflies. (00212a)

2. See Figure 4-27. Cover air intakes (3) to prevent debris from entering cylinders.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

3. Disconnect negative battery cable.
4. Unplug TP sensor connector [88B] (2) by pulling external latch outward and using rocking motion to remove.
5. Remove two screws to detach TP sensor (1) from throttle body. Discard screws.

INSTALLATION

NOTES

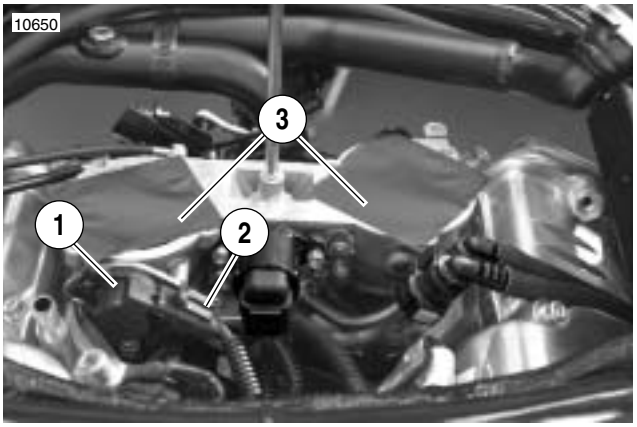
- *Throttle must be closed for proper installation of throttle position sensor.*
- *Throttle position sensor does not have to be adjusted.*

1. See Figure 4-28. With connector facing rear of vehicle, verify that shaft pocket of TP sensor fits over shaft on throttle body.
2. Align holes in TP sensor with holes in throttle body.

NOTE

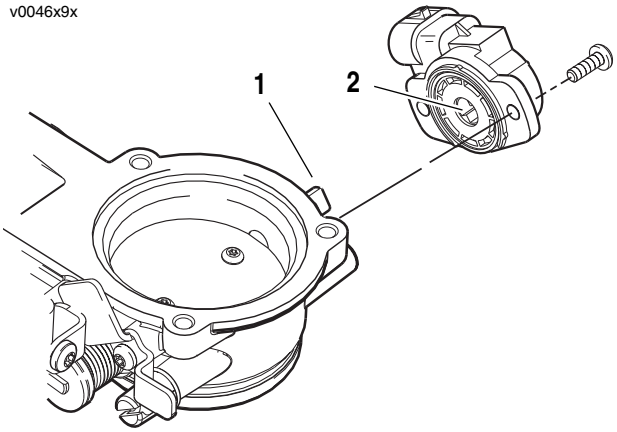
TP sensor may have to be turned slightly for holes to align.

3. Install **new** screws and tighten to 2.0-2.8 Nm (18-25 **in-lbs**).
4. See Figure 4-27. Connect TP sensor connector (2).
5. Connect negative battery cable.
6. Install airbox and air filter. See 1.3 AIRBOX AND AIR FILTER.



1. **Throttle position sensor (TP sensor)**
2. **TP sensor connector [88B]**
3. **Air intakes (covered)**

Figure 4-27. Throttle Position Sensor



1. **Shaft**
2. **Shaft pocket**

Figure 4-28. Throttle Position Sensor Installation

INTAKE AIR TEMPERATURE SENSOR: IAT 4.13

GENERAL

Refer to the VRSC Electrical Diagnostic Manual for information on the function and testing of the intake air temperature sensor (IAT sensor).

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove airbox cover. See 1.3 AIRBOX AND AIR FILTER.
3. See Figure 4-29. Remove IAT sensor connector [89B].
   a. See Figure 4-30. Depress wire form.
   b. Use rocking motion to detach connector from IAT.
4. See Figure 4-31. Depress the retaining fingers (2) on the under side of IAT sensor and pull IAT sensor from upper airbox.

NOTE

A short length of tubing with an ID of 7.62 mm (0.312 in) can be pushed over the retaining fingers to ease the sensor removal.

INSTALLATION

1. See Figure 4-31. Inspect IAT o-ring (1). Replace IAT sensor if o-ring is worn or damaged.
2. Apply **clean** engine oil to IAT sensor o-ring.
3. Install IAT sensor into upper airbox.
4. Connect IAT sensor connector [89B].
5. Install airbox cover. See 1.3 AIRBOX AND AIR FILTER.
6. Install the maxi-fuse.
7. Install right side cover.

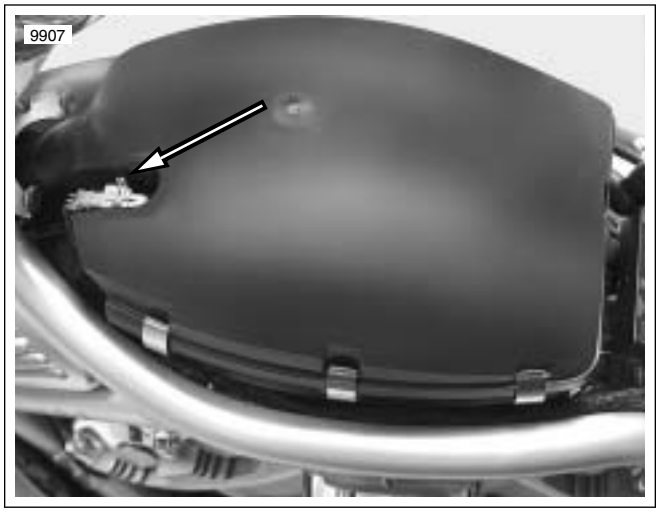


Figure 4-29. Intake Air Temperature Sensor Location (typical)

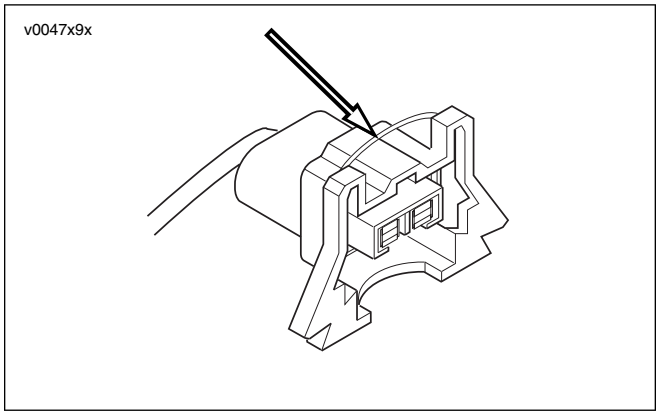
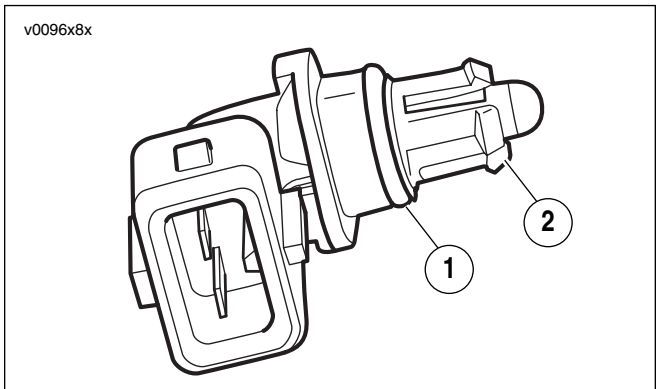


Figure 4-30. IAT Connector Wire Form



1. **O-ring**
2. **Retaining fingers**

Figure 4-31. IAT Sensor

ENGINE COOLANT TEMPERATURE SENSOR: ECT 4.14

GENERAL

Refer to the VRSC Electrical Diagnostic Manual for information on the function and testing of the engine coolant temperature (ECT) sensor.

REMOVAL

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
2. Remove airbox assembly. See 1.3 AIRBOX AND AIR FILTER.

CAUTION

Cover the injector intakes with duct tape to prevent objects from falling down the injector bore. Do NOT use shop cloths or objects that could damage the injector butterflies. (00212a)

3. Cover air intakes to prevent debris from entering cylinders.
4. Remove block drain screw. Drain cooling system. See 6.3 ENGINE COOLANT.
5. Loosen clamps at each intake and lift throttle body straight up.

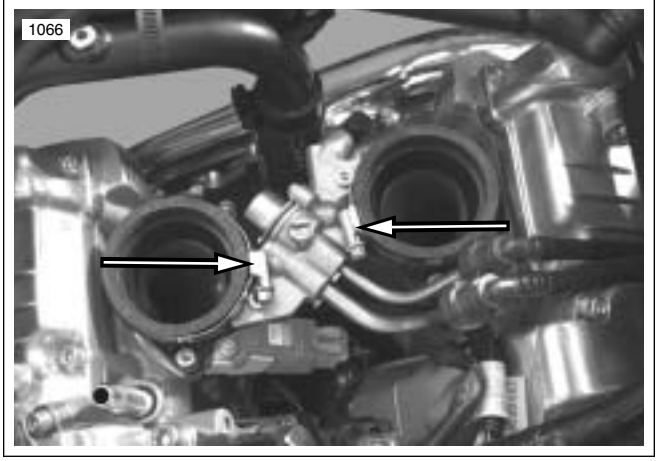


Figure 4-32. Intake Clamps, Throttle Body Removed (typical)

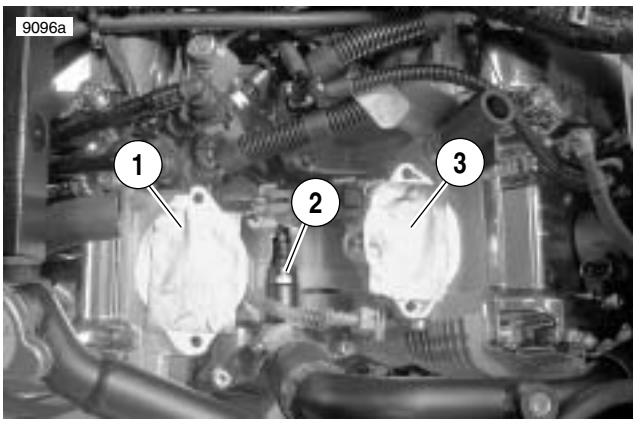
NOTE

Note position of the clamps for reassembly.

6. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine.
7. Cover intake openings to prevent objects from falling into intake bore. Remove throttle body and fuel rail.
8. See Figure 4-33. Unplug ECT sensor connector [90B] by pulling external latch outward and using rocking motion to remove.
9. Loosen ECT sensor using socket. When sensor starts to turn easily, finish removing by hand.

INSTALLATION

1. Hand start **new** ECT sensor into thermostat housing 2-3 turns.
2. Tighten sensor to 23 Nm (17 ft-lbs).
3. Connect ECT sensor connector [90B].
4. Uncover intake openings and throttle body.
5. Orient intake clamps as shown and install throttle body and fuel rail. Tighten clamps 1.25 Nm (11 **in-lbs**).
6. See 1.21 SPARK PLUG AND COIL. Install coils.
7. Attach fuel lines.
   a. Insert fuel lines from injector back under frame and connect to fuel tank.
   b. Push connector onto fuel tank elbow until a “click” is heard.
   c. Install right angle connectors on rigid lines from injector. Push until audible “click” is heard.
8. Fill engine coolant system with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through the coolant overflow bottle.
9. Replace the maxi-fuse and right side cover.
10. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
11. Continue to run engine, check level, and add antifreeze until coolant level remains at COLD FULL line with the motorcycle on the jiffy stand.



1. **Front intake**
2. **ECT**
3. **Rear intake**

Figure 4-33. ECT Sensor Location (typical)

IDLE AIR CONTROL: IAC 4.15

GENERAL

Refer to the VRSC Electrical Diagnostic Manual for information on the function and testing of the idle air control (IAC).

REMOVAL

⚠WARNING

Before IAC can be removed, throttle body must be removed from vehicle. Heat must be applied to IAC screws for removal. Heat can only by applied to screws away from fuel. Failure to remove throttle body before applying heat to screws could result in death or serious injury.

1. Remove airbox and air filter. See 1.3 AIRBOX AND AIR FILTER.

CAUTION

Cover the injector intakes with duct tape to prevent objects from falling down the injector bore. Do NOT use shop cloths or objects that could damage the injector butterflies. (00212a)

2. See Figure 4-34. Cover air intakes (3) to prevent debris from entering cylinders.

⚠WARNING

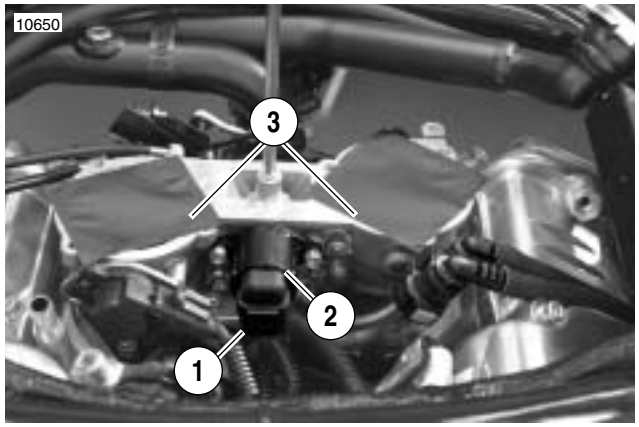
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

3. Disconnect negative battery cable.
4. Remove throttle body. See 3.9 THROTTLE BODY.
5. Disconnect throttle cables from throttle body.

CAUTION

Do not apply excessive heat to idle air control. Apply only enough heat to break LOCTITE® patch on screws. Excessive heat will cause damage to idle air control.

6. See Figure 4-35. Using heat gun, apply heat to idle air control screws (2) to break LOCTITE® patch. Remove screws.
7. Pull IAC (1) and o-ring from throttle body (3).

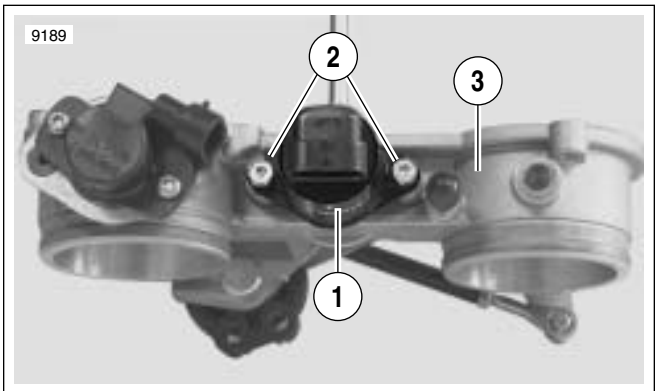


1. **IAC sensor connector [87B]**
2. **Idle air control (IAC)**
3. **Air intakes (covered)**

Figure 4-34. IAC Sensor (typical)

INSTALLATION

1. Inspect IAC o-ring, replace if damaged.
2. Apply **clean** engine oil to IAC o-ring.
3. Place idle air control and o-ring into throttle body. Be sure o-ring is properly seated in throttle body groove.
4. See Figure 4-35. Apply LOCTITE® TREADLOCKER 243 (blue) to screws (2). Loosely install front and rear IAC screws (2).
5. Tighten front and rear IAC screws to 2-4 Nm (25-35 **in-lbs**).
6. Connect throttle cables to throttle body.
7. Install throttle body. See 3.9 THROTTLE BODY.
8. Connect negative battery cable.
9. Install airbox and air filter. See 1.7 ENGINE OIL AND FILTER.



1. **IAC**
2. **Screws**
3. **Throttle body**

Figure 4-35. IAC Removal

MANIFOLD ABSOLUTE PRESSURE SENSOR: MAP 4.16

GENERAL

Refer to the VRSC Electrical Diagnostic Manual for information on the function and testing of the manifold absolute pressure sensor (MAP).

REMOVAL

1. Remove airbox and air filter. See 1.3 AIRBOX AND AIR FILTER.

CAUTION

Cover the injector intakes with duct tape to prevent objects from falling down the injector bore. Do NOT use shop cloths or objects that could damage the injector butterflies. (00212a)

2. Cover air intakes to prevent debris from entering cylinders.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

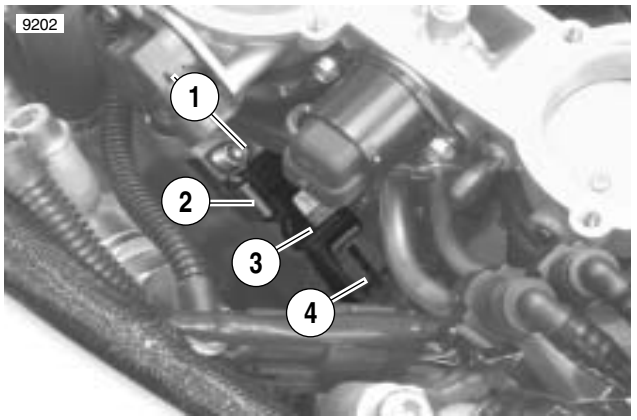
3. Disconnect negative battery cable.
4. See Figure 4-36. Remove bolt (1) securing MAP sensor bracket (2) to front cylinder.
5. Unplug MAP sensor connector [80B] (4) by pulling external latch outward and using rocking motion to remove.

NOTE

If the original sensor is re-installed, the grommet must be inspected. Grommets not in good condition could cause vacuum leaks.

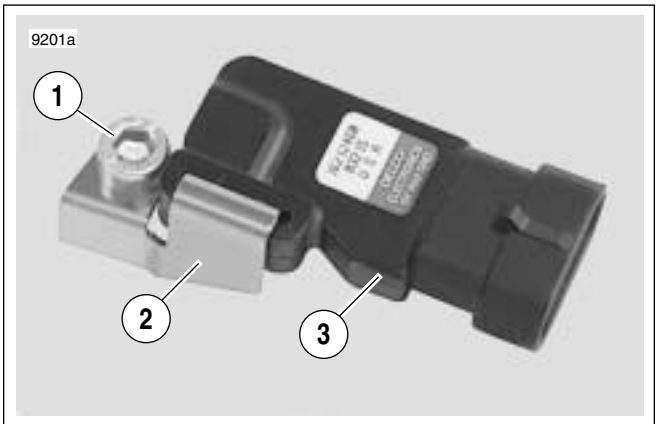
INSTALLATION

1. Plug connector into MAP sensor.
2. See Figure 4-37. Install bracket (2) over MAP sensor (3).
3. Install (push) MAP sensor and grommet to intake manifold.
4. Secure MAP sensor bracket with bolt. Tighten bolt to 6.0-10.0 Nm (53.0-88 **in-lbs**).
5. Connect negative battery cable.
6. Install airbox and air filter. See 1.3 AIRBOX AND AIR FILTER.



1. **Bolt**
2. **Bracket**
3. **MAP sensor**
4. **Connector [80B]**

Figure 4-36. MAP Sensor Location (typical)



1. **Bolt**
2. **Bracket**
3. **MAP sensor**

Figure 4-37. MAP Sensor

FUEL RAIL/FUEL INJECTORS 4.17

GENERAL

⚠WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

Refer to the VRSC Electrical Diagnostic Manual for information on the function and testing of the fuel injectors.

REMOVAL

1. Remove airbox and air filter. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

2. Disconnect negative battery cable.
3. Loosen clamps at each intake and lift throttle body straight up.

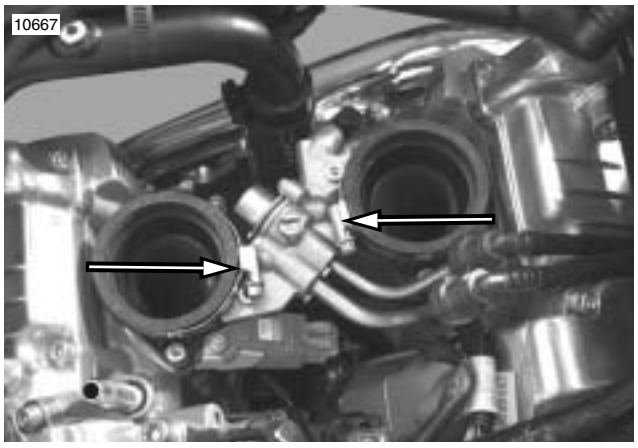


Figure 4-38. Intake Clamps (throttle body removed)

NOTE

Observe the position of the clamps for reassembly.

4. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine. See 3.9 THROTTLE BODY.

DISASSEMBLY

Fuel Injectors

1. See Figure 4-39. Remove screw (7).
2. Pull fuel injector and clip from induction module.
3. Remove clip from fuel injector.
4. Repeat procedure for other fuel injector.

Fuel Pressure Regulator

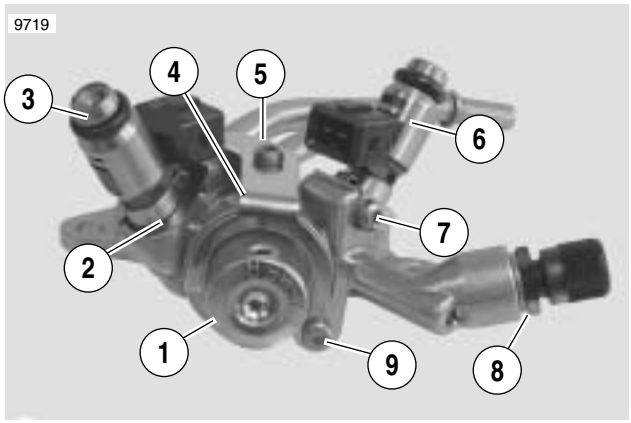
1. See Figure 4-39. Remove screws (5, 9).
2. Remove fuel pressure regulator clip (4) from fuel rail.
3. Use rocking motion to detach fuel pressure regulator (1) from fuel rail.

Fuel Tubes

NOTE

Do not remove fuel tubes, o-rings or spacers if not replacing.

1. See Figure 4-39. Remove screws (9, 5).
2. Remove fuel pressure regulator clip (4) from fuel rail.
3. See Figure 4-40. Pull feed (4) and return (5) fuel tubes from fuel rail.



1. **Fuel pressure regulator**
2. **Fuel injector clip**
3. **Front fuel injector**
4. **Fuel pressure regulator clip**
5. **Screw**
6. **Rear fuel injector**
7. **Screw**
8. **Schrader valve 6.8-9.6 Nm (60.0-85.0 in-lbs)**
9. **Screw**

Figure 4-39. Fuel Rail

ASSEMBLY

Fuel Injectors

1. Inspect fuel injector o-rings, replace if damaged
2. Apply **clean** engine oil to fuel injector o-rings.
3. Insert fuel injector into fuel rail.
4. Slide fuel injector clip into slot in fuel injector.
5. Secure with screw and tighten to 2.0-2.8 Nm (18.0-25.0 **in-lbs**).
6. Repeat for other fuel injector.

Fuel Pressure Regulator

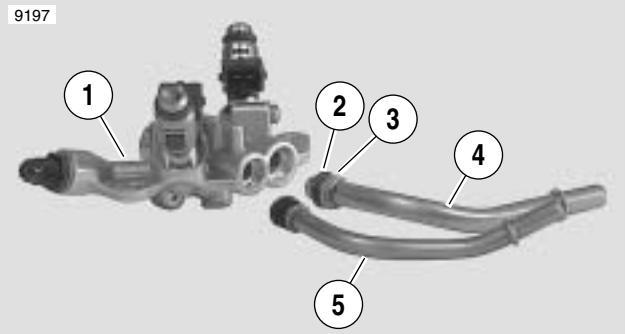
1. Inspect fuel pressure regulator o-rings. Replace pressure regulator if o-rings are damaged.
2. Apply **clean** engine oil to fuel pressure regulator o-rings.
3. Install fuel pressure regulator into bore in fuel rail.
4. See Figure 4-39. Install fuel pressure regulator clip over fuel tubes.
5. Install screws (5, 9). Tighten to 2.0-2.8 Nm (18.0-25.0 **in-lbs**).

Fuel Tubes

1. See Figure 4-40. Install washers (3) over fuel tube.
2. Apply **clean** engine oil to **new** fuel tube o-rings (2).
3. Install feed and return fuel tubes into proper holes in fuel rail.
4. See Figure 4-39. Install fuel pressure regulator clip over fuel tubes.
5. Install screws (5, 9). Tighten to 2.0-2.8 Nm (18.0-25.0 **in-lbs**).

INSTALLATION

1. Install fuel rail and throttle body. See 3.9 THROTTLE BODY.
2. Connect negative battery cable.
3. Install airbox and filter. See 1.3 AIRBOX AND AIR FILTER.



1. **Fuel rail**
2. **O-ring**
3. **Washer**
4. **Feed fuel tube**
5. **Return fuel tube**

Figure 4-40. Fuel Tubes

FUEL PRESSURE TEST 4.18

GENERAL

The fuel pump is located in the fuel tank. It delivers fuel to the fuel metering assembly. The fuel metering assembly contains the fuel injectors and the pressure regulator, where the system pressure is controlled. Excess fuel pressure is returned to the fuel tank by a return line. The ECM controls the system relay that supplies 12 vdc to the fuel pump.

When the engine is stopped, the pump can be turned on by applying battery voltage to pin 1 and ground to pin 3 of the fuel pump connector [86A] or by using the Scanalyzer.

Improper fuel system pressure may contribute to one of the following conditions:

- Cranks, but won't run.
- Cuts out (may feel like ignition problem).
- Hesitation, loss of power or poor fuel economy.

NOTE

Refer to the VRSC Electrical Diagnostic Manual for further information on the function and testing of the fuel system.

TESTING

The fuel pressure gauge (0-100 PSI) allows for fuel injector and fuel system pressure diagnosis.

PART NO.	SPECIALTY TOOL
HD-41182	Fuel pressure gauge
26338-68	1/8 in. pipe thread 90° (right angle) elbow

1. See Figure 4-41. Disconnect fuel pump connector [141] from top of fuel tank.
2. Start the engine and allow the vehicle to run.
3. When engine stalls, operate the starter for 3 seconds to remove any remaining fuel from the fuel lines. Turn ignition key off.
4. See Figure 4-42. Insert a 1/8 in. pipe thread 90° degree (right angle) elbow (1) between the fuel valve (2) and the Schrader valve adapter (3).
5. See Figure 4-43. Remove protective cap from Schrader valve in fuel metering assembly.
6. Verify that the fuel valve and air bleed petcock on the FUEL PRESSURE GAUGE (Part No. HD-41182) are closed.

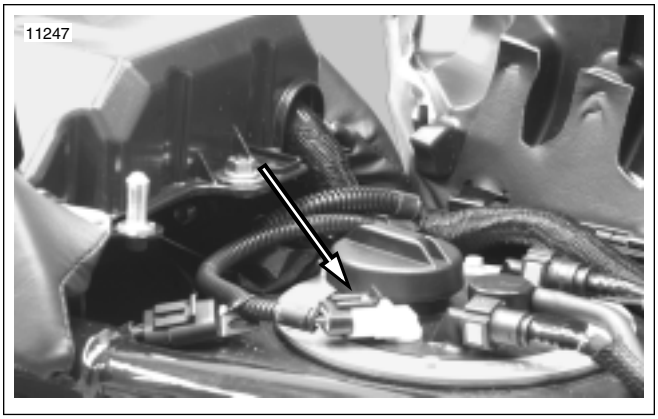
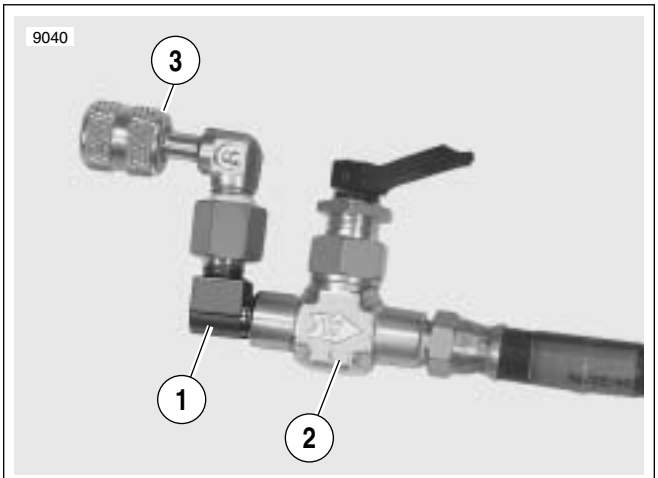


Figure 4-41. Fuel Pump Connector [141] (typical) (VRSCR shown)



1. **1/8 in. pipe thread 90° elbow**
2. **Fuel valve**
3. **Schrader valve adapter**

Figure 4-42. Fuel Pressure Gauge Valves

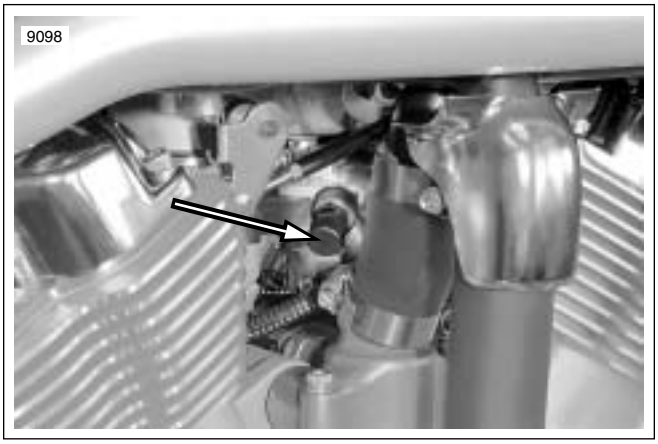


Figure 4-43. Schrader Valve Location (typical)

7. Connect fuel pressure gauge to Schrader valve. Reconnect connector [141].
8. Start and idle engine to pressurize the fuel system. Open the fuel valve to allow the flow of fuel down the hose of the pressure gauge.
9. Position the clear air bleed tube in a suitable container and open and close the air bleed petcock to purge the gauge and hose of air. Repeat this step several times until only solid fuel (without bubbles) flows from the air bleed tube. Close the petcock.
10. Open and close throttle to change engine speed. Note the reading of the pressure gauge. Fuel pressure should remain steady at 380-425 kPa (55-62 psi).
11. Turn the engine off. Open the air bleed petcock to relieve the fuel system pressure and purge the pressure gauge of gasoline.

⚠WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

12. Remove fuel pressure gauge from the Schrader valve in fuel metering assembly. Install protective cap over Schrader valve.

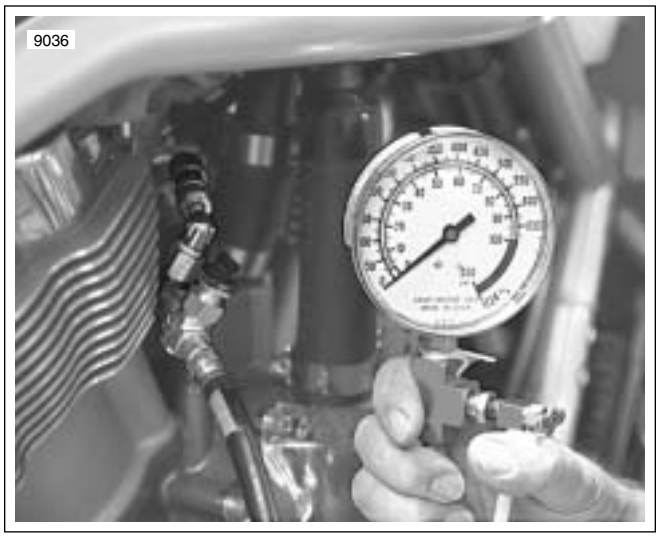


Figure 4-44. Fuel Pressure Gauge Installed

INTAKE LEAK TEST 4.19

GENERAL

⚠WARNING

Propane is an extremely flammable liquid and vapor. Vapor may cause flash fire. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation. Failure to follow this alert can result in death or serious injury

⚠WARNING

Read all directions and warnings on propane bottle. Failure to follow all directions and warnings on bottle could result in death or serious injury.

- To prevent false readings, keep airbox cover installed when performing test.
- Do not direct propane into air horn, false readings will result.

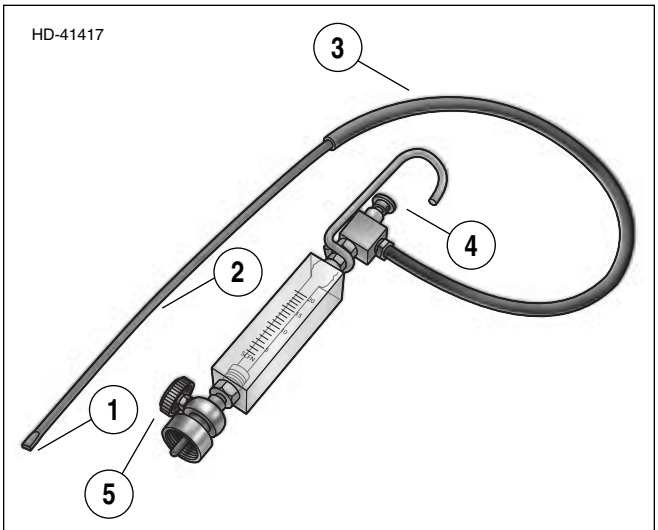
LEAK TESTER

Parts List

- Standard 14 oz. propane cylinder.
- Propane Enrichment Kit (HD-41417).

Tester Assembly

Install a standard 14 oz. propane cylinder to propane enrichment kit (HD-41417) per instructions included with tester.



1. **Nozzle**
2. **Copper tube**
3. **Hose**
4. **Valve**
5. **Knob**

Figure 4-45. Propane Enrichment Kit (HD-41417)

INTAKE LEAK TESTING

1. Start engine.
2. Warm engine to operating temperature.
3. See Figure 4-46. Turn knob (5) counterclockwise to open propane bottle (6).

⚠WARNING

Propane is an extremely flammable liquid and vapor. Vapor may cause flash fire. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

NOTE

Do not direct propane stream toward front of engine. If propane enters air horn, a false reading will be obtained.

4. See Figure 4-46. Aim nozzle toward possible sources of leak such as fuel injectors and intake tract.
5. See Figure 4-45. Push valve (4) to release propane. Tone of engine will change when propane enters source of leak.

Figure 4-46. Checking for Leaks (typical) (VRSCA shown)

ELECTRIC STARTER 5

Table Of Contents

SUBJECT **PAGE NO.**

.SPECIFICATIONS 5.1

Table 5-1. Starter Performance

STARTER	
Free speed	9200 RPM (min)
Free current	32 Amp
Cranking current	180 Amp

TORQUE VALUES

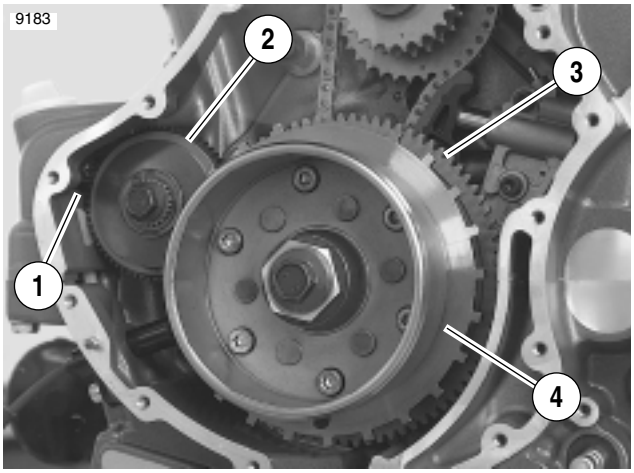
ITEM	TORQUE		NOTES
Starter mounting bolts	6-10 Nm	53-88 **in-lbs**	page 5-5
Solenoid cable terminal ring	6-10 Nm	53-88 **in-lbs**	page 5-5
Solenoid bracket hex-nuts	6-10 Nm	53-88 **in-lbs**	page 5-7
Lower radiator bolts	23 Nm	17 ft-lbs	page 5-7

ELECTRIC STARTER SYSTEM 5.2

GENERAL

The electric starter system is made up of the starter relay, starter solenoid, and starter motor. The starter drive gear engages a geared limiter assembly which engages a starter ring gear whose hub rotates inside a ball clutch on the rotor assembly.

The rotation of the starter is transferred to the crankshaft of the engine through the ball clutch. The starter motor torque is multiplied through the gear reduction of the starter drive gear to the limiter assembly gear and to the starter ring gear. The three gears remain in constant engagement.



1. **Starter drive gear**
2. **Limiter assembly**
3. **Starter ring gear**
4. **Rotor**

Figure 5-1. Starter Drive
(Left side engine cover/stator removed)

Wiring Diagrams

See Figure 5-2. For additional information concerning the starting system circuit, see the wiring diagrams in Appendix B.

Starter Relay

The starter relay is not repairable. Replace the unit if it fails.

Starter

The starter is not repairable. Replace the unit if it fails.

Starter Solenoid

The starter solenoid is not repairable. Replace the unit if it fails.

OPERATION

When the starter switch is pushed, the starter relay is activated which activates the starter solenoid allowing current to flow to the starter motor.

The starter drive gear transfers rotation to the limiter assembly and the limiter assembly gear transfers rotation to the starter ring gear. The starter ring gear drives the alternator rotor on the end of the crankshaft.

When the engine starts, a ball clutch on the back side of the rotor disengages allowing the starter ring gear and the rotor to rotate independently of each other.

NOTE

For troubleshooting and diagnostic information see VRSC Electrical Diagnostic manual.

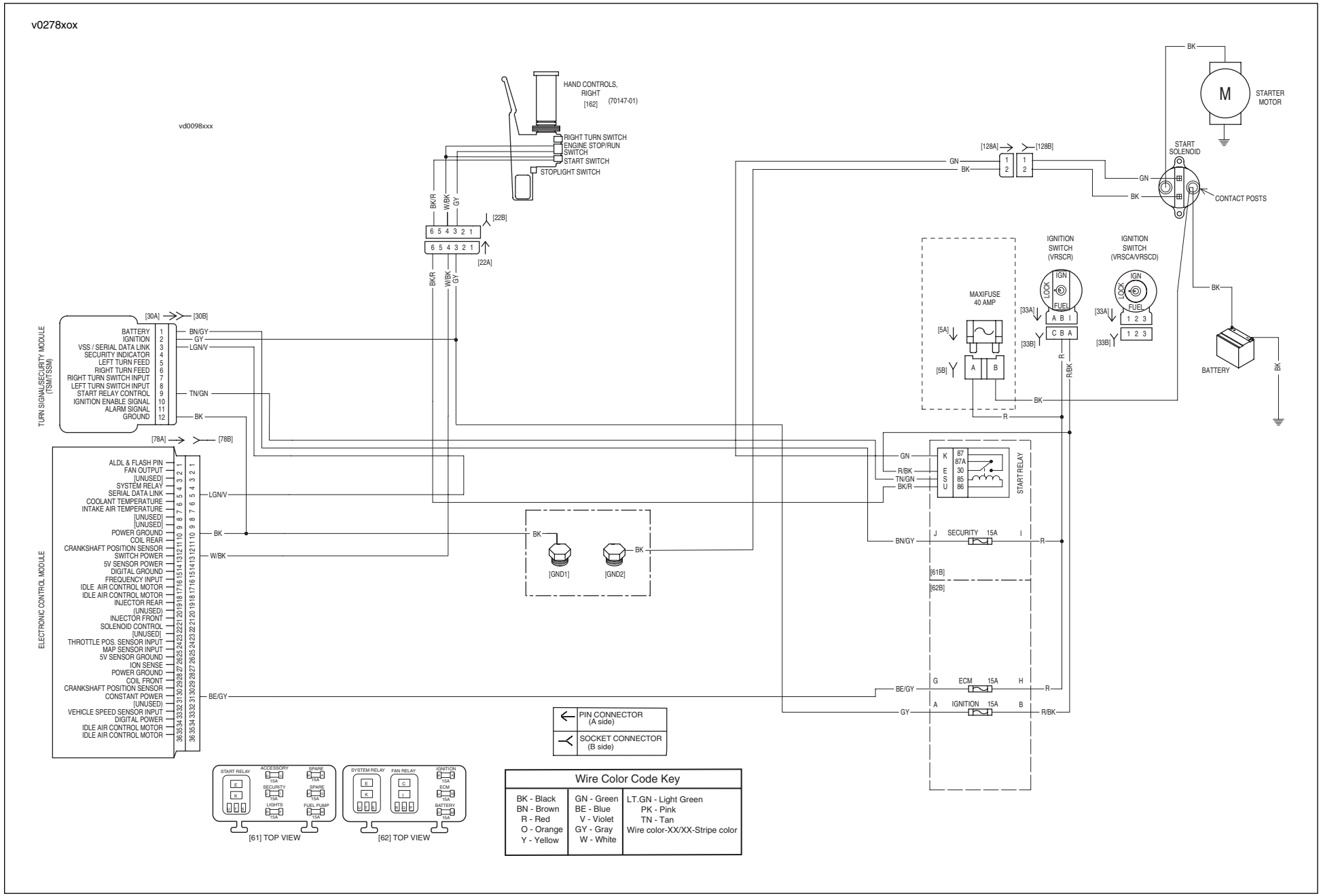


Figure 5-2. Starting Circuit

STARTER RELAY 5.3

REMOVAL

NOTE

Before removing the relay, perform diagnostics listed in the VRSC Electrical Diagnostic manual.

The starter relay is located beneath the airbox cover in the fuse block.

1. See Figure 5-3. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.

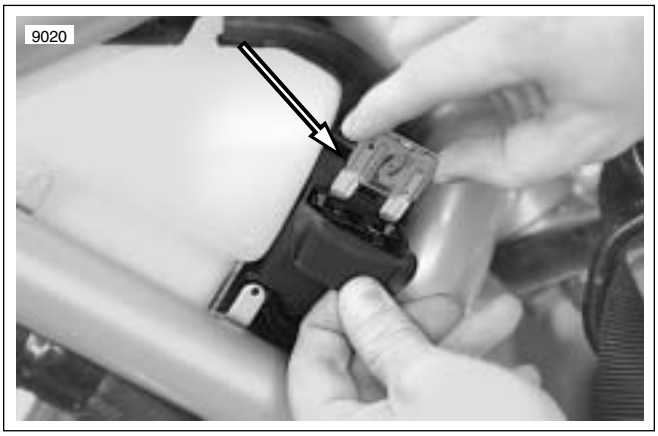


Figure 5-3. Maxi-fuse (typical)

2. Unlatch and open seat.
3. Remove the airbox cover. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

4. Disconnect the negative battery cable.
5. See Figure 5-4. Locate fuse block behind air cleaner. Pull fuse blocks from tabs on mounting bracket. Tabs on bracket fit into slots on each side of fuse block cover. To remove cover, raise latches slightly to disengage tabs on fuse blocks.
6. Remove gray starter relay from fuse block with single relay.

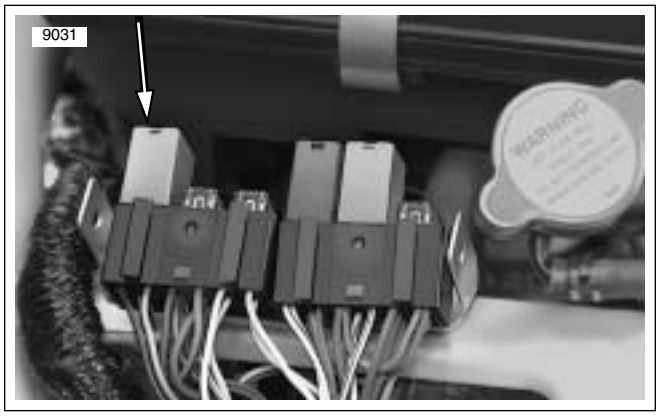


Figure 5-4. Starter Relay (fuse block cover removed) (typical)

INSTALLATION

1. Install relay in fuse block.
2. Slide cover over fuse blocks until latches fully engage tabs on blocks.
3. Slide fuse blocks onto frame mounting bracket. Tabs on bracket fit into slots on each side of fuse block cover.

CAUTION

Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)

CAUTION

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

⚠WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

4. Connect negative battery cable. See 1.8 BATTERY MAINTENANCE.
5. Install airbox cover by positioning the airbox cover with the locating pins in the holes on the frame tabs. Turn bail-head fastener 1/4 turn clockwise.
6. Reinstall maxi-fuse and right side cover.
7. Turn ignition switch to FUEL and close seat. Then turn ignition switch to LOCK.

STARTER 5.4

REMOVAL

NOTE

Before removing the starter, perform diagnostics listed in the VRSC Electrical Diagnostic Manual.

1. Remove right side cover.
2. See Figure 5-3. Remove maxi-fuse. See 8.5 MAXI-FUSE.
3. Unlatch and open seat.
4. Remove the airbox cover. See 1.3 AIRBOX AND AIR FILTER.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

5. Disconnect the negative battery cable.
6. Remove exhaust system to provide clearance for starter removal. See 2.7 EXHAUST SYSTEM (VRSCA). or 2.8 EXHAUST SYSTEM (VRSCD/VRSCR)
7. See Figure 5-5. Pull back solenoid cable protective boot and loosen and remove hex-nut. Remove solenoid cable terminal ring (2).
8. Remove both starter mounting bolts and washers (1).
9. Remove starter from right side of motorcycle.

INSTALLATION

1. Lubricate the starter o-ring with Harley-Davidson Special Purpose Grease, Part No. 99857-97.
2. Install starter gear shaft into engine housing.

NOTE

Be sure starter gear shaft engages the teeth of the limiter assembly in the engine housing.

3. See Figure 5-5. Install the two starter mounting bolts and washers (1). Alternately tighten the bolts to 6-10 Nm (53-88 **in-lbs**).
4. Slide solenoid cable terminal ring (2) over starter post. Thread on and tighten hex-nut to 6-10 Nm (53-88 **in-lbs**).
5. **Slide protective boot securely over terminal.**

⚠WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

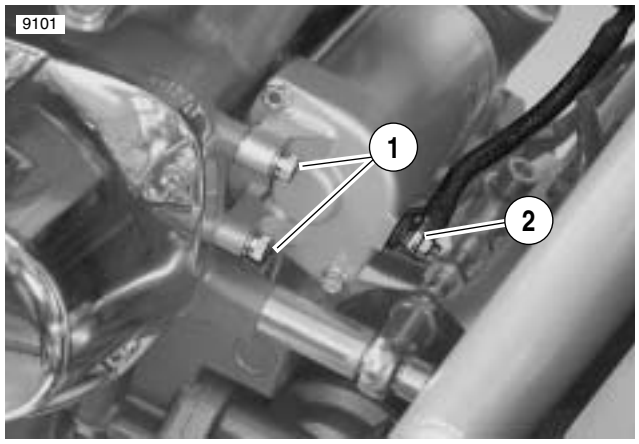
CAUTION

Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)

CAUTION

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

6. Connect negative battery cable. See 1.8 BATTERY MAINTENANCE.
7. Install airbox cover. See 1.3 AIRBOX AND AIR FILTER.
8. Reinstall maxi-fuse and the right side cover. See 8.5 MAXI-FUSE.
9. Turn ignition switch to FUEL and close seat. Then turn ignition switch to LOCK.



1. **Starter mounting bolts and washers**
2. **Solenoid cable terminal ring**

Figure 5-5. Starter (protective boot removed)

STARTER SOLENOID 5.5

GENERAL

The starter solenoid is a switch that is designed to open and close the circuit to the electric starter motor.

REMOVAL

CAUTION

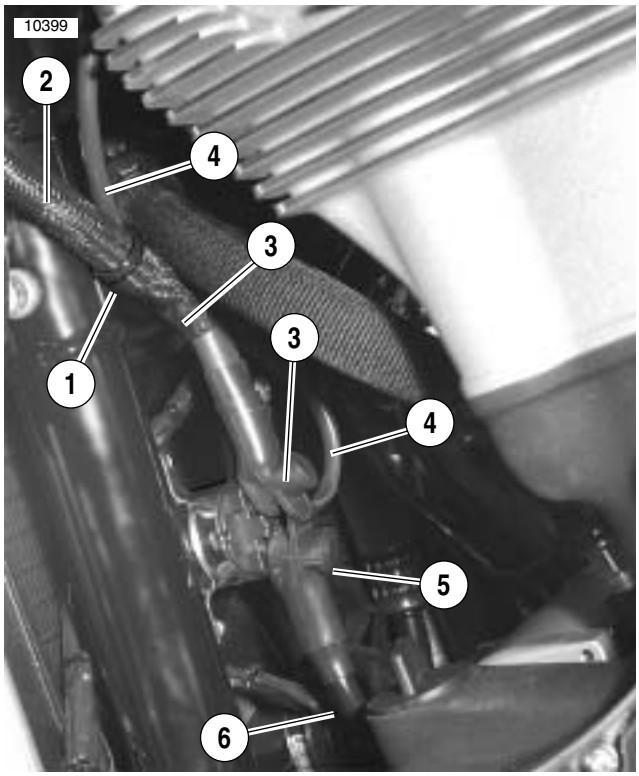
The radiator fans are thermostatically controlled and will run will the ignition switch in the OFF position. However, pulling the maxi-fuse will disconnect power to the fans. To prevent damage to engine components, be sure the radiator has cooled before removing the maxi-fuse.

1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
2. Unlatch and open rider's seat.
3. Remove the airbox cover. See 1.3 AIRBOX AND AIR FILTER.

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

4. Disconnect the negative battery cable from battery. See 1.8 BATTERY MAINTENANCE.
5. See Figure 5-6. Trace paired black wire and green wire lead (4) from solenoid back to connector under side cover.
6. See Figure 5-7. Press in release square and separate connector halves.
7. Cut cable wrap tying paired lead to negative battery cable.
8. Pull back covers from negative battery cable hex-nut and starter cable hex-nut.
9. Unthread two hex-nuts and remove negative battery cable and the starter cable from the solenoid posts.
10. Remove two bottom radiator bolts and pull bottom of radiator forward.
11. See Figure 5-8. Unthread two bracket hex-nuts from frame studs and remove solenoid with bracket and paired wire lead.



1. **Cable wrap**
2. **Negative battery cable**
3. **Negative battery cable hex-nut cover**
4. **Paired wire lead**
5. **Starter cable hex-nut cover**
6. **Starter cable**

Figure 5-6. Starter Solenoid

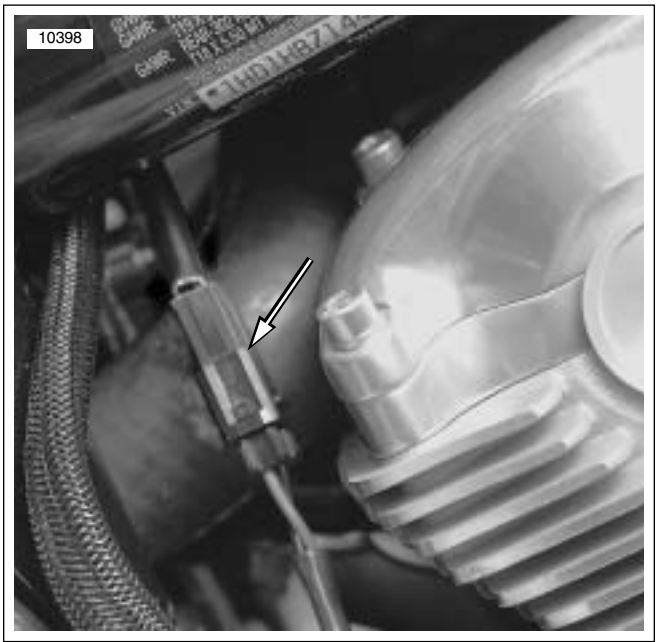


Figure 5-7. Paired Wire Lead Connector

INSTALLATION

1. See Figure 5-8. Install replacement solenoid on frame studs.
2. Thread on the two bracket hex-nuts and tighten to 6-10 Nm (53-88 **in-lbs**).
3. Install solenoid cover.
4. See Figure 5-9. Install negative battery cable and starter cable on the solenoid posts. Thread on and torque the hex-nuts to 6-10 Nm (53-88 **in-lbs**).
5. Thread paired black and green wire along inside of negative battery cable.
6. Mate connector halves and tuck paired wire lead up under side cover.
7. Cable wrap paired lead to negative battery cable.
8. Snap top of cover onto solenoid.
9. Seat radiator crossmember and thread in and torque the two bottom radiator bolts to 23 Nm (17 ft-lbs).

CAUTION

Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)

CAUTION

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

⚠WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

10. Connect negative battery cable to battery. See 1.8 BATTERY MAINTENANCE.
11. Install airbox cover. See 1.3 AIRBOX AND AIR FILTER.
12. Reinstall the maxi-fuse and the right side cover. See 8.5 MAXI-FUSE.
13. Turn ignition switch to FUEL and close seat. Then turn ignition switch to LOCK.

Figure 5-8. Solenoid

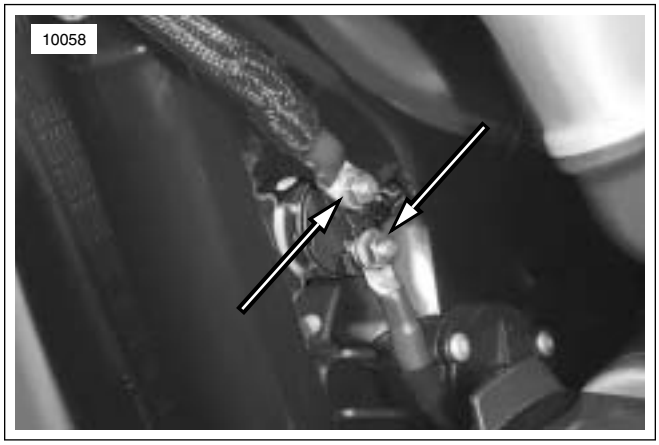


Figure 5-9. Negative Battery and Starter Cables

NOTES

Table Of Contents

INSTRUMENTS 2

SUBJECT **PAGE NO.**

CHECKING FOR TROUBLE CODES 2.1

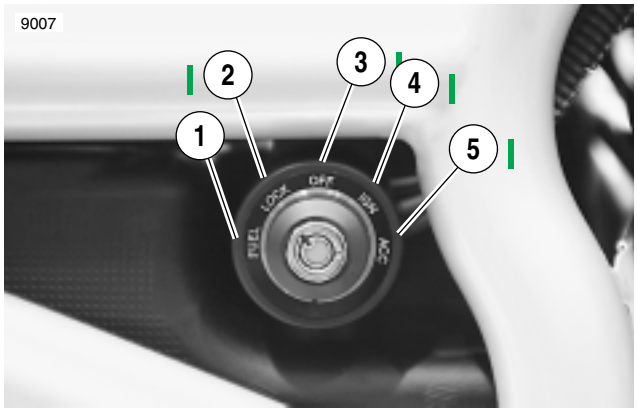
CHECK ENGINE LAMP

To diagnose system problems, start by observing the behavior of the check engine lamp.

NOTES

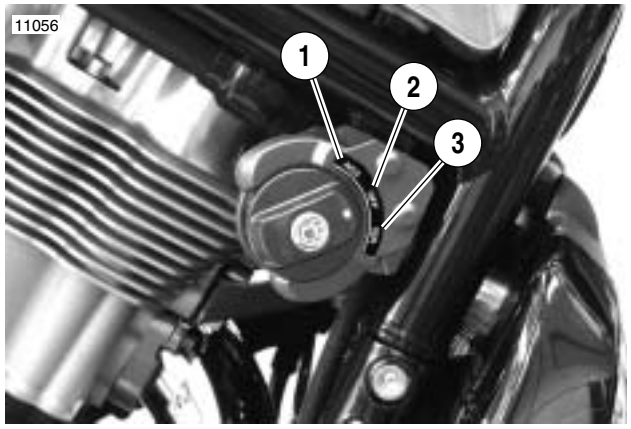
- *See Figure 2-1. and Figure 2-2. "Key ON" means that the ignition key is turned to IGN and the engine stop switch is set to RUN (although the engine is **not** running).*
- *When the ignition key is turned ON, the check engine lamp will illuminate for approximately four seconds and then turn off.*
- *If the check engine lamp is not illuminated at Key ON or if it fails to turn OFF after the initial four second period, then see 2.3 INSTRUMENT MODULE (IM) SELF DIAGNOSTICS.*

1. See Figure 2-3. After lamp turns off after being illuminated for the first four second period, one of three situations may occur.
   a. The lamp remains off. This indicates there are no current fault conditions or stored functional trouble codes currently detected by the ECM.
   b. The lamp stays off for only four seconds and then comes back on for an eight second period. This indicates a code is stored, but no current trouble code exists.
   c. If the lamp remains on beyond the eight second period, then a current trouble code exists.



1. **Seat release**
2. **LOCK position**
3. **OFF position**
4. **Ignition position**
5. **Accessory position**

Figure 2-1. Ignition Switch (VRSCA/VRSCD)



6. **Accessory position**
7. **OFF position**
8. **Ignition position**

Figure 2-2. Ignition Switch (VRSCR)

2. See CODE TYPES which follows for a complete description of trouble code formats.

NOTE

Some trouble codes can only be fully diagnosed during actuation. For example, a problem with the ignition coil will be considered a current fault even after the problem is corrected, since the ECM will not know of its resolution until after the coil is exercised by vehicle start sequence. In this manner, there may sometimes be a false indication of the current trouble code.

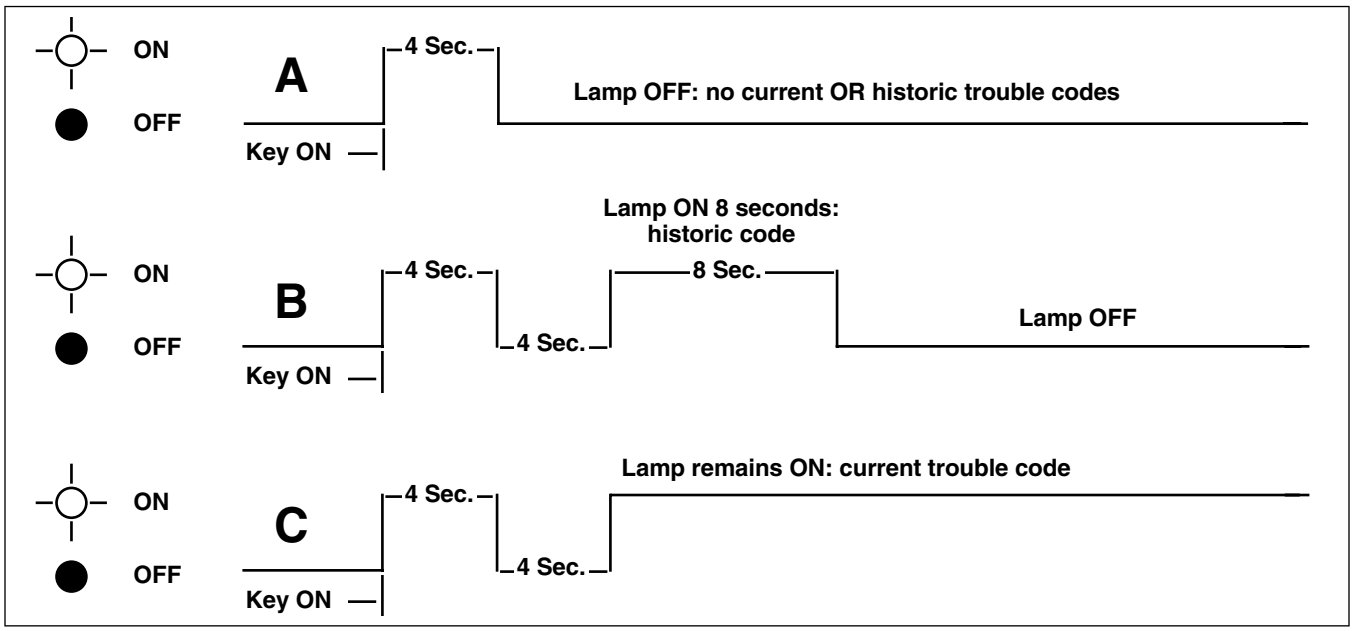


Figure 2-3. Check Engine Lamp Operation

CODE TYPES

There are two types of **diagnostic trouble codes (DTCs):** current and historic. If a trouble code is stored, it can be read using either a Scanalyzer or IM self diagnostics.

Trouble codes reside in the memory of the IM until the code is cleared by use of the Scanalyzer, instrument module or a total of 50 trips has elasped. A trip consists of a start and run cycle, the run cycle lasting at least 5 seconds. After the 50 trip retention period, the trouble code is automatically erased from memory providing that no subsequent faults of the same type are detected in that period.

Current

Current trouble codes are those which occur during the present ignition cycle. See the appropriate flow charts for solutions.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic code rather current code.

Historic codes are stored for 50 trips to assist in the diagnosis of intermittent faults. On TSM models, the check engine lamp will also indicate the existence of historic codes for one ignition cycle.

It is important to note that historic codes may also be present whenever the system indicates the existence of a current code. See MULTIPLE TROUBLE CODES if multiple trouble codes are found.

Diagnostic charts are designed for use with current trouble codes and as a result they frequently suggest part replacement. When diagnosing a historic code the charts can be helpful but should not lead to part replacement without verification the part is faulty.

SECURITY LAMP

The security lamp functions in the same manner as the check engine lamp, except that it is controlled by the TSSM. The security lamp will be turned on when codes are present in the TSSM.

RETRIEVING TROUBLE CODES

There are three levels of diagnostics.

- The most sophisticated mode uses a computer based diagnostic package called the DIGITAL TECHNICIAN (Part No. HD-44750-P50 or HD-44750-P29).
- The second mode employs a portable diagnostic tool called a Scanalyzer. This device plugs into the motorcycle wiring harness. It facilitates the diagnosis of system problems through a direct interface with the ECM TSM/TSSM and IM. See 2.2 SCANALYZER.
- The third mode requires using the instrument module (IM) self diagnostics. IM, TSM/TSSM, and ECM codes can be accessed and cleared. See 2.3 INSTRUMENT MODULE (IM) SELF DIAGNOSTICS for more information.

Use of IM self diagnostics assumes that the SCANALYZER (Part No. HD-41325) is not available.

MULTIPLE TROUBLE CODES

While it is possible for more than one fault to occur and set more than one trouble code, there are several conditions which may result in **one** fault setting **multiple** trouble codes:

Serial data codes (DTC U1300, U1301, U1016, U1064, U1096 and U1255) may be accompanied by other codes. **Always** correct the serial data codes before resolving the other codes.

SCANALYZER 2.2

SCANALYZER DIAGNOSTICS

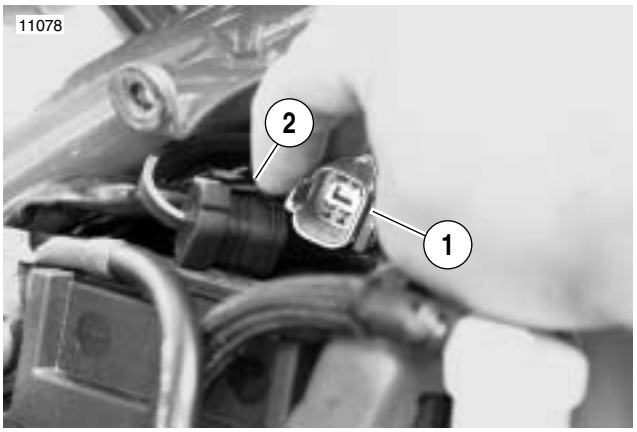
Serial Data Connector

See Figure 2-4. Using the Scanalyzer requires access to the data connector (1). See below for instructions on reaching the data connector.

Scanalyzer Cartridge

See Figure 2-5. Through a special programmable application cartridge, the Scanalyzer offers data displays and menu selections that allow for quick and easy retrieval of data. The device enables the user to perform a variety of diagnostic tests while monitoring inputs and outputs.

Sample Scanalyzer menu selections are shown in Figure 2-6.



1. **Data connector [91A]**
2. **Protective rubber plug**

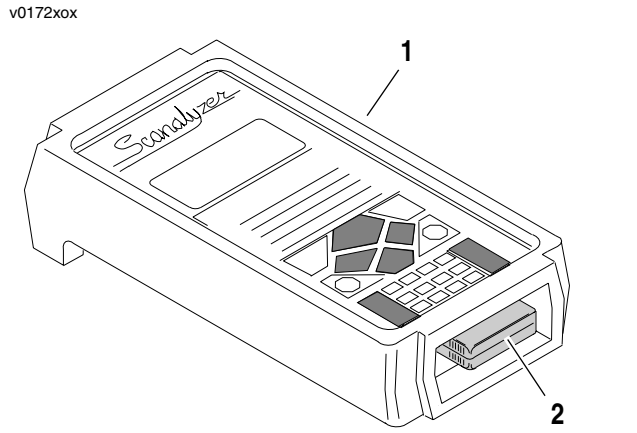
Figure 2-4. Serial Data Connector [91A]

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-41325	Scanalyzer
HD-41325-95C	Scanalyzer cartridge
HD-42921A	Cable

The behavior of the check engine lamp (2.1 CHECKING FOR TROUBLE CODES) indicates the presence of trouble codes.

1. Turn ignition key OFF.
2. Remove left side cover.
3. See Figure 2-4. Remove rubber protective plug (2) from data connector (1). Plug Scanalyzer into connector.
4. Turn ignition key ON. Set engine stop switch to RUN, but do not start engine.
5. See Figure 2-5. Insert the diagnostic application cartridge (2) into the Scanalyzer (1). During the next few seconds, the Scanalyzer sequences through a series of screens that reflect a power-on self test, the system copyright, and then an attempt at communications with the ECM, IM and turn signal module (TSM) or turn signal security module (TSSM). Once communication is established between the modules, the diagnostic menu appears. See Figure 2-6.
6. Continue with the instructions listed under USAGE which follows.



1. **Scanalyzer (Part No. HD-41325)**
2. **Cartridge (Part No. HD-41325-95C)**

Figure 2-5. Scanalyzer and Cartridge

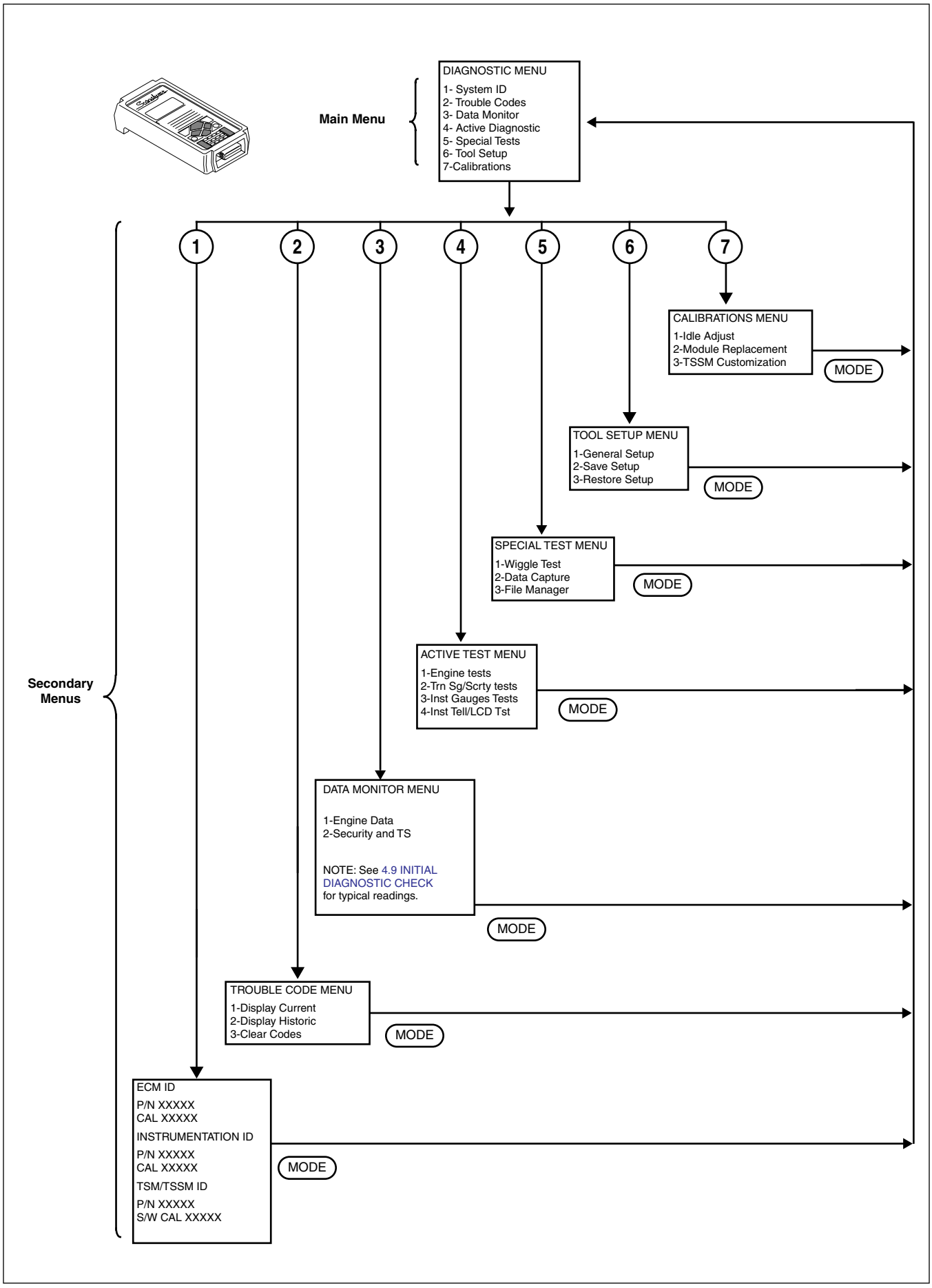


Figure 2-6. Scanalyzer Menus

USAGE

See Figure 2-6. The diagnostic menu is the primary system menu (main menu) through which all other secondary menus and displays are accessed. Since the screen may not be large enough to display all line items at any given time, use the up and down arrow keys to scroll through the list.

Checking Codes

1. See Figure 2-7. From the diagnostic menu, press number “2” to access the trouble codes menu. At this point, the unit allows the operator to:
   a. Press number “1” to display current trouble codes.
   b. Press number “2” to display historic trouble codes.
   c. Press number “3” to clear trouble codes. See Clearing Codes below.
2. When examining trouble codes, write down all codes on a piece of paper. If a current trouble code exists, place it at the top of the list.
   a. If trouble codes are present, refer to Table 2-1. Follow the applicable flow charts for each code.
   b. If trouble codes are NOT present, but starting or driveability problems are evident, see symptoms charts under 4.9 INITIAL DIAGNOSTIC CHECK.
   c. After reading current/historic trouble codes, simply press the mode key to return to the trouble codes menu.
3. Press the mode key again to return to the diagnostic menu. In this manner, regardless of where the operator is in the program, the mode key need only be pressed once or twice to return to the main menu.
4. After correcting system problems, clear trouble codes using the trouble codes menu of the scanalyzer.

Clearing Codes

The Scanalyzer allows the operator to clear trouble codes from memory as well as differentiate between current and historic codes.

NOTE

For more detailed instructions, refer to the literature provided with the Scanalyzer.

Figure 2-7. Scanalyzer Diagnostic Menu

REMOVAL

1. Turn ignition key OFF. Set engine stop switch to the OFF position.
2. Unplug Scanalyzer from data connector. Install protective plug connector.
3. Install passenger seat.
4. Road test vehicle and observe check engine lamp. Confirm proper operation without the reoccurrence of trouble codes. See 2.1 CHECKING FOR TROUBLE CODES.

INSTRUMENT MODULE (IM) SELF DIAGNOSTICS 2.3

GENERAL

The instrument module is capable of displaying and clearing IM, TSM/TSSM, and ECM trouble codes.

DIAGNOSTICS

Diagnostic Tips

- For a quick check of IM function, a “wow” test can be performed. See Figure 2-8. See Figure 2-9. Ignition Switch (VRSCA/VRSCD) and Figure 2-10. Ignition Switch (VRSCR). Turn ignition switch to ACC. Background lighting should illuminate, gauge needles should sweep their full range of motion, and indicator lamps controlled by the serial bus (battery, security, coolant temperature and check engine) should illuminate.
- If instrument module fails “wow” test, check for battery, ground and accessory to IM. If any feature in the instrument module is non-functional, see 2.7 NO IM POWER

Diagnostic Notes

Use of IM self diagnostics assumes that the SCANALYZER (Part No. HD-41325) is not available.

The reference numbers below correlate with the circled numbers in the IM Self Diagnostics Chart.

1. To exit diagnostic mode, turn ignition switch OFF.
2. To clear DTCs for selected module, press instrument module trip switch for more than 5 seconds when code is displayed. This procedure will clear all codes for selected module.

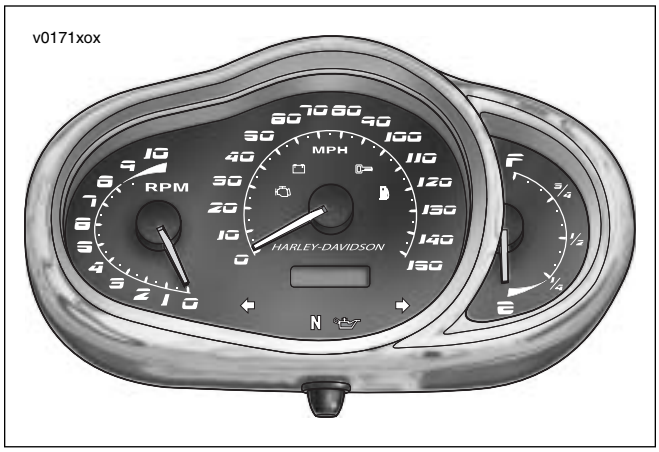
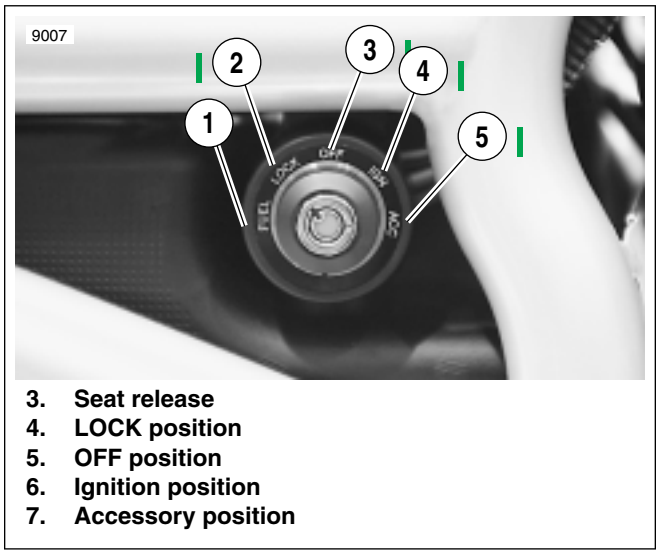
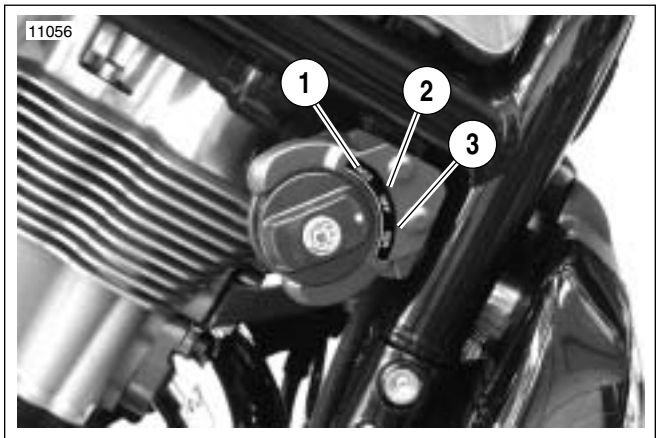


Figure 2-8. Instrument Module (typical) (VRSCR shown)



3. **Seat release**
4. **LOCK position**
5. **OFF position**
6. **Ignition position**
7. **Accessory position**

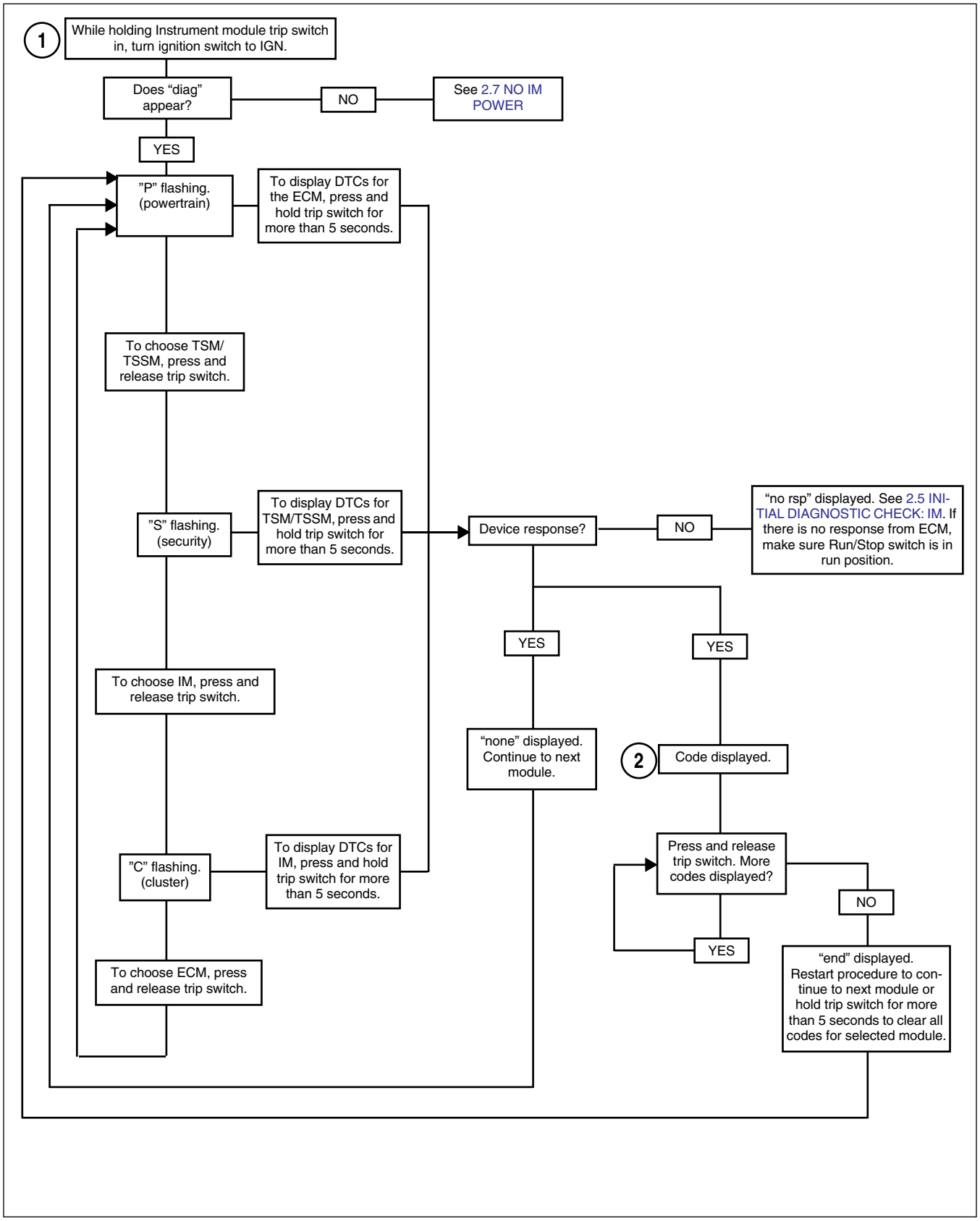
Figure 2-9. Ignition Switch (VRSCA/VRSCD)



1. **Accessory position**
2. **OFF position**
3. **Ignition position**

Figure 2-10. Ignition Switch (VRSCR)

IM Self Diagnostics Chart



BREAKOUT BOX: IM 2.4

GENERAL

The BREAKOUT BOX (Part No. HD-42682) and ADAPTERS (Part No. HD-45325) connect to the instrument module (IM) connector [39]. Used in conjunction with a DVOM, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects

NOTE

See wiring diagrams for IM terminal functions.

INSTALLATION

1. Remove handlebar cover.
2. See Figure 2-11. Depress latch on connector [39B].
3. Connect Harness Adapters to connectors [39A] and [39B].
4. Attach connectors from Breakout Box to Harness Adapters.

REMOVAL

1. Detach connectors from Breakout Box to Harness Adapters.
2. See Figure 2-11. Detach Harness Adapters from connectors [39A] and [39B].
3. Install connector [39B] to instrument module.

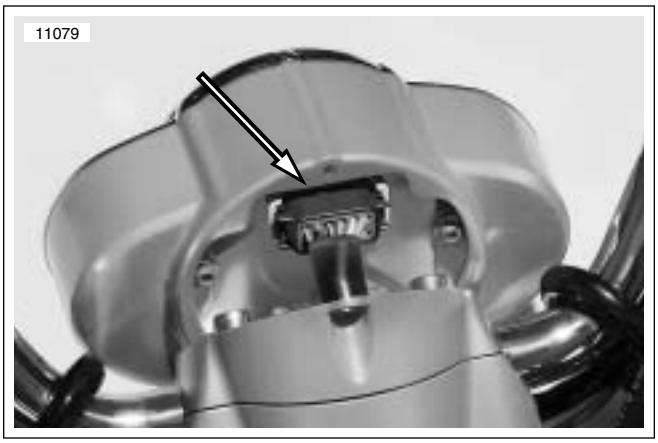


Figure 2-11. Instrument Module Connector [39] (typical) (VRSCD Shown)

INITIAL DIAGNOSTIC CHECK: IM 2.5

GENERAL

To locate faulty circuits or other system problems, follow the diagnostic flow charts and tests in this section. For a systematic approach, always begin with INITIAL DIAGNOSTICS which follows. Read the general information and then work your way through the flow chart box by box.

Diagnostic Notes

If a numbered circle appears adjacent to a flow chart box, then more information is offered in the diagnostic notes. Many diagnostic notes contain supplemental information, descriptions of various diagnostic tools or references to other parts of the manual where information on the location and removal of components may be obtained.

Scanalyzer Icon

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the Scanalyzer notes, which are similar to the diagnostic notes, but are restricted to information on the use of the Scanalyzer. All Scanalyzer notes may be found at the end of the respective flow chart.

Circuit Diagram/Wire Harness Connector Table

When working through a flow chart, refer to the illustrations, the associated circuit diagram and the wire harness connector table as necessary. The wire harness connector table for each circuit diagram identifies the connector number, description, type and general location.

In order to perform most diagnostic routines, a Breakout Box and a DVOM are required. See 2.4 BREAKOUT BOX: IM.

To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

INITIAL DIAGNOSTICS

Diagnostic Tips

- If the Scanalyzer is not working properly, check operation on another vehicle.
- See Figure 2-12. If proper Scanalyzer function is verified, check serial data connector [91A] for 12 volts (Terminal 4) and proper ground (Terminal 2).
- If Scanalyzer reads “No Response” with the ignition key turned ON (engine stop switch at RUN with the engine off), check data link for an open or short to ground between data connector [91A] Terminal 3 and ECM, TSSM, or IM.
- Check for an open diagnostic test terminal between data connector Terminal 3 and IM. With ignition key turned ON, transmit data should be typically 0.6-0.8 volts. The range of acceptable operation is 0-7.0 volts. Scanalyzer should communicate when proper voltage is present.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the diagnostic check flow charts. See page 2-12.

1. Compare engine behavior to symptoms tables in section 4.9 INITIAL DIAGNOSTIC CHECK.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probes and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 4.7 BREAKOUT BOX: ECM.

All IM diagnostic codes are listed on page 2-10 in Table 2-1.

Other Codes

See 3.10 INITIAL DIAGNOSTIC CHECK: TSM/TSSM for any codes related to the turn signal module (TSM) or turn signal security module (TSSM).

See 4.9 INITIAL DIAGNOSTIC CHECK for any codes related to the electronic control module (ECM).

Table 2-1. IM Diagnostic Trouble Codes (DTC) and Fault Conditions

DTC	RANKING	FAULT CONDITION	SOLUTION
B1003	1	Internal fault	2.11 DTC B1003
B1004	8	Fuel level sending unit low	2.12 DTC B1004, B1005
B1005	9	Fuel level sending unit high/open	2.12 DTC B1004, B1005
B1006	6	Accessory line overvoltage	2.13 DTC B1006, B1007
B1007	5	Ignition line overvoltage	2.13 DTC B1006, B1007
B1008	7	Trip switch closed	2.14 DTC B1008
U1016	2	Loss of ECM serial data	2.15 DTC U1016
U1064	3	Loss of TSM/TSSM serial data	2.16 DTC U1064, U1255
U1255	4	Missing response from other module (TSSM) at startup	2.16 DTC U1064, U1255

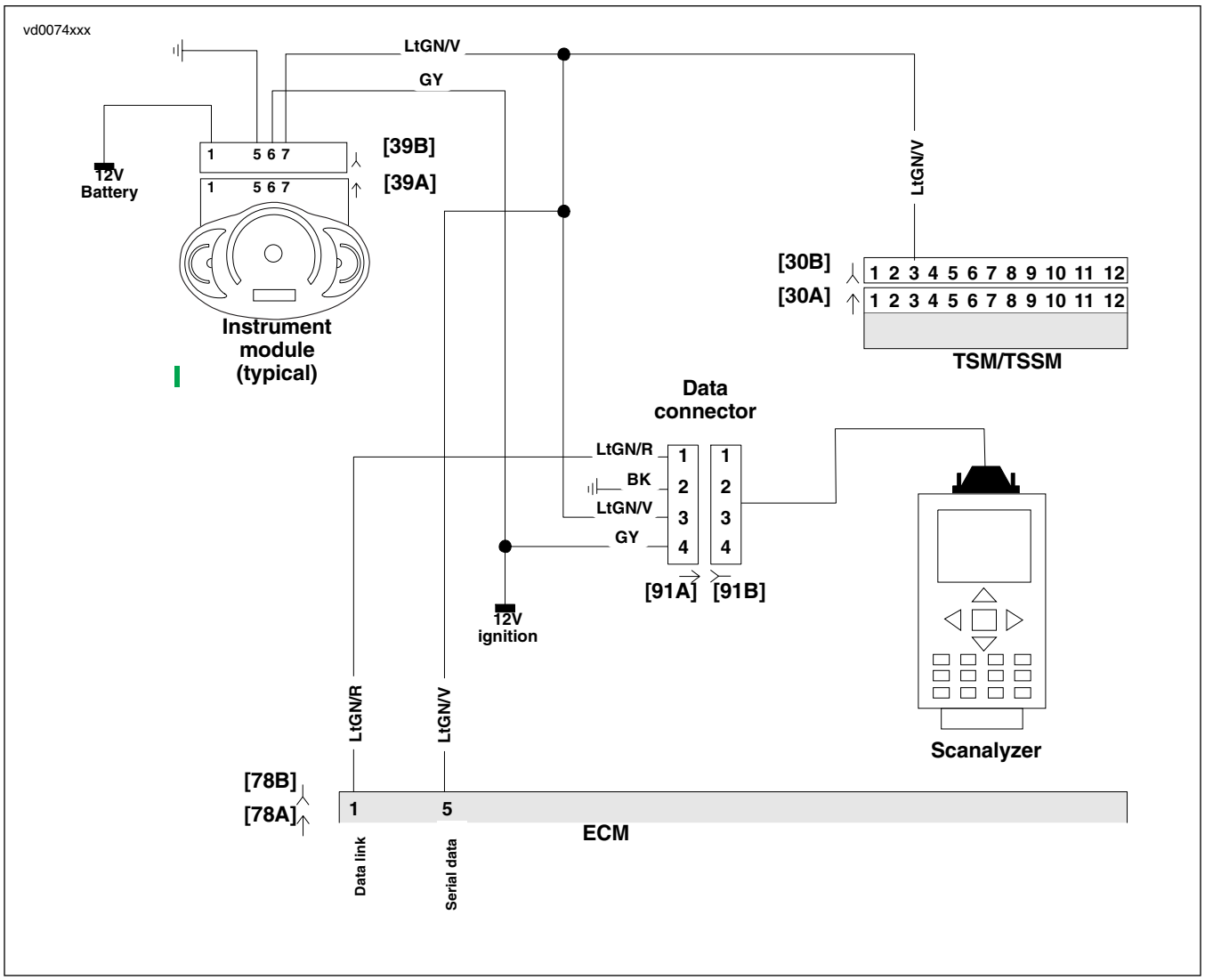
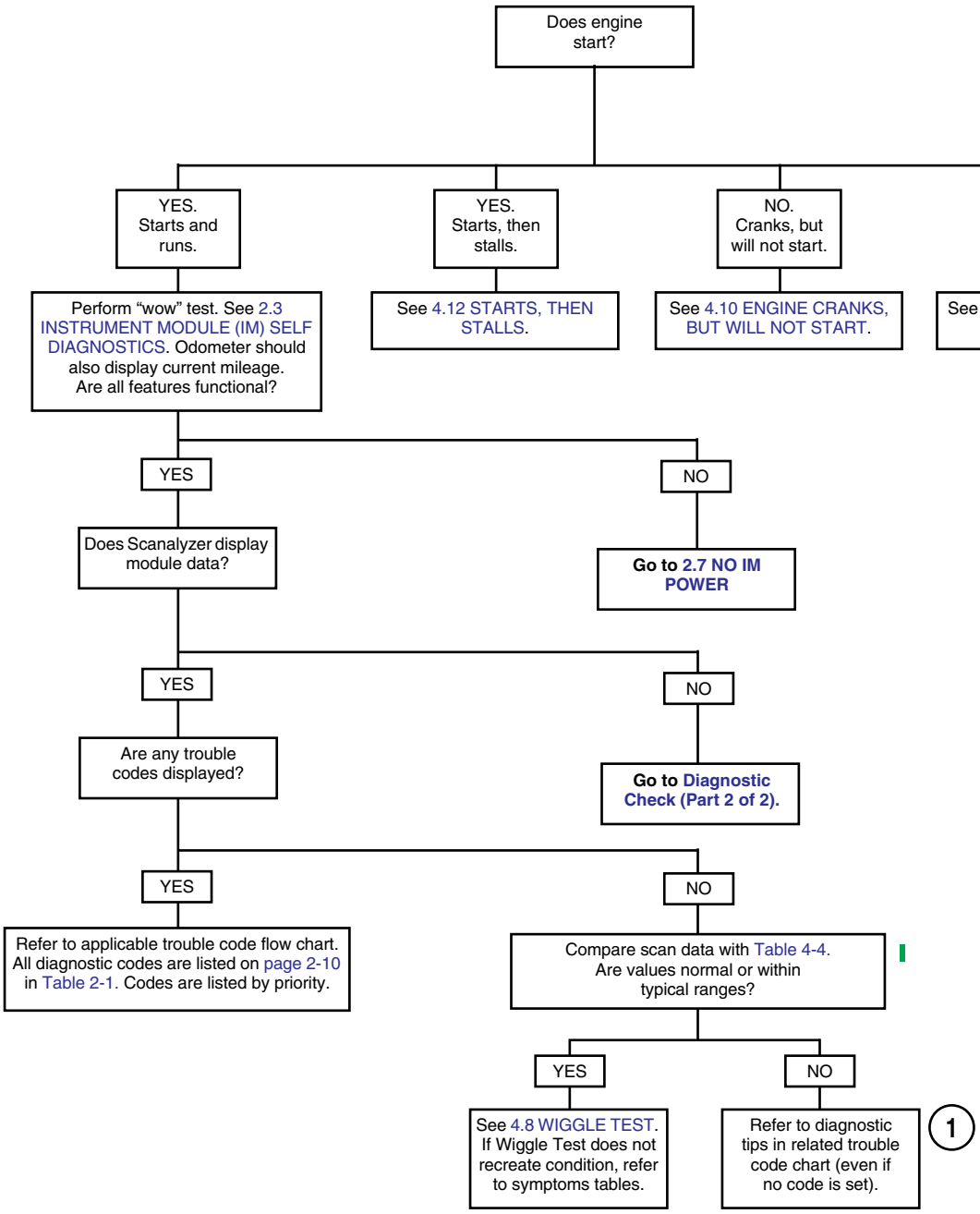


Figure 2-12. Diagnostic Check (typical)

Table 2-2. Wire Harness Connectors in Figure 2-12.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	IM	12-place Mini-Deutsch	under handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91A]	Data	4-place Deutsch	under left side cover

Diagnostic Check (Part 1 of 2)



Diagnostic Check (Part 2 of 2)

Continued from Diagnostic Check (Part 1 of 2).

2
3

Test the four data connector terminals for continuity.

DATA TERMINAL		TERMINAL	
No.	Wire Color	No.	Connector
1	Lt. GN/R	1	[78B]
2	BK	28	[78B]
3	Lt. GN/V	5	[78B]
4	GY	GY terminal on left side of ignition fuse	

Continuity present in all four circumstances?

- NO → Inspect terminals for damage or repair opens as necessary.
- YES → Check Scanalyzer on another vehicle. Scanalyzer OK?
  - NO → Scanalyzer malfunction.
  - YES → Disconnect ECM at [78]. Does Scanalyzer display IM and TSM/TSSM data?
    - YES → Replace ECM. Reprogram and learn password.
    - NO → 2 Remove TSM/TSSM connector [30]. Check for continuity to ground at data connector [91A] Terminal 3. Continuity to ground?
      - YES → Locate and repair short to ground.
      - NO → Check for voltage at terminal 3 of data connector [91A]. Voltage present?
        - YES → Locate and repair short to voltage.
        - NO → Replace TSM/TSSM. Reprogram and learn password. System OK?
          - YES → System OK.
          - NO → Replace IM.

Clear codes and confirm proper operation with no check engine lamp.

INSTRUMENT MODULE 2.6

GENERAL

The instrument module consists of a speedometer, tachometer, fuel gauge and several icons. The icons include: check engine, security, high beam, low battery, coolant temp, neutral, left turn, right turn, oil pressure and low fuel.

Trip Switch

See Figure 2-13. Pressing the odometer trip switch provides the following capabilities:

- Change the odometer display between mileage, trip and fuel range values (press and immediately release).
- Reset the trip odometer (press and hold 2-3 seconds).
- Gain access to the diagnostic mode and clear diagnostic codes. See 2.3 INSTRUMENT MODULE (IM) SELF DIAGNOSTICS.

1. **Instrument module**
2. **Trip switch**

Figure 2-13. Instrument Module (typical) (VRSCR shown)

Table 2-3. Instrument Module Trouble Codes

CODE	TROUBLE
B1003	Internal fault
B1004	Fuel level sending unit low
B1005	Fuel level sending unit high/open
B1006	Accessory line overvoltage
B1007	Ignition line overvoltage
B1008	Trip switch closed
U1016	Loss of ECM serial data
U1064	Loss of TSM/TSSM serial data
U1255	Missing response from other module (TSSM) at startup

SPEEDOMETER THEORY OF OPERATION

The speedometer which is contained in the instrument module consists of a speed sensor, odometer trip switch and speedometer. The speed sensor is mounted on the left side of transmission case. The sensor circuitry is that of a Hall-Effect sensor that is triggered by the gear teeth of 5th gear on the transmission mainshaft.

The output from the sensor is a series of pulses that are interpreted by ECM circuitry, converted into serial data then sent to the IM. The IM converts the data to control the position of the speedometer needle. It also provides input to the TSM/TSSM for turn signal cancellation.

The odometer mileage is permanently stored and will not be lost when electrical power is turned off or disconnected. The odometer trip switch allows switching between the odometer, trip odometer and fuel range displays.

To zero the trip odometer, have the odometer display visible, press and keep the function switch depressed. The trip odometer mileage will be displayed for 2-3 seconds and then the trip mileage will return to zero miles.

The odometer can display six numbers to indicate a maximum of 999999 miles. The trip odometer can display six numbers with a tenth of a mile accuracy for a maximum of 99999.9 miles.

TACHOMETER THEORY OF OPERATION

The tachometer receives serial data from the ECM. The tachometer interprets the serial data and converts it into tachometer needle movement.

Tachometer needle will turn from amber to red when RPM limit is reached.

DIAGNOSTICS

Instrument Gauge Performance Tests

The SCANALYZER (Part No. HD-41325) can be used to check the function of IM instrument gauge function and backlighting.

1. From the diagnostic menu, press number “4” to access the active test menu. Press number “3” to access the instrument gauges tests. At this point, the unit allows the operator to:
   a. Press number “1” to select Speedometer (tests speedometer needle sweep function).
   b. Press number “2” to select Tachometer (tests tachometer needle sweep function).
   c. Press number “3” to select Fuel level (tests fuel level needle sweep function).
   d. Press number “4” to select Tach Ptr Amber (tests tachometer needle amber backlight function.
   e. Press number “5” to select Tach Ptr Red (tests tachometer needle red backlight function).
   f. Press number “6” to select Spd Ptr LED (tests speedometer needle and LED backlight function).
   g. Press number “7” to select Fuel Ptr Red (tests fuel level needle red backlight function).
   h. Press number “8” to select Fuel Ptr Amber (tests fuel level needle amber backlight function).
2. After performing a test, simply press the mode key to return to the active test menu.
3. Press the mode key again to return to the diagnostic menu. In this manner, regardless of where the operator is in the program, the mode key need only be pressed once or twice to return to the main menu.

NO IM POWER 2.7

GENERAL

Constant power is supplied to the IM through terminal 1. The IM turns on when power is applied to terminal 6 of connector [39]. The IM goes through an initialization sequence every time power is removed and re-applied to terminal 6. The visible part of this sequence is the check engine lamp, security lamp, backlighting, odometer and fuel level. Upon key ON, the check engine lamp and security lamp will illuminate for 4 seconds and then (if parameters are normal) go out.

Loss of power on any of the three power inputs will change IM behavior. Refer to Table 2-4.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 2.7 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-42682) and ADAPTERS (Part No. HD-45325) between wire harness and IM.

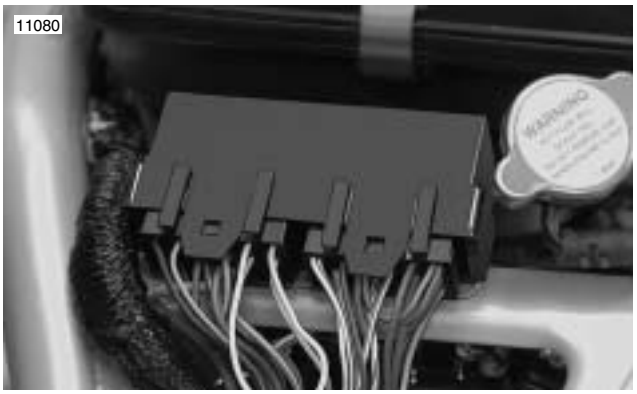
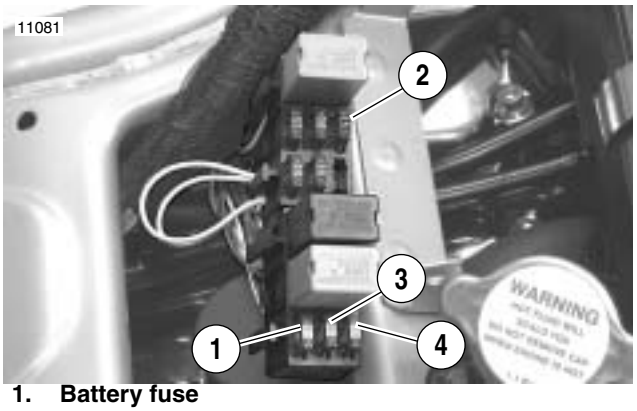


Figure 2-14. Fuse Block Location (typical)



1. **Battery fuse**
2. **Accessory fuse**
3. **ECM fuse**
4. **Ignition fuse**

Figure 2-15. Fuses (typical)

Table 2-4. Function Chart-Loss Of Input

TERMINAL 6 (IGN)	TERMINAL 12 (ACC)	TERMINAL 5 (GRD)
Will “wow”	Will not “wow”	Neutral and oil pressure lamps still functional
Needles freeze	Backlighting and odometer non-functional	Other features non-functional or erratic
Turn signals and fuel gauge still functional	Fuel gauge, turn signals and security lamp non-functional	Diagnostics absent
Speedometer, tachometer, check engine lamp, security lamp, oil pressure lamp and high beam indicators non-functional If any features is non-functional or erratic and other features are OK - Replace IM (Job Time Code 6014)	Diagnostics absent	
Diagnostics absent		

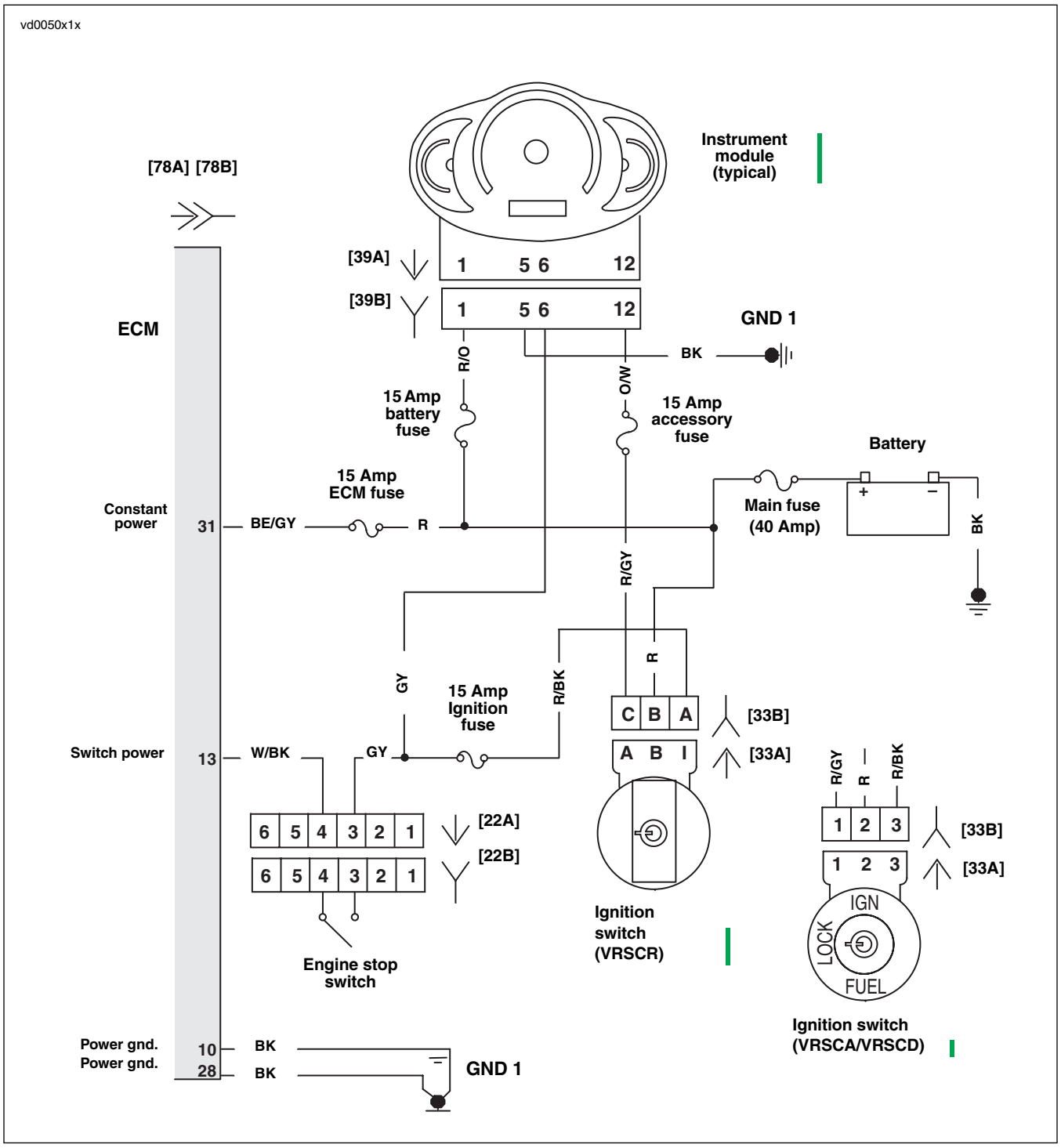


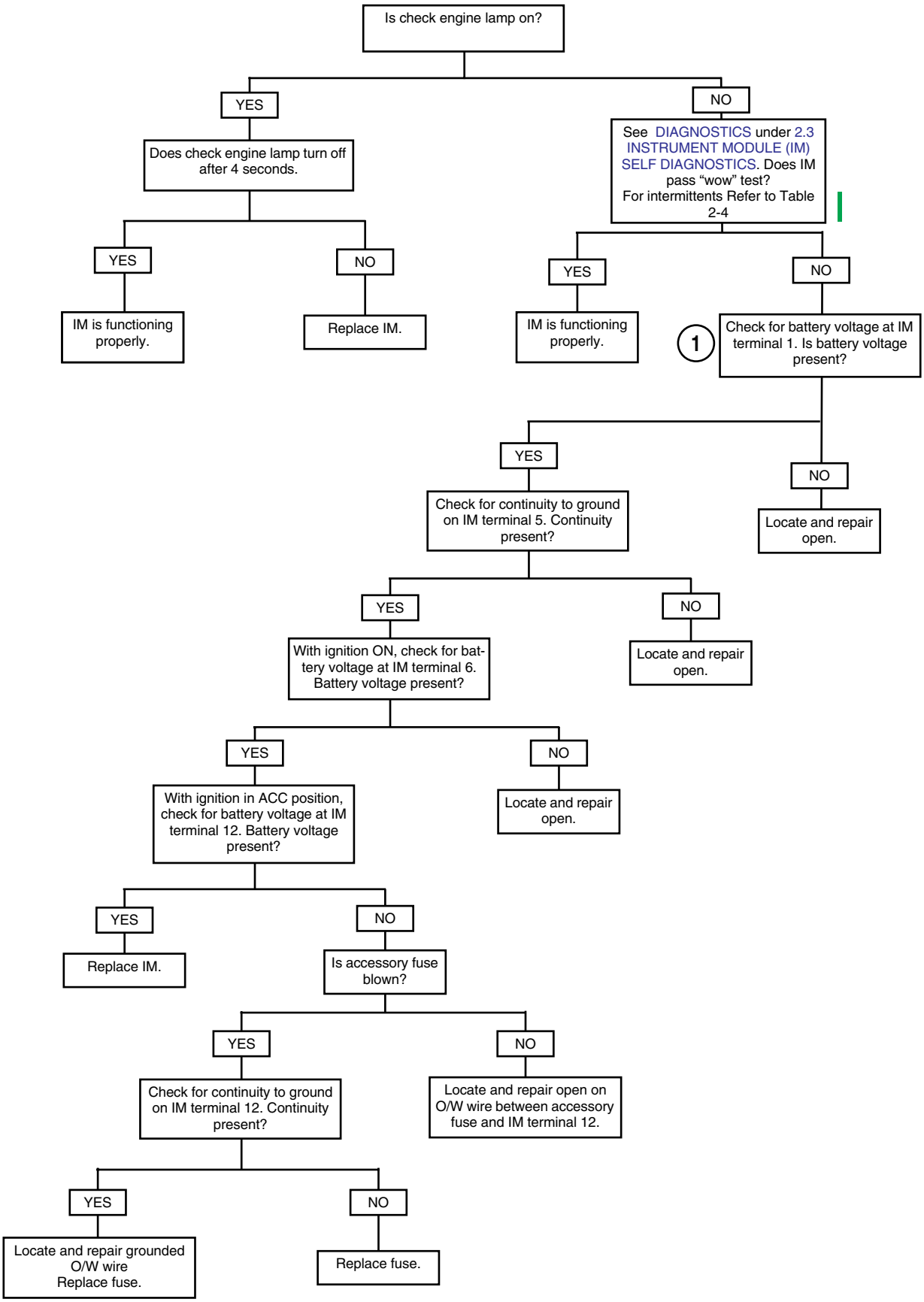
Figure 2-16. IM Power Circuit Diagram

Table 2-5. Wire Harness Connectors in Figure 2-16.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar switch (black)	6-place Deutsch	under left side cover
[39]	IM	12-place Mini-Deutsch	inside handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
GND 1	ECM ground	Ring terminal	rear cylinder head
	Fuse block	fuse block	under airbox cover

Test 2.7

NO IM POWER



INDICATOR LAMPS 2.8

GENERAL

VRSC models are equipped with Light Emitting Diode (LED) indicators. The indicator lamps are not serviceable. If an LED is bad, the IM must be replaced.

See DIAGNOSTICS which follows for troubleshooting procedures.

Table 2-6. Connector [39] Terminals

TERMINAL ON [39]	WIRE COLOR	FUNCTION
1	Red/Orange	battery
2	White	high beam
3	Violet	left turn
4	Brown	right turn
5	Black	ground
6	Grey	ignition
7	Lt. Green/Violet	serial data
8	N/A	N/A
9	Green/Yellow	oil pressure
10	Tan	neutral
11	Yellow/White	fuel sender
12	Orange/White	accessory

Table 2-7. LED Function

INDICATOR LAMP	CONNECTION
Check engine	serial data
Security	serial data
Coolant temperature	serial data
Battery	serial data
Oil pressure	ground through switch
Neutral	ground through switch
High beam	12 volts when active
Right/left turn	12 volts when active
Low fuel	voltage varies through sender, active at 1/4 tank or less

Figure 2-17. Indicator Lamps (VRSCA/VRSCD)

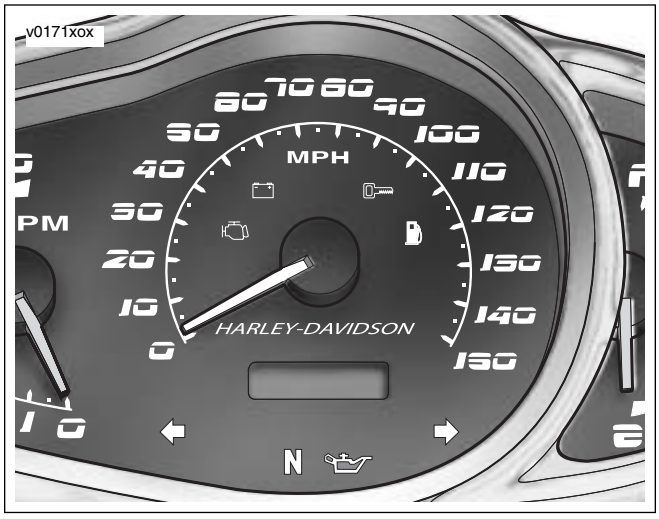


Figure 2-18. Indicator Lamps (VRSCR)

DIAGNOSTICS

LED Indicators

Certain LED indicators can be checked using the SCANALYZER (Part No. HD-41325). These are the battery, security, coolant temperature, check engine and low fuel indicator.

1. From the diagnostic menu, press number “4” to access the active test menu. Press number “3” to access the instrument gauges tests. At this point, the unit allows the operator to:
   a. Press number “1” to select Low Fuel (tests low fuel LED function).
   b. Press number “2” to select Battery (tests battery LED function).
   c. Press number “3” to select Check Engine (tests check engine LED function).
   d. Press number “4” to select Coolant Hot (tests coolant temperature LED function).
   e. Press number “5” to select Security (tests security LED function).
   f. Press number “6” to select LED Test (tests LED function).
2. After performing a test, simply press the mode key to return to the active test menu.
3. Press the mode key again to return to the diagnostic menu. In this manner, regardless of where the operator is in the program, the mode key need only be pressed once or twice to return to the main menu.

NOTE

The remaining LED indicators (oil pressure, neutral, high beam, and right/left turn signals) can be diagnosed using the charts below.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 2.8 flow charts.

1. Connect BREAKOUT BOX (Part No. HD-42682) and ADAPTERS (Part No. HD-45325) between wire harness and IM.

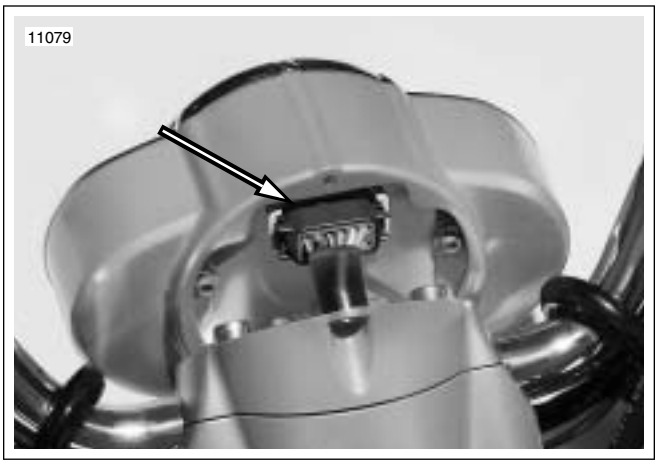
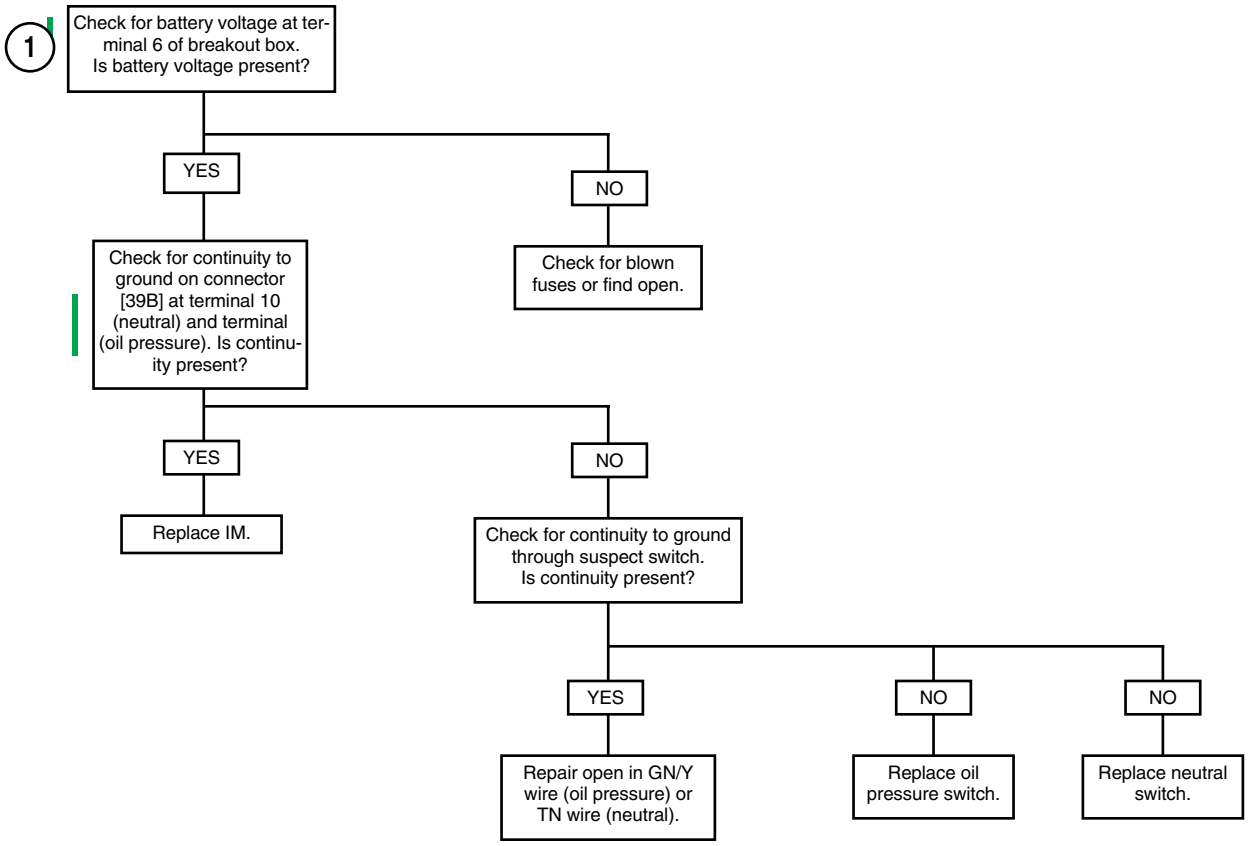
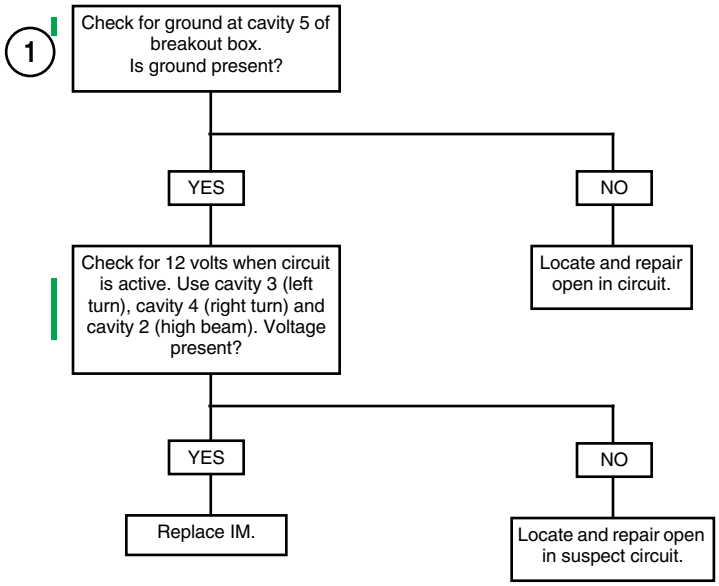


Figure 2-19. Instrument Module Connector [39] (typical) (VRSCD Shown)

Oil Pressure or Neutral Indicator Will Not Function



High Beam or R/L Turn Signal Indicator Will Not Function



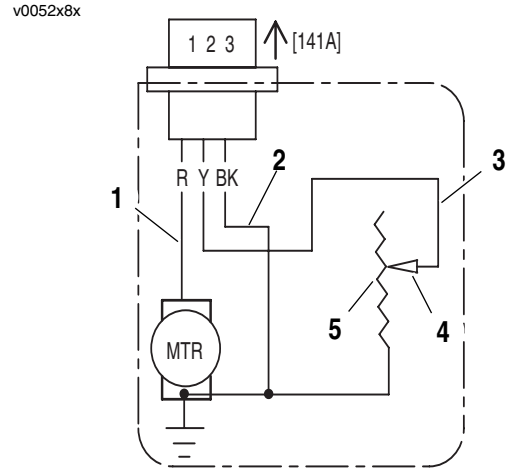
FUEL GAUGE OPERATION (VRSCA/VRSCD) 2.9

GENERAL

See Figure 2-20. With ignition switch ON, the fuel gauge (1) is connected to +12 volts. Current flows through the gauge and variable resistor (5) in the fuel gauge sending unit (4) to ground. The sending unit float controls the amount of resistance in the variable resistor.

Inoperative gauges may be caused by four circumstances.

- Sender or instrument module not grounded.
- Malfunction in sender or instrument module.
- Loss of accessory input, blown accessory fuse.
- Broken or disconnected wire from instrument module to fuel pump/sender.



1. +12 volts wire
2. Ground wire
3. Fuel level signal wire
4. Sending unit
5. Resistance value (varies on fuel present)

Figure 2-20. Fuel Gauge Schematic (VRSCA/VRSCD)

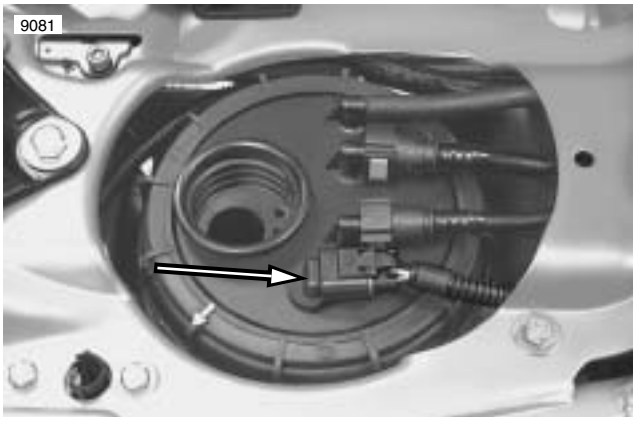


Figure 2-21. Fuel Pump Connector [141] (VRSCA/VRSCD)

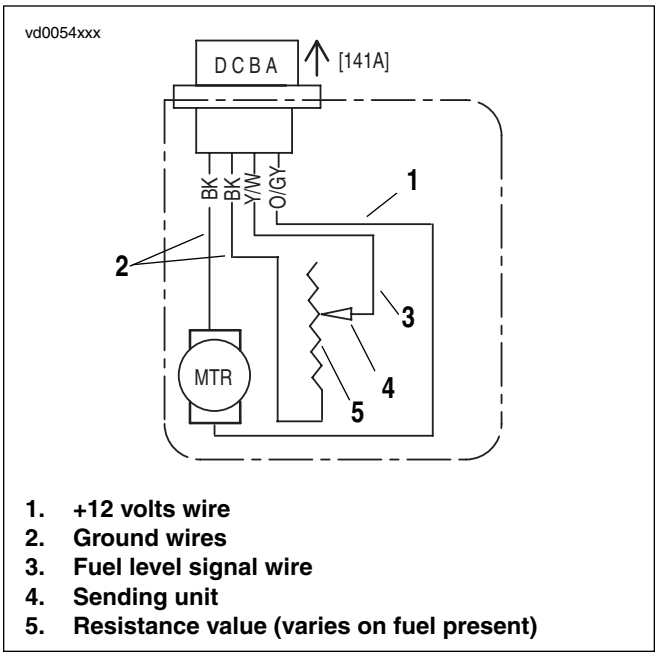
FUEL GAUGE OPERATION (VRSCR) 2.10

GENERAL

See Figure 2-22. With ignition switch ON, the fuel gauge (1) is connected to +12 volts. Current flows through the gauge and variable resistor (5) in the fuel gauge sending unit (4) to ground. The sending unit float controls the amount of resistance in the variable resistor.

Inoperative gauges may be caused by four circumstances.

- Sender or instrument module not grounded.
- Malfunction in sender or instrument module.
- Loss of accessory input, blown accessory fuse.
- Broken or disconnected wire from instrument module to fuel pump/sender.



1. **+12 volts wire**
2. **Ground wires**
3. **Fuel level signal wire**
4. **Sending unit**
5. **Resistance value (varies on fuel present)**

Figure 2-22. Fuel Gauge Schematic (VRSCR)

Figure 2-23. Fuel Pump Connector [141] (VRSCR)

DTC B1003

GENERAL

Internal Fault

This DTC indicates a failure which requires replacement of the instrument module.

NOTE

When DTC B1003 is set as current, the instrument module has an internal error such as memory check sum error, EEPROM error or Program Code Lost. This is a non-serviceable failure. Replace the instrument module.

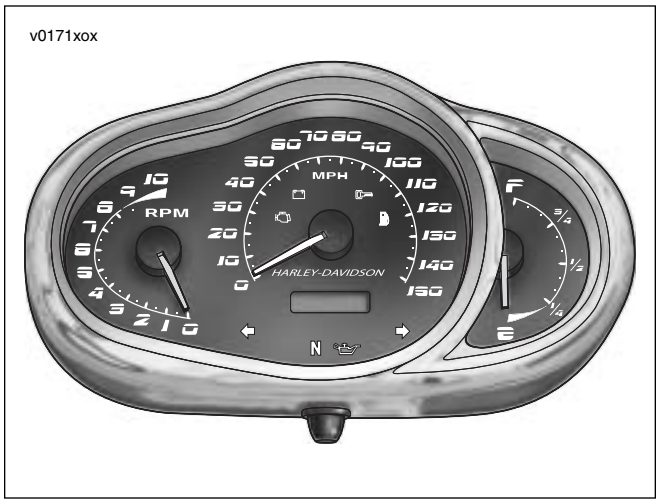


Figure 2-24. Instrument Module (typical) (VRSCR shown)

DTC B1004, B1005 2.12

GENERAL

Fuel Level Sending Unit High/Low

The fuel level is monitored by the speedometer terminal 11 of connector [39] (Y/W).

- If the voltage on terminal 11 of connector [39] exceeds the lower limit for greater than or equal to 15 seconds a DTC B1004 will be set.
- If the voltage on terminal 11 of conductor [39] exceeds the upper limit (or is open) for greater than or equal to 15 seconds a DCT B1005 will set.

Table 2-8. Code Description

DTC	DESCRIPTION
B1004	Fuel level sending unit low.
B1005	Fuel level sending unit high/open.

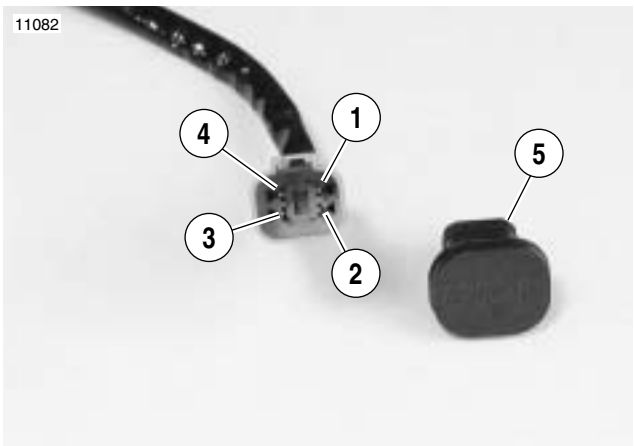
DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 2.12 flow chart.

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and brown socket terminal.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), brown terminal probe and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-42682) and ADAPTERS (Part No. HD-45325) between wire harness and IM.

Figure 2-25. Instrument Module Connector [39] (typical) (VRSCD Shown)



1. **Terminal 1: flash terminal (Lt GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**
5. **Protective cap**

Figure 2-26. Data Connector Terminals

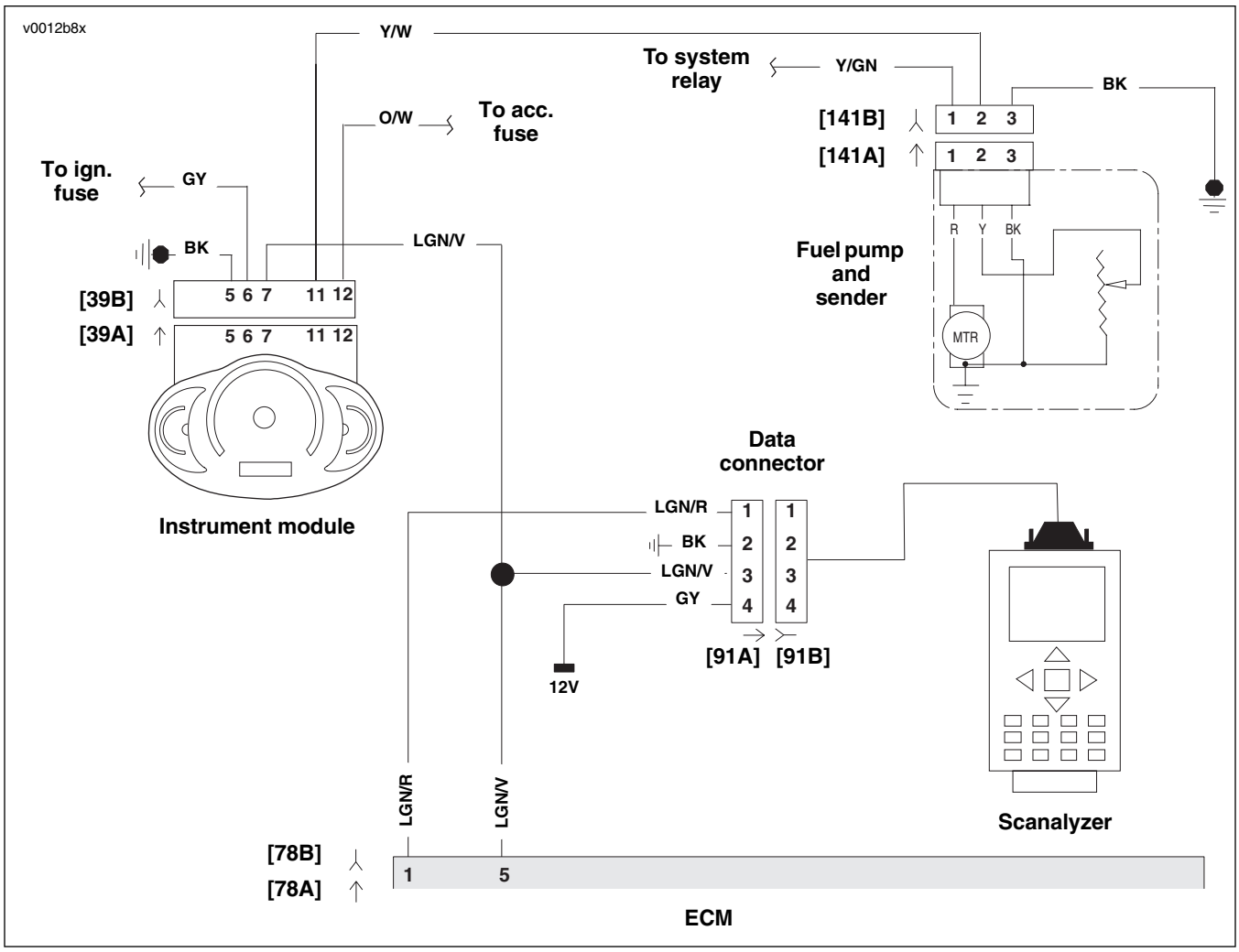


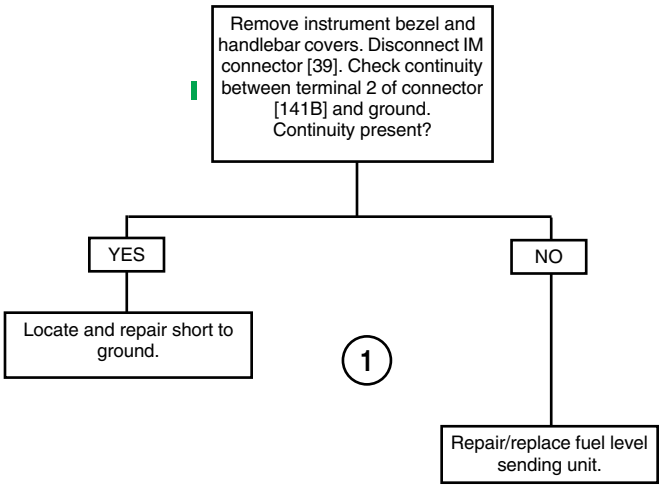
Figure 2-27. Fuel Sender Circuit (VRSCA/VRSCD)

Table 2-9. Wire Harness Connectors in Figure 2-27.

NO.	DESCRIPTION	TYPE	LOCATION
[39]	Instrument module	12-place Mini-Deutsch	under handlebar cover
[78]	ECM	36-place Packard	under left side cover
[91]	Data	4-place Deutsch	under left side cover
[141]	Fuel pump and sender	3-place Mini-Deutsch	top of fuel tank

Test 2.12: DTC 1004 (VRSCA/VRSCD)

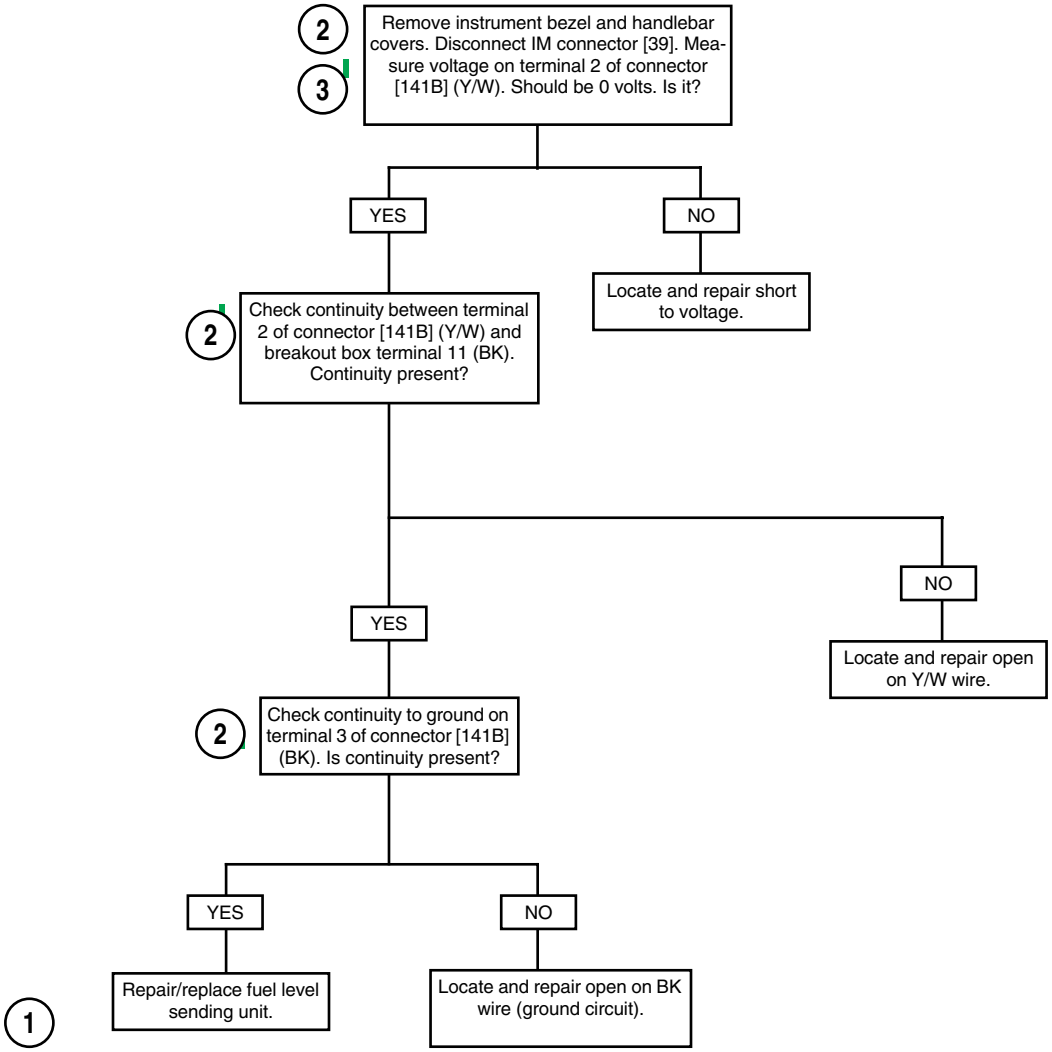
FUEL LEVEL SENDING UNIT



Clear codes and confirm proper operation with no check engine lamp.

Test 2.12: DTC B1005 (VRSCA/VRSCD)

FUEL LEVEL SENDING UNIT



Clear codes and confirm proper operation with no check engine lamp.

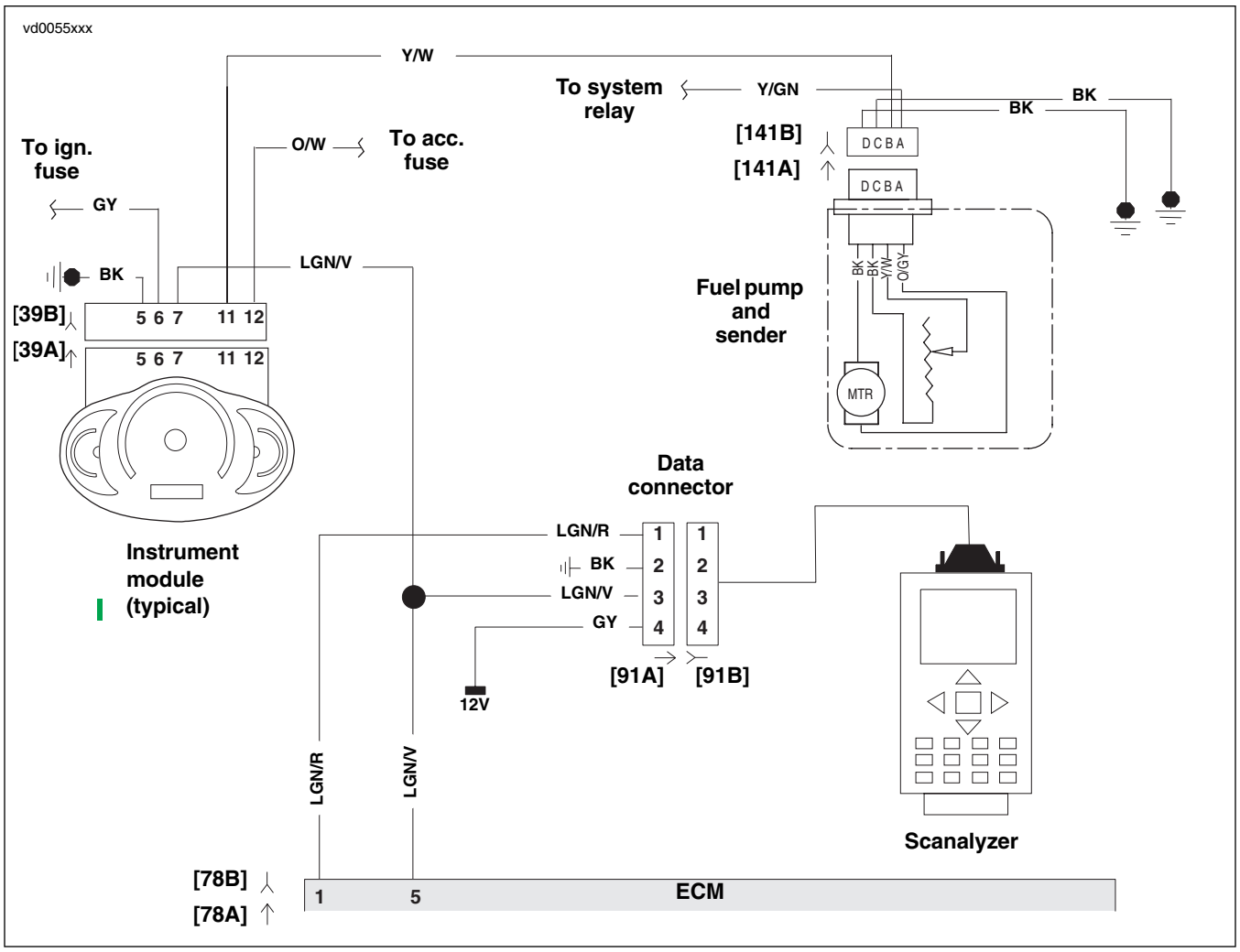


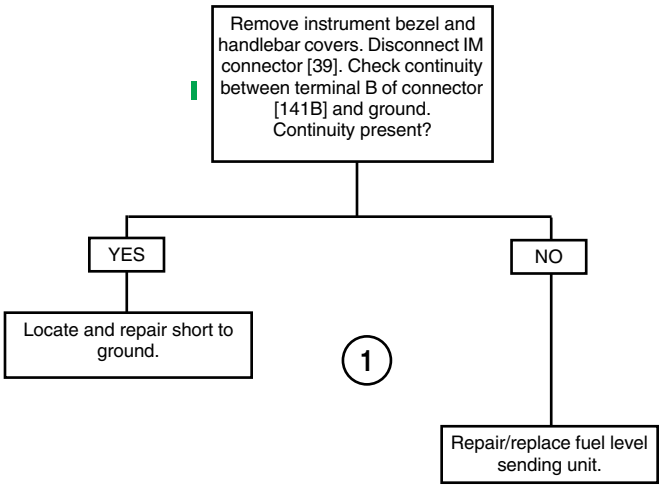
Figure 2-28. Fuel Sender Circuit (VRSCR)

Table 2-10. Wire Harness Connectors in Figure 2-28.

NO.	DESCRIPTION	TYPE	LOCATION
[39]	Instrument module	12-place Mini-Deutsch	under handlebar cover
[78]	ECM	36-place Packard	under passenger seat
[91]	Data	4-place Deutsch	under left side cover
[141]	Fuel pump and sender	4-place Packard	top of fuel tank

Test 2.12: DTC 1004 (VRSCR)

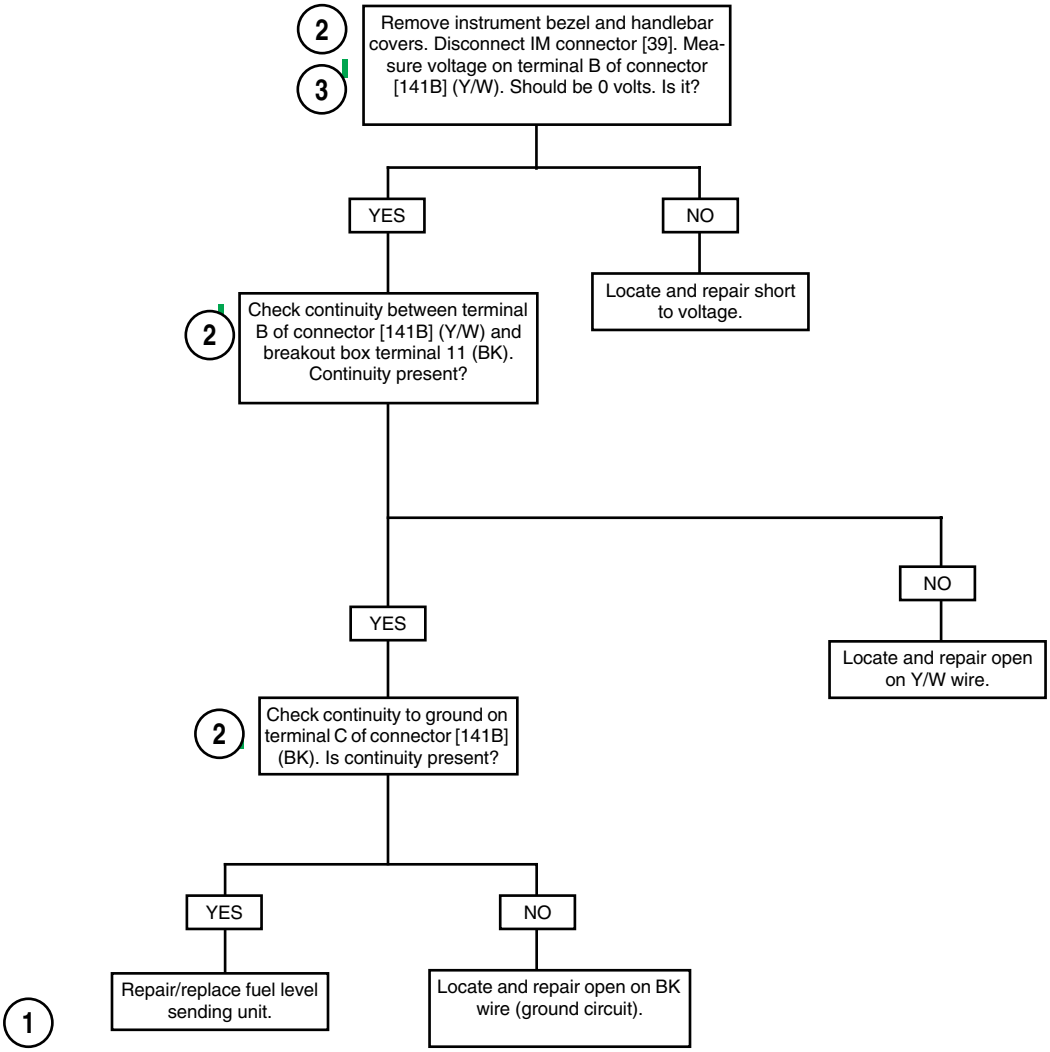
FUEL LEVEL SENDING UNIT



Clear codes and confirm proper operation with no check engine lamp.

Test 2.12: DTC B1005 (VRSCR)

FUEL LEVEL SENDING UNIT



Clear codes and confirm proper operation with no check engine lamp.

GENERAL

Accessory Or Ignition Line Overvoltage

Battery voltage is constantly monitored by the IM (Terminal 6-ignition and Terminal 12-accessory). If the battery voltage fails to meet normal operating parameters, a code is set.

- Code B1006 is displayed when accessory line voltage is greater than 16.0 volts for longer than 5 seconds.
- Code B1007 is displayed when ignition line voltage is greater than 16.0 volts for longer than 5 seconds.

NOTE

ECM or TSSM may also set a battery voltage diagnostic codes.

Table 2-11. Code Description

DTC	DESCRIPTION
B1006	Accessory line overvoltage
B1007	Ignition line overvoltage

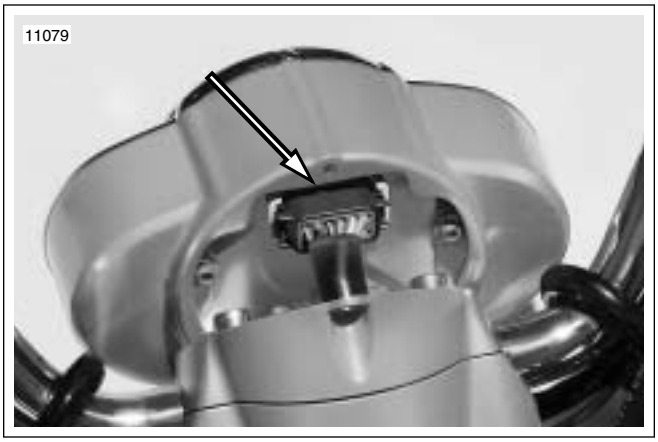
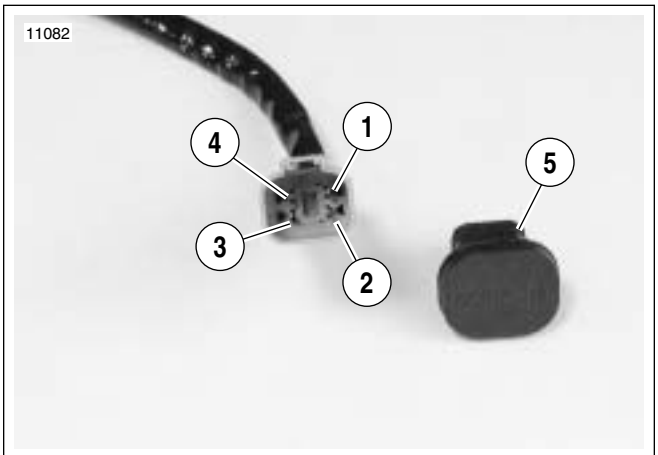


Figure 2-29. Instrument Module Connector [39] (typical) (VRSCD Shown)

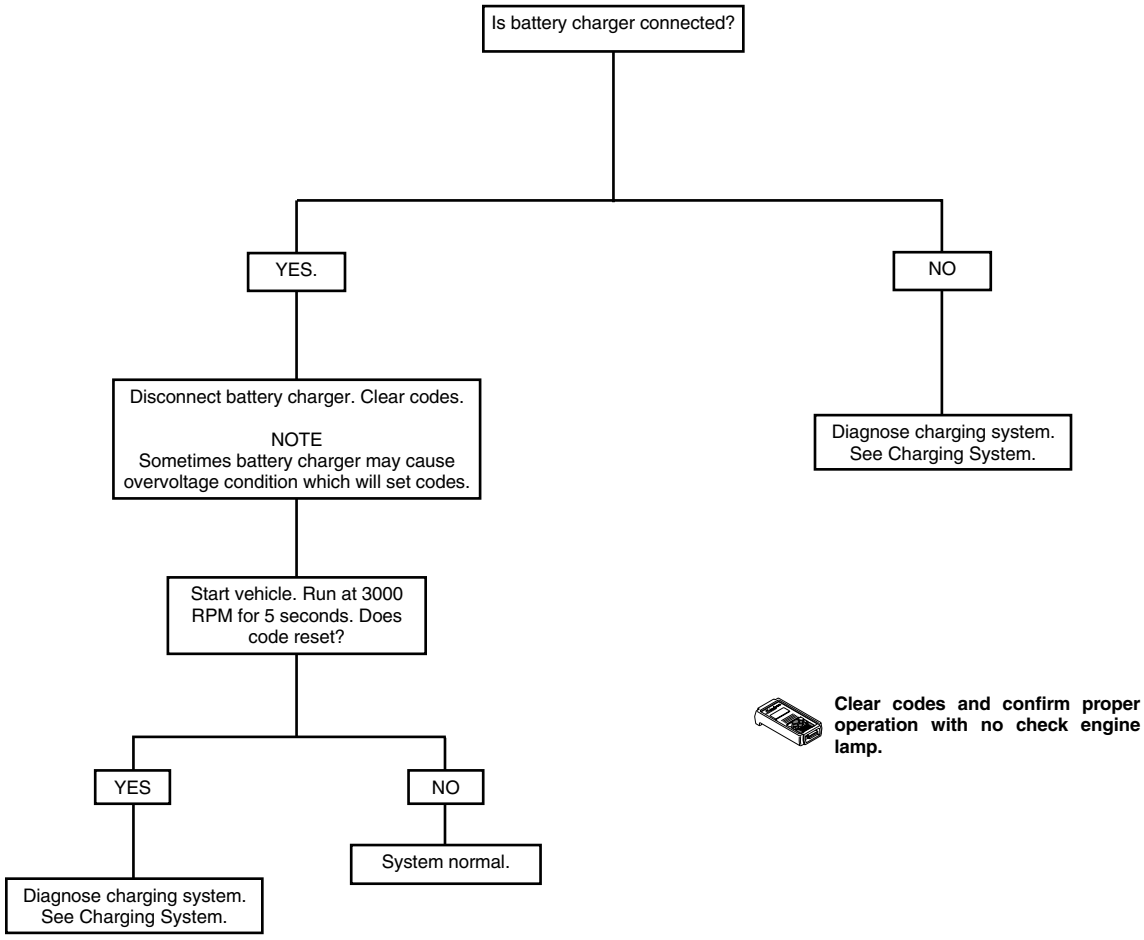


1. **Terminal 1: flash terminal (Lt GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**
5. **Protective cap**

Figure 2-30. Data Connector Terminals

Test 2.13

ACCESSORY OR IGNITION LINE OVERVOLTAGE: DTC B1006/B1007



Clear codes and confirm proper operation with no check engine lamp.

DTC B1008

GENERAL

Trip Switch Closed

Code B1008 will be set if switch terminals are in a constant shorted state.

Table 2-12. Code Description

DTC	DESCRIPTION
B1008	Trip switch closed

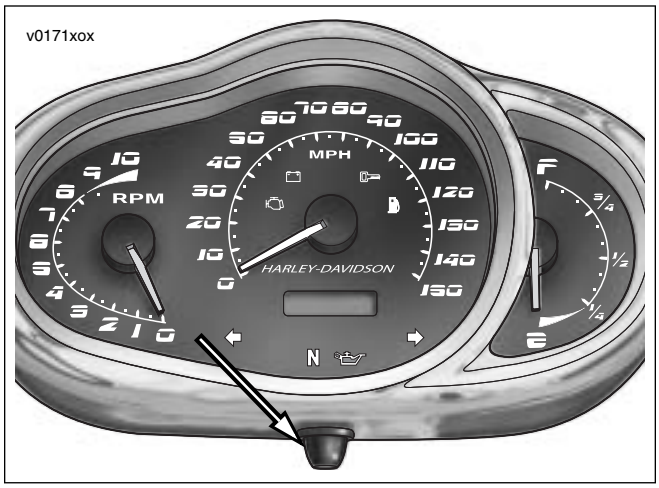
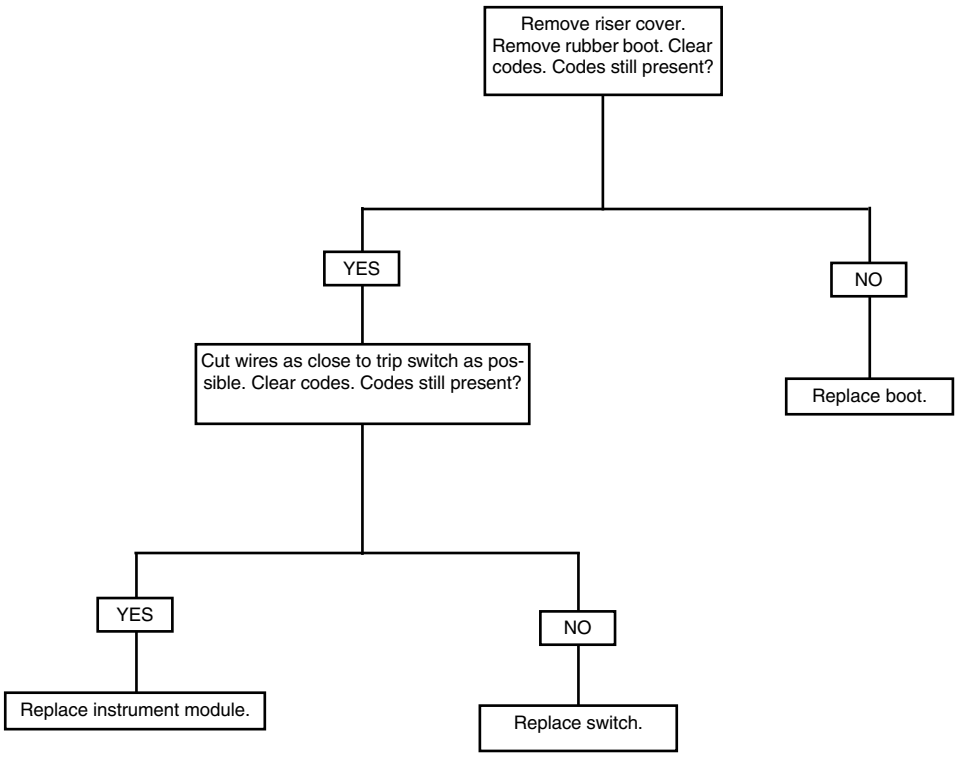


Figure 2-31. Trip Switch (typical) (VRSCR shown)

Test 2.14

TRIP SWITCH CLOSED: DTC B1008



Clear codes and confirm proper operation with no check engine lamp.

DTC U1016

GENERAL

Loss of ECM Serial Data

The serial data connector provides a means for the IM, ECM and TSM/TSSM to communicate their current status. When all operating parameters on the serial data link are within specifications, state of health messages are sent between the modules. A DTC U1016 indicates that the ECM is not capable of sending this state of health message.

A DTC U1255 indicates that no messages were present during power up of the current key cycle. A DTC U1016 indicates that there was communication on the data bus since power up, but was lost or interrupted during that key cycle.

Table 2-13. Code Description

DTC	DESCRIPTION
U1016	Loss of all ECM serial data (state of health)

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 2.15 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.
2. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness and TSM/TSSM. See 3.12 BREAKOUT BOX:TSM/TSSM.

Figure 2-32. ECM Connector (VRSCA/VRSCD) (under left side cover)

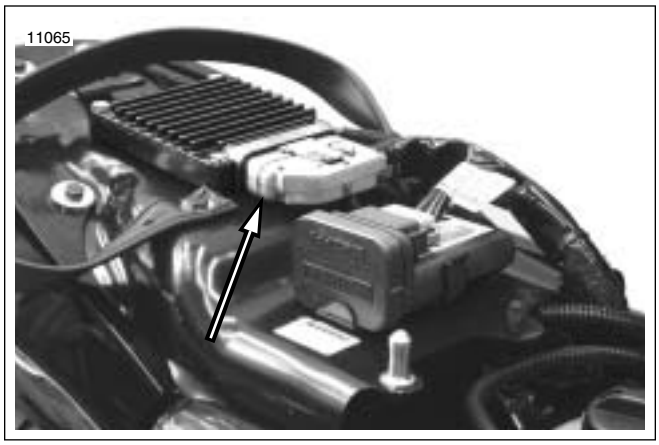
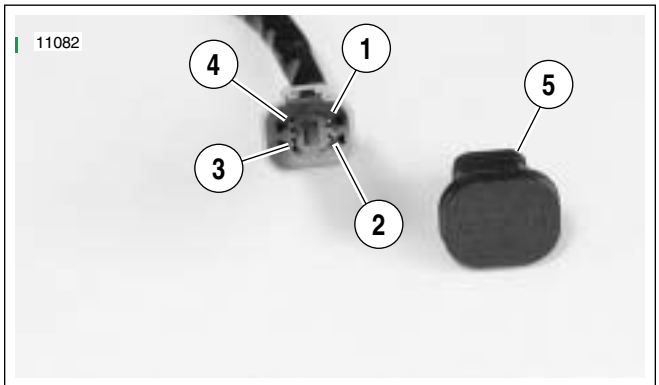


Figure 2-33. ECM Connector (VRSCR) (under passenger seat)



1. **Terminal 1: flash terminal (Lt GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**
5. **Protective cap**

Figure 2-34. Data Connector Terminals

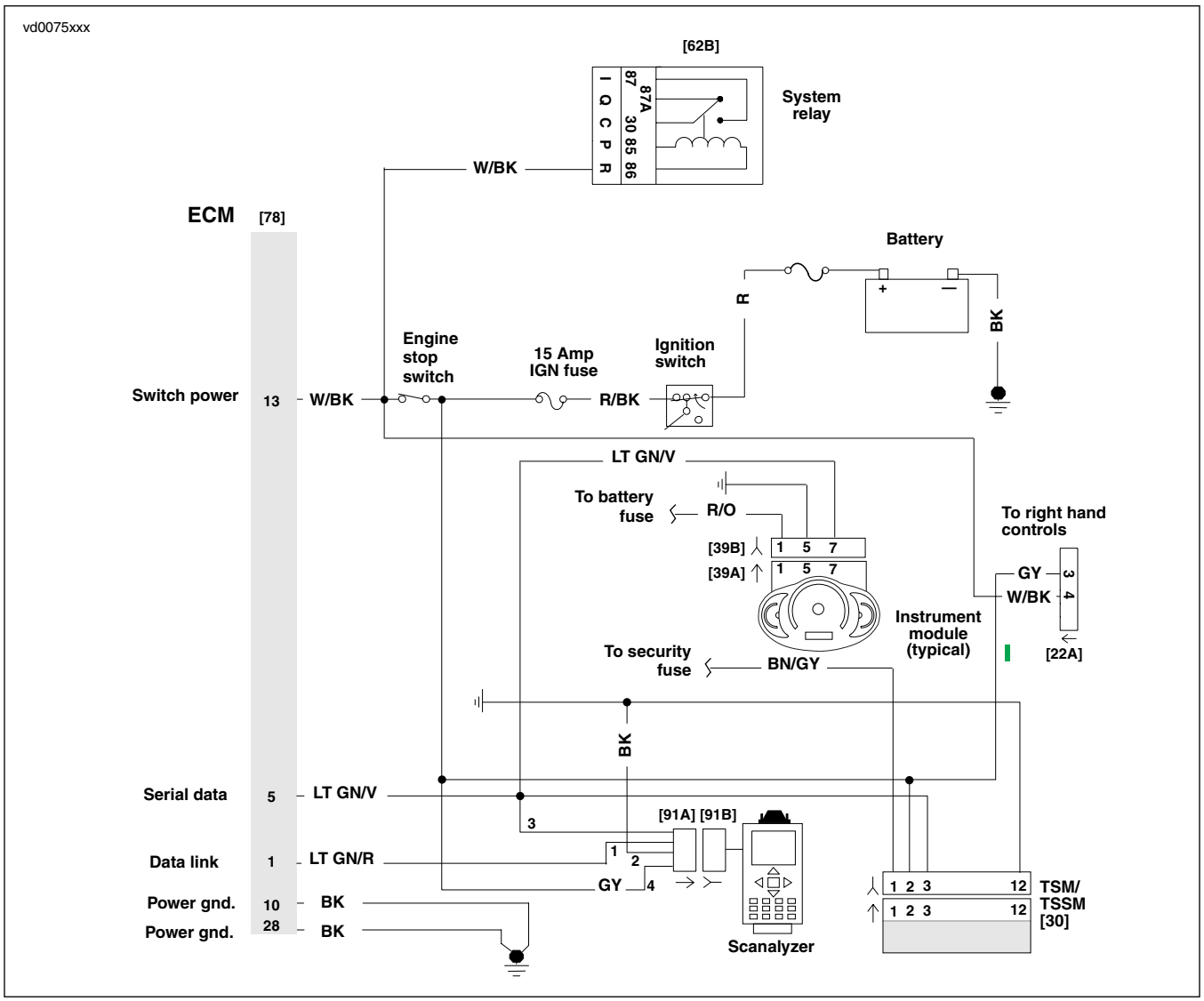


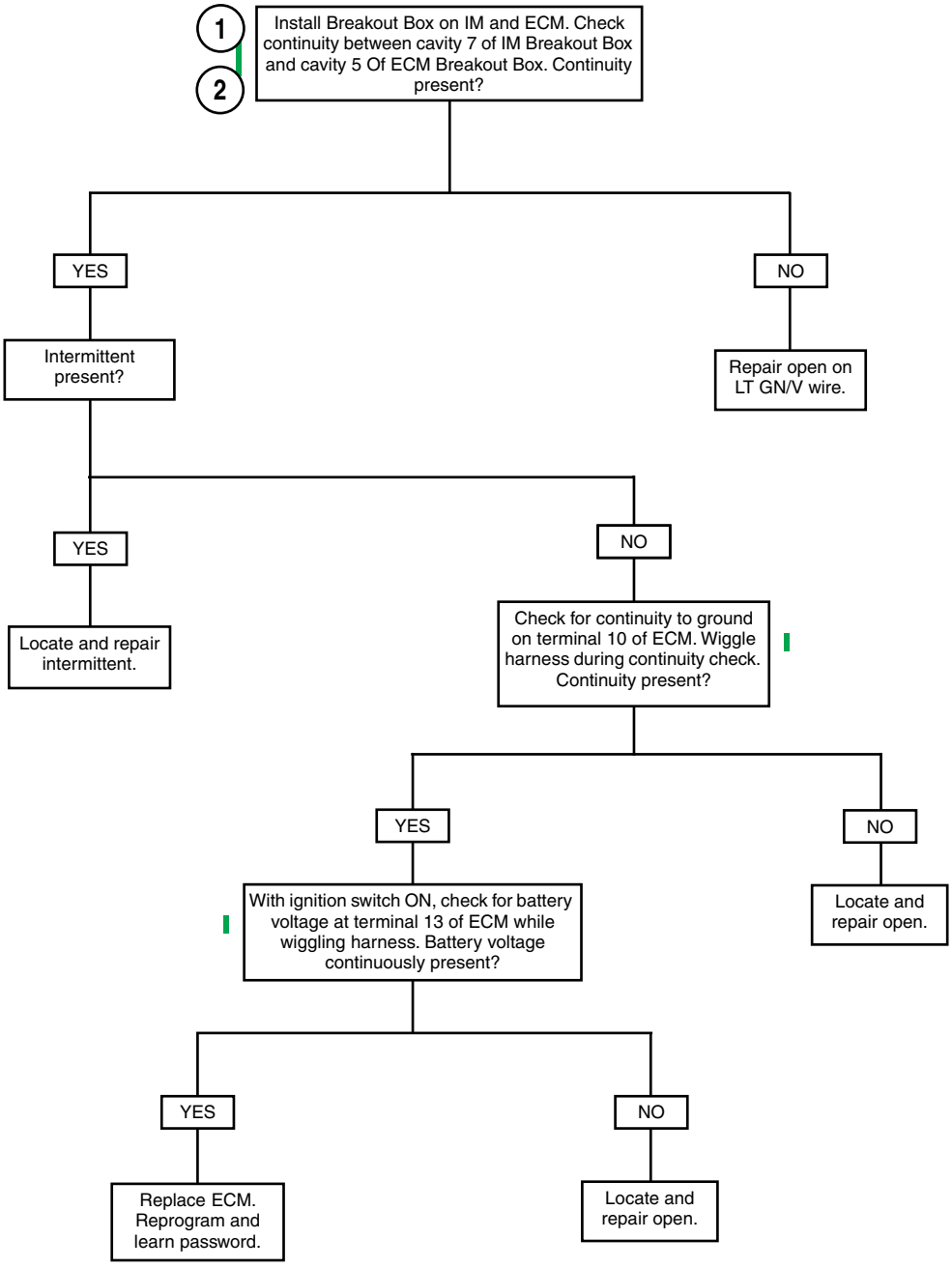
Figure 2-35. ECM, TSM/TSSM and IM Circuit (VRSCR)

Table 2-14. Wire Harness Connectors in Figure 2-35.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	Instrument module	12-place Mini-Deutsch	handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91]	Data	4-place Deutsch	under left side cover

Test 2.15

LOSS OF ECM SERIAL DATA: DTC U1016



Clear codes and confirm proper operation with no check engine lamp.

DTC U1064, U1255 2.16

GENERAL

Loss of TSM/TSSM Serial Data

The serial data connector provides a means for the ECM, IM and TSM/TSSM to communicate their current status. When all operating parameters on the serial data link are within specifications, state of health messages are sent between the modules. A DTC U1064 indicates that the TSM/TSSM is not sending this state of health message.

A DTC U1255 indicates that no messages were present during power up of the current key cycle. A DTC U1016 indicates that there was communication on the data bus since power up, but was lost or interrupted during that key cycle.

Table 2-15. Code Description

DTC	DESCRIPTION
U1064	Loss of TSM/TSSM serial data (state of health)
U1255	Missing response from other module (TSSM) at startup

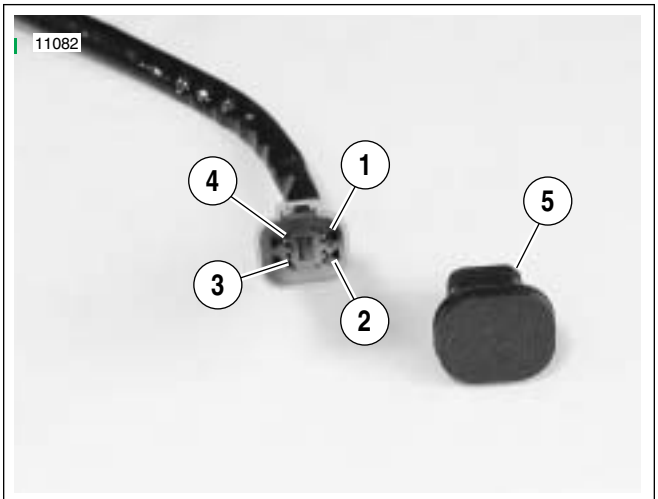
DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 2.16 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.
2. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness and TSM/TSSM. See 3.12 BREAKOUT BOX:TSM/TSSM.

Figure 2-36. TSM/TSSM (typical)



1. **Terminal 1: flash terminal (Lt GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**

Figure 2-37. Data Connector Terminals

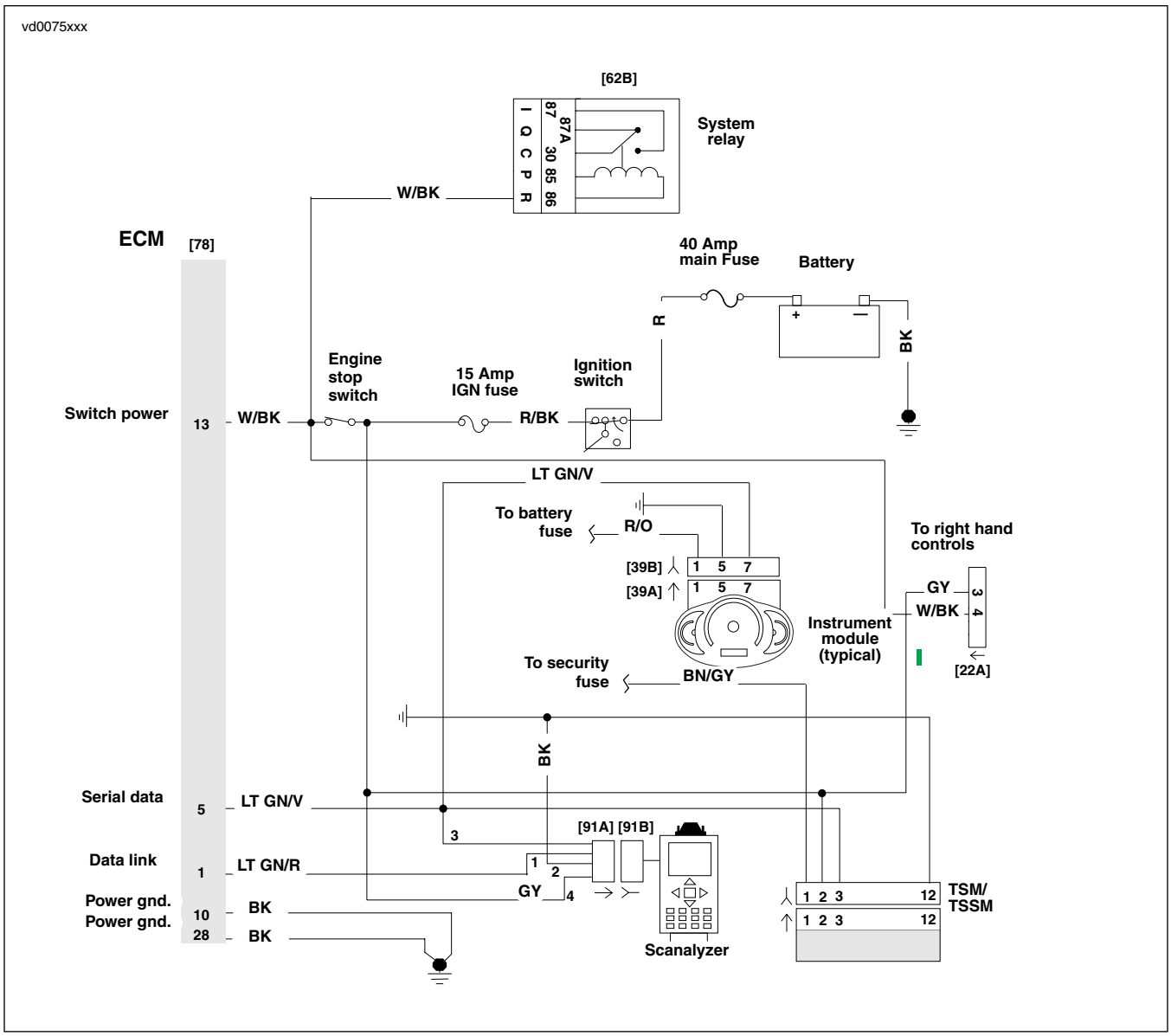


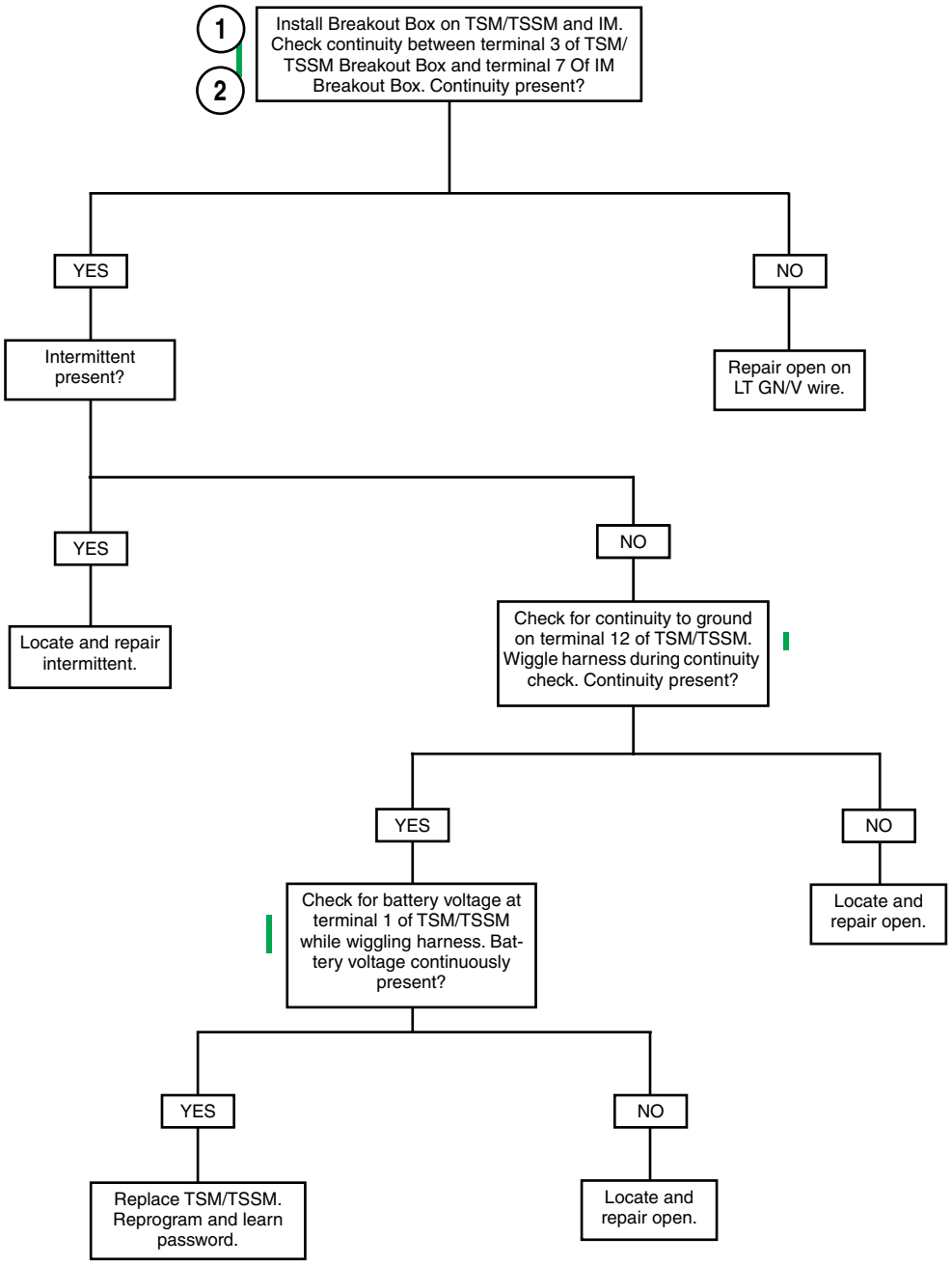
Figure 2-38. TSM/TSSM, ECM and IM Circuit

Table 2-16. Wire Harness Connectors in Figure 2-38.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	Instrument module	12-place Mini-Deutsch	handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91]	Data	4-place Deutsch	under left side cover

Test 2.16

LOSS OF TSM/TSSM SERIAL DATA: DTC U1064, U1255



Clear codes and confirm proper operation with no check engine lamp.

NOTES

Table Of Contents

TSM & TSSM 3

SUBJECT **PAGE NO.**

TSM/TSSM OVERVIEW 3.1

GENERAL

See Figure 3-1. The turn signal module (TSM) has two major functions:

- Control turn signals.
- Serve as bank angle sensor.

The optional, factory-installed, security system (turn signal security module or TSSM) provides the same functionality as the TSM, but also includes security and immobilization functions.

See 3.2 TSM/TSSM FEATURES for complete details.

Figure 3-1. TSM/TSSM

TROUBLESHOOTING

Problems fall into at least one of four categories:

- Turn signal malfunction.
- Bank angle (engine disable).
- Security lamp problem.
- Security system malfunction (TSSM only).

To resolve TSM/TSSM problems, four basic steps are involved. In order of occurrence, they are:

1. Retrieve diagnostic trouble codes (DTCs) using SCANALYZER (Part No. HD-41325) or TSM/TSSM diagnostics. See 3.11 INSTRUMENT MODULE SELF DIAGNOSTICS.
2. Diagnose system problems. This involves using special tools and the diagnostic flow charts in this section.
3. Correct problems through the replacement and/or repair of the affected components.
4. After repairs are performed, the work must be validated. This involves clearing the diagnostic trouble codes and confirming proper vehicle operation as indicated by the behavior of the turn signals.

Figure 3-2. Key Fob

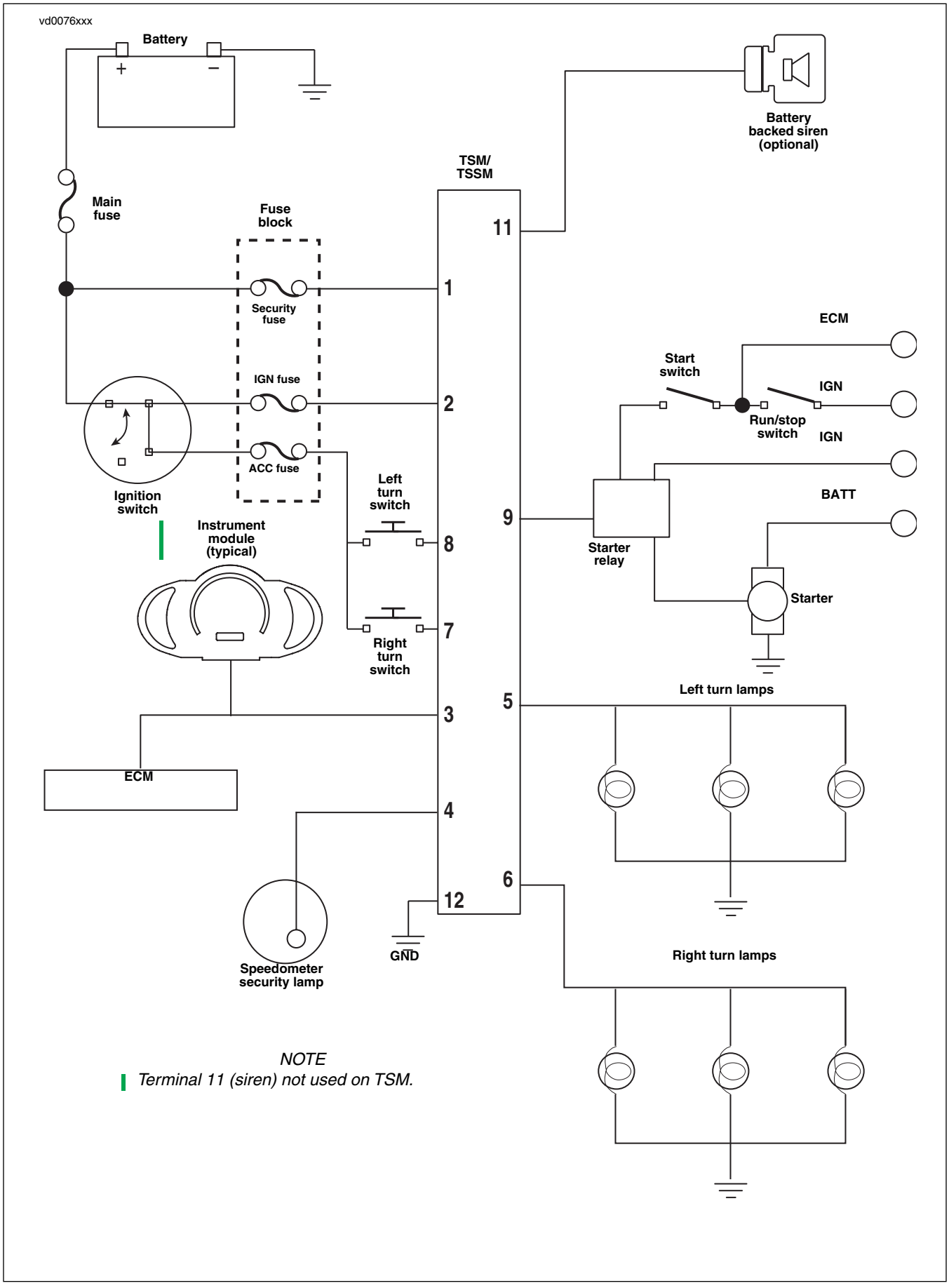


Figure 3-3. Simplified TSM/TSSM Wiring: See Wiring Diagrams For Wire Colors

TSM/TSSM FEATURES 3.2

GENERAL

The Turn Signal Module (TSM) and the Turn Signal Security Module (TSSM) provide the following capabilities. Note that some hardware options and software settings are dependent upon vehicle market specifications.

TURN SIGNAL FUNCTIONS

TSM/TSSM Features

See 3.4 TSM/TSSM TURN SIGNAL FUNCTIONS for complete details.

- **Manual turn signal control:** Manual activation/deactivation of left and right turn signal flashing sequences.
- **Automatic turn signal cancellation:** Automatic cancellation of left and right turn signal flashing sequences based on either vehicle speed, vehicle acceleration or turn completion.
- **Emergency flashers:** Four-way left and right turn signal flashing capability.
- **Turn signal lamp diagnostics:** Self-diagnostics for short circuit and open lamp conditions on both left and right turn signal systems.

BANK ANGLE FUNCTIONS

TSM/TSSM Features

See 3.5 TSM/TSSM BANK ANGLE FUNCTION for complete details.

- **Emergency engine shutdown:** Monitors vehicle lean and will provide engine shutdown when lean exceeds 45° from vertical for more than one second.
- **Emergency outputs disable:** Monitors vehicle lean and will disable turn signal lamps and starter motor when lean exceeds 45° from vertical for more than one second.

SECURITY ALARM AND IMMOBILIZATION FUNCTIONS

TSSM Only Feature

The following information applies only to vehicles with the security option (TSSM). See 3.6 SECURITY SYSTEM (TSSM) FUNCTIONS for more information.

- **Remote arming/disarming:** See Figure 3-4. Owners may enable and disable security alarm and immobilization functions with a remote, personally carried transmitter. This transmitter is referred to as a **key fob** within this document.

Figure 3-4. Key Fob

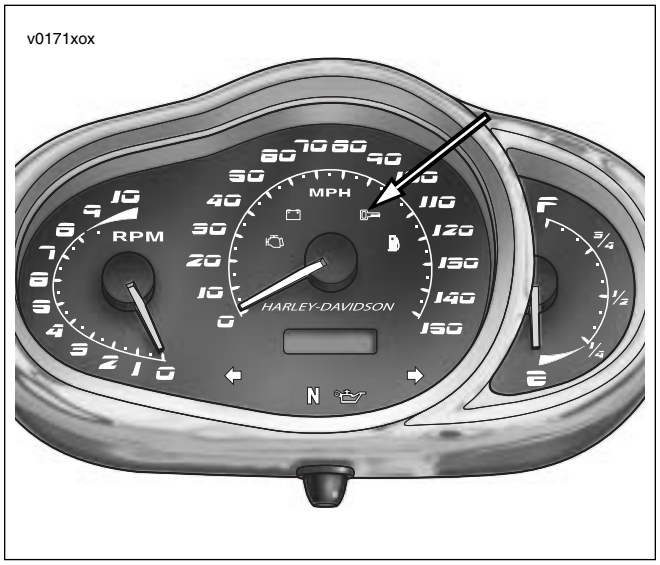


Figure 3-5. TSSM Lamp (typical) (VRSCR shown)

- **Security status lamp:** See Figure 3-5. A lamp within the instrument module face tells the rider if the system is armed or disarmed.
- **Personal code disarming:** If a key fob is not available, the TSSM allows the rider to disable the security alarm and immobilization functions if the rider knows the previously entered personal code.
- **Security command confirmation:** When the system is armed or disarmed, the system provides visual feedback to the rider by flashing the turn signals and sounding the optional siren.

- **Auto-arming:** Automatically enables the security alarm and immobilization functions when the ignition key is switched OFF.

NOTE

Default auto-arming behavior depends upon vehicle market. All vehicles are shipped without self arming, however all vehicles delivered to the Netherlands market require self arming activation using Digital technician. Motorcycles sold in other markets have auto-arming disabled, but may be activated. See 3.3 TSM/TSSM VEHICLE DELIVERY.

- **Transport mode:** It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the vehicle to be moved in an immobilized state.
- **Starter/ignition disable:** Should the security alarm and immobilization functions be triggered by a vehicle security condition, the starter and ignition system will be disabled.
- **Security system alarm:** See Figure 3-6. The system will alternately flash the left and right turn signals and sound an optional siren if a vehicle security condition is detected while the system is armed.

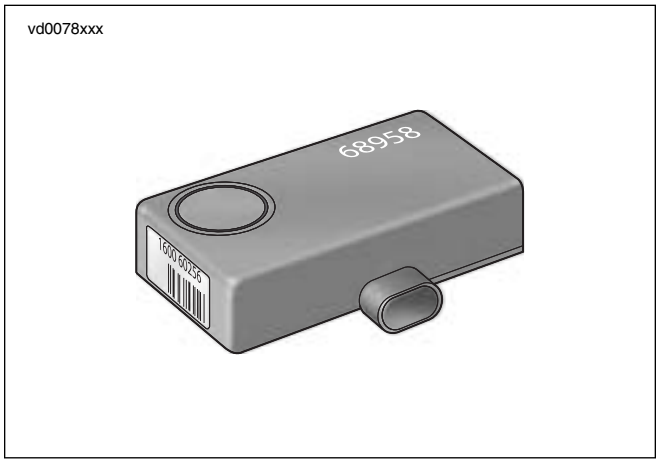


Figure 3-6. Siren

TSM/TSSM VEHICLE DELIVERY 3.3

GENERAL

⚠WARNING

Only Touring Harley-Davidson Motorcycles are suitable for sidecar use. Consult a Harley-Davidson dealer. Use of motorcycles other than Touring models with sidecars could result in death or serious injury. (00040a)

Setting up a vehicle TSM/TSSM depends on whether the vehicle has a turn signal module (TSM) or the optional security system (TSSM) installed.

All motorcycles ship with the TSM/TSSM set for use **without** a sidecar installed. If a motorcycle is equipped with a TSM, no further configuration is required. However, if a motorcycle has an optional security system (TSSM) installed, perform the following steps as necessary.

1. Configure TSSM motorcycles by assigning **both** key fobs to the vehicle.
2. Configure TSSM motorcycles by entering a personal code picked by the owner. The personal code allows the owner to operate the system if the key fob is lost or inoperable. Record this code in the owner's manual and instruct the customer to carry a copy.

NOTES

Do not forget to enter a personal code for TSSM vehicles. If a code is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.

Changes to TSM/TSSM settings are made by a series of programming operations involving the ignition key, left/right turn signal switches and key fob (security systems).

At certain steps in the programming sequence, the motorcycle may provide confirmation of settings by flashing the turn signals, turn signal indicators and/or security lamp. In addition, when programming a personal code into a TSSM system, the odometer displays the personal code to the user and dynamically updates it as the code is entered or changed.

All programming operations are listed in table format. Follow the numbered steps to configure the system. If a confirmation response is listed, wait for the confirmation before continuing to the next step. Important information pertaining to certain actions will be found in the NOTES column.

SIDECAR CONFIGURATION

⚠WARNING

Only Touring Harley-Davidson Motorcycles are suitable for sidecar use. Consult a Harley-Davidson dealer. Use of motorcycles other than Touring models with sidecars could result in death or serious injury. (00040a)

USING SCANALYZER

The SCANALYZER CARTRIDGE (Part No. HD-41325-95C) has TSM/TSSM configuration capability.

NOTE

DIGITAL TECHNICIAN (Part No. HD-44750-P50 or HD-44750-P29) can also be used to configure TSM/TSSM.

POWER DISRUPTION AND CONFIGURING

The TSM/TSSM will not enter configuration mode on the first attempt after battery voltage has been removed from terminal 1. This will occur after any of the following situations:

- Battery disconnect or power drain.
- Security fuse removal.
- Connecting Breakout Box to TSM/TSSM connector.

Therefore, after all battery reconnects, the configuration sequence must be modified as follows.

1. Set run switch to **OFF**, cycle ignition key **ON**-OFF-**ON**-OFF-**ON** and press left turn signal switch **twice**.
2. Repeat step listed above.
3. Continue with configuration sequence listed.

KEY FOB ASSIGNMENT

The key fob on TSSM motorcycles must be set so it will operate the alarm system on the vehicle. This assignment **must** be completed with no pauses between steps greater than 10 seconds. Turn the ignition OFF after all key fobs have been assigned. The programming mode will also exit after 60 seconds has elapsed without detecting any fob signup messages or turn signal switch activity.

Two key fobs may be assigned to the TSSM. The first successful attempt to program a fob will disable all previously assigned fobs. If a second fob is to be programmed, it must be done in the same programming sequence as the initial fob.

To assign a key fob to a motorcycle, refer to Table 3-1.

PERSONAL CODE ENTRY

First Time Code Entry: TSSM Only

NOTE

Do not forget to enter a personal code for TSSM vehicles. If a code is not assigned and both key fobs are lost or damaged while the vehicle is armed, the TSSM must be replaced.

The TSSM personal code (Personal Identification Number or PIN) consists of five digits. Each digit can be any number from 1-9. The personal code **must** be used to disarm the security system in case the key fob becomes unavailable.

To set a personal code on a motorcycle with no code previously installed, refer to Table 3-2. The procedure listed uses 3-1-3-1-3 as the desired personal code.

NOTE

For better security, do not use 3-1-3-1-3 as a personal code. It is shown as an example only.

Decide what five digit code the owner would like to use. The code will be programmed using the turn signal switches and key fob. Keep a record of the code in a secure place such as your wallet or the owner's manual.

- When programming the personal code, the security lamp flashes to provide feedback when entering each digit. The odometer also displays the PIN and the change dynamically.
- The number of security lamp flashes corresponds to the number currently selected for a given digit. Therefore, the lamp may flash 1-9 times depending on the number entered. The five-digit code will change on the odometer display and the active digit will blink.
- Press the left turn switch one time to increment each digit of the code.
- Quickly press the key fob button twice to advance to the next digit of the code.

NOTE

The programming mode exits upon turning the ignition switch to OFF or if no turn signal switch/key fob button activity occurs for 60 seconds. No data is saved for partial configuration attempts if entering a PIN for the first time. If a PIN has previously been entered, the user can change any digit or group of digits.

Modifying Existing Codes: TSSM Only

If a code was previously entered, the lamp will flash the equivalent digit, and the odometer will display the existing code with the active digit blinking. Each additional press of the left turn switch will increment the digit.

- To advance from 5 to 6, press and release the left turn switch 1 time.
- To advance from 8 to 2, press and release the left turn switch 3 times (9-1-2).

Table 3-1. TSSM Key Fob Assignment

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is disarmed) This assignment procedure **must** be completed with no pauses between steps greater than 10 seconds
2	Turn **IGN** key **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	1-3 flashes turn signals & indicators depending on vehicle configuration (See 3.3 TSM/TSSM VEHICLE DELIVERY regarding battery disconnects.)	1 flash-Worldwide TSM, no security 2 flashes-North American/ Domestic and European/HDI configuration TSSM 3 flashes-Netherlands configuration TSSM
4	Press **right** turn switch **1 time** and release	1 flash turn signals & indicators	
5	Press **left** turn switch **1 time** and release	2 flashes turn signals & indicators	
6	Press and hold **key fob** button until confirmation is received	2 flashes turn signals & indicators	This may take 10-25 seconds
7	If you have two key fobs, press and hold button on second **key fob** until confirmation is received	2 flashes turn signals & indicators	optional step
8	Turn **IGN** key OFF		

Table 3-2. Programming a TSSM Personal Code (Example: 3-1-3-1-3) With No Code Previously Installed

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is disarmed) This assignment procedure **must** be completed with no pauses between steps greater than 10 seconds
2	Turn **IGN** key **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	1-3 flashes turn signals & indicators depending on vehicle configuration (See 3.3 TSM/TSSM VEHICLE DELIVERY regarding battery disconnects)	1 flash-Worldwide TSM, no security 2 flashes-North American/ Domestic and European/HDI configuration TSSM 3 flashes-Netherlands configuration TSSM
4	Quickly press **key fob** button **2 times** and release	One flash turn signals and indicators Odometer displays current five-digit personal code (five dashes if no code entered), first digit blinks	Vehicle is in personal code entry mode ready to enter or modify first digit
5	Press **left** turn switch **1 time** and release	Security lamp flashes 1 - 9 times if code was previously entered	A lack of confirmation flashes indicates no digit is entered

Table 3-2. Programming a TSSM Personal Code (Example: 3-1-3-1-3) With No Code Previously Installed

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
6	Press and release **left** turn switch to advance through the digits In this example, you will press and release three times	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 3 and the security lamp will flash three times	You've selected 3 as a number for the first digit
7	Quickly press **key fob** button **2 times** and release	Two flashes turn signals and indicators second digit in odometer display blinks	You've confirmed 3 as a number for the first digit and have advanced to entering the second digit
8	Press **left** turn switch **1 time** and release	none	A lack of confirmation flashes indicates no digit is entered
9	Press and release **left** turn switch to advance through the digits In this example, you will perform this step one time	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 1 and the security lamp will flash one time	You've selected 1 as a number for the second digit
10	Quickly press **key fob** button **2 times** and release	Three flashes turn signals and indicators third digit in odometer display blinks	You've confirmed 1 as a number for the second digit and have advanced to entering the third digit
11	Press **left** turn switch **1 time** and release	none	A lack of confirmation flashes indicates no digit is entered
12	Press and release **left** turn switch to advance through the digits In this example, you will repeat this step three times	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 3 and the security lamp will flash three times	You've selected 3 as a number for the third digit
13	Quickly press **key fob** button **2 times** and release	Four flashes turn signals and indicators fourth digit in odometer display blinks	You've confirmed 3 as a number for the third digit and have advanced to entering the fourth digit
14	Press **left** turn switch **1 time** and release	none	A lack of confirmation flashes indicates no digit is entered
15	Press and release **left** turn switch to advance through the digits In this example, you will perform this step one time	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 1 and the security lamp will flash one time	You've selected 1 as a number for the fourth digit
16	Quickly press **key fob** button **2 times** and release	Five flashes turn signals and indicators fifth digit in odometer display blinks	You've confirmed 1 as a number for the fourth digit and have advanced to entering the fifth digit
17	Press **left** turn switch **1 time** and release	none	A lack of confirmation flashes indicates no digit is entered

Table 3-2. Programming a TSSM Personal Code (Example: 3-1-3-1-3) With No Code Previously Installed

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
18	Press and release **left** turn switch to advance through the digits In this example, you will repeat this step three times	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 3 and the security lamp will flash three times	You've selected 3 as a number for the fifth digit
19	Quickly press **key fob** button **2 times** and release	One flash turn signals and indicators first digit in odometer display blinks	You've confirmed 3 as a number for the fifth digit and have gone back to the first digit
20	Turn **IGN** key OFF		
21	Write down code in owner's manual		
22	Arm the security system and attempt to disarm using personal code entry. Refer to Table 3-8.		

TSM/TSSM TURN SIGNAL FUNCTIONS 3.4

GENERAL

The TSM/TSSM's turn signal feature has several modes:

- Automatic cancellation.
- Manual cancellation.
- Four-way flashing.
- Diagnostics mode

Turn signals cannot be activated or deactivated when the ignition key is in the ACC position. The turn signals can only be activated or deactivated with the ignition key in the IGN position.

⚠WARNING

Only Touring Harley-Davidson Motorcycles are suitable for sidecar use. Consult a Harley-Davidson dealer. Use of motorcycles other than Touring models with sidecars could result in death or serious injury. (00040a)

AUTOMATIC CANCELLATION

Press the left or right turn switch to activate automatic turn signal cancellation. There is no need to hold the turn switch in when approaching the turn. The TSM/TSSM will not cancel the signal before the turn is actually completed.

- When the directional switch is released, the system starts a 20 count. As long as the vehicle is traveling above 7 MPH (11.2 KPH) the directional will always cancel after 20 flashes if the system does not recognize any other input.
- If the vehicle speed drops to 7 MPH (11.2 KPH) or less, including stopped, the directionals will continue to flash. Counting will resume when vehicle speed reaches 8 MPH (12.8 KPH) and will automatically cancel when the count total equals 20 as stated above.
- The turn signals will cancel within two seconds upon turn completion. A sensor inside the TSM/TSSM cancels the signal after the vehicle has been returned to an upright position.

NOTE

The bank angle cancellation function has an automatic calibration feature. Ride the motorcycle for 1/4 mile (0.4 KM) at steady speeds (upright) to calibrate the system. Performance of bank angle function may not be optimal until this calibration is performed. This self-calibration is performed automatically every time the vehicle is started and ridden.

MANUAL CANCELLATION

If you want to stop the turn signals from flashing, briefly depress the turn signal switch a second time.

If you are signalling to turn in one direction and you depress the switch for the opposite turn signal, the first signal is cancelled and the opposite side begins flashing.

FOUR-WAY FLASHING

Use the following method to activate the four-way flashers.

1. With the ignition key ON and security system disarmed (models with security only), press the left and right turn signal switches at the same time.
2. Turn the ignition key OFF and arm the security system if present and desired. The four-way flashers will continue for two hours.
3. To cancel four-way flashing, disarm the security system if necessary, turn the ignition key ON and press the left and right turn signal switches at the same time.

NOTE

Auto-arming (always active on the Netherlands bikes, user selectable on other vehicles) requires that the four-way flashers be activated within 30 seconds of key OFF or after the vehicle has been disarmed.

This system allows a stranded vehicle to be left in the four-way flashing mode and secured until help is found.

If the security system is disarmed while the four-way flashers are active, the lights will flash as follows:

1. TSSM stops four-way flashing mode. Motorcycle sits for 1 second with turn signals off.
2. TSSM performs disarming confirmation (1 flash).
3. Motorcycle sits for 1 second with turn signals off.
4. Motorcycle restarts four-way flashing mode.

DIAGNOSTICS MODE

The TSM/TSSM measures the current when the turn signals are used. If there is a burned out light bulb on one side, the remaining light and the corresponding turn signal indicator flash at double the normal rate starting with the fifth flash.

Other diagnostic conditions monitored include:

- Short circuit in the turn signal wiring.
- Open circuit in the turn signal wiring.
- Stuck turn signal switch.

NOTE

- *A stuck turn signal switch will disable the automatic turn signal cancellation feature.*
- *If a stuck switch is detected, you must hold the left and right turn signal switches in for more than one second to activate the four-way flashers.*

See 3.8 CHECKING FOR DIAGNOSTIC TROUBLE CODES for more information.

TSM/TSSM BANK ANGLE FUNCTION 3.5

GENERAL

The turn signals, starter motor, electronic control module, fuel pump and coil will be disabled in the event the vehicle tilts more than 45 degrees from vertical for longer than one second.

⚠WARNING

Only Touring Harley-Davidson Motorcycles are suitable for sidecar use. Consult a Harley-Davidson dealer. Use of motorcycles other than Touring models with sidecars could result in death or serious injury. (00040a)

OPERATION

The engine will shut off automatically if the vehicle tilts more than 45 degrees from vertical for longer than one second. The engine will automatically shut off even if the tilt occurs at a very slow speed. The odometer displays “tIP” when a tip over condition is detected.

To restart the motorcycle after shutdown has occurred:

1. Return the motorcycle to an upright position.
2. Cycle the ignition key OFF-**ON** before restarting the vehicle.

SECURITY SYSTEM (TSSM) FUNCTIONS 3.6

GENERAL

Security System Operation

The TSSM provides security and immobilization functions not found on the TSM. The TSSM will disable the starter and ignition system. Additional functions include the ability to alternately flash the left and right turn signals and sound a siren (if purchased as an option) if a theft attempt is detected.

Conditions that activate the security system when system is armed include:

- **Detecting tempering of the ignition circuit:** Turn signals flash 3 times, optional siren chirps once and then turns off. If the tampering continues, a second warning will activate after four seconds. Continued tampering will cause the alarm to activate for 30 seconds and then turn off. The two warnings/alarm cycle is repeated for each tampering incident.
- **Detecting vehicle movement:** Turn signals flash three times, optional siren chirps once and then turns off. If the vehicle is not returned to it's original position, a second warning will activate after four seconds. If the vehicle is not returned to it's original position, the alarm activates for thirty seconds then turns off. The two warnings/alarm cycle may repeat a maximum of 10 times.
- **Detecting tampering of the security lamp circuit:** Turn signals flash three times, optional siren chirps once and then turns off. If the tampering continues, a second warning will activate after four seconds. Continued tampering will cause the alarm to activate for 30 seconds and then turn off. The two warnings/alarm cycle repeats once for each tampering incident.
- **Detecting that a battery or ground disconnect has occurred while armed.** Siren, if installed, activates its self-alarm mode. Turn signals will not flash.

See 3.7 ARMING/DISARMING SECURITY SYSTEM (TSSM) for more information.

NOTE

Always disarm the TSSM before removing or disconnecting the battery to prevent the siren (if installed) from activating. If the TSSM is in auto-arming mode, you must disarm the system using two clicks of the key fob and disconnect the battery or remove the TSSM fuse before the 30 second arming period expires.

Security System Options

The following customization options are only available on the TSSM unit: alarm sensitivity, auto-arming feature and storage mode.

Default settings for the TSSM include:

- Solo vehicle configuration.
- Medium motion sensitivity on alarm sensitivity.
- Default auto-arming behavior depends upon vehicle market. All vehicles are shipped without self arming, however all vehicles delivered to the Netherlands market require self arming activation using Digital technician. Motorcycles sold in other markets have auto-arming disabled, but it may be activated.
- Storage mode set to 10 days.

Differences By Market Specifications

The Netherlands TSSM set-up differs from other TSSM set-ups in the following ways:

- The Netherlands configuration always auto-arms itself within 30 seconds after the ignition key is turned OFF.
- The Netherlands version does not have the remote arming only option.

ALARM SENSITIVITY

Sensitivity

The TSSM has four sensitivity settings: extremely low, low, medium or high. The selection picked controls the sensitivity of the security system in regards to motion detection.

To set alarm sensitivity, refer to Table 3-3.

Transport Mode

It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the vehicle to be picked up and moved in an armed state. In this mode, any attempt to hot-wire the vehicle will trigger the security system.

- To enter the transport mode, refer to Table 3-4.
- To exit from transport mode and return the system to normal operation/functions, disarm the system using either the key fob or personal code.

NOTE

Transport mode is especially useful when working on the Netherlands vehicles. If it is not used, then the alarm will activate under many typical service activities.

AUTO-ARMING FUNCTION

Auto-arming causes the system to automatically arm itself (no key fob needed) within 30 seconds after the ignition key is turned OFF. During this period, the security lamp stays on solid to indicate auto-arming is starting up.

The vehicle may be moved during these 30 seconds without triggering the alarm. However, any motion after that period will trigger the security alarm. Upon expiration of the auto-arming period, the turn signals flash twice, the security lamp begins to flash and the siren (if installed) chirps twice.

The TSSM allows remote arming via the key fob at anytime. However, if the system is remotely disarmed (with the key fob) but the ignition key is not turned ON within 30 seconds, the system will rearm itself when auto-arming is enabled.

The auto-arming setting depends upon vehicle market specifications.

- Domestic and HDI motorcycles have auto-arming **disabled** by default. However, the feature may be enabled if the customer desires.
- Vehicles sold in the Netherlands have auto-arming **enabled** and this setting cannot be changed.

When auto-arming is disabled, the key fob must be used to arm the security system.

To set the auto-arming function, if it is available on your vehicle, refer to Table 3-5.

STORAGE MODE

The TSSM has a special mode for long term storage. This mode prevents the security system from draining the battery after a period of days (10, 20, 60 or infinite) without any ignition key switch activity.

- If the TSSM is set to infinite, the system will not go into storage mode.
- Vehicles will enter storage mode whether the security system is armed or disarmed.
- If set to 10 days or greater, the customer must use an approved trickle charger to keep the battery from discharging.

In storage mode, all alarm functions remain active, but the receiver is shut down and will not respond to the key fob. The vehicle is immobilized because the starter motor and electronic control module (ECM) are disabled. When the storage mode is entered, the security lamp stops flashing to conserve power.

To wake up the TSSM from storage mode, the ignition key must be turned ON. This will trigger a warning/alarm if the system was previously armed. You must use the key fob or personal code to disarm the system and stop the alarm.

To set the storage mode preferences, refer to Table 3-6.

Table 3-3. TSSM Alarm Sensitivity

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is disarmed)
2	Turn **IGN** key **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	2 or 3 flashes turn signals & indicators depending on vehicle configuration (See section under 3.3 TSM/TSSM VEHICLE DELIVERY regarding battery disconnects.)	2 flashes-North American/ Domestic and European/HDI configuration TSSM 3 flashes-the Netherlands configuration TSSM
4	Press and hold **key fob** button until confirmation is received	1 flash turn signals & indicators	
5	Press **left** turn switch **1 time** and release	turn signals & indicators flash to indicate option selected	1 flash-10 days 2 flashes-20 days 3 flashes-60 days 4 flashes-infinite
6	Press and release **left** turn switch to advance through options	turn signals & indicators flash to indicate option selected	1 flash-10 days 2 flashes-20 days 3 flashes-60 days 4 flashes-infinite
7	Turn **IGN** key OFF		

Table 3-4. TSSM Transport Mode

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is dis-armed)
2	Turn **IGN** key **ON**		
3	Press and hold **key fob** button until confirmation is received	3 flashes turn signals & indicators	
4	Turn **IGN** key OFF		
5	Press and hold **key fob** button until confirmation is received	3 flashes turn signals & indicators	The vehicle can be moved without tripping the alarm

Table 3-5. Selecting TSSM Auto-arming Function (Not Available on Netherlands Vehicles)

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is dis-armed)
2	Turn **IGN** key **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	2 or 3 flashes turn signals & indicators depending on vehicle configuration (See section under 3.3 TSM/TSSM VEHICLE DELIVERY regarding battery disconnects.)	2 flashes-North American/ Domestic and European/HDI configuration TSSM 3 flashes-the Netherlands configuration TSSM
4	Press and hold **key fob** button until confirmation is received	1 flash turn signals & indicators	
5	Press and hold **key fob** button until confirmation is received	2 flashes turn signals & indicators	
6	Press **left** turn switch **1 time** and release	turn signals & indicators flash to indicate option selected	1 flash- auto-arming disabled 2 flashes- auto-arming enabled
7	Press and release **left** turn switch to advance through options	turn signals & indicators flash to indicate option selected	
8	Turn **IGN** key OFF		

Table 3-6. TSSM Storage Mode Preferences

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		Verify that security lamp is not blinking (vehicle is dis-armed)
2	Turn **IGN** key **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	2 or 3 flashes turn signals & indicators depending on vehicle configuration (See section under 3.3 TSM/TSSM VEHICLE DELIVERY regarding battery disconnects.)	2 flashes-North American/ Domestic and European/HDI configuration TSSM 3 flashes-Netherlands config-uration TSSM
4	Press and hold **key fob** button until confirmation is received	1 flash turn signals & indicators	
5	Release and then hold **key fob** button until confirmation is received	2 flashes turn signals & indicators	
6	Release and then hold **key fob** button until confirmation is received	3 flashes turn signals & indicators	
7	Press **left** turn switch **1 time** and release	turn signals & indicators flash to indicate option selected	1 flash-10 days 2 flashes-60 days 3 flashes-90 days 4 flashes-Infinite
8	Press **left** turn switch to advance through options	turn signals & indicators flash to indicate option selected	1 flash-10 days 2 flashes-60 days 3 flashes-90 days 4 flashes-Infinite
9	Turn **IGN** key OFF		

ARMING/DISARMING SECURITY SYSTEM (TSSM) 3.7

GENERAL

There are two methods to arm the security system:

- Using the key fob.
- Using auto-arming. See 3.6 SECURITY SYSTEM (TSSM) FUNCTIONS.

NOTE

The vehicle cannot be armed with the engine running or the ignition ON.

There are two ways to disarm the system:

- Using the key fob. This method works in all situations **except** before turning ignition key ON when TSSM storage mode is activated.
- Using the personal code.

SECURITY LAMP

Refer to Table 3-7. The security lamp within the speedometer provides feedback to the rider confirming armed or disarmed status.

Table 3-7. Security Lamp Status

LAMP	MODE
Does not flash	No security system (TSM), security system not armed or storage mode active
Flashes every second	10 minute timeout after failed personal code entry attempt or a battery reconnect has occurred while armed
Flashes every 2 seconds	Security system armed
Flashes 3 times a second	Personal code entry mode
Stays on solid with ignition key OFF	Auto-arming is starting up. You have 30 seconds before system is armed.
Stays on solid with ignition key ON	If solid for more than 4 seconds after key ON, a current DTC is present
Four-way flashers flash 6 times (TSM)	See 3.8 CHECKING FOR DIAGNOSTIC TROUBLE CODES

USING KEY FOB

General

The TSSM's reception range for the key fob signal depends on a specific receiver pattern.

NOTE

Environmental and geographic conditions may affect signal range.

Arming the System

1. Hold key fob horizontal at waist level.
2. Point key fob at the front of the vehicle.
3. Hold down the key fob button until the system responds with two turn signal flashes.

Disarming the System

1. Hold key fob horizontal at waist level.
2. Point key fob at the front of the vehicle.
3. Quickly press the key fob button twice. The system will respond with one turn signal flash.

NOTE

Disarming function may require practice. The key fob button must be pressed twice within 1.5 seconds to send the disarm command. The action is very similar to double-clicking a computer mouse. Light quick taps work best; very hard or very slow taps are less likely to work.

Troubleshooting

If the key fob button has been pressed numerous times while away from the vehicle, the fob may fall out of synchronization with the TSSM. If this happens, the TSSM might fail to recognize the key fob's commands.

To solve this problem, press and hold the key fob button for 10-15 seconds until the security system responds with two turn signal flashes. After confirmation, you may resume normal fob operation.

USING THE PERSONAL CODE

General

The personal code consists of five digits entered using the left and right turn signal switches. Each digit can be any number from 1-9. The personal code is intended to be used to disarm the vehicle in case the key fob becomes unavailable or inoperable.

See 3.3 TSM/TSSM VEHICLE DELIVERY to set a personal code.

Disarming the System

Refer to Table 3-8. If you make an error while disarming the TSSM using the personal code, the alarm will activate for 30 seconds after the last digit is entered. After a failed attempt, the security lamp will flash once every second for 10 minutes. **During this time, the vehicle will not accept any attempt to enter a personal code.**

Table 3-8. Entering A Personal Code To Disarm TSSM (Example: 3-1-3-1-3)

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set **RUN/OFF** switch to **OFF**		
2	Turn **IGN** key to **ACC**		
3	Hold **both** turn switches in until confirmation	security lamp blinks at fast rate	System is ready for personal code entry
4	Enter first digit of code (3) by pressing **left** turn switch **3 times**		
5	Press **right** turn switch **1 time**		Serves as “enter” key for first digit
6	Enter second digit of code (1) by pressing **left** turn switch **1 time**		
7	Press **right** turn switch **1 time**		Serves as “enter” key for second digit
8	Enter third digit of code (3) by pressing **left** turn switch **3 times**		
9	Press **right** turn switch **1 time**		Serves as “enter” key for third digit
10	Enter fourth digit of code (1) by pressing **left** turn switch **1 time**		
11	Press **right** turn switch **1 time**		Serves as “enter” key for fourth digit
12	Enter fifth digit of code (3) by pressing **left** turn switch **3 times**		
13	Press **right** turn switch **1 time**	security lamp stops blinking	System is disarmed. You may use the vehicle or program another key fob

CHECKING FOR DIAGNOSTIC TROUBLE CODES 3.8

TSM

- If the turn signals flash six four-way flashes shortly after key ON, it indicates a diagnostic trouble code (DTC) has been logged sometime in the last three ignition cycles.
- If “BUS Er” is displayed on the odometer, it may take up to twenty seconds for the security lamp to illuminate.

TSSM

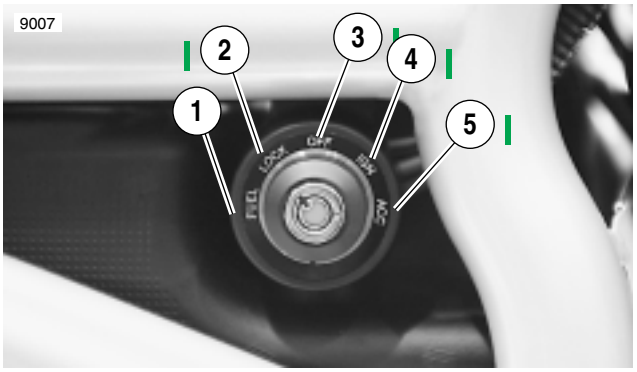
To diagnose system problems, start by observing the behavior of the security lamp.

NOTES

- *See Figure 3-7. Ignition Switch (VRSCA/VRSCD) and Figure 3-8. Ignition Switch (VRSCR). “Key ON” means that the ignition key is turned to IGN and the engine stop switch is set to RUN (although the engine is **not** running).*
- *See Figure 3-9. When the ignition key is turned ON, the security lamp will illuminate for approximately four seconds and then turn off.*
- *If the security lamp is not illuminated at Key ON or if it fails to turn OFF after the initial four second period, then then the instrument module may need to be replaced. See 3.11 INSTRUMENT MODULE SELF DIAGNOSTICS. If “BUS Er” is displayed on the odometer, it may take up to twenty seconds for the security lamp to illuminate.*
- *The security lamp will also light for eight seconds after the bulb check if historic diagnostic trouble codes (DTCs) are present. The security lamp will stay on if current DTCs are set. If a historic DTC is present, the security lamp will light for 50 ignition cycles or until the DTC is cleared manually.*

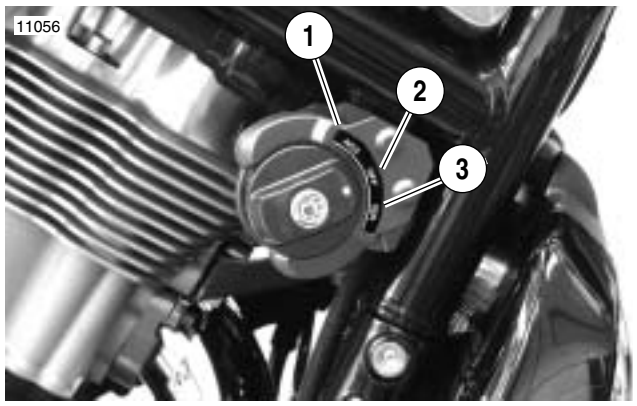
1. See Figure 3-10. After the lamp turns off after being illuminated for the first four second period, one of three events may occur:
   a. The lamp remains off. This indicates there are no current fault conditions or stored historic DTCs currently detected by the TSSM.
   b. The lamp stays off for only four seconds and then comes back on for an eight-second period. This indicates a historic DTC is stored, but no current DTC exists.
   c. If the lamp remains on beyond the eight-second period, a current DTC exists.

See CODE TYPES under 3.8 CHECKING FOR DIAGNOSTIC TROUBLE CODES for a complete description of DTC formats.



1. **Seat release**
2. **LOCK position**
3. **OFF position**
4. **Ignition position**
5. **Accessory position**

Figure 3-7. Ignition Switch (VRSCA/VRSCD)



1. **Accessory release**
2. **OFF position**
3. **Ignition position**

Figure 3-8. Ignition Switch (VRSCR)

Figure 3-9. Security Lamp (typical) (VRSCR shown)

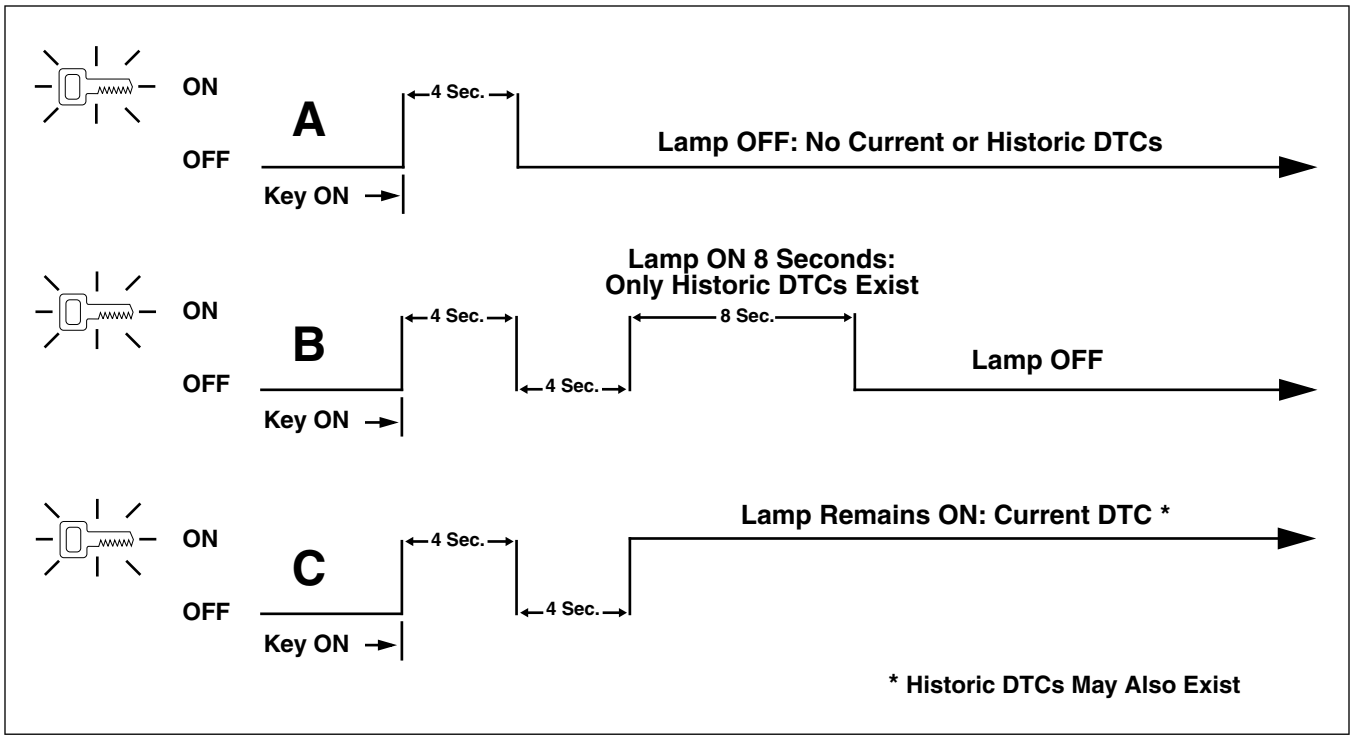


Figure 3-10. Security Lamp Operation

CODE TYPES

There are two types of diagnostic trouble codes (DTCs): current and historic. If a DTC is stored, it can be read using one of the following methods:

- Scanalyzer. See 3.9 SCANALYZER.
- Instrument Module (IM) self diagnostics. See 3.11 INSTRUMENT MODULE SELF DIAGNOSTICS.
- A computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750-P50 or HD-44750-P29).

NOTES

- *You must use the Scanalyzer or Digital Technician to differentiate between current and historic DTCs. If a Scanalyzer is available, see 3.10 INITIAL DIAGNOSTIC CHECK: TSM/TSSM.*
- *All DTCs reside in the memory of the ECM/ICM, TSM/TSSM or IM until the DTC is cleared by use of the speedometer self diagnostics. See 3.11 INSTRUMENT MODULE SELF DIAGNOSTICS.*
- *A historic DTC is also cleared after a total of 50 trips has elapsed. A trip consists of a start and run cycle. After the 50 trip retention period, the DTC is automatically erased from memory providing that no subsequent faults of the same type are detected in that period.*

Current

Current DTCs are those which are present during the current ignition cycle. See the appropriate flow charts for solutions.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic DTC rather than a current DTC. For example, intermittent output shorts can become typical historic DTCs.

Historic DTCs can only be retrieved using a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750-P50 or HD-44750-P29) or the Scanalyzer.

Historic DTCs are stored for 50 ignition cycles after any DTC was last set as current to assist in the diagnosis of intermittent faults. On the 50th cycle, the DTC will clear itself. The check engine lamp will not indicate the existence of only historic DTCs.

It is important to note that historic DTCs will exist whenever the system indicates the existence of a current fault. See MULTIPLE DIAGNOSTIC TROUBLE CODES if multiple DTCs are found.

Diagnostic charts are designed for use with current DTCs and as a result they frequently suggest part replacement. When diagnosing a historic DTC the charts can be helpful but should not lead to part replacement without verification the part is faulty.

RETRIEVING TROUBLE CODES

The TSM/TSSM allows three levels of diagnostics:

- The most sophisticated mode employs a computer based diagnostic package called the DIGITAL TECHNICIAN (Part No. HD-44750-P50 or HD-44750-P29).
- The second mode employs a portable diagnostic tool called a Scanalyzer. This device plugs into the motorcycle wiring harness. It facilitates the diagnosis of system problems through a direct interface with the TSM/TSSM.
- The third mode is to perform the instrument module (IM) self diagnostics. See 3.11 INSTRUMENT MODULE SELF DIAGNOSTICS which follows.

Use of IM self diagnostics assumes that the SCANALYZER (Part No. HD-41325) or Digital Technician is not available.

MULTIPLE DIAGNOSTIC TROUBLE CODES

While it is possible for more than one fault to occur and set more than one DTC, there are several conditions which may result in **one** fault setting **multiple** DTCs.

Serial data DTCs (U1016, U1064, U1096, U1255, U1300 and U1301) may be accompanied by other DTCs. **Always** correct the serial data DTCs before resolving the other DTCs.

Refer to Table 3-9. This table gives most TSM/TSSM DTCs a priority ranking.

SCANALYZER DIAGNOSTICS

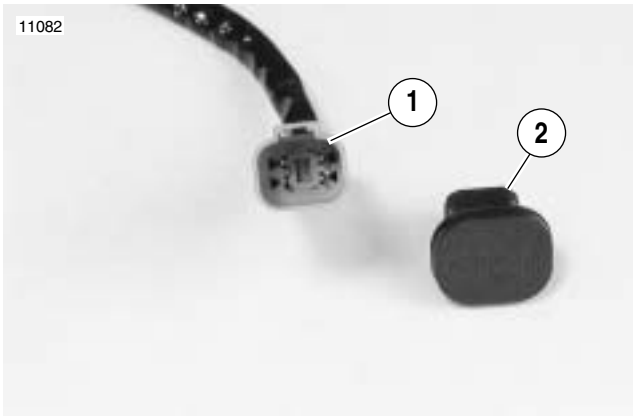
Serial Data Connector

See Figure 3-11. Using the Scanalyzer requires access to the data connector (1). See below for instructions on reaching the data connector.

Scanalyzer Cartridge

See Figure 3-12. Through a special programmable application cartridge, the Scanalyzer offers data displays and menu selections that allow for quick and easy retrieval of data. The device enables the user to perform a variety of diagnostic tests while monitoring inputs and outputs.

Sample Scanalyzer menu selections are shown in Figure 3-13.



1. **Data connector [91A]**
2. **Protective rubber plug**

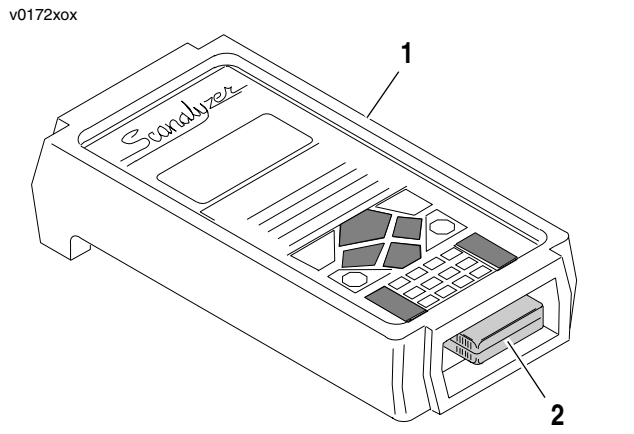
Figure 3-11. Serial Data Connector [91A] (typical)

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-41325	Scanalyzer
HD-41325-95C	Scanalyzer cartridge
HD-42921A	Cable

The behavior of the turn signal lamps (3.8 CHECKING FOR DIAGNOSTIC TROUBLE CODES) may indicate the presence of diagnostic trouble codes (DTC).

1. Turn ignition key OFF.
2. Remove left side cover.
3. See Figure 3-11. Remove rubber protective plug (2) from data connector (1). Plug Scanalyzer into connector.
4. Turn ignition key ON. Set engine stop switch to RUN, but do not start engine.
5. See Figure 3-12. Insert the diagnostic application cartridge (2) into the Scanalyzer (1). During the next few seconds, the Scanalyzer sequences through a series of screens that reflect a power-on self test, the system copyright, and then an attempt at communications with the ECM and turn signal module (TSM) or turn signal security module (TSSM). Once communications is established with both modules, the diagnostic menu appears. See Figure 3-13.
6. Continue with the instructions listed under USAGE which follows.



1. **Scanalyzer (Part No. HD-41325)**
2. **Cartridge (Part No. HD-41325-95C)**

Figure 3-12. Scanalyzer and Cartridge

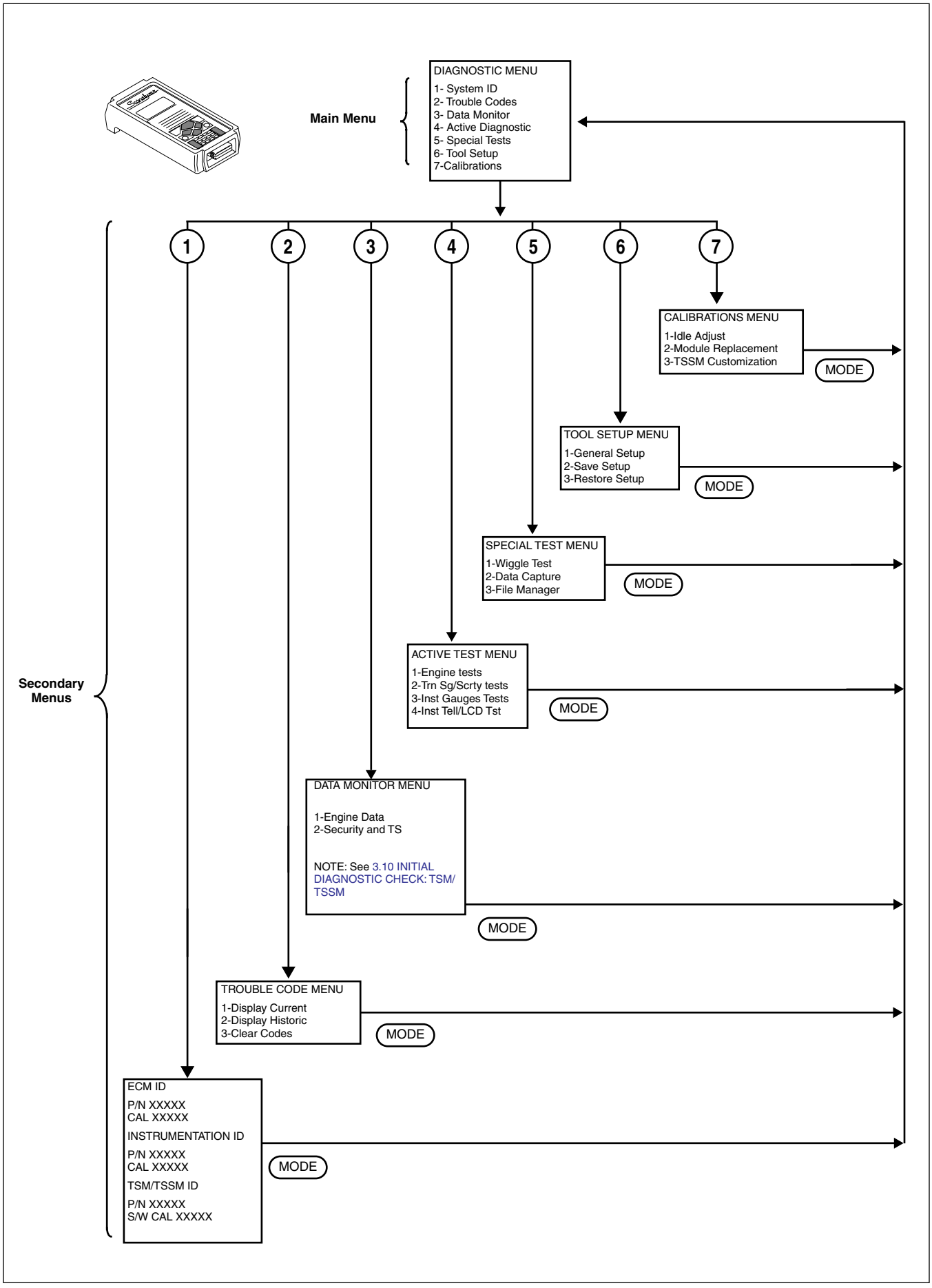


Figure 3-13. Scanalyzer Menus

USAGE

See Figure 3-13. The diagnostic menu is the primary system menu (main menu) through which all other secondary menus and displays are accessed. Since the screen may not be large enough to display all line items at any given time, use the up and down arrow keys to scroll through the list.

Checking Diagnostic Trouble Codes

1. See Figure 3-14. From the diagnostic menu, press number “2” to access the “Trouble Codes” menu. At this point, the unit allows the operator to:
   a. Press number “1” to display current diagnostic trouble codes (DTCs).
   b. Press number “2” to display historic DTCs.
   c. Press number “3” to clear DTCs. See Clearing Codes below.
2. When examining DTCs, write down all codes on a piece of paper. If a current DTC exists, place it at the top of the list.
   a. If DTCs are present, refer to Table 3-9. Follow the applicable flow charts for each DTC.
   b. If DTCs are NOT present, but starting or driveability problems are evident, see symptoms charts under 3.10 INITIAL DIAGNOSTIC CHECK: TSM/TSSM.
   c. After reading current/historic DTCs, simply press the mode key to return to the “Trouble Codes” menu.
3. Press the mode key again to return to the diagnostic menu. In this manner, regardless of where the operator is in the program, the mode key need only be pressed once or twice to return to the main menu.
4. After correcting system problems, clear DTCs using the “Trouble Codes” menu of the scanalyzer.

Clearing Codes

The Scanalyzer allows the operator to clear DTCs from memory as well as differentiate between current and historic DTCs.

NOTE

For more detailed instructions, refer to the literature provided with the Scanalyzer.

Figure 3-14. Scanalyzer Diagnostic Menu

REMOVAL

1. Turn ignition key OFF. Set engine stop switch to the OFF position.
2. Unplug Scanalyzer from data connector. Install protective plug connector.
3. Install left side cover.
4. Road test vehicle and observe security lamp. Confirm proper operation without the reoccurrence of DTCs. See 3.8 CHECKING FOR DIAGNOSTIC TROUBLE CODES.

INITIAL DIAGNOSTIC CHECK: TSM/TSSM 3.10

GENERAL

To locate faulty circuits or other system problems, follow the diagnostic flow charts in this section. For a systematic approach, always begin with INITIAL DIAGNOSTICS which follows. Read the general information and then work your way through the flow chart box by box.

Diagnostic Notes

If a numbered circle appears adjacent to a flow chart box, then more information is offered in the diagnostic notes. Many diagnostic notes contain supplemental information, descriptions of various diagnostic tools or references to other parts of the manual where information on the location and removal of components may be obtained.

Scanalyzer Icon

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the Scanalyzer notes, which are similar to the diagnostic notes, but are restricted to information on the use of the Scanalyzer. All Scanalyzer notes may be found at the end of the respective flow chart.

Circuit Diagram/Wire Harness Connector Table

When working through a flow chart, refer to the illustrations, the associated circuit diagram and the wire harness connector table as necessary. The wire harness connector table for each circuit diagram identifies the connector number, description, type and general location.

In order to perform most diagnostic routines, a Breakout Box and a digital volt/ohmmeter (DVOM) are required. See 3.12 BREAKOUT BOX:TSM/TSSM.

To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

Job/Time Code Values

Some charts may contain warranty job/time codes. Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

Reprogramming ICM

Diagnostic charts frequently suggest ECM replacement. In the event an electronic control module (ECM) needs to be replaced, it must be reprogrammed using a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750-P50 or HD-44750-P29). See your dealer. Password learn procedure must also be performed. See 3.23 TSSM MAINTENANCE.

INITIAL DIAGNOSTICS

Diagnostic Tips

- If the Scanalyzer is not working properly, check operation on another vehicle.
- See Figure 3-15. If proper Scanalyzer function is verified, check serial data connector [91A] for 12 volts (Terminal 4) and proper ground (Terminal 2).
- If Scanalyzer reads “No Response” with the ignition key turned ON (engine stop switch at RUN with the engine off), check data link for an open or short to ground between data connector [91A] Terminal 3 and ECM, TSSM or IM.
- Check for an open diagnostic test terminal between data link connector [91A] terminal 3 and TSM/TSSM connector [30B] terminal 3. With ignition key turned ON, serial data bus voltage should be typically 0.6-0.8 volts. The range of acceptable voltage is 0-7.0 volts. Scanalyzer should communicate when proper voltage is present.
- To identify intermittents, wiggle instrument and/or vehicle harness while performing steps in the Diagnostic Check charts.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the diagnostic check flow charts. See page 3-27.

1. Compare engine behavior to symptoms tables in section 4.9 INITIAL DIAGNOSTIC CHECK.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probes and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 4.7 BREAKOUT BOX: ECM.

All TSM/TSSM diagnostic trouble codes are listed in Table 3-9.

Other Diagnostic Trouble Codes (DTCs)

See 2.5 INITIAL DIAGNOSTIC CHECK: IM for any DTCs related to the instrument module (IM).

See 4.9 INITIAL DIAGNOSTIC CHECK for any DTCs related to the electronic control module (ECM).

Table 3-9. TSM/TSSM Diagnostic Trouble Codes (DTC) and Fault Conditions

PRIORITY	DTC	FAULT CONDITION	SOLUTION
1	“BUS Er”	Serial data bus shorted low/open/high	3.21 DTC U1300, U1301 or “BUS ER”
2	U1300	Serial data low	3.21 DTC U1300, U1301 or “BUS ER”
3	U1301	Serial data high	3.21 DTC U1300, U1301 or “BUS ER”
4	U1016	Loss of all ECM serial data (state of health)	3.19 DTC U1016, U1255
5	U1096	Loss of IM serial data (state of health)	3.20 DTC U1096, U1255
6	U1255	Missing response from other module (IM) at startup	3.20 DTC U1096, U1255
7	B1135	Accelerometer fault	3.18 DTC B1135
8	B1151	Sidecar BAS low	Sidecar DTCs apply only to Touring models. If these DTCs are present on VRSC models, the TSM/TSSM is not properly configured.
	B1152	Sidecar BAS high	
	B1153	Sidecar BAS out of range	
9	B1134	Starter output high	3.17 DTC B1134
10	B1121	Left turn output fault	3.14 TURN SIGNAL ERRORS: DTC B1121, B1122, B1141
11	B1122	Right turn output fault	3.14 TURN SIGNAL ERRORS: DTC B1121, B1122, B1141
12	B0563	Battery voltage high	3.15 DTC B0563
13	B1131	Alarm output low	3.16 DTC B1131, B1132
14	B1132	Alarm output high	3.16 DTC B1131, B1132
15	B1141	Ignition switch open/low	3.14 TURN SIGNAL ERRORS: DTC B1121, B1122, B1141

Table 3-10. Symptoms That May Not Set Diagnostic Trouble Codes

SYMPTOM	SOLUTION
Fob signal to TSSM weak or fails	3.13 KEY FOB SIGNAL TO TSSM WEAK OR FAILS
No security lamp at key ON	3.8 CHECKING FOR DIAGNOSTIC TROUBLE CODES
Security lamp on continuously	3.8 CHECKING FOR DIAGNOSTIC TROUBLE CODES

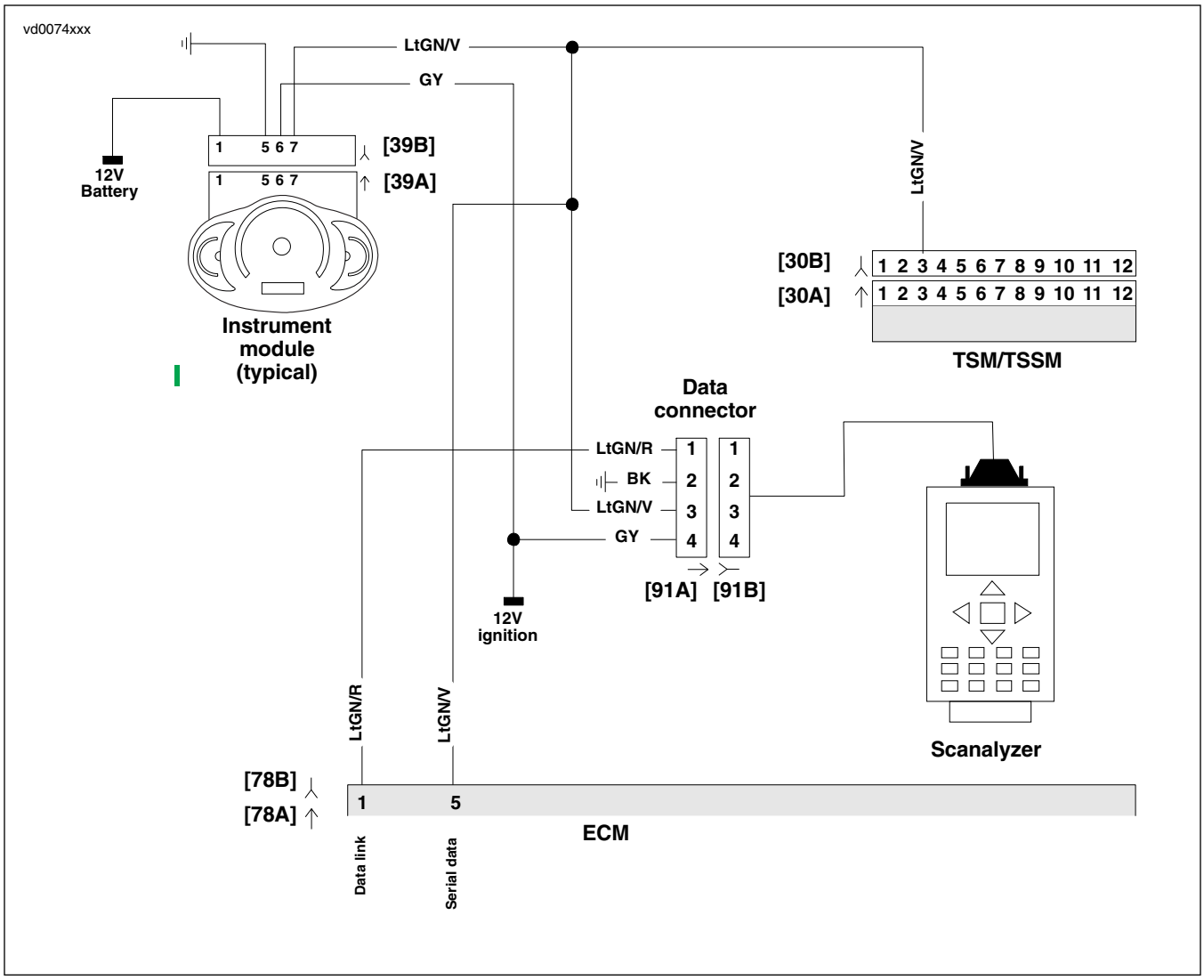
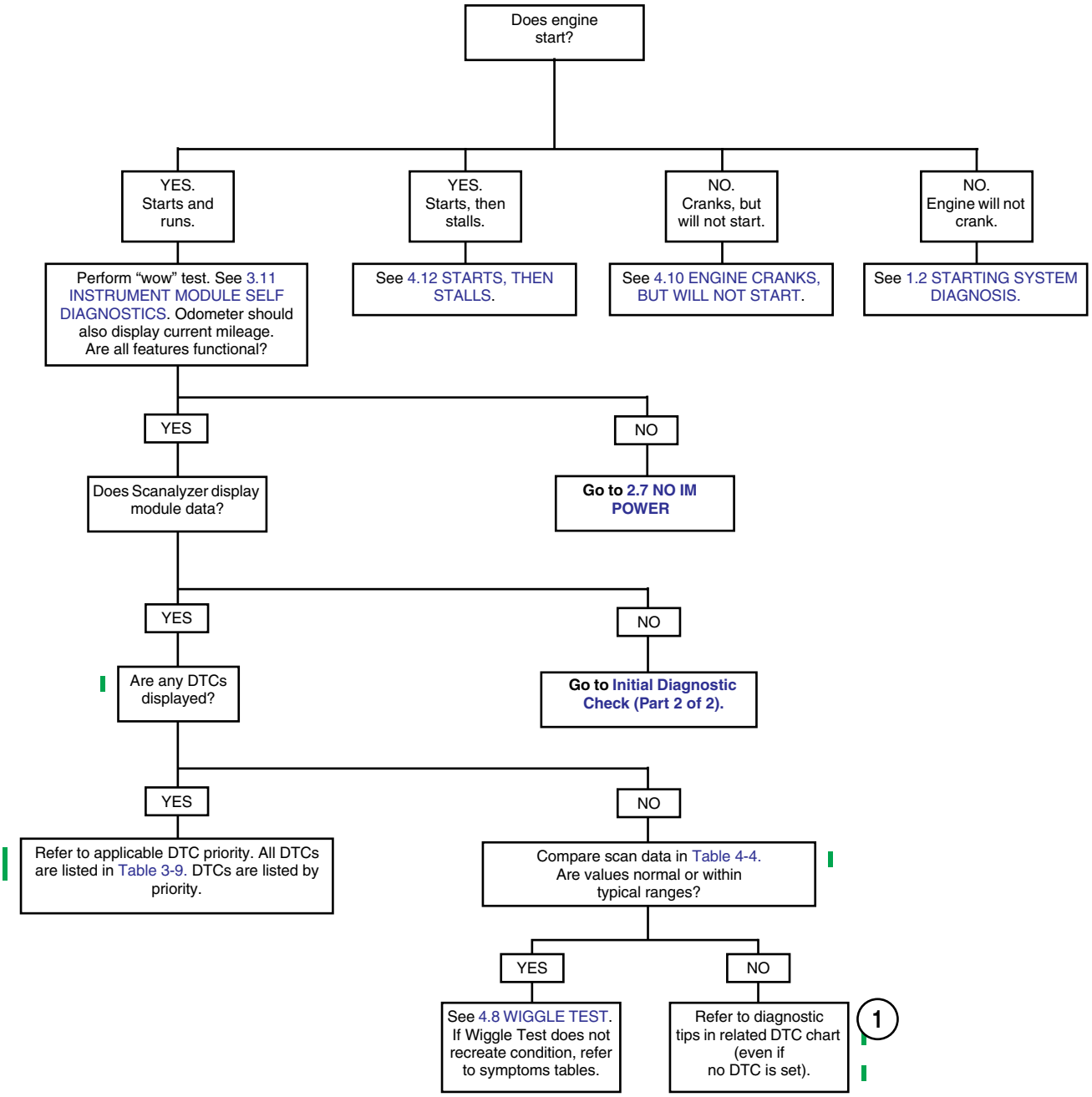


Figure 3-15. Diagnostic Check

Table 3-11. Wire Harness Connectors in Figure 3-15.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	IM	12-place Mini-Deutsch	under handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91A]	Data	4-place Deutsch	under left side cover

Initial Diagnostic Check (Part 1 of 2)



Initial Diagnostic Check (Part 2 of 2)

Continued from Initial Diagnostic Check (Part 1 of 2).

2
3

Test the four data connector terminals for continuity.

DATA TERMINAL		TERMINAL	
No.	Wire Color	No.	Connector
1	Lt. GN/R	1	[78B]
2	BK	28	[78B]
3	Lt. GN/V	5	[78B]
4	GY	GY terminal on left side of ignition fuse	

Continuity present in all four circumstances?

- NO → Inspect terminals for damage or repair opens as necessary.
- YES → Check Scanalyzer on another vehicle. Scanalyzer OK?
  - NO → Scanalyzer malfunction.
  - YES → Disconnect ECM at [78]. Does Scanalyzer display IM and TSM/TSSM data?
    - YES → Replace ECM. Reprogram and learn password.
    - NO → 2 Remove TSM/TSSM connector [30]. Check for continuity to ground at data connector [91A] Terminal 3. Continuity to ground?
      - YES → Locate and repair short to ground.
      - NO → Check for voltage at terminal 3 of data connector [91A]. Voltage present?
        - YES → Locate and repair short to voltage.
        - NO → Replace TSM/TSSM. Reprogram and learn password. System OK?
          - YES → System OK.
          - NO → Replace IM.

Clear codes and confirm proper operation with no check engine lamp.

INSTRUMENT MODULE SELF DIAGNOSTICS 3.11

GENERAL

The instrument module is capable of displaying and clearing TSM/TSSM, IM and ECM diagnostic trouble codes (DTCs).

DIAGNOSTICS

Diagnostic Tips

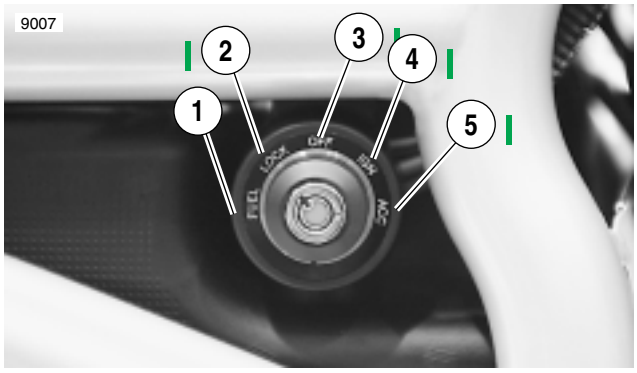
- For a quick check of IM function, a “wow” test can be performed. See Figure 3-16. Ignition Switch (VRSCA/VRSCD), Figure 3-17. Ignition Switch (VRSCR) and Figure 3-18.Turn ignition switch to ACC. Background lighting should illuminate, gauge needles should sweep their full range of motion, and indicator lamps controlled by the serial bus (battery, security, coolant temperature and check engine) should illuminate.
- If instrument module fails “wow” test, check for battery, ground and accessory to IM. If any feature in the instrument module is non-functional, see 2.7 NO IM POWER.

Diagnostic Notes

Use of IM self diagnostics assumes that the SCANALYZER (Part No. HD-41325) is not available.

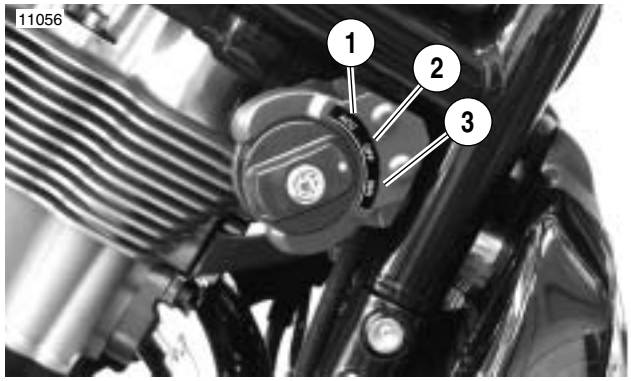
The reference numbers below correlate with the circled numbers in the IM Self Diagnostics (chart).

1. To exit diagnostic mode, turn ignition switch OFF.
2. To clear diagnostic trouble codes (DTCs) for selected module, press instrument module reset switch for more than 5 seconds when DTC is displayed. This procedure will clear all DTCs for selected module.



3. Seat release
4. LOCK position
5. OFF position
6. Ignition position
7. Accessory position

Figure 3-16. Ignition Switch (VRSCA/VRSCD)



1. Accessory position
2. OFF position
3. Ignition position

Figure 3-17. Ignition Switch (VRSCR)

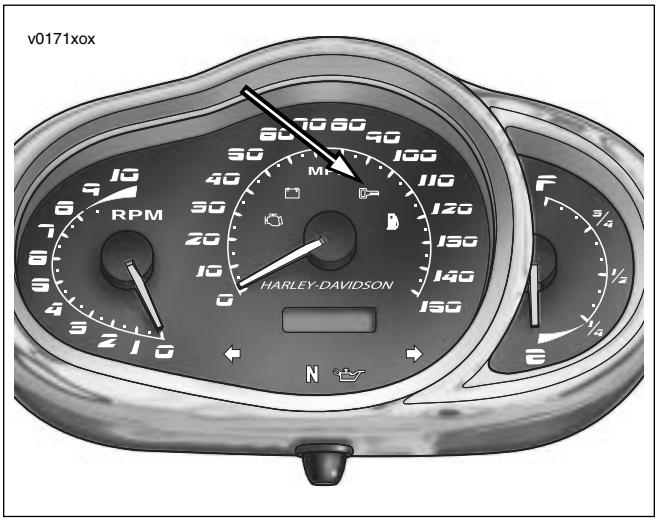
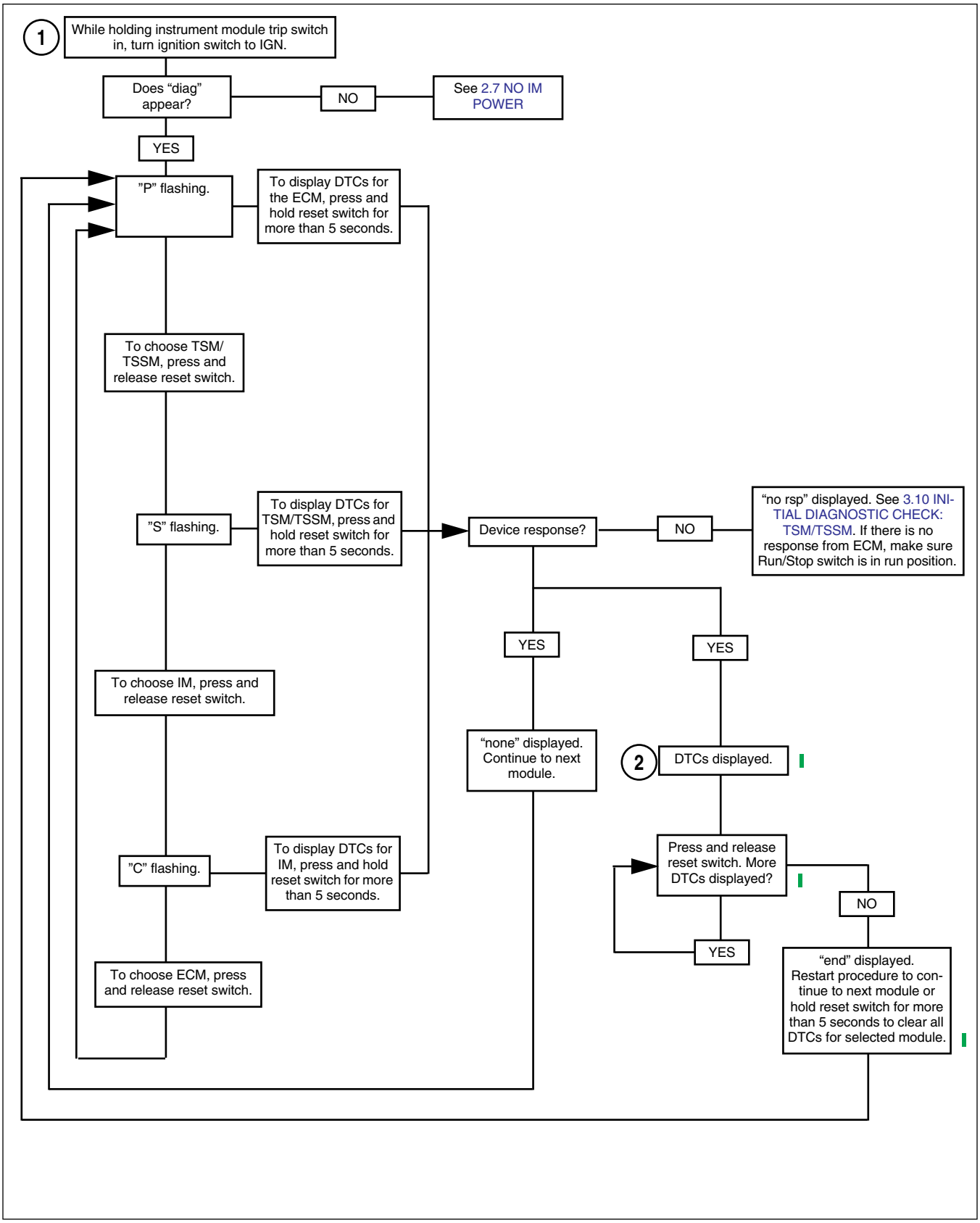


Figure 3-18. Security Lamp (typical) (VRSCR shown)

IM Self Diagnostics (chart)



BREAKOUT BOX:TSM/TSSM 3.12

GENERAL

The BREAKOUT BOX (Part No. HD-42682) splices into the main harness. Used in conjunction with a digital volt/ohmmeter (DVOM), it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects.

INSTALLATION

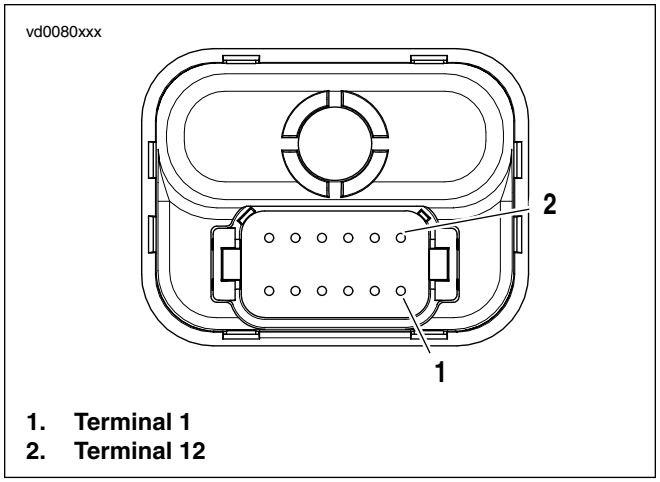
1. Gain access to TSM/TSSM. See VRSC Service Manual.
2. See Figure 3-19. Depress latches on connector [30B].
3. See Figure 3-20. Attach Breakout Box to connector.
   a. Mate gray connector from Breakout Box to TSM/TSSM connector [30A].
   b. Mate connector from the wiring harness to gray connector on Breakout Box.

REMOVAL

1. See Figure 3-19. Depress latches on connector [30B].
2. Detach gray Breakout Box connector from TSM/TSSM connector.
3. Detach gray Breakout Box connector from wiring harness.
4. Install TSM/TSSM per procedure in the VRSC Service Manual

NOTE

Vehicle will not start with TSM/TSSM disconnected or incorrectly mounted.



1. Terminal 1
2. Terminal 12

Figure 3-19. TSM/TSSM Connector [30A] Terminals

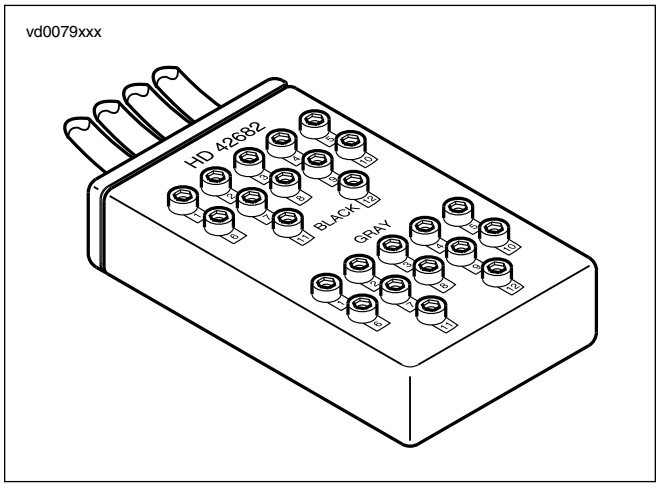


Figure 3-20. Breakout Box

Table 3-12. TSM/TSSM Connector [30B]

TERMINAL	FUNCTION	TERMINAL	FUNCTION
1	Battery	7	Right turn switch input
2	Ignition	8	Left turn switch input
3	serial data	9	Starter relay control
4	Security indicator	10	Ignition enable signal (not used)
5	Left turn feed	11	Alarm signal
6	Right turn feed	12	Ground

NOTES

KEY FOB SIGNAL TO TSSM WEAK OR FAILS 3.13

GENERAL

Security Equipped Vehicles Only

This section applies only to those vehicles equipped with the optional security system.

NOTE

*Disarming function may require practice. The key fob button **must** be pressed twice within 1.5 seconds to send the disarm command. The action is very similar to double-clicking a computer mouse. Light quick taps work best; very hard or very slow taps are less likely to work.*

See Figure 3-21. The key fob sends a RF signal to activate all remote TSSM functions. The left front turn signal switch wire serves as the vehicle's antenna. If the TSSM does not respond (no confirmation at arming/disarming system) or responds weakly (limited range, won't consistently arm/disarm or synchronize), follow the Test 3.13 flow chart.

Job/Time Code Values

Some charts may contain warranty job/time codes. Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

DIAGNOSTICS

Diagnostic Tips

- Verify key fob battery voltage is least 2.9 volts. See 3.23 TSSM MAINTENANCE.
- Interference from physical surroundings may affect RF transmission. Place fob next to left handgrip and disarm with two clicks or move motorcycle to a new location and retest.
- Check for damage to antenna wire. Does left turn signal work?

NOTE

See 3.7 ARMING/DISARMING SECURITY SYSTEM (TSSM). Use only the proper key fob for your market and TSSM package.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 3.13 flow charts.

1. After a battery disconnect, the TSSM will not enter the configuration mode on the first attempt. All attempts to assign a fob or enter the configuration mode will require at least two attempts.

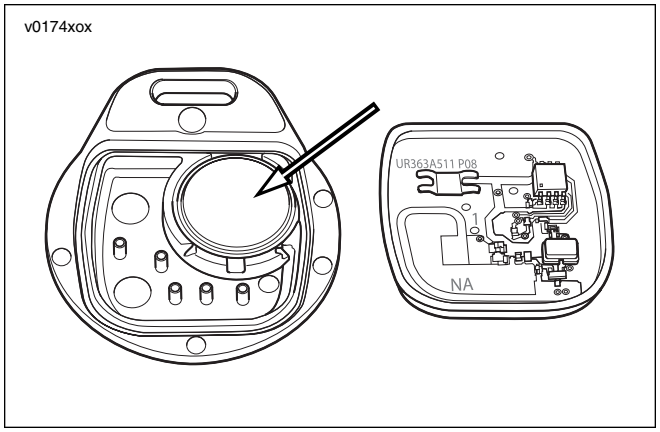


Figure 3-21. Key Fob Battery (typical)

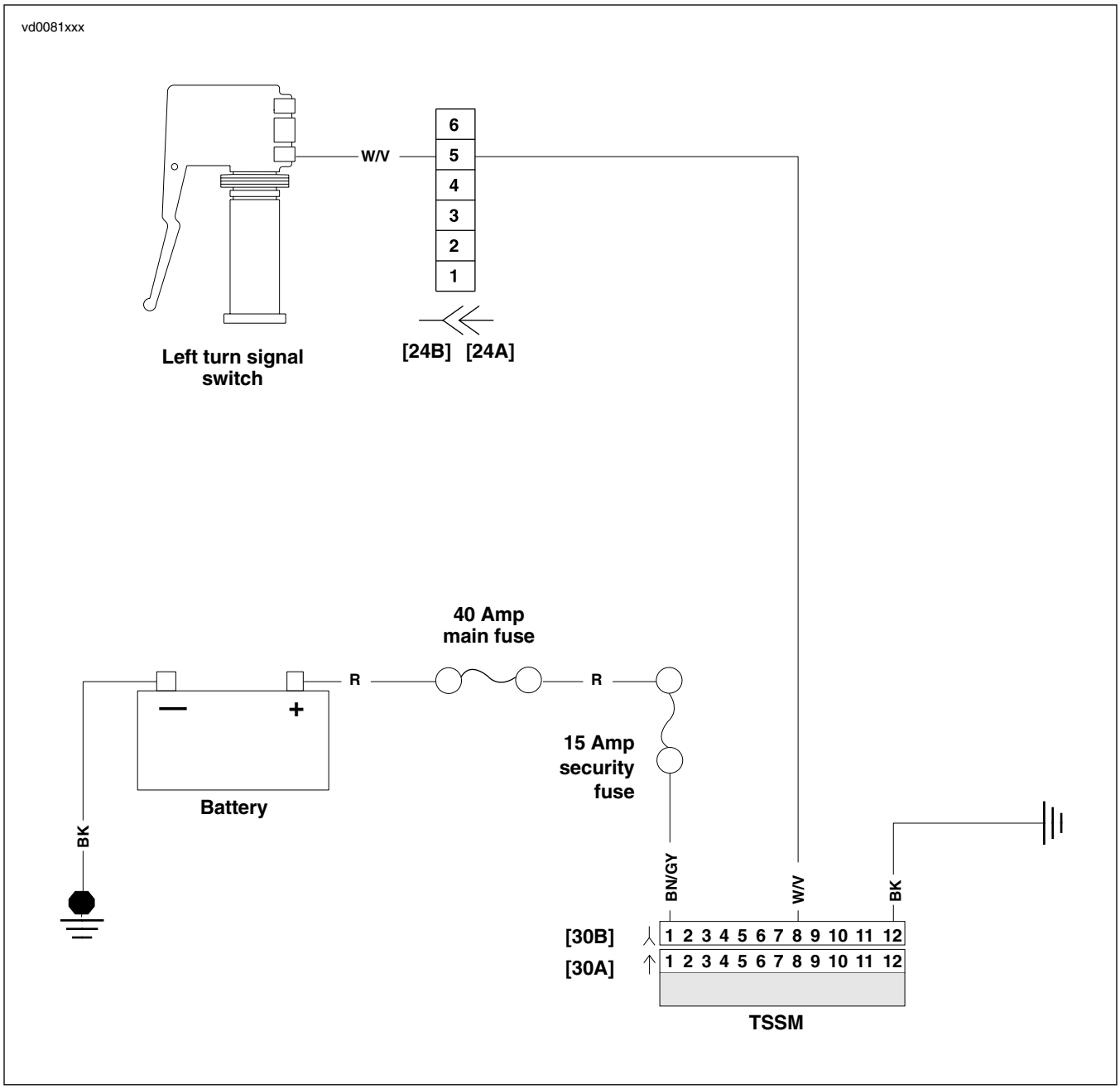


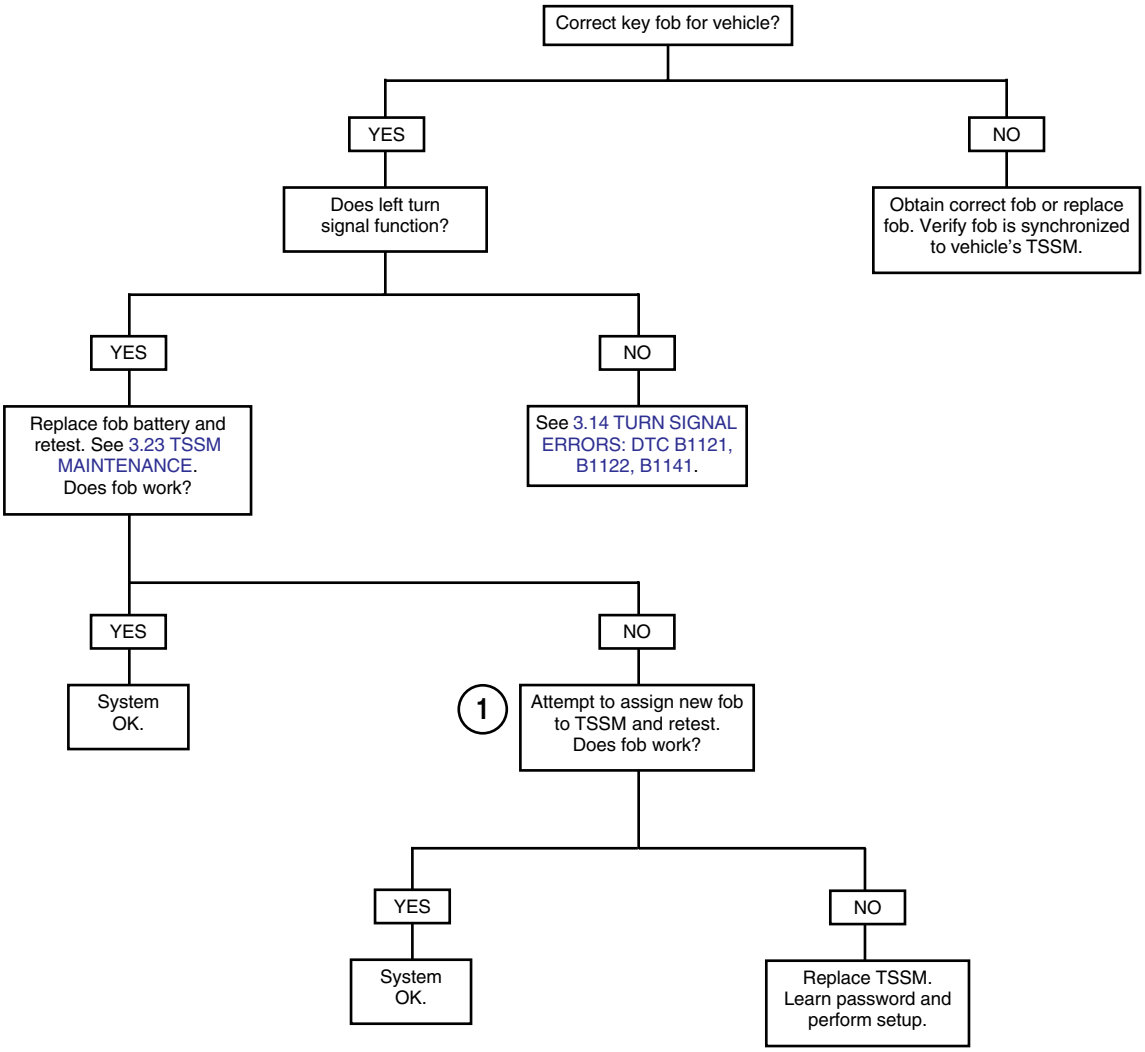
Figure 3-22. TSSM Circuit

Table 3-13. Wire Harness Connectors in Figure 3-22.

NO.	DESCRIPTION	TYPE	LOCATION
[24]	Left hand controls	6-place Deutsch	under left side cover
[30]	TSSM	12-place Deutsch	under passenger seat

Test 3.13

FOB SIGNAL TO TSSM WEAK OR FAILS



TURN SIGNAL ERRORS: DTC B1121, B1122, B1141 3.14

GENERAL

The turn signals will automatically cancel either based on the speed/acceleration of the vehicle or based upon turn completion. See 3.4 TSM/TSSM TURN SIGNAL FUNCTIONS.

For turn signal diagnostics, refer to Table 3-14.

Figure 3-23. TSM/TSSM

DIAGNOSTICS

Diagnostic Tips

- On vehicles with a security system, DTC B1121 and B1122 will illuminate the security lamp.
- On vehicles with a security system, DTC B1141 will not illuminate the security lamp.
- When the TSM/TSSM is in four-way flasher mode, a fault on either the left or right turn lamp output will not cause either DTC B1121 and DTC B1122 to be set as current. If fault occurs on both left and right outputs, then both DTC B1121 and DTC B1122 will be set as current.
- When the TSM/TSSM detects an over current (or short to ground) condition, it will turn off the turn lamp outputs. The outputs will be automatically reactivated once the fault is removed.

Table 3-14. Turn Signal Errors

SYMPTOM	START WITH FLOW CHART	DTC(S)
Turn signals will not cancel or cancel erratically	Turn Signal Error 1A (Part 1 of 2)	N/A
Turn signals will not flash, 4-way flashers inoperable	Turn Signal Error 2A	B1121, B1122, B1141
Left or right turn signals flash at double the normal rate while all bulbs are working	Turn Signal Error 3A	N/A

v0124x8x

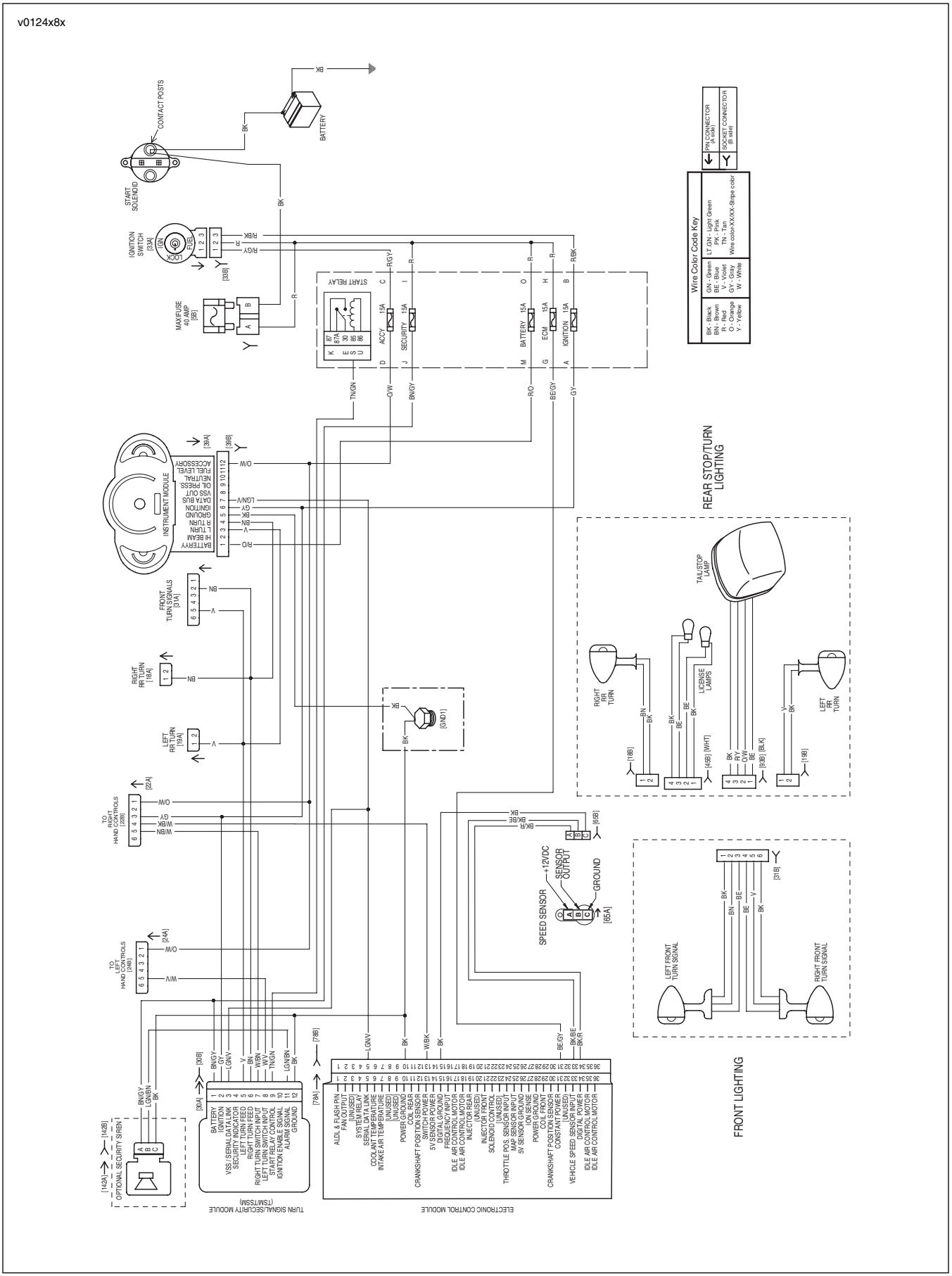


Figure 3-24. Turn Signal/Security Circuit (VRSCA/VRSCD)

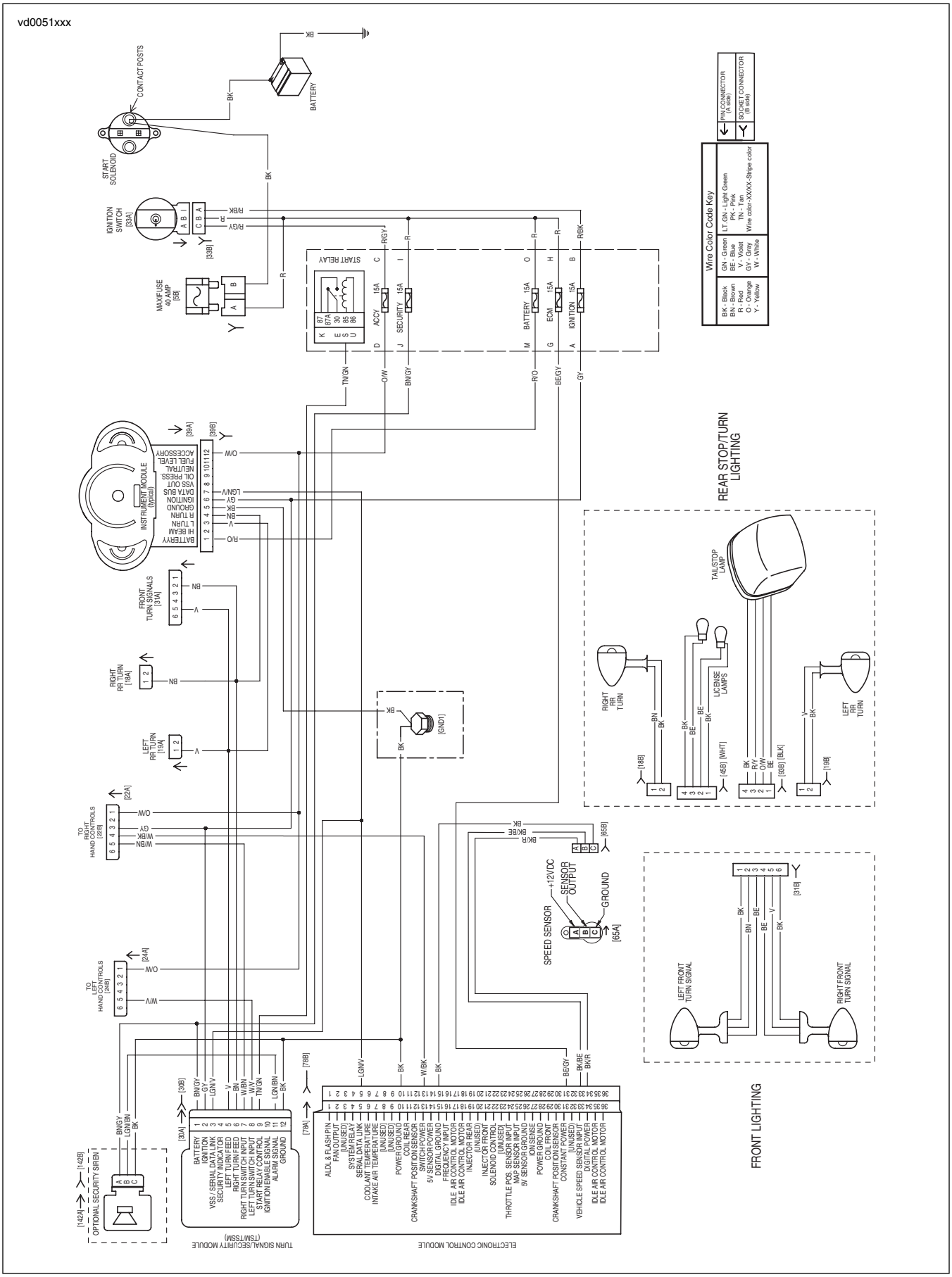


Figure 3-25. Turn Signal/Security Circuit (VRSCR)

Table 3-15. Wire Harness Connectors in Figure 3-25.

NO.	DESCRIPTION	TYPE	LOCATION
[18]	Right rear turn signal	2-place Multi-lock	under outer rear fender
[19]	Left rear turn signal	2-place Multi-lock	under outer rear fender
[22]	Right hand controls	6-place Deutsch	under left side cover
[24]	Left hand controls and horn	6-place Deutsch	under left side cover
[30]	Turn signal/security module	12-place Deutsch	under passenger seat
[31]	Front turn signals	6-place Multi-lock	under handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat

Diagnostic Notes: All Turn Signal Flow Charts

The reference numbers below correlate with the circled numbers on the turn signal flow charts.

1. Gain access to vehicle's TSM/TSSM. Perform the following procedure:
   a. See Figure 3-27. Position TSM/TSSM in same orientation it is mounted on vehicle. Turn on ignition switch. Turn on 4-way flashers by depressing both left and right turn signal switches simultaneously. Turn ignition off; 4-way flashers should continue to flash.
   b. Tilt module greater than 45 degrees to the left.
   c. Repeat step a.
   d. Tilt module greater than 45 degrees to the right.
2. Connect SCANALYZER. Turn on ignition switch. Set RUN/STOP switch to RUN position. Use SCANALYZER to input a signal which duplicates a speed greater than or equal to 20 MPH (32.2 KPH). If turn signals are working correctly, they will flash 20 times and then cancel.
3. To enable diagnostic mode, see 4.6 INSTRUMENT MODULE SELF DIAGNOSTICS.
4. Connect BREAKOUT BOX (Part No. HD-42682) (gray) between TSM/TSSM connector [30A] and wiring harness connector [30B]. See 3.12 BREAKOUT BOX:TSM/TSSM.
5. Closely inspect handlebar controls for pinched wiring.
6. Remove BREAKOUT BOX (Part No. HD-42682) (gray) from between TSM/TSSM connector [30A] and wiring harness connector [30B]. Reconnect [30].
7. Connect BREAKOUT BOX (Part No. HD-42682) (black) and 6-pin Harness Adapters (Part No. HD-42962) between wiring harness connector [24A] and left hand control harness connector [24B].
8. Connect BREAKOUT BOX (Part No. HD-42682) (black) and 6-pin Harness Adapters (Part No. HD-42962) between wiring harness connector [22A] and right hand control harness connector [22B].
9. Check for corrosion at rear turn signal connectors [18 and 19], and front lighting harness connector [31] and TSSM [30].

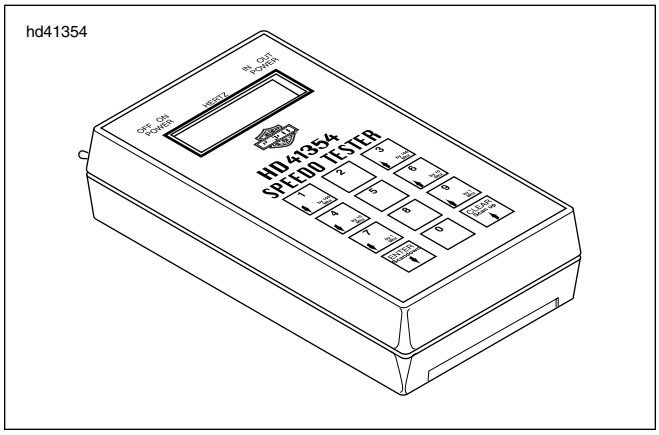
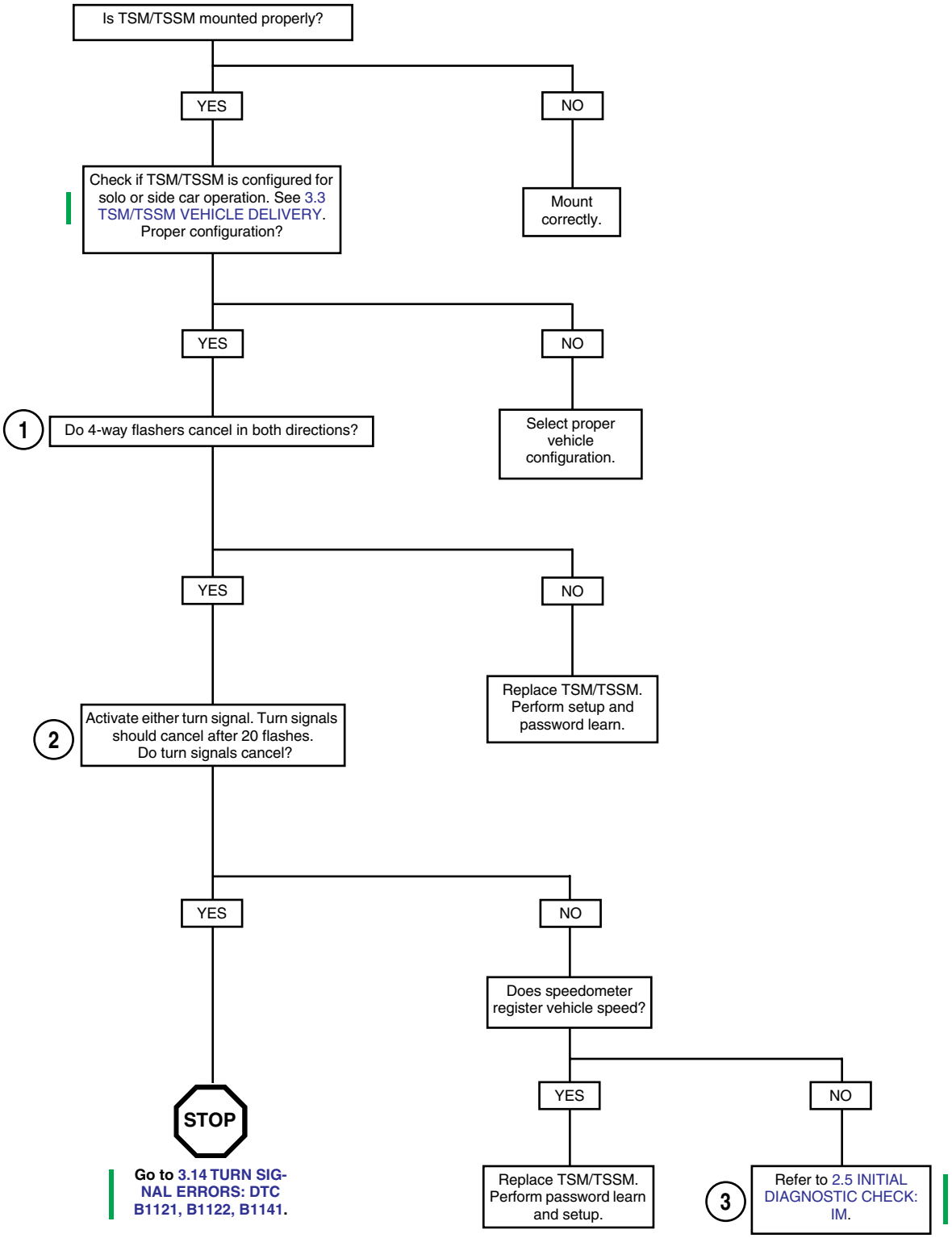


Figure 3-26. Speedometer Tester

Figure 3-27. Tilting TSM/TSSM

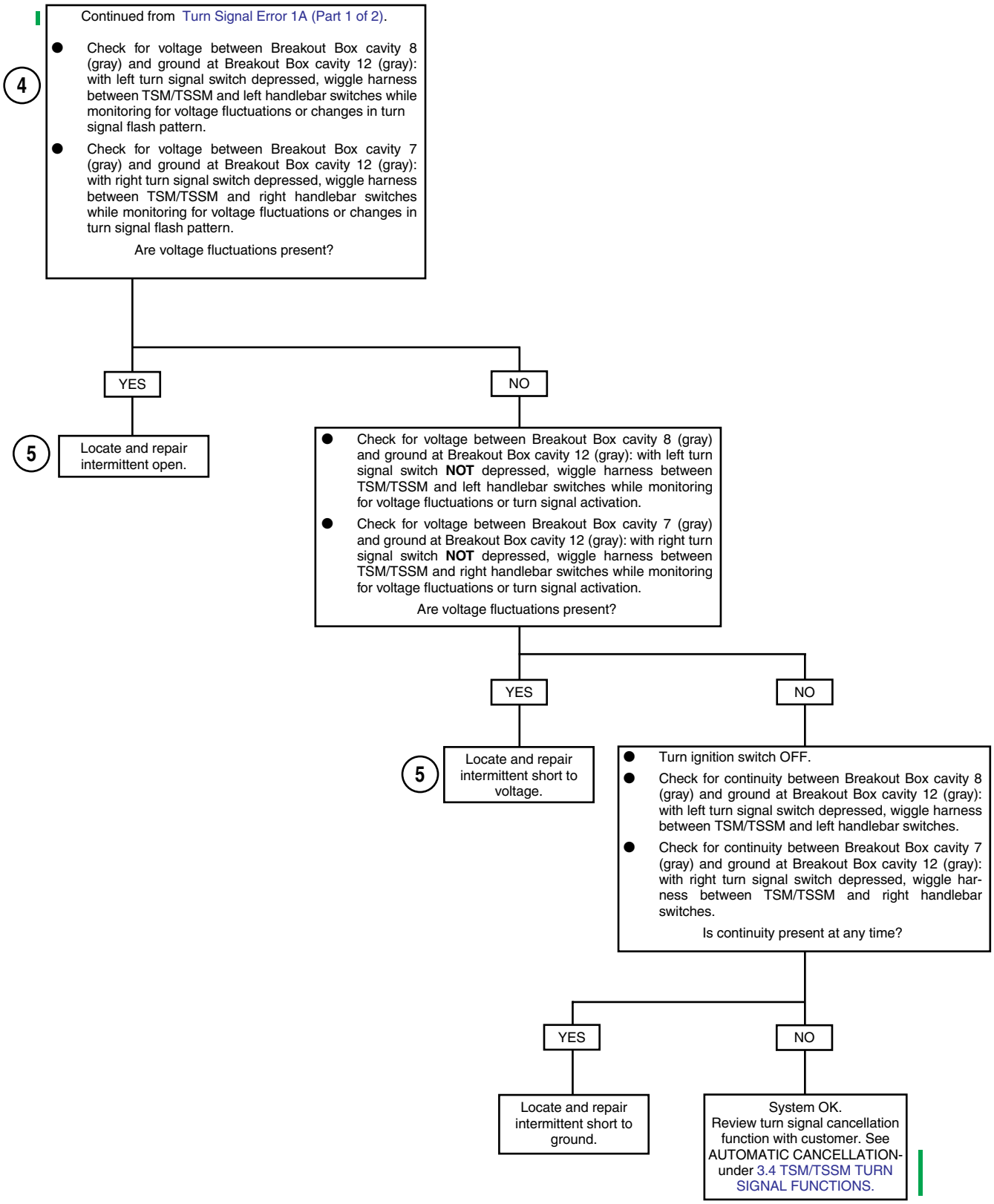
Turn Signal Error 1A (Part 1 of 2)

WILL NOT CANCEL UPON TURN COMPLETION



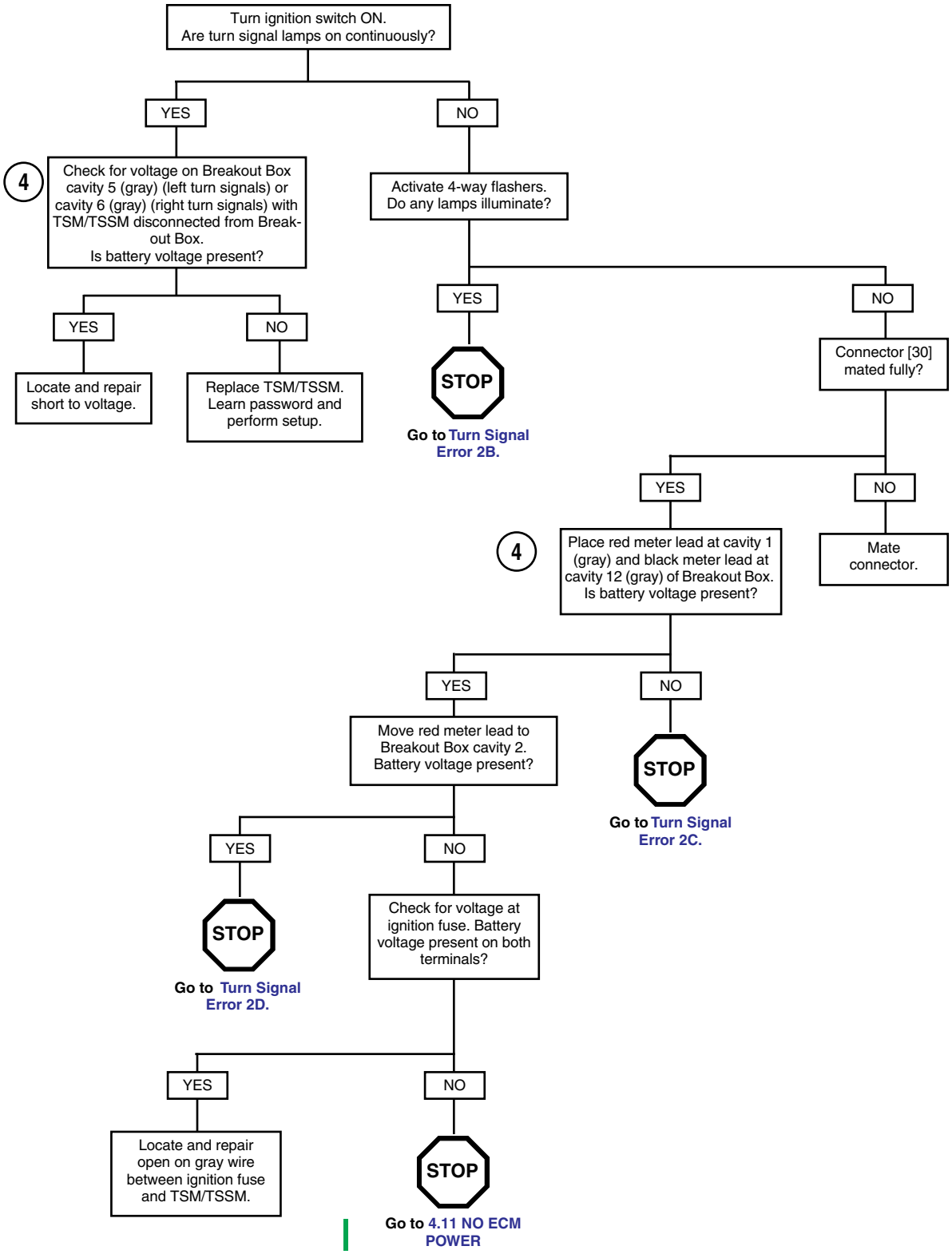
Turn Signal Error 1A (Part 2 of 2)

CANCELS ERRATICALLY



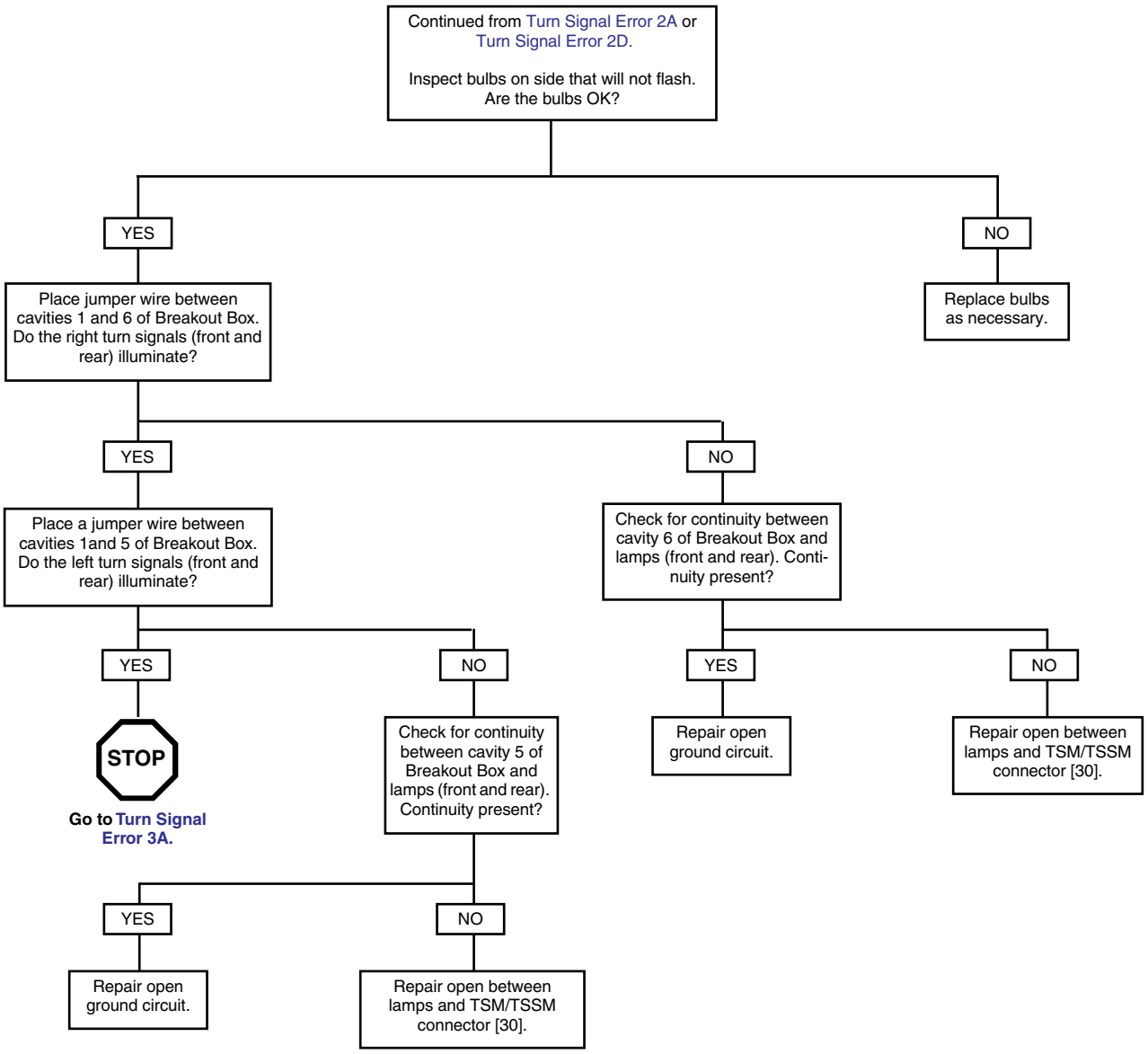
Turn Signal Error 2A

WILL NOT FLASH, 4-WAY FLASHERS INOPERABLE: DTC B1121, B1122, B1141



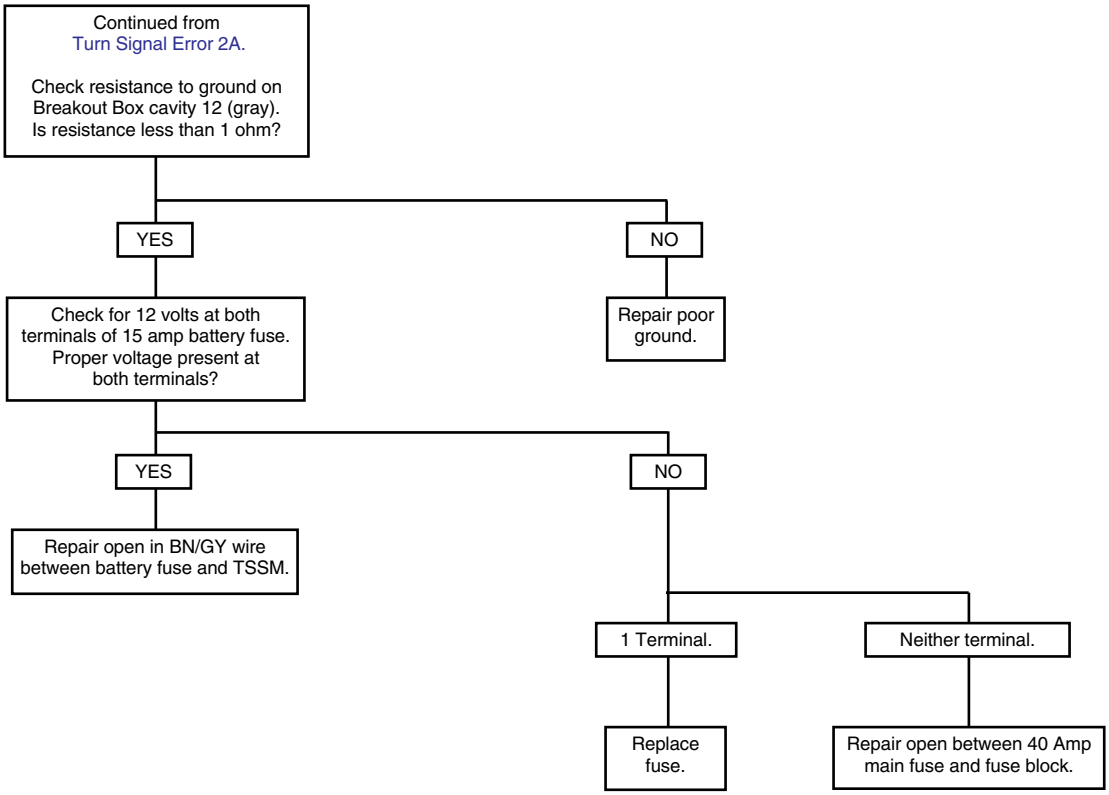
Turn Signal Error 2B

WILL NOT FLASH, 4-WAY FLASHERS INOPERABLE: DTC B1121, B1122, B1141



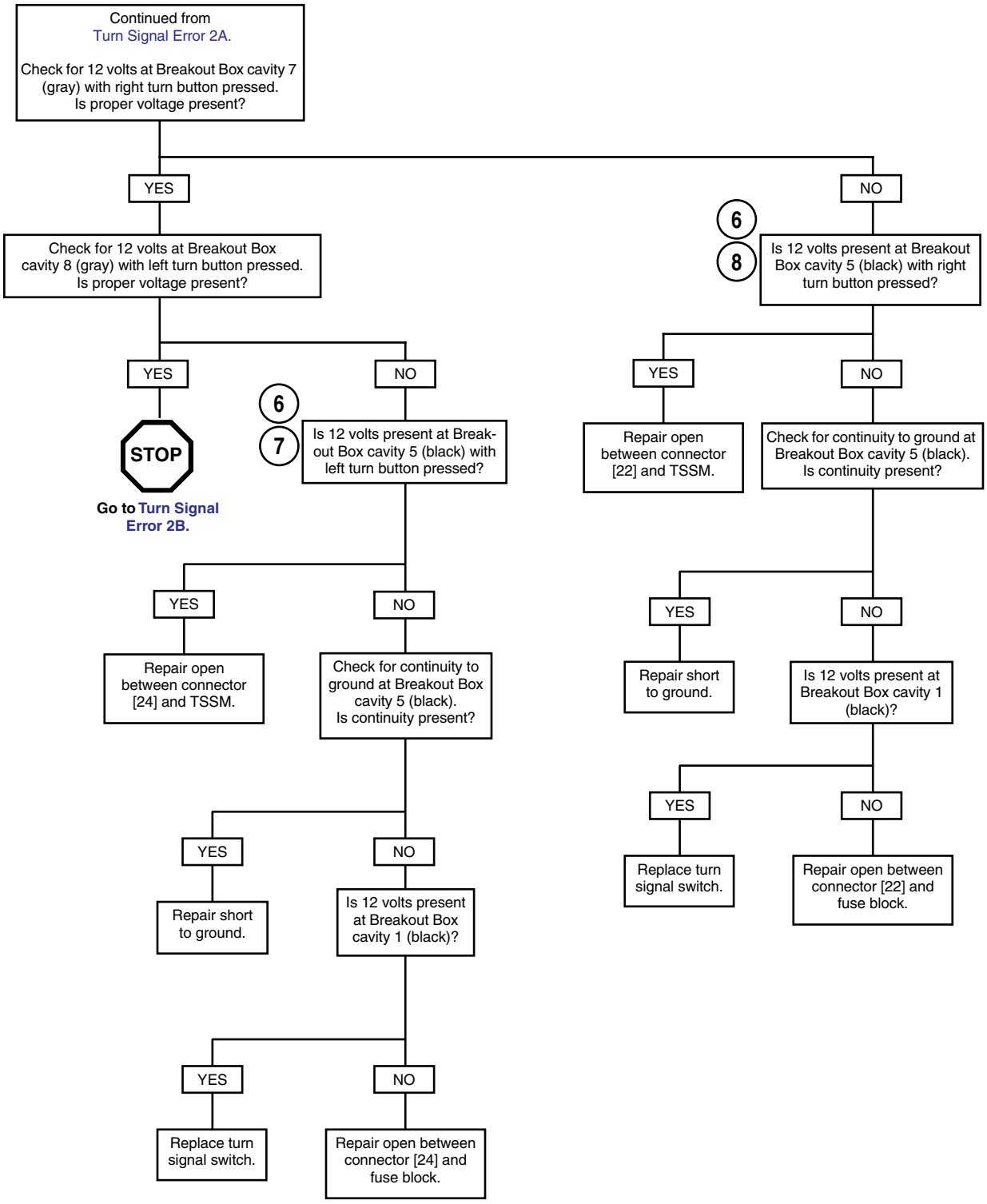
Turn Signal Error 2C

WILL NOT FLASH, 4-WAY FLASHERS INOPERABLE: DTC B1121, B1122, B1141



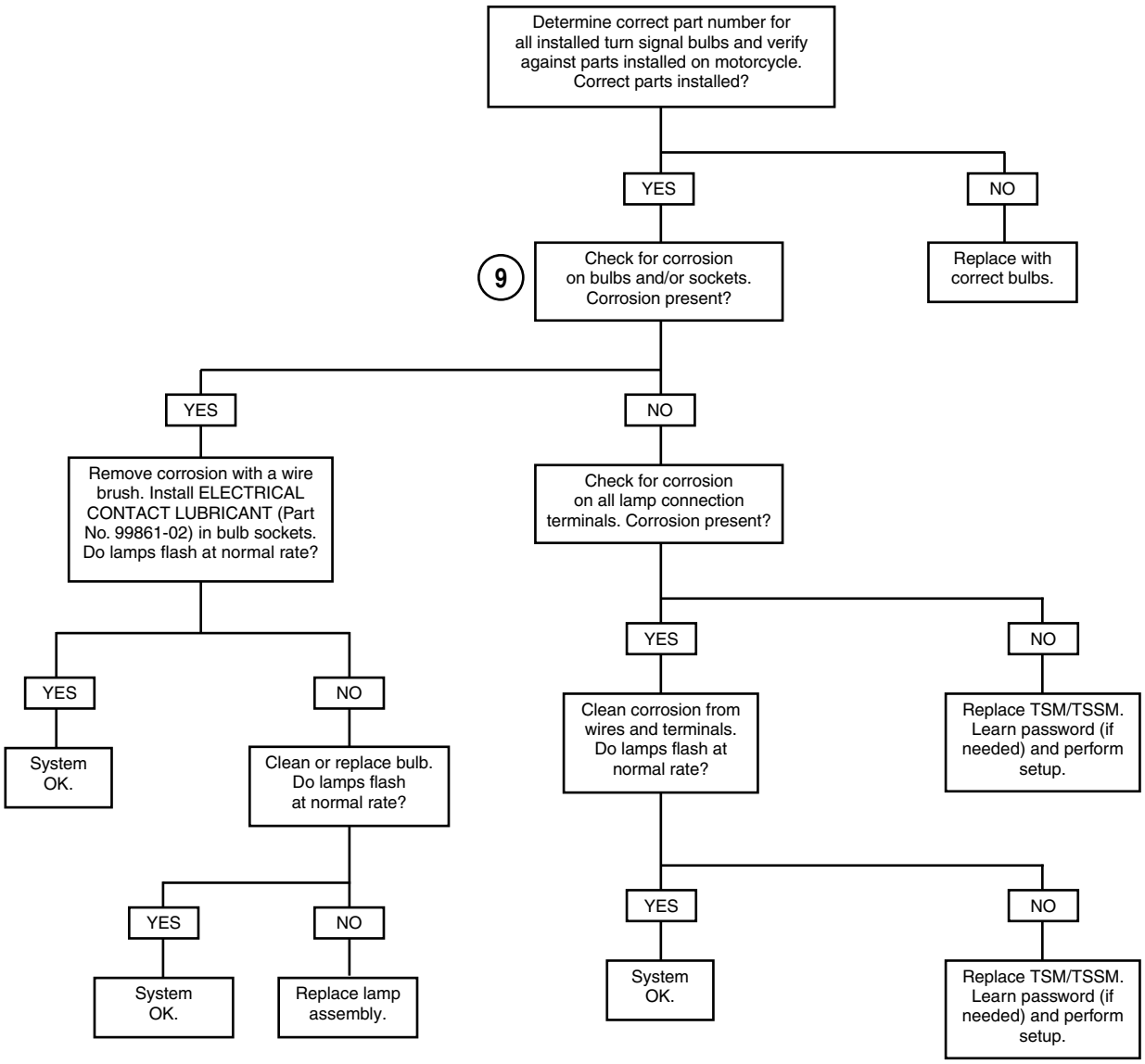
Turn Signal Error 2D

WILL NOT FLASH, 4-WAY FLASHERS INOPERABLE: DTC B1121, B1122, B1141



Turn Signal Error 3A

FLASH AT DOUBLE NORMAL RATE, ALL BULBS WORKING



DTC B0563 3.15

GENERAL

Battery Voltage High

The TSM/TSSM continually checks the battery voltage during IGN/OFF and IGN/RUN power modes. If the voltage exceeds 16.0 volts for more than 4.5-5.5 seconds, the TSM/TSSM sets diagnostic trouble code (DTC) B0563.

DIAGNOSTICS

Diagnostic Tips

- This DTC may set when the vehicle is placed on a battery charger, on fast charge, for a long period of time.
- The TSSM does not illuminate the security lamp when this DTC is set as current.

Diagnostic Notes

See 1.7 CHARGING SYSTEM tests in Section 1 to correct. Problem may be faulty voltage regulator.

DTC B1131, B1132 3.16

GENERAL

NOTE

This section applies only to those vehicles equipped with the optional security system.

Alarm Output Low (DTC B1131) or Alarm Output High (DTC B1132)

See Figure 3-28. An alarm cycle is activated when the TSSM is connected, the siren has been armed by the TSSM and a security event occurs. See 3.6 SECURITY SYSTEM (TSSM) FUNCTIONS. Under normal armed operation, the siren input (terminal B) is driven low by the TSSM to trigger the audible alarm. When the siren input is driven high by the TSSM the audible alarm stops.

DIAGNOSTICS

Diagnostic Tips

- If the siren is armed and the internal siren battery is dead, shorted, disconnected, or has been charging for a period longer than 24 hours, the siren will respond with three chirps on arming instead of two.
- The internal siren battery may not charge if the vehicle's battery is less than 12.5 volts.
- If the siren does not chirp, two or three times, on a valid arming command from the TSSM, the siren is either not connected, not working, or the siren wiring was opened or shorted while the siren was disarmed.
- If the siren enters the self-driven mode where it is powered from the siren internal nine-volt battery, the turn-signal lamps will not alternately flash. If the TSSM activates the siren, the turn-signal lamps will flash. If the siren has been armed and a security event occurs, and the siren is in self-driven mode, the siren will alarm for 20 to 30 seconds and then turn off for 5 to 10 seconds. This alarm cycle will be repeated ten times if the siren is in the self-driven mode.
- If the siren does not stop alarming after it has been armed, then either the TSSM output or siren input may be shorted to ground, or the siren vehicle battery connection is open or shorted to ground, or the siren vehicle ground connection is open, or a security event has occurred. See 3.6 SECURITY SYSTEM (TSSM) FUNCTIONS for a description of alarm actions.

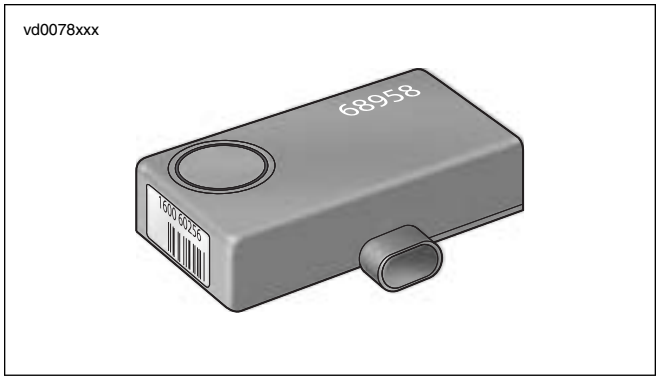


Figure 3-28. Siren

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 3.16 flow chart.

1. Use BREAKOUT BOX (Part No. HD-42682) and HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probe and patch cord. See 3.12 BREAKOUT BOX:TSM/TSSM.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray socket probe and patch cord.
3. Having the correct multimeter ohm scale is important for this test. Some meters may read infinity for high ohm values. If this is the case, check your ohm scale and retest.

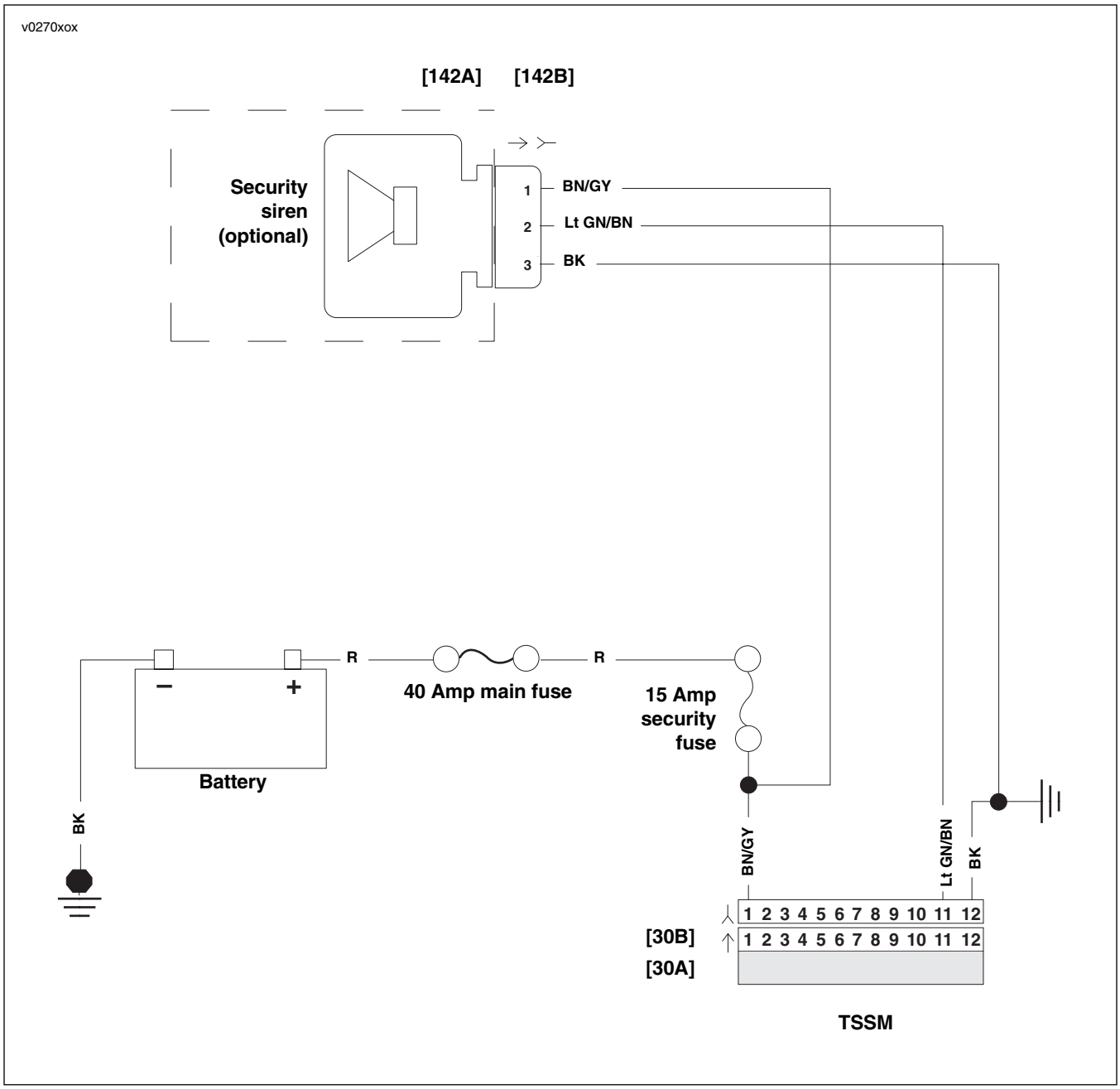


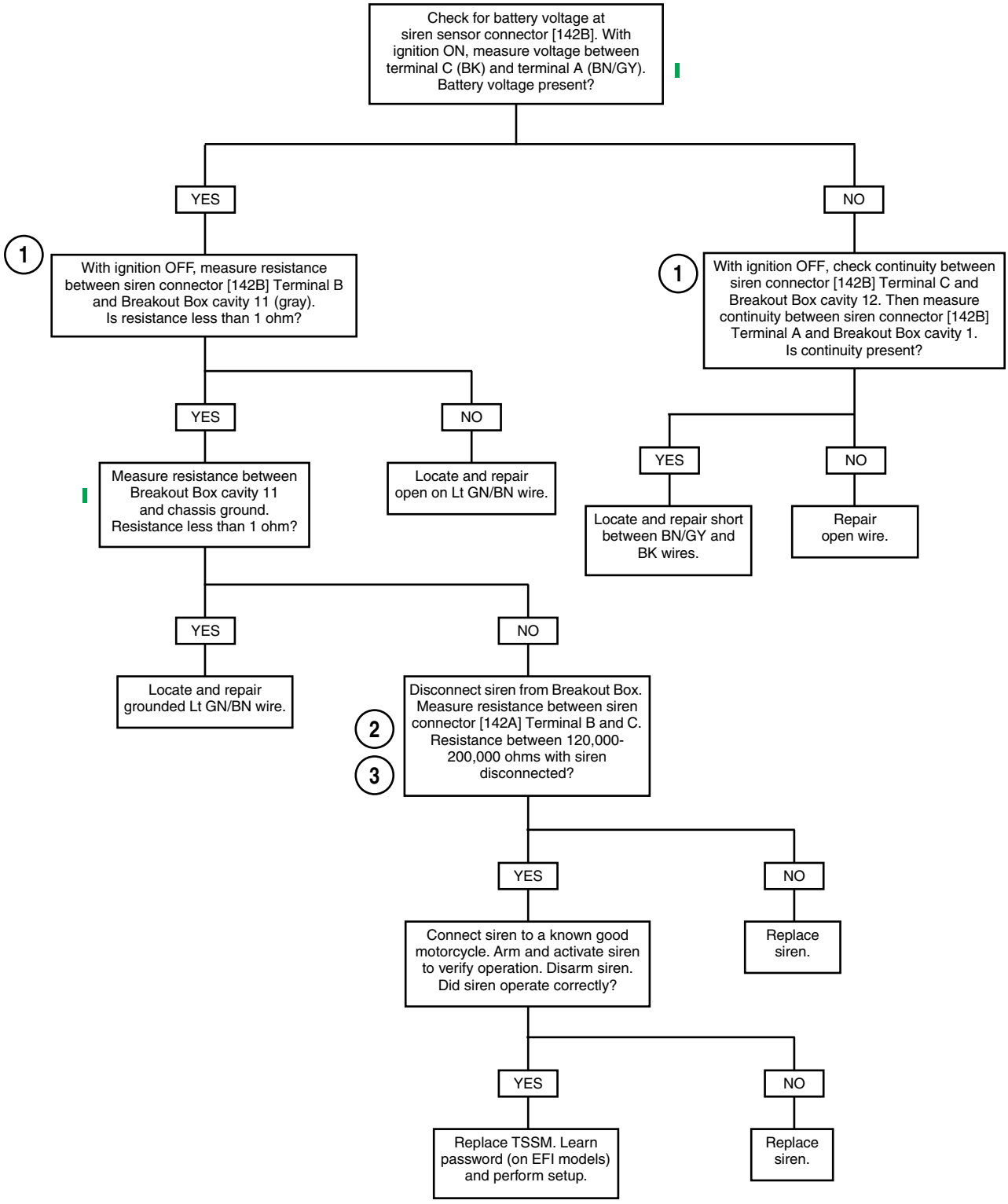
Figure 3-29. Siren Circuit

Table 3-16. Wire Harness Connectors in Figure 3-29.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	turn signal/security module	12-place Deutsch	under passenger seat
[142]	security siren (optional)	3-place Packard	electrical panel behind fender extension

Test 3.16

ALARM OUTPUT: DTC B1131, B132



Clear codes and confirm proper operation with no check engine lamp.

DTC B1134 3.17

GENERAL

Starter Output High

With the TSM/TSSM disarmed, ignition ON and RUN/STOP switch set to RUN the starter relay is grounded. Battery voltage is applied to the starter relay and coil which are grounded through the TSM/TSSM. This diagnostic trouble code (DTC) is set when that ground is not established through the TSM/TSSM.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 3.17 flow charts.

1. Connect BREAKOUT BOX (Part No. HD-42682) (gray) to wire harness connector [30] leaving TSM/TSSM disconnected. See 3.12 BREAKOUT BOX:TSM/TSSM.

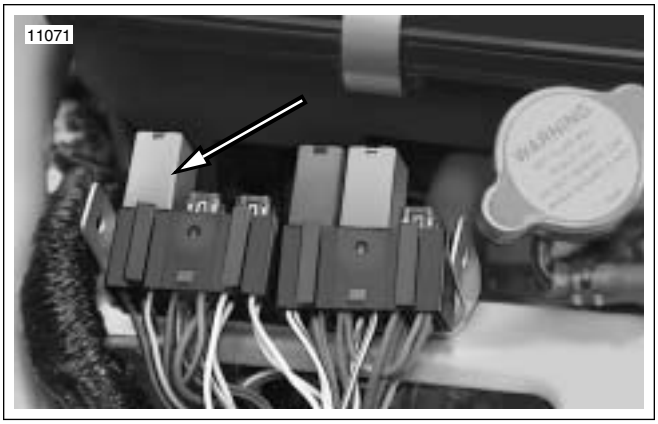


Figure 3-30. Starter Relay

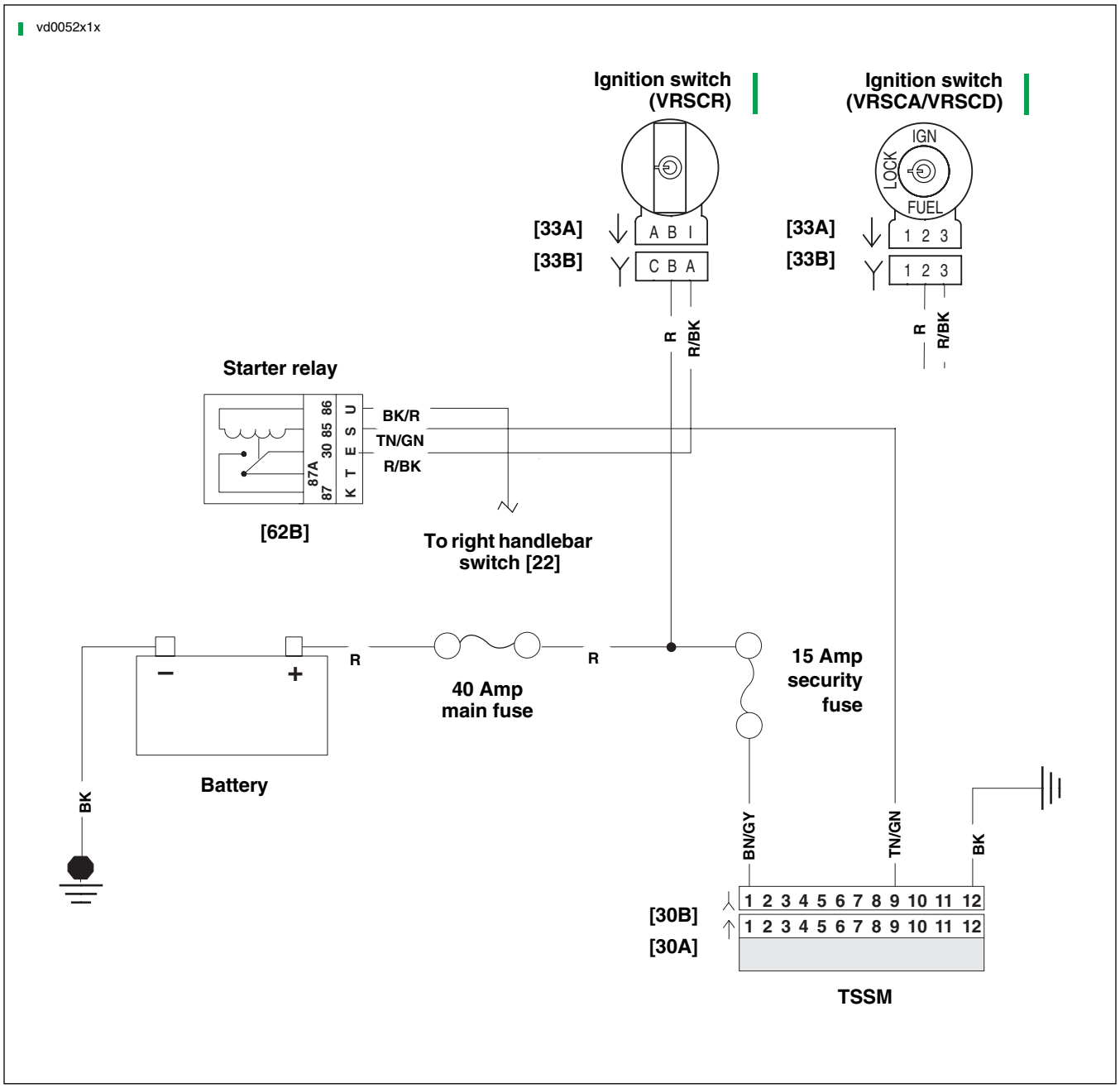


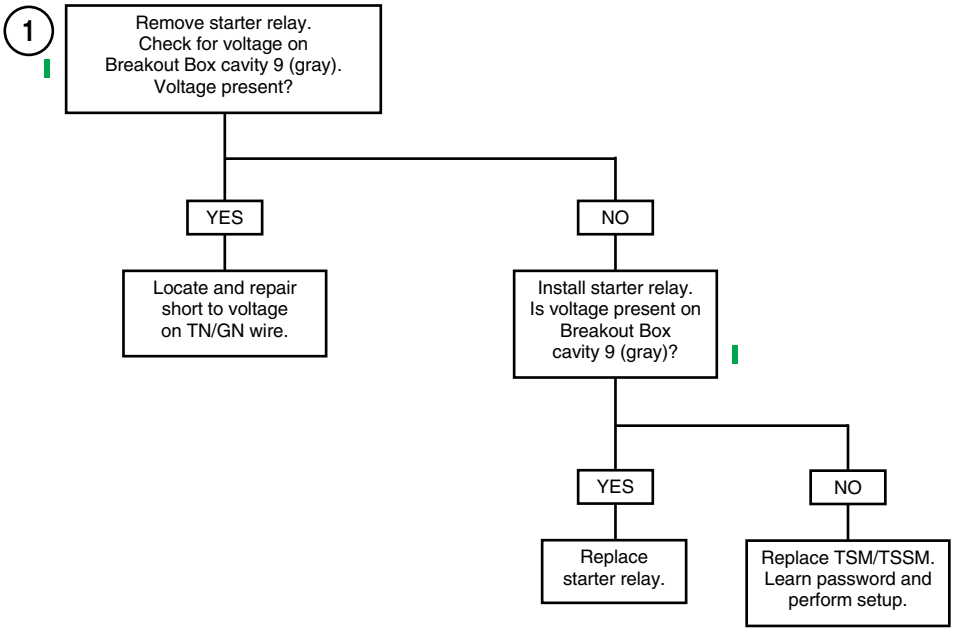
Figure 3-31. Starter/TSSM Circuit

Table 3-17. Wire Harness Connectors in Figure 3-31.

NO.	DESCRIPTION	TYPE	LOCATION
[5]	main fuse	spade terminals	under right side cover
[30]	turn signal/security module	12-place Deutsch	under passenger seat
[61]	starter relay	5-place Amp	under airbox cover, in fuse block

Test 3.17

STARTER OUTPUT HIGH: DTC B1134



Clear codes and confirm proper operation with no check engine lamp.

DTC B1135 3.18

GENERAL

Accelerometer Fault

This diagnostic trouble code (DTC) indicates a failure which requires replacement of the TSM/TSSM.

NOTE

When DTC B1135 is set, the tip-over engine shutdown, TSSM tamper alarm and bank angle sensors are disabled. The security lamp will also illuminate on vehicles with security systems.

DTC U1016, U1255 3.19

GENERAL

Loss of ECM Serial Data

The serial data connector provides a means for the IM, ECM and TSM/TSSM to communicate their current status. When all operating parameters on the serial data link are within specifications, a state of health message is sent between the components. A diagnostic trouble code (DTC) U1016 indicates that the ECM is not capable of sending this state of health message.

A DTC U1255 indicates that no messages were present during power up of the current key cycle. A DTC U1016 indicates that there was communication on the data bus since power up, but was lost or interrupted during that key cycle.

Table 3-18. Code Description

DTC	DESCRIPTION
U1016	Loss of all ECM serial data (state of health)
U1255	Serial data error/missing message

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 3.19 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.
2. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness and TSM/TSSM. See 3.12 BREAKOUT BOX:TSM/TSSM.

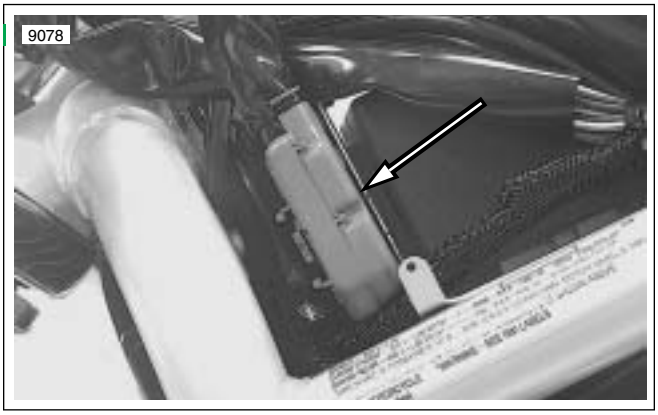


Figure 3-32. ECM (VRSCA/VRSCD)

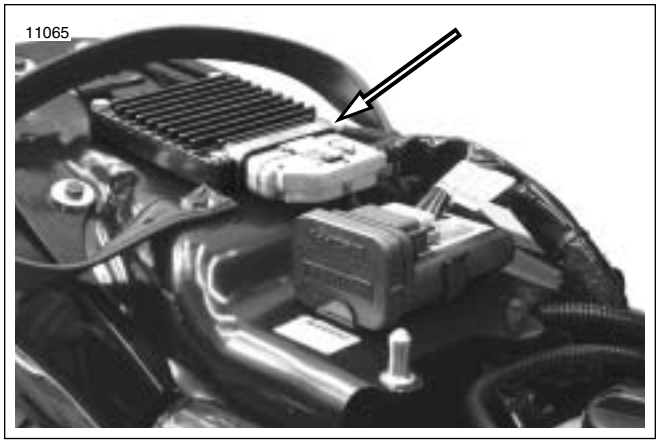
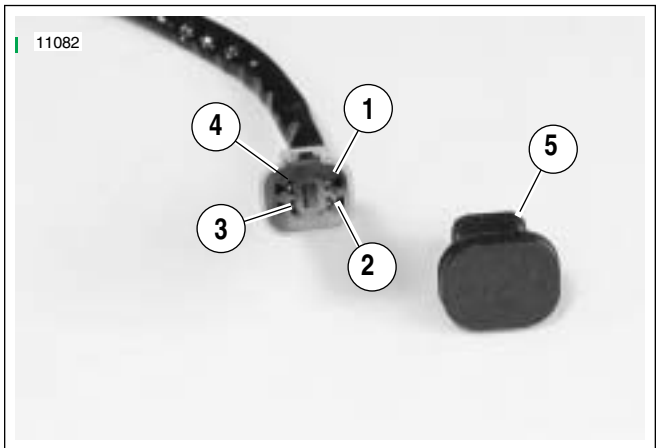


Figure 3-33. ECM (VRSCR)



1. **Terminal 1: flash terminal (Lt GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**
5. **Protective cap**

Figure 3-34. Data Connector Terminals

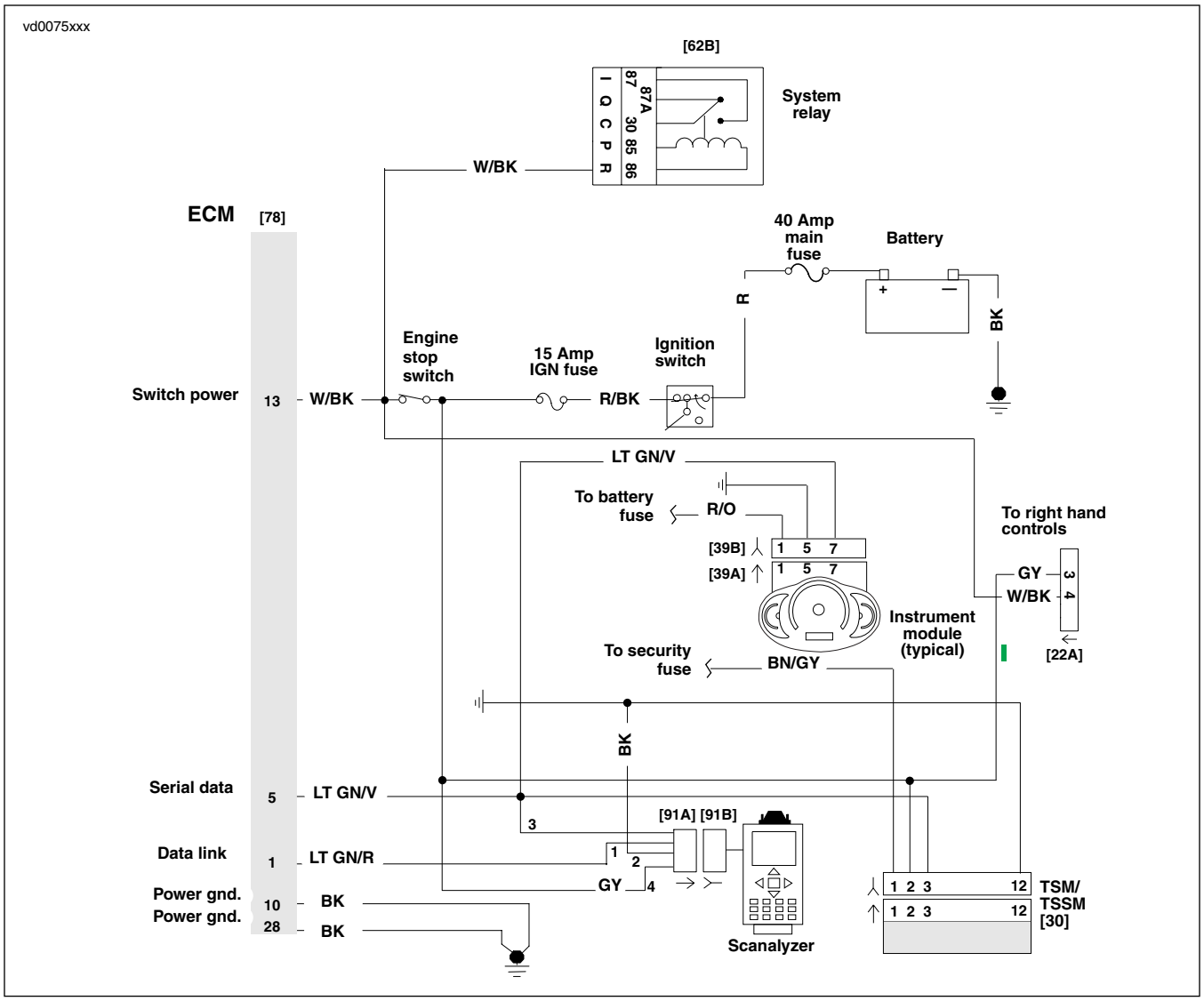


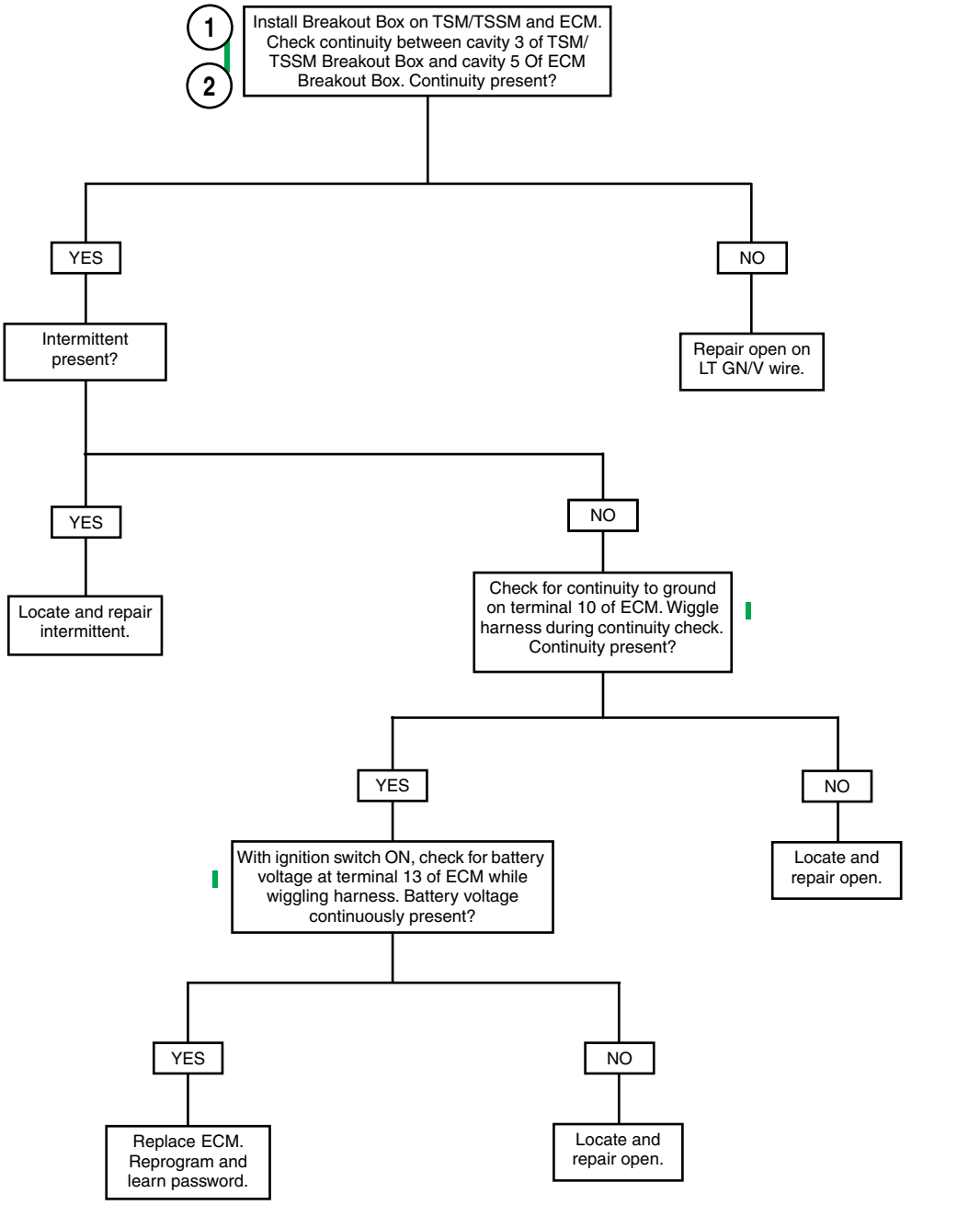
Figure 3-35. ECM and TSM/TSSM Circuit

Table 3-19. Wire Harness Connectors in Figure 3-35.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	Instrument module	12-place Mini-Deutsch	handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91]	Data	4-place Deutsch	under left side cover

Test 3.19

LOSS OF ECM SERIAL DATA: DTC U1016



Clear codes and confirm proper operation with no check engine lamp.

DTC U1096, U1255 3.20

GENERAL

Loss of IM Serial Data

The serial data connector provides a means for the IM, ECM and TSM/TSSM to communicate their current status. When all operating parameters on the serial data link are within specifications, a state of health message is sent between the components. A diagnostic trouble code (DTC) U1096 indicates that the IM is not capable of sending this state of health message.

A DTC U1255 indicates that no messages were present during power up of the current key cycle. A DTC U1016 indicates that there was communication on the data bus since power up, but was lost or interrupted during that key cycle.

Table 3-20. Code Description

DTC	DESCRIPTION
U1096	Loss of all IM serial data (state of health)
U1255	Missing message at IM

DIAGNOSTICS

NOTE

If DTC is historic and not current, wiggle wire harness while performing voltage and continuity tests to identify intermittents.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 3.20 flow chart.

1. Mate gray terminal housing on Breakout Box with TSM/TSSM harness connector [30B]. Leave TSSM [30A] disconnected.
2. Mate black terminal housing on Breakout Box with harness connector [39B] using INSTRUMENT HARNESS ADAPTERS (Part No. HD-46601). Leave speedometer [39A] disconnected.

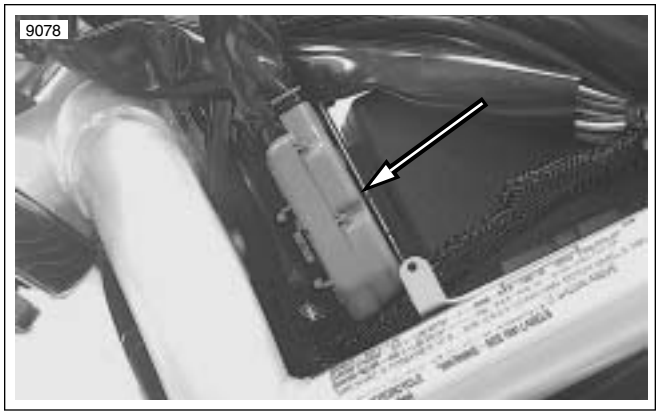


Figure 3-36. ECM (VRSCA/VRSCD)

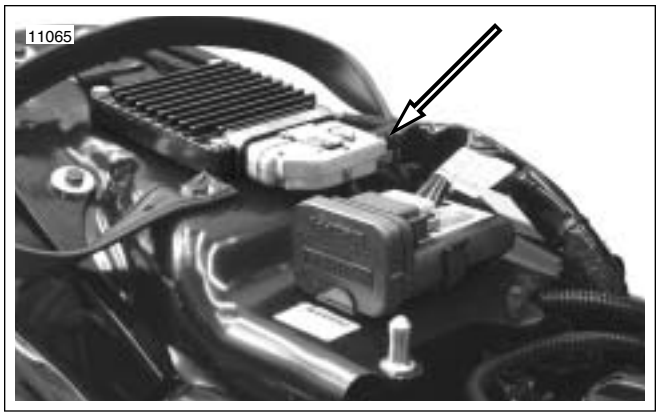
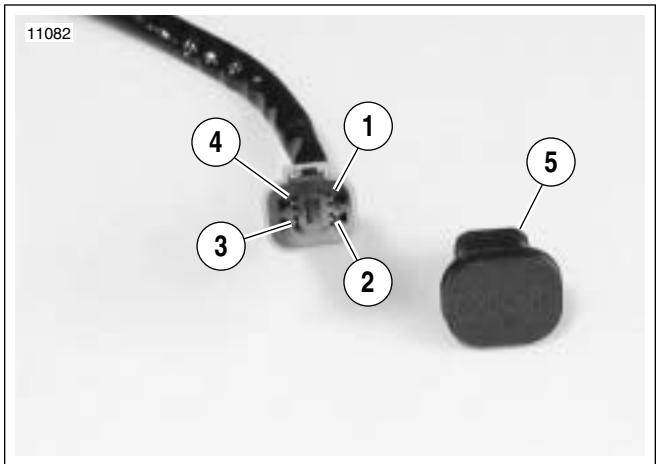


Figure 3-37. ECM Connector



1. **Terminal 1: flash terminal (Lt GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**

Figure 3-38. Data Connector Terminals

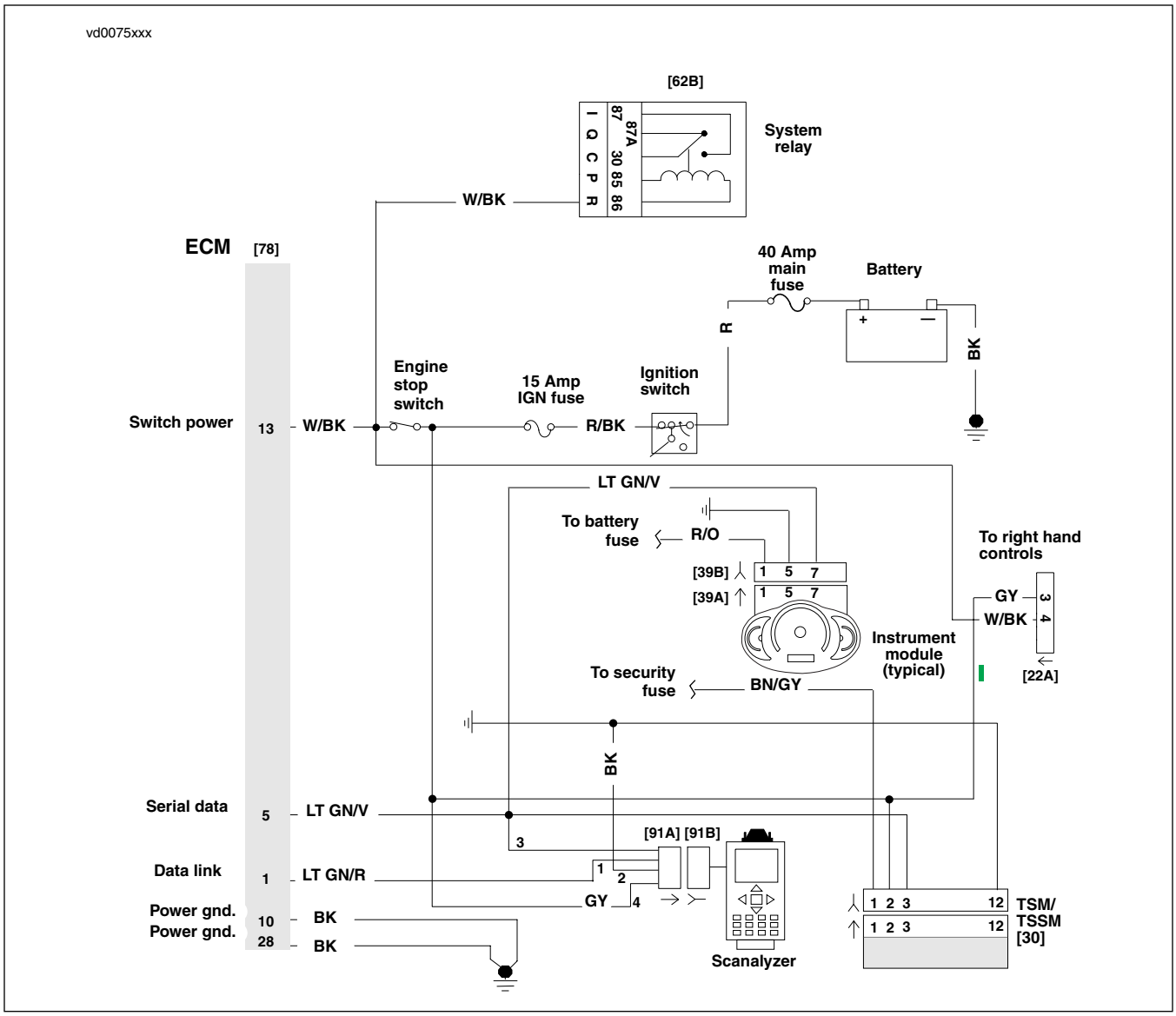


Figure 3-39. IM, ECM and TSM/TSSM Circuit

Table 3-21. Wire Harness Connectors in Figure 3-39.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	Instrument module	12-place Mini-Deutsch	handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91]	Data	4-place Deutsch	under left side cover

Test 3.20

LOSS OF IM SERIAL DATA: DTC U1096, U1255

IMPORTANT:
Always start from 3.10 INITIAL DIAGNOSTIC CHECK: TSM/TSSM

1. Install Breakout Box on IM and TSSM. Check continuity between cavity 7 (Black) of IM Breakout Box and cavity 3 (Gray) Of TSSM Breakout Box. Continuity present?
   - YES
     - Intermittent present?
       - YES
         - Locate and repair intermittent.
       - NO
         - Check for continuity to ground on terminal 5 of IM. Wiggle harness during continuity check. Continuity present?
           - YES
             - Check for battery voltage at terminal 1 of IM while wiggling harness. Battery voltage continuously present?
               - YES
                 - Replace IM.
               - NO
                 - Locate and repair open.
           - NO
             - Locate and repair open.
   - NO
     - Repair open on LT GN/V wire.

Clear codes and confirm proper operation with no check engine lamp.

DTC U1300, U1301 OR “BUS ER” 3.21

GENERAL

Serial Data Low or Serial Data Open/High

See Figure 3-40. The typical serial data voltage range is 0 volts (inactive) to 7 volts (active). Due to the short pulse, voltages will be much lower on a DVOM. In analog mode, a DVOM reading serial data will show continuous voltage when active, typically 0.6-0.8 volts. The range for acceptable operations is 0-7.0 volts.

Table 3-22. Code Description

DTC	DESCRIPTION
U1300	Serial data low
U1301	Serial data open/high

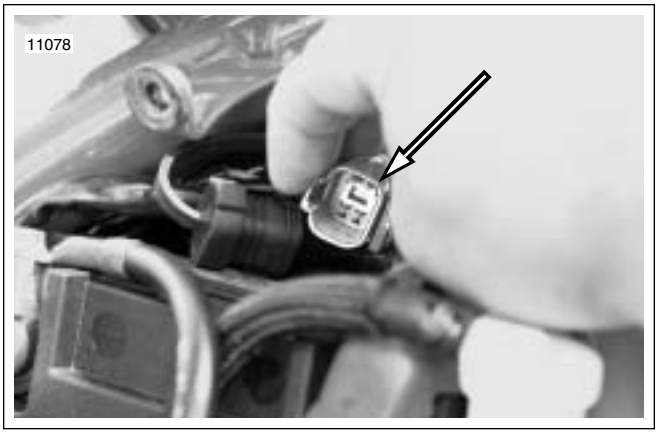


Figure 3-40. Data Link Connector [91A]

DIAGNOSTICS

Diagnostic Tips

- If serial data is shorted, these diagnostic trouble codes (DTCs) will automatically cause the check engine lamp to illuminate. The odometer will read “Bus Er” in this condition.
- Diagnostic trouble codes P1009 and P1010 may accompany DTCs U1300 and U1301.

Diagnostic Notes

If a U1300, U1301 or “BUS Er” is present, perform diagnostic procedures listed in 4.12 STARTS, THEN STALLS.

PASSWORD LEARN 3.22

GENERAL

If the ECM or TSM/TSSM is faulty, follow the instructions in the VRSC Service Manual for ECM or TSM/TSSM replacement. Then, to determine if password learn is necessary, refer to Table 3-23.

Table 3-23. Password Learning Needed?

PART REPLACED	PASSWORD LEARNING NEEDED
TSM (no security)	No*
TSSM (security)	Yes
Instrument module	No
ECM	Yes

* If a TSM has been replaced by a TSSM, or a TSSM has been replaced by a TSM, password learn **is** necessary.

PASSWORD LEARNING

Using Scanalyzer

Refer to Table 3-24. Use the information in this table and a SCANALYZER (Part No. HD-41325) with CARTRIDGE (Part No. HD-41325-95C) and CABLE (Part No. HD-42921A) to mate the TSM/TSSM and ECM after replacement. When finished, continue with all instructions under 3.3 TSM/TSSM VEHICLE DELIVERY.

Without Scanalyzer

If a Scanalyzer is not available, refer to Table 3-25. When finished, continue with all instructions under 3.3 TSM/TSSM VEHICLE DELIVERY.

NOTE

Do not forget to enter a personal code for TSSM vehicles. If a code is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.

Table 3-24. Setting TSM/TSSM and ECM Password Using Scanalyzer

No.	Action	Confirmation	Notes
	Before beginning, the Scanalyzer should not be connected and the ignition must be turned off for at least 15 seconds.	With ignition turned off, Check Engine Lamp and Security Lamp will be off. If Security Lamp is illuminated, cycle IGN switch **ON-OFF**.	V-Rod Security Lamp is active with either TSM or TSSM.
1	Install new TSM/TSSM or ECM. If vehicle has EFI, continue with Step 2. If vehicle is carbureted, Password Learn is not required. Perform all steps under 3.3 TSM/TSSM VEHICLE DELIVERY.		
2	Set **Run/Off** switch to **Run**		
3	Turn **IGN** key **On**	Verify Check Engine Lamp and Security Lamp illuminate then turn off.	TSM/TSSM enables starter relay.
4	Attempt normal start one time.	Engine starts and stalls. Check Engine Lamp illuminates and stays on.	Password has not been learned. ECM sets DTC P1009. Fuel flow is stopped.
5	Wait ten seconds. Then begin 10 minute countdown cycle for TSM replacement.	Security Lamp illuminates.	ECM enters Password Learning mode for ten minutes. Do not cycle ignition switch or interrupt vehicle power or Password Learn will be unsuccessful.
6	Connect Scanalyzer to connector [91A]. After Scanalyzer initializes, verify ECM and TSSM part numbers using System ID. Check for diagnostic trouble codes. Verify that ECM set DTC P1009. Return to main menu and select menu item 7 (calibrations) then select menu item 2 (module replacement). **Do not press Enter.**		
7	Wait until Security Lamp turns off or a minimum of ten minutes has passed.		
8	Press **Enter** on Scanalyzer key pad. Wait 5 seconds.		
9	Turn ignition switch **OFF**. **Wait 15 seconds before turning Ignition on**. Turn ignition switch **ON** and start engine to confirm successful Password Learn procedure. Clear diagnostic trouble codes.		
10	Perform all steps under 3.3 TSM/TSSM VEHICLE DELIVERY.		

Table 3-25. Setting TSM/TSSM and ECM Password Without Scanalyzer

NO.	ACTION	CONFIRMATION	NOTES
1	Install **new** TSM/TSSM or ECM. If vehicle has fuel injection, continue with step 2. If vehicle does not have fuel injection, perform all steps under 3.3 TSM/TSSM VEHICLE DELIVERY.		
2	Set **Run/Off** switch to **Run**		
3	Turn **IGN** key **On**	Verify Check Engine Lamp and Security Lamp illuminate then turn off.	TSM/TSSM enables starter relay.
4	Attempt normal start one time.	Engine starts and stalls. Check Engine Lamp illuminates and stays on.	Password has not been learned. ECM sets DTC P1009. Fuel flow is stopped.
5	Wait ten seconds.	Security Lamp illuminates and stays on models with TSSM.	ECM enters Password Learning mode for ten minutes. Do not cycle ignition switch or interrupt vehicle power or Password Learn will be unsuccessful.
6	Wait until Security Lamp turns off or a minimum of ten minutes has passed.		
7	Quickly (within two seconds) turn **IGN** key OFF-**ON**.	Security Lamp illuminates and stays on models with TSSM.	
8	Wait until Security Lamp turns off or a minimum of ten minutes has passed.		
9	Quickly (within two seconds) turn **IGN** key OFF-**ON**.	Security Lamp illuminates and stays on models with TSSM.	
10	Wait until Security Lamp turns off or a minimum of ten minutes has passed.		
11	Quickly (within two seconds) turn **IGN** key OFF-**ON**.	Security Lamp will illuminate and then turn **off**.	
12	Turn ignition switch **OFF. Wait 15 seconds before turning Ignition on**. Turn ignition switch **ON** and start engine to confirm successful Password Learn procedure. Clear diagnostic trouble codes.		
13	Password learning is complete. Perform all steps under 3.3 TSM/TSSM VEHICLE DELIVERY.		

GENERAL

The TSSM system uses batteries in the key fob and siren. These are the only parts requiring periodic maintenance.

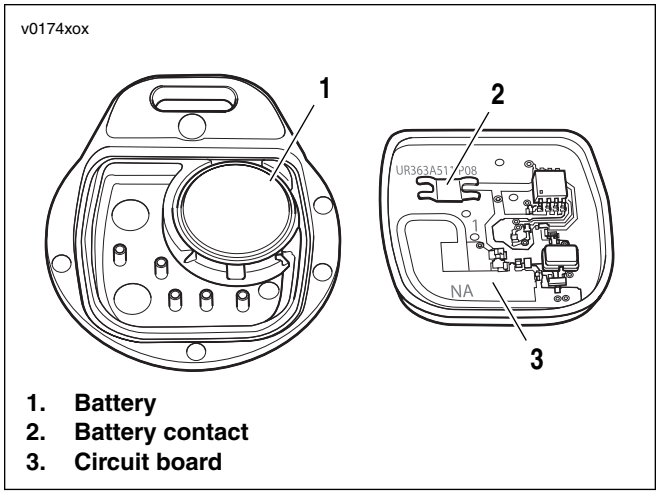
KEY FOB

Schedule

Replace the key fob battery every 2 years.

Battery Replacement

1. Open the key fob case.
   a. Place a thin blade between the 2 halves of the case.
   b. Slowly twist the blade.
2. See Figure 3-41. Replace battery (1).
   a. Remove the original battery.
   b. Install a **new** battery with the positive (+) side down. Use a Panasonic® 2032 or equivalent.
3. See Figure 3-42. Align case and circuit board as shown. Snap case halves together.
4. While standing next to the motorcycle, press and hold the key fob button for 10-15 seconds until the security system responds with two turn signal flashes/siren chirps.



1. **Battery**
2. **Battery contact**
3. **Circuit board**

Figure 3-41. Open Key Fob Case

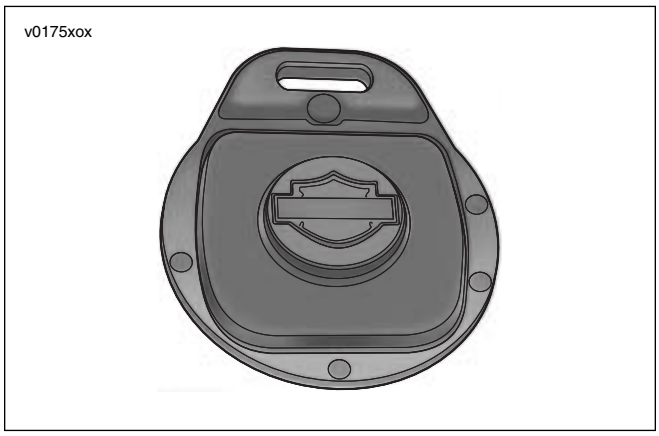


Figure 3-42. Key Fob Assembly

SIREN (IF INSTALLED)

Schedule

The siren's internal 9 volt battery is rechargeable and does not need to be replaced on a regular basis. Battery life under normal conditions is approximately three to six years.

NOTE

The internal siren battery may not charge if the vehicle's battery is less than 12.5 volts.

Battery Replacement

1. Disarm system and remove siren.
2. See Figure 3-43. Remove battery cover (1).
   a. Place the siren module on a flat and sturdy table with the potted section (area with epoxy covering circuit board) facing up and towards you.
   b. Position a knife blade at a 45 degree angle to the long side of the siren case. Insert the knife blade between the siren case and battery cover at one of the two accessible corners of the battery cover. Keep the blade slightly higher towards the battery cover as this helps keep the blade away from the battery seal.
   c. Slowly twist the blade towards the battery cover and the cover will pop off.

NOTE

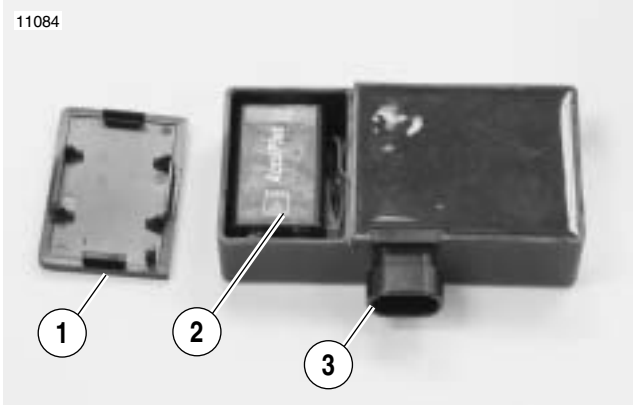
*For protection against corrosion, battery terminals and battery clip are covered with a special grease. Do not wipe away this substance. Apply all available existing grease to terminals on **new** battery.*

3. See Figure 3-44. Replace battery by removing old battery from polarized battery clip. Install a **new** 9 volt nickel metal hydride battery. See VRSC Parts Catalog for correct part number.

NOTE

Only a nickel metal hydride nine-volt battery should be used in the siren.

4. See Figure 3-43. Reinstall battery cover (1).
   a. Carefully replace the rubber seal.
   b. Align battery cover (1) with case placing round corners on cover away from connector [142A]. Snap cover into place.
5. Install siren and check operation. If siren is working properly, it will respond with two chirps after receiving the arm command.



1. **Cover**
2. **Battery**
3. **Connector [142A]**

Figure 3-43. Siren Battery Compartment

Figure 3-44. Siren Battery

NOTES

SUBJECT **PAGE NO.**

ENGINE MANAGEMENT 4

SPECIFICATIONS 4.1

Table 4-1. Spark Specifications

IGNITION	DATA
Idle speed	1150-1250 RPM
Spark plug size	12 mm
Spark plug gap	0.035 in
	0.89 mm
Spark plug type	Harley-Davidson No. 10R12A (no substitute)
Ignition coil primary resistance at room temperature	0.3-0.5 ohms
Ignition coil secondary resistance at room temperature	3500-4500 ohms

Table 4-2. Circuit Breaker/Fuse Specifications

ITEM	RATING (AMPERES)
Main fuse	40
Ignition fuse	15
Lighting fuse	15
Accessory fuse	15
Battery fuse	15
Security fuse	15
ECM power fuse	15
Fuel pump fuse	15

NOTE

The fuse labeled Security provides basic turn signal functionality on vehicles without a factory-installed security system. Do not remove this fuse or use it as a replacement fuse for other systems.

Table 4-3. Charging Specifications

ITEM	DATA
Battery	12 amp hour/200 CCA
Alternator AC voltage output	16-22 VAC per 1000 RPM
Alternator stator coil resistance	0.1-0.3 ohms
Regulator voltage output @ 3600 RPM	14.4-14.6 volts
Regulator amperes @ 3600 RPM	30-35 amps

GENERAL

The engine management system consists of the following components:

- Electronic control module (ECM).
- Crank position sensor (CKP).
- Manifold absolute pressure sensor (MAP).
- Intake air temperature sensor (IAT).
- Engine coolant temperature sensor (ECT).
- Idle air control (IAC).
- Throttle position sensor (TP).
- Vehicle speed sensor (VSS).
- Turn signal module (TSM) or optional factory-installed turn signal security module (TSSM). This includes an integrated bank angle sensor (BAS).
- Fan relay.
- System relay.
- Ignition (plug top) coils.
- Purge solenoid (California models only).

The ECM is mounted ahead of the battery behind the left side cover. It computes the spark advance for proper ignition timing and fuel control based on sensor inputs (from CKP, MAP, IAT and TP sensor) and controls the low-voltage circuits for the ignition coils and injectors. The Scanalyzer can access the data received by and stored in the ECM.

The ECM contains all of the solid state components used in the ignition system. The dwell time for the ignition coil is also calculated in the microprocessor and is dependent upon battery voltage. The programmed dwell is an added feature to give adequate spark at all speeds. (The ECM has added protection against transient voltages, continuous reverse voltage protection, and damage due to jump starts.) The ECM is fully enclosed to protect it from vibration, dust, water or oil. This unit is a non-repairable item. If it fails, it must be replaced.

The crank position sensor (CKP) is located on the left front of the lower crankcase half. The CKP generates an AC signal which is sent to the ECM where it is used to reference engine position (TDC) and speed. It functions by taking readings off the 22 teeth on the alternator rotor (two teeth are missing to establish a reference point).

The MAP sensor is located at the rear intake port. The MAP sensor monitors the intake manifold pressure (vacuum) and sends the information to the ECM where the module adjusts the spark and fuel timing advance curves for optimum performance.

The bank angle sensor is within the TSM/TSSM. If the vehicle lean angle exceeds 45 degrees for one second, the fuel injectors are shut off. Once the sensor is tripped, the motorcycle must be uprighted, turned off and then on again before the engine can be restarted. This is communicated across the data bus.

Front and rear coils fire each spark plug independently (one cylinder at a time - no wasted spark). The coil also has an extra terminal to monitor current on the coil secondary circuit. This is used for knock detection and combustion diagnostics.

The ignition system gives a spark near top dead center for starting. At RPM and loads above this, the system gives a spark advance that varies between 0° and 50°.

The IAT, ECT and TP sensors are used to provide information to the ECM to fine tune spark and fuel delivery. The engine coolant temperature (ECT) sensor also controls the cooling fan relay that provides 12vdc to the fans. The VSS is used as an input for idle speed control.

The purge solenoid (California models only) allows vapors from the charcoal canister to flow to the throttle body. The timing and amount of solenoid opening depends on engine speed, vehicle speed, engine temperature and throttle position.

NOTE

On models not equipped with a purge solenoid, a resistive plug (Part No. 72529-01) is installed in the purge solenoid connector [95B] to prevent an error message being generated.

TROUBLESHOOTING

See the diagnostic charts that follow for troubleshooting information.

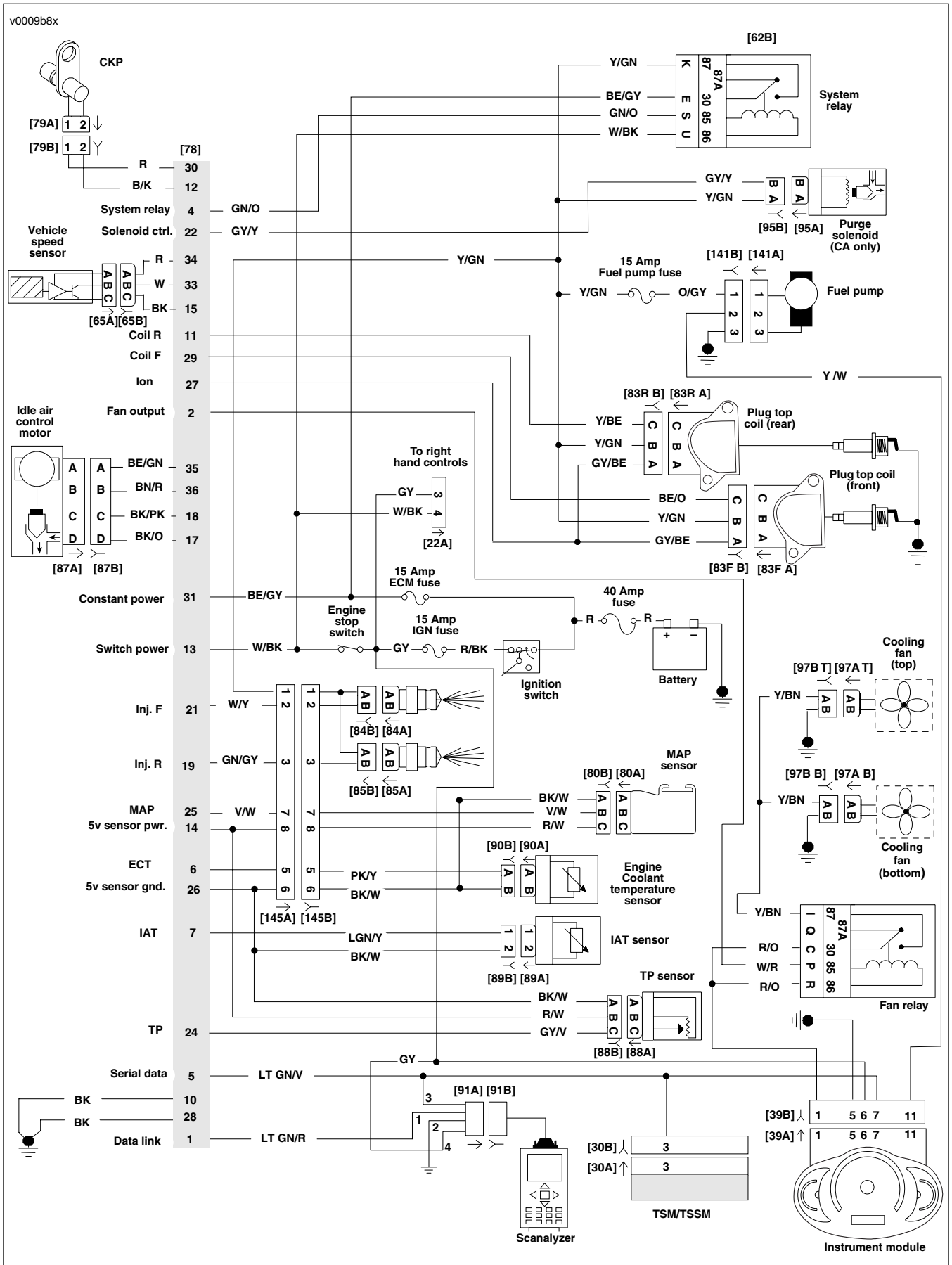


Figure 4-1. EFI System Circuit (VRSCA/VRSCD)

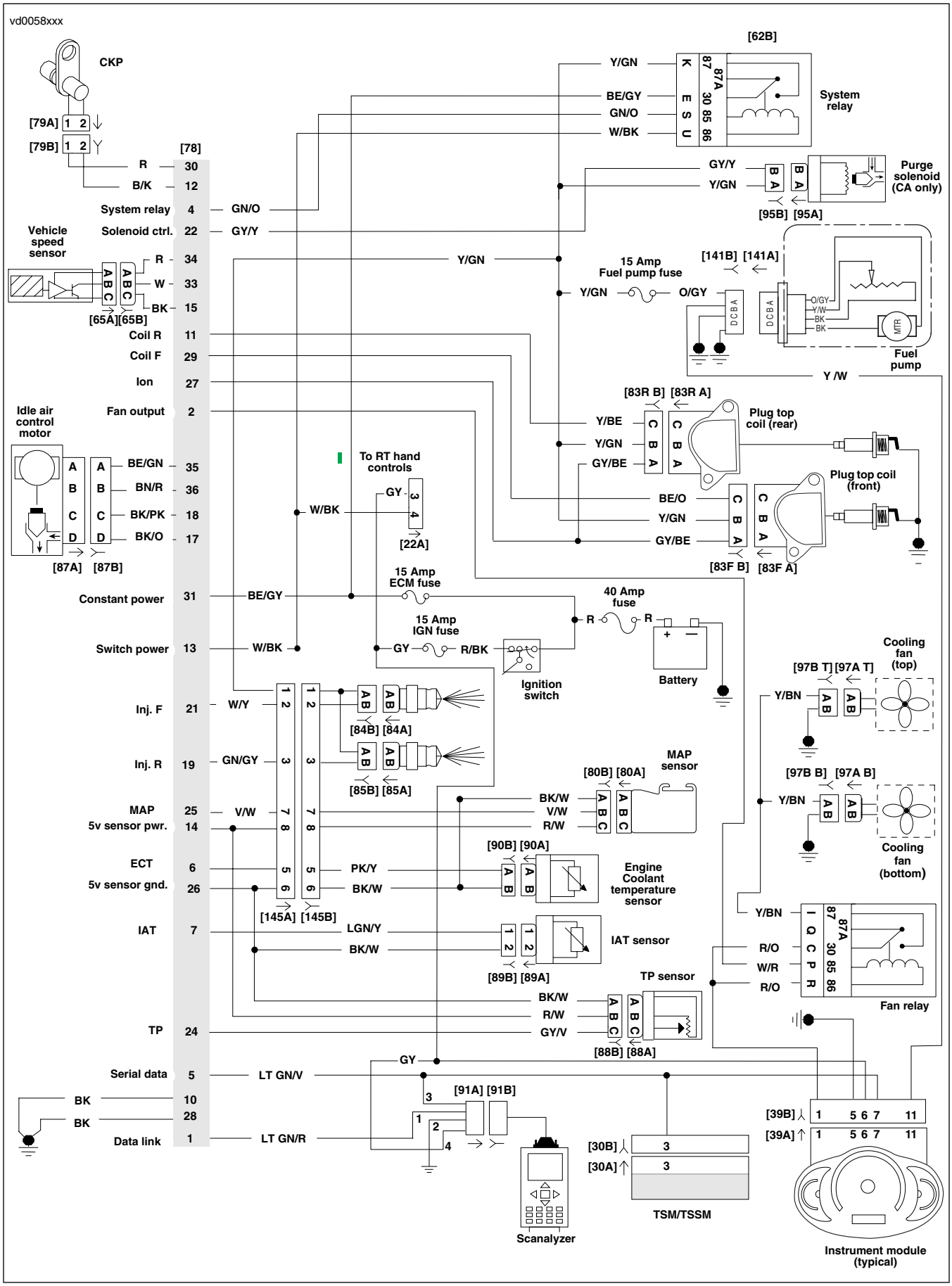


Figure 4-2. EFI System Circuit (VRSCR)

DIAGNOSTIC INTRODUCTION 4.3

SYSTEM PROBLEMS

All system problems fall into at least one of three general categories.

No Start

The engine cranks over freely, but will not start. This does not include situations where the engine will not crank, such as a security disabled starter, dead battery, etc. This condition assumes that all obvious checks (fuel in tank, etc.) have been made.

Poor Performance

The engine starts but there are performance problems. These problems may include poor fuel economy, rough idle, engine misfire, engine hesitation, severe spark knock, etc.

Check Engine Lamp

See Figure 4-3. The check engine lamp indicates the ECM has determined a fault condition exists. There may also be starting or performance problems.

RESOLVING PROBLEMS

To resolve system problems, five basic steps are involved. In order of occurrence, they are:

1. Check for trouble codes by observing check engine lamp. See 4.4 CHECKING FOR TROUBLE CODES.
2. Retrieve trouble codes using SCANALYZER (Part No. HD-41325) or instrument module self diagnostics. See 4.5 SCANALYZER, 4.6 INSTRUMENT MODULE SELF DIAGNOSTICS and Figure 4-4.
3. Diagnose system problems. This involves using special tools and the diagnostic flow charts in this section.
4. Correct problems through the replacement and/or repair of the affected components.
5. After repairs are performed, the work must be validated. This involves clearing the trouble codes and confirming proper vehicle operation as indicated by the behavior of the check engine lamp.

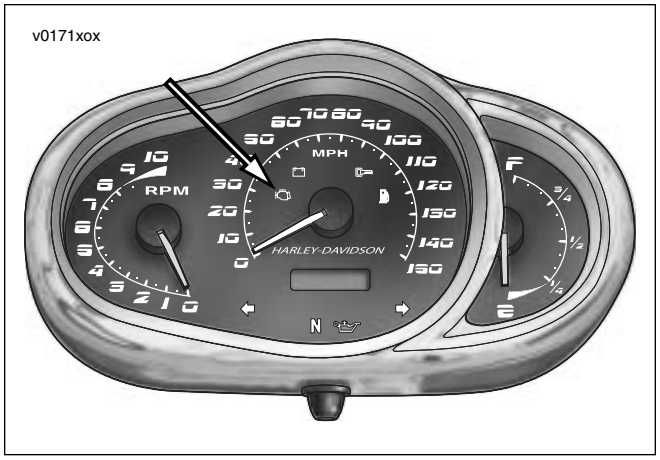


Figure 4-3. Check Engine Lamp (typical) (VRSCR shown)

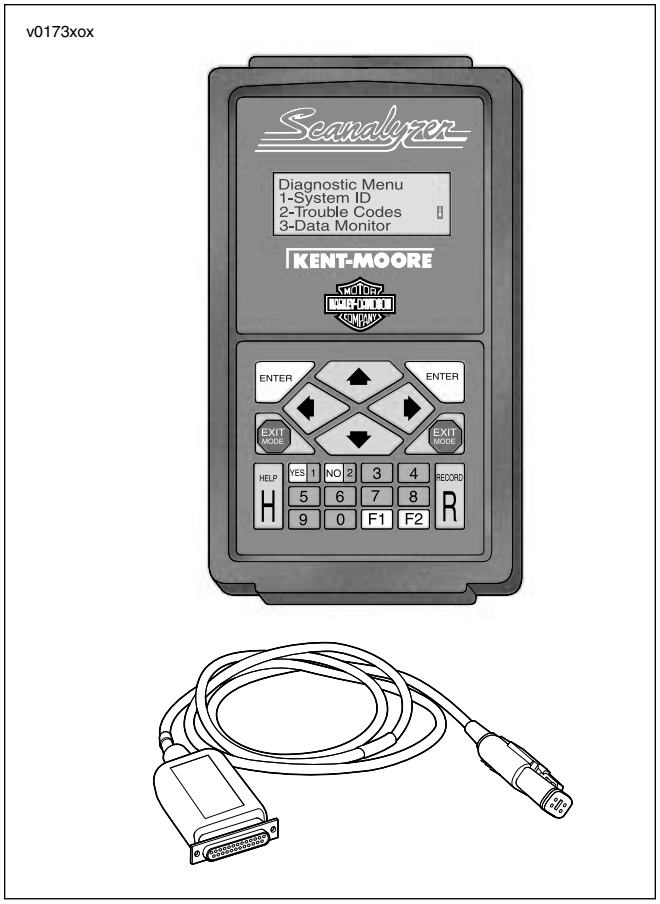


Figure 4-4. Scanalyzer and Cable

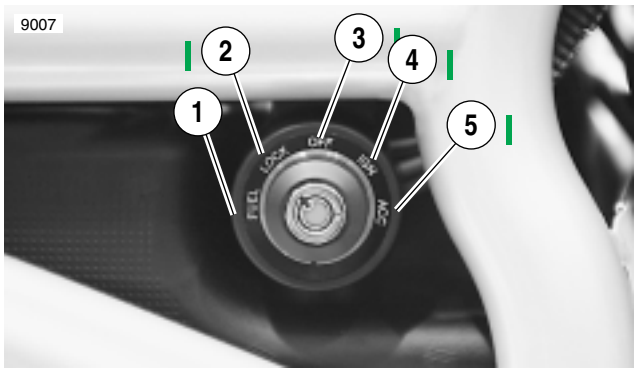
CHECKING FOR TROUBLE CODES 4.4

CHECK ENGINE LAMP

To diagnose system problems, start by observing the behavior of the check engine lamp.

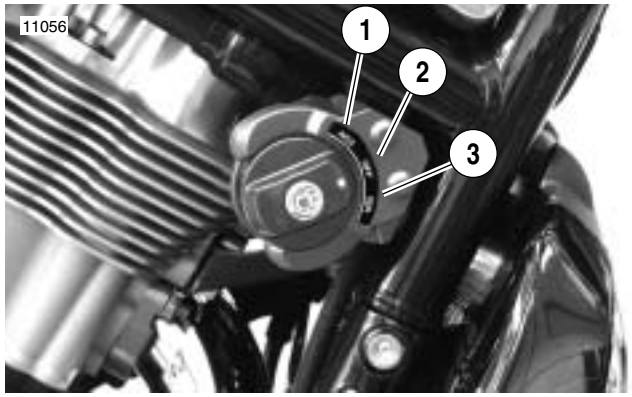
NOTES

- *See Figure 4-5. Ignition Switch (VRSCA/VRSCD) and Figure 4-6. Ignition Switch (VRSCR). "Key ON" means that the ignition key is turned to IGN and the engine stop switch is set to RUN (although the engine is **not** running).*
- *When the ignition key is turned ON, the check engine lamp will illuminate for approximately four seconds and then turn off.*
- *If the check engine lamp is not illuminated at Key ON or if it fails to turn OFF after the initial four second period, then the instrument module may need to be replaced. See 4.6 INSTRUMENT MODULE SELF DIAGNOSTICS.*



1. **Seat release**
2. **LOCK position**
3. **OFF position**
4. **Ignition position**
5. **Accessory position**

Figure 4-5. Ignition Switch (VRSCA/VRSCD)



1. **Accessory position**
2. **OFF position**
3. **Ignition position**

Figure 4-6. Ignition Switch (VRSCR)

1. See Figure 4-7. After lamp turns off after being illuminated for the first four second period, one of three situations may occur.
   a. The lamp remains off. This indicates there are no current fault conditions or stored functional trouble codes currently detected by the ECM.
   b. The lamp stays off for only four seconds and then comes back on for an eight second period. This indicates a code is stored, but no current trouble code exists.
   c. If the lamp remains on beyond the eight second period, then a current trouble code exists.
2. See CODE TYPES which follows for a complete description of trouble code formats.

NOTE

Some trouble codes can only be fully diagnosed during actuation. For example, a problem with the ignition coil will be considered a current fault even after the problem is corrected, since the ECM will not know of its resolution until after the coil is exercised by vehicle start sequence. In this manner, there may sometimes be a false indication of the current trouble code.

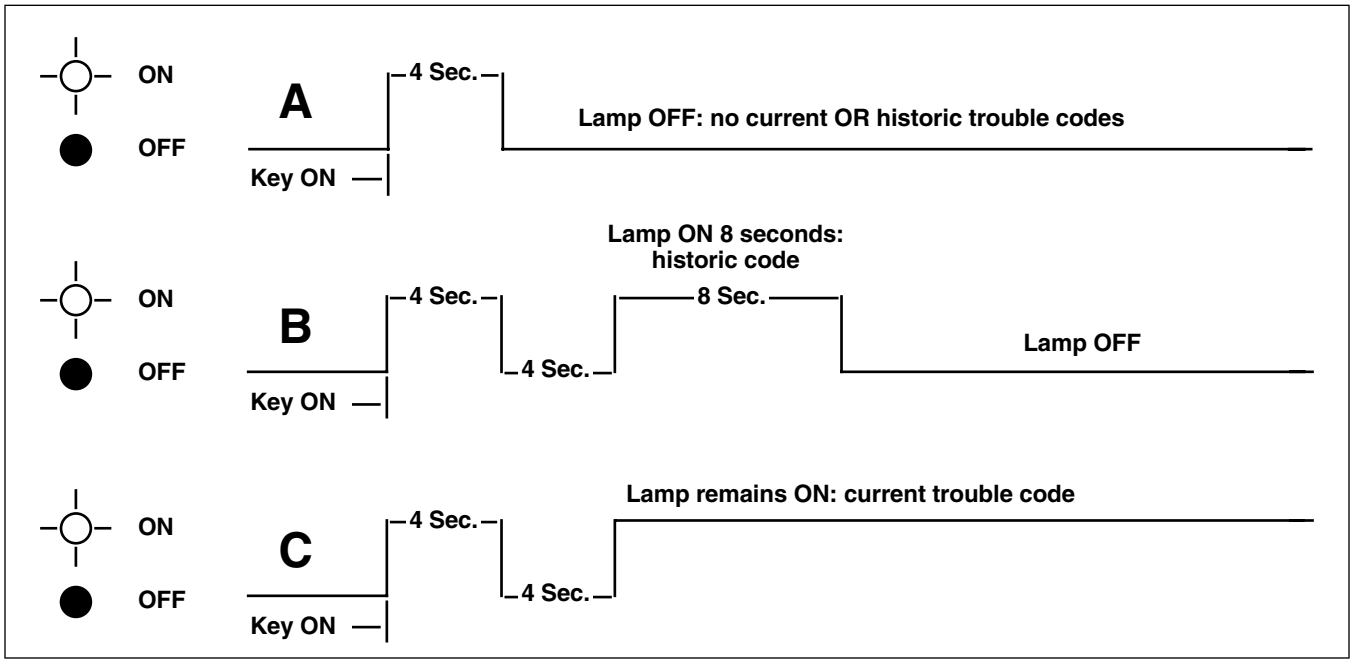


Figure 4-7. Check Engine Lamp Operation

CODE TYPES

There are two types of **diagnostic trouble codes (DTCs):** current and historic. If a trouble code is stored, it can be read using either a Scanalyzer or IM self diagnostics.

All trouble codes reside in the memory of the ECM until the code is cleared by use of the Scanalyzer, instrument module or a total of 50 trips has elapsed. A trip consists of a start and run cycle, the run cycle lasting at least 5 seconds. After the 50 trip retention period, the trouble code is automatically erased from memory providing that no subsequent faults of the same type are detected in that period.

Current

Current trouble codes are those which occur during the present ignition cycle. See the appropriate flow charts for solutions.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic code rather than a current code.

Historic codes are stored for a length of time to assist in the diagnosis of intermittent faults. The check engine lamp will not indicate the existence of only historic codes.

It is important to note that historic codes may also be present whenever the system indicates the existence of a current code. See MULTIPLE TROUBLE CODES if multiple trouble codes are found.

Diagnostic charts are designed for use with current trouble codes and as a result they frequently suggest part replacement. When diagnosing a historic code the charts can be helpful but should not lead to part replacement without verification the part is faulty.

RETRIEVING TROUBLE CODES

The engine management system provides three levels of diagnostics.

- The most sophisticated mode uses a computer based diagnostic package called the DIGITAL TECHNICIAN (Part No. HD-44750-P50 or HD-44750-P29).
- The second mode employs a portable diagnostic tool called a Scanalyzer. This device plugs into the motorcycle wiring harness. It facilitates the diagnosis of system problems through a direct interface with the ECM. See 4.5 SCANALYZER.
- The third mode requires using the instrument module (IM) self diagnostics. IM, TSM/TSSM, and ECM codes can be accessed and cleared. See 4.6 INSTRUMENT MODULE SELF DIAGNOSTICS for more information.

Use of IM self diagnostics assumes that the SCANALYZER (Part No. HD-41325) is not available.

MULTIPLE TROUBLE CODES

While it is possible for more than one fault to occur and set more than one trouble code, there are several conditions which may result in **one** fault setting **multiple** trouble codes:

- The MAP and TP sensors are connected to the same reference line (+5V Vref). If the reference line goes to ground or open, multiple codes will be set (DTC P0107 P0122 and P0501).
- Serial data codes (DTC U1300, U1301, U1016, U1064, U1096 and U1255) may be accompanied by other codes. **Always** correct the serial data codes before resolving the other codes.

Refer to Table 4-8. This table gives most ECM DTCs a priority ranking.

SCANALYZER DIAGNOSTICS

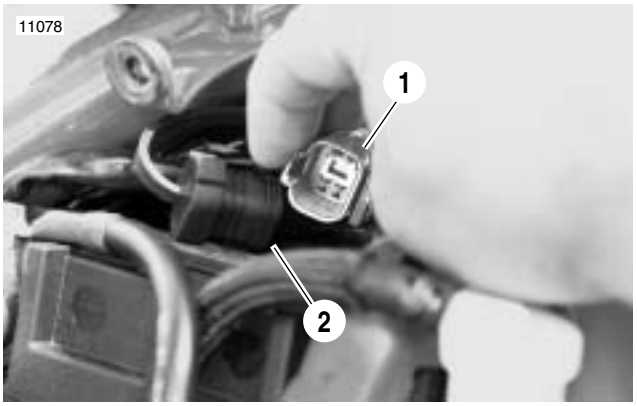
Serial Data Connector

See Figure 4-8. Using the Scanalyzer requires access to the data connector (1). See below for instructions on reaching the data connector.

Scanalyzer Cartridge

See Figure 4-9. Through a special programmable application cartridge, the Scanalyzer offers data displays and menu selections that allow for quick and easy retrieval of data. The device enables the user to perform a variety of diagnostic tests while monitoring inputs and outputs.

Sample Scanalyzer menu selections are shown in Figure 4-10.



1. **Data connector [91A]**
2. **Protective rubber plug**

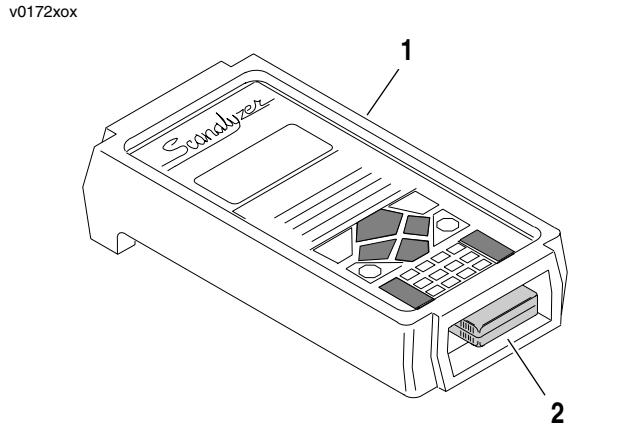
Figure 4-8. Serial Data Connector [91A] (typical)

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-41325	Scanalyzer
HD-41325-95C	Scanalyzer cartridge
HD-42921A	Cable

The behavior of the check engine lamp (4.4 CHECKING FOR TROUBLE CODES) indicates the presence of trouble codes.

1. Turn ignition key OFF.
2. Remove left side cover.
3. See Figure 4-8. Remove rubber protective plug (2) from data connector (1). Plug Scanalyzer into connector.
4. Turn ignition key ON. Set engine stop switch to RUN, but do not start engine.
5. See Figure 4-9. Insert the diagnostic application cartridge (2) into the Scanalyzer (1). During the next few seconds, the Scanalyzer sequences through a series of screens that reflect a power-on self test, the system copyright, and then an attempt at communications with the IM, ECM and turn signal module (TSM) or turn signal security module (TSSM). Once communication is established between the modules, the diagnostic menu appears. See Figure 4-10.
6. Continue with the instructions listed under USAGE which follows.



1. **Scanalyzer (Part No. HD-41325)**
2. **Cartridge (Part No. HD-41325-95C)**

Figure 4-9. Scanalyzer and Cartridge

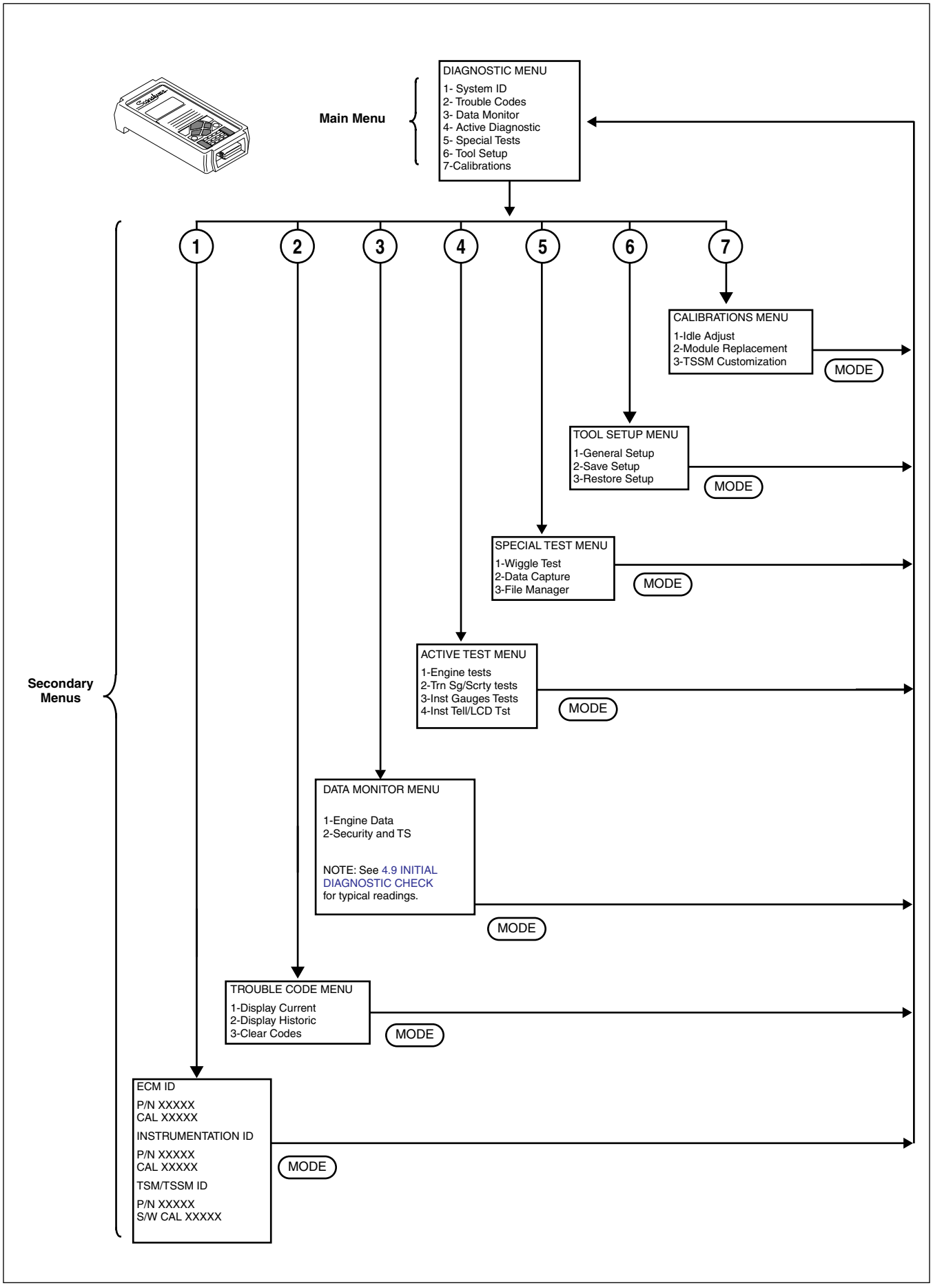


Figure 4-10. Scanalyzer Menus

USAGE

See Figure 4-10. The diagnostic menu is the primary system menu (main menu) through which all other secondary menus and displays are accessed. Since the screen may not be large enough to display all line items at any given time, use the up and down arrow keys to scroll through the list.

Checking Codes

1. See Figure 4-11. From the diagnostic menu, press number “2” to access the trouble codes menu. At this point, the unit allows the operator to:
   a. Press number “1” to display current trouble codes.
   b. Press number “2” to display historic trouble codes.
   c. Press number “3” to clear trouble codes. See Clearing Codes below.
2. When examining trouble codes, write down all codes on a piece of paper. If a current trouble code exists, place it at the top of the list.
   a. If trouble codes are present, refer to Table 4-8. Follow the applicable flow charts for each code.
   b. If trouble codes are NOT present, but starting or driveability problems are evident, see symptoms charts under 4.9 INITIAL DIAGNOSTIC CHECK.
   c. After reading current/historic trouble codes, simply press the mode key to return to the trouble codes menu.
3. Press the mode key again to return to the diagnostic menu. In this manner, regardless of where the operator is in the program, the mode key need only be pressed once or twice to return to the main menu.
4. After correcting system problems, clear trouble codes using the trouble codes menu of the scanalyzer.

Clearing Codes

The Scanalyzer allows the operator to clear trouble codes from memory as well as differentiate between current and historic codes.

NOTE

For more detailed instructions, refer to the literature provided with the Scanalyzer.

Figure 4-11. Scanalyzer Diagnostic Menu

REMOVAL

1. Turn ignition key OFF. Set engine stop switch to the OFF position.
2. Unplug Scanalyzer from data connector. Install protective plug connector.
3. Install left side cover.
4. Road test vehicle and observe check engine lamp. Confirm proper operation without the reoccurrence of trouble codes. See 4.4 CHECKING FOR TROUBLE CODES.

INSTRUMENT MODULE SELF DIAGNOSTICS 4.6

GENERAL

The instrument module is capable of displaying and clearing IM, TSM/TSSM, and ECM trouble codes.

DIAGNOSTICS

Diagnostic Tips

- For a quick check of IM function, a “wow” test can be performed. See Figure 4-12. Figure 4-13. Ignition Switch (VRSCA/VRSCD) and Figure 4-14. Ignition Switch (VRSCR) Turn ignition switch to ACC. Background lighting should illuminate, gauge needles should sweep their full range of motion, and indicator lamps controlled by the serial bus (battery, security, coolant temperature and check engine) should illuminate.
- If instrument module fails “wow” test, check for battery, ground and accessory to IM. If any feature in the instrument module is non-functional, see 2.7 NO IM POWER.

Diagnostic Notes

Use of IM self diagnostics assumes that the SCANALYZER (Part No. HD-41325) is not available.

The reference numbers below correlate with the circled numbers in the IM Self Diagnostics (chart)

1. To exit diagnostic mode, turn ignition switch OFF.
2. To clear DTCs for selected module, press instrument module reset switch for more than 5 seconds when code is displayed. This procedure will clear all codes for selected module.

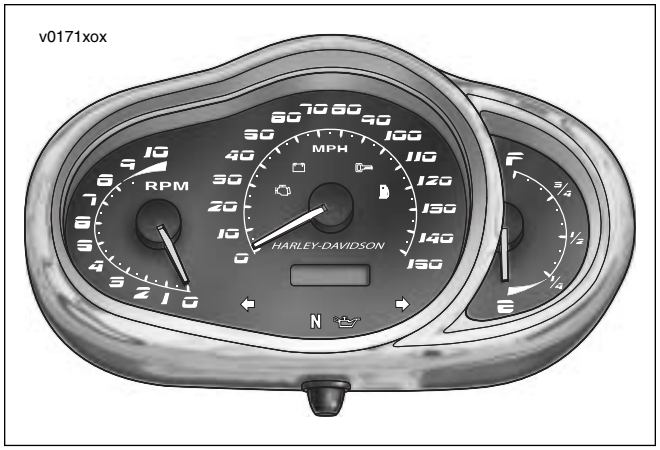
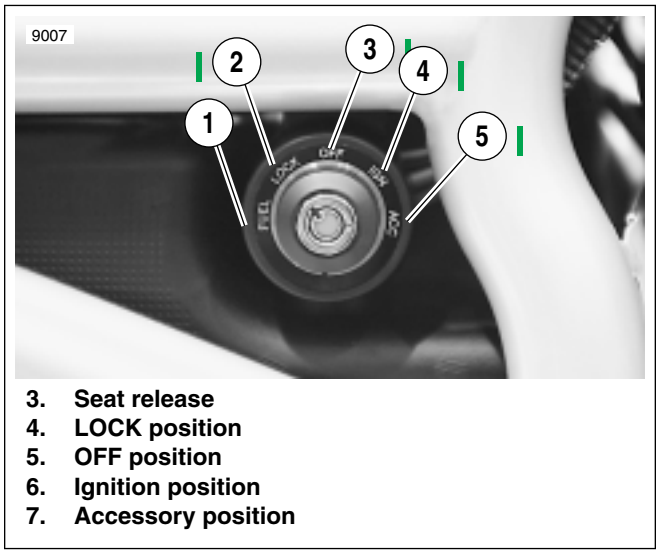
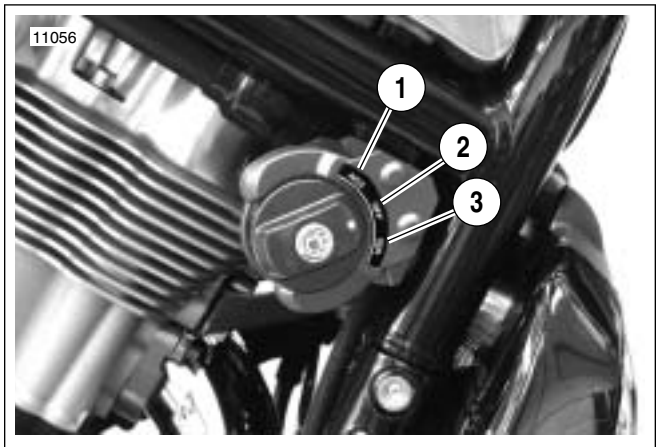


Figure 4-12. Instrument Module (typical) (VRSCR shown)



3. **Seat release**
4. **LOCK position**
5. **OFF position**
6. **Ignition position**
7. **Accessory position**

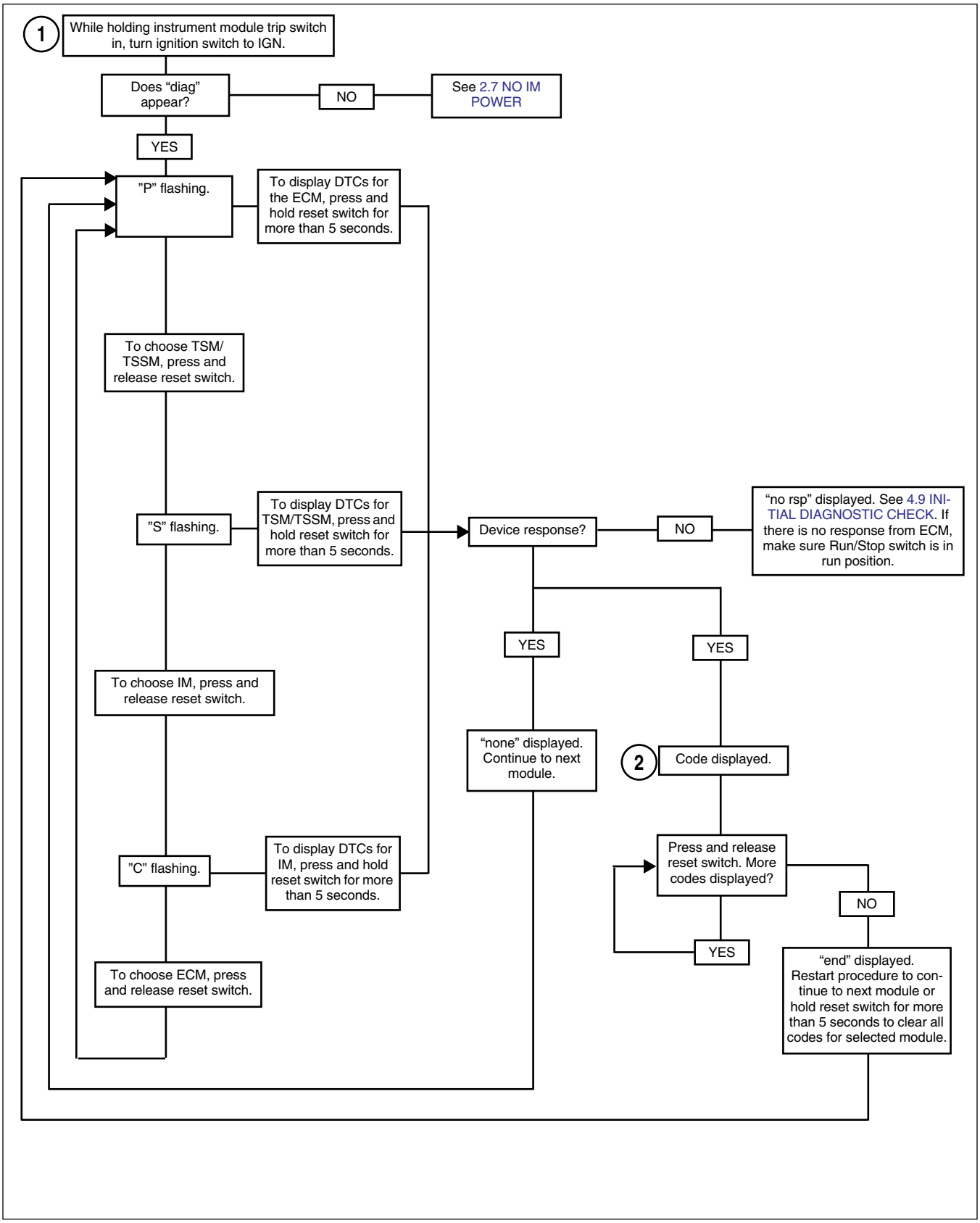
Figure 4-13. Ignition Switch (VRSCA/VRSCD)



1. **Accessory position**
2. **OFF position**
3. **Ignition position**

Figure 4-14. Ignition Switch (VRSCR)

IM Self Diagnostics (chart)



BREAKOUT BOX: ECM 4.7

GENERAL

The BREAKOUT BOX (Part No. HD-43876) connects to the main harness. Used in conjunction with a DVOM, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects

NOTE

See wiring diagrams for ECM terminal functions. ECM is located under passenger seat on VRSCR models.

INSTALLATION

1. Remove passenger seat.
2. See Figure 4-15. ECM (VRSCA/VRSCD) and Figure 4-16. ECM (VRSCR). Depress latch on connector [78B] and disconnect from ECM.
3. See Figure 4-17. Attach Breakout Box (3) by connecting ECM connector (4) to ECM and wiring harness connector (5) to ECM connector removed in previous step.

NOTE

To connect Scanalyzer (2), connect Data link connector (1) to data link on motorcycle.

REMOVAL

1. See Figure 4-17. Depress latch on ECM connection.
2. Detach Breakout Box connector from ECM connector.
3. Detach Breakout Box connector from wiring harness.
4. Reattach ECM connector to wiring harness.
5. Install passenger seat.

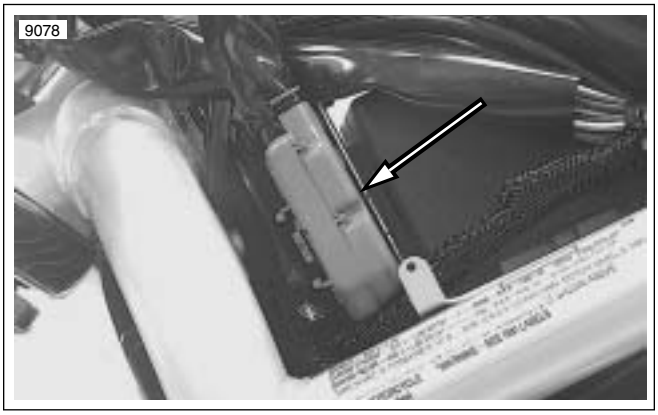
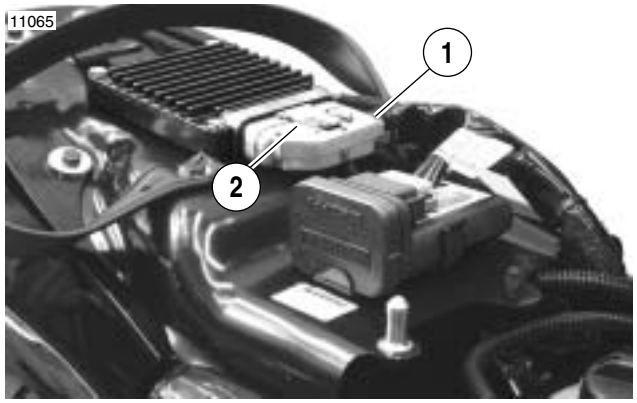
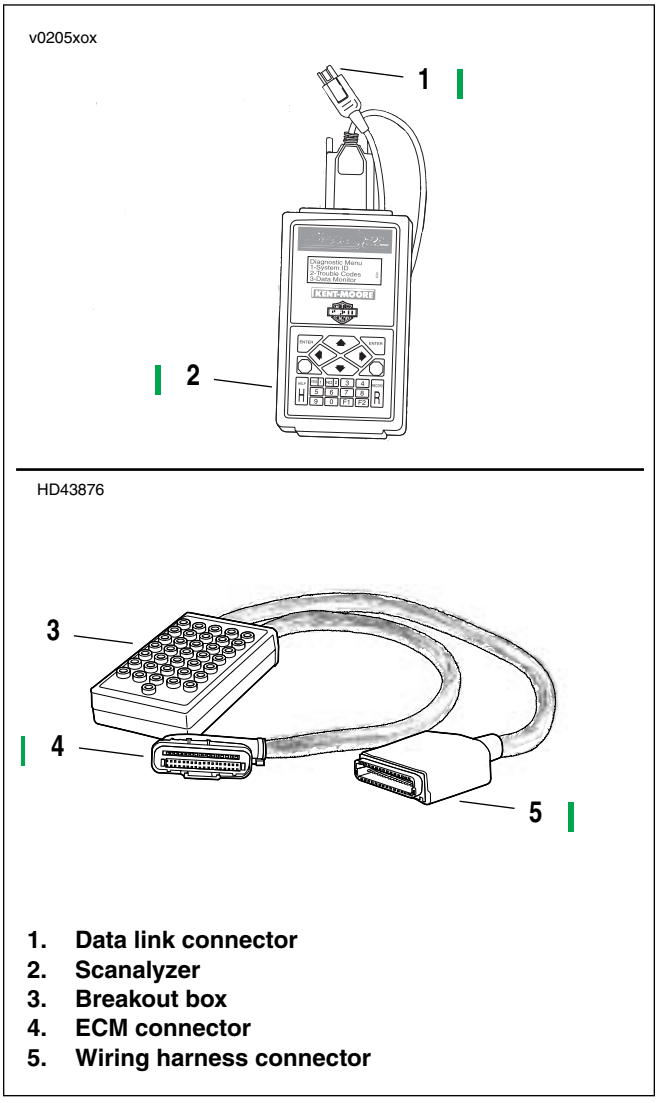


Figure 4-15. ECM (VRSCA/VRSCD)



1. **ECM connector [78B]**
2. **Latch**

Figure 4-16. ECM (VRSCR)



1. **Data link connector**
2. **Scanalyzer**
3. **Breakout box**
4. **ECM connector**
5. **Wiring harness connector**

Figure 4-17. Breakout Box

WIGGLE TEST 4.8

GENERAL

The wiggle test indicates the presence of intermittents in a wiring harness. Depending upon the availability of diagnostic tools, either version of this test may be used.

PROCEDURE

Using Scanalyzer (Part No. HD-41325)

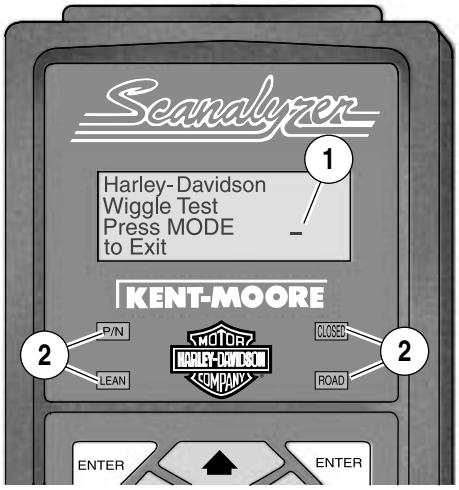
1. Connect Scanalyzer to vehicle. See 4.5 SCANALYZER.
2. Start motorcycle engine and run at idle.
3. Enter wiggle test mode.
   a. Press “5” from the DIAGNOSTIC MENU to enter the SPECIAL TESTS menu.
   b. Press “1” from the SPECIAL TESTS menu to enter the WIGGLE TEST.
4. Shake or wiggle harness to detect intermittents. If intermittents are present the Scanalyzer will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. See Figure 4-18.

NOTE

If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With key ON and engine off, clear trouble codes and then perform wiggle test with vehicle running.

Using DVOM (Part No. HD-39978)

1. See Figure 4-19. Connect DVOM to wiring harness between the suspect connections. When diagnosing ECM connections, use a BREAKOUT BOX (Part No. HD-43876) to simplify the procedure. See 4.7 BREAKOUT BOX: ECM.
2. Set DVOM to read voltage changes.
3. Start motorcycle engine and run at idle.
4. Shake or wiggle harness to detect intermittents. If intermittents are present, radical voltage changes will register on the DVOM.



1. Minus sign
2. Corner LED (4)

Figure 4-18. Wiggle Test Indicators

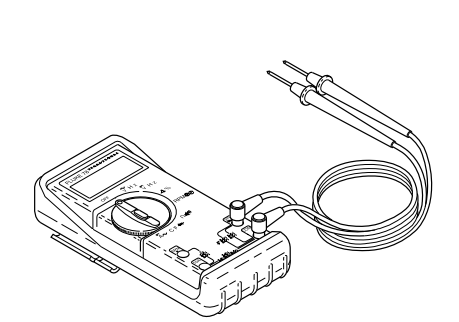


Figure 4-19. Fluke 78 Multimeter (DVOM) (Part No. HD-39978)

INITIAL DIAGNOSTIC CHECK 4.9

GENERAL

To locate faulty circuits or other system problems, follow the diagnostic flow charts in this section. For a systematic approach, always begin with INITIAL DIAGNOSTICS which follows. Read the general information and then work your way through the flow chart box by box.

Diagnostic Notes

If a numbered circle appears adjacent to a flow chart box, then more information is offered in the diagnostic notes. Many diagnostic notes contain supplemental information, descriptions of various diagnostic tools or references to other parts of the manual where information on the location and removal of components may be obtained.

Scanalyzer Icon

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the Scanalyzer notes, which are similar to the diagnostic notes, but are restricted to information on the use of the Scanalyzer. All Scanalyzer notes may be found at the end of the respective flow chart.

Circuit Diagram/Wire Harness Connector Table

When working through a flow chart, refer to the illustrations, the associated circuit diagram and the wire harness connector table as necessary. The wire harness connector table for each circuit diagram identifies the connector number, description, type and general location.

In order to perform most diagnostic routines, a Breakout Box and a DVOM are required. See 4.7 BREAKOUT BOX: ECM.

To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

INITIAL DIAGNOSTICS

General Information

The diagnostic check (see page 4-23) is an organized approach to identifying a problem caused by an electronic control system malfunction. If no problems are found after completion of the diagnostic check, a comparison of Scanalyzer parameters may be used to help locate intermittents and out-of-specification sensors. Refer to Table 4-4.

Diagnostic Tips

- If the Scanalyzer is not working properly, check operation on another vehicle.
- See Figure 4-20. If proper Scanalyzer function is verified, check data connector [91A] for 12 volts (Terminal 4) and proper ground (Terminal 2).
- If Scanalyzer reads “No Response” with the ignition key turned ON (engine stop switch at RUN with the engine off), check data link for an open or short to ground between data connector [91A] Terminal 3 and ECM, IM or TSM/TSSM.
- Check for an open diagnostic test terminal between data Terminal 3 and ECM. With ignition key turned ON, transmit data should be typically 0.6-0.8 volts. The range of acceptable operation is 0-7.0 volts. Scanalyzer should communicate when proper voltage is present.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the diagnostic check flow charts. See page 4-23.

1. Compare engine behavior to symptoms tables.
   a. Starts hard. Refer to Table 4-5.
   b. Hesitates, stumbles, surges, misfires and/or sluggish performance. Refer to Table 4-6.
   c. Engine exhaust emits black smoke or fouls plugs. Refer to Table 4-7.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probes and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 4.7 BREAKOUT BOX: ECM.

All EFI diagnostic codes are listed in Table 4-8.

Other Codes

See 3.10 INITIAL DIAGNOSTIC CHECK: TSM/TSSM for any codes related to the turn signal module (TSM) or turn signal security module (TSSM).

See 2.5 INITIAL DIAGNOSTIC CHECK: IM for any codes related to the instrument module (IM).

Table 4-4. Typical Scan Values for Engine Data

ITEM	MIN. VALUE	MAX. VALUE	HOT IDLE
MAP sensor	10 kPa	104 kPa	9.1-10.6 in. Hg 31-36 kPa
	0 volts	5.1 volts	1.1-1.4 volts
TP sensor	0	100	0%
	0.2 volts	4.8 volts	0.2-0.8 volts
IAC pintle	0	150	20-50 steps
RPM (non-adjustable)	0	9000	1200
ECT sensor	Ambient	302° F (150° C)	208-217° F (98-103° C)
	0 volts	5.1 volts	1.5-1.7 volts
IAT sensor	Ambient	248° F (120° C)	68-120° F (20-49° C)
	0 volts	5.1 volts	2.2-3.7 volts
INJ PW front	0	50 mS	1.6-2.3 mS
INJ PW rear	0	50 mS	1.6-2.3 mS
Advance front	0	50°	8-10°
Advance rear	0	50°	8-10°
VSS	0	136/140**	0 MPH
Battery voltage	10 volts	15 volts	13.4-14.5 volts
ENG RUN	off	run	run
Idle RPM	1200	1600	1200
Purge solenoid	0%	100%	0%
Fan relay	off 208° F (98° C) and lower	on 217° F (103° C) and higher	depends on coolant temperature

NOTE

Hot idle specifications are with stock exhaust, the engine operating at 1200 RPM and an engine temperature of approximately 212° F (100° C). Idle settings are controlled by the ECM and cannot be changed.

Table 4-5. Engine Starts Hard

CAUSE	SOLUTION
Battery discharged	See charging system trouble-shooting in this section.
Spark plugs	4.19 MISFIRE AT IDLE OR UNDER LOAD.
Spark plug boots	4.19 MISFIRE AT IDLE OR UNDER LOAD.
Ignition coil	4.19 MISFIRE AT IDLE OR UNDER LOAD.
Valve sticking	See Section 3 in the VRSC Service Manual.
Water or dirt in fuel system	Drain and refill with fresh fuel.
Loss of battery power to ECM terminal 31*	See 4.11 NO ECM POWER

* Codes will not clear (although they appear to).

** 136 MPH (218.8 KPH) for domestic models using 28 tooth sprocket. 140 MPH (225.3 KPH) for HDI models using 30 tooth sprocket.

Table 4-6. Engine Performance Problems

CAUSE	SOLUTION
Manifold leak (When manifold leak is large enough, IAC will close to 0 and a P0505 DTC will set.)	See VRSC Service Manual, Intake Leak Test. A low IAC count may also indicate an air leak.
MAP sensor plugged or not operating properly	4.21 DTC P0107, P0108.
Water or dirt in fuel system	Drain and refill with fresh fuel.
Spark plugs	4.19 MISFIRE AT IDLE OR UNDER LOAD.
Throttle plate not opening fully	See throttle cable adjustment in the VRSC Service Manual.
Low fuel pressure	4.17 FUEL PRESSURE TEST.
Cooling system fan(s) inoperative	4.16 FAN OPERATION CHECK.

Table 4-7. Engine Exhaust Emits Black Smoke or Fouls Plugs

CAUSE	SOLUTION
Clogged air filter	See AIR CLEANER FILTER in the VRSC Service Manual.
MAP sensor plugged or not operating properly	4.21 DTC P0107, P0108.

Table 4-8. Diagnostic Trouble Codes (DTC) and Fault Conditions

RANKING	DTC	STATUS	FAULT CONDITION	SOLUTION
1	P0605	Current	ECM flash error	4.30 DTC P0603, P0605
2	P0605	Historic	ECM flash error	4.30 DTC P0603, P0605
3	P0603	Current	ECM EEPROM error	4.30 DTC P0603, P0605
4	P0603	Historic	ECM EEPROM error	4.30 DTC P0603, P0605
5	U1300	Current	ECM serial data low	4.12 STARTS, THEN STALLS
6	U1301	Current	ECM serial data open/high	4.12 STARTS, THEN STALLS
7	U1300	Current	TSSM serial data low	4.12 STARTS, THEN STALLS
8	U1301	Current	TSSM serial data open/high	4.12 STARTS, THEN STALLS
9	U1300	Current	IM serial data low	4.12 STARTS, THEN STALLS
10	U1301	Current	IM serial data open/high	4.12 STARTS, THEN STALLS
11	U1064	Current	Loss of TSM/TSSM serial data-at ECM	4.33 DTC U1064, U1255
12	U1016	Current	Loss of all ECM serial data-at TSSM	3.19 DTC U1016, U1255
13	U1096	Current	Loss of IM serial data-at TSSM	3.20 DTC U1096, U1255
14	U1255	Current	Missing response-at TSSM	4.33 DTC U1064, U1255
15	U1064	Current	Loss of TSM/TSSM serial data-at IM	2.16 DTC U1064, U1255
16	U1016	Current	Loss of all ECM serial data-at IM	2.15 DTC U1016
17	U1255	Current	Missing response-at IM	4.34 DTC U1096, U1255
18	P1003	Current	System relay contacts open	4.15 SYSTEM RELAY CHECK
19	P1002	Current	System relay coil high/shorted	4.15 SYSTEM RELAY CHECK
20	P1001	Current	System relay coil open/low	4.15 SYSTEM RELAY CHECK
21	P1004	Current	System relay contacts closed	4.15 SYSTEM RELAY CHECK
22	P1009	Current	Incorrect password	4.31 DTC P1009, P1010
23	P1010	Current	Missing password	4.31 DTC P1009, P1010
24	P0373	Current	CKP sensor intermittent	4.26 DTC P0373, P0374
25	P0374	Current	CKP sensor synch error	4.26 DTC P0373, P0374
26	P0122	Current	TP sensor open/low	4.24 DTC P0122, P0123
27	P0123	Current	TP sensor high	4.24 DTC P0122, P0123
28	P0107	Current	MAP sensor open/low	4.21 DTC P0107, P0108
29	P0108	Current	MAP sensor high	4.21 DTC P0107, P0108
30	P0117	Current	ET sensor voltage low	4.23 DTC P0117, P0118
31	P0118	Current	ET sensor open/high	4.23 DTC P0117, P0118
32	P0112	Current	IAT sensor voltage low	4.22 DTC P0112, P0113
33	P0113	Current	IAT sensor open/high	4.22 DTC P0112, P0113
34	P1351	Current	Front ignition coil open/low	4.32 DTC P1351, P1352, P1354, P1355
35	P1354	Current	Rear ignition coil open/low	4.32 DTC P1351, P1352, P1354, P1355
36	P1352	Current	Front ignition coil high/shorted	4.32 DTC P1351, P1352, P1354, P1355
37	P1355	Current	Rear ignition coil high/shorted	4.32 DTC P1351, P1352, P1354, P1355
38	P1357	Current	Front cylinder combustion intermittent	4.20 COMBUSTION ABSENT/INTERMITTENT
39	P1358	Current	Rear cylinder combustion intermittent	4.20 COMBUSTION ABSENT/INTERMITTENT
40	P0261	Current	Front injector open/low	4.25 DTC P0261, P0262, P0263, P0264
41	P0263	Current	Rear injector open/low	4.25 DTC P0261, P0262, P0263, P0264
42	P0262	Current	Front injector high	4.25 DTC P0261, P0262, P0263, P0264
43	P0264	Current	Rear injector high	4.25 DTC P0261, P0262, P0263, P0264
44	P0562	Current	Battery voltage low	4.29 DTC P0562, P0563
45	P0563	Current	Battery voltage high	4.29 DTC P0562, P0563
46	P0501	Current	VSS sensor low	4.28 DTC P0501, P0502
47	P0502	Current	VSS sensor high	4.28 DTC P0501, P0502

Table 4-8. Diagnostic Trouble Codes (DTC) and Fault Conditions

RANKING	DTC	STATUS	FAULT CONDITION	SOLUTION
48	P1651	Current	Check engine light open/low	4.6 INSTRUMENT MODULE SELF DIAGNOSTICS
49	P1652	Current	Check engine light high	4.6 INSTRUMENT MODULE SELF DIAGNOSTICS
50	P1653	Current	Tachometer low	4.6 INSTRUMENT MODULE SELF DIAGNOSTICS
51	P1654	Current	Tachometer high	4.6 INSTRUMENT MODULE SELF DIAGNOSTICS
52	P1356	Current	Rear cylinder no combustion	4.20 COMBUSTION ABSENT/INTERMITTENT
53	P1353	Current	Front cylinder no combustion	4.20 COMBUSTION ABSENT/INTERMITTENT
54	P0444	Current	Purge control open/low	4.27 DTC P0444, P0445
55	P0445	Current	Purge control high	4.27 DTC P0444, P0445
56	P1481	Current	Fan output open/low	4.16 FAN OPERATION CHECK
57	P1482	Current	Fan output high	4.16 FAN OPERATION CHECK
58	P0505	Current	Loss of idle speed control	4.18 IDLE AIR CONTROL
59	B1135	Current	Accelerometer fault	3.18 DTC B1135
60	B1134	Current	Starter output high	3.17 DTC B1134
61	B1121	Current	Left turn output fault	3.14 TURN SIGNAL ERRORS: DTC B1121, B1122, B1141
62	B1122	Current	Right turn output fault	3.14 TURN SIGNAL ERRORS: DTC B1121, B1122, B1141
63	B0563	Current	Battery voltage high	3.15 DTC B0563
64	B1131	Current	Alarm output low	3.16 DTC B1131, B1132
65	B1132	Current	Alarm output high	3.16 DTC B1131, B1132
66	B1141	Current	Ignition switch open/low	3.14 TURN SIGNAL ERRORS: DTC B1121, B1122, B1141
67	B1003	Current	IM internal fault	2.11 DTC B1003
68	B1004	Current	Fuel sender low	2.12 DTC B1004, B1005
69	B1005	Current	Fuel sender open/high	2.12 DTC B1004, B1005
70	B1006	Current	Accessory line overvoltage	2.13 DTC B1006, B1007
71	B1007	Current	Ignition line overvoltage	2.13 DTC B1006, B1007
72	B1008	Current	Trip switch closed	2.14 DTC B1008
73	U1300	Historic	ECM serial data low	4.12 STARTS, THEN STALLS
74	U1301	Historic	ECM serial data open/high	4.12 STARTS, THEN STALLS
75	U1300	Historic	TSSM serial data low	4.12 STARTS, THEN STALLS
76	U1301	Historic	TSSM serial data open/high	4.12 STARTS, THEN STALLS
77	U1300	Historic	IM serial data low	4.12 STARTS, THEN STALLS
78	U1301	Historic	IM serial data open/high	4.12 STARTS, THEN STALLS
79	U1064	Historic	Loss of TSM/TSSM serial data-at ECM	4.33 DTC U1064, U1255
80	U1016	Historic	Loss of all ECM serial data-at TSSM	3.19 DTC U1016, U1255
81	U1096	Historic	Loss of IM serial data-at TSSM	3.20 DTC U1096, U1255
82	U1255	Historic	Missing response-at TSSM	4.33 DTC U1064, U1255
83	U1064	Historic	Loss of TSM/TSSM serial data-at IM	2.16 DTC U1064, U1255
84	U1016	Historic	Loss of all ECM serial data-at IM	2.15 DTC U1016
85	U1255	Historic	Missing response-at IM	4.34 DTC U1096, U1255
86	P1003	Historic	System relay contacts open	4.15 SYSTEM RELAY CHECK
87	P1002	Historic	System relay coil high/shorted	4.15 SYSTEM RELAY CHECK
88	P1001	Historic	System relay coil open/low	4.15 SYSTEM RELAY CHECK
89	P1004	Historic	System relay contacts closed	4.15 SYSTEM RELAY CHECK
90	P1009	Historic	Incorrect password	4.31 DTC P1009, P1010

Table 4-8. Diagnostic Trouble Codes (DTC) and Fault Conditions

RANKING	DTC	STATUS	FAULT CONDITION	SOLUTION
91	P1010	Historic	Missing password	4.31 DTC P1009, P1010
92	P0373	Historic	CKP sensor intermittent	4.26 DTC P0373, P0374
93	P0374	Historic	CKP sensor synch error	4.26 DTC P0373, P0374
94	P0122	Historic	TP sensor open/low	4.24 DTC P0122, P0123
95	P0123	Historic	TP sensor high	4.24 DTC P0122, P0123
96	P0107	Historic	MAP sensor open/low	4.21 DTC P0107, P0108
97	P0108	Historic	MAP sensor high	4.21 DTC P0107, P0108
98	P0117	Historic	ET sensor voltage low	4.23 DTC P0117, P0118
99	P0118	Historic	ET sensor open/high	4.23 DTC P0117, P0118
100	P0112	Historic	IAT sensor voltage low	4.22 DTC P0112, P0113
101	P0113	Historic	IAT sensor open/high	4.22 DTC P0112, P0113
102	P1351	Historic	Front ignition coil open/low	4.32 DTC P1351, P1352, P1354, P1355
103	P1354	Historic	Rear ignition coil open/low	4.32 DTC P1351, P1352, P1354, P1355
104	P1352	Historic	Front ignition coil high/shorted	4.32 DTC P1351, P1352, P1354, P1355
105	P1355	Historic	Rear ignition coil high/shorted	4.32 DTC P1351, P1352, P1354, P1355
106	P1357	Historic	Front cylinder combustion intermittent	4.20 COMBUSTION ABSENT/INTERMITTENT
107	P1358	Historic	Rear cylinder combustion intermittent	4.20 COMBUSTION ABSENT/INTERMITTENT
108	P0261	Historic	Front injector open/low	4.25 DTC P0261, P0262, P0263, P0264
109	P0263	Historic	Rear injector open/low	4.25 DTC P0261, P0262, P0263, P0264
110	P0262	Historic	Front injector high	4.25 DTC P0261, P0262, P0263, P0264
111	P0264	Historic	Rear injector high	4.25 DTC P0261, P0262, P0263, P0264
112	P0562	Historic	Battery voltage low	4.29 DTC P0562, P0563
113	P0563	Historic	Battery voltage high	4.29 DTC P0562, P0563
114	P0501	Historic	VSS sensor low	4.28 DTC P0501, P0502
115	P0502	Historic	VSS sensor high	4.28 DTC P0501, P0502
116	P1651	Historic	Check engine light open/low	4.6 INSTRUMENT MODULE SELF DIAGNOSTICS
117	P1652	Historic	Check engine light high	4.6 INSTRUMENT MODULE SELF DIAGNOSTICS
118	P1653	Historic	Tachometer low	4.6 INSTRUMENT MODULE SELF DIAGNOSTICS
119	P1654	Historic	Tachometer high	4.6 INSTRUMENT MODULE SELF DIAGNOSTICS
120	P1356	Historic	Rear cylinder no combustion	4.20 COMBUSTION ABSENT/INTERMITTENT
121	P1353	Historic	Front cylinder no combustion	4.20 COMBUSTION ABSENT/INTERMITTENT
122	P0444	Historic	Purge control open/low	4.27 DTC P0444, P0445
123	P0445	Historic	Purge control high	4.27 DTC P0444, P0445
124	P1481	Historic	Fan output open/low	4.16 FAN OPERATION CHECK
125	P1482	Historic	Fan output high	4.16 FAN OPERATION CHECK
126	P0505	Historic	Loss of idle speed control	4.18 IDLE AIR CONTROL
127	B1135	Historic	Accelerometer fault	3.18 DTC B1135
128	B1134	Historic	Starter output high	3.17 DTC B1134

Table 4-8. Diagnostic Trouble Codes (DTC) and Fault Conditions

RANKING	DTC	STATUS	FAULT CONDITION	SOLUTION
129	B1121	Historic	Left turn output fault	3.14 TURN SIGNAL ERRORS: DTC B1121, B1122, B1141
130	B1122	Historic	Right turn output fault	3.14 TURN SIGNAL ERRORS: DTC B1121, B1122, B1141
131	B0563	Historic	Battery voltage high	3.15 DTC B0563
132	B1131	Historic	Alarm output low	3.16 DTC B1131, B1132
133	B1132	Historic	Alarm output high	3.16 DTC B1131, B1132
134	B1141	Historic	Ignition switch open/low	3.14 TURN SIGNAL ERRORS: DTC B1121, B1122, B1141
135	B 1003	Historic	IM internal fault	2.11 DTC B1003
136	B 1004	Historic	Fuel sender low	2.12 DTC B1004, B1005
137	B 1005	Historic	Fuel sender open/high	2.12 DTC B1004, B1005
138	B 1006	Historic	Accessory line overvoltage	2.13 DTC B1006, B1007
139	B 1007	Historic	Ignition line overvoltage	2.13 DTC B1006, B1007
140	B 1008	Historic	Trip switch closed	2.14 DTC B1008

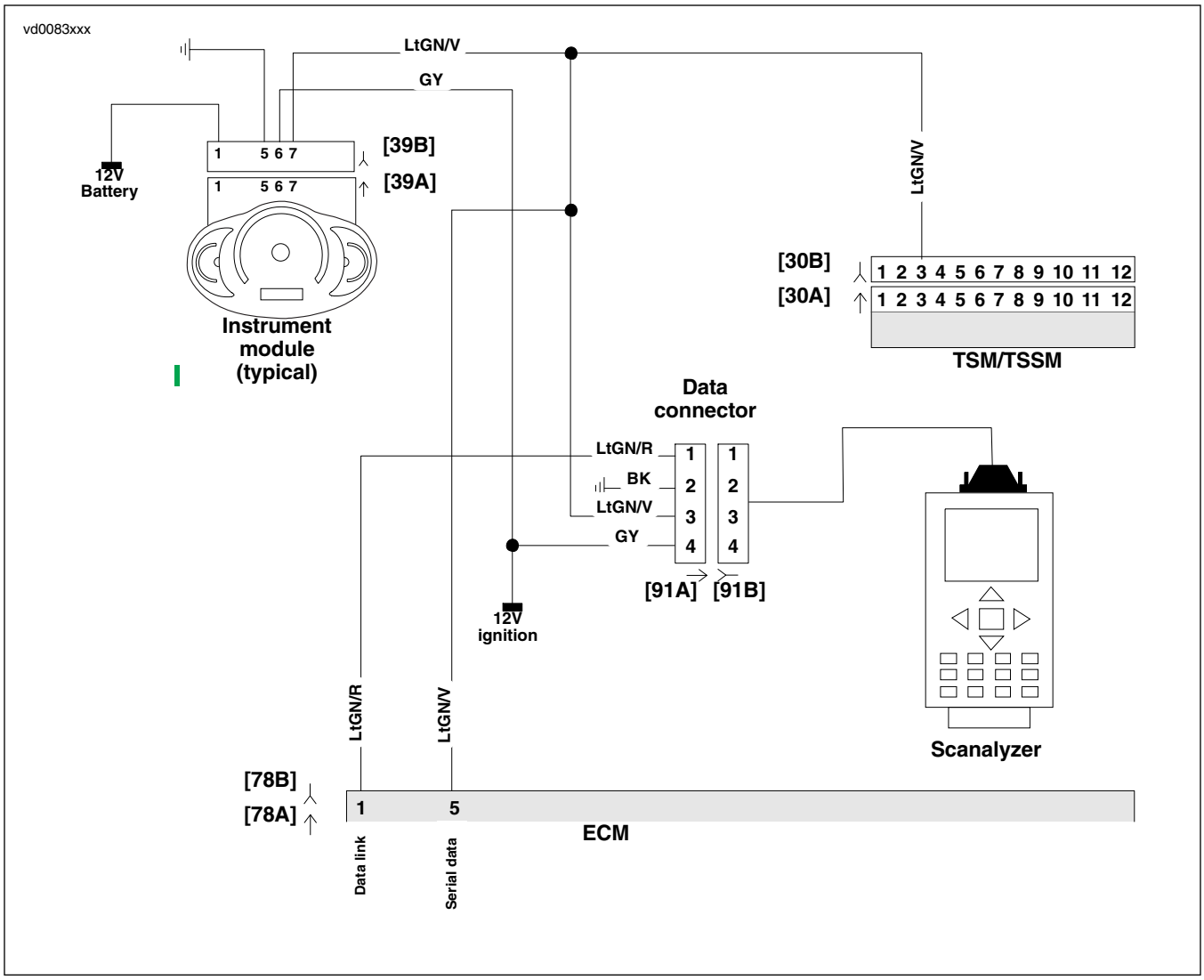
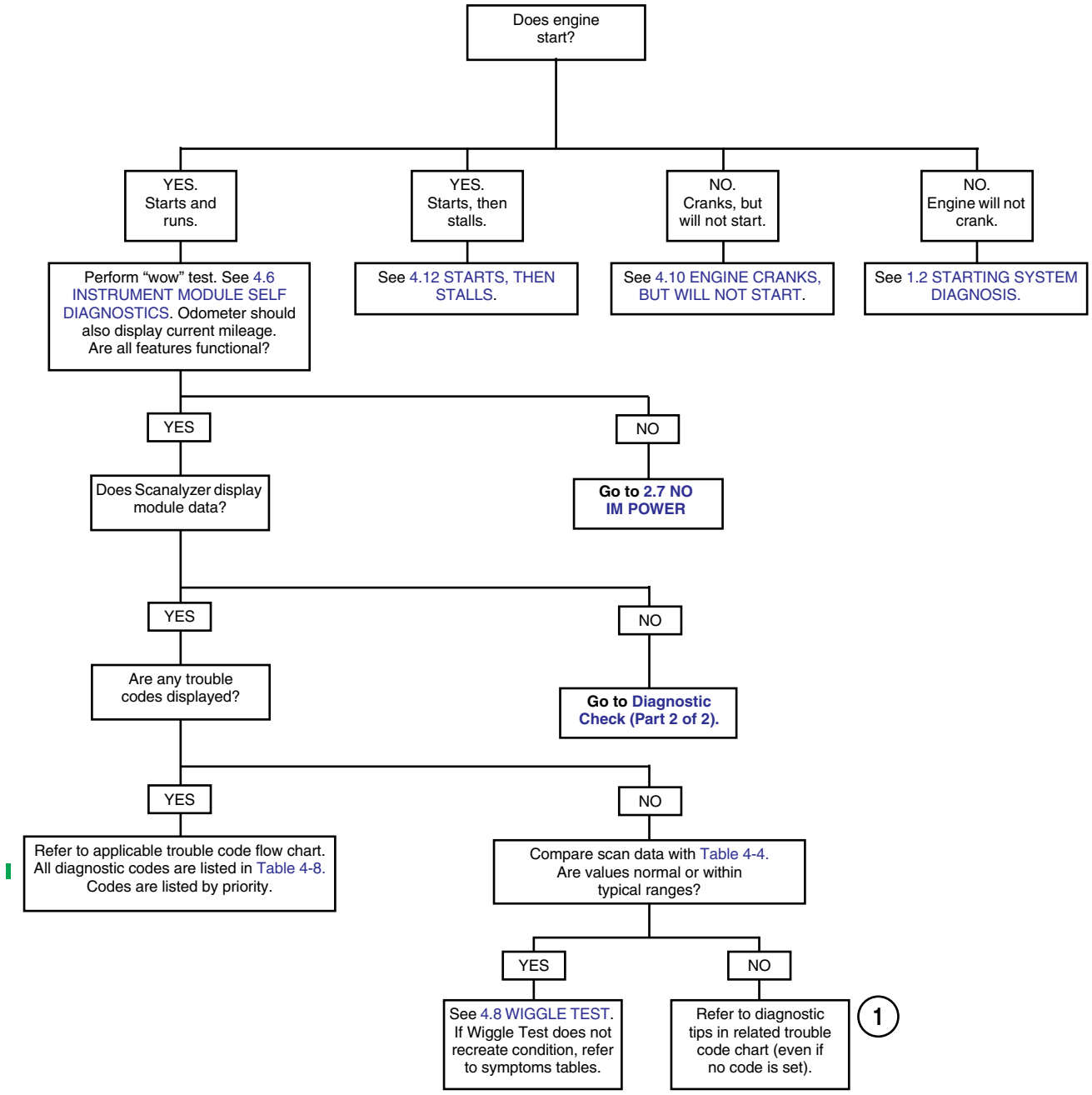


Figure 4-20. Diagnostic Check

Table 4-9. Wire Harness Connectors in Figure 4-20.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	IM	12-place Mini-Deutsch	under handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91A]	Data	4-place Deutsch	under left side cover

Diagnostic Check (Part 1 of 2)



Diagnostic Check (Part 2 of 2)

Continued from Diagnostic Check (Part 1 of 2).

2
3

Test the four data connector terminals for continuity.

DATA TERMINAL		TERMINAL	
No.	Wire Color	No.	Connector
1	Lt. GN/R	1	[78B]
2	BK	28	[78B]
3	Lt. GN/V	5	[78B]
4	GY	GY terminal on left side of ignition fuse	

Continuity present in all four circumstances?

- YES → Check Scanalyzer on another vehicle. Scanalyzer OK?
  - YES → Disconnect ECM at [78]. Does Scanalyzer display IM and TSM/TSSM data.
    - YES → Replace ECM. Reprogram and learn password.
    - NO → 2 Remove TSM/TSSM connector [30]. Check for continuity to ground at data connector [91A] Terminal 3. Continuity to ground?
      - YES → Locate and repair short to ground.
      - NO → Check for voltage at terminal 3 of data connector [91A]. Voltage present?
        - YES → Locate and repair short to voltage.
        - NO → Replace TSM/TSSM. Reprogram and learn password. System OK?
          - YES → System OK.
          - NO → Replace IM.
  - NO → Scanalyzer malfunction.
- NO → Inspect terminals for damage or repair opens as necessary.

Clear codes and confirm proper operation with no check engine lamp.

ENGINE CRANKS, BUT WILL NOT START 4.10

GENERAL

If the starter will not crank the engine, the problem is not EFI related. Refer to SECTION 1-STARTING & CHARGING or SECTION 3-TSM & TSSM.

Instrument module self diagnostics can be used to retrieve trouble codes. See 4.6 INSTRUMENT MODULE SELF DIAGNOSTICS.

DIAGNOSTICS

Diagnostic Tips

Check TP sensor value with Scanalyzer. If TP sensor is greater than 90%, system is in “clear flood” mode and engine will not start. While spark is present, fuel is shut off. Problem can be mechanical, such as stuck throttle cables.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.10 flow charts.

1. Check for DTC’s. See RETRIEVING TROUBLE CODES under 4.4 CHECKING FOR TROUBLE CODES. If Scanalyzer does not communicate and check engine lamp comes back on after 4 second pause, see 4.12 STARTS, THEN STALLS.
2. Check the condition of the battery. Perform a voltage test and recharge if below 12.60V. Check battery connections and perform either a conductance test (using MCR-101 HD Electrical System Analyzer) or load test. Replace the battery if necessary. See BATTERY in the VRSC Service Manual.
3. Typically, when IAC is not functioning, the engine will not start unless throttle is opened and the engine will stall when throttle is closed.
4. See Figure 4-22. Plug IGNITION COIL CIRCUIT TEST ADAPTER (Part No. HD-44687) and FUEL INJECTOR TEST LAMP (Part No. HD-34730-2C) into Breakout Box Terminals 13 and 11. Start engine. If lamp flashes, no problem is found. Repeat for Breakout Box cavities 13 and 29.
5. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probe and patch cord.

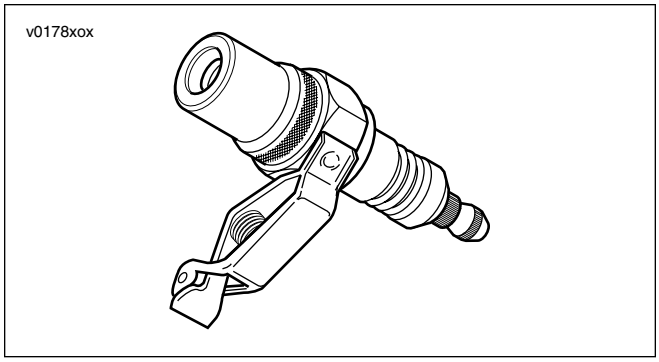


Figure 4-21. Spark Tester

Figure 4-22. Ignition Coil Circuit Test

6. Connect BREAKOUT BOX (Part No. HD-43876). See 4.7 BREAKOUT BOX: ECM.
7. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404) gray terminal probes and patch cords.

⚠WARNING

An open spark can ignite gasoline. Gasoline is extremely flammable and highly explosive which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner.

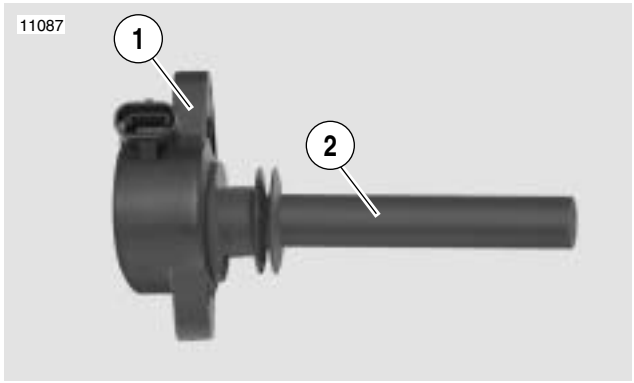
8. Remove both plug top coils and spark plugs.

NOTE

Engine will not spark with both spark plugs removed. When checking for spark, use SPARK TESTER (Part No. HD-26792) with both plugs installed.

   a. Visually check condition of plugs.
   b. Reinstall spark plugs.
   c. See Figure 4-21. Attach plug top coil to SPARK TESTER (Part No. HD-26792). Clip tester to ground.
   d. While cranking engine, look for spark. Repeat procedure on other cylinder.

9. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), brown socket probe and patch cord.



1. **Plug top coil**
2. **Boot**

Figure 4-23. Plug Top Coil

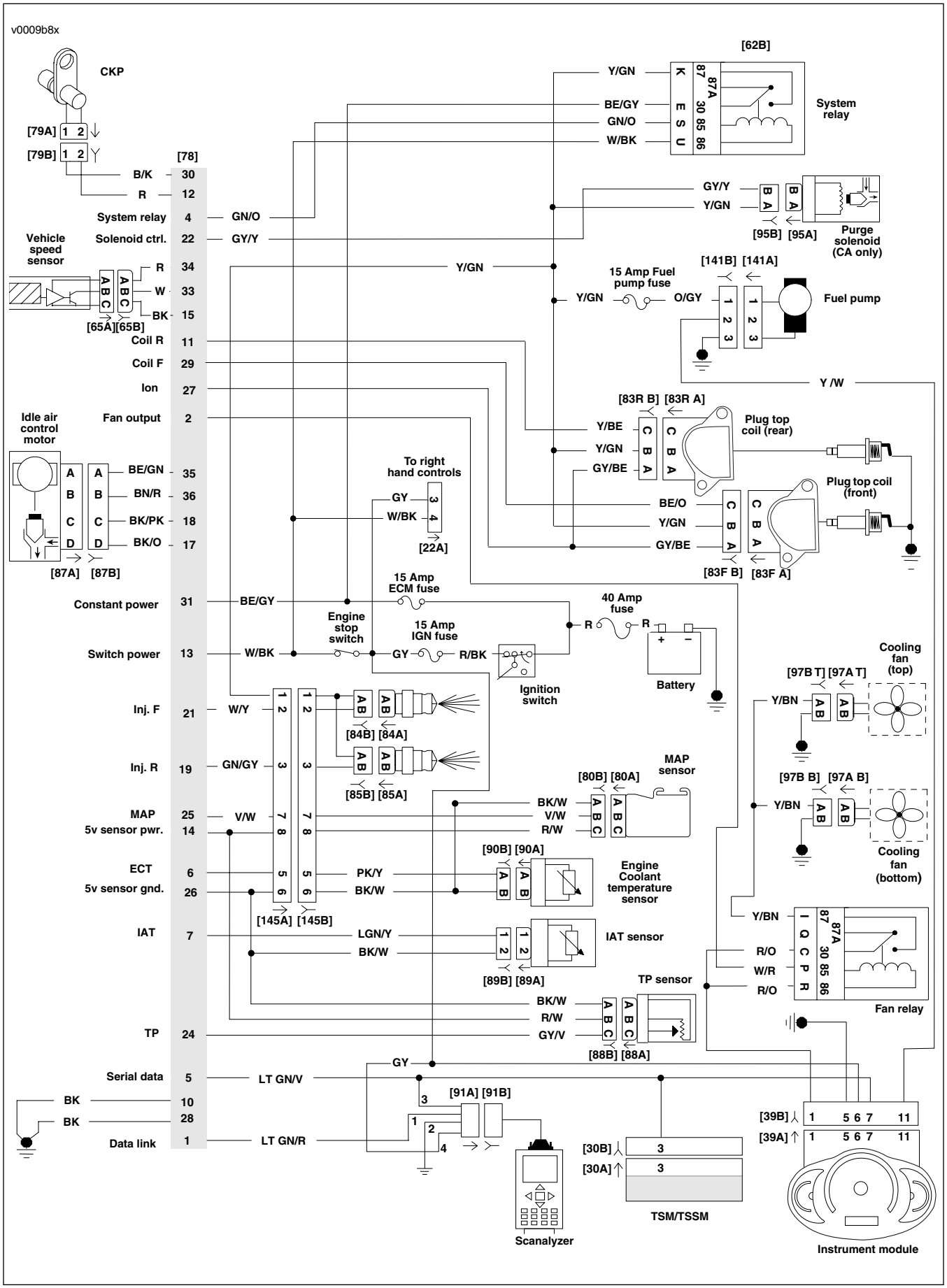


Figure 4-24. EFI Circuit Diagram (VRSCA/VRSCD)

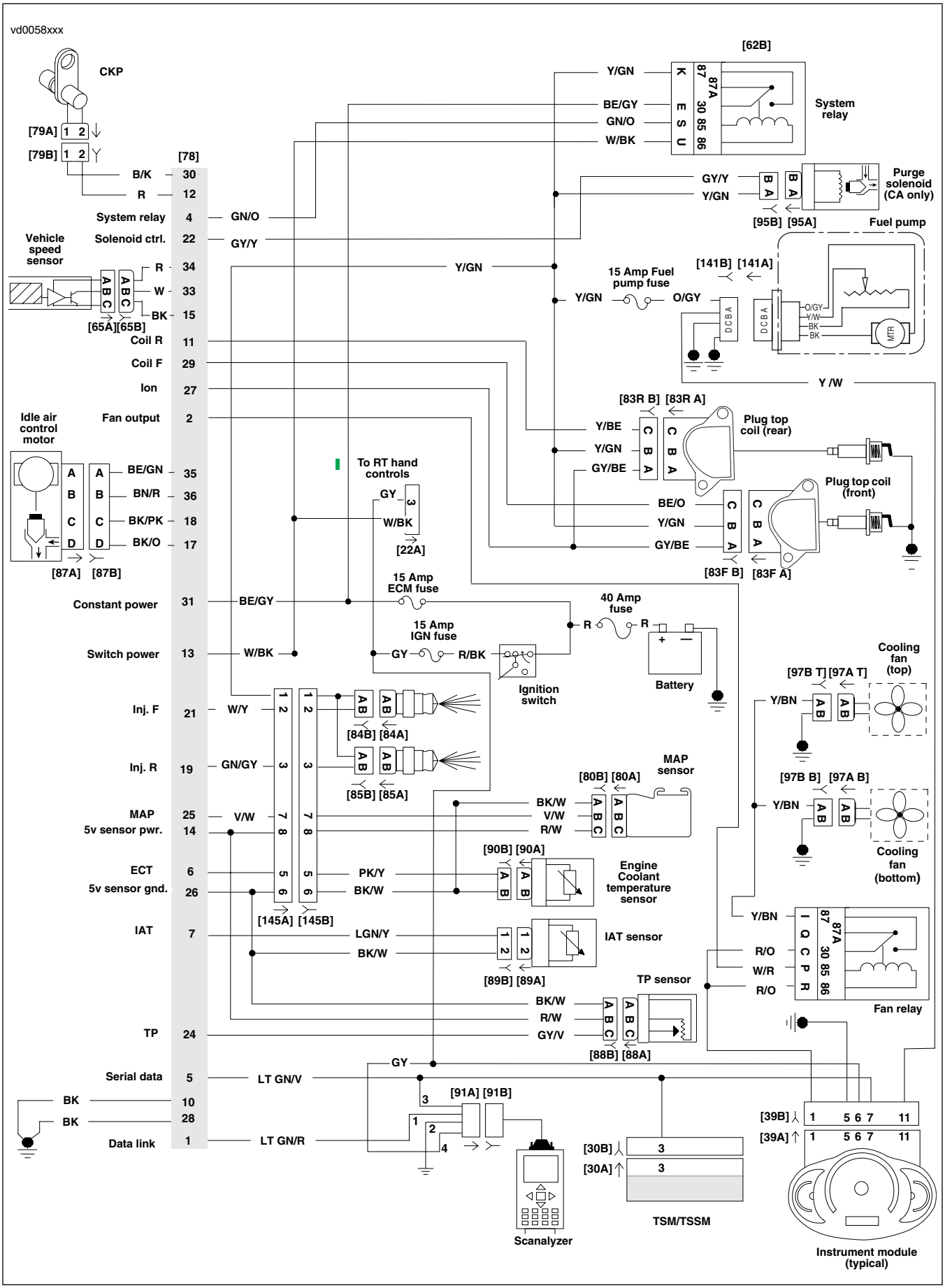


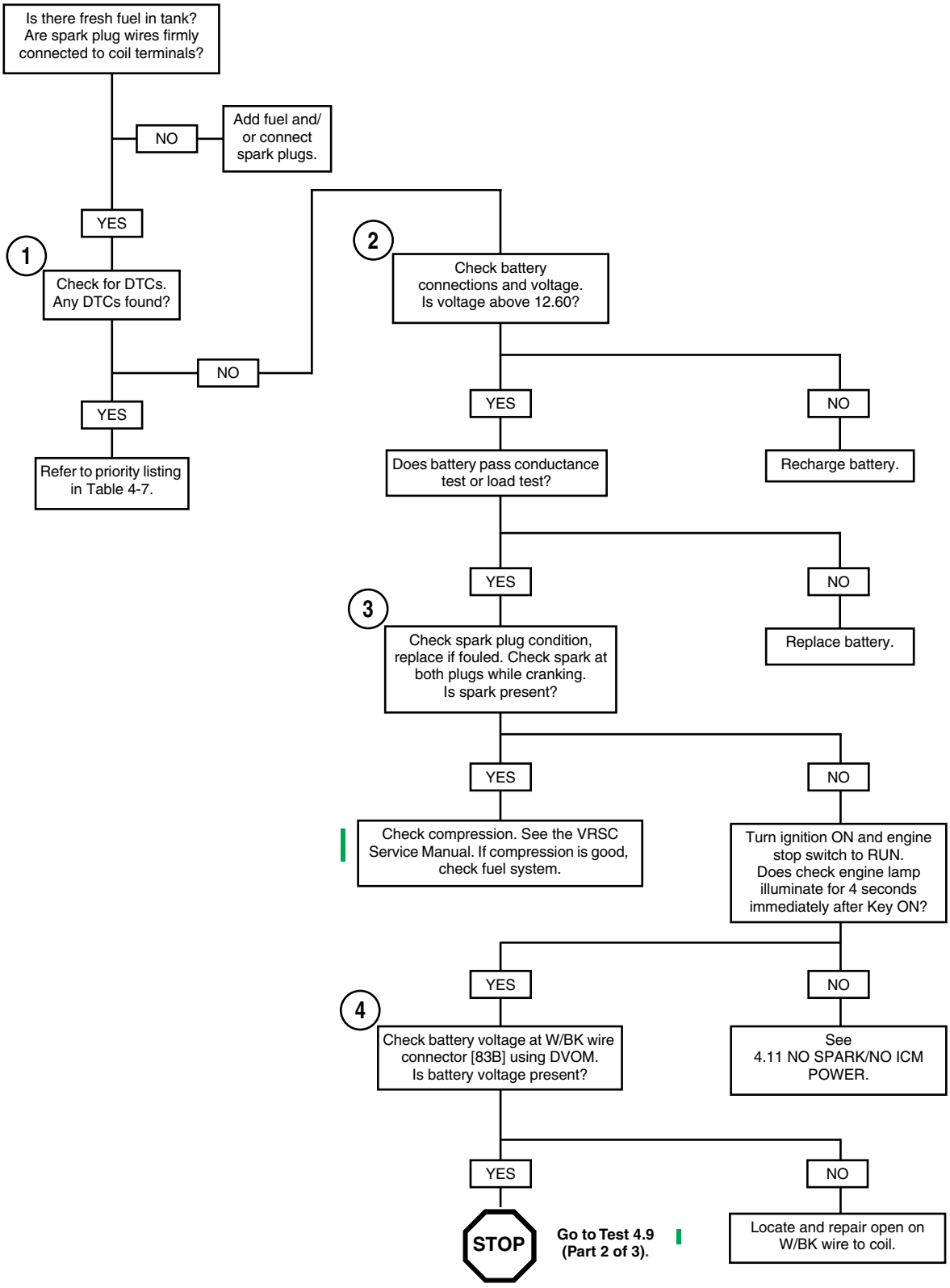
Figure 4-25. EFI Circuit Diagram (VRSCR)

Table 4-10. Wire Harness Connectors in Figure 4-25.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar switch (black)	6-place Deutsch	under left side cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[79]	CKP sensor	2-place Mini-Deutsch	under crankcase
[83F]	Front plug top coil	3-place Packard	on top of front rocker box
[83R]	Rear plug top coil	3-place Packard	on top of rear rocker box
[91]	Data link	4-place Deutsch	under left side cover
[145]	Engine harness	12-place Deutsch	under air cleaner

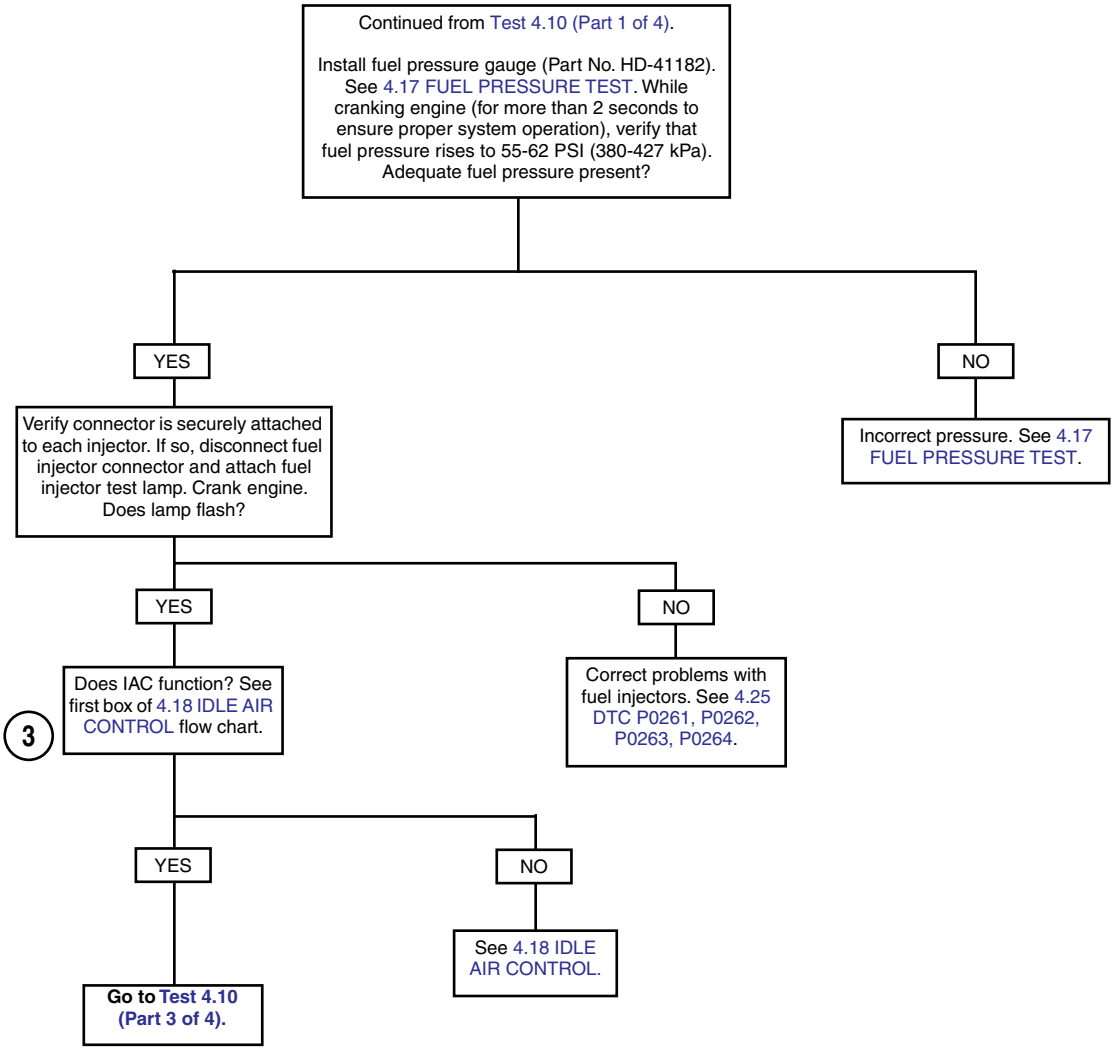
Test 4.10 (Part 1 of 4)

ENGINE CRANKS, BUT WILL NOT START



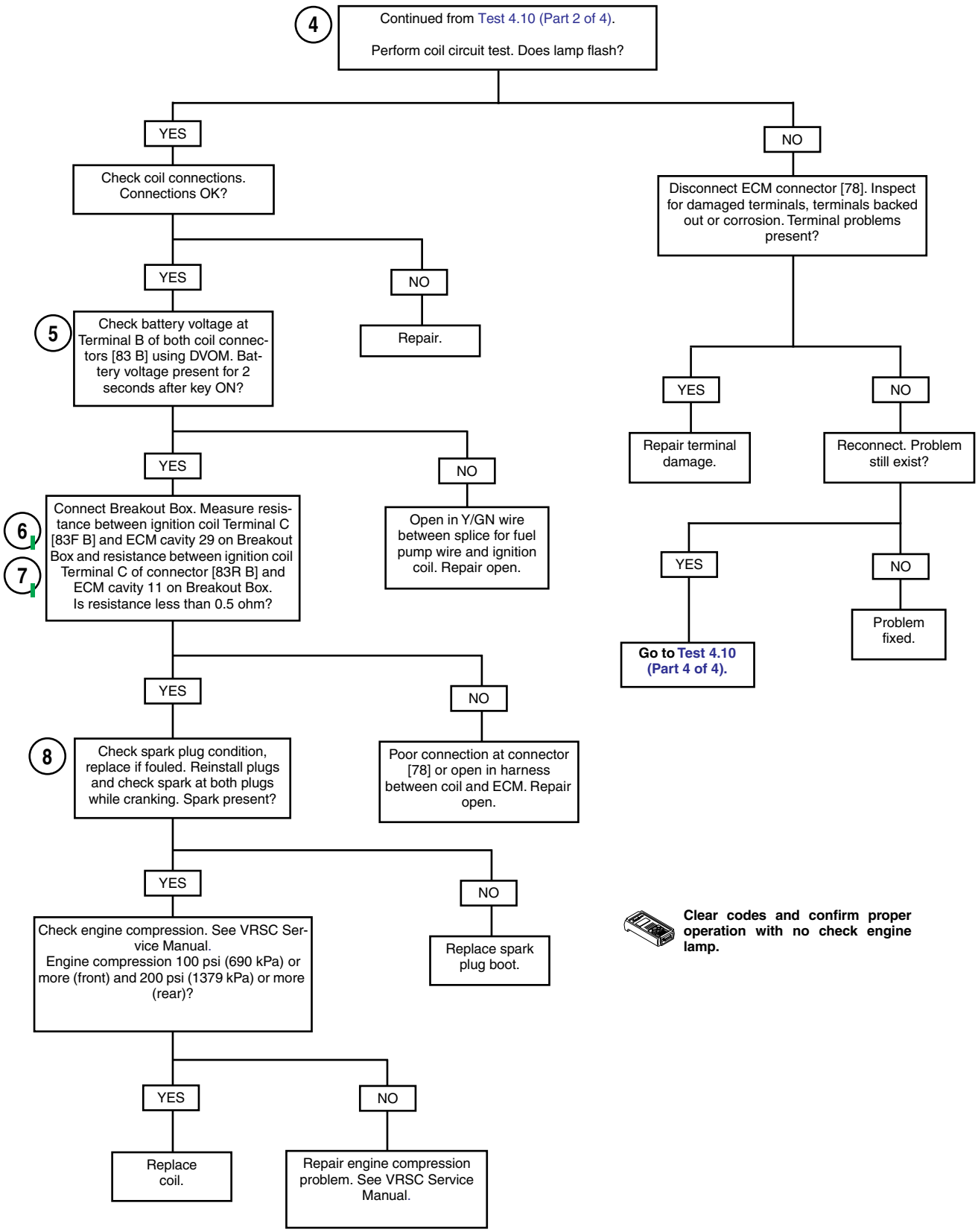
Test 4.10 (Part 2 of 4)

ENGINE CRANKS, BUT WILL NOT START



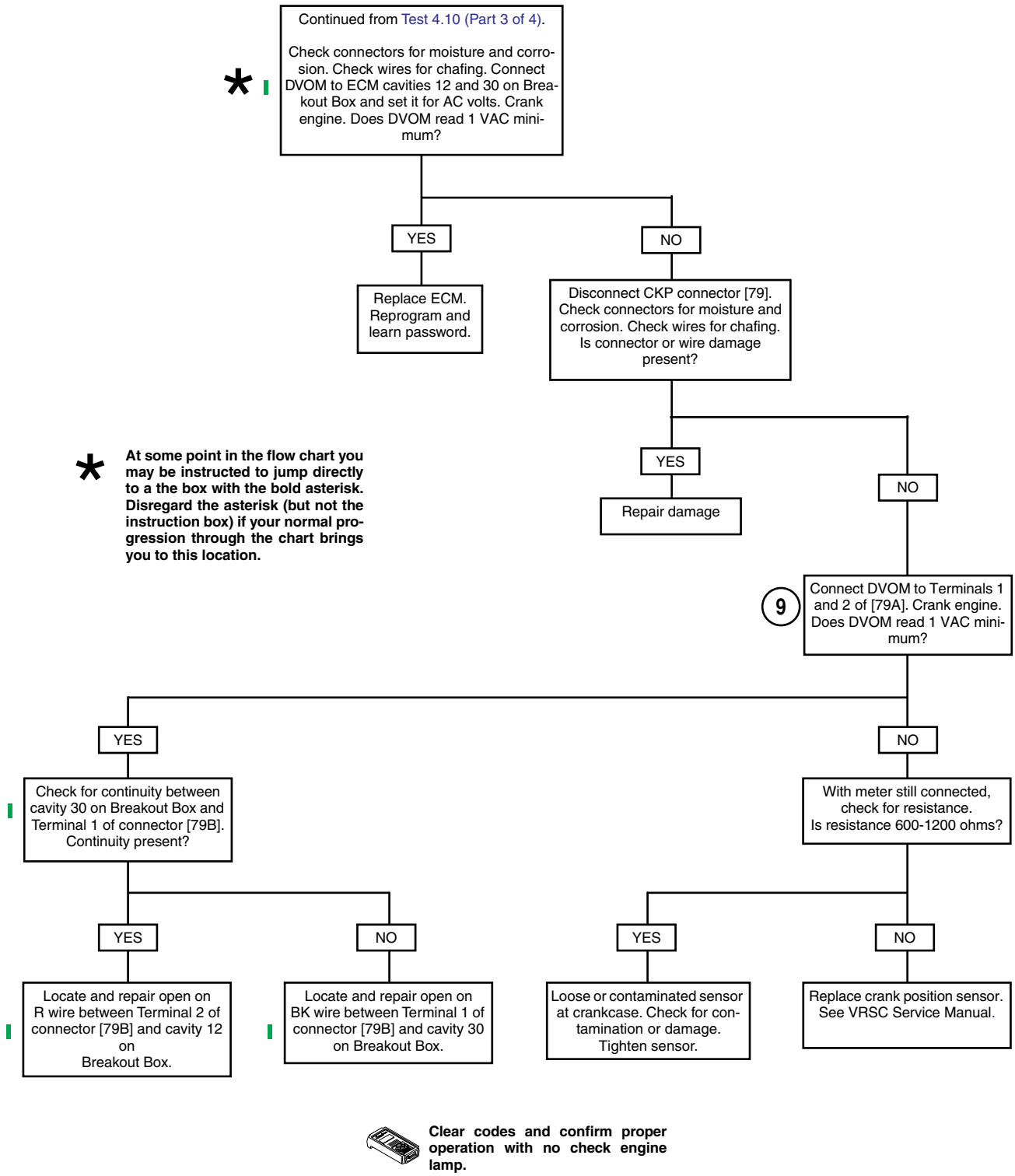
Test 4.10 (Part 3 of 4)

ENGINE CRANKS, BUT WILL NOT START



Test 4.10 (Part 4 of 4)

ENGINE CRANKS, BUT WILL NOT START



*** At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Clear codes and confirm proper operation with no check engine lamp.

NO ECM POWER 4.11

GENERAL

No Spark/No Check Engine Lamp at Key ON

Constant power is supplied to the ECM through terminal 31. The ECM turns on when power is applied to terminal 13 of connector [78]. The ECM goes through an initialization sequence every time power is removed and re-applied to terminal 13. The only visible part of this sequence is the check engine lamp. Upon key ON, the check engine lamp and security lamp will illuminate for 4 seconds and then (if parameters are normal) go out.

If battery power is absent at ECM terminal 31:

- DTCs cannot be cleared. Tool will show them as cleared but will be present next time ignition key is cycled.
- ECM cannot be reflashed.
- Vehicle will run but IAC will not reset eventually leading to idle speed or hard starting problems.

NOTE

The key ON sequence also activates the idle air control motor. If power from terminal 31 is disrupted (blown fuse, etc.) always turn the key OFF wait 10 seconds then turn the key ON to reset the motor to the default position.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.11 flow charts.

1. Connect BREAKOUT BOX (Part No. HD-43876). See 4.7 BREAKOUT BOX: ECM.
2. Connect BREAKOUT BOX (Part No. HD-42682) to connector [22] using ADAPTERS (HD-42962).

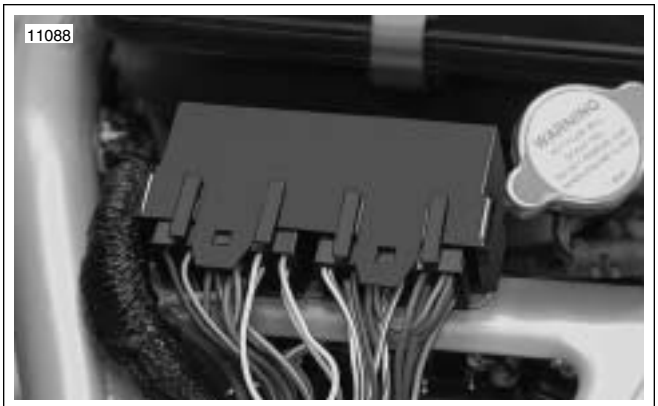
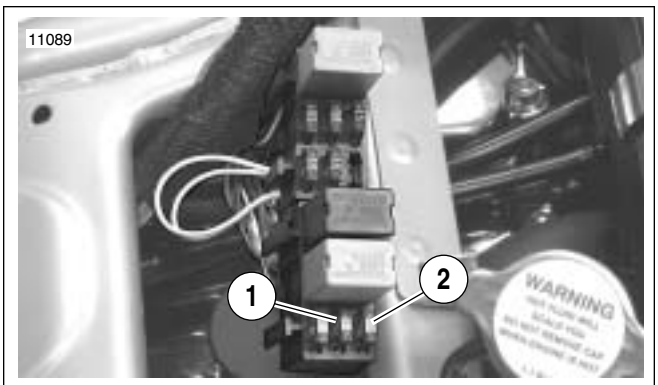


Figure 4-26. Fuse Block Location



1. **ECM fuse**
2. **Ignition fuse**

Figure 4-27. Ignition and ECM Fuse

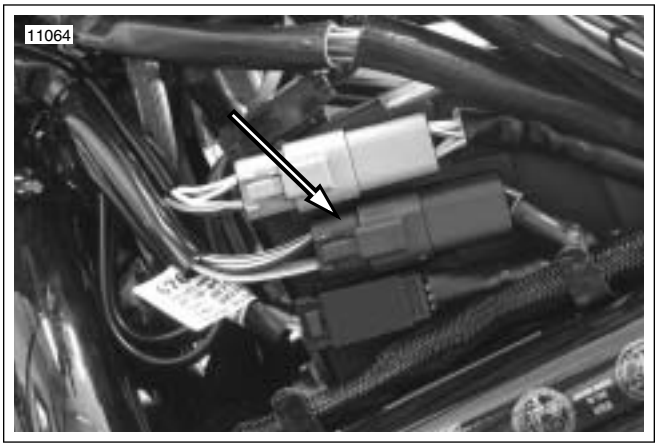


Figure 4-28. Right Hand Control Connector [22] - Under Left Side Cover (typical)

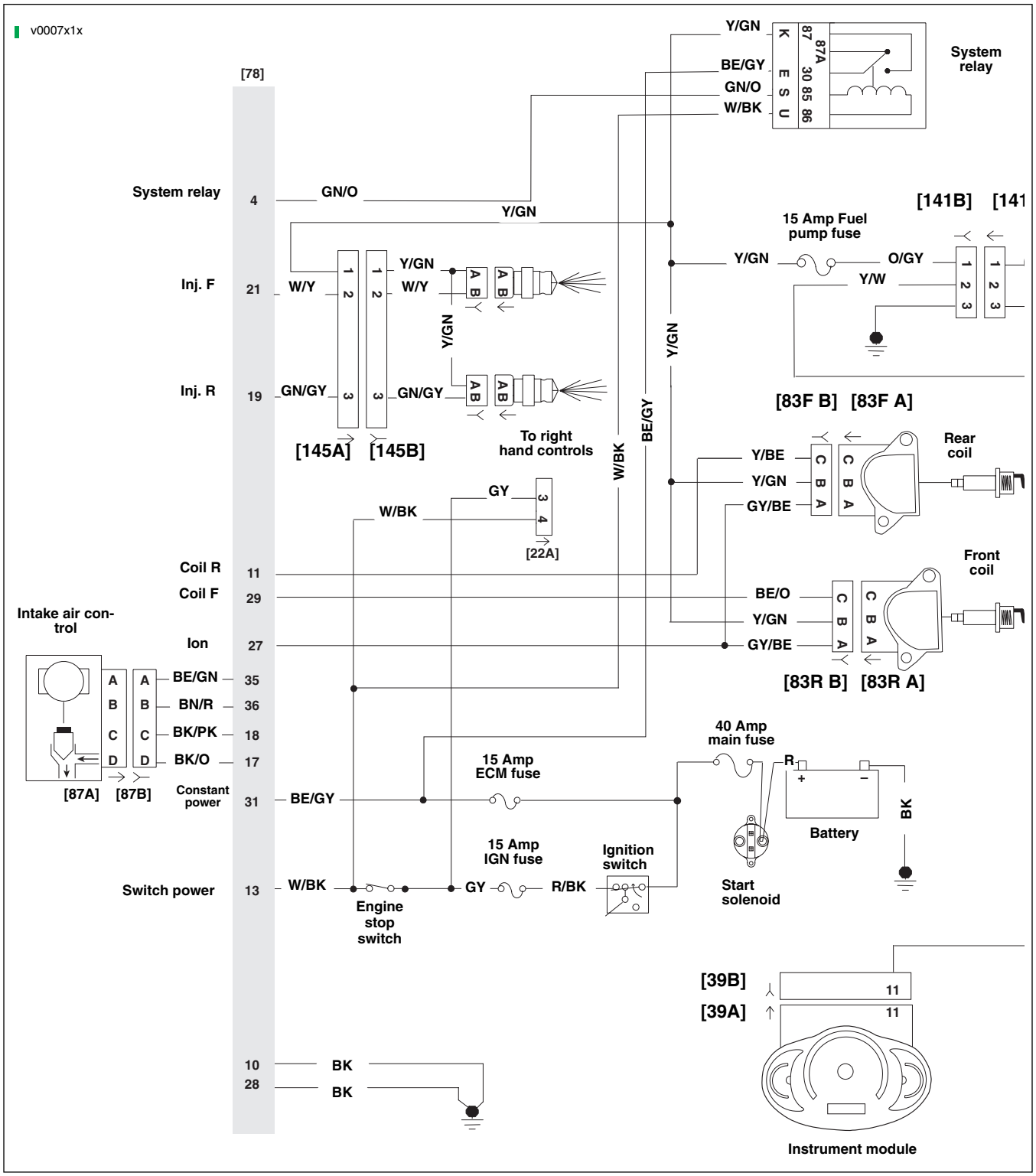


Figure 4-29. ECM Power Circuit Diagram (VRSCA/VRSCD)

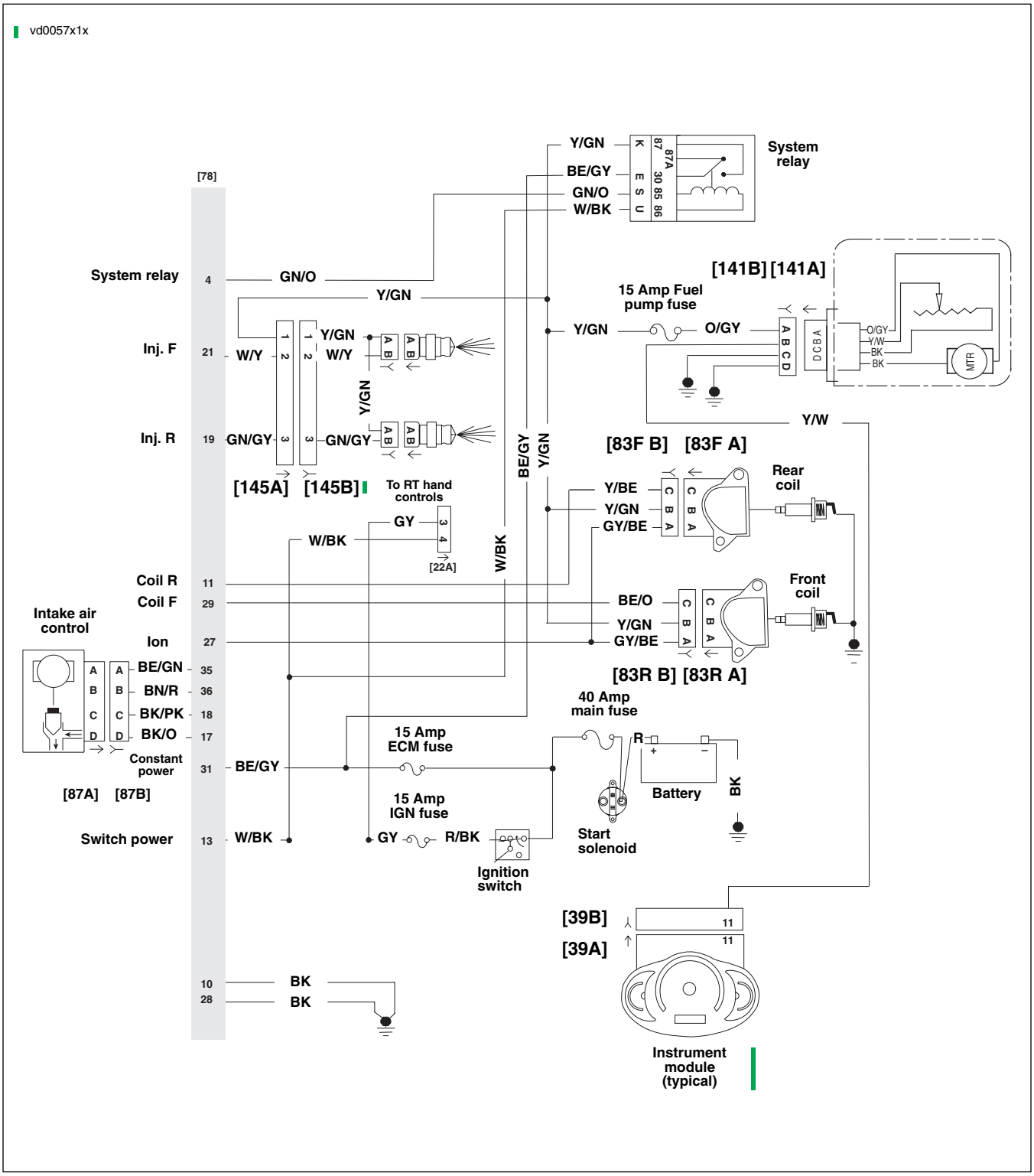


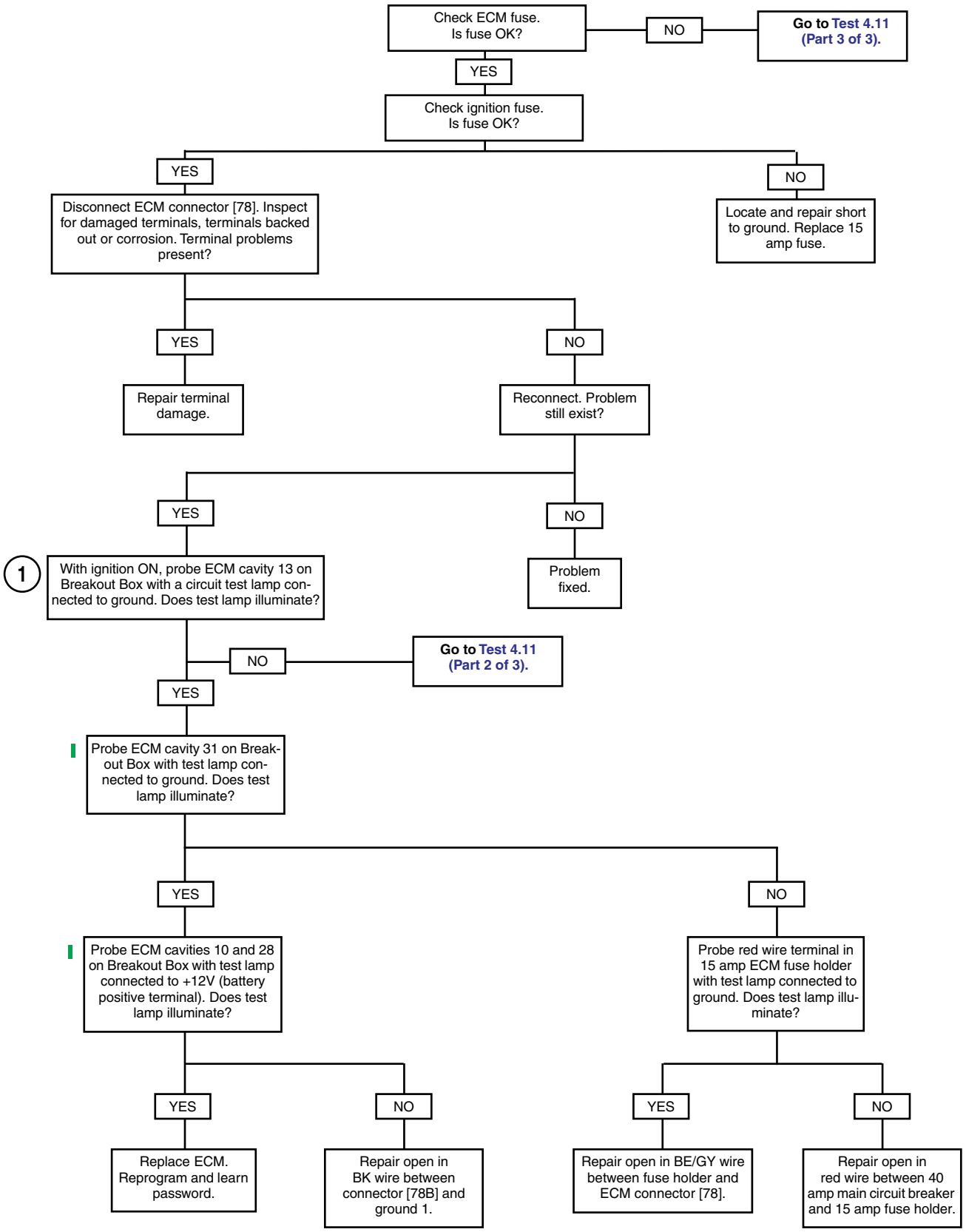
Figure 4-30. ECM Power Circuit Diagram (VRSCR)

Table 4-11. Wire Harness Connectors in Figure 4-30.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar switch (black)	6-place Deutsch	under left side cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
GND 1	ECM ground	Ring terminal	rear cylinder head
	Fuse block	fuse block	under airbox cover

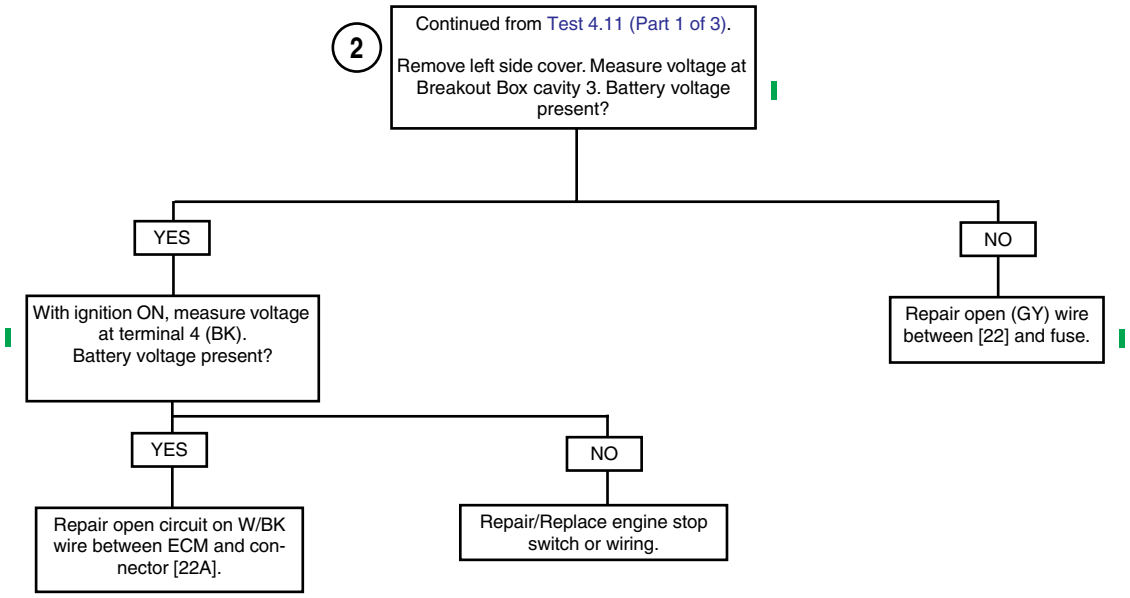
Test 4.11 (Part 1 of 3)

NO ECM POWER



Test 4.11 (Part 2 of 3)

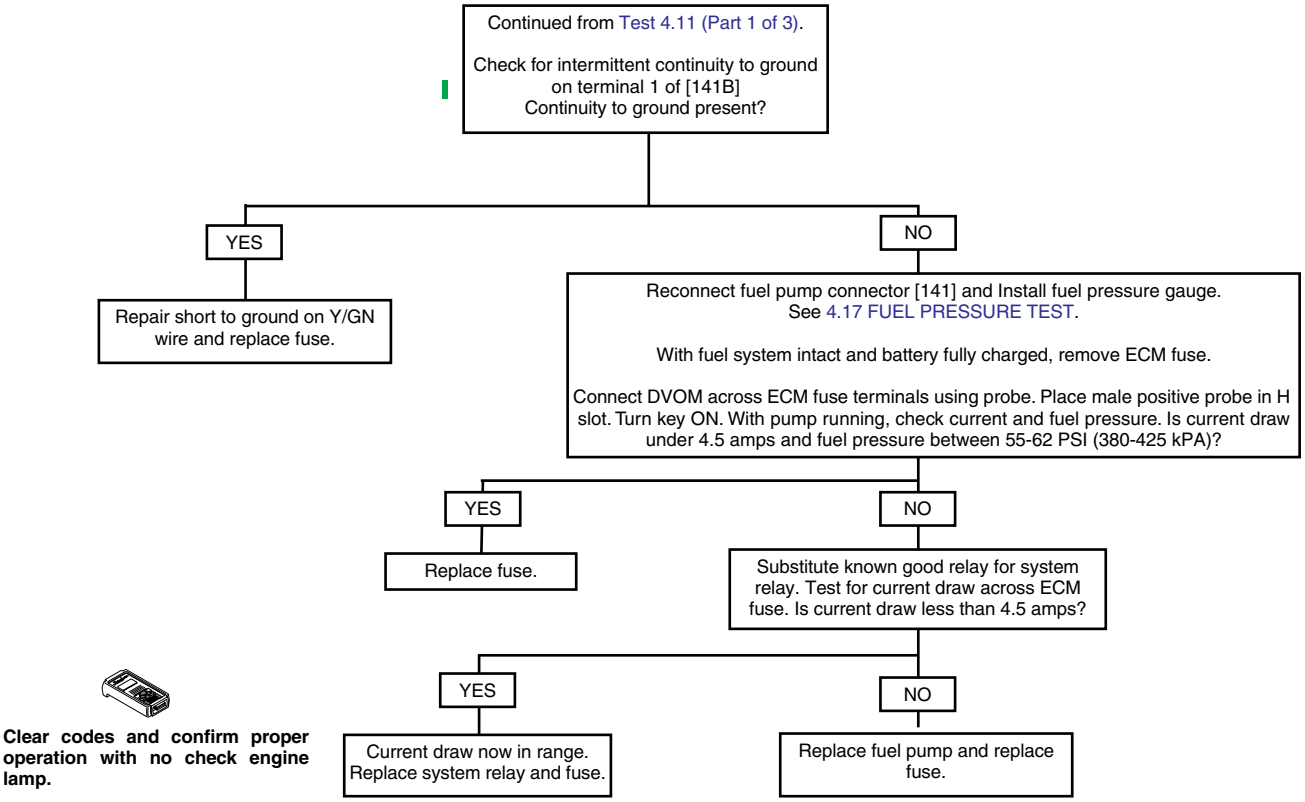
NO ECM POWER



Clear codes and confirm proper operation with no check engine lamp.

Test 4.11 (Part 3 of 3)

NO ECM POWER



Clear codes and confirm proper operation with no check engine lamp.

STARTS, THEN STALLS 4.12

GENERAL

Diagnostic Trouble Codes U1300, U1301: Serial Data Failure

See Figure 4-31. The typical serial data voltage range is 0 volts (inactive) to 7 volts (active). Due to the short pulse, voltages will be much lower on a DVOM. In analog mode, a DVOM reading serial data will show continuous voltage when active, typically 0.6-0.8 volts. The range for acceptable operations is 0-7.0 volts.

NOTE

Problems in the fuel system or idle air control system may also create this symptom.

Table 4-12. Code Description

DTC	DESCRIPTION
U1300	Serial data low
U1301	Serial data open/high

DIAGNOSTICS

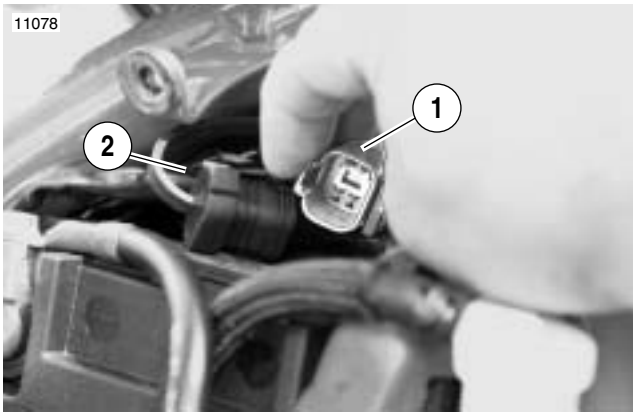
Diagnostic Tips

- If serial data is shorted, these codes will automatically trip the check engine light.
- DTCs P1009 and P1010 may accompany DTCs U1300 and U1301.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.12 flow charts.

1. Check for trouble codes. See RETRIEVING TROUBLE CODES under 4.4 CHECKING FOR TROUBLE CODES.
2. Connect BREAKOUT BOX (Part No. HD-43876). See 4.7 BREAKOUT BOX: ECM.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probes and patch cord.
4. Historic code U1300 would have been set. Clear historic codes.



1. **Data connector [91A]**
2. **Protective rubber plug**

Figure 4-31. Serial Data Connector [91A]

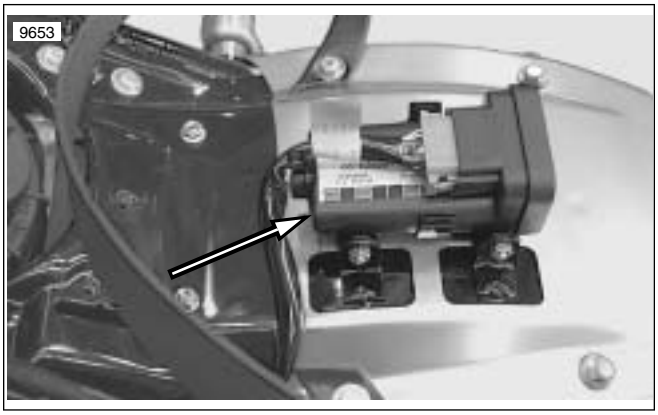


Figure 4-32. TSM/TSSM (VRSCA/VRSCD)

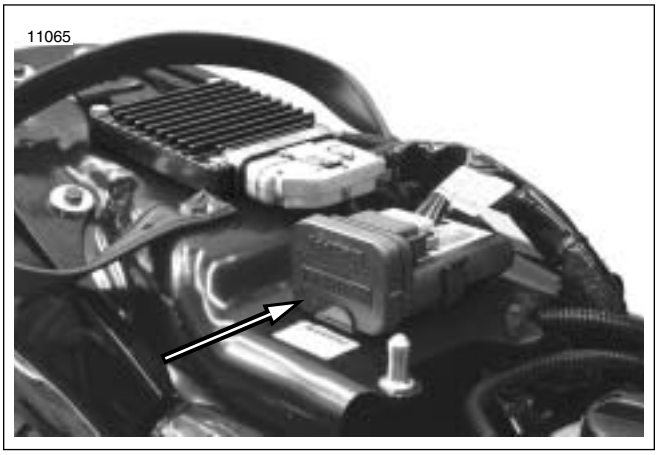


Figure 4-33. TSM/TSSM (VRSCR)

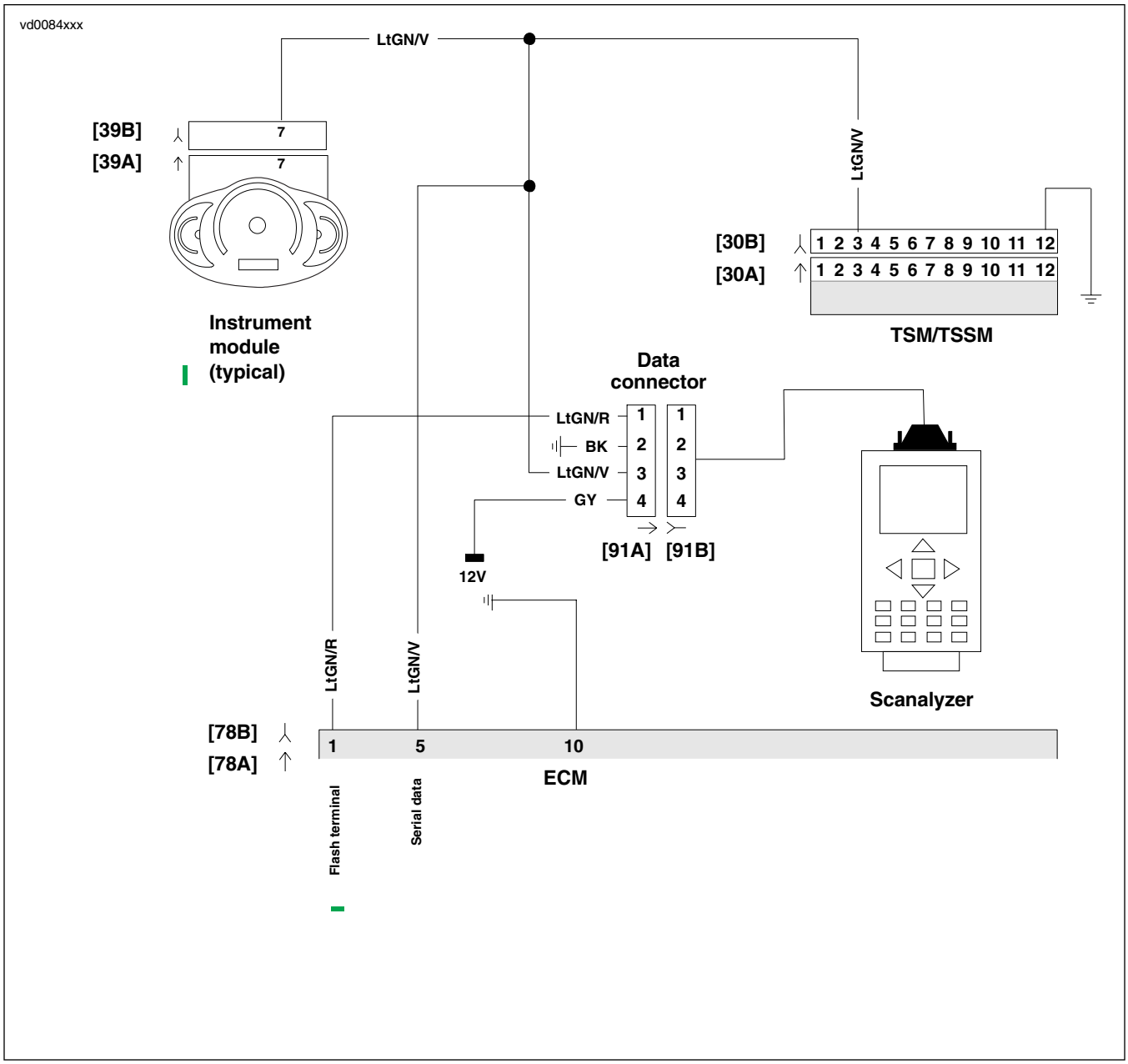


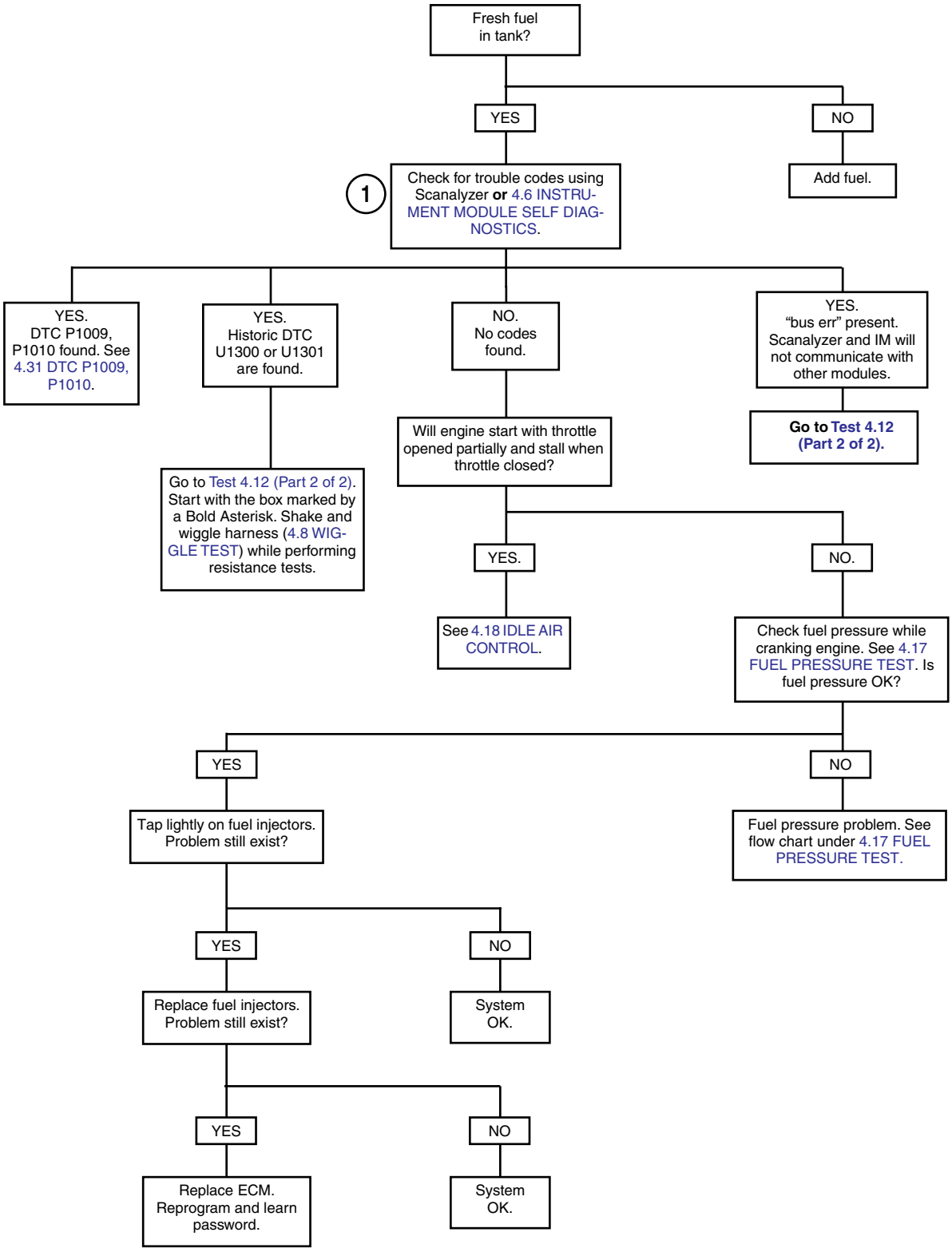
Figure 4-34. Serial Data Circuit

Table 4-13. Wire Harness Connectors in Figure 4-34.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	IM	12-place Mini-Deutsch	inside handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91]	Data	4-place Deutsch	behind left side cover

Test 4.12 (Part 1 of 2)

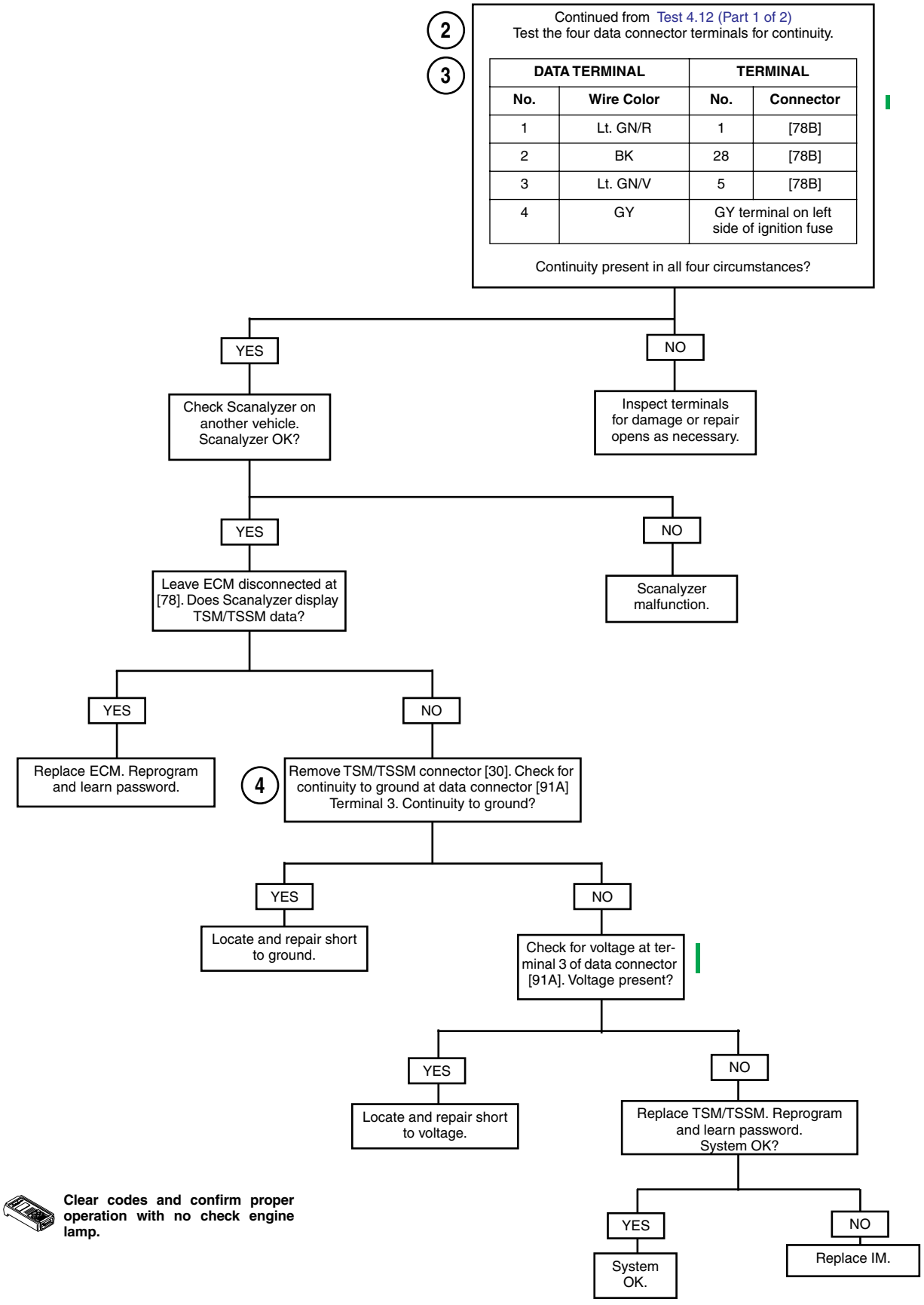
STARTS, THEN STALLS: DTC U1300, U1301



Clear codes and confirm proper operation with no check engine lamp.

Test 4.12 (Part 2 of 2)

STARTS, THEN STALLS: DTC U1300, U1301



FUEL SYSTEM ELECTRICAL TEST (VRSCA/VRSCD) 4.13

GENERAL

With the ignition key ON and the engine stop switch at RUN, the ECM will energize the system relay to complete the circuit to the in-tank fuel pump. It will remain on as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses from the CKP. If there are no reference pulses, the ECM will de-energize the system relay within 2 seconds after ignition is ON or engine has stalled, or immediately after the ignition is shut OFF.

The fuel pump delivers fuel to the injectors then to the pressure regulator. The regulator controls system pressure. Excess fuel flow is returned to the fuel tank through the pressure regulator.

See Figure 4-38. When the engine is stopped, the pump can be turned on by applying battery voltage to terminal 1 and ground to terminal 3 of the fuel pump connector [141A] or by using the Scanalyzer. See Scanalyzer Notes under 4.17 FUEL PRESSURE TEST. The fuel pump connector is located on top of the fuel tank.

Improper fuel system pressure may contribute to one or all of the following symptoms.

- Engine cranks, but won't run.
- Engine cuts out (may feel like ignition problems).
- Hesitation, loss of power and poor fuel economy.

NOTE

After turning ignition OFF, you must wait 10 seconds before turning the ignition back ON to get the fuel pump to reprime. This time out period is necessary for the fuel pump and IAC to reset.

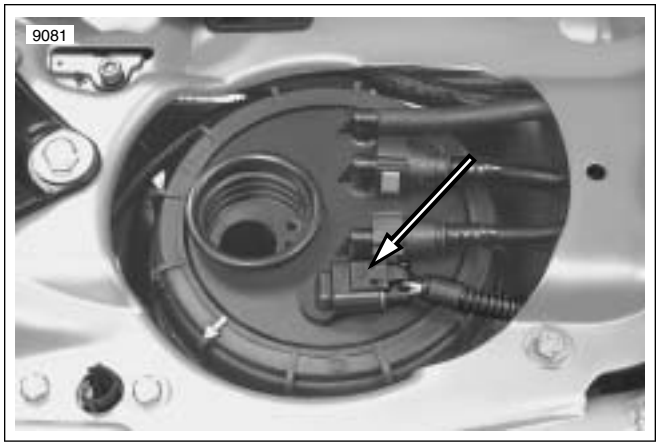


Figure 4-35. Fuel Pump Connector [86]

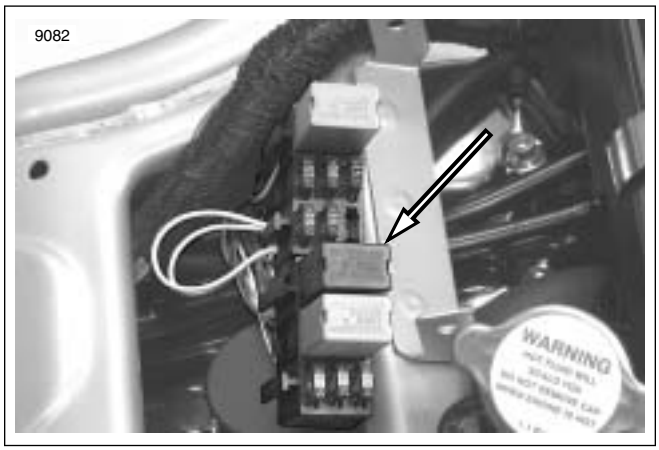


Figure 4-36. System Relay

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.13 flow charts.

1. Turns on fuel pump if wiring is OK. If pump runs, problem is in basic fuel delivery.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), brown terminal probe and patch cord.
3. See RELAYS in the VRSC Service Manual. This test checks for a short to ground in the system relay harness circuit.
4. See FUEL INJECTORS or IGNITION COIL in the VRSC Service Manual.
5. See Figure 4-39. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple terminal probe and patch cord.
6. Connect BREAKOUT BOX (Part No. HD-43876). See 4.7 BREAKOUT BOX: ECM.

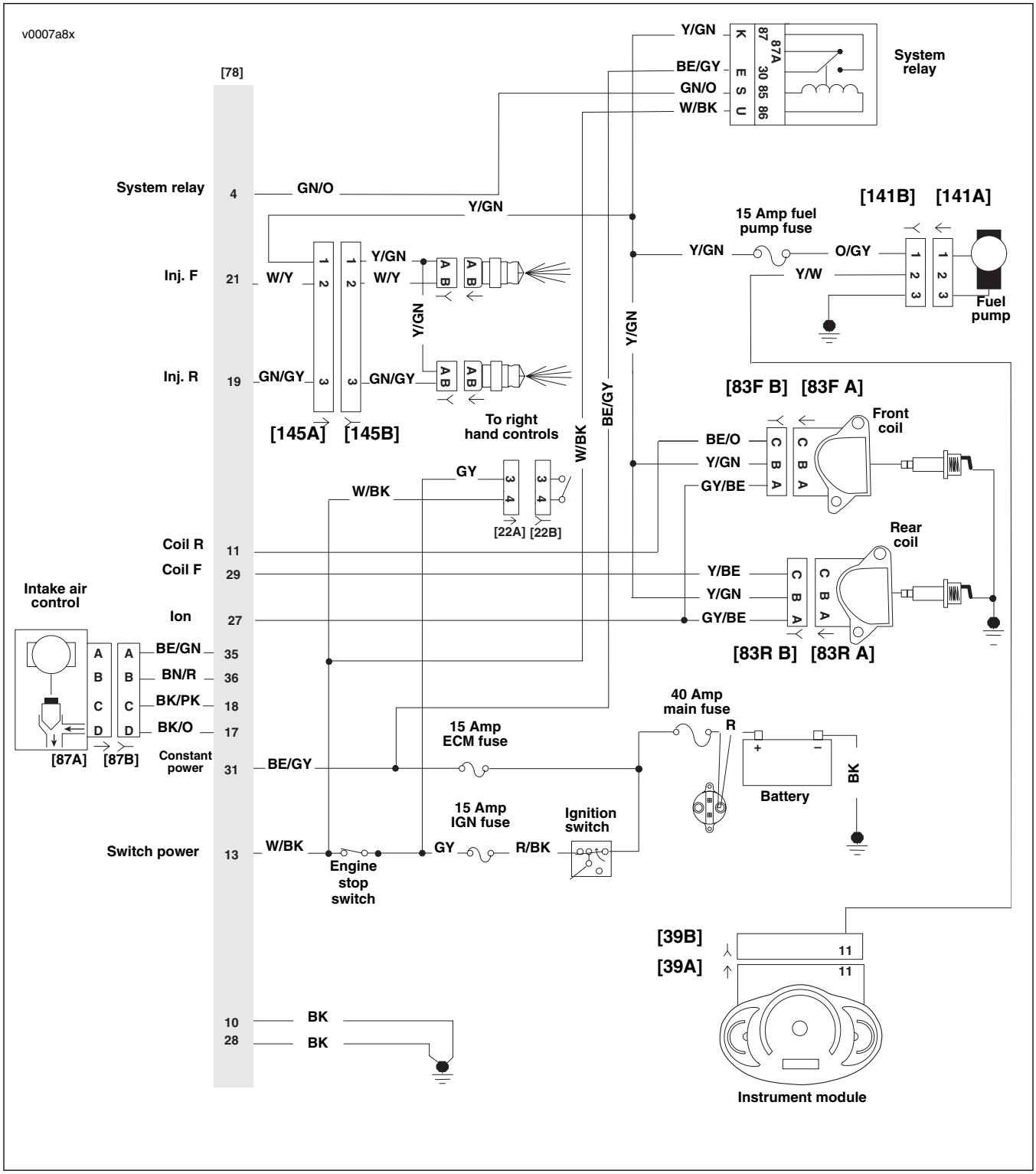


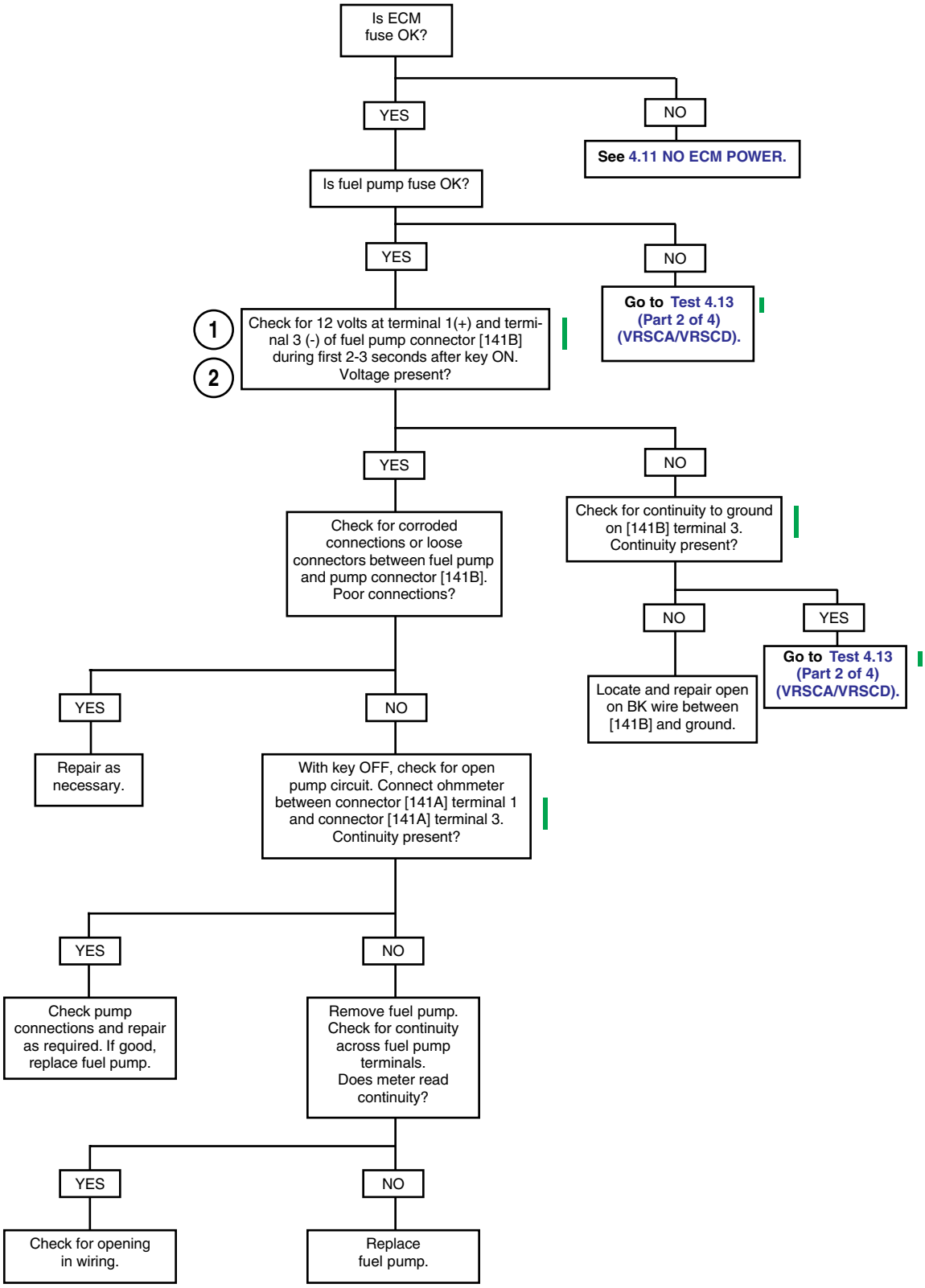
Figure 4-37. Fuel Pump Circuit (VRSCA/VRSCD)

Table 4-14. Wire Harness Connectors in Figure 4-37.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM	36-place Packard	under left side cover
[141]	Fuel pump	3-place Packard	under seat
[145]	Engine harness	12-place Deutsch	under air cleaner
[22]	Right handlebar switch (Black)	6-place Deutsch	under left side cover

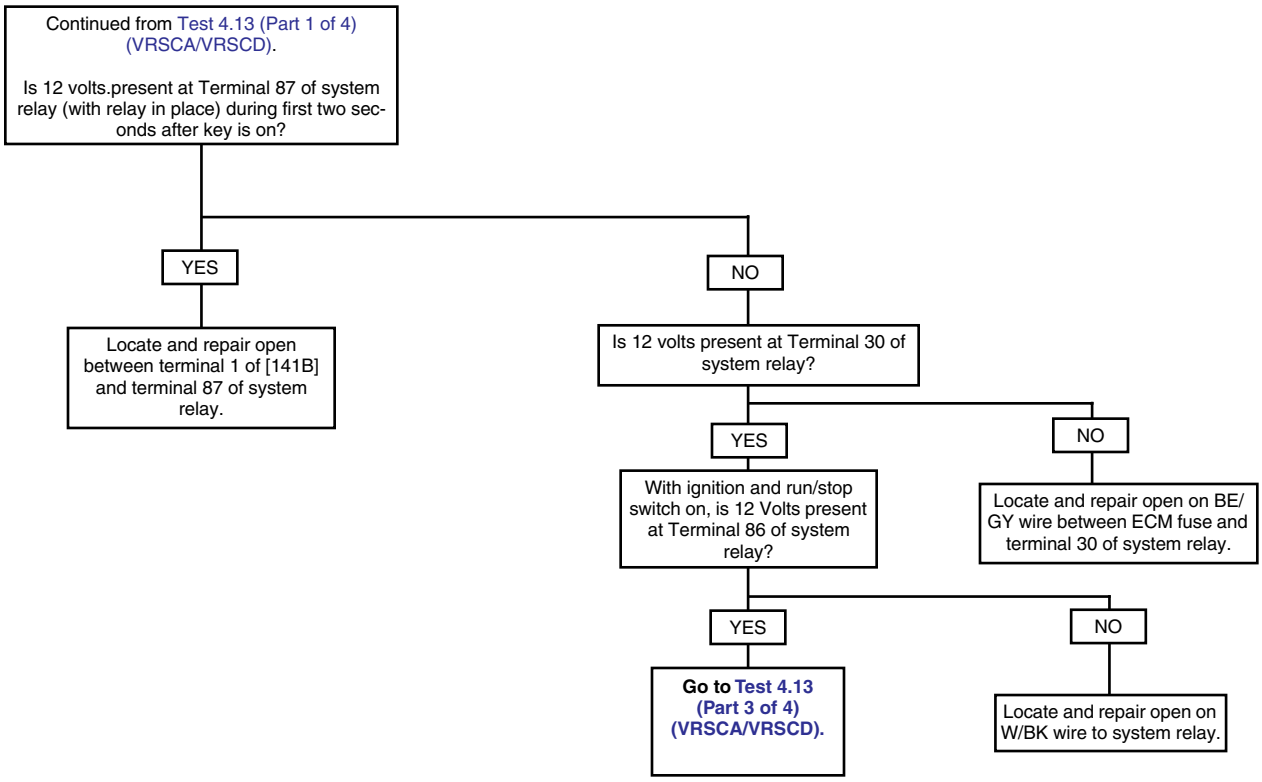
Test 4.13 (Part 1 of 4) (VRSCA/VRSCD)

FUEL SYSTEM ELECTRICAL TEST



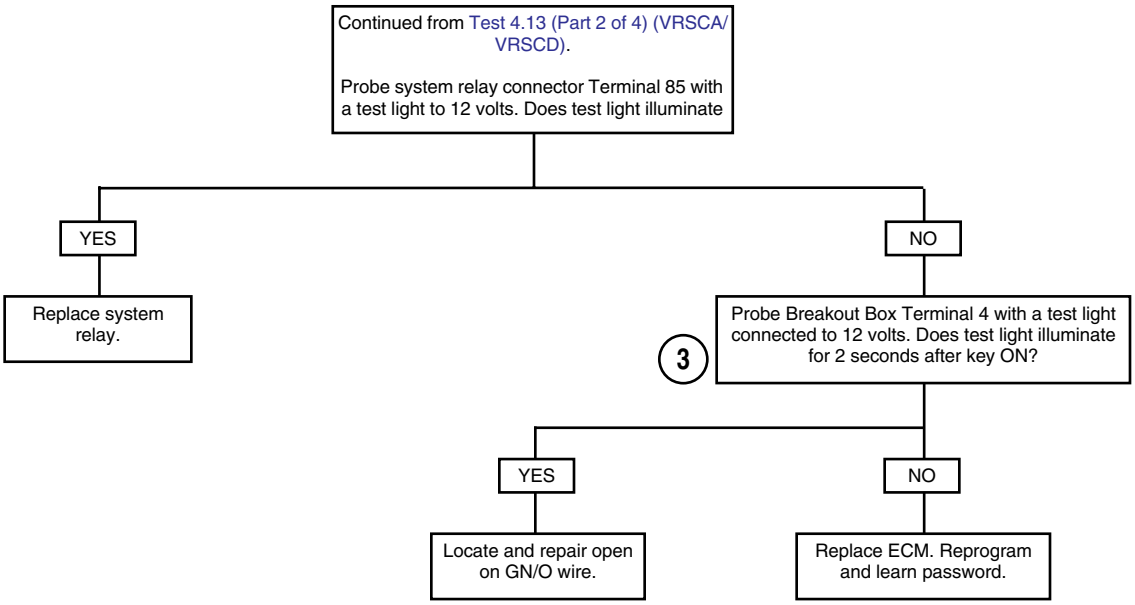
Test 4.13 (Part 2 of 4) (VRSCA/VRSCD)

FUEL SYSTEM ELECTRICAL TEST



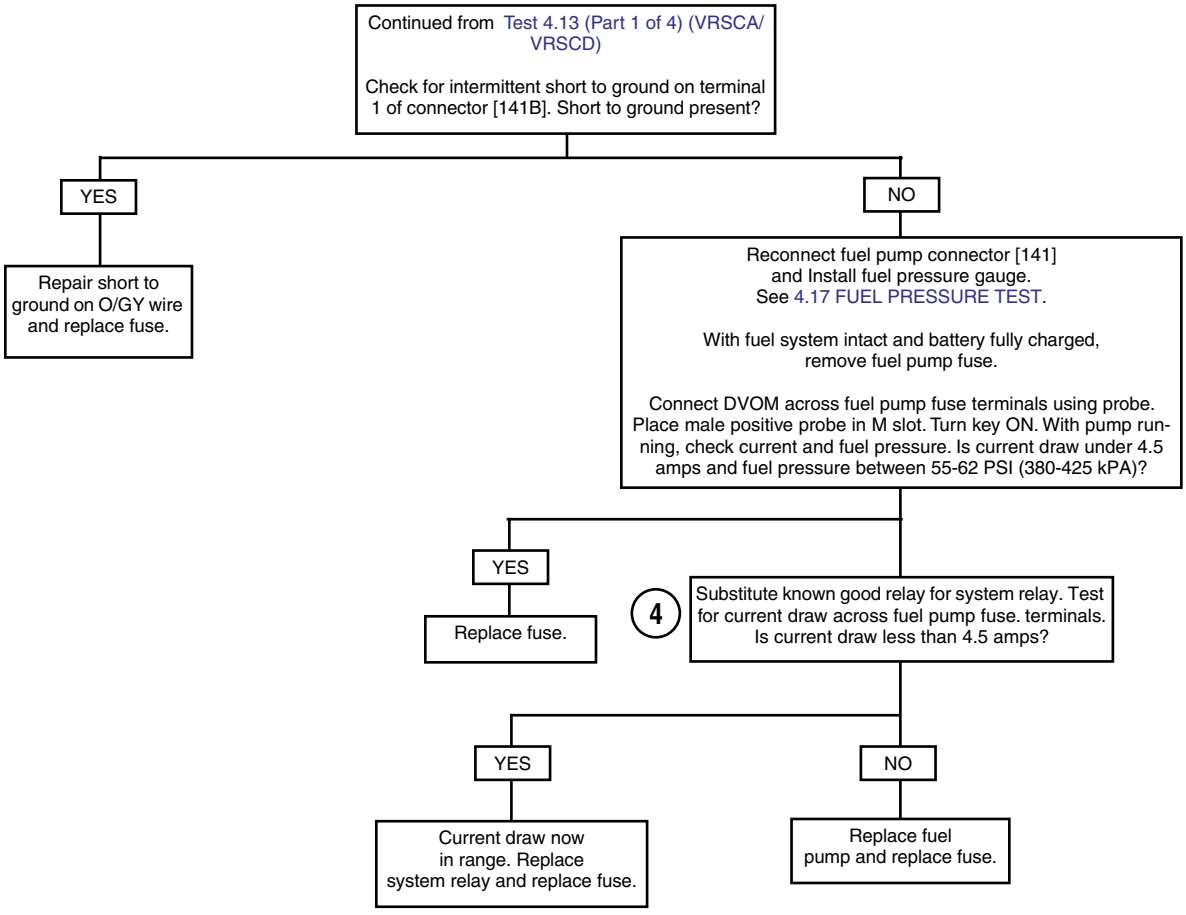
Test 4.13 (Part 3 of 4) (VRSCA/VRSCD)

FUEL SYSTEM ELECTRICAL TEST



Test 4.13 (Part 4 of 4) (VRSCA/VRSCD)

FUEL SYSTEM ELECTRICAL TEST



FUEL SYSTEM ELECTRICAL TEST (VRSCR) 4.14

GENERAL

With the ignition key ON and the engine stop switch at RUN, the ECM will energize the system relay to complete the circuit to the in-tank fuel pump. It will remain on as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses from the CKP. If there are no reference pulses, the ECM will de-energize the system relay within 2 seconds after ignition is ON or engine has stalled, or immediately after the ignition is shut OFF.

The fuel pump delivers fuel to the injectors then to the pressure regulator. The regulator controls system pressure. Excess fuel flow is returned to the fuel tank through the pressure regulator.

See Figure 4-38. When the engine is stopped, the pump can be turned on by applying battery voltage to terminal 1 and ground to terminal 3 of the fuel pump connector [141A] or by using the Scanalyzer. See Scanalyzer Notes under 4.17 FUEL PRESSURE TEST. The fuel pump connector is located on top of the fuel tank.

Improper fuel system pressure may contribute to one or all of the following symptoms.

- Engine cranks, but won't run.
- Engine cuts out (may feel like ignition problems).
- Hesitation, loss of power and poor fuel economy.

NOTE

After turning ignition OFF, you must wait 10 seconds before turning the ignition back ON to get the fuel pump to reprime. This time out period is necessary for the fuel pump and IAC to reset.

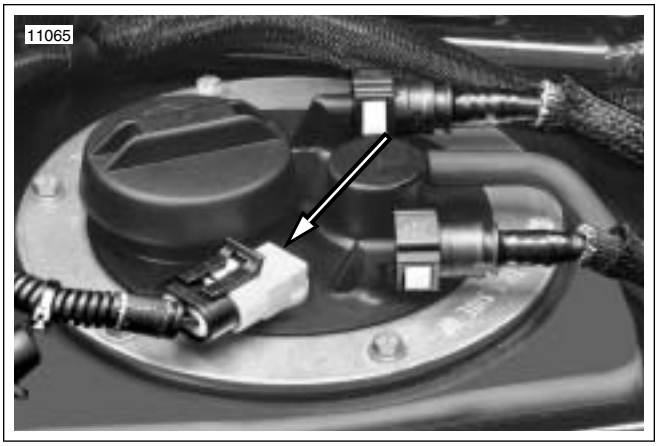


Figure 4-38. Fuel Pump Connector [141]

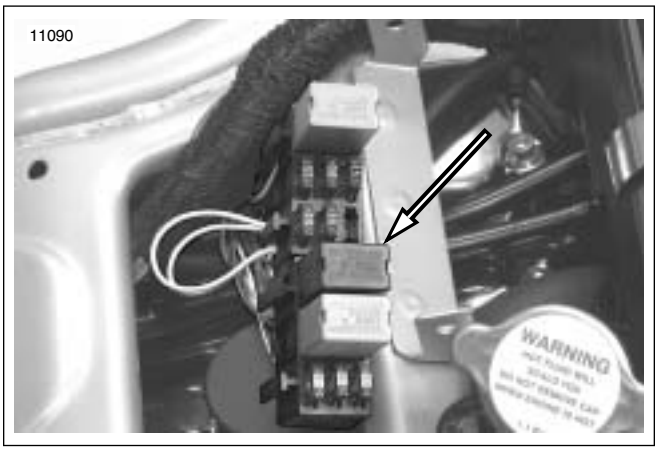


Figure 4-39. System Relay (typical)

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.14 flow charts.

1. Turns on fuel pump if wiring is OK. If pump runs, problem is in basic fuel delivery.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), brown terminal probe and patch cord.
3. See RELAYS in the VRSC Service Manual. This test checks for a short to ground in the system relay harness circuit.
4. See FUEL INJECTORS or IGNITION COIL in the VRSC Service Manual.
5. See Figure 4-39. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple terminal probe and patch cord.
6. Connect BREAKOUT BOX (Part No. HD-43876). See 4.7 BREAKOUT BOX: ECM.

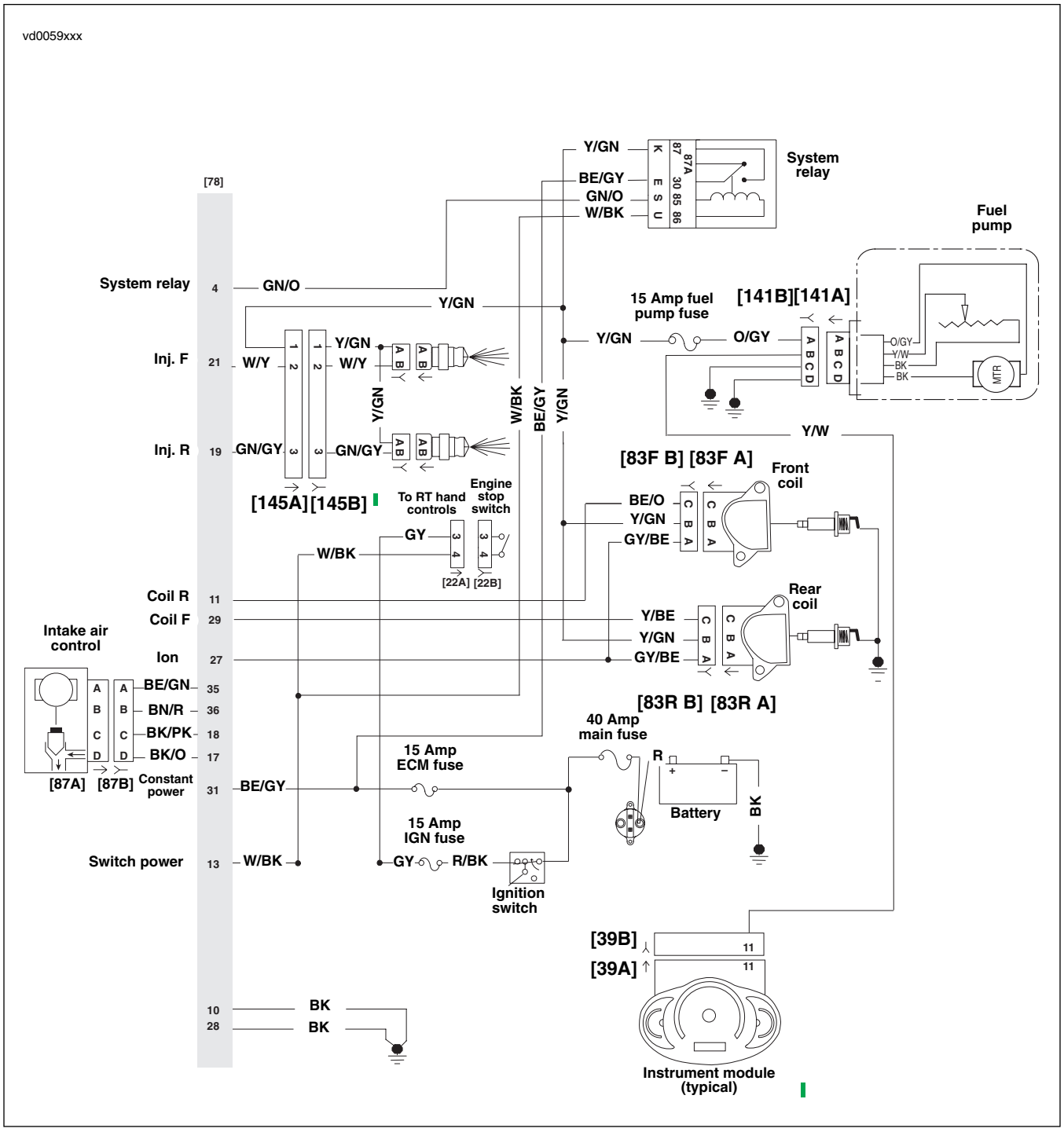


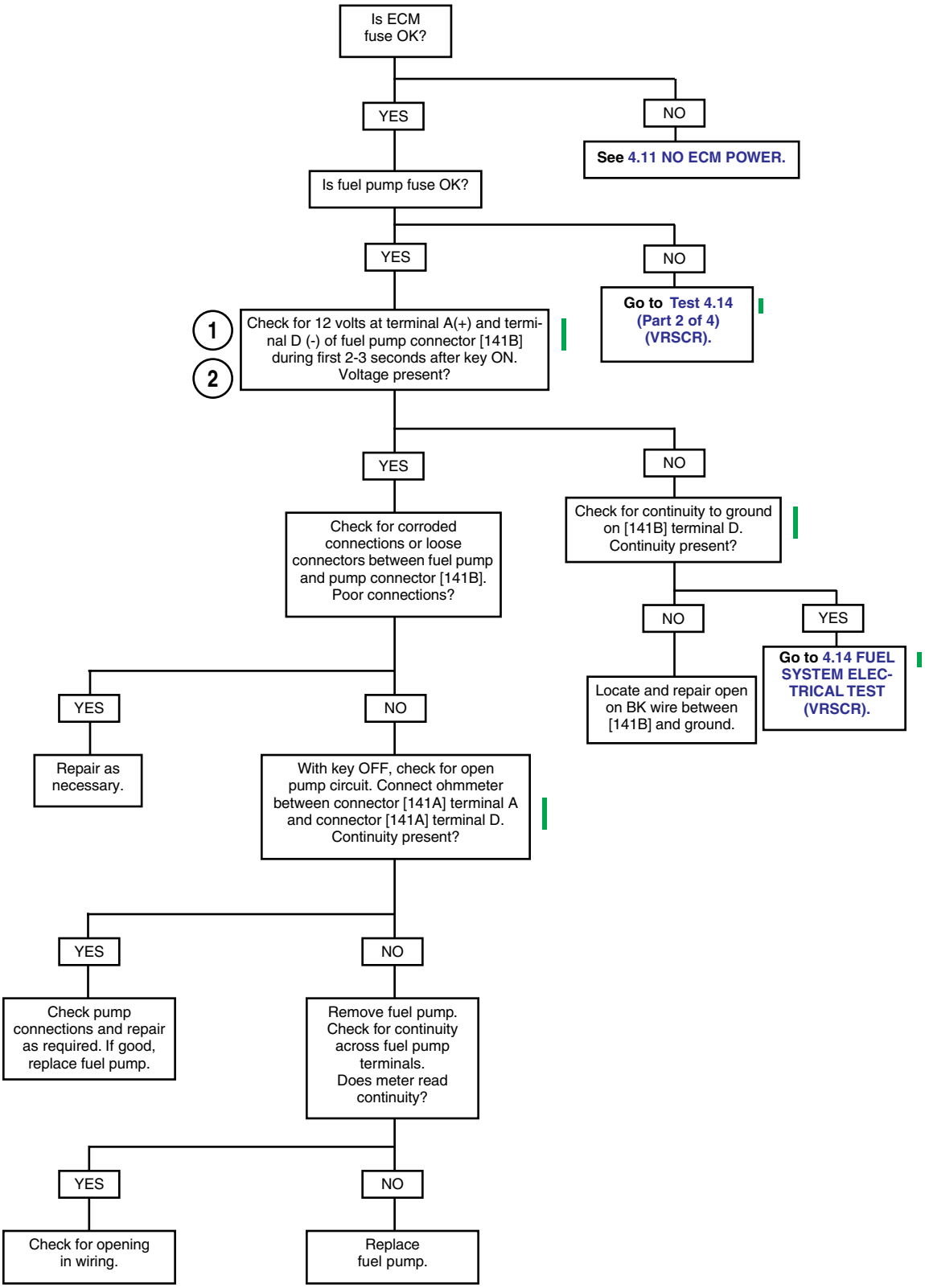
Figure 4-40. Fuel Pump Circuit (VRSCR)

Table 4-15. Wire Harness Connectors in Figure 4-40.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[141]	Fuel pump	4-place Packard	under seat
[145]	Engine harness	12-place Deutsch	under air cleaner
[22]	Right handlebar switch (Black)	6-place Deutsch	under left side cover

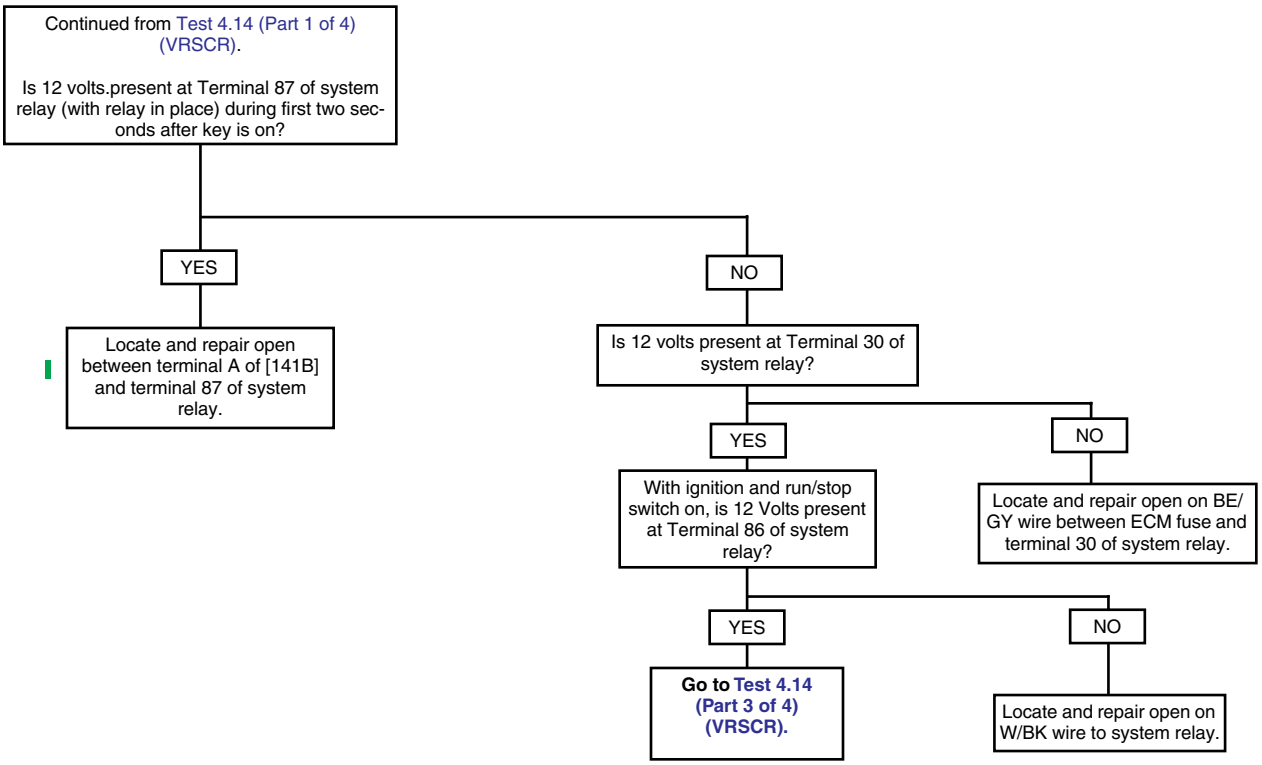
Test 4.14 (Part 1 of 4) (VRSCR)

FUEL SYSTEM ELECTRICAL TEST (VRSCR)



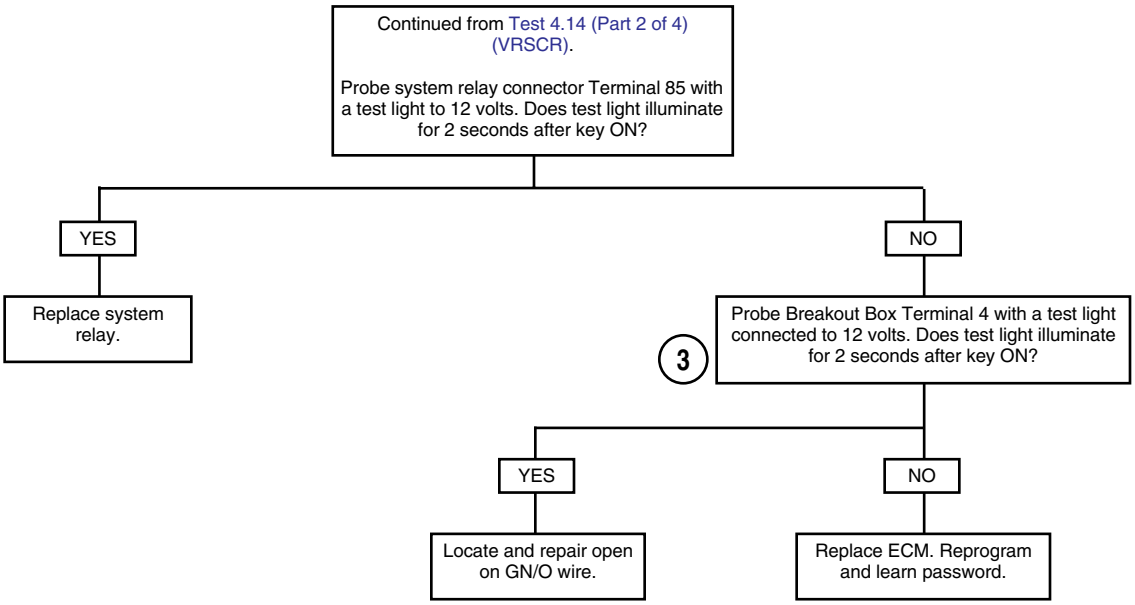
Test 4.14 (Part 2 of 4) (VRSCR)

FUEL SYSTEM ELECTRICAL TEST (VRSCR)



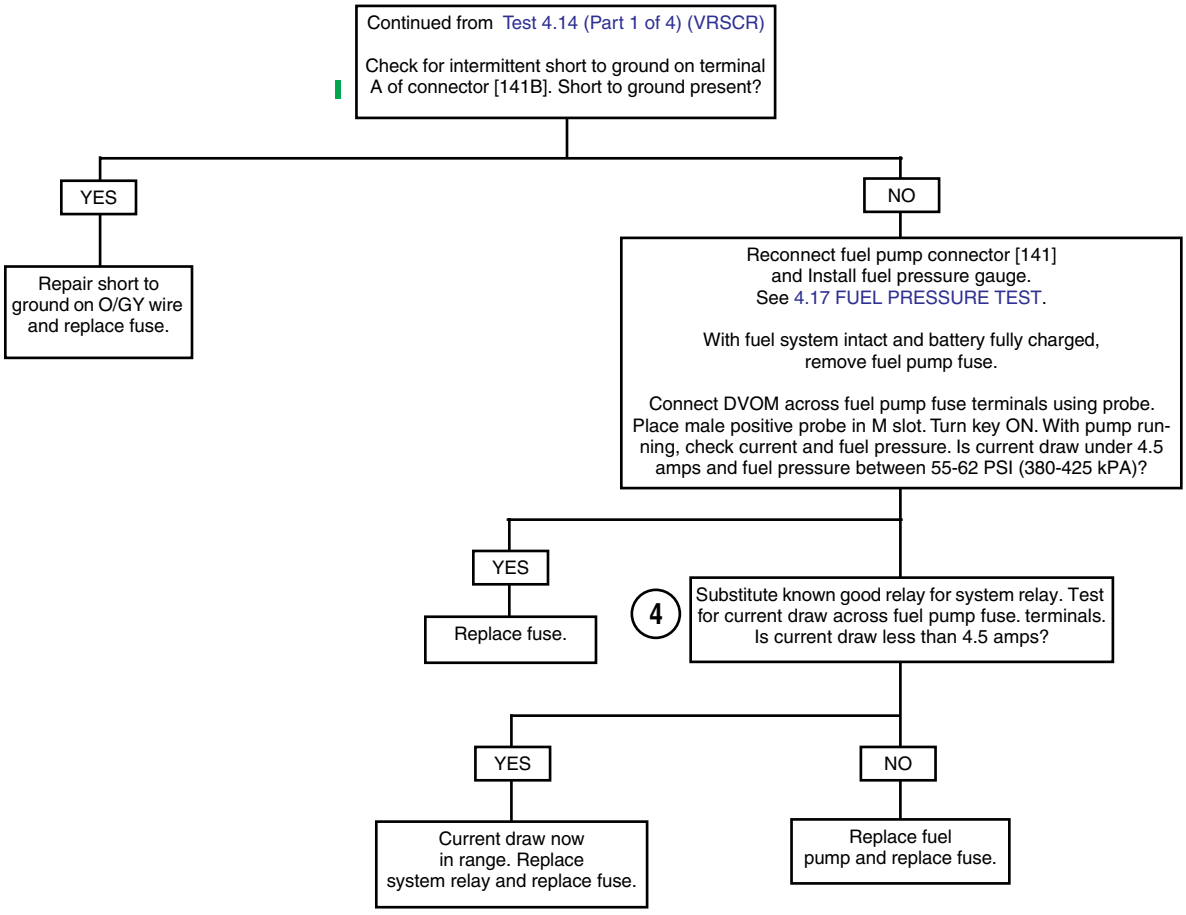
Test 4.14 (Part 3 of 4) (VRSCR)

FUEL SYSTEM ELECTRICAL TEST (VRSCR)



Test 4.14 (Part 4 of 4) (VRSCR)

FUEL SYSTEM ELECTRICAL TEST



SYSTEM RELAY CHECK 4.15

GENERAL

System Relay

See Figure 4-41. With the ignition key ON and the engine stop switch at RUN, the ECM will energize the system relay to complete the circuit to the in tank fuel pump, ignition coils and injectors. they will remain powered as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses from the CKP. If there are no reference pulses, the ECM will de-energize the system relay within 2 seconds after ignition is ON or engine has stalled, or immediately after the ignition is shut OFF.

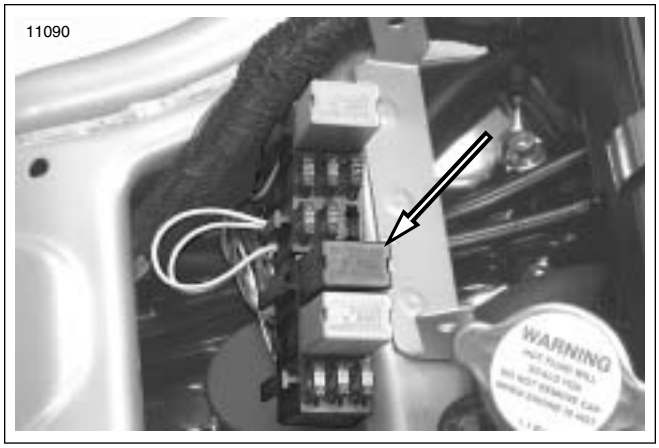


Figure 4-41. System Relay

Table 4-16. Code Description

DTC	DESCRIPTION
P1001	System relay coil open/low
P1002	System relay coil high/shorted
P1003	System relay contacts open
P1004	System relay contacts closed

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.15 flow charts.

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), red terminal probe and patch cord to relay and gray terminal probe and patch cord to the coil connectors [83B].
2. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 4.7 BREAKOUT BOX: ECM.

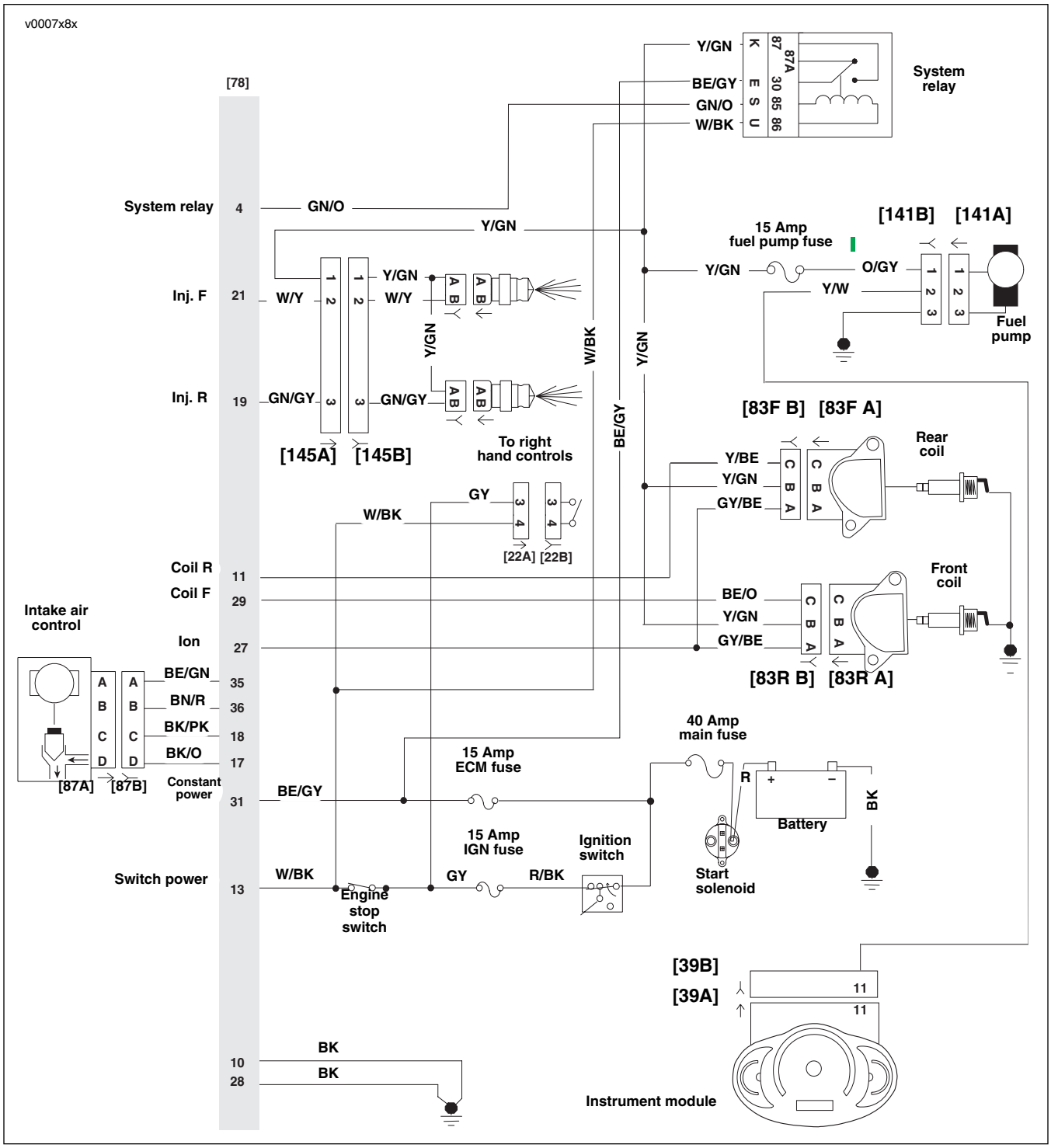


Figure 4-42. System Relay Circuit (VRSCA/VRSCD)

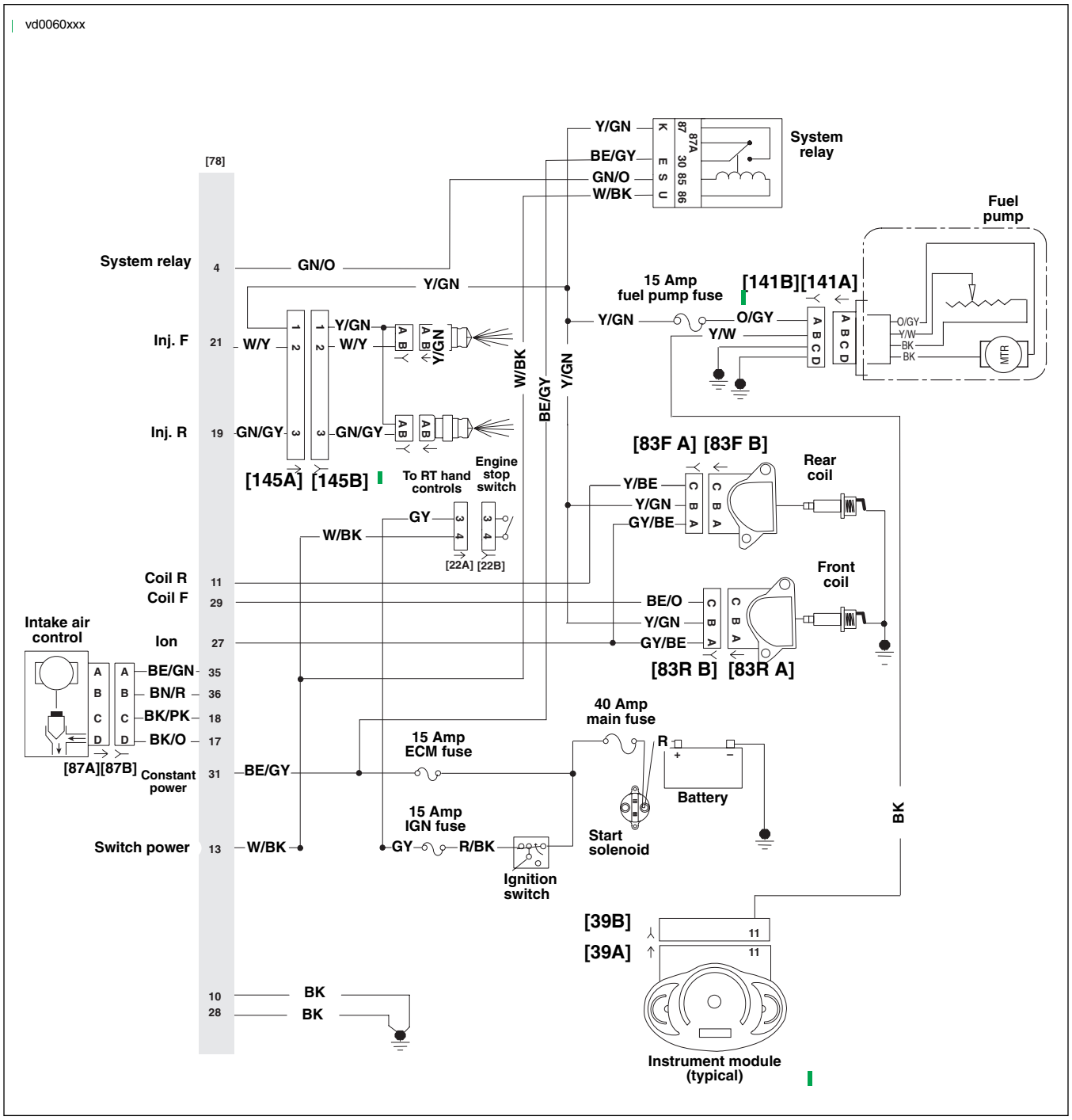


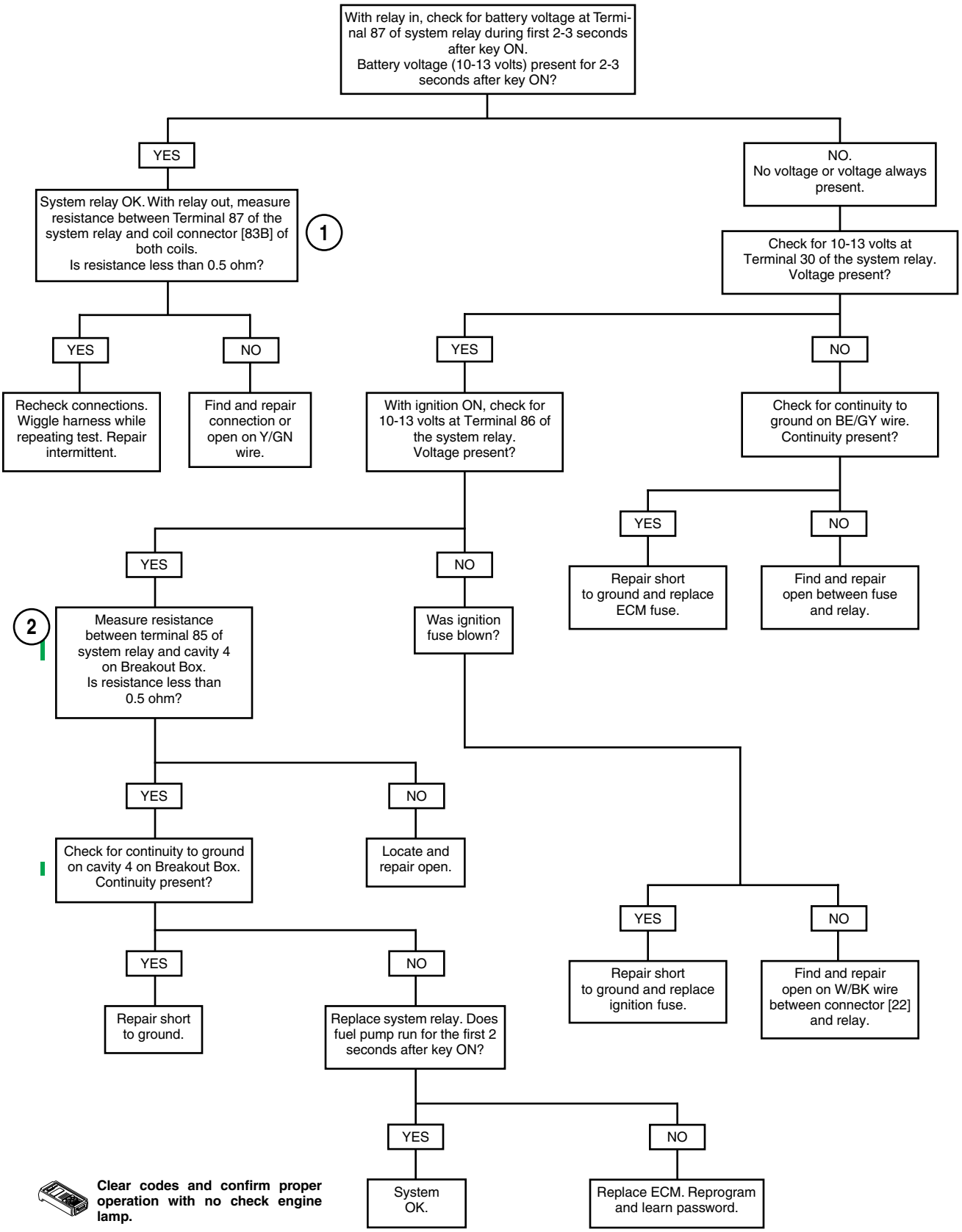
Figure 4-43. System Relay Circuit (VRSCR)

Table 4-17. Wire Harness Connectors in Figure 4-43.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar switch (black)	6-place Deutsch	under left side cover
[62]	System relay	fuse block	under airbox cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[83F]	Front plug top coil	3-place Packard	on top of front rocker box
[83R]	Rear plug top coil	3-place Packard	on top of rear rocker box
[145]	Engine harness	12-place Deutsch	under air cleaner

Test 4.15 (Part 1 of 3)

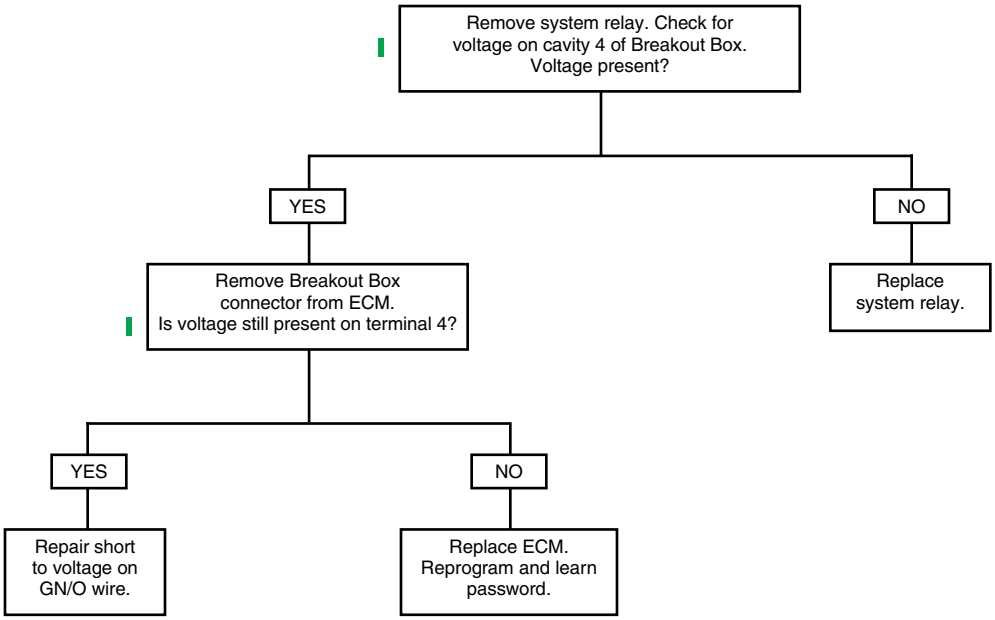
SYSTEM RELAY: DTC P1001, P1003



Clear codes and confirm proper operation with no check engine lamp.

Test 4.15 (Part 2 of 3)

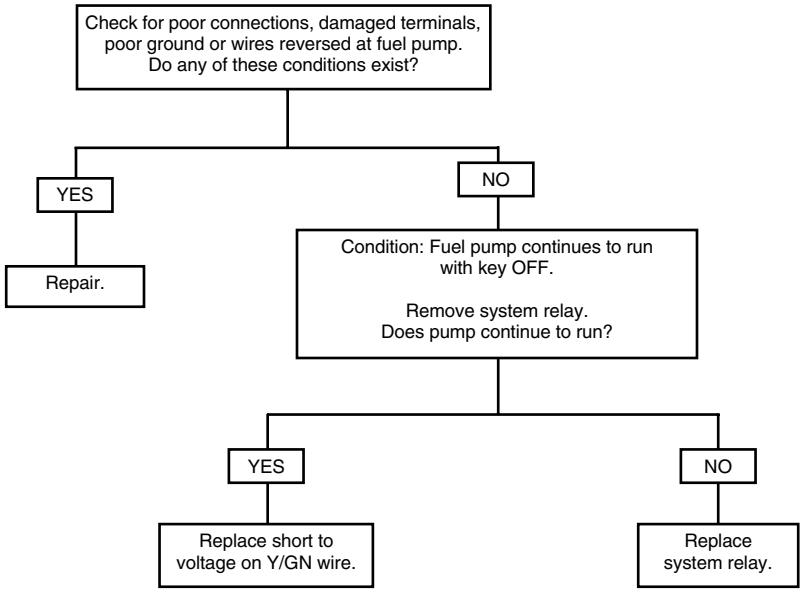
SYSTEM RELAY: DTC P1002



Clear codes and confirm proper operation with no check engine lamp.

Test 4.15 (Part 3 of 3)

SYSTEM RELAY: DTC P1004



Clear codes and confirm proper operation with no check engine lamp.

FAN OPERATION CHECK 4.16

GENERAL

Fan Relay

See Figure 4-44. The ECM will energize the fan relay when coolant temperature rises to 217° F (103° C) and shut off when coolant temperature falls to 208° F (98° C). The ECM may continue this function for up to one minute when engine is off if engine temperature is above 208° F (98° C)

Table 4-18. Code Description

DTC	DESCRIPTION
P1481	Fan relay coil open/low
P1482	Fan relay coil high

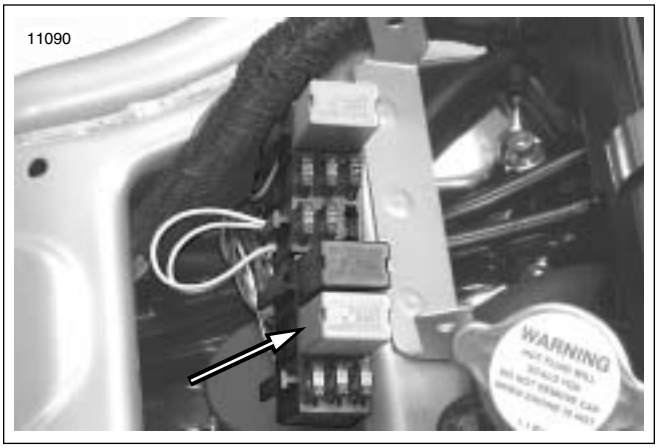


Figure 4-44. Fan Relay

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.16 flow charts.

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probe and patch cord.
2. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 4.7 BREAKOUT BOX: ECM

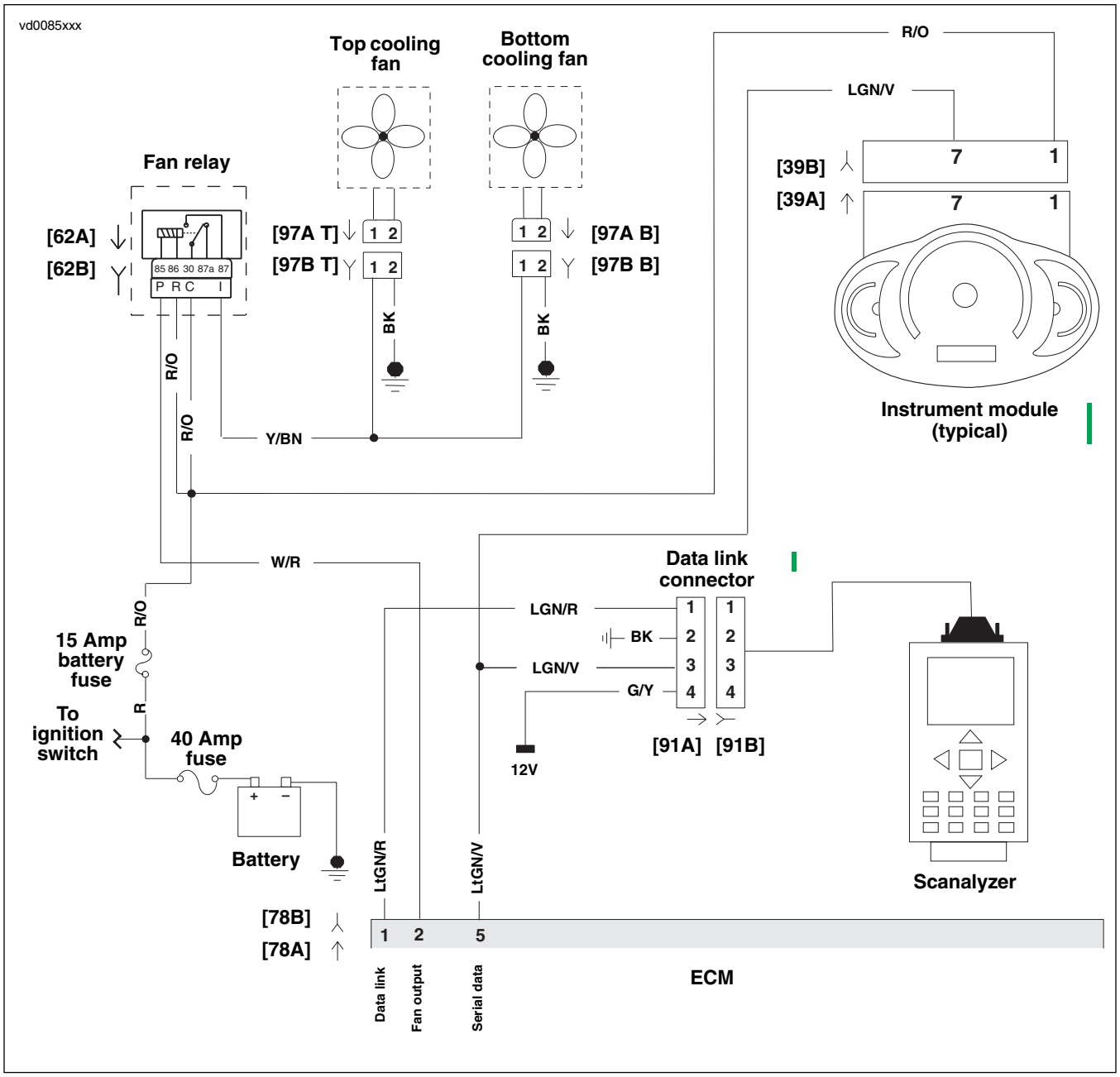


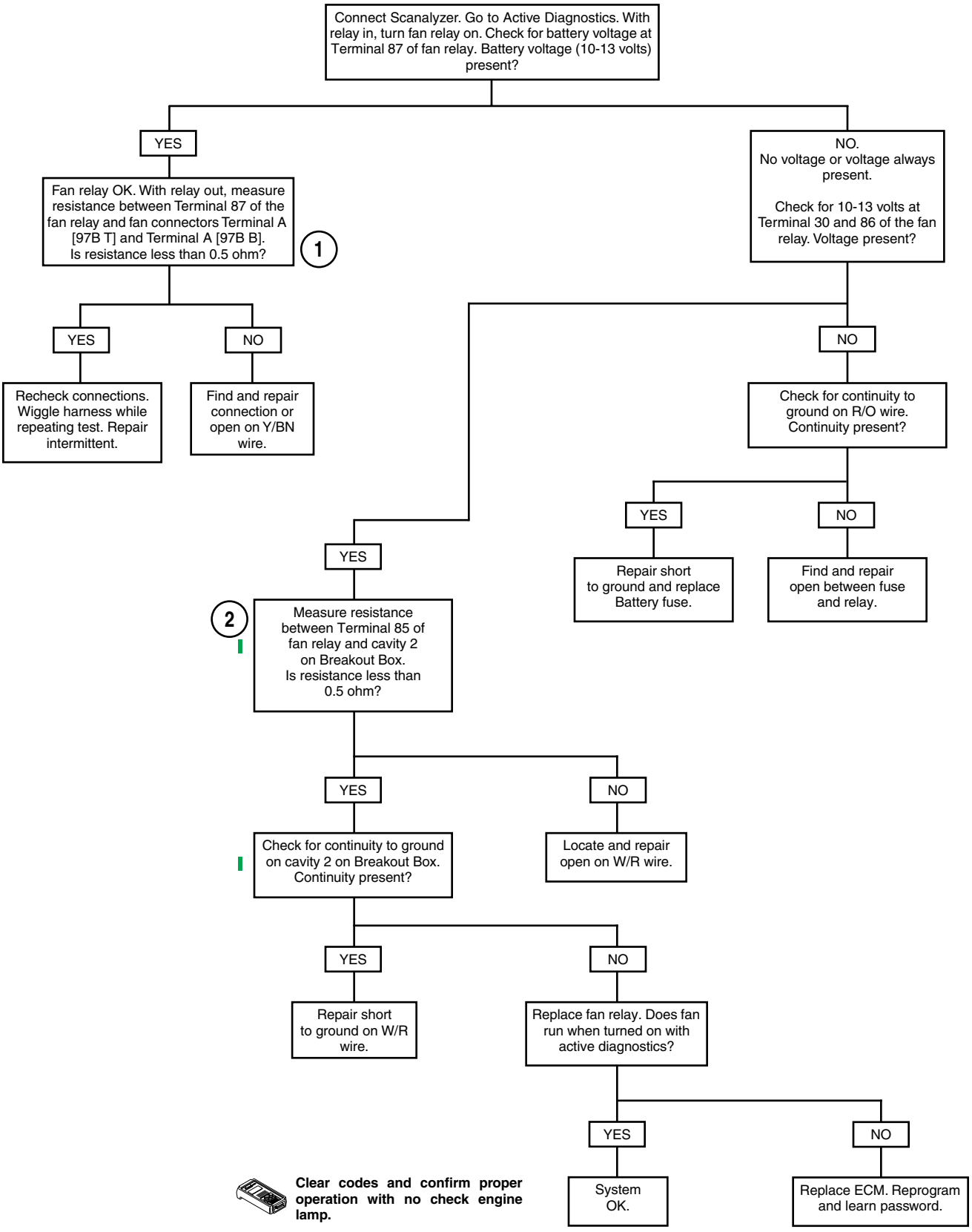
Figure 4-45. Fan Relay Circuit

Table 4-19. Wire Harness Connectors in Figure 4-45.

NO.	DESCRIPTION	TYPE	LOCATION
[39]	Instrument module	12-place Mini-Deutsch	inside handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[62]	Fan relay	fuse block	under airbox cover
[97 T]	Top cooling fan	2-place Multilock	behind radiator
[97 B]	Bottom cooling fan	2-place Multilock	behind radiator

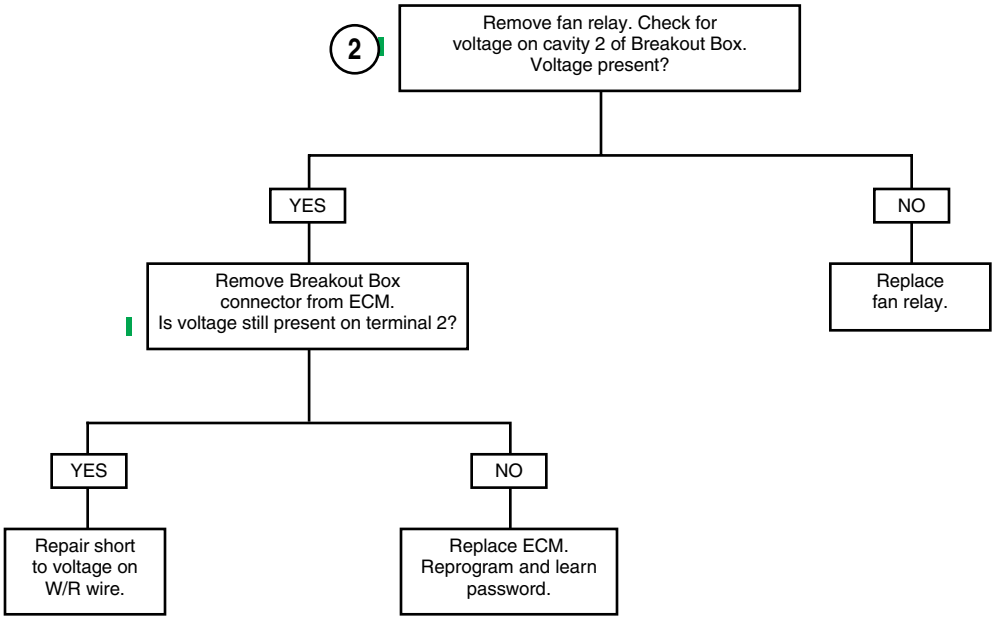
Test 4.16 (Part 1 of 2)

FAN OPERATION CHECK: DTC P1481 OR NO CODES



Test 4.16 (Part 2 of 2)

FAN OPERATION CHECK: DTC P1482 OR NO CODES



Clear codes and confirm proper operation with no check engine lamp.

FUEL PRESSURE TEST 4.17

GENERAL

The fuel pump is located in the fuel tank. It delivers fuel to the fuel metering assembly. The fuel metering assembly contains the fuel injectors and the pressure regulator, where the system pressure is controlled. Excess fuel pressure is returned to the fuel tank by a return line. The ECM controls the system relay that supplies 12 vdc to the fuel pump.

When the engine is stopped, the pump can be turned on by applying battery voltage to terminal A and ground to terminal D of the fuel pump connector [141A] (terminal 1 and ground to terminal 3 of the fuel pump connector [141A] on VRSCR models) or by using the Scanalyzer.

Improper fuel system pressure may contribute to one of the following conditions:

- Cranks, but won't run.
- Cuts out (may feel like ignition problem).
- Hesitation, loss of power or poor fuel economy.

TESTING

The fuel pressure gauge (0-100 PSI) allows for fuel injector and fuel system pressure diagnosis.

PART NO.	SPECIALTY TOOL
HD-41182	Fuel pressure gauge
26338-68	1/8 in. pipe thread 90° (right angle) elbow

1. See Figure 4-46. Fuel Pump Connector [141] (VRSCA/VRSCD) or Figure 4-47. Fuel Pump Connector [141](VRSCR). Disconnect fuel pump connector [141] from top of fuel tank.
2. Start the engine and allow the vehicle to run.
3. When engine stalls, operate the starter for 3 seconds to remove any remaining fuel from the fuel lines. Turn ignition key off.
4. See Figure 4-48. Insert a 1/8 in. pipe thread 90° degree (right angle) elbow (1) between the fuel valve (2) and the Schrader valve adapter (3).
5. See Figure 4-49. Remove protective cap from Schrader valve in fuel metering assembly.
6. Verify that the fuel valve and air bleed petcock on the Fuel Pressure Gauge (HD-41182) are closed.

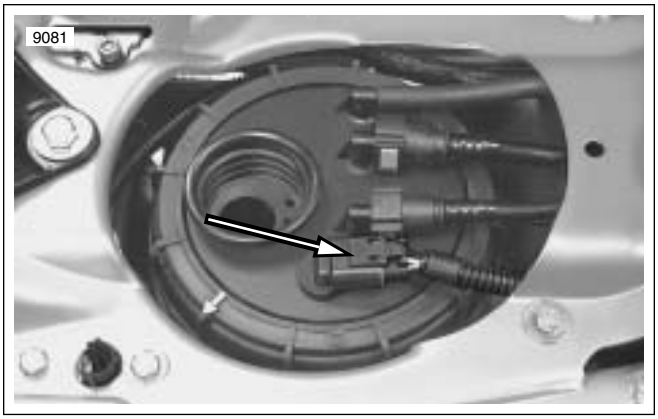


Figure 4-46. Fuel Pump Connector [141] (VRSCA/VRSCD)

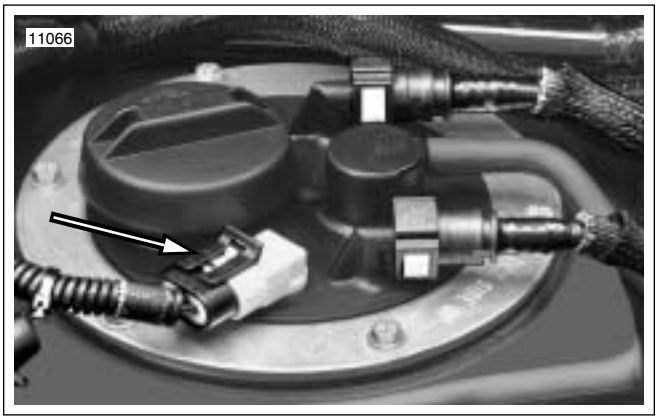
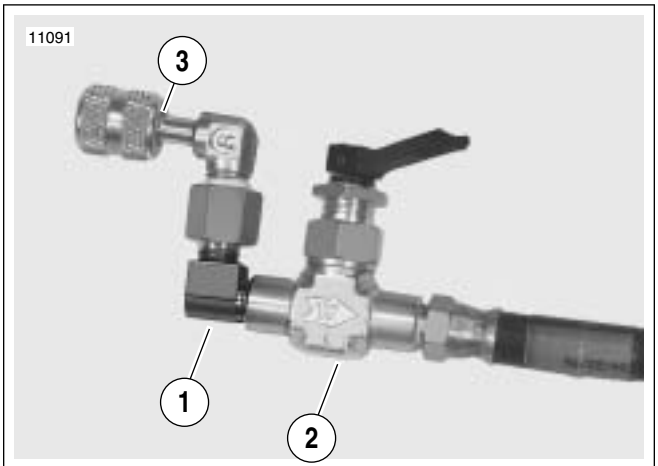


Figure 4-47. Fuel Pump Connector [141] (VRSCR)



1. 1/8 in. pipe thread 90° elbow
2. Fuel valve
3. Schrader valve adapter

Figure 4-48. Fuel Pressure Gauge Valves

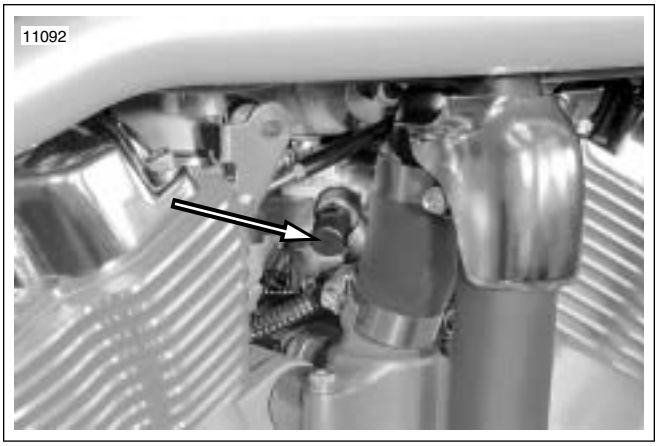


Figure 4-49. Schrader Valve Location

7. Connect fuel pressure gauge to Schrader valve. Reconnect connector [141].
8. Start and idle engine to pressurize the fuel system. Open the fuel valve to allow the flow of fuel down the hose of the pressure gauge.
9. Position the clear air bleed tube in a suitable container and open and close the air bleed petcock to purge the gauge and hose of air. Repeat this step several times until only solid fuel (without bubbles) flows from the air bleed tube. Close the petcock.
10. Open and close throttle to change engine speed. Note the reading of the pressure gauge. Fuel pressure should remain steady at 380-425 kPa (55-62) psi.
11. Turn the engine off. Open the air bleed petcock to relieve the fuel system pressure and purge the pressure gauge of gasoline.

⚠WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

12. Remove fuel pressure gauge from the Schrader valve in fuel metering assembly. Install protective cap over Schrader valve.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.17 flow chart.

1. If the regulator is faulty, see VRSC Service Manual.
2. If fuel system has pressure, but it is less than specification, check for the following conditions.
   a. The amount of fuel to the injectors is within limits, but pressure is too low. Also, hard starting cold and overall poor performance condition may exist.
   b. Restricted fuel flow causing pressure drop. However, if pressure drop occurs only when driving, engine may surge and lose power as pressure begins to drop rapidly.
3. This condition may be identified when the fuel level is low and the fuel pump turned on for the first 2 seconds after key ON. A ringing sound can be heard as the high pressure fuel is sprayed against the inside wall of the fuel tank.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.

NOTE

With the engine OFF, the Scanalyzer (Active Diagnostic Test Mode) can be used to turn the fuel pump on for periods of up to 30 seconds.

Figure 4-50. Fuel Pressure Gauge Installed

Test 4.17

FUEL PRESSURE TEST

Install fuel pressure gauge. See TESTING under 4.17 FUEL PRESSURE TEST.

Start and idle engine.

Open and close throttle to change engine speed. Does fuel pressure remain steady at 55-62 PSI (380-425 kPa)?

- YES — Steady pressure.
  - No trouble found. Review symptoms.
- NO — Low pressure.
  - (2) Check for restricted fuel filter or pump inlet screen. Are filter and screen OK?
    - YES
      - (1) (3) Check for restricted pressure line or flex hose between Schrader and test gauge. If lines are OK, check for:
        - Faulty fuel pump.
        - Leak inside tank caused by faulty coupling hose or connection, such as hose at filter or pump.
        - Faulty fuel pressure regulator.
    - NO
      - Replace filter or clean pump inlet screen. Retest.
- NO — High pressure.
  - (1) Inspect return line to fuel tank for damage or obstructions. If OK, replace faulty fuel pressure regulator.

IDLE AIR CONTROL 4.18

GENERAL

IAC Operation

The ECM controls engine idle speed by moving the idle air control (IAC) to open or close a passage around the throttle plates. It does this by sending voltage pulses to the proper motor winding of the IAC. This causes the pintle to move in or out of the IAC a given distance for each pulse received.

- To increase idle speed, the ECM retracts the pintle, allowing more air to flow through the throttle body.
- To decrease idle speed, the ECM extends the pintle, allowing less air to flow through the throttle body.

The IAC position can be measured in steps. Use the Data Monitor Display (4.5 SCANALYZER) to check this measurement.

- A high number of steps represents a fully retracted pintle and open passage around throttle plate. This correlates with an increase in the amount of air flowing through the throttle body.
- Zero steps represents a fully extended pintle. A zero reading indicates an abnormal condition in which the pintle has been fully extended and has consequently closed the passage around throttle plate.

Each time the ignition is turned off, the ECM resets the IAC by sending enough pulses to extend the pintle and effectively close the throttle body. The fully extended value is the ECM reference point. A given number of steps are then calculated by the ECM for use in setting the proper idle speed and IAC position.

NOTE

Idle speed is controlled by the ECM and can not be adjusted.

Diagnostic Trouble Code P0505: Loss of Idle Speed Control

Loss of idle speed control will result if the idle RPM is ±200 from preset idle speed and IAC motor is at zero or maximum for greater than 5 seconds. This code may occur with others for a multiple code situation. Resolve the other codes first to correct.

Table 4-20. Code Description

DTC	DESCRIPTION
P0505	Loss of idle speed control

DIAGNOSTICS

Diagnostic Tips

Engine idle speed can be adversely affected by the following:

- A loss of idle speed control does not necessarily imply the IAC actuator or wiring has failed. It can be caused by a number of conditions such as an intake air leak, improperly adjusted throttle linkage or a misfiring cylinder.
- Leaking injectors will cause fuel imbalance and poor idle quality due to different air/fuel ratios in each cylinder. To check for leaky injectors, first remove the airbox and air filter. See AIRBOX AND AIR FILTER in the VRSC Service Manual. Then, with the throttle wide open, turn key ON for 2 seconds and then OFF for 2 seconds five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores. See FUEL INJECTORS in the VRSC Service Manual.
- Vacuum leaks. To check for vacuum leaks, spray water around the throttle body seals while idling the engine. If RPM changes, replace seals. A leak can also be indicated by a low IAC count on the Scanalyzer Data Monitor.
- Contaminated fuel.
- TPS reading of greater than 1% (possible throttle cable misadjustment) or battery voltage reading of less than 9 volts or a vehicle speed sensor (VSS) greater than 0 will disable idle speed control.
- If there is a loss of battery power at ECM terminal 31, vehicle will start but IAC pintle will not reset at key OFF. Eventually pintle will be out of position causing performance problems.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.18 flow charts.

1. When the engine is stopped, the IAC pintle extends and then retracts to a fixed “Park” position for increased airflow and idle speed during the next engine start sequence. This key OFF reset procedure takes 10 seconds to perform.
2. Test lamp behavior may follow two patterns. The color of the lights is not relevant to IAC operation.
   a. **Normal behavior:** At key ON, test lights will alternately flash and then remain steady on to confirm ECM signals. At key OFF lights alternately flash and go out after 10 second reset procedure.
   b. **Problem indicated:** One or more lights fail to illuminate during key ON/key OFF cycle.

NOTE

There is a remote possibility that one of the circuits is shorted to voltage which would have been indicated by a steady light. Disconnect ECM and turn the ignition ON. Probe terminals to check for this condition.

3. Connect BREAKOUT BOX (Part No. HD-43876) to EFI wire harness only, leaving ECM disconnected. See 4.7 BREAKOUT BOX: ECM.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probe and patch cord.
5. Repair faulty ECM connection or replace ECM. If ECM requires replacement, see ECM in the VRSC Service Manual.

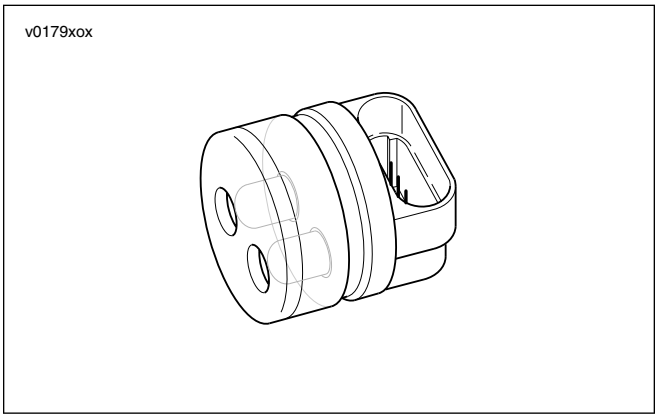


Figure 4-51. IAC Test Lamp (Part No. HD-41199-3)

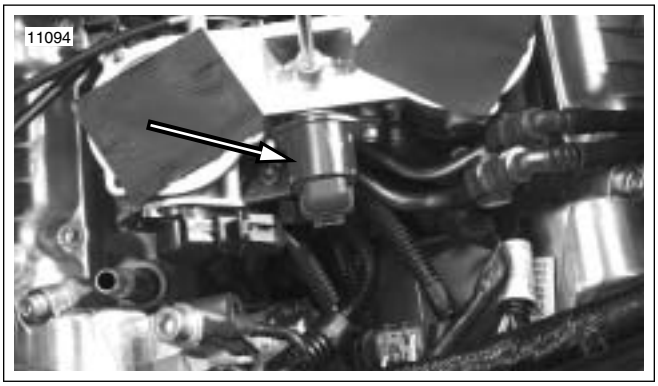


Figure 4-52. IAC

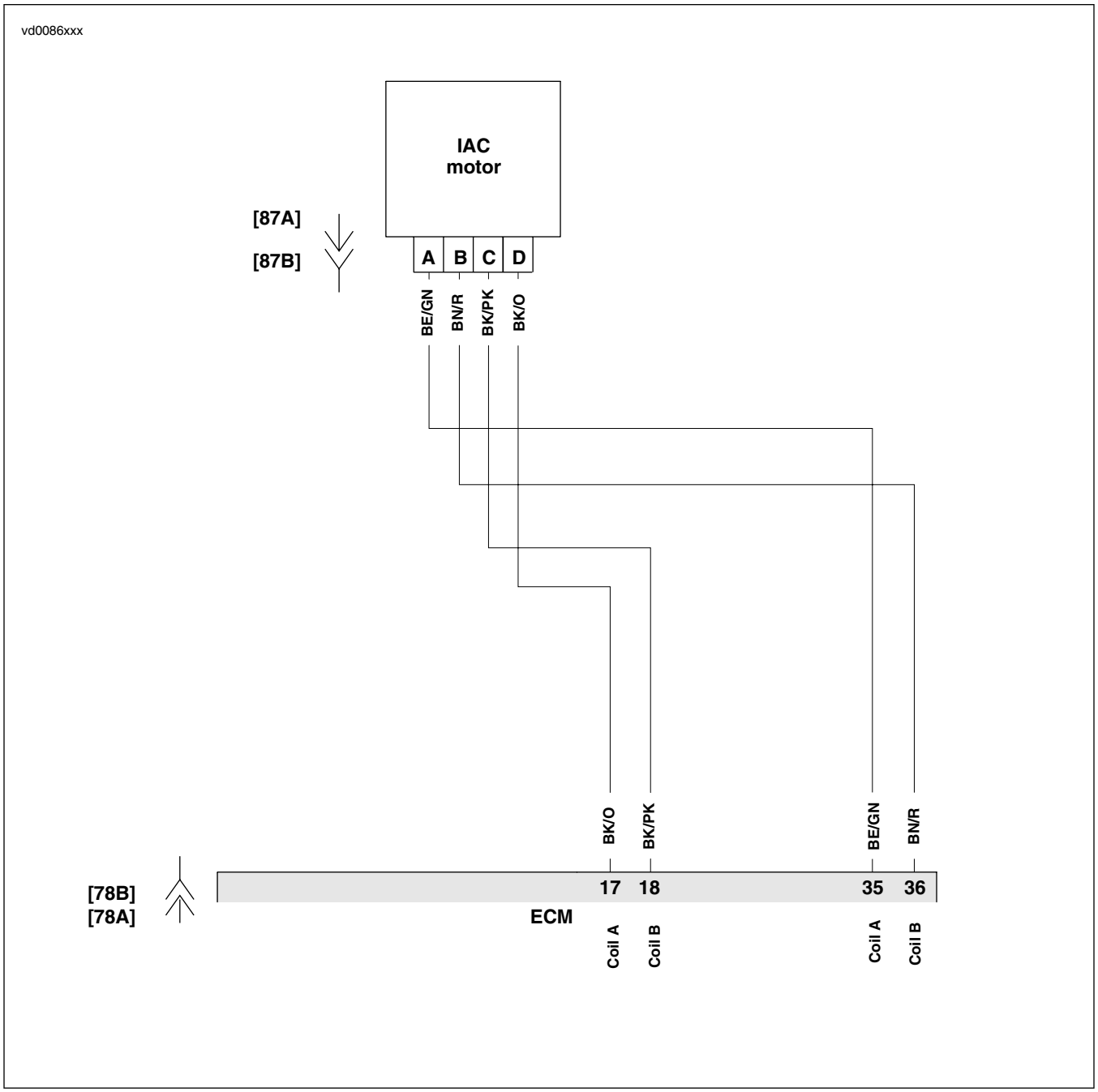


Figure 4-53. IAC Circuit

Table 4-21. Wire Harness Connectors in Figure 4-53.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[87]	IAC	4-place Packard	below air cleaner assembly

Test 4.18 (Part 1 of 2)

IDLE AIR CONTROL: DTC P0505

View data monitor display on Scanalyzer. Is TP sensor reading greater than 0%?

- YES → Lubricate and adjust throttle cables.
- NO → Remove air cleaner cover and element.

Monitor IAC pintle for 10 seconds after turning ignition OFF. Does pintle extend and then retract during 10 second key OFF reset procedure? (1)

- YES → Check intake manifold for leaks. See VRSC Service Manual, Intake Leak Test.
  - YES → Repair intake leak.
  - NO → Check fuel pressure. See 4.17 FUEL PRESSURE TEST.
- NO → Remove airbox. Disconnect IAC and connect test lamp. See Figure 4-51.

Turn ignition key ON for 2 seconds, then turn ignition key OFF for 10 seconds. (2)

- Problem indicated. → Remove test lamp. Connect Breakout Box to connector [78B] leaving ECM disconnected. Check terminal 31 for battery voltage. Battery voltage present?
  - YES → Using DVOM, measure resistance between IAC connector [87B] and Breakout Box. (3)

IAC	WIRE COLOR	ECM
A	BE/GN	to 35
B	BN/R	to 36
C	BK/PK	to 18
D	BK/O	to 17

(4) Does each wire measure 0.5 ohms or less?

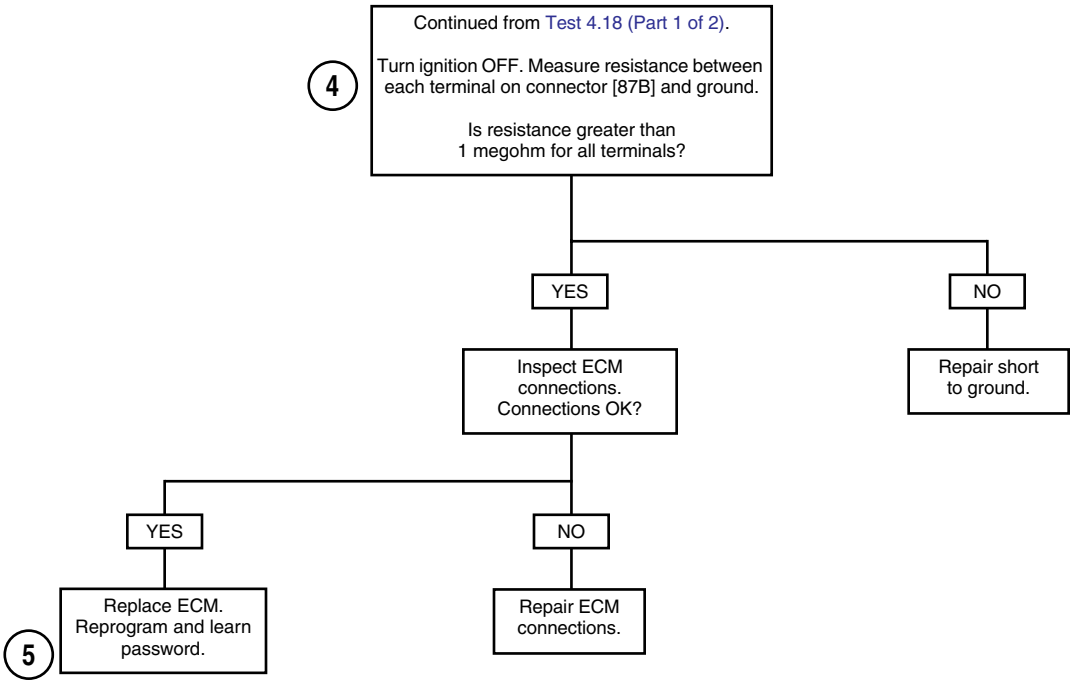
- YES → (4) Turn ignition ON. With ECM still disconnected, check voltage on all four terminals at connector [87B]. Is voltage present?
  - YES → Repair short to voltage.
  - NO → **Go to Test 4.18 (Part 2 of 2).**
- NO → Repair poor connection at connectors [87B] or [78B] or repair open wire in harness.

  - NO → Go to 4.11 NO ECM POWER.
- Normal behavior. → Repair faulty IAC connection or IAC assembly.

Clear codes and confirm proper operation with no check engine lamp.

Test 4.18 (Part 2 of 2)

IDLE AIR CONTROL: DTC P0505



Clear codes and confirm proper operation with no check engine lamp.

MISFIRE AT IDLE OR UNDER LOAD 4.19

GENERAL

Misfire at Idle or Under Load

- Battery condition and connections may also cause misfires. See BATTERY in the VRSC Service Manual for more information.
- Fuel system problems may also cause misfires. Consult 4.17 FUEL PRESSURE TEST and then refer to symptom tables under 4.9 INITIAL DIAGNOSTIC CHECK.
- Mechanical problems with the engine may cause misfires. See VRSC Service Manual for more information.
- Vehicle modifications including intake and exhaust changes may cause misfires.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.19 flow charts.

⚠WARNING

An open spark can ignite gasoline. Gasoline is extremely flammable and highly explosive which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner.

1. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 4.7 BREAKOUT BOX: ECM.
2. See Figure 4-54. A SPARK TESTER (Part No. HD-26792) must be used to verify adequate secondary voltage (25,000 volts) at the spark plug.

NOTE

Engine will not spark with both spark plugs removed. When checking for spark, use SPARK TESTER (Part No. HD-26792) with both plugs installed.

   a. Turn ignition key OFF.
   b. See Figure 4-21. Attach plug top coil to SPARK TESTER (Part No. HD-26792). Clip tester to ground.
   c. While cranking engine, watch for spark to jump tester gap on leads.
   d. Reinstall and repeat procedure on other coil.

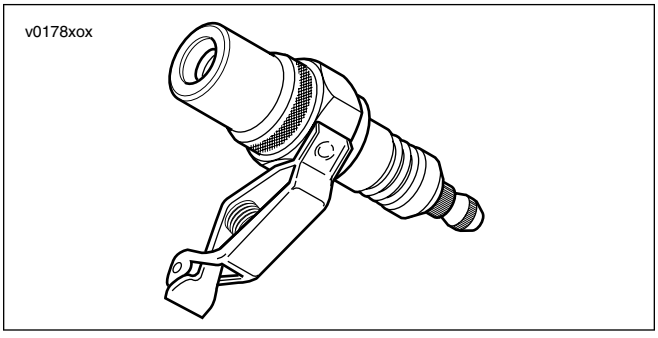
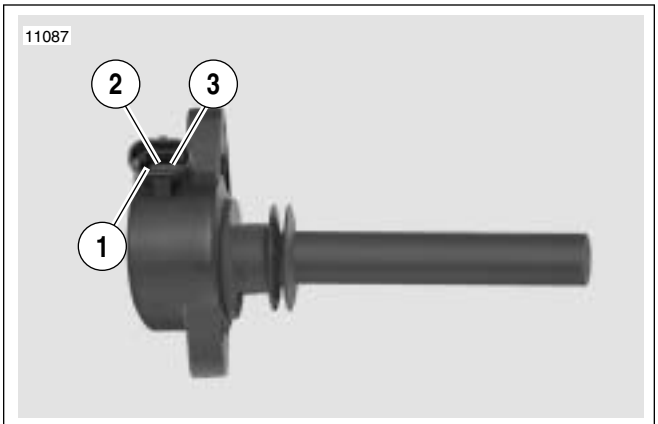


Figure 4-54. Spark Tester

3. See Figure 4-55. Perform plug top coil resistance test.
   a. Remove plug top coil.
   b. Using an ohmmeter, touch probes to coil terminals referred to in Table 4-22.
   c. If coil primary is out of range or coil secondary is below range, replace coil.
   d. If coil secondary is above specified range, remove boot and recheck coil. If coil readings are within specifications, replace boot. If coil secondary readings are still above specifications, replace coil.
   e. Reinstall and repeat procedure on other coil.
4. This test can also be performed by substituting a known good coil for one causing the no spark condition. The coil does not require full installation to be functional. Verify faulty coil by performing resistance test. See IGNITION COIL in the VRSC Service Manual.
5. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), red terminal probe and patch cord to relay and gray terminal probe and patch cord to the coil connector [83B].
6. See 1.4 DIAGNOSTICS/TROUBLESHOOTING for more information on voltage drop testing.

Table 4-22. Plug Top Coil

COIL	SPECIFICATION
Primary terminal B to terminal C	0.3-0.5 ohms
Secondary terminal A to plug end of boot	3500-4500 ohms
Plug top coil boot	less than 5 ohms



1. **Terminal A**
2. **Terminal B**
3. **Terminal C**

Figure 4-55. Plug Top Coil

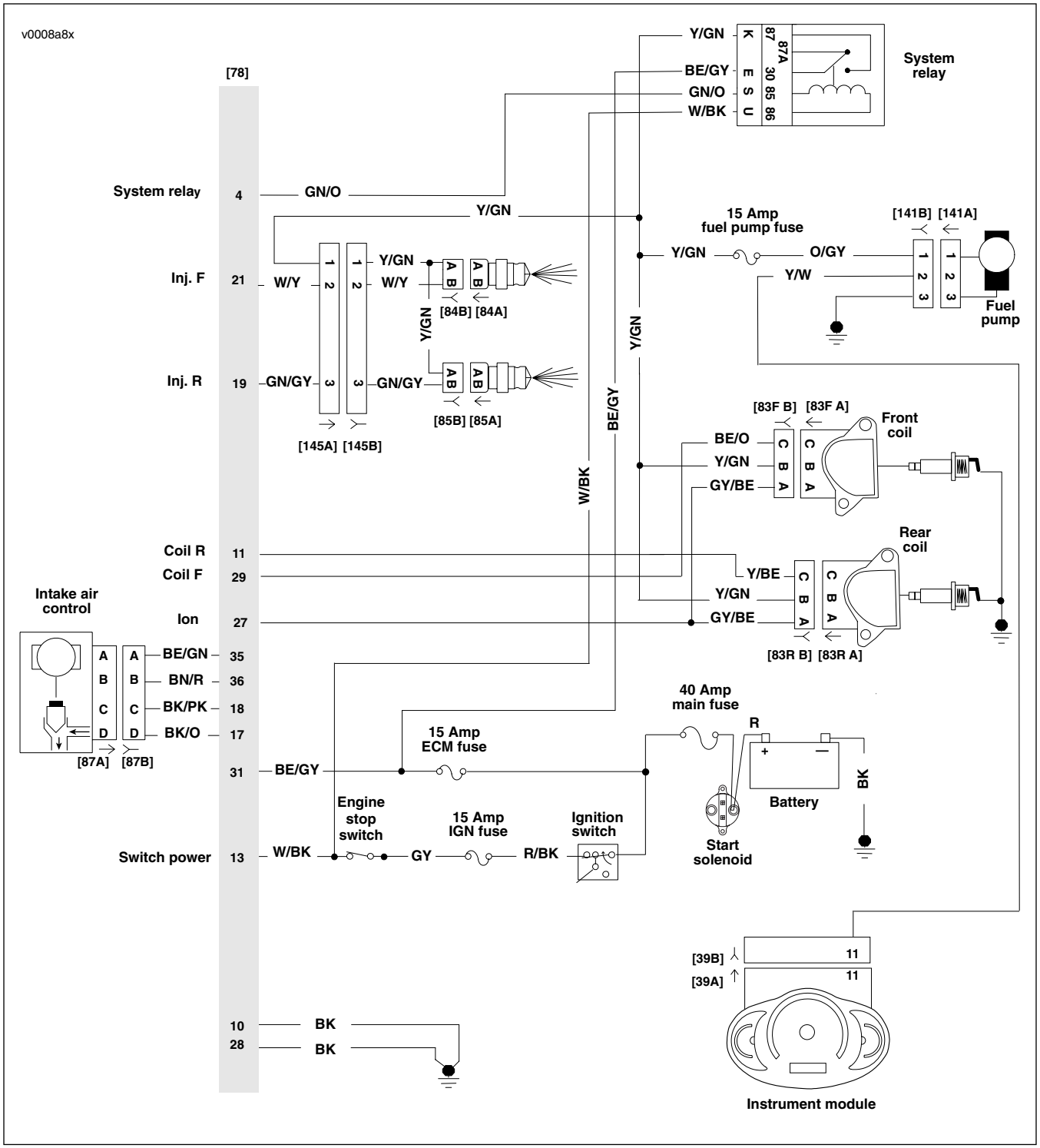


Figure 4-56. Ignition Coil Circuit Diagram (VRSCA/VRSCD)

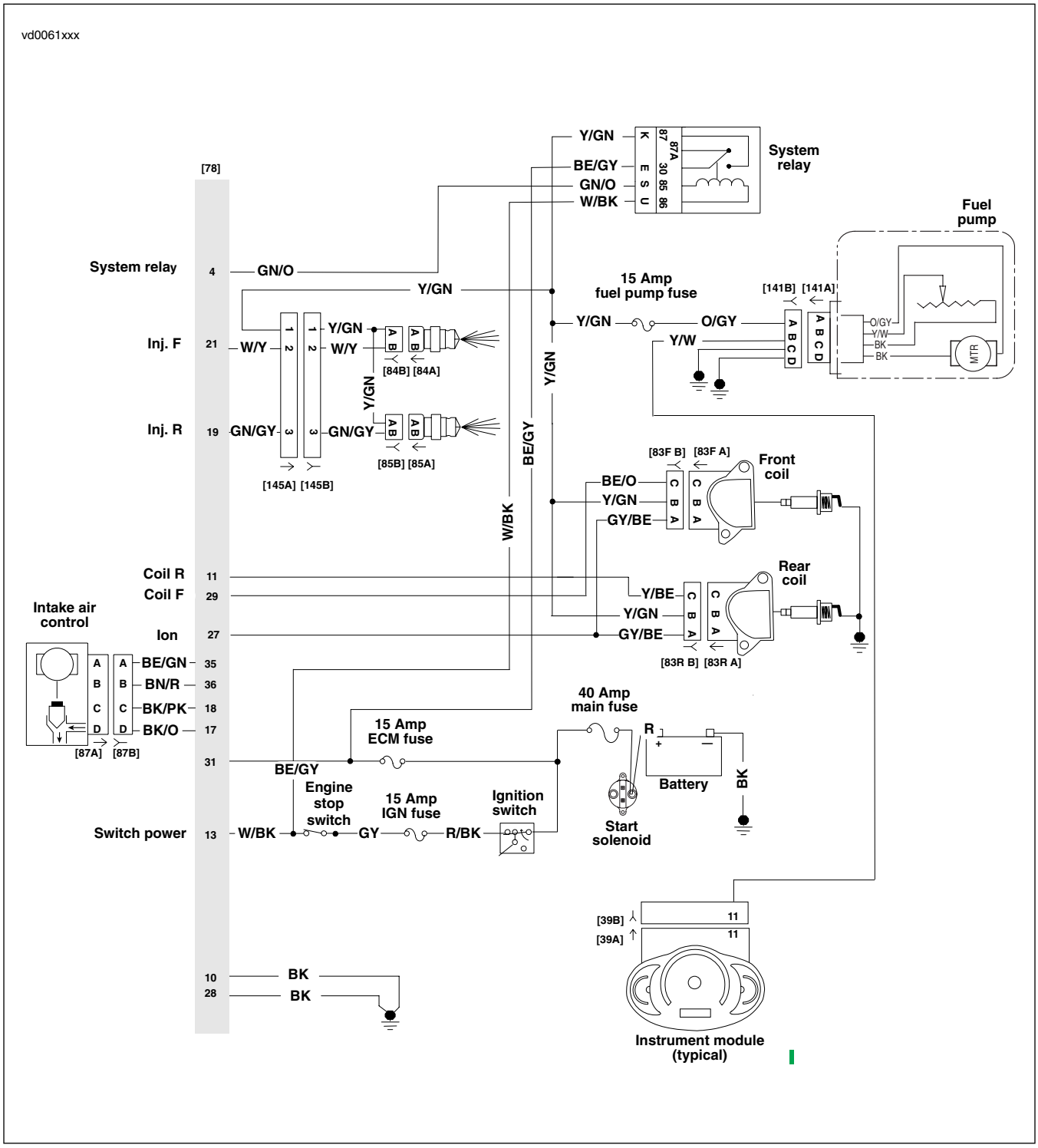


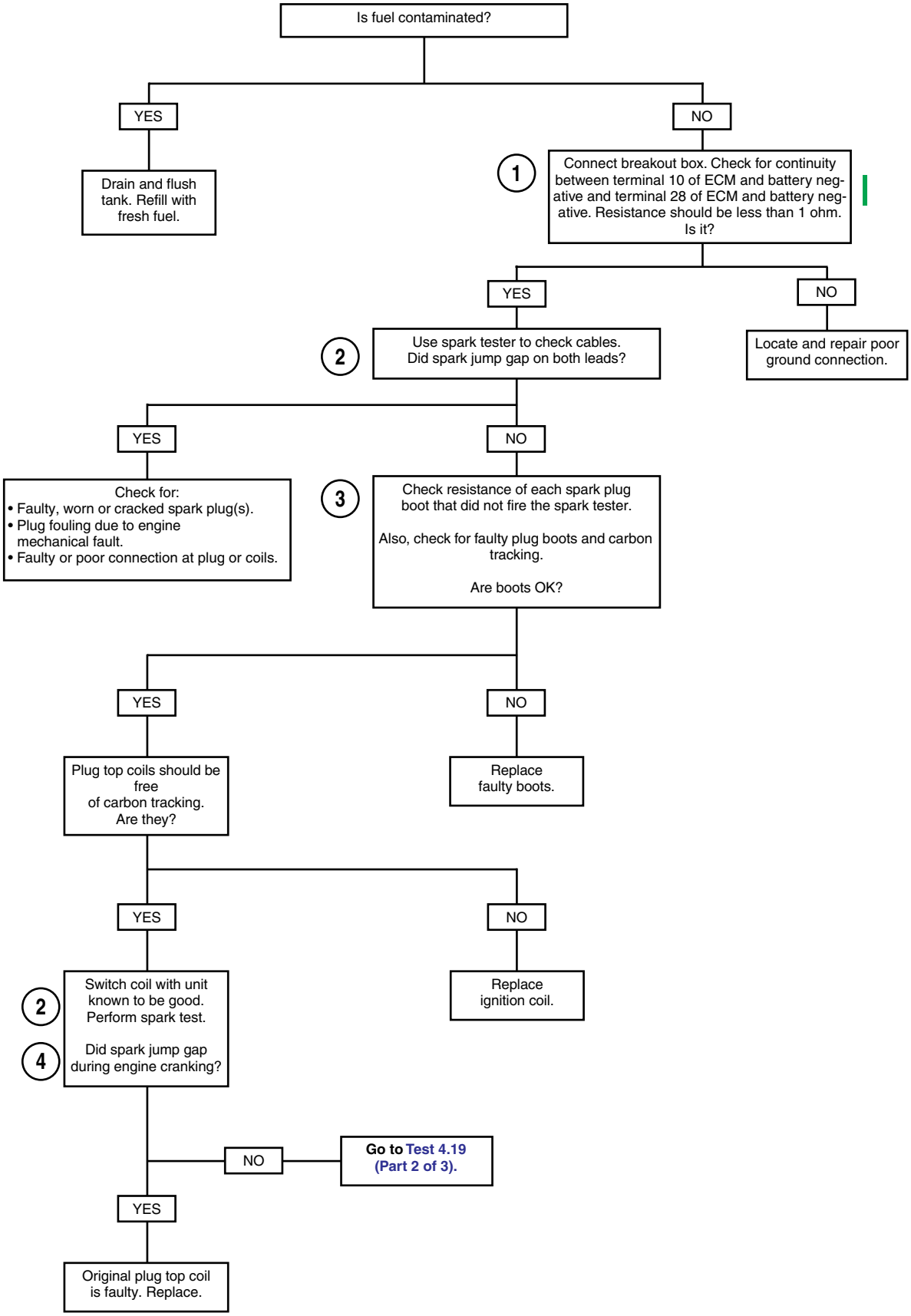
Figure 4-57. Ignition Coil Circuit Diagram (VRSCR)

Table 4-23. Wire Harness Connectors in Figure 4-57.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[83F]	Front plug top coil	3-place Packard	on top of front cam cover
[83R]	Rear plug top coil	3-place Packard	on top of rear cam cover
[145]	Engine harness	12-place Deutsch	under air cleaner

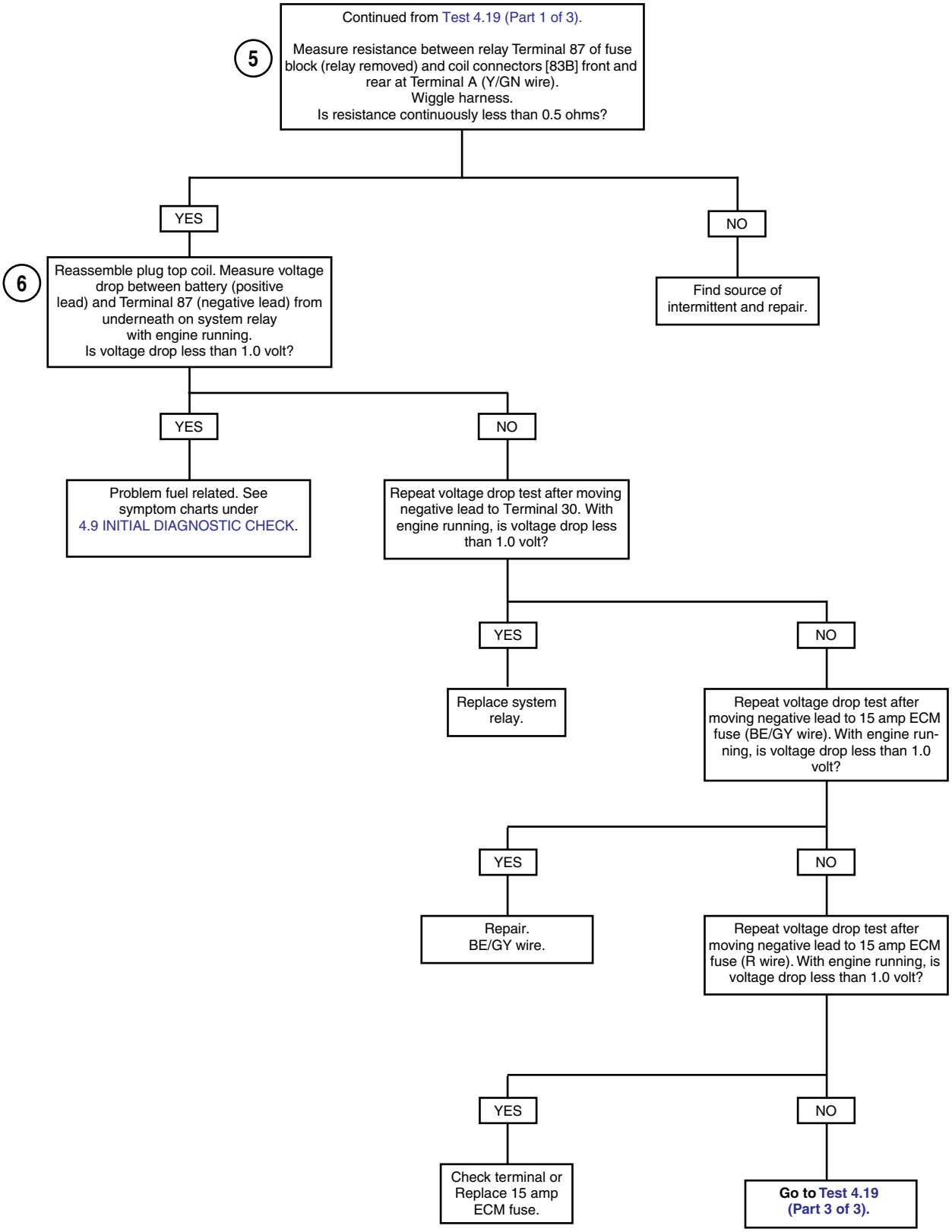
Test 4.19 (Part 1 of 3)

MISFIRE AT IDLE OR UNDER LOAD



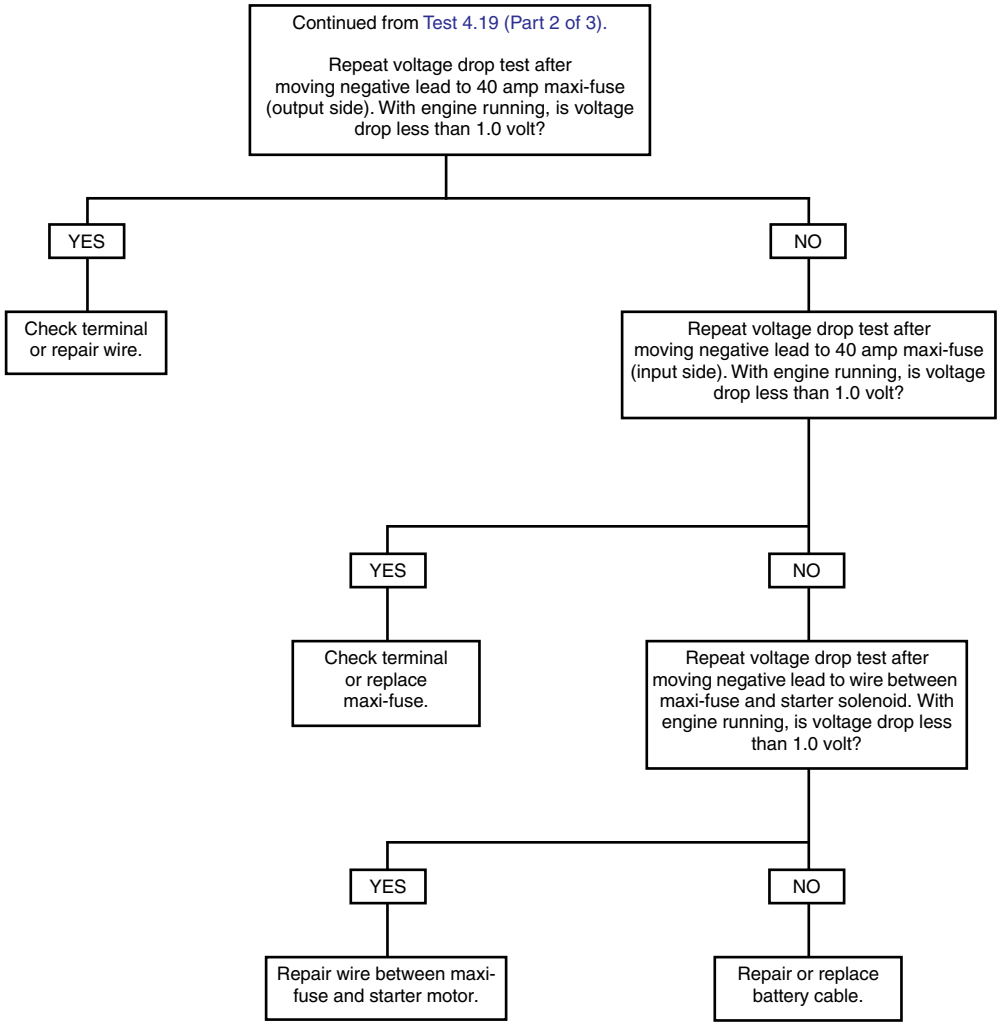
Test 4.19 (Part 2 of 3)

MISFIRE AT IDLE OR UNDER LOAD



Test 4.19 (Part 3 of 3)

MISFIRE AT IDLE OR UNDER LOAD



COMBUSTION ABSENT/INTERMITTENT 4.20

GENERAL

Diagnostic Trouble Codes P1353, P1356, 1357, 1358: No Combustion

See Figure 4-58. A feedback voltage signal in the secondary ignition circuit (terminal A) detects the presence of combustion each time a cylinder fires on ECM terminal 27. For diagnostic purposes, this signal is only analyzed at high speed and load where it may be easily measured. Failure to detect combustion at high speed and load means one of following conditions is true.

- Cylinder is truly misfiring.
- There is a lack of continuity in the ignition coil secondary circuit.

Table 4-24. Code Description

DTC	DESCRIPTION
P1353	Front cylinder no combustion
P1356	Rear cylinder no combustion
P1357	Front cylinder combustion intermittent
P1358	Rear cylinder combustion intermittent

Table 4-25. Plug Top Coil

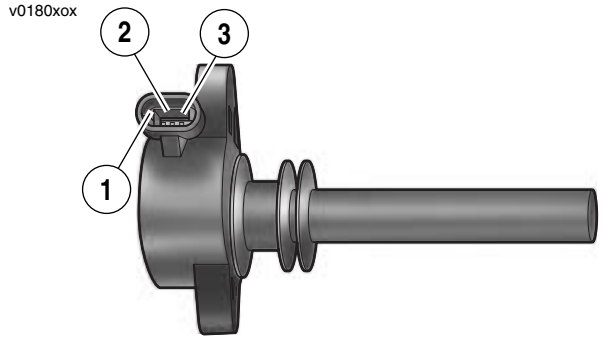
COIL	SPECIFICATION
Primary terminal B to terminal C	0.3-0.5 ohms
Secondary terminal A to plug end of boot	3.5-4.5K ohms
Plug top coil boot	< 5 ohms

DIAGNOSTICS

Diagnostic Notes

The reference number below correlates with the circled numbers on the Test 4.20 flow charts.

1. Perform plug top coil resistance test.
   a. Remove plug top coil.
   b. Using an ohmmeter, touch probes to coil terminals referred to in Table 4-25.
   c. If coil primary is out of range or coil secondary is below range, replace coil.
   d. If coil secondary is above specified range, remove boot and recheck coil. If coil readings are within specifications, replace boot. If coil secondary readings are still above specifications, clean the coil terminals and repeat resistance test. If resistance is still high after cleaning terminals, replace plug top coil.
   e. An infinite ohms (∞ or no continuity) resistance value indicates an open circuit (a break in the coil winding). Replace plug top coil.
   f. Reinstall and repeat procedure on other coil.
2. Connect BREAKOUT BOX (Part No. HD-43876) to ECM. See 4.7 BREAKOUT BOX: ECM.



1. **Terminal A**
2. **Terminal B**
3. **Terminal C**

Figure 4-58. Plug Top Coil

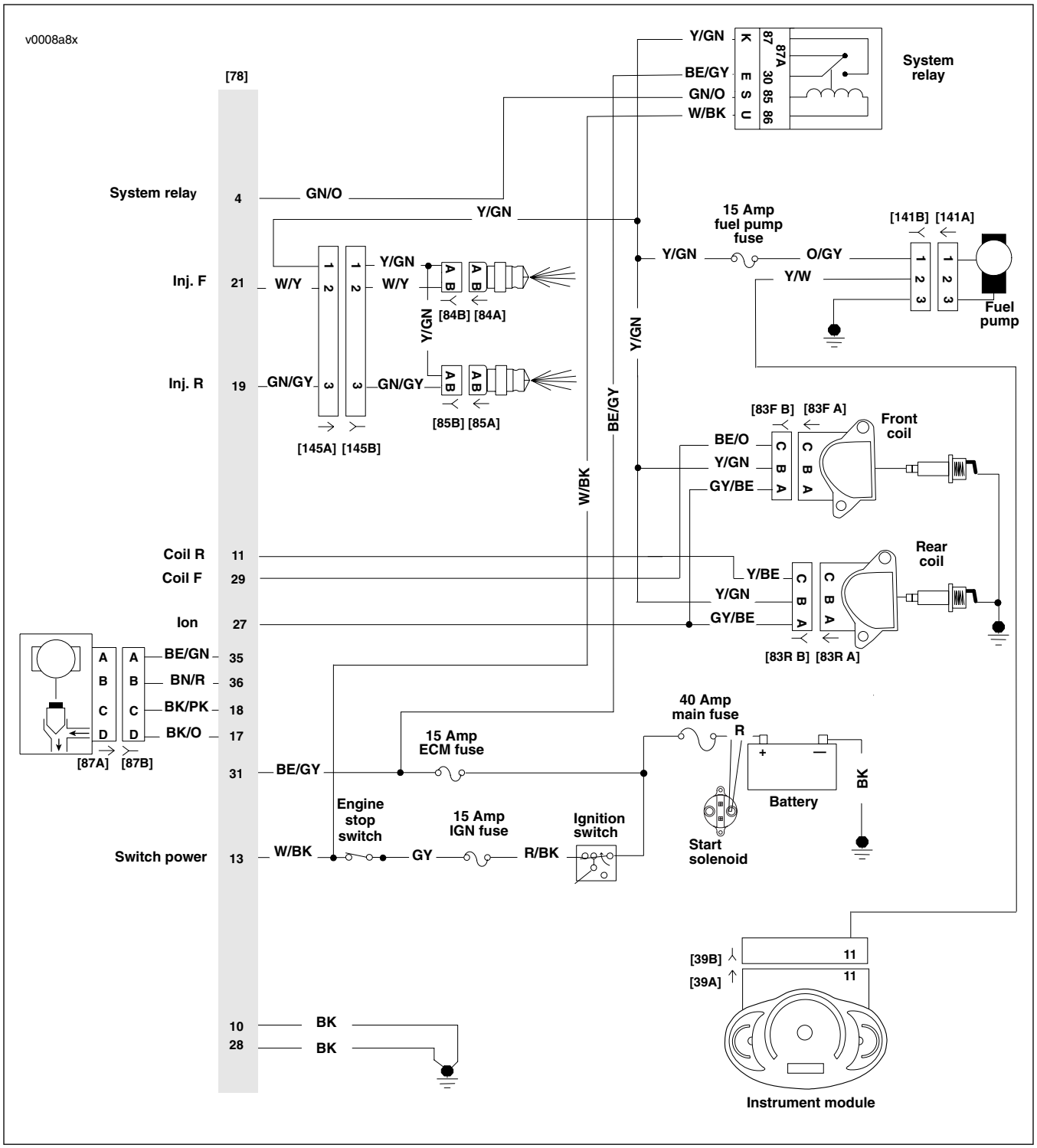


Figure 4-59. Secondary Ignition Circuit Diagram (VRSCA/VRSCD)

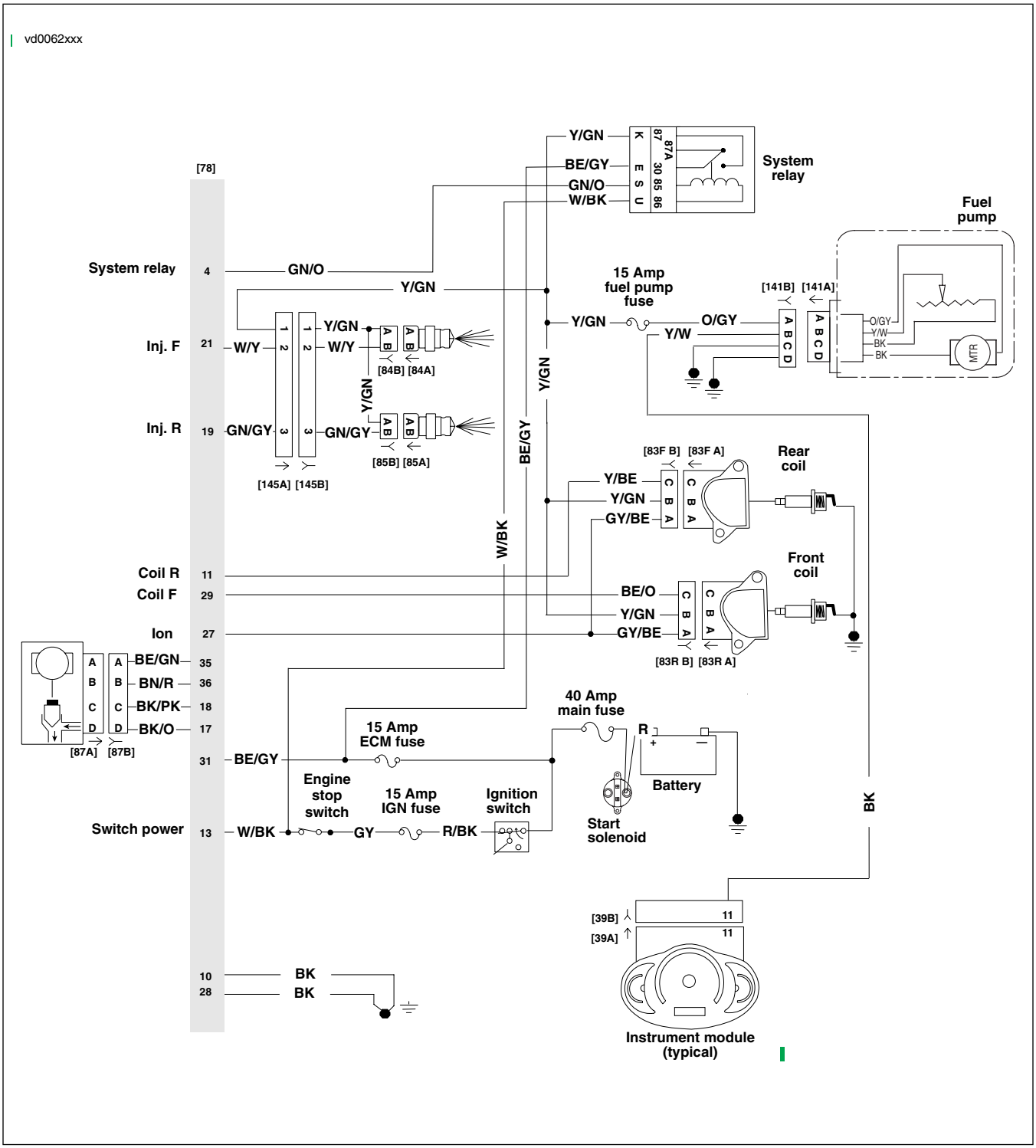


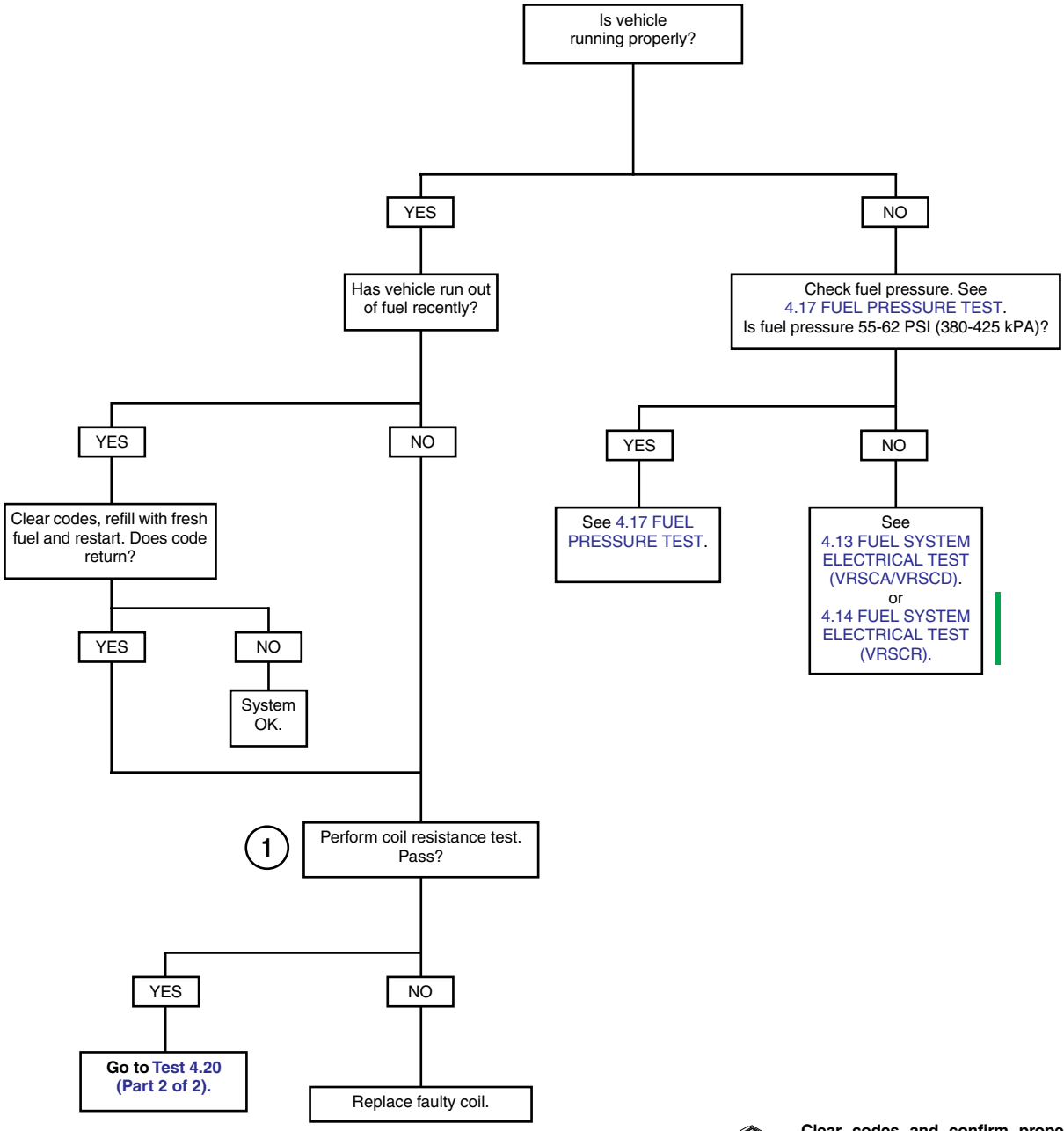
Figure 4-60. Secondary Ignition Circuit Diagram (VRSCR)

Table 4-26. Wire Harness Connectors in Figure 4-60.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[83F]	Front plug top coil	3-place Packard	on top of front cam cover
[83R]	Rear plug top coil	3-place Packard	on top of rear cam cover
[145]	Engine harness	12-place Deutsch	under air cleaner

Test 4.20 (Part 1 of 2)

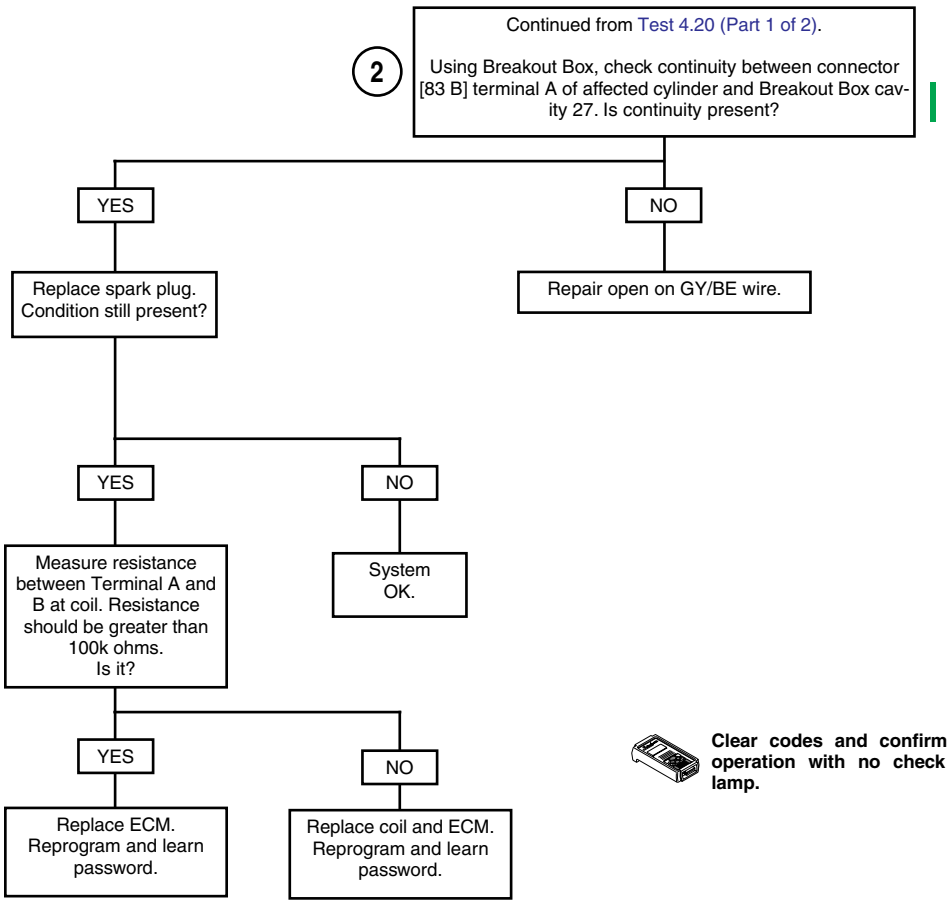
COMBUSTION ABSENT: DTC P1353, P1356, 1357, 1358



Clear codes and confirm proper operation with no check engine lamp.

Test 4.20 (Part 2 of 2)

COMBUSTION ABSENT: DTC P1353, P1356, 1357, 1358



Clear codes and confirm proper operation with no check engine lamp.

DTC P0107, P0108 4.21

GENERAL

MAP Sensor

See Figure 4-61. The manifold absolute pressure sensor (MAP sensor) is supplied 5 volts from the ECM (terminal 14) and sends a signal back to the ECM (terminal 25). This signal varies in accordance with engine vacuum and atmospheric barometric pressure. Changes in barometric pressure are influenced by weather and altitude.

Table 4-27. Code Description

DTC	DESCRIPTION
P0107	MAP sensor open/low
P0108	MAP sensor high

DIAGNOSTICS

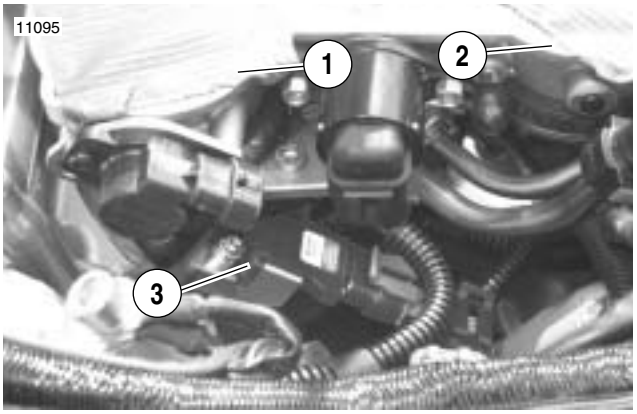
Diagnostic Tips

- These codes will set if the MAP sensor signal is out of range. Code P0108 can only be detected with the engine running.
- With the MAP sensor disconnected, the ECM and Scanalyzer should recognize a low voltage. If low voltage is observed, the ECM and harness are not at fault unless there is a short to ground.
- Gently place a jumper wire across MAP sensor connector [80B] Terminals B and C using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), grey male probes and patch cord. With the jumper in place, the ECM and Scanalyzer should recognize a high voltage.

NOTE

Use caution not to over-pump vacuum pump during MAP sensor output check as sensor damage may result.

- MAP sensor output check. Using the VACUUM PUMP (Part No. HD-23738), apply a vacuum to the pressure port of the MAP sensor. The signal voltage should lower as the vacuum is applied.
- The MAP and TP sensors are connected to the same reference line (+5V Vref). If the reference line goes to ground or open, multiple codes will be set (DTC P0107, P0108, P0122, P0123).



1. **Front intake**
2. **Rear intake**
3. **MAP sensor**

Figure 4-61. MAP Sensor (throttle body removed)

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.21 flow charts.

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probes and patch cords.

Scanalyzer Notes

- The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.
- Scanalyzer default is to show engineering values. Press F1 to view volts.

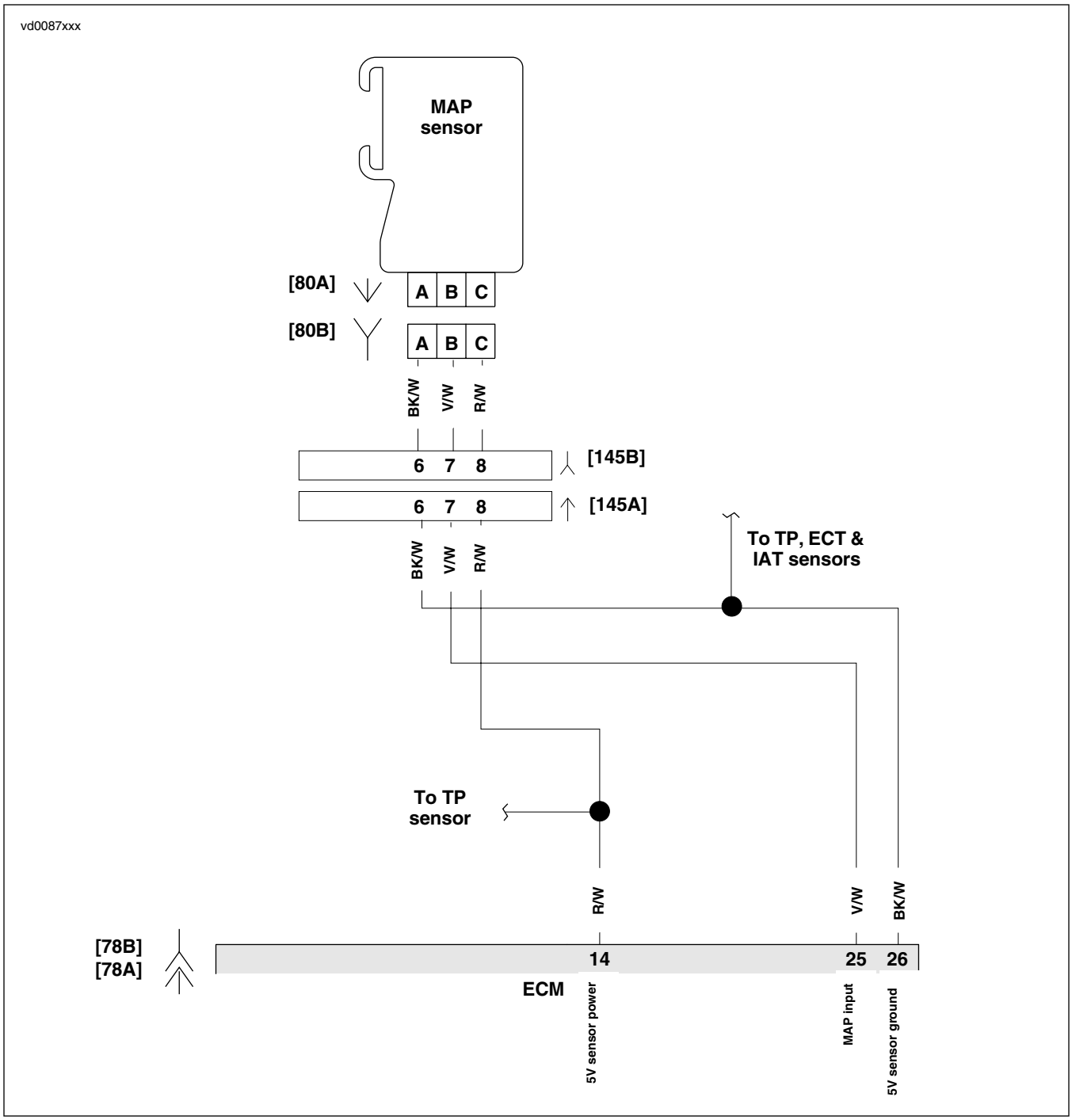


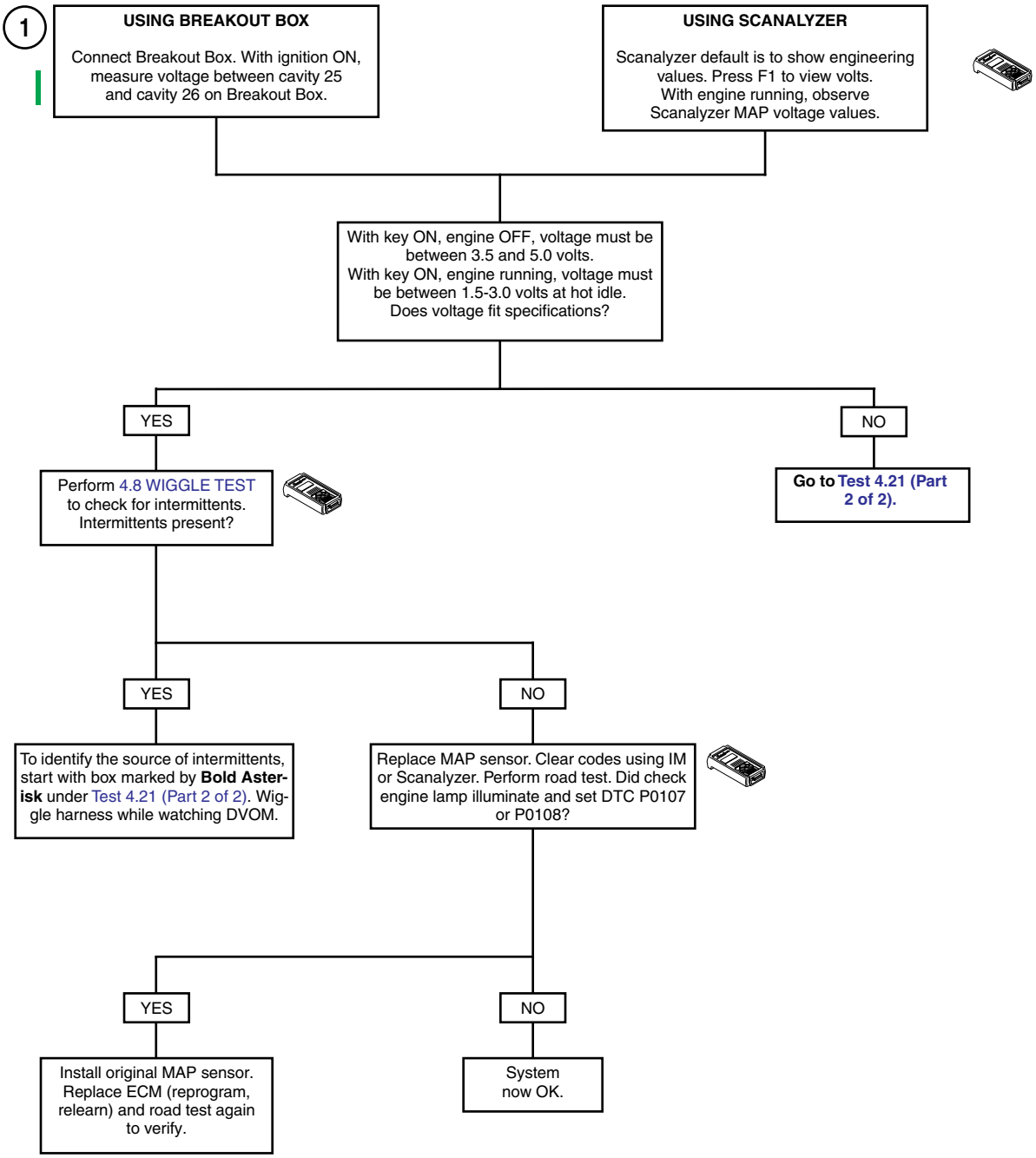
Figure 4-62. MAP Sensor Circuit

Table 4-28. Wire Harness Connectors in Figure 4-62.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[80]	MAP sensor	3-place Packard	front intake passage
[145]	Engine harness	12-place Deutsch	under air cleaner

Test 4.21 (Part 1 of 2)

MAP SENSOR: DTC P0107, P0108

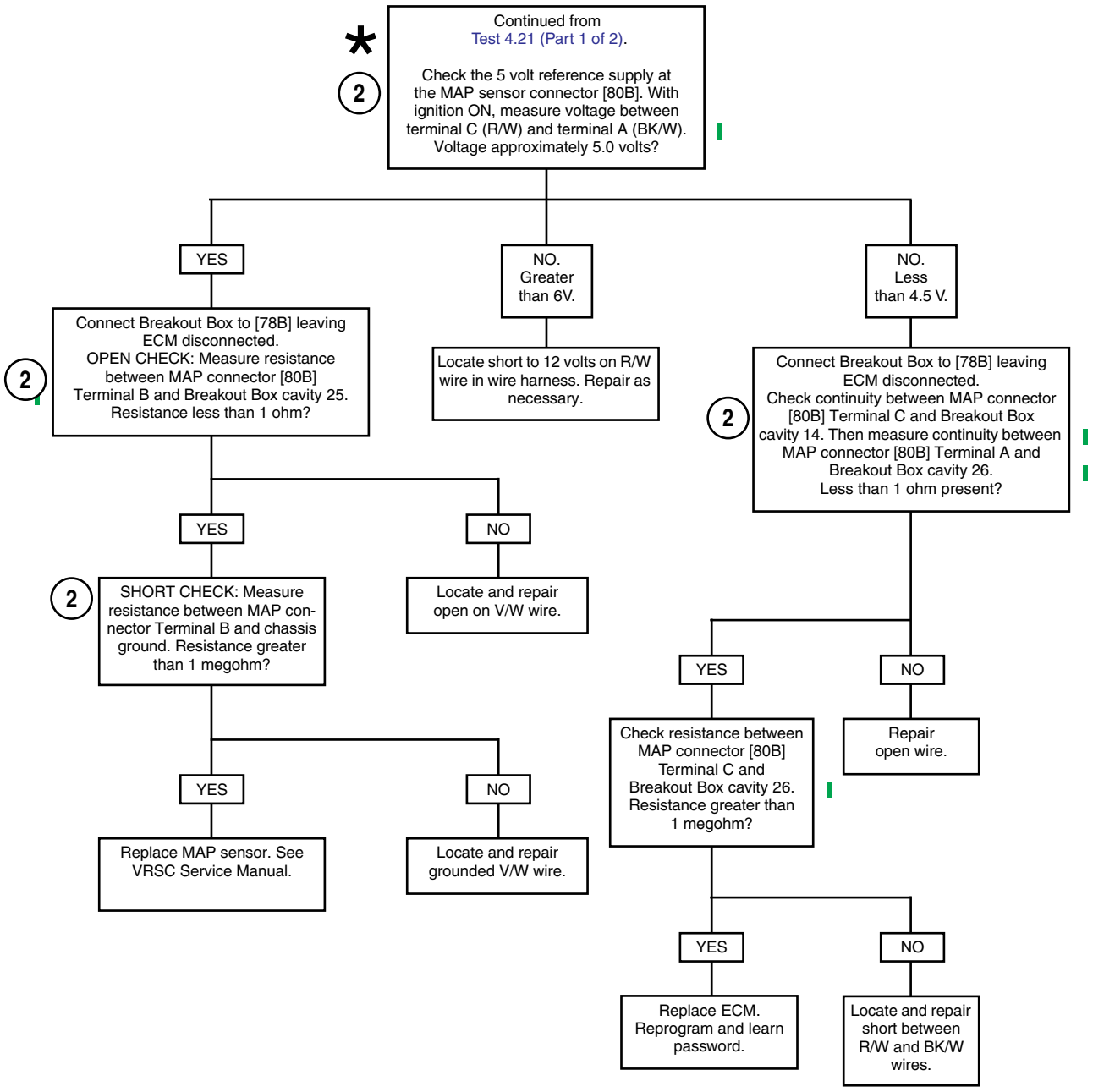


Clear codes and confirm proper operation with no check engine lamp.

* **At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Test 4.21 (Part 2 of 2)

MAP SENSOR: DTC P0107, P0108



Clear codes and confirm proper operation with no check engine lamp.

*** At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

DTC P0112, P0113 4.22

GENERAL

IAT Sensor

The ECM supplies and monitors a voltage signal (terminal 7) to one side of the intake air temperature sensor (IAT sensor). The other side of the IAT sensor is connected to a common sensor ground, which is also connected to the ECM (terminal 26).

The IAT sensor is a thermistor device, meaning that at a specific temperature, it will have a specific resistance across its terminals. As this resistance varies, so does the voltage (terminal 7).

- At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on terminal 7.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5 volts.

The ECM monitors this voltage to compensate for various operating conditions.

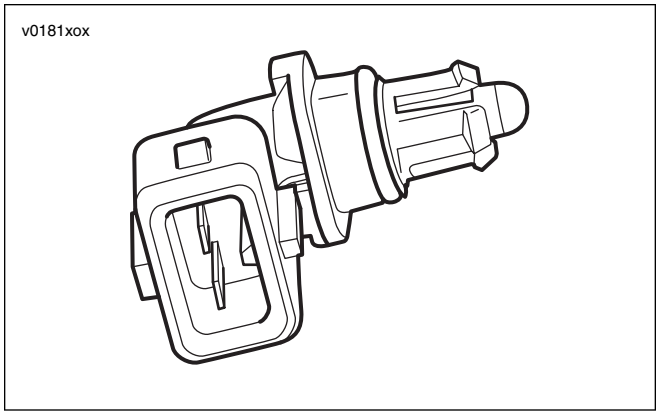


Figure 4-63. IAT sensor

Table 4-29. Code Description

DTC	DESCRIPTION
P0112	IAT sensor voltage low
P0113	IAT sensor open/high

Table 4-30. IAT Sensor Table

TEMP °C	RESISTANCE	VOLTAGE	TEMP °F
-20	15701	**4.8**	-4
-10	9539	**4.6**	14
0	5959	**4.3**	32
10	3820	**4.0**	50
20	2509	**3.6**	68
25	2051	**3.4**	77
30	1686	**3.2**	86
40	1157	**2.7**	104
50	810	**2.3**	122
60	578	**1.9**	140
70	419	**1.5**	158
80	309	**1.2**	176
90	231	**1.0**	194
100	176	**0.8**	212

DIAGNOSTICS

Diagnostic Tips

- The Scanalyzer displays intake air temperature in degrees or volts. The Scanalyzer default is to show degrees. Press F1 to view volts.

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation.

Check the following conditions:

- **Poor connection:** Inspect ECM and harness connector [78] for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform 4.8 WIGGLE TEST to locate intermittents:** If connections and harness check out OK, use the Scanalyzer to check the intake air temperature reading while moving related connectors and wiring harness. If the failure is induced, the intake air temperature display will change.
- **Shifted sensor:** Refer to Table 4-30. This table may be used to test the intake air temperature sensor at various temperature levels in order to evaluate the possibility of a shifted (out-of-calibration) sensor which may result in driveability problems.

NOTE

All voltage and resistance values are approximate (±20%). Measure IAT sensor resistance between ECM Terminal 7 and system ground (ECM Terminal 26).

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.22 flow charts.

1. Connect BREAKOUT BOX (Part No. HD-43876) to EFI wire harness **only** (leave ECM disconnected). See 4.7 BREAKOUT BOX: ECM.
2. If the engine has not been operated for 1 hour, the measured resistance should be very close to the measured resistance across the ECT sensor which is terminals 6 and 26 on the Breakout Box. Scanalyzer values (using Data Monitor Mode) will be approximately the same if code is historic. Current code will read default value.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probes and patch cords.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple socket probes and patch cords.
5. Replace IAT sensor. See VRSC Service Manual.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.

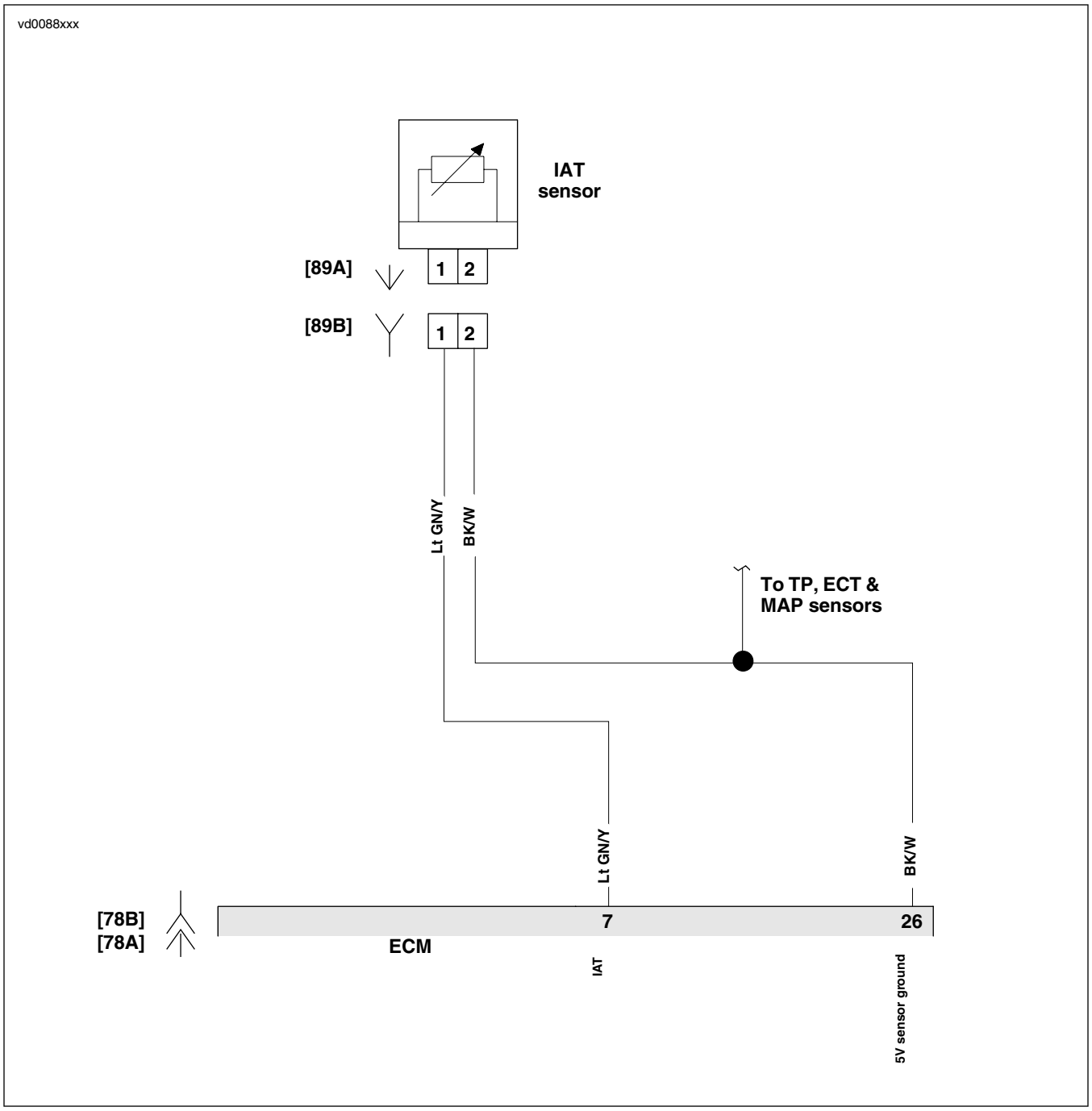


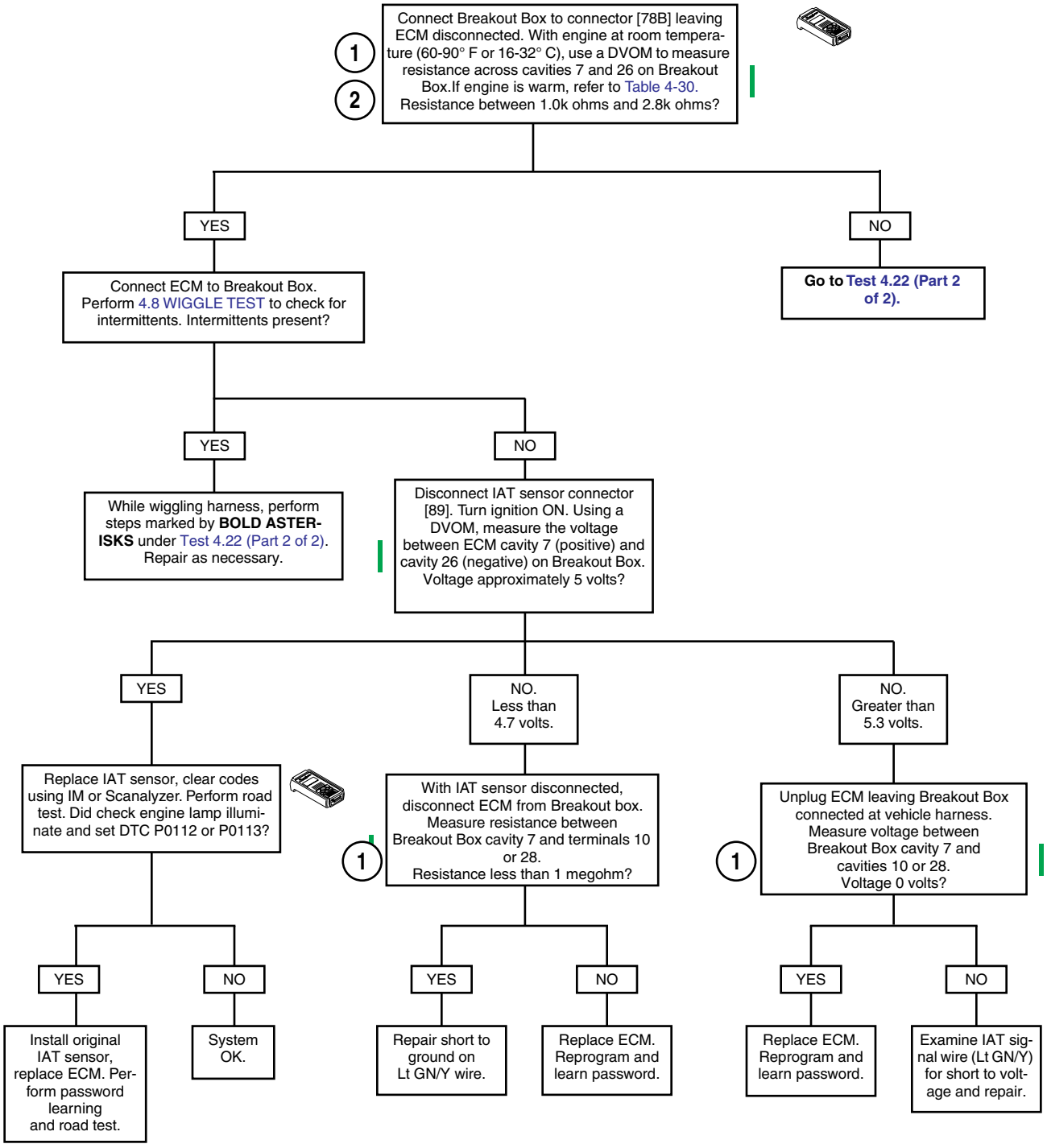
Figure 4-64. IAT Sensor Circuit

Table 4-31. Wire Harness Connectors in Figure 4-64.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[89]	IAT sensor	2-place Packard	under airbox cover
[145]	Engine harness	12-place Deutsch	under air cleaner

Test 4.22 (Part 1 of 2)

IAT SENSOR: DTC P0112, P0113

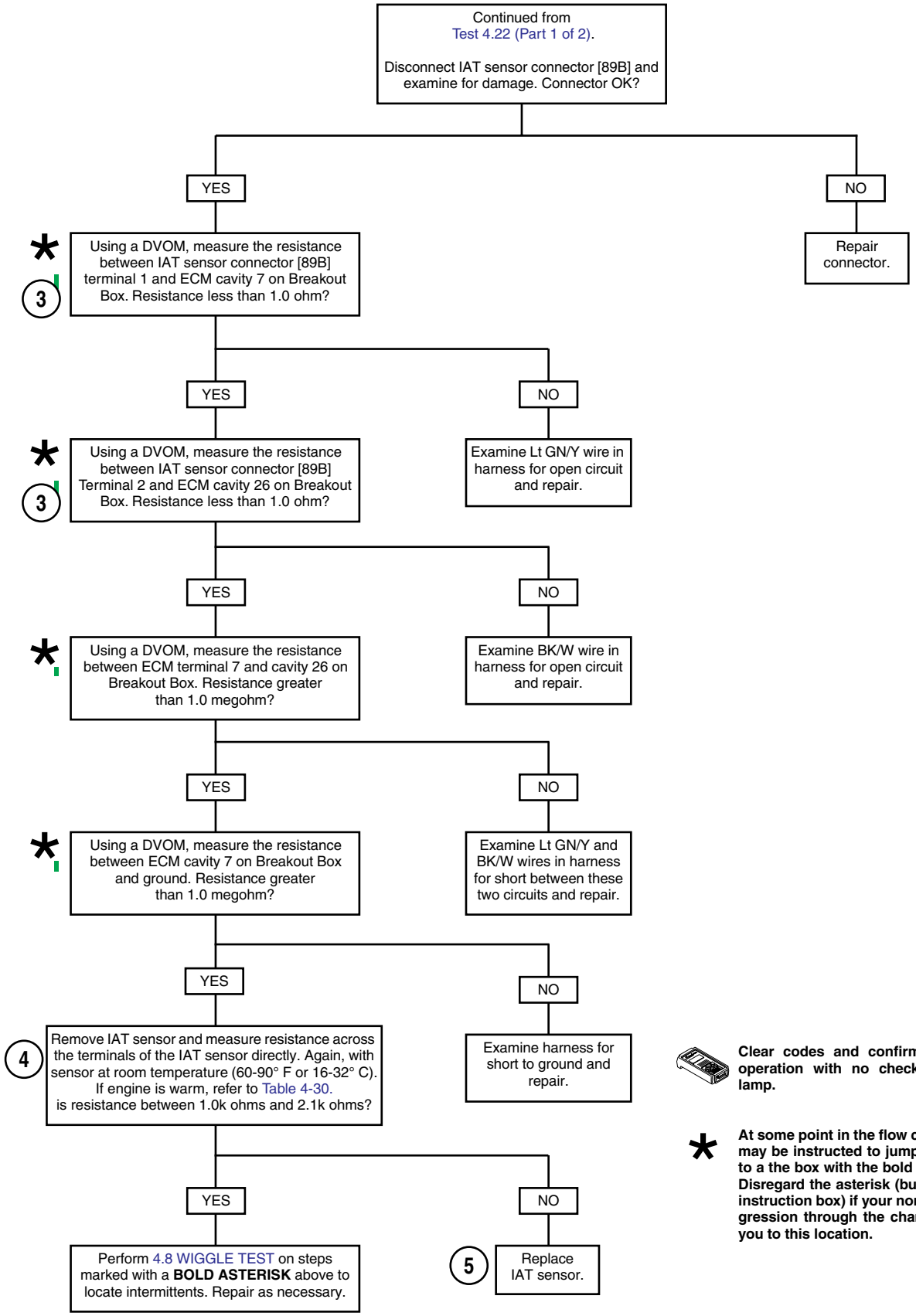


Clear codes and confirm proper operation with no check engine lamp.

* **At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Test 4.22 (Part 2 of 2)

IAT SENSOR: DTC P0112, P0113



Clear codes and confirm proper operation with no check engine lamp.

*** At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

DTC P0117, P0118

GENERAL

ECT Sensor

The ECM supplies and monitors a voltage signal (terminal 6) to one side of the engine coolant temperature sensor (ECT sensor). The other side of the ECT sensor is connected to a common sensor ground, which is also connected to the ECM (terminal 26).

The ECT sensor is a thermistor device, which means that at a specific temperature it will have a specific resistance across its terminals. As this resistance varies, so does the voltage on terminal 6.

- At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on terminal 6.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5 volts.

The ECM monitors this voltage to compensate for various operating conditions. The ECM also uses the sensor input as a reference for determining IAC pintle position.

Table 4-32. Code Description

DTC	DESCRIPTION
P0117	ECT sensor voltage low
P0118	ECT sensor open/high

Table 4-33. ECT Sensor Table

TEMP °C	RESISTANCE	VOLTAGE*	TEMP °F
-20	28582	4.4	-4
-10	16120	4.1	14
0	9399	3.6	32
10	5658	3.0	50
20	3511	2.4	68
25	2800	2.1	77
30	2240	1.8	86
40	1465	1.4 **or** 4.1	104
50	980	1.0 **or** 3.7	122
60	671	3.3	140
70	469	2.9	158
80	334	2.5	176
90	242	2.1	194
100	178	1.7	212

* Between 40-50°C the ECM changes scaling. Voltages for ECT sensor will shift scales in that range. This provides proper sensor resolution for all temperatures.

DIAGNOSTICS

Diagnostic Tips

The Scanalyzer displays engine temperature in degrees or volts. The Scanalyzer default is to show degrees. Press F1 to view volts. Once the engine is started, the temperature should rise steadily.

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation.

Check the following conditions:

- **Poor connection:** Inspect ECM harness connector [78] for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform 4.8 WIGGLE TEST to locate intermittents:** If connections and harness check out OK, use the Scanalyzer to check the intake air temperature reading while moving related connectors and wiring harness. If the failure is induced, the engine coolant temperature display will change.
- **Shifted sensor:** Refer to Table 4-33. This table may be used to test the engine temperature sensor at various temperature levels in order to evaluate the possibility of a shifted (out-of-calibration) sensor which may result in driveability problems.

NOTE

All voltage and resistance values are approximate (±20%). Measure ECT sensor resistance between ECM Terminal 6 and system ground (ECM Terminal 26).

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.23 flow charts.

1. Connect BREAKOUT BOX (Part No. HD-43876) to EFI wire harness **only** (leave ECM disconnected). See 4.7 BREAKOUT BOX: ECM.
2. If engine has not been operated for 1 hour, the measured resistance should be very close to the measured resistance across the IAT sensor which is cavities 7 and 26 on the Breakout Box. Scanalyzer values (using Data Monitor Mode) will be approximately the same if code is historic. Current code will read default value.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probes and patch cords.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray socket probes and patch cords.
5. Replace ECT sensor. See VRSC Service Manual.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.

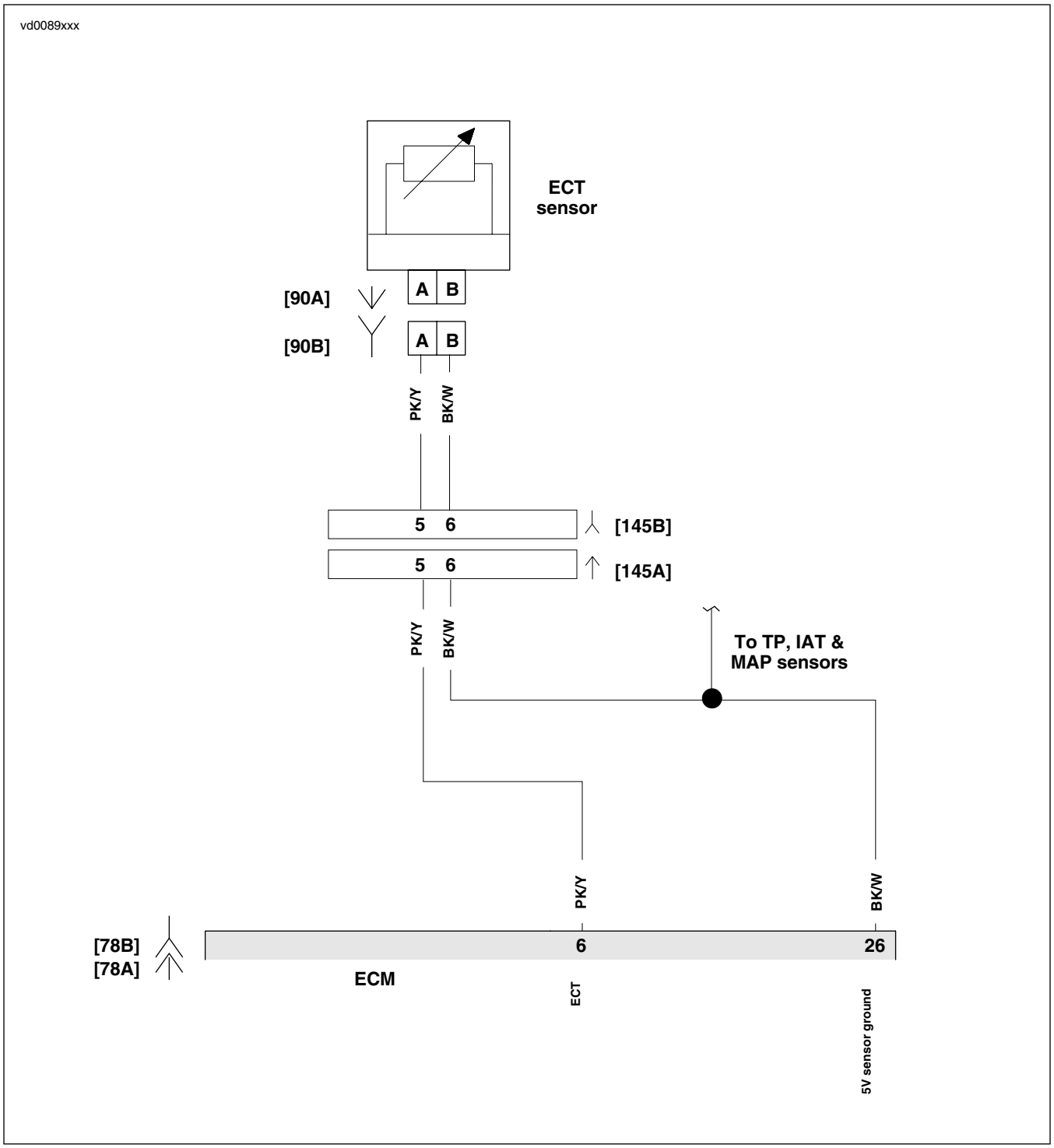


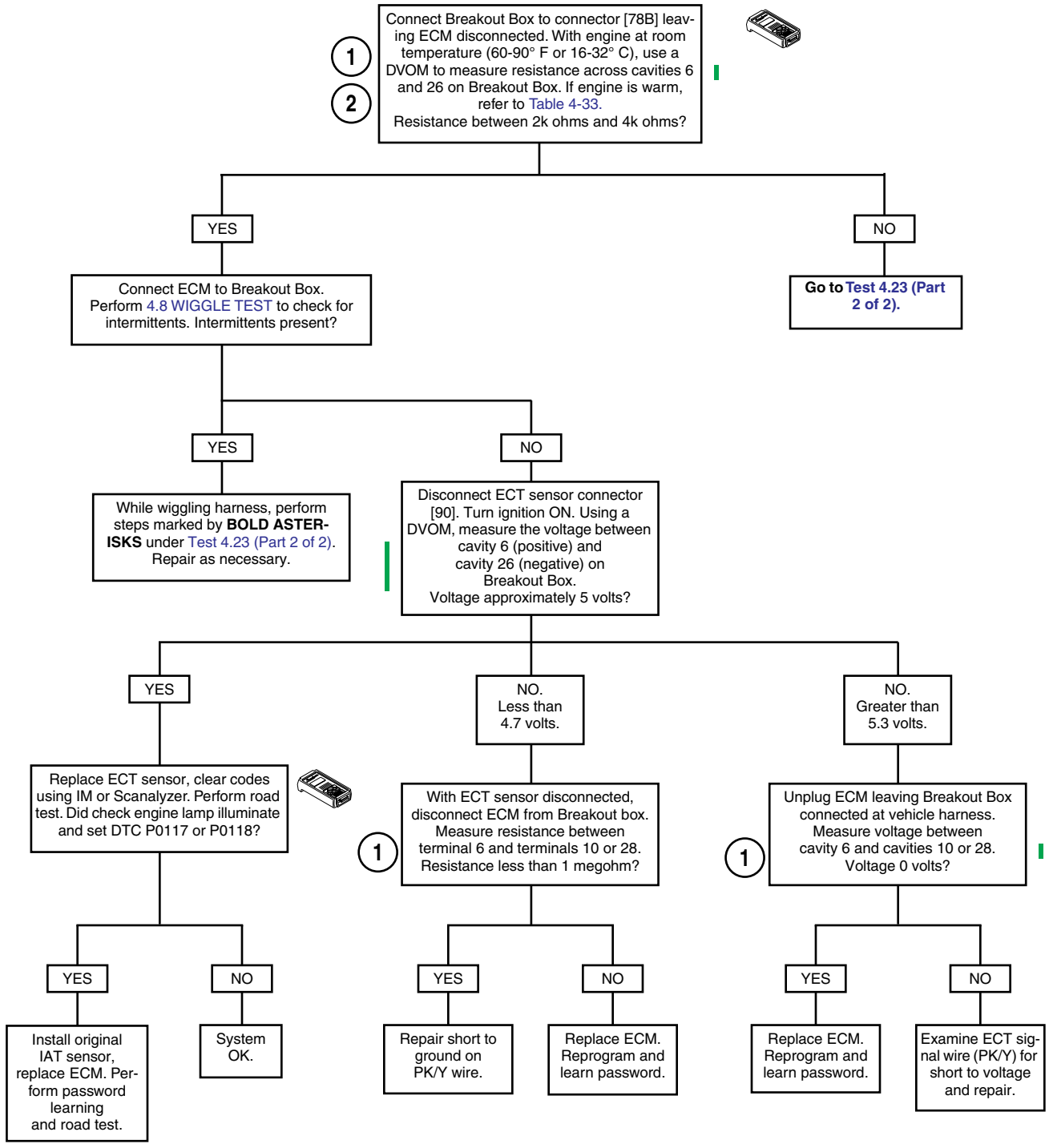
Figure 4-65. ECT Sensor Circuit

Table 4-34. Wire Harness Connectors in Figure 4-65.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[90]	ECT sensor	2-place Packard	water pump housing
[145]	Engine harness	12-place Deutsch	under air cleaner

Test 4.23 (Part 1 of 2)

ECT SENSOR: DTC P0117, P0118

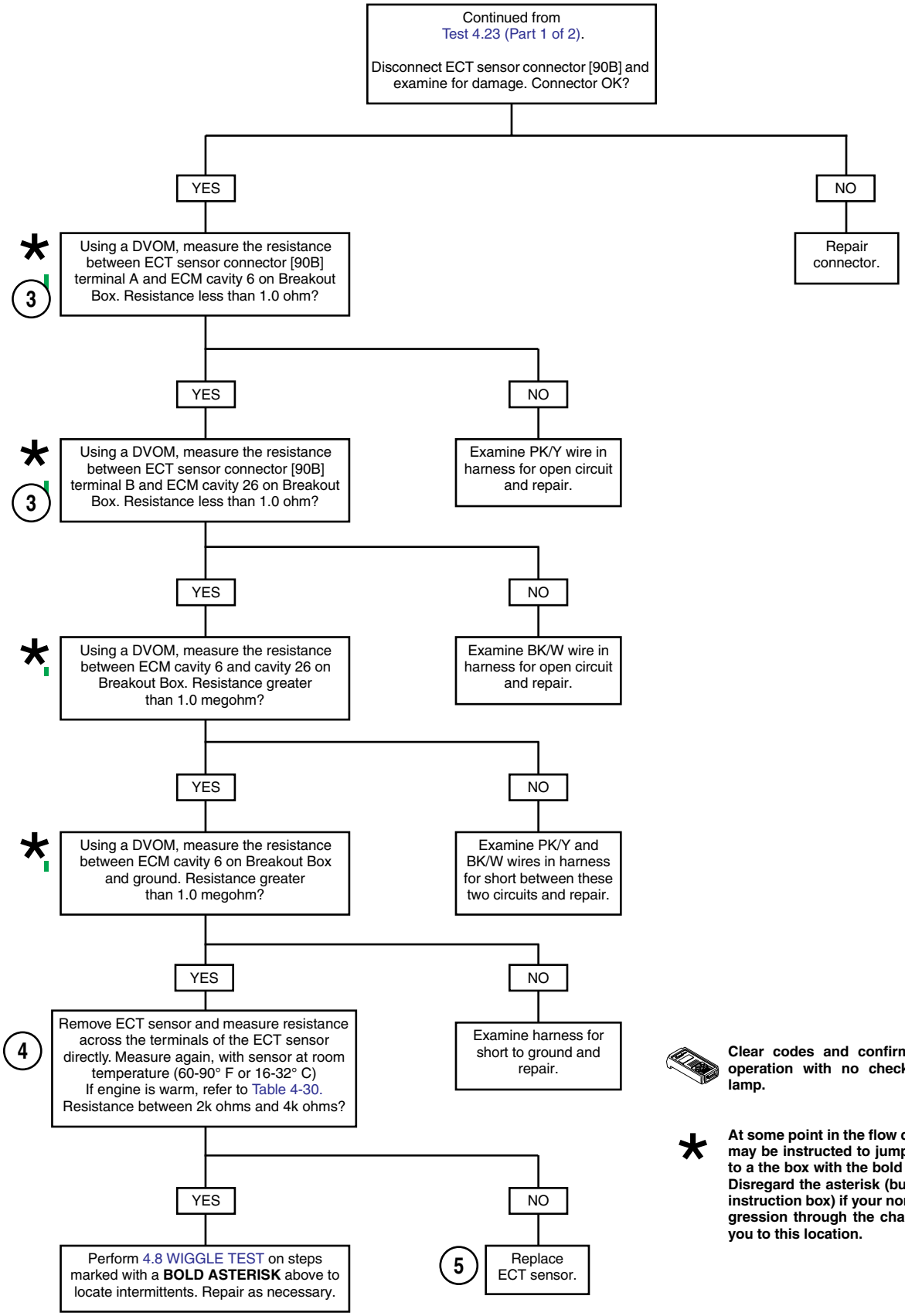


Clear codes and confirm proper operation with no check engine lamp.

* **At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Test 4.23 (Part 2 of 2)

ECT SENSOR: DTC P0117, P0118



Clear codes and confirm proper operation with no check engine lamp.

*** At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

DTC P0122, P0123 4.24

GENERAL

TP Sensor

The ECM supplies a 5 volt signal (terminal 14) to the throttle position sensor (TP sensor). The TP sensor sends a signal back to the ECM (terminal 24). The returned signal varies in voltage according to throttle position.

- At idle (closed throttle), the signal is typically in the range of 0.20-0.80 volts.
- At wide open throttle, the signal is normally 4.0-4.9 volts.

A code P0122 or P0123 will set if the TP sensor voltage signal does not fall within the acceptable range.

- Check TP sensor reading with Scanalyzer. If TP sensor is greater than 90%, then the system is in “clear flood” mode and engine will not start. While spark is present, fuel is shut off. Problem can be mechanical, such as stuck throttle cables.

Table 4-35. Code Description

DTC	DESCRIPTION
P0122	TP sensor open/low
P0123	TP sensor high

DIAGNOSTICS

Diagnostic Tips

The Scanalyzer or DVOM reads throttle position as a percentage of throttle opening (the Scanalyzer can also read throttle position in volts, press F1 to view volts). Voltage should increase at a steady rate as the throttle is moved from idle to wide open. A short to ground or open on the GY/V or R/W wires also will result in a DTC P0122. A short to ground or open on the R/W wire (+5v REF) sets multiple codes as described below.

NOTE

The MAP and TP sensors are both connected to the same reference line (+5v Vref). If the line goes to ground or open, multiple trouble codes will be set, that is, diagnostic trouble codes P0107, P0108 and P0122 or P0123. Start with the trouble code having the lowest ranking value.

Check for the following conditions:

- **Poor Connection:** Inspect ECM harness connector [78B] for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform 4.8 WIGGLE TEST to locate intermittents:** If connections and harness check out OK, monitor TP sensor voltage using a Scanalyzer or DVOM while moving related connectors and wiring harness. If the failure is induced, the TP sensor display will change.
- **TP sensor scaling:** Observe the TP sensor voltage display while opening the throttle with engine stopped and ignition key ON. Display should vary from closed throttle TP sensor voltage (when throttle is closed) to greater than 4.0 volts (when throttle is held wide open). As the throttle is **slowly** moved, the voltage should change gradually without spikes or low voltages being observed.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.24 flow charts.

1. Connect a BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM before measuring voltage. See 4.7 BREAKOUT BOX: ECM.
   a. If using a DVOM to measure voltage, take reading across cavity 24 (positive lead) and cavity 26 (negative lead) on Breakout Box.
   b. If using Scanalyzer to measure voltage, consult Data Monitor Mode. See 4.5 SCANALYZER for more information.
2. Replace TP sensor. See VRSC Service Manual.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probes and patch cords.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.

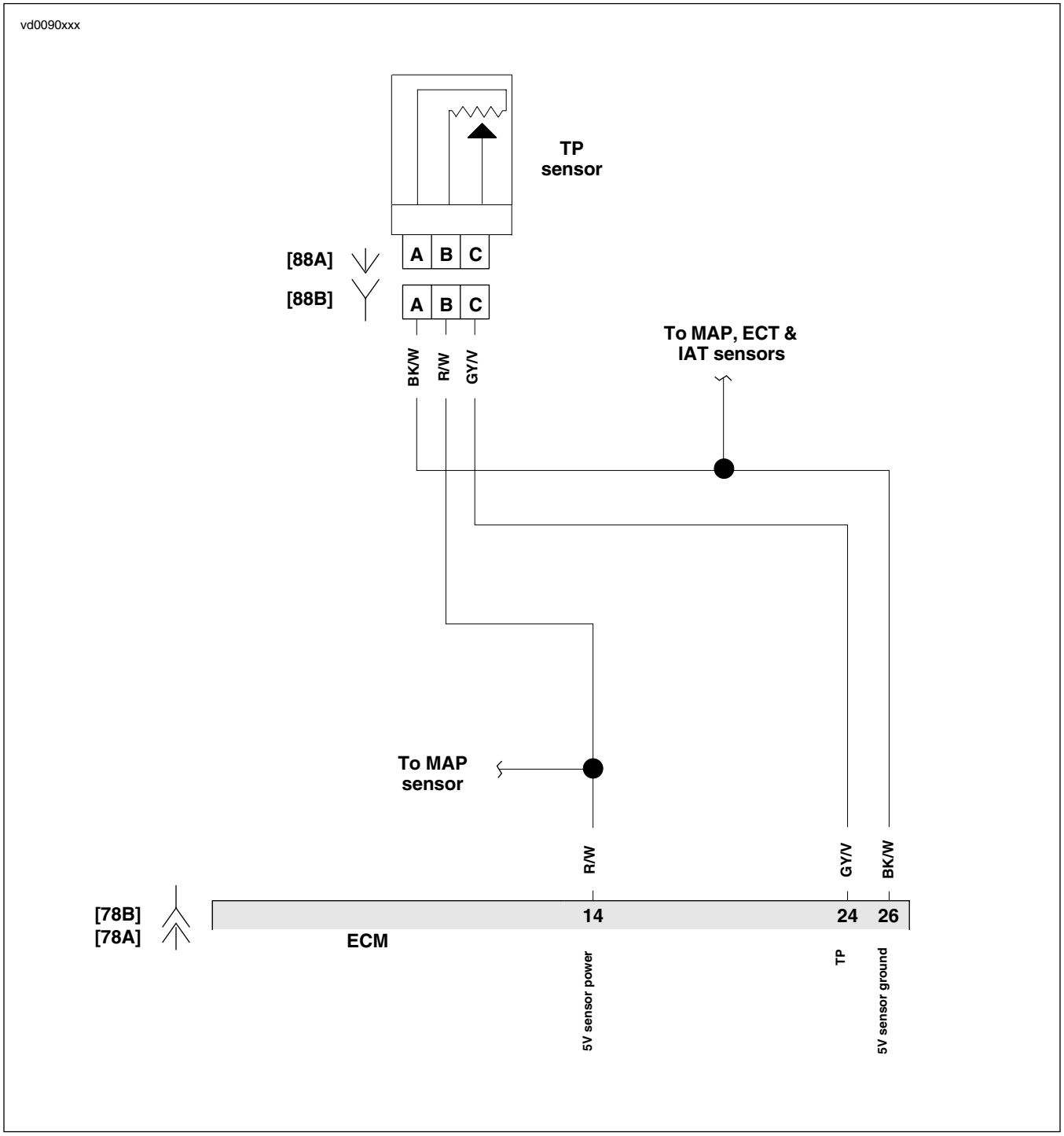


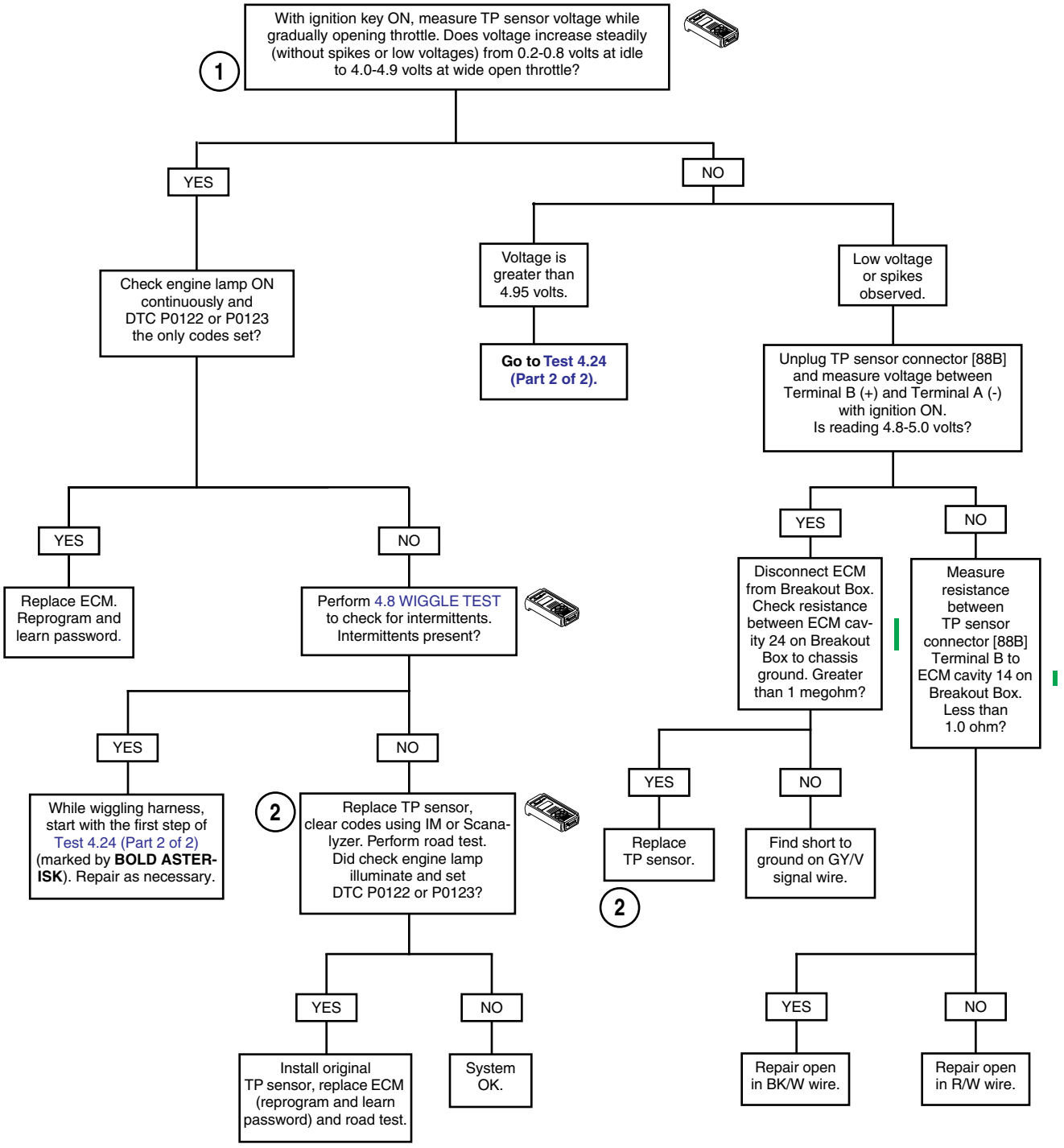
Figure 4-66. TP Sensor Circuit

Table 4-36. Wire Harness Connectors in Figure 4-66.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[88]	TP sensor	3-place Packard	front of throttle body

Test 4.24 (Part 1 of 2)

TP SENSOR: DTC P0122, P0123

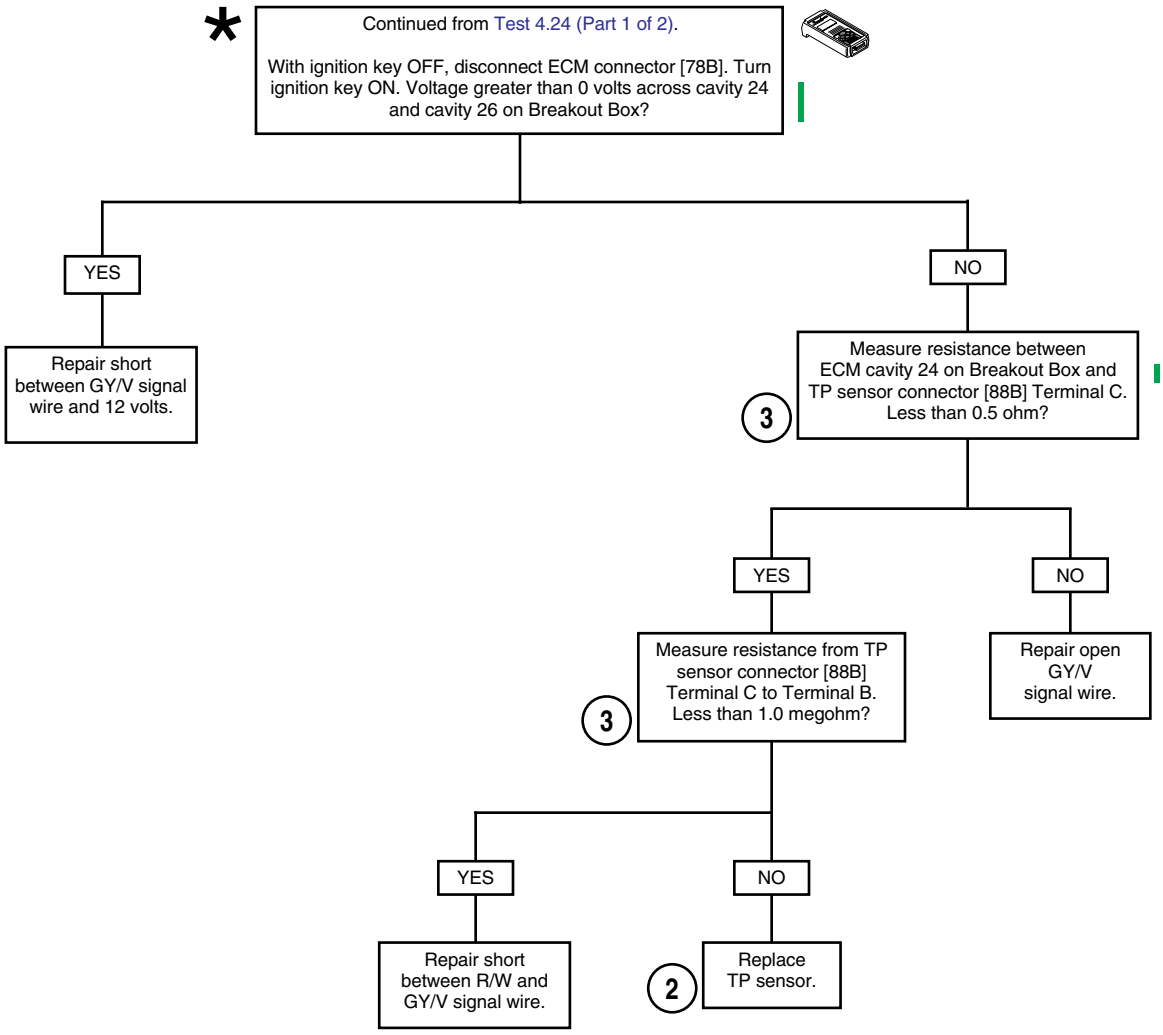


Clear codes and confirm proper operation with no check engine lamp.

*** At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Test 4.24 (Part 2 of 2)

TP SENSOR: DTC P0122, P0123



Clear codes and confirm proper operation with no check engine lamp.

*** At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

DTC P0261, P0262, P0263, P0264 4.25

GENERAL

Fuel Injectors

The fuel injectors are solenoids that allow pressurized fuel into the intake tract. The injectors are timed to the engine cycle and triggered sequentially. The power for the injectors comes from the system relay. The system relay also provides power for the fuel pump and the ignition coils. The ECM provides the path to ground to trigger the injectors.

NOTE

ECM fuse and system relay failures or wiring harness problems will cause 12 volt power to be lost to both injectors, ignition coils and fuel pump.

Table 4-37. Code Description

DTC	DESCRIPTION
P0261	Front injector open/low
P0262	Front injector high
P0263	Rear injector open/low
P0264	Rear injector high

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.25 flow charts.

1. See VRSC Service Manual for all service information.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple terminal probe and patch cord.
3. Connect a BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.

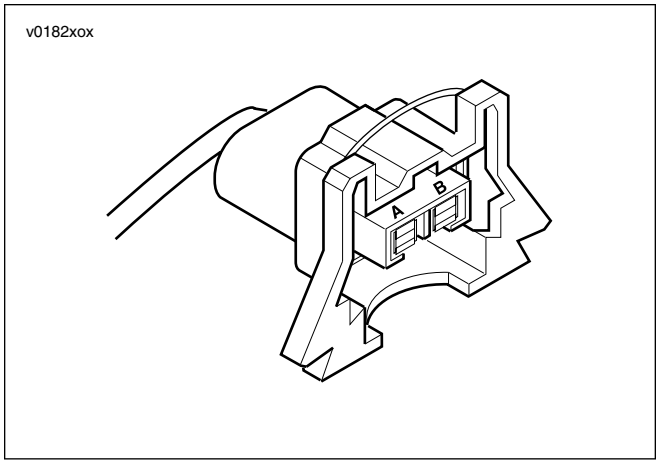


Figure 4-67. Fuel Injector Connector

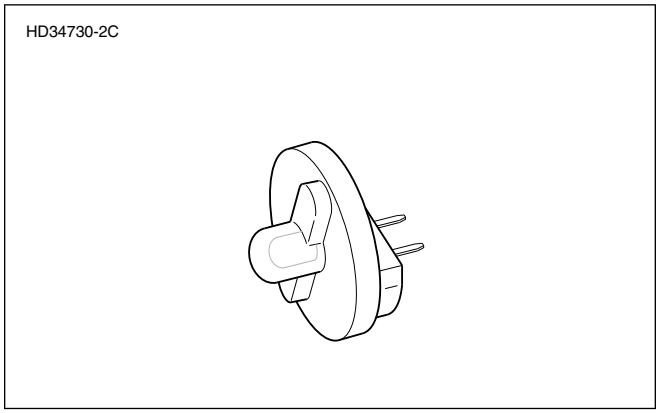


Figure 4-68. Fuel Injector Test Lamp (Part No. HD-34730-2C)

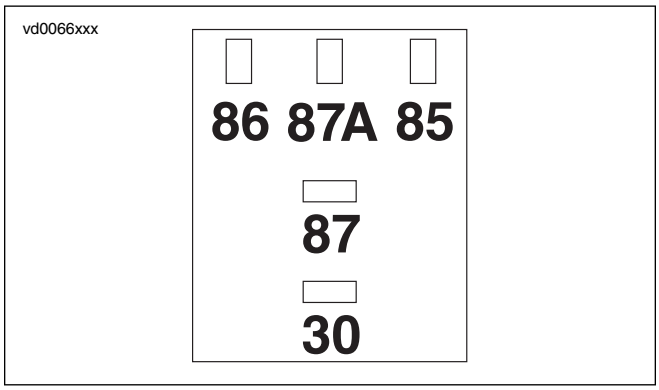


Figure 4-69. Relay Terminals

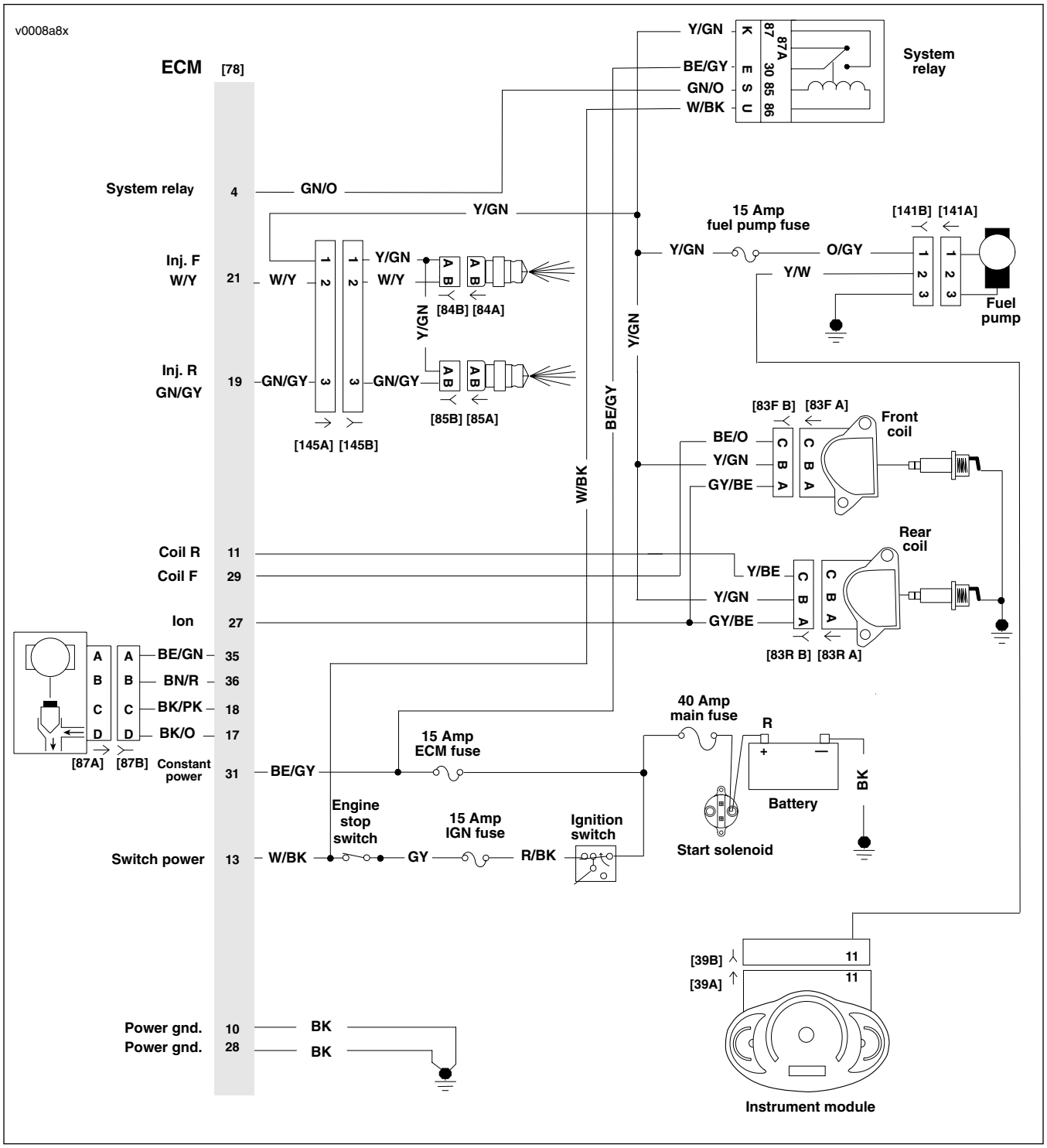


Figure 4-70. Fuel Injectors Circuit (VRSCA/VRSCD)

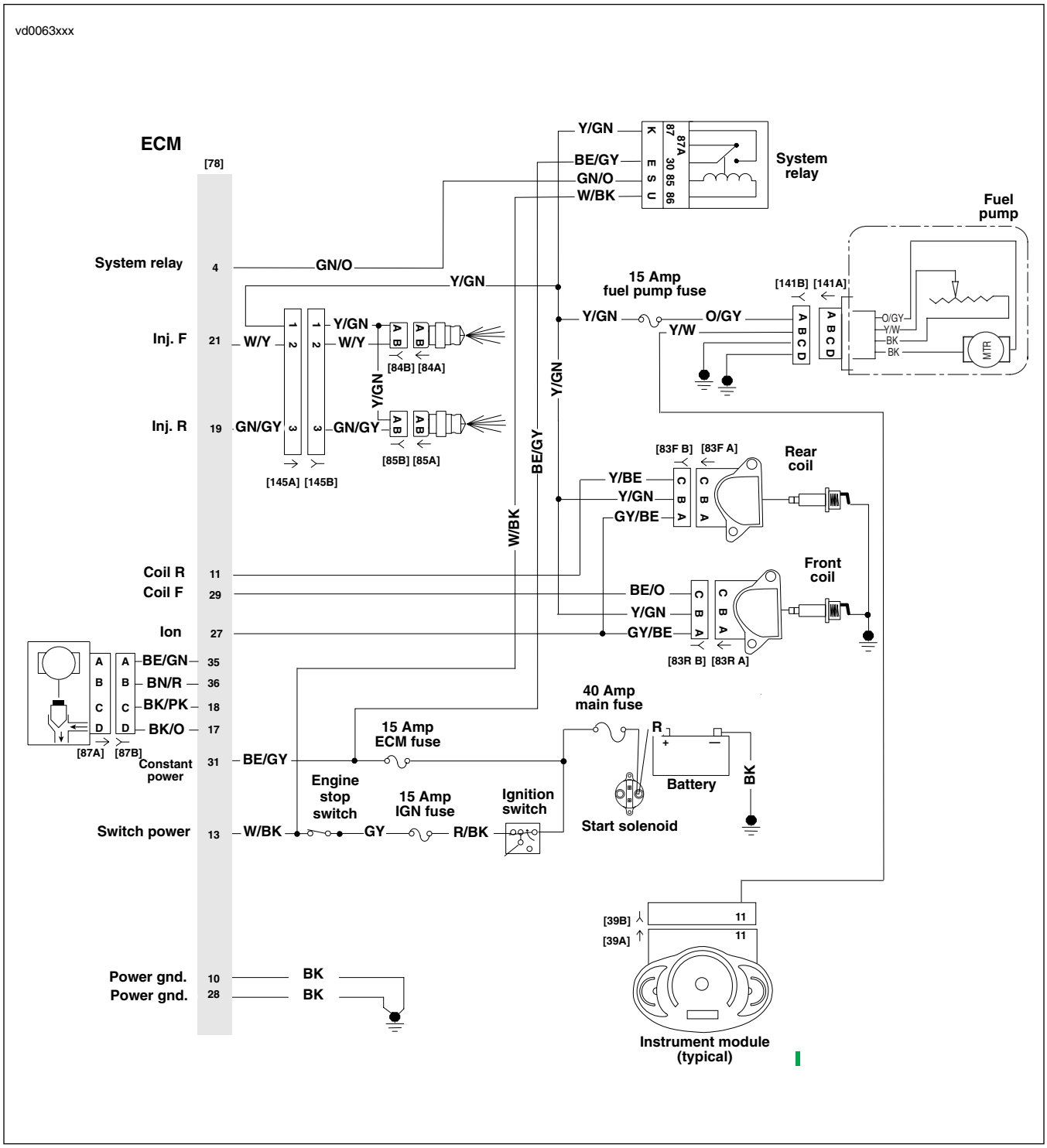


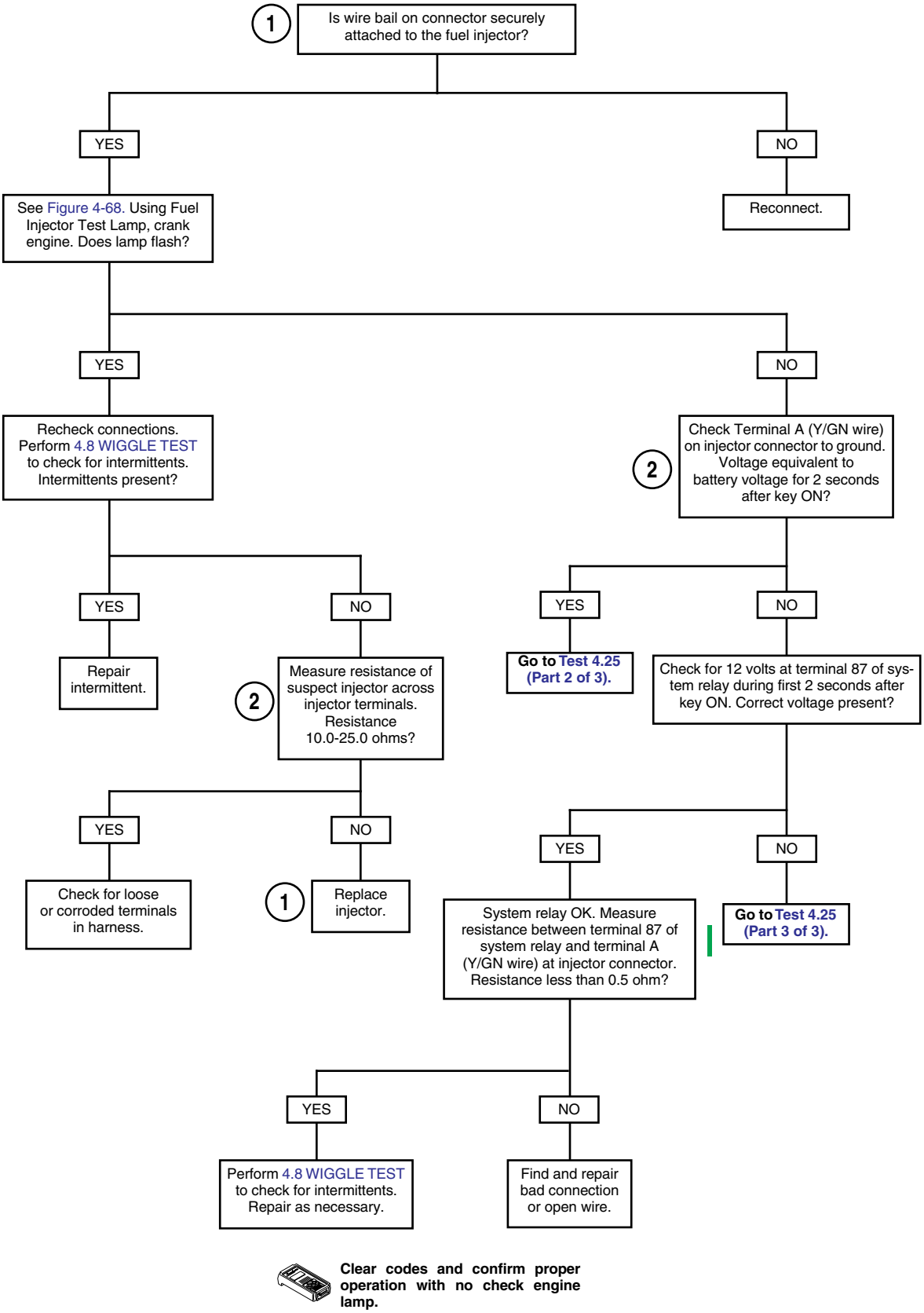
Figure 4-71. Fuel Injectors Circuit (VRSCR)

Table 4-38. Wire Harness Connectors in Figure 4-70. and Figure 4-71.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[84]	Front injector	2-place Packard	throttle body
[85]	Rear injector	2-place Packard	throttle body
[145]	Engine harness	12-place Deutsch	under air cleaner

Test 4.25 (Part 1 of 3)

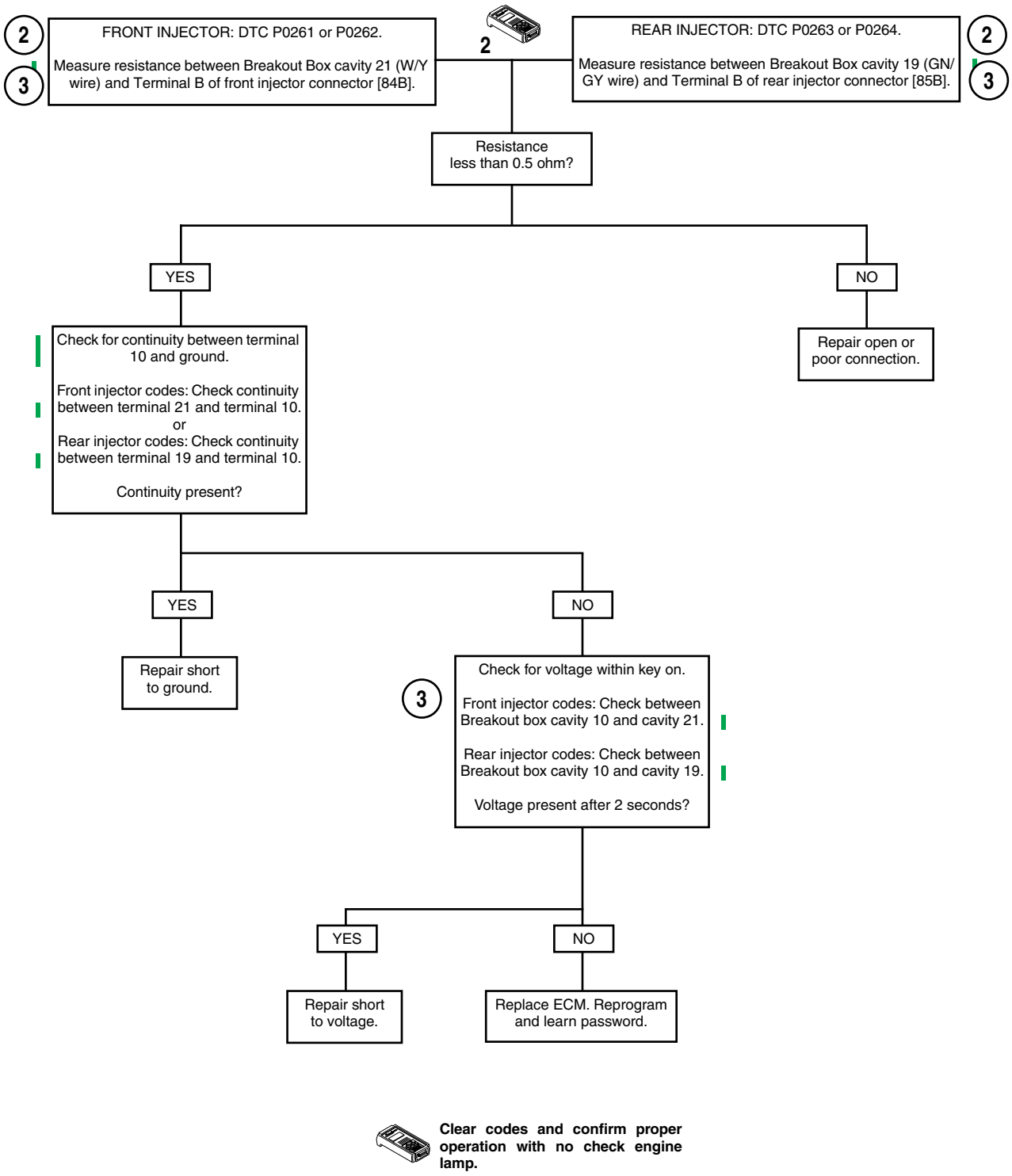
FUEL INJECTORS: DTC P0261, P0262, P0263, P0264



Clear codes and confirm proper operation with no check engine lamp.

Test 4.25 (Part 2 of 3)

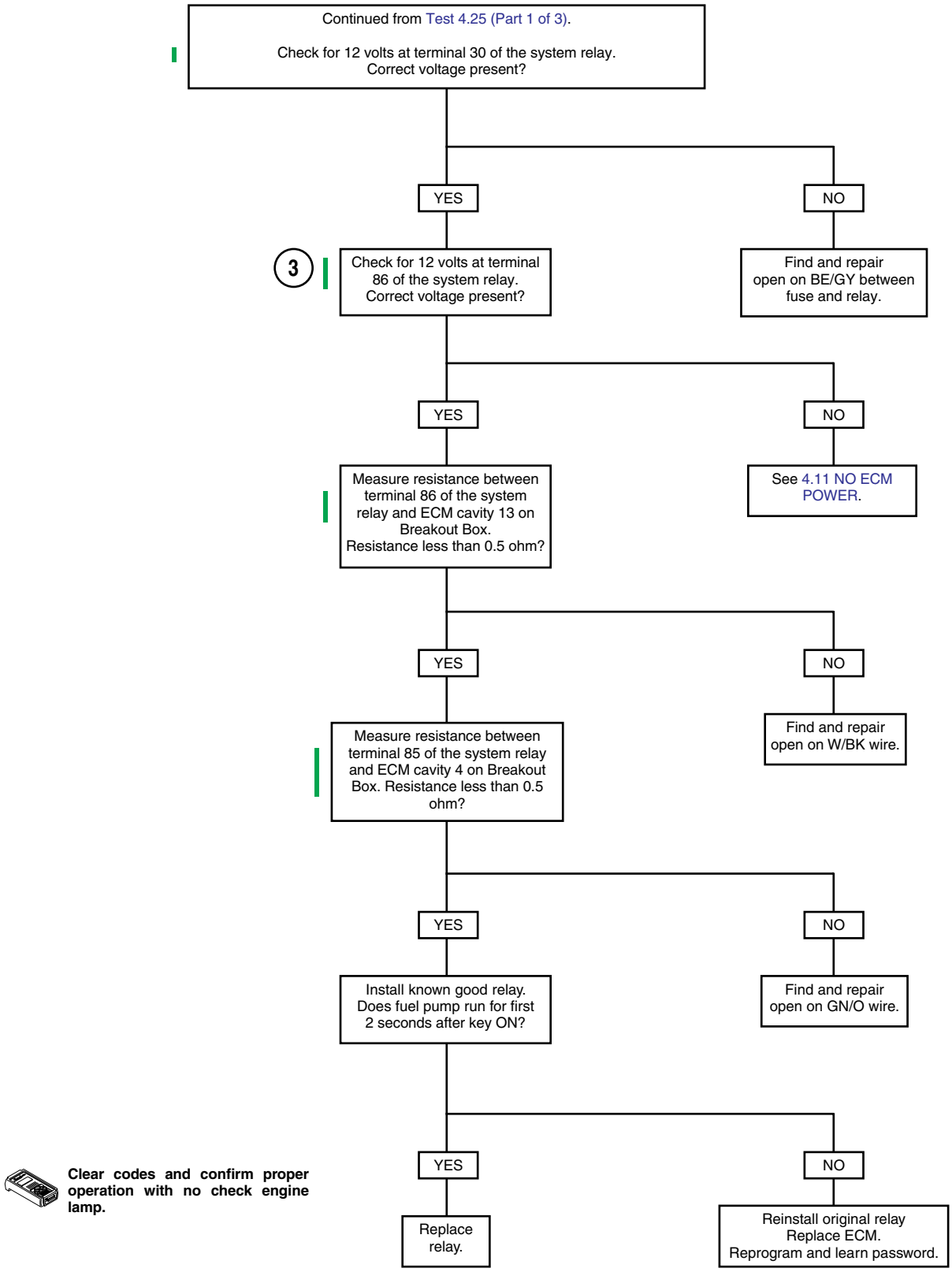
FUEL INJECTORS: DTC P0261, P0262, P0263, P0264



Clear codes and confirm proper operation with no check engine lamp.

Test 4.25 (Part 3 of 3)

FUEL INJECTORS: DTC P0261, P0262, P0263, P0264



Clear codes and confirm proper operation with no check engine lamp.

DTC P0373, P0374 4.26

GENERAL

CKP Sensor

If the crank position sensor (CKP sensor) signal is weak or absent, diagnostic trouble codes P0373 or P0374 will be set.

NOTE

If signal is not detected or cannot synchronize (DTC P0374), engine will not start.

Table 4-39. Code Description

DTC	DESCRIPTION
P0373	CKP sensor intermittent
P0374	CKP sensor synch error

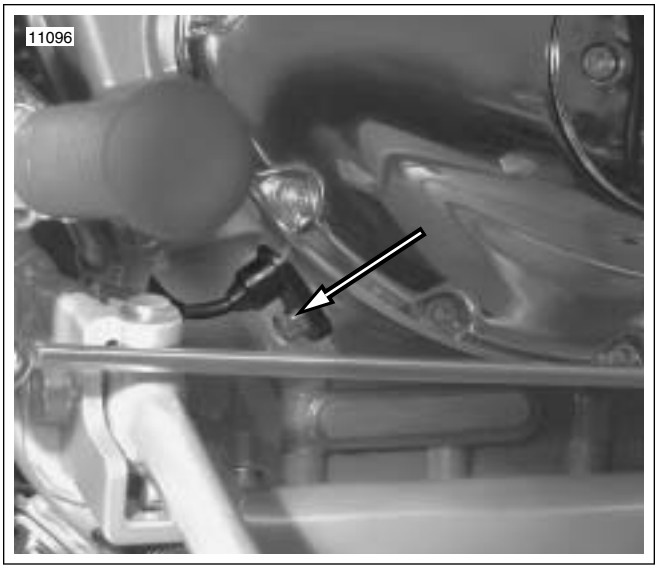


Figure 4-72. CKP Sensor (typical)

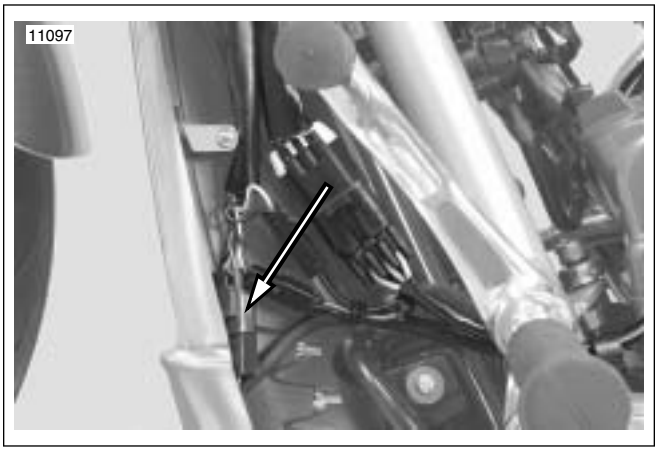


Figure 4-73. CKP Sensor Connector Location (typical)

DIAGNOSTICS

Diagnostic Tips

- Engine must be cranked for more than five seconds without CKP signal to set code.
- With a fully charged battery and vehicle at room temperature, the Scanalyzer should display RPM in Data Monitor Mode while cranking (A low voltage during cranking may cause the Scanalyzer to reset). If RPM is present, problem is intermittent.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.26 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-43876) to ECM wire harness **only** (leave ECM disconnected). See 4.7 BREAKOUT BOX: ECM.
2. One megohm is very high resistance. Some meters will read ∞, OL, etc.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), brown socket probes and patch cords.
4. For testing purposes, install sensor without running wiring along normal path. Disconnect and route wiring properly if system is now OK.

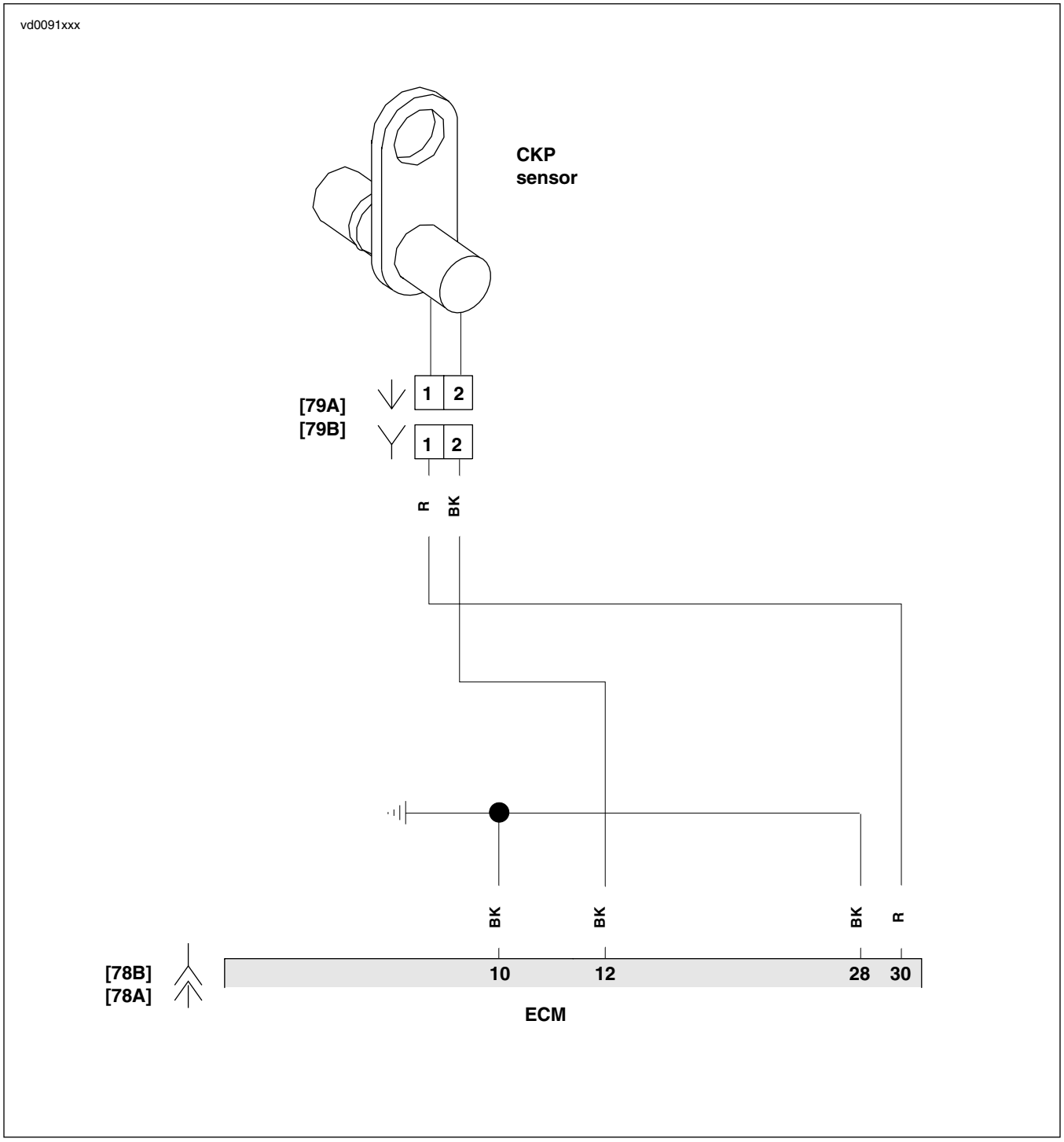


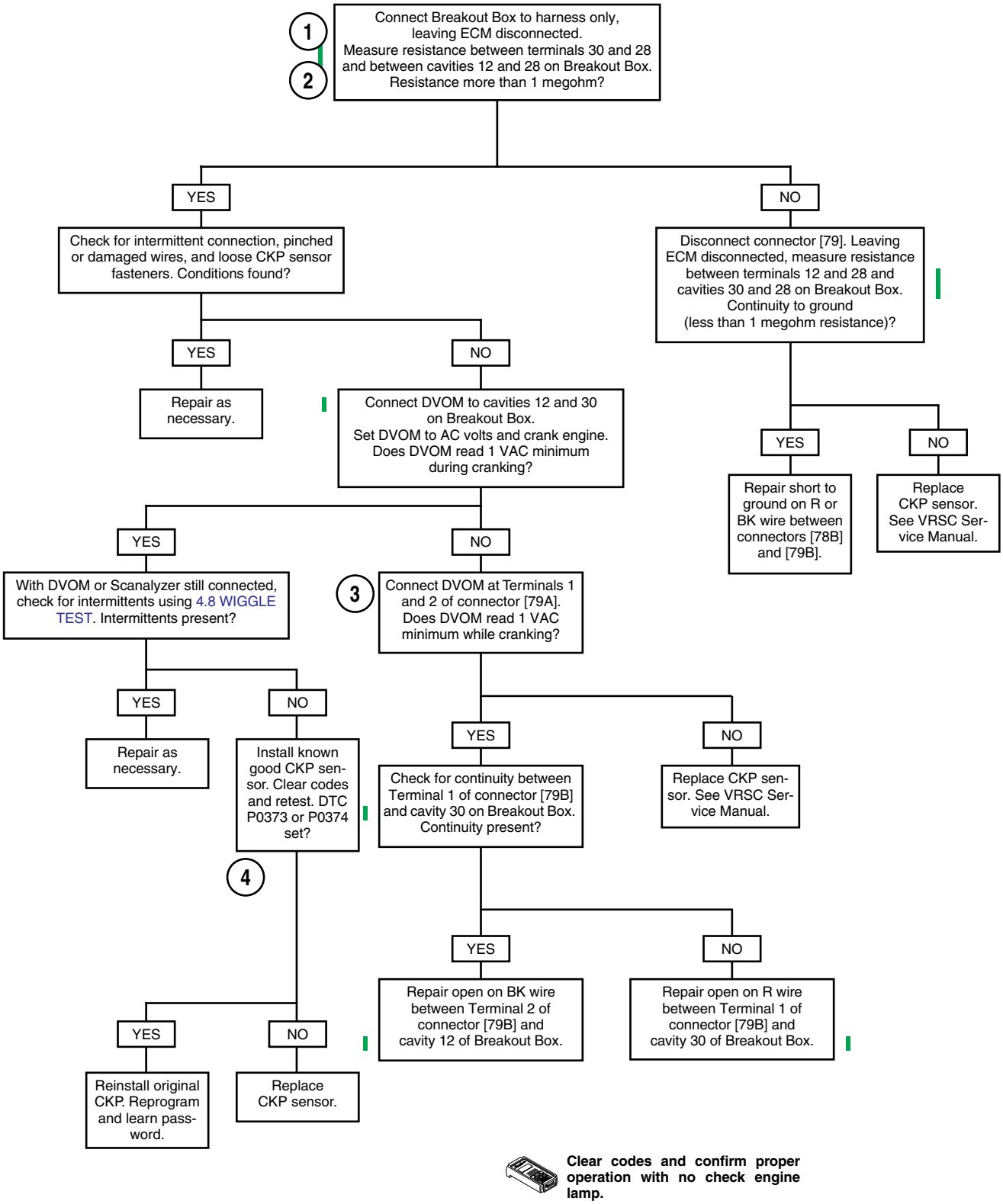
Figure 4-74. CKP Circuit

Table 4-40. Wire Harness Connectors in Figure 4-74.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[79]	CKP sensor	2-place Mini-Deutsch	under left trim cover

Test 4.26

CKP SENSOR: DTC P0373, P0374



DTC P0444, P0445 4.27

GENERAL

Purge Solenoid (CA Models Only)

The purge solenoid allows vapors to escape back into the throttle body. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed or low vehicle speed. The power for the purge solenoid comes from the system relay. The system relay also provides power for the injectors, fuel pump and the ignition coil. The ECM provides the path to ground to trigger the purge solenoid.

NOTES

- *System fuse and system relay failures or wiring harness problems will cause 12 volt power to be lost to both injectors, ignition coils, fuel pump and purge solenoid.*
- *See Figure 4-75. A P0444 DTC can be set on non-California models if resistive plug is removed from connector [95B] or plug is faulty.*

Table 4-41. Code Description

DTC	DESCRIPTION
P0444	Purge solenoid open/low
P0445	Purge solenoid high

Figure 4-75. Resistive Plug

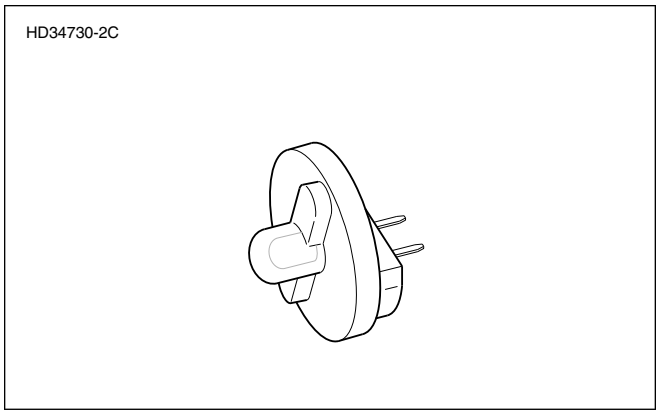


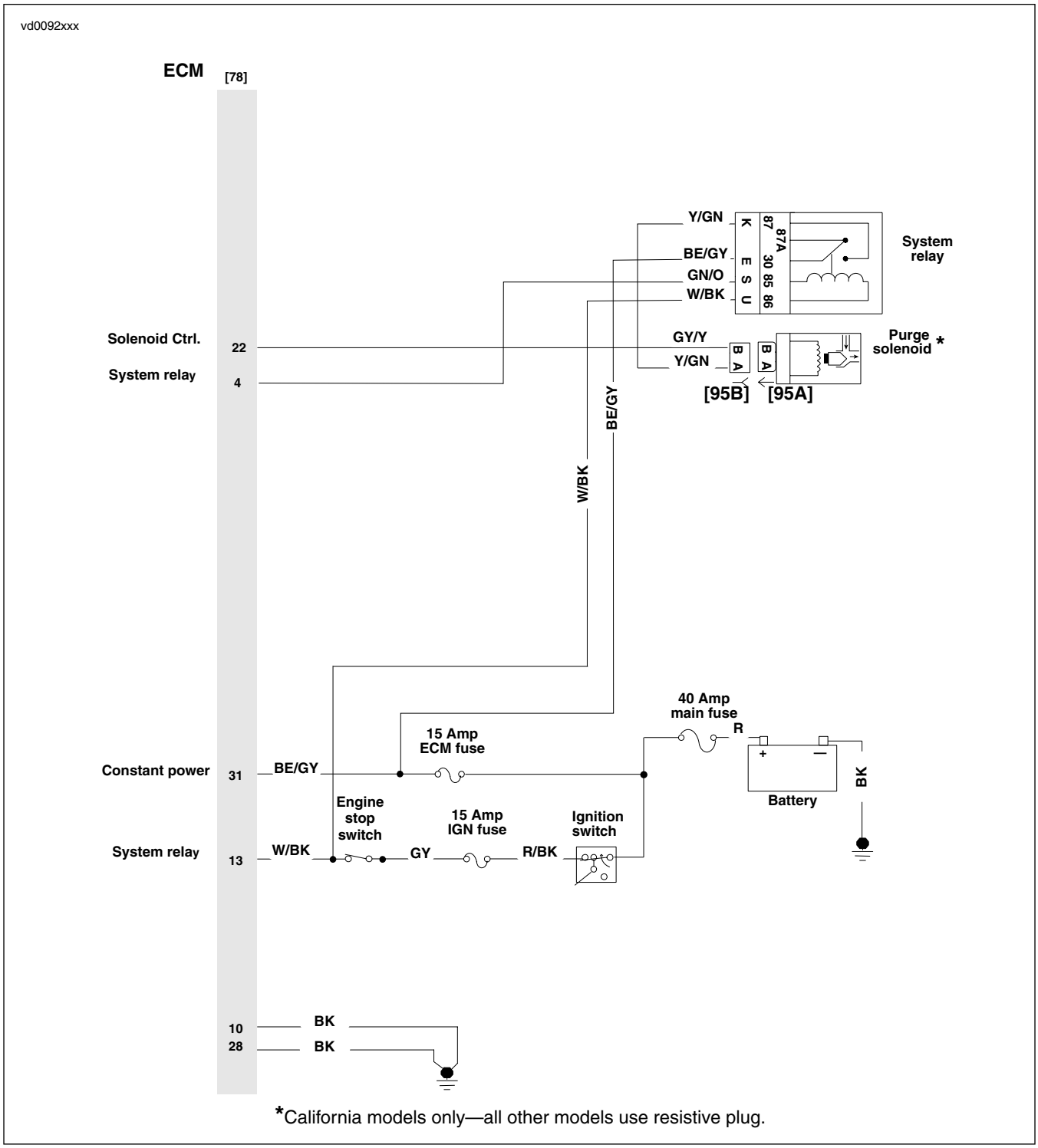
Figure 4-76. Purge Solenoid Test Lamp (Part No. HD-34730-2C)

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.27 flow charts.

1. See VRSC Service Manual for all service information.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple terminal probes and patch cord to BREAKOUT BOX and gray socket probes and patch cord to FUEL INJECTOR TEST LAMP (Part No. HD-34730-2C). See Figure 4-68.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple terminal probe and patch cord.
4. Connect a BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.



*California models only—all other models use resistive plug.

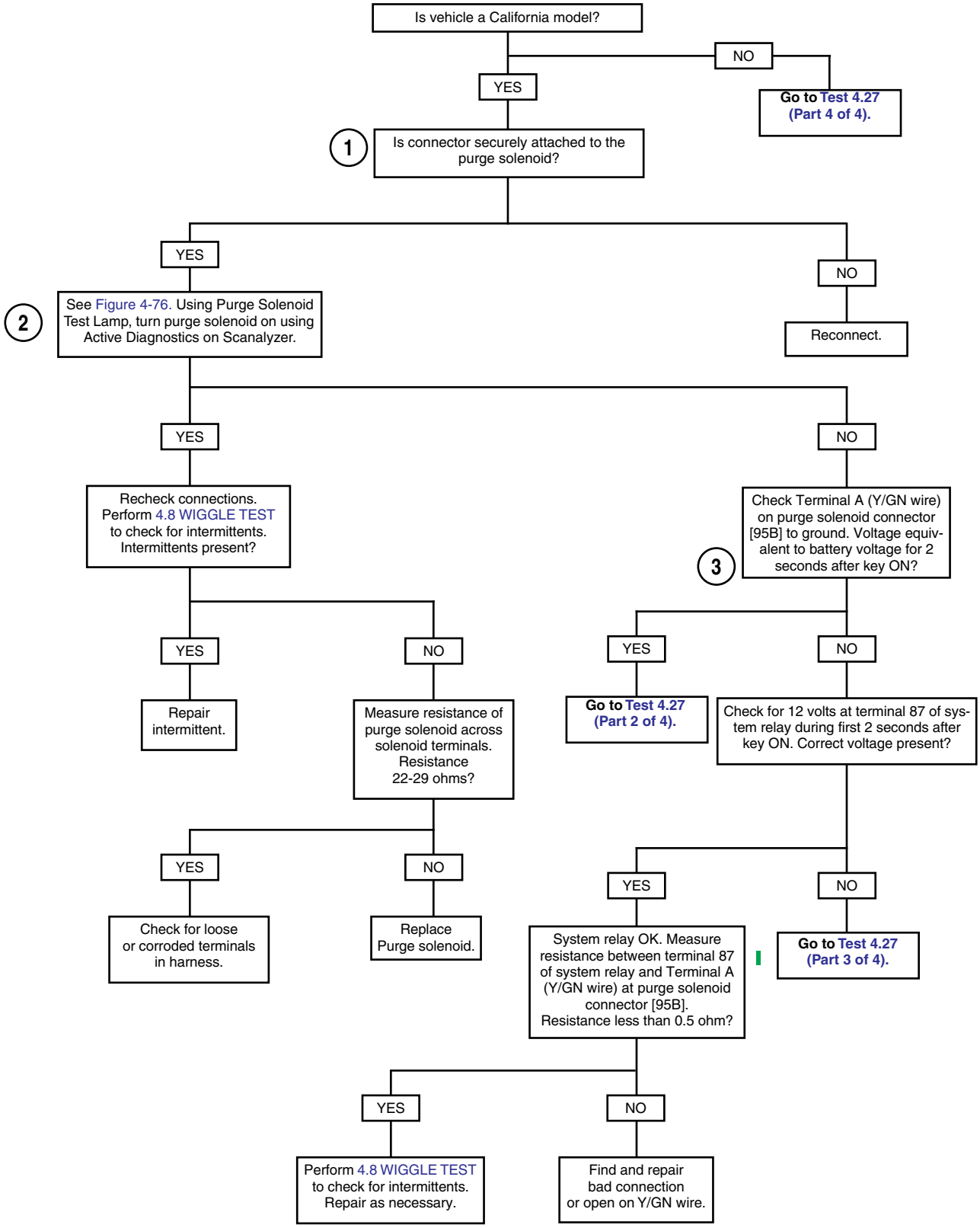
Figure 4-77. Purge Solenoid Circuit

Table 4-42. Wire Harness Connectors in Figure 4-77.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[95]	Purge Solenoid	2-place Packard	below seat

Test 4.27 (Part 1 of 4)

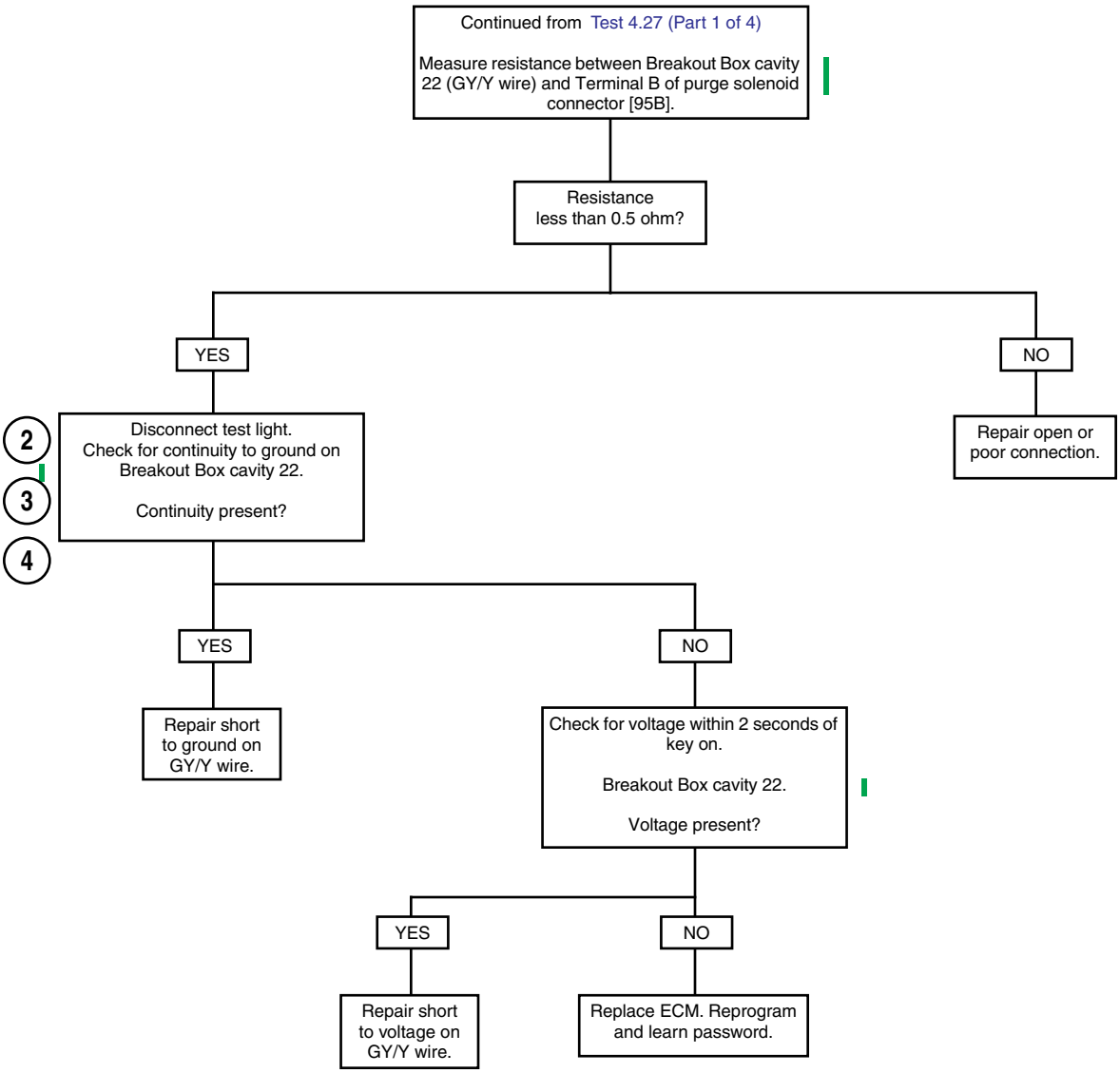
PURGE SOLENOID P0444, P0445



Clear codes and confirm proper operation with no check engine lamp.

Test 4.27 (Part 2 of 4)

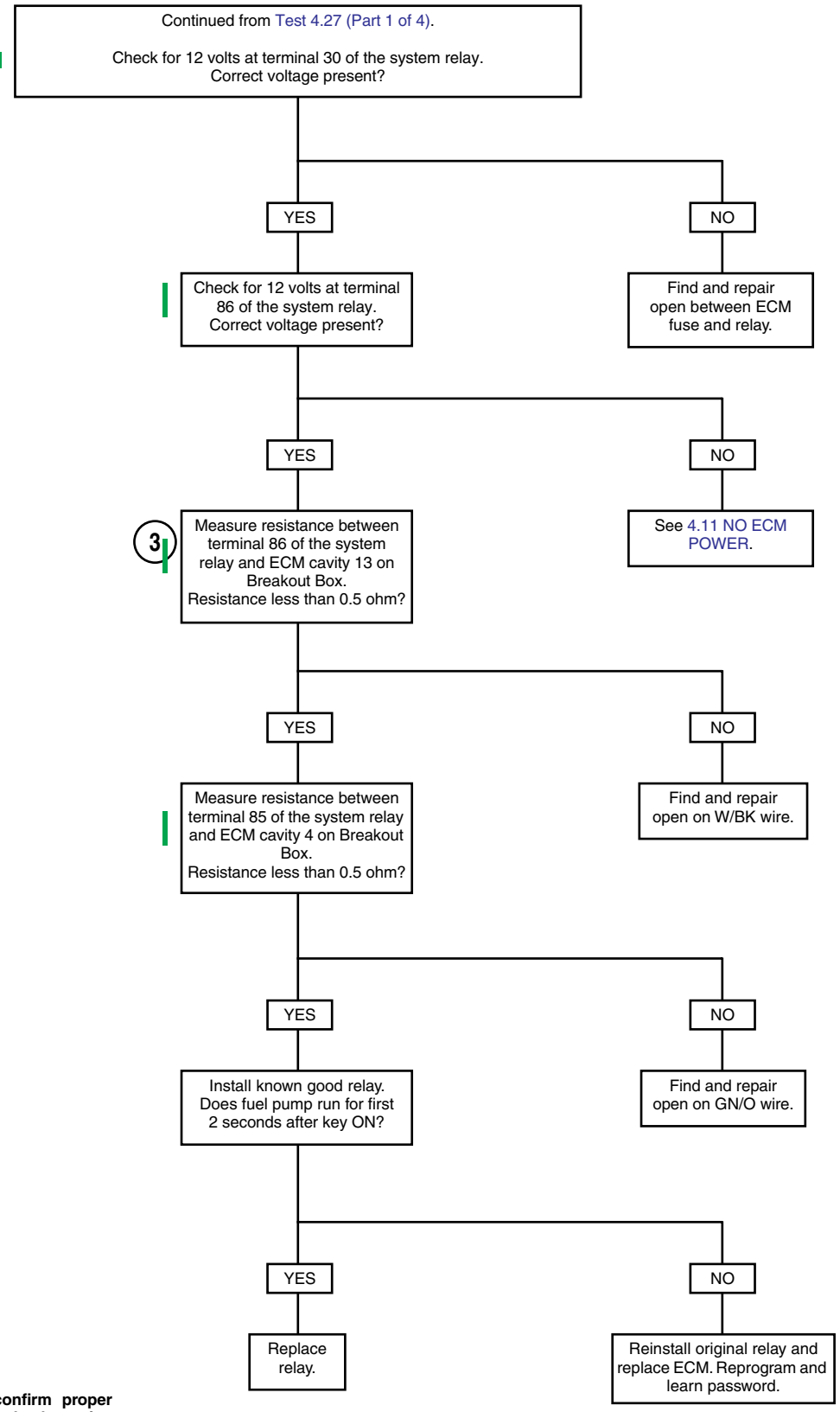
PURGE SOLENOID P0444, P0445



Clear codes and confirm proper operation with no check engine lamp.

Test 4.27 (Part 3 of 4)

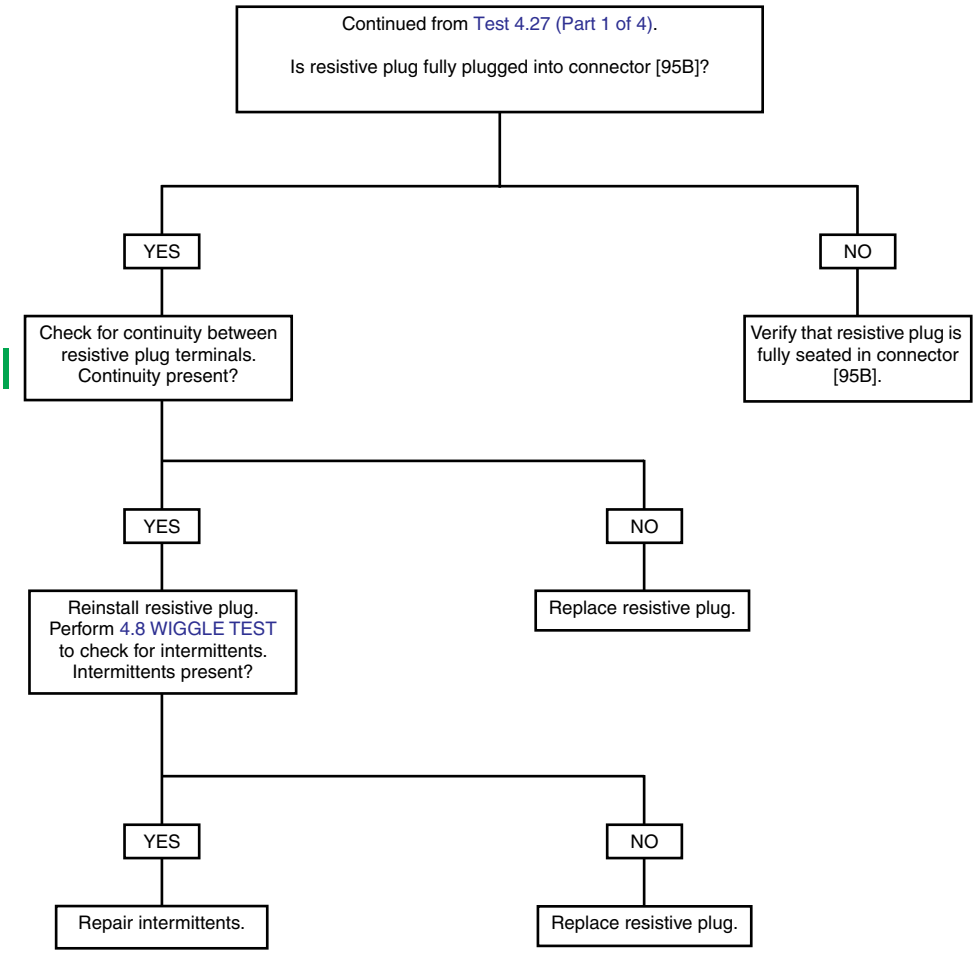
PURGE SOLENOID P0444, P0445



Clear codes and confirm proper operation with no check engine lamp.

Test 4.27 (Part 4 of 4)

PURGE SOLENOID P0444, P0445



Clear codes and confirm proper operation with no check engine lamp.

DTC P0501, P0502 4.28

GENERAL

Vehicle Speed Sensor

See Figure 4-78. The vehicle speed sensor is powered and monitored by the ECM. The ECM processes the vehicle speed signal and transmits this signal to the TSM/TSSM and IM through serial data.

NOTE

Vehicle speed is input to the idle air control system. Therefore problems with the vehicle speed signal can lead to improper operation of the idle air control.

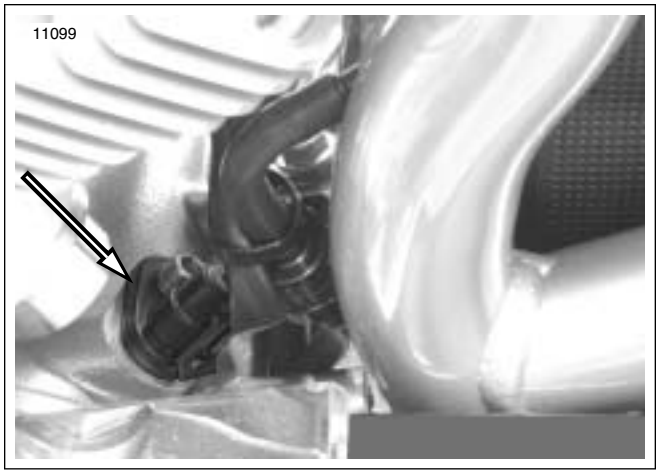


Figure 4-78. Vehicle Speed Sensor (typical)

Table 4-43. Code Description

DTC	DESCRIPTION
P0501	VSS sensor low
P0502	VSS sensor high/open

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.28 flow charts.

1. The instrument module has a built-in diagnostic mode. See 4.6 INSTRUMENT MODULE SELF DIAGNOSTICS.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probe and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.

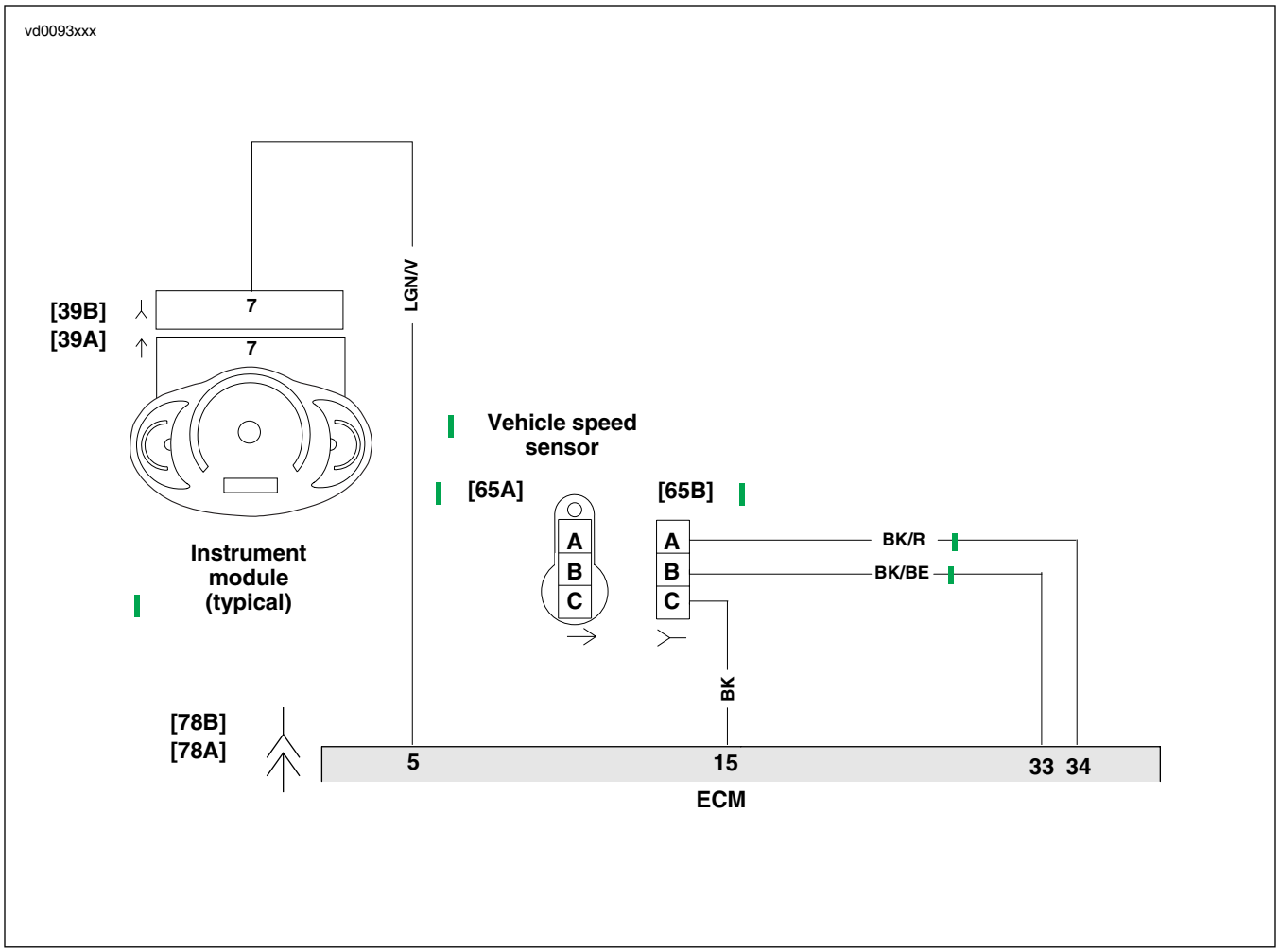


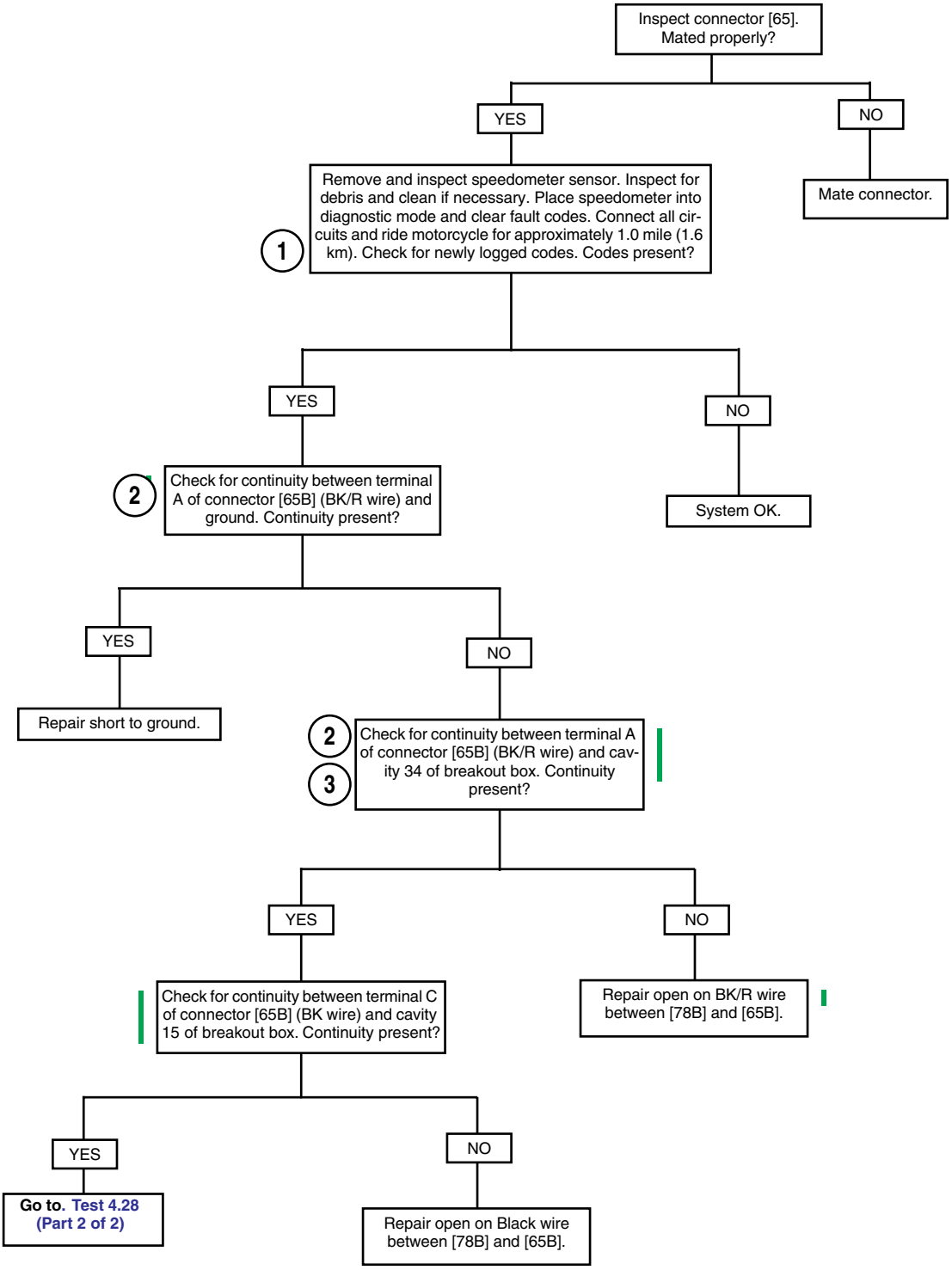
Figure 4-79. Vehicle Speed Sensor Circuit

Table 4-44. Wire Harness Connectors in Figure 4-79.

NO.	DESCRIPTION	TYPE	LOCATION
[39]	Instrument module	12-place Mini-Deutsch	under handlebar cover
[65]	Vehicle speed sensor	3-place Packard	at vehicle speed sensor
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat

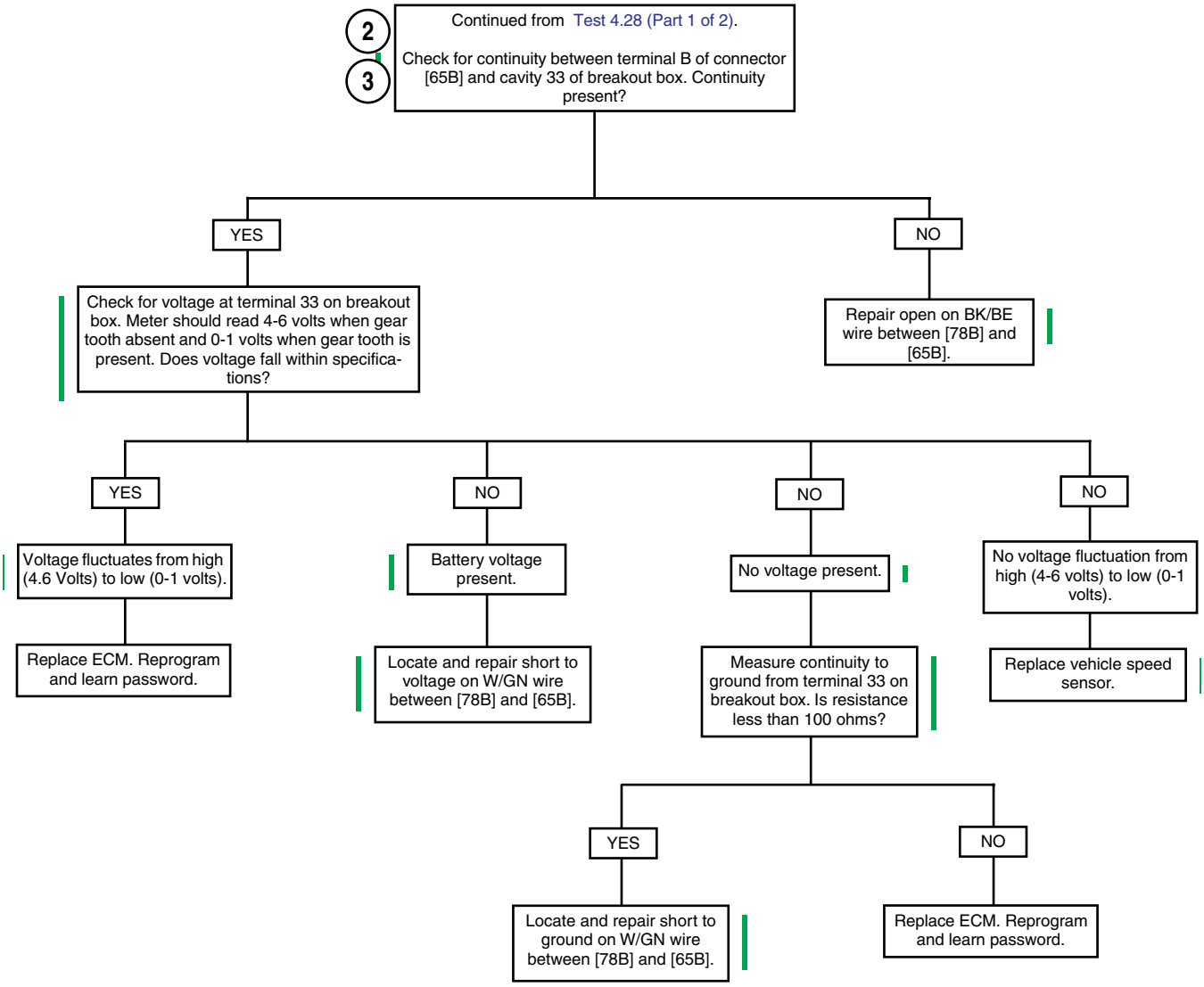
Test 4.28 (Part 1 of 2)

VEHICLE SPEED SENSOR: DTC P0501, P0502



Test 4.28 (Part 2 of 2)

VEHICLE SPEED SENSOR: DTC P0501, P0502



Clear codes and confirm proper operation with no check engine lamp.

DTC P0562, P0563 4.29

GENERAL

Battery Voltage

See Figure 4-80. Battery voltage is monitored by the ECM (terminal 13). If the battery voltage fails to meet normal operating parameters, a code is set.

- Code P0562 is displayed when battery positive voltage is less than 12.2 volts at idle and voltage does not increase when engine speed is greater than 2000 RPM.
- Code P0563 is displayed when battery positive voltage is greater than 15.0 volts for more than 4 seconds.

NOTES

- *Warm idle speed will be automatically increased if battery voltage is low at idle.*
- *IM or TSSM problems may also set a battery voltage diagnostic code P0563.*

Table 4-45. Code Description

DTC	DESCRIPTION
P0562	Battery voltage low
P0563	Battery voltage high

DIAGNOSTICS

Diagnostic Tips

- Low voltage generally indicates a loose wire, corroded connections, battery and/or a charging system problem.
- A high voltage condition may be caused by a faulty voltage regulator.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.

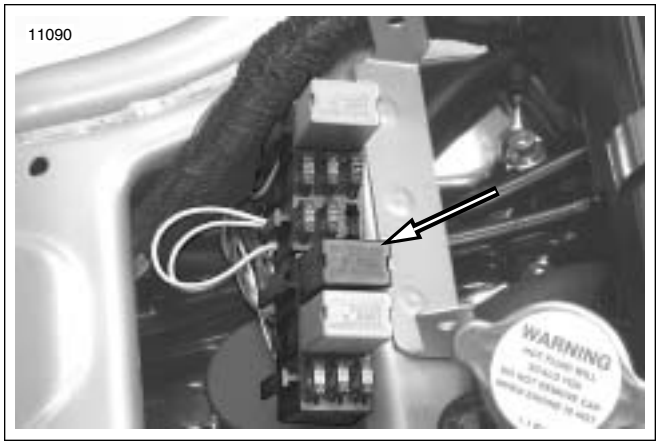


Figure 4-80. System Relay

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.29 flow charts.

1. Was battery allowed to discharge? Was battery drawn down by a starting problem?
   a. **Yes.** Charge battery.
   b. **No.** See charging system troubleshooting.
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.
3. This checks for voltage drops in the ignition module circuit.
   a. Place (+) probe to battery positive terminal.
   b. Place (-) probe to W/BK terminal on Breakout Box.
4. Connect BREAKOUT BOX (Part No. HD-42682) using ADAPTERS (HD-45325).
5. Problem is most likely the ground connection at the frame.

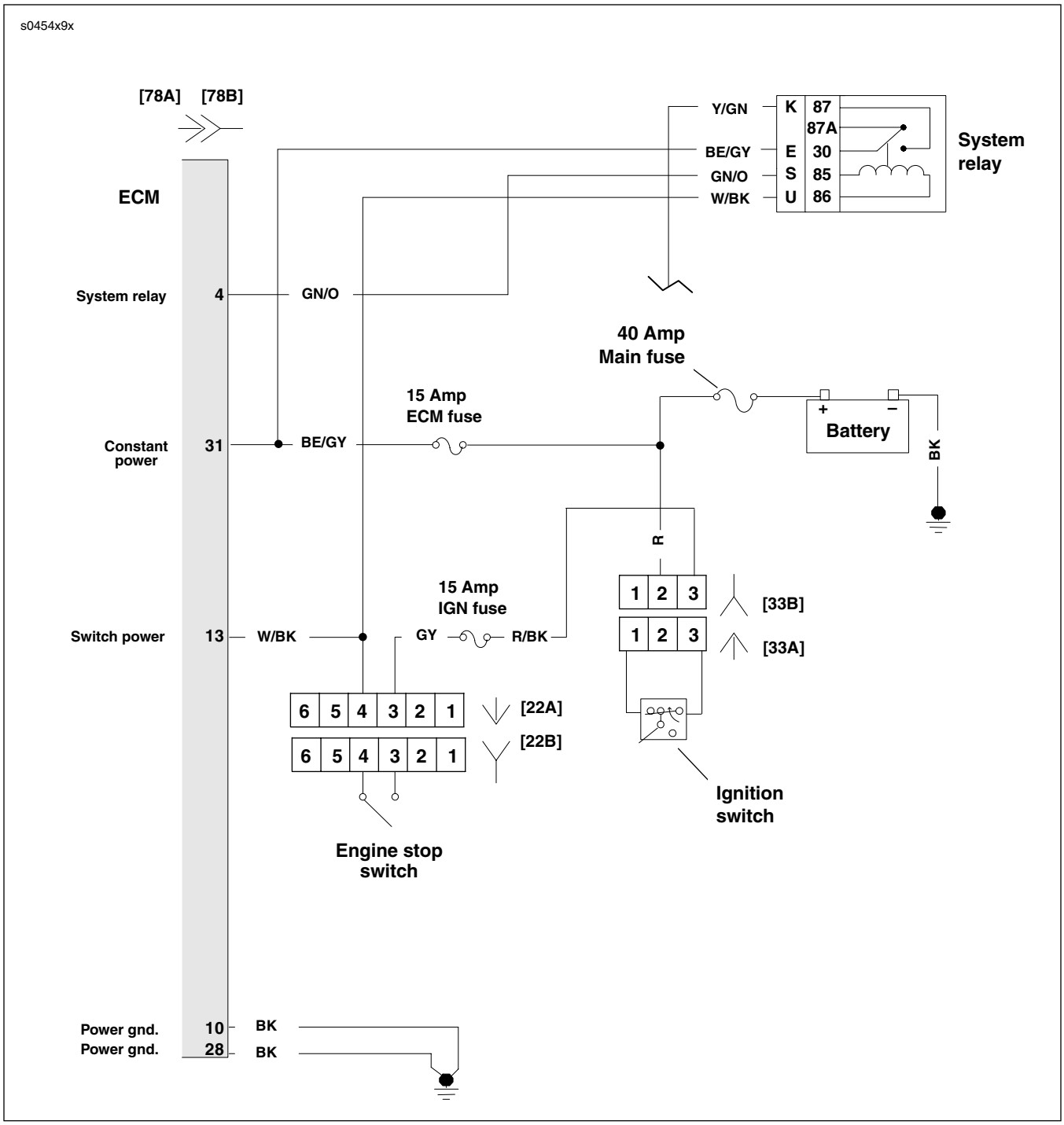


Figure 4-81. Battery Voltage Circuit Diagram (VRSCA/VRSCD)

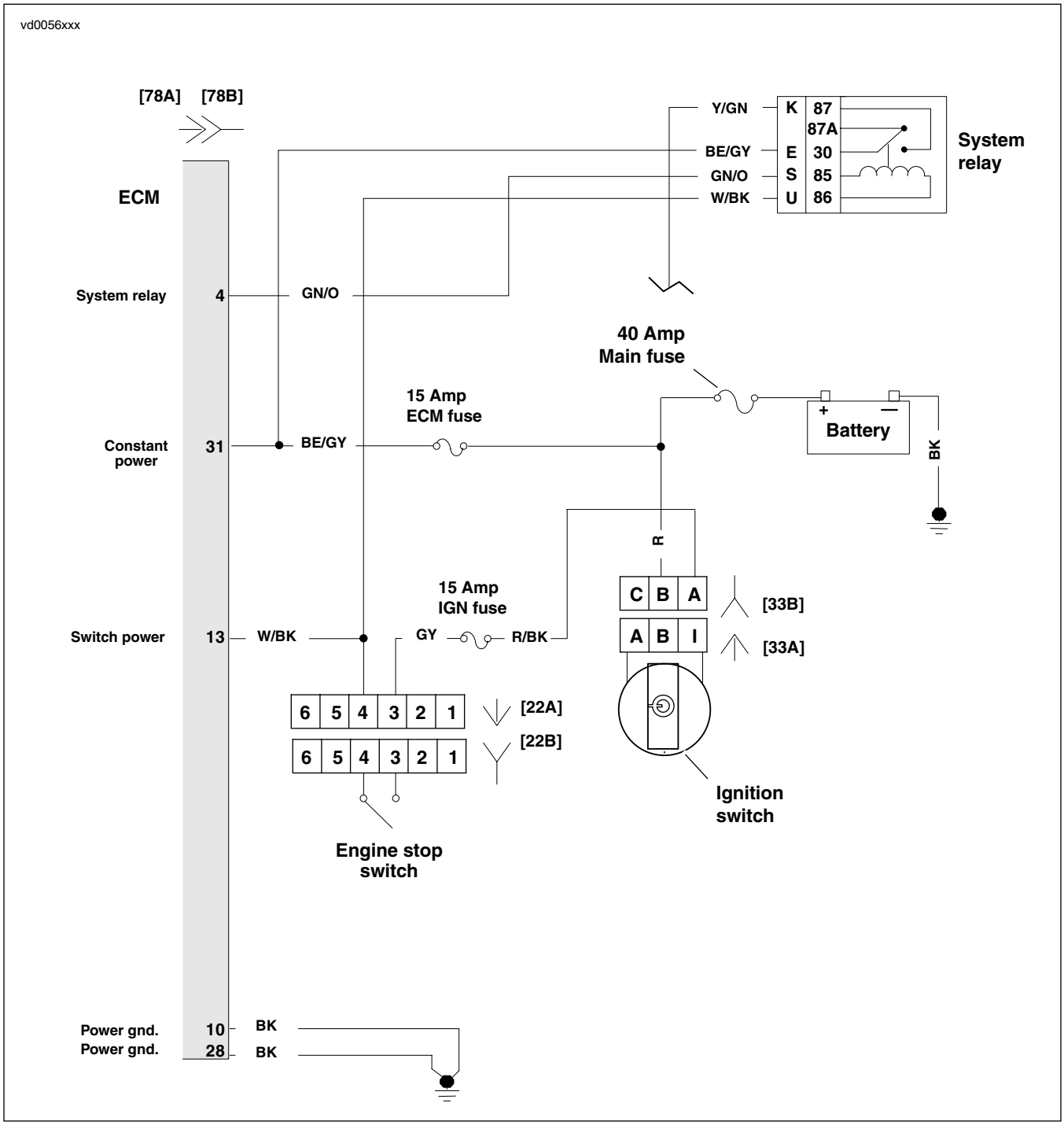


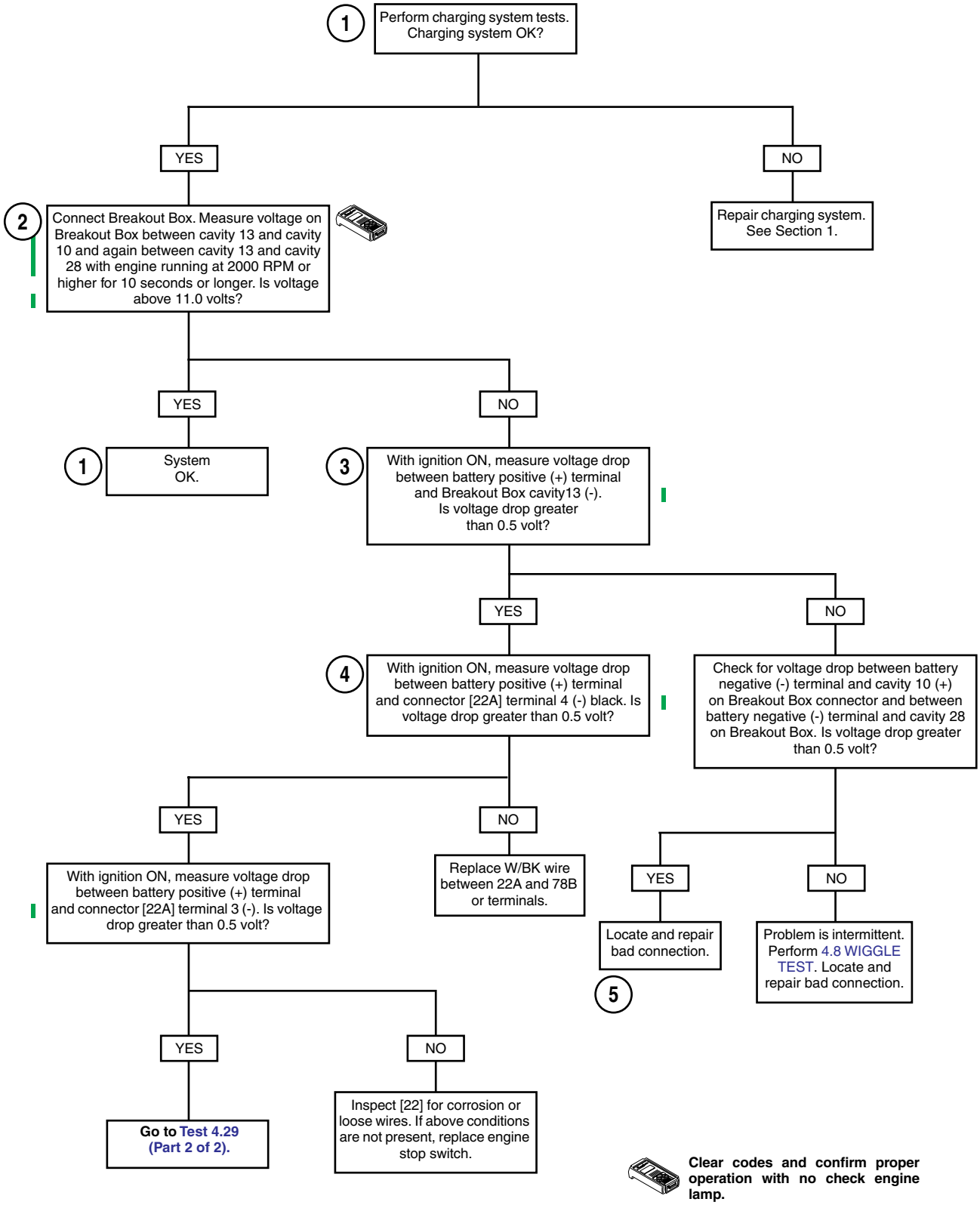
Figure 4-82. Battery Voltage Circuit Diagram (VRSCR)

Table 4-46. Wire Harness Connectors in Figure 4-81. and Figure 4-82.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar switch (black)	6-place Deutsch	under passenger seat
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under left passenger seat

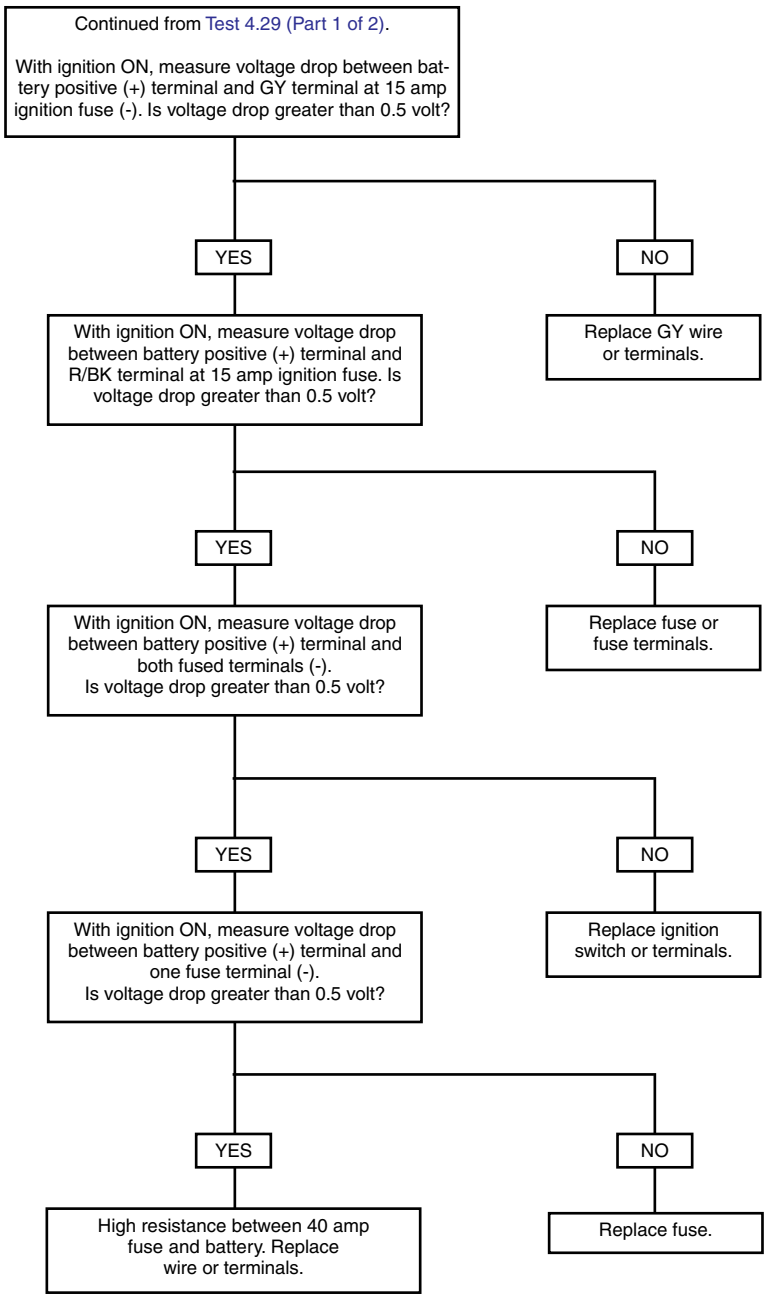
Test 4.29 (Part 1 of 2)

BATTERY VOLTAGE: DTC P0562, P0563



Test 4.29 (Part 2 of 2)

BATTERY VOLTAGE: DTC P0562, P0563



Clear codes and confirm proper operation with no check engine lamp.

DTC P0603, P0605 4.30

GENERAL

ECM Failure

Refer to Table 4-47. The codes listed indicate a failure which requires replacement of the ECM (Job Time Code 7913). See the VRSC Service Manual for replacement information.

NOTE

After replacing ECM, perform password learning procedure and clear codes.

Table 4-47. Code Description

DTC	DESCRIPTION
P0603	ECM EEPROM error
P0605	ECM flash error

DIAGNOSTICS

DTC P0603 Test

1. Turn IGN switch to OFF position.
2. Clear codes using Scanalyzer or IM self diagnostics. See 4.6 INSTRUMENT MODULE SELF DIAGNOSTICS.
3. Replace ECM if codes reappear.

DTC P0605 Test

1. Turn IGN switch to OFF position.
2. Clear codes using Scanalyzer or IM self diagnostics. See 4.6 INSTRUMENT MODULE SELF DIAGNOSTICS.
3. Attempt to reprogram ECM using correct calibration.
4. Restart vehicle. If code reappears, replace ECM.

DTC P1009, P1010 4.31

GENERAL

Password Problem

The ECM, IM and TSM/TSSM exchange passwords during operation. An incorrect password or missing password will set a diagnostic code.

NOTE

If the TSM/TSSM is not connected to the wiring harness, the vehicle will not start.

Table 4-48. Code Description

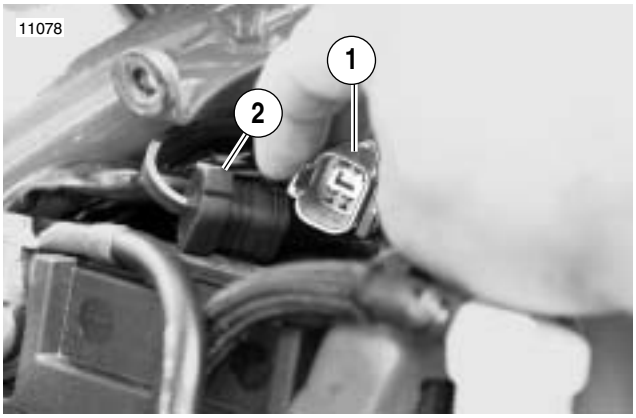
DTC	DESCRIPTION
P1009	Incorrect password
P1010	Missing password

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.31 flow charts.

1. DTC P1009 may be set if a recent ECM or TSM/TSSM replacement did not follow the correct password assignment procedure. See 3.23 TSSM MAINTENANCE for details.
2. See the VRSC Service Manual for TSM/TSSM replacement. See TSM/TSSM section of this document for the password learning routine (Scanalyzer menu refers to this function as “module replacement”).
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probes and patch cord.
4. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.



1. **Data connector [91A]**
2. **Protective rubber plug**

Figure 4-83. Serial Data Connector [91A]

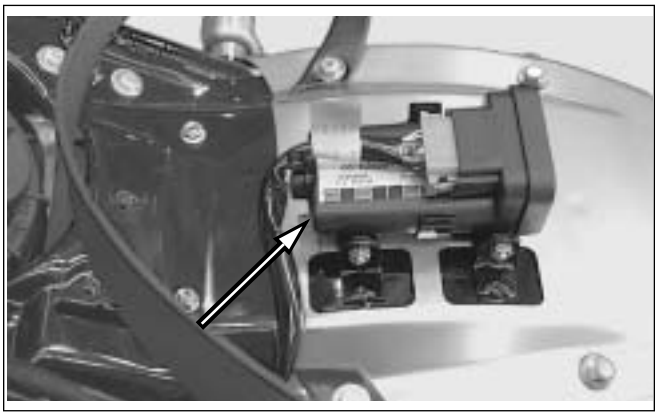


Figure 4-84. TSM/TSSM (VRSCA/VRSCD)

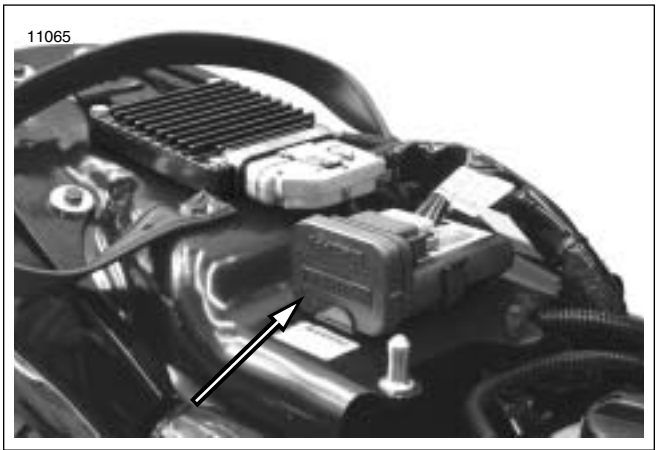


Figure 4-85. TSM/TSSM (VRSCR)

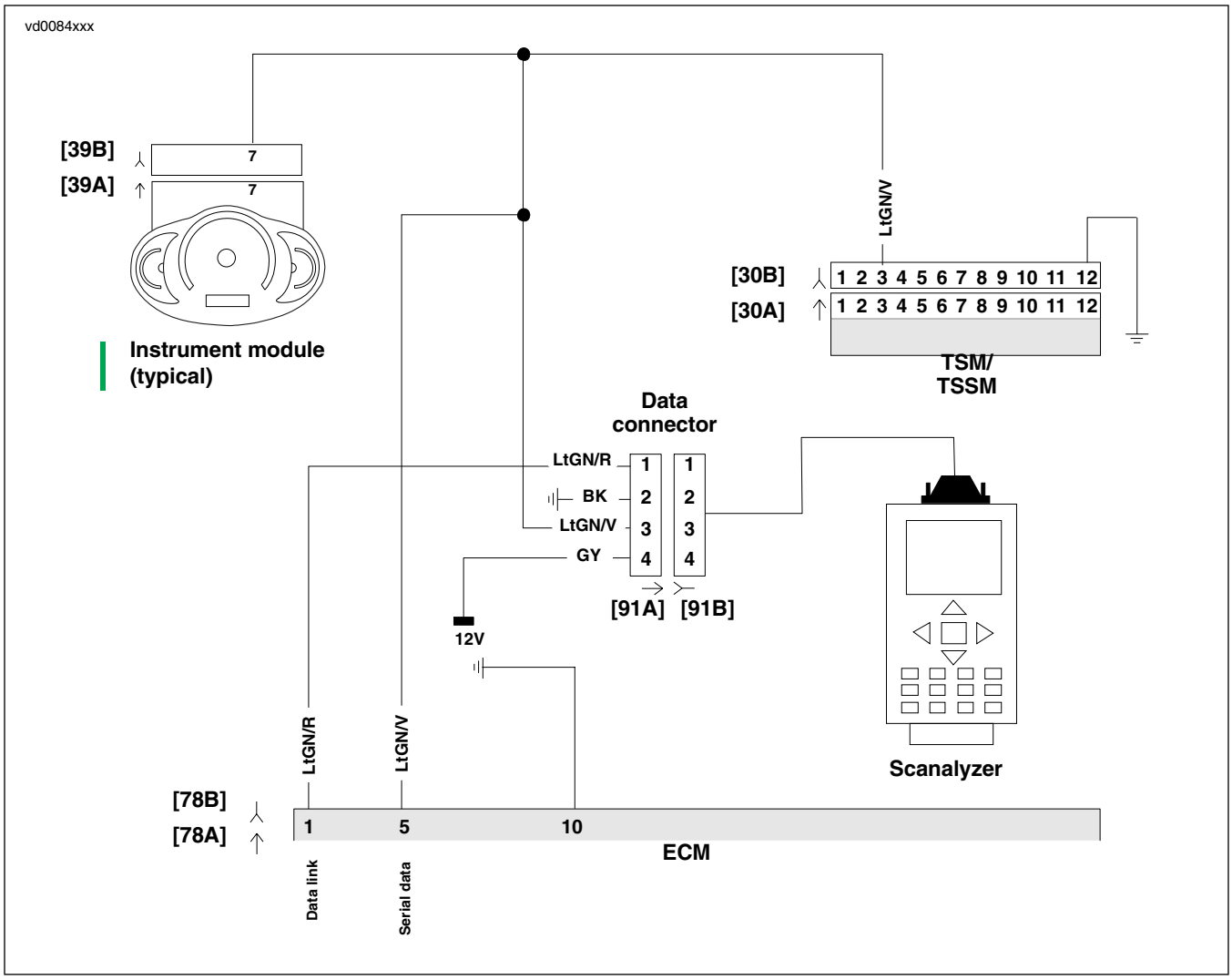


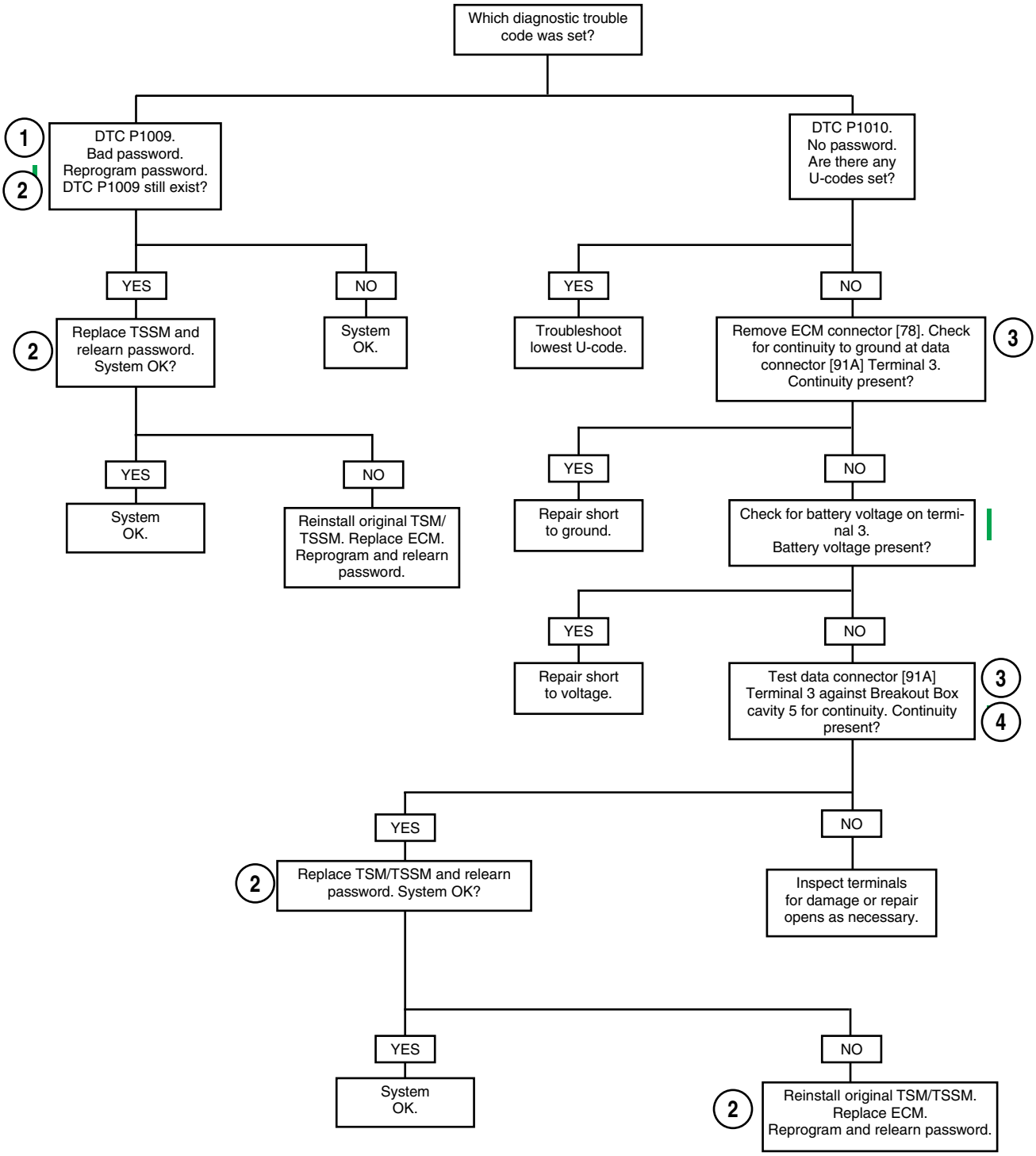
Figure 4-86. ECM and TSM/TSSM Circuit

Table 4-49. Wire Harness Connectors in Figure 4-86.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	Instrument module	12-place Mini-Deutsch	handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91]	Data link	4-place Deutsch	under left side cover

Test 4.31

PASSWORD PROBLEM: DTC P1009, P1010



DTC P1351, P1352, P1354, P1355 4.32

GENERAL

Ignition Coil

Ignition coil codes will set if an ignition coil primary voltage is out of range. This could occur if there is an open coil or loss of power to a coil. If front and rear codes are set simultaneously, it is likely a coil power failure or a coil failure.

The coils receive power from the system relay at the same time that the fuel pump and injectors are activated. The system relay is active for the first 2 seconds after the ignition is turned ON and then shuts off until RPM is detected from the CKP sensor, at which time it is reactivated. The ECM is responsible for turning on the system relay by providing the ground to activate the relay, which in turn powers the coil.

Table 4-50. Code Description

DTC	DESCRIPTION
P1351	Front ignition coil open/low
P1352	Front ignition coil high/shorted
P1354	Rear ignition coil open/low
P1355	Rear ignition coil high/shorted

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.32 flow charts.

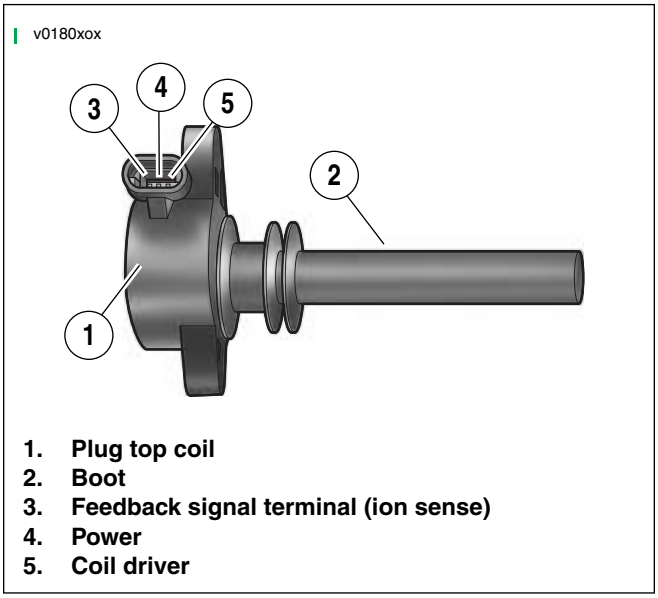
1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray terminal probes and patch cord.

CAUTION

Gently connect test lamp to connector [83B]. Forcefully inserting test lamp will result in ignition connector terminal damage.

2. See Figure 4-87. Plug IGNITION COIL CIRCUIT TEST ADAPTER (Part No. HD-44687) and FUEL INJECTOR TEST LAMP (Part No. HD-34730-2C) into Breakout Box. Note that cranking the engine with test lamp in place of the ignition coil can sometimes cause a DTC P1351, P1352, P1354 or P1355. This condition is normal and does not by itself indicate a malfunction.
3. Connect BREAKOUT BOX (Part No. HD-43876) between EFI wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), grey socket probes and patch cords.

Figure 4-87. Ignition Coil Circuit Test



1. **Plug top coil**
2. **Boot**
3. **Feedback signal terminal (ion sense)**
4. **Power**
5. **Coil driver**

Figure 4-88. Plug Top Coil

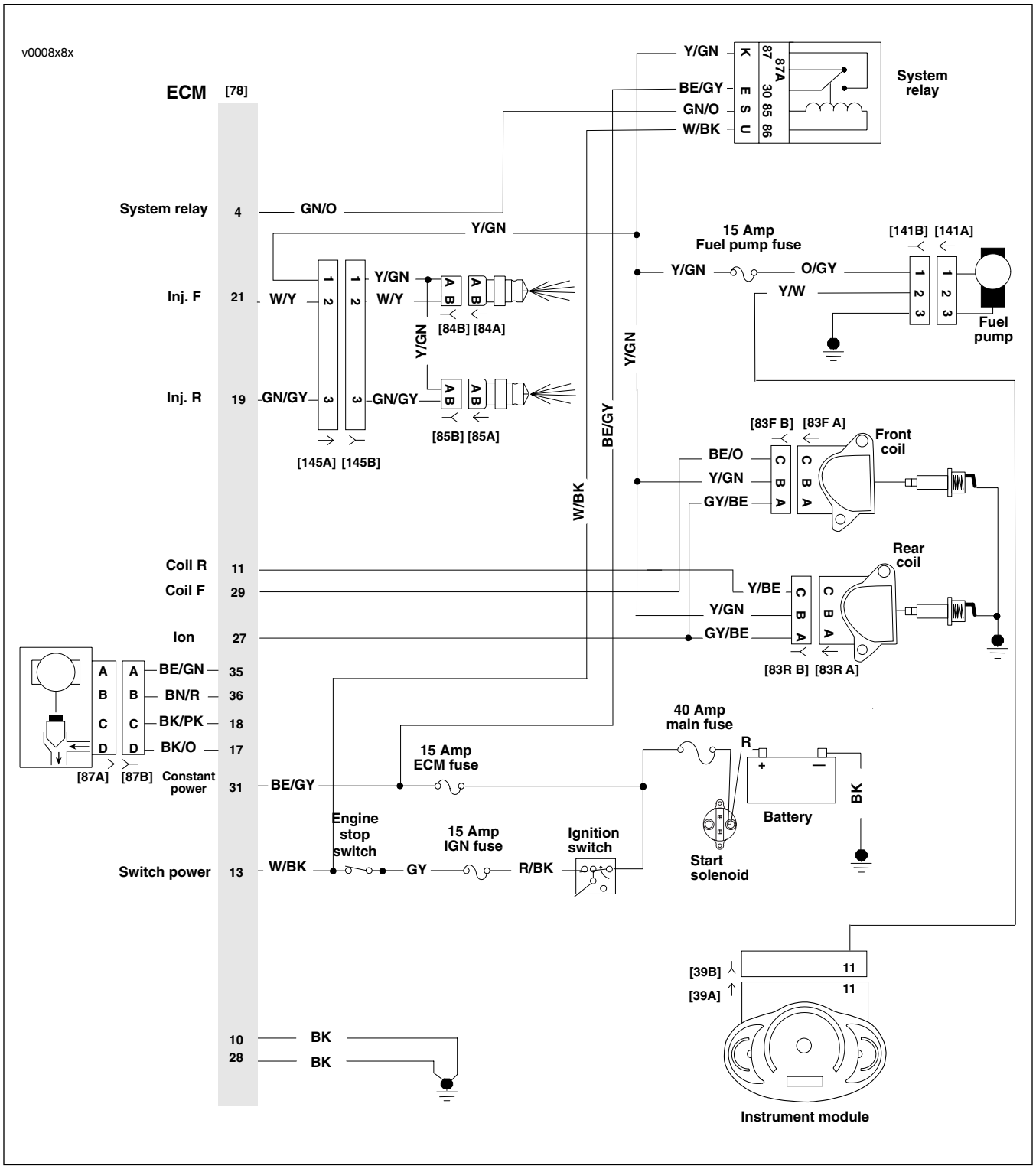


Figure 4-89. Ignition Coil Circuit (VRSCA/VRSCD)

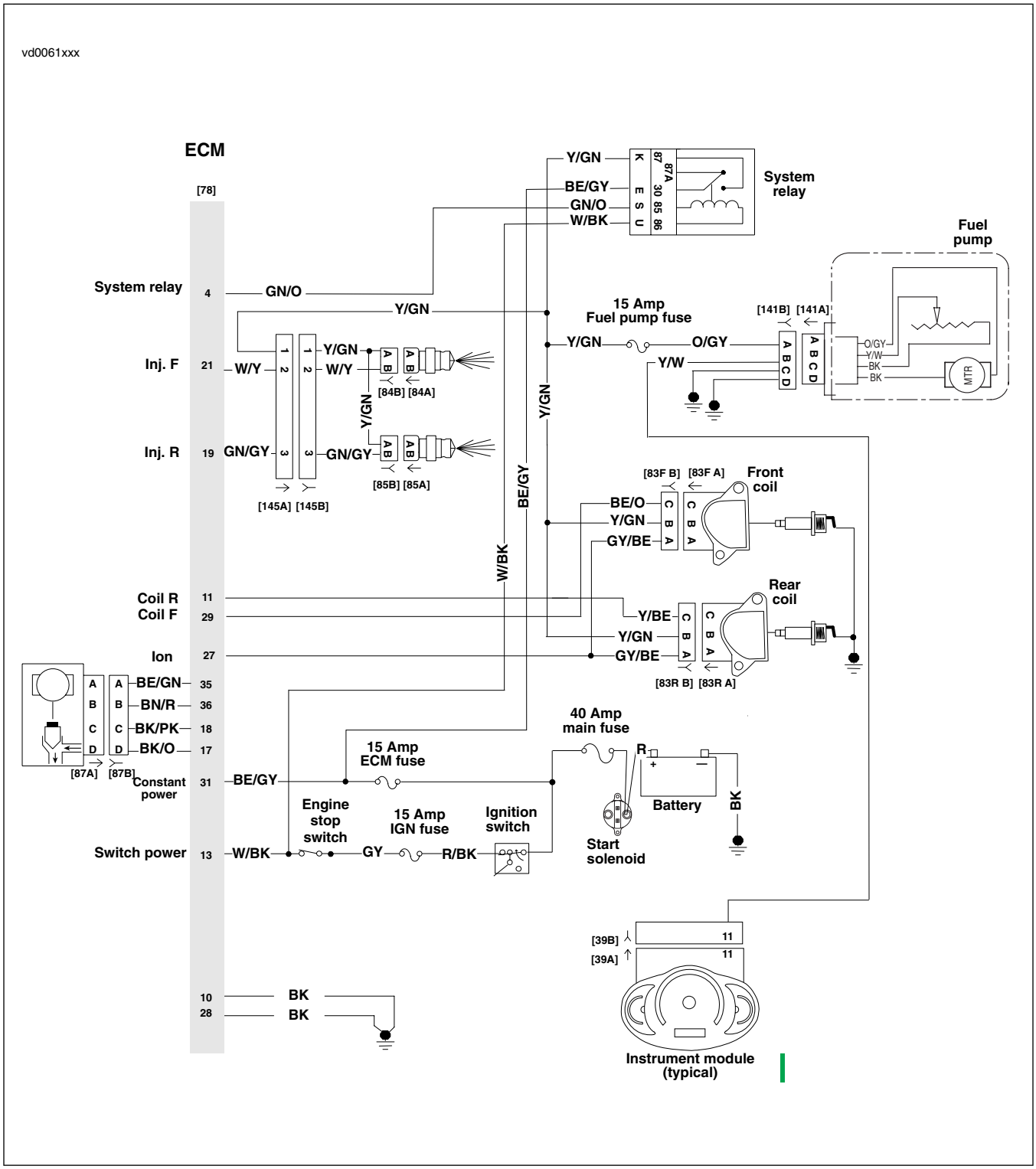


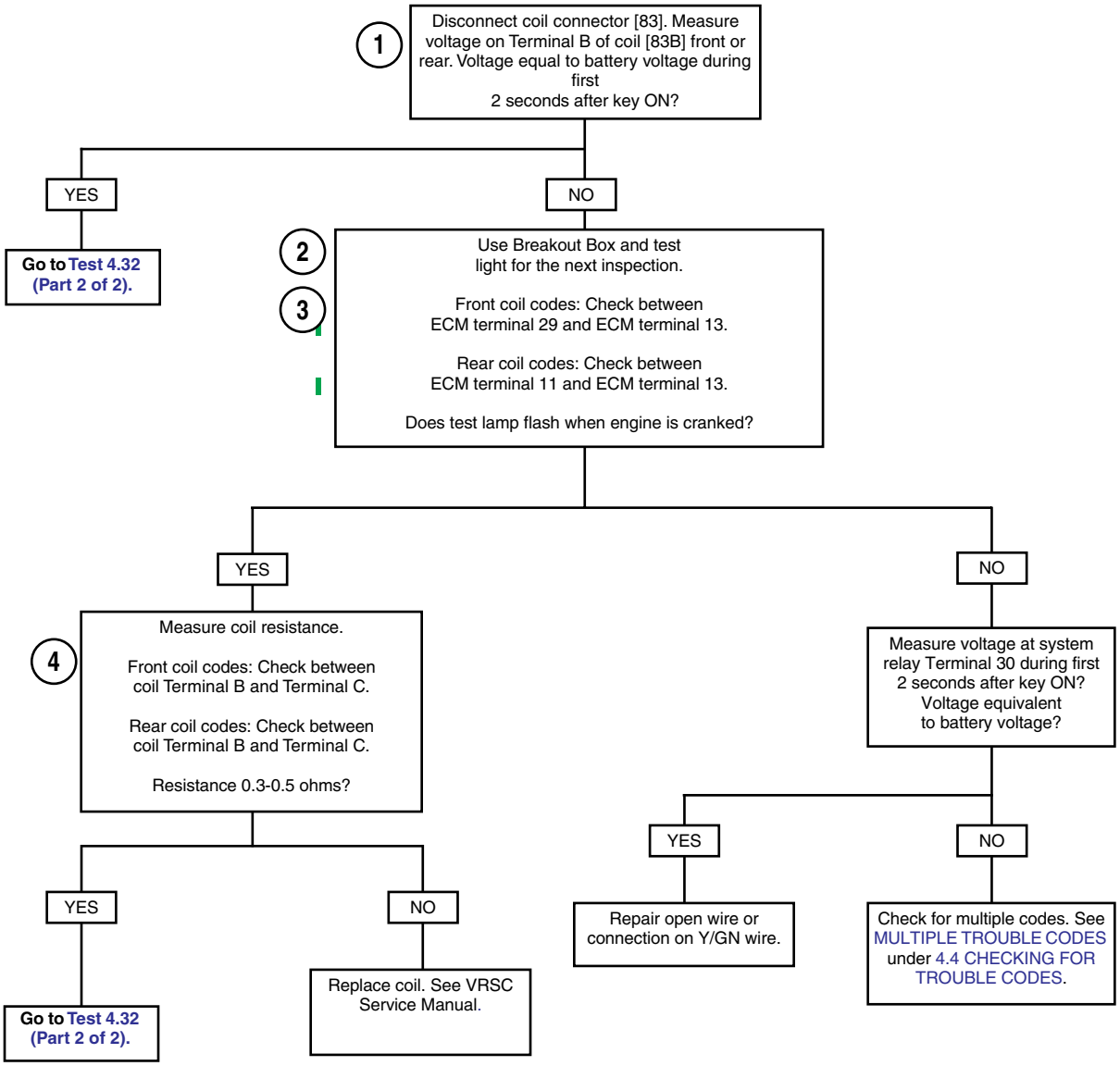
Figure 4-90. Ignition Coil Circuit (VRSCR)

Table 4-51. Wire Harness Connectors in Figure 4-90.

NO.	DESCRIPTION	TYPE	LOCATION
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[83F]	Front plug top coil	3-place Packard	on top of front cam cover
[83R]	Rear plug top coil	3-place Packard	on top of rear cam cover

Test 4.32 (Part 1 of 2)

IGNITION COIL: DTC P1351, P1352, P1354, P1355



Clear codes and confirm proper operation with no check engine lamp.

Test 4.32 (Part 2 of 2)

IGNITION COIL: DTC P1351, P1352, P1354, P1355

Continued from Test 4.32 (Part 1 of 2).

Using Breakout Box, measure resistance between ECM and coil terminals as follows.

DTC	COIL TERMINAL	BREAK-OUT BOX TERMINAL
P1351/ P1352	C (BE/O wire)	29
P1353/ P1354	C (Y/BE wire)	11

1

3

Resistance less than 0.5 ohms?

YES

Perform 4.8 WIGGLE TEST to check for intermittents. Intermittents present?

YES

Repair intermittent.

NO

Check for continuity to ground.

Front coil codes: Check Breakout Box cavity 29.

Rear coil codes: Check Breakout Box cavity 11.

Continuity present?

YES

Repair short to ground.

NO

Check for voltage.

Front coil codes: Check Breakout Box cavity 29.

Rear coil codes: Check Breakout Box cavity 11.

Voltage present?

YES

Repair short to voltage.

NO

Replace ECM. Reprogram and learn password.

NO

Repair open wire or connection.

Clear codes and confirm proper operation with no check engine lamp.

DTC U1064, U1255

GENERAL

Loss of TSM/TSSM Serial Data

The serial data connector provides a means for the ECM, IM and TSM/TSSM to communicate their current status. When all operating parameters on the serial data link are within specifications, a state of health message is sent between the components. A DTC U1064 indicates that the TSM/TSSM is not receiving this state of health message.

Table 4-52. Code Description

DTC	DESCRIPTION
U1064	Loss of TSM/TSSM serial data (state of health)
U1255	Missing message at TSSM

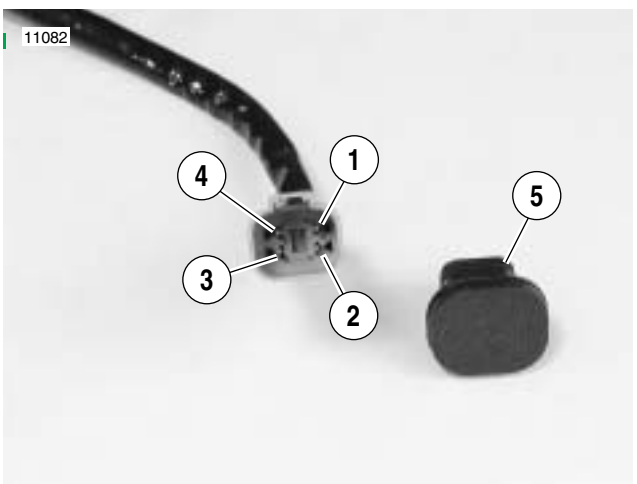
DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.33 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness and ECM. See 4.7 BREAKOUT BOX: ECM.
2. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness and TSM/TSSM. See 3.12 BREAKOUT BOX:TSM/TSSM.

Figure 4-91. TSM/TSSM (typical)



1. **Terminal 1: flash terminal (Lt GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**
5. **Protective cap**

Figure 4-92. Data Connector Terminals

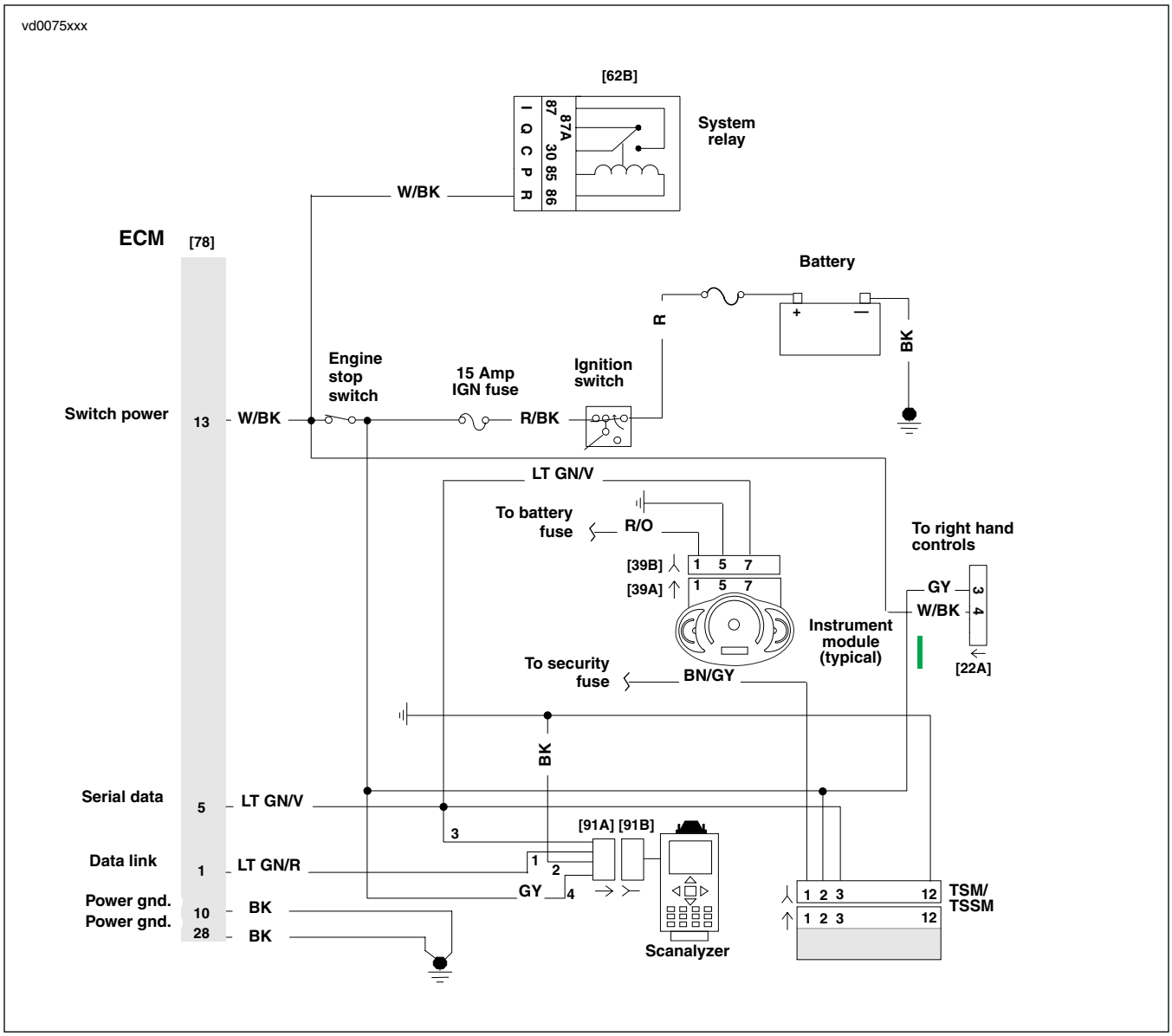


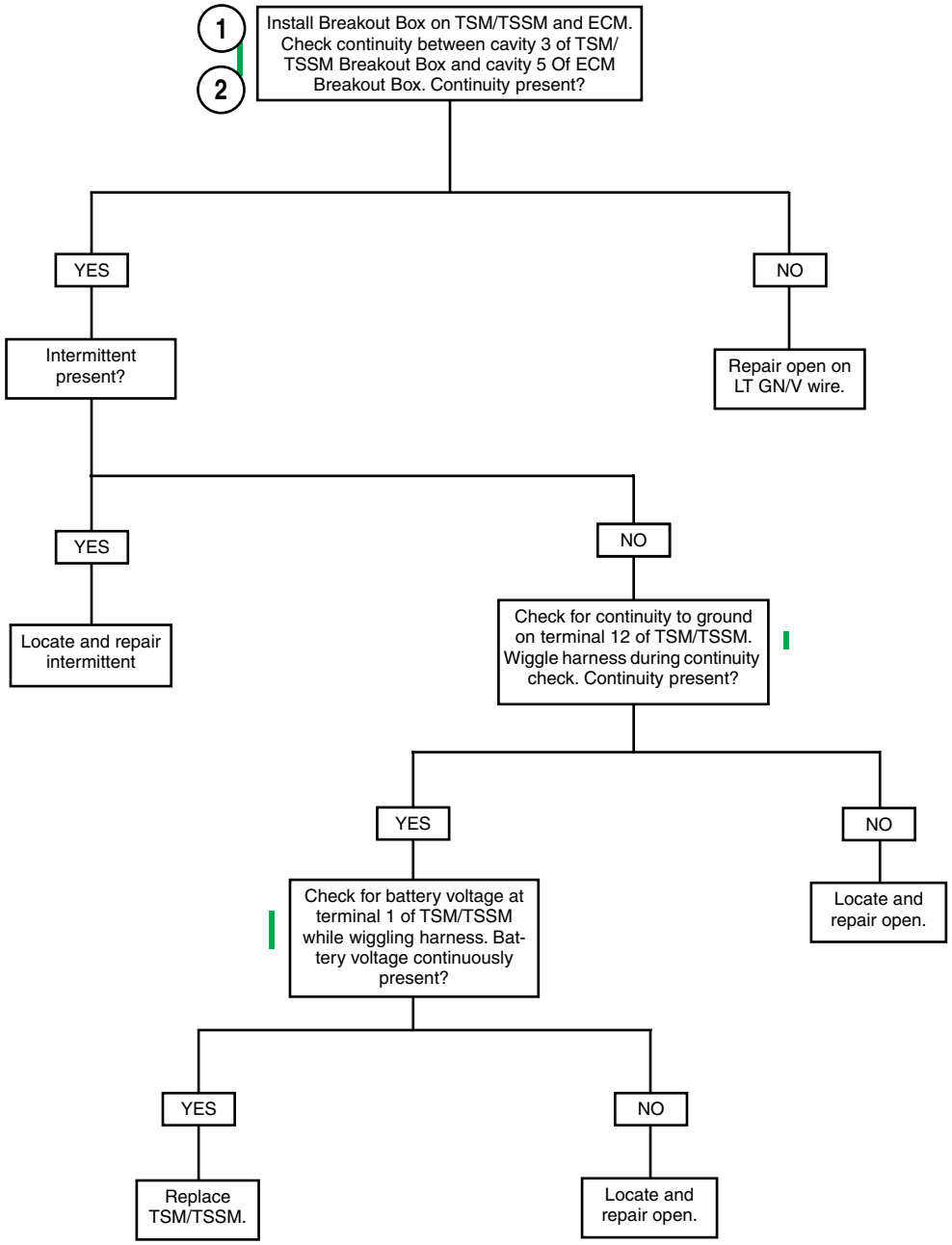
Figure 4-93. TSM/TSSM, ECM and IM Circuit

Table 4-53. Wire Harness Connectors in Figure 4-93.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	Instrument module	12-place Mini-Deutsch	handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91A]	Data	4-place Deutsch	under left side cover

Test 4.33

LOSS OF TSM/TSSM SERIAL DATA: DTC U1064, U1255



Clear codes and confirm proper operation with no check engine lamp.

DTC U1096, U1255 4.34

GENERAL

Loss of IM Serial Data

The serial data connector provides a means for the IM, ECM and TSM/TSSM to communicate their current status. When all operating parameters on the serial data link are within specifications, a state of health message is sent between the components. A DTC U1096 indicates that the IM is not capable of sending this state of health message.

Table 4-54. Code Description

DTC	DESCRIPTION
U1096	Loss of all IM serial data (state of health)
U1255	Missing message at IM

DIAGNOSTICS

NOTE

If code is historic and not current, wiggle wire harness while performing voltage and continuity tests to identify intermittents.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the test 4.34 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness connector [78B] Leave ECM [78A] disconnected. See 4.7 BREAKOUT BOX: ECM.
2. Connect Breakout Box (Part No. HD-42682) (black) to wire harness connector [39B] using SPEEDOMETER HARNESS ADAPTER (Part No. HD-46601). Leave speedometer [39A] disconnected. See 2.4 BREAKOUT BOX: IM.

Figure 4-94. ECM Connector (VRSCA/VRSCD)

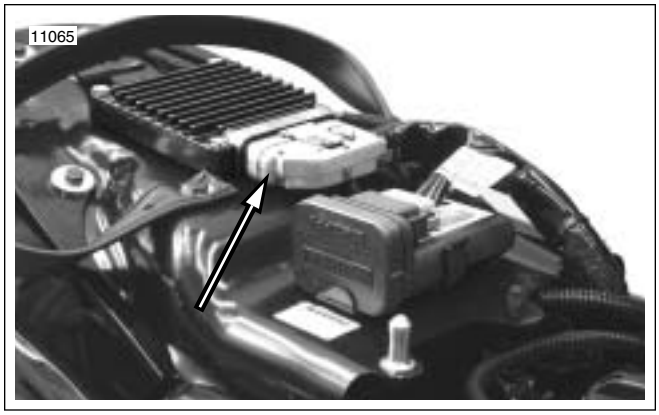
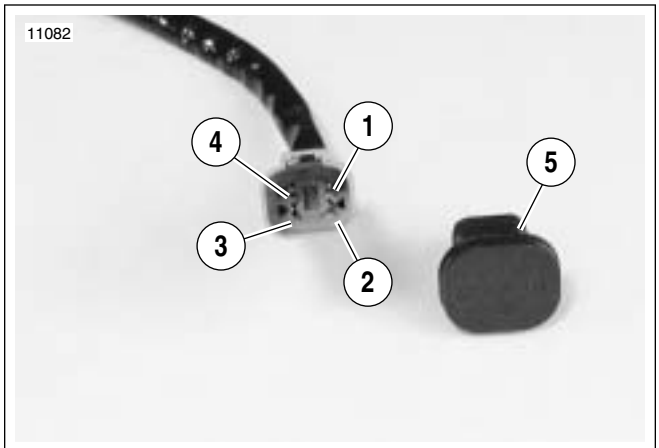


Figure 4-95. ECM Connector (VRSCR)



1. **Terminal 1: flash terminal (Lt GN/R)**
2. **Terminal 2: ground (BK)**
3. **Terminal 3: serial data (Lt GN/V)**
4. **Terminal 4: power (GY)**
5. **Protective cap**

Figure 4-96. Data Connector Terminals

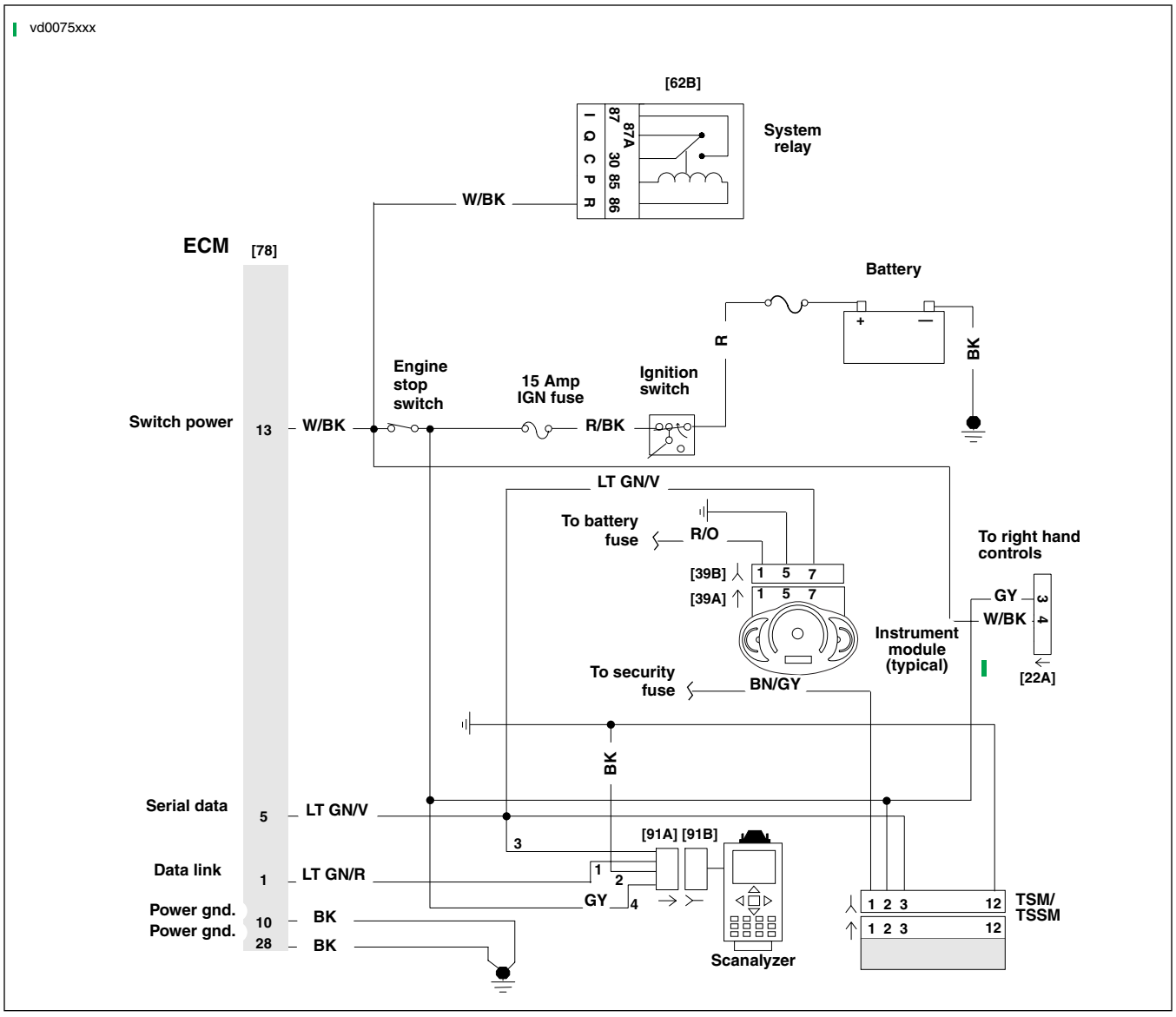


Figure 4-97. IM, ECM and TSM/TSSM Circuit

Table 4-55. Wire Harness Connectors in Figure 4-97.

NO.	DESCRIPTION	TYPE	LOCATION
[30]	TSM/TSSM	12-place Deutsch	under passenger seat
[39]	Instrument module	12-place Mini-Deutsch	handlebar cover
[78]	ECM (VRSCA/VRSCD)	36-place Packard	under left side cover
[78]	ECM (VRSCR)	36-place Packard	under passenger seat
[91A]	Data	4-place Deutsch	under left side cover

Test 4.34

LOSS OF IM SERIAL DATA: DTC U1096, U1255

IMPORTANT! Always start from Initial Diagnostics Check: EFI 4.9

1
2
Install Breakout Box on IM and ECM. Check continuity between cavity 7 of IM Breakout Box and cavity 5 Of ECM Breakout Box. Continuity present?

- NO → Repair open on LT GN/V wire.
- YES → Intermittent present?
  - YES → Locate and repair intermittent.
  - NO → Check for continuity to ground on terminal 5 of IM. Wiggle harness during continuity check. Continuity present?
    - NO → Locate and repair open.
    - YES → Check for battery voltage at terminal 1 of IM while wiggling harness. Battery voltage continuously present?
      - NO → Locate and repair open.
      - YES → Replace IM.

Clear codes and confirm proper operation with no check engine lamp.

Table Of Contents

SUBJECT **PAGE NO.**

CONNECTOR LOCATIONS 5.1

Table 5-1. Connector Locations

CONNECTOR NO.	DESCRIPTION	TYPE	LOCATION
[5]	main fuse	spade terminals	under right side cover
[18]	right rear turn signal	2-place Multilock	under outer rear fender
[19]	left rear turn signal	2-place Multilock	under outer rear fender
[22]	right hand controls	6-place Deutsch	under left side cover
[24]	left hand controls and horn	6-place Deutsch	under left side cover
[29]	position lamp (HDI)	2-place Mini-Deutsch	under left side cover
[30]	turn signal/security module	12-place Deutsch	under passenger seat
[31]	front turn signals	6-place Multilock	under handlebar cover
[33]	ignition key switch	3-place Packard	back of ignition switch
[38L]	low beam lamp	2-place Amp	back of headlamp
[38H]	high beam lamp	2-place Amp	back of headlamp
[39]	instrument module (IM)	12-place Mini-Deutsch	under handlebar cover
[45]	license plate lamp	3-place Multilock	under outer rear fender
[46]	voltage regulator to stator	3-place Packard	under left trim cover
[65]	vehicle speed sensor (VSS)	3-place Deutsch	above rear rocker box
[77]	voltage regulator to main harness	1-place Deutsch	behind radiator cover
[78]	electronic control module (ECM)	36-place Packard	under passenger seat
[79]	crank position sensor (CKP)	2-place Mini-Deutsch	under left trim cover
[80]	manifold air pressure sensor (MAP)	3-place Packard	front intake passage
[83 F]	front plug top coil	3-place Packard	on top of front rocker box
[83 R]	rear plug top coil	3-place Packard	on top of rear rocker box
[84]	front injector	2-place Packard	throttle body
[85]	rear injector	2-place Packard	throttle body
[87]	idle air control (IAC)	4-place Packard	below air cleaner assembly
[88]	throttle position sensor (TP)	3-place Packard	front of throttle body
[89]	intake air temperature sensor (IAT)	2-place Packard	under airbox
[90]	engine coolant sensor (ECT)	2-place Packard	water pump housing
[91]	data link connector	4-place Deutsch	under left side cover
[93]	tail lamp	4-place Multilock	under outer rear fender
[95]	purge solenoid	2-place Packard	below seat
[97 T]	cooling fan	2-place Multilock	under left trim cover
[97 B]	cooling fan	2-place Multilock	under left trim cover
[120]	oil pressure switch	post terminal	crankcase between cylinders
[122]	horn	spade terminals	between cylinders, left side

Table 5-1. Connector Locations

CONNECTOR NO.	DESCRIPTION	TYPE	LOCATION
[128A]	starter solenoid coil	2-place Amp	under left side cover
[61]	starter relay	5-place Amp	under airbox cover, in fuse block
[62]	system relay	5-place Amp	under airbox cover, in fuse block
[62]	fan relay	5-place Amp	under airbox cover, in fuse block
[141]	fuel pump and sender	3-place Mini-Deutsch	top of fuel tank
[142]	security siren (optional)	3-place Packard	electrical panel behind fender extension
[145]	engine harness	12-place Mini-Deutsch	below air cleaner assembly
-	fuse block	spade terminals	under airbox cover
-	rear stoplight switch	spade terminals	behind transmission
-	neutral switch	post terminals	bottom rear of crankcase
-	harness grounds (2)	ring terminals	front and rear cam covers

AMP MULTILOCK ELECTRICAL CONNECTORS 5.2

REMOVING SOCKET TERMINALS

1. Remove connector from the retaining device, either attachment or rosebud clip.
2. Depress the button on the socket terminal side of the connector (plug) and pull apart the terminal and socket halves.
3. Bend back the latch slightly and free one side of secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access terminals in chambers of connector housing.
4. Looking in the terminal side of the connector (opposite the secondary lock), take note of the cavity next to each terminal.
5. See Figure 5-2. With the flat edge against the terminal, insert the pick tool (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick away from the terminal (locktab is inside housing) and gently tug on wire to pull terminal from chamber. Do not tug on the wire until the tang is released or the terminal will be difficult to remove. A “click” is heard if the tang is engaged but then inadvertently released. Repeat the step without releasing the tang.

NOTE

- *If pick tool is not available, a push pin/safety pin may be used instead.*
- *An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-41609) is used to install Amp Multi lock terminal and socket terminals on wires. If new terminals must be installed, see Crimping Instructions on the next page.*

INSTALLING SOCKET TERMINALS

NOTE

For wire location purposes, numbers are stamped into the secondary locks of both the socket and terminal housings. See Figure 5-2.

1. From the secondary lock side of the connector, insert the terminal into its respective numbered chamber until it snaps in place. For proper fit, the slot in the terminal must face the tang in the chamber.

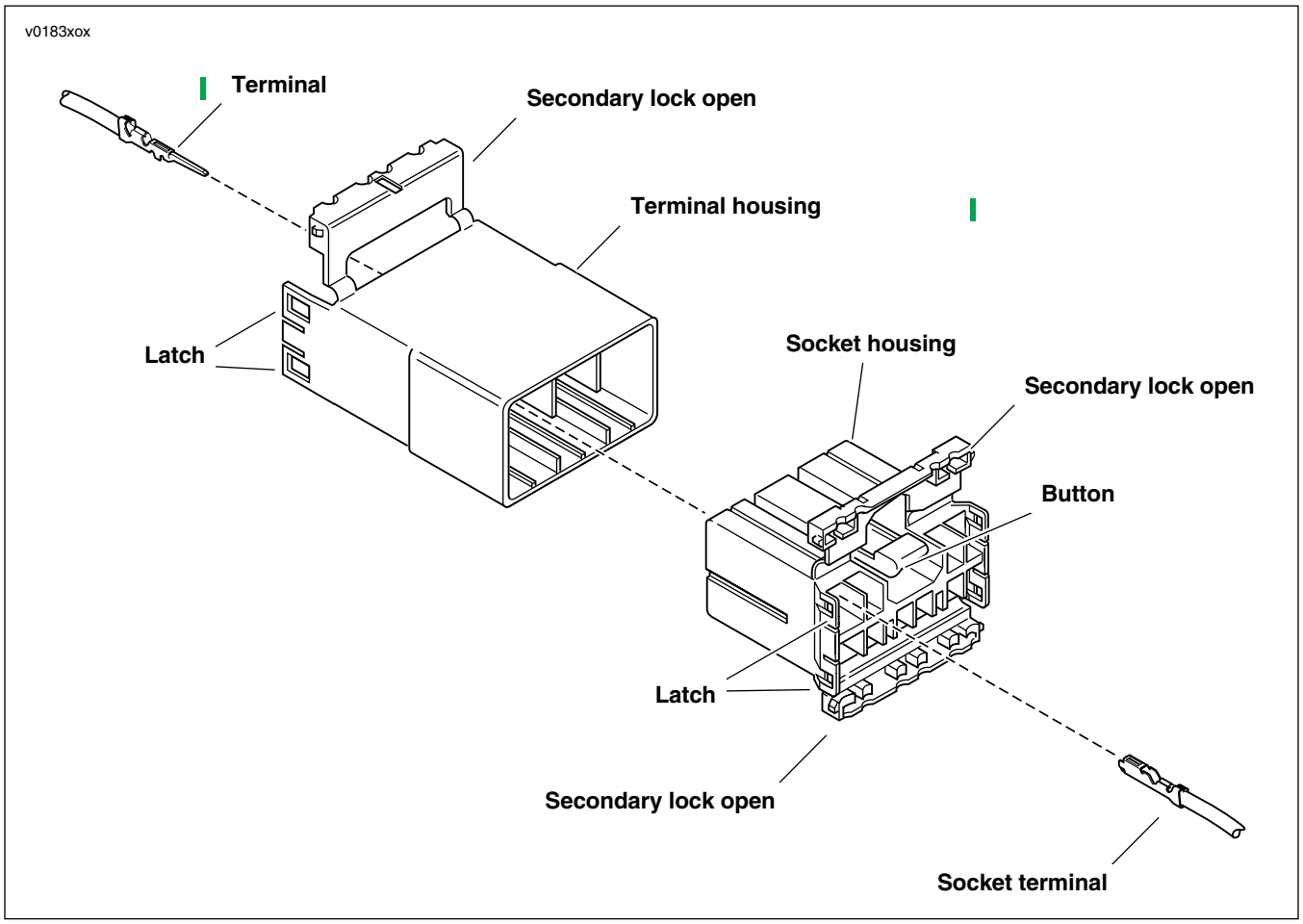


Figure 5-1. 10-Place Amp Multilock Connector

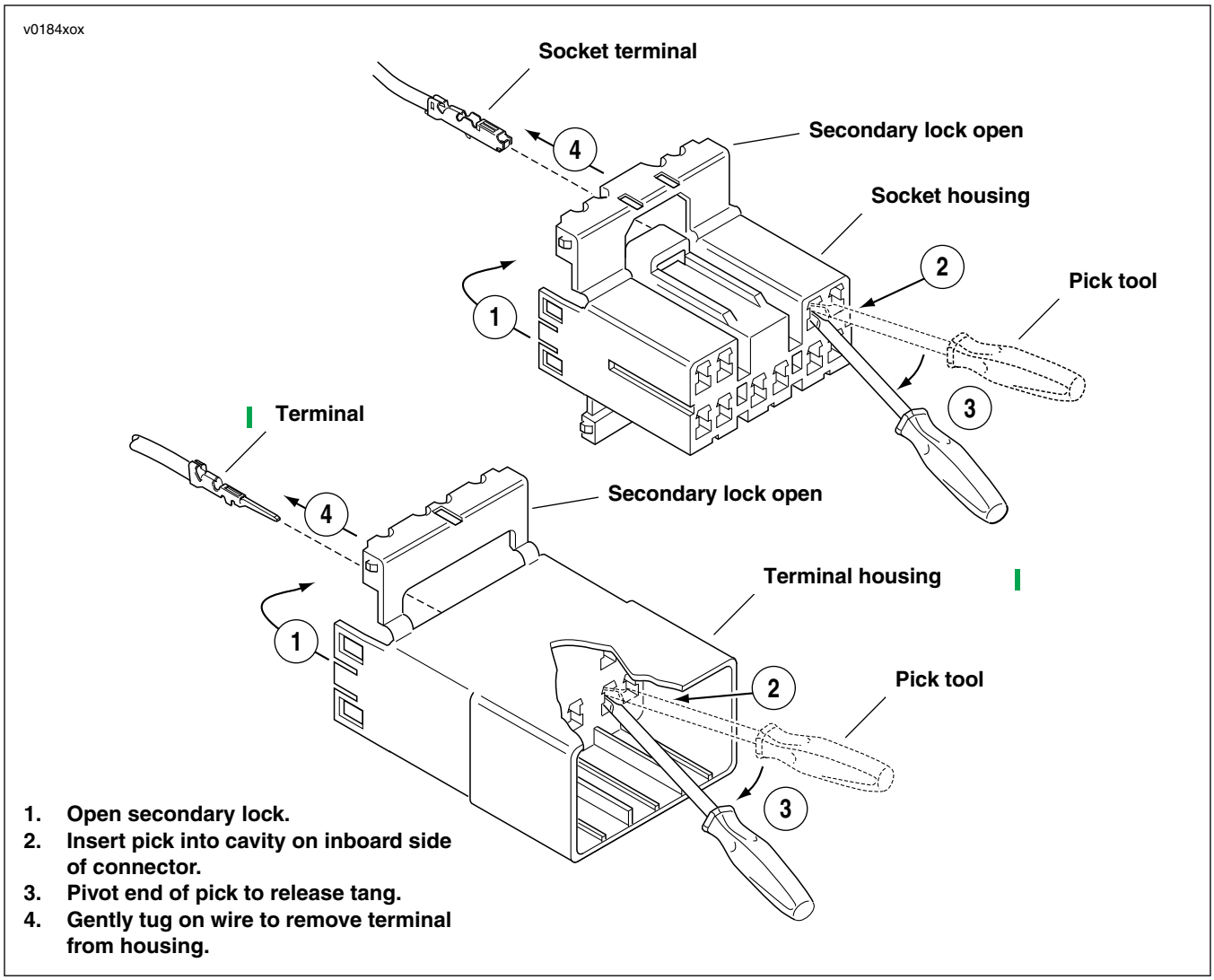


Figure 5-2. Release Tang and Back Out Terminals

NOTES

- *See Figure 5-3. The tang in the chamber engages the slot to lock the terminal in position.*
- *On the terminal side of the connector, tangs are positioned at the bottom of each chamber, so the slot in the terminal (on the side opposite the crimp tails) must face downward.*
- *On the socket side, tangs are at the top of each chamber, so the socket terminal slot (on the same side as the crimp tails) must face upward.*
- *Up and down can be determined by the position of the release button (used to separate the terminal and socket halves). Consider the button to always be on top of the connector.*

2. Gently tug on wire end to verify that the terminal is locked in place and will not back out of chamber.
3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.
4. Insert the socket housing (plug) into the terminal housing (receptacle) until it snaps in place.
5. Install connector on retaining device, either attachment or rosebud clip.

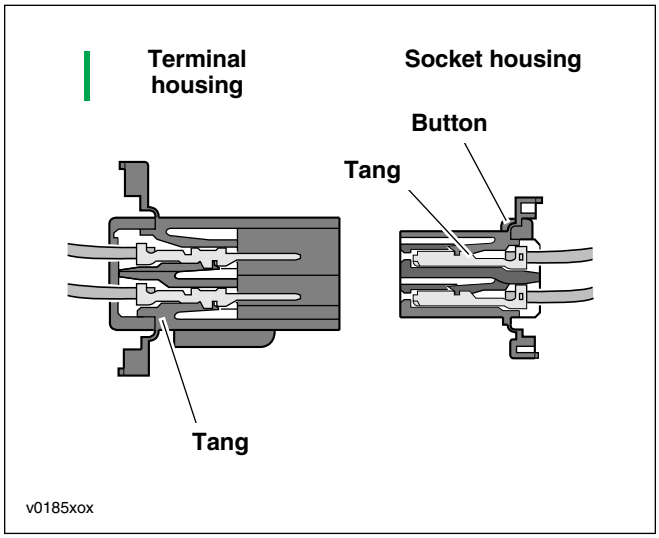


Figure 5-3. Multilock Connector Cutaway View

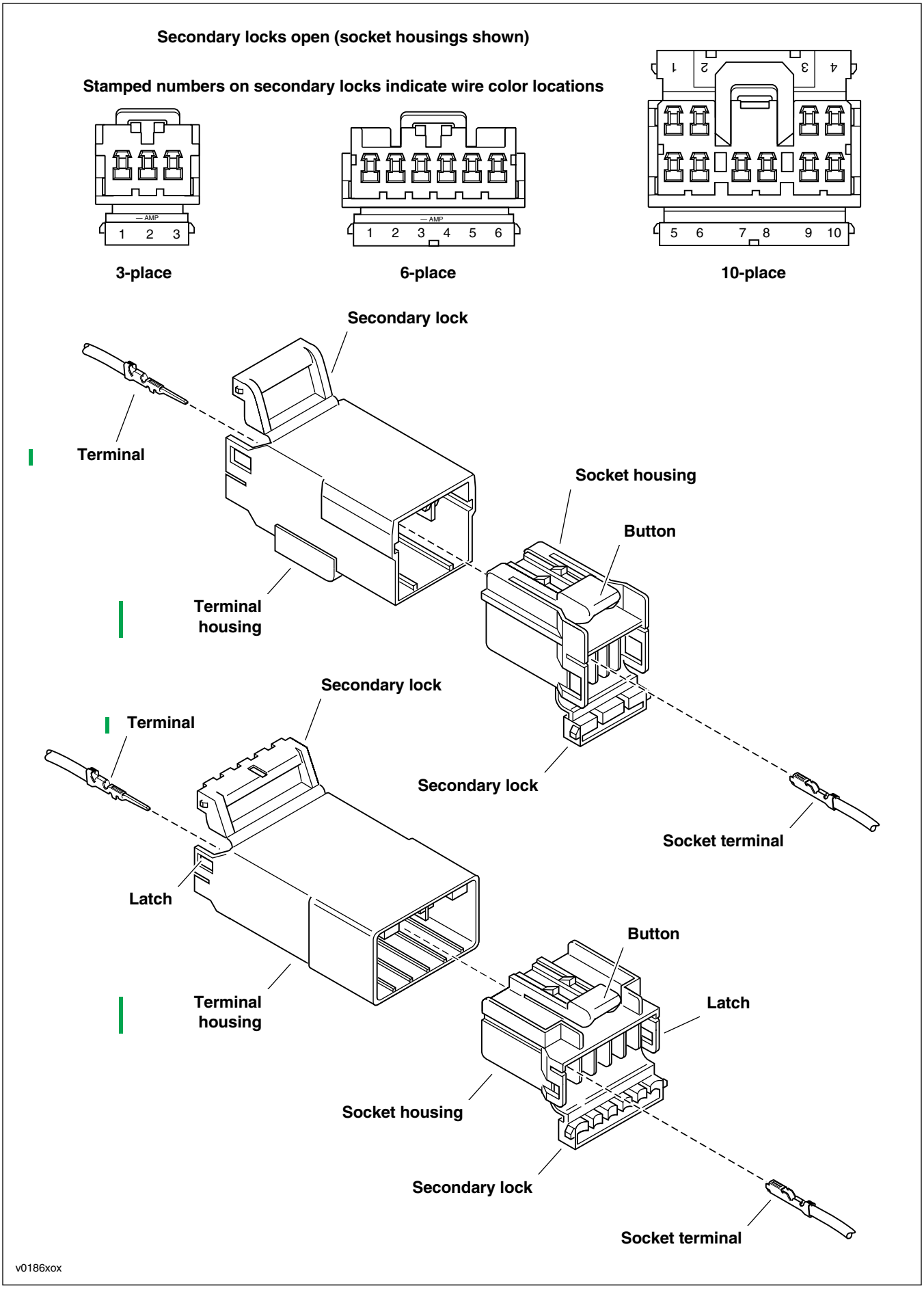
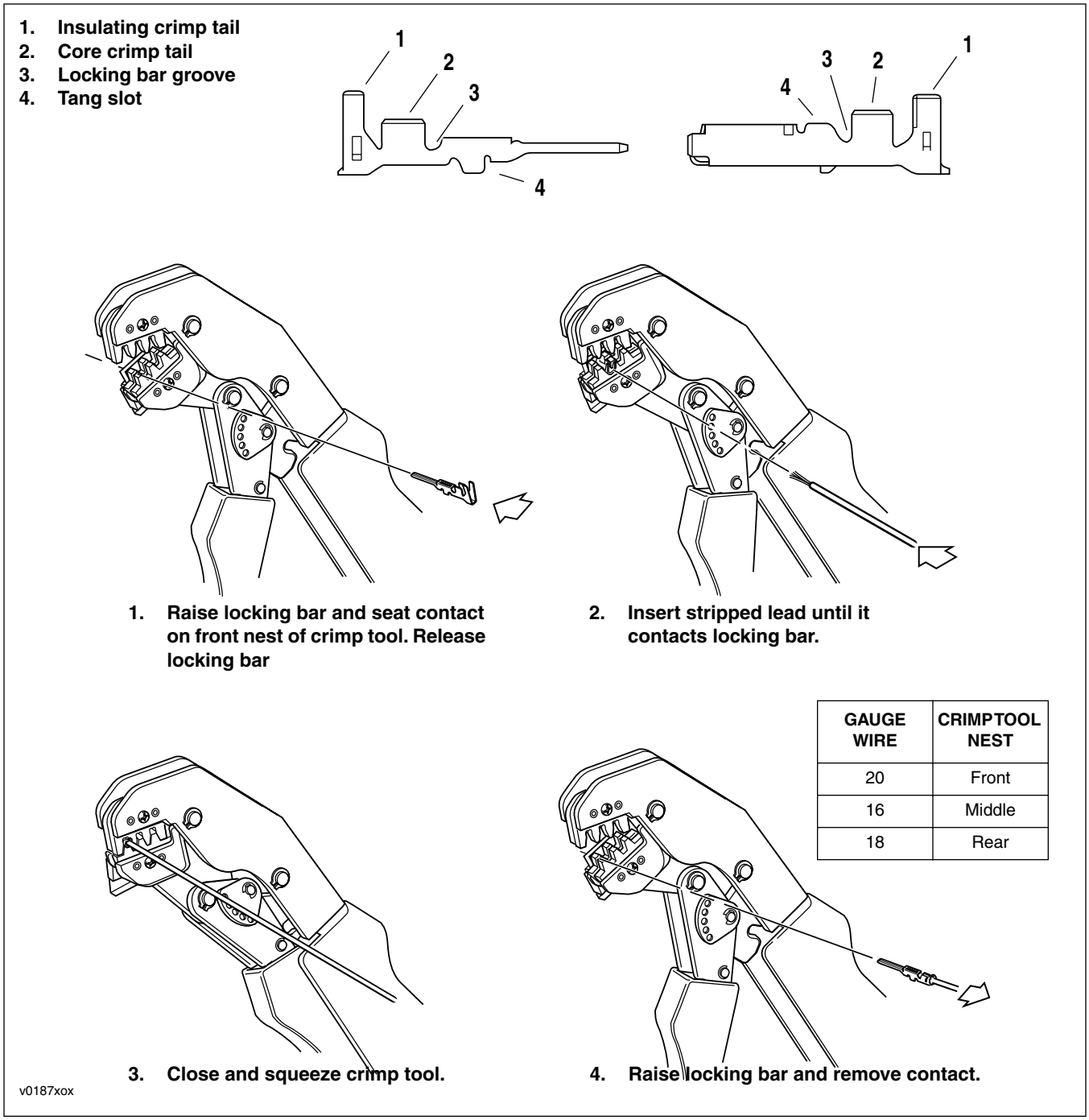


Figure 5-4. 3-Place and 6-Place Amp Multilock Connectors

CRIMPING INSTRUCTIONS

1. Squeeze the handles to cycle the crimp tool (Part No. HD-41609) to the fully open position.
2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward, insert contact (socket/terminal) through locking bar, so that the closed side of the contact rests on the front nest (concave split level area of the crimp tool). See Figure 5-5.
3. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.
4. Strip lead removing 5/32 in. (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.
6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.



GAUGE WIRE	CRIMP TOOL NEST
20	Front
16	Middle
18	Rear

Figure 5-5. Amp Multilock Crimping Procedure

DEUTSCH ELECTRICAL CONNECTORS 5.3

GENERAL

Deutsch Connectors feature a superior seal to protect electrical contacts from dirt and moisture in harsh environments. The connector also provides superior terminal retention.

See Figure 5-8. This 12-terminal connector illustrates the various parts of the Deutsch connector. The following instructions may be followed for all 2-terminal through 12-terminal Deutsch connectors.

Socket housing: alignment tabs and/or external latch, secondary locking wedge, internal seal, wire seal, seal terminal.

NOTE

Seal terminals or plugs are installed in the wire seals of unused terminal and socket locations. If removed, seal terminals must be replaced to maintain the integrity of the environmental seal.

Terminal housing: alignment grooves and/or external latch cover, attachment clip, secondary locking wedge, wire seal, seal terminal.

REMOVING/DISASSEMBLING

Attachment clips are attached to the terminal housings of most connectors. The clips are then attached to T-studs on the motorcycle frame. T-studs give positive location to electrical connectors and wire harness. Consistent location reduces electrical problems and improves serviceability.

1. Push the connector to disengage small end of slot on attachment clip from T-stud. Lift connector off T-stud.
2. Depress the external latch(es) on the socket housing side and use a rocking motion to separate the terminal and socket halves. Two-, three-, four- and six-terminal Deutsch connectors have one external latch, while eight- and twelve-terminal connectors have two, both of which must be pressed simultaneously to separate the connector halves.

NOTE

With few exceptions, the socket housing can always be found on the accessory side, while the terminal side of the connector is connected to the wiring harness.

REMOVING/INSTALLING SOCKETS

1. See Figure 5-6. Remove the secondary locking wedge. Insert the blade of a small screwdriver between the socket housing and locking wedge inline with the groove (inline with the terminal holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up.
2. See Figure 5-7. Gently depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

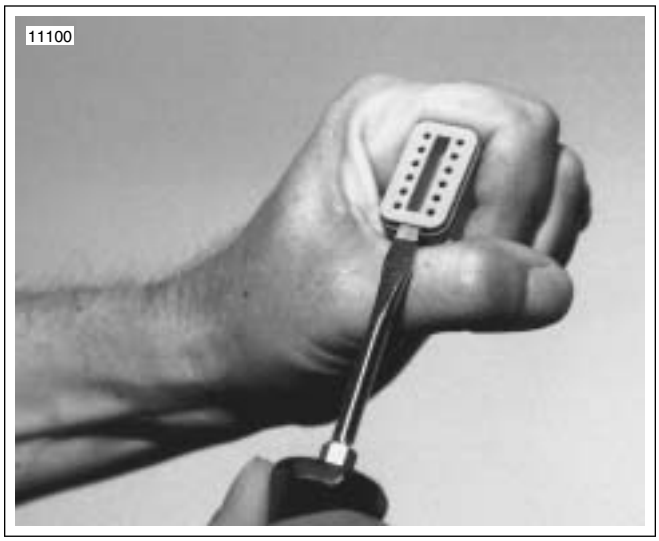


Figure 5-6. Remove Secondary Locking Wedge

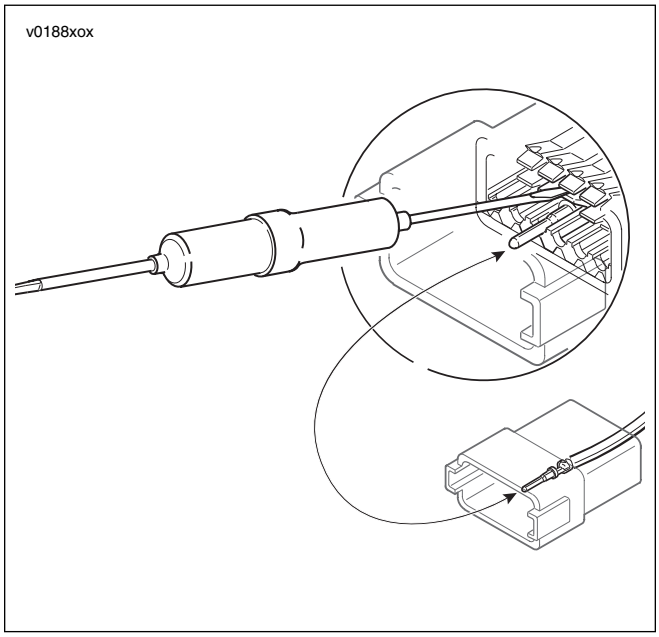


Figure 5-7. Depress Latches/Back Out Terminals

NOTE

*An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-39965) is used to install Deutsch terminal and socket terminals on wires. If **new** terminals must be installed, follow the instructions included with the crimping tool or see Crimping Instructions in this section.*

Fit rear wire seal into back of socket housing, if removed. Grasp socket approximately 1.0 in. (25.4 mm) behind the contact barrel. Gently push sockets through holes in wire seal into their respective chambers. Feed socket into chamber until it “clicks” in place. Verify that socket will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.

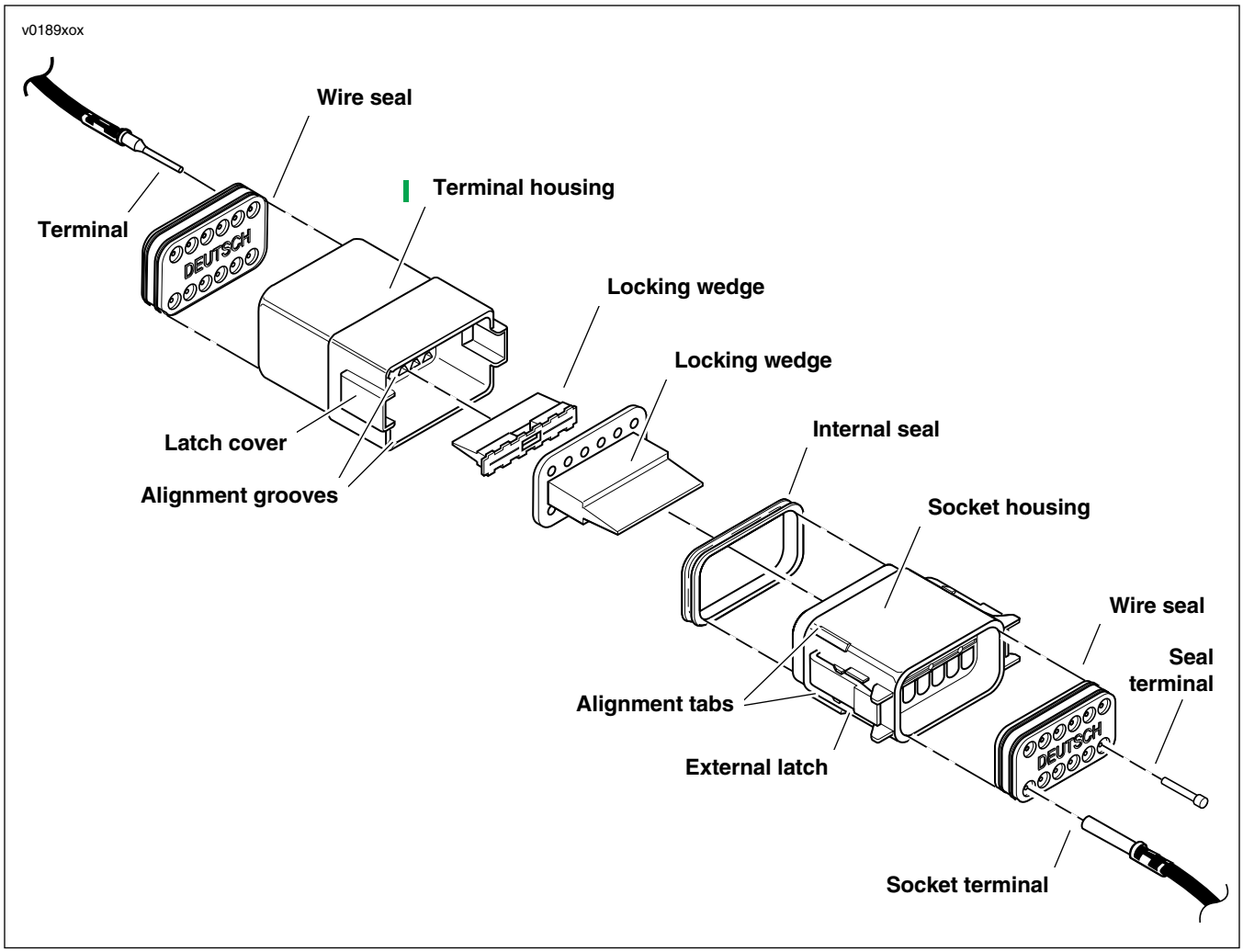


Figure 5-8. 12-Terminal Deutsch Connector (Exploded View)

3. Install internal seal on lip of socket housing, if removed. Insert tapered end of secondary locking wedge into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

NOTES

- *While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-terminal connector must be installed with the arrow pointing toward the external latch. See Figure 5-9.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

REMOVING/INSTALLING TERMINALS

1. Remove the secondary locking wedge. Use the hooked end of a stiff piece of mechanics wire a needle nose pliers, or a suitable pick tool (Part No. HD-41475-100). See Figure 5-10.
2. Gently depress terminal latches inside terminal housing and back out terminals through holes in wire seal.

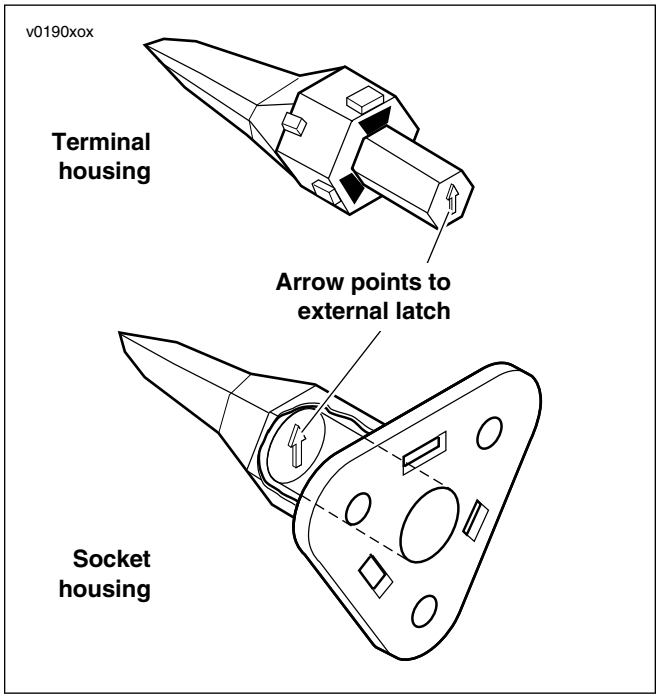


Figure 5-9. Depress Terminal Latches/Back Out Terminals

NOTE

*An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-39965) is used to install Deutsch terminal and socket terminals on wires. If **new** terminals must be installed, see Crimping Instructions in this section.*

3. Fit wire seal into back of terminal housing. Grasp crimped terminal approximately 1.0 in. (25.4 mm) behind the contact barrel. Gently push terminals through holes in wire seal into their respective numbered locations. Feed terminal into chamber until it "clicks" in place. Verify that terminal will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.
4. Insert tapered end of secondary locking wedge into terminal housing and press down until it snaps in place. The wedge fits in the center groove within the terminal housing and holds the terminal latches tightly closed.

NOTES

- *While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-terminal connector must be installed with the arrow pointing toward the external latch. See Figure 5-9.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the terminal housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

ASSEMBLING/INSTALLING

1. Insert socket housing into terminal housing until it snaps in place. Two-, three-, four- and six-terminal Deutsch connectors have one external latch on the socket half of the connector. To fit the halves of the connector together, the latch on the socket side must be aligned with the latch cover on the terminal side.

   For those connectors with two external latches (8-terminal and 12-terminal), a different system is used to prevent improper assembly. Align the tabs on the socket housing with the grooves on the terminal housing. Push the connector halves together until the latches "click." If latches do not click (latch), press on one side of the connector until that latch engages, then press on the opposite side to engage the other latch.

NOTE

*Deutsch connectors are color coded for location purposes. Those connectors associated with **left** side accessories, such as the front and rear **left** turn signals, are **gray**. All other connectors, including those associated with right side accessories, are black.*

If it should become necessary to replace a plug or receptacle, please note that the 8-terminal and 12-terminal gray and black connectors are not interchangeable. Since location of the alignment tabs differ between the black and gray connectors, plugs or receptacles must be replaced by those of the same color. If replacing both the socket and terminal halves, then the black may be substituted for the gray, and vice versa. The socket and terminal halves of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.

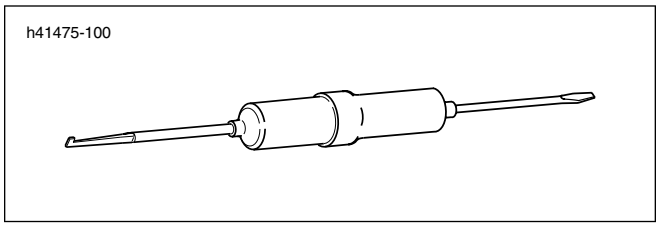


Figure 5-10. Deutsch Connector Pick Tool (Part No. HD-41475-100)

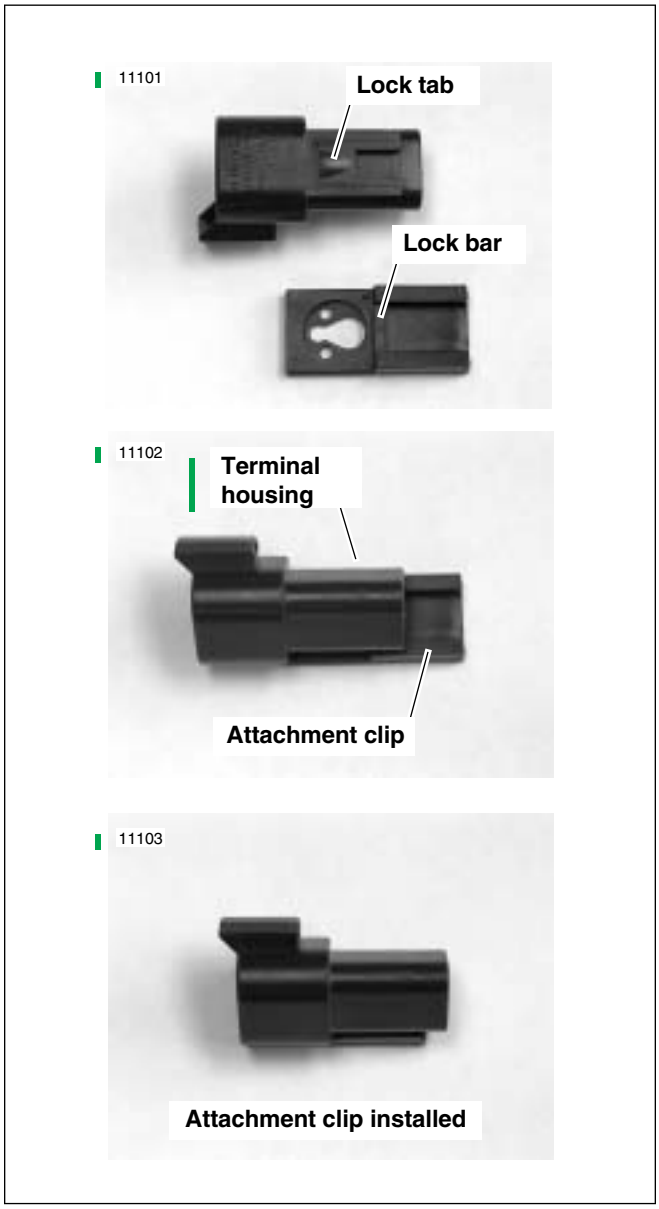


Figure 5-11. Attachment Clip Installation

2. See Figure 5-11. Fit the attachment clip to the terminal housing, if removed. Place large end of slot on attachment clip over T-stud on frame. Push assembly forward to engage small end of slot.

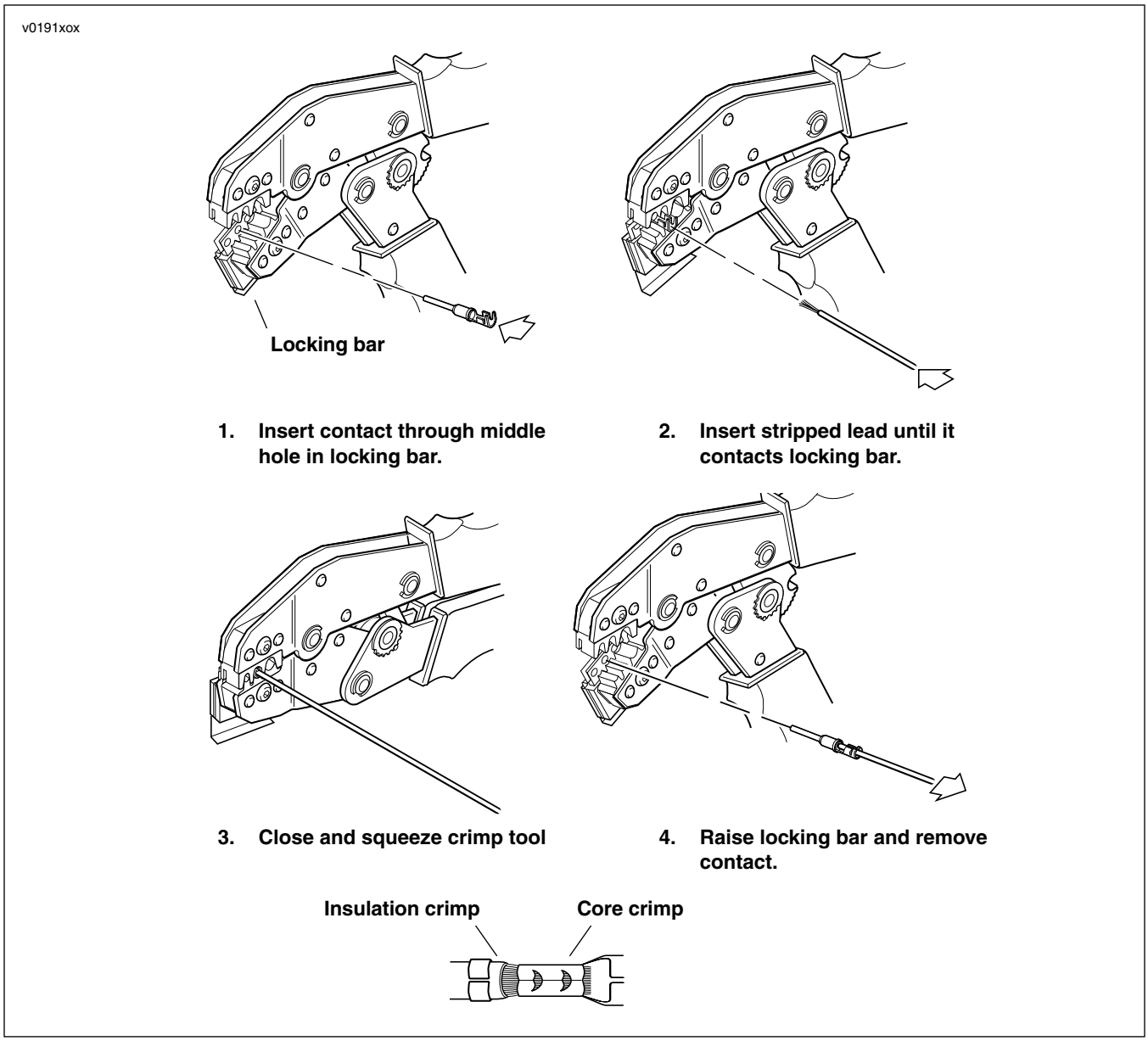


Figure 5-12. Deutsch Crimping Procedure

CRIMPING INSTRUCTIONS

1. See Figure 5-12. Squeeze the handles to cycle the crimp tool to the fully open position.
2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward and the rounded side of the contact barrel resting on the concave split level area of the crimp tool, insert contact (socket/terminal) through middle hole of locking bar.
3. Release locking bar to lock position of contact. If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the contact so that the tails face straight upward. When correctly positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.
4. Strip lead removing 5/32 in. (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.
6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.

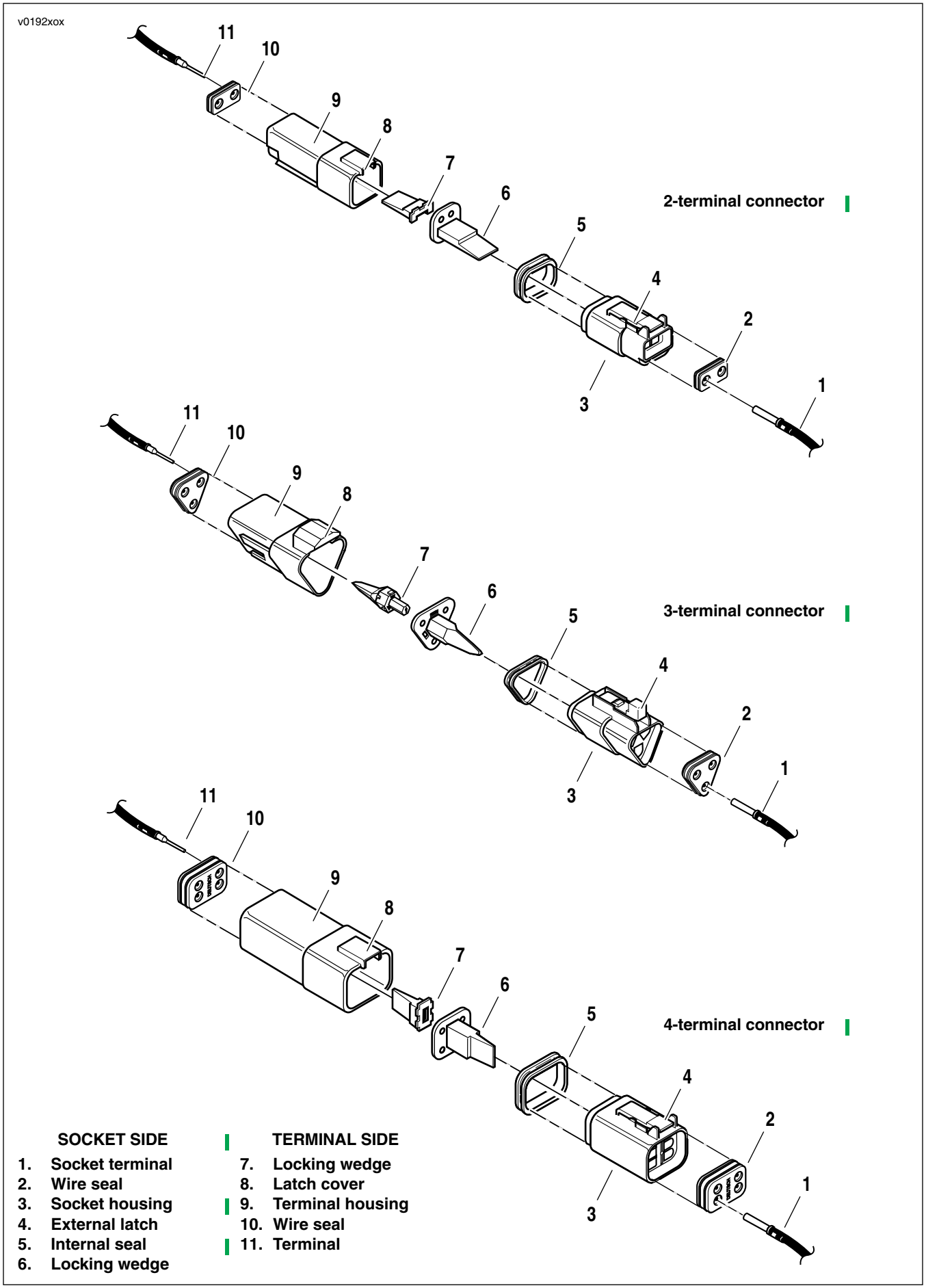


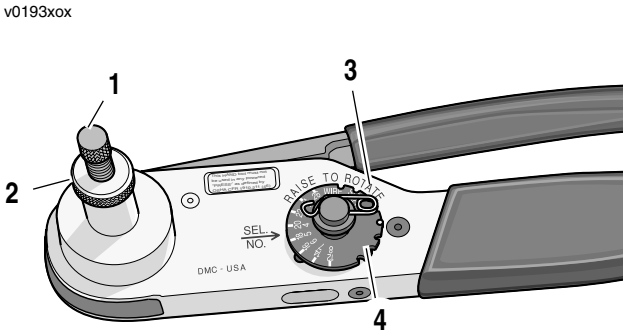
Figure 5-13. 2 3 and 4-Terminal Deutsch Connectors

MINI-DEUTSCH CONNECTORS 5.4

GENERAL

For Size 20, 16 and 12 Contacts Wire Range 26-12 AWG

Mini-Deutsch connectors make use of a solid barrel contact without crimp tails. As a result, a special TERMINAL CRIMP TOOL (Part No. HD-42879) is needed to install terminal and socket terminals on wires.



1. Adjusting screw
2. Locknut
3. Locking terminal
4. Selector knob

Figure 5-14. Deutsch Solid Barrel Contact Crimp Tool (Part No. HD-42879)

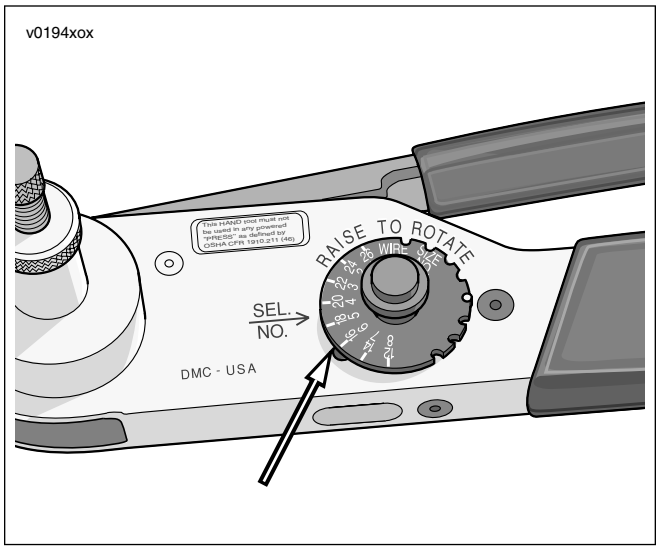


Figure 5-15. Selector Knob

1. Indentor cover
2. Contact
3. Indentor points

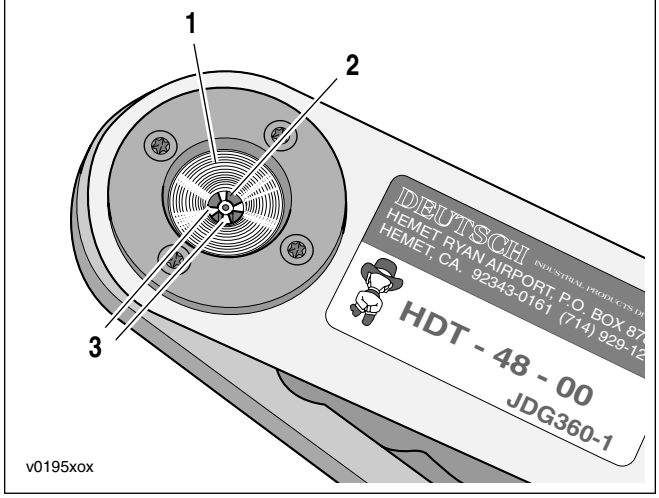


Figure 5-16. Indentor Points

CRIMPING INSTRUCTIONS

1. Squeeze the handles to cycle the crimp tool to the fully open position.
2. See Figure 5-14. Remove locking terminal (3) from selector knob (4).
3. See Figure 5-15. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with “SEL. NO.” arrow.
4. Loosen knurled locknut and turn adjusting screw clockwise (in) until it stops.
5. Turn tool over and drop contact into indentor cover hole with the wire end out.
6. Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indentor cover. Tighten knurled locknut.
7. See Figure 5-16. Slowly squeeze handles of crimp tool until contact (2) is centered between indentor points (3).

8. Strip wire lead removing 1/4 in. (6.3 mm) of insulation.
9. See Figure 5-17. Insert bare wire strands into contact barrel.
10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
11. Remove crimped contact from indentor.
12. Inspect the quality of the crimp. Verify that all wire strands are in crimp barrel.

NOTE

Tool must be readjusted when changing contact size/type.

13. Install terminal to lock position of selector knob.

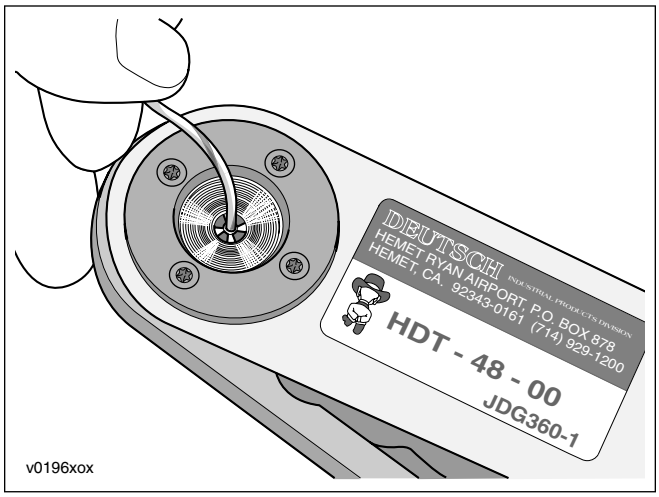


Figure 5-17. Contact Barrel

SEALED BUTT SPLICE CONNECTORS 5.5

INSTALLATION

Butt splicing may be a necessary procedure for the replacement of some components.

1. Strip 3/8 in. (9.5 mm) of insulation off the ends of the wires.
2. Compress the handles of the Packard Crimp Tool (HD-38125-8) until the ratchet automatically opens.
3. Refer to Table 5-2. Since the size of the connectors varies with the gauge of the wire, always used the correct components when creating sealed splices.
4. See Figure 5-18. Determine the correct dye or nest for the crimping operation. Match the color or gauge wire marked on the butt splice connector with the corresponding crimp cavity on the crimp tool.
5. Gently apply pressure to the handles until the crimper lightly secures one side of the metal insert inside the butt splice connector. The connector must be crimped in two stages; one side then the other.
6. See Figure 5-19. Feed the wire into the butt splice connector until the stripped end contacts the wire stop inside the metal insert.
7. Squeeze the handles of the crimp tool until tightly closed. The tool automatically opens when the crimping sequence is complete.
8. Repeat steps 5, 6, and 7 on the other side of the butt splice connector.

NOTE

If adjacent wires are being spliced, stagger the splices so that the butt splice connectors are spaced at different positions along the length of the wires.

⚠ WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

9. Using the UltraTorch UT-100 (Part No. HD-39969), Robinair Heat Gun (Part No. HD-25070) with heat shrink attachment (Part No. HD-41183) or other suitable radiant heating device, heat the crimped splice to encapsulate the butt splice connection. Apply heat from the center of the crimp out to each end until the meltable sealant exudes out both ends of the connector.

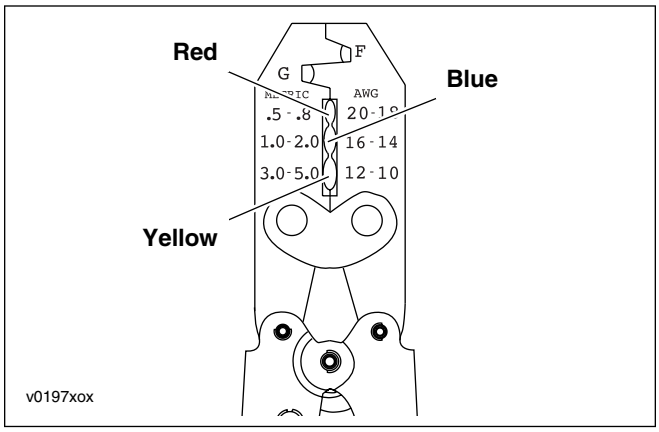


Figure 5-18. Packard Crimp Tool (Part No. HD-38125-8)

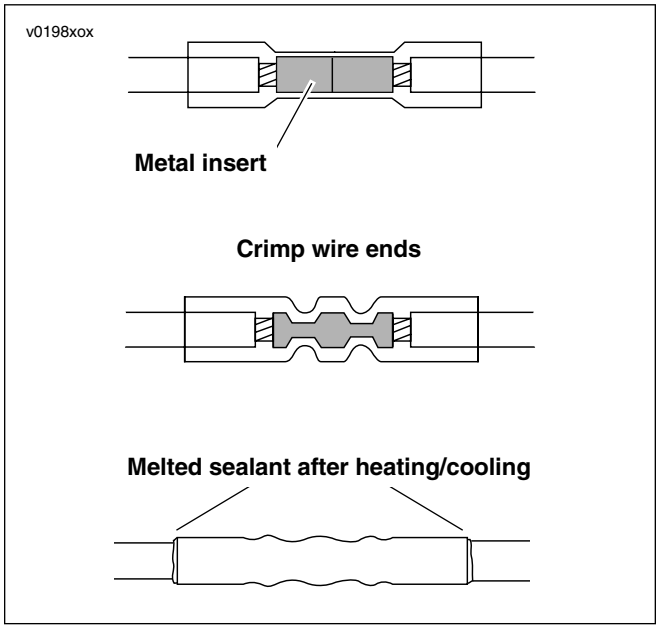


Figure 5-19. Installing Sealed Butt Splice Connectors

Table 5-2. Common Sealed Splices

GAUGE WIRE	CONNECTOR COLOR	PART NO.
18-20	Red	70585-93
14-16	Blue	70586-93
10-12	Yellow	70587-93

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

10. Heat the center of the splice until the crimp indentations disappear and the tubing assumes a smooth cylindrical appearance.

PACKARD ELECTRICAL CONNECTORS 5.6

GENERAL

From a servicing standpoint, there are two basic types of Packard electrical connectors, those with pull-to-seat terminals and those with push-to-seat terminals.

Look into the mating end of the connector. If it appears that the terminal can be extracted from this side, then it is probably the pull-to-seat type.

At least one Packard pull-to-seat terminal can be easily recognized by the presence of a locking ear. The ear engages a slot in the connector housing and prevents the terminal from being removed from the wire end side of the connector. The ear also acts as a strain relief in the event that the wires are pulled and further inhibits movement of the terminal inside the chamber.

Unlike most connectors, where the terminals are pulled out the wire end of the connector, to remove the terminals from the pull-to-seat connectors, the terminal is pushed out the mating end of the connector. Once a **new** terminal is crimped onto the end of the wire, the wire is pulled to draw the terminal back inside the chamber of the connector housing.

Two types of Packard pull-to-seat electrical connectors are used. One type has an external latch to lock the terminal and socket halves together, while the other makes use of a wireform. See Figure 5-20. The manner in which the terminals are picked differs between these two types of connectors, as further described below.

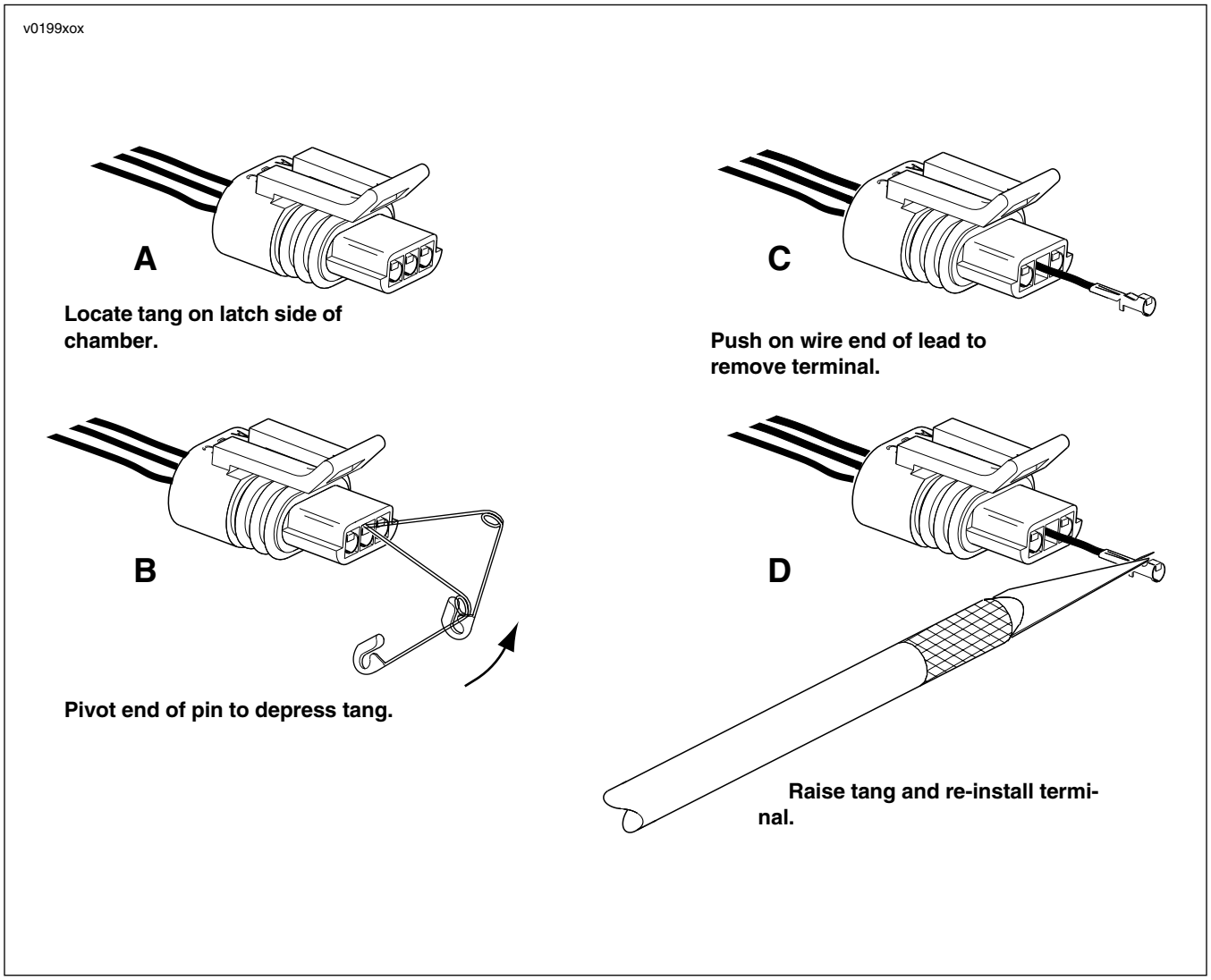


Figure 5-20. Packard Connectors

PULL-TO-SEAT TERMINALS

Removing External Latch Type

To remove a pull-to-seat terminal from connectors with external latches, proceed as follows:

1. Remove the connector from the retaining device, if present.
2. Bend back the external latch(es) slightly and separate the terminal and socket halves of the connector.
3. To free a pull-to-seat terminal from the connector housing, first look into the mating end of the connector to find the locking tang. See A in Figure 5-20. The tangs are always positioned in the middle of the chamber and are on the same side as the external latch. On those connectors with locking ears, the tang is on the side opposite the ear.
4. At a slight angle, gently insert the point of a one inch safety pin down the middle of the chamber (about 1/8 inch) and pivot the end of the pin toward the terminal body. When a click is heard, remove the terminal and repeat the procedure. See B in Figure 5-20. The click is the sound of the tang returning to the locked position as it slips from the point of the pin. Pick at the tang in this manner until the clicking stops and the pin seems to slide in at a slightly greater depth than it had previously. This is an indication that the tang has been depressed.

NOTES

- *On those terminals that have been extracted on a previous occasion, no clicking sound may be heard when the pin is pivoted to depress the tang, but proceed as if the clicking is audible and then push on the wire end of the lead to check if the terminal is free.*
- *When picking multiple terminals, the end of the pin may become malleable. For best results, continue the procedure with a new safety pin.*

5. Remove the terminal and push on the wire end of the lead to extract the terminal from the mating end of the connector. See C in Figure 5-20. If necessary, pull back the conduit and remove the wire seal at the back of the connector to introduce some slack in the wires.

NOTE

*A series of Packard Electrical Terminal Crimp Tools are available to install Packard terminal and socket terminals on wires. If **new** terminals must be installed, see Crimping Instructions.*

Installing External Latch Type

NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

1. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body. See D in Figure 5-20.
2. Gently pull on the lead at the wire end of the connector to draw the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Push on the lead to verify that the terminal is locked in place.
4. Push the terminal and socket halves of the connector together until the latches “click.”

PUSH-TO-SEAT TERMINALS

Removing Push-to-Seat Terminals

Like most connectors, Packard push-to-seat terminals are pulled out the wire end of the connector. To remove a push-to-seat terminal, proceed as follows:

1. Remove the connector from the retaining device, if present.
2. Bend back the external latch(es) slightly and separate the terminal and socket halves of the connector.

NOTE

Both the Ignition Light/Key Switch and the Main Power connectors are provided with secondary locks. The secondary lock, which may be molded onto the connector or exist as a separate piece, aids in terminal retention. Secondary locks must be opened (or removed) before the terminals can be extracted from the connector housing.

3. Open or remove the secondary lock. **Ignition Switch:** Bend back the latch slightly and free one side of the secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access the terminals in the chambers of the connector housing.
4. Looking in the mating end or terminal side of the connector (opposite the secondary lock), take note of the larger cavity next to each terminal.
5. Insert the pick (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick toward the terminal to depress the locking tang. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat the step if the terminal is still locked in place.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard terminal and socket terminals on wires. If new terminals must be installed, see Crimping Instructions.

Installing Push-to-Seat Terminals

NOTE

For wire location purposes, alpha characters are stamped onto the secondary locks or onto the wire end of the connector housing.

1. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body.
2. Push the lead into the chamber at the wire end of the connector. A click is heard when the terminal is properly seated.
3. Gently tug on the wire end to verify that the terminal is locked in place and will not back out of the chamber.
4. Close or install the secondary lock. **Ignition Switch:** Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.
5. Push the terminal and socket halves of the connector together until the latches “click.”
6. Install connector on retaining device, if present.

CRIMPING INSTRUCTIONS

1. Strip wire lead removing 5/32 in. (4 mm) of insulation.
2. Compress handles until ratchet automatically opens.

NOTE

Always perform core crimp before insulation/seal crimp.

3. Determine the correct dye or nest for the core crimp by checking with the appropriate crimp table.

NOTE

When the word “TIP” appears in the Crimp Table, use the tip of the tool specified to perform the core crimp procedure. See Figure 5-21.

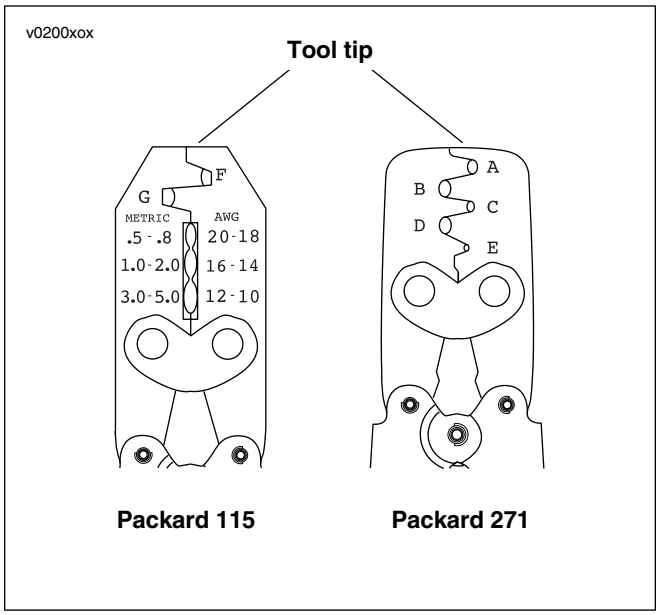
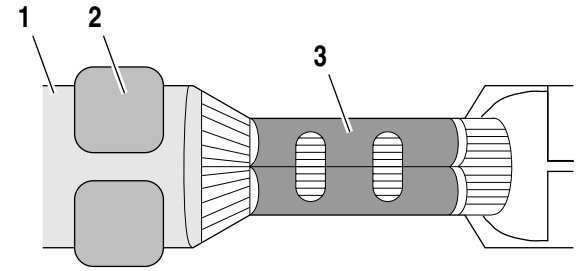


Figure 5-21. Packard Terminal Crimp Tools

Table 5-3. Packard Terminal Crimp Tools

SPECIFICATION	PACKARD 115	PACKARD 271
Part No.	HD-38125-8	HD-38125-7
Type of Crimp	Non-sealed terminals, butt splices	Non-sealed terminals
Dye/nests	F-G	A-E

4. Lay the back of the core crimp tails on the appropriate nest. Be sure the core crimp tails are pointing towards the forming jaws.
5. Gently apply pressure to handles of tool until crimpers slightly secure the core crimp tails.
6. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation or seal material.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
8. Determine the correct dye or nest for the insulation/seal crimp.
9. Lay the back of the insulation/seal crimp tails on the appropriate nest. Be sure the insulation/seal crimp tails are pointing towards the forming jaws.
10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
11. See Figure 5-22. Inspect the quality of the core (3) and insulation/seal (2) crimps. Distortion should be minimal.



1. **Insulation**
2. **Insulation crimp**
3. **Core crimp**

Figure 5-22. Inspect Core and Insulation/Seal Crimps

PACKARD ECM CONNECTOR 5.7

DISASSEMBLY

1. See Figure 5-23. Depress tabs (3) on the sides of connector and remove clear plastic cover (4).
2. Remove cable strap (2).
3. See Figure 5-24. Pry three tabs to separate connector halves.
4. See Figure 5-25. Push on desired wire from back of connector to expose wire terminal.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard socket terminals on wires. If new terminals must be installed, see CRIMPING INSTRUCTIONS which follows.

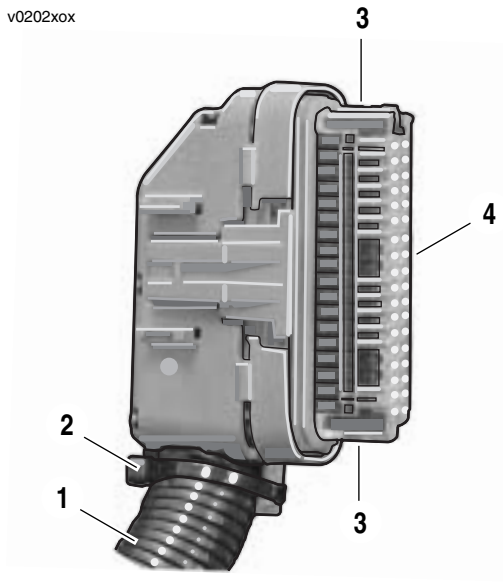
ASSEMBLY

Pull on wire from back of connector until terminal is seated.

NOTE

In next step be sure wires are not pinched while mating connector halves.

1. See Figure 5-23. Mate connector halves making sure wires are not pinched and end of wire conduit (1) is inside connector halves.
2. Install **new** cable strap on end of connector.
3. Install clear plastic cover over terminals.



1. **Conduit**
2. **Cable strap**
3. **Tabs**
4. **Clear plastic cover**

Figure 5-23. ECM Connector

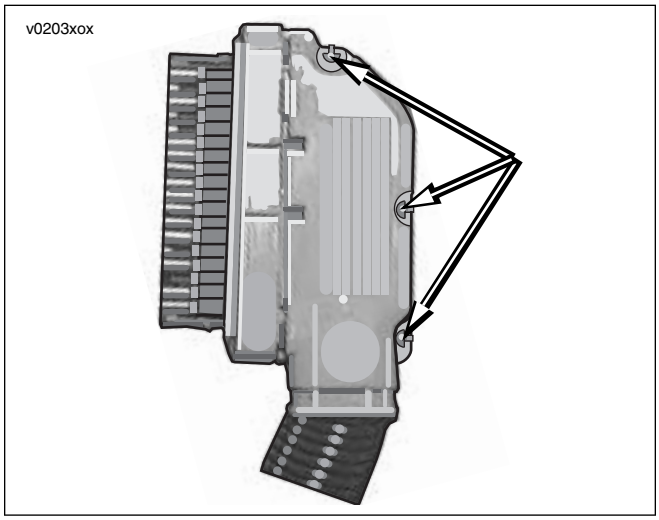


Figure 5-24. Connector Tabs

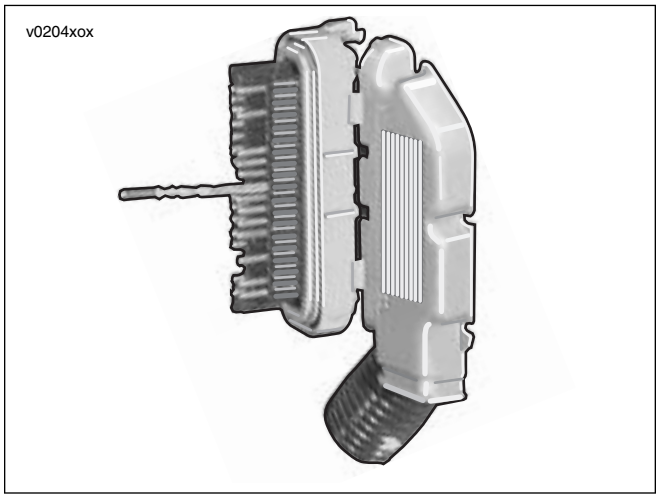


Figure 5-25. Terminal Replacement

CRIMPING INSTRUCTIONS

1. Strip wire lead removing 5/32 in. (4 mm) of insulation.
2. Compress handles until ratchet automatically opens.

NOTE

Always perform core crimp before insulation/seal crimp.

3. Determine the correct dye or nest for the core crimp by checking with the appropriate crimp table.

NOTE

When the word "TIP" appears in the Crimp Table, use the tip of the tool specified to perform the core crimp procedure. See Figure 5-26.

4. Lay the back of the core crimp tails on the appropriate nest. Be sure the core crimp tails are pointing towards the forming jaws.
5. Gently apply pressure to handles of tool until crimpers slightly secure the core crimp tails.
6. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation or seal material.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
8. Determine the correct dye or nest for the insulation/seal crimp.
9. Lay the back of the insulation/seal crimp tails on the appropriate nest. Be sure the insulation/seal crimp tails are pointing towards the forming jaws.
10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
11. See Figure 5-27. Inspect the quality of the core (3) and insulation/seal (2) crimps. Distortion should be minimal.

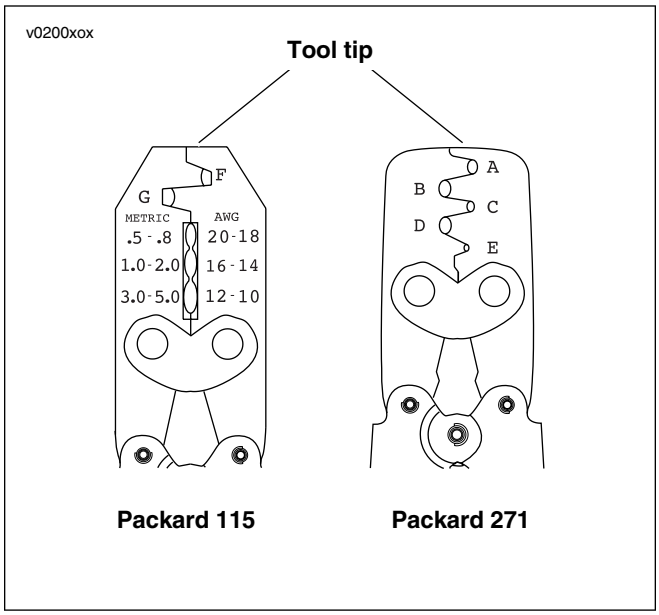
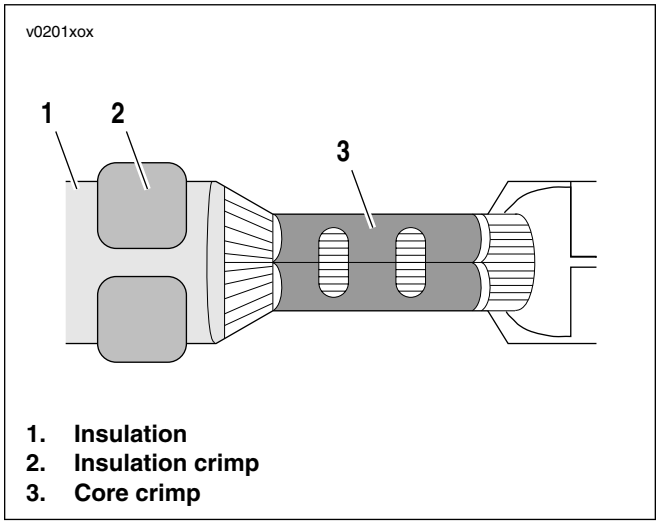


Figure 5-26. Packard Terminal Crimp Tools

Table 5-4. Packard Terminal Crimp Tools

SPECIFICATION	PACKARD 115	PACKARD 271
Part No.	HD-38125-8	HD-38125-7
Type of Crimp	Non-sealed terminals, butt splices	Non-sealed terminals
Dye/nests	F-G	A-E



1. **Insulation**
2. **Insulation crimp**
3. **Core crimp**

Figure 5-27. Inspect Core and Insulation/Seal Crimps

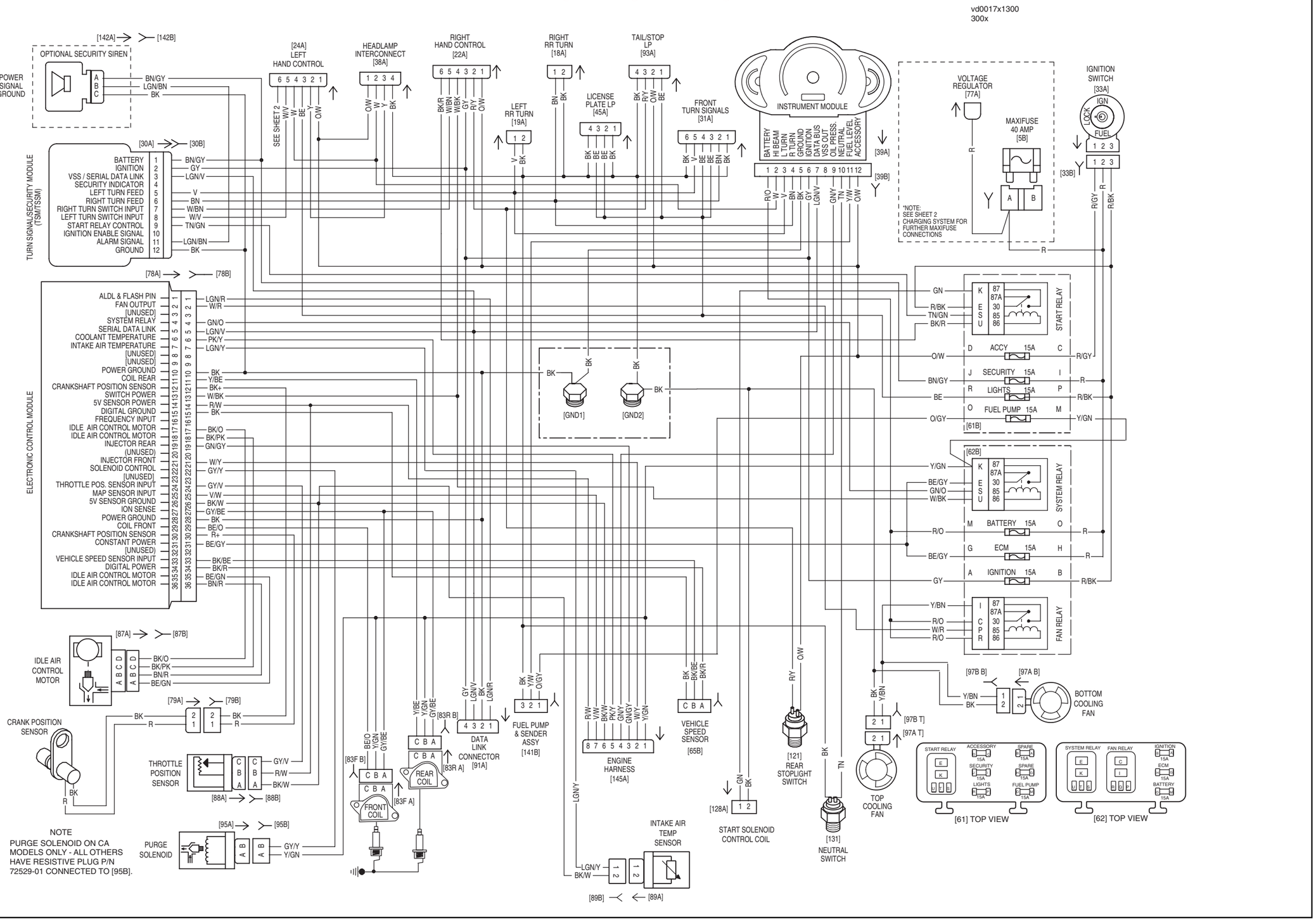
INDEX TO WIRING DIAGRAMS 5.8

Table 5-5. Wiring Diagrams

Table 5-6. Wiring Color Codes

CODE	COLOR	CODE	COLOR
BE	Blue	PK	Pink
BK	Black	R	Red
BN	Brown	TN	Tan
GN	Green	V	Violet
GY	Grey	W	White
LT GN	Light green	Y	Yellow
O	Orange		

NOTES



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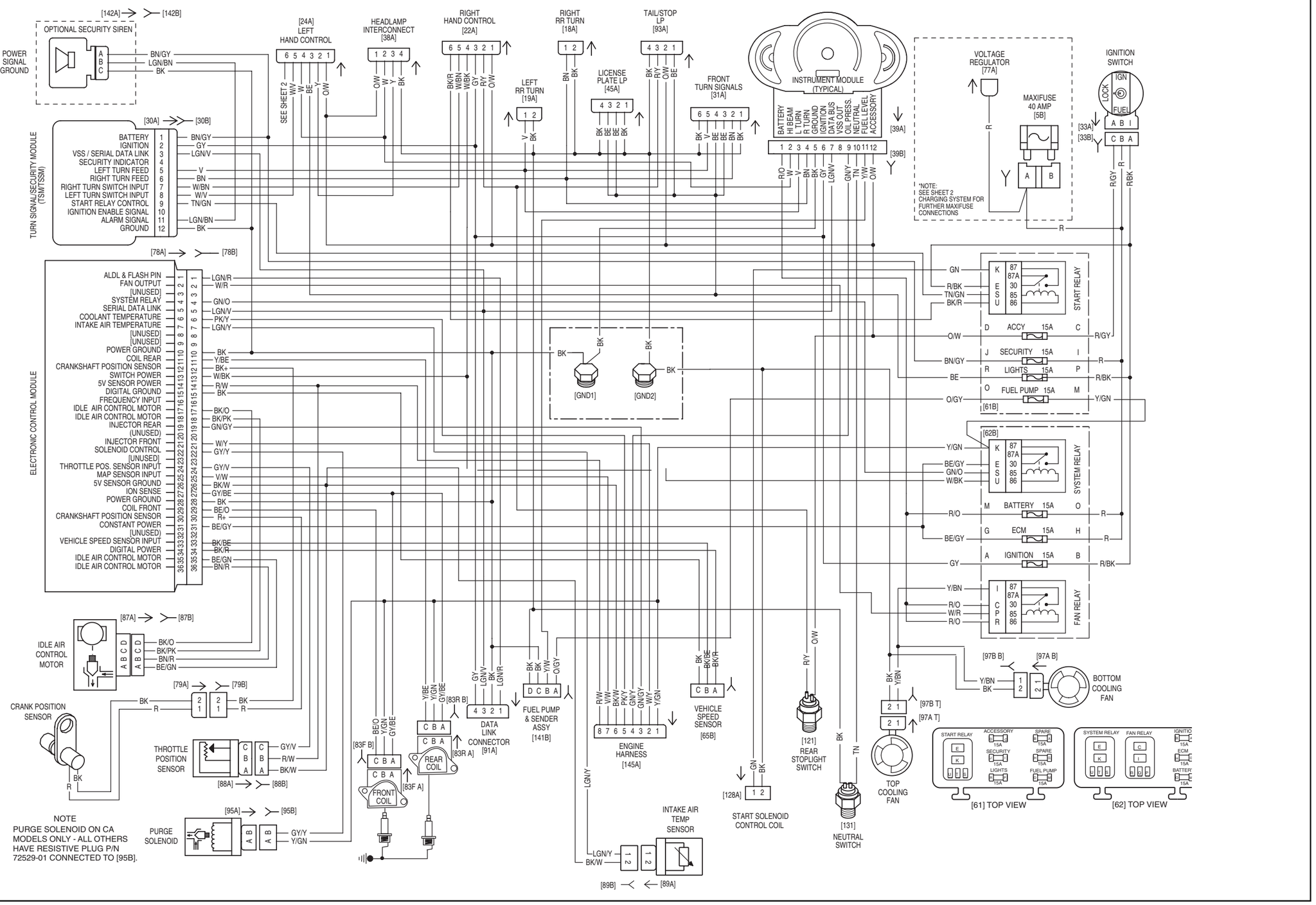
2006 VRSCA/VRSCD MODEL, MAIN HARNESS: PAGE 1 OF 2

2006 VRSCA/VRSCD MODEL, MAIN HARNESS: PAGE 1 OF 2

vd0094x1x 94x1x



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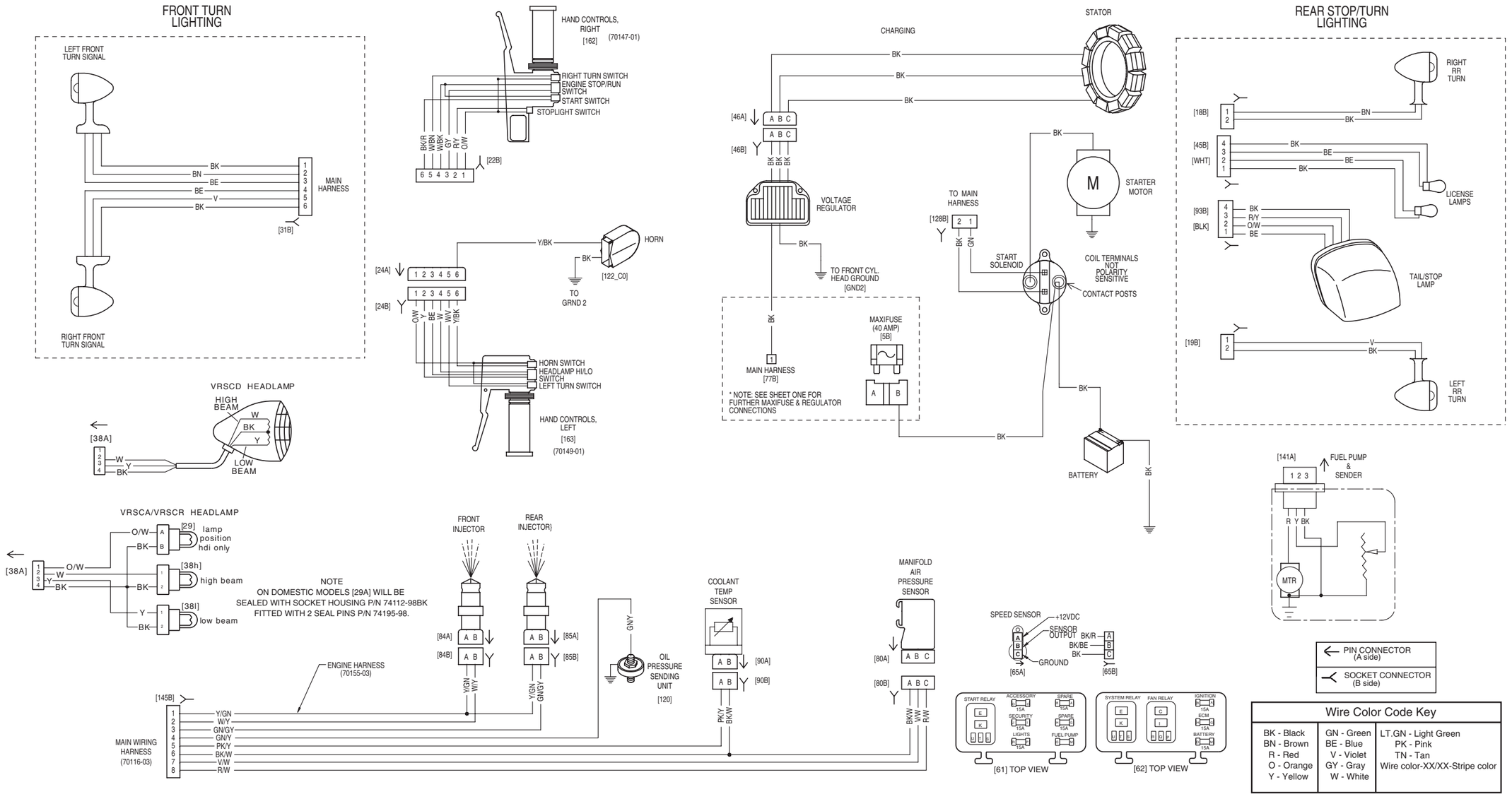
2006 VRSCR MODEL, MAIN HARNESS: PAGE 1 OF 2

2006 VRSCR MODEL, MAIN HARNESS: PAGE 1 OF 2

vd0018x1x

vd0018x1x



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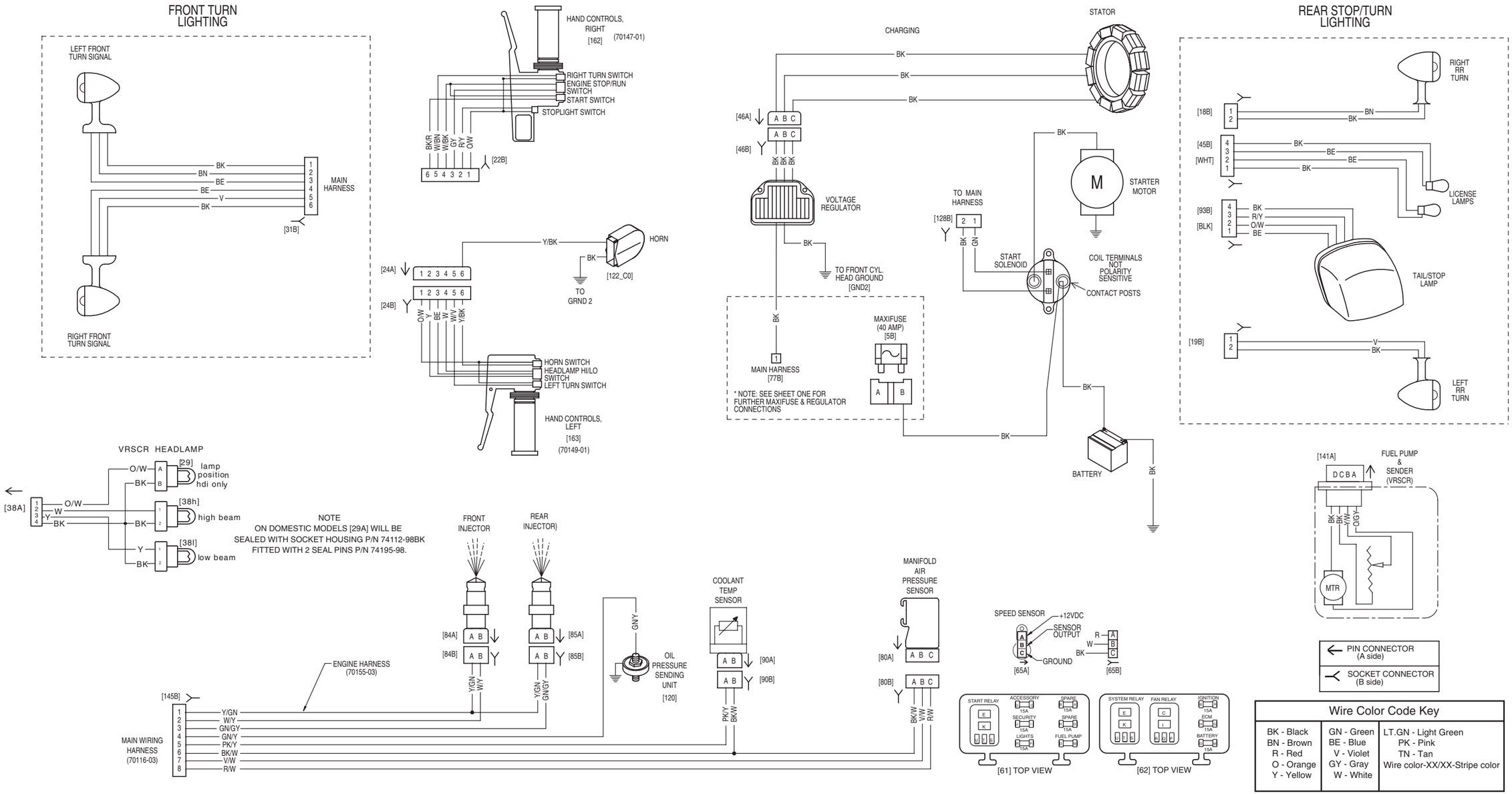
2006 VRSCA/VRSCD MODEL, MAIN HARNESS: PAGE 2 OF 2

2006 VRSCA/VRSCD MODEL, MAIN HARNESS: PAGE 2 OF 2

vd0095x1x

vd0095x1x

vd0018xx



Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

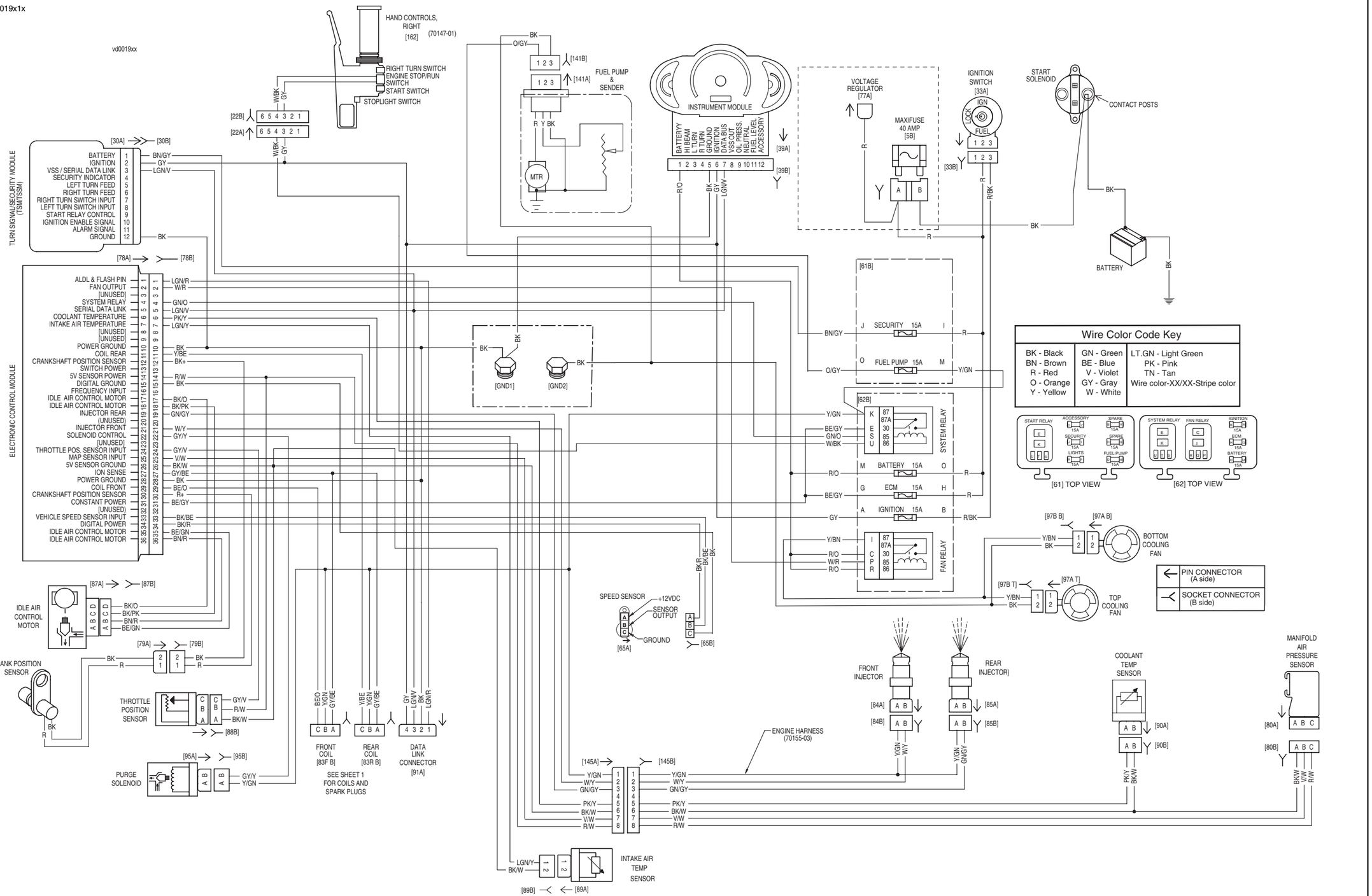
2006 VRSCR MODEL, MAIN HARNESS: PAGE 2 OF 2

2006 VRSCR MODEL, MAIN HARNESS: PAGE 2 OF 2

2006 VRSCR MODEL, MAIN HARNESS: PAGE 2 OF 2

vd0019x1x

vd0019xx

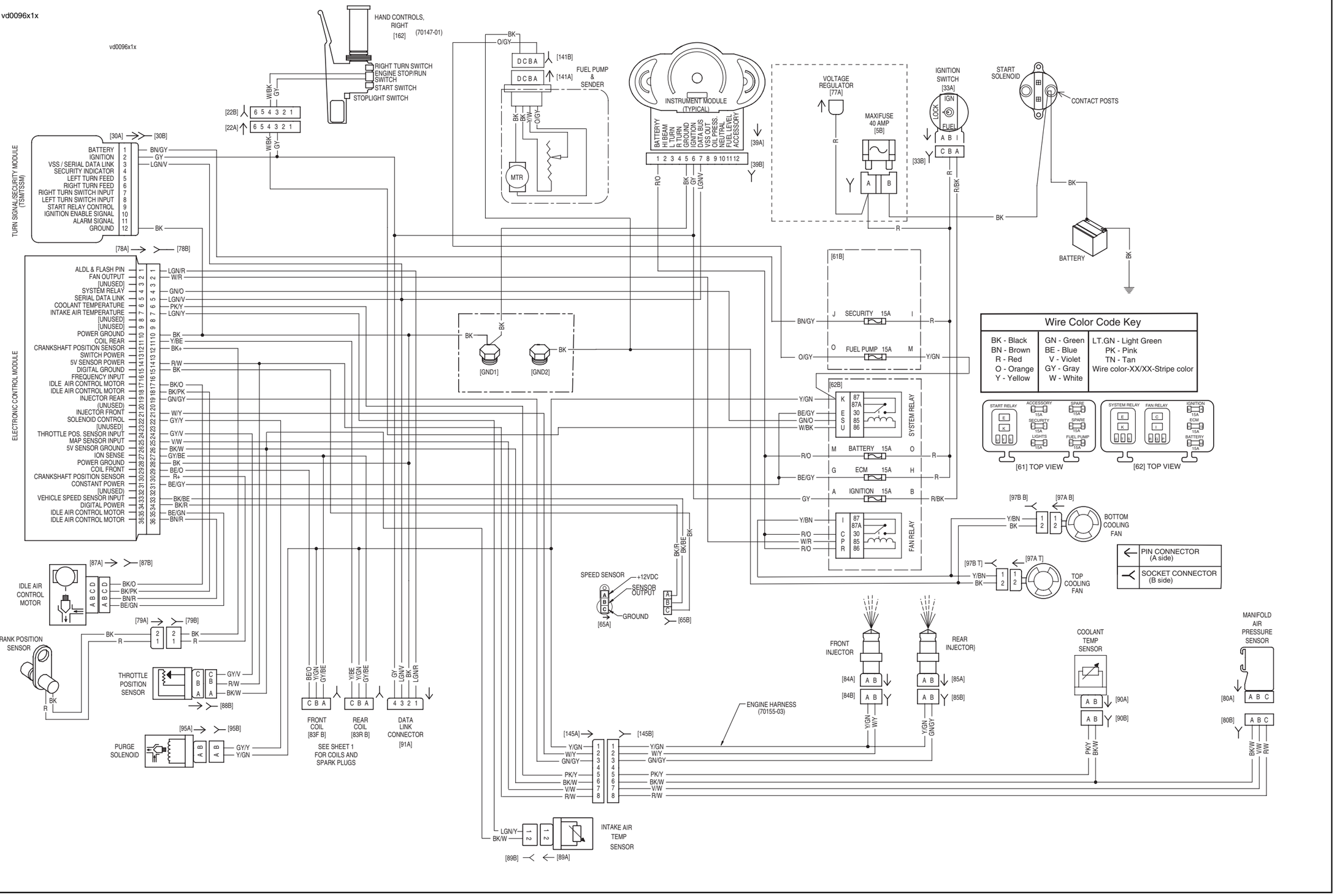


2006 VRSCA/VRSCD MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

vd0096x1x



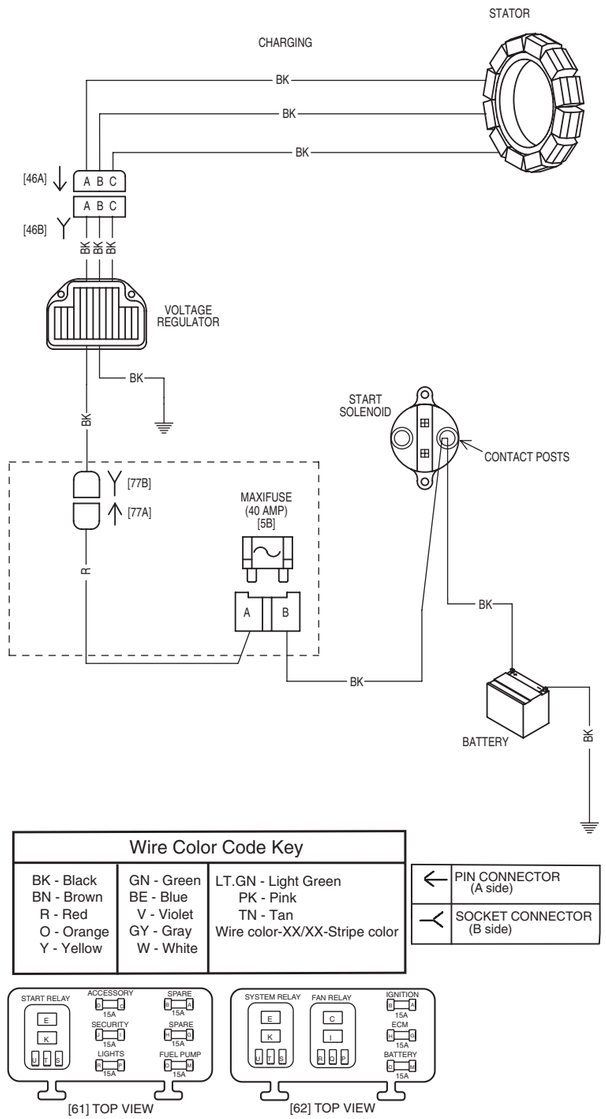
2006 VRSCR MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, IGNITION CIRCUIT: PAGE 1 OF 1

vd0097xxx

vd0097xxx



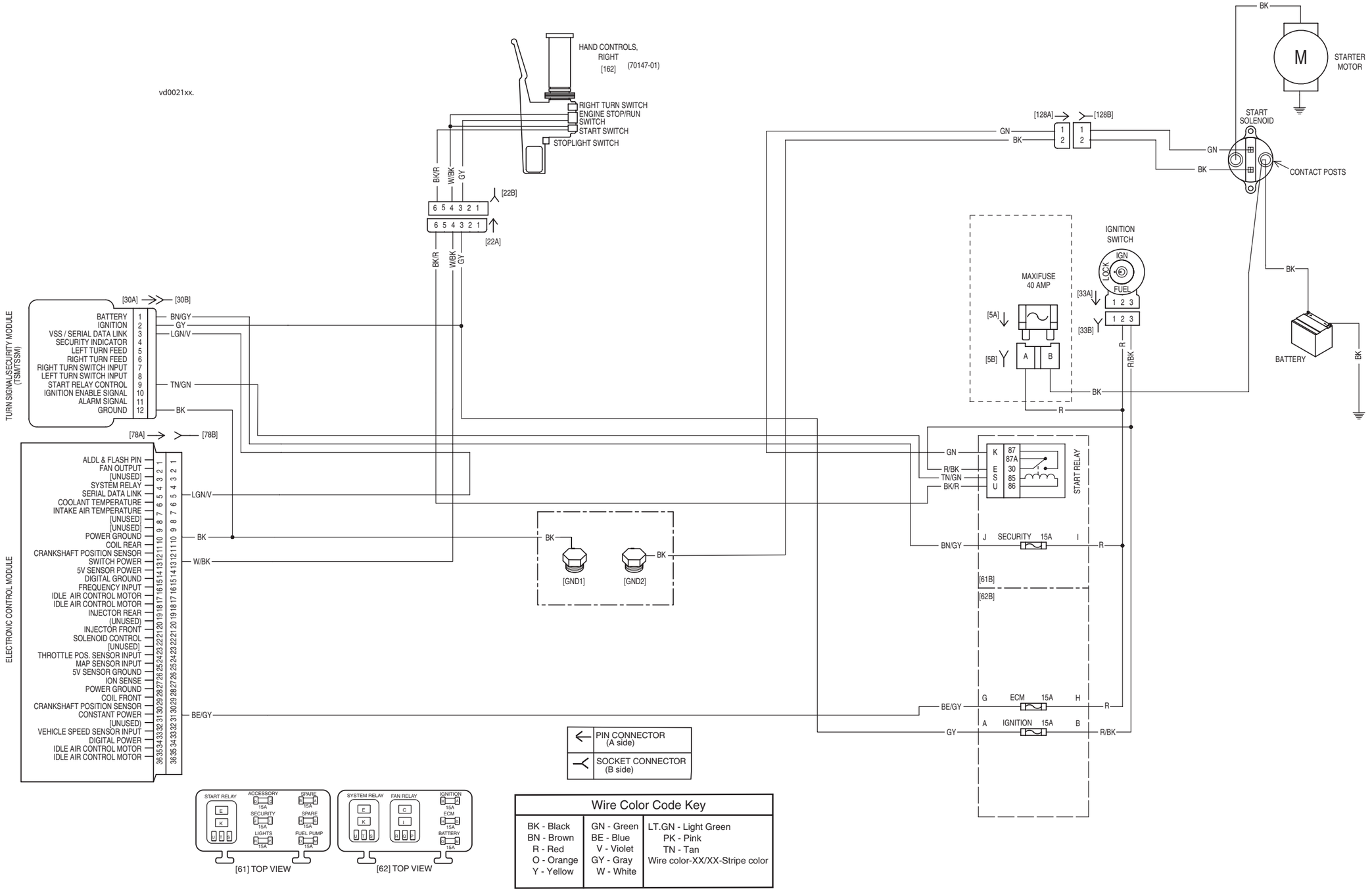
2006 VRSC (ALL) MODEL, CHARGING CIRCUIT: PAGE 1 OF 1

2006 VRSC (ALL), CHARGING CIRCUIT: PAGE 1 OF 1

2006 VRSC (ALL), CHARGING CIRCUIT: PAGE 1 OF 1

vd0021xxx

vd0021xx.



Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

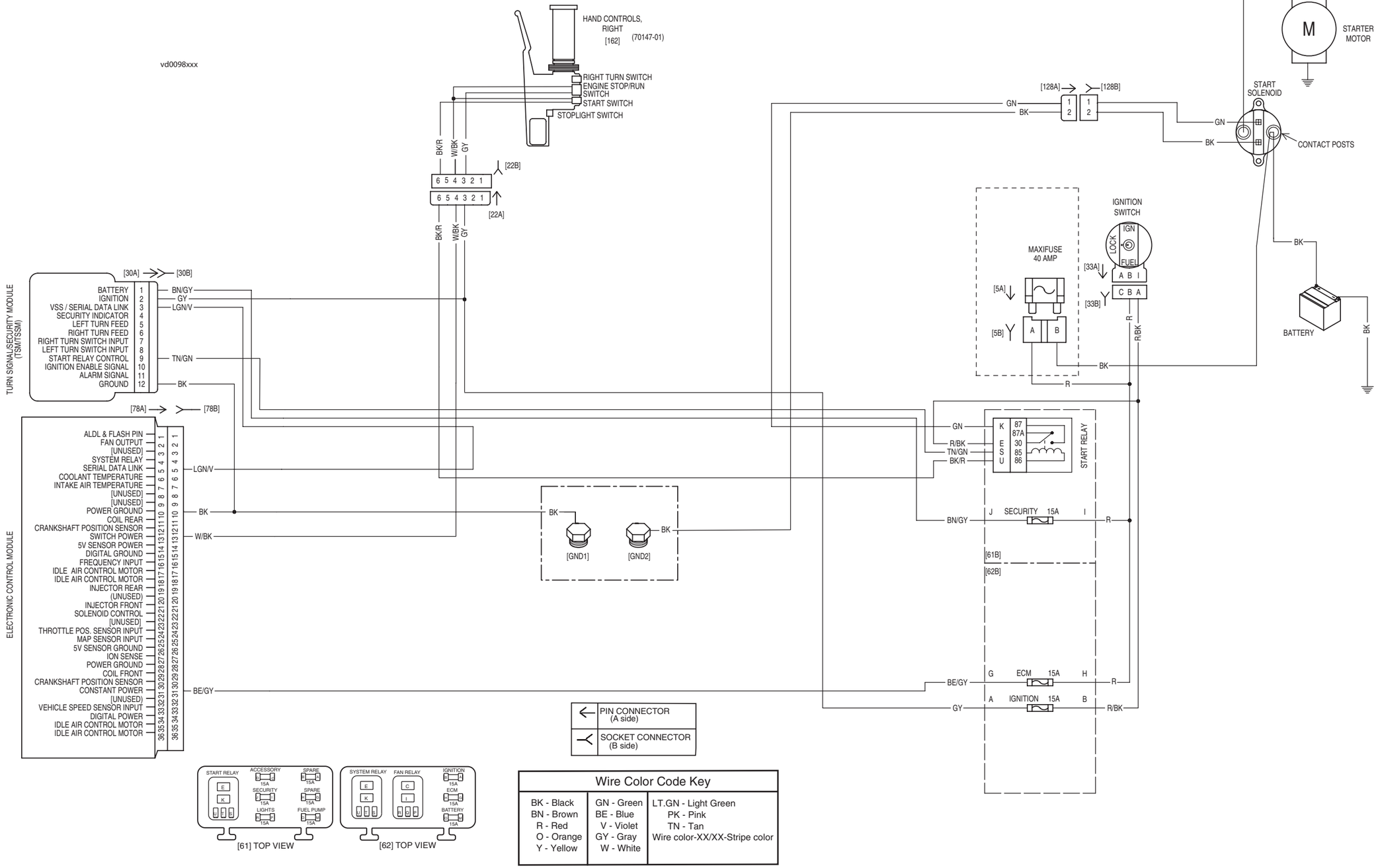
2006 VRSCA/VRSCD MODEL, STARTING CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, STARTING CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, STARTING CIRCUIT: PAGE 1 OF 1

vd0098xxx

vd0098xxx



Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

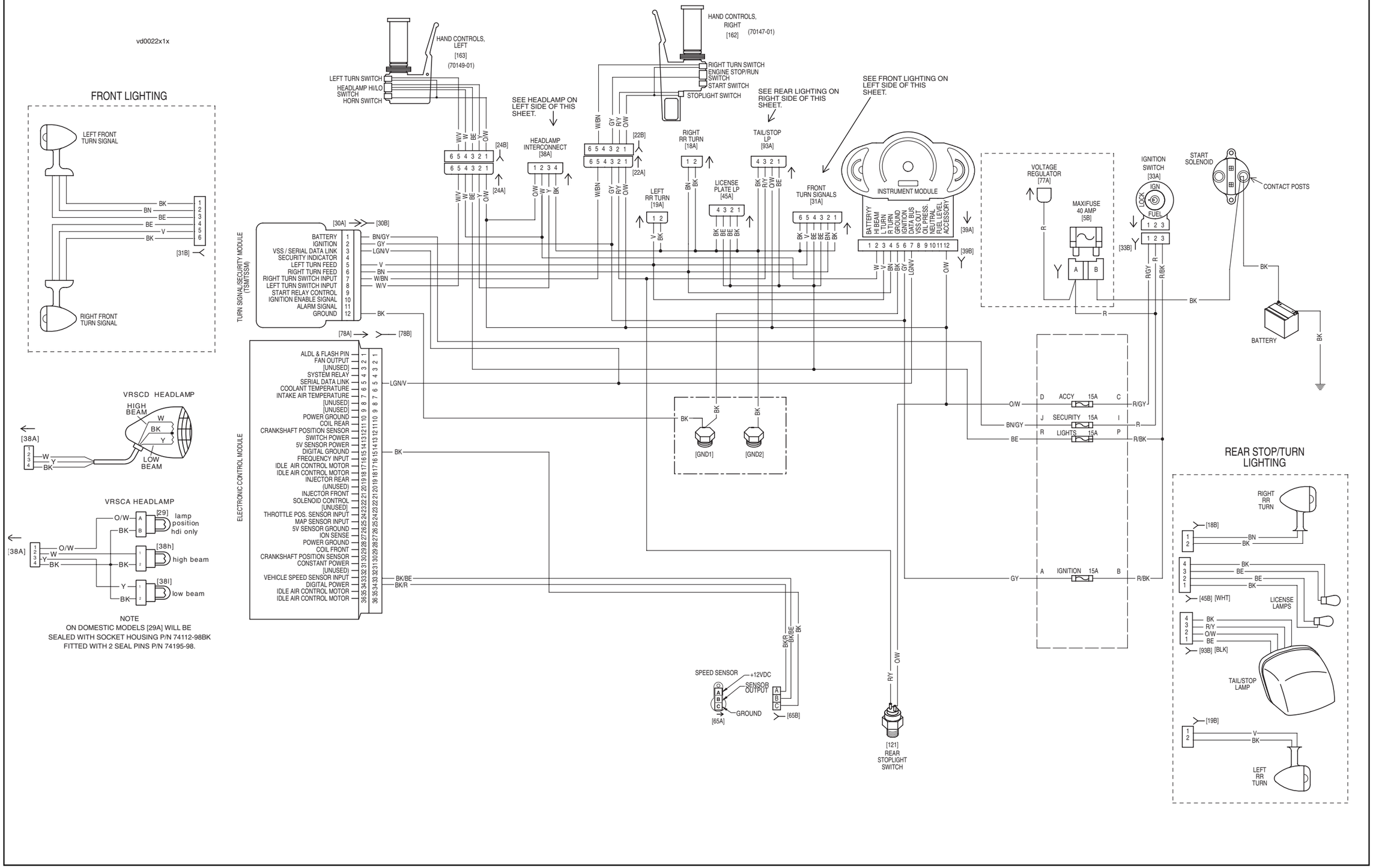
2006 VRSCR MODEL, STARTING CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, STARTING CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, STARTING CIRCUIT: PAGE 1 OF 1

vd0022xxx

vd0022x1x



2006 VRSCA/VRSCD MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

vd0099x1x

vd0099x1x

FRONT LIGHTING

LEFT FRONT TURN SIGNAL

RIGHT FRONT TURN SIGNAL

BK
BN — BE
BE
V
BK
[31B]

VRSCR HEADLAMP

[38A]
O/W
W
Y
BK
O/W — BK — [29] lamp position hdi only
BK — [38h] high beam
Y — BK — [38l] low beam

NOTE
ON DOMESTIC MODELS [29A] WILL BE SEALED WITH SOCKET HOUSING P/N 74112-98BK FITTED WITH 2 SEAL PINS P/N 74195-98.

HAND CONTROLS, LEFT [163] (70149-01)
LEFT TURN SWITCH
HEADLAMP HI/LO SWITCH
HORN SWITCH

HAND CONTROLS, RIGHT [162] (70147-01)
RIGHT TURN SWITCH
ENGINE STOP/RUN SWITCH
START SWITCH
STOPLIGHT SWITCH

SEE HEADLAMP ON LEFT SIDE OF THIS SHEET.

SEE REAR LIGHTING ON RIGHT SIDE OF THIS SHEET.

SEE FRONT LIGHTING ON LEFT SIDE OF THIS SHEET.

W/V W BE Y O/W [24B]
W/V W BE Y O/W [24A]
HEADLAMP INTERCONNECT [38A]
O/W W Y BK
W/BN GY R/Y O/W [22B]
W/BN GY R/Y O/W [22A]
RIGHT RR TURN [18A]
BN BK
LEFT RR TURN [19A]
V BK
LICENSE PLATE LP [45A]
BK BE BE BK
TAIL/STOP LP [93A]
BK R/Y O/W BE
FRONT TURN SIGNALS [31A]
BK V BE BE BK
[39A]
[39B]

INSTRUMENT MODULE (TYPICAL)
BATTERY
HI BEAM
L TURN
R TURN
GROUND
DIGITAL BUS
VSS OUT
OIL PRESS.
NEUTRAL
FUEL LEVEL
ACCESSORY
1 2 3 4 5 6 7 8 9 10 11 12
W V BN BK GY LGN/V O/W

VOLTAGE REGULATOR [77A]
R
MAXIFUSE 40 AMP [5B]
A B
IGNITION SWITCH [33A]
LOCK ACC TGN
FUEL
A B I
C B A
[33B]
R/GY R R/BK
START SOLENOID
CONTACT POSTS
BK
R
BATTERY
BK

TURN SIGNAL/SECURITY MODULE (TSM/TSSM)
[30A] [30B]
BATTERY 1 — BN/GY
IGNITION 2 — GY
VSS / SERIAL DATA LINK 3 — LGN/V
SECURITY INDICATOR 4
LEFT TURN FEED 5 — V
RIGHT TURN FEED 6 — BN
RIGHT TURN SWITCH INPUT 7 — W/BN
LEFT TURN SWITCH INPUT 8 — W/V
START RELAY CONTROL 9
IGNITION ENABLE SIGNAL 10
ALARM SIGNAL 11
GROUND 12 — BK

[78A] [78B]
ELECTRONIC CONTROL MODULE
ALDL & FLASH PIN
FAN OUTPUT
[UNUSED]
SYSTEM RELAY
SERIAL DATA LINK — LGN/V
COOLANT TEMPERATURE
INTAKE AIR TEMPERATURE
[UNUSED]
[UNUSED]
POWER GROUND
COIL REAR
CRANKSHAFT POSITION SENSOR
SWITCH POWER
5V SENSOR POWER
DIGITAL GROUND
FREQUENCY INPUT
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
INJECTOR REAR
(UNUSED)
INJECTOR FRONT
SOLENOID CONTROL
[UNUSED]
THROTTLE POS. SENSOR INPUT
MAP SENSOR INPUT
5V SENSOR GROUND
ION SENSE
POWER GROUND
COIL FRONT
CRANKSHAFT POSITION SENSOR
CONSTANT POWER
[UNUSED]
VEHICLE SPEED SENSOR INPUT — BK/BE
DIGITAL POWER — BK/R
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
BK

BK BK BK
BK
[GND1] [GND2]

SPEED SENSOR
+12VDC
SENSOR OUTPUT
GROUND
[65A] [65B]
BK/R BK/BE BK

R/Y O/W
[121] REAR STOPLIGHT SWITCH

D ACCY 15A C — O/W — R/GY
J SECURITY 15A I — BN/GY — R
R LIGHTS 15A P — BE — R/BK
A IGNITION 15A B — GY — R/BK

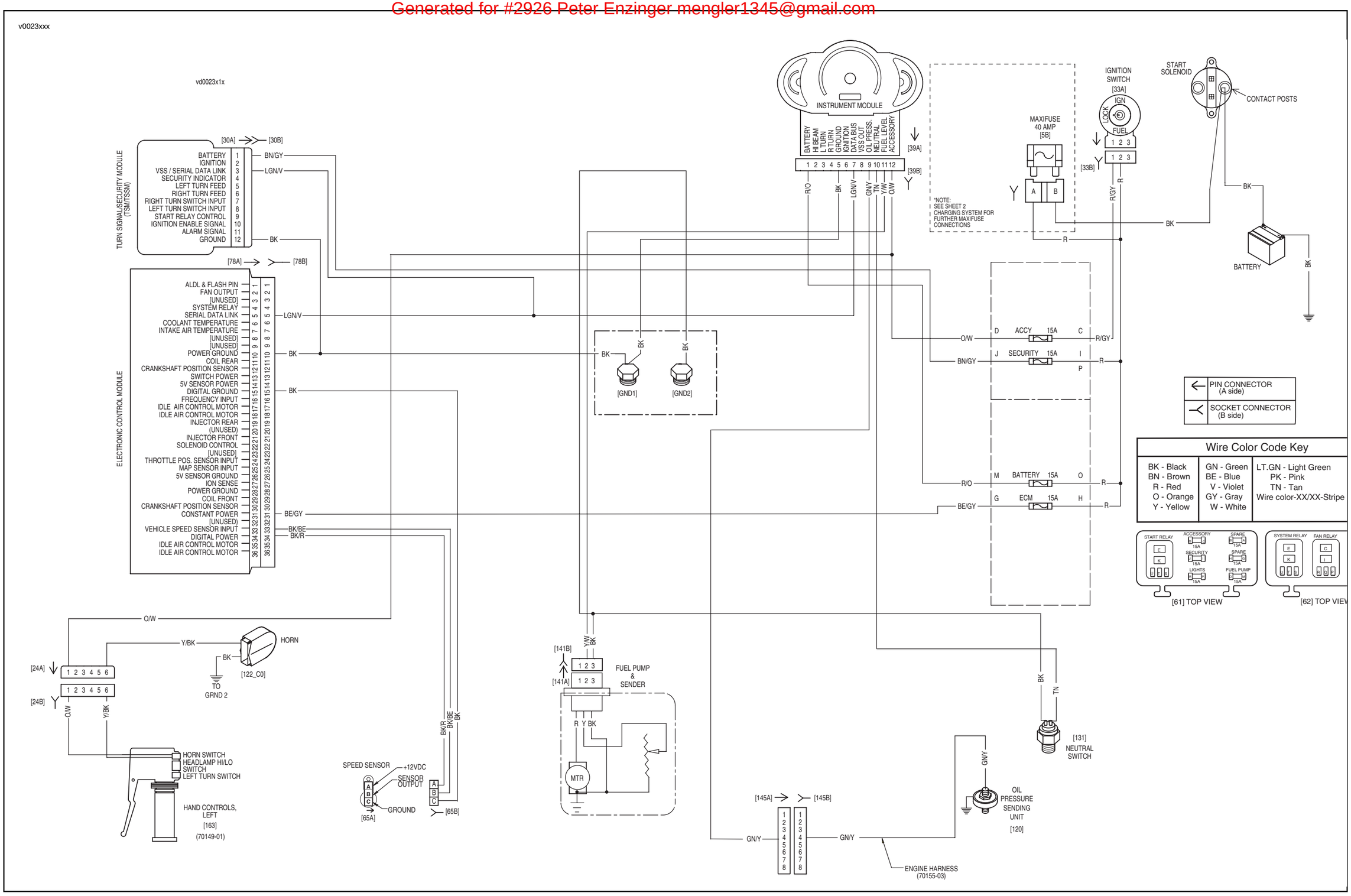
REAR STOP/TURN LIGHTING
RIGHT RR TURN
[18B]
1 2 — BN — BK
4 3 2 1 — BK — BE — BE — BK
[45B] [WHT]
LICENSE LAMPS
4 3 2 1 — BK — R/Y — O/W — BE
[93B] [BLK]
TAIL/STOP LAMP
[19B]
1 2 — V — BK
LEFT RR TURN

2006 VRSCR MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1

v0023xxx



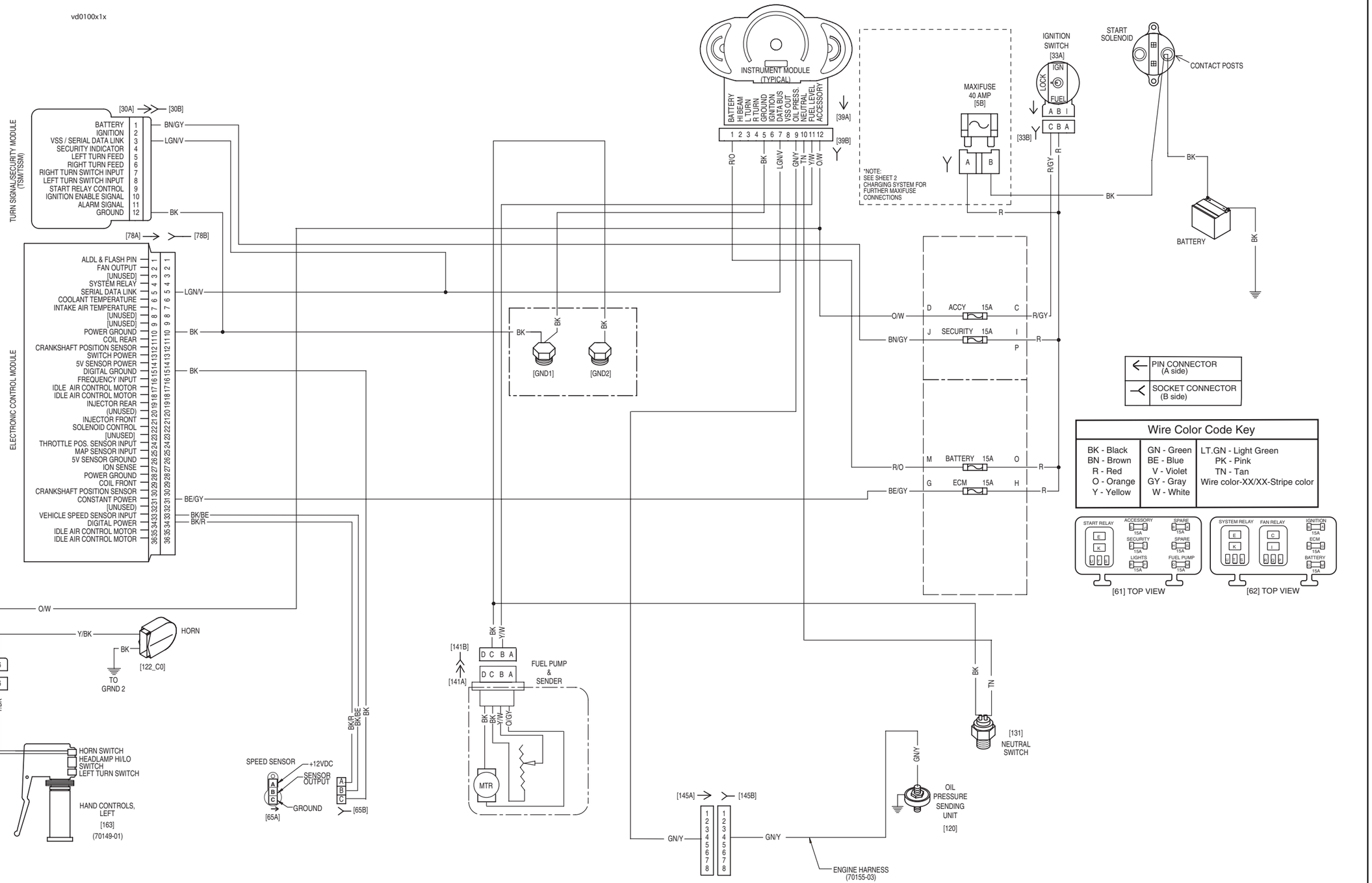
2006 VRSCA/VRSCD MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

2006 VRSCA/VRSCD MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

vd0100x1x

vd0100x1x



2006 VRSCR MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

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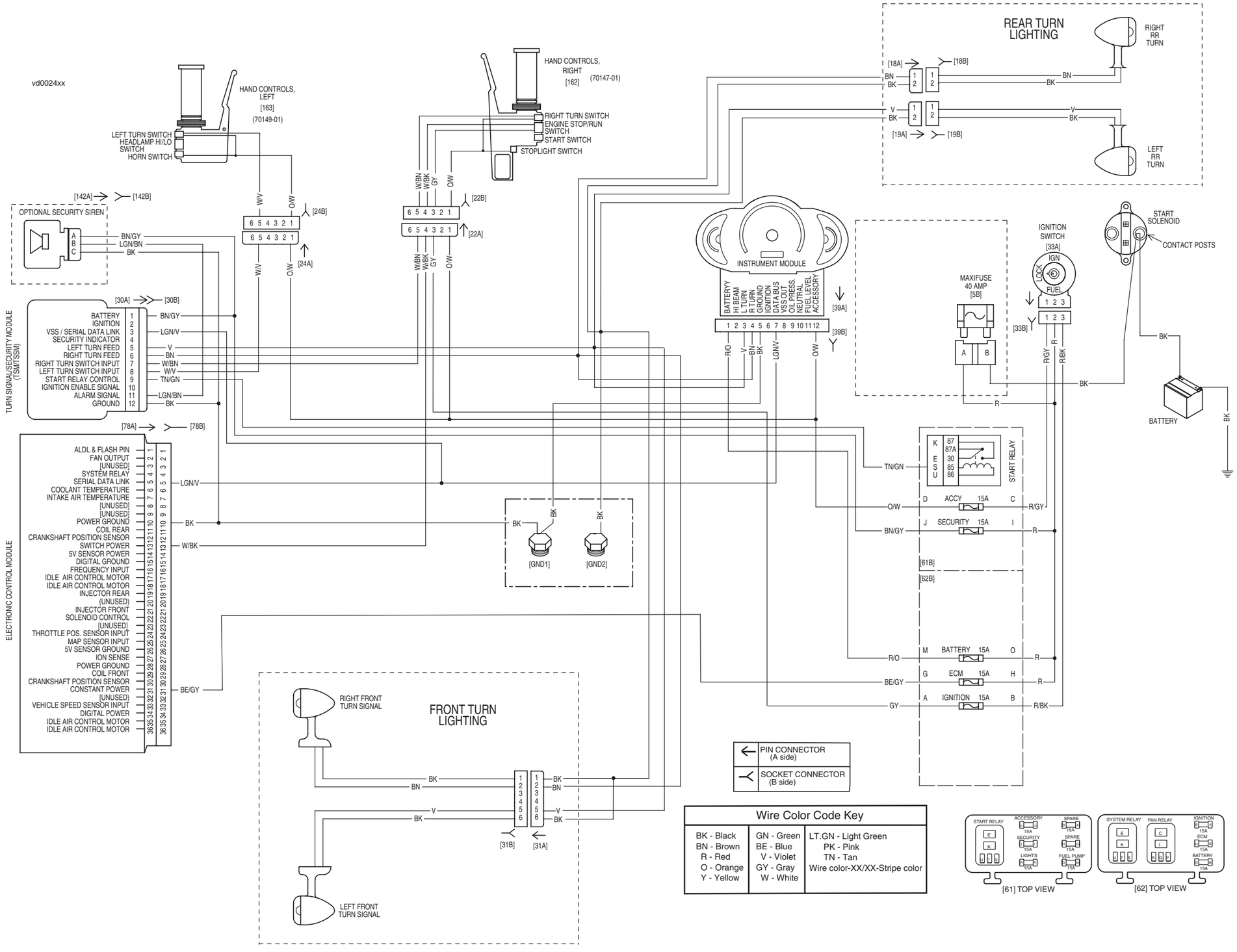
2006 VRSCR MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1

vd0024xxx



2006 VRSCA/VRSCD MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

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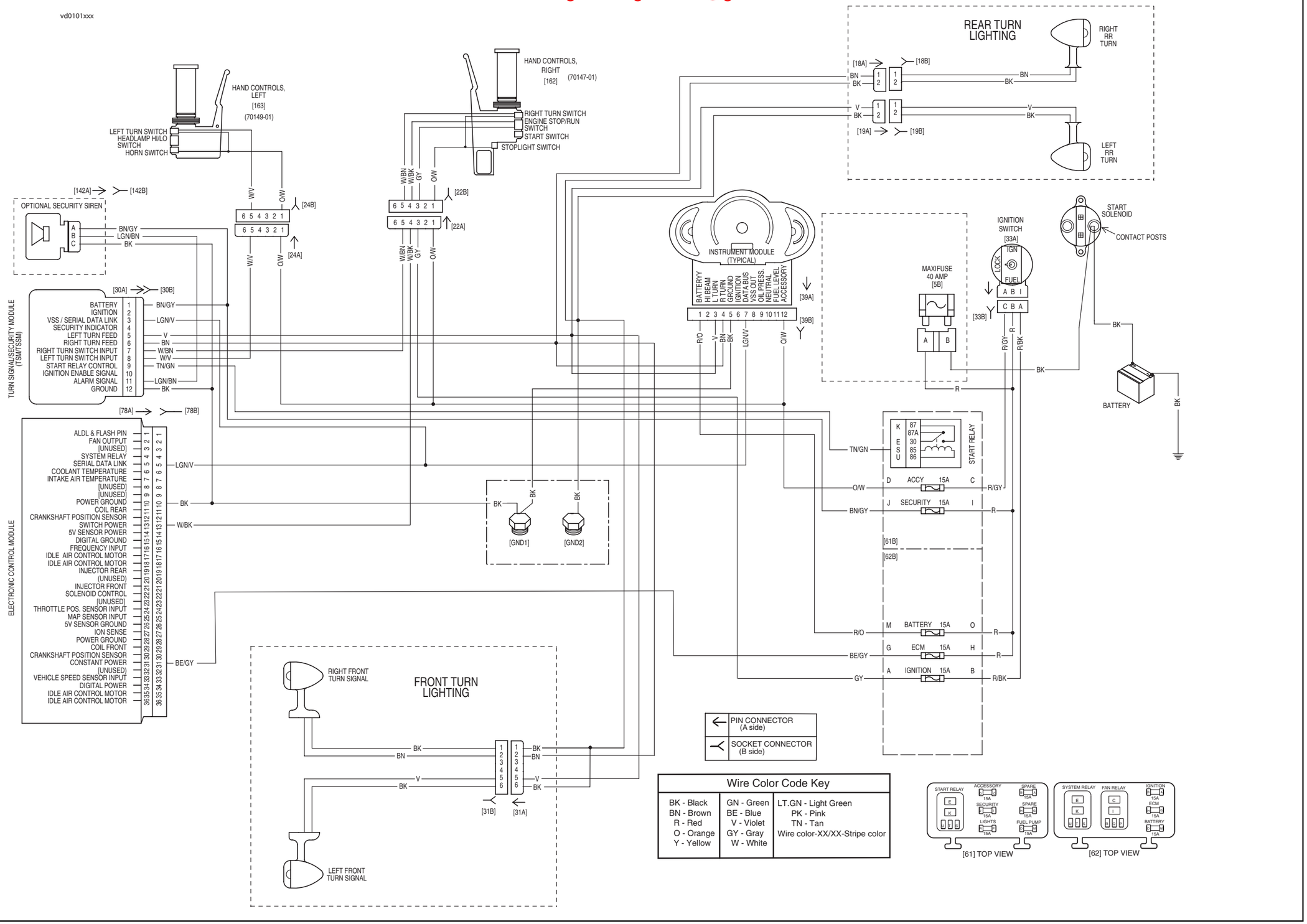
2006 VRSCA/VRSCD MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

vd0101xxx

vd0101xxx



2006 VRSCR MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

2006 VRSCR MODEL, SECURITY CIRCUIT: PAGE 1 OF 1

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APPENDIX

APPENDIX A–GLOSSARY A.1

Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
A	Amperes
AC	Alternating Current
ACC	Accessory
ACR	Automatic Compression Release
AGM	Absorbed Glass Mat (battery)
AMP	Ampere
AWG	American Wire Guage
B+	Battery voltage
BAS	Bank Angle Sensor
BTDC	Before Top Dead Center
C	Celcius (Centigrade)
CA	California
CAL	Calibration
CC	Cubic Centimeters
CCA	Cold Cranking Amps
CKP	Crankshaft Position
cm	Centimeter
CV	Constant Velocity
DC	Direct Current
DLC	Data Link Connector
DOM	Domestic
DTC	Diagnostic Trouble Code
DVOM	Digital Volt Ohm Meter
ECM	Electronic Control Module
ECT	Engine Coolant Temperature
EEPROM	Electrically Erasable Programmable Read Only Memory
EFI	Electronic Fuel Injection
ET	Engine Temperature
EVAP	Evaporative Emissions Control System
F	Fahrenheit
ft-lbs	Foot-Pounds
fl oz.	Fluid Ounce
g	Gram
GAL	Gallon
GAWG	Gross Axle Weight Rating
GND	Ground (electrical)
GVWR	Gross Vehicle Weight Rating
HDI	Harley-Davidson International
Hg	Mercury
IAC	Idle Air Control
IAT	Intake Air Temperature
ICM	Ignition Control Module
ID	Inside Diameter

Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
IGN	Ignition Light/Key Switch
IM	Instrument Module
In.	Inch
INJ PW	Injector Pulse Width
in-lbs	Inch-Pounds
Kg	Kilogram
Km	Kilometer
kPa	Kilopascal
km/hr	Kilometers Per Hour
L	Liter
LCD	Liquid Crystal Display
LED	Light Emitting Diode
mA	Milliampere
MAP	Manifold Absolute Pressure
ml	mililiter
mm	millimeter
MPH	Miles Per Hour
ms	millisecond
Nm	Newton-Meter
N/A	Not Applicable
no.	number
O2	oxygen
OD	Outside Diameter
OEM	Original Equipment Manufacturer
oz	Ounce
P&A	Parts and Accessories
PN	Part Number
PSI	Pounds Per Square Inch
RES	Reserve
RPM	Revolutions Per Minute
SCFH	Cubic Feet per Hour at Standard Conditions
TDC	Top Dead Center
TP	Throttle Position
TSM	Turn Signal Module
TSSM	Turn Signal/Security Module
V	Volt
VAC	Volts of Alternating Current
VDC	Volts of Direct Current
VIN	Vehicle Identification Number
VSS	Vehicle Speed Sensor

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STARTING & CHARGING 1

SUBJECT **PAGE NO.**

STARTER TROUBLESHOOTING 1.1

Table 1-1. Starter Does Not Run or Runs At Very Low Speeds

SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
Battery	Voltage drop due to discharged battery.	Charge battery.
	Short-circuited or open between electrodes.	Replace battery.
	Poor contact condition of battery terminal(s).	Clean and retighten.
Wiring	Poor or no connection at either battery positive or negative cable, at either end.	Repair or replace cable(s).
	Cracked or corroded battery cable ends.	Clean, tighten or replace cable(s) as needed.
	Open wire(s) or poor connection at handlebar switch or starter relay, especially relay ground wire.	Tighten connections or repair or replace wire(s).
Handlebar start switch	Poor switch contacts or open switch.	Replace switch.
Starter relay	Open coil winding.	Replace relay.
	Poor or no continuity at relay points.	Replace relay.
	TSM/TSSM has disabled starter relay.	Disarm security system.
Solenoid	Poor contact condition caused by burnt contact.	Replace solenoid assembly.
	Windings open or short-circuited.	Replace solenoid assembly.
Starting motor	Free running current draw out of range.	Replace starter.
Limiter assembly	Limiter assembly failure.	Replace limiter assembly.
Ball clutch	Ball clutch failure.	Replace rotor/ball clutch assembly.

Table 1-2. Engine Cannot Be Cranked

SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
Battery	Voltage drop due to discharged battery.	Charge battery.
	Short-circuited or open between electrodes.	Replace battery.
	Poor contact condition of battery terminal(s).	Clean and retighten.
Starting motor	Starter gear teeth worn out.	Replace starter.
Limiter assembly.	Limiter assembly malfunction.	Replace limiter assembly.
	Limiter assembly gears damaged.	Replace limiter assembly.
Gear teeth on ball clutch gear	Excessively worn teeth.	Replace ball clutch gear.
Ball clutch	Ball clutch failure.	Replace rotor assembly.

Table 1-3. Starter Does Not Stop Running

SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
Starting switch or starter relay.	Unopened contacts.	Replace starting switch or starter relay.
	Poor return caused by sticky switch or relay contacts.	Replace starting switch or starter relay.
Solenoid.	Coil shorted.	Replace solenoid.
	Contact plate melted and stuck.	Replace solenoid.
Ball clutch	Ball clutch seizure.	Replace rotor assembly.

STARTING SYSTEM DIAGNOSIS 1.2

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the starter system flow charts.

1. See 1.4 DIAGNOSTICS/TROUBLESHOOTING.
2. Remove starter motor. Connect jumper wires as described under FREE RUNNING CURRENT DRAW TEST on page 1-15.
3. Connect BREAKOUT BOX (Part No. HD-42682) and ADAPTERS (Part No. HD-42962) to right handlebar connector [22] located under left side cover.
4. Remove TSSM and use HARNESS CONNECTOR TEST KIT (Part No. HD-41404) to short terminal 9 on connector [30] to ground. If starter motor cranks, replace TSSM.
5. See Starter Current Draw Test on page 1-14.
6. See FREE RUNNING CURRENT DRAW TEST on page 1-15.

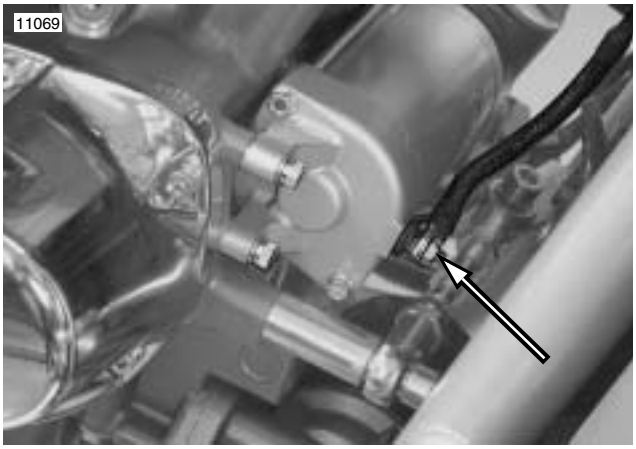
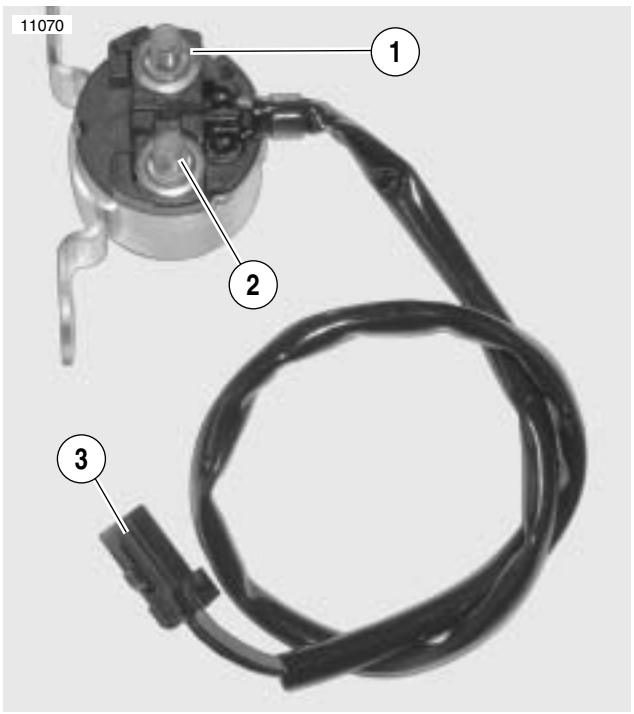


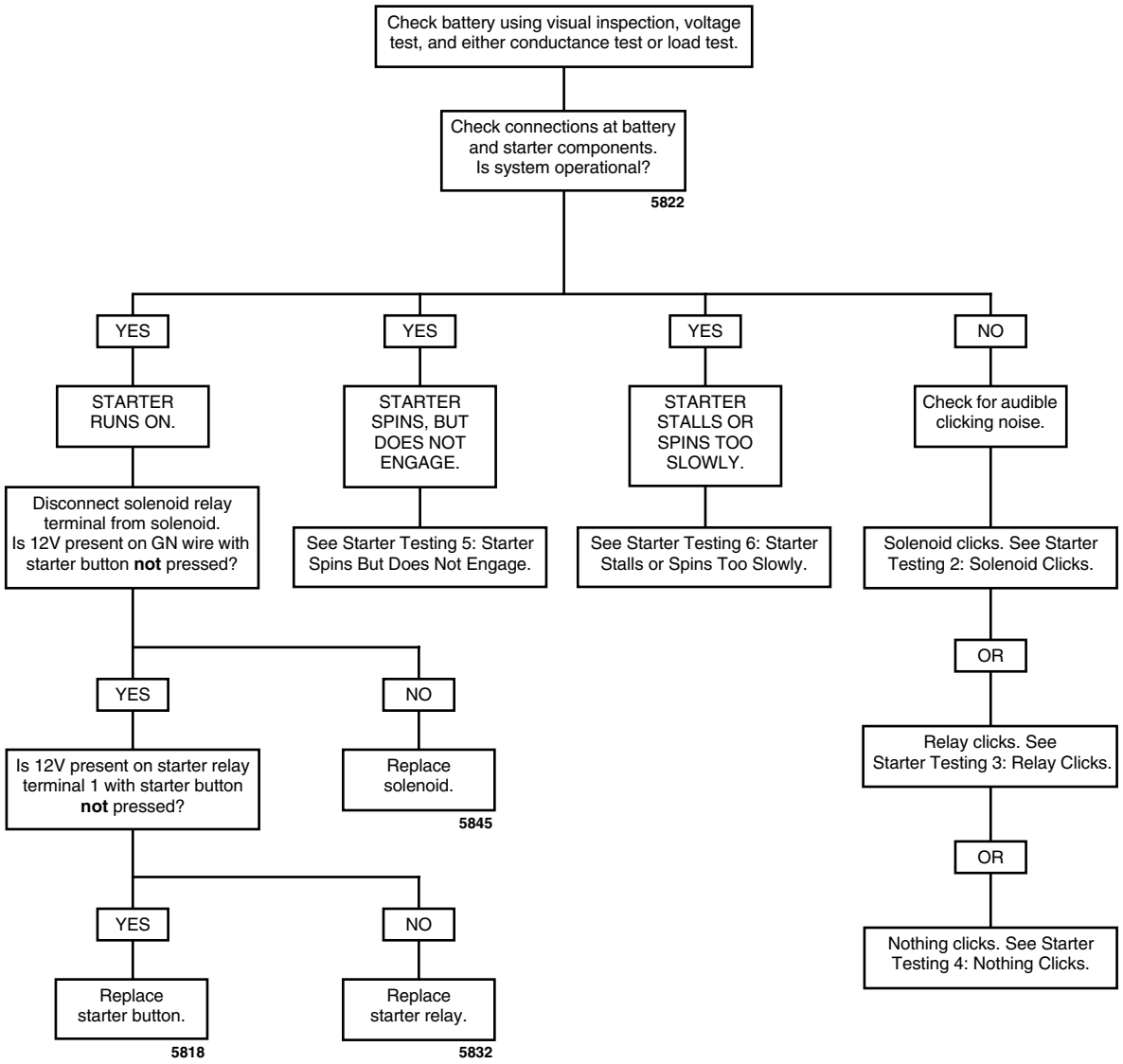
Figure 1-1. Starter Terminal



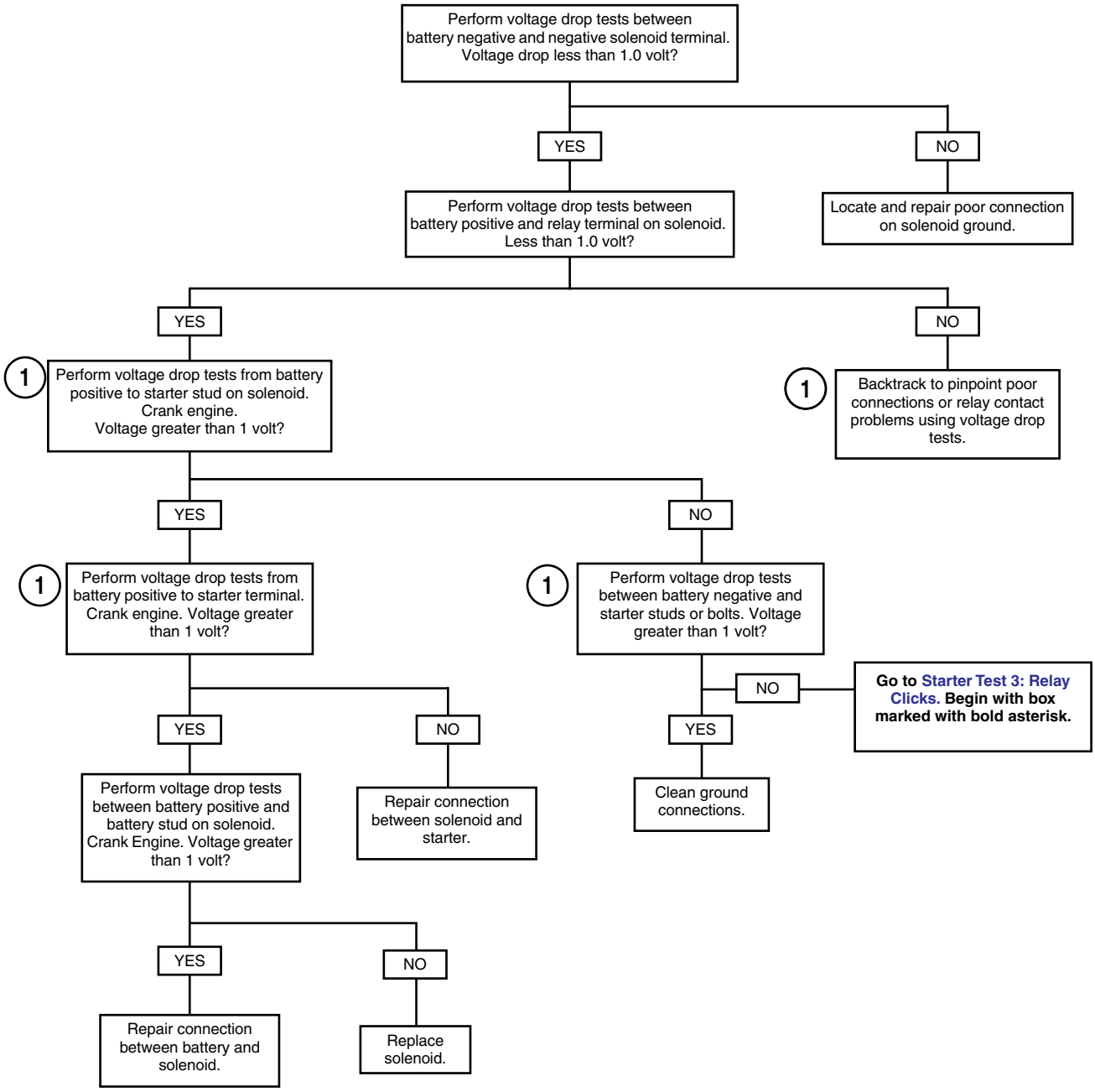
1. **Solenoid stud (to battery)**
2. **Solenoid stud (to starter)**
3. **Connector [128B]**

Figure 1-2. Starter Solenoid Terminals

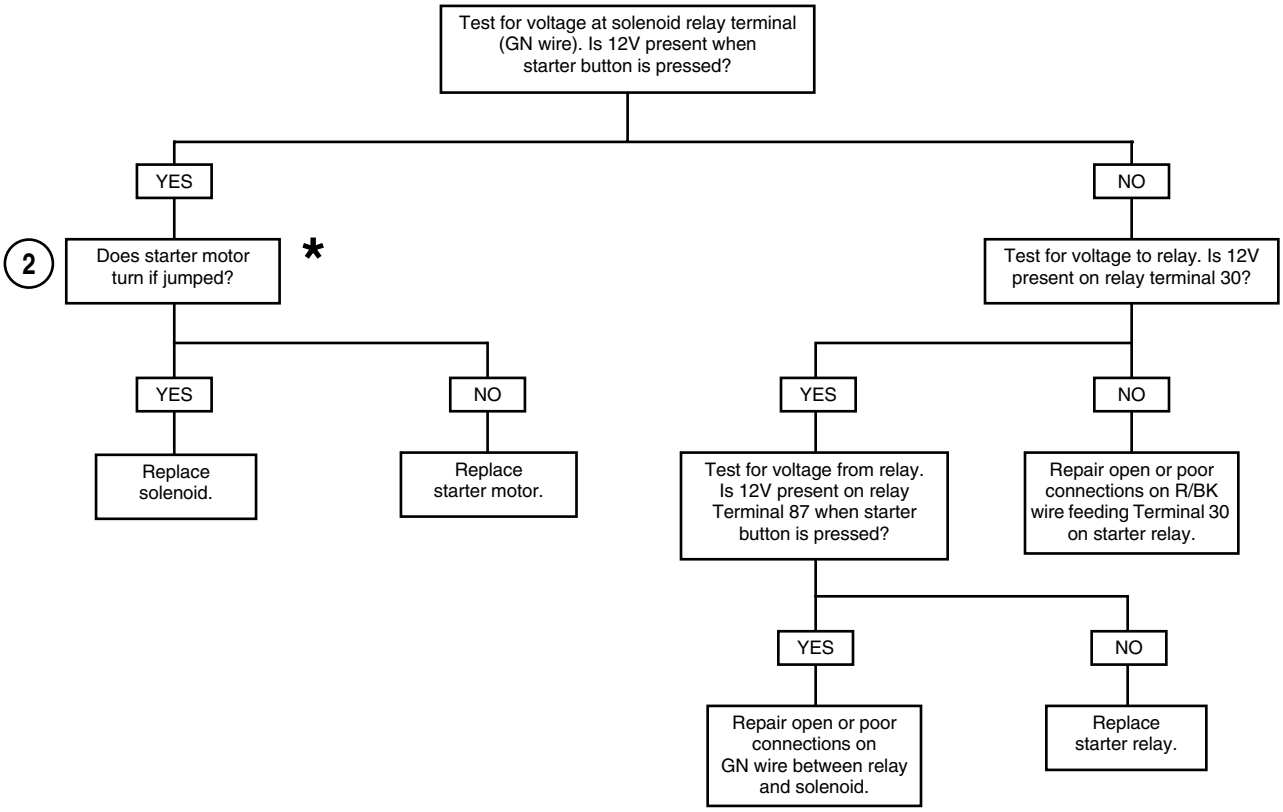
Starter Test 1



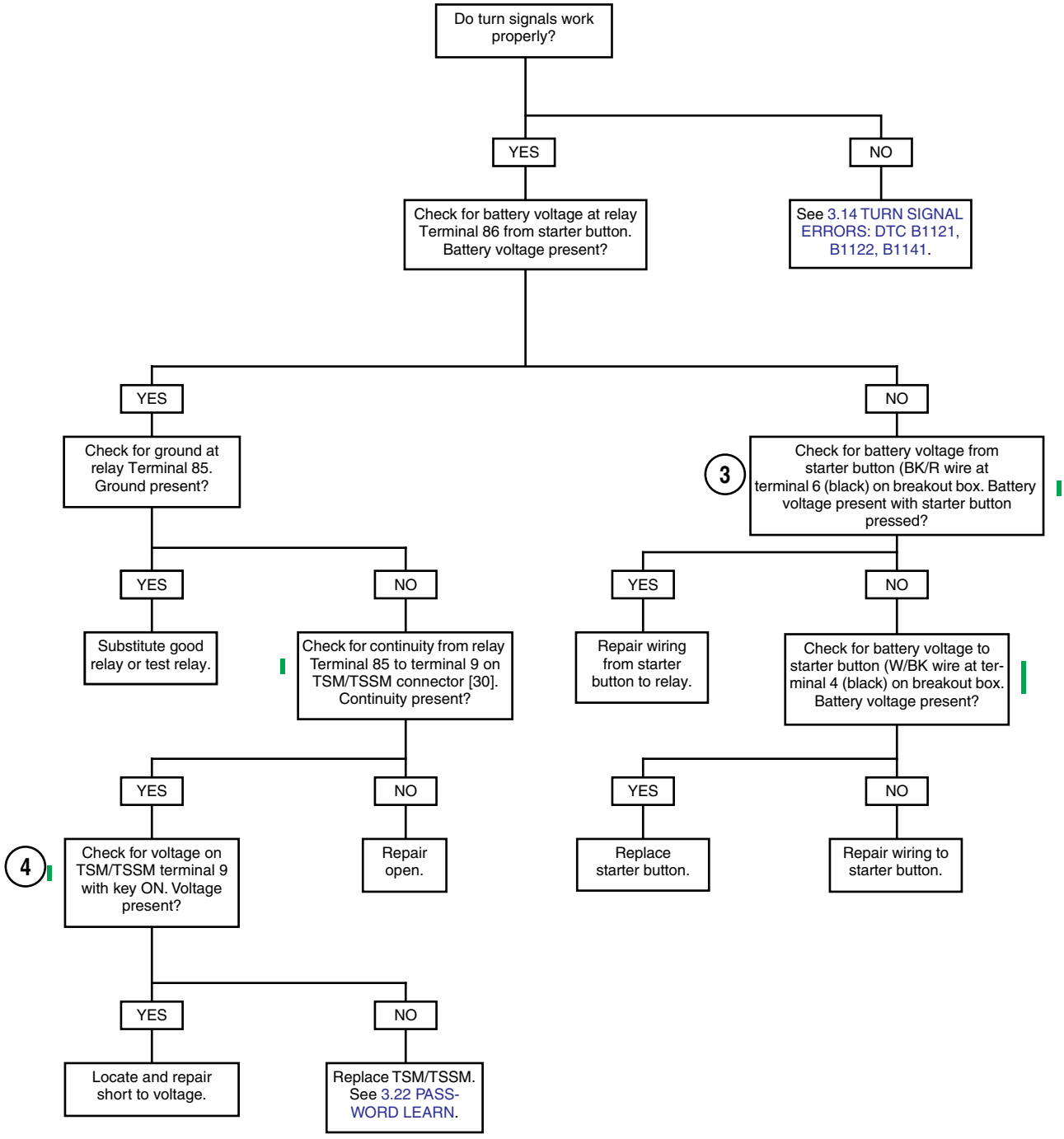
Starter Test 2: Solenoid Clicks



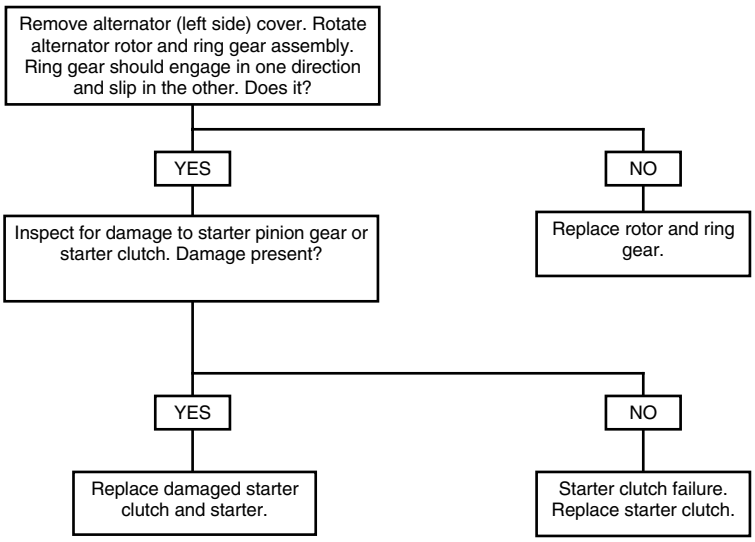
Starter Test 3: Relay Clicks



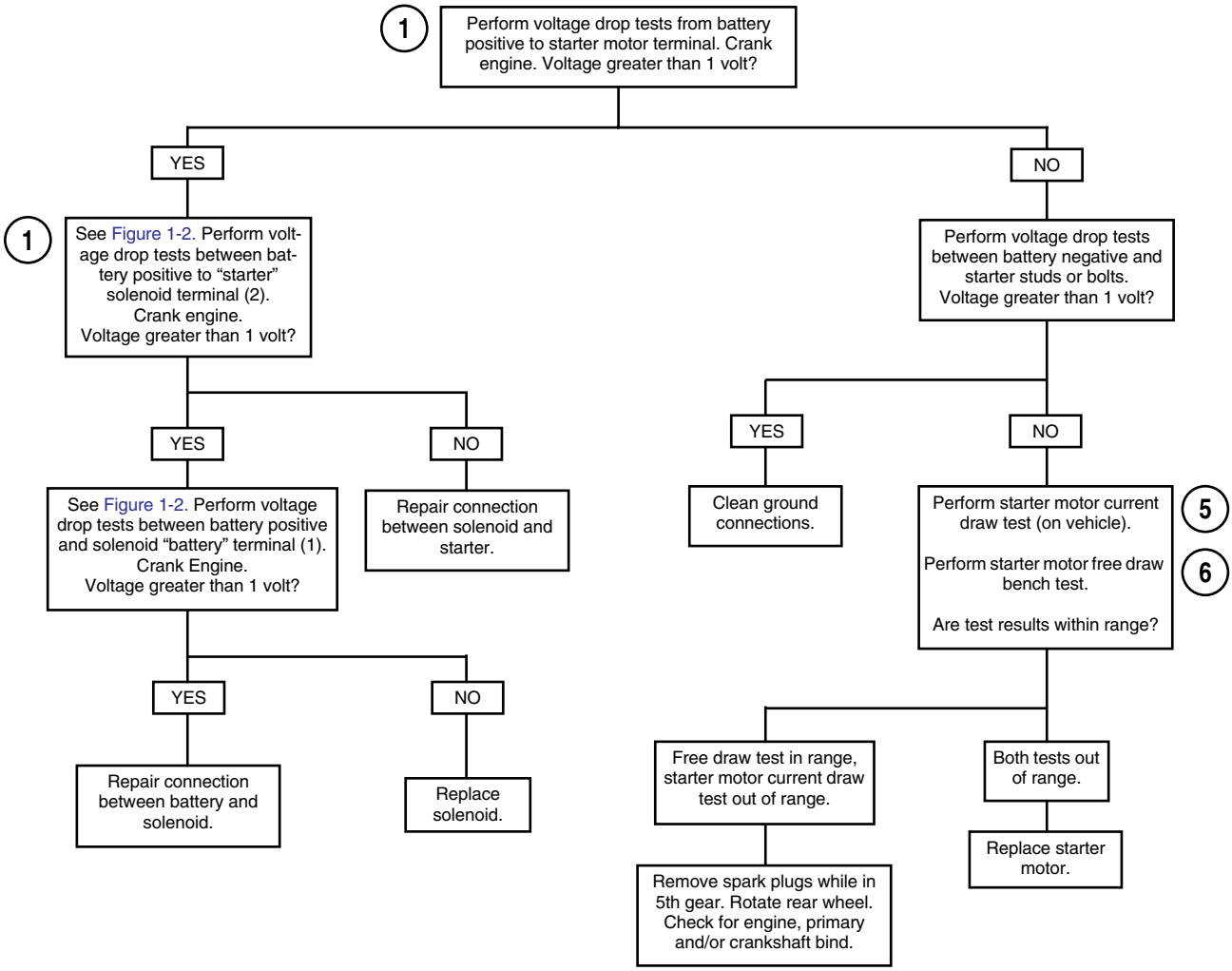
Starter Test 4: Nothing Clicks



Starter Test 5: Starter Spins, But Does Not Engage



Starter Test 6: Starter Stalls or Spins Too Slowly



STARTER ACTIVATION CIRCUITS 1.3

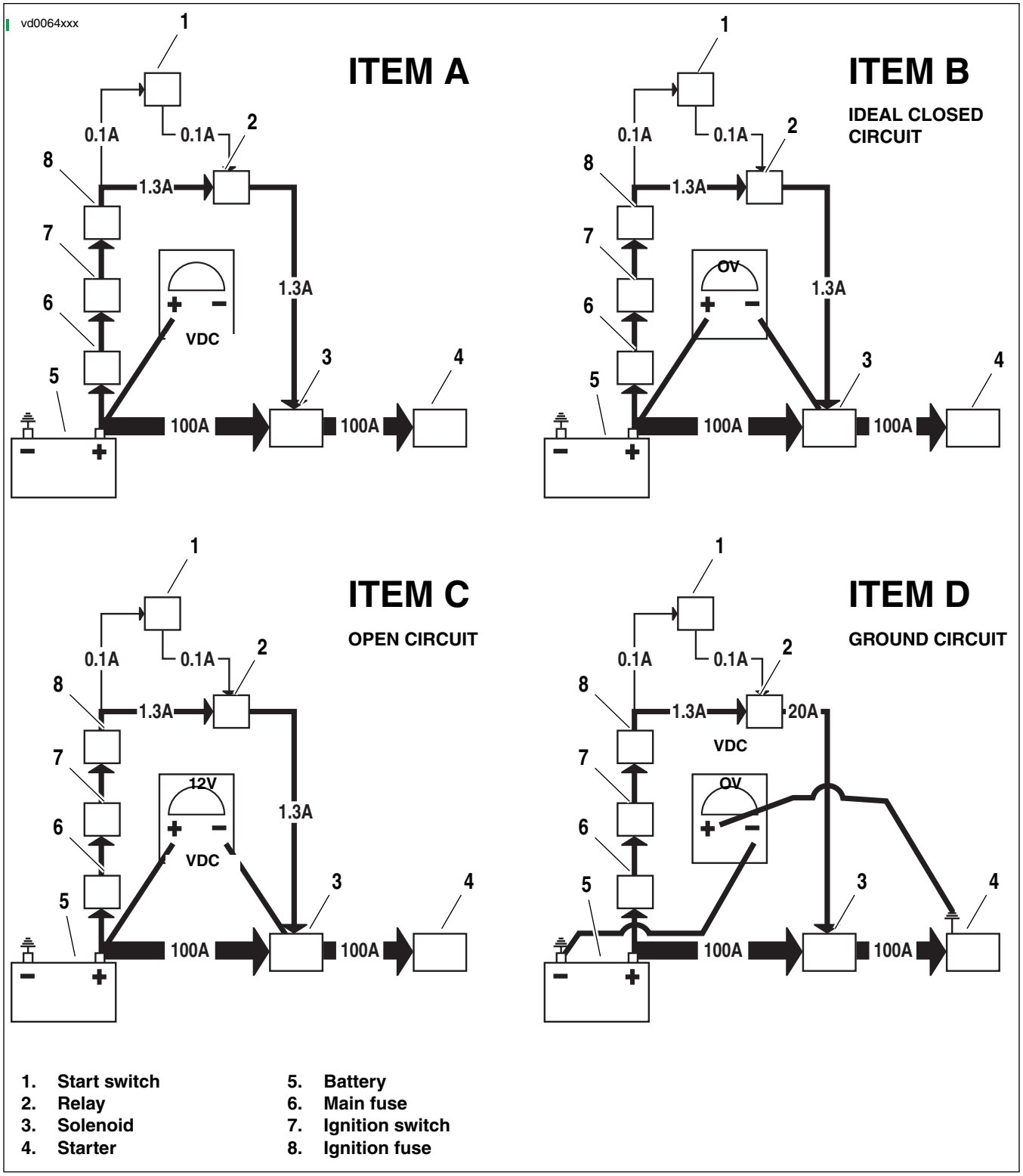


Figure 1-3. Typical Circuity. Refer to wiring diagrams for more information.

GENERAL

The troubleshooting tables beginning on page 1-1 contain detailed procedures to solve and correct problems. Follow the 1.2 STARTING SYSTEM DIAGNOSIS diagram to diagnose starting system problems. The VOLTAGE DROPS procedure below will help you to locate poor connections or components with excessive voltage drops.

VOLTAGE DROPS

Check the integrity of all wiring, switches, circuit breakers and connectors between the source and destination.

The voltage drop test measures the difference in potential or the actual voltage dropped between the source and destination.

1. See ITEM A in Figure 1-3. Attach your red meter lead to the most positive part of the circuit, which in this case would be the positive post of the battery (5).
2. See ITEM B in Figure 1-3. Attach the black meter lead to the final destination or component in the circuit (solenoid terminal from relay).
3. Activate the starter and observe the meter reading. The meter will read the voltage dropped or the difference in potential between the source and destination.
4. An ideal circuit's voltage drop would be 0 volts or no voltage dropped, meaning no difference in potential.
5. See ITEM C in Figure 1-3. An open circuit should read 12 volts, displaying all the voltage dropped, and the entire difference in potential displayed on the meter.

NOTE

Open circuits on the ground side will read zero.

6. Typically, a good circuit will drop less than 1 volt.
7. If the voltage drop is greater, back track through the connections until the source of the potential difference is found. The benefit of doing it this way is speed and accuracy.
   a. Readings aren't as sensitive to real battery voltage.
   b. Readings show the actual voltage dropped, not just the presence of voltage.
   c. This tests the system as it is actually being used. It is more accurate and will display hard to find poor connections.
   d. This approach can be used on lighting circuits, ignition circuits, etc. Start from most positive and go to most negative (the destination or component).
8. See ITEM D in Figure 1-3. The negative or ground circuit can be checked as well.
   a. Place the negative lead on the most negative part of the circuit (or the negative battery post). Remember, there is nothing more negative than the negative post of the battery.
   b. Place the positive lead to the ground you wish to check.
   c. Activate the circuit. This will allow you to read the potential difference or voltage dropped on the negative or ground circuit. This technique is very effective for identifying poor grounds due to powdered paint. Even the slightest connection may cause an ohmmeter to give a good reading. However, when sufficient current is passed through, the resistance caused by the powdered paint will cause a voltage drop or potential difference in the ground circuit.

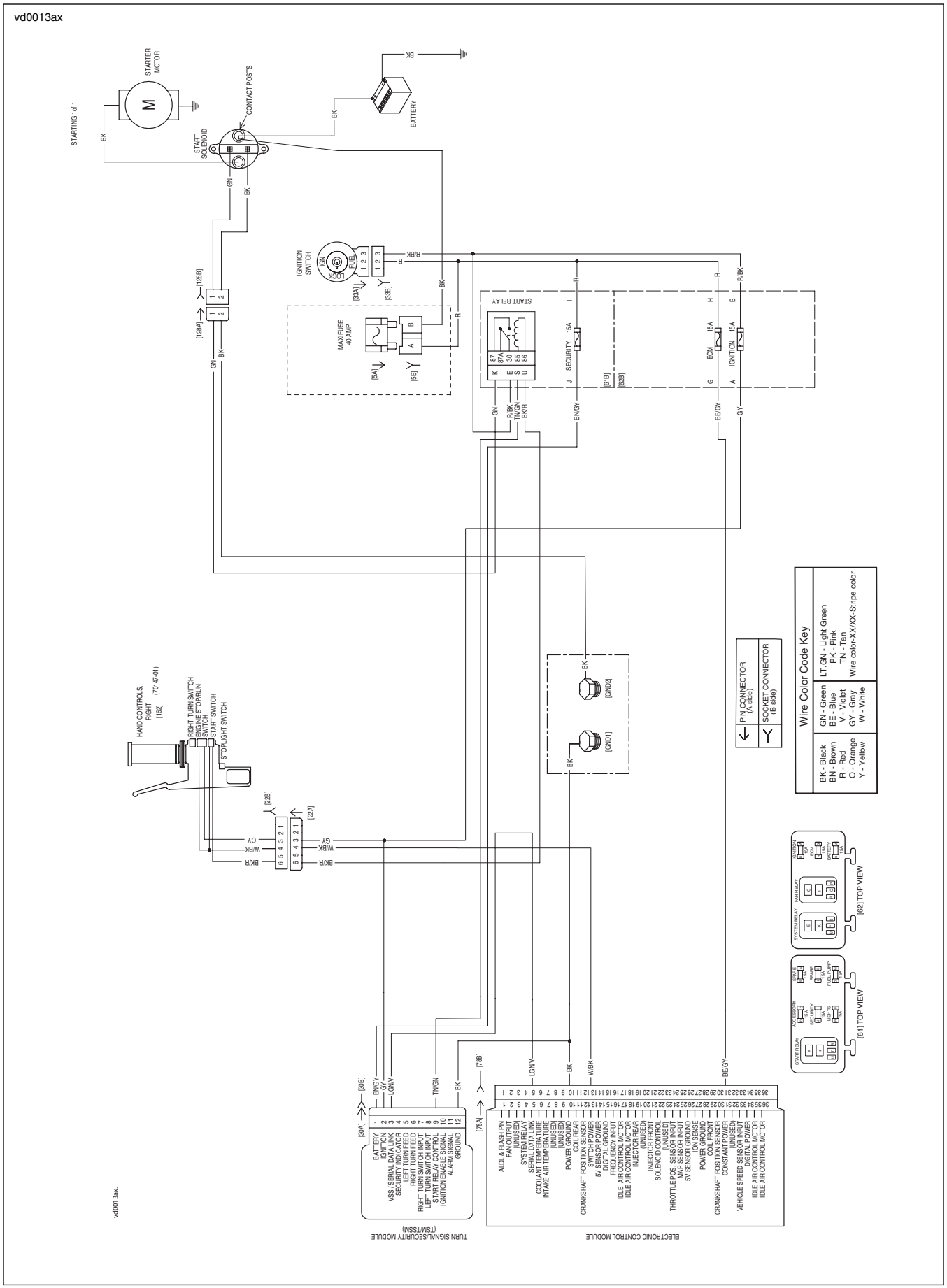


Figure 1-4. Starting Circuit (VRSCA/VRSCD)

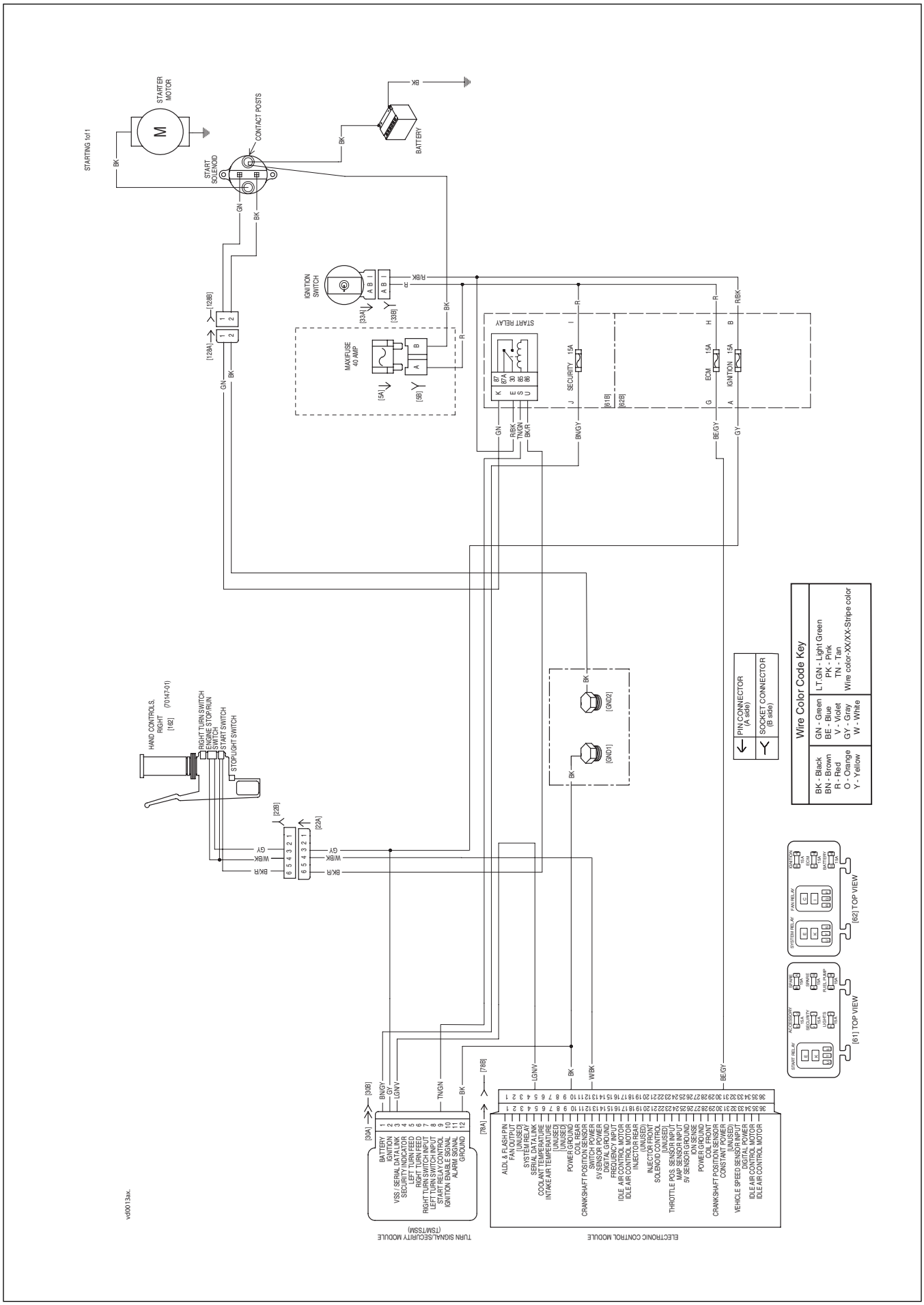


Figure 1-5. Starting Circuit (VRSCR)

STARTER SYSTEM TESTING 1.5

"ON-MOTORCYCLE" TESTS

Starter Relay Test

1. See Figure 1-6. Locate the starter relay under the seat.
2. To test relay, proceed to Step 3. If installing a **new** starter relay, disconnect old relay and replace.

CAUTION

Only connect relay terminal 85 to negative battery terminal. Improper connections will damage the diode connected across the relay windings.

3. See Figure 1-7. The starter relay can be tested using the motorcycle's 12 volt battery and a multimeter.
   a. Unplug connector from relay.
   b. To energize relay, connect the battery leads to terminals 86 and 85 as shown.
   c. Check for continuity between the 30 and 87 terminals. A good relay shows continuity (continuity tester lamp "on" or a zero ohm reading on the ohmmeter). A malfunctioning relay will not show continuity and must be replaced.
4. If starter relay is functioning properly, proceed to STARTER CURRENT DRAW TEST.

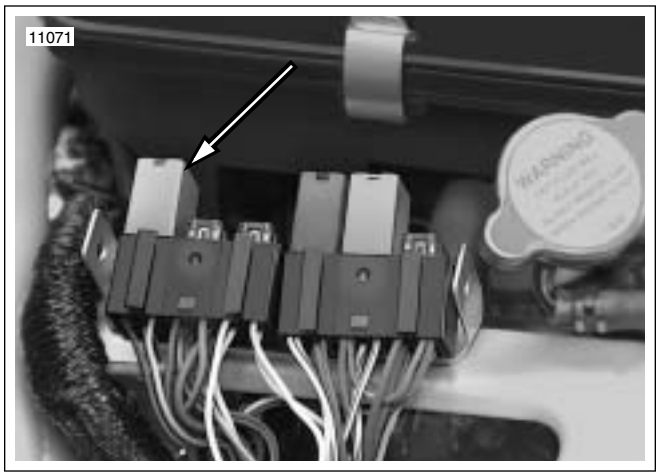


Figure 1-6. Starter Relay (typical)

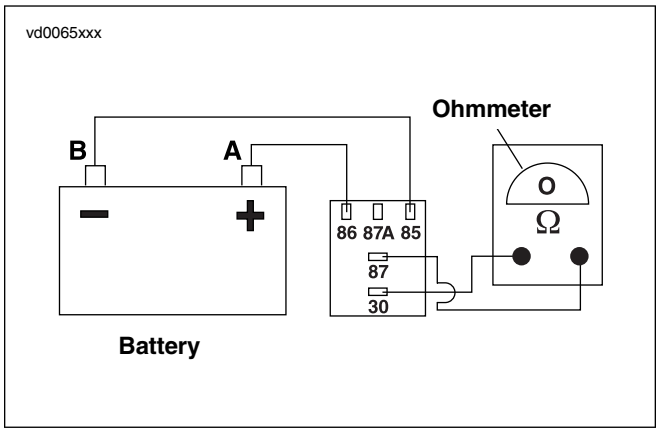


Figure 1-7. Starter Relay Test

Starter Current Draw Test

NOTES

- *Engine temperature should be stable and at room temperature.*
- *Battery should be fully charged.*

See Figure 1-8. Check starter current draw with an induction ammeter before disconnecting battery. Proceed as follows:

1. Verify that transmission is in neutral. Verify engine stop switch is in the **off** position.
2. Remove air cleaner cover.
3. See Figure 1-6. Remove start relay.
4. See Figure 1-9. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), connect red socket probes and patch cord to relay terminals 30 and 87.
5. See Figure 1-8. Clamp induction ammeter over positive starter cable to solenoid.

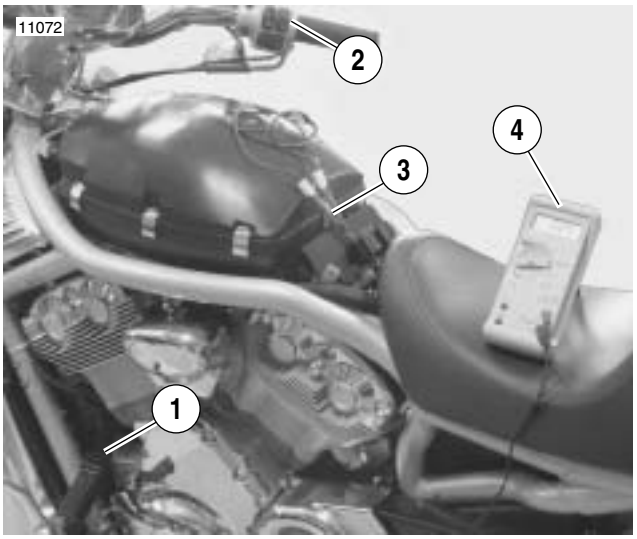
NOTE

In next step with engine stop switch in off position and red male probes connected to the 30 and 87 terminals of start relay, starter will turn but engine will not start. This configuration also prevents diagnostic trouble codes from being set.

6. Turn ignition key switch ON while taking a reading on the ammeter. Disregard initial high current reading which is normal when engine is first turned over.
   a. Typical starter current draw will range between 80-120 amperes.
   b. If starter current draw exceeds 120 amperes, then the problem may be in the starter or starter drive. Remove starter for further tests. See FREE RUNNING CURRENT DRAW TEST under 1.6 TESTING STARTER.

NOTE

See Figure 1-8. A DC current probe may be used if an induction ammeter is not available.



1. Red socket probes
2. Engine stop switch (Off)
3. Probe
4. Meter

Figure 1-8. Current Draw Test (typical)

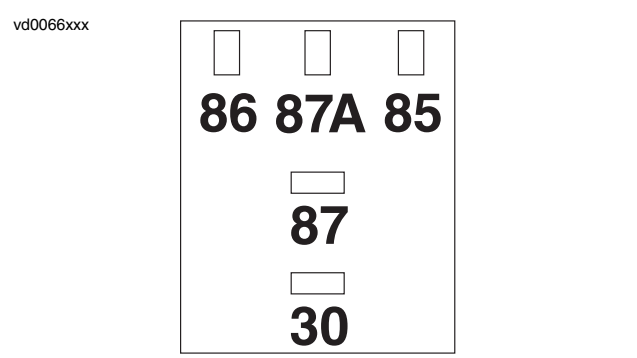


Figure 1-9. Relay Terminals

TESTING STARTER 1.6

FREE RUNNING CURRENT DRAW TEST

1. Place starter in vise, using a clean shop towel to prevent scratches or other damage.
2. See Figure 1-10. Attach one heavy jumper cable (6 gauge minimum).
   a. Connect to the starter mounting flange (1).
   b. Connect to negative (-) terminal of a fully charged battery (2).
3. Connect a second heavy jumper cable (6 gauge minimum).
   a. Connect to positive (+) terminal of the battery (2).
   b. Place an inductive ammeter (3) over cable. Continue on to the battery terminal (4) on the starter solenoid.
4. Check ammeter reading.
   a. Ammeter should show 30-45 amps.
   b. If reading is higher, replace starter motor. See the VRSC Service Manual.
   c. If starter current draw on vehicle was over 120 amps and this test was within specification, there may be a problem with engine, primary drive or crankshaft.

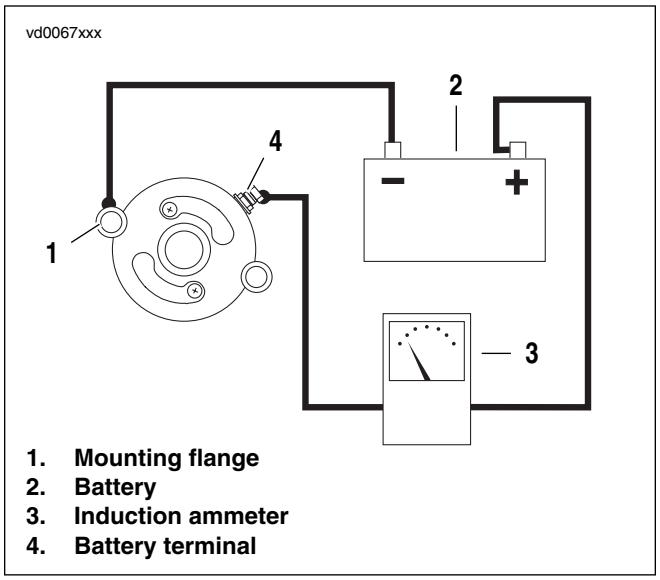


Figure 1-10. Free Running Current Draw Test

GENERAL

The charging system consists of the alternator and regulator. Charging system circuits are shown in Figure 1-14.

Alternator

The alternator consists of two main components:

- The rotor which mounts to the cam drive side of the crankshaft.
- The stator which bolts to the alternator cover.

Voltage Regulator

See Figure 1-11. The voltage regulator is a series regulator. The circuit combines the functions of rectifying and regulating.

TROUBLESHOOTING

When the charging system fails to charge or does not charge at a satisfactory rate, make the following recommended checks.

Battery

Check for a weak or dead battery. See 1.9 BATTERY TESTING for battery testing procedures. Battery must be fully charged in order to perform a load test, or starting or charging tests. However, a partially discharged battery may be tested using the BATTERY TEST function of the MCR-101 HD Electrical System Tester.

Wiring

Check for corroded or loose connections in the charging circuit.

Voltage Regulator Inspection

See Figure 1-12. The voltage regulator must have a clean, tight connection for proper grounding. Check by using an ohmmeter with one lead on a known good ground, such as battery ground cable, and the other on the regulator ground lead.

See Figure 1-13. Stator wire plug at engine crankcase must be clean and tight.

Figure 1-11. Voltage Regulator

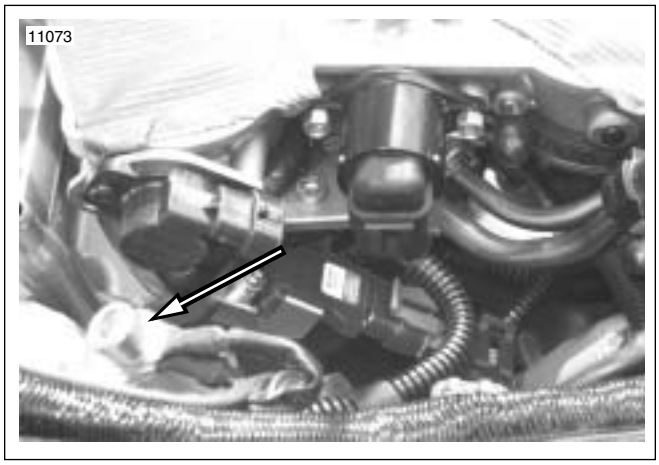


Figure 1-12. Regulator Ground Lead (typical)

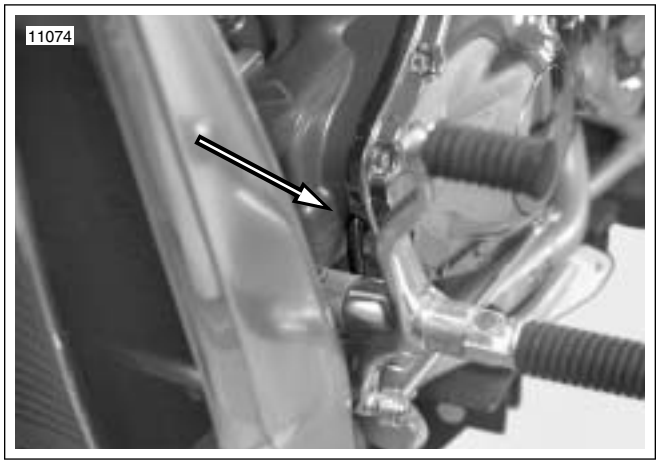
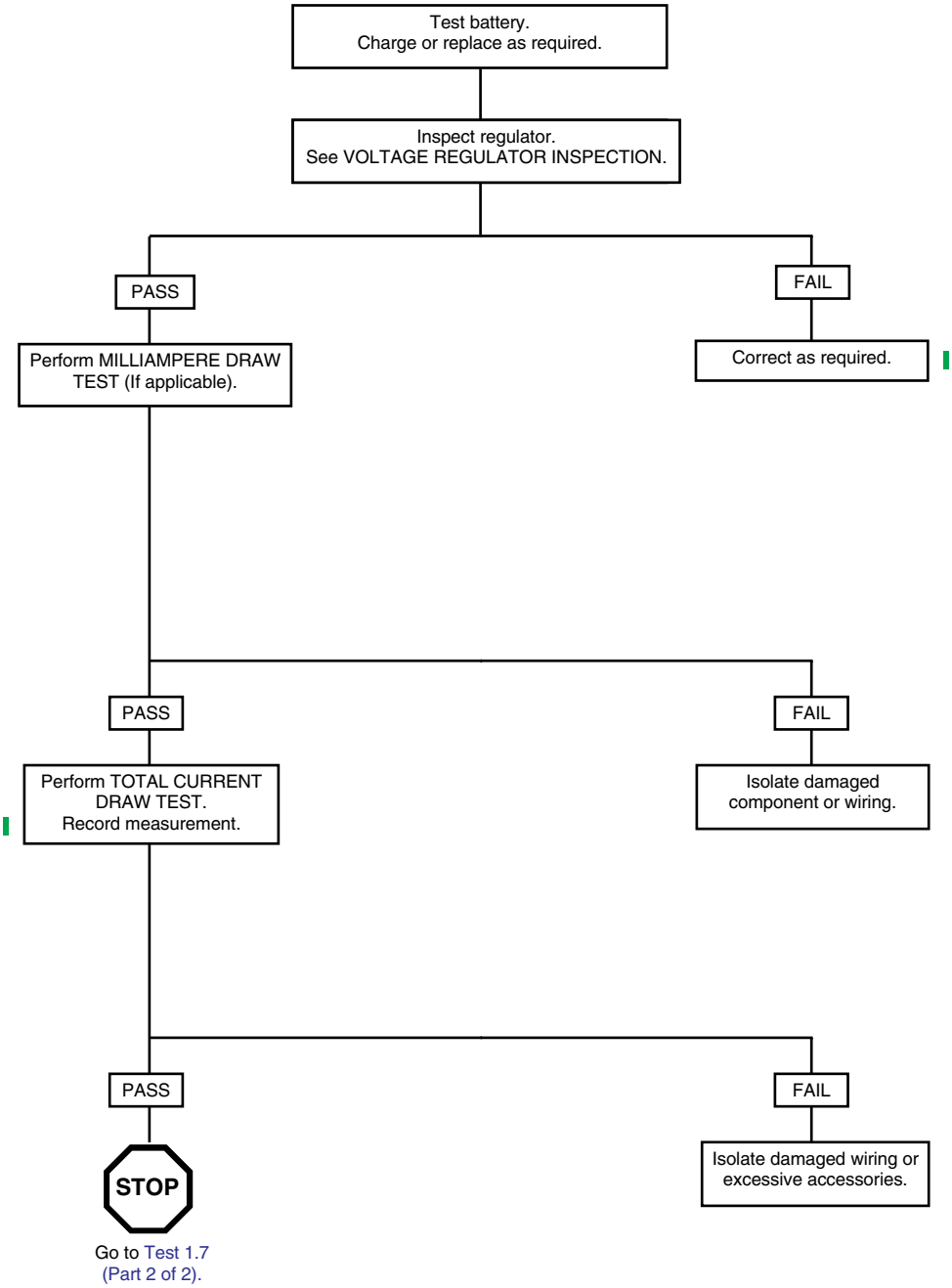


Figure 1-13. Stator Wire Plug (typical)

Test 1.7 (Part 1 of 2)

SYMPTOM: BATTERY BECOMES DISCHARGED

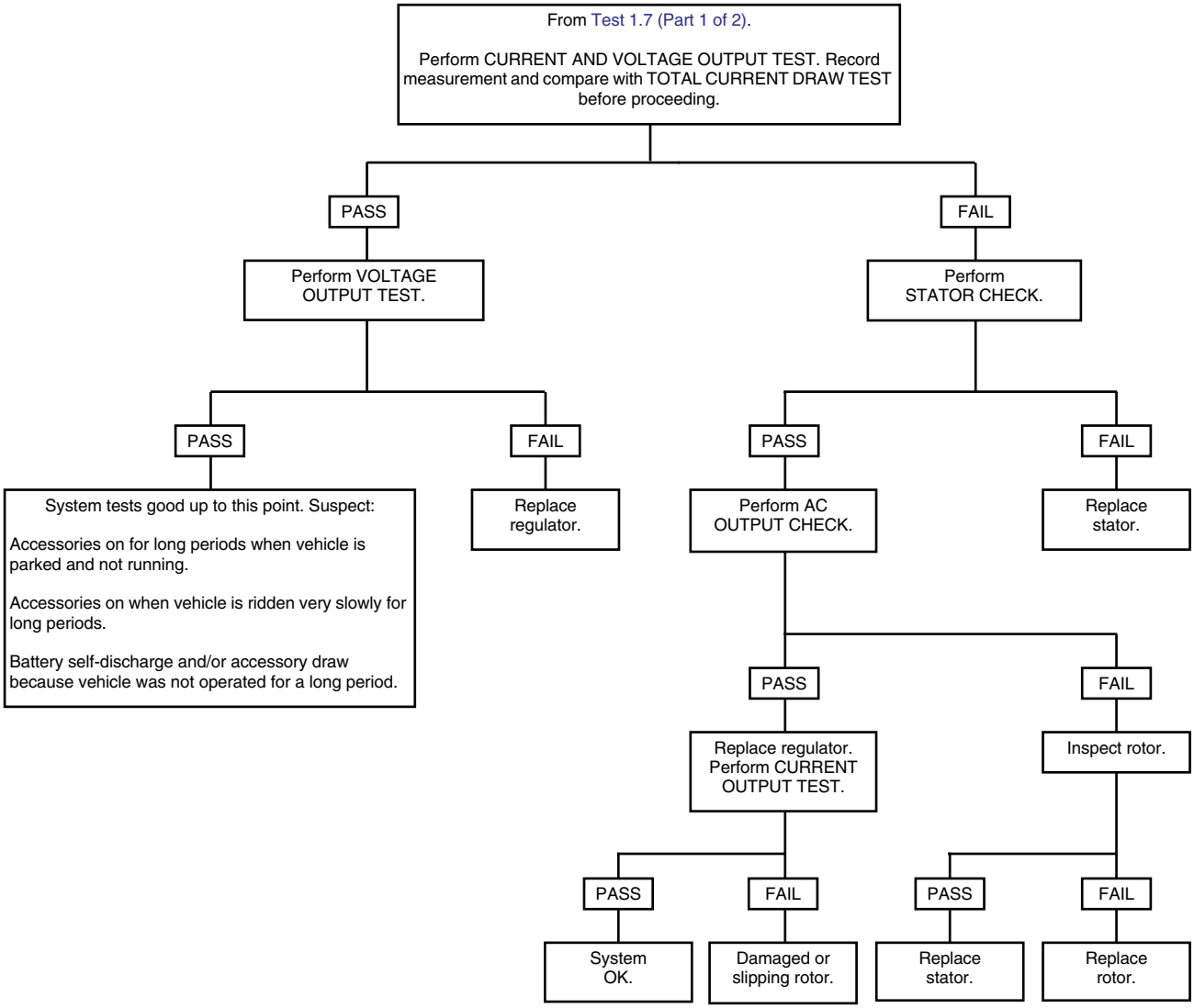


NOTE

Whenever a charging system component fails a test and is replaced, re-test the system to be sure the problem has been corrected.

Test 1.7 (Part 2 of 2)

SYMPTOM: BATTERY BECOMES DISCHARGED



NOTE

Whenever a charging system component fails a test and is replaced, re-test the system to be sure the problem has been corrected.

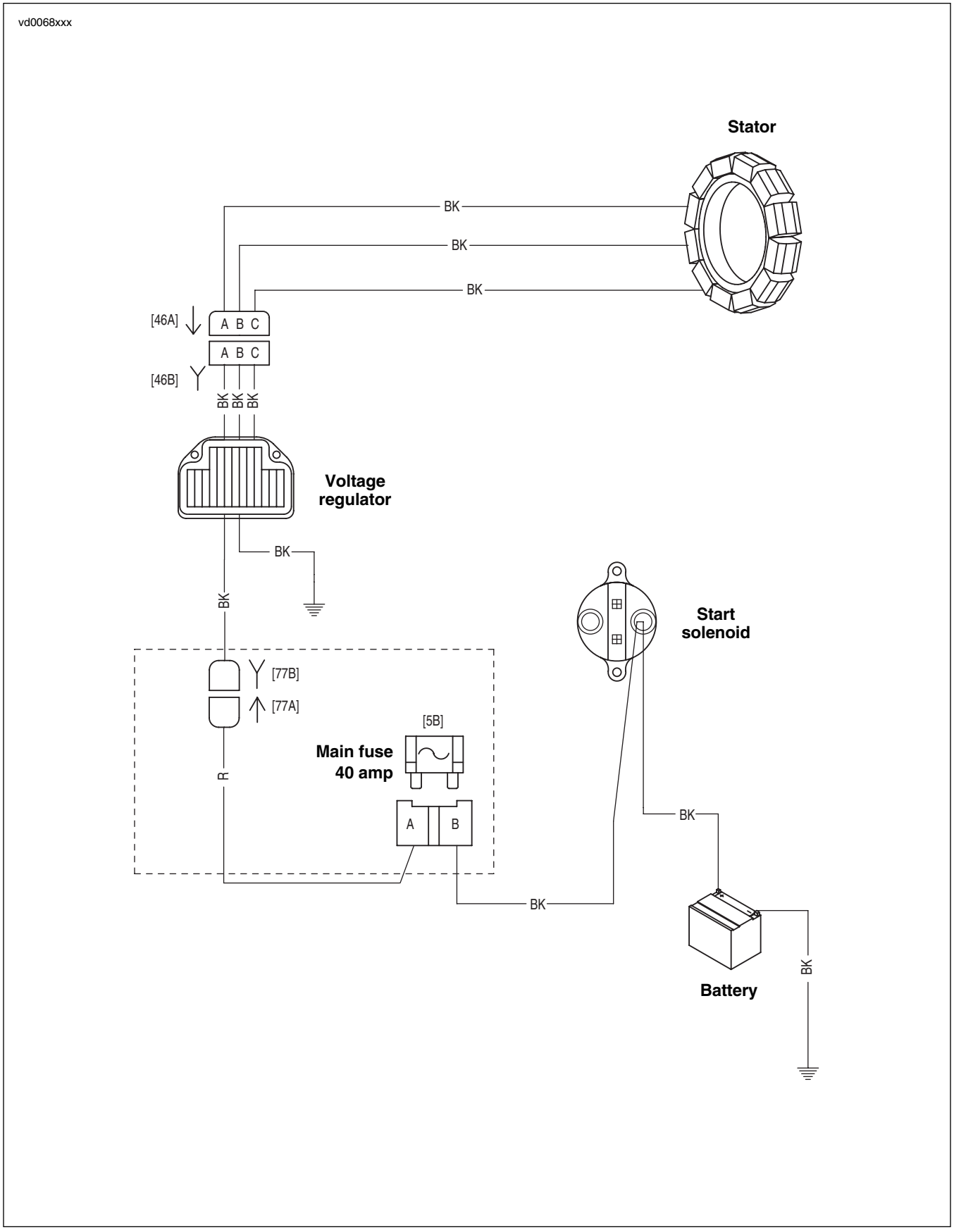


Figure 1-14. Charging System Circuit (typical)

TESTING

Milliampere Draw Test

NOTE

Be sure accessories are not wired so they stay on at all times. This condition could drain battery completely if vehicle is parked for a long time. Check for this by connecting ammeter between negative battery terminal and battery.

With the key off, an initial current draw of up to 200mA will occur directly after connecting meter. This should drop to the values shown in table in less than one minute.

Disconnect siren during milliamperes draw test.

1. Remove right side cover. Remove maxi-fuse.
2. See Figure 1-15. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) red male socket probes and patch cords, connect ammeter to maxi-fuse socket terminals. With this arrangement, you will also pick up any regulator drain.
3. With ignition key switch turned to OFF and all lights and accessories off, observe amperage reading.
   a. Refer to Table 1-4. Add regulator draw ammeter reading to appropriate value for TSM/TSSM/ECM. If observed ammeter reading is less than listed in table, draw is within limits.
   b. A higher reading indicates excessive current draw. Any accessories must be considered and checked for excessive drain.

NOTE

A battery with a surface discharge condition could suffer a static drain. Correct by cleaning battery case.

Table 1-4. Maximum Meter Reading (Average)

ITEM	MILLIAMPERES DRAW
Regulator	0.5
TSM (non security models)	0.5
TSSM (disarmed)	3.0
TSSM (armed)	3.0
TSSM -Storage mode (armed or disarmed)	0.5
ECM	1.0
Security Siren (optional)	*

*Siren will draw for 2-24 hours from time motorcycle battery is connected and 0.05 milliamperes once siren battery is charged. For best results, disconnect siren during milliamperes draw test. Siren will draw up to 20.0 milliamperes.

Total Current Draw Test

If battery runs down during use, the current draw of the motorcycle components and accessories may exceed output of the charging system.

WARNING

Turn battery load tester OFF before connecting tester cables to battery terminals. Connecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00252a)

1. See Figure 1-16. To check for this condition, place load tester induction pickup or current probe pickup over battery negative cable.
2. Disconnect regulator from stator wiring. Start the motorcycle and run the engine at 2000 RPM.

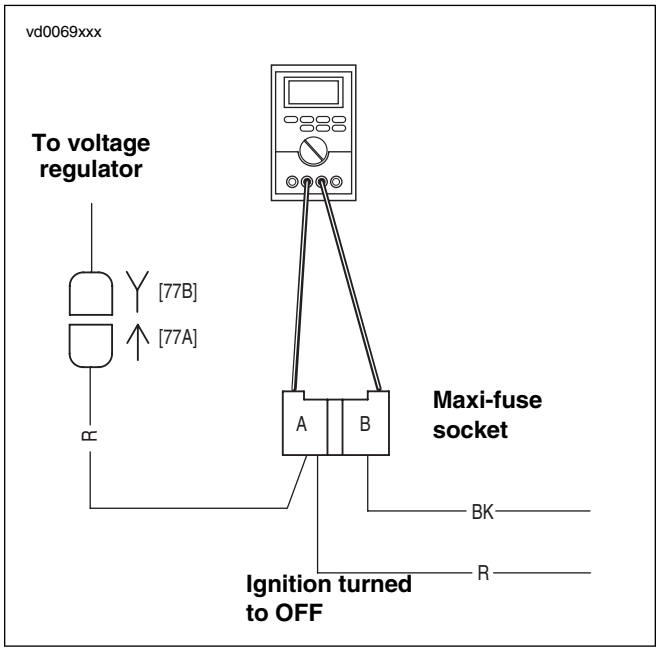


Figure 1-15. Milliampere Draw Test

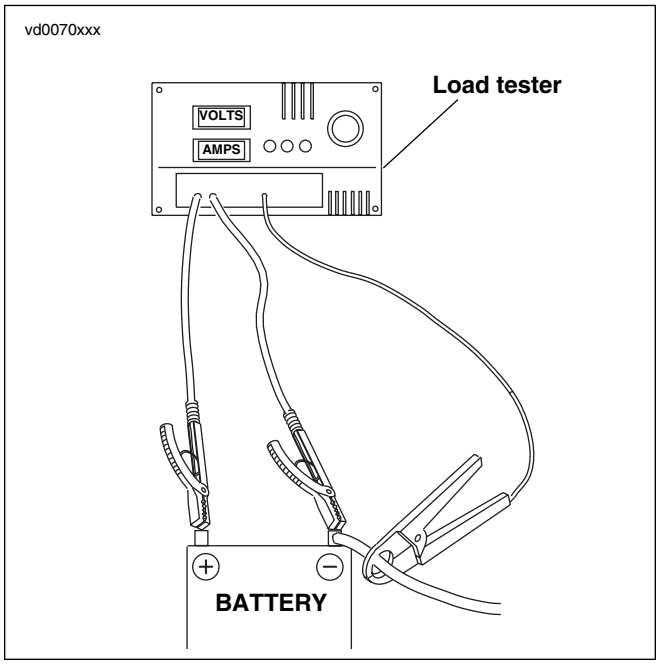


Figure 1-16. Check Current Draw (Ignition Switch On)

3. With ignition and all continuously running lights and accessories turned on (headlamp on high beam), read the total current draw.
4. Compare this reading to the reading obtained after performing the CURRENT AND VOLTAGE OUTPUT TEST.
   a. The current output should exceed current draw by 3.5 amps minimum.
   b. If output does not meet specifications, there may be too many accessories for the charging system to handle.
5. Reconnect regulator after testing.

Current and Voltage Output Test

For this test, you may use either the MCR-101 HD ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER or a load tester.

CHARGING SYSTEM OUTPUT TEST (MCR-101 HD)

1. Connect the MCR-101 HD analyzer leads to the vehicle's battery.
2. Follow the instructions in the analyzer's instruction manual to perform a Charging System Test.

See Figure 1-17. The test results will include a decision on the charging system's condition and the measured output voltage at idle and at 3000 RPM. The analyzer's printer will provide you with a printout including one of two possible test results:

- CHARGING SYSTEM NORMAL–No problem found.
- CHARGING SYSTEM PROBLEM–The analyzer detected a problem and will display one of the three following results:
  a. LOW CHARGING VOLTS–the alternator is not supplying sufficient current for the system's electrical loads.
  b. HIGH CHARGING VOLTS–The voltage output from the alternator exceeds the normal regulator limits.
  c. INVESTIGATE VOLT OUTPUT–The rev voltage is lower than the idle voltage.

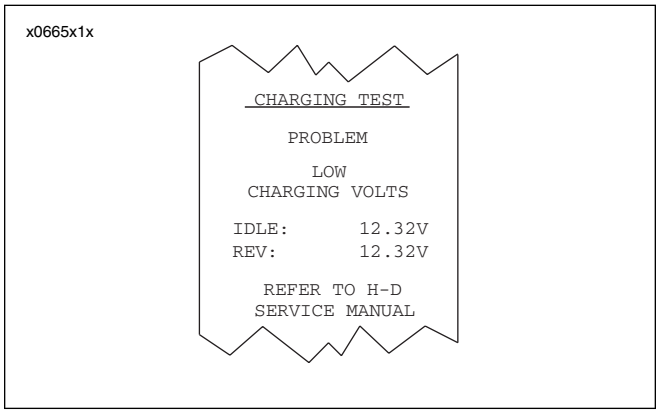


Figure 1-17. Charging System Test Results–Printout

LOAD TEST

1. See Figure 1-18. Connect load tester.
   a. Connect negative and positive leads to battery terminals.
   b. Place load tester induction pickup over positive regulator cable.

CAUTION

Do not leave any load switch turned on for more than 20 seconds or overheating and tester damage are possible.

2. Run the engine at 3000 RPM. Increase the load as required to obtain a constant 13.0 VDC.
3. The current output should be 19-23 amps. Make note of measurement for use in Total Current Draw Test.

NOTE

Rider's habits may require output test at lower RPM.

Stator Check

1. Turn ignition key switch OFF.
2. See Figure 1-18. Connect an ohmmeter.
   a. Disconnect voltage regulator connector from alternator stator wiring.
   b. Insert one ohmmeter lead into a stator socket.
   c. Attach the other lead to a suitable ground.
3. Test for continuity with ohmmeter set on the RX1 scale.
   a. A good stator will show no continuity (∞ ohms) across **all** stator sockets.
   b. Any other reading indicates a grounded stator which must be replaced.
4. See Figure 1-19. Remove ground lead. Check resistance across stator sockets 1-2, 2-3 and 3-1.
5. Test for resistance with ohmmeter set on the RX1 scale.
   a. Resistance across all the stator sockets should be 0.1-0.3 ohms.
   b. If the resistance is higher, the stator is damaged and must be replaced.

NOTE

Verify that meter reads 0 ohms when probes are shorted together. If not, subtract lowest value to resistance value of stator.

AC Output Check

1. See Figure 1-20. Test AC output.
   a. Disconnect voltage regulator connector from alternator stator wiring.
   b. Connect an AC voltmeter across stator connector terminals 1-2.
   c. Run the engine at 2000 RPM. The AC output should be 32-40 volts AC (approximately 16-22 per 1000 RPM).
   d. Repeat test using terminals 2-3 and 1-3.
2. Compare test results to specifications.
   a. If the output is below specifications, charging problem could be a faulty rotor or stator.
   b. If output is good, charging problem might be faulty regulator. Replace as required.
3. Check the output again as previously described under CURRENT AND VOLTAGE OUTPUT TEST

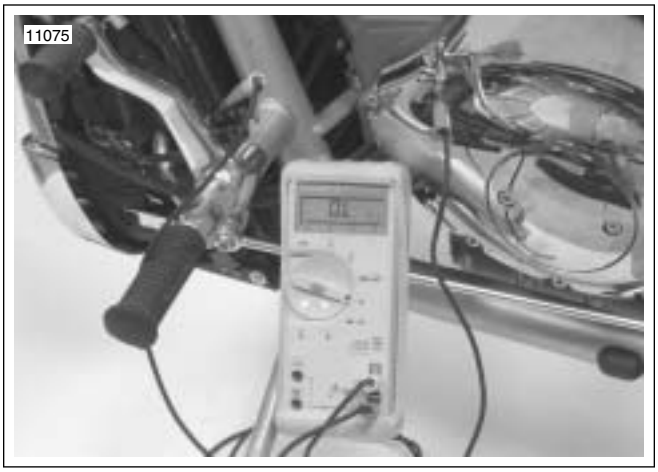


Figure 1-18. Test for Grounded Stator (typical)

Figure 1-19. Check for Stator Resistance (typical)

Figure 1-20. Check Stator AC Voltage Output (typical)

IGNITION COIL 1.8

TROUBLESHOOTING

Follow the troubleshooting procedures listed under 4.9 INITIAL DIAGNOSTIC CHECK if the engine will not start, is difficult to start or runs roughly. Also check condition of plug top coils and boots. Boots may be cracked or damaged allowing high tension current to short to metal parts. This problem is most noticeable when coils are wet.

If poor starting/running condition persists, check resistance of plug top coil primary and secondary windings using an ohmmeter.

NOTE

Plug top coil cannot be repaired. Replace the unit if it fails.

Ignition Coil Primary Circuit Test

1. Remove plug top coil.
2. See Figure 1-21. Set ohmmeter scale to RX1.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) gray socket probes, place multimeter wire on primary coil terminals C to B.
4. Check for primary coil winding resistance.
   a. Normal resistance range is 0.3-0.5 ohms.
   b. See TEST RESULTS if resistance is not within normal operating range.

Ignition Coil Secondary Circuit Test

1. Remove ignition coil.
2. See Figure 1-21. Set ohmmeter scale to RX1K.
3. Place multimeter wire on secondary coil terminals A to plug end of boot.
4. Check for secondary coil winding resistance.
   a. Normal resistance range is 3.5-4.5K ohms.
   b. See TEST RESULTS if resistance is not within normal operating range.

Test Results

1. Refer to Table 1-5. If coil primary is out of range or coil secondary is below range, replace coil.
2. If coil secondary is above specified range, remove boot and recheck coil. If coil readings are within specifications, reinstall boot. If coil secondary readings are still above specifications, clean the coil terminals and repeat resistance test. If resistance is still high after cleaning terminals, replace plug top coil.
3. An infinite ohms (∞ or no continuity) resistance value indicates an open circuit (a break in the coil winding). Replace plug top coil.

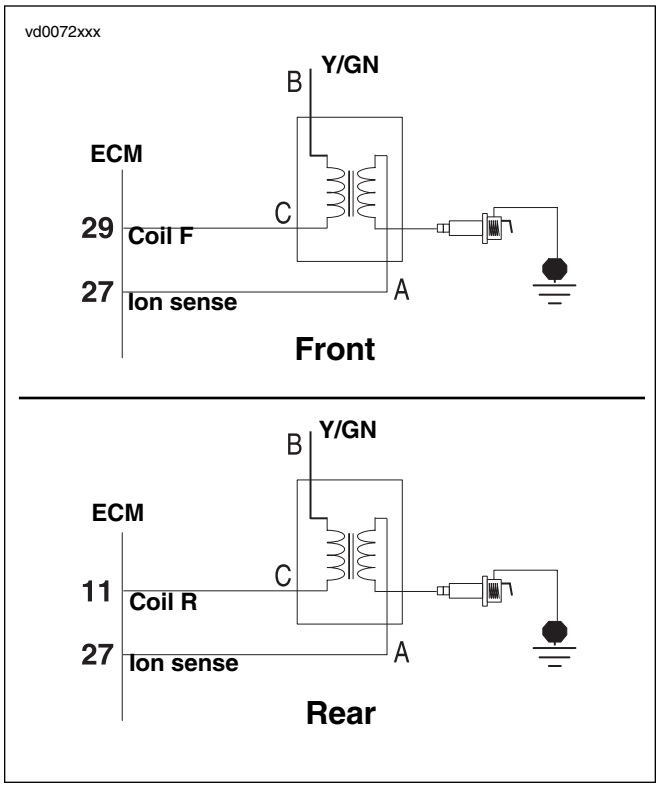


Figure 1-21. Plug Top Coil Testing

Table 1-5. Plug Top Coil

COIL	SPECIFICATION
Primary terminal B to terminal C	0.3-0.5 ohms
Secondary terminal A to plug end of boot	3.5-4.5K ohms
Plug top coil boot	less than 5 ohms

CONDUCTANCE TEST OR LOAD TEST 1.9

GENERAL

Three different procedures may be performed to provide a good indicator of battery condition: a voltage test, a conductance test, or a load test.

A battery may be tested, whether fully charged or not, via conductance test. In order to perform a load test, however, the battery must be fully charged.

VOLTMETER TEST

The voltmeter test provides a general indicator of battery condition. Check the voltage of the battery to verify that it is in a 100% fully charged condition. Refer to Table 1-6.

If the open circuit (disconnected) voltage reading is below 12.6V, charge the battery and then recheck the voltage after the battery has set for one to two hours. If the voltage reading is 12.7V or above, perform the LOAD TEST described in this section.

Table 1-6. Voltmeter Test

Voltage	State of Charge
12.7	100%
12.6	75%
12.3	50%
12.0	25%
11.8	0%

CONDUCTANCE TEST

Test the battery using the MCR-101 HD ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER. Perform a battery test as follows:

1. Connect the MCR-101 HD analyzer leads to the vehicle's battery.
2. Follow the instructions in the analyzer's instruction manual to perform a battery test.

The test results will include a decision on the battery's condition, the measured state of charge and the measured CCA.

See Figure 1-22. The analyzer's printer will provide you with a printout including one of five possible test results:

- GOOD BATTERY–return the battery to service.
- GOOD-RECHARGE–fully charge the battery and return to service.
- CHARGE & RETEST–fully charge the battery and retest.
- REPLACE BATTERY–replace the battery and retest.
- BAD CELL-REPLACE–replace the battery and retest.

NOTE

A REPLACE BATTERY test result may also mean a poor connection between the battery cables and the vehicle. After disconnecting the battery cables from the battery, retest the battery using the out-of-vehicle test before replacing.

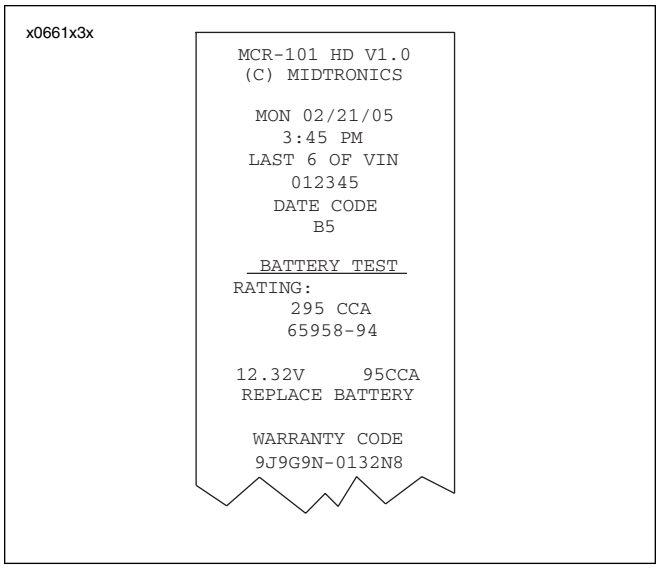


Figure 1-22. Battery Test Results–Printout

LOAD TEST

The load test measures battery performance under full current load. To load test the battery, proceed as follows:

1. Remove battery from motorcycle.

CAUTION

Load testing a discharged battery can result in permanent battery damage.

2. Always fully charge the battery before testing or test readings will be incorrect. Load testing a discharged battery can also result in permanent battery damage.
3. After charging, allow battery to stand for at least one hour before testing.